

B3: 2022 Smoke Management Plan Demonstration



2022 Smoke Management Plan Demonstration

Final May 2022

By: **Wildland Fire Management Division**

For the **Smoke Management Program**

Washington State Department of Natural Resources

Table of Contents

2022 Smoke Management Plan Demonstration	i
Table of Contents.....	i
Appendices.....	ii
List of Figures and Tables.....	v
Figures.....	v
Tables.....	v
Acronyms and Abbreviations.....	vi
Acknowledgements.....	viii
Executive Summary.....	1
Introduction	3
Purpose	3
Changes from the 1998 SMP	3
Silvicultural and Prescribed Burning.....	6
Washington forests.....	6
The Planning Process	7
National Ambient Air Quality Standards.....	11
Washington Compliance with NAAQS	12
Particulate Matter Standards	14
Ozone Standards.....	28
Lead (Pb)	30
Carbon Monoxide (CO)	30
Nitrogen Oxides (NOx)	31
Sulfur Oxides (SO ₂)	32
Visibility Protection and Regional Haze	33
Purpose	33
Washington’s Class I Areas	33
What is Regional Haze?.....	34
Regional Haze Laws and Rules.....	34
Washington’s Regional Haze Program.....	36
Minimizing Smoke Impacts to Class I Areas.....	37
Technical Analysis Summary: Summer Weekend Burning.....	38
Monitors and Sensors	40
Locations of monitors and sensors	40
Burn Decision Approval – Criteria and Process	44
The Burn Approval Process.....	44
Background Concentrations.....	45
Approval Criteria.....	48
Population Density of Washington	52
Designated and Sensitive Areas.....	52
Summary	55
Looking Forward: Protecting Air Quality into the Future	56
Restoring forest health to prevent wildfire	56

Prioritizing areas for treatment	56
Prescribed fire use in Washington	58
Air Quality Protections.....	61
Summary	62
Recent Legislation Regarding Silvicultural Burning	63
Best Burn Practices, Tools.....	72
Smoke Management Tools	72
Best Practices for Silvicultural Burning.....	72
Alternatives to Burning and Emissions Reduction Techniques	74
Reducing Emissions from Prescribed Burning	76
Intrusions	78
Action Level.....	78
Reporting Requirements.....	80
Intrusion Data	81
Mitigation.....	81
Enforcement	83
Complaints	85
Conclusion.....	86

Appendices

Appendix 1. Technical Analysis Protocols & Results – Day Before Approval1

Background	1
Proposed Data and Methodology.....	1
Model performance evaluation results	3
Appendix A: Report on UW Verification of WRF Forecasts for DNR	5

Appendix 2. Technical Analysis Protocol– Summer Weekend Burning1

Executive Summary:.....	1
Introduction:	2
Methods:.....	5
Results and Discussion:.....	6
Conclusion:.....	21
References:	22
Appendices:.....	23
Appendix A: Blank copy of DNR burn permit with permit conditions.....	23
Appendix B: Additional Charts and Figures	25

Appendix 3. 1998 and 2022 SMP Approval Criteria for Large Burns and Burns of any size in UGAs Comparison1

Appendix 4. Comparison between 1998 and 2022 SMP Visibility Protection sections.....1

Appendix 5. DNR Public Involvement Documents.1

Smoke Management Plan Outreach and comments.....	1
Stakeholders	1
2018 Focus groups	1
2017-2018 Task force.....	1
2019 SEPA Outreach docs and Comments	2
Burn Season After Action Review (AAR)	3
Washington Air Quality Manager Group meeting.....	3
Other Air Director’s Meeting	3
DNR Tribal Outreach Letter, January 19, 2021	4
2021 Webinar – February 18, 2021	5
DNR Smoke Management Plan Webinar Frequently Asked Questions	6
Webinar Slides, DNR and Ecology, February 18, 2021	19
SEPA outreach for Smoke Management Plan (19-071601).....	35
SEPA outreach for the UGA Wildfire Reduction Burning Rule Revision (19-110701) .	186
Appendix 6. Laws and Rules Crosswalk	1
Appendix 7. Washington Clean Air Act Crosswalk.....	1
Appendix 8. 1998 and 2022 SMP Crosswalk	1
Appendix 9. Laws and Rule Strikethrough	1
Code of Federal Regulations (CFR).....	1
Revised Code of Washington (RCW).....	4
RCW 52.12.103-Burning permits—Issuance—Contents.	4
RCW 52.12.104-Burning permits—Duties of permittee.....	5
RCW 76.04.005- Definitions.....	5
RCW 76.04.165-Legislative declaration—Forest protection zones.....	6
RCW 76.04.205 - Burning permits—Civil penalty.	7
RCW 70A.15.5000-Definition of "outdoor burning."	16
Washington Administrative Code (WAC).....	29
WAC 332-24: DNR Burning Permit Regulations.....	29
Appendix 10. Washington Smoke Information – 2018	1
October 2018	1
September 2018.....	1
August 2018	1
July 2018	3
June 2018	3
April 2018.....	3
Website Images – Washington Smoke Information - 2018.....	4
Appendix 11. Washington Smoke Information – 2019	1
October 2019	1
August 2019	1

July 2019	1
June 2019	2
May 2019	2
Website Images – Washington Smoke Information – 2019	3
Appendix 12. Washington Smoke Information – 2020	1
October 2020	1
September 2020.....	1
August 2020	2
July 2020	2
June 2020	2
Website Images – Washington Smoke Information – 2020	3
Appendix 13. EPA Letter approving Ecology’s 2020 Annual Network Report	1
Appendix 14. Statutory and Administrative Changes to RCW and WAC governing Silvicultural Smoke Management	1

List of Figures and Tables

Figures

Figure 1. Permitted Burns by Burn Type, 2019.....	8
Figure 2. Consumption and Acreage by Burn Type, 2019.	8
Figure 3. Showing locations of Permitted Pile Burns in Washington, 2019	9
Figure 4. Showing locations of permitted Broadcast and Natural Burns in Washington, 2019... ..	10
Figure 5. 24-hour PM _{2.5} concentrations for WAQA and AQI categories	13
Figure 6. Number of days with wildfire influenced data by location, 2018-2020.....	18
Figure 7. MODIS image of smoke from fires (red triangles) and AQI at PM _{2.5} monitors (circles) in the Pacific Northwest on August 14, 2018 (source: AirNowTech Navigator).....	19
Figure 8. Mandatory Class 1 Areas and IMPROVE Monitoring Sites	33
Figure 9. Statewide monitoring resources.....	43
Figure 10. Map of designated areas as of January 2020.	54
Figure 11. Wildland Urban Interface and Urban Growth Areas	65
Figure 12. Forested Percent of Washington State Urban Growth Areas (2018).....	66
Figure 13. WUI Mapping Process, 02/04/2020.....	67
Figure 14. Public Notification, in case of unintended impacts.....	80

Tables

Table 1. National Ambient Air Quality Standards, December 2020	11
Table 2. Monitoring site 98th percentile and 24-hour PM _{2.5} DV with and without wildfire, 2018-2020.	15
Table 3. Site names and dates where wildfire- influenced data was removed for PM _{2.5} in 2018.	20
Table 4. Site names and dates where wildfire influenced data was removed for PM _{2.5} in 2019.	22
Table 5. Site names and dates where wildfire influenced data was removed PM _{2.5} in 2020. ...	23
Table 6. Primary Annual PM _{2.5} Means for monitoring sites over 12 µg/m ³ , for at least one of the years 2018-2020	24
Table 7. Number of PM ₁₀ Exceedances, 2018-2020, with and without natural event exceedances	26
Table 8. Dates and locations of 2018 PM ₁₀ values removed due to natural events.....	26
Table 9. Dates and locations of 2020 PM ₁₀ values removed due to natural events	27
Table 10. Sites and Dates where ozone was impacted by wildfires in 2018	28
Table 11. Ozone 4th highest daily maximum 8-hour concentrations, ppb	28
Table 12. Nitrogen dioxide (NO ₂) 2020 design values (ppb)	31
Table 13. Sulfur Dioxide (SO ₂) 2020 design values (ppb)	32
Table 14. IMPROVE monitoring sites.....	34
Table 15. Intrusions in Washington 2009-2019, by Location	81

Acronyms and Abbreviations

AAR.....	After Action Review
AIRPACT-4	Air Indicator Report for public Awareness and Community Tracking
AQI.....	Air Quality Index
BLM	Bureau of Land Management
CAA.....	Federal Clean Air Act
CO.....	Carbon Monoxide
DNR	Washington State Department of Natural Resources
DV.....	Design Value
Ecology	Washington State Department of Ecology
EER	Exceptional Events Rule
EPA	U.S. Environmental Protection Agency
ESRI.....	ESRI ArcGIS Online
FLM.....	Federal Land Manager
FEM	Federal Equivalent Method
FRM	Federal Reference Method
GACC	Geographic Area Coordinating Centers
IMPROVE.....	Interagency Monitoring of Protected Visual Environments
LCAA	Local Clean Air Agency
MID.....	Most Impaired Days
NAAQS.....	National Ambient Air Quality Standard
NATTS.....	National Air Toxics Trend Station
NEPA.....	National Environmental Policy Act
NFDRS.....	National Fire Danger Rating System
NICC.....	National Interagency Coordinating Center
NIFC.....	National Interagency Fire Center
NO	Nitrogen Monoxide
NO ₂	Nitrogen Dioxide
NO _x	Nitrogen Oxides
NPS	National Park Service
NWS.....	National Weather Service
O ₃	Ozone
Pb	Lead
PL.....	Preparedness Level
PM _{2.5}	Fine Particles or Particulate Matter; with an aerodynamic diameter of 2.5 microns or less
PM ₁₀	Coarse Particle Matter or Particulate Matter; with an aerodynamic diameter of 10 microns or less
RAVI.....	Reasonably Attributable Visibility Impairment
RAWS.....	Remote Automated Weather Stations
RCW.....	Revised Code of Washington
RH.....	Regional Haze
RHR.....	Regional Haze Rule

SIP.....State Implementation Plan
SMPSmoke Management Plan
SO₂.....Sulfur Dioxide
UGAUrban Growth Area
USFSU.S. Forest Service
USFWS.....U.S. Fish and Wildlife Service
WAC.....Washington Administrative Code
WAQA.....Washington Air Quality Advisory
WRAPWestern Regional Air Partnership
WUIWildland Urban Interface

Acknowledgements

The authors of this report thank the following people for their contribution to this project:

- Department of Ecology
 - Jason Alberich, Air Quality Rules and Planning Unit Supervisor
 - Ranil Dhammapala, Natural Resource Scientist
 - Beth Friedman, Natural Resource Scientist
 - Martha Hankins, Air Quality Policy and Planning Section Manager
 - Farren Herron-Thorpe, Natural Resource Scientist
 - Laurie Hulse-Moyer, Air Quality Planner
 - Jill Shulte, Natural Resource Scientist
- Department of Natural Resources
 - Vaughn Cork, Fuels Analyst
 - Jonathan Guzzo, Wildland Fire Management Division Policy Coordinator
 - Carolyn Kelly, Smoke Management Field Coordinator
 - Karen Zirkle, Wildland Fire Management Division Assistant Division Manager for Logistics

Executive Summary

This document supports the Washington State Department of Natural Resources' (DNR) request to the Washington State Department of Ecology (Ecology) to submit the revised 2022 Smoke Management Plan (2022 SMP) to the U.S. Environmental Protection Agency (EPA) to include in the state's air quality plan, called the State Implementation Plan, or SIP. After a public comment period, Ecology will submit the 2022 SMP to EPA and request it replace the existing, federally enforceable version of the SMP (1998 SMP) now in the SIP.

This document is the product of collaboration between Ecology, EPA, DNR, and other partners. In Washington, several agencies share oversight and authority for various types of outdoor burning. DNR regulates silvicultural burning; Ecology and [local clean air agency partners](#)¹ oversee other types of [outdoor burning](#)²: land clearing, residential yard waste, recreational, some fire training, and [commercial agricultural](#).³

DNR regulates [outdoor burning](#)⁴ on all state and private lands that it protects from fire. Washington state law (RCW 70A.15.5120, RCW 70A.15.5130) assigns the responsibility to regulate smoke from silvicultural burning to the DNR. Silvicultural burning includes burning piled debris in the wake of timber operations, burning to reduce wildfire fuels, burning to eliminate invasive species, and burning to encourage the propagation of native and fire-dependent species.

In 2016, DNR began working on updating the SMP to modernize the SMP, more effectively use resources on prescribed fires, and maximize opportunities for burning on the best air dispersion days. This document demonstrates how the updated SMP complies with the federal Clean Air Act (CAA), Section 110(l), with a focus on the three main changes:

- 1. Aligning assessment threshold in Large Burn Approval Criterion #1 with state law:** This change clarifies when permission to burn will be denied. DNR changed the threshold in criterion #1 to an exceedance of standards, which can be enforced under existing statute. To prevent public health impacts that can result from smoke exposures below NAAQS, DNR further defines smoke intrusions at a level well below NAAQS, and proposes new mitigation measures to prevent smoke intrusions.
- 2. Removing the prohibition against summer weekend burning:** The 1998 SMP prohibited igniting units that would consume more than 100 tons of material on summer weekends from June 15 to October 1, in order to reduce haze and preserve visibility in Class I Federal Areas. The 2022 SMP removes this restriction and the analysis presented in this demonstration shows that visibility in Class I areas is protected.
- 3. Notifying burners of permission to ignite their units by 4:30 PM the day prior to ignition:** Under the 1998 SMP, the site-specific smoke management decision is issued the morning of ignition. DNR proposes changing this decision deadline to 4:30 PM the

¹ <<https://ecology.wa.gov/About-us/Our-role-in-the-community/Partnerships-committees/Clean-air-agencies>>

² <<https://ecology.wa.gov/Air-Climate/Air-quality/Smoke-fire/Outdoor-residential-burning>>

³ <<https://ecology.wa.gov/Air-Climate/Air-quality/Smoke-fire/Agricultural-burning>>

⁴ <<https://www.dnr.wa.gov/OutdoorBurning>>

day prior to ignition. The analysis in this demonstration shows that air quality is protected.

4. **Allowing burning in Urban Growth Areas (UGAs)** on forestlands under DNR’s jurisdiction under certain circumstances with additional protections. In 2019, the Washington Legislature passed a law allowing DNR to set approval policies and issue certain permits within the state’s Urban Growth Areas (UGAs). DNR subsequently added to the 2022 SMP additional requirements to protect air quality.

As part of the standard SIP process, Ecology plans to hold a comment period in May 2022 and will submit the SIP request to EPA later in the year.

This demonstration document provides explanation of silvicultural and prescribed burning, and the burn approval process. It includes information on current concentration of criteria pollutants: Washington complies with all NAAQS except for a small portion of Whatcom County designated as nonattainment for SO₂.

Silvicultural burning is regulated based on the tonnage of consumable material. Burns that will consume 100 tons or more (300 tons or more in low risk areas) of material require site-specific ignition approval. All burns within UGAs, including those less than 100 tons, will require ignition approval.⁵

DNR relies on all available air monitors when making smoke management decisions. While highly accurate quality-assured and calibrated monitors are the gold standard for decision-making, low cost monitors provide important supplemental information.

DNR directs burn practitioners to prevent and manage impacts and take preventative or mitigative action at a lower level than the NAAQS exceedance levels. DNR will use the fine particulate (PM_{2.5}) action level of 20.5 µg/m³ to evaluate burns for potential approval for ignition and to direct burners to take mitigative action, if needed.

Based on the analysis provided in this document, DNR asserts that the updated 2022 SMP will continue to protect the national ambient air quality standards (NAAQS) and the state regional haze goals from the impacts of silvicultural burning, and that the 2022 SMP can replace the 1998 SMP in the SIP.

We understand the importance of clean air for all of Washington, now and into the future. As the state anticipates use of prescribed burning to achieve forest health, the actions and tools described in this document will work together to protect air quality. This document describes ignition approval criteria, forecasting tools, restrictions on burning when air quality is impaired, air monitoring, coordination among agencies, and communication to communities.

⁵ Ignition approval is also called the “go/no go” decision. It’s also referred to as the smoke management decision since approval is contingent on whether smoke will sufficiently disperse. The decision issued by DNR’s Smoke Management experts to either approve or deny an ignition. The eight criteria detailed below form the basis for the Go/No-Go Decision, which is applied to any burn that will consume 100 tons or more (300 tons in low risk areas), or a burn of any tonnage in a low risk area.

Introduction

Purpose

This document supports updates to Washington’s Smoke Management Plan (2022 SMP) for inclusion in the state’s air quality plan, (the State Implementation Plan or SIP). It considers and analyzes changes to the SMP as required by the federal Clean Air Act (CAA) Section 110 (I). After a public comment period, the Washington State Department of Ecology (Ecology) will submit the 2022 SMP to EPA and request it replace the 1998 SMP currently in the SIP.

The Washington State Department of Natural Resources (DNR) manages and protects state forest lands. State law requires DNR to develop and maintain a plan to manage smoke from silvicultural burning.⁶ The goals of the SMP are to:

- Protect human health and safety from the effects of silvicultural burning.⁷
- Facilitate the enjoyment of the natural attractions of the state.⁸
- Provide a limited burning program for the people of this state.⁹
- Provide the opportunity for essential forestland burning while minimizing emissions.¹⁰
- Maintain emissions from silvicultural burning other than for forest health reasons to the year 2000 threshold, as required by law.¹¹
- Foster and encourage the development of alternative methods for disposing of, or reducing the amount of organic refuse on forestlands.¹²
- Acknowledge the role of fire in forest ecosystems and allow the use of fire under controlled conditions to maintain healthy forests.¹³

DNR is organized into six geographical regions; regional offices review permit applications, issue permits, and authorize burns. In addition, DNR has a headquarters located in Olympia, Washington, where divisions set statewide policy. DNR’s Wildfire Division, in collaboration with the agency’s six regions, implements the SMP program.

Changes from the 1998 SMP

DNR is considering four major changes to the 1998 SMP, as well as several smaller clarifying changes. The three changes are:

1. Aligning assessment threshold in Large Burn Approval Criterion #1 with state law.
2. Removing the prohibition against summer weekend burning.
3. Notifying burners of permission to ignite their units by 4:30 PM the day prior to ignition.

⁶ Revised Code of Washington (RCW) 70A.15.5130(2)(a)

⁷ RCW 70A.15.1005

⁸ Ibid.

⁹ RCW 70A.15.5070

¹⁰ RCW 70A.15.5130

¹¹ RCW 70A.15.5130

¹² RCW 70A.15.5140

¹³ Ibid.

4. Allowing burning in Urban Growth Areas (UGAs) on forestlands under DNR’s jurisdiction under certain circumstances with additional protections.

1. Aligning assessment threshold in Large Burn Approval Criterion #1 with state law.

The [State of Washington Department of Natural Resources: Smoke Management Plan \(Revised 1998\)](#)¹⁴ contains the following language for Criteria #1:

There is the likelihood of an "intrusion" of smoke into "designated areas," which includes air space 2,000 feet above the ground, or "sensitive areas," such as population centers (see map, Appendix 8). (Washington State Department of Natural Resources, "Smoke Management Plan," 1998, p.8)

RCW 70A.15.5140, the Washington State Clean Air Act, applies “exceedance of State air quality standards” as the approval threshold, rather than “intrusion.” The 2022 SMP uses the language consistent with state law.

In order to mitigate against smoke in communities below the level of an exceedance, but that still might cause impacts to human health or property, DNR includes an intrusion procedure in the 2022 SMP that will be triggered when air quality degrades to the level identified by Ecology as dangerous for sensitive populations—20.5 µg/m³ of PM_{2.5}. This is significantly lower than the 24-hour National Ambient Air Quality Standard (NAAQS) for PM_{2.5}, which is 35 µg/m³. This procedure is designed to mitigate the impacts of smoke already produced by burning operations, and to prevent, to the extent possible, the production of more smoke. Taking action at this level also provides a buffer against exceedances of the NAAQS.

2. Removing the prohibition against summer weekend burning

The 1998 SMP prohibits large burn (100 tons or more of consumed material or 300 tons in low risk areas) ignition on weekends from June 15 to October 1. This restriction only applies to large burns) The 2022 SMP proposes removing this prohibition because the amounts are inconsequential and orders of magnitude more material is burning in other months while protecting the NAAQS. Moreover, the theoretical impacts of removing this prohibition will be reduced to some extent due to operational limitations such as fire-danger being too high, preparedness levels¹⁵ being too high and geographical burn bans in place throughout most of the summer.

¹⁴ https://www.dnr.wa.gov/publications/rp_burn_smptoc.pdf.

¹⁵ Preparedness Level is defined as circumstances in which:

- Shared resources are heavily committed. National mobilization trends affect all Geographic Areas (GAs) and regularly occur over larger and larger distances. National priorities govern resources of all types. Heavy demand on inactive/low activity GA's with low levels of activity for available resources.
- Significant wildland fire activity is occurring in multiple geographic areas; significant commitment of Incident Management Teams.
- The National Interagency Coordinating Center (NICC) increasingly engages Geographic Area Coordinating Centers (GACC) in an effort to coordinate and fill orders for available resources.
- Potential for significant incidents emerging in multiple GAs indicates that resource demands will continue or increase.

-National Interagency Fire Center (NIFC)

Analysis shows that allowing summer weekend burning, when certain conditions are met, along with the DNR procedure and other criteria for approving burning, will not interfere with compliance of any NAAQS or Regional Haze (RH) goals in the state.

3. Notifying burners of permission to ignite their units by 4:30 PM the day prior to ignition.

The 1998 SMP requires DNR to notify burners on the morning of ignition. The 2022 SMP would change the timing of the smoke management decision to the prior afternoon, in order to be more consistent with the operational tempo of both agencies and burners, and would take advantage of new and improved smoke and weather forecasting technology and science.

Analysis shows that issuing burn permission the day before the requested burning, in conjunction with the application of approval criteria, results in a small decrease in model accuracy, but still allows for sound smoke management decision making. The results of these analyses are in Appendix 1.

4. Allowing burning in Urban Growth Areas (UGAs) on forestlands under DNR's jurisdiction under certain circumstances with additional protections.

In 2019, the Washington Legislature passed a law allowing DNR to set approval policies and issue certain permits within the state's Urban Growth Areas (UGAs). DNR subsequently added to the 2022 SMP additional requirements to protect air quality.

The following pages lay out the key issues in this submittal, describe the state and federal standards to which agencies must adhere, and describe the technical analyses conducted to demonstrate non-interference with air quality standards.

Silvicultural and Prescribed Burning

The 2022 Silvicultural Smoke Management Plan¹⁶ defines silviculture as:

“Management practices related to controlling, establishment, growth, composition, and quality of forest vegetation.”

It also defines prescribed burning as:

“Controlled application of fire to wildland fuels in either their natural or modified state under specific environmental conditions which allow the fire to be confined to a predetermined area, and at the same time to produce the fire line intensity and rate of spread required to attain planned management objectives.”

Silvicultural burning is the burning related to silviculture. It is distinct from other treatments that contribute to the control, establishment, growth composition and quality of forest vegetation, for example planting, slashing, harvesting, mulching and mastication. Prescribed fire defines the parameters needed to establish the objectives or outcome of the burn on the landscape.

Washington forests

The Cascade Range runs north south, bisecting Washington, with areas west of the divide receiving considerably greater amounts of rain and snow.

To the east, Central and Eastern Washington includes fire-adapted forestlands, with ponderosa pine savannah, mixed-conifer forests, and adjacent grasslands. Most of these forestlands are in departure from historic fire regimes, meaning that they are often the site of insect infestations, are impacted by pathogens and parasites, and subject to severe overstocking. They often display conditions that put them in danger of catastrophic wildfire, such as high levels of tree mortality, crowding, and multiple canopies.

Despite being primarily rural in character, Central and Eastern Washington are home to communities as diverse in culture and economy as Omak, Winthrop, Chelan, Wenatchee, Leavenworth, Ellensburg, Cle Elum, Yakima, Richland, Walla Walla, Spokane, Colville, and Republic.

Western Washington forestlands are predominantly Douglas fir, western red cedar, sitka spruce, and hemlock. Western Washington is among the most productive forestland in the world, and the primary use of fire on Western Washington forestlands is post-harvest burning of piled slash to clear land for replanting. Generally speaking, smoke from pile burning is relatively easy to manage from an air quality perspective. Piles tend to burn hot which reduces smoldering, and it is possible to refrain from igniting new piles when smoke impacts are detected.

¹⁶ https://www.dnr.wa.gov/publications/amp_sepa_other_smpupdate_smp.pdf

Western Washington's weather is generally favorable, with prevailing winds often transporting smoke away from communities and out to sea.

The Planning Process

The prescribed fire process begins years before any burning takes place. The planning phase often begins with a National Environmental Policy Act (NEPA) analysis for the Federal Lands or a thinning or harvesting plan for private or federal lands. These can be either 3-5 years prior for NEPA or 2-3 years prior for a thinning or harvesting project on private land. Private landowners conduct pile and broadcast burns as well as occasional under burns (as defined in the 2022 SMP). Clear-cuts larger than 120 acres are subject to review by an interdisciplinary team should the DNR deem such review necessary. In any case, clear-cuts larger than 240 acres are prohibited (Washington Administrative Code (WAC) 222-30-25(1) and (2)). Federal land managers conduct both understory burning and pile burning. In part, this process helps to dictate the pace of burning in the woods. Most burns range between 50–250 acres and fewer in the magnitude of 500+ acres due to the manageability of such projects with the given personnel limitations.

Many areas are treated initially through a thinning process which may generate some pile or woody material to burn, or through a mastication or mulching process reducing the height of the forest floor fuels. Some areas undergo a number of forest treatments prior to any large burn, and forested areas are treated in a patchwork fashion. Burns are planned to only occur on limited units in any general area and only for specific days. Back-to-back burns are completed when metrological conditions are favorable for smoke direction and dispersion.

Burning in either a mechanical (formed by a machine) or hand (work crews pile woody debris) pile is the majority of burning in WA (Figure 1) and the majority of the tonnage of material consumed and calculated into the emissions calculation RCW 70A.15.5130 (Figure 2).

[DNR's 20-Year Forest Health Strategic Plan](#)¹⁷ underlines fire's role as a management tool, particularly in Eastern Washington dry forestlands:

Fire is a natural part of the dry forest ecosystems in eastern Washington and the use of controlled fire promotes forest health. Prescribed fire, or controlled burning, is "the planned, professional application of fire in the right place, at the right time" with the right intensity to meet a forest health improvement prescription or meet the landowner's objectives (Washington Prescribed Fire Council). Burning helps to reduce fuel loads and increase effectiveness of mechanical treatments to withstand and constrain future wildfires. Prescribed fire also improves forest aesthetics and viewsheds, removes slash that cannot be utilized, improves forage conditions for big game and livestock, and reduces risk of insect and disease spread. (Washington State Department of Natural Resources, "20-Year Forest Health Strategic Plan," p.14.)

The use of prescribed fire will vary in scale and application. There will be situations where prescribed fire is the only appropriate tool, and other situations that require other tactics.

¹⁷ 20-Year Forest Health Strategic Health Plan, Eastern Washington, October 25, 2017, <https://www.dnr.wa.gov/publications/rp_forest_health_20_year_strategic_plan.pdf>

Some circumstances will need both mechanical treatments and the application of controlled ignition.

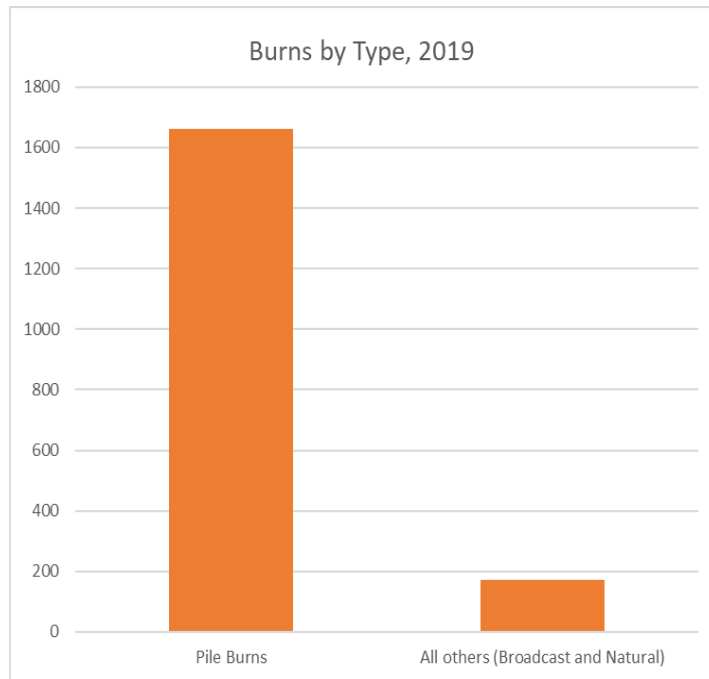


Figure 1. Number of Burns by Type, 2019.

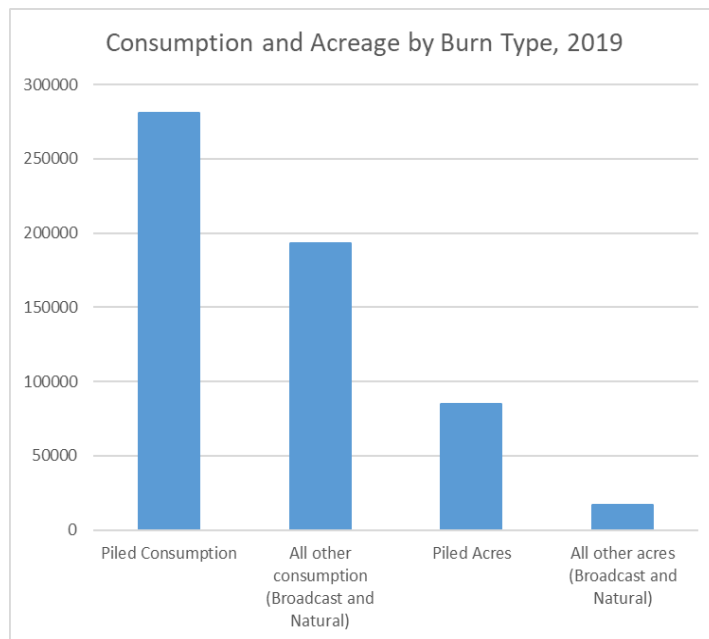


Figure 2. Consumption and Acreage by Burn Type, 2019.

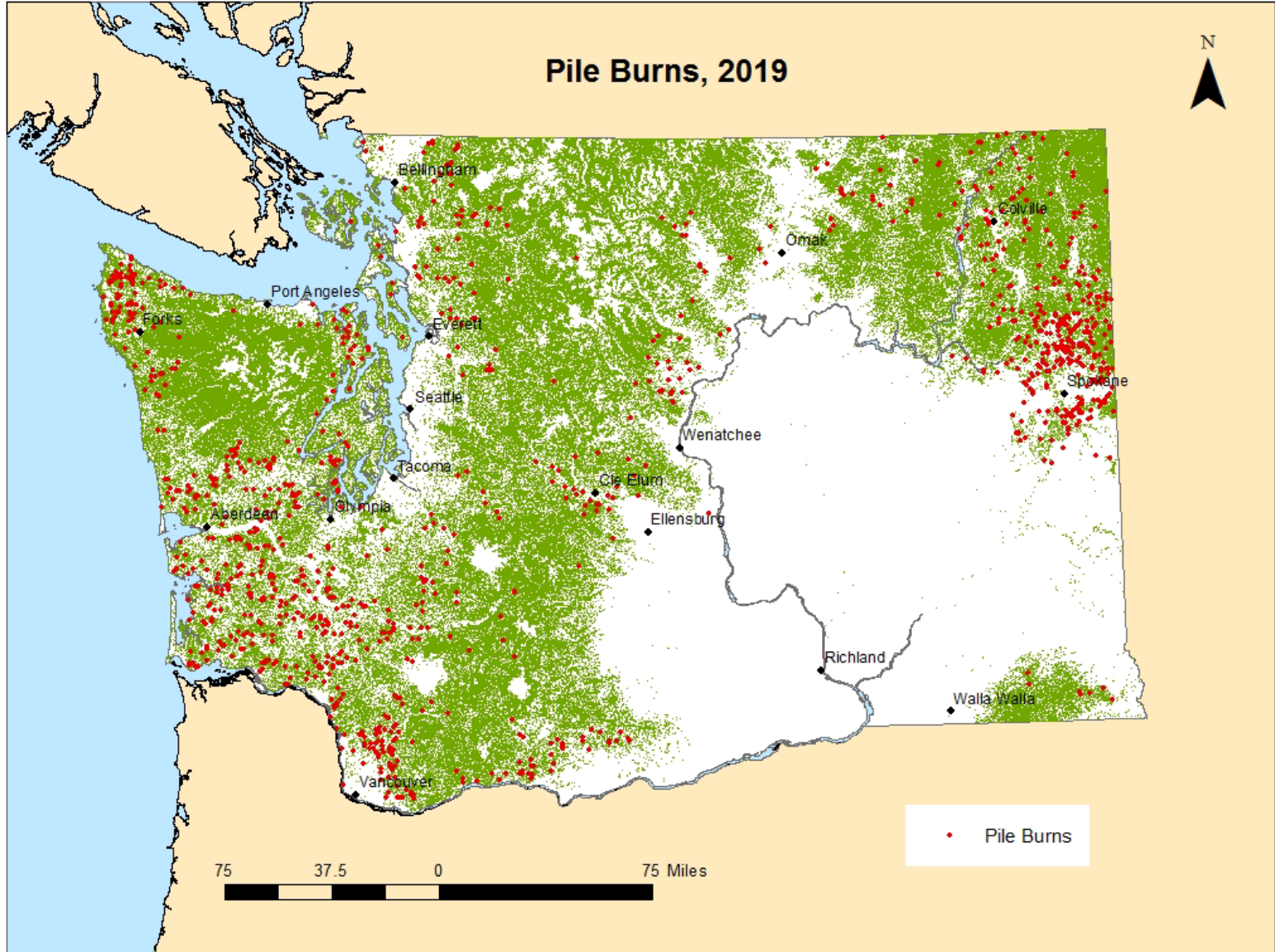


Figure 3. Pile Burns, 2019.

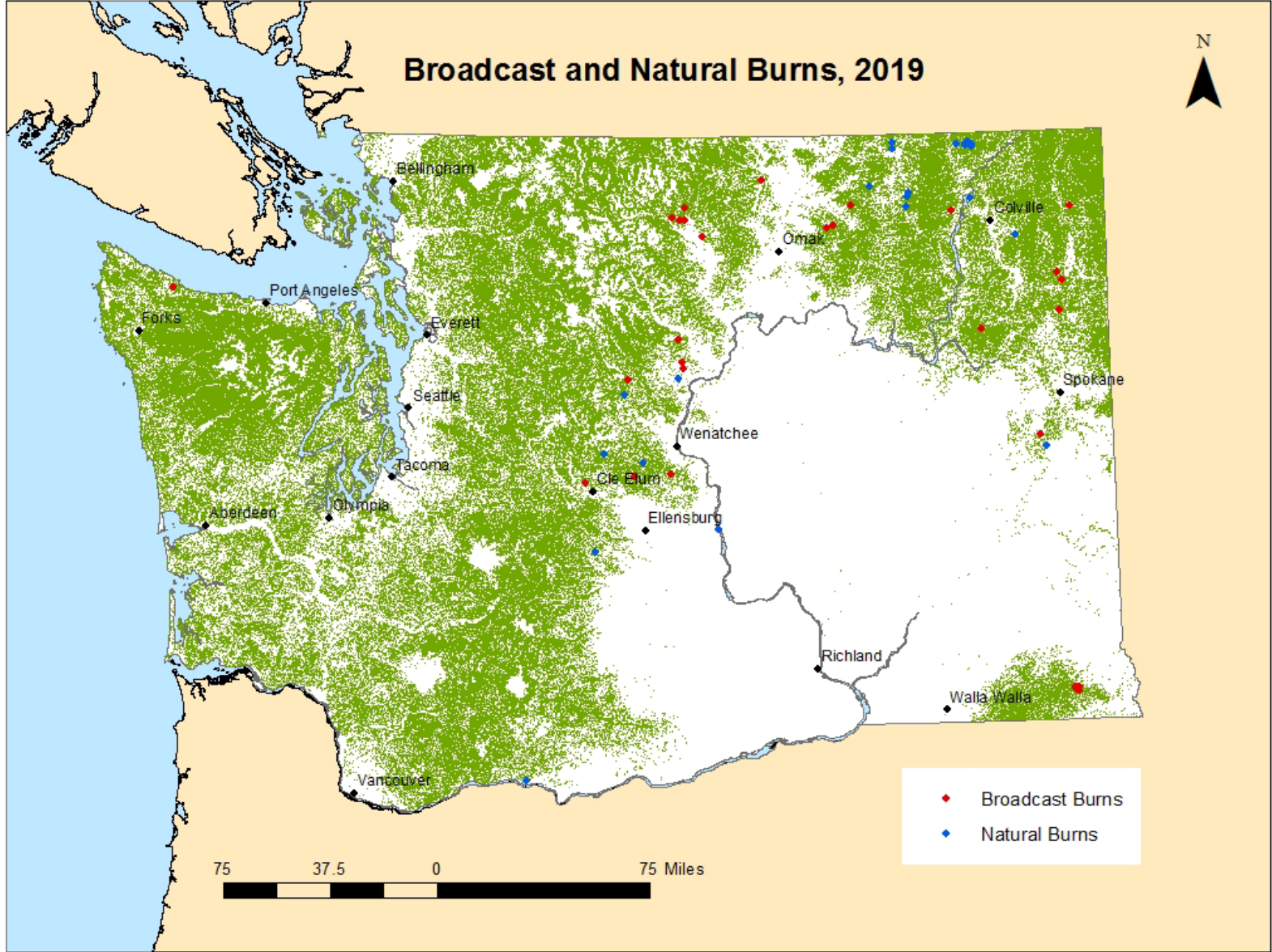


Figure 4. Broadcast and Natural Burns, 2019.

National Ambient Air Quality Standards

The National Ambient Air Quality Standards (NAAQS) are federal health-based standards set to protect public health and the environment. The SMP is designed to prevent smoke impacts and ensure Washington’s communities attain and maintain the standard.

Primary standards set by EPA are based on health research to protect public health; secondary standards protect the public welfare from adverse effects on water, soils, crops, wildlife, animals, property, visibility, etc.¹⁸

Table 1. National Ambient Air Quality Standards, December 2020

Pollutant	Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide (CO)	P	8 hours	9 ppm	Not to be exceeded more than once per year
Carbon Monoxide (CO)	P	1 hour	35 ppm	Not to be exceeded more than once per year
Lead (Pb)	P & S	Rolling 3 month average	0.15 µg/m ³	Not to be exceeded
Nitrogen Dioxide (NO ₂)	P	1 hour	100 ppb	98th percentile of 1-hour daily maximum levels, averaged over 3 years
Nitrogen Dioxide (NO ₂)	P & S	1 year	53 ppb	Annual Mean
Ozone (O ₃)	P & S	8 hours	0.070 ppm	Annual fourth-highest daily maximum 8-hour level, averaged over 3 years
Particle Pollution (PM _{2.5})	P	1 year	12.0 µg/m ³	Annual mean, averaged over 3 years
Particle Pollution (PM _{2.5})	S	1 year	15.0 µg/m ³	Annual mean, averaged over 3 years
Particle Pollution (PM _{2.5})	P & S	24 hours	35 µg/m ³	98th percentile, averaged over 3 years
Particle Pollution (PM ₁₀)	P & S	24 hours	150 µg/m ³	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide (SO ₂)	P	1 hour	75 ppb	99th percentile of 1-hour daily maximum level, averaged over 3 years
Sulfur Dioxide (SO ₂)	S	3 hours	0.5 ppm	Not to be exceeded more than once per year

¹⁸ NAAQS Table, EPA, <https://www.epa.gov/criteria-air-pollutants/naaqs-table>, referenced 2-15-22

Smoke emissions from prescribed burning primarily contribute to particulate matter levels — both PM₁₀ and PM_{2.5} — and secondarily, to ozone levels. The Burn Decision Criteria (Go/No-Go Decision #3) prohibits exceeding the NAAQS. See the **Burn Decision Approval – Criteria and Process** section. In particular, the 24-hour PM_{2.5} intrusion threshold is set at 20.5 µg/m³ to help protect the 24-hour NAAQS for all areas of the state. This provides a margin of safety for the NAAQS.

Washington Compliance with NAAQS

When an area does not meet national air quality standards, the area is classified by EPA as "nonattainment." When an area returns to meeting national air quality standards, we ask EPA to re-classify the area as in attainment and in maintenance.

Washington has one area that was formerly designated a nonattainment area for PM_{2.5} – based on the Tacoma L Street monitor – due to smoke from woodstoves.¹⁹ Monitors recorded consistent values below the particulate matter 2.5 microns or less (PM_{2.5}) 24-hour standard and the U.S. Environmental Protection Agency (EPA) issued a Clean Data Determination in 2012. The EPA re-designated the area to attainment on March 12, 2015.²⁰ As long as this area continues to meet the National Ambient Air Quality Standards (NAAQS), many of the federal Clean Air Act (CAA) requirements are suspended. This area is under the jurisdiction of the Puget Sound Clean Air Agency.

Washington has a number of areas formerly out of compliance with the PM₁₀ standard that are current maintenance areas. These areas all comply with the 24-hour PM₁₀ standard when monitored values for high wind dust events and wildfire impacts are not included in compliance calculations. EPA can potentially exclude exceedances of the NAAQS caused by natural events from the official record, if the events meet the Exceptional Event Rule (EER) criteria. Washington Department of Ecology (Ecology) — with DNR assistance — would need to prepare an exceptional event demonstration and submit it to EPA. Not all events qualify for consideration under the EER and an EER demonstration requires substantial documentation. Washington has recalculated values with wildfire-influenced data removed. Neither Ecology nor EPA removed data from the official record.

All of Washington complies with all NAAQS, after removing wildfire-influenced data, except for SO₂. EPA designated a small portion of Whatcom County as nonattainment in March 2021 and Ecology identified a single facility as the sole cause of the designation. Details of compliance with each NAAQS are discussed below.

Washington Air Quality Advisory

The Washington Air Quality Advisory (WAQA) is similar to EPA's national information tool, the Air Quality Index (AQI). Both use color-coded categories to show when air quality ranges from good to hazardous; WAQA is based on lower levels of fine particle pollution than the federal AQI. See **Figure 5** below.

¹⁹ Tacoma-Pierce County PM_{2.5} Redesignation Request and Maintenance Plan, Ecology publication 14-02-021, 2011 winter day emission inventory, October 2014, pp.23-24

²⁰ 80 FR 7347, Federal Register Notice, March 12, 2015

Color – Category	Index Value	WAQA	AQI
Concentration of fine particles (PM _{2.5}) (µg/m ³)			
● Green – Good	0–50	0–12.0	0–12.0
● Yellow – Moderate	51–100	12.1–20.4	12.1–35.4
● Orange – Unhealthy for Sensitive Groups	101–150	20.5–35.4	35.5–55.4
● Red – Unhealthy	151–200	35.5–80.4	55.5–150.4
● Purple – Very Unhealthy	201–300	80.5–150.4	150.5–250.4
● Dark red – Hazardous	301–500	more than 150.4	250.5–500

Figure 5. 24-hour PM_{2.5} concentrations for WAQA and AQI categories

Under WAQA, 20.5 µg/m³ level is the concentration at which Ecology considers particulate matter levels ‘Unhealthy for Sensitive Groups.’ Children, elders, and persons with respiratory diseases, such as asthma are sensitive groups. DNR has made it their goal to stay below this PM_{2.5} concentration level when making burn decisions and to take action when the data shows it is likely that concentrations will exceed this level, when managing smoke around the state.

Federal Reference Methods (FRM) and Federal Equivalent Methods (FEM) use specified monitors and require the equipment and method to pass rigorous quality assurance and control procedures. Other monitoring equipment such as nephelometers and air sensors, are not official compliance monitors. Design Values (DVs) calculated using these non-regulatory monitors are estimated DVs. DNR will use data from all types of monitoring sites and sensors available to inform smoke management decisions, such as daily burn authorizations, and intrusion management. See the **Burn Decision Approval – Criteria and Process** section, for more information on DNR approval criteria and the **Intrusions** section for information on the planned actions DNR and burners will take to prevent and respond to smoke impacts.

Particulate Matter Standards

Particulate Matter NAAQS include a primary and secondary 24-hour and an annual standard for PM_{2.5} and a 24-hour standard for particulate matter ten microns or less (PM₁₀).

On December 18, 2020²¹, [EPA published their decision to retain](#), without revision, the existing (2012) primary (health-based) and secondary (welfare-based) NAAQS for particulate matter. EPA announced in 2021 that they are reconsidering the PM standard.²² The EPA intends to have a proposal ready in spring 2022, with a final action in summer 2023.

PM_{2.5} 24-hour standard

The 24-hour PM_{2.5} standard is 35 µg/m³, based on the 98th percentile, averaged over three years.

EPA last approved the compliance values (i.e., design values or DVs) for this standard around the state in the [2021 Ambient Monitoring Network Plan](#)²³ on May 1, 2021. Only Federal Reference Methods (FRMs) or Federal Equivalent methods (FEMs) report official compliance values. However, DNR uses all available monitors, including non-regulatory monitors, to inform smoke management activities. Values for 2020 shown in the table below are from the 2021 ANR.

Table 2 shows all 98th percentiles and DVs for the 24-hour PM_{2.5} standard. DVs from nephelometer sites are estimates only and not used to determine compliance with the NAAQS. Ecology estimated the DVs in brackets, which had fewer than three years of available data. All shaded and italicized values are FEM or FRM values. In years with one or more quarters with less than 50 percent complete data, Ecology did not report the 98th percentiles (Appendix 13).²⁴ All areas of the state comply with the PM_{2.5} 24-hour NAAQS, after removing values over 20µg/m³ impacted from wildfires, as shown in the far right column of **Table 2**. Summer wildfires significantly impacted Washington State in the third quarter of the calendar year, in both 2018 and 2020, and to a lesser extent, in 2019.

Ecology may submit to EPA an exceptional event demonstration (a report submitted for events that qualify to remove the exceeding value from compliance calculations) for natural events. Ecology does not develop an exceptional event demonstration for every natural event that causes an exceedance of the standard that might qualify. The federal Exception Events Rule (EER) has specific criteria that qualifies an event and directs when Ecology can submit a demonstration to EPA. Ecology is not seeking to request official removal of wildfire data from the official record.

²¹ See 85 FR 82684, Federal Register notice, December 18, 2020.

<<https://www.federalregister.gov/documents/2020/12/18/2020-27125/review-of-the-national-ambient-air-quality-standards-for-particulate-matter>>

²² EPA to Reexamine Health Standards for Harmful Soot that Previous Administration Left Unchanged | U.S. EPA News Releases | US EPA, dated June 10, 2021, EPA expects to issue a proposed rulemaking in Summer 2022 and a final rule in Spring 2023. <<https://www.epa.gov/newsreleases/epa-reexamine-health-standards-harmful-soot-previous-administration-left-unchanged>>

²³ Table 24, Appendix A, 2021 Ambient Air Annual Network Plan, publication number 21-02-013, June, 2021- <<https://apps.ecology.wa.gov/publications/SummaryPages/2102013.html>>

²⁴ Appendix 13, EPA approves Ecology's 2021 Annual Network Report, Letter from Debra Suzuki, Manager of Air Planning, State and Tribal Coordination Branch to Jill Schulte, Ambient Air Monitoring Coordinator, March 24, 2022.

Table 2. Monitoring site 98th percentile and 24-hour PM2.5 DV with and without wildfire, 2018-2020.²⁵

Site	AQS ID	98th Percentile 2018	98th Percentile 2019	98th Percentile 2020	24-hour DV 2018-2020	24-hour estimated DV 2018-2020 (no wildfire)
Aberdeen Division St	530272002	12.4	NA	27.3	[20]	[11]
<i>Anacortes 202 O Ave</i>	<i>530570011</i>	<i>27.7</i>	<i>12.0</i>	<i>NA</i>	<i>[20]</i>	<i>[13]</i>
Bellevue SE 12th St	530330031	9.2	9.4	68	29	9
<i>Bellingham Pacific St</i>	<i>530730015</i>	<i>24</i>	<i>12.2</i>	<i>42.4</i>	<i>26</i>	<i>12</i>
<i>Bremerton Spruce Ave</i>	<i>530350007</i>	<i>24</i>	<i>11.6</i>	<i>41.42</i>	<i>26</i>	<i>13</i>
Cheeka Peak	530090013	27.4	5.2	48.6	27	6
Chehalis Market Blvd	53-041-0004	28.5	13.7	12.7	18	15
Chelan Woodin Ave	530070007	137.8	12.4	99.1	83	14
Clarkston 13th St	530030004	37.8	22.8	117.5	59	23
Colville E 1st St	530650005	73.3	24.3	65.7	54	21
<i>Darrington Fir St</i>	<i>530610020</i>	<i>41.9</i>	<i>22.8</i>	<i>51.2</i>	<i>39</i>	<i>22</i>
Dayton W Main St	530130002	37.3	15.4	79.2	44	14
<i>Ellensburg Ruby St</i>	<i>530370002</i>	<i>46.5</i>	<i>18.8</i>	<i>50.3</i>	<i>39</i>	<i>18</i>
Kennewick Metaline	530050002	32.6	18.6	76.5	43	17
<i>Kent Central & James</i>	<i>530332004</i>	<i>32.8</i>	<i>17.8</i>	<i>42.2</i>	<i>31</i>	<i>19</i>
<i>Lacey College St</i>	<i>53-067-0013</i>	<i>29.6</i>	<i>18.1</i>	<i>33.2</i>	<i>27</i>	<i>17</i>
LaCrosse Hill St	530750005	38.4	11.8	48.3	33	12
Lake Forest Park	530330024	50.7	18.1	52.7	41	19
Leavenworth Evans St	530070010	60	19.6	57.4	46	17
Longview 30th Ave	530150015	24.8	16.7	63.9	35	15
<i>Marysville 7th Ave</i>	<i>530611007</i>	<i>31.2</i>	<i>28</i>	<i>47.2</i>	<i>35</i>	<i>24</i>
Mesa Peplot Way	530210002	32.5	16	90.3	46	15
Moses Lake Balsam St	530251002	37.3	14.7	50.9	34	15
Mt Vernon S Second St	530570015	14.5	7.6	NA	[11]	[10]
Neah Bay Makah Tribe	530090015	22.2	NA	19.5	[21]	[9]
North Bend North Bend Way	530330017	34.6	12.2	45.9	31	12
<i>Omak Colville Tribe</i>	<i>530470013</i>	<i>93.5</i>	<i>21.3</i>	<i>83.1</i>	<i>66</i>	<i>24</i>
Pomeroy Paraha St	530230001	25.4	12.6	50.1	29	14
Port Angeles E 5th St	530090017	41.9	14.6	30.4	29	16

²⁵ Design Values —official compliance values — from *FRM and FEM monitoring sites are italicized and shaded.*

Site	AQS ID	98th Percentile 2018	98th Percentile 2019	98th Percentile 2020	24-hour DV 2018-2020	24-hour estimated DV 2018-2020 (no wildfire)
Port Townsend San Juan Ave	530310003	28.3	10.1	44.6	28	11
Quincy 3rd Ave NE	530251003	58.4	12.8	66.7	46	14
Ritzville Alder St	530010003	44.3	11.6	81.3	46	12
Rosalia Josephine St	530750006	36	12	20.1	23	13
<i>Seattle 10th & Weller</i>	<i>530330030</i>	<i>35.5</i>	<i>16.5</i>	<i>60.5</i>	<i>38</i>	<i>19</i>
<i>Seattle Beacon Hill</i>	<i>530330080</i>	<i>37</i>	<i>11.9</i>	<i>53</i>	<i>34</i>	<i>14</i>
<i>Seattle Duwamish</i>	<i>530330057</i>	<i>41.7</i>	<i>20.2</i>	<i>46.3</i>	<i>36</i>	<i>19</i>
Seattle South Park	530331011	43.8	16.3	19.1	26	18
Shelton W Franklin	530450007	25.7	14.5	52	31	15
<i>Spokane Augusta Ave</i>	<i>530630021</i>	<i>49.5</i>	<i>25.1</i>	<i>31</i>	<i>35</i>	<i>22</i>
Spokane Monroe St	530630047	51	23.3	23.7	33	20
Sunnyside S 16th St	530770005	62.4	31.3	118.1	71	30
Tacoma Alexander Ave	530530031	35.1	15.3	34.5	29	16
<i>Tacoma L Street</i>	<i>530530029</i>	<i>37.5</i>	<i>27.5</i>	<i>36.8</i>	<i>34</i>	<i>26</i>
<i>Tacoma S 36th St</i>	<i>530530024</i>	<i>29.4</i>	<i>19.2</i>	<i>40.5</i>	<i>30</i>	<i>19</i>
Taholah Quinault Tribe	530270011	25.6	NA	44.4	[35]	[14]
<i>Toppenish Yakama Tribe</i>	<i>530770015</i>	<i>50.4</i>	<i>34.4</i>	<i>90</i>	<i>58</i>	<i>27</i>
Tukwila Allentown	530330069	51.5	16.6	56.5	42	18
Tulalip Totem Beach Rd	530610021	NA	NA	29.5	[30]	[6]
Twisp Glover St	530470009	NA	20.7	51.3	[36]	[18]
<i>Vancouver NE 84th Ave</i>	<i>530110024</i>	<i>30</i>	<i>24.9</i>	<i>147.4</i>	<i>67</i>	<i>22</i>
Walla Walla 12th St	530710005	37.7	16.5	100.1	51	17
Wellpinit Spokane Tribe	530650002	46.5	15.1	42.4	35	13
Wenatchee Fifth St	530070011	90.1	18.6	92.7	67	17
White Swan Yakama Tribe	530770016	51.6	21.9	NA	[37]	[20]
Winthrop Chewuch Rd	530470010	71.7	15.7	56.9	48	16
Yacolt Yacolt Rd	530110022	18.4	17.4	17.3	18	16
<i>Yakima 4th Ave</i>	<i>530770009</i>	<i>47.5</i>	<i>31.8</i>	<i>104.6</i>	<i>61</i>	<i>27</i>

While many sites show DV estimates over the PM_{2.5} NAAQS for 2020, once Ecology removes values influenced by wildfires in 2018, 2019, and 2020, all areas of the state meet the 24-hour PM_{2.5} standards.

Data Influenced by wildfires in 2018, 2019 and 2020

Wildfire smoke episodes were by far the primary factor in NAAQS elevated PM_{2.5} values in 2018, 2019, and 2020.

Ecology calculated values for 24-hour PM_{2.5} using all certified data. Ecology also re-calculated values without wildfire-influenced data that was above Washington's healthy air goal of 20 µg/m³. **Figure 6** shows how many dates Ecology removed due to wildfire influence over the three-year period. Where text and figures note that data was "removed", this term indicates Ecology only excluded that data from calculations of design values without wildfire influence. No monitored values were removed from Ecology's database or EPA's Air Quality System database. Appendices 10 through 12 includes information from the [Washington Smoke Information blog](#)²⁶ for the three-year period from 2018 through 2020.

²⁶ <https://wasmoke.blogspot.com/>

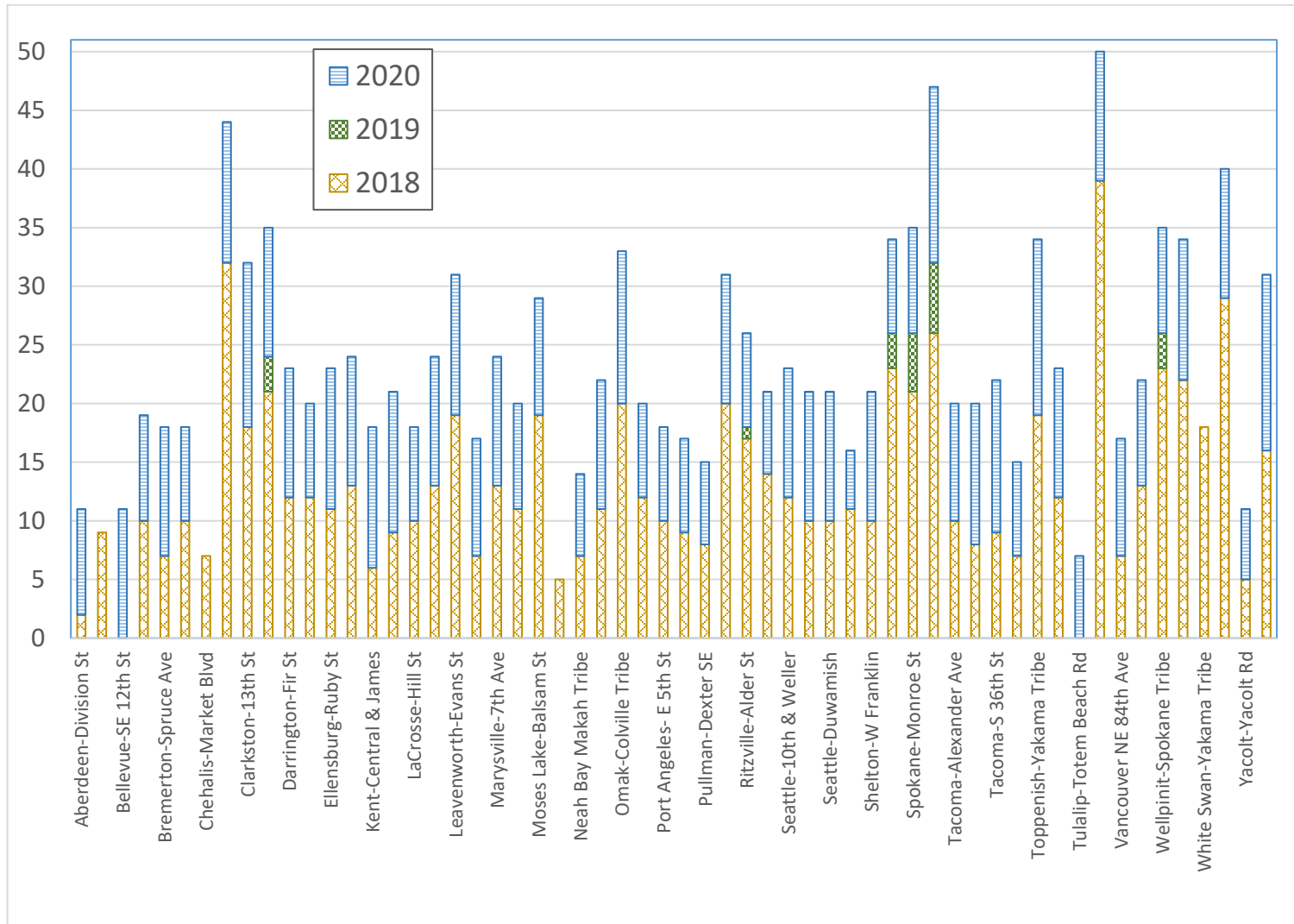


Figure 6. Number of days with wildfire influenced data by location, 2018-2020.

2018 PM_{2.5} data: During August 2018, the State of Washington experienced significant wildfire smoke events, which blanketed the state and contributed to exceedances of PM_{2.5}, PM₁₀ and ozone. The contributing wildfires were from British Columbia (BC), Canada and Washington State.

The impacts from Canada in early August were from multiple fire complexes, as BC was in the midst of its largest wildfire season ever recorded. Seven wildfire complexes in BC that ignited between July 27 and August 8 combined to burn over 2.2 million acres over several weeks: the Tweedsmuir complex fire, Johnny Creek fire, Alkali Lake complex fire, Lutz Creek complex fire, Shovel Lake fire, Nadina Lake fire, and Verdun Mountain fire.²⁷ Several fires in Washington ignited during the same time period, with both lightning and human caused sources, including: the Cougar Creek fire (42k acres), Crescent Mountain fire (148k acres), McLeod fire (25k acres), and others.²⁸

Figure 7 provides an example from August 14, 2018, showing the severity and widespread nature of the wildfire smoke.

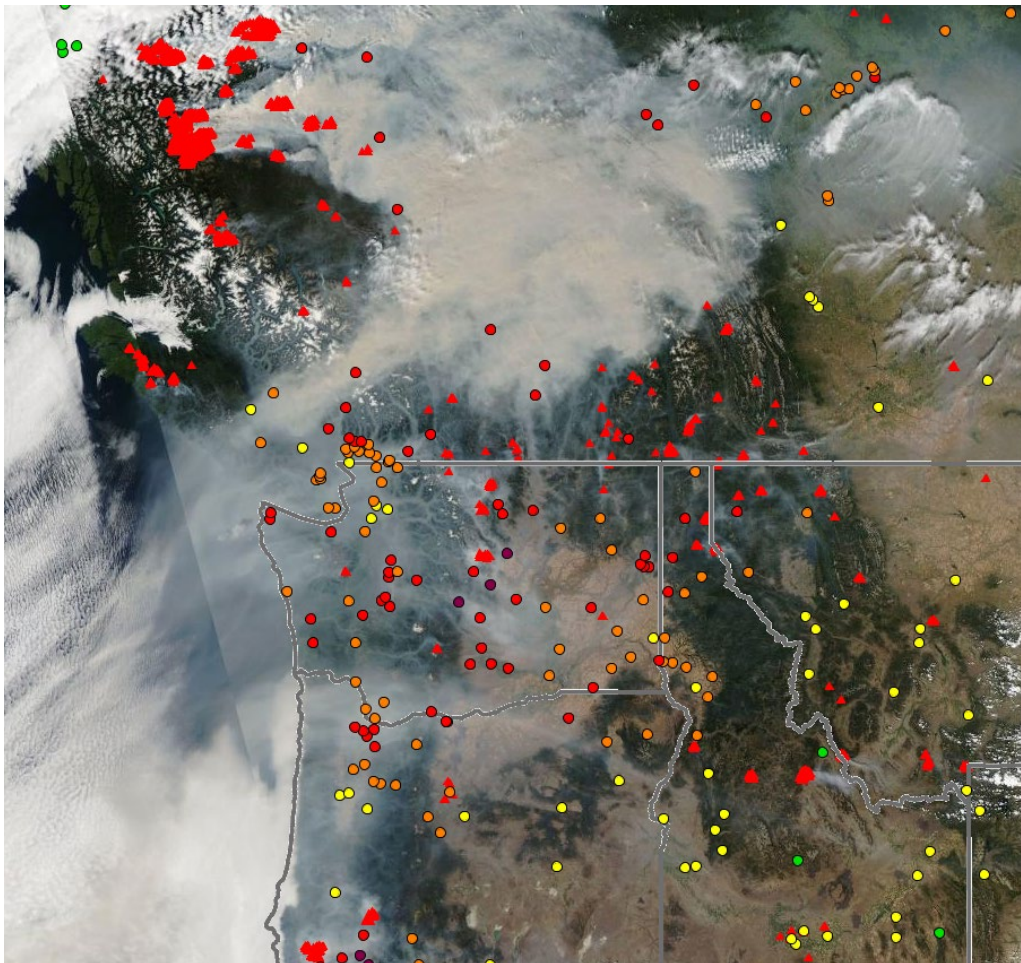


Figure 7. MODIS image of smoke from fires (red triangles) and AQI at PM_{2.5} monitors (circles) in the Pacific Northwest on August 14, 2018 (source: AirNowTech Navigator).

²⁷ The main Canada wildfire names are on this list: https://en.wikipedia.org/wiki/2018_British_Columbia_wildfires, downloaded 5/24/21

²⁸ [Washington Smoke Information: 2018 \(wasmoke.blogspot.com\)](https://wasmoke.blogspot.com/2018/) <<https://wasmoke.blogspot.com/2018/>>

Table 2 shows the monitoring sites impacted across the state mid-August through early September by either Canadian fires or wildfires in the US. 24-hour average concentrations of 20.5 µg/m³ or over were removed prior to calculating the “No Wildfires” columns of the Design Values/estimated DVs listed in **Table 3**.

Table 3. Site names and dates where wildfire- influenced data was removed for PM2.5 in 2018.

Site Name	Wildfire Dates Removed
Aberdeen-Division St	8/13-8/15
Anacortes-202 O Ave	8/13-15, 8/20-8/25
Bellingham-Pacific St	8/13-8/16, 8/20-8/25
Bremerton-Spruce Ave	8/19-8/25
Cheeka Peak	8/13-8/15, 8/17-8/22, 8/24
Chehalis-Market Blvd	8/13-8/15, 8/20-8/22
Chelan-Woodin Ave	7/30-7/31, 8/1-8/20, 8/22-8/26, 9/4-9/7
Clarkston-13th St	8/5-8/10, 8/13-8/14, 8/17-8/26, 9/7
Colville-E 1st St	7/31, 8/2-8/3, 8/7-8/20, 8/22-8/25
Darrington-Fir St	8/13-8/16, 8/19-8/26
Dayton-W Main St	8/7-10, 8/13-8/16, 8/19-8/20, 8/22-8/23
Ellensburg-Ruby St	8/8-8/9, 8/13-8/16, 8/18-8/20, 8/23, 8/25
Kennewick-Metaline	8/7-8/10, 8/13-8/16, 8/19-8/23
Kent-Central & James	8/14-8/15, 8/19-8/22
Lacey-College St	8/13-8/15, 8/19-8/22, 8/24-8/25
LaCrosse-Hill St	8/10, 8/13-8/16, 8/19-8/23
Lake Forest Park Town Center	8/13-8/16, 8/18-8/26
Leavenworth-Evans St	8/8-8/10, 8/12-8/25, 9/5-9/6
Longview-30th Ave	8/13-8/15, 8/19-8/22
Marysville-7th Ave	8/13-8/16, 8/18-8/26
Mesa-Pepiot Way	7/19, 8/8, 8/13-8/16, 8/20-8/23
Moses Lake-Balsam St	8/5-8/9, 8/10, 8/13-8/25
Mt Vernon-S Second St	8/14-8-15, 8/20-8/22
Neah Bay Makah Tribe	8/14-8/15, 8/20-8/22, 8/24-8/25
North Bend-North Bend Way	8/13-8-19, 8/20-8/25
Omak-Colville Tribe	8/9-8/26, 9/6 ,9/7

Site Name	Wildfire Dates Removed
Pomeroy	8/7-8/10, 8/13-8/16, 8/19-8/20, 8/22-8/23
Port Angeles- E 5th St	8/13-8/15, 8/18, 8/20-8/25
Port Townsend-San Juan Ave	8/1-8/15, 8/20-8/25
Pullman-Dexter SE	8/8, 8/13-8/16, 8/19-8/20, 8/23
Quincy-3rd Ave NE	8/5-8/7, 8/9-8/10, 8/13-8/25
Ritzville-Alder St	8/7-8/10, 8/13-8/25
Rosalia-Josephine St	8/8-8/10, 8/13-8/17, 8/19-8/23
Seattle-10th & Weller	8/14-8/16, 8/19-8/25
Seattle-Beacon Hill	8/14-8/15, 8/18-8/25
Seattle-Duwamish	8/14-8/15, 8/19-8/25
Seattle-South Park	8/13-8/16, 8/19-8/25
Shelton-W Franklin	8/13-8/15, 8/19-8/22, 8/24-8/25
Spokane-Augusta Ave	7/27, 8/7-8/11, 8/13-8/26
Spokane-Monroe St	8/7-8/10, 8/12-8/26, 8/30
Sunnyside-S 16th St	7/28-7/31, 8/6-8/10, 8/13-8/25
Tacoma-Alexander Ave	8/13-8/15, 8/19-8/25
Tacoma-L Street	8/14-8/15, 8/19-8/22, 8/24-8/25
Tacoma-S 36th St	8/13-8/15, 8/19-8/22, 8/24-8/25
Taholah-Quinault Tribe	8/14-8/15, 8/18, 8/21-8/22, 8/24-8/25
Toppenish-Yakama Tribe	8/7-8/10, 8/13-8/17, 8/19-8/24, 9/4-9/6
Tukwila Allentown	8/13-8/16, 8/18-8/25
Twisp	7/26-7/31, 8/1-8/26, 8/28-8/30, 9/1-9/2, 9/4-9/7
Wellpinit-Spokane Tribe	8/3-8/4, 8/7-8/26
Wenatchee-Fifth St	7/29, 8/5-8/10, 8/13-8/25, 9/5-9/6
White Swan-Yakama Tribe	8/6-8/10, 8/13-8/23, 8/25
Wenatchee-Fifth St	7/29, 8/5-8/10, 8/13-8/25, 9/5-9/6
White Swan-Yakama Tribe	8/6-8/10, 8/13-8/23, 8/25, 9/6
Winthrop-Chewuch Rd	8/4-8/10, 8/12-8/25
Yacolt-Yacolt Rd	8/14-8/15, 8/20-8/22
Yakima-4th Ave	8/7-8/10, 8/13-8/16, 8/18-8/23, 8/25, 9/6

2019 PM_{2.5} data: Although the State of Washington experienced a relatively mild wildfire season in 2019, there were still days that exceeded the NAAQS in late July and August due to wildfire impacts. The Left Hand fire (3.5k acres), Pipeline fire (6.5k acres), and Kusshi Creek fire (1.1k acres) impacted Sunnyside in late July²⁹; the Williams Flats fire³⁰ (47k acres) impacted the Ritzville and Spokane monitors in early August³¹; the North Mill Creek fire (500 acres) impacted Colville on August 10th.³²

Table 4. Site names and dates where wildfire influenced data was removed for PM_{2.5} in 2019.

Site Name	Wildfire Dates Removed
Colville-E 1st St	8/10
Ritzville-Alder St	8/4
Spokane-Augusta Ave	8/5-8/7,
Spokane-Monroe St	8/3-8/5
Sunnyside-S 16th St	7/26-7/28, 8/4-8/6
Wellpinit-Spokane Tribe	8/2, 8-6, 8/8

2020 PM_{2.5} data: There were nine sites that exceeded the 24-hour PM_{2.5} standard in 2020: Vancouver, Omak, Yakima, Toppenish, Colville, Darrington, Ellensburg, Seattle-10th and Weller, and Seattle-Duwamish. Yakima and Kittitas counties were impacted by wildfire smoke from the Evans Canyon Fire (70k acres) in early September 2020. A few days later, dangerous fire weather coincided with Labor Day weekend, and many fires ignited and/or grew to historic size all across the western US. Wildfires in California, Oregon, and Washington generated massive amounts of smoke, which was followed by a multi-day stagnation event. Western states experienced one of the most massive wildfire smoke events recorded, which blanketed many states in smoke for several days and resulted in many exceedances of PM_{2.5} and PM₁₀.³³ The Whitney fire (125k acres), Cold Springs fire (49k acres), and Pearl Hill fire (220k acres) were the largest contributors from within the state.³⁴ Oregon had several contributing fires, most notable was the Santiam complex (402k acres). California endured its largest wildfires ever recorded including the LNU Lightning complex (363k acres), the North complex (319k acres), the August complex (1M acres), the SCU Lightning complex (397k acres), and many other large fires. Smoke from many of these fires traveled north into Washington and accumulated during the stagnation events. Ecology removed PM_{2.5} values influenced by wildfire over 20.5 µg/m³ in 2020, as shown in **Table 5**.

²⁹ Washington Smoke Information: July 2019 (wasmoke.blogspot.com), <<https://wasmoke.blogspot.com/2019/07/>>

³⁰ Williams Flats Fire Information - InciWeb the Incident Information System (nwcg.gov), <<https://inciweb.nwcg.gov/incident/6493/>>

³¹ Washington Smoke Information: Eastern WA smoke pummeling the funneling point (Spokane) until Thursday, <<https://wasmoke.blogspot.com/2019/08/eastern-wa-smoke-pummeling-funneling.html>>

³² Washington Smoke Information: August 2019 (wasmoke.blogspot.com), Washington Smoke Information: Eastern WA smoke pummeling the funneling point (Spokane) until Thursday <<https://wasmoke.blogspot.com/2019/08/>>

³³ <<https://wasmoke.blogspot.com/2020/>>

³⁴ <https://en.wikipedia.org/wiki/2020_Washington_Labor_Day_fires>

Table 5. Site names and dates where wildfire influenced data was removed PM2.5 in 2020.

Site Name	Wildfire Dates Removed
Aberdeen-Division St	9/8-9/16
Bellevue-SE 12th St	9/8-9/18
Bellingham-Pacific St	9/8, 9/11-9/18
Bremerton-Spruce Ave	9/8-9/18
Cheeka Peak	9/8, 9/11-9/17
Chelan-Woodin Ave	9/7-9/18
Clarkston-13th St	8/25-8/26, 9/2; 9/9-9/18, 9/23
Colville-E 1st St	9/8-9/9;9/11-9/19
Darrington-Fir St	9/8-9/18
Dayton-W Main St	9/11-9/18
Ellensburg-Ruby St	9/4; 9/7; 9/9; 9/10-9/18
Kennewick-Metaline	9/7-9/9
Kent-Central & James	9/7-9/18
Lacey-College St	9/7-9/18
LaCrosse-Hill St	9/11-9/18
Lake Forest Park Town Center	9/8-9/18
Leavenworth-Evans St	9/7-9/18
Longview-30th Ave	9/8-9/17
Marysville-7th Ave	9/8-9/18
Moses Lake-Balsam St	9/9-9/18
Neah Bay Makah Tribe	9/8, 9/11-9/16
North Bend-North Bend Way	9/8-9/9-9/18
Omak-Colville Tribe	9/7-9/19
Pomeroy	9/11-9/14, 9/16-9/19
Port Angeles- E 5th St	9/8, 9/11-9/17
Port Townsend-San Juan Ave	9/8, 9-11-9/17
Pullman-Dexter SE	9/12-9/18
Quincy-3rd Ave NE	9/8-9/18
Ritzville-Alder St	9/11-9/18
Rosalia-Josephine St	9/12-9/18
Seattle-10th & Weller	9/8-9/18
Seattle-Beacon Hill	9/8-9/18
Seattle-Duwamish	9/8-9/18
Seattle-South Park	9/14-9/18
Shelton-W Franklin	9/8-9/18
Spokane-Augusta Ave	9/12-9/19
Spokane-Monroe St	9/11-9/19
Sunnyside-S 16th St	9/2-9/5, 9/7, 9/9-9/18
Tacoma-Alexander Ave	9/7, 9/9, 9/11-9/18

Site Name	Wildfire Dates Removed
Tacoma-L Street	9/7-9/18
Tacoma-S 36th St	8/19, 9/7-9/18
Taholah-Quinault Tribe	9/8-9/16
Toppenish-Yakama Tribe	9/1-9/4, 9/7, 9/9-9/18
Tukwila Allentown	9/8-9/18
Tulalip-Totem Beach Rd	9/11-9/17
Twisp	9/8-9/18
Vancouver NE 84th Ave	9/7, 9/10-9/18
Walla Walla-12th St	9/10-9/18
Wellpinit-Spokane Tribe	9/11-9/19
Wenatchee-Fifth St	9/7-9/18
Winthrop-Chewuch Rd	9/8-9/18
Yacolt-Yacolt Rd	9/7, 9/10-9/14
Yakima-4th Ave	9/1-9/4, 9/7-9/18

PM_{2.5} annual standard

The primary annual standard for PM_{2.5} is 12 µg/m³; the secondary standard is 15 µg/m³, based on the annual mean, averaged over 3 years.

All areas of Washington are below the annual primary and secondary standards in 2020, except for the non-regulatory monitor at Sunnyside. The annual DV for 2020 and the annual means from 2018-2020 for areas above the level of the primary annual standard in any of the three years are shown below in **Table 6**. Only those monitor values shaded or italicized are official compliance values, the others are non-regulatory monitors. DNR uses all monitors for burn decision making and smoke management purposes. All shaded and italicized values in **Table 6** are official FEM or FRM monitors. Annual mean values are shown with fire data from the three-year period, 2018-2020. The last column shows DVs without wildfire data.

Table 6. Primary Annual PM_{2.5} Means for monitoring sites over 12 µg/m³, for at least one of the years 2018-2020

Site	AQS ID	Annual Mean 2018	Annual Mean 2019	Annual Mean 2020	Annual Design Value 2018-2020	Annual Design Value 2018-2020 (no wildfire)
Chelan Woodin Ave	530070007	12.98	4.8	9.70	9.2	4.6
Colville E 1st St	530650005	12.24	8.36	14.6	11.7	8.4
<i>Omak Colville Tribe</i>	<i>530470013</i>	<i>13.41</i>	<i>7.36</i>	<i>15.04</i>	<i>11.9</i>	<i>7.9</i>
Sunnyside S 16th St	530770005	11.92	10.77	15.21	12.6	9.5
<i>Toppenish Yakama</i>	<i>530770015</i>	<i>10.42</i>	<i>9.8</i>	<i>14.12</i>	<i>11.4</i>	<i>8.5</i>
<i>Vancouver NE 84th Ave</i>	<i>530110024</i>	<i>7.35</i>	<i>7.04</i>	<i>13.91</i>	<i>9.4</i>	<i>6.8</i>
<i>Yakima 4th Ave</i>	<i>530770009</i>	<i>10.54</i>	<i>9.24</i>	<i>12.29</i>	<i>10.7</i>	<i>8.4</i>

Ecology excluded wildfire-influenced data that exceeded the state healthy air goal, for informational purposes only. Ecology is not pursuing any exceptional event demonstrations for

PM_{2.5}. Although PM_{2.5} annual official DVs at Omak and Toppenish are near 12 µg/m³, once wildfire-influenced data is informally removed, all areas comply with the PM_{2.5} annual standard.

Due to the intermittent burning at different times of the year for any location, the annual standard will not be greatly influenced by prescribed fires. The 24-hour PM_{2.5} DNR intrusion threshold is set at 20.5 µg/m³ to help protect the NAAQS for all areas. For any given area, smoke impacts could last from a few hours to perhaps eight or more, but most of the intrusion impact hours are below the 24-hour PM_{2.5} NAAQS. Even if an intrusion resulted in an impact of 15-30 µg/m³ in a 24-hour average, overall this does not add up to a large impact on the annual average.

For example, if there are 10 intrusions into an area contributing an additional 20.5 µg/m³ above background per day (a highly unusual situation), the annual average is influenced by 10 days times a 20.5 µg/m³ increase in background divided by 365 days, equals a 0.56 µg/m³ increase. If three intrusions occurred in the same location in one year (unlikely) without exceeding the NAAQS, the resultant increase in annual average would be 3 days of a 35 µg/m³ increase, divided by 365 days, equaling a 0.29 µg/m³ increase.

The result overall is that few prescribed burns are expected to cause intrusions of smoke into an area at all or for more than a few hours, but rarely for a full day or days. Due to the more intermittent nature of the smoke in communities and because of the limited amount of burning under conditions when smoke would possibly enter a community, the annual ambient standard is expected to be impacted to a very minor degree, if at all. The 2022 SMP should, at a minimum, ensure a continuation of this level of protection.

Since the 24-hour PM_{2.5} intrusion threshold is set at 20.5 µg/m³ to help protect the 24-hour NAAQS for all areas of the state, the annual standard should be protected as well.

PM₁₀ Standard

The PM₁₀ NAAQS is 150 µg/m³, based on a 24-hour average, not to be exceeded more than once per year on average over three years. Compliance is determined by estimating the number of exceedances over three years; a value less than or equal to one per year is in compliance with this standard. The PM₁₀ exceedances from 2018-2020 were all due to either wildfires or high wind dust events.

Washington has several at-risk, (i.e., close to the standard) areas for PM₁₀. These are generally areas that were once out of compliance with the PM₁₀ NAAQS, called “maintenance areas.” Former PM₁₀ maintenance areas at risk include Wallula (as measured at Burbank), Spokane, and Yakima. **Table 7** shows the PM₁₀ values with and without wildfire and high wind dust event data. 2020 data is from Ecology’s 2021 Ambient Monitoring Network Plan.³⁵

³⁵ Table 25, Appendix A, Criteria Pollutant Design Values, 2021 Annual Air Network Monitoring Plan, publication number 21-02-013, June, 2021 < <https://apps.ecology.wa.gov/publications/SummaryPages/2102013.html> >

Table 7. Number of PM₁₀ Exceedances, 2018-2020, with and without natural event exceedances

Site	AQS ID	2018 Expected Exceedances	2019 Expected Exceedances	2020 Expected Exceedances	3 year Expected Exceedances	3 year estimate DV, w/o natural events
Burbank Maple St.	530710006	2	0	9.5	3.8	0
Colville E 1st St	530650005	1.2	0	4.3	1.8	0
Kennewick Metaline	530050002	3	0	12.5	5.2	0
Seattle Beacon Hill	530330080	0	0	0	0	0
Spokane Augusta	530630021	2	0	6	2.7	0
Yakima 4th Ave S	530770009	0	0	8.2	2.7	0

There were no exceedances of the PM₁₀ standard for 2019 as seen in the 2020 final DV table, **Table 7** above.

Burbank, Colville, Kennewick, and Spokane exceeded the PM₁₀ standard in 2018 because of wildfires; Kennewick also exceeded the standard due to high wind dust events in April and October. Ecology removed values over 150 µg/m³ for these natural events for informational purposes only. Ecology is not planning to submit Exceptional Event demonstrations, for these exceedances. The 2018 dates and locations are in **Table 8** below. The maximum wind speed for Kennewick for October 2, 2018, was 31.4 mph; For April 27, nearby Pasco airport reported 49 mph gusts.

Table 8. Dates and locations of 2018 PM₁₀ values removed due to natural events

Site Location	Dates Removed (2018)	Natural Event Type
Kennewick	4/27, 10/2	High Wind Dust
Burbank	8/19, 8/20	WF
Colville	8/19	WF
Kennewick	8/19	WF
Spokane	8/19-20	WF

In 2020, wildfires caused PM₁₀ exceedances at Burbank, Colville, Kennewick, Spokane- Augusta Ave, and Yakima. Dates and location for 2020 PM₁₀ exceedances due to September (Labor Day) wildfires or high wind dust events are shown in **Table 9** below. At Kennewick-Metaline, high wind dust events in October exceeded the PM₁₀ 24-hour standard. The recorded maximum wind speeds for those dates are: 10/16/2020 - 32.1 mph, 10/18/2020 - 36.9 mph, and 10/30/2020 - 31.1 mph.

Table 9. Dates and locations of 2020 PM₁₀ values removed due to natural events

Site Name	Dates Removed (2020)	Natural Event Type
Burbank-Maple St	9/7, 9/11-18	WF
Colville-E 1st St	9/12-9/15	WF
Kennewick-Metaline	9/7, 9/11-9/18	WF
Spokane-Augusta Ave	9/12-9/16, 9/18	WF
Yakima-4th Ave S	9/7, 9/13-9/17	WF
Kennewick-Metaline	10/16, 10/18, 10/30	High Wind Dust

While possible, prescribed burning is not expected to impact PM₁₀ levels. Smoke from fires is generally composed of fine particulate matter (PM_{2.5}), except for fallout of ash near fires. Future exceedances of the NAAQS caused by prescribed burning, could qualify for exclusion from the record, if the event meets the EER criteria and there is a regulatory need.

Ozone Standards

In July 2020, EPA proposed to retain the current ozone standards set in 2015. The primary and secondary standards are 0.070 parts per million (ppm), as the fourth-highest daily maximum 8-hour concentration, averaged across three consecutive years. In October 2021, EPA announced their intention to reconsider the 2020 decision to retain the 2015 standard.

All areas in Washington are in compliance with the 8-hour ozone standard. Higher values include exceedances likely due to wildfires. Although wildfires contributed to ozone exceedances in late July and early August of 2018, this data was not removed for official DVs shown below. Wildfires from Canada or the US in July and August 2018 influenced ozone data on the dates below.

Table 10. Sites and Dates where ozone was impacted by wildfires in 2018

Site Name	Dates impacted by wildfires in 2018
Kennewick-S. Clodfleter	7/24, 7/27, 8/16
Enumclaw-Mud Mtn	7/29, 8/8, 8/9, 8/22
North Bend-North Bend Way	7/30
Spokane-Greenbluff	8/16

Only those stations where a 4th Highest Daily Maximum 8-Hour Concentration (D8M) over .70 ppm (0.070 ppb) in one of the last three years are shown below.

Table 11. Ozone 4th highest daily maximum 8-hour concentrations, ppb

Site Name	AQS ID	2018 4th Highest D8M	2019 4th Highest D8M	2020 4th highest D8M	2020 design value
Enumclaw Mud Mtn	530330023	0.077	0.055	0.059	0.063
Kennewick S	530050003	0.073	0.061	0.061	0.065
North Bend North	530330017	0.071	0.053	0.051	0.058
Spokane Greenbluff	530630046	0.072	0.057	0.055	0.061

Prescribed burning is infrequently done during the peak ozone formation season (summer months), because FLMs, such as the United States Forest Service (USFS), National Park Service (NPS), and Bureau of Land Management (BLM) will not ignite at wildfire preparedness level (PL) 4 or higher.³⁶

During the summer, the hot and dry climate of eastern Washington is often at or beyond PL 4. The prescribed fire season generally ends by early to mid-June if the temperatures are cooler and the forest fuels are not too dry, but can end earlier if the forest fuels are dryer. The summer ozone season in Washington is May to September. This is when conditions can develop that are favorable for ozone formation and generally when ozone concentrations could potentially exceed the NAAQS. Ozone levels in the summer do not generally begin to elevate until late June, at the earliest. Higher levels can occur in July and August, when conditions are optimum for ozone generation.

³⁶ Regional and National resource (firefighting crews and aviation assets) availability, weather and lightning forecasts also play a role in setting preparedness levels.

While summer can have periods with ideal smoke dispersing conditions (adequate ventilation, low fuel moistures, and high temperatures), infrequently, stagnant days that do not have good dispersion can occur. Therefore, DNR would not approve burns during the more stagnant days, which are also the meteorological conditions required for the formation of higher ozone levels. In addition, when temperatures are optimum for ozone generation, other factors beyond low fuel moisture and high temperature raise the preparedness level, so burning is not likely to be conducted. Therefore, ozone production due to prescribed burning is not expected to contribute to an exceedance of the ozone NAAQS.

Lifting the summer weekend burning restriction will increase the number of days where burning may be allowed. See the sections on ***Changes from 1998 Plan***, the ***Analysis for Removal of Summer Weekend Burning Restriction*** or the ***Visibility Protection and Regional Haze Program***. With this restriction lifted, additional weekend days, where smoke dispersion is favorable, can be available for burning. The conditions favorable to good smoke dispersion do not occur on stagnant days and are therefore not favorable to the formation of higher ozone levels.

Lead (Pb)

The primary and secondary Pb standards are 0.15 micrograms (or 150 nanograms) per cubic meter Pb in total suspended particles as a 3-month average set in 2008.³⁷ On September 16, 2016, EPA decided to retain the existing 2008 standards. In April 2020, EPA proposed to maintain the Pb standard without changes.

In 2016, EPA discontinued the requirement for ambient lead monitoring at national multipollutant monitoring network (NCore) sites to compare against the NAAQS. The only Pb sites required for NAAQS compliance are source-oriented monitoring sites, which are sites near sources that emit at least 0.5 tons of Pb per year. Washington has one source that qualified for source-oriented monitoring, but an EPA waiver was granted in April 2019. Ecology continues to report measurements of lead in PM₁₀ at Seattle-Beacon Hill through the National Air Toxics Trend Station (NATTS) program, but these measurements are not used to demonstrate compliance with the NAAQS.

Lead is not expected to be a concern from prescribed burning since the level in wood and woody debris is low, and is a product of uptake from soil, consisting of only minute trace amounts. Additionally, the daily smoke management analysis that DNR conducts on large burns works to prevent smoke from intruding into populated areas, and the activity being intermittent in general.

Carbon Monoxide (CO)

The NAAQS for CO is 9 ppm in an 8-hour period, and 35 ppm in a 1-hour period, neither standard is to be exceeded more than once a year. Therefore, compliance is based on the second maximum 8-hour average concentrations. All Washington sites measuring CO show design values of zero for 2020. Most the CO monitors in Washington have been removed; Due to tighter emission standards for motor vehicles and low levels of CO, there is no need for a large CO monitoring network. By 2004, all areas of Washington met the national CO standards. There has not been an exceedance of these standards since before 2000.

CO is measured at a remote area, Cheeka Peak, and in two urban sites in Seattle— 10th and Weller and Beacon Hill. The Seattle 10th and Weller near-road site is designed to measure CO from traffic; Cheeka Peak and Seattle-Beacon Hill represent rural background and urban conditions, respectively.

While fires do produce a mixture of gases, including carbon dioxide, methane, and CO, prescribed fires are not expected to contribute to ambient concentrations any where near CO NAAQS levels. While carbon monoxide is the most abundant criteria air pollutant emitted from fires, any elevated CO levels would likely only be found in the immediate burn area. D.V. Sandbert, et. al,(1) found that, unlike urban fires in a closed fire environment, “..., open burning

³⁷ <https://www.epa.gov/pm-pollution/proposal-retain-national-ambient-air-quality-standards-particulate-matter-pm>

CO concentrations drop rapidly from approximately 200 ppm very near the fire line to less than 10 ppm within 30 meters of the fire line.”³⁸

Ambient air is considered any area where the public may have access. While prescribed fire practitioners could be within 10 meters of the fire, they are covered by industrial safety regulations, which are different from the ambient air standards.

CO is very reactive and dissipates quickly. Since prescribed fire is not ignited on the same unit more than once per year, this temporal and spatial distribution ensures that no one area will likely experience elevated levels of CO in the same place in the same year. Therefore, exceedances of the CO NAAQS are not expected.

Nitrogen Oxides (NO_x)

The primary NAAQS for nitrogen dioxide (NO₂) is a 1-hour standard of 100 ppb based on the 3-year average of 98th percentile of the yearly distribution of 1-hour daily maximum concentrations, and an annual primary and secondary standard set at an annual mean of 53 ppb (0.053 ppm). In 2012, EPA decided to retain the current secondary NAAQS for NO₂.

Vehicular emissions are largely responsible for NO_x (NO and NO₂) measured at three monitoring sites in Washington. Two sites in Seattle (10th and Weller and Beacon Hill) and the third in Tacoma S 36th street location all report values below the 1-hour and the annual standards.³⁹

Table 12. Nitrogen dioxide (NO₂) 2020 design values (ppb)

Site	AQS ID	2018 98 th Percentile	2019 98 th Percentile	2020 98 th Percentile	2020 Design Value
Seattle 10 th & Weller	530330030	63.7	57.2	56.8	59
Seattle Beacon Hill	530330080	44.5	42.8	39.4	42
Tacoma S 36 th	530530024	46.4	40.3	39.8	42

NO_x emissions from prescribed burning vary by vegetation and burn practices, but measured concentrations of NO₂ are not normally a concern for exceeding the NAAQS. NO_x are short-lived compounds that react quickly in the atmosphere and are generally only considered problematic as an ozone precursor. As discussed previously, prescribed burning in Washington is not likely to occur at high volume when conditions for ozone production are present.

³⁸ Air Pollution Control Association, For Presentation at the 76th Annual Meeting of the Air Pollution Control Association Atlanta, Georgia, June 19-24,1983, 83-451, page 12, footnote 11, (D. V. Sandberg, J. M. Pierovich, D. G. Fox [and others], "Effects of fire on air," Forest Service General Technical Report WO-9, U. S. Department of Agriculture, Washington, DC, 40 pp. (January 1979).)", <mcmahon_1983.pdf (frames.gov), <https://www.frames.gov/documents/smoke/serdp/mcmahon_1983.pdf>

³⁹ Table 21, Appendix A, Criteria Pollutant Design Values, 2021 Annual Air Network Monitoring Plan, publication number 21-02-013, June, 2021< <https://apps.ecology.wa.gov/publications/SummaryPages/2102013.html>>

Sulfur Oxides (SO₂)

The primary NAAQS for the sulfur dioxide (SO₂) standard, established in 2010 and retained in 2019 is 75 ppb. Compliance is based on the 3-year average of the 99th percentile of the yearly distribution of 1-hour daily maximum concentrations. In 2012, EPA retained the current secondary NAAQS for SO₂. The secondary SO₂ standard is 500 ppb averaged over three hours, not to be exceeded more than once per year.⁴⁰

Table 13. Sulfur Dioxide (SO₂) 2020 design values (ppb)

Site	AQS ID	2018 99 th Percentile	2019 99 th Percentile	2020 99 th Percentile	2020 Design Value
Anacortes 202 Ave	530570011	2.4	3.4	NA	NA
Cheeka Peak	530090013	1	1	1	1
Ferndale-Kickerville Rd	530730013	73.7	69.6	59	68
Ferndale-Mountain View Rd	530730017	101.3	104.5	62	89
Malaga-Malaga Hwy	530070012	1.2	1.0	2	1
Seattle-Beacon Hill	530730013	8	6	4	6

One small area in Washington is in violation of the 2010 1-hour SO₂ standard; the rest of the state meets it. EPA designated a small portion of Whatcom County as nonattainment in March 2021.⁴¹ This nonattainment area encompasses an aluminum smelter facility and the area immediately adjacent to this facility. No other sources of emissions, including prescribed fires, were identified as contributing factors. Ecology concluded that the aluminum smelter is the sole cause of the violation. This is supported by the air dispersion modeling performed in 2020 by Ecology, which looked at all of the potential contributors to the exceedance at the violating SO₂ monitor. Ecology provided the technical information for this assessment to EPA, who then designated only the area around this smelter as in nonattainment. For more information, see Ecology's web page [Sulfur Dioxide in Washington's Air](#).⁴²

While the area near the smelter is predominantly industrial, some prescribed burning may occur. SO₂ is not expected to be a challenge from prescribed burning due to the low level of sulfur in wood and woody debris. SO₂ can only form if sulfur is present in the fuel; little or no sulfur in the fuel leads to little or no SO₂ emitted.

In conclusion, the 2022 SMP includes planning activities and forecasting that is intended to protect air sheds and keep levels below the NAAQS, and requires corrective action when intrusions occur. The program has been and will remain protective of the NAAQS for Washington communities into the future. See the Intrusions section for more detail.

⁴⁰ Table 23, Appendix A, Criteria Pollutant Design Values, 2021 Annual Air Network Monitoring Plan, publication number 21-02-013, June, 2021 < <https://apps.ecology.wa.gov/publications/SummaryPages/2102013.html> >

⁴¹ Federal Register 86 FR 16055, Air Quality Designations for the 2010 Primary Sulfur Dioxide (SO₂) National Ambient Air Quality Standard—Round 4, < <https://www.govinfo.gov/content/pkg/FR-2021-03-26/pdf/2021-05397.pdf> >

⁴² <<https://ecology.wa.gov/Air-Climate/Air-quality/Air-quality-targets/Air-quality-standards/Sulfur-dioxide>>

Visibility Protection and Regional Haze

Purpose

This chapter describes how the objectives and provisions of the 2022 SMP continue to protect visibility and minimize regional haze in mandatory Class I Areas in Washington and nearby states. Class I Areas include national parks larger than 6,000 acres and national wilderness areas larger than 5,000 acres that were in existence in 1977.

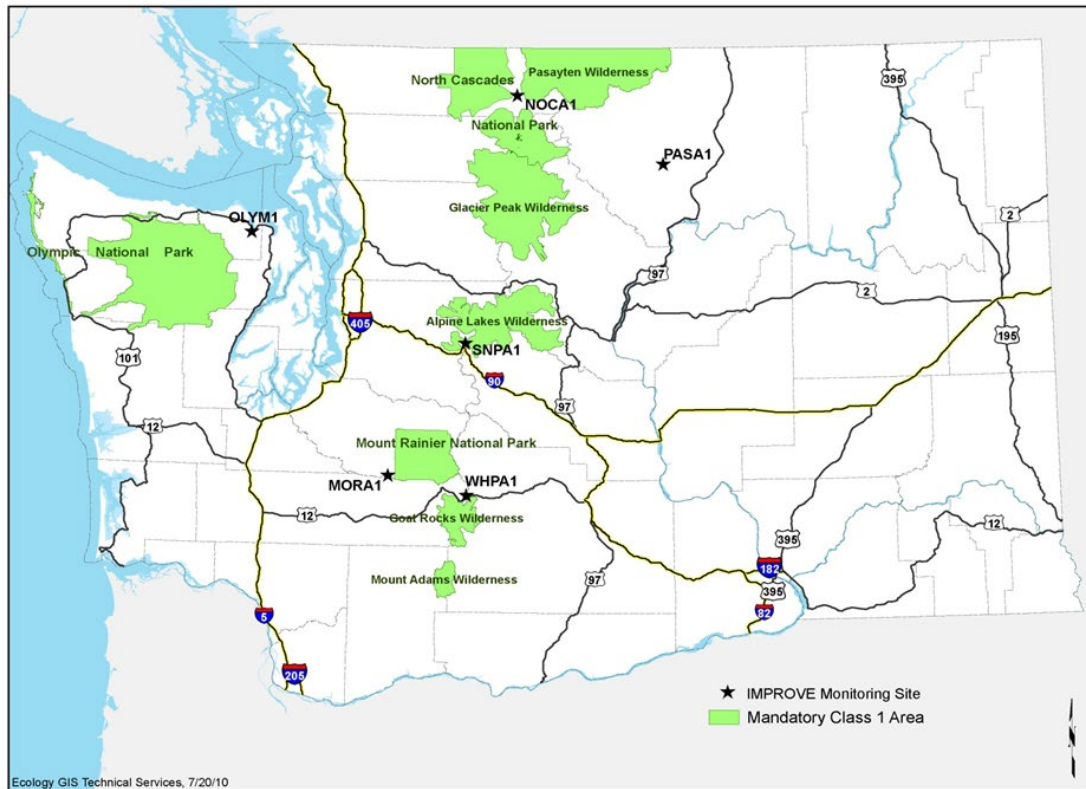


Figure 8. Mandatory Class 1 Areas and IMPROVE Monitoring Sites

Below, we evaluate whether the proposed changes to the SMP affect the level of visibility protection in the Class I Areas. We demonstrate that the proposed changes to the SMP and modernization of the processes continue to meet the visibility protection requirements as required by the federal Clean Air Act and Regional Haze Rule (RHR).

Washington's Class I Areas

Class I Areas are managed by the NPS, U.S. Fish and Wildlife Service (USFWS), U.S. Forest Service (USFS), the BLM and several Native American Tribes. In Washington, three national parks and five wilderness areas are classified as Class I Areas. They total more than 3.3 million acres of land, and include:

- Alpine Lakes Wilderness
- Glacier Peak Wilderness
- Goat Rocks Wilderness
- Mt. Adams Wilderness
- Mt. Rainier National Park
- North Cascades National Park
- Olympic National Park
- Pasayten Wilderness

Washington has six interagency monitoring of protected visual environments (IMPROVE) sites that track pollutants affecting visibility in Washington’s eight Class I Areas. Table 14. provides general information on the six IMPROVE sites. The IMPROVE sites are managed by federal agencies including the NPS, USFWS, USFS and BLM.

Table 14. IMPROVE monitoring sites.

Site Name	Site Abbreviation	Site Sponsor	Monitored Mandatory Class I Area
Olympic	OLYM1	USDI-NPS	Olympic National Park
North Cascades	NOCA1	USDI-NPS	North Cascades National Park & Glacier Peak Wilderness
Snoqualmie Pass	SNPA1	USDA-USFS	Alpine Lakes Wilderness
Mount Rainier	MORA1	USDI-NPS	Mount Rainier National Park
White Pass	WHPA1	USDA-USFS	Goat Rocks Wilderness & Mt. Adams Wilderness
Pasayten	PASA1	USDA-USFS	Pasayten Wilderness

What is Regional Haze?

Smoke from silvicultural burning can form a plume blight and is one of the contributors to formation of regional haze – a form of air pollution that degrades visibility. Hazy conditions occur when sunlight strikes pollution particles in the air. This affects the clarity and color of the view, as well as how far we can see in our nation’s parks and wilderness areas.

The particles that cause haze come from both natural and human-caused sources. Natural sources include windblown dust and soot from wildfires or other burning. Human-caused sources include motor vehicles, electric utilities, industrial fuel burning, and manufacturing. Haze from these sources can come from thousands of miles away. Some sources emit particles that cause haze directly to the air. Haze can also form from gases, such as sulfur dioxide and nitrogen dioxide that can be carried far from their original source. This is why haze often forms in locations where there are no major sources of air pollution nearby.

Regional Haze Laws and Rules

The U.S. Congress, concerned with haze and plume blights obscuring national scenic vistas, amended the CAA in 1977 to add a national visibility goal to prevent any future— and remedy

any existing— visibility impairment in the mandatory Class I Areas. “Impairment” specifically refers to human caused air pollution.⁴³

These amendments included provisions to protect scenic vistas in certain Class I Areas. In these amendments, Congress declared the following national visibility goal:

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

In 1980, the EPA finalized Reasonably Attributable Visibility Impairment (RAVI) regulations to address visibility impairment attributed to a single source or small groups of sources.

In 1999, the EPA promulgated the RHR to address the effects that a large and geographically dispersed set of sources has on visibility in downwind areas, where no single source can be identified as predominately responsible. These emissions often mix and transport over long distances. The RHR called for states to establish goals and emission reduction strategies for improving visibility in Federal Class I Areas.

The objectives of the RHR are:

1. Improve existing visibility in Class I Areas,
2. Prevent future impairment of visibility by man-made sources, and
3. Meet the national goal of natural visibility conditions in all 156 Class I Areas by 2064.

The 1999 RHR required states to consider all types of anthropogenic sources of visibility impairment when developing their long-term strategies, including major and minor stationary sources, mobile sources, and area sources. It further requires states to consider a number of factors when developing their long-term strategies, including smoke management techniques for agricultural and forestry management purposes (40 CFR 51.308(d)(3)(v)). Consequently, regional haze planning must address silvicultural smoke if it contributes to visibility impairment in in the state’s Class I Areas.

The RHR set ten-year planning periods extending from 2005-2064 and required an RH SIP for each period. States must develop strategies to make “reasonable progress” toward meeting the visibility goals in the federal Class I Areas. The RH SIP must provide for improvement of visibility on the 20 percent most impaired days (MID). It also must prevent degradation of existing visibility on the 20 percent clearest days. The RH SIP must also address Class I Areas outside of the state that Washington emissions can potentially impact.

EPA updated the RHR in 2017 to clarify requirements for submitting RH SIPs and progress reports.

⁴³ For more information visit EPA’s website, <<https://www.epa.gov/visibility>>.

Washington's Regional Haze Program

Following the 1977 amendments to the CAA addressing visibility impairment in scenic national parks and wilderness areas, EPA required states to make reasonable progress toward visibility goals. States were required to identify and incorporate into the SIP methods by which they would protect visibility. WA included a smoke management plan as part of the SIP updates required by EPA's visibility protection program. As described in the 2003 Federal Register Notice (40 CFR 52.2470, Containing a codification of documents of general applicability and future effect as of July 1, 2003), the first submittals of the Washington Smoke Management Plan to EPA took place on April 27, 1979, and January 5, 1984, with subsequent revisions as the state updated the SMP. The most current version of the SMP in the SIP is from 1998.

Washington chose to address plumes from silvicultural smoke proactively. Specifically, Ecology coordinated with DNR to update visibility protections in the 1998 SMP. Ecology submitted a RAVI SIP —that included the 1998 SMP —that focused on silvicultural smoke management in addition to other sources that affect haze. Ecology submitted the 1999 RAVI SIP (i.e., Visibility SIP) to EPA on November 5, 1999; EPA approved it June 11, 2003.⁴⁴

In 2010, Ecology developed the RH SIP to identify key sources of air pollution and define a strategy to improve visibility in Washington's Class I Areas. Washington's 2010 RH SIP relies on smoke management as a way to protect visibility. The analysis provided in this document (see Appendix 2, Summer Weekend Burning) demonstrates that removing the restriction on summer weekend burning in the SMP will not negatively impact visibility in Washington's Class 1 Areas. DNR removed this restriction in the 2022 SMP. Based on this analysis, this prohibition is no longer relied upon to meet regional haze goals.

Ecology developed a revision to the 2010 RH SIP that covers 2018–2028. Ecology submitted this plan to EPA on January 28, 2022. For information on Washington's Regional Haze program, visit [Ecology's Regional Haze website](#).⁴⁵

See the final Regional Haze plan, [State Implementation Plan Revision: Second Regional Haze Plan \(2018 – 2028\)](#), at Ecology's publication library.⁴⁶

⁴⁴ Final: Federal Register Notice, 68 FR 34821, June 11, 2003. <https://www.govinfo.gov/content/pkg/FR-2003-06-11/pdf/03-14573.pdf#page=1>; proposal: Federal Register Notice, 67 FR 65077, October 23, 2002, <<https://www.govinfo.gov/content/pkg/FR-2002-10-23/pdf/02-26992.pdf>>

⁴⁵ <https://ecology.wa.gov/Air-Climate/Air-quality/Air-quality-targets/Regional-haze>. See the final Regional Haze plan at <https://apps.ecology.wa.gov/publications/SummaryPages/2202005.html>, published January 2022.

⁴⁶< <https://apps.ecology.wa.gov/publications/SummaryPages/2202005.html>>

Minimizing Smoke Impacts to Class I Areas

The visibility protection section of the 1998 SMP was created in 1985 after consultation with DNR, USFS, private landowners, Ecology, and other stakeholders. The 1998 SMP visibility protection section specified:

- Emission reduction goals.
- Expanded visibility protection period (i.e., prohibition of summer weekend burning).
- A program for conducting forest health burning while maintaining enhanced visibility protection.

Appendix 4 compares the visibility provisions in the 1998 SMP and 2022 SMP. Overall, visibility protection measures in the 2022 SMP are similar to those in the 1998 SMP, and include:

- Maintaining particulate emissions below mandatory emission reductions levels described in the SMP and the WCAA. Restricting burning during poor air quality days, which are also the days that have generally poor visibility conditions.
- Requiring a mandatory "call-in" before igniting burns of less than 100 tons (or 300 tons in low risk areas).⁴⁷
- Promoting alternative methods of debris disposal to reduce the need to burn forest debris.
- Promoting "pile-burning" and other best management practices to increase combustion efficiency resulting in reduction in visible. (See the Best Burn Practices, Tools, and Alternative to Burning and Emissions Reduction Techniques sections of this document.)

When prescribed burning is conducted inside a Class I Area, the SMP objective is to use best practices that vent the main smoke plume up and out of the Class I Area and minimize residual smoke.

When prescribed burning is conducted outside any Class I Area, an objective of the SMP is to minimize any smoke that impairs visibility inside the Class I Area. In addition to compliance with smoke management instructions issued in the daily forecast and compliance with all conditions of the burn permit, burn bosses, field administrators, and onsite personnel are instructed by DNR regional staff, to closely observe local conditions at the burn site to avoid the main smoke plume entering a Class I Area at ground level. Other more protective approval criteria for large burns and all burns within UGAs will also minimize impacts to Class I areas.

DNR is submitting the 2022 SMP with the summer weekend burning restriction removed. The next section will describe the technical analysis conducted to demonstrate that the removal of the summer weekend burning restrictions, with the other protections inherent in the burning approval criteria, will not adversely affect visibility in Class I Areas or hinder Washington's progress toward RH goals.

⁴⁷ To check if there are any burn restrictions in place.

Technical Analysis Summary: Summer Weekend Burning

DNR conducted a technical analysis to assess removing the summer weekend burning restriction. See the Technical Analysis, Summer Weekend Burning (Appendix 2).

The technical analysis quantified possible increases in burning due to lifting the summer weekend burning restriction. Note that this prohibition only applied to large burns, which are subject to air quality considerations under the approval criteria. The analysis shows a maximum of 44 additional days during which burning may be allowed. However, the actual expected number of additional days is likely much less due to conditions that preclude ignition of silvicultural burns. These include days with high fire danger, days when an air quality curtailment has been called by air agencies (likely due to wildfire impacts during the summer), or days when resources are not available or are otherwise committed (for example, fire crews are deployed elsewhere).

DNR smoke management experts interpret meteorological and modeling data, evaluate local topography, and anticipate whether adverse effects are likely to develop. If the DNR decision maker, based on observations, skills and experience, sees that conditions that could affect Class I Areas are likely to develop, the decision maker denies the burn request or alters the permit conditions to reduce haze, such as approving a smaller tonnage. DNR will follow the same procedures for any burns on these newly available days and take the same care to anticipate and prevent impacts to the Class I Areas as they do during the rest of the year.

Protecting Visibility When making Go/No-Go decisions

DNR Smoke Management Program experts consider both how much smoke will be generated and where it will go. This protects both NAAQS and visibility impacts to Class I Areas. The tools DNR uses to assess impacts, include:

Approval criteria: The decision making criteria that provide protections regarding air quality standards (NAAQS) also provide visibility protection and result in DNR disallowing any burns that would impact visibility. (42 U.S.C. 7470)

Training: The trained expert staff of the DNR Smoke Management Program burn center do not grant burn authorization if they determine that wind forecast would bring the smoke from a prescribed burn directly into the Class I Area.

Forecasting Tools: Sophisticated software tools used in the approval process provide information regarding whether a burn will impact Class I Areas.

Interstate Impacts: Approval criteria protections regarding air quality standards offer sufficient visibility protection and result in DNR disallowing any burns that would impact visibility in neighboring states.

DNR will deny burn approval if:

- Ignition will violate any other state or federal air quality regulations, laws, or rules.⁴⁸

⁴⁸ RCW 70A.15.5140, RCW 70A.15.2510, RCW 70A.15.5020

- Burning will not protect the public welfare, *preserve visibility*, protect scenic, aesthetic, historic, and cultural values, and prevent air pollution problems that interfere with the enjoyment of life, property, or cultural attractions.⁴⁹
- Burning will not comply with the SIP of the federal Clean Air Act regarding visibility protection of federal Class I Areas (42 USC 7470).

Large burns that will consume 100 tons (300 tons in low risk areas) or more of material require a site-specific DNR Smoke Management decision. DNR decision makers will use the same procedure/tools/best practices used to approve burns in potential days of additional burning that will be allowed in the summer. The burn decision makers will assess whether smoke will enter Class I Areas, in the same way they check to see if smoke will affect designated areas.

DNR will continue to use the criteria in law (the eight Go/No-Go criteria) and their knowledge of meteorology, topography and locations of the Class I Areas, to assess the impacts from burns to these areas on the newly available (44 days max) days.

⁴⁹ RCW 70A.15.1005

Monitors and Sensors

DNR staffers use a variety of monitoring tools and real-time sensor data to make their burning decisions. There are several permanent networks available, as well as portable, temporary monitors that may be deployed. The resources available in and to Washington are:

- Ecology's Ambient Air Quality Network: fixed network for informing current air quality status, including compliance with NAAQS standards (See the National Ambient Air Quality Standards (NAAQS) section of this document).
- Ecology has eight solar-powered emergency monitors for wildfire season only.
- NPS Regional Haze network: Washington has six IMPROVE monitors that represent eight Class I Federal Areas.
- Low cost public air quality monitoring networks (for example, PurpleAir sensors⁵⁰).
- Various other monitoring networks (for example, Remote Automated Weather Stations (RAWS)).
- DNR has four portable PM_{2.5} monitoring sensors attached to portable weather stations that can be deployed anywhere in the state by request. DNR also has five portable air quality monitors (nephelometers) that can be deployed to keep track of smoke. These can be identified during permitting and required by DNR or requested by burn bosses separately.
- FLMs have portable temporary monitors that can be deployed on request. USFS has 35 monitors that can be deployed for specific burns.

Locations of monitors and sensors

State Ambient Air Quality Network

Ecology operates, with assistance from LCAAs, an ambient air monitoring network. This network includes FRM and FEM monitors, used to determine compliance with NAAQS, as well as other types of monitors.

In addition to its network of criteria pollutant monitoring sites, Ecology also uses nephelometers throughout Washington to estimate PM_{2.5} concentrations and inform the public of air quality conditions in communities where criteria pollutant monitoring is not required. At nephelometer sites where PM_{2.5} concentrations are consistently measured at or greater than 80 percent of the NAAQS, Ecology transitions to FEM monitoring. [Washington's Air Monitoring Network](#)⁵¹ website, operated by Ecology, provides current information about the network. In addition, Ecology has eight solar-powered Clarity Node[®] monitors for emergency wildfire deployment only.

⁵⁰ <https://www2.purpleair.com/>

⁵¹ <https://enviwa.ecology.wa.gov/home/map>

Low Cost Air Quality Sensor networks

Interest in local air quality has grown in recent years. At the same time, there has been an increase in the use and popularity of low cost air quality sensors. This, in turn, has increased the amount of information available to the general public and burn decision personnel.

DNR and other decisions makers may choose to consult this information. However, these devices do not meet the requirements for official federal monitors used for measuring air quality to compare to the NAAQS. EPA will not use this data to make regulatory decisions.

EPA has been tracking the availability and accuracy of these devices.⁵² Ecology also tested and compared various sensors.⁵³ Ecology estimates there are several hundred of these sensors placed around the state.

Although networks consisting of low cost monitors provide useful information to burn bosses and decision makers, these sensors are not as accurate or robust nor do they have the level of quality control as the FRMs or FEMs air quality agencies use. Their primary utility is in tracking trends in air quality and using them as a supplement to, rather than substitute for, more robust and quality assured federal and state monitors.

Other Networks – Remote Automated Weather Stations – DNR

RAWS play a critical role in determining fire weather conditions, establishing fire danger ratings, predicting fire behavior, forecasting by the National Weather Service for spot weather forecasts, resource prepositioning and response, climate trending, atmospheric modeling, air quality measurements, and forest health assessments. Most importantly, these stations are useful for revealing rapidly changing atmospheric conditions that may threaten firefighter and public safety. Depending on the station type, observations of temperature, humidity, precipitation, wind, and solar radiation are recorded either during fire season or year-round. This data is then warehoused at a national level via satellite communication and used to calculate National Fire Danger Rating System (NFDRS) indices such as staffing levels, ignition component, fuel moistures, and energy release component.

Interagency Monitoring of Protected Visual Environments monitors

The NPS deploys monitors to assess haze and visibility in Class I Federal Areas.

According to Colorado State University:

“IMPROVE samplers collect 24 hour samples, every three days. The IMPROVE particle monitor consists of four independent sampling modules. Data from all of the modules are used to calculate visibility metrics. Module A ... [measures] PM_{2.5} gravimetric fine mass, elemental concentration, and light absorption. Module B ... [measures] the anions sulfate, nitrate, nitrite, and chloride using ion chromatography. Module C ... [analyzes] for organic and elemental carbon (EC). Module D ... [measures] PM₁₀ aerosol mass concentrations gravimetrically. Some

⁵² Air Sensor Performance Targets and Testing Protocols | Air Sensor Toolbox | US EPA;
<<https://www.epa.gov/air-sensor-toolbox/air-sensor-performance-targets-and-testing-protocols>>

⁵³ Ecology, 2020 Washington State Ambient Air Monitoring Network Assessment, page 23,
<<https://apps.ecology.wa.gov/publications/SummaryPages/2002016.html>>

sites also include a nephelometer for optical monitoring, and a webcam for documenting scenic appearance” (Colorado State University, 2021).⁵⁴

DNR relies on all available monitors when making smoke management decisions. While highly accurate quality-assured and calibrated monitors are the gold standard for decision making, in a quickly changing environment, low cost monitors can be an important supplement to other networks. See the Burn Decision Approval – Criteria and Process section for more information.

⁵⁴ IMPROVE Program <<http://vista.cira.colostate.edu/Improve/improve-program/>>

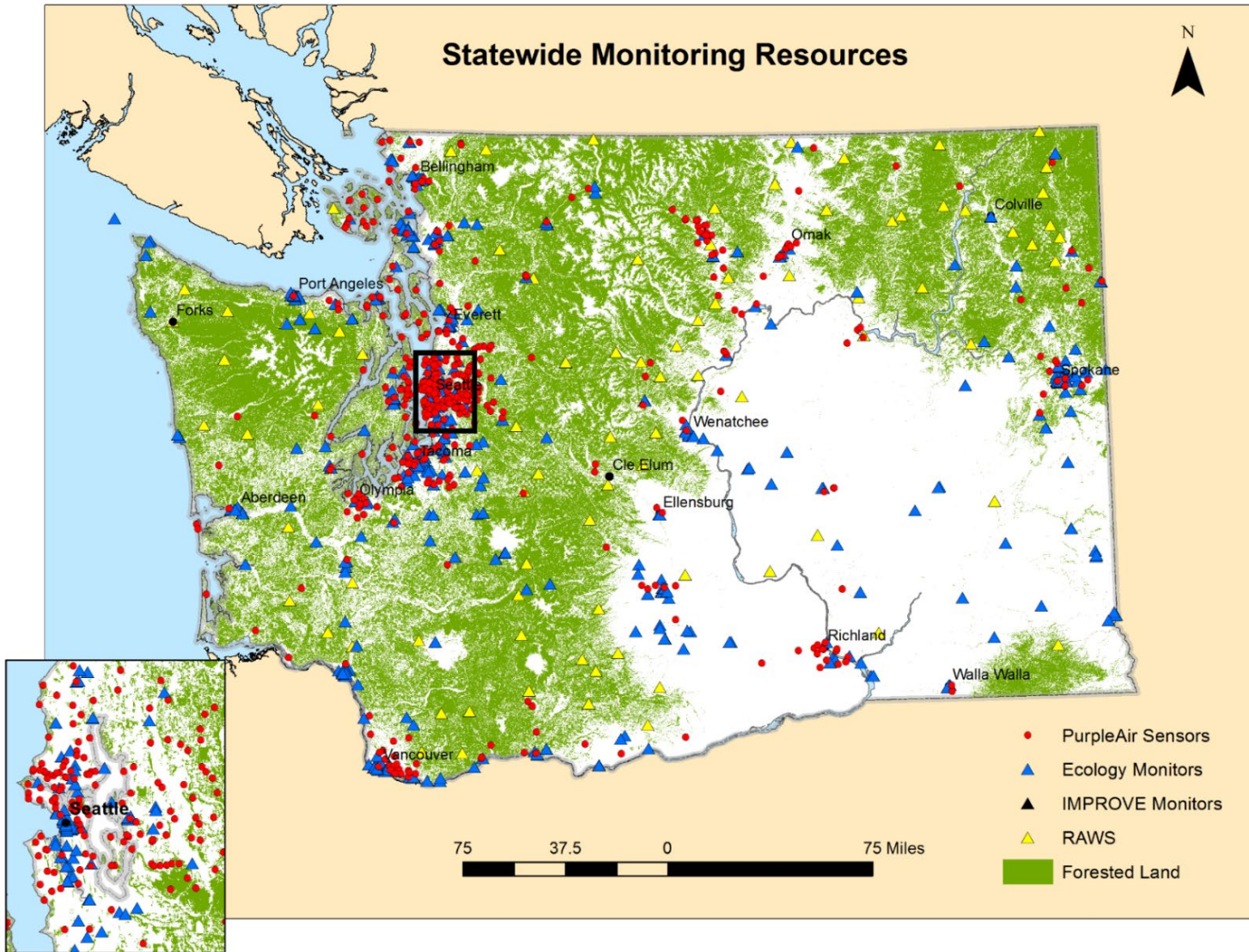


Figure 9. Statewide monitoring resources.

Burn Decision Approval – Criteria and Process

The Burn Approval Process

The 2022 SMP provides general burning requirements, including the burn approval process. It describes the categories of silvicultural burns, how multiple requests are prioritized, approval criteria and the tools used by DNR to inform decision-making.

Certain types of small burns regulated by DNR are allowed by WAC 332-24-211⁵⁵ and do not require a permit.⁵⁶ Burns larger than allowed by the rule require a DNR permit. Burns greater than or equal to 100 tons (or 300 tons in a low risk area) and all permitted burns inside a UGA, require ignition approval using the approval criteria.

DNR Smoke Experts employ best professional judgement and a variety of modeling and forecasting tools to inform ignition approval decisions. They consider wind, precipitation, and humidity; where available and applicable they consider monitor readings and background pollution concentrations; they consider other burns scheduled in the vicinity.⁵⁷ In areas where monitor data is not available, they consider webcams, personal accounts from regional employees, and information supplied by the general public. DNR staff experts receive email notification from Ecology's Gov Delivery system of daily agricultural burn decisions by county, and burn bans.⁵⁸ The specific tools and decision process used is based on the specific needs of the situation. For example, before approving large burns in remote isolated locations, DNR staff experts refer to coarse scale low resolution wind direction data and the ventilation index.⁵⁹ However, for burns in areas more likely to be affected in the event of adverse meteorological

⁵⁵ WAC 332-24-211 Specific rules for small fires not requiring a written burning permit.

<https://apps.leg.wa.gov/wac/default.aspx?cite=332-24-211>

⁵⁶ DNR, Rules for Burning Without a Permit,

https://www.dnr.wa.gov/publications/rp_burn_need_burn_permit.pdf

⁵⁷ Background concentrations, including how DNR takes into account burns less than 100 tons, is discussed elsewhere in this document.

⁵⁸ Air quality burn bans are called by Ecology, local clean air agencies, and tribes to protect people's health; burn bans limit woodstove use and outdoor burning. Refer to ecology.wa.gov/Air-Climate/Air-quality/Smoke-fire/Burn-bans.

⁵⁹ The ventilation index, used to inform whether smoke will disperse, is defined as the mixing height (m) multiplied by the wind speed (m/s). Mixing height is the extent or depth to which smoke will be dispersed vertically by turbulence and diffusion. Transport winds (the average wind speed in the mixing depth above the surface) is a good indication of the horizontal dispersion of suspended particles. Models run by the University of Washington - Dept. of Atmospheric Sciences calculate the ventilation index as the product of the planetary boundary layer (PBL) height (m) and transport wind speed (m/s). A thicker PBL/mixing height provides a larger volume of air to dilute smoke, and DNR considers the two values interchangeable.

conditions, DNR staff experts employ fine scale, point specific model outputs, and higher resolution gridded weather forecasts.⁶⁰

The tool or tools employed and level of analysis for a particular approval decision depends upon multiple factors. Considerations include the location and size of the burn request (tons of material), and the type of burn planned. Burn permit applications distinguish three burn types and require estimates of tonnage to be burned.

- Pile (piled activity fuels) created as a result of human activity.
- Broadcast (non-piled activity fuels) created as a result of human activity.
- Natural (underburn) found “as is” in nature.

Under the General Burning Requirements section, the 2022 SMP describes the process used by DNR for providing the approval decision. After the permit is issued, permission to burn still must be obtained prior to ignition.

With a goal of keeping smoke away from certain areas, and a federal requirement to not exceed NAAQS therefore protecting public health, the DNR Smoke Expert reviews the burn requests, checking on burn size, type, and relation to other burns in the area. Using forecast tools appropriate to the situation, they evaluate whether smoke will significantly disperse within approximately eight hours of ignition and be fully dispersed by 12:00 PM the next afternoon (unless the burn meets the criteria and requirements of a multiple day burn, described below).

Background Concentrations

Multiple sources of information are considered in evaluating potential contributions to ambient background concentrations to avoid cumulative impacts.

For those burns greater than or equal to 100 tons, or 300 tons in low-risk areas (see Appendix 10 of SMP for defining low risk areas), and all permitted burns inside a UGA, a state or private burner must receive ignition approval through DNR’s Smoke Management Program’s smoke management experts (a Go/No-Go Decision), and through the applicable DNR Region. Federal agency burners, such as USFS, USFWS, NPS, and BLM, must also receive ignition approval through DNR’s smoke management experts. However, the region-level approval is replaced by approval from the relevant federal land manager. The secondary approval by either a DNR Region or a FLM can be more restrictive than the DNR Smoke Management Program but not less so. The secondary decision can take into account missed local smoke impacts. This decision is primarily focused on fire danger.

⁶⁰ Weather prediction models output high resolution meteorological data used by various forecasting tools. The tools provide information about wind speed and direction at multiple levels, including at the planetary boundary layer, and about potential atmospheric instability. DNR staff experts most frequently use SpotWx, which provides the same grid coverage as output from the University of Washington Department of Atmospheric Sciences graphical model and facilitates a multi variable point specific forecast. They may also consult Pivotal Weather, which specializes in data visualization, and the BlueSky wildfire modeling suite developed by the US Forest Service.

Other burns may be occurring when these burn decisions are made, and the DNR Smoke Management Program uses several tools to account for background levels of smoke coming from other burns. These include:

- Permit requirements and programmatic expertise,
- Communication tools,
- Widespread and resourceful monitoring,
- Smoke Dispersion modeling, and
- Frequent coordination and collaboration.

Permit requirements and programmatic expertise

Silvicultural burns on state and private forestlands in the state must be permitted by DNR, and burners must follow permit conditions.⁶¹ Every permit issued by DNR requires calling 1-800-323-BURN prior to igniting. This information line is updated with air stagnation or fire danger burn bans, fire danger restrictions, and other pertinent information. Updates on this line are entered by each region as conditions change. Burns that will consume 100 tons or more of material, (or 300 tons in low-risk areas), or any burn ignited in a UGA, also require a site-specific smoke management decision, followed by approval from the relevant DNR region.

Burn permits include many of the components of a burn plan. Together with the smoke management plan, permits impose the following requirements on burners: Actions to minimize fire emissions, approaches to evaluate dispersion, public notification and exposure reduction procedures and air quality monitoring.

Part of planning a fire is to identify and anticipate possible smoke impacts. Burners must know what areas could be potentially impacted, so that if an impact occurs, the communication can be directed appropriately. DNR staff also provide expertise, and condition burn permits based on site characteristics, such as aspect, elevation, fuel types and moistures to limit, to the greatest extent possible, smoke impacts and fire escape. In the case of an emerging intrusion, DNR staff will work with burners to decide on and implement actions that will limit the scale and severity of smoke impacts.

DNR launched the DNR Burn Portal⁶² in December 2020. The burn portal is a public-facing application where burn permits are stored and proposals, approvals and denials are displayed for >100 ton/>300 ton burns and all permitted burns inside a UGA. The portal allows smoke management experts to publish burn ban notices and other urgent information prominently, and it provides resources for burn practitioners to make more informed decisions.

Another requirement of DNR permit holders who wish to ignite <100 tons of consumable material is to notify the applicable regional office and local fire departments. Special conditions specific to UGA burning require notifications to air agencies with jurisdiction. There is no permission implied in this notification, however, it does give region staff a reasonably clear

⁶¹ A narrow exemption is provided in WAC 332-24-211 Specific rules for small fires not requiring a written burning permit. See also DNR Rules for Burning Without a Permit, <https://www.dnr.wa.gov/publications/rp_burn_need_burn_permit.pdf>

⁶²Washington State Department of Natural Resources Burn Portal, <<https://burnportal.dnr.wa.gov/>>

picture of who is burning on landscapes under their management, and if there is a fire danger or smoke decision, they have situational awareness. DNR region staff maintain close contact with burners and with partners at the air agencies with jurisdiction. Permits contain information to inform smoke management activities. A burner should be clear on the following:

- Actions to minimize fire emissions,
- Approaches to evaluate smoke dispersion,
- Public notification and exposure reduction procedures, and
- Air quality monitoring.

Burners must also understand their responsibilities in the case of an imminent or active intrusion. (See the **Intrusion** Section).

In addition, smoke management experts who are making decisions about >100 ton/>300 ton burns and any request to burn inside a UGA, fold several assumptions into their daily decision-making. They are aware that any burner who is denied permission to ignite large burns may change their strategy to ignite one or more smaller burns. By accounting for these possible burns, the smoke management experts are able to avoid situations in which they would add smoke to already smoke-filled airsheds.

Monitoring

DNR employs several strategies to account for background PM levels, including reviewing monitoring information at the time of the Go/No Go decision and throughout the day of ignition, tracking complaints, watching webcams, employing full time DNR field staff with geographic responsibility and knowledge. The most useful tool for understanding background concentrations is the large, widespread, and redundant monitoring network that is composed of DNR owned portable monitors (deployed on a case by case basis), Ecology's robust air quality monitoring network⁶³, and distributed private networks—most notably PurpleAir sensors,⁶⁴ to yield a full picture of background ambient air quality. See the **Monitoring** section.

Coordination

The Smoke Management Program organizes a twice weekly smoke coordination call during burn windows to bring together statewide burn practitioners at the federal, state, and private level, and air quality regulators. The call starts out with a review of current air quality, a discussion about the upcoming week's weather along with some broad scale recommendations of the best and worst days to be burning and ends with a round robin for DNR staff and burners from each region to provide information on upcoming burns and ask questions. The call is also open to our partners at the local clean air agencies to listen in or participate if they wish. This call gives burners and regulators—including those responsible for regulating other types of burning in the state such as agricultural—the opportunity to work together and gain more insight on potential upcoming burn locations and sizes. The smoke coordination call helps DNR

⁶³ <https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Air-quality-monitoring-network>

⁶⁴ <https://www2.purpleair.com/collections/air-quality-sensors>

gather more complete information as to where we can expect to see smoke from <100 ton ignitions, and to project how air quality might be affected around the state.

In addition, when DNR permits an outdoor burn that reduces the risk of a wildfire, or a burn that is normal, necessary, and customary to ongoing silvicultural activities, within an urban growth area, DNR consults with Department of Ecology (Ecology) (RCW 70A.15.5020). If Ecology is not the air agency with jurisdiction, DNR will consult with the appropriate Local Clean Air Agency.

Modeling

DNR uses smoke plume forecasting tools, such as BlueSky⁶⁵, which combines user-supplied information on the burn with current and forecasted weather, and climactic conditions to yield predictions of where smoke will travel after ignition. Smoke management experts use these tools when there is greater uncertainty about ventilation and transport, since the sheer number of calculations required to build these projections results in very sluggish processing. Switching the decision timing to the afternoon before ignition would allow more time to run these projections on other burns, potentially resulting in more robust analyses of smoke trajectories.

Potential impacts from Agricultural Burning authorized after silvicultural burning authorizations

Agricultural burning is regulated by Ecology and decisions are made at a landscape scale, rather than a site-specific burn request decision. Ecology allows a specified tonnage within a county on a given day or weekend. Ecology's practice is to consult DNR's approvals (now on the Burn Portal) before making their determination. In addition there is not much overlap in timing between silvicultural and agricultural burning. Agricultural burning happens after the harvest, normally late October through December, and primarily in eastern WA. In eastern WA, the primary silvicultural burning conducted is forest health burning (as defined in the SMP Appendix 9) primarily in September and October. Forest health burns in eastern WA occur on Federal lands which are topographically higher in elevation and distances away from where agricultural burns take place. DNR anticipates no change to Ecology's agricultural burning process based on changes in the Smoke Management Plan, nor do we anticipate that unaccounted-for emissions will become a larger part of the ambient air burden as a result of these changes.

Approval Criteria

One of the four changes identified for analysis was changes to the approval criteria. This section provides context and discusses the change.

There are no changes made from the 1998 SMP to the 2022 SMP for permitting multiple day burns and burns in low risk areas. Language in the approval criteria process for large burns has changed. The approval criteria are no longer used only for large burns. Large burn criteria also apply to any size burn inside UGAs.

⁶⁵ <https://www.fs.usda.gov/pnw/tools/bluesky-framework>

The approval criteria details circumstances when approval to ignite is denied. The revisions to this section communicate the specific statutory authority for denying a burn. That is, the purpose of changes in the approval criteria for large burns is to provide clarity and notice around when DNR can deny approval to burn. No intended operational changes to the decision process are expected.

Approval criteria are restated

Approval criteria are restated to reference statutory authority. The changes were made to clarify the authority for withholding permission to proceed; they do not reflect changes to the decision making process. This same criteria is applies for burning in UGAs, with additional protections as conditions in the permit.

The new wording does not translate to changes in what will be approved because, consistent between the 1998 and 2022 SMPs, DNR staff disapprove burning if:

Smoke will not significantly disperse within approximately eight hours of ignition, and be fully dispersed by 12:00 PM the next afternoon unless the burn meets the criteria and requirements of a multiple day burn. This does not include residual smoke in the immediate burn area itself.

In **Appendix 3**, the wording for approval criteria used in the 1998 SMP is compared to that in the 2022 SMP. The updated wording provides statutory references for when permission to burn will be denied.

During the SMP update process some reviewers reported confusion regarding the restatement of Criteria 1 from preventing intrusions to preventing exceedances of air quality standards. The change was made to align with state law, clarifying DNRs authority to deny ignition based on atmospheric conditions and background concentrations.

Large burn approval process is maintained

In practice, approval is denied when the DNR smoke expert, following evaluation and exercising professional judgement, concludes that “Smoke will not significantly disperse within approximately eight hours of ignition, and be fully dispersed by 12:00 PM the next afternoon unless the burn meets the criteria and requirements of a multiple day burn. This does not include residual smoke in the immediate burn area itself.”⁶⁶ Please note, approval criteria formerly used only for large burns now applies in UGAs as well.

Multiple day burns

There are no changes to the process for approving multiple day burns; this section is for context only. DNR sets additional conditions and requirements for multiple day burns. As described in the SMP, specific information must be provided and certain actions taken by the burner before DNR will approve a multiple day burn.

- Three months before the burn, the burner must provide a rationale, smoke monitoring plan, communication plan, coordination call plan, and extinguishment plan.

⁶⁶ “2022 Silvicultural Smoke Management Plan,” Washington State Department of Natural Resources, May 11, 2022, page 9, Approval Criteria for Large Burns and All Burns within UGAs..

- Two months before the burn, DNR will determine whether the burn qualifies for a multiple day burn and will notify the burner of additional steps needed.

If DNR determines that the burn can affect communities, the burner must notify the public at least one week before they plan to burn. If the burner cannot mitigate potential adverse impacts such that DNR is confident that air quality can be maintained below 20.5 $\mu\text{g}/\text{m}^3$ of $\text{PM}_{2.5}$ DNR will deny the multiday request.

In addition, DNR requires extra steps for multiple day burns, including daily monitoring of atmospheric conditions.

If the burn causes an intrusion, DNR will immediately consult with the burner to discuss mitigation measures and burn plan modifications.

Response to smoke intrusions caused by burning

This section describes the change in DNR’s approval criteria language, which is how DNR decides whether or not to allow a burn. For additional context, a discussion is included here about what happens after the decision is made, the burn is ignited and there is smoke in the air.

The 2022 SMP notes that “particulate matter concentrations not exceeding NAAQS can still impact the public and should be avoided. When smoke enters an area with a potential to affect public health, at unacceptable levels at ground level, it is called a smoke intrusion. Knowing when and where an intrusion is occurring is possible, using either monitoring data or visibility (in miles) indexes.”

The 2022 SMP provides a procedure that DNR will follow to detect and respond to smoke intrusions.⁶⁷ Burners must be prepared to begin emission reduction techniques if an intrusion appears likely. Burners must also have plans in place, (i.e., contingency plans) to notify neighbors and those potentially impacted by smoke, especially sensitive populations (i.e., receptors) – both **before** and **during** the burn. DNR will collaborate with burners to reduce emissions.

If smoke does not dissipate or leave an area within approximately eight hours of ignition, and is not fully dispersed by 12:00 PM the next afternoon, or there are impacts to people or NAAQS exceedances, DNR takes action. DNR will implement the intrusion procedure as described in the SMP, starting with a discussion with the burner on the best way to reduce and eliminate the smoke, and will initiate the intrusion documentation process.

The SMP calls for starting this action when a monitor records a 3-hr rolling average (currently established through using the [NowCast Calculator](#)⁶⁸) of an air quality reading of 20.5 $\mu\text{g}/\text{m}^3$. DNR chose this action level to stay under the level Ecology has deemed “unhealthy.” DNR established this level to take action far before a potential $\text{PM}_{2.5}$ NAAQS violation of greater than 35 $\mu\text{g}/\text{m}^3$ could occur. The purpose of the action level is to significantly reduce the possibility of a NAAQS exceedance.

⁶⁷2022 Silvicultural Smoke Management Plan, Washington State Department of Natural Resources, May 2022, Intrusions caused by any silvicultural burning

⁶⁸ Under AirNow.gov, <<https://www3.epa.gov/airnow/aqicalctest/nowcast.htm>>

Contingency Plans

Burners must to notify their DNR Region if conditions change and it appears an intrusion, i.e., unintended impact, is likely, imminent or has occurred, so that proper notifications can be made. DNR Wildland Fire Management Division is responsible for communicating with the Washington Department of Health (DOH). DOH will determine whether to issue a health advisory. Burners are instructed to be prepared to use fire management options, such as cutting off a burn, to minimize smoke impact in case of an intrusion. See the **Intrusion** section.

Intrusion reports provide data to improve the decision-making processes, educate burners and provide lessons learned to improve actions in the future.

Monitors

Washington has a robust air quality monitoring network, and the collected air pollution monitor data is used by DNR in making burn decisions. DNR staff experts refer to available monitor data for information about current pollutant levels.⁶⁹

Air monitors do not cover all areas of the state, and DNR staff experts consider other available information when making Go/No-Go decisions, including monitors, webcams, on-the-ground observations and air quality complaints. These tools provide information about current air quality, allowing DNR to evaluate each burn's contribution to overall air quality with the goal of ensuring any authorizations do not exceed air quality standards.

Ecology continuously evaluates the effectiveness of the Air Quality Monitoring Network and prioritizes monitoring efforts based upon the best available information to place monitors in communities and locations that are believed to be impacted by air pollution. Most of the critical areas designated by Ecology as affected by pollution from other sources are monitored by EPA approved compliance monitors (such as FRMs or FEMs). Where these monitors do not exist, smoke personnel and burners may rely on other monitoring networks. (It is important to note that while FRM/FEM monitors are necessary for a retrospective determination that smoke has exceeded NAAQS, other monitors provide useful information for assessing conditions.)

For multiple burns as defined in the SMP, DNR may require burners to place temporary air quality monitors.

⁶⁹ Washington monitors include 18 Federal Reference Monitors (FRM)/ Federal Equivalent Monitors FEMs, 77 nephelometers managed by the Department of Ecology, and private networks with hundreds of monitors.

Population Density of Washington

Washington's population is largely concentrated in Western Washington along the I-5 corridor in the Puget Sound region, and along rivers east of the Cascade Mountains, as shown in **Figure 9**.

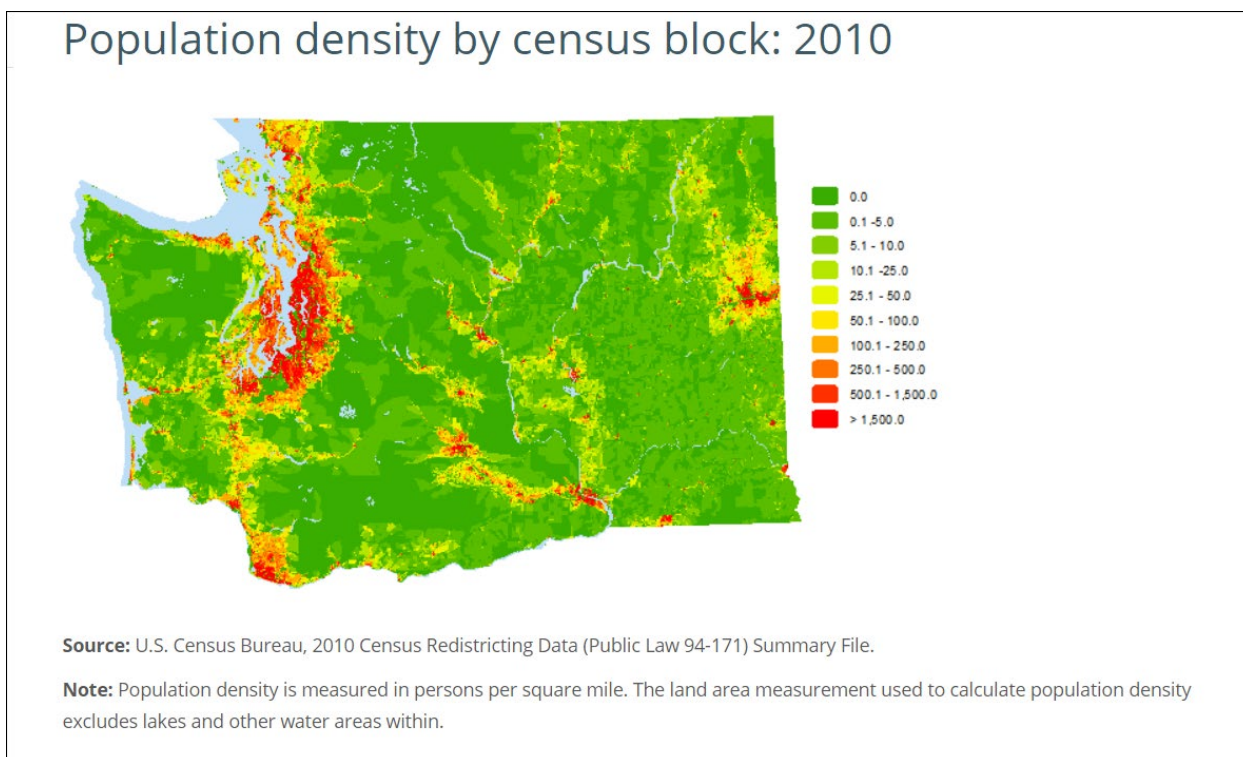


Figure 9. Population density by census bloc: 2010 (Office of Financial Management).

Designated and Sensitive Areas

The goal of smoke management as provided in the SMP is to protect all areas in the state from NAAQS exceedances and to protect public health.

While historically managing smoke anticipated that certain areas would require special consideration, the DNR approval process aims to protect the ambient air in all areas of the state.

State law prohibits burning in any area of the state where federal or state ambient air quality standards are exceeded for pollutants emitted by outdoor burning. (RCW 70A15.5020.) DNR does not allow silvicultural burning if monitor data indicates there are current exceedances of any criteria pollutant. (There is a narrow exception in state law for burning to improve or maintain fire dependent ecosystems for rare plants or animals within state, federal, and private natural area preserves, natural resource conservation areas, parks, and other wildlife areas). RCW 70A.15.5020(4).

DNR pays particularly close attention to areas otherwise subject to air pollution from other sources which Ecology identifies as critical to protect (designated areas, described below). The

1998 SMP used the term “sensitive areas” to refer to “[a]reas of heavy recreational use and population centers outside designated areas.” This term is no longer included in the 2022 SMP because “heavy recreational use and population centers” were not defined, and DNR protects all ambient air of the state for the protection of public health.

Designated areas map

Designated areas are critical areas designated by Ecology that are otherwise subject to air pollution from other sources.⁷⁰ The “designated areas map” in the 1998 SMP is from the early 1990s. It shows Port Angeles, Spokane, Grays Harbor, Raymond and the I-5 corridor as designated areas.

Ecology monitors air quality statewide and identifies areas with routinely elevated PM_{2.5} concentrations. The map has been updated to reflect current understanding of dominant PM_{2.5} sources and spatial patterns of elevated PM_{2.5} across Washington. It shows areas of predicted PM_{2.5} design values at a 4 kilometer x 4 kilometer resolution and identifies areas exceeding Ecology’s healthy air goal of 20 µg/m³. Ecology posted the map “Designated Areas for Smoke Planning” on wa.data.gov.⁷¹

⁷⁰ RCW 70A.15.5140

⁷¹ Washington State Dept. of Ecology, “Designated Areas for Smoke Planning”, ArcGIS Online, 23 April 2021, <<https://waecy.maps.arcgis.com/home/item.html?id=20198f0fc6db49a2a097152df5c309b2>>

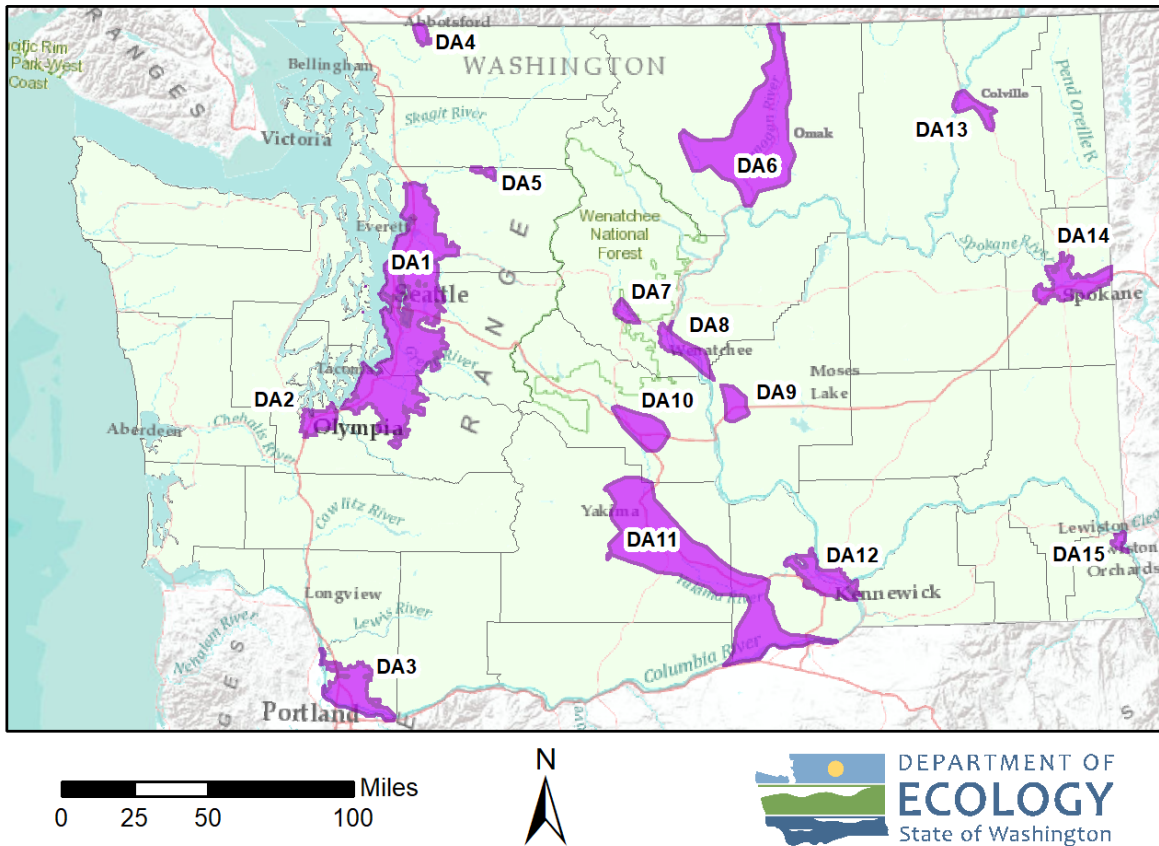


Figure 10. Map of designated areas as of January 2020.

The labeled areas on the map correspond with the following locations:

- DA1: Seattle, Everett, Bellevue
- DA2: Olympia, Lacey, Tumwater
- DA3: Vancouver
- DA4: Columbia Valley
- DA5: Darrington
- DA6: Methow Valley and Omak
- DA7: Leavenworth
- DA8: Wenatchee
- DA9: Western Grant County
- DA10: Ellensburg
- DA11: Yakima Valley to the Columbia River
- DA12: Tri-Cities
- DA13: Colville
- DA14: Spokane
- DA15: Clarkston

To develop the map, Ecology leveraged a tool developed jointly by Ecology and the Oregon and Idaho Departments of Environmental Quality called “Regional Background Design Values 2014-2017.” This tool includes a map of estimated PM_{2.5} design values interpolated from measured concentrations at agency monitoring sites and output from the Air Indicator Report for Public Awareness and Community Tracking (AIRPACT-4) daily air quality forecast model. The interpolated PM_{2.5} design value map is currently the best tool available for estimating air quality conditions outside of monitored areas. It is used for a variety of other applications and is described in Ecology’s 5-year Ambient Air Monitoring Network Assessment. Ecology will review and if appropriate update the map every five years coincident with the ambient air monitoring network assessment.⁷²

Summary

This chapter adds context to the discussion of the burn decision approval criteria by including discussion of what happens after ignition approval is granted and description of the updated designated areas map.

While the wording change between the 1998 and the 2022 SMPs may appear confusing, the operational decision making for large burn decisions is consistent and unchanged. The approach is consistent: permission to ignite will be denied based on whether smoke will sufficiently disperse. The wording change clarifies authority for a denial.

If a burn affects air quality at a level defined in the SMP as unacceptable (even following steps taken to avoid it) then DNR will take action. DNR starts this action when a monitor records a 3-hr rolling average (currently established using AirNow) with an air quality reading of 20.5 µg/m³ to ensure action is taken well before an exceedance of the NAAQS. When evaluating whether to take action in an area without monitor data, DNR will consider other information for the intrusion process outlined in Appendix 4 of the SMP. They look at complaints received, observations from DNR regional personnel, web camera images, and other available monitor data (for example, from low cost monitors).

⁷² 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 accordance with stated monitoring objectives and goals. See for example the 2020 Washington State Ambient Air Monitoring Network Assessment (Ecology publication number 20-02-016).

Looking Forward: Protecting Air Quality into the Future

The State of Washington recognizes the importance of protecting air quality into the future. Permit requirements and SMP provisions, plus additional controls in UGAs, will protect air quality as prescribed fire is used as a tool for restoring forest health.

This section addresses, on a forward looking basis, how air quality will be protected as the state anticipates additional use of prescribed burning. It accounts for future implementation of the 2022 SMP, known forest health considerations, wildfire prevention needs, and new legislation in Washington allowing for silvicultural burning within UGAs.

An increase in prescribed burning emissions may occur; this section describes the known targets and explains how the NAAQS will be protected.

Restoring forest health to prevent wildfire

Forests across the west are widely recognized to be in trouble and wildfires are occurring at an unprecedented rate, with resulting loss of life and property. While wildfires are a natural and desirable phenomena, restoring forests to health is acknowledged as key to avoiding extreme and highly damaging wildfires.

Two recent DNR analyses quantify, prioritize, and provide plans for restoring forest health.

The *20-Year Forest Health Strategic Plan for Eastern Washington*, adopted in 2017, sets a goal of treating 1.25 million acres in priority watersheds to increase forest and watershed resilience by 2037.

https://www.dnr.wa.gov/publications/rp_forest_health_20_year_strategic_plan.pdf

The Forest Health Assessment and Treatment Framework 2020 includes data for Forest Restoration Need in Eastern Washington (estimates restoration need by land ownership); Forest Health Assessment and Treatment Framework Methodology (landscape evaluation); Landscape Evaluation Summary Results for 2020 Priority Planning Areas; and 20 Year Forest Health Strategic Plan Monitoring Framework

<<https://deptofnaturalresources.app.box.com/s/eig0hx8l9n6uj5bfeocwd9km0qwme4eg/file/748708049818>>

Prioritizing areas for treatment

Washington forests vary considerably from east to west, with drastic differences in rainfall, geographic difference in tree species, and a patchwork of land ownership, and land use. DNR has identified and prioritized forest lands for treatment to restore forest health.

The 20-Year Forest Health Strategic Plan for Eastern Washington describes scientifically sound, landscape-scale, cross-boundary management and restoration treatments in priority landscapes to increase forest and watershed resiliency by 2037. The development of this plan included analyses to prioritize hydrologic unit code (HUC) 5 watersheds using two groups of metrics or Tiers.⁷³ Tier 1 included metrics that represented forest health conditions and probability of major fire or insect and disease disturbances that could affect forest health. Tier 2 metrics represented natural and human values at risk from major, uncharacteristic disturbances or declines in forest health. The two tiers were used to allow for separate evaluations of each tier and to ensure equal weighting between the two sets of metrics. Scores for each metric were derived from one or more datasets that represent the best available science that was publicly available during the planning process. Data sources, methodology, and final results from the analysis are in Appendix 1.I of the strategic plan: *Prioritizing Landscapes in Eastern Washington*.

Following the prioritization process across Eastern Washington, DNR is employing a landscape evaluation and prescription process to assess and prioritize forest health treatment needs in the forest health priority landscapes (also known as planning areas) to fulfill the 20-Year Forest Health Strategic Plan for Eastern Washington. The landscape evaluation serves as the assessment component of the Forest Health Assessment and Treatment Framework as required by RCW 76.06.200, and [the methodology has been documented and made available to the public](#). To date, DNR has completed landscape evaluations on 30 priority landscapes totaling 3.37 million acres. Landscape evaluations for the 30 priority landscapes have identified a need to conduct forest health treatments on 807,720 to 1,162,620 acres overall, to transform these landscapes into resilient forests, using a combination of tools including prescribed fire. DNR has committed to assessing an additional 9 priority landscapes by December 2022, totaling over 1 million acres. [Completed landscape evaluation summaries are available on DNR's Box data share page](#), and additional landscape evaluations will be added as they are completed.

Increased demand for prescribed fire

DNR prescribed fire policy is based on established science regarding fire-adapted ecosystems and the role of fire in forest health, and the poor health of western forests resulting from a century of fire suppression. Improving forest health involves increased use of various treatments, including mechanical thinning, the removal of biomass, and prescribed burning.

It's helpful to note how DNR defines prescribed fire in implementing strategic plans and legislation: "Prescribed fire - Also sometimes called prescribed burn fire or controlled fire, this is when fire is intentionally applied by trained practitioners to vegetation to improve forest

⁷³ The US Geological Survey developed the HUC classification system as a way to categorize watersheds. As part of the 20-Year Forest Health Strategic Plan, a prioritization process was developed at the HUC 5 watershed level (an average HUC 5 watershed is approximately 150,000 acres) using a variety of available data sets to help describe forest health/wildfire risk and the values at risk.

ecosystem health and resiliency. This includes two primary types of prescribed fire: broadcast burning and pile burning.”

In 2020, DNR contracted with University of Washington to complete an analysis of forest restoration need in Eastern Washington using the latest methods and most current vegetation datasets. This analysis assessed forest restoration need in a consistent manner across Eastern Washington annually from 1986 to 2017. The analysis provides both the absolute amount of acres needing forest restoration and trends over the last 30 years. The analysis found that the active forest restoration need (disturbance only, and disturbance plus growth) in Eastern Washington for 2017 was 3.07 million acres. Over 75 percent of the total disturbance need (2.35 million of the 3.07 million acres) is in dry mixed conifer and ponderosa pine forest types, where prescribed fire is likely to be an important tool for treatments and maintenance over time.⁷⁴

While prescribed fire is a tool used statewide, increased demand for prescribed fire as a forest health treatment tool is expected, especially in Eastern Washington forested landscapes, particularly in dry mixed conifer and ponderosa pine forest types.

Prescribed fire use in Washington

DNR-issued permits identify three burn types. Pile burning can consist of large or small piles of forest materials. Broadcast burning is application of controlled burning where no canopy is present. Understory burning is controlled broadcast burning managed to stay below the canopy. Although the type used depends on the specific needs at a particular location (and is specified in the permit or burn plan) some generalities apply.

Western Washington forestlands are predominantly Douglas fir, western red cedar, sitka spruce, and hemlock. Western Washington is among the most productive forestland in the world, and the primary use of fire on Western Washington forestlands is post-harvest burning of piled slash to clear land for replanting. Generally speaking, smoke from pile burning is relatively easy to manage from a smoke perspective. Piles tend to burn hot which reduces smoldering, and it is possible to refrain from igniting new piles when smoke impacts are detected. No increase is anticipated in the use of prescribed pile burning in Western Washington.

Broadcast and understory burning is more prevalent in the eastern Washington forests where the forests are not as dense or wet. The anticipated increase in prescribed burning is for the forests in the eastern part of the state only, where forest health is a significant concern and understory burning an effective tool. Central and Eastern Washington includes fire-adapted forestlands, including ponderosa pine savannah, mixed-conifer forests, and adjacent grasslands. Most of these forestlands are in departure from historic fire regimes, meaning that they are often the site of insect infestations, impacted by pathogens and parasites, and subject to severe

⁷⁴ Forest Health Assessment and Treatment Framework 2020, Appendix A: Forest Health Need in Eastern Washington, Washington State Department of Natural Resources

overstocking. They often display conditions that put them in danger of catastrophic wildfire, such as high levels of tree mortality, crowding, and multiple canopies.

Burn size and distribution

DNR data show:

- 76% of the burning permitted under the SMP are large burns;
- 96% of the burning permitted under the SMP are pile burns, which are conducted primarily in Western Washington; and
- 86% of the burning permitted under the SMP is conducted by private landowners (the largest tonnage burning by private landowners is industrial pile burning in Western Washington).

DNR is committed (with partners) to treating at least 1.25 million acres of forestland in eastern Washington in the next 20 years to increase forest health and resiliency. If the rate of treatment were consistent for various land types (federal, state-managed, and private) this would be, approximately, 62,500 acres of treatment completed per year, with some as yet unknown percent of the treatment being prescribed fire.

In 2021, DNR received a historic level of funding from the state legislature for long-term forest health and reduction of wildfire danger.⁷⁵ DNR has identified over 3,500 acres of prescribed fire projects with partners to work towards implementing this biennium (2021-2023). This includes 1,000 acres of state-led prescribed burning in priority landscapes for forest health treatment.

5-year work plans developed by national forests in USFS Region 6 indicate that 285,211 acres of fuels treatments will be conducted from 2021 to 2016. Prescribed fire is expected to be some component of that treatment, likely increasing annually after initial thinning treatments are completed. Between 2017 and 2021, land managers reported completing a total of 52,702 acres of prescribed fire forest health treatments in eastern Washington, an average of about 13,000 acres per year.

From the USDA Forest Service, Colville National Forest:

“[We]...do not anticipate an increase in pace and scale of our fall hand and mechanical pile burning. We have been burning anywhere between 5,000-8,000 acres annually for a handful of years now (the amounts ebb and flow some each year) and we do not have the contractor or workforce capacity to do more (it is already a struggle in some years to complete that....). So our aim is to maintain that level moving forward as effectively as possible. Any increase in pace and scale of prescribed fire for us will

⁷⁵ SSHB 1168, Chapter 298, Laws of 2021

come in the form of underburning and we rarely conduct underburns under 100/300 tons. Perhaps some blackline operations, but that is minimal.”⁷⁶⁷⁷

From the Okanogan Wenatchee National Forest:

“... we aren’t going to increase pace and scale with under 100/300 tons scenarios as a general statement, especially for natural fuels underburns...”⁷⁸

Practical considerations regarding the planned use of prescribed fire

Practical considerations limit how much actual prescribed burning can be accomplished each year. The goals of the Eastern Washington 20 year strategic plan put the rate of treatments at about 62,000 acres per year, of which prescribed fire would always be expected to be some component of that treatment. Even with recent increases in funding, availability of trained personnel, will continue to limit treatment on DNR managed lands to around 2,000 acres per biennium (about 1,000 acres per year) in Eastern Washington.

Anticipated locations for future prescribed burning

It can be difficult to determine specifically when and where prescribed fire will be employed. The following is based on a number of reasonable assumptions and is provided as illustration. We assume that land managers will prioritize forest health:

- In areas with high risk from wildfire to identified shared values (homes, infrastructure, water resources, fish and wildlife habitat, timber resources), and
- In collaboratively established priority landscapes.

We also assume:

- Budget considerations will be a factor;
- A greater implementation of prescribed fire in Eastern Washington versus Western Washington, and in fire prone forested landscapes – particularly dry mixed conifer and ponderosa pine forest types; and
- Larger burn acreages at one time will occur on public lands.

On federal land in Washington, assuming funding and resources are available, planned potential large landscape projects are:

- [Mount Hull Restoration Project](#) with prescribed burning, including underburning and pile burning up to 19,568 acres;
- [Little Crow Restoration Project](#) with small tree thinning and prescribed fire authorized on 10,542 acres;
- [Swauk Pine Restoration Project](#) with prescribed fire on 2,795 acres; and

⁷⁶ E-mail 10/21/2021 from Shane Robson, Deputy Fire Staff – Fuels Colville National Forest

⁷⁷ Forest land managers generally prefer fall for pile burning as approaching winter reduces risk of fire escape.

⁷⁸ E-mail 10/21/2021 from Aaron Rowe Fuels and Prevention Specialist

- [Mission Restoration Project](#) with 10,219 acres of prescribed fire as well as treatment of landings.

Projects are designed to meet Clean Air Act standards and meet goals of the Washington SMP. Additional maintenance burning would occur at a 10 to 15-year interval.

Utilizing optimal weather conditions through coordination and communication

Planning and coordination around using optimal weather conditions aids in protecting air quality. DNR coordinates among burners and regulatory agencies, including twice-weekly burn calls during spring and fall burning seasons. On these calls, meteorologists and smoke experts facilitate region and site specific conversations, including reviewing modeling results that forecast dispersal conditions in the upcoming days. The pre-planning and coordination facilitates planning for optimal ventilation and allows for larger acreage accomplishments during best conditions, preventing smaller burns done on moderate or less favorable days.

Air Quality Protections

To protect air quality, prescribed burns must meet the parameters established in the burn permit or burn plan. In addition, burning is prohibited if (1) an air quality episode is declared, or (2) conditions of impaired air have been declared by Ecology or the local clean air agency.

Ecology and the Washington local clean air agencies issue outdoor burn bans based on stagnant air conditions and the likelihood of exceeding 35 $\mu\text{g}/\text{m}^3$ to help prevent an exceedance of the standard.

They issue burn bans when forecasts of cool, stagnant air would result in a risk for unhealthy levels of air pollution. Ecology's atmospheric scientists and burn team members assess a number of factors in determining whether a burn ban is needed, and if so, whether a Stage 1 or Stage 2 ban is necessary. They look at weather and temperature conditions for specific areas to understand how severe and how long stagnant air is likely to last, and thereby allow air pollution to build up to levels that threaten human health. Under a Stage 1 ban, all outdoor burning is prohibited, including residential, agricultural, and silvicultural burning. A Stage 2 ban prohibits all outdoor burning in addition to the use of wood stoves, inserts, fireplaces, pellet stoves, and other wood-burning devices - unless they are a home's only adequate source of heat.

Fire safety burn bans are called by DNR, local fire districts, and tribes to protect people and property when wildfire danger is high. These burn bans limit outdoor, residential, agricultural, and forest burning.

The statutory and regulatory framework for the prohibitions are:

- [WAC 332-24-205\(4a\)](#) specifies DNR will curtail burning when Ecology declares an air pollution episode as identified in WAC 173-435.

- WAC 173-435 Emergency Episode Plan – intended to curtail emissions when significant harm levels of pollutants are reached.
 - The first stage is based on forecast events such as air stagnation advisories issued by National Weather Service or when equivalent conditions are forecast to persist for 24 hours ([WAC 173-435-030\(1\)](#)). No specific pollutant level is required.
 - Stage 2 PM10 $\geq 350\mu\text{g}/\text{m}^3$ and can be expected to remain at or above this level for 12 hours, or can be expected to recur within 24 hours.
- WAC 173-433 Solid Fuel Burning Devices, specifically [WAC 173-433-140](#) Criteria for impaired air quality burn bans.
 - Stage 1 air quality burn ban may be called by Ecology or the local air authority when they predict that the 24 hour average of PM2.5 will reach or exceed $35\mu\text{g}/\text{m}^3$ within the next 48 hours.

Refer to [RCW70A.15.5010\(2\)](#) which references [RCW70A.15.3580](#) relating to solid fuel (wood stove) burning curtailments and [RCW70A.15.6010\(1\)](#) which prohibits outdoor burning during a forecast, alert, warning, or emergency condition.

Summary

DNR anticipates prescribed fire as a key tool in restoring forest health. Forests in eastern Washington differ considerably from forests western Washington. In Eastern Washington, where DNR has identified and prioritized forest lands for treatment, understory burning fire is a particularly useful tool. In western Washington, prescribed fire is predominantly pile burning related to commercial harvesting.

Future impacts to air quality are influenced by the varied goals of state, federal, and private landowners. For state managed lands, although priority areas in eastern Washington have been identified, goals outpace resources, and on federal lands in eastern Washington land managers are not anticipating an increase in use of prescribed fire. Coordination among state and federal agencies regarding planned activities, use of optimal weather conditions, and prohibitions during burn bans contribute to protecting air quality. Importantly, statutory provisions require permits be conditioned on protecting air quality and prohibit burning during episodes of poor air quality. These elements, along with action level (i.e., the 3-hour rolling average concentration at $20.5\ \mu\text{g}/\text{m}^3$) to reduce impacts as required under the SMP, provide the mechanism for coordinated decision making that will protect the NAAQS into the future, even with the planned increases anticipated in prescribed burning.

Recent Legislation Regarding Silvicultural Burning

DNR had wrapped up a multi-year public process to update the 1998 SMP when the 2019 and 2021 Washington State Legislatures amended laws pertaining to silvicultural burning.

This section reviews the legislative changes adopted in 2019 that pertain to smoke from silvicultural burning, and demonstrates how the SMP will be applied to protect NAAQS.

Urban Growth Areas (UGA) Burning

This section addresses the provision in Washington state legislation passed in 2019 (2SHB 1784, Chapter 305, Laws of 2019) allowing burning in Urban Growth Areas (UGAs) under DNR's jurisdiction. It demonstrates how DNR will manage silvicultural burning allowed inside UGAs to protect NAAQS.

The legislation amended RCW 70.94.6514 (recodified in 2020 as RCW 70A.15.5020), to add the following section:

“(5) Notwithstanding any other provisions of this section, outdoor burning that reduces the risk of a wildfire, or is normal, necessary, and customary to ongoing silvicultural activities consistent with silvicultural burning authorized under RCW 70.94.6534(1), [70A.15.5120(1)] is allowed within the urban growth area in accordance with RCW 70.94.6534 [70A.15.5120]. Before issuing a burn permit within the urban growth area for any burn that exceeds one hundred tons of material, the department of natural resources shall consult with department of ecology and condition the issuance and use of such permits to comply with air quality standards established by the department of ecology.”

The Washington state legislature has encouraged the use of prescribed fire as a means of mitigating the risk of catastrophic wildfires. In passing HB 1784 in 2019, the legislature amended several provisions within the Washington Clean Air Act (now [RCW 70A.15](#)) to extend DNR's authority over burning in UGAs designated under the Growth Management Act (see [RCW 36.70A.110](#)). The State of Washington interprets these amendments as pertaining to DNR's authority over silvicultural burning on lands protected by DNR, to be consistent with [RCW 76.04.205](#) and other provisions in the Washington Clean Air Act that compose this regulatory scheme.⁷⁹ The amendments to [RCW 70A.15.5120\(2\)](#) give DNR the authority to issue burn permits on lands within UGAs, though the statute authorizes DNR to enter into cooperative agreements with local fire protection agencies so that they may also issue these permits. DNR has not exercised this delegation authority. Any entity issuing burn permits in Washington must

⁷⁹ The Washington Clean Air Act and DNR's burn permit program for lands it protects under the Forest Protection provisions each cross reference the other, indicating the connection between the programs. *See, e.g.,* [RCW 70A.15.5050](#) and [RCW 70A.15.3160](#), and [RCW 76.04.205](#). DNR protects “forestlands,” defined in [RCW 76.04.005\(11\)](#).

adhere to declarations of impaired air quality or any stage of an air pollution episode. ([RCW 70A.15.5010](#)(2); [RCW 70A.15.5030](#))

Agency Response

In response to the legislation allowing silvicultural burning in UGAs, DNR conducted rulemaking in accordance with the state Administrative Procedures Act, 34.05 RCW and met requirements of the State Environmental Policy Act, 43.21C RCW.

Rulemaking

Rulemaking was conducted to change WAC 332-24-205 to align with the RCW. No comments were received during the public comment period, and the proposed rule was adopted 11/22/2019. This rulemaking made changes to WAC 332-24-205(3)(c) as shown below:

“... (3) Burning shall not be allowed inside urban growth areas as designated under growth management plans, or in cities of greater than ten thousand population as follows:

(a) In urban growth areas where reasonable alternatives exist.

(b) In cities with a population of ten thousand or more as established by the office of financial management:

(i) That exceed or threaten to exceed federal or state ambient air quality standards; and

(ii) Where reasonable alternatives to outdoor burning exist, in accordance with WAC 173-425-090.

~~(c) After December 31, 2000, burning shall not be allowed in urban growth areas or cities with a population of ten thousand or more. Outdoor burning that reduces the risk of a wildfire, or is normal, necessary, and customary to ongoing silvicultural activities consistent with silvicultural burning authorized under RCW 70.94.6534(1), is allowed within the urban growth area in accordance with RCW 70.94.6534. Before issuing a burn permit within the urban growth area for any burn that exceeds one hundred tons of material, the department of natural resources shall consult with department of ecology....”~~

As a result of additional requirements added to the Smoke Management Plan, DNR is committed to additional rulemaking requiring a test burn, spot forecast, and specific approval decision from DNR for all UGA burning.

State Environmental Policy Act

DNR completed State Environmental Policy Act review of the proposed UGA outdoor burning rule (19-110701), including a public comment period held from November 7, 2019, through

November 21, 2019. A Notice of Final Determination and response to comments was issued on November 22, 2019.

Analysis

The following analysis considers the potential effects to air quality of the new legislation allowing burning in UGAs.

Because of this law, DNR is authorized to issue permits for silvicultural burning in UGAs.

Since silvicultural burning in the UGA was previously prohibited, an estimation of how much burning will be requested, permitted and actually burned in these areas is speculative. The following considers how much land area is potentially affected, additional protections, and describes how DNR permits and approves burning in UGAs to protect air quality.

UGAs in Washington

UGAs are areas designated by counties required or choosing to plan under Washington State Growth Management Act, RCW 36.70A.110. UGAs are areas where urban growth is encouraged and outside of which growth can occur only if it is not urban in nature.

Figure 11. below shows where WUI and UGAs are located.

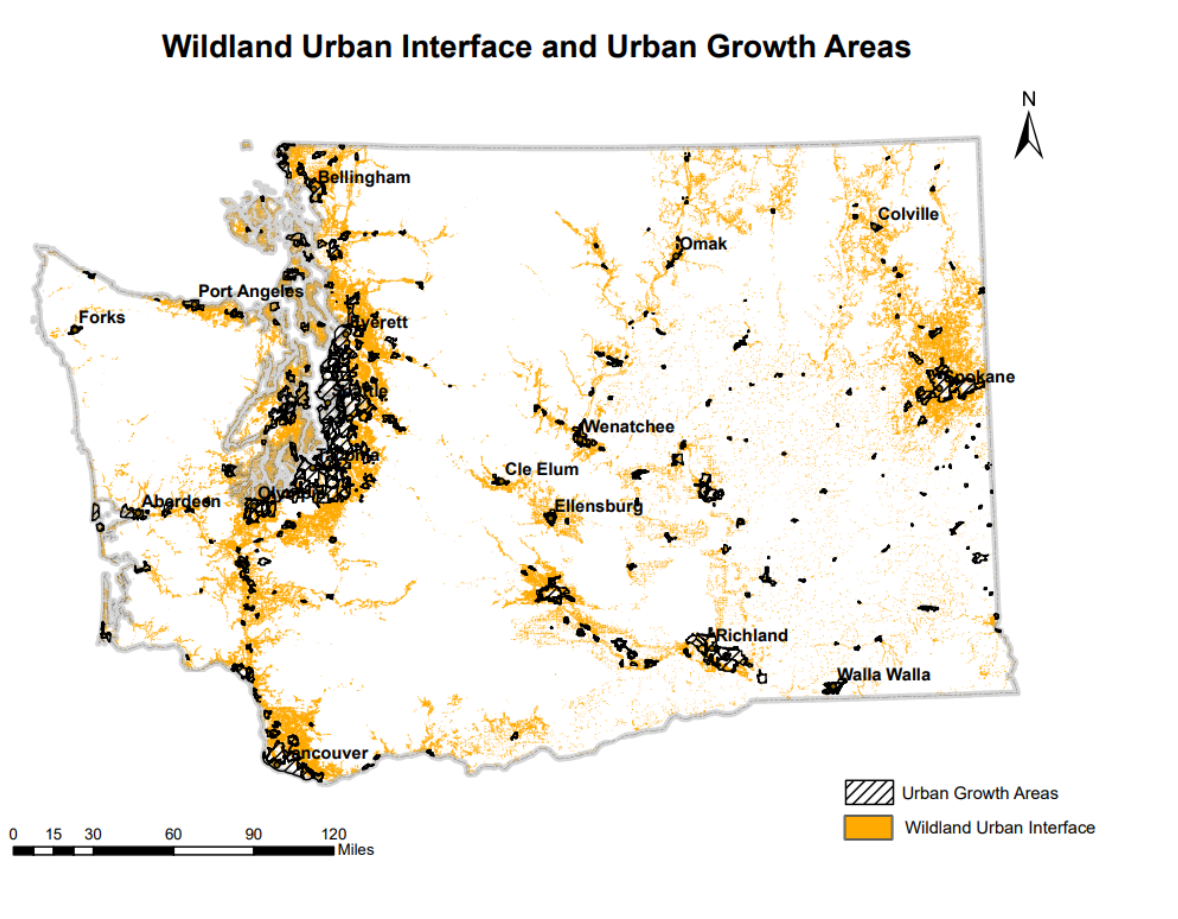


Figure 11. Wildland Urban Interface and Urban Growth Areas

Washington is a large state, with an area of 71,362 square miles, and land inside UGAs is a small fraction of the total area. There are currently 550 UGA's in Washington encompassing approximately 1.6M acres. This is 4% of the total 43.2M acres in the state. Physical and practical considerations further reduce the potential for the two types of UGA burning allowed by this legislation.

Of the 1.6M acres within a UGA, 17% are forested. Landowners in those areas could request to burn for silvicultural activities. See Figure 12. below for DNR Forestland and UGAs.

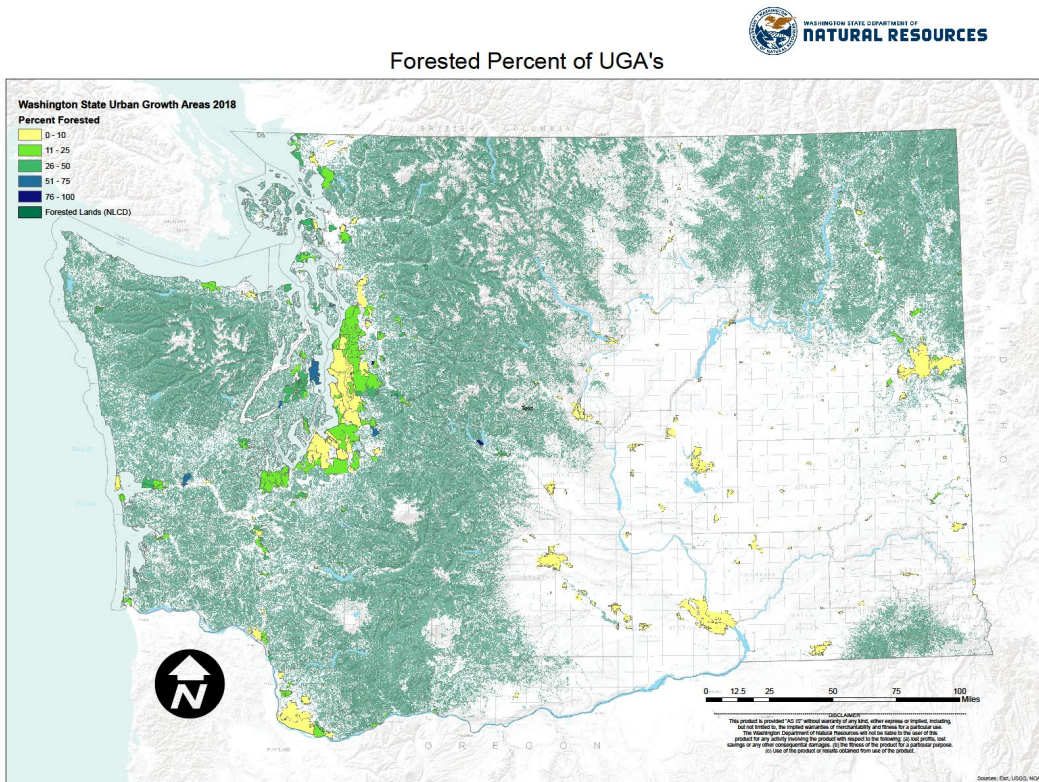


Figure 12. Forested Percent of Washington State Urban Growth Areas (2018)

Reducing wildfire risk with silvicultural burning allows the state to implement forest health goals to strategically focus forest health treatments that restore structural conditions and spatial patterns, increasing forest landscape-level resilience and reducing the amount of uncharacteristic high severity wildfires.

Wildland Urban Interface (WUI) is defined by DNR as an area “where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels.” Figure 13 describes DNR’s methodology for establishing WUI areas.

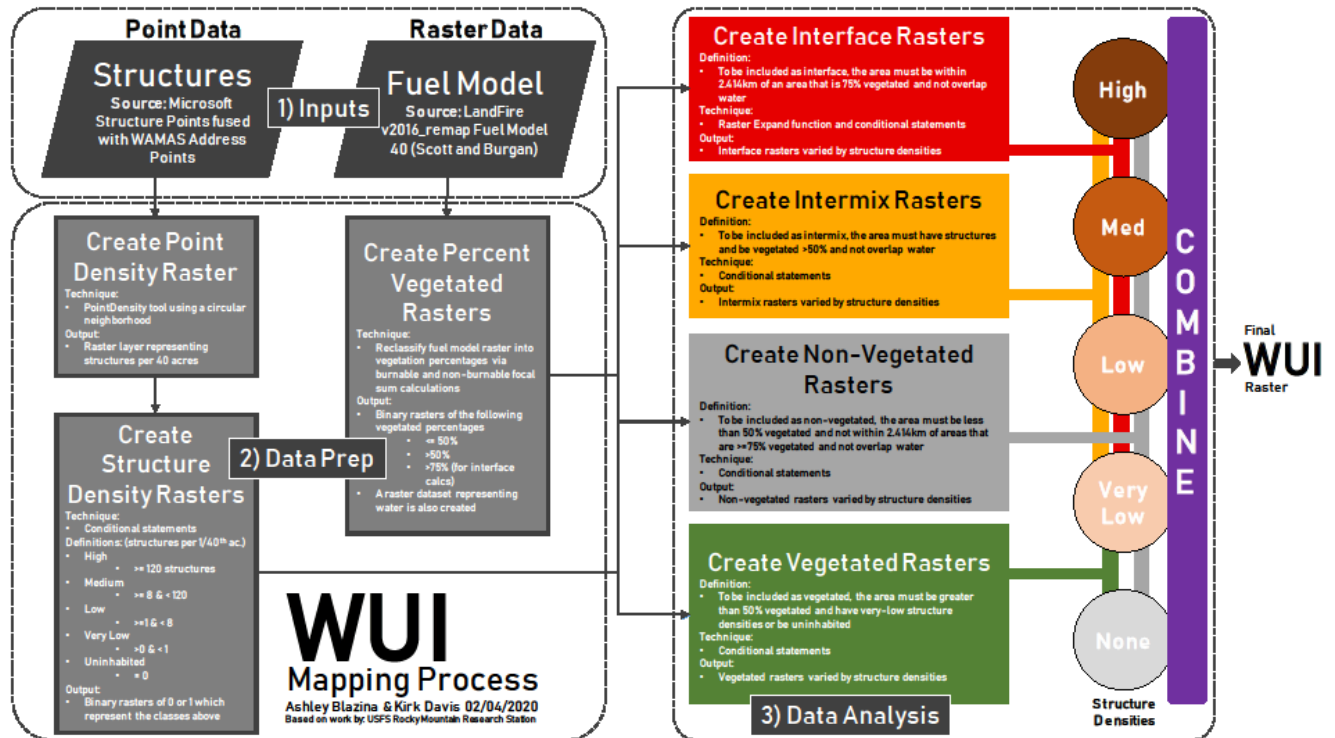


Figure 13. WUI Mapping Process, 02/04/2020

Conducting strategically focused treatments in unhealthy forest stands adjacent to communities and other densely populated areas known as the wildland urban interface (WUI) can greatly reduce the risk to the public, firefighters, and communities. Reducing the risk of wildfire in the WUI is critical to achieving forest health and protecting communities. As illustrated, there is far more WUI in the state than there are UGA's, especially in eastern WA, and the regulatory framework around silvicultural burning in WUI's outside of UGA's remains unchanged. The legislation change allowing strategic silvicultural burning within the 17% of UGA's that are forested, and even a smaller percentage of forested UGA in eastern WA, could allow for more protection of communities at risk of wildfire.

Implementation

DNR does not anticipate a high volume of burn requests in UGAs. As described in the SMP, DNR will require that all burning is done in a manner protective of the NAAQS and will set permit conditions accordingly, and may deny approval to ignite. All requirements of the SMP will apply to burning in UGAs, plus additional restrictions described below.

The Washington Clean Air Act protects air quality in Washington, and Washington regulations incorporate NAAQS. As required by the SMP, for large burns (over 100 tons (300 tons in low risk areas and all burns within UGAs) approval to ignite anywhere in the state, including in UGAs, is conditioned on smoke not being likely to cause an exceedance of the NAAQS.

Additional protections

DNR will use existing and added protections for public health as described in the SMP through the protection of NAAQS.

Added protections in UGA's required in RCW, WAC, or permanently implemented by DNR in the permitting process:

- **Permit applications are flagged:** DNR has developed an automated system, increasing accountability and reporting. One feature of the new burn portal is that each burn application in a UGA is automatically flagged resulting in early awareness, coordination and implementation of the additional NAAQS protections.
- **Consultation:** Before a permit is issued DNR will notify the air agency with jurisdiction and provide the opportunity to consult on conditioning the permit.
- **Burner required to alert local air agency after receiving ignition approval:** As a requirement of the permit burner must contact the air agency with jurisdiction, notifying them of approval to burn.

Existing protection in the burn approval process:

- Smoke management experts will analyze all the same parameters described throughout this demonstration and in the SMP.
- Smoke Management experts apply the eight approval criteria as detailed in the SMP.⁸⁰

Additional protections in UGAs added to the SMP:

- **Ignition approval required for all tonnages:** All tonnages must get smoke management approval from the Smoke Management Program and the regional experts (burns outside the UGA only need this level of scrutiny over 100 tons and 300 tons in low risk areas).
- **Test burn required:** As a requirement of the permit, a test burn must be conducted and documented. This typically happens immediately prior to ignition and verifies that smoke is rising and dissipating.
- **Spot forecast required:** As a requirement of the permit, DNR will obtain a spot weather forecast from a meteorologist prior to making burn approval decision.

Contributions to emission reporting

DNR reports emissions to Ecology for incorporation into the state emissions tracking and delivery to EPA for the National Emissions Inventory. Currently, DNR's silvicultural burning is about 50% below statutory ceiling. (RCW 70A.15.5130). With about 4% of Washington land being in a UGA, and only a portion of that being eligible for burning permits, DNR does not anticipate UGA burning being significant enough to bring emissions close to the statutory cap.

Within UGAs, NAAQS protection on a forward looking basis

Protecting the NAAQS requires managing smoke as a key consideration when using prescribed fire as a tool for preventing wildfire. The descriptions elsewhere in this demonstration regarding how the approval process works explains in detail how decisions are made.

⁸⁰ The eight criteria detailed form the basis for the Go/No-Go Decision, which is applied to any burn that will consume 100 tons or more (300 tons in low risk areas), or a burn of any tonnage in a low risk area

The permitting and approval process includes two key mechanisms in the SMP that will continue to protect air quality into the future:

- If and when air quality causes concern as noted on monitors consulted by DNR staff, or as modeled by meteorologists, then ignition approval is denied.
- DNR issued permits require ignition approval for all burns over 100 tons and for all burns within UGAs.

Washington protects air quality through a combination of conservative decisions regarding ignition approval, using ambient readings in nearby communities to inform decisions; and prohibiting burns large and small when burn bans are in place. The permitting and approval process applies into the future and is designed to deny ignition approval well before a NAAQS exceedance.

Conclusion

UGA's are 4% of the acres in Washington and only a portion of this will meet the above eligibility conditions for the two types of burning allowed in UGAs. (Note that the SMP covers silvicultural burning only. Burning related to land clearing and other types of outdoor burning is not regulated by DNR.) Treatments strategically focused to reduce the risk of wildfire in eastern WA UGA's, which commonly include WUI, are a tool for protecting communities.

UGAs help control urban sprawl, encourage high density development, and guard against the loss of agricultural and timber lands. The Washington Growth Management Act requires cities and counties to develop comprehensive plans that guide future development. Increasing populations and effects of climate change raise concern of fire along the WUI; and although prescribed burning is one tool for reducing risk, most land within UGAs is urban, which will limit its use. Together with the SMP, state laws and regulations, the additional requirements for burning in UGAs ensure that the small volume of potential increases in burning will be protective of the NAAQS.

Silvicultural burning permits / to the extent feasible

This section addresses the provision in Washington state legislation passed in 2019 (2SHB 1784, Chapter 305, Laws of 2019) that added language regarding permits issued by DNR.

RCW 70.94.6538 (recodified in 2020 as RCW 70A.15.5140) provides for "Burning permits for abating or prevention of forest fire hazards, management of ecosystems, instruction or silvicultural operations—Conditions for issuance and use of permits—Air quality standards to be met—Alternate methods to lessen forest debris."

The legislation amended RCW 70.94.6538 (recodified in 2020 as RCW 70A.15.5140), adding "to the extent feasible" and removing "after full consultation with the department of natural resources," as shown below:

"The department of natural resources, in granting burning permits for fires for the purposes set forth in RCW 70.94.6534 [70A.15.5120], shall condition the issuance and use of such permits to comply to the extent feasible with air

quality standards established by the department of ecology ~~after full consultation with the department of natural resources~~. Such burning shall not cause the state air quality standards to be exceeded in the ambient air up to two thousand feet above ground level over critical areas designated by the department of ecology, otherwise subject to air pollution from other sources. Air quality standards shall be established and published by the department of ecology which shall also establish a procedure for advising the department of natural resources when and where air contaminant levels exceed or threaten to exceed the ambient air standards over such critical areas. The air quality shall be quantitatively measured by the department of ecology or the appropriate local air pollution control authority at established monitoring stations over such designated areas. Further, such permitted burning shall not cause damage to public health or the environment. All permits issued under this section shall be subject to all applicable fees, permitting, penalty, and enforcement provisions of this chapter. The department of natural resources shall set forth smoke dispersal objectives designed consistent with this section to minimize any air pollution from such burning and the procedures necessary to meet those objectives.

The department of natural resources shall encourage more intense utilization in logging and alternative silviculture practices to reduce the need for burning. The department of natural resources shall, whenever practical, encourage landowners to develop and use alternative acceptable disposal methods subject to the following priorities: (1) slash production minimization, (2) slash utilization, (3) nonburning disposal, (4) silvicultural burning. Such alternative methods shall be evaluated as to the relative impact on air, water, and land pollution, public health, and their financial feasibility.

The department of natural resources shall not issue burning permits and shall revoke previously issued permits at any time in any area where the department of ecology or local board has declared a stage of impaired air quality as defined in RCW 70A.15.3580.

Whether these two changes have implications for air quality led to consideration of consequences to the permitting process or to application of the approval criteria.

Potential changes in the permitting process

No changes. Experience shows it is feasible to protect the NAAQS and the 2022 SMP will continue to protect NAAQS.

DNR will not change operations as a result of the 2019 Legislature adding the language “to the extent feasible” in 70A.15.5140, regarding complying burn permits with air quality standards. Burners are and will continue to be required to meet Washington’s air quality standards which adopt the NAAQS.

Potential changes to burn approval decisions

DNR will not change operations as a result of the 2019 Legislature adding the language “*to the extent feasible*”.

Best Burn Practices, Tools

Smoke Management Tools

DNR uses a suite of tools to make smoke management decisions, including:

DNR Burn Portal⁸¹

The burn portal is where burners submit large burn requests and all requests for burns inside UGAs, (if burners do not have access to a computer DNR staff will enter the request into the portal), and where approval or denial is recorded by DNR staff. The portal functions as a one-stop location for information on all permitted burns, including location, burn type, and tonnage. The portal contains links to useful tools and important contacts, and prominently features a map showing the locations of all large burns being ignited statewide, as well as requests to burn that have been denied.

Air Quality Monitoring Networks

See Monitors and Sensors section. These tools provide DNR with a picture of current air quality, and combined with NowCast, allow DNR to tentatively forecast air quality and account for approved burns' contribution.

Airfire Smoke Forecasting Products

This suite of tools allows DNR to track air quality at monitors around the region, and to forecast the trajectory of smoke given burn type, timing, and tonnage.

National Weather Service (NWS) Spot Weather Forecasts

These special forecasts are issued to fit the time, topography, and weather of a specific incident or natural resource management project. These forecasts are issued upon request of the user agency and are more detailed, timely, and specific than zone forecasts.

Best Practices for Silvicultural Burning

We can divide silvicultural burning best practices into three categories—preventing fire escape, managing smoke, and achieving burn objectives.

Preventing fire escape

Where people, property, structures, resources, are close to the fire, preventing escape becomes key to burn success. By blacklining (burning the perimeter of the fire) or mechanically scraping the boundary of the burn down to mineral soil—or a combination of both strategies—burners can prevent fire from escaping the planned burn area. Further, by lighting backfires (fires ignited downwind), practitioners can conduct burns more safely when conditions are less safe.

⁸¹ Burnportal.dnr.wa.gov

Managing smoke

After the burn application is submitted with the burn parameters the practitioner needs to meet their objectives, and DNR permits the burn setting appropriate restrictions for the site, a specific burn decision to ignite is needed. An analysis (see **Burn Decision Approval – Criteria and Process** in the Demonstration) is conducted by DNR smoke experts to assess ventilation, transport, and dispersion, and minimizing smoke impacts. In addition to those three steps, there are some finer scale, site specific best management practices that burn practitioners can implement to reduce smoke. When fire danger conditions allow, igniting faster burning, hotter fires result in more complete combustion and less smoke. Piling debris also allows for hotter ignitions and better smoke management. Finally, burning around the perimeter of larger fuels, such as stumps and large logs prevents those fuels from igniting and smoldering for longer periods.

Achieving burn objectives

Every broadcast burn has a prescription, which is a set of conditions under which the objectives of the burn can be achieved, whether those objectives are to dispose of debris, to combat insect or pest infestation, or to encourage germination of seeds that are dependent upon fire. Similarly, private industry burners will often ignite only under narrow windows in which piled debris will combust completely, smoke will disperse quickly, and recent precipitation will prevent fire escape.

Alternatives to Burning and Emissions Reduction Techniques

Burners are required to consider alternative ways to address or prevent wood waste. WA State Clean Air Act directs burners to consider ways to produce less slash, utilize slash, and explore and consider alternatives to burning. Specifically, RCW 70A.15.5140 outlines this requirement and methods to consider.

Assistance to Small Forest Landowners

DNR has a Small Forest Landowner Office,⁸² where small forest land owners can access assistance with management of their lands. This office helps landowners reduce fuels and improve forest health on their lands using a variety of strategies, including thinning and clearing.

Alternative Mechanical Treatments

Alternative mechanical treatments include brush and tree clearing projects that are implemented with excavators, skidders, or masticators. These tools have the advantage of efficiency—it is possible to complete a large project quickly. The cost of this efficiency can be measured in terms of impact on the landscapes in question and on the workers implementing the projects. These tools are commonly used on large units by experienced operators, and the products of these tools, such as chips and limbs can be reused.

Increased Utilization

The wood chips left behind by chippers and masticators can be sold and reused for landscaping purposes. If fuel prices and unit proximity to a cogeneration plant allows, chips left behind from a thinning and chipper or mastication operation can be used to produce fuel for the electrical grid which has its own air quality protections.

Chemical Treatment

Herbicides may be used in a variety of areas to control competing and unwanted vegetation. Herbicides used must be registered by the U.S. Environmental Protection Agency. Treatments are made within the manufacturers' label restrictions and agency administrative directions. Herbicides are applied with four different techniques.

- Aerial application, using helicopter or fixed-wing aircraft.
- Mechanical equipment, using truck-mounted wand or boom sprayers.
- Backpack equipment, generally a pressurized container with an agitation device.
- Hand application by injection, daubing cut surfaces, and ground application of granular formulation.

⁸² Small Forest Landowner Office | WA - DNR, <https://www.dnr.wa.gov/sflo>, 3-11-2021

Advantages of herbicide application is the ability to target vegetation growth patterns (periods when the target species are susceptible and the crop species is not), and the low impact to soil surfaces. In addition, aerial applications can be very cost efficient, through treatment of large acreages in a short time period. The other three alternatives have the advantage of being a highly selective treatment.

Disadvantages of herbicide treatment include:

- Planting can be more expensive amid chemically killed brush.
- Does not expose mineral soil necessary for natural or artificial seeding.
- Herbicides may not be acceptable near sensitive areas.
- Animals move about freely under sprayed brush where they are protected from predators.
- Increased monitoring for drift and impact on water.
- The possibility of a chemical spill.
- Herbicides do little to control wildfire risk, they do not reduce fuel loadings.

Human health effects, in conjunction with the application of herbicides, deal with the amount of exposure the workers have in mixing and applying the herbicide, and for the public in the chance that they might be exposed during an herbicide application. The amount of adverse health effect that either of these two groups could experience would depend upon the toxicity of herbicide, concentration, and length of exposure. Generally, the human health risk is very low when herbicides are properly used.

Chemicals for site preparation and release have not been an alternative that has been available for federal agencies since 1983 due to a district court injunction. This has led to a much greater dependency on other alternatives.

Manual/Hand Labor

This entails creating planting spots by hand, or hand piling slash. The advantage of hand methods is their specificity and low impact on the soil surface. Site specific areas can be targeted. In riparian areas, and sites with sensitive plants, hand methods assure that only target species are treated.

The major disadvantages of manual methods are their lower production rates, higher costs, and re-sprouting when vegetation is removed but roots are not killed. In addition, manual methods require extensive human exposure to potentially dangerous working conditions. Manual methods have been very ineffective in the most productive sites and with certain brush species, due to re-sprouting and high costs.

Adverse health effects of manual methods include working on steep slopes with poor footing, in dense or tall brush, and exposure to exhaust and gas vapors. Chain saws are dangerous if used unsafely. Workers also face a greater exposure to the risk of being cut and the exposure to poisonous plants, snakes and insects.

No Treatment

No treatment would consist of not using any of the available alternatives for site preparation after harvest. Units would be harvested and reforested either naturally or by planting.

Advantages to this alternative are lower costs, as long as successful regeneration results. In the eastern part of the State, some sites, are quite suitable for this alternative. Disadvantages to this treatment, are heavy slash accumulations leading to increased unhealthy forests, wildfire hazards, higher planting costs, increased unfavorable animal and insect habitat.

Reducing Emissions from Prescribed Burning

There are a number of techniques that burners can use to reduce the emissions output of their units, including options described above. Burners can also:

Reduce the fuel load

Fuel loading can be reduced either mechanically, or by grazing. Mechanical treatment can include onsite chipping of debris, firewood collection, thinning, piling, mastication, mechanical removal of logging debris, or whole tree harvesting. Sometimes these fuel reduction techniques may be effective enough to eliminate the immediate need for prescribed burning. Grazing is another option for reducing fuel loading. Grazing may be economical, however animals are selective in what they eat, and may cause changes in the plant community over time. Grazing on steep slopes may also cause erosion.

Reduce fuel burned

Reducing how much fuel is burned in high moisture conditions is another method of reducing emissions. Further emissions reductions can be realized by implementing mop up quickly after a burn, or by burning before new fuels emerge.

Reducing the quantity of fuel consumed by fire may be achieved by burning in high moisture conditions when less fuel will be consumed than in dry conditions. Generally, conditions that facilitate this strategy occur a few days after a soaking rain, or following snowmelt. Burning in high moisture conditions creates the possibility of longer smoldering times and increased emissions if burning material does not extinguish soon after the burn. Rapid mop up is another strategy to reduce the amount of fuels consumed by not allowing them to smolder for long periods of time. Burning before new fuels emerge is another method of reducing the quantity of fuel consumed, thereby reducing emissions.

Increase burning efficiency

Pile burning, fans, and burning in dry conditions are all methods which generate greater heat allowing the materials to be consumed by fire more completely. These methods cause more fuel to be burned in the flaming phase of combustion, creating less emissions than if the fuel were allowed to smolder. This method should be chosen with care, due to the risk that a hotter fire may burn more fuels than would have otherwise consumed, reducing its usefulness in decreasing emissions. Soil heating should also be taken into account when using this strategy. High heat for long durations of time can destroy soil organic matter and greatly alter soil structural properties, which may result in increased post-burn erosion.

Burn more frequently

Burning more frequently on landscapes with short fire intervals (historically burned every 3 to 5 years) reduces fuel accumulation, resulting in less biomass burned. This approach of frequent low intensity burns may also prevent unwanted species from establishing.

Intrusions

A smoke intrusion is defined in the SMP as “[t]he intrusion of visible smoke into a designated area at an altitude less than 2,000 feet above ground level.” Designated areas are “[c]ritical areas designated by the Department of Ecology that are otherwise subject to air pollution from other sources.”⁸³

Action Level

Smoke concentrations are considered unacceptable for the purposes of the SMP, and therefore constitute an intrusion, when a 3-hour rolling average concentration reaches 20.5 µg/m³. This is the level at which Ecology begins to consider concentrations as unhealthy for sensitive groups.⁸⁴ WAQA is similar to EPA's Air Quality Index (AQI) but shows health effect warnings at lower PM_{2.5} levels than the AQI does.

DNR will withhold burn approval, or take action during the course of a currently implemented, burn, if the burner cannot mitigate potential adverse impacts such that DNR is confident that air quality will not degrade past this level.

Burners must notify their DNR region if an unintended impact is imminent or has occurred. Burners must also notify local residents, if they have maintained lists of interested parties for the specific area that will be impacted so these individuals may take protective actions to reduce their exposure.

Public Notification Procedure: DNR region will notify the Wildland Fire Management Division, or Wildland Fire Management Division will notify the DNR Region(s) so that the appropriate agencies can be notified and a DOH can determine whether a public health warning needs to be issued for the area impacted.

DNR Region will:

- Notify those people on their custom sensitive population lists, if they have maintained such a list.
- Notify the fire departments/district having jurisdiction over the area in case the burner has not. These would be the same fire departments that were initially notified about the start of burning. This is so that the fire department can respond with appropriate information in case of inquiries from the public.

DNR Wildland Fire Management Division will:

- Notify the air authority(ies) responsible for burning.
 - Either a local clean air agency (LCAA) or Ecology, based on who has jurisdiction.

⁸³ Designated areas are discussed elsewhere in the demonstration; add reference and/or citations.

⁸⁴ Sensitive groups include people with heart or lung disease, asthma, diabetes, infants, children, adults older than 65, pregnant women, or people who have had a stroke.

- DNR also notifies Ecology even if a local clean agency has jurisdiction so that agricultural burn decisions can take the intrusion into consideration.

The local clean air agency or Ecology will make note of the location of the intrusion, in case they receive complaints from the public. The LCAAs and Ecology will notify DNR of any complaints related to the intrusion.

- Notify the DOH so the appropriate alerts can be issued, through social media or other methods.
 - Alert DNR Wildland Fire Management Division communication staff: to alert the public through DNR social media alerts, if appropriate. Notices will ideally include an estimate of how long the impact is expected to last. Messages should also include information from the health department on how people may reduce their exposure (i.e., a protective health message)

The Washington State Department of Health (DOH) will:

- Issue alert through social media or other method.
- Contact local health jurisdictions (LHJ) to develop health messaging about air pollution that is relevant at a local level.⁸⁵ State and LHJ of DOH will include information on how people may reduce their exposure, if smoke impacts occur. The state DOH may issue social media alerts, if warranted; the LHJs will alert affected populations in their areas (by web, social media or other measures) as well.

⁸⁵ <<https://www.doh.wa.gov/Portals/1/Documents/1000/SHA-OutdoorAirQuality.pdf>>, Washington State Department of Health, 2018 assessment, page 172, “DOH works with local health jurisdictions (LHJs), Washington State Department of Ecology, Local Air Authorities, and others to identify when and where ambient air pollution reaches levels of concern, and to identify and alert populations that are most affected”.

The following figure represents the public notification process.

Public Notification, in case of unintended impacts

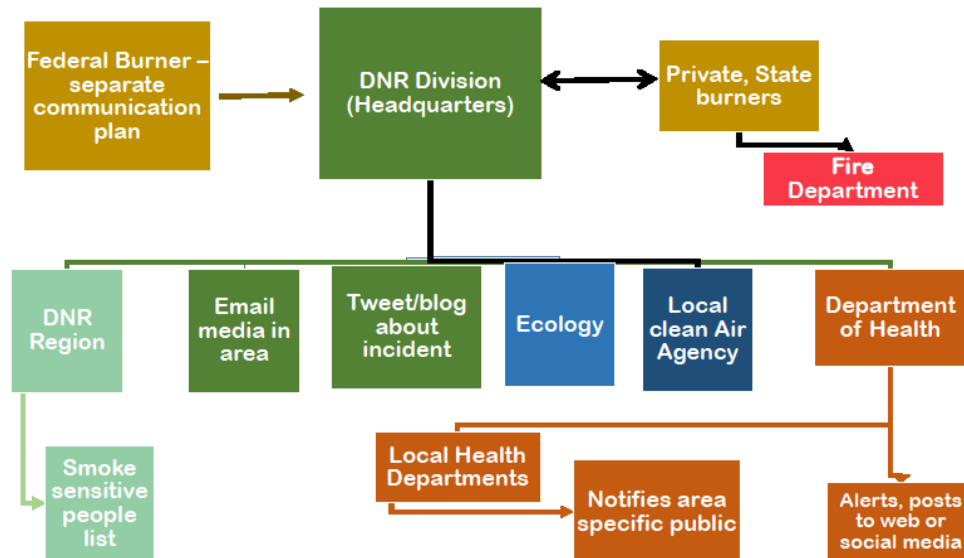


Figure 14. Public Notification, in case of unintended impacts

Burners and DNR staff (regional and division) will be briefed and trained on the intrusion public notification procedures. To clarify this process, DNR will assess permit applications, burn plans and final permit text and modify as necessary. DNR will notify state DOH when an unintended impact is likely or has occurred so DOH can determine whether to issue a health advisory. If DOH recommends a health advisory be issued, they will work with the local health jurisdiction to develop locally relevant health messaging. DNR will formalize this procedure with the DOH.

Reporting Requirements

Smoke Intrusion Reports must be filled out by the burner and submitted to the DNR Region Manager or Forest Land Manager (FLM) for smoke intrusions meeting the PM_{2.5} action level. They also must be filled out for any area when the DNR Region Manager or FLM determines the smoke impact on the public warrants submission of the report.

The SMP identifies information needed to evaluate the root cause of the intrusion. The DNR Burn Portal has the Preliminary Report Form which DNR requests back from the DNR authorized burner within 24hrs, this preliminary report is to notify DNR leadership of the possibility of an intrusion. If it appears a DNR authorized burn caused an intrusion, DNR requires a Comprehensive Intrusion Report, also found on the DNR Burn Portal. This report requests detailed information from the burner including burn logs, photos, lists of complaints, and the required post burn report. The DNR smoke expert adds data about ventilation, visibility, mixing depth, transport wind and wind shear, plus general synoptic conditions (large and small), and addresses whether forecasts were adequate and why to the report. Together DNR smoke experts and the burner collaborate on suggested changes in procedures and

techniques necessary to prevent future intrusions under similar conditions. This report must be finalized within five days of the intrusion occurring and is provided to DNR leadership and retained in accordance with state records retention. DNR may request an after action review (AAR), including root cause analysis, so that practices can be adjusted and knowledge shared.

Smoke Intrusion Reports provide an opportunity for close consideration of events, conditions, communication, and responses. DNR staff and managers review intrusion reports to identify the cause and determine if or how the problem could have been prevented, and to support continuous process improvements.

Intrusion Data

DNR reviewed intrusion data from 2009 to 2019. **Table 15** shows intrusion records from DNR’s Smoke Management Program from 2009 to 2019. As shown, none of these instances resulted in PM_{2.5} concentrations near or above the NAAQS for the affected communities.

Table 15. Intrusions in Washington 2009-2019, by Location

Intrusion Name	Date of Intrusion	Affected Communities	Magnitude	Start Time	Duration (hrs)	PM _{2.5} (µ3, 24hr)	Acres Burned	Tons Consumed
Kaboom	9/28/2009	Yakima	Light	16:00	7	23.2	2000	29410
Deer	4/23/2013	Twisp	Heavy	22:00	10	4.1	35	
WRRD	10/14/2015	Leavenworth	Light	11:00	5	3.8	70	817
Pasayten	4/28/2016	Winthrop	Heavy	17:00	13	N/A	25	125
Natapoc	9/29/2016	Plain	Medium	9:00	24	15.8	93	1026
Eightmile Bottom	5/21/2018	Twisp	Heavy	22:00	12	27.5	300	1767
Eightmile Bottom	5/25/2018	Twisp	Heavy	22:00	10	21.62	218	120
Forest Johnson	4/17/2019	Manson, Chelan	Light	11:30	4.5	4.7	403	3164
Deer Block	5/6/2019	Winthrop	Light	6:00	4	12.5	50	3300
Raymond Large Burns	10/17/2019	Raymond	Moderate	11:00	3	12		247
Wolf Creek	11/18/2019	Wolf Creek	Moderate	16:00	7	21.5	25	28

Mitigation

DNR implements specific actions, should DNR-approved burning cause an intrusion. The methods describing how DNR will monitor air quality throughout the day if issues are

suspected, persons to contact, and the intrusion process to follow is in the Intrusion Section of the SMP.

If an unintended intrusion occurs, burners will mitigate smoke impacts, using fire management and suppression options and consider techniques such as mop up operations or cut offs Smoke minimization procedures are described in the **Reducing Emissions from Prescribed Burning** chapter.

After Action Review

Once each year, DNR may convene state, federal, private burners, partner agencies (including Ecology and local clean air agencies (LCAAs)), and relevant DNR staff for a full day After Action Review (AAR). The AAR usually includes:

- Lessons learned.
- Tonnage burned.
- Total annual emissions.
- Outreach and education efforts undertaken.
- Air quality impacts.
- Intrusion Reports, if any.
- Complaints, if any.
- Interactions between smoke from silvicultural burning, wildfires and other types of burning.
- A look forward to the next burn season, with a focus on priority areas and projects, goals, strategies on how to share the air shed with other burning.
- Any business adjustments needed.

The intent of the AAR is to evaluate the effectiveness, successes, and failures of the SMP over the past year and to allow DNR to determine if procedural, operation, or policy changes are warranted.

Enforcement

DNR shares responsibility with LCAAs and Ecology for implementing the Washington Clean Air Act, chapter 70A.15 RCW. In section RCW 70A.15.5120⁸⁶, the Washington Clean Air Act assigns DNR responsibility for issuing permits for silvicultural burning on lands where DNR has fire protection authority.⁸⁷ The Washington legislature also specifically assigned DNR responsibility for regulating burning on forestlands.⁸⁸ All laws and rules pertaining to silvicultural burning in Washington are identified in Appendix 6 – Laws and Rules, and also in the 2022 SMP, Appendix 7.

DNR issues all silvicultural burn permits and manages smoke related to silvicultural burning under rules in chapter 332-24 WAC. A violation of WAC 332-24-217 is expressly a violation of forest protection laws chapter 76.04 RCW and the Washington Clean Air Act.

Washington State has authority to issue civil penalties under 70A.15 RCW. “[A]ny person who violates any of the provisions of this chapter, [the state clean air act], or any of the rules in force under such chapters or section may incur a civil penalty in an amount not to exceed ten thousand dollars per day for each violation.”⁸⁹

DNR has specific authority to issue orders revoking or suspending burn privileges or permits when necessary to prevent air pollution or for the safety of adjacent property (RCW 76.04.205(4) and WAC 332-24-205(1)). DNR may also suspend burning under RCW 76.04.315 in order to address unusual fire danger. Any burning that occurs without a required permit, or in violation of any permit requirements, violates WAC 332-24-201(4) or other provisions of WAC 332-24. Any burning in violation of DNR rules voids any prior permission granted to burn (WAC 332-24-217).

DNR has authority to seek injunctive relief to enforce all of its rules and orders under the Washington State Administrative Procedure Act, RCW 34.05. Specifically, RCW 34.05.578 provides that an agency, such as DNR, “may seek enforcement of its rule or order by filing a petition for civil enforcement in the superior court” and authorizes a court to provide “temporary or permanent injunctive relief.” RCW 34.05.578(1) and (4). Thus, DNR has broad authority to stop burns for a variety of reasons, and have its orders enforced in court.

DNR has specific authority to issue civil penalties for violations of RCW 76.04.205 per RCW 70A.15.3160.⁹⁰ As directed in RCW 76.04.205, DNR is in the administrative procedure process, including public input, of conducting rulemaking. The rule will establish: (a) A framework for resolving conflicts that may arise related to this section, including the issuance of civil penalties

⁸⁶ RCW 70A.15.5120. <<http://app.leg.wa.gov/RCW/default.aspx?cite=70A.15.5120>>

⁸⁷ RCW 76.04.610. <<https://apps.leg.wa.gov/rcw/default.aspx?cite=76.04.610>>

⁸⁸ RCW 76.04.205. <<https://app.leg.wa.gov/RCW/default.aspx?cite=76.04.205>>

⁸⁹ RCW 70A.15.3160(1)(a). <<https://apps.leg.wa.gov/rcw/default.aspx?cite=70a.15.3160>>

⁹⁰ Note: A bill passed in the 2021 Washington State Legislature amends RCW 70A.15.3160 to clarify and confirms DNR's authority to issue civil penalties. SHB 1423 provided for penalties not to exceed \$10,000 per day for each violation of DNR's silvicultural burn permit program. Rulemaking is in process.

pursuant to RCW 70A.15.3160 for violations of this section; and (b) the method by which penalties issued pursuant to RCW 70A.15.3160 for violations of this section will be calculated.

The primary enforcement mechanisms employed by DNR are education regarding requirements and mitigating impacts as they occur, followed by revoking current burn permits and withholding permits, if there is a refusal to comply. Permit holders who are repeatedly in violation the SMP may have their current burn permits and ability to apply for new permits suspended until they demonstrate the ability to comply with the SMP.

DNR Law Enforcement Officers, stationed throughout Washington to protect the public, employees, and state lands, resources and other assets, and DNR can take action under chapter 76.04 RCW for willful violations of permit provisions.

In summary, the SMP provides a graduated approach to enforcement that starts with education and leverages communication to ensure permitted entities comply with requirements.

Complaints

The 1998 SMP did not address complaints outside of those recorded in the event of an intrusion. The 2022 SMP corrects this by providing a method of complaint tracking intended to account for, and respond to, complaints regardless of source or circumstance.

Smoke complaints and intrusion reports (see **Intrusions**) provide an opportunity for close consideration of events, conditions, communication, and responses. Every complaint that comes in to DNR dispatch is treated as a fire, logged and responded to. If it is a known burn, compliance is evaluated immediately. They are reviewed by DNR staff and managers to determine if the cause was related to silvicultural burning, determine if or how the problem could have been prevented, and to support continuous process improvements.

The methods describing what helpful information to obtain from a complainant, timelines for responding to a complaint and back to the complainant, and follow up are in the Complaint Tracking section of the SMP.

The responsibility lies with the Region Manager in consultation with the Wildfire Division Manager to respond to complaints that result from a silvicultural burn. (See Responsibilities section of the SMP).

A potential future addition to the DNR Burn Portal is a complaint-tracking feature. While DNR regions are currently required to track complaints, addition of the complaint-tracking feature to the burn portal will put all smoke related information in one easy to track location, continuing the culture of continuous improvement.

Conclusion

Based on this Demonstration, DNR's updated SMP will protect air quality and visibility goals in Washington State. DNR requests that Ecology submit this information to EPA for approval into the Washington State SIP.