United States Department of Agriculture

Draft Air Quality Assessment

Tongass National Forest Plan Revision

Forest Service
Alaska Region
Tongass National Forest
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Cover Photo: Air quality in the Tongass National Forest as shown on Sawyers Island at Tracey Arm.

Draft Air Quality Resource Assessment

Tongass National Forest Plan Revision

Forest Service, Alaska Region

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Introduction

This assessment report describes the existing status and trends of airshed conditions and air quality. Influences of air quality can be generally grouped into two categories of emissions: natural and anthropogenic. Many sources of air emissions on the Tongass are the result of natural processes inherent to the landscape and geology of the Forest, such as glacial and volcanic dust. However, air pollution derived from human activity, such as fuel combustion exhaust and greenhouse gas emissions, is having an increasing, though relatively minor, influence on the air quality of Tongass National Forest and surrounding communities. This type of air pollution, referred to as anthropogenic, is of particular interest because it can be mitigated through regulatory action or best management practices and lead to air quality improvements (EPA 2008).

Anthropogenic emission sources are classified into three main categories: stationary sources (otherwise referred to as point sources), mobile sources (or non-point sources), and area sources. Stationary sources are individual and fixed in nature, such as power plants and industrial facilities, whereas mobile sources are, as the name implies, movable such as cars, airplanes, and boats. Area sources are collections of smaller stationary sources that collectively result in large amounts of diffuse emissions. Examples include wood burning stoves, unpaved roads, and gas stations.

Once emitted, air pollutants are subject to a variety of chemical and physical forces that determine when, where, and how they move through the environment. Prevailing wind patterns carry and disperse airborne pollutants from their sources to other locations. Atmospheric chemical reactions may consume some airborne pollutants and create others. Depending on their chemical and physical properties, some pollutants deposit to the Earth's surface near their sources, while others remain airborne for hours, days, or years. The levels of air pollution at a given location and at a given time are influenced by emissions from nearby and distant sources as well as by atmospheric factors. Airborne pollutants can deposit onto surfaces such as plants, soils, and surface waters in precipitation (wet deposition) and through gases and particles (dry deposition). Deposition, especially of persistent and bioaccumulate pollutants and heavy metals, can accumulate in other media such as soils and surface waters. (EPA 2008).

Human exposure to outdoor air pollution is a function of the composition and magnitude of air pollution, combined with human activity patterns. Whether people are harmed by poor air quality depends on the level and mixture of pollutants in the air, exposure doses and durations, individuals' susceptibilities to diseases, and other factors (EPA 2008). In EPA's 2008 Report on the Environment, several indicators of disease and conditions for which outdoor air is a risk factor are discussed, including cancer, asthma, cardiovascular disease, and chronic obstructive pulmonary disease. However, since there are many other risk factors for these diseases, the contribution of outdoor air to these trends cannot be determined.

Similarly to human exposure, air pollutants' interactions with ecosystems determine whether air pollution causes harmful environmental effects. As discussed in the 2007 Tongass National Forest Monitoring and Evaluation Report, air pollution is directly tied to forest health. Deposition of certain pollutants may harm vegetation and soil resources due to changes in pH of the soil water, thus increasing the solubility of certain ions and promoting leaching. These mobilized ions can damage roots and soil biota. Some toxic compounds "biomagnify," meaning that small concentrations in air, water, snow, and plants can result in larger concentrations at higher levels of the food web like fish and mammals. Biological effects of airborne contaminants include impacts on reproductive success, growth, behavior, disease, and survival. On a global scale, air pollution can also change the atmosphere's composition with important consequences, including depletion of the Earth's ozone layer and changes to the Earth's climate (EPA 2008).

Resource Importance

When people think of the Tongass National Forest, they likely picture fjord and mountain vistas, expansive glaciers and ice fields, groves of conifer shrouded in mist, and the sprawling islands of the Alexander Archipelago. Or perhaps they think of activities such as hiking and camping, hunting and fishing, wildlife viewing, or exploring the bays and inlets of the Inside Passage by watercraft. While many people don't actively consider air quality unless they can see haze or smell smoke or exhaust, air quality is an essential part of the overall experience on the Tongass. It is a vital natural resource directly tied to the overall health of the Forest and makes possible the scenery and activities iconic to the Forest.

Resource History and Current Management Direction

Air Quality Regulations

Air quality is subject to several State and Federal laws, regulations, policies, and standards. Principally, the Federal Clean Air Act of 1970 (42 U.S.C 7401), further amended in 1990, regulates air emissions from stationary and mobile sources. Among other things, the Clean Air Act directed the U.S. Environmental Protection Agency (EPA) to establish National Ambient Air Quality Standards (NAAQS) to protect public and environmental health and welfare, and to regulate emissions of hazardous air pollutants. As a result, the EPA established ambient air quality standards for six air pollutants that are commonly found in outdoor air and can harm human health or the environment: carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter of two different size fractions, and sulfur dioxide. These six pollutants are known as criteria pollutants because the EPA regulates them by developing human health-based or environmentally based criteria for setting permissible levels (EPA 2008).

Additional state and local regulations have been adopted to ensure compliance with the requirements of the Clean Air Act. Most notably, the Alaska Air Quality Control Regulations, described in AS 46.14 and 18 AAC 50, established the ambient air quality management and air emission source permitting programs, administrated by the Alaska Department of Environmental Conservation (ADEC) Division of Air Quality. Under this authority, state standards for emission sources were established as well as the Air Permit Program which regulates emissions from industrial operations, in consultation with Tongass National Forest. Through the Air Permit Program, ADEC regulates air emission from stationary sources through the issuance of air permits to industrial sources that demonstrate compliance with the Alaska Ambient Air Quality Standards, which are identical to the NAAQS. The primary standards were developed to protect public human health and the secondary standards to protect public welfare (Table 1). The Clean Air Act also requires State and local air pollution control agencies to develop what is known as a State Implementation Plan, which is a federally approved and enforceable plan developed at the state level that explains how the state will comply with air quality standards according to the Clean Air Act.

Under the Clean Air Act, it is the responsibility of the Federal Land Manager, specifically the Regional Forester for Alaskan national forests, to monitor the effects of air pollution on the national forests and to affirmatively protect these resources (Geiser et al 1994).

Table 1. Criteria Pollutants, National Ambient Air Quality Standards (NAAQS)

Air Pollutant	Averaging Period	Primary NAAQS	Secondary NAAQS
Sulfur Dioxide (SO2)	1-Hour[1] 3-Hour	75 ppb N/A	N/A 500 ppb
Carbon Monoxide (CO)	1-Hour[2] 8-Hour[2]	35 ppm 9 ppm	N/A N/A
Nitrogen Dioxide (NO2)	1-Hour[3] Annual	100 ppb 53 ppb	N/A 53 ppb
Ozone (03)	8-Hour[4]	0.075 ppm	0.075 ppm
Particulate Matter <10 microns (PM10)	24 Hour[5]	150 µg/m^3	150 µg/m^3
Particulate Matter <2.5 microns (PM2.5)	24-Hour[6] Annual[7]	35 µg/m^3 9.0 µg/m^3	35 µg/m^3 15.0 µg/m^3
Lead (Pb)	3-Month[8]	0.15 µg/m^3	0.15 µg/m^3

Notes:
µg/m^3 = micrograms per cubic meter
ppb = parts per billion
ppm = parts per million
[1]NAAQS applies to the 3-year average of the annual (99th percentile) of the daily maximum 1-hour average concentration
[2]NAAQS is not to be exceeded more than once per calendar year
[3]NAAQS applied to the 3-year average of the annual (98th percentile) of the daily maximum 1-hour average concentration
[4]NAAQS applied to the 3-year average of the annual 4th highest daily maximum 8-hour average concentration
[5]Not to be exceeded more than once per year on average over 3 years
[6]NAAQS applies to the 3-year average of the annual 98th percentile 24-hour concentration
[7]NAAQS applies to the 3-year average of annual concentrations
[8]NAAQS applies to the maximum arithmetic 3-month mean

Air Quality Classifications on the Tongass

For air quality monitoring purposes, the Clean Air Act classifies different areas in terms of their "airsheds." Class I airsheds include most national parks and wilderness areas greater than 5,000 acres and designated before 1977. Additionally, Section 164 of the Clean Air Act gives states and tribes the ability to request redesignation from Class II to Class I, referred to as "non-federal" Class I areas. Under the Clean Air Act, Class I airsheds have the highest degree of protection: little to no degradation to air quality related values is acceptable. The four Class I airsheds in Alaska are the Denali National Park and Preserve, Tuxedni Wilderness Area, Simeonof Wilderness Area, and Bering Sea Wilderness Area.

Since all 19 Wilderness Areas on the Tongass National Forest were established after 1977, none qualify for Class I status. Additionally, there are no "non-federal" Class I areas in Alaska. As such, all airsheds on the Tongass National Forest are classified as Class II. Under the Clean Air Act, Class II areas may receive a greater amount of human-caused pollution than Class I areas. However, all Wilderness Areas are protected by the Wilderness Act, which grants protection to sensitive resources that may be adversely affected by a change in air quality, such as visibility, odor, vegetation, water quality, soils, wildlife, and cultural resources.

Sources of Air Pollution on the Tongass

Community development in Southeast Alaska is hampered by steep topography and most settlements are located on narrow benches on the seacoast. Land surface transportation, and thus vehicle emissions, is very limited, and the Alaska Marine Highway System and air travel provide most of the access in and through this region. Stationary sources are usually associated with population centers, and there are several on or adjacent to the Tongass that require ADEC Air Quality Control permits. These include

diesel power plants, asphalt plants, incinerators, mining facilities, and other facilities. Some operate intermittently while others operate continuously at full capacity (USDA 2016a). The permitting authority for these facilities is through ADEC, in consultation with the US Forest Service.

Other sources of air pollution in Southeast Alaska include mobile sources such as cars, trucks, boats, cruise ships, airplanes, and helicopters and area sources, including home furnaces, wood stoves, and open burning. Under certain weather conditions, wildfires in Canada can also affect air quality and visibility in parts of Southeast Alaska (USDA 2016a).

Ambient Air Biomonitoring Program

An air quality biomonitoring program for the Tongass National Forest was initiated in 1989 to establish baseline conditions, develop sensitive and easily repeatable methods for continued monitoring, and provide information to help Forest Supervisors meet Forest Service responsibilities under the Clean Air Act (Geiser et al 1994).

As described by Geiser et al in their 1994 report entitled "Air Quality Monitoring on the Tongass National Forest, Methods and Baselines Using Lichens", since legally allowable pollutant levels are described in terms of ambient atmospheric concentrations, monitoring methods needed to involve determinations of the air and deposition (wet and dry) composition. However, maintenance of continuous monitoring instrumentation is expensive and in Southeast Alaska, the rough topography necessitates the use of several monitors to make accurate assessments over impacted areas of even limited size. Using naturally occurring elements of the Forest, specifically lichen species, as biomonitors offers an economical approach which provides a sensitive overview of air quality, detects fairly small changes in air quality geographically or over time, and identifies specific areas which might need instrument monitoring. Moreover, lichen studies have the advantage of translating pollutant concentration numbers to tangible effects on biological systems.

Because lichens accumulate chemical elements, radioactivity, and organic compounds in amounts correlating to average atmospheric concentrations, they are good summarizers of the environmental conditions in which they are growing. Elevated concentrations of certain elements in lichens are evidence that human activities near and on the Forest generate air pollution and the associated airborne contaminants are being introduced into the ecosystem (Geiser et al 1994).

The biomonitoring program includes elemental analysis of sample lichen tissue coupled with mapping species presence and cover and calls for sample plots to be periodically revisited approximately every 10 years. Threshold levels for several elements or contaminants have been established by Tongass National Forest for lichen tissue analysis and trend evaluation, which helps identify areas of concern. Detailed discussions of the lichen ambient air biomonitoring program, including development, methods, lichen physiology, implementation, thresholds, and baseline analyses is included in the Geiser et al. 1994 report entitled "Air Quality Monitoring on the Tongass National Forest, Methods and Baselines Using Lichens," and "Air Quality Biomonitoring with Lichens, Tongass National Forest" by Dillman et al. 2007.

Current Management Direction

Legal and Regulatory Compliance

As discussed further in Status and Trends below, the current management direction is to maintain the current air resource condition. Forest activities have historically had little effect on air quality on the Tongass.

Scope and Scale of Assessment

This assessment chapter primarily considers effects on Tongass National Forest land but will consider adjacent communities and ecosystems where there is potential for forest management decisions to affect conditions. Issues related to socioeconomics and environmental health of adjacent communities will be discussed further in the Socioeconomic Conditions assessment chapter. To provide bounds for the assessment, help identify particular areas of concern, and provide context for the status and trends discussion, emissions sources were analyzed based on emission type: stationary, area, and mobile.

Most stationary sources are located outside the boundaries of Tongass National Forest and are permitted by ADEC, in consultation with the U.S. Forest Service (USFS). Since they are minimally affected by USFS management, discussion of these sources will be limited to their effects on air quality within the Tongass, with focus on specific stationary sources within Forest boundaries (i.e. mining facilities). The assessment will focus on and be organized by a few key issues: particulate matter within Mendenhall Valley area of Juneau, ambient air biomonitoring results throughout the forest, cruise ship emissions, mining activities, and other area and mobile emission sources of concern.

Status and Trends

Current Status of Air Resources on the Tongass

According to the 2020-2021 Biennial Monitoring Evaluation Report, air quality on the Tongass National Forest is generally good and relatively clean compared to the rest of the country due to high precipitation, oceanic winds, low population, and distance from major pollution sources. Air quality was also seen as generally good according to the 2024 assessment public engagement (USDA 2024c). Air pollutants impacting scenic values and other resources on the Tongass come from forest fires in interior Alaska and Canada; glacial, volcanic, and road dust; fuel combustion from air traffic and marine vessels, especially sight-seeing ships in Wilderness; wood burning stoves, and light industry. Trans-Pacific peroxyacetyl nitrates (PANs – decomposition of which produces ozone), persistent semi-volatile organic pollutants, black carbon (a byproduct of incomplete combustion), and greenhouse gases are a growing concern for all of Alaska, especially due to the roles these pollutants play in accelerating climate change at these high latitudes.

Mendenhall Valley of Juneau

The EPA classified the City and Borough of Juneau as a "nonattainment area" for PM_{10} in 1991 due to violations of the 24-hr particulate matter NAAQ standard in the Mendenhall Valley area that occurred throughout the 1980s, stemming from dust from unpaved roads and smoke from wood burning stoves. After the nonattainment classification, the 1994 State Implementation Plan revision included the Mendenhall Valley Attainment Plan, which established control measures to maintain PM_{10} levels with the goal of eventually achieving attainment status, and particulate matter values began to improve. Given the improvements, the EPA granted the request by the State of Alaska in 2013 to reevaluate the area and approved a 10-year limited maintenance plan which redesignated the Mendenhall Valley to a "maintenance area" for PM_{10}. A second 10-year limited maintenance plan was approved by EPA in 2021, which states the Mendenhall Valley currently meets and will continue to meet the 1987 NAAQS for PM10 through 2033. Juneau has continued its maintenance status for coarse particulate matter (PM10) since 2013 and fine particulate matter (PM2.5) since 2010. New regulations for both particulate sizes were strengthened in 2006 by the EPA, and monitoring efforts at the Mendenhall Glacier Visitor Center (in 2018 for PM2.5 and in 2019 for PM10) showed particulate measurements continuing to be below

NAAQS. EPA further strengthened the primary annual PM2.5 standard in 2024 by lowering the level from 12.0 µg/m3 to 9.0 µg/m3. However, the EPA retained the current primary 24-hour PM2.5 standard, primary 24-hour PM10 standard, secondary 24-hour PM2.5 standard, secondary annual PM2.5 standard, and secondary 24-hour PM10 standard.

Ambient Air Biomonitoring

Between 1989 and 1992, several permanent ambient air quality baseline biomonitoring plots were established across Tongass National Forest. Lichen tissue data was collected from plots considered relatively free of human disturbance and pollution effects. Results indicated that most elemental values were within expected ranges for non-industrial locations and were comparable to or lower than values available from other national parks or forests (Geiser et al 1994). Contemporary biomonitoring efforts have been focused on Wilderness Areas, driven primarily by the Forest Service Chief's 10-Year Wilderness Stewardship Challenge, which began in 2004 and included air quality as an important wilderness characteristic. The original goal for the biomonitoring program was to revisit lichen plots every 10 years and assess for 26 different elements to evaluate trend data and environmental conditions. Lichen biomonitoring has proven to be an efficient and cost-effective tool for monitoring air quality; however, the ability to maintain the intended schedule has subsided in recent years due to capacity, resource, and funding constraints. Since 2015, a total of 31 biomonitoring plots have been sampled, compared to 249 plots between 2005 and 2014. Notably, since a majority of the air quality monitoring efforts have been focused on Wilderness Areas, data availability outside of these areas continues to be extremely limited.

Data obtained through the lichen biomonitoring program indicates air quality on the Tongass is generally good and no significant shifts in lichen species composition have been observed. Additionally, lichen tissue percent nitrogen (%N), an indicator of elevated nitrogen pollution which is a common constituent of anthropogenic emissions, is generally low. Localized elevated %N have been found, which tend to occur around port cities, including Skagway, Juneau, Sitka and Ketchikan. While these indicate possible local air quality impacts, the signal drops off rapidly with distance from the port. Currently, the measurements of lichen %N and lichen community composition show that pollution levels are not high enough to impact ecosystems; however, impacts could worsen as tourism traffic continues to increase. Continued monitoring would be necessary to evaluate these impacts.

Despite the generally good air quality conditions, results from past sampling events at various sample plot locations have indicated a few locations of concern. Samples collected from Greens Creek Mine on Admiralty Island and Mount Roberts near downtown Juneau contain elevated sulfur levels, likely from anthropogenic sources as both locations contain large machinery and vehicles that burn fossil fuels. Most elements above thresholds at Greens Creek Mine (including cadmium, copper, iron, sulfur, lead, zinc, vanadium, and nickel) were from the tailings pile and portal entrance lichen plots, indicating open tailings pile releases of contaminants into the air and surrounding environs through weather of the exposed ore. Several of these contaminants were of the highest levels reported in lichens on the Tongass (USDA 2008). This is discussed further in the Other Emission Sources subsection below.

Elemental analyses at the Mount Roberts site found values elevated above thresholds for nitrogen, potassium, phosphorus, sulfur, and zinc. The sources are probably local and anthropogenic as sampling sites are above the cruise ship docking area where ships use diesel power when in port. Additionally, automobile traffic and wood burning stoves play a role in contributing air pollutants in the downtown Juneau area. Though contamination in lichens from both the Greens Creek and Mount Roberts locations are attributed to industrial and urban sources, the distance beyond the monitoring sites that the elements have dispersed into the forest remains unknown (USDA 2008).

Several samples taken from designated Wilderness Areas throughout the Tongass during recent monitoring events were found to be above threshold levels for at least one or more elements, including phosphorus, potassium, aluminum, manganese, zinc, nitrogen, and sulfur. Most elevated concentrations were likely due to natural variation, possibly enhanced by salt spray in exposed locations, local geology, windblown soils, or exposure to interior climates of the mainland where windblown sands and soils are continual sources for dry and wet deposition on lichen tissues. Some of these elements are also common constituents of anthropogenic emissions. It is also possible elevated levels of nitrogen and sulfur could be at least partially due to popular marine vessel anchorages where fossil fuel combustion releases nitrogen- and sulfur-containing emissions (USDA 2008). This is explored further in in the Other Emission Sources subsection below.

Elevated contaminants in lichens are more indicative of localized emissions and dusts rather than poor regional air quality. Enhanced concentrations of certain elements in lichens are evidence that human activities near and on the Forest generate air pollution and the associated airborne contaminants are being introduced into the ecosystem. However, natural sources of some elements can also be high in lichens. Certain contaminants can affect photosynthesis and other metabolic processes in lichens more readily than others, such as sulfur, nitrogen, and some heavy metals. Additional work is needed to combine elemental analysis with the diversity and abundance of expected lichen species to form a more complete picture (USDA 2008).

Other Emission Sources

Cruise Ship Emissions

Increased cruise ship tourism in Southeast Alaska has been accompanied by increasing concerns about air pollution, particularly in Wilderness Areas and within port communities. These concerns were also expressed during the 2024 assessment public engagement, and by the Tribes (USDA 2024c). Combustion of low-grade marine fuels produces visible haze and releases nitrogen and sulfur oxides, poly-cyclic aromatic hydrocarbons, and metals (Geiser 2021). The Tongass National Forest has received an increasing number of public complaints concerning air quality within the Tracy Arm-Fords Terror Wilderness Area. Tracy Arm is less than a mile wide (on average) and is surrounded by high mountains. Ships transiting the narrow fjords produce visible plumes, with emissions lingering sometimes for hours. Ship emissions often increase because of rapid changes in engine loading necessary for the ship to maneuver through ice and turn around. The emissions are most heavily concentrated in upper Tracy Arm, where vessels stop near the South Sawyer Glacier for up to 4 hours (USDA 2016a).

Ambient air biomonitoring plots were established within the Wilderness Area and elemental analysis results indicate that cruise ship emission constituents are present at all sites, with levels at or above threshold levels for sulfur, nitrogen, potassium, manganese, and silicon. In addition, deposition of nitrogen and sulfur oxides were also elevated at these sites. High levels of nitrogenous compounds can cause plant tissue damage or alter ecosystem structure by increasing the amount of bioavailable nitrogen and altering pH (Schirokauer et al 2014).

Schirokauer et al. (2014) and Geiser et al. (2021) examined the effects of cruise ship emissions on the National Park Service Southeast Alaska Network, including the Tracy Arm-Fords Terror Wilderness Area and adjacent port communities. Both studies noted elevated nitrogen levels in lichen tissue from Skagway and Sitka near port sites correlated with increasing nitrogen oxides from cruise ship emissions and tourism. It can be assumed similar effects would be present in other communities that see similar tourism patterns. It was also noted that in communities such as Skagway, frequent summer inversions prevent dispersal of emissions from in-port operation of diesel and bunker fuel generators, resulting in

noticeable haze and odors. However, the studies also found pollution levels decreased rapidly with distance from stationary sources (i.e., when cruise ships were in port). Because the most impacted areas coincide with densest population centers, human health impacts remain a potential concern. Although sulfur and nitrogen oxides were elevated at several locations, they were below levels known to cause direct human health or phytotoxic impacts. However, indirect effects on plant community composition (e.g., from acidic deposition of nitrogen and sulfur compounds) are possible (Geiser et al 2021). Ultimately, it was determined by Geiser et al (2021) that as evidenced by the continuing widespread distribution of sensitive lichen species across the Tongass, there is as yet no evidence of blanket adverse ecological effects from nitrogen or sulfur deposition in Southeast Alaska.

Geiser et al (2021) concluded that reducing cruise ship emissions would have beneficial effects on visitor experiences of visibility and odor. It would also reduce potential human health effects from combustion-related air pollutants such as fine particulates, polycyclic aromatic hydrocarbons, and metals. Because pollutant concentrations fall off rapidly with distance from sources, the worst impacts can be expected in locations close to docking areas or where topographic and meteorological conditions frequently combine to trap emissions close to the ground. Nitrogen and sulfur containing pollutants are quickly processed compared to many metals, which have a much longer residence time (decades vs. years) in soils and vegetation. Continued monitoring of established sites can be used to verify effectiveness of air resource management policies.

Within Tracy Arm-Fords Terror Wilderness Area, the Forest Service, Glacier Bay National Park and ADEC have developed a Memorandum of Understanding to train Forest Service wilderness rangers to visually monitor cruise ship emissions during the summer tourist season with EPA-approved standards. ADEC annually reviews the visible emission observations and acts on any that exceed the State Marine Vessel Emission standard (18 AAC 50.070) (USDA 2016a).

Ultimately, due to the potential for harm to human and environmental health as well as the measurable impacts noted to date, continued monitoring of air quality impacts associated with cruise ship emissions may be important, both in Wilderness Areas and within port communities.

Mining Activities and Fugitive Dust – Greens Creek Mine

Located within the Admiralty Island National Monument on the Tongass National Forest, Greens Creek Mine is the only U.S. mine allowed to operate in a national monument (ANILCA Section 503) (Figure 1). During dry and windy conditions, primarily in winter when high-pressure systems create strong northerly winds and dry, cold conditions, dust is lost from the tailings disposal facility which can contain heavy metals such as lead (USDA 2013b and 2024a). Similar to dust from unpaved roads, this dust is knowns as "fugitive dust" and can be transported from the source, depending on wind speed and direction.

ADEC has issued Air Quality Control permits that regulate emissions from stationary sources at the mine site, including the tailings disposal facility, and the mine conducts year-round monitoring of fugitive dust deposition at six sites surrounding the tailings disposal facility. However, the methods used do not provide quantitative measurements of pollutant loading to the environment, rather they are used to understand the direction and distance fugitive dust may travel, providing relative comparisons between sites and allowing evaluation of general trends over time. The mine also monitors meteorology and real-time PM_{10} concentrations and conducts visual observations and reporting as part of required mitigation measures and BMPs for air quality under the issued ADEC Air Quality Control Permit. To date, all measured ambient concentrations have been within the NAAQS for PM_{10}. Lichen biomonitoring conducted in 2017 and 2018, however, indicates that fugitive dust containing lead has been transported south of the tailings disposal facility. Results suggest that lead concentrations diminish with increasing distance from the tailings disposal facility, with concentrations approaching or reaching the Forest Service

pristine wilderness reference values at distances less than 2 miles from the center of the facility (USDA 2024a).

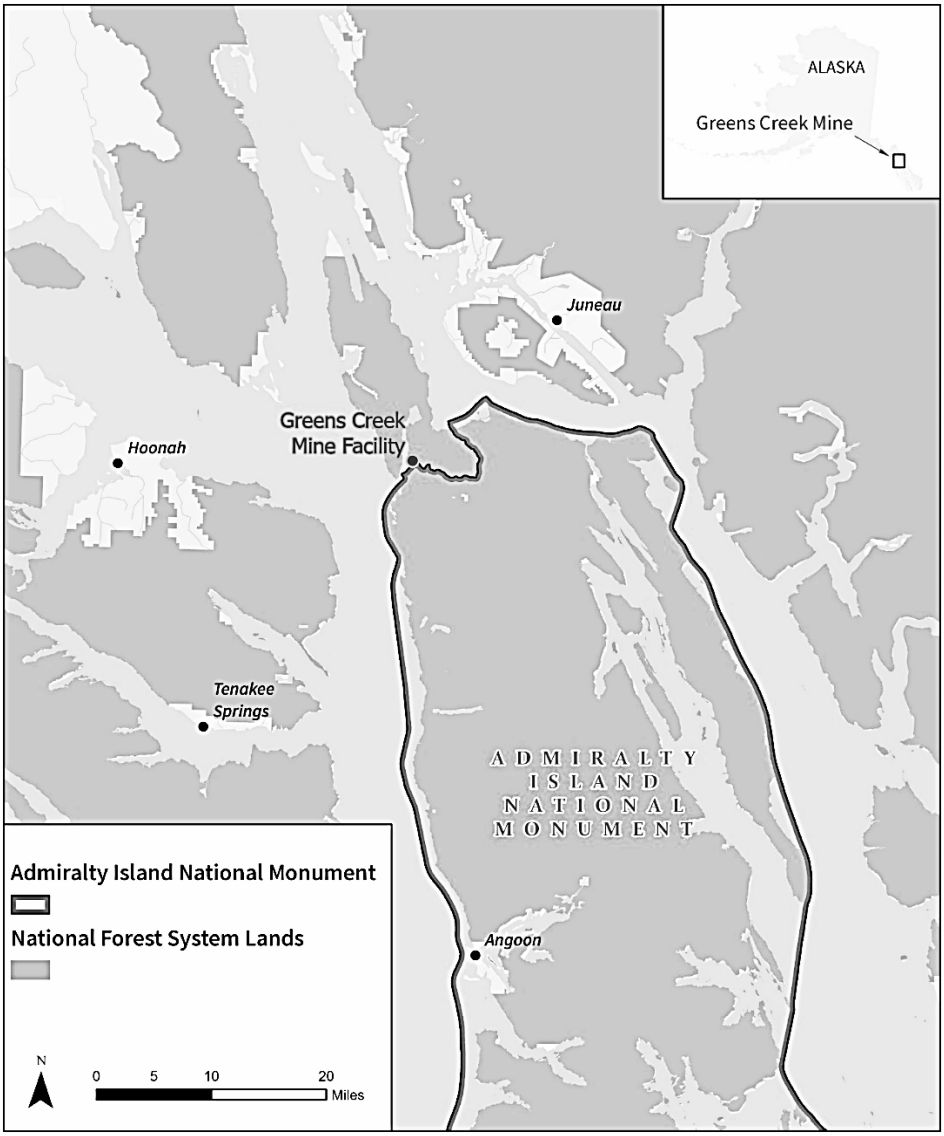

Figure 1. Greens Creek Mine location and vicinity map.

The mine plans to expand its tailings- and waste-disposal operations, with a final Record of Decision and Final Supplemental Environmental Impact Statement (FSEIS) for the project released in November 2024 (USDA 2024a). The FSEIS includes new mitigation efforts aimed at decreasing fugitive dust emissions and escapement into the Forest, including the development of a Fugitive Dust Mitigation and Monitoring Plan. This plan includes additional monitoring, including lichen monitoring for known dust-impacted areas, probable dust-impacted areas, and probable non-impacted areas as suggested in fugitive dust deposition modeling. During public scoping for the FSEIS, air quality concerns were brought up, including about metals-laden fugitive dust deposition potentially resulting in bioconcentration and accumulation of metals in subsistence food and traditional use resources in Hawk Inlet (USDA 2024a). Per the 2024 FSEIS and ROD, air quality concerns would be addressed through project design, implementation of best management practices, and through additional mitigation and monitoring measures. The Forest Service will also seek to establish a Collaborative Integrated Monitoring Panel that

will, among other duties, evaluate trends in air quality, fugitive dust, water quality, sediment, and biomonitoring data to validate the effectiveness of BMPs and mitigation measures and consider additional monitoring and adaptive management (USDA 2024b).

Uncertainties and Data Gaps

In general, the incorporation of Indigenous Knowledge and Traditional Ecological Knowledge has been lacking or absent in previous planning efforts regarding air quality. This presents an important data gap that should be addressed. There are other growing concerns for air quality on the Tongass, especially due to the roles these pollutants play in accelerating climate change at high latitudes, but not enough information is currently available to assess status or trends. These include the direct and indirect impacts of black carbon emissions, effects of trans-Pacific pollution and greenhouse gas emissions, and the impact of climate change regarding wildfire smoke from outside the Tongass.

Black carbon, a main component of combustion generated soot, is a strong absorber of solar radiation and a major contributor to climate change. Airborne black carbon particles can be deposited by snowfall over snow or ice, darken the substrate and increase the amount of radiation absorbed by the substrate, which increases snow and ice melt rates. This is of particular concern at the Mendenhall Glacier in Juneau where black carbon from nearby anthropogenic emission sources can accelerate glacial melting and retreat (USDA 2021a).

Impacts from anthropogenic sources far beyond the bounds of Tongass National Forest, such as trans-Pacific pollutants, including semi-volatile organics and greenhouse gas emissions, are also of concern. Ambient air biomonitoring data shows increases in the concentration of nitrogen in lichen tissue at sites not influenced by local sources, suggesting a far afield trans-Pacific source. Greater trans-Pacific emissions associated with industrial expansion and energy production in Asia and more wildfires emissions from northern Alaska/Canada could contribute to background regional nitrogen oxide levels (Geiser 2021).

Finally, though wildfires are typically a rare occurrence within the Tongass due to the temperate and wet climate, smoke from large wildfires occurring elsewhere can affect air quality on the Tongass depending on wind and weather patterns. This can be exacerbated by climate change, with longer fire seasons and hotter, drier weather further driving large wildfires across interior Alaska and Canada. However, the extent of these influences remains unknown and requires further research.

Key Takeaways

- Air quality on the Tongass is generally good and relatively clean compared to the rest of the country due to high precipitation, oceanic winds, low population, and distance from major pollution sources.
- Lichen biomonitoring has proven to be an efficient and cost-effective tool for evaluating air quality trends and environmental conditions; however, biomonitoring efforts have subsided in recent years due to capacity, resource, and funding constraints. Since a majority of the air quality monitoring on the Tongass have been focused on Wilderness Areas, data availability outside of these areas is quite limited.
- Cruise ship traffic in Tracy Arm creates a particular concern for air quality in Wilderness.
- Trans-Pacific emissions, black carbon, and greenhouse gases are a growing concern for all of Alaska, especially due to the roles these pollutants play in accelerating climate change.

- Fugitive dust from industrial operations, particularly Greens Creek Mine, is also a growing concern due to the potential for introducing heavy metal contamination to surrounding environs. A Fugitive Dust Mitigation and Monitoring Plan will be used for additional monitoring, including lichen biomonitoring for known dust-impacted areas surrounding Greens Creek Mine, probable dust-impacted areas, and probable non-impacted areas as suggested in fugitive dust deposition modeling.

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Glossary

Airshed
Geographical areas which, because of topography, meteorology, and climatic ambient conditions, share the same air mass. Air is managed by airshed.

Ambient Air
Geographical areas which, because of topography, meteorology, and climatic ambient conditions, share the same air mass. Air is managed by airshed.

Ambient Air Quality Standard
The prescribed level of pollutants in the outside air that cannot be exceeded legally during a specified time in a specified geographical area.

Best Management Practices (BMP's)
Land management methods, measures or practices selected by an agency to meet its non-point source control needs. BMPs include but are not limited to structural and nonstructural controls and operation and maintenance procedures. BMP's can be applied before, during and after pollution-producing activities to reduce or eliminate the introduction of pollutants into receiving waters. BMPs are selected based on site-specific conditions that reflect natural background conditions and political, social, economic, and technical feasibility. BMPs are found in Forest Service Handbook 2509.22.

Dust, fugitive or Fugitive dust
Particulate matter that enters the environment without first passing through a definable point source or process (such as a stack or duct) designed to direct or control its flow. Fugitive dust sources include unpaved roads, industrial operations such as mining and rock quarries, construction sites and activities, manufacturing activities such as asphalt and concrete plants and rock crushing operations.

Memorandum of Understanding (MOU)
An agreement between the Forest Service and other agencies resulting from consultation between agencies that states specific measures the agencies will follow to accomplish a large or complex project. A memorandum of understanding is not a fund obligating document.

Monitoring
Gathering information and observing results of management activities to provide a basis for the periodic evaluation of the Forest Plan.