2025 Washington Ambient Air Monitoring Network Assessment

Air Quality Program

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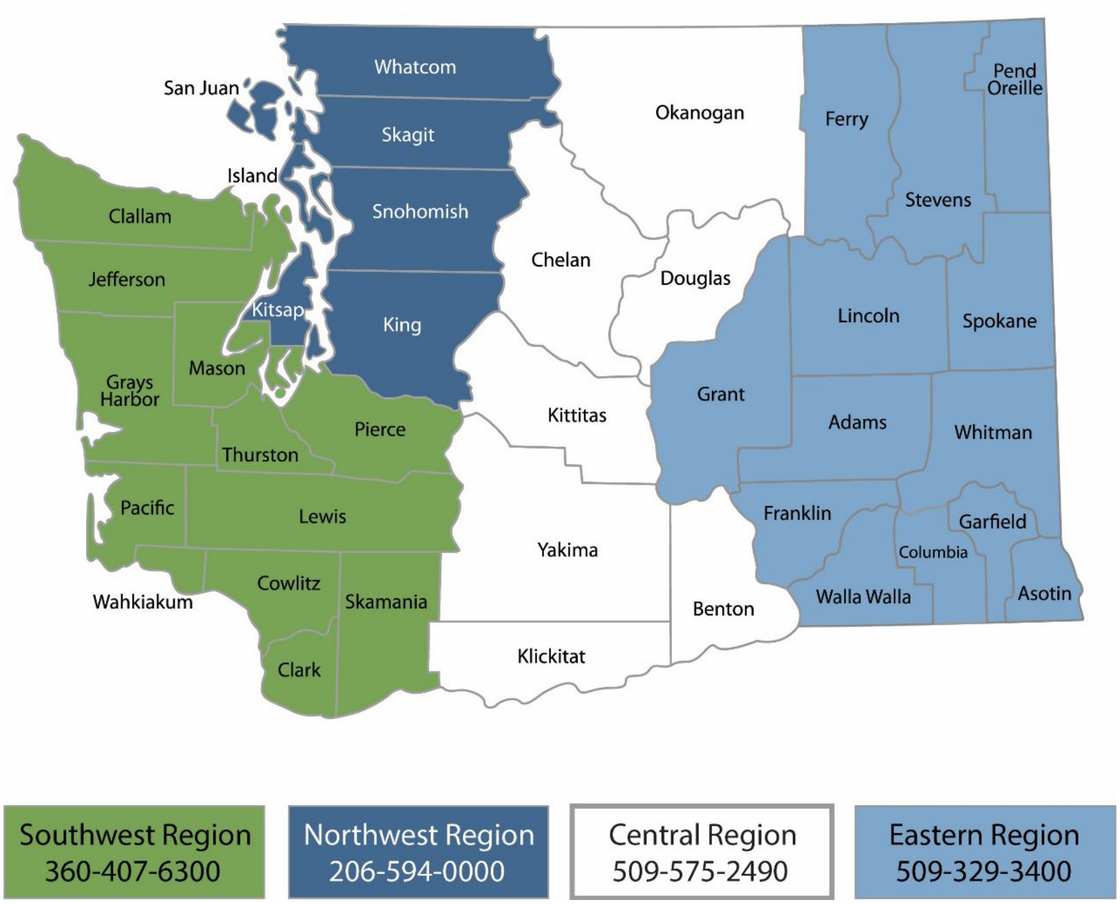
Map of Counties Served



Region	Counties served	Mailing Address	Phone
Southwest	Clallam, Clark, Cowlitz, Grays Harbor, Jefferson, Mason, Lewis, Pacific, Pierce, Skamania, Thurston, Wahkiakum	P.O. Box 47775 Olympia, WA 98504	360-407-6300
Northwest	Island, King, Kitsap, San Juan, Skagit, Snohomish, Whatcom	P.O. Box 330316 Shoreline, WA 98133	206-594-0000
Central	Benton, Chelan, Douglas, Kittitas, Klickitat, Okanogan, Yakima	1250 West Alder Street Union Gap, WA 98903	509-575-2490
Eastern	Adams, Asotin, Columbia, Ferry, Franklin, Garfield, Grant, Lincoln, Pend Oreille, Spokane, Stevens, Walla Walla, Whitman	4601 North Monroe Spokane, WA 99205	509-329-3400
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DEPARTMENT OF
ECOLOGY
State of Washington

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Acknowledgements

This Network Assessment was written by multiple authors:

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The authors also thank the local, Tribal, and federal monitoring partners who operate monitoring sites as part of Ecology's Primary Quality Assurance Organization. The work of these partners is critical to provide the data used in this assessment. Staff from these partners also provided helpful feedback about monitoring sites and data uses in their jurisdictions.

Acronyms

AQS	EPA's Air Quality System database
BAM	Beta Attenuation Monitor
BCAA	Benton County Clean Air Agency
CBSA	Core-Based Statistical Area
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CSA	Combined Statistical Area
CSN	Chemical Speciation Network
DV	Design Value
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
FEM	Federal Equivalent Method
FRM	Federal Reference Method
IMPROVE	Interagency Monitoring of Protected Visual Environments
MSA	Metropolitan Statistical Area
NAAQS	National Ambient Air Quality Standard
NATTS	National Air Toxics Trends Station
NCore	National Core
NO	Nitrogen Oxide
NO_2	Nitrogen Dioxide
NO_X	Oxides of Nitrogen
NO_y	Total Reactive Oxides of Nitrogen
NWCAA	Northwest Clean Air Agency
O_3	Ozone
ORCAA	Olympic Region Clean Air Agency
Pb	Lead
$PM_{2.5}$	Particulate matter ≤ 2.5 micrometers in diameter
PM_{10}	Particulate matter ≤ 10 micrometer in diameter
$PM_{10-2.5}$	Particulate matter ≤10 microns and > 2.5 micrometers in diameter
ppb	parts per billion
ppm	parts per million
PAMS	Photochemical Assessment Monitoring Station
PQAO	Primary Quality Assurance Organization
PSCAA	Puget Sound Clean Air Agency
PSD	Prevention of Significant Deterioration
QA	Quality Assurance
QC	Quality Control
SLAMS	State and Local Air Monitoring Station
SO_2	Sulfur Dioxide
SPM	Special Purpose Monitor
SRCAA	Spokane Region Clean Air Agency
SWCAA	Southwest Clean Air Agency
STN	Speciation Trends Network
$\mu g/m^3$	micrograms per cubic meter
VOC	Volatile Organic Compound
YRCAA	Yakima Region Clean Air Agency

Executive Summary

This document describes the Washington Department of Ecology's (Ecology's) 2025 Ambient Air Monitoring Network Assessment. The U.S. Environmental Protection Agency's (EPA's) ambient air monitoring regulations require states to conduct detailed assessments of their monitoring networks every five years.

Purpose

The primary goal of the Washington Ambient Air Monitoring Network (Washington Network) is to characterize air quality in Washington for public health protection. The Washington Network was designed to meet three objectives in support of this goal:

1. Provide air pollution data to the public in a timely manner
2. Support compliance with National Ambient Air Quality Standards (NAAQS) and development of pollution control strategies
3. Support air pollution research

In this assessment, Ecology evaluated the effectiveness and efficiency of the Washington Network in meeting this goal and objectives. Ecology considered monitoring data and trends from existing Washington Network sites, the population size of Washington's Core-Based Statistical Areas (CBSAs), summaries of emissions inventory information, monitoring data needs for planning and air quality management, and the availability of new monitoring technologies.

Washington Network Overview

As of July 1, 2025, Ecology and its partners operate 70 monitoring sites as part of the Washington Network. The majority of Washington Network monitoring sites are sited to characterize the two pollutants that have been shown to pose the greatest risk to public health in Washington: fine particulate matter ($PM_{2.5}$) and ozone (O_3). The remainder of the network is made up of monitors that measure larger particles (PM_{10}), carbon monoxide (CO), sulfur dioxide (SO_2), oxides of nitrogen (NO_x and NO_y), fine particle chemical composition, air toxics, and meteorological parameters.

Findings and Recommendations

This assessment found that the Washington Network meets the three objectives for criteria pollutant monitoring. The scope of the Washington Network far exceeds EPA's minimum monitoring requirements and includes extensive non-regulatory $PM_{2.5}$ monitoring to provide local-scale AQI information across the state for public health protection.

Several network modifications and new technologies can improve the network's efficiency and effectiveness. These recommended network modifications include new monitoring sites, sites identified for modification of monitoring methods, and sites identified for termination.

Additional ozone monitoring in eastern Washington was identified as a potential enhancement to the existing Washington Network. The Clarkston-13th St, Ellensburg-Ruby St, Pomeroy-Pataha

St, and LaCrosse-Hill St $PM_{2.5}$ monitoring sites were identified as sites where a different $PM_{2.5}$ monitoring method would be more suitable based on design values and monitoring objectives. Ecology also identified several non-required meteorological monitoring sites (Burbank-Maple St, Wenatchee-Fifth St, Vancouver-Blairmont Dr, Enumclaw-Mud Mtn, Kennewick-Metaline) where meteorological monitoring could be discontinued or replaced with less resource-intensive methods to improve efficiency. Finally, Ecology identified a Chemical Speciation Network (CSN) monitoring site (Tacoma-L St) where a less resource-intensive instrument such as an aethalometer would be an adequate replacement for CSN monitoring.

Ecology also identified several opportunities to incorporate new technologies into the Washington Network. These include replacement of aging nephelometers with Ecology's custom SensWA sensor or newer monitoring instruments such as portable spectrometers, and replacement of traditional meteorological monitoring stations with more flexible meteorological monitoring site design and instrumentation.

Introduction

This document summarizes Ecology's 5-year review of the Washington Ambient Air Monitoring Network (Washington Network) to meet the assessment requirements defined in 40 C.F.R. Part 58.10. In 2006, EPA amended its ambient air monitoring regulations to require states to conduct detailed assessments of their monitoring networks every five years. The purpose of the 5-year Network Assessment is to evaluate the effectiveness and efficiency of monitoring networks in meeting their stated monitoring objectives and goals.

The specific requirements of the Network Assessment, as detailed in 40 C.F.R. Part 58.10(d) are to determine:

1. …if the network meets the monitoring objectives defined in 40 C.F.R. Part 58 Appendix D.
2. …whether new monitoring sites are needed.
3. …whether existing sites are no longer needed and can be terminated. For any sites proposed for termination, the assessment must consider the effect on other data users, such as nearby states, Tribes, or health effects studies.
4. …whether new technologies are appropriate for incorporation into the ambient air monitoring network.
5. …whether existing and proposed sites adequately support air quality characterization for areas with relatively high populations of susceptible individuals (e.g. children with asthma) and other at-risk populations

This is the fourth 5-year Network Assessment the Washington Department of Ecology (Ecology) has prepared and covers years 2020-2024.

Analysis approach

This assessment was conducted in general accordance with EPA guidance on monitoring network assessments. However, Ecology has found that many of the specific analysis tools in the NetAssess2025 application provided by EPA for assistance in Network Assessment development are not suitable for analysis in Washington. These tools rely largely on a nearest-neighbor approach to assigning represented areas and populations to monitoring sites. A nearest-neighbor approach does not consider the terrain barriers that define distinct airsheds in Washington, such as major bodies of water (Puget Sound, the Columbia River), mountain ranges (the Cascade Range), and valleys (Yakima Valley, Methow Valley). Instead of these tools, Ecology relied largely on its own analyses, routine monitoring data, results of short-term studies, and the perspectives of regional office and local clean air agency staff who have expertise in local air quality issues in their respective jurisdictions.

Ecology also acknowledges that the assessment of the Washington Network is not an activity that takes place only once every five years but rather is an ongoing process of evaluation and improvement. Ecology evaluates how well the Washington Network meets its objectives and whether network modifications are needed on an annual basis in its Ambient Air Monitoring

Network Plans, also required by 40 C.F.R. Part 58.10. Since 2020, new funding opportunities have arisen that also prompted an assessment of new monitoring needs and the suitability of new monitoring technologies. These included one-time federal grant programs that funded the purchase of new monitoring equipment and installation of new monitoring sites to improve and expand the Washington Network.

Therefore, in addition to future recommendations, this document also describes the decision-making processes and analyses used to support Ecology's ongoing process of network assessment, as well as the recent and future network improvements funded by these investments.

Background

Monitoring objectives

The Washington Network was designed to meet the three monitoring objectives defined in 40 C.F.R. Part 58 Appendix D:

1. **Provide air pollution data to the public in a timely manner.** Ecology provides timely air quality data to the public in a variety of ways:
   - Near-real-time data are available on Ecology's monitoring website.
   - Near-real-time data are submitted to EPA's AirNow system for public display and reporting.
   - Ecology conducts public outreach and issues alerts and bulletins when air quality is compromised.
2. **Support compliance with National Ambient Air Quality Standards (NAAQS) and development of pollution control strategies**. Ambient air quality data are used to:
   - Determine compliance with the NAAQS
   - Determine the location of maximum pollutant concentrations
   - Track the progress of SIPs
   - Determine the effectiveness of air pollution control programs
   - Develop responsible and cost-effective emission control strategies
   - Assist with permitting work
3. **Support air pollution research.** Ecology and its partners use ambient air quality data to improve our understanding of air pollution and its consequences. Research applications of air quality include:
   - Improving air quality forecasting
   - Evaluating the effects of air pollution on public health
   - Informing dispersion models
   - Identifying air quality trends and emerging pollution issues
   - Analyzing pollution episodes

In order to meet these three objectives, 40 C.F.R. Part 58 Appendix D calls for the design of SLAMS networks to include several different types of monitors. These general types are sites that:

1. Determine the highest pollutant concentrations expected in the area covered by the network ("highest concentration").
2. Determine representative pollutant concentrations in areas of high population density ("population exposure").
3. Determine the impact of significant sources or source categories on pollutant concentrations in the ambient air ("source impacts").
4. Determine general background pollutant concentrations ("general/background").
5. Determine the regional extent of pollutant transport between populated areas ("regional transport").
6. Determine the impacts on visibility or vegetation in more rural and remote areas ("welfare related impacts").

Appendix D of 40 C.F.R. Part 58 also provides guidance on spatial scales of representativeness for stations in a SLAMS network. Ideally, the station is located so that its sample represents the air quality across the scale that the station is intended to represent. Appendix D defines the following spatial scales:

- **Microscale**: Area dimensions between several and 100 meters.
- **Middle scale**: Areas between 100 and 500 meters, typically several city blocks.
- **Neighborhood scale**: Areas between 0.5 and 4 kilometers with relatively uniform land use.
- **Urban scale**: Areas with city-like dimensions between 4 and 50 kilometers. Urban and neighborhood scales can overlap considerably. Heterogeneous urban areas may not have a single representative site.
- **Regional scale**: Areas from tens to hundreds of kilometers with relatively homogeneous geography and no large sources.
- **National and global scales**: Scales representing the nation or globe as a whole.

Table 1 summarizes the appropriate spatial scales for each criteria pollutant and applicable site types.

Table 1. Summary of applicable spatial scales for criteria pollutants and monitoring objectives

Scale	SO_2	CO	O_3	NO_2	Pb	PM_{10}	$PM_{2.5}$	Site Types
Micro	✓	✓		✓	✓		✓	Highest concentration; source impact
Middle	✓	✓		✓	✓	✓	✓	Highest concentration; source impact
Neighborhood	✓	✓	✓	✓	✓	✓	✓	Highest concentration; population; source impact; general/background
Urban	✓		✓	✓			✓	Highest concentration; population; general/background; regional transport; welfare-related impacts
Regional	✓		✓				✓	General/background; regional transport; welfare-related impacts

Monitoring partners

Ecology is the Primary Quality Assurance Organization (PQAO) for the Washington Network, which is operated in partnership with a variety of local clean air agencies, Tribal nations, and federal agencies.

Local clean air agencies

- Benton Clean Air Agency
- Northwest Clean Air Agency
- Olympic Region Clean Air Agency
- Puget Sound Clean Air Agency
- Spokane Regional Clean Air Agency

- Southwest Clean Air Agency
- Yakima Regional Clean Air Agency

Tribal nations

- Makah Tribe
- Confederated Tribes of the Colville Reservation
- Quinault Indian Nation
- Spokane Tribe of Indians
- Tulalip Tribes
- Yakama Nation

Federal partners

- Environmental Protection Agency
- National Park Service

Washington Core-Based Statistical Areas (CBSAs)

The minimum monitoring requirements listed in 40 C.F.R. Part 58 Appendix D are based on the core-based statistical areas (CBSAs) defined by the U.S. Office of Management and Budget. Washington's CBSAs are shown in the map in Figure 1 (U.S. Census Bureau, 2020). The populations of CBSAs in Washington over 50,000 people are listed in Table 2.

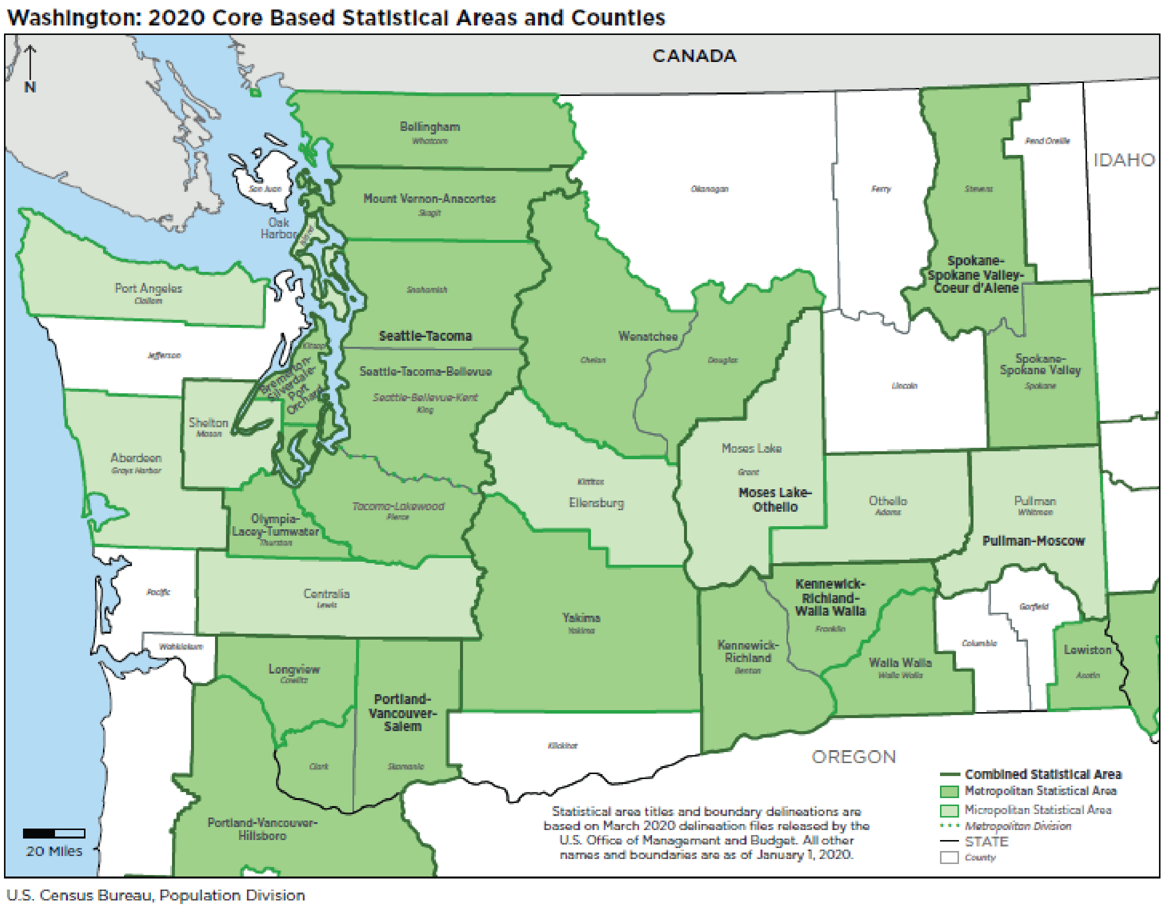

Figure 1. Washington's Core-Based Statistical Areas (CBSAs), U.S. Census Bureau 2020

Table 2. Washington's CBSA populations over 50,000 (U.S. Census Bureau, 2024)

Core-Based Statistical Area	2024 Population
Seattle-Tacoma-Bellevue, WA	4,145,494
Portland-Vancouver-Hillsboro, OR-WA	2,537,904
Spokane-Spokane Valley, WA	604,962
Kennewick-Richland, WA	319,428
Olympia-Lacey-Tumwater, WA	302,912
Bremerton-Silverdale-Port Orchard, WA	281,420
Yakima, WA	258,523
Bellingham, WA	234,954
Mount Vernon-Anacortes, WA	132,736
Wenatchee, WA	127,023
Longview, WA	113,982
Moses Lake, WA	104,717
Centralia, WA	87,049

Core-Based Statistical Area	2024 Population
Oak Harbor, WA	86,478
Port Angeles, WA	77,958
Aberdeen, WA	77,893
Shelton, WA	69,632
Lewiston, ID-WA	65,370
Walla Walla, WA	62,068

Washington shares the Portland-Vancouver-Hillsboro, OR-WA CBSA with the state of Oregon. The minimum monitoring requirements for PM_{10}, $PM_{2.5}$, ozone, an NO_2 in this CBSA are met through a combination of monitors operated by Washington Network agencies and the Oregon Department of Environmental Quality (DEQ).

Climate and topography

Washington is divided into two distinct geographic regions by the north-south Cascade Mountain Range. West of the Cascade Range, summers are relatively cool and dry, and winters are marked by mild cool temperatures and frequent precipitation. Annual precipitation in Western Washington ranges from approximately 20 inches along the Strait of Juan de Fuca to 150 inches on the southwest slopes of the Olympic Range. Western Washington is more densely populated, containing approximately 78% of the state's population and most of its major cities.

Eastern Washington is part of an inland basin spanning several states between the Cascade and Rocky Mountains. Eastern Washington experiences warmer summers, cooler winters and less precipitation than does western Washington. In eastern Washington, annual precipitation ranges from approximately 7-9 inches near the Tri-Cities (Kennewick, Richland, and Pasco) to approximately 75-90 inches near the Cascade Range, though most of the region experiences fewer than 25 inches of precipitation per year (Washington Department of Commerce, Desert Research Institute). Eastern Washington contains the state's major agricultural areas.

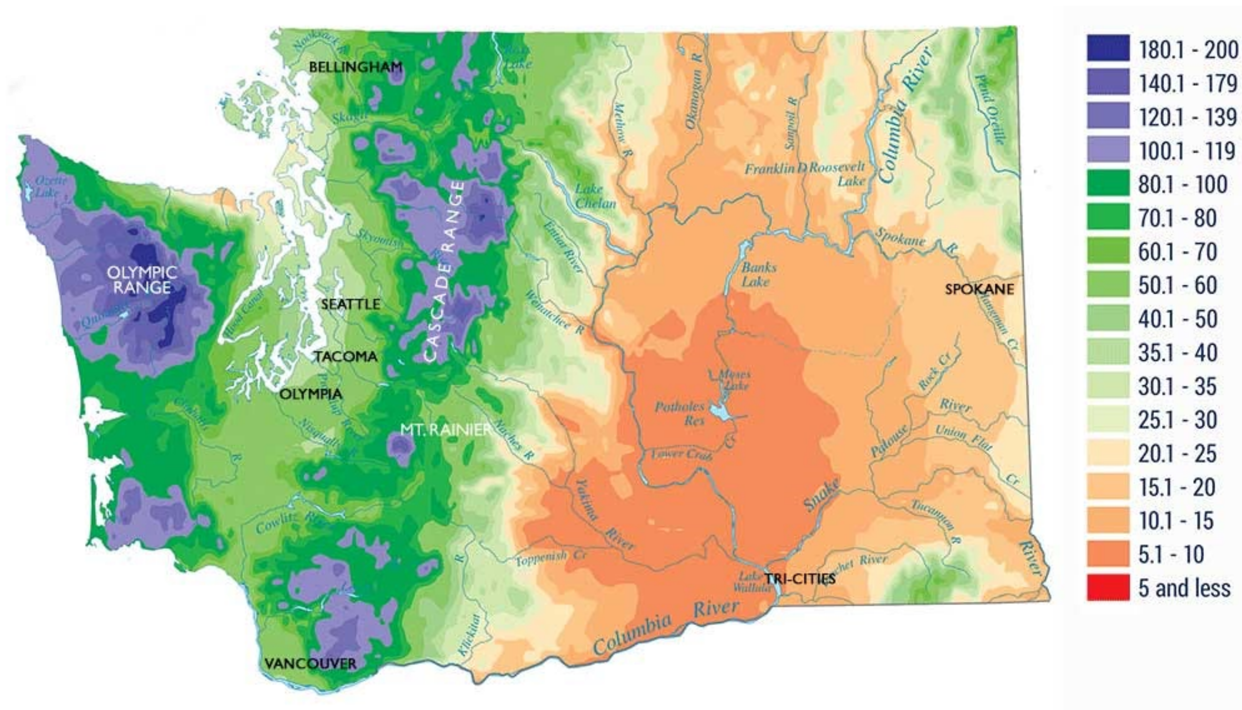

Figure 2. Washington's annual precipitation in inches per year (Washington Department of Commerce)

Emissions information

Monitoring needs and priorities in Washington are also informed by data on sources of criteria pollutant emissions and their spatial distribution throughout the state. Ecology maintains a point source emissions inventory (EI) of permitted facilities as well as a Comprehensive EI that also includes mobile, biogenic, and area sources. The Comprehensive EI summarizes emissions of criteria pollutants and key precursors at the county level, in coordination with the EPA National Emissions Inventory (NEI). Emissions estimates are calculated using a variety of tools, including EPA models, published emissions factors, population and vehicle information, permits, and facility reports. The Comprehensive EI provides a broad overview of Washington’s dominant sources of criteria air pollution and is thus a key source of information in the identification of monitoring priorities in Washington’s diverse regions.

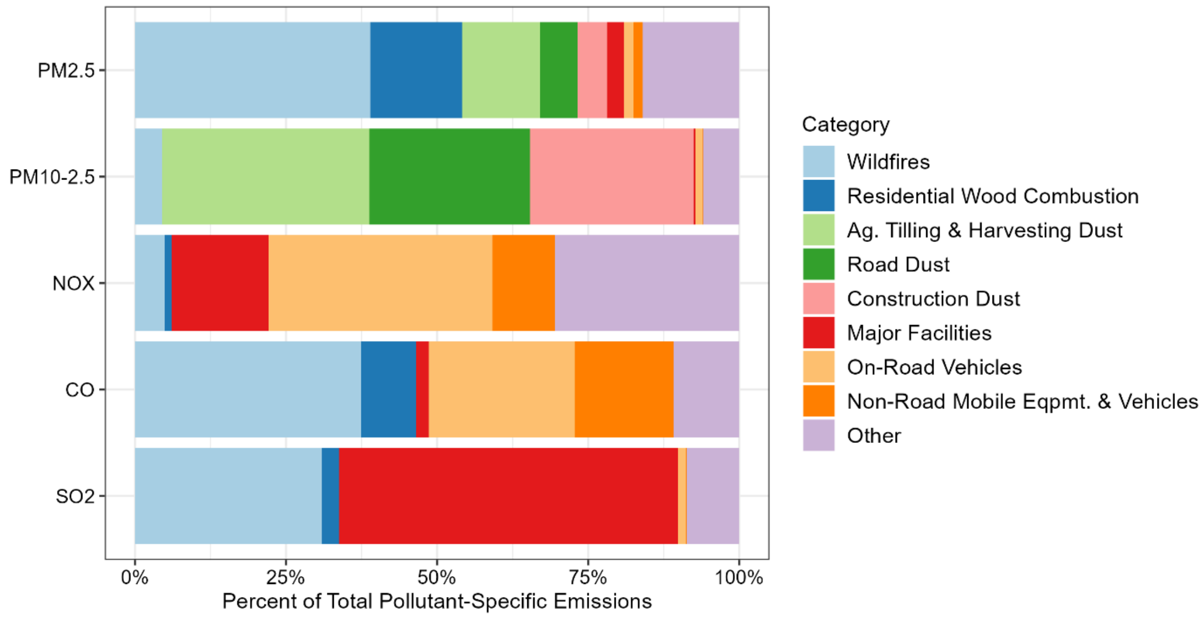

Figure 3. Washington Comprehensive Emissions Inventory summary for available criteria pollutants

Figure 3 summarizes the largest emissions source categories for the criteria pollutants with available data from the most recent (2020) Comprehensive EI. Examples of how this information guides the Washington Network monitoring priorities include:

- The largest sources of $PM_{2.5}$ emissions are wildfires and residential wood combustion. Priority communities for $PM_{2.5}$ monitoring are those with high rates of residential wood heating and communities with frequent wildfire smoke impacts, particularly where those overlap with population centers.
- The largest sources of $PM_{10-2.5}$ are dust from agricultural tilling and harvesting, roads, and construction. Most of the Washington Network's PM_{10} monitors are in eastern Washington, where agricultural activities are concentrated and where high winds can cause sporadic dust events.
- On-road and non-road vehicles are the dominant sources of NO_x and CO. These pollutants are primarily measured at near-road monitoring sites where concentrations are expected to be highest.
- Most SO_2 is emitted by large industrial point sources, though facilities with high SO_2 emissions are no longer common in Washington. In the absence of these facilities, the remaining few SO_2 monitors in the Washington Network typically record background levels.
- Many modeling platforms use the Comprehensive EI for emissions inputs. Modeling output then predicts locations where ambient concentrations are elevated, which can inform the need for new monitoring sites. One such model is the Air Indicator Report for Public Awareness and Community Tracking (AIRPACT) model in the Pacific Northwest, which identified a previously unknown area of elevated ozone concentrations in the Tri-

Cities in 2012. This led to the establishment of the Kennewick-S Steptoe St ozone monitoring site.

Air monitoring history

In the 1970s and 1980s, Ecology's air monitoring program was primarily focused on monitoring CO, SO_2 and Pb. Stricter emissions regulations across a variety of sources and industries reduced concentrations of these pollutants, and new research emerged on health impacts of particulate matter and ozone pollution in the 1990s and 2000s. Consequently, the focus of Ecology's air monitoring program in those decades shifted to $PM_{2.5}$ and ozone, which remain the two pollutants with the largest number of monitoring sites and the greatest investments in their monitoring networks. Figure 4 shows the number of monitoring sites by parameter from 1970 through 2024.

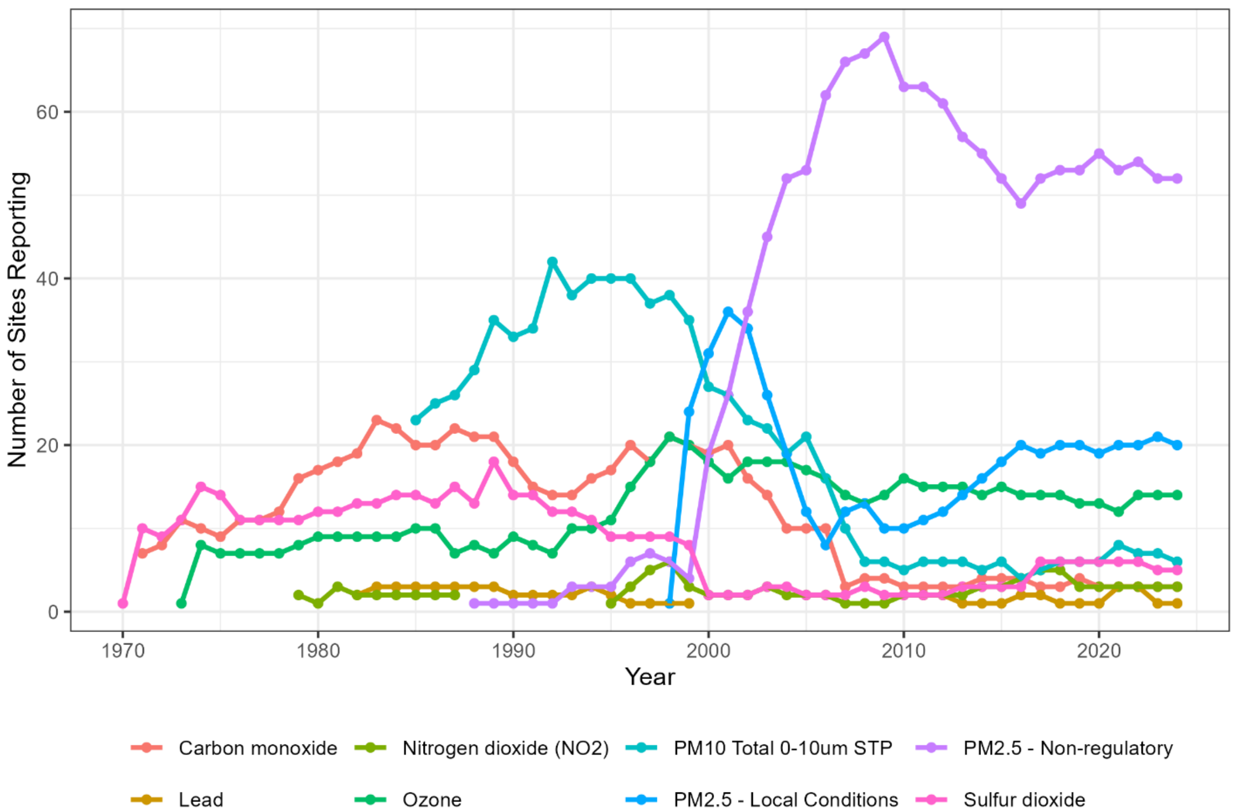

Figure 4. Number of Washington Network monitoring sites by parameter, 1970-2024.

Since the early 2000s, the Washington Network has generally recorded more NAAQS exceedances for $PM_{2.5}$ than any other parameter. The number of exceedances of the 24-hour $PM_{2.5}$ standard rose sharply in the past 5-10 years due to the increased intensity of wildfire smoke impacts. Figure 5 shows the number of exceedances by criteria pollutant from 1970 through 2024.

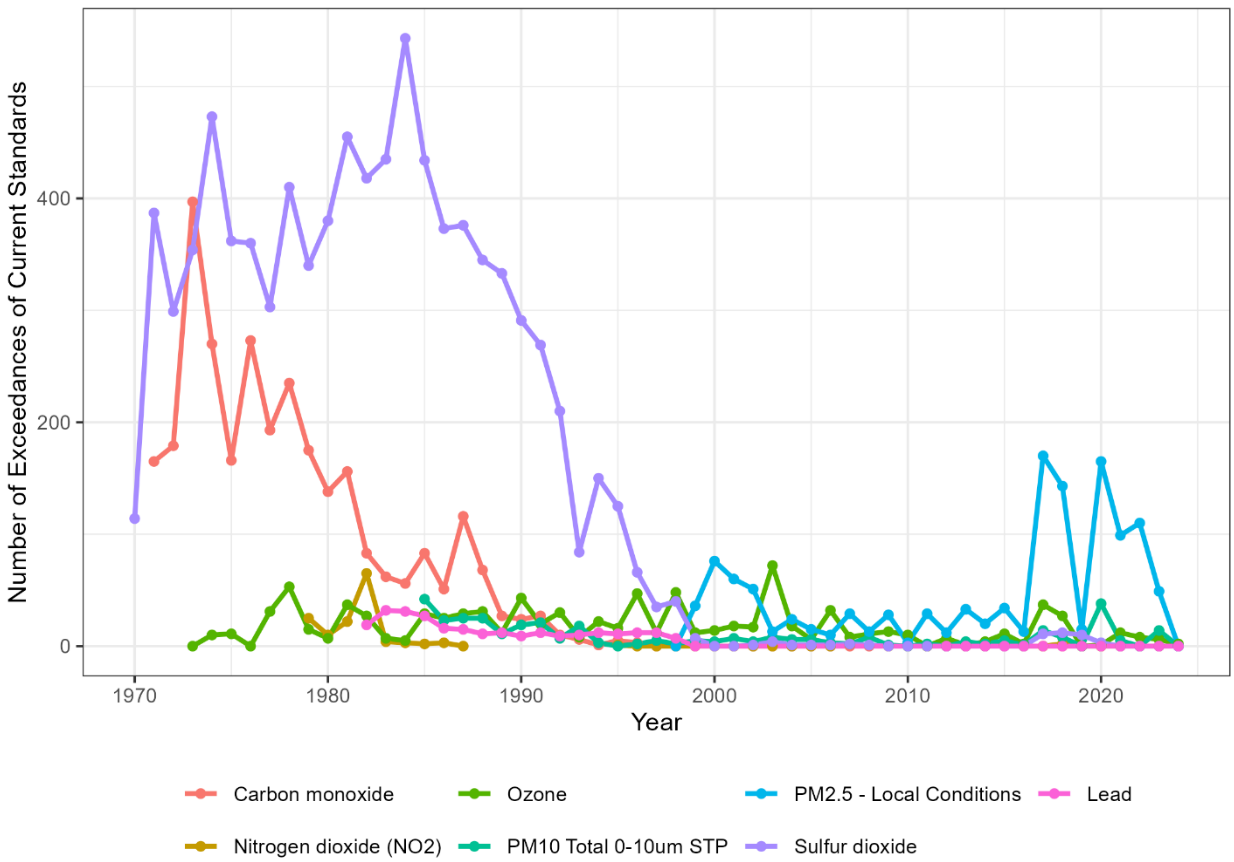

Figure 5. Number of exceedances of current NAAQS by parameter, 1970-2024.

Similar trends are evident when comparing criteria pollutant design values to their respective NAAQS. Figure 6 shows the range of criteria pollutant design values as a percentage of their respective current NAAQS as the mean (lines) and 5th-95th percentiles (shading). While CO, SO_2, and NO_2 design values were well over current NAAQS in the 1970s and 1980s, they are now much lower than the NAAQS. Though ozone exceedances are not as common as $PM_{2.5}$ exceedances in recent decades, ozone design values are generally quite close to the level of the NAAQS largely due to elevated background ozone in the western U.S. These trends in both exceedances and criteria pollutant design values inform Ecology's monitoring priorities and account for the shift in monitoring resources toward ozone and PM, and away from other criteria pollutants.

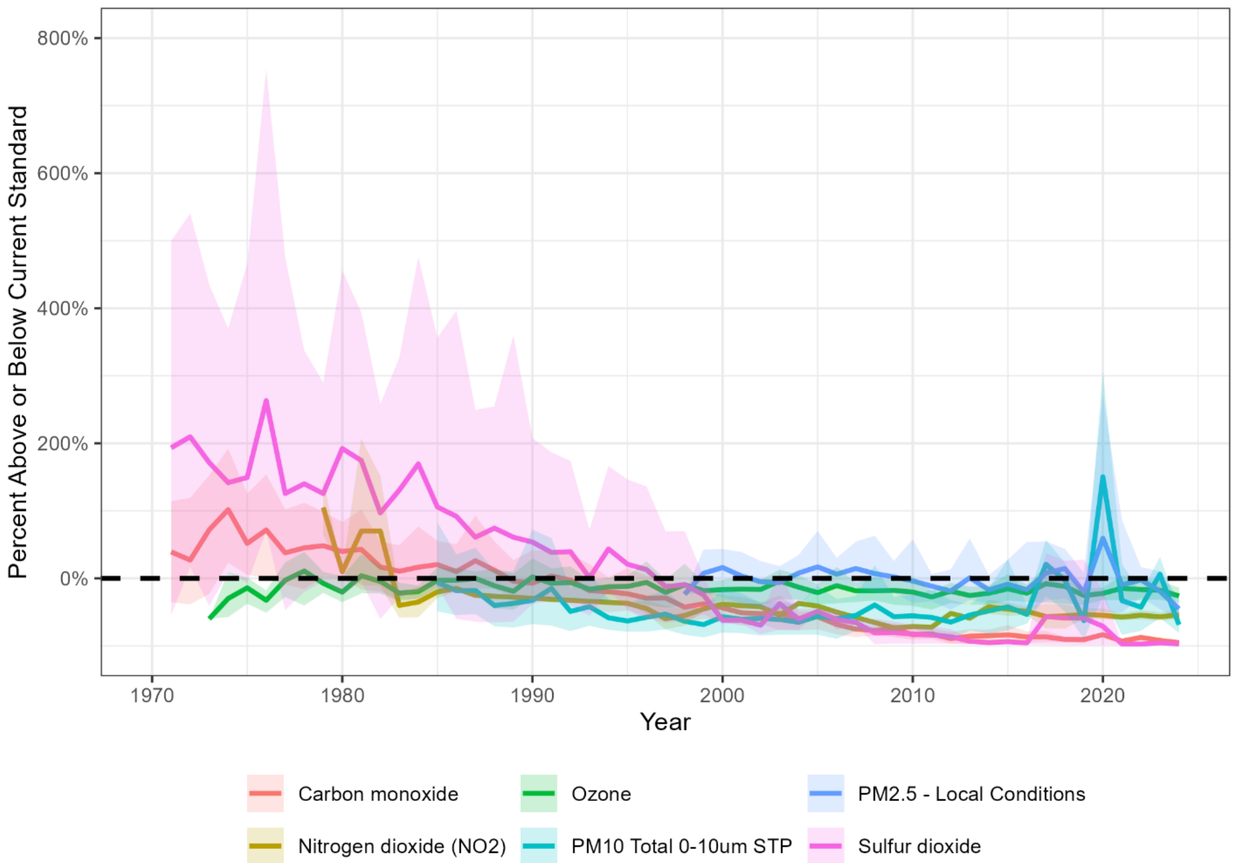

Figure 6. Criteria pollutant design values relative to the NAAQS. Mean (lines) and 5th-95th percentile (shading) design values as a percent of their corresponding NAAQS, 1970-2024.

Air quality planning

Maintenance areas

As of July 1, 2025, Washington has five maintenance areas for criteria pollutants within their 20-year maintenance planning period. During the 20-year maintenance planning period, maintenance areas demonstrate continued attainment of the NAAQS either through monitoring or through EPA-approved alternate methods. These methods are summarized in Table 3.

Table 3. Washington maintenance areas within their 20-year maintenance planning period and methods of demonstrating NAAQS attainment

Maintenance Area (Pollutant)	End of Maintenance Period	Method of Demonstrating NAAQS Attainment
Spokane (PM_{10})	8/30/2025	Spokane-Augusta PM_{10} monitor (530630021) until March 2021; Spokane Valley-E Broadway Ave PM_{10} monitor (530630017) as of April 2021
Spokane (CO)	8/30/2025	Modeled onroad, nonroad and residential wood combustion CO emissions
Wallula (PM_{10})	9/26/2025	Burbank-Maple St PM_{10} monitor (530710006)
Tacoma ($PM_{2.5}$)	3/12/2035	Tacoma-L St $PM_{2.5}$ monitor (530530029)
Whatcom County Intalco (SO_2)	1/16/2045	Ferndale-Kickerville Road SO_2 monitor (530730013) and Ferndale-Mountain View Road SO_2 monitor (530730017) until December 2024; Calculated cumulative potential to emit of all stationary SO_2 sources in maintenance area as of January 1, 2025.

Future monitoring and planning needs

Ecology also considers recent and upcoming NAAQS revisions to identify new monitoring needs. In February 2024, EPA finalized a new primary annual NAAQS for $PM_{2.5}$ of 9 ug/m^3. Ecology submitted a recommendation to EPA Region 10 in February 2025 on behalf of the Governor that all of Washington be designated in attainment of the new NAAQS based on monitor data from 2021-2023 as well as preliminary monitor data from 2024. EPA is expected to announce their final designation decision in February of 2026. The 2024 NAAQS revision did not impose any new monitoring requirements applicable to the Washington Network.

In March of 2025, EPA announced plans to revisit the 2024 $PM_{2.5}$ NAAQS, citing implementation concerns. EPA has not yet shared details on the process they will follow or what this will mean for states. Ecology is not aware of any expected changes to federal monitoring requirements applicable to the Washington Network as a result of this plan.

EPA has previously indicated their intention to review the Ozone and Lead NAAQS. The timeline for this review is unknown. A previous Clean Air Scientific Advisory Committee (CASAC) supported a substantial tightening of the primary 8-hour Ozone NAAQs (55-60 ppb); however, EPA staff disagreed. Based on the information available at the time of publication, Ecology did not consider the potential for any new monitoring requirements as a result of these NAAQS reviews in this Network Assessment.

Monitoring Network Assessment

As of July 1, 2025, Ecology and its partners operate 70 monitoring sites as part of the Washington Network. These sites are shown on the map in Figure 7.

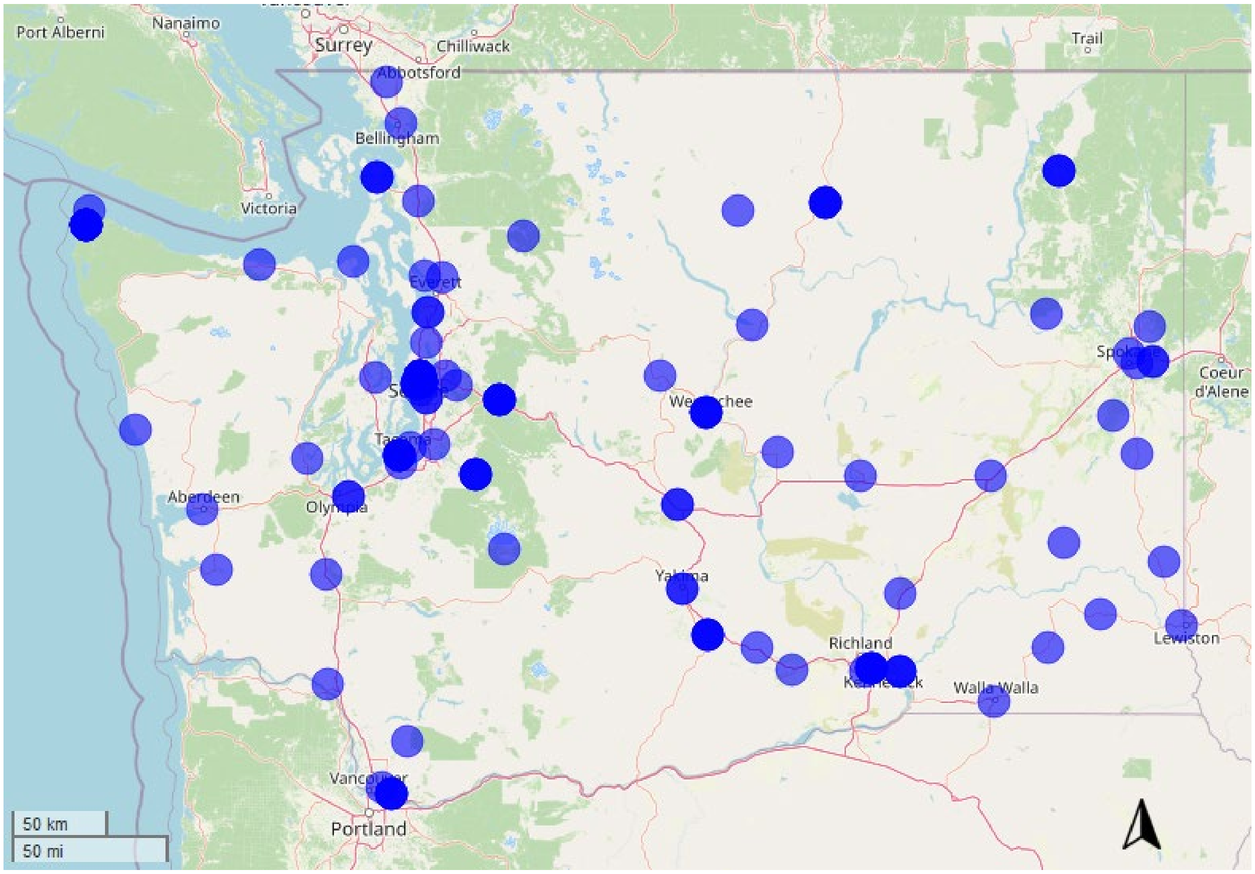

Figure 7. Map of all Washington Network monitoring sites

Sulfur dioxide, carbon monoxide, and oxides of nitrogen

As concentrations of SO_2, CO, and oxides of nitrogen are generally much lower than federal standards, monitoring for these pollutants is limited to sites that meet minimum federal requirements, participate in national monitoring programs, or serve a specific localized interest. Table 4 summarizes the Washington Network monitoring sites for these pollutants and their purpose, and Figure 8 - Figure 10 show maps of monitoring sites for each parameter.

Table 4. Summary of Washington Network monitoring sites for SO_2, CO, and oxides of nitrogen

Site	AQS ID	SO_2	CO	NO_x	NO_y	Purpose
Anacortes-202 O Ave	530570011	X				Local clean air agency priority site.
Cheeka Peak	530090013	X	X		X	Rural NCore site. (Cheeka Peak is in the process of relocation to nearby Bahokas Peak.)

Site	AQS ID	SO_2	CO	NO_x	NO_y	Purpose
Seattle-10th & Weller	530330030		X	X		Near-road site.
Seattle-Beacon Hill	530330080	X	X	X	X	Urban NCore, area-wide NO_2, PAMS, NATTS, CSN and IMPROVE site.
Seattle-Duwamish	530330057			X		Special purpose monitor to assess microscale impacts from diesel traffic.
Tacoma-S 36th St	530530024			X		Near-road site.

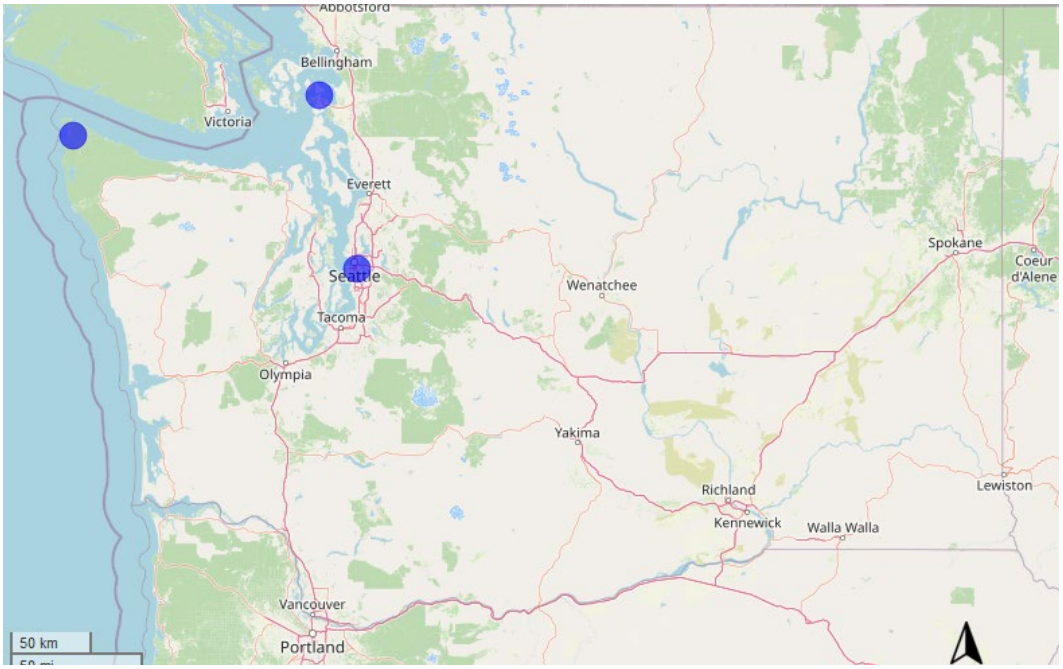

Figure 8. Map of Washington Network SO_2 monitoring sites.

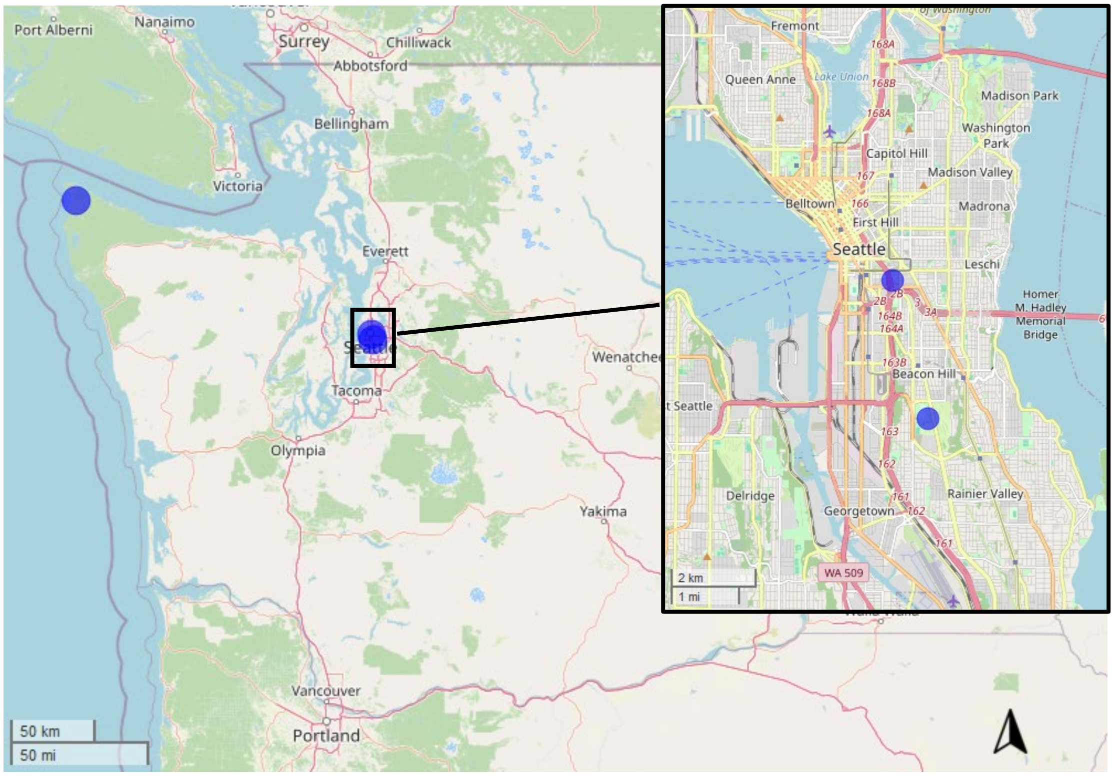

Figure 9. Map of Washington Network CO monitoring sites.

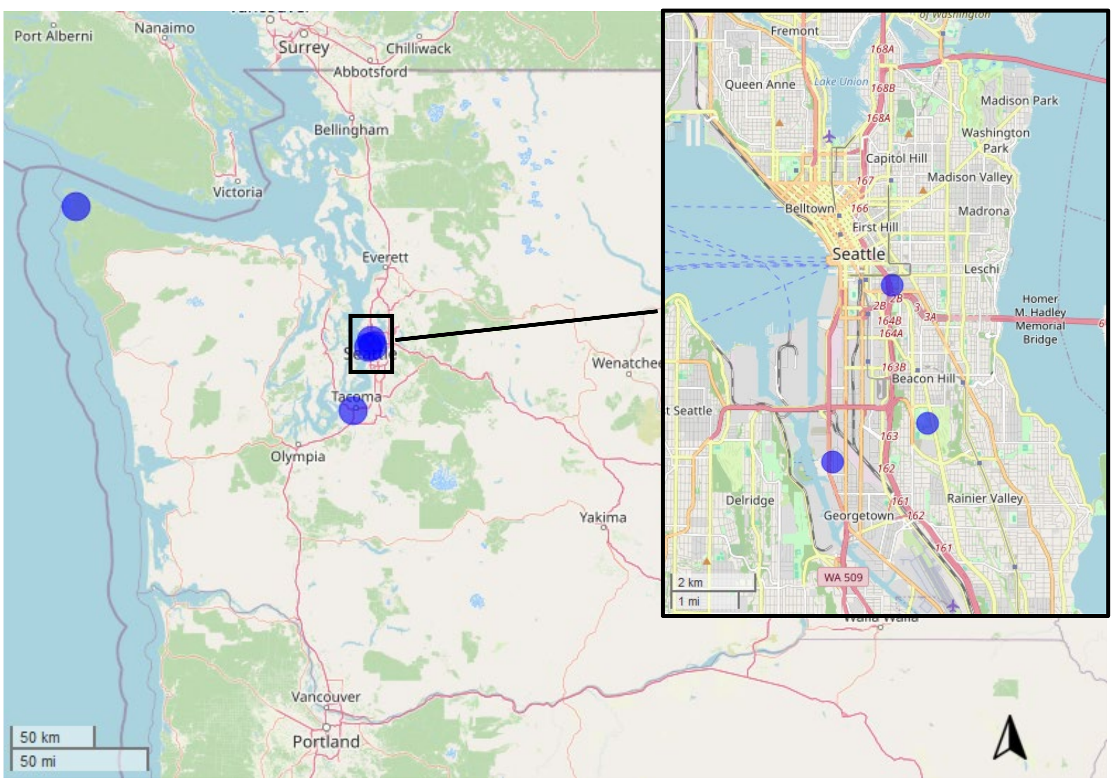

Figure 10. Map of Washington Network NO_X and NO_Y monitoring sites.

Two sites (Seattle-Beacon Hill and Cheeka Peak) are National Core (NCore) network sites. Cheeka Peak is in the process of relocation to nearby Bahokas Peak. Seattle-Beacon Hill also meets the federal requirement for area-wide NO_2 monitoring in CBSAs with a population of 1,000,000 or more people. Two sites (Seattle-10th & Weller and Tacoma-S 36th St) are near-road monitoring sites adjacent to Interstate 5 that meet federal requirements for near-road monitoring of CO and NO_x in CBSAs exceeding 1,000,000 people.

The remaining two sites were established due to local clean air agency priorities. The Anacortes-202 O Ave site is operated by the Northwest Clean Air Agency due to its proximity to several nearby refineries. It consistently records concentrations near background levels.

The Puget Sound Clean Air Agency's (PSCAA's) Seattle-Duwamish Special Purpose Monitor (SPM) for NO_2 was established in 2024 to evaluate the impacts of diesel traffic from nearby truck routes and seaport activity.

Ecology has not identified any unmet monitoring needs for CO or SO_2. In unmonitored areas, concentrations of these pollutants are expected to be below federal standards by very large margins based on modeling, emissions information, and available monitoring data.

The Seattle-10th & Weller near-road monitors are sited as microscale monitors adjacent to one of Washington's most heavily-trafficked interstate roadways. This site is expected to represent the highest concentrations of CO found in ambient air anywhere in the state. Its concentrations are so far below the federal CO standards that it has never exceeded 25% of either CO NAAQS since it was established. Since concentrations are expected to be even lower elsewhere in Washington outside of the near-road environment, Ecology does not consider additional CO monitoring to be warranted.

Prior to 2020, the largest source of SO_2 emissions in the state was the Intalco aluminum smelter in Ferndale. Two source-oriented Washington Network SO_2 monitoring sites adjacent to the facility (Ferndale-Mountain View Rd and Ferndale-Kickerville Rd) regularly recorded exceedances of the SO_2 NAAQS until facility operations were curtailed in 2020, at which point concentrations dropped to single digits (ppb). These two source-oriented monitoring sites were discontinued at the end of 2024. In the absence of any remaining large point sources emitting significant amounts of SO_2, design values at Washington Network SO_2 monitoring sites are routinely below 10 ppb, as shown in Figure 11. Circles indicate design values that meet EPA criteria for data completeness, and Xs indicate those that do not.

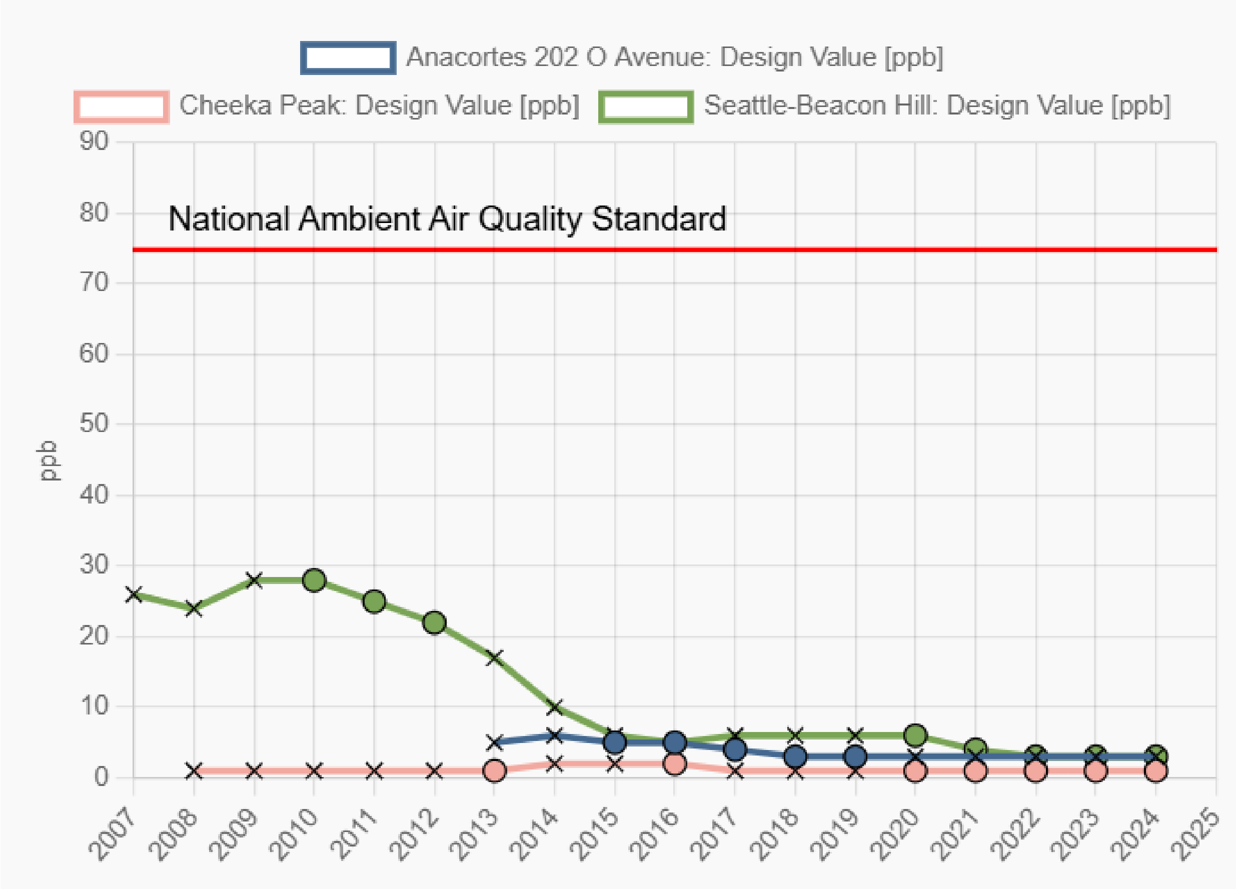

Figure 11. Historical SO_2 design values at Washington Network monitoring sites.

Similar to the near-road CO monitor at Seattle-10th & Weller, the two near-road NO_2 monitors (Seattle-10th & Weller and Tacoma-S 36th St) also represent the microscale environment adjacent to I-5 where concentrations are expected to be highest. Traffic volumes near Seattle-10th & Weller are higher than those near Tacoma-S 36th. Since it was established in 2014, design values at Seattle-10th & Weller have declined steadily and are approaching 50% of the NAAQS, as shown in Figure 12. Circles indicate design values that meet EPA criteria for data completeness, and Xs indicate those that do not.

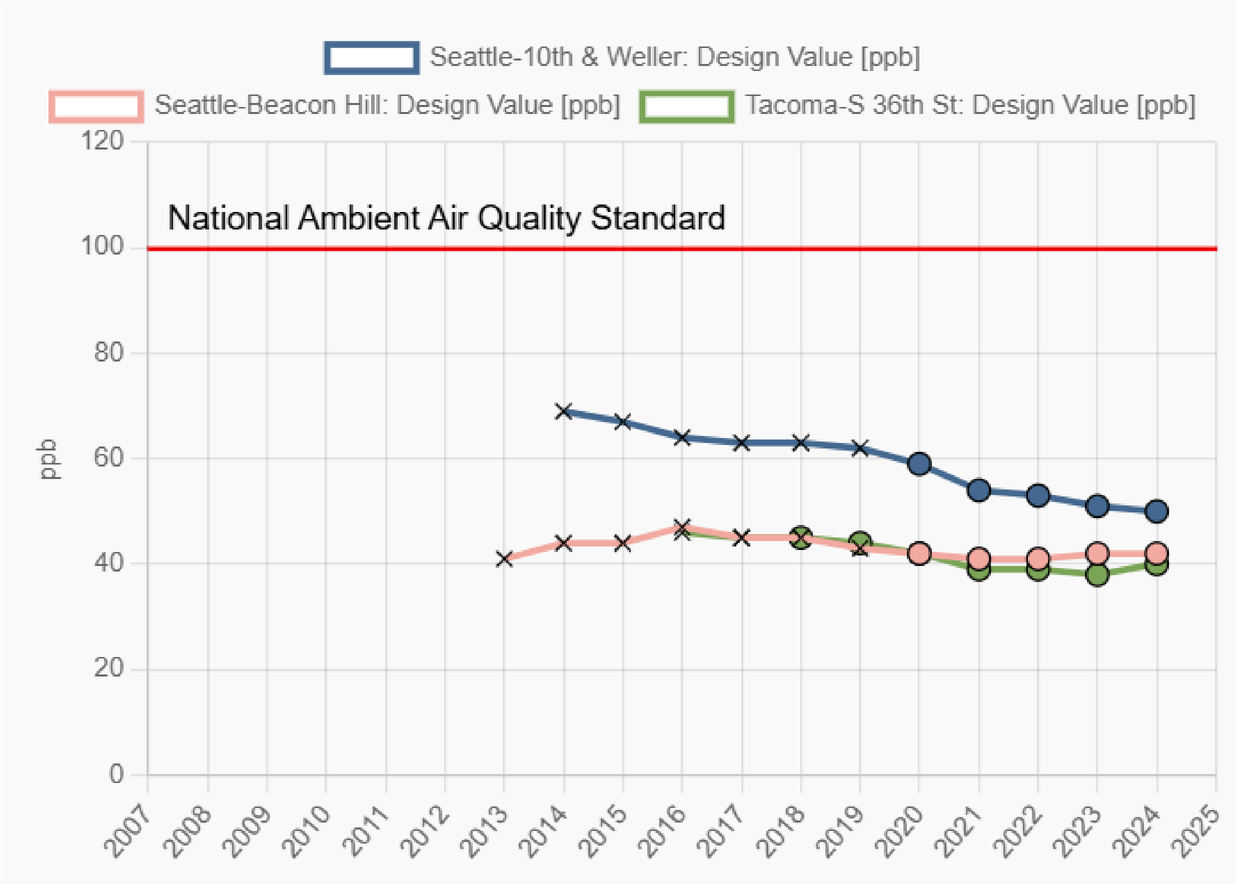

Figure 12. Historical NO_2 design values at Washington Network monitoring sites.

While the near-interstate environment is well characterized by the national near-road monitoring network, there is less information available on the air quality impacts of smaller urban expressways and arterial roads. The new NO_2 SPM at the Seattle-Duwamish site will provide valuable information on NO_2 concentrations in the vicinity of a major urban commercial truck route (State Route 99). Ecology plans to evaluate concentrations measured by this new monitor in the coming years, particularly in comparison to the data from the Seattle-10th & Weller near-road site. This comparison is likely to indicate whether expanded NO_2 monitoring in urban areas is merited, or whether existing near-road monitors adequately capture the NO_2 impacts of on-road mobile sources in the highest-concentration areas.

Does the network meet the monitoring objectives defined in 40 C.F.R. Part 58 Appendix D?

Ecology finds that Washington's network of SO_2, CO, and NO_x/NOy monitors is adequate to meet the objectives to provide air pollution data to the public in a timely manner, support NAAQS compliance, and support air pollution research.

Are new monitoring sites needed?

Ecology does not identify any outstanding needs for new monitoring sites.

Can existing sites be terminated?

Ecology does not identify any existing sites that should be terminated. The Anacortes-202 O Avenue site is operated by the Northwest Clean Air Agency (NWCAA) to meet what NWCAA has identified as a specific and localized need for SO_2 data in its jurisdiction, though the site is not otherwise needed to meet any 40 C.F.R. Part 58 requirements. As a partner agency to NWCAA, Ecology plans to continue support for this site as long as NWCAA maintains that such a local need exists.

The Seattle-Duwamish NO_2 SPM is not used to meet any 40 C.F.R. Part 58 requirements but was established due to a specific, local concern around diesel exhaust emissions. Ecology and PSCAA plan to evaluate its data in the coming years to determine whether ongoing monitoring is worthwhile.

Ozone

There are 13 ozone monitors in the Washington Network, which serve a variety of purposes summarized in Table 5. Washington's ozone monitoring season is May 1 - September 30. Ozone monitors operate only during this season except those noted with a *, which operate year-round.

Table 5. Summary of Washington Network monitoring sites for ozone

AQS ID	Site Name	Purpose
530570011	Anacortes-202 O Ave	Local clean air agency priority site.
530090013	Cheeka Peak*	Rural NCore site. (Cheeka Peak is in the process of relocation to nearby Bahokas Peak.)
530630001	Cheney-Turnbull	Urban scale monitor downwind (southwest) from Spokane metropolitan area.
530730005	Custer-Loomis	Local clean air agency priority site near the Canadian border downwind (southeast) from metropolitan Vancouver, BC.
530330023	Enumclaw-Mud Mtn	Urban scale monitor downwind (southeast) from Seattle-Tacoma metropolitan area. Highest concentration monitor in the Seattle-Tacoma-Bellevue MSA.
530330010	Issaquah-Lake Sammamish	Urban scale monitor downwind (east) from Seattle metropolitan area.
530050003	Kennewick-S Steptoe St	Urban scale monitor representing highest concentrations in Kennewick-Richland MSA.
530670013	Lacey-College St	Urban scale monitor representing population exposure in Olympia-Lacey-Tumwater MSA.
530530012	Mt Rainier-Jackson Visitors Ctr*	Regional scale monitor representing high elevation conditions downwind (southeast) from the Seattle-Tacoma metropolitan area and a Class I area.
530330017	North Bend-North Bend Way	Neighborhood scale monitor downwind (east) from Seattle metropolitan area.
530330080	Seattle-Beacon Hill*	Urban NCore, PAMS, NATTS, CSN and IMPROVE site.

AQS ID	Site Name	Purpose
530630046	Spokane-Greenbluff	Urban scale monitor downwind (northeast) from Spokane metropolitan area. Highest concentration monitor in the Spokane-Spokane Valley MSA.
530110011	Vancouver-Blairmont	Urban scale monitor representing the Washington side of the Portland-Vancouver-Hillsboro MSA.

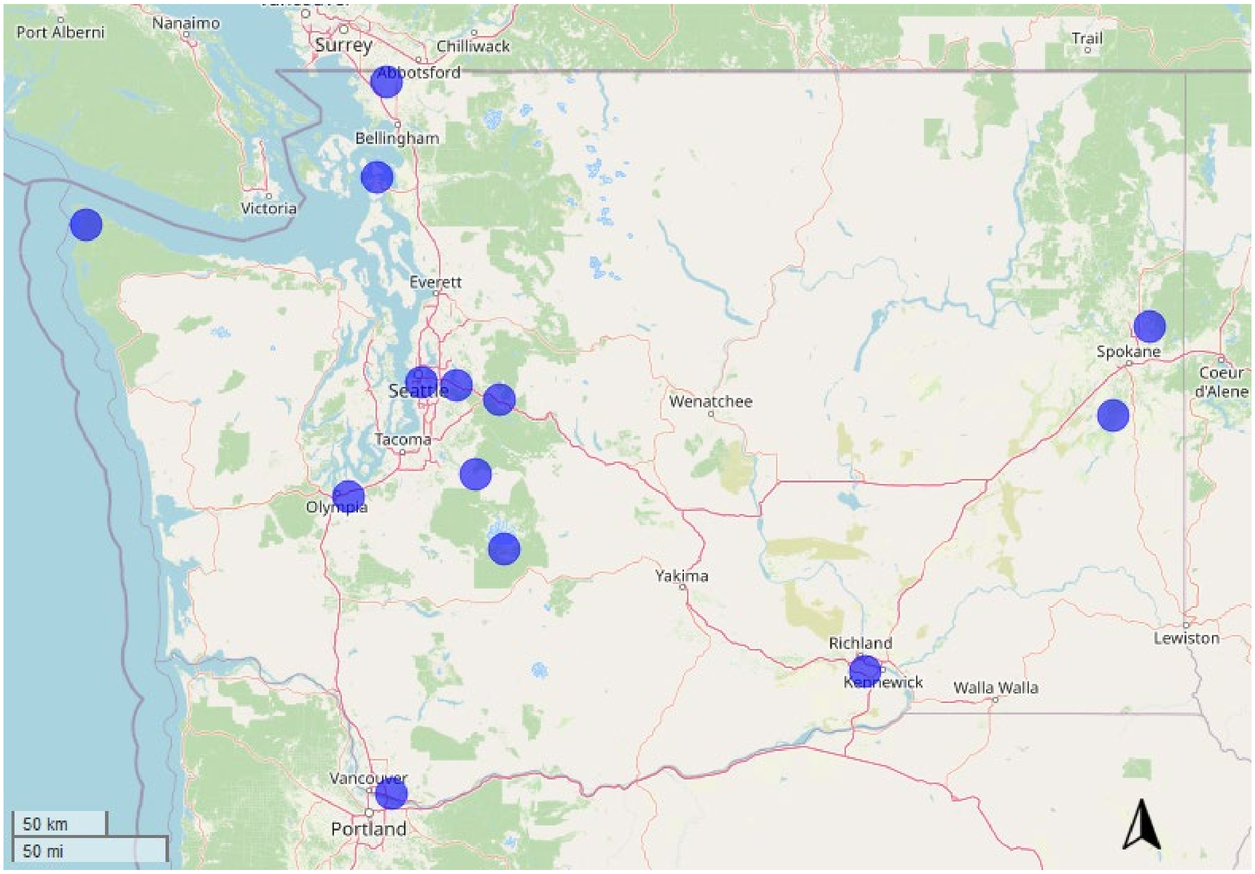

Figure 13. Map of Washington Network ozone monitoring sites.

Figure 14 shows the history of design values measured at Washington Network ozone monitoring sites relative to the current NAAQS of 0.070 ppm (red line). The Enumclaw-Mud Mtn and Kennewick-S Steptoe St monitors generally record the highest design values in the Washington Network, routinely above 0.065 ppm. The Spokane-area monitors (Spokane-Greenbluff and Cheney-Turnbull), North Bend-North Bend Way, and Issaquah-Lake Sammamish generally record design values between 0.060 and 0.065 ppm. The design values at remaining monitors are generally below 0.060 ppm.

The lowest design values are recorded at low-elevation sites near the Interstate-5 corridor (Anacortes-202 O Ave, Seattle-Beacon Hill, and Custer-Loomis), where conditions are not favorable to ozone formation.

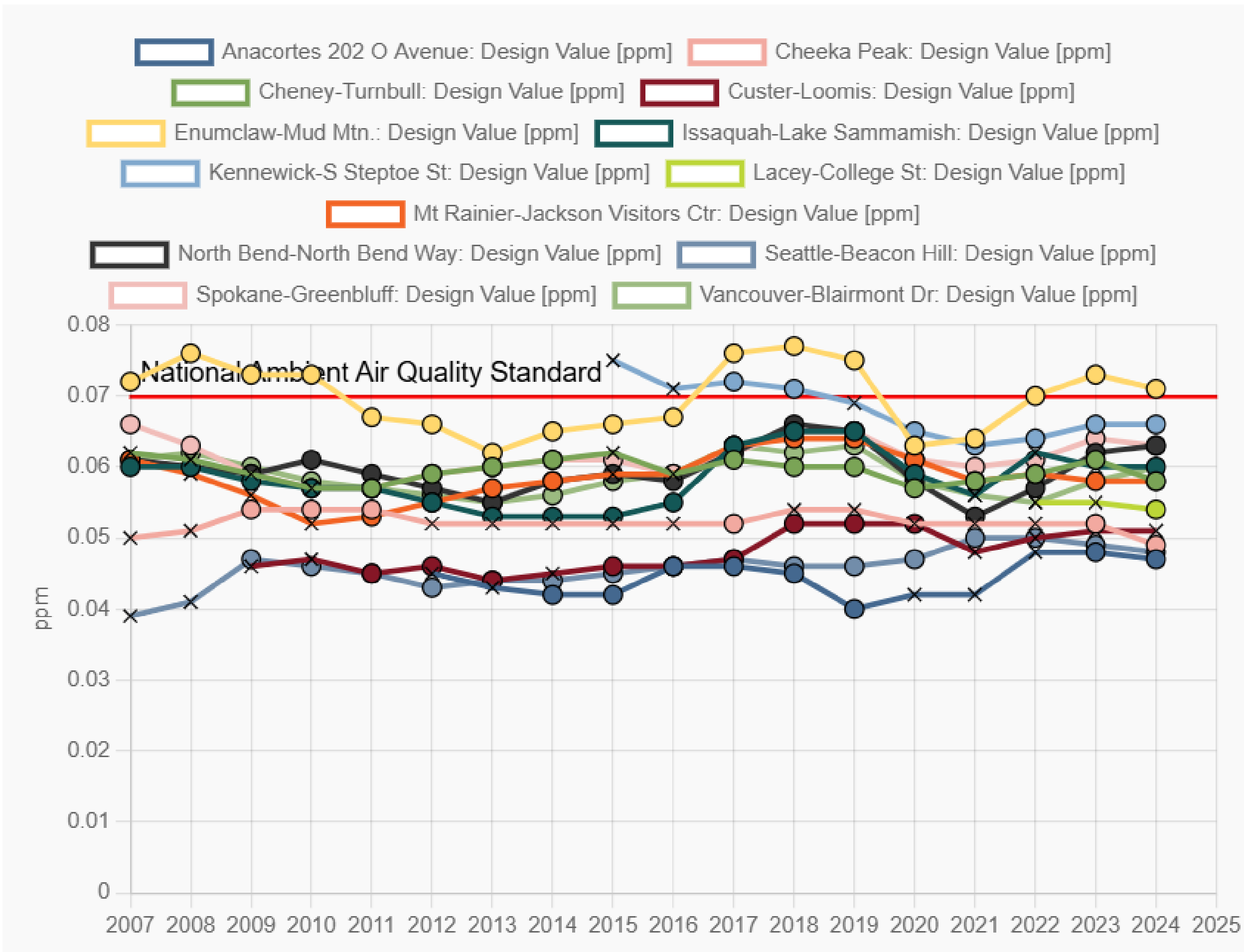

Figure 14. Historical ozone design values at Washington Network monitoring sites.

The Washington Network exceeds EPA's minimum monitoring requirements for ozone in the Seattle-Tacoma-Bellevue MSA. As the North Bend and Issaquah monitors are neither the highest concentration sites in the MSA nor otherwise required to meet any 40 C.F.R. Part 58 requirements, these monitors are in excess of minimum monitoring requirements. However, both have operated for more than 20 years and provide significant value due to their long historical records. They also provide valuable information about the spatial variation in elevated ozone across the Cascade foothills. Therefore, Ecology does not consider them priority monitors to discontinue.

Three monitors are not required by minimum monitoring requirements in 40 C.F.R. Part 58 due to their low design values: Lacey-College St, Anacortes-202 O Ave, and Custer-Loomis. All three are operated by local clean air agencies and have been identified as priority monitors for those agencies in order to provide ozone data to their jurisdictions. Ecology supports local clean air agency efforts to provide multi-pollutant monitoring data to the public even where not federally required. Ecology plans to continue network support for these monitors as long as the local clean air agencies continue to operate them.

Special monitoring studies

In summer 2024, Ecology conducted two short-term ozone monitoring studies, which are summarized below. In the Tri-Cities (Kennewick, Richland, and Pasco), Ecology conducted a multi-site survey of ozone concentrations in order to inform site selection for a second permanent ozone monitoring site in the Kennewick-Richland, WA MSA. A second ozone monitoring site will be required in this MSA once its population reaches 350,000 people, which is expected by 2030. In Yakima, Ecology conducted a three-week study of continuous ozone concentrations to establish an understanding of baseline of ozone levels using the existing $PM_{2.5}$ and PM_{10} monitoring site on 4th Avenue. There are no current or historic permanent ozone monitoring sites in or near Yakima, but some community members have raised concerns about ground-level ozone in the Yakima region.

Tri-Cities ozone study

Ozone sampling was conducted at a total of 7 study locations in the Tri-Cities on 5 different sampling days with a 2B Technologies Personal Ozone Monitor (POM). The POM is a Federal Equivalent Method (FEM) instrument for ozone monitoring.

Sampling was only conducted while stationary in a parked vehicle. This sampling plan minimized instrument noise from vehicle motion and reduced the influence of fresh roadway emissions on monitored concentrations. Though measurements were not collected while in motion, the Tri-Cities ozone sampling is referred to as “mobile” hereafter for brevity.

Sampling days were selected based on forecast ozone and meteorology, which were assessed daily during the study period. High ozone is most often forecast in the Tri-Cities when temperatures will exceed 95°F and winds are calm and from the north and northeast.

Sampling was conducted for approximately 15 minutes per sampling location per day. Not all locations were sampled each day, and locations were sampled in a different order each day. The specific locations sampled each day and their order were determined based on that day’s forecasts and the measured concentrations from prior sampling days. When identifying sampling locations and their order, the primary goals were to sample areas where high concentrations were forecast during peak hours and to ensure that each general area was sampled in the early, mid, and late afternoon at least once. Collocated sampling was also conducted next to the permanent ozone monitoring site at the BCAA office (Kennewick-S Steptoe St) on two sampling days for verification of the POM’s performance. Additional information on the study design, quality control and quality assurance are provided in the Quality Assurance Project Plan for Summer 2024 Tri-Cities and Yakima Mobile Ozone Study.

Table 6. Summary of sampling dates and locations for summer 2024 Tri-Cities ozone study

Location	Address	July 23	August 1	August 2	August 5	August 7
WSU Richland	1266 Lee Blvd, Richland, WA 99352	X	X			
Pasco Sporting Complex	6520 Homerun Rd, Pasco, WA 99301	X	X	X	X	X
Columbia Basin College	2600 N 20th Ave, Pasco, WA 99301	X	X	X		X
Highland Park	500 N Wehe Ave, Pasco, WA 99301	X	X	X	X	X
Columbia High School	755 Maple St, Burbank, WA 99323		X	X	X	
Riverview High School	36509 S Lemon Dr, Kennewick, WA 99337		X	X	X	X
Benton County Fairgrounds	1500 S Oak St, Kennewick, WA 99336		X	X	X	X
Kennewick-S Steptoe St	526 S Steptoe St, Kennewick, WA 99336			X	X	

Since there was significant day-to-day variation in the timing and magnitude of peak ozone concentrations, results were normalized to concentrations at the Kennewick-Steptoe St monitor to minimize the influence of temporal variation on study results. Figure 15 summarizes these results as boxplots of the difference in 1-minute concentrations between the mobile ozone monitor and the Kennewick-S Steptoe St monitor, and Figure 16 shows the median difference as a map.

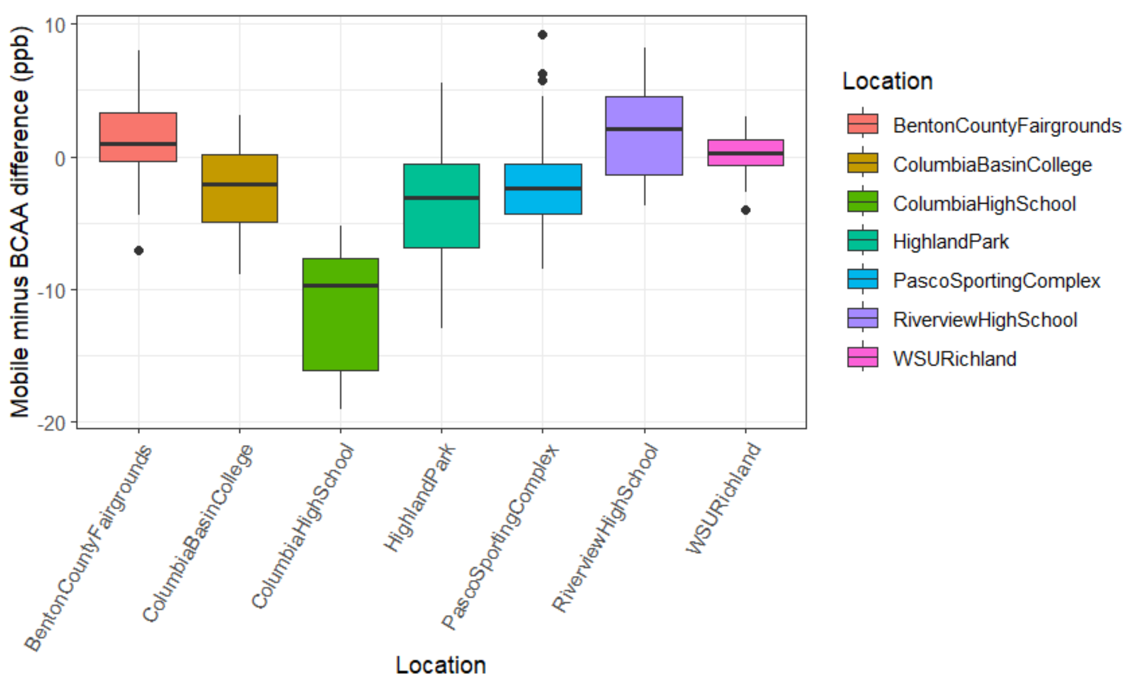

Figure 15. Boxplots of 1-minute mobile ozone concentrations relative to 1-minute Kennewick-S Steptoe St ozone concentrations

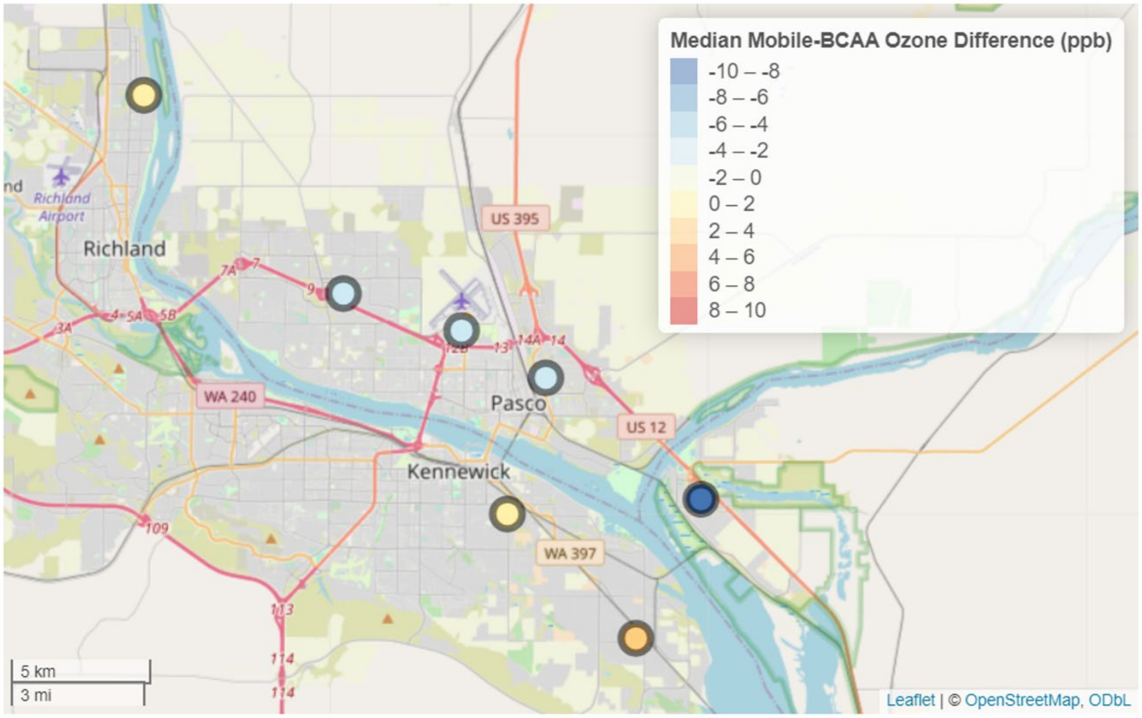

Figure 16. Map of median difference between 1-minute mobile ozone concentrations and 1-minute Kennewick-S Steptoe St ozone concentrations.

Summary of key findings

- Relative to the Kennewick-S Steptoe St monitor, the highest concentrations were observed southeast of Kennewick at the River View High School and Benton County Fairgrounds sampling sites. Of these two sites, River View High School was generally higher.
- The three sampling locations in Pasco (Pasco Sporting Complex, Columbia Basin College, and Highland Park), generally tracked the Kennewick-S Steptoe St monitor but were slightly lower. On days when the Kennewick-S Steptoe St monitor peaked above 70 ppb, none of the Pasco locations were similarly elevated. Prior to the study, staff had hypothesized that because Kennewick-S Steptoe St sees elevated concentrations when winds are from the north and northeast, Pasco may see elevated concentrations when winds were from the south and southwest. The data collected during this study did not indicate elevated ozone in Pasco during any wind conditions. However, none of the sampling periods occurred during calm southwest winds, so this hypothesis was not fully tested during the study.
- Columbia High School in Burbank (where the current Burbank PM_{10} site is located) was consistently lower than Kennewick-S Steptoe St. On the sampling day with highest ozone at Kennewick-S Steptoe St, the mean concentration at the Columbia High School sampling location was 15 ppb lower than the mean at Kennewick-S Steptoe St during the same time period. Based on these results, Burbank was ruled out for further study.

The study results indicate that ozone concentrations in the Tri-Cities area are likely to be highest southeast of the current site, with River View High School in Finley recording the highest concentrations in the study. Pasco and Richland are not likely to experience elevated concentrations of the same magnitude, though concentrations reached the low-to-mid-60s ppb in both locations.

Pasco and Richland may be suitable locations for a second ozone site if the goal of the new site is to capture different spatial and diurnal patterns than the current Kennewick-S Steptoe St site. Finley or southeast Kennewick would be suitable locations if the goal of the second site is to capture the highest concentrations, though this goal may be adequately met with the existing Kennewick-S Steptoe St monitoring site. Based on the study results, Burbank is not recommended as a location for the second ozone site since concentrations measured at Columbia High School were much lower than those measured at other sites.

Ecology plans to consult with BCAA and its Central and Eastern Regional Offices to identify the primary goal for the second ozone site. Ecology then plans to evaluate potential site locations in southeast Kennewick/Finley, Pasco, and/or Richland and install the new ozone site by summer 2026.

Yakima ozone study

Ozone monitoring was conducted at the Yakima-4th Ave monitoring site (402 S 4th Ave) from July 17 through August 12, 2024. The Yakima-4th Ave site is a permanent monitoring site for $PM_{2.5}$ and PM_{10} operated by the Yakima Regional Clean Air Agency. An FEM POM was added to the existing monitoring site.

Yakima is located approximately 70 miles northwest of the Tri-Cities. Their climates are largely similar, though each is in a distinct valley. A primary research question that motivated the study was the extent to which ozone concentrations were similar between the two areas, or whether Yakima’s distinct airshed is not represented by existing monitors.

The time-series graph below shows forward-running 8-hour average ozone concentrations from the temporary Yakima-4th Ave and permanent Kennewick-S Steptoe St monitors. The federal 8-hour standard of 70 ppb is shown in the black line.

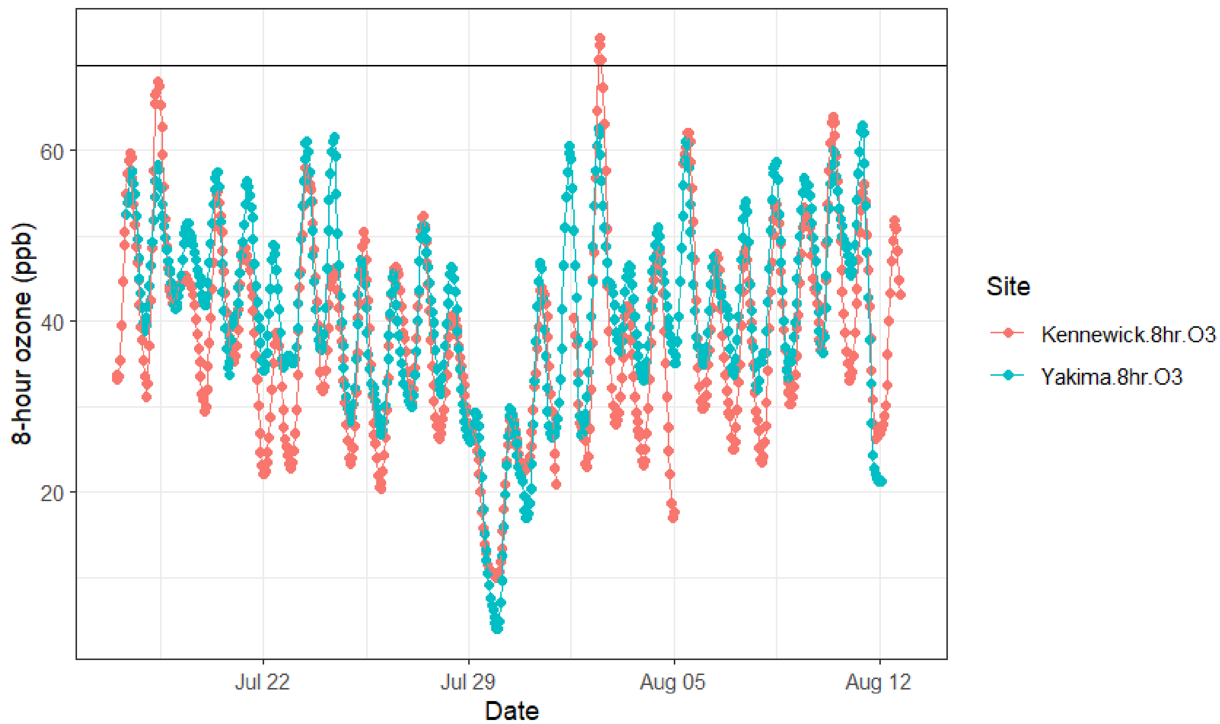

Figure 17. Comparison between 8-hour forward-running average ozone concentrations at Kennewick-Steptoe St (permanent) and Yakima-4th Ave (temporary) monitoring sites

The pollution rose in Figure 18 shows ozone concentrations measured at the Yakima-4th Ave site by wind direction. Hourly concentrations above 60 ppb occurred almost exclusively during winds from the northeast, east, southeast, and south. Though west winds predominate in general, they did not coincide with elevated ozone concentrations.

Since the Yakima-4th Ave S site is located in eastern Yakima and elevated concentrations occurred during east winds, it may not be in the optimal location for monitoring peak concentrations. If ongoing ozone monitoring is pursued in Yakima in the future, additional mobile or saturation sampling should be conducted across a broader area of Yakima to identify the most suitable location for an ozone monitor in the Yakima MSA.

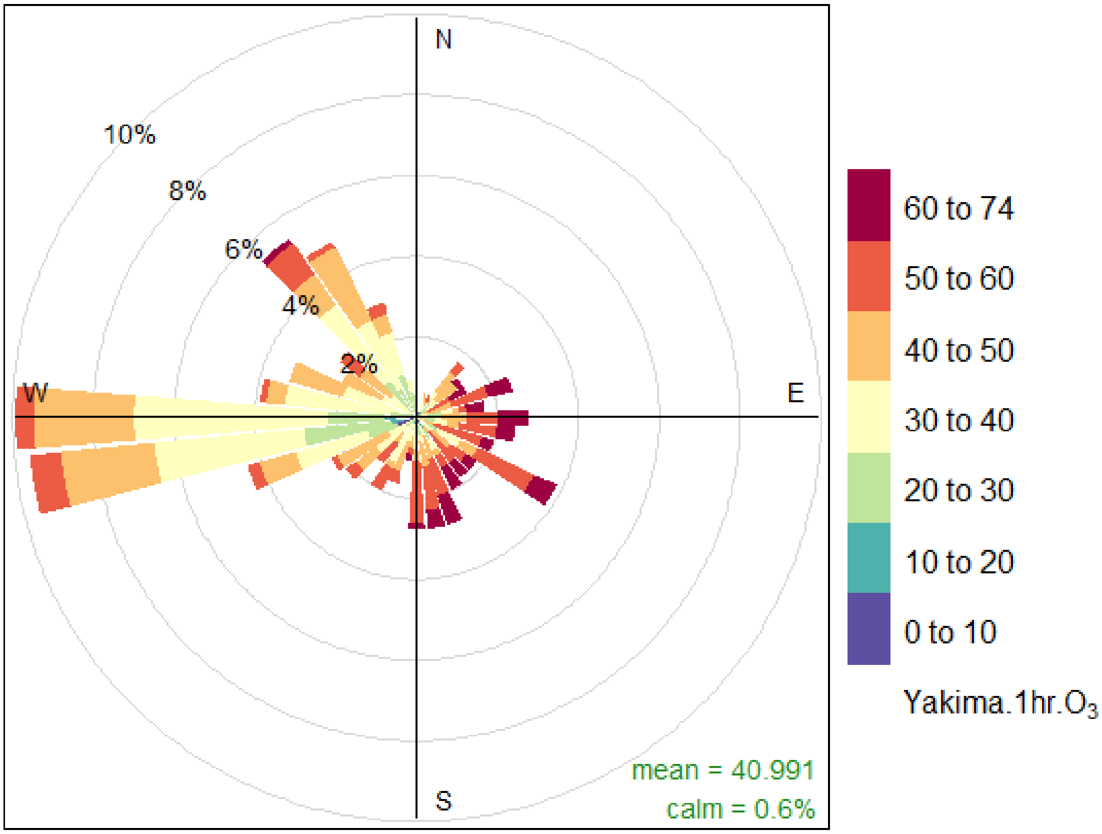

Figure 18. Pollution rose showing hourly ozone concentrations at Yakima-4th Ave S by wind direction.

Summary of key findings

- The highest daily maximum 8-hour average (D8M) observed in Yakima was 63 ppb. During the study period, the highest D8M observed in Kennewick was 73 ppb, though not on the same day as Yakima's highest D8M.
- The comparison between the two sites indicates a mix of regional and local influences on ozone concentrations. While broader regional meteorological patterns such as elevated temperatures and precipitation affected both sites similarly, their D8Ms were not always elevated simultaneously. The weak correlation between peak D8Ms at the two sites indicates that the sites represent two different airsheds, with local-scale variation in ozone conditions between them.
- There were two days during the study when the D8M in Kennewick reached near or above the federal standard of 70 ppb: July 18 (68 ppb) and August 2 (73 ppb, an exceedance of the federal standard). On both days, the D8M at Yakima was 10-11 ppb lower (58 ppb and 62 ppb, respectively). These results indicate that on days when meteorological conditions are favorable for high ozone formation in Kennewick, Yakima does not experience peaks of the same magnitude.

These results indicate that ozone concentrations above 60 ppb are relatively common in Yakima, with hourly concentrations routinely reaching 65 ppb when meteorological conditions are favorable. However, hourly ozone concentrations above 70 ppb were only recorded once on July 24, when significant wildfire smoke was present. No exceedances of the 8-hour NAAQS of 70 ppb were recorded during the study period, though the Kennewick-S Steptoe St monitor recorded one NAAQS exceedance during this window. These results indicate that even on days with favorable conditions for ozone formation, the "ceiling" for high ozone in Yakima is likely in the low-to-mid-60s ppb D8M, though wildfire smoke may contribute to higher concentrations.

Without evidence of routine D8Ms over 65 ppb, ongoing ozone monitoring in Yakima is likely not a preeminent need. The area is not at risk for nonattainment of the current ozone NAAQS, and concentrations are unlikely to reach the Unhealthy for Sensitive Groups (>70 ppb) range where AQI information is more urgent for public health protection. However, ongoing ozone monitoring may be considered if (a) the ozone NAAQS and/or AQI breakpoints are lowered in the future, or (b) the goal of characterizing a unique and currently unmonitored ozone airshed is identified as a priority for Ecology, YRCAA, and/or EPA.

The resource implications of a decision to add a permanent SLAMS for ozone in Yakima should be carefully considered in light of the restrictions of EPA's minimum monitoring requirements for ozone (40 C.F.R. Part 58 Appendix D 4.1). Minimum monitoring requirements for ozone apply at a relatively low design value threshold (≥60 ppb) that is close to background concentrations in the western U.S. Therefore, a permanent SLAMS site should only be added if resources are identified to support the operation of the site for the indefinite future. SPM monitoring would provide more operational flexibility.

Additional, more detailed results of the summer 2024 Tri-Cities and Yakima ozone studies are available upon request.

Does the network meet the monitoring objectives defined in 40 C.F.R. Part 58 Appendix D?

Ecology finds that Washington's network of ozone monitors is adequate to meet the objectives to provide air pollution data to the public in a timely manner, support NAAQS compliance, and support air pollution research.

Are new monitoring sites needed?

Ecology plans to install a new ozone monitor in the Kennewick-Richland MSA in 2026.

As resources allow, the addition of ozone monitoring in the Yakima MSA may provide value in characterizing a unique and currently unmonitored ozone airshed. If Yakima ozone monitoring is pursued in the future, additional mobile or saturation sampling should be conducted to identify the most suitable location for an ozone monitor in the Yakima MSA.

Can existing sites be terminated?

Though several ozone monitors in the Washington Network are in excess of minimum monitoring requirements, Ecology does not identify any as priority monitors for discontinuation.

Fine particulate matter ($PM_{2.5}$)

The Washington Network is heavily invested in $PM_{2.5}$ monitoring, since $PM_{2.5}$ is routinely elevated across Washington and thus represents an ongoing and widespread public health concern. Every site in the Washington Network monitors for $PM_{2.5}$.

Ecology has identified three tiers of $PM_{2.5}$ monitoring needs in Washington, which correspond to the instruments selected for monitoring and the treatment of their data. Federal Equivalent Method monitors are used at sites with design values greater than 80% of the $PM_{2.5}$ NAAQS, at sites that participate in national monitoring programs (such as near-road and urban NCore sites), and at sites required to meet federal minimum monitoring requirements. There are 23 FEM monitoring sites for $PM_{2.5}$, which report data to parameter code 88101. Ecology operates three FRMs as collocated monitors at sites where the primary monitor is an FEM, in order to fulfill the collocation requirements defined in 40 C.F.R. Part 58 Appendix A.

The next tier of sites use non-regulatory $PM_{2.5}$ monitors, including nephelometers and BAM 1022s with Sharp-Cut Cyclones, and report data to AQS with parameter code 88502. These non-regulatory monitoring sites have design values between 50-80% of the $PM_{2.5}$ NAAQS, are used for specific air quality management applications such as agricultural burn permitting or smoke management, or have been identified by Ecology or local clean air agencies as priority monitoring sites for providing AQI information to the public in populated areas. All non-regulatory $PM_{2.5}$ monitors meet any applicable requirements of 40 C.F.R. Part 58 Appendices A, B, C, D, and E, except where noted in Ecology's Ambient Air Monitoring Network Plan.

At the remaining monitoring sites, Ecology uses a custom $PM_{2.5}$ sensor device called a SensWA designed and built by Ecology to report the $PM_{2.5}$ AQI. SensWA data are submitted to AirNow for display on the AirNow Fire & Smoke map, but they are not submitted to AQS. The SensWA is a relatively low-cost tool Ecology has used to expand the $PM_{2.5}$ monitoring network to previously unmonitored areas and to add $PM_{2.5}$ monitoring to sites for other pollutants that lacked $PM_{2.5}$ monitors. Other applications include monitoring smoke impacts from wildland fires, responding to isolated or emergent events, monitoring to aid in smoke management decisions, temporary surveys, and saturation studies.

Additional information about the SensWA is available in the following Ecology documents: Focus on SensWA, SensWA Quality Assurance Project Plan, and SensWA Correlations for $PM_{2.5}$ Reporting Technical Document.

Figure 19. SensWA used for supplemental non-regulatory $PM_{2.5}$ monitoring.

Since Ecology began using the SensWA for $PM_{2.5}$ AQI reporting in 2022, they have become the primary way Ecology evaluates the need for additional $PM_{2.5}$ monitors in the Washington Network. A SensWA can be installed relatively quickly and easily, and due to its small footprint and flexible mounting options, it can operate in locations where installation of a traditional monitoring site would be logistically prohibitive. When Ecology identifies a need for $PM_{2.5}$ data in new communities, installation of a SensWA is generally the first step as a screening tool. Then, Ecology evaluates the SensWA data to determine whether its design values support monitoring with a higher-tier instrument, according to the criteria described above. Some local clean air agencies also use the SensWA as a screening tool in their jurisdictions, and others choose to use other monitoring tools such as commercial sensors or mobile monitoring studies instead.

Ecology has also established a framework for using SensWA to continue monitoring in communities where planned, short-term $PM_{2.5}$ studies have ended. Ecology operated temporary nephelometer monitoring trailers for 1-2 year studies in Soap Lake (2022-2024) and Newport (2020-2022). In Newport, Ecology operated a collocated SensWA alongside the nephelometer trailer. In both communities, Ecology left a SensWA in place when the trailer was removed. The high level of agreement between the SensWA and the nephelometer in Newport supported the ongoing use of the SensWA as a $PM_{2.5}$ AQI reporting instrument.

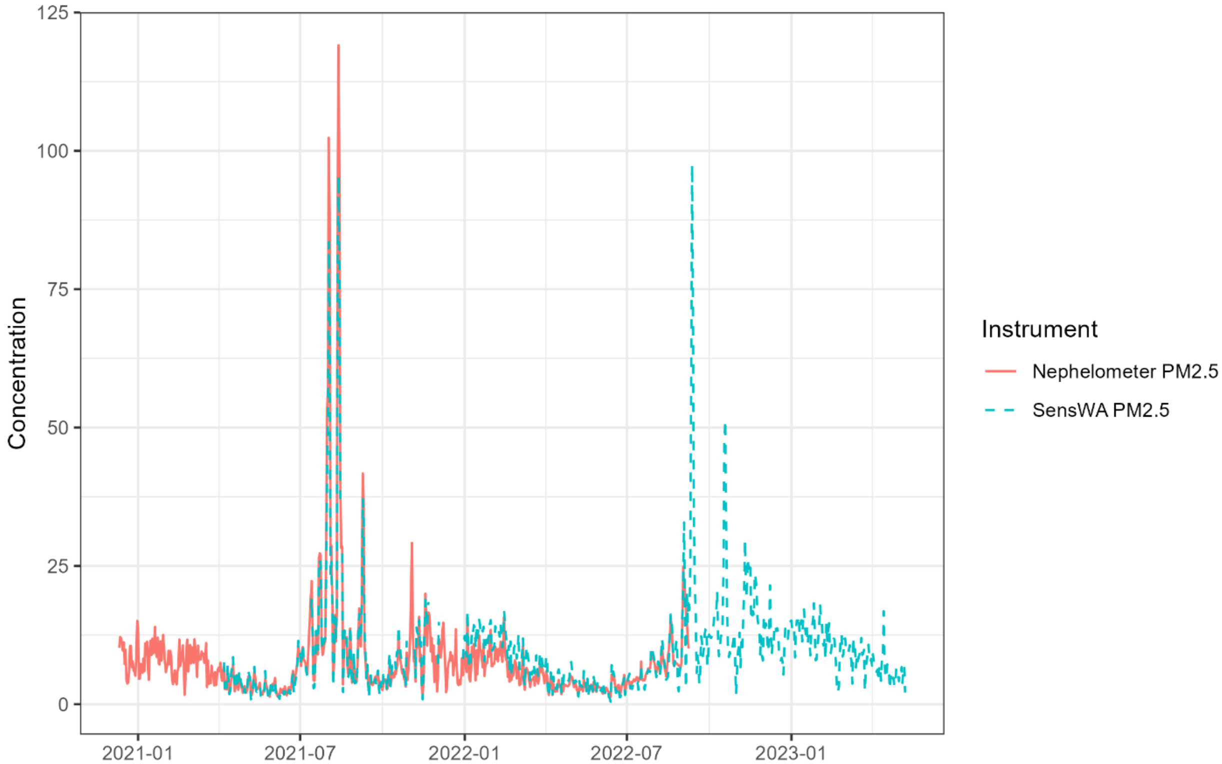

Figure 20. Example of use of a SensWA to continue $PM_{2.5}$ reporting in a community after a temporary nephelometer monitoring study has ended (Newport, 2021-2023)

Since the Washington Network collects such a large volume of $PM_{2.5}$ monitoring data across its three tiers of instruments, the primary question in assessing the $PM_{2.5}$ monitoring network is whether each site is monitoring with the appropriate instrument type for its objectives and levels of $PM_{2.5}$ pollution. FEM sites with relatively low design values are evaluated for potential resource savings by switching to a non-regulatory instrument. Similarly, Ecology evaluates whether FEM monitoring is warranted at sites with non-regulatory monitors but relatively high design values.

Since Ecology only began installing SensWA in mid-2022, there are no SensWA sites with a complete 2024 3-year estimated design value.[2] Therefore, Ecology compared the individual year design value statistics (98^{th} percentile and annual mean concentrations) by instrument type in 2024, as well as the 3-year (2022-2024) and 5-year (2020-2024) estimated design values. Five-year estimated 24-hour and annual design values are calculated as the mean of annual 98^{th} percentile and annual mean concentrations, respectively, from 2020-2024. While individual year 98^{th} percentiles and means are subject to expected year-to-year fluctuations, the 2024

[2] Since "design values" are official summary statistics calculated for regulatory monitors, Ecology uses the term "estimated design values" to refer to these calculations for non-regulatory monitors.

summary statistics provided a useful basis for comparisons across instrument types from the largest number of sites.

These comparisons are shown in Figure 21 through Figure 26. SensWA sites are only shown if they have complete data for all years covered by the graph. Two current SensWA sites (Withrop-Chewuch Rd, Newport-Calispel) are shown on the design value graphs because the SensWA replaced nephelometers previously operated at those sites and the datasets were combined to calculate estimated design values.

The addition of wildfire smoke-impacted days over 15 $\mu g/m^3$, which are flagged in AQS with informational flags on FEM data, are shown separately in the purple bars. Ecology generally assesses design values for instrument selection after excluding wildfire smoke-impacted data, since wildfire smoke impacts are so variable year-to-year.

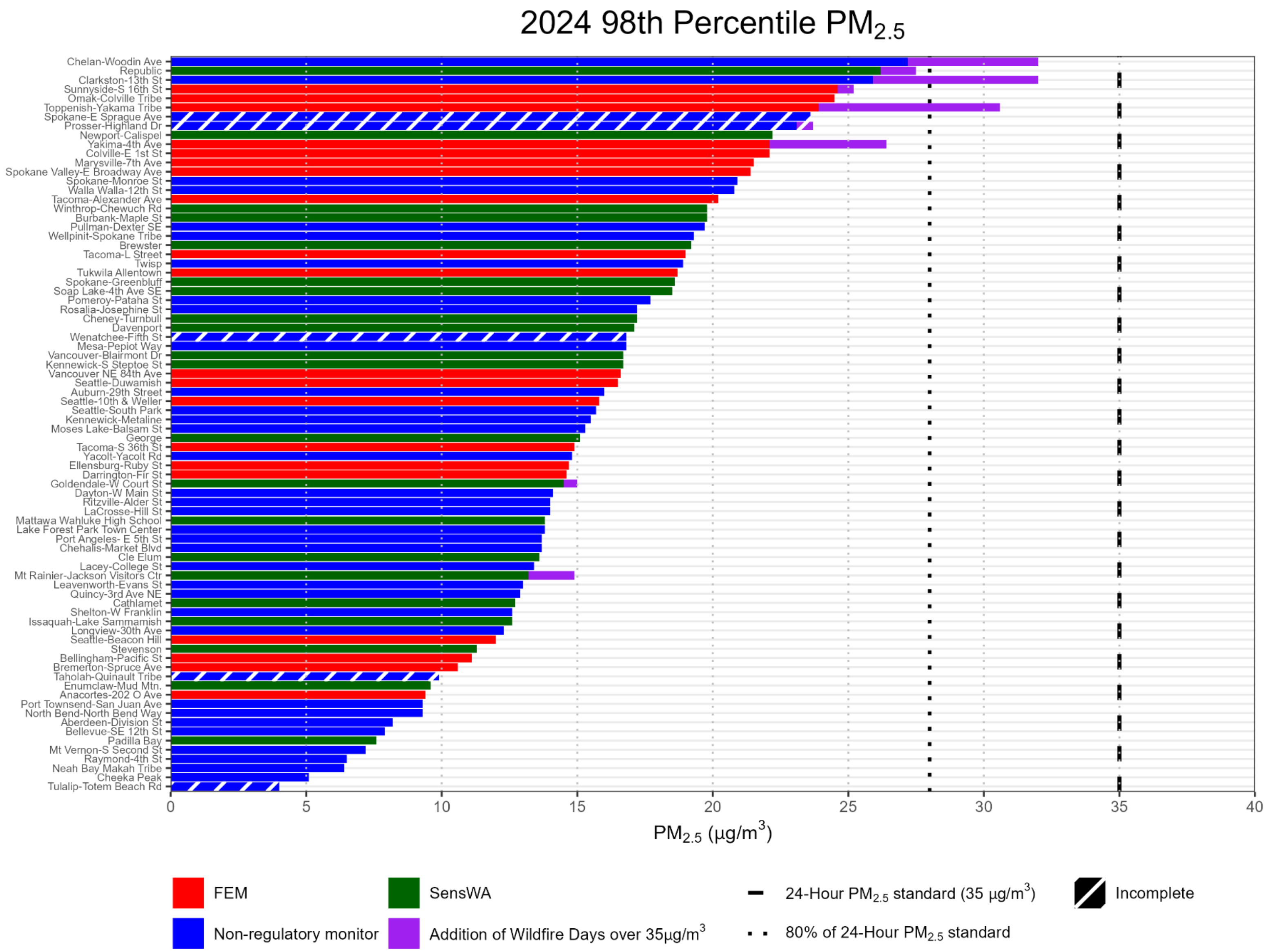

Figure 21. 98th percentile 24-hour average $PM_{2.5}$ concentrations by instrument type, 2024

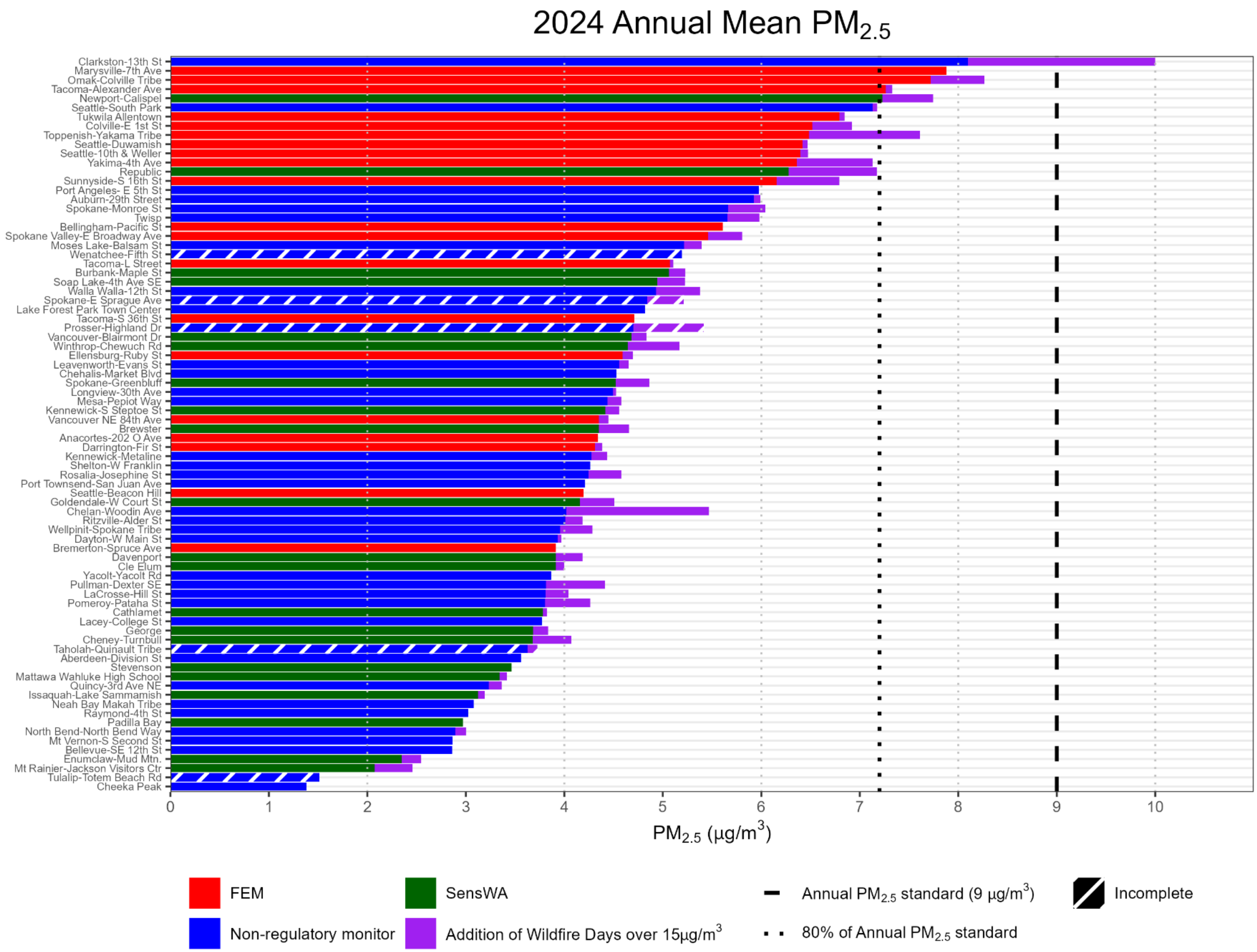

Figure 22. Annual mean $PM_{2.5}$ concentrations by instrument type, 2024

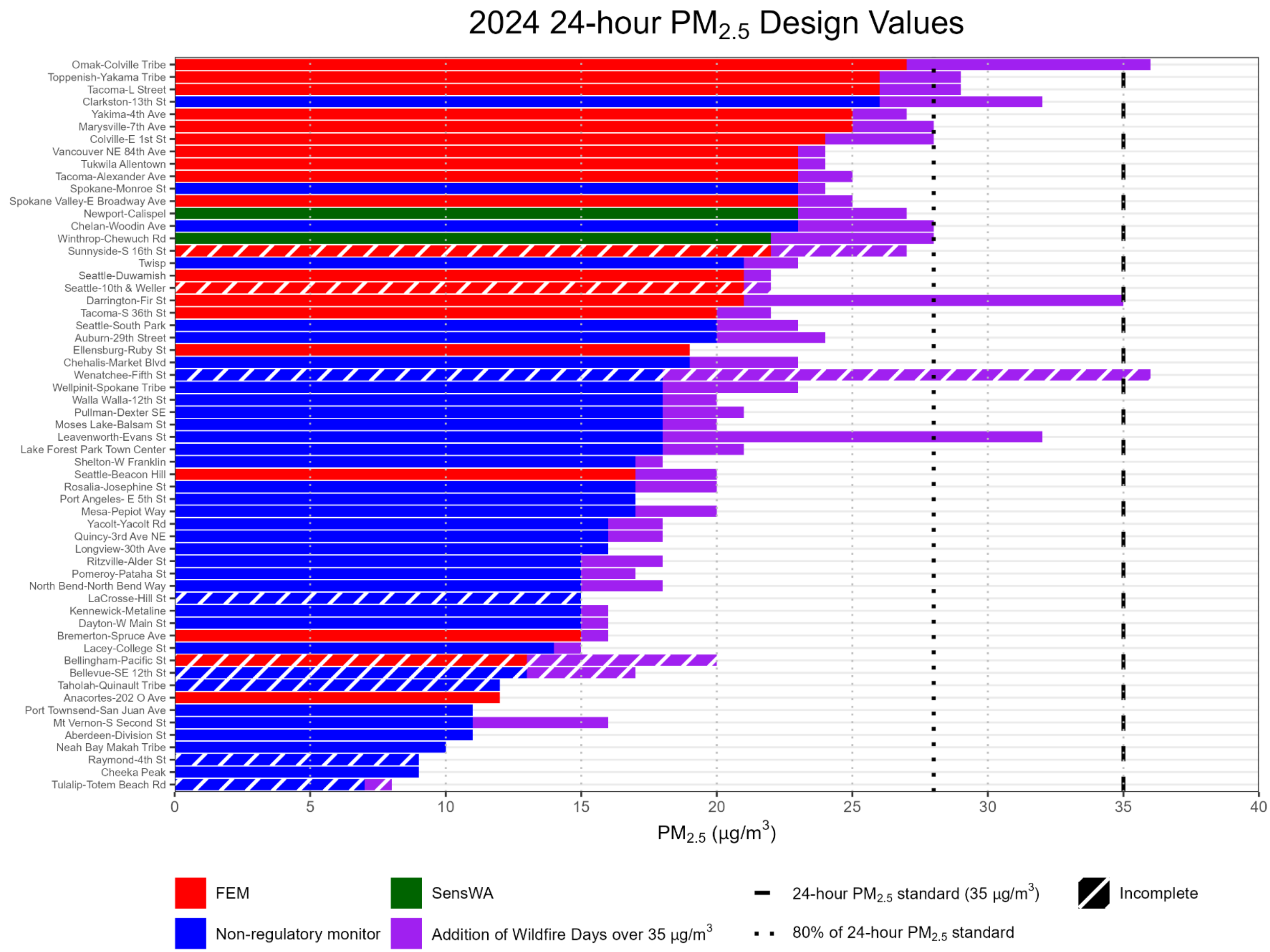

Figure 23. 24-hour $PM_{2.5}$ design values by instrument type, 2024 (2022-2024)

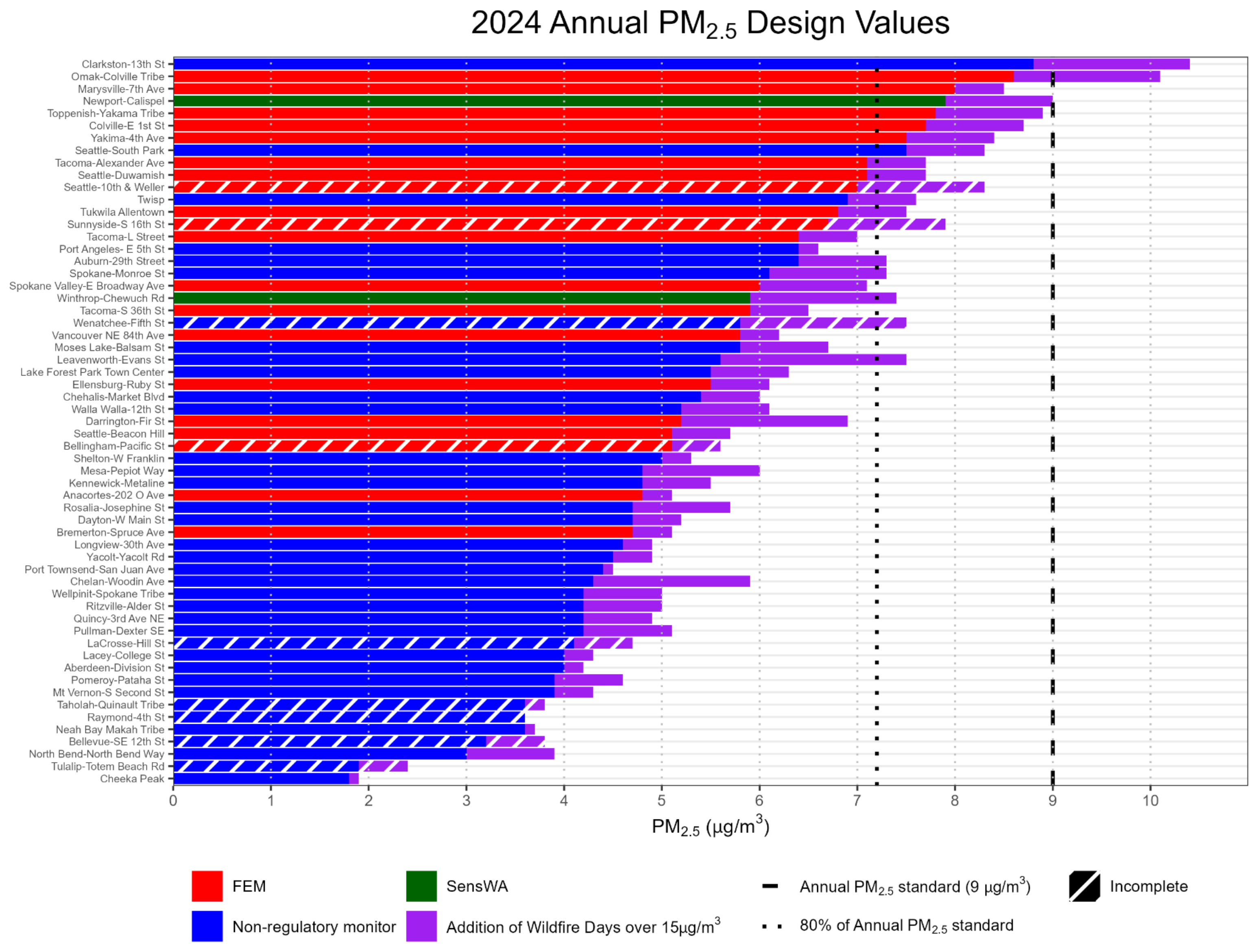

Figure 24. Annual $PM_{2.5}$ design values by instrument type, 2024 (2022-2024)

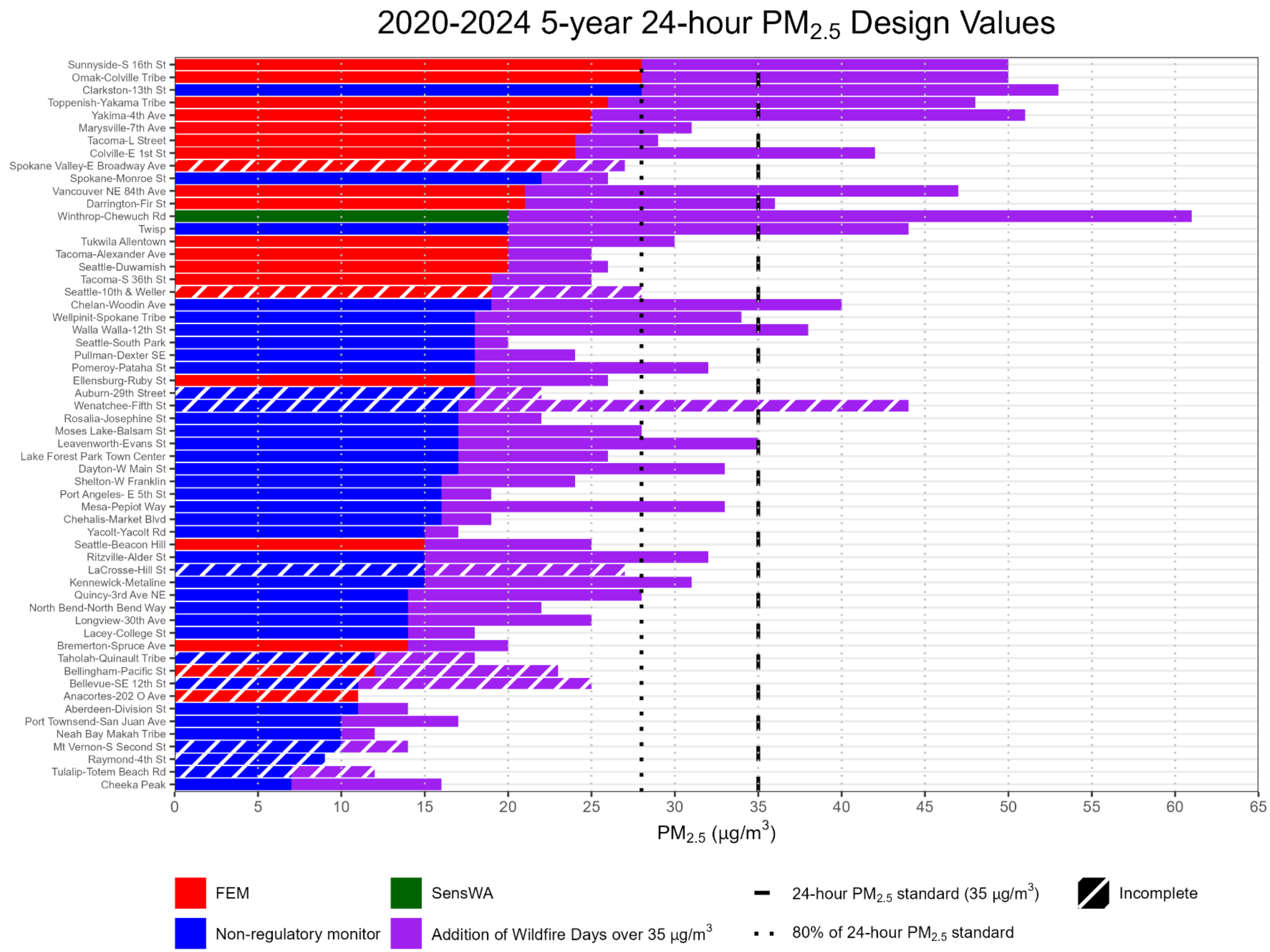

Figure 25. 5-year 24-hour $PM_{2.5}$ design values, 2020-2024

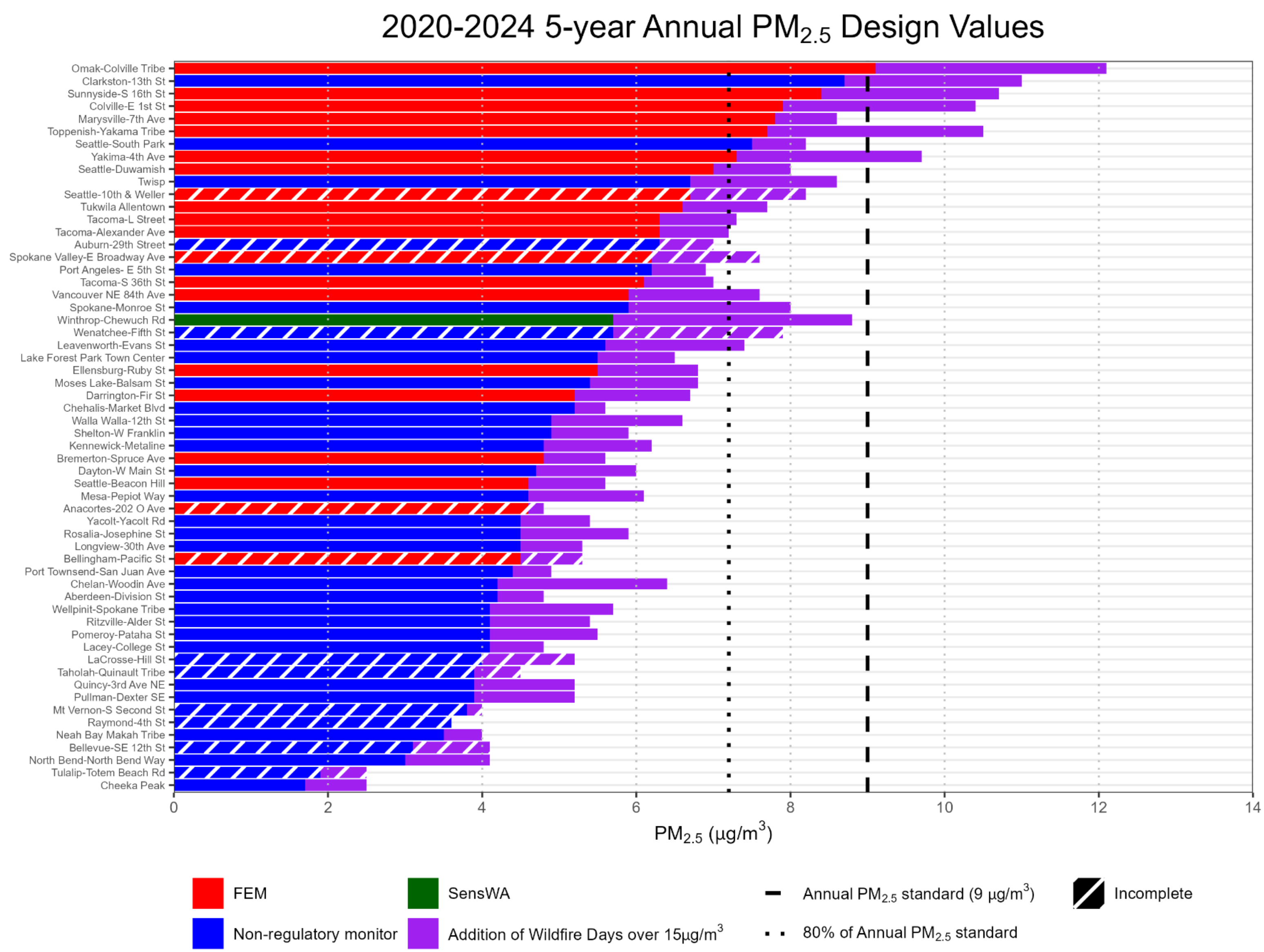

Figure 26. 5-year annual $PM_{2.5}$ design values, 2020-2024

Figure 21 through Figure 26 show that in general, sites with the highest $PM_{2.5}$ (estimated) design values monitor for $PM_{2.5}$ with FEMs, and the sites with lower (estimated) design values use a mix of non-regulatory AQS monitors and SensWA. Exceptions to this general trend are explained below.

There are several FEM $PM_{2.5}$ monitors whose design values are routinely relatively low:

- Bellingham-Pacific St and Anacortes-202 O Ave are identified by NWCAA as priority monitors for local $PM_{2.5}$ reporting and fulfill NWCAA's network design objective of one FEM per county in its jurisdiction.
- Similarly, Bremerton-Spruce Ave is owned and operated by PSCAA and meets PSCAA's network design objective of at least one FEM per county in its jurisdiction.
- Seattle-Beacon Hill is also an urban NCore, PAMS, NATTS, CSN and IMPROVE site, where continued FEM monitoring is required regardless of design value.
- Ellensburg-Ruby St has been a priority monitor in Ecology's jurisdiction due to localized smoke impacts and is used as a collocation site for multiple instruments (BAM 1020, nephelometer, SensWA). However, declining design values in recent years have dropped well below 80% of their respective NAAQS, and the need for FEM monitoring can be reevaluated at this site for potential resource savings.

There are several non-regulatory AQS monitors and SensWA where estimated design values are relatively high:

- In recent years, Clarkston-13th St has repeatedly recorded the highest estimated design values of the non-regulatory monitors. Nearby $PM_{2.5}$ sources include local residential wood smoke, regional smoke from agricultural burning, and a pulp and paper mill in nearby Lewiston, ID. Though 24-hour $PM_{2.5}$ design values are not above the 80% of the NAAQS threshold, annual design values have been consistently above this threshold for several years. Clarkston should be considered for FEM monitoring in the future as resources allow.
- The SensWA with the highest estimated $PM_{2.5}$ 24-hour design values were in Republic and Newport in rural northeast Washington. Both communities have populations below 3,000 people and are county seats in relatively low-population counties (<15,000 people each). Since the primary needs for $PM_{2.5}$ data in these counties are public information, forecasting, and smoke management, and the SensWA data are of sufficient quality to meet these needs, Ecology does not consider more resource-intensive monitoring to be a necessary investment at this time.
- In some communities, non-regulatory monitors may be elevated but those communities are already represented by nearby FEMs. Examples of this include Spokane-Monroe St (nearby to the Spokane Valley-E Broadway Ave FEM) and Seattle-South Park (nearby to the Seattle-Duwamish FEM).

Clarkston-13th St (non-FEM) and Ellensburg-Ruby St (FEM) are the two monitoring sites identified above whose instruments are not consistent with Ecology's policy of instrument selection based on design values. For ease of comparison between the two sites, the trends in their annual 98th percentile and mean concentrations over the past 10 years are shown in Figure 27 and Figure 28 with flagged wildfire-affected days removed.

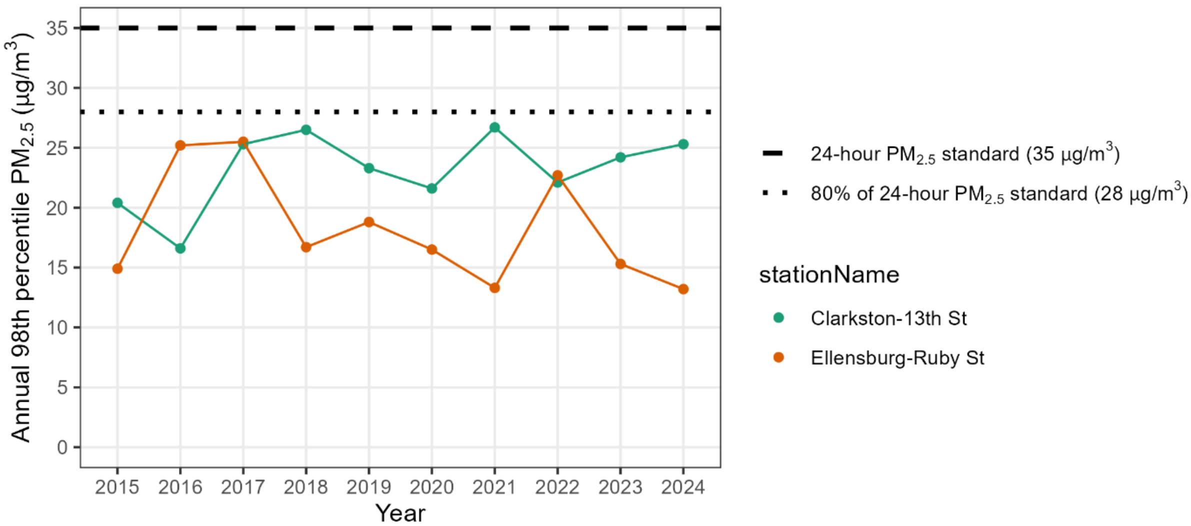

Figure 27. Clarkston and Ellensburg annual 98th percentile $PM_{2.5}$, 2015-2024, with flagged wildfire-affected days removed.

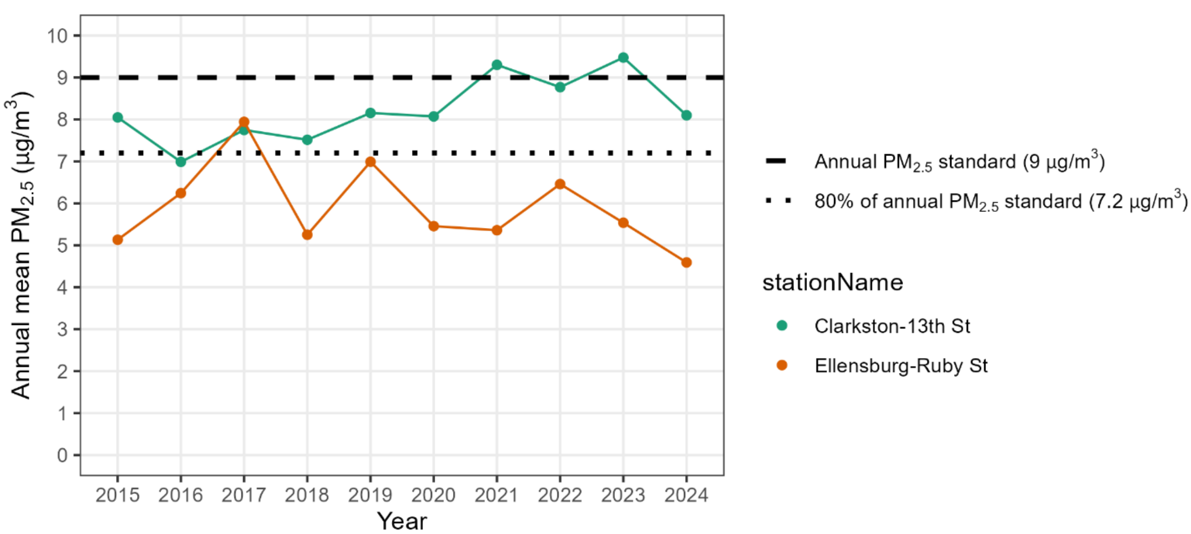

Figure 28. Clarkston and Ellensburg annual mean $PM_{2.5}$, 2015-2024, with flagged wildfire-affected days removed.

Regulatory (FEM/FRM)

There are 23 FEM $PM_{2.5}$ monitors in the Washington Network as summarized in Table 7. Sites where “elevated concentrations” are noted under the Purpose heading are those where recent design values have exceeded 80% of their respective standards, which is Ecology’s threshold for prioritizing FEM monitoring. Other, lower-concentration monitors are identified as priority monitors in order to support smoke management, compliance and enforcement, complaint response, and forecasting in their jurisdictions.

Table 7. Summary of Washington Network FEM monitors for $PM_{2.5}$

AQS ID	Site Name	Purpose
530570011	Anacortes-202 O Ave	NWCAA priority monitor representing the Mount Vernon-Anacortes MSA.
530730019	Bellingham-Pacific St	NWCAA priority monitor representing the Bellingham MSA.
530350007	Bremerton-Spruce Ave	PSCAA priority monitor representing the Bremerton-Silverdale MSA.
530650005	Colville-E 1st St	Minimum monitoring requirements for $PM_{2.5}$ in the Spokane-Spokane Valley MSA, elevated concentrations.
530610020	Darrington-Fir St	PSCAA priority monitor, minimum monitoring requirements for $PM_{2.5}$ in the Seattle-Tacoma-Bellevue MSA, elevated concentrations.
530370002	Ellensburg-Ruby St	Unique airshed, collocation site for nephelometer and SensWA.
530610022	Everett-Beverly Park Rd	Microscale SPM to assess highest concentrations and source impacts at an elementary school adjacent to an aggregate yard.
530670013	Lacey-College St	ORCAA priority monitor representing the Olympia-Lacey-Tumwater MSA.
530611007	Marysville-7th Ave	PSCAA priority monitor, minimum monitoring requirements for $PM_{2.5}$ in the Seattle-Tacoma-Bellevue MSA, elevated concentrations.
530470013	Omak-Colville Tribe	Tribal monitor, elevated concentrations.
530330040	SeaTac-Sunset Park	PSCAA priority monitor representing local air quality impacts from SeaTac airport.
530330030	Seattle-10th & Weller	Near-road monitoring site, elevated concentrations.
530330080	Seattle-Beacon Hill	Urban NCore, PAMS, NATTS, CSN and IMPROVE site.
530330057	Seattle-Duwamish	PSCAA priority monitor representing local air quality impacts from industrial and seaport activity.
530630017	Spokane Valley-E Broadway Ave	SRCAA priority monitor representing Spokane-Spokane Valley MSA, minimum monitoring requirements for $PM_{2.5}$.
530770005	Sunnyside-S 16th St	YRCAA priority monitor representing the Yakima MSA, minimum monitoring requirements for $PM_{2.5}$, elevated concentrations.
530530031	Tacoma-Alexander Ave	PSCAA priority monitor representing local air quality impacts from industrial and seaport activity.
530530029	Tacoma-L Street	PSCAA priority monitor representing Seattle-Tacoma-Bellevue MSA, minimum monitoring requirements for $PM_{2.5}$, elevated concentrations.
530530024	Tacoma-S 36th St	Near-road monitoring site.
530770015	Toppenish-Yakama Tribe	Tribal monitor, elevated concentrations.

AQS ID	Site Name	Purpose
530330069	Tukwila Allentown	PSCAA priority monitor representing Seattle-Tacoma-Bellevue MSA.
530110024	Vancouver NE 84th Ave	SWCAA priority monitor representing Washington side of the Portland-Vancouver-Hillsboro MSA.
530770009	Yakima-4th Ave	YRCAA priority monitor representing the Yakima MSA, minimum monitoring requirements for $PM_{2.5}$, elevated concentrations.

Figure 29 and Figure 30 show historical $PM_{2.5}$ 24-hour and annual design values at Washington Network monitoring sites. Violations of both NAAQS became more common in 2017, as the frequency of prolonged and extreme summer and fall wildfire smoke events rapidly increased.

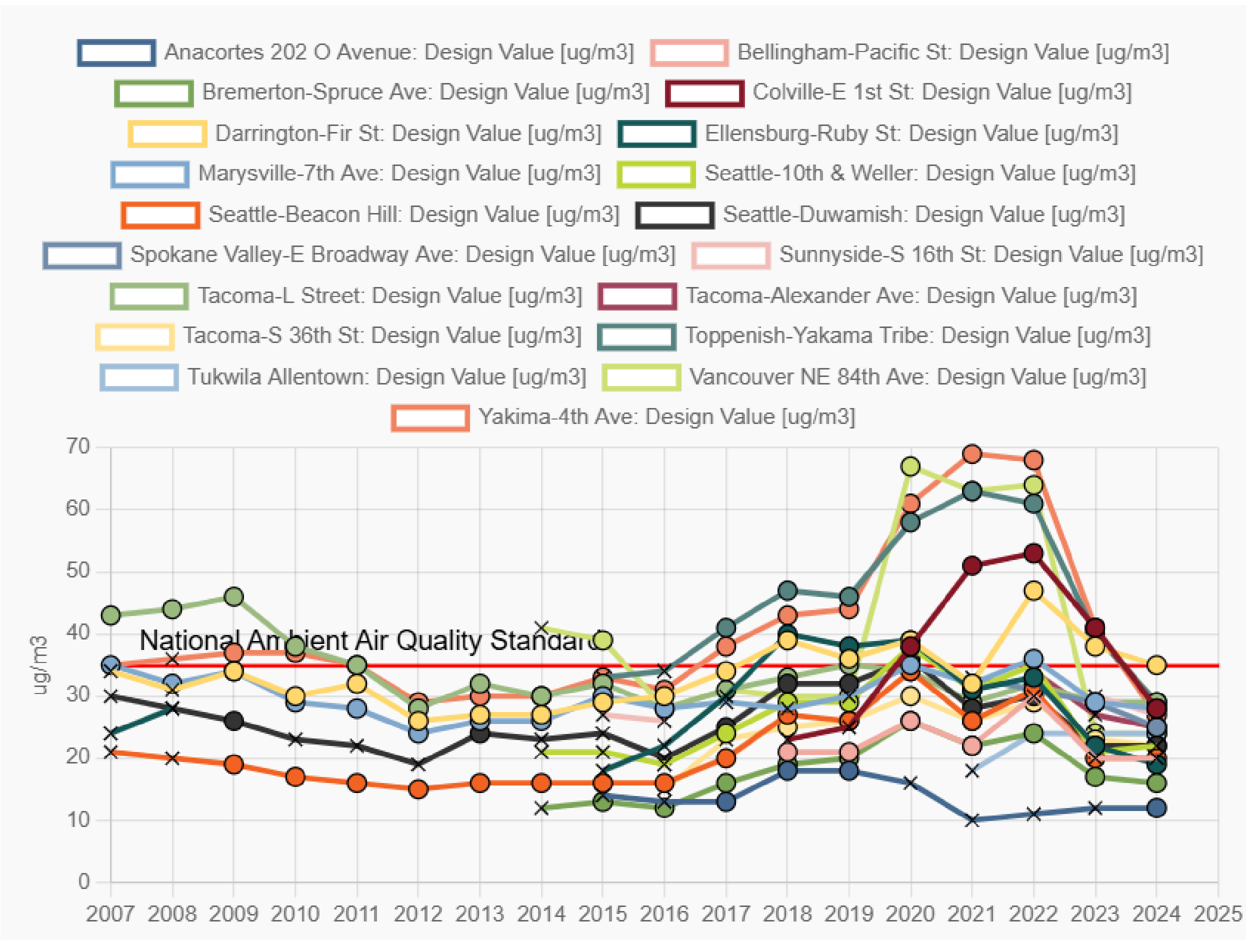

Figure 29. Historical $PM_{2.5}$ 24-hour design values at Washington Network monitoring sites.

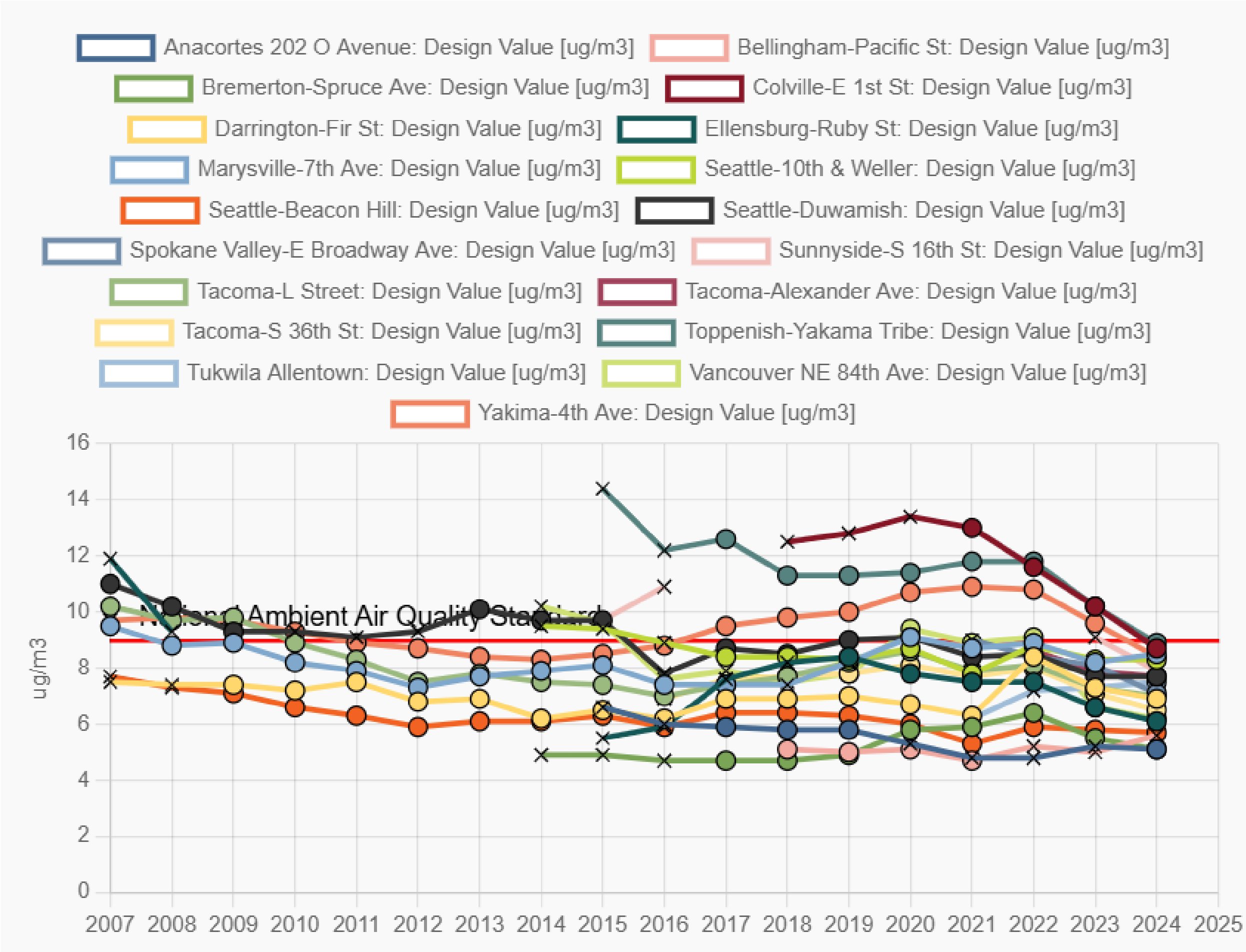

Figure 30. Historical $PM_{2.5}$ annual design values at Washington Network monitoring sites.

Does the network meet the monitoring objectives defined in 40 C.F.R. Part 58 Appendix D?

Ecology finds that Washington's network of $PM_{2.5}$ monitors is adequate to meet the objectives to provide air pollution data to the public in a timely manner, support NAAQS compliance, and support air pollution research.

Are new monitoring sites needed?

As resources allow, adding an FEM monitor to the Clarkston-13th St site would be consistent with Ecology's policy of FEM monitoring at sites whose design values exceed 80% of their respective NAAQS.

Can existing sites be terminated?

Ecology identified the Ellensburg-Ruby St site as a potential site for replacement of FEM monitoring with non-regulatory monitoring. Ecology can evaluate whether the need for a collocation site for nephelometers and SensWA can be met with other, higher-concentration sites in Washington's Central Region.

Several other monitors operated by local clean air agencies are not required by monitoring requirements in 40 C.F.R. Part 58 due to their low design values: Anacortes-202 O Ave, Bellingham-Pacific St, and Bremerton-Spruce Ave. The Lacey-College St monitor does not have sufficient data to calculate design values, though previous non-regulatory monitoring data indicate its design values will likely be below 80% of their respective NAAQS. However, all four monitors have been identified as priority monitors for the local clean air agencies that own and operate them, in order to support air quality management needs in their jurisdictions. Ecology plans to continue network support for these monitors as long as they continue to be priority monitors for their respective local clean air agencies.

Non-regulatory $PM_{2.5}$

There are 40 non-regulatory monitors for $PM_{2.5}$ in the Washington Network. Nine of these monitors are part of Ecology's Agricultural Burn (AgBurn) monitoring network. Data from these monitors are used for burn permitting, burn decisions, assessing smoke impacts of agricultural burning, and other elements of smoke management.

Table 8. Summary of Washington Network non-regulatory monitors for $PM_{2.5}$

AQS ID	Site Name	Purpose
530272002	Aberdeen-Division St	ORCAA priority monitor for AQI reporting in Grays Harbor County.
530330047	Auburn-29th St	PSCAA priority monitor for AQI reporting and woodsmoke impacts in south King County.
530330031	Bellevue-SE 12th St	Ecology monitor for AQI reporting in population-dense east King County with generally low $PM_{2.5}$ concentrations.
530090013	Cheeka Peak (suspended)	Rural NCore site. (Cheeka Peak is in the process of relocation to nearby Bahokas Peak.)
530410004	Chehalis-Market Blvd	Ecology monitor for AQI reporting in Lewis County.
530070007	Chelan-Woodin Ave	Former USFS monitor for smoke management and AQI reporting in Ecology's Central Region.
530030004	Clarkston-13th St	Ecology monitor for AQI reporting and smoke management in Asotin County.
530650005	Colville-E 1st St	Collocation site for nephelometer, SensWA, and BAM (FEM data used for public reporting).
530130002	Dayton-W Main St	AgBurn monitor for agricultural smoke management in Columbia County.
530370002	Ellensburg-Ruby St	Collocation site for nephelometer, SensWA, and BAM (FEM data used for public reporting).
530050002	Kennewick-Metaline	AQI reporting in Tri-Cities area (Benton, Franklin, Walla Walla Counties).
530750005	LaCrosse-Hill St	AgBurn monitor for agricultural smoke management in Whitman County.
530330024	Lake Forest Park	PSCAA priority monitor for AQI reporting in north King County adjacent to local highway.
530070010	Leavenworth-Evans St	Former USFS monitor for smoke management and AQI reporting in Ecology's Central Region.

AQS ID	Site Name	Purpose
530150015	Longview-30th Ave	SWCAA priority monitor for AQI reporting in Cowlitz County.
530210002	Mesa-Pepiot Way	AgBurn monitor for agricultural smoke management in Franklin County.
530251002	Moses Lake-Balsam St	AgBurn monitor for agricultural smoke management in Grant County.
530570015	Mt Vernon-S Second St	NWCAA priority monitor for AQI reporting in Skagit County.
530090015	Neah Bay-Makah Tribe	Tribal monitor.
530330017	North Bend-North Bend Way	AQI reporting in wildfire smoke-impacted community in east King County.
530230001	Pomeroy-Pataha St	AgBurn monitor for agricultural smoke management in Garfield County.
530090017	Port Angeles- E 5th St	ORCAA priority monitor for AQI reporting in Clallam County.
530310003	Port Townsend-San Juan Ave	ORCAA priority monitor for AQI reporting in Jefferson County.
530050004	Prosser-Highland Dr	BCAA priority monitor for AQI reporting in southern end of the Yakima Valley.
530750003	Pullman-Dexter SE	AgBurn monitor for agricultural smoke management in Whitman County.
530251003	Quincy-3rd Ave NE	Ecology monitor for AQI reporting and assessment of local-scale impacts of permitted sources.
530490003	Raymond-4th St	ORCAA priority monitor for AQI reporting in Pacific County.
530010003	Ritzville-Alder St	AgBurn monitor for agricultural smoke management in Adams County.
530750006	Rosalia-Josephine St	AgBurn monitor for agricultural smoke management in Whitman County.
530331011	Seattle-South Park	PSCAA priority monitor for AQI reporting in Seattle.
530450007	Shelton-W Franklin	ORCAA priority monitor for AQI reporting in Mason County.
530630054	Spokane-E Sprague Ave	SRCAA monitor to assess middle-scale impacts of nearby roadway and industrial sources.
530630047	Spokane-Monroe St	Ecology monitor for AQI reporting in Spokane.
530270011	Taholah-Quinault Tribe	Tribal monitor.
530610021	Tulalip-Totem Beach Rd	Tribal monitor.
530470009	Twisp-S Lincoln St	Former USFS monitor for smoke management and AQI reporting in Ecology's Central Region.
530710005	Walla Walla-12th St	AgBurn monitor for agricultural smoke management in Walla Walla County.
530650002	Wellpinit-Spokane Tribe	Tribal monitor.
530070011	Wenatchee-Fifth St	Smoke management and AQI reporting in Ecology's Central Region.
530110022	Yacolt-Yacolt Rd	SWCAA priority monitor for AQI reporting.

Does the network meet the monitoring objectives defined in 40 C.F.R. Part 58 Appendix D?

Ecology finds that Washington's network of non-regulatory $PM_{2.5}$ monitors is adequate to meet the objectives to provide air pollution data to the public in a timely manner, support NAAQS compliance, and support air pollution research.

Are new monitoring sites needed?

Ecology does not identify any locations where new monitoring sites are needed at this time. However, Ecology will continue to use SensWA to evaluate monitoring needs in previously unmonitored areas and will upgrade SensWA sites to non-regulatory monitors in high-concentration areas as resources and logistics allow.

Can existing sites be terminated?

None of the non-regulatory $PM_{2.5}$ monitoring sites in the Washington Network are required by EPA. There are no minimum monitoring requirements for non-regulatory $PM_{2.5}$ in 40 C.F.R. Part 58 Appendix D. Ecology and its monitoring partners fully meet the AQI reporting requirements in 40 C.F.R. Part 58 Appendix G with the FEM $PM_{2.5}$ monitors in the Washington Network.

However, Ecology recognizes that non-regulatory $PM_{2.5}$ monitoring provides valuable public health information, particularly in rural areas where minimum monitoring requirements by population do not apply, and where smoke from wildfires and residential wood combustion are particularly impactful. Non-regulatory $PM_{2.5}$ monitoring also supports smoke management programs for silvicultural and agricultural burning and woodsmoke reduction efforts by Ecology, local clean air agencies, and Tribal Nations.

While many non-regulatory $PM_{2.5}$ sites have relatively low estimated design values and could likely be replaced with SensWA, several local clean air agencies have policies to maintain at least one AQS monitor in each county of their jurisdictions. Ecology generally supports local clean air agency efforts to fulfill their local monitoring needs and does not actively seek to discontinue monitors that local clean air agencies have identified as priorities.

Ecology's AgBurn team identified the Pomeroy-Pataha St and LaCrosse-Hill St AgBurn sites as low-concentration sites where SensWA monitoring would be adequate to support smoke management needs. Ecology requested EPA approval to discontinue these two SLAMS monitors in the 2025 Ambient Air Monitoring Network Plan.

Ecology continues to evaluate whether the SensWA are a suitable replacement for other non-regulatory $PM_{2.5}$ monitors with relatively low design values. However, as of 2024, access to SensWA data submitted to AirNow is limited to the Fire and Smoke Map, not the broader AirNow system. Ecology is concerned that this constraint on public access to AQI data limits the SensWA's utility as a tool for public information and public health protection. In evaluating which non-regulatory $PM_{2.5}$ monitoring sites could be adequately operated with SensWA, Ecology must also consider whether the loss of data access through the AirNow system will have a negative impact, or whether data users are likely to be adequately served by Ecology's website and EPA's Fire and Smoke Map.

Are new technologies appropriate for incorporation into the ambient air monitoring network?

For several years, Ecology has evaluated whether new non-regulatory $PM_{2.5}$ monitoring instruments are suitable to replace existing nephelometers. The Washington Network primarily uses Radiance Research M903 nephelometers for non-regulatory $PM_{2.5}$ monitoring in the Washington Network. Radiance Research no longer manufactures the M903, and Ecology's M903 instruments have largely reached the end of their useful life, with limited options for repair and parts replacement. The need for a replacement instrument was a major impetus for Ecology's development of the SensWA.

Since the 2020 Ambient Air Monitoring Network Assessment, Ecology has expanded the use of BAM 1022s as both a regulatory and non-regulatory monitoring instrument whose data can be submitted to AirNow and AQS. While Ecology has found the performance of the BAM 1022s to be adequate on the basis of 24-hour average concentrations, they are not a suitable replacement for all M903 nephelometers in the Washington Network due to the increased operational resources they require (monthly quality control checks, replacement tape, annual pump rebuild, etc.) and the higher level of noise in their hourly data.

Since fall 2024, Ecology has evaluated a Grimm EDM264 mobile aerosol spectrometer as a potential replacement for M903 nephelometers. Ecology expects that the resources required to operate the EDM264 would be more comparable to those required to operate an M903 nephelometer, and thus they may be a more suitable replacement particularly at remote monitoring sites. The EDM264 is a laser spectrometer that provides measurements of PM_1, $PM_{2.5}$, PM_{10}, and Total Suspended Particulate as well as particle counts across 31 size bins. It operates using a similar spectrometer to that of the FEM Grimm EDM180, but in a self-contained enclosure.

Ecology operated an EDM264 on loan from Durag at Clarkston-13th St (530030004) from September 2024 through January 2025, and at Colville-E 1st St (530650005) from January through mid-summer 2025. Comparisons of the 24-hour concentrations measured on the BAM 1022 (Clarkston) or BAM 1020 (Colville) and the Grimm EDM264 are shown in Figure 31 and Figure 32.

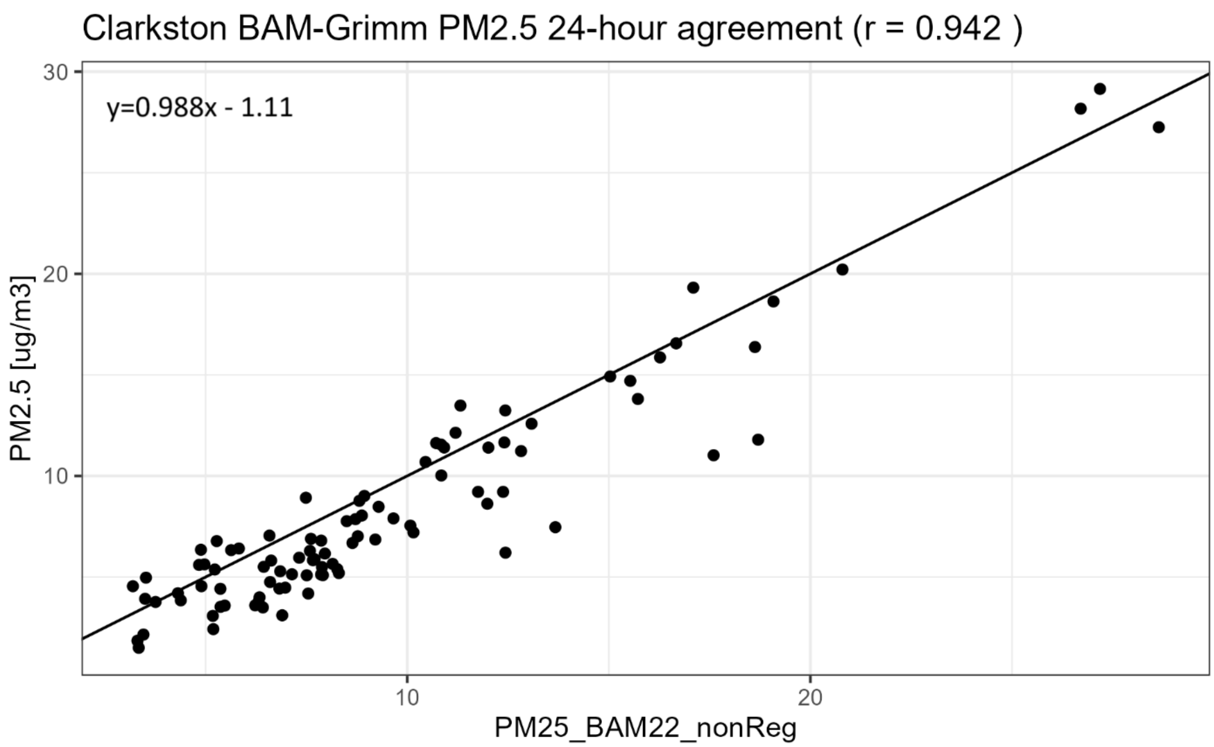

Figure 31. Agreement between Clarkston BAM 1022 and Grimm EDM264, 24-hour $PM_{2.5}$, September 2024 - January 2025 (n=94)

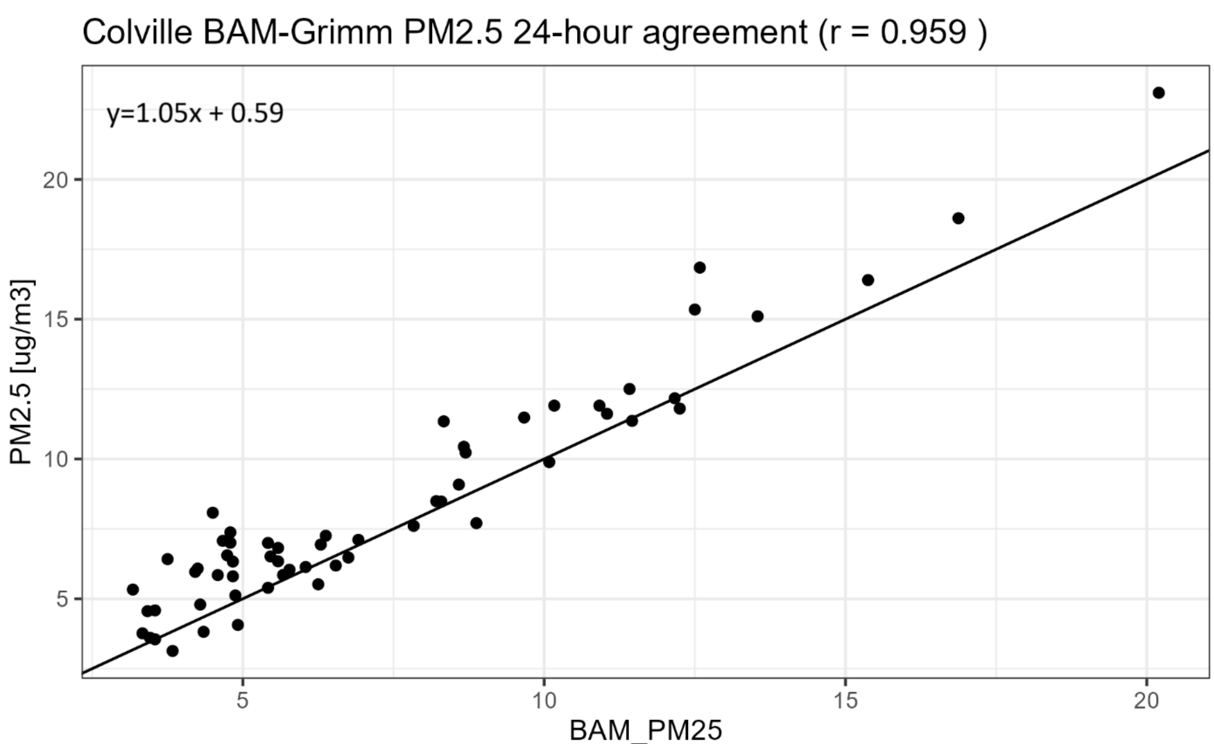

Figure 32. Agreement between Colville BAM 1020 and Grimm EDM264, 24-hour $PM_{2.5}$, January - May 2025 (n=59)

Results from these evaluations at Clarkston and Colville are plotted in Figure 33 following the EPA template for $PM_{2.5}$ Continuous Monitor Comparability Assessments. The Clarkston and Colville evaluations are not the same as formal $PM_{2.5}$ Continuous Monitor Comparability Assessments, which use FRMs as reference instruments. However, using FEMs as the reference instrument, these results indicate that the performance of the Grimm EDM264 is comparable to that of an FEM, with slopes and intercepts well within the limits of EPA's requirements for FEM performance relative to FRMs. Based on these results, Ecology considers the Grimm EDM264 to be suitable for reporting non-regulatory $PM_{2.5}$ data to 88502.

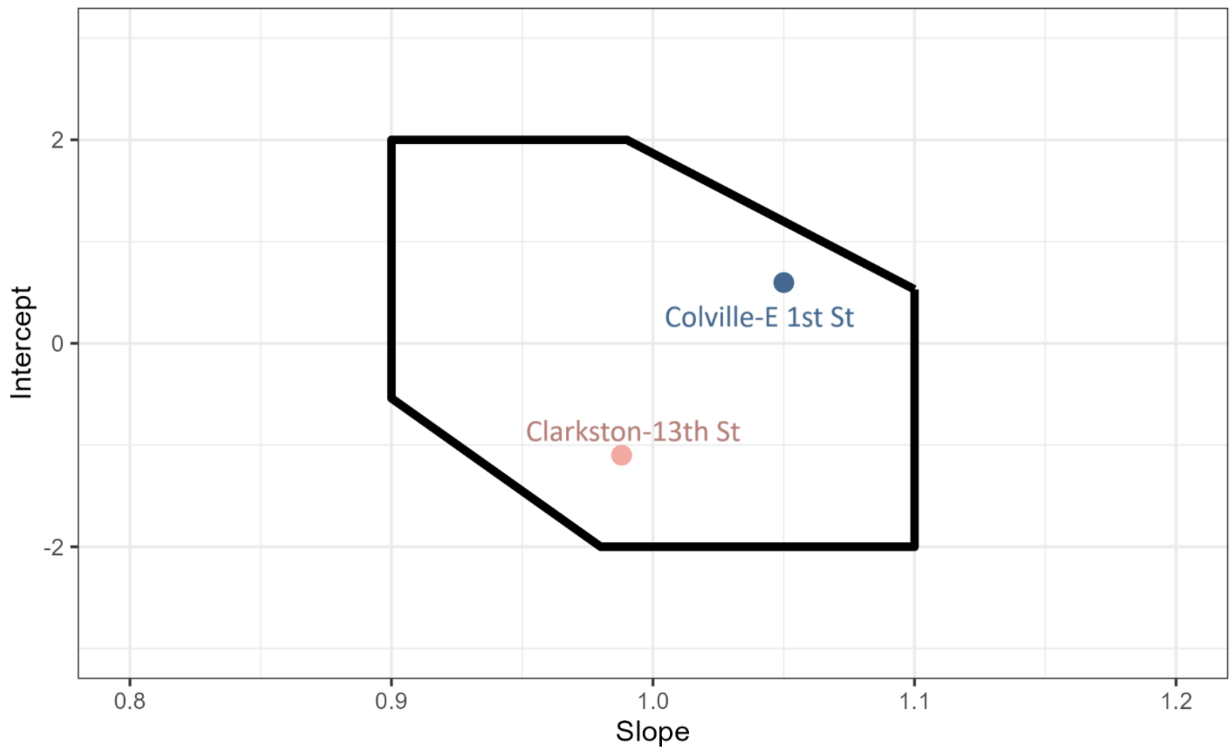

Figure 33. Plot of slope and intercept of Clarkston and Colville BAM-Grimm EDM264 comparisons

Ecology plans to continue the evaluation of the Grimm EDM264 at Colville-E 1st St through summer 2025 and then determine whether to begin replacing M903 nephelometers with EDM264s. This decision is also pending updated guidance from EPA regarding requirements for submitting data with parameter code 88502 to AirNow and AQS and obtaining method codes for new non-regulatory monitoring instruments.

Particulate matter (PM_{10})

There are eight PM_{10} monitoring sites in the Washington Network. Many are federally required, and several are sited to inform local dust issues.

Table 9. Summary of Washington Network monitoring sites for PM_{10}

AQS ID	Site Name	Purpose
530710006	Burbank-Maple St	Demonstration of continued PM_{10} maintenance in Wallula Maintenance Area.
530650005	Colville-E 1st St	Local PM_{10} impacts from road dust. Minimum monitoring requirements for PM_{10} in Spokane-Spokane Valley MSA.
530610022	Everett-Beverly Park Rd	Microscale SPM to assess highest concentrations and source impacts at an elementary school adjacent to an aggregate yard.
530050002	Kennewick-Metaline	Minimum monitoring requirements for PM_{10} in Kennewick-Richland MSA
530330080	Seattle-Beacon Hill	Urban NCore, PAMS, NATTS, CSN and IMPROVE site. Minimum monitoring requirements for PM_{10} in Seattle-Tacoma-Bellevue MSA.
530330057	Seattle-Duwamish	Minimum monitoring requirements for PM_{10} in Seattle-Tacoma-Bellevue MSA.
530630017	Spokane Valley-E Broadway Ave	Minimum monitoring requirements for PM_{10} in Spokane-Spokane Valley MSA.
530770009	Yakima-4th Ave S	Minimum monitoring requirements for PM_{10} in Yakima MSA.

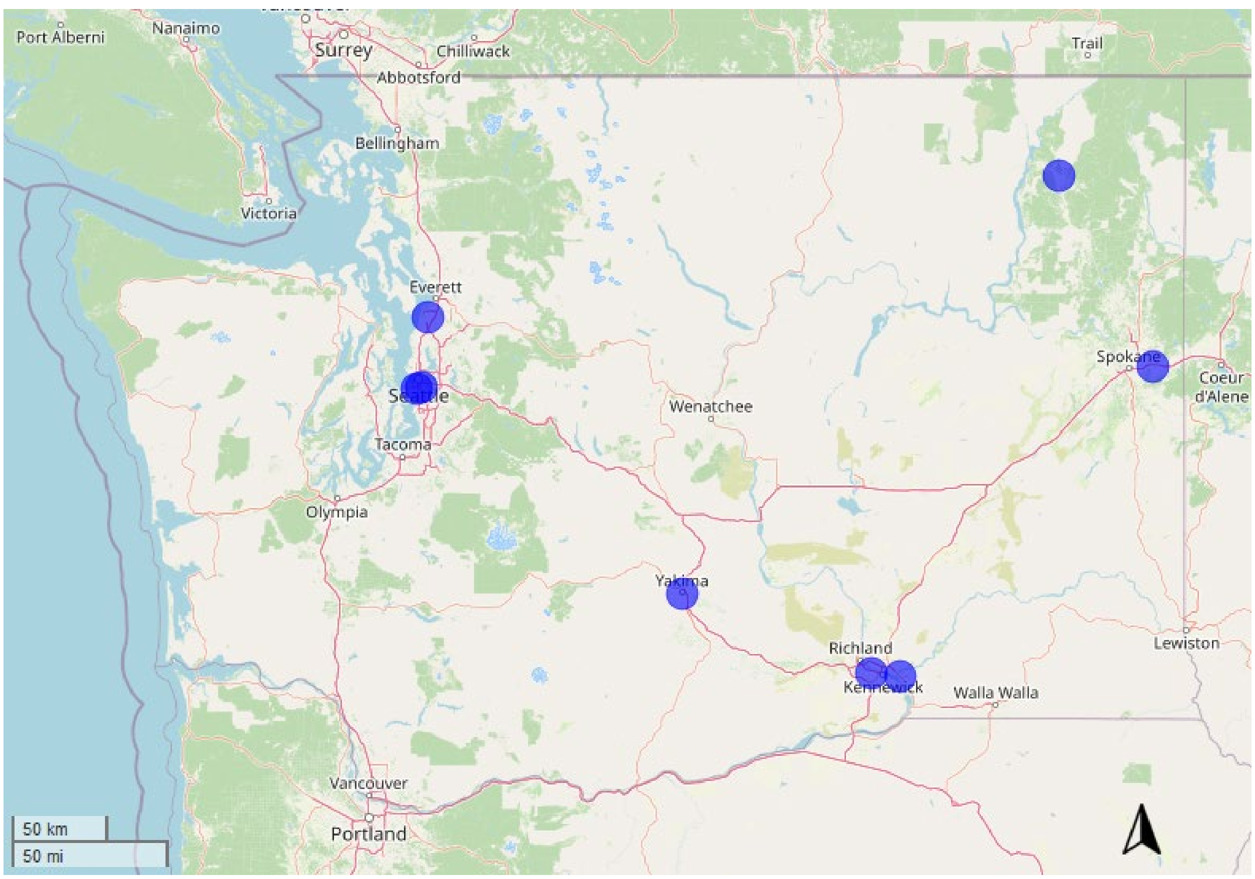

Figure 34. Map of Washington Network PM_{10} monitoring sites.

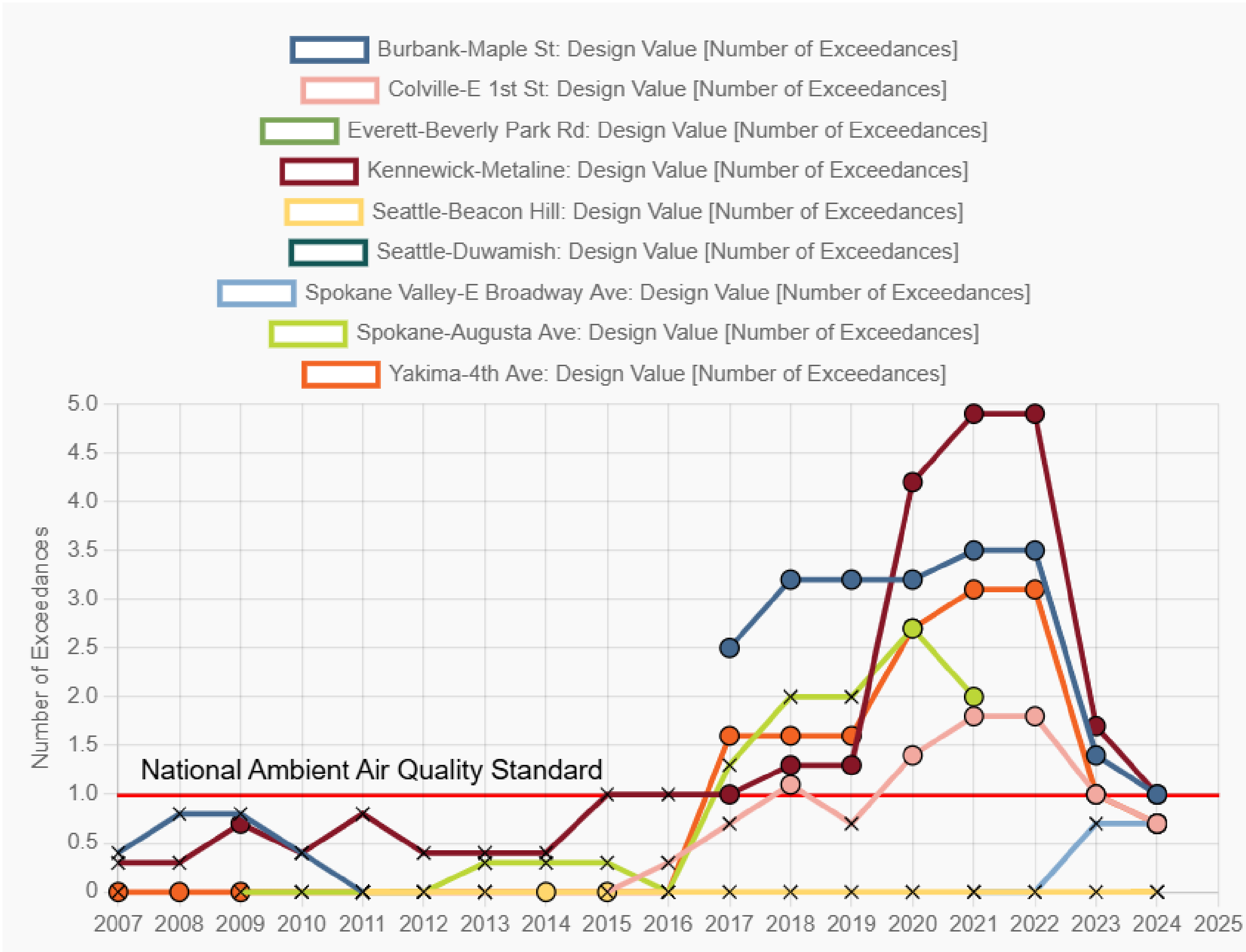

Figure 35. Historical PM_{10} design values at Washington Network PM_{10} monitoring sites.

Figure 35 shows historical PM_{10} design values at Washington Network PM_{10} monitoring sites. PM_{10} design values are expressed as the average annual number of exceedances of the 24-hour PM_{10} standard over a rolling three-year period. All eastern WA PM_{10} monitoring sites have violated the PM_{10} standard in recent years due to smoke and dust events. Ecology has determined that these exceedances likely meet EPA's definition of exceptional events, as "unusual or naturally occurring events that can affect air quality but are not reasonably controllable".

Outside of the Tri-Cities (Kennewick and Burbank monitors), all exceedances of the PM_{10} standard were due to extreme wildfire smoke events on days when $PM_{2.5}$ was similarly elevated. Ecology considers the more-extensive $PM_{2.5}$ monitoring network to be the critical source of public information during these events, since the AQI for $PM_{2.5}$ is higher than the AQI for PM_{10} at equal concentrations.

At various points in the past 8 years, these events have caused the Yakima, Kennewick-Richland, and Spokane-Spokane Valley MSAs to be categorized as "high concentration areas" requiring additional monitors according to Table D-4 of 40 C.F.R. Part 58 Appendix D. The PM_{10} minimum monitoring requirements have not been revised since the expansion of $PM_{2.5}$

monitoring, and they provide no exceptions for exceptional events that are primarily $PM_{2.5}$ issues, not PM_{10} issues.

On February 12, 2025, EPA Region 10 granted Ecology's request for a waiver of these unmet PM_{10} minimum monitoring requirements until 2030. Ecology appreciates the flexibility granted by the waiver process but also encourages EPA to address the underlying issue of legacy PM_{10} minimum monitoring requirements without clearly-defined exceptions for these events. Western states continue to experience extreme wildfire smoke conditions causing routine violations of the PM_{10} standard due to $PM_{2.5}$. Waivers are a temporary solution to what is likely to be a long-term problem until the minimum monitoring requirements are revised.

Does the network meet the monitoring objectives defined in 40 C.F.R. Part 58 Appendix D?

Ecology finds that Washington's network of PM_{10} monitors is adequate to meet the objectives to provide air pollution data to the public in a timely manner, support NAAQS compliance, and support air pollution research.

Are new monitoring sites needed?

Ecology does not identify any outstanding needs for new monitoring sites.

Can existing sites be terminated?

Ecology does not identify any PM_{10} monitors for termination. Most PM_{10} monitors in the Washington Network are required in order to meet minimum monitoring requirements for PM_{10} as defined in 40 C.F.R. Part 58 Appendix D, with two exceptions.

Everett-Beverly Park is a microscale SPM sited to assess the impacts of a nearby aggregate yard on the elementary school where the monitor is located, which is an ongoing need. The Burbank-Maple St monitor was sited to demonstrate continued maintenance of the PM_{10} standard in the Wallula Maintenance Area. When the 20-year planning period for the Wallula Maintenance Area ends in September 2025, this monitor will no longer be required. However, Ecology's Eastern Regional Office has identified this monitor as a priority monitor for dust management and plans to continue its operation.

Meteorology

Ecology operates a network of 14 Prevention of Significant Deterioration-quality (PSD-quality) meteorological monitoring sites, few of which are federally required. Many were installed at criteria pollutant monitoring sites to provide information on meteorological conditions favorable to elevated concentrations, to assist in the identification of sources and control strategies, and to support air quality forecasting. However, the value of continued support for this large supplemental meteorological monitoring network may be outweighed by its costs.

Dispersion modeling utilized in air quality permitting relies on meteorological data to estimate pollution concentrations. While Ecology's PSD-quality meteorological network is designed to meet the requirements of meteorological data used in permit modeling, the majority of air quality permit applications in recent years utilize data from other sources, such as NWS or facility-run on-site towers. Ecology meteorological sites are also generally not utilized by

Ecology air quality forecasters, as broad meteorological conditions are more useful than point-specific conditions, which can be obtained from other sources.

Ecology has identified this network of non-required, supplemental meteorological monitors as a priority area for potential resource savings and conducted the following analysis in order to identify monitors suitable for discontinuation.

Table 10. Summary of Washington Network meteorological monitoring sites.

AQS ID	Site Name	Required?	Purpose	Considered for Discontinuation?
530710006	Burbank-Maple St	No	PM_{10} monitoring site representing Wallula Maintenance Area	Yes
530090013	Cheeka Peak	Yes	Rural NCore site. (Cheeka Peak is in the process of relocation to nearby Bahokas Peak.)	No
530650005	Colville-E 1st St	No	Neighborhood scale $PM_{2.5}$ and PM_{10} monitoring site	No
530330023	Enumclaw-Mud Mtn.	No	Urban scale ozone monitoring site	Yes
530050002	Kennewick-Metaline	No	Neighborhood scale $PM_{2.5}$ and PM_{10} monitoring site	Yes
530330017	North Bend-North Bend Way	No	Neighborhood scale PM.5 and ozone monitoring site	Yes
530470013	Omak-Colville Tribe	No	Tribal $PM_{2.5}$ monitoring site	No
530251003	Quincy-3rd Ave NE	No	Meteorological monitoring to inform local permitting decisions	No
530330030	Seattle-10th & Weller	Yes	Near-road site	No
530330080	Seattle-Beacon Hill	Yes	Urban NCore, PAMS, NATTS, CSN and IMPROVE site	No
530530024	Tacoma-S 36th St	Yes	Near-road site	No
530770015	Toppenish-Yakama Tribe	No	Tribal $PM_{2.5}$ monitoring site	No
530110011	Vancouver-Blairmont Dr	No	Urban scale ozone monitoring site	Yes
530070011	Wenatchee-Fifth St	No	Neighborhood scale $PM_{2.5}$ monitoring site	Yes

Analysis of sites targeted for discontinuation

In particular, the following sites were considered for discontinuation: Burbank-Maple St, Enumclaw-Mud Mtn., Kennewick-Metaline, North Bend-North Bend Way, Vancouver-Blairmont Dr, and Wenatchee-Fifth St. The discussion that follows includes an analysis of nearby meteorological sites that could be used in lieu of the existing Ecology sites, as well as the current utility of the existing Ecology sites.

Enumclaw-Mud Mtn

Enumclaw-Mud Mtn. (elevation 1328 ft) meteorological data is rarely used in air quality permitting modeling demonstrations. However, there are no nearby representative meteorological data substitutes. Both the Enumclaw Remote Automated Weather Station site (756 ft elevation, 9 km away) and Puyallup NWS Automated Surface Observing System site (538ft, 27 km away) do not meet air quality permit modeling requirements. Neither site is a valid substitute for use in potential permitting analyses.

The lack of nearby representative meteorological sites suggests that Enumclaw-Mud Mtn. meteorological measurements should be continued as resources allow. However, given that meteorological data from Enumclaw-Mud Mtn. is rarely used in air quality permitting demonstrations, a more informational, less-resource intensive wind measurement should be explored at the site.

Wenatchee-Fifth St

Ecology's Wenatchee-Fifth St site (elevation 814 ft) is located in West Wenatchee, while the closest NWS Automated Surface Observing System meteorological site is located in East Wenatchee at Pangborn Memorial Airport (EAT, elevation 1243 ft). The NWS EAT site has been widely used in air quality permitting applications, as data centers have expanded in East Wenatchee in recent years.

Site locations and wind roses from 2020-2024 are shown in Figure 36. Ecology's Wenatchee-Fifth St site observes winds originating from all directions, with the highest percentage of winds originating from the northwest and southwest. The predominant wind direction observed at EAT is from the northwest.

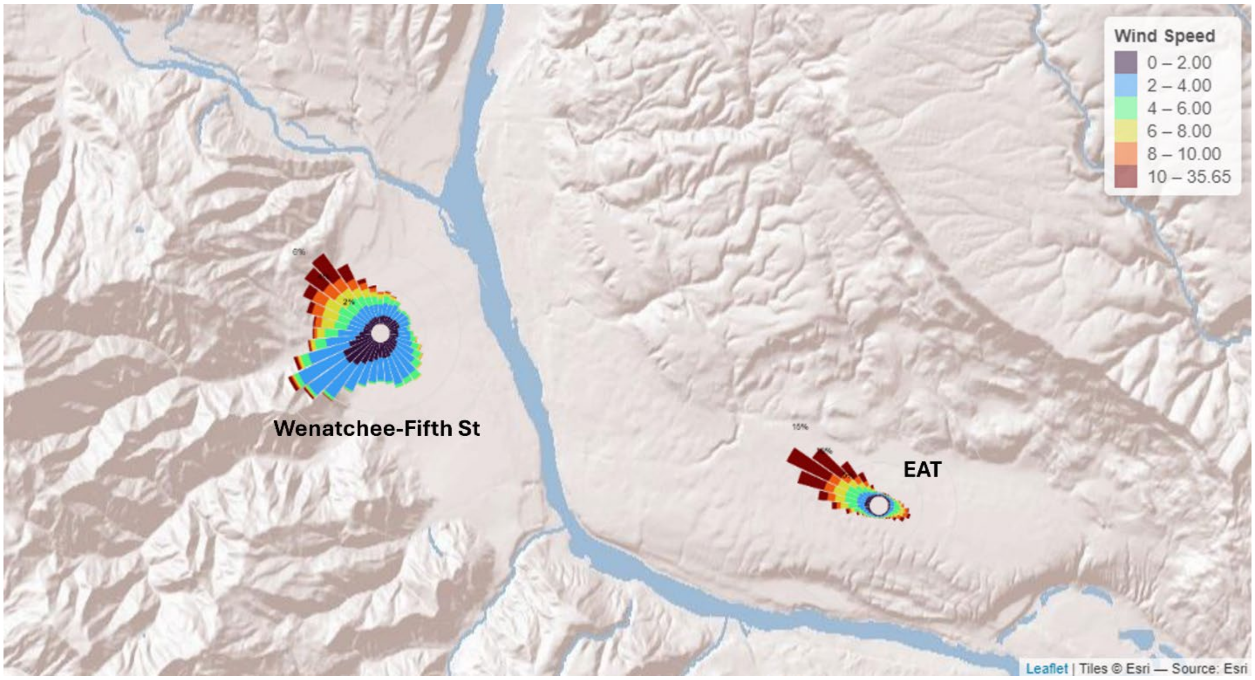

Figure 36. Site locations and 2020-2024 wind roses for EAT and Wenatchee-Fifth St.

Both Wenatchee-Fifth St and EAT meet completeness and calm hour requirements for air quality dispersion modeling purposes. A comparison of the summary statistics at the two sites is shown in Figure 37. Temperature and wind speed measured at both sites observe similar interquartile ranges. Wind speed measurements differ at the two sites; EAT observes a higher median wind speed and a higher number of outliers at the higher wind speeds.

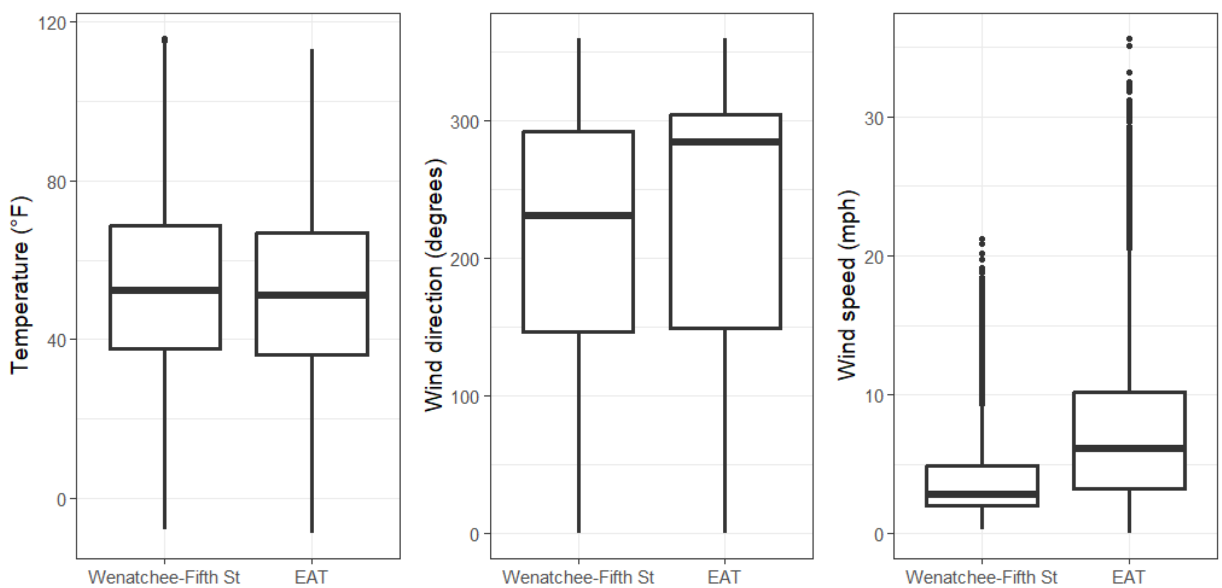

Figure 37. Wenatchee-Fifth St and EAT boxplots for 2020-2024 data.

Violin plots are a useful tool to visualize the distributions of each meteorological parameter and how they differ at the two sites (Figure 38). The two sites observe very similar temperature distributions. Consistent with the wind roses in Figure 36, Wenatchee-Fifth St observes winds from all directions whereas the predominant wind direction at EAT is from the northwest. EAT also observes a larger range of wind speeds than Wenatchee-Fifth St as well as wind speeds that are more evenly distributed at lower wind speeds.

It is not surprising that the wind speed and direction distributions differ between Wenatchee-Fifth St and EAT given that elevation and topography differences between the two sites. However, the EAT site is more representative of conditions most applicable to recent permitting projects. Wenatchee-Fifth St is another candidate for lower cost and less resource intensive meteorological monitoring.

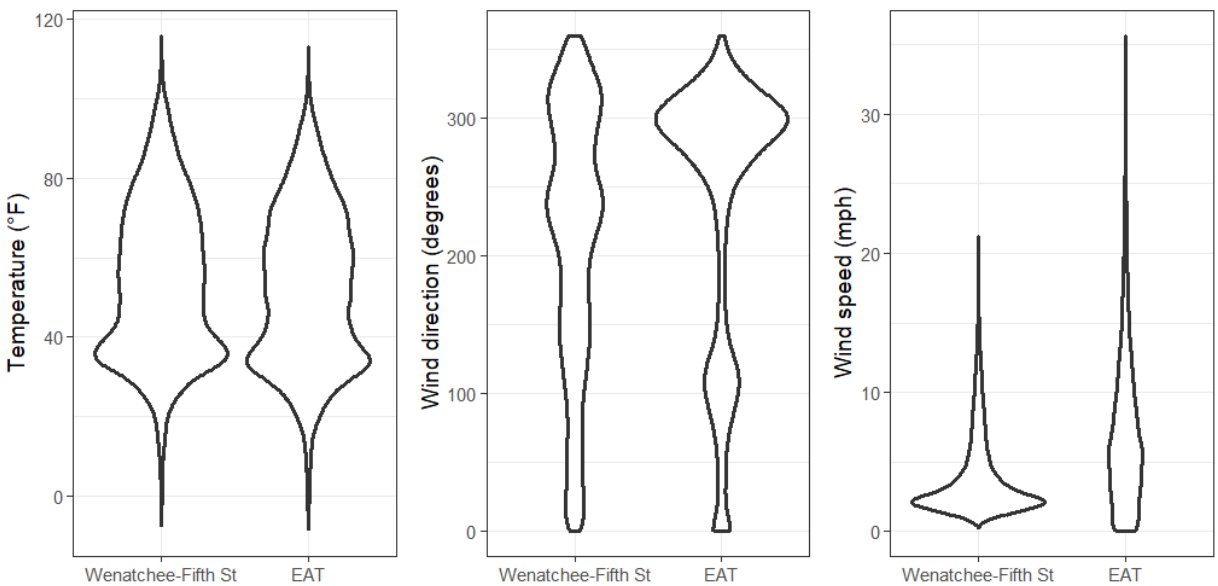

Figure 38. Temperature, wind direction, and wind speed distributions at each meteorological site from 2020-2024.

Kennewick-Metaline and Burbank-Maple St

Two NWS sites (Pasco PSC and West Richland RLD) were considered as potential replacements for Kennewick-Metaline and/or Burbank-Maple St. Wind roses and site locations are shown in Figure 39. All four meteorological sites observe the highest winds from the southwest. RLD, PSC, and Burbank-Maple St observe more winds from the northwest than Kennewick-Metaline. RLD does not satisfy calm hour requirements for air quality permit modeling purposes and so was not further considered in this analysis.

In considering if PSC is a representative substitute for Burbank-Maple St, seasonal wind roses are shown in Figure 40. The wind roses are qualitatively similar aside from Burbank-Maple St observing a higher percentage of winds from the northeast across all seasons. However, these northeasterly winds are relatively low (< 6mph) and likely do not contribute to significant source transport.

The shape and spread of temperature, wind speed, and wind direction at each site are shown in Figure 40 for further comparison. Burbank-Maple St and PSC show largely similar temperature and wind direction distributions, with the exception of Burbank-Maple St observing a higher frequency of winds from the northeast and slightly less frequency of winds from the northwest. Wind speeds differ slightly—while average wind speeds are similar, the highest wind speeds observed at PSC are lower than the highest wind speeds observed at Burbank-Maple St. Given the similarity of Burbank-Maple St to PSC and lack of usage of Burbank-Maple St meteorological data in air permitting demonstrations, PSC is an adequately representative substitute if Burbank-Maple St is discontinued or downgraded to non-PSD meteorological measurements.

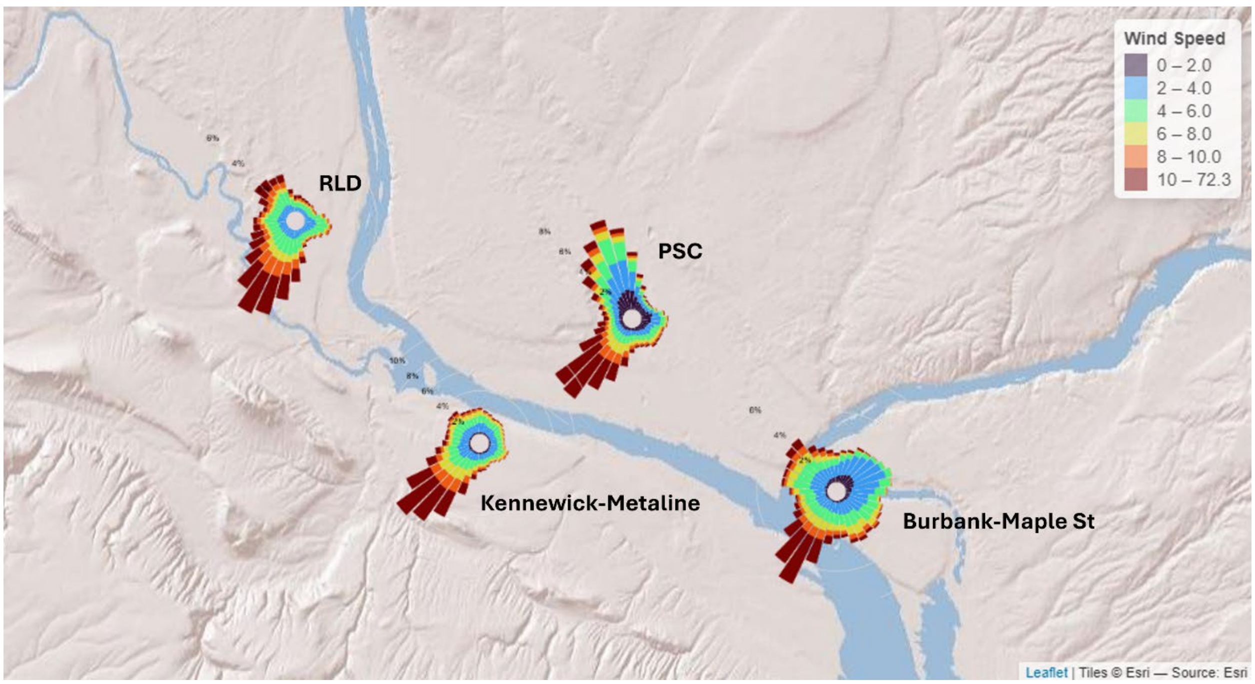

Figure 39. Wind roses observed at RLD, PSC, Kennewick-Metaline, and Burbank-Maple St from 2020-2024.

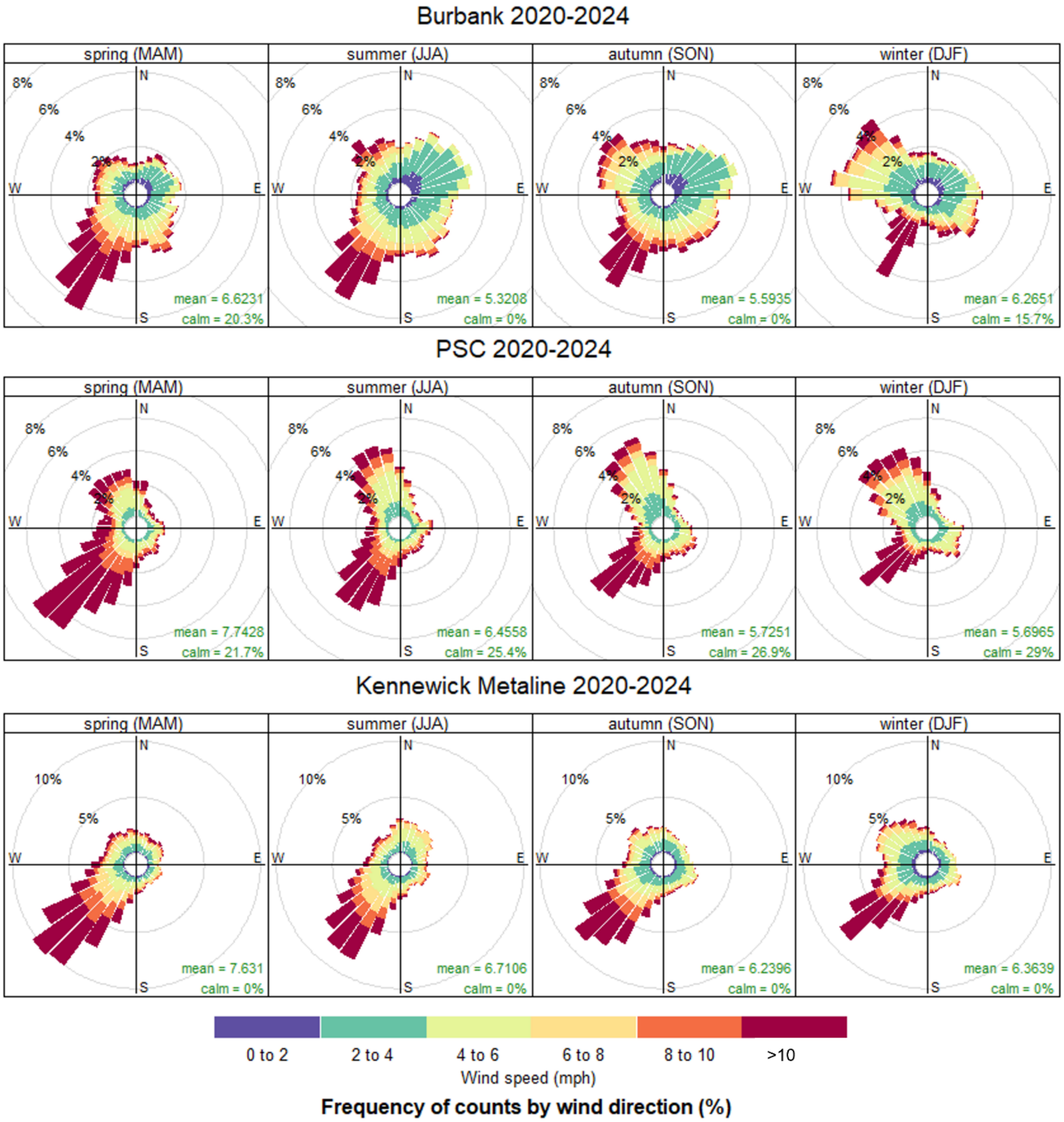

Figure 40. Seasonal wind roses observed at Burbank-Maple St, PSC, and Kennewick-Metaline from 2020-2024.

PSC and Kennewick-Metaline both observe a high percentage of winds from the southwest, but PSC is also impacted by winds from the northwest. Differences in wind speed and direction are most pronounced between the two sites in the summertime. Distributions (Figure 41) confirm that PSC and Kennewick-Metaline observe similar temperature and wind speed distributions, while differences between the two sites' wind directions are most apparent in the higher frequency of winds from the northwest and the slightly lower frequency of winds from the southwest observed at PSC.

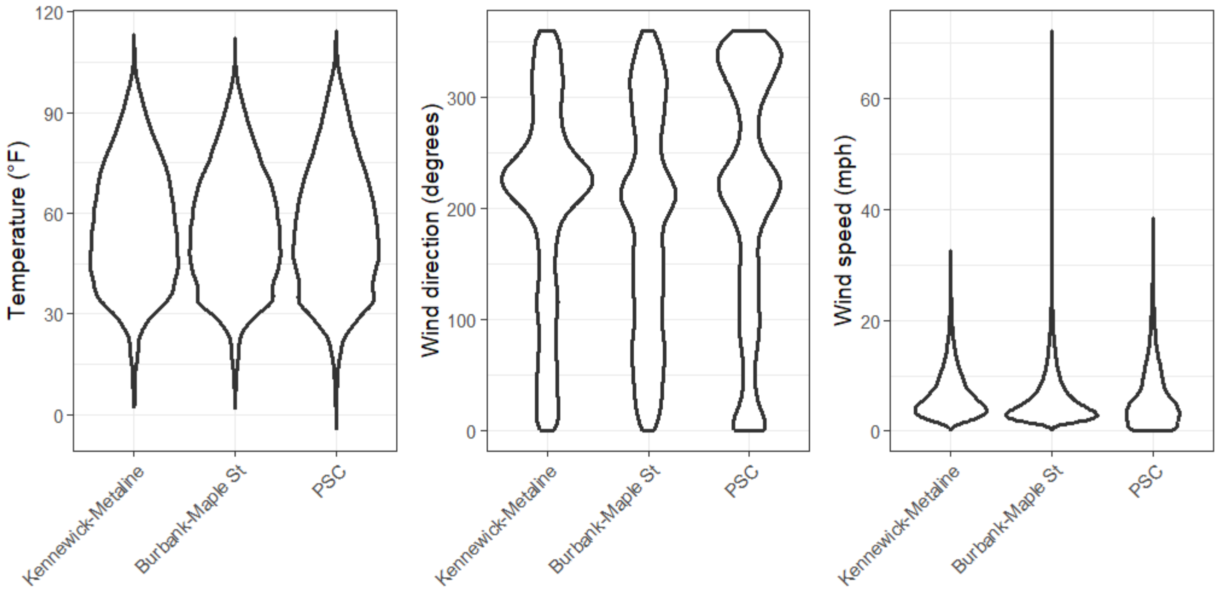

Figure 41. Temperature, wind direction, and wind speed distributions at each meteorological site from 2020-2024.

While also representative of meteorological conditions in the broader area of Kennewick, meteorological data at Kennewick-Metaline has historically been used to assess conditions when ozone formation is most favorable in the Tri-Cities. As the Tri-Cities is an area of concern for ozone, continuous meteorological data in Kennewick is useful in forecasting and evaluating high ozone episodes. However, PSD-quality meteorological measurements are not necessary for these efforts. To save resources but preserve analysis of meteorological conditions that are favorable for high ozone concentrations, this analysis recommends two options for meteorological monitoring at Kennewick-Metaline:

- Replace Kennewick-Metaline with lower-cost non-PSD measurements; or
- Relocate Kennewick-Metaline meteorological monitoring to the existing Kennewick ozone site (Kennewick-S Steptoe) where a meteorological tower already exists. Meteorological measurements at Kennewick-S Steptoe could either be PSD-quality or lower-cost non-PSD. If there are concerns about the larger-scale representativeness of meteorological measurements at Kennewick-S Steptoe, a comparison of the two Kennewick sites could be conducted.

North Bend-North Bend Way

An upgraded meteorological tower was installed at North Bend-North Bend Way (elevation 460 ft) in May 2024. The nearest meteorological site (Fire training Academy RAWS, 9 km away, elevation 1600 ft) does not meet completeness requirements. The closest NWS Automated Surface Observing Station is located in Renton. Not only is Renton over 30 km away from North

Bend, it is also not representative of the topography in North Bend. For these reasons, Ecology does not currently recommend discontinuing meteorological monitoring at North Bend-North Bend Way.

Vancouver-Blairmont Dr

Ecology's existing meteorological site—Vancouver-Blairmont Dr (elevation 300 ft)—is located about 11 km east of the nearest NWS site at Pearson Airport (VUO, elevation 23 ft). Vancouver-Blairmont Dr is also located slightly more inland than VUO at about 2.5 km north of the Columbia River. VUO is located about 0.5 km from the Columbia River.

Wind roses and distributions at the two sites (Figure 42 and Figure 43) are significantly different. Winds observed at VUO appear more aligned with the river and topography as the majority of observed winds are from the northwest and southeast. Vancouver-Blairmont Dr observes a higher percentage of winds from the northwest and south. These differences are likely mostly due to terrain and elevation differences. The two sites observe very similar temperature distributions. Wind speed distributions and averages are relatively similar between the two sites, although VUO observes a higher frequency of lower wind speeds.

The majority of permit applications in the area have utilized on-site facility met or meteorological data from VUO. Many sources in the area are located closer to VUO along the river. While a new meteorology tower was installed at Vancouver-Blairmont Dr in May 2023, there was a large data gap between June 2020 and May 2023 that render recent data useless in air quality permitting modeling demonstrations. The most recent 5-year period of data from VUO (2020-2024) meets air quality permitting requirements.

While VUO and Vancouver-Blairmont Dr observe different wind conditions, recent data from Vancouver-Blairmont Dr is not useful in air quality permitting analyses and has largely not been used for other analyses. This analysis recommends discontinuing Vancouver-Blairmont Dr or replacing current meteorological parameters with lower-cost non-PSD measurements.

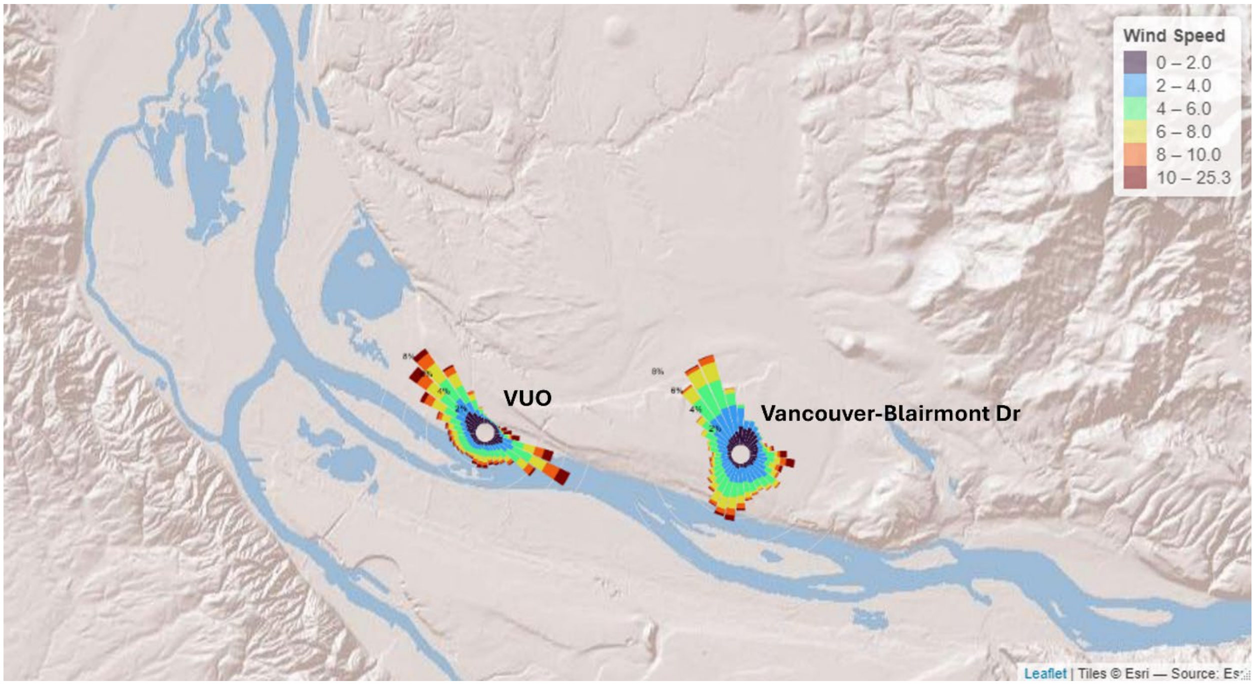

Figure 42. Wind roses observed at Vancouver-Blairmont Dr and VUO from 2020-2024.

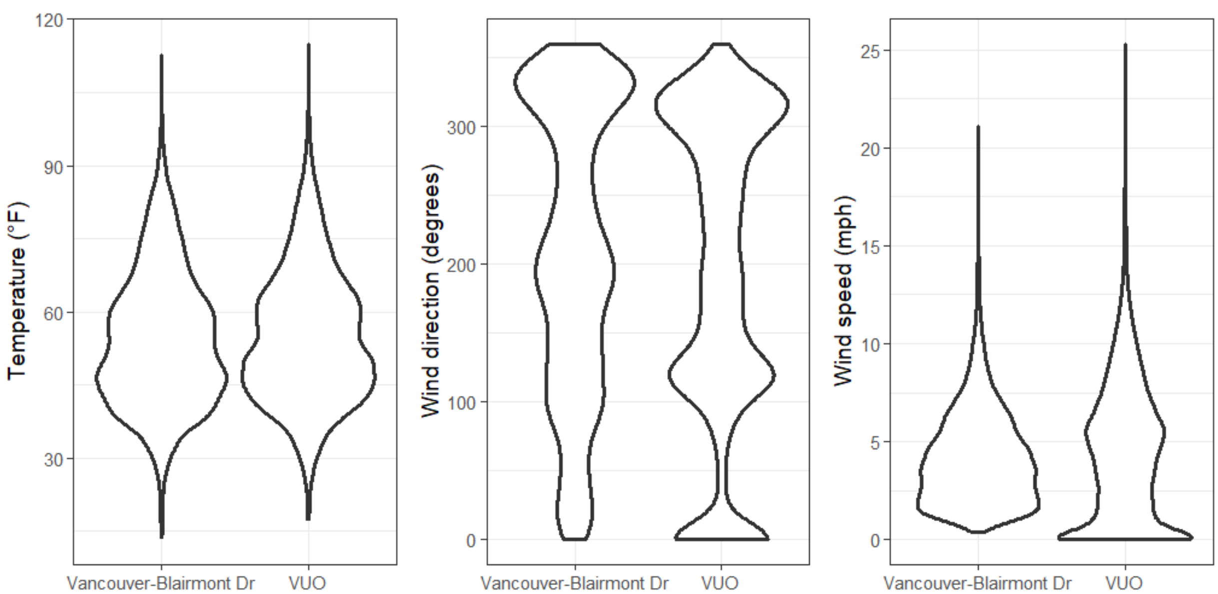

Figure 43. Temperature, wind direction, and wind speed distributions at each meteorological site from 2020-2024.

Other considerations

Ecology recognizes that several of Washington's local clean air agencies conduct supplemental meteorological monitoring outside of the Washington Network. In many cases, these monitors do not meet the requirements for PSD-quality data. They may be positioned on towers shorter than 10 meters; they may have obstructions closer than PSD requirements allow, and/or their meteorological instruments may not be calibrated as frequently as PSD monitoring requires. However, their data are of sufficient quality for the purposes of understanding meteorological conditions favorable to elevated concentrations, identifying dominant sources, and forecasting.

Ecology has not previously conducted this type of non-PSD-quality meteorological monitoring but plans to look to the examples set by local air agency partners to see if this approach provides a suitable, less resource-intensive alternative to PSD-quality meteorological monitoring at sites where it is not required. This is an area where new technologies may be suitable for incorporation into the Washington Network. For example, new sonic anemometers with an internal compass can be affixed to the inlet of a Beta Attenuation Monitor, eliminating the need for a meteorological tower, vane alignment procedure, and separate data logger.

Ecology also notes that historical meteorological monitoring data can be used in air quality permit modeling demonstrations if it is determined to be climatologically relevant. In the event that a discontinued meteorological monitoring site is deemed useful for a future air quality permit application, the most recent 5 years of data is likely climatologically relevant for the next 20-30 years.

Does the network meet the monitoring objectives defined in 40 C.F.R. Part 58 Appendix D?

Ecology finds that Washington's meteorological monitoring network is adequate to meet the objectives to provide air pollution data to the public in a timely manner, support NAAQS compliance, and support air pollution research.

Are new monitoring sites needed?

Ecology does not identify any outstanding needs for new monitoring sites.

Can existing sites be terminated?

Ecology identifies meteorological measurements at Burbank-Maple St, Wenatchee-Fifth St, and Vancouver-Blairmont Dr as candidates for discontinuation or replacement with low-cost non-PSD-quality measurements. Ecology identifies Enumclaw-Mud Mtn as a candidate for low-cost non-PSD-quality meteorological measurements. Ecology also recommends replacing meteorological measurements at Kennewick-Metaline with low-cost non-PSD measurements either at Kennewick-Metaline or at Kennewick-S Steptoe.

Ceilometers

Ceilometers measure cloud heights and atmospheric visibility. Recent instrumentation upgrades (i.e., the Vaisala CL51 and CL61 compared to the Vaisala CL31) allow ceilometers to distinguish smoke plumes from clouds and other aerosol particles present in the atmosphere. In addition to identifying pollution associated with residential wood smoke, ceilometers have become more widely used in Washington to detect the presence of wildfire smoke aloft in the atmosphere. In particular, ceilometer data is especially useful in identifying and tracking smoke plumes as a complement to ground-level measurements.

PSCAA, NWCAA, and Ecology operate ceilometers in Western Washington, and SRCAA is planning a ceilometer deployment in Spokane. As wildfire frequency increases in the Western U.S., ceilometers are a valuable tool to understand the presence and transport of smoke plumes and their impact on surface air quality.

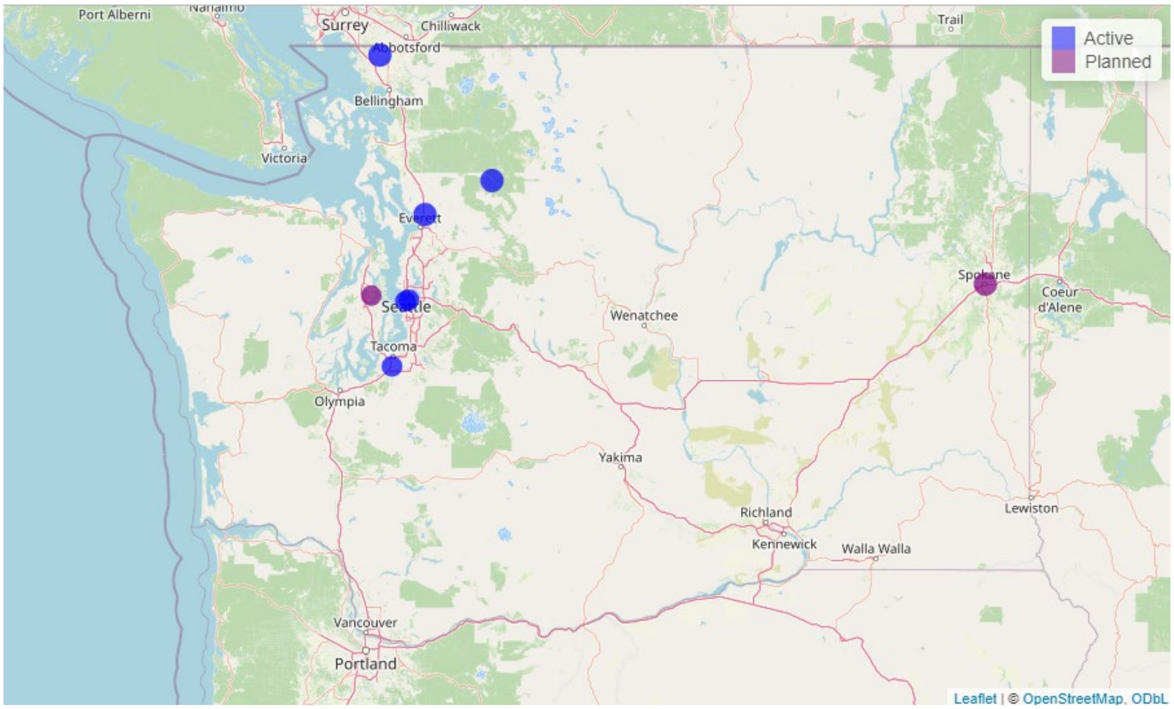

Figure 44. Current and planned ceilometer deployments in Washington State.

Many NWS ASOS sites deploy ceilometers to measure cloud height, and there has been interest from local, state, and federal partners to both make this data accessible and also upgrade existing ceilometers to better detect smoke plumes. However, Ecology is currently unaware of significant progress that will lead to increased ceilometer data availability. The existing network of ceilometers in Washington shown in Figure 44 currently meets wildfire smoke forecasting needs. Future needs include ceilometers in Southern and Northern WA to track smoke plumes transported regionally.

Chemical speciation network (CSN)

There are four active chemical speciation network (CSN) monitoring sites operated as part of the Washington Network. As a complement to $PM_{2.5}$ measurements, CSN data are utilized for annual and seasonal trend assessments, State Implementation Plan development, and source apportionment. Details about monitoring periods for active and historic CSN sites are shown in Figure 45. Chemical speciation monitoring at Tacoma-L St and Toppenish-Ward Rd (Yakama Tribe) were examined further in the following sections.

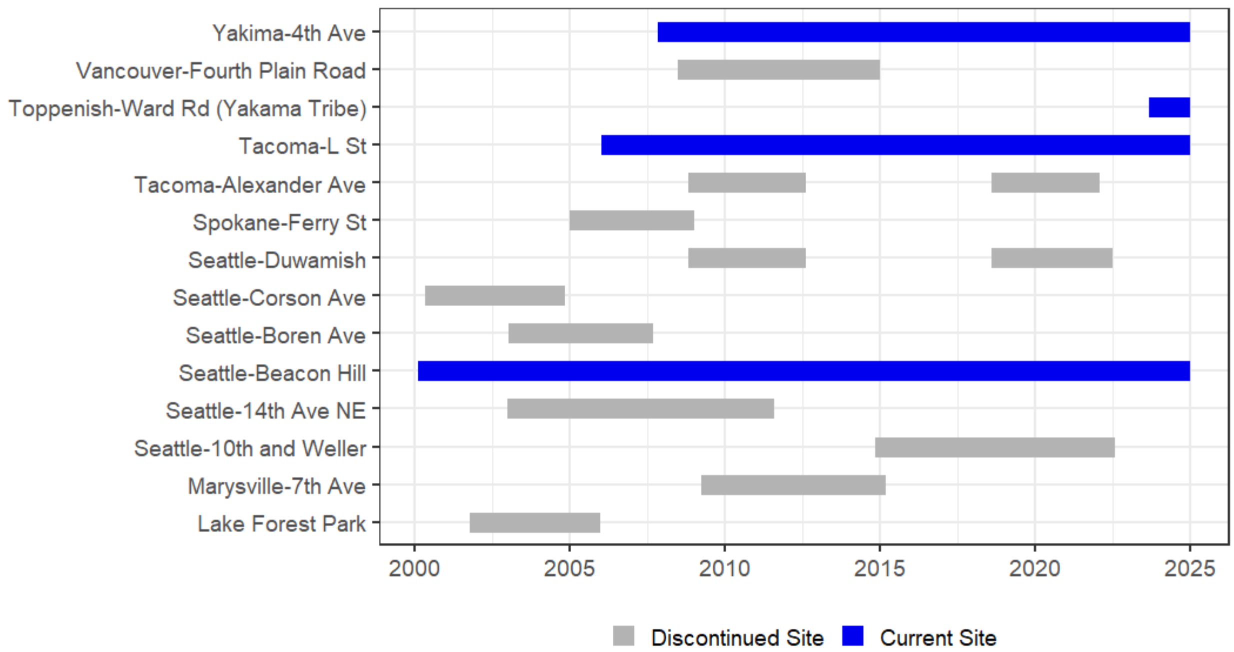

Figure 45. Gantt chart showing the active monitoring periods for current and discontinued CSN sites as part of the Washington Network.

Tacoma-L St

The following analysis considers the utility of the current Tacoma-L St speciation site. Speciated $PM_{2.5}$ measurements at Tacoma L-St began in 2006. The area (Wapato Hills Puyallup River Valley) was designated as nonattainment for the 24-hour $PM_{2.5}$ standard in 2008. Successful efforts to reduce $PM_{2.5}$ in the area included controlling $PM_{2.5}$ emissions from residential wood combustion. EPA redesignated the area to attainment in 2015. To understand the current utility of CSN measurements at Tacoma L St, a $PM_{2.5}$ source apportionment analysis was conducted to understand how $PM_{2.5}$ sources have changed at Tacoma-L St over time.

Source apportionment analysis of CSN data from May 2007-April 2024 utilized Positive Matrix Factorization (PMF, EPA PMF Version 5.0.14). PMF solves a receptor-only, unmixing model that assumes a measured dataset conforms to a mass balance of a specific number of constant source profiles that contribute varying concentrations over time (Paatero and Tapper, 1994). PMF analysis parses a time series of measured chemical species into a number of user-prescribed factors, each with its own chemical profile and mass contribution to the total measured dataset. In PMF analysis, the optimal solution describes the measured dataset with a number of factors such that the solution minimizes a quality of fit parameter. Error analysis and guidance (Paatero et al., 2014, Brown et al., 2015), knowledge of potential sources, and previously defined chemical fingerprints are utilized to determine the solution that best explains the measured dataset. CSN data was prepared for PMF analysis in accordance with prior analyses (Friedman, 2020; Ecology, 2023). Days heavily influenced by wildfire smoke and fireworks were removed from the dataset.

Factor Solution

A nine-factor solution was chosen as the optimal solution. The overall contribution of each factor is shown in Figure 46. Wood smoke dominated the factor contributions, consistent with previous studies (Kotchenruther, 2020, Kotchenruther, 2016). A few factors were unable to be delineated as single sources. The ammonium sulfate factor includes common species also observed in $PM_{2.5}$ associated with burning of residual fuel oil. A second vehicles factor (labeled as vehicles/diesel) exhibits a similar chemical fingerprint to the vehicles factor but contains a higher contribution of elemental carbon commonly associated with diesel emissions.

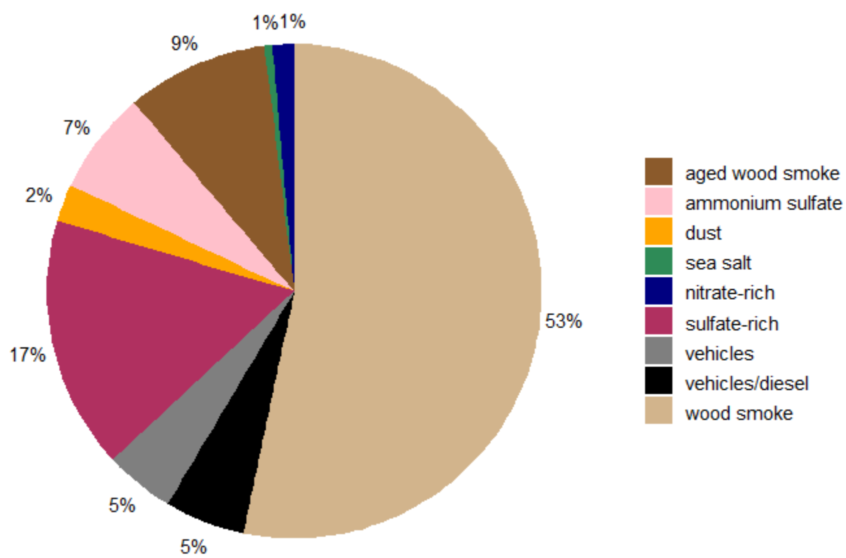

Figure 46. Overall contribution of each factor to $PM_{2.5}$, Tacoma-L St.

Many factors exhibited significant seasonal differences (Figure 47 and Figure 48). $PM_{2.5}$ associated with wood smoke was significantly higher in the fall and winter months when residential wood combustion is common, while $PM_{2.5}$ associated with sulfate was significantly higher during the summer months.

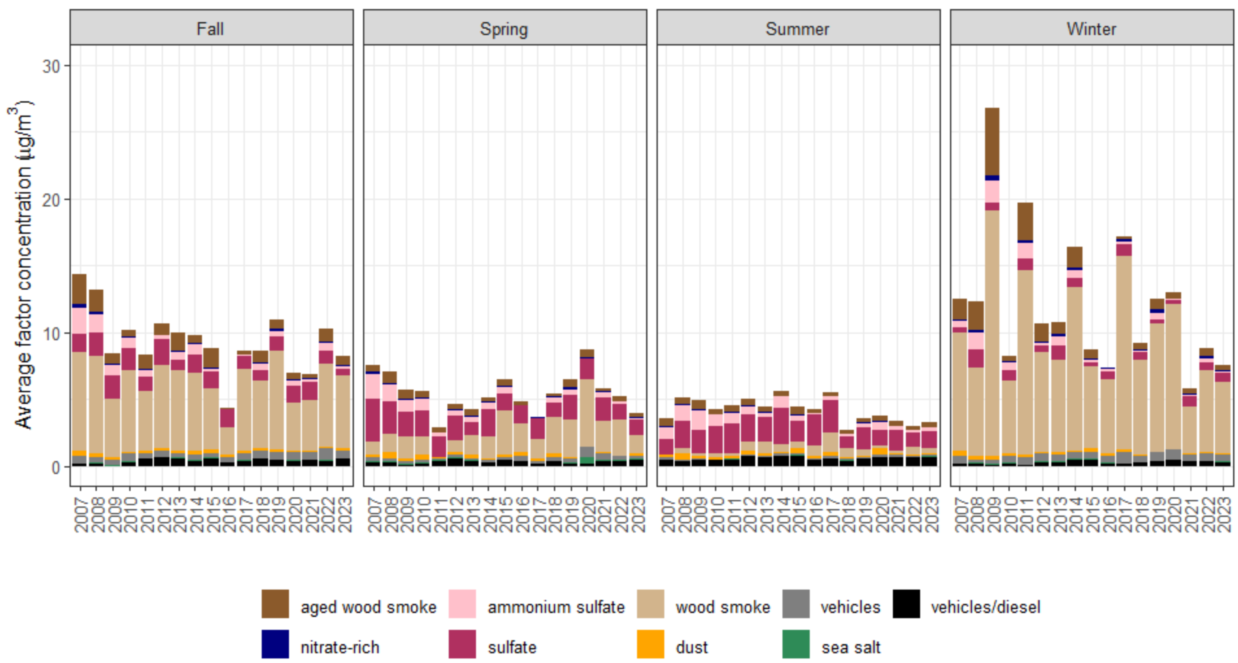

Figure 47. Average factor concentrations by year and season, Tacoma-L St.

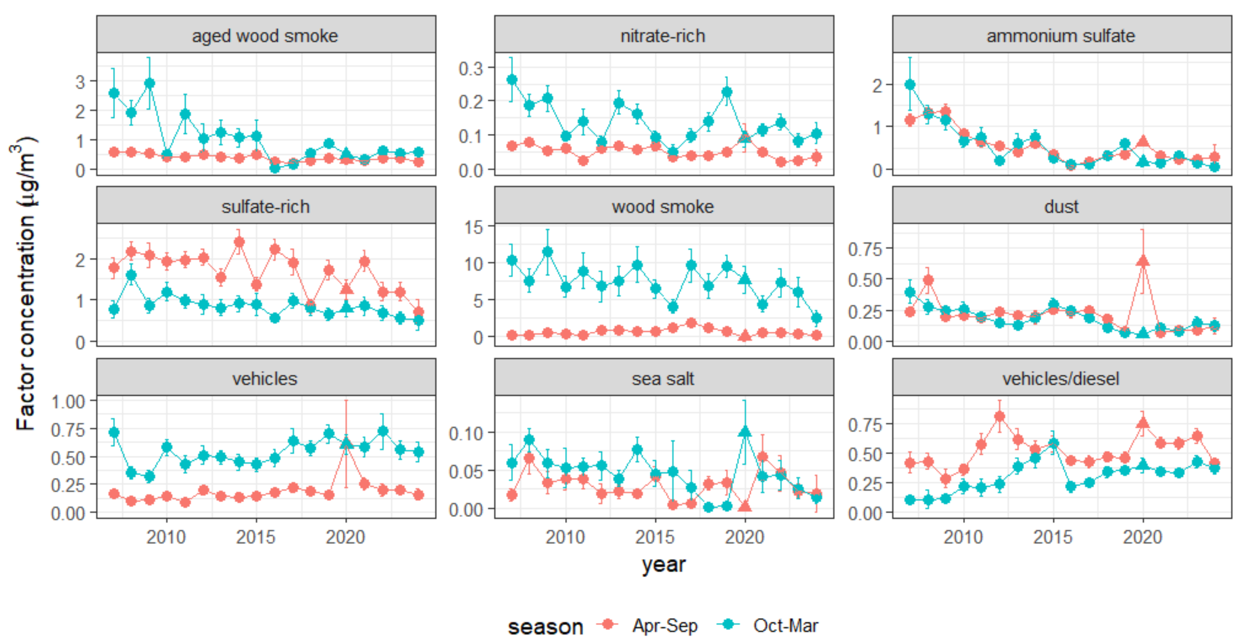

Figure 48. Average factor concentrations by year and grouped into heating (Oct-Mar) and non-heating (Apr-Sep) seasons, Tacoma-L St.

Error bars show standard errors. In 2020 sampling was suspended from March-August; 2020 averages are denoted with triangle symbols.

Trends

TheilSen trend analysis was conducted by season. Significant trends (p-values less than 0.05) are shown in Figure 49 as a function of their respective factor's seasonal mean concentration. With the exception of vehicles, each factor exhibits a decreasing trend each year. $PM_{2.5}$ associated with wood smoke exhibited the largest decreasing trend over time, consistent with reduction strategies employed after the nonattainment designation.

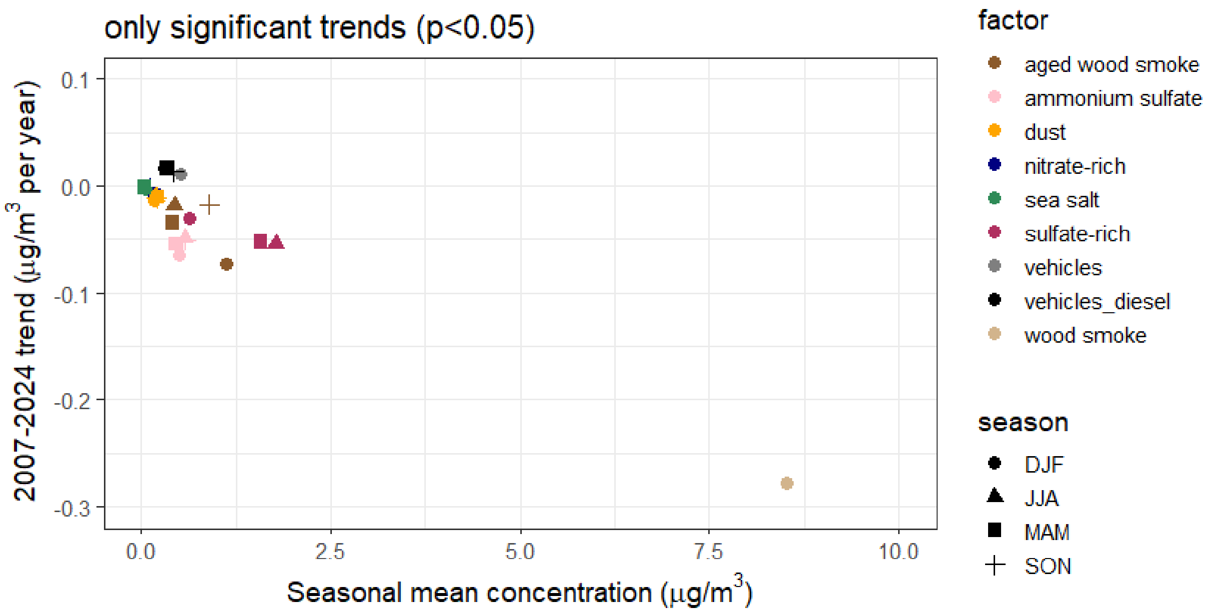

Figure 49. Trends over time compared to seasonal mean concentrations of each PMF factor, Tacoma-L St.

Only significant trends (p-value less than 0.05) are displayed.

Contribution to exceedances

With wildfire and firework data excluded, there were multiple exceedances of the 24-hour $PM_{2.5}$ standard that also overlapped with sampling days from 2007-2024. These exceedances occurred during winter and were dominated by $PM_{2.5}$ associated with wood smoke. The most recent exceedance (excluding wildfire and firework impacts) of the 24-hour $PM_{2.5}$ standard recorded at Tacoma-L St occurred in November 2022. This exceedance coincided with stagnant weather conditions as well as a Stage 1 burn ban for Greater Pierce County. Figure 50 demonstrates that non-wildfire exceedances of the daily $PM_{2.5}$ are largely due to $PM_{2.5}$ associated with wood smoke, and that knowledge is reflected in the reduction of exceedances over the last decade and strategies to reduce impacts from wood stove emissions. If considering all sample days and not just those that overlapped with CSN sampling days, there were 44 total exceedances of the daily $PM_{2.5}$ standard from 2007-2024; only 4 have occurred in the most recent 5-year period (2020-2024).

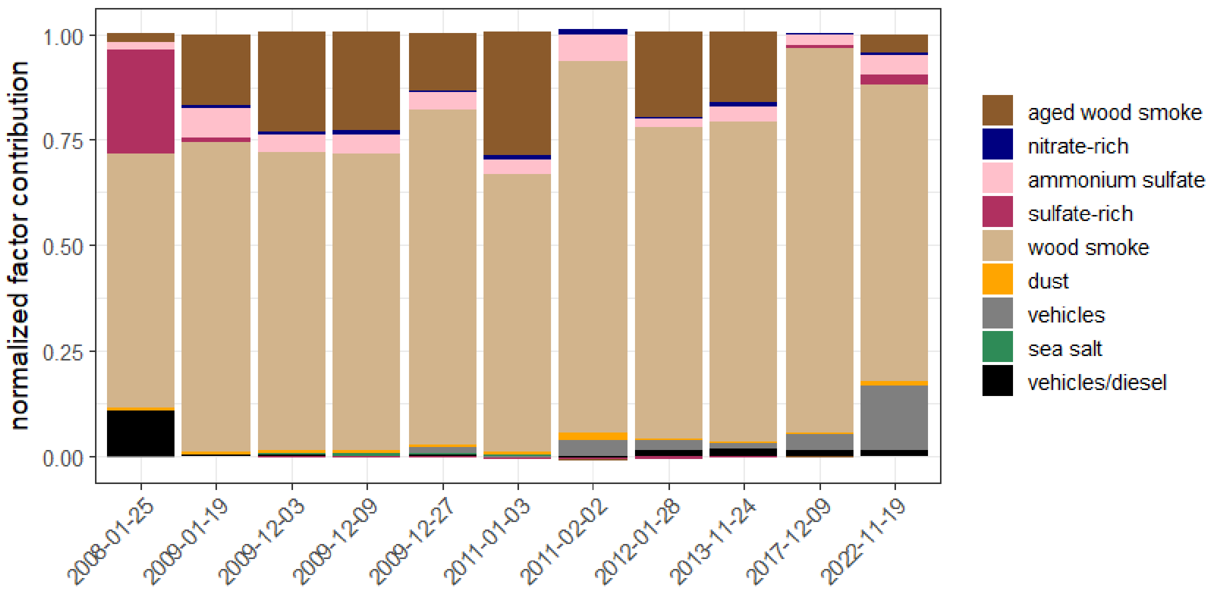

Figure 50. Exceedances of the $PM_{2.5}$ standard from 2007-2024 that overlapped with CSN sampling days and their respective factor contributions.

Exceedances associated with wildfires and fireworks are not included.

Long-term site value

Speciated $PM_{2.5}$ data collected at Tacoma-L St has been used previously to determine that $PM_{2.5}$ associated with wood smoke is the dominant $PM_{2.5}$ source in the area. Following the nonattainment designation in 2009, Ecology (2010) determined that wood smoke is the single most important source of $PM_{2.5}$ in the Tacoma area, contributing on average 45% to total $PM_{2.5}$. Using speciation data from 2007-2014, Kotchenruther (2016) found that primary wood smoke contributed approximately 60% of total $PM_{2.5}$ in the winter. A follow-up study (Kotchenruther, 2020) determined that wintertime $PM_{2.5}$ associated with wood smoke significantly decreased between 2015-2017 and 2007-2009. Kotchenruther (2020) attributes this statistically significant decrease to wood stove changeouts and wood stove curtailments. Using speciated $PM_{2.5}$ data collected from 2018-2022, Puget Sound Clean Air Agency found that Tacoma-L St observed the highest contributions from $PM_{2.5}$ associated with fresh and aged wood smoke (PSCAA, 2023).

Consistent with previous studies, this analysis determined $PM_{2.5}$ associated with wood smoke is the largest contributor to $PM_{2.5}$ at Tacoma-L St, especially during the winter. To understand changes over time, the percent change in each factor for a 3-year period compared to 2008-2010 was assessed during the fall and winter when concentrations are elevated. Figure 51 shows that changes in the 3-year average fall and winter $PM_{2.5}$ are relatively stable in recent years. This is consistent with design values at Tacoma L St and their changes over time (Figure 52); both annual and daily design values have decreased compared to 2008-2010. While fluctuations exist, for the most part changes in both design value statistics are within 10-30% in recent years.

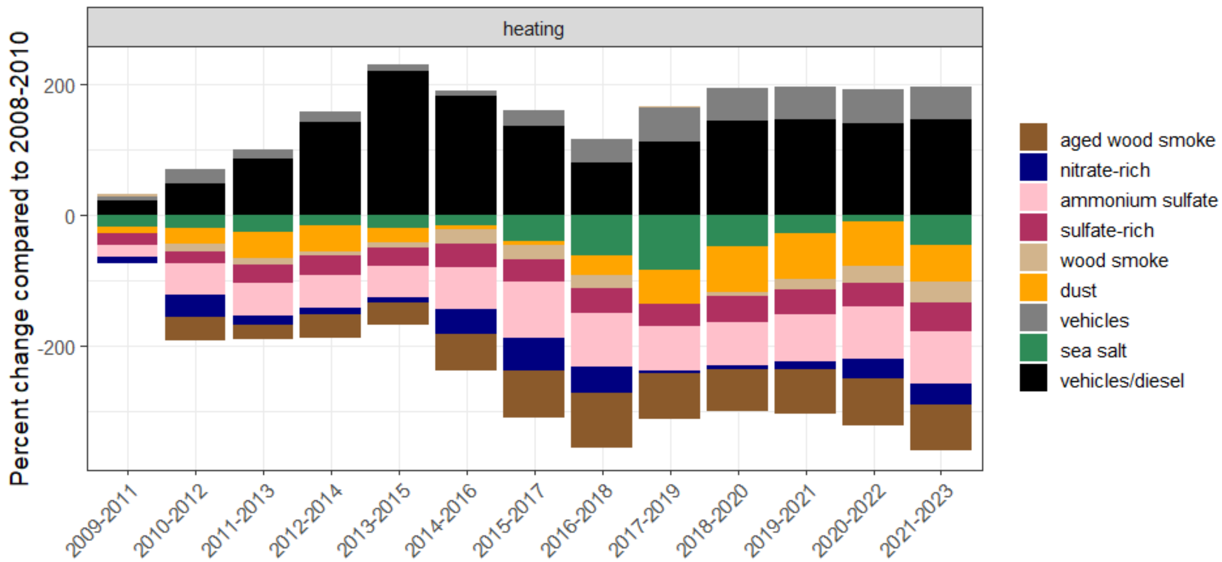

Figure 51. Percent change of each factor compared to 2008-2010.

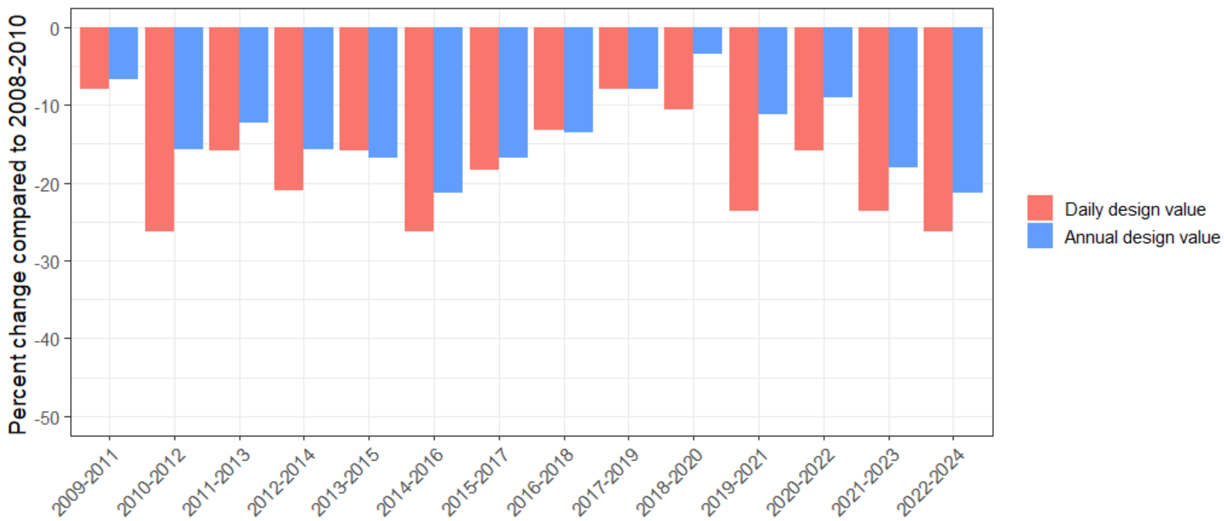

Figure 52. Percent change of daily and annual design values for each 3-year period compared to 2008-2010.

Alternative monitoring to track wood smoke contributions

If speciation measurements are discontinued at Tacoma-L St, wood smoke contributions can be assessed using existing measurements. In particular, continuous $PM_{2.5}$ and aethalometer measurements can be utilized. Until 2017, and again from 2021-2022, PSCAA operated a 7-channel aethalometer at Tacoma-L St. Previous measurements have found that the difference between the ultraviolet 370nm channel and the black carbon 880 nm channel can be used as a chemical marker for wood smoke (Wang et al., 2011). Correlations between aethalometer parameters and $PM_{2.5}$ associated with wood smoke were determined; $PM_{2.5}$ associated with wood smoke exhibited its highest correlation with the ultraviolet channel. The relationships shown in Figure 53 could be used to determine the wood smoke contribution to $PM_{2.5}$ throughout the year or during fall and winter. Using continuous $PM_{2.5}$ or aethalometer measurements to track wood smoke contributions to total $PM_{2.5}$ eliminates the need for resource-intensive chemical speciation measurements.

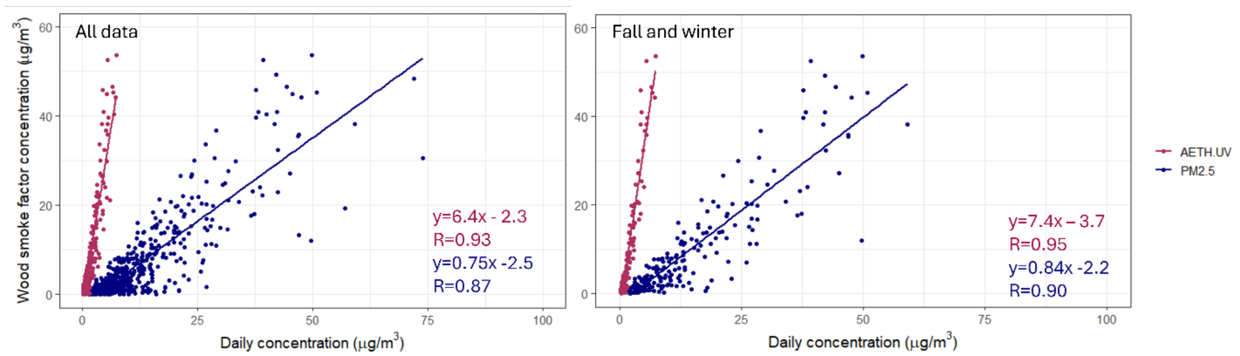

Figure 53. Relationships between $PM_{2.5}$ associated with wood smoke and aethalometer and total $PM_{2.5}$ measurements.

Summary: Consistent with previous studies, source apportionment analysis determined that $PM_{2.5}$ associated with wood smoke is the largest contributor to $PM_{2.5}$ at Tacoma-L St. Successful reduction strategies can explain the decreasing trend exhibited by $PM_{2.5}$ associated with wood smoke over time. Minimal changes in source contributions in recent years suggest little value in continuing measurements. Existing aethalometer and $PM_{2.5}$ measurements at Tacoma-L St can be used to track $PM_{2.5}$ associated with wood smoke.

Are new monitoring sites needed?

Ecology does not identify any outstanding needs for new monitoring sites.

Can existing sites be terminated?

Ecology recommends that Tacoma-L St CSN monitoring can be discontinued. The wood smoke contribution to total $PM_{2.5}$ can be monitored on an ongoing basis with less resource-intensive existing measurements (aethalometer, $PM_{2.5}$).

Toppenish-Ward Rd (Yakama Tribe)

Chemical speciation network measurements began at Toppenish-Ward Rd (Yakama Tribe) in September 2023. CSN measurements have been ongoing at Yakima-4th Ave S since November 2007. Yakima speciation data has been used in multiple source apportionment studies to determine sources of $PM_{2.5}$ in the Yakima Valley (Kotchenruther, 2020; Ecology, 2020). Toppenish-Ward Rd (Yakama Tribe) is located approximately 26 km southeast of Yakima-4th Ave S. Major sources of $PM_{2.5}$ at both sites include residential wood combustion, agricultural and silvicultural burning, and wildfires. In the wintertime, agricultural emissions, motor vehicle emissions, and stagnant air contribute to elevated $PM_{2.5}$ concentrations.

Speciation data from both Toppenish-Ward Rd (Yakama Tribe) and Yakima-4th Ave S were compared from Sept 2023-Aug 2024 to determine similarities in $PM_{2.5}$ composition and potential future site changes.

Daily $PM_{2.5}$ concentrations at both sites are shown in Figure 54. Concentrations were similar across all seasons. Summer and winter months observed the highest concentrations of $PM_{2.5}$, due to impacts from wildfire smoke in the summer and residential wood combustion during the colder seasons.

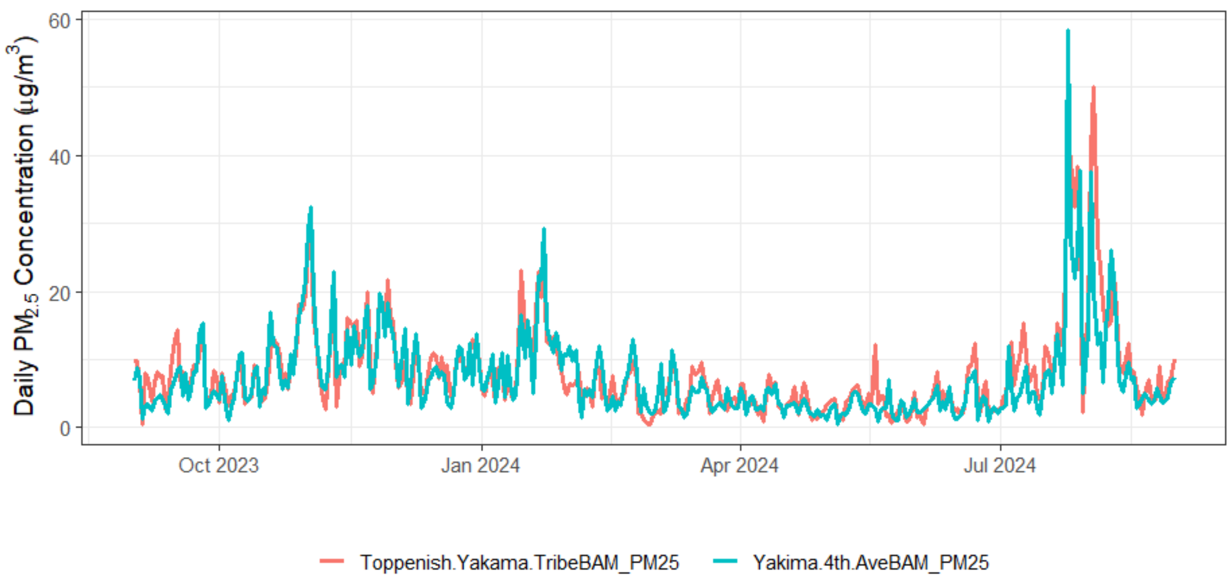

Figure 54. Daily $PM_{2.5}$ concentrations at Toppenish and Yakima.

With only 59 samples in the Toppenish data set, a full source apportionment was not conducted. Instead, this analysis considers CSN species that contribute to the bulk of $PM_{2.5}$. Concentrations of ammonium, elements, elemental carbon, organic carbon, sulfate, and nitrate were aggregated by month and are compared in Figure 55. Concentrations are relatively similar between sites during the sampling period. Distinct seasonal patterns are observed at both sites—nitrate and ammonium are highest in winter. The large discrepancy observed in March is misleading—there were only two samples collected at Yakima in March 2024 (compared to six samples collected at Toppenish) due to operational issues.

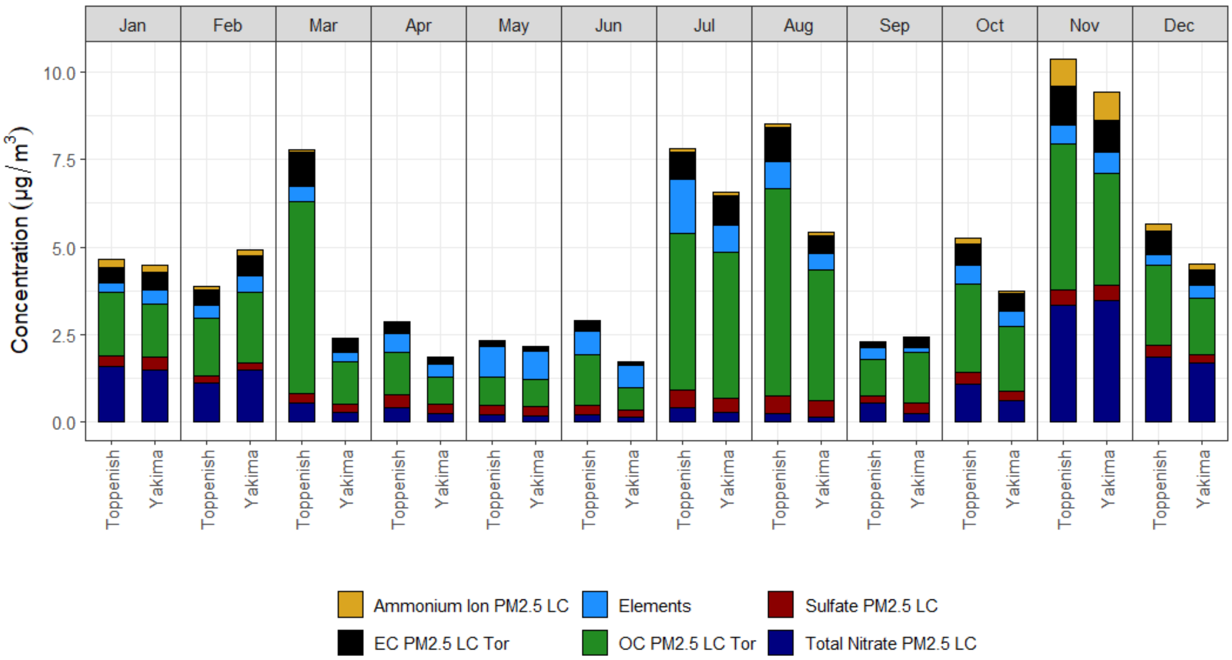

Figure 55. Average monthly concentrations of key species measured at Toppenish.

Elements is the sum of Na, Mg, Al, Si, P, S, Cl, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Se, Br, Rb, Sr, Zr, Ag, Cd, In, Sn, Sb, Cs, Ba, Ce, Pb. Note that in March only two samples were collected at Yakima.

To directly compare measurements of individual $PM_{2.5}$ components, correlations between the two sites were calculated (Figure 56). Many species show positive and significant correlations, suggesting similar $PM_{2.5}$ sources.

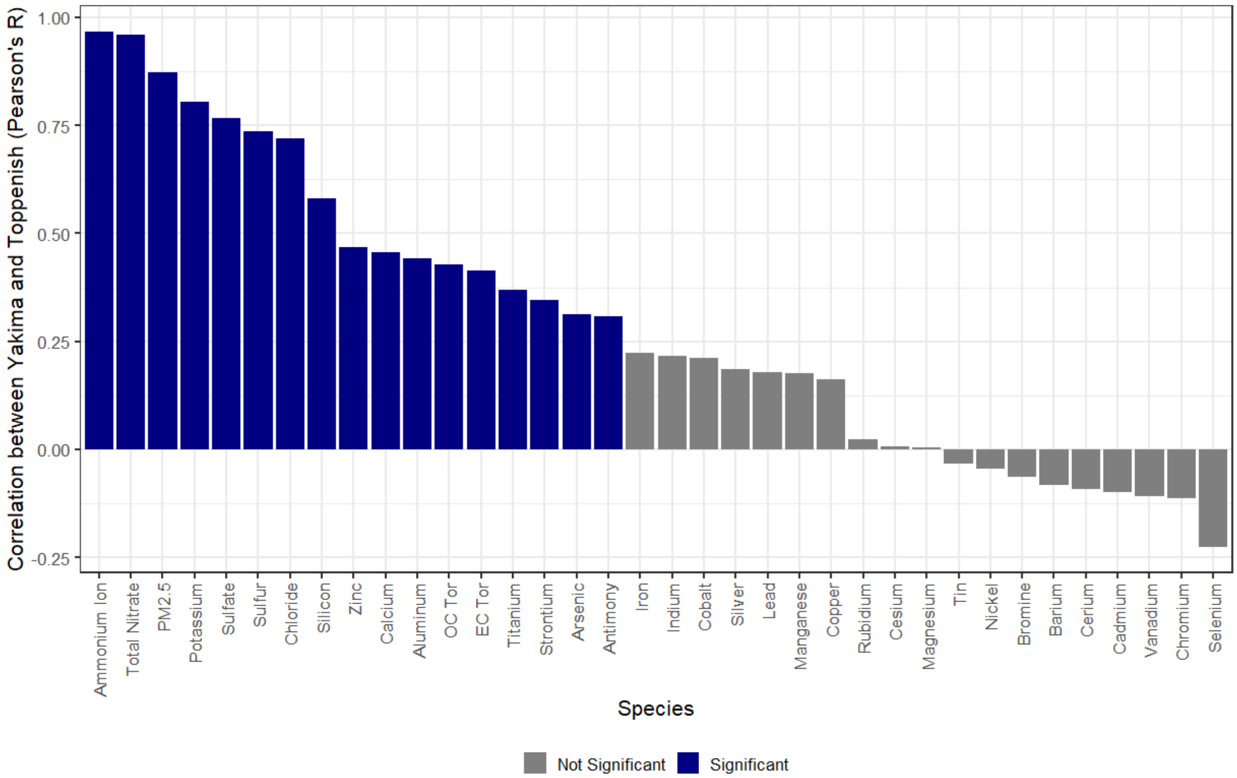

Figure 56. Correlation (Pearson's R) between Yakima and Toppenish $PM_{2.5}$ components.

Significance was calculated at the p=0.05 level.

Summary: A comparison of one year of speciated $PM_{2.5}$ concentrations between Yakima and Toppenish indicates that the two sites observe similar $PM_{2.5}$ sources.

Recommendation: Conduct a full $PM_{2.5}$ source apportionment study at Toppenish after over 100 samples have been collected. Compare source apportionment results to Yakima to determine future site changes.

Summary of Findings and Recommendations

Ecology evaluated how well the Washington Network meets the monitoring objectives defined in 40 C.F.R. Part 58 Appendix D: to provide air pollution data to the public in a timely manner, to support compliance with National Ambient Air Quality Standards (NAAQS) and development of pollution control strategies, and to support air pollution research.

This assessment found that the Washington Network meets the three objectives for criteria pollutant monitoring. The scope of the Washington Network far exceeds EPA's minimum monitoring requirements and includes extensive non-regulatory $PM_{2.5}$ monitoring to provide local-scale AQI information across the state for public health protection.

Several network modifications and new technologies can improve the network's efficiency and effectiveness. These recommended network modifications include new monitoring sites, sites identified for modification of monitoring methods, and sites identified for termination.

Recommended network modifications:

- Addition of a second ozone monitor to represent the Kennewick-Richland MSA will be required once the population of the MSA reaches 350,000 people. This network addition is planned in 2026.
- As resources allow, the addition of an ozone SPM in the Yakima MSA may provide value in characterizing a unique and currently unmonitored ozone airshed. Additional mobile or saturation sampling should be conducted to identify the most suitable location for an ozone monitor in the Yakima MSA.
- As resources allow, upgrading the $PM_{2.5}$ monitor at the Clarkston-13th St site to an FEM would be consistent with Ecology's policy of FEM monitoring at sites whose design values exceed 80% of their respective NAAQS.
- Ellensburg-Ruby St site is a potential site for replacement of FEM $PM_{2.5}$ monitoring with non-regulatory monitoring. Ecology can evaluate whether the need for a collocation site for nephelometers and SensWA can be met with other, higher-concentration sites in Washington's Central Region.
- Ecology's AgBurn team identified the Pomeroy-Pataha St and LaCrosse-Hill St non-regulatory $PM_{2.5}$ AgBurn sites as low-concentration sites where SensWA monitoring would be adequate to support smoke management needs. Ecology requested EPA approval to discontinue these two SLAMS monitors in the 2025 Ambient Air Monitoring Network Plan.
- Ecology identified meteorological measurements at Burbank-Maple St, Wenatchee-Fifth St, and Vancouver-Blairmont Dr as candidates for discontinuation or replacement with low-cost non-PSD-quality measurements. Ecology identified Enumclaw-Mud Mtn as a candidate for low-cost non-PSD-quality meteorological measurements. Ecology also recommends replacing meteorological measurements at Kennewick-Metaline with low-cost non-PSD measurements either at Kennewick-Metaline or at Kennewick-S Steptoe.

- Ecology recommends that Tacoma-L St CSN monitoring can be discontinued. The wood smoke contribution to total $PM_{2.5}$ can be monitored on an ongoing basis with less resource-intensive instruments, such as an aethalometer.

New monitoring technologies

Ecology identified several new monitoring technologies that can be incorporated in order to modernize the Washington Network:

- Continued use of Ecology's SensWA sensor device for AQI reporting in previously unmonitored areas, monitoring smoke impacts from wildland fires, responding to isolated or emergent events, monitoring to aid in smoke management decisions, temporary surveys, and saturation studies.
- Replacement of aging M903 nephelometers. At relatively low-concentration sites where the primary objective is AQI reporting, the SensWA is generally a suitable replacement instrument for the M903 nephelometer. At sites where design values are higher but still below 80% of the NAAQS, or sites where permitting or smoke management needs require greater accuracy and reliability than the SensWA can provide, portable spectrometers such as the Grimm EDM264 are a promising tool.
- Non-PSD meteorological instruments present an opportunity for resource savings at meteorological monitoring sites where PSD-quality data are not required. These instruments include sonic anemometers with or without an internal compass, and mounting options shorter and more flexible than standard 10-meter towers.

Air quality characterization for at-risk populations

Ecology evaluated whether existing and proposed sites adequately support air quality characterization for areas with relatively high populations of susceptible individuals (e.g. children with asthma) and other at-risk populations. The available resolution of health data related to conditions such as asthma is generally at the county level or lower. Since the Washington Network includes multiple monitoring sites in the state's more populous counties, and at least one monitoring site in all but a few low-population counties, the spatial resolution of monitoring data is generally higher than the spatial resolution of publicly-accessible health data related to air pollution exposure. Therefore, Ecology is not able to identify any unmet needs for additional monitoring data to support air quality characterization based on the available health data.

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