2014 Alaska Wildfire Emissions Inventory

and

ESMP Report

Department of Environmental Conservation
Air Quality Division
Non-Point Mobile Sources Program

June 3, 2015

Table of Contents

Exhibits

2014 Alaska Wildfire Emissions Inventory

1 INTRODUCTION

The Alaska Department of Environmental Conservation (DEC), in coordination with the Alaska Wildfire Coordinating Group (AWFCG), developed the Alaska Enhanced Smoke Management Plan (ESMP) to reduce smoke impacts from prescribed burning in Alaska. The current ESMP and accompanying volume of appendices were adopted by the AWFCG in June 2009. According to the ESMP, DEC is responsible for collecting, reviewing, tracking, and summarizing burn data for annual ESMP emissions inventory reports to be distributed to the AWFCG, the US Environmental Protection Agency, and the Western Regional Air Partnership (WRAP).

The ESMP helps Alaska protect air quality and human health under federal and state law and reflects the Clean Air Act requirement to improve visibility in Class I areas. The ESMP is an important component of Alaska's Regional Haze State Implementation Plan.

This report fulfils the Department of Environmental Conservation's responsibility for reporting 2014 prescribe fire emissions as required by the ESMP. It provides information about the Department of Environmental Conservation (DEC) Open Burn Applications for prescribed or land clearing burns received and approved by DEC for 2014 and it reports statewide wildfire emissions for the same year. In the past, DEC has prepared two reports to address the fire inventory and ESMP reporting requirements. This report combines the two reports into one document.

1.1 Fire Management in Alaska

The Alaska Interagency Coordination Center (AICC) is the Geographic Area Coordination Center for Alaska. Located on Fort Wainwright, near Fairbanks, the AICC serves at the focal point for initial attack, resource coordination, logistics support, and predictive services for all state and federal agencies involved in wildfire management and suppression in Alaska.

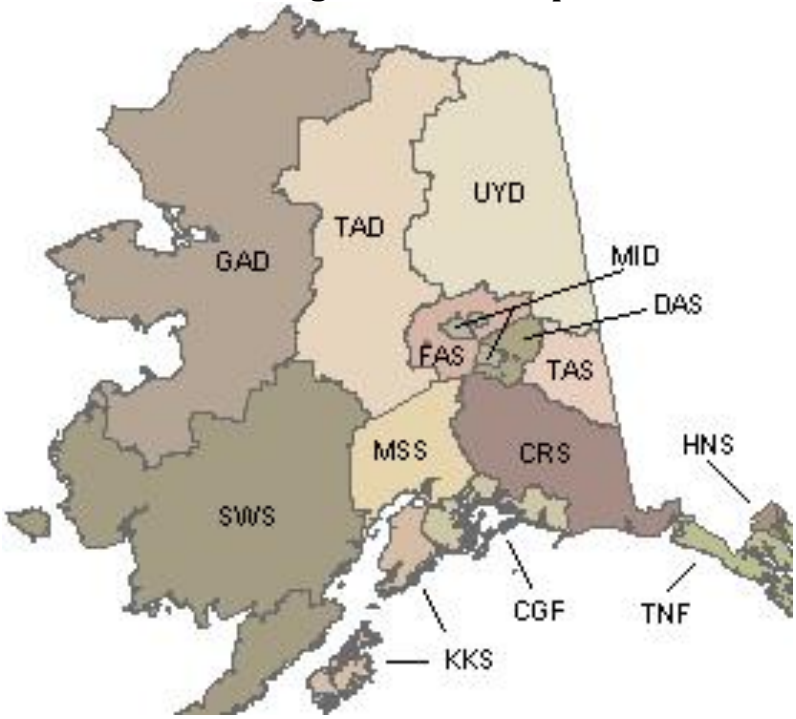
The AICC operates on an interagency basis; cooperators include Bureau of Land Management, State of Alaska Department of Natural Resource's Division of Forestry, USDA Forest Service, National Park Service, Bureau of Indian Affairs, and the US Fish and Wildlife Service. AICC collects wildfire data and prepares daily situation reports.

Fire management planning, preparedness, suppression, prescribed fire, and related activities are coordinated on an interagency basis through the AICC and AWFCG. For the purposes of fire suppression, the Bureau of Land Management, the Forest Service, and state Division of Forestry each take responsibility for managing fire in agreed upon regions of the state, regardless of ownership. This approach reduces the duplication of efforts: Cooperation between state and federal agencies promotes efficient and cost effective use of facilities and resources to manage fires.

The state of Alaska is divided into 14 Fire Management Zones; see Exhibit 1:

- Chugach National Forest (CGF)
- Valdez/Copper River Area Forestry (CRS)
- Delta Area Forestry (DAS)
- Fairbanks Area Forestry (FAS)
- Galena Fire Management Zone (GAD)
- Haines/Northern Southeast Area Forestry (HNS)
- Kenai-Kodiak Area Forestry (KKS)
- Military Fire Management Zone (MID/MIL)
- Mat-Su/Southwest Area Forestry (MSS)
- Southwest District Forestry (SWS)
- Tanana Fire Management Zone (TAD)
- Tok Area Forestry (TAS)
- Tongass National Forest (TNF)
- Upper Yukon Fire Management Zone (UYD)

Exhibit 1 – Fire Management Zone Map



1.2 Fire and Air Quality

A flip of the old adage tells us that where there's fire, there's smoke. Because of the smoke from wildland fires, DEC's Air Quality Division tracks wildfires and regulates prescribed fires.

Smoke is made up of a wide range of chemical compounds, including all of the criteria pollutants regulated by the US Environmental Protection Agency (EPA). Smoke also impairs visibility: local impairment can be severe and contribute to unsafe driving conditions, regional impairment contributes to haze and obscures vistas. The pollutants inventoried for this report are listed in Exhibit 2, along with the reasons for including the pollutants.

Exhibit 2 – Pollutants Inventoried

Pollutant	Abbreviation	Reason for tracking
Fine particulate matter	$PM_{2.5}$	Criteria pollutant
Coarse particulate matter	PM_{10}	Criteria pollutant
Elemental carbon	EC	Visibility impairment
Organic carbon	OC	Visibility impairment
Sulfur dioxide	SO_2	Criteria pollutant
Oxides of nitrogen	NO_X	Criteria pollutant
Volatile organic compounds	VOC	Hazardous air pollutant
Methane	CH_4	Hazardous air pollutant
Ammonia	NH_3	Visibility impairment
Carbon monoxide	CO	Criteria pollutant

This report focuses on fine particulate matter, also called $PM_{2.5}$, because it is the primary pollutant of concern from wildland fires. Fine particulate matter comprises all airborne particles with a diameter smaller than 2.5 microns. Because $PM_{2.5}$ is based on size, not chemical composition, it can be made up of a wide range of chemical compounds. Typically, particles in this size range result from combustion such as wildland fires, power plants, engines, wood stoves, heaters, and vehicles. And, because the particles are so small, they can be inhaled deeply into the lungs, causing cardiovascular and respiratory health risks.

1.3 Open Burn Approvals

Because of the health and visibility effects of smoke, DEC requires anyone burning, or clearing and burning, over 40 acres in one year to obtain an air quality approval before burning. Open burn approvals outline steps to minimize impacts from smoke such as weather monitoring, emission reduction techniques, and consideration of sensitive features like roads, population centers, and airports where smoke can impact health and

visibility. Open burn approvals also require those conducting burns to work with the DEC meteorologist and to submit post burn reports that allow DEC to track and inventory pollutants.

During 2014, DEC granted 10 approvals for open burns for a total of 23 active approvals during the year. Resource agencies submitted post burn reports for 14 prescribed fires, some of these were covered by the same approval while no action was taken under other approvals. There were two active approvals for land clearing burns; neither party conducted their planned burn. AICC records include four open burns that were less than 40 acres. These burns do not require an approval from DEC and do not submit a post burn report; however, they are included in the inventory calculations.

Delta Area Forestry received phone calls regarding one open burn, but the post burn report indicates the callers, although concerned, did not complain. The Oklahoma fire did not receive complaints during the prescribed phase. After the fire escaped, the Alaska Fire Service received some complaints.

There were no known adverse effects to Sensitive Areas or to Class I Areas.

2 METHOD

To prepare the 2014 wildfire emissions inventory, DEC used the Wildland Fire Emission Template prepared in 2006 by Air Sciences. The template is an Excel spreadsheet prepopulated with formulas and emission factors to calculate wildland fire emissions. The user enters basic information about each fire and assigns fuel loading factors based on vegetation type. The inputs include:

- Fire name
- Acres
- Start date
- Out date
- Vegetation type
- Prescribed or wildfire
- Broadcast or piles
- For prescribed fires, vegetation category determines emission reduction technique effectiveness

As in previous years, AICC provided this data to DEC at the end of the year.

For the 2014 inventory, as for the 2012 and 2013 inventories, fuel loading factors were determined using either the Basic Method or the LANDFIRE method. These methods are described below.

2.1 Basic Method

For most of the fires, DEC assigned a fuel loading factor for each fire based on the vegetation type listed in the AICC dataset; see Exhibit 3. Some fires did not have a vegetation type assigned in the data set. For these fires, where available, the vegetation type listed in the situation report was used. Otherwise, DEC assumed that all fires without a vegetation type listed were grass fires.

Exhibit 3 – Fuel Loading Factors

Fuel Factor Name	Wildfire (tons per acre)	Prescribed (tons per acre)
Western grasses (annual)	0.5	0.5
Intermediate brush	15	15
Short needle (heavy dead)	43.5	25.6
Western grasses (perennial)	0.75	0.75
Alaskan black spruce	57.57	48.76
Hardwood litter (summer)	3.05	3.05
Tundra	19.3	19.05
None	0	0

2.2 LANDFIRE Method

Because fires can start in one vegetation type, and burn through others, for the largest fires, AICC provided more detailed vegetation data from the LANDFIRE system. This is the third year this approach has been used for the largest fires. DEC strives to capture at least 80 percent of the area burned or up to the 20 largest fires. This year, the three largest fires burned 94 percent of the total area burned during the fire season; see Exhibit 4.

The LANDFIRE data set provides the percentage of area for each fire by vegetation type and draws on a more extensive list of vegetation types. These vegetation types were assigned known fuel constants as listed in Appendix 1. For a number of the vegetation types, though, an average of two known fuel loading factors was used.

Finally, combining the fuel factors of individual vegetation types that burn in a fire gives a calculated fuel factor for each fire that more accurately describes calculates the fire emissions.

Exhibit 4 – 2014 Largest Fires

Fire Name	Acres	Calculated Fuel Factor
Funny River Fire	196,610	49.81
Oklahoma Range Prescribed Fire	56,648	21.84
100 Mile Fire	23,270	32.92

2.3 Temporal Adjustments

The Wildland Fire Emission Template assigns emissions to certain months based on a fire's start and end dates, which may produce misleading results. The template averages the calendar start and end dates then assigns the emissions to the month of the averaged date. Sometimes this does not accurately reflect the time period a fire actually produced the most emissions because fires may not be declared out until long after the majority of the active combustion occurred. Temporal adjustments shift the fire to the time period that better reflect actual emission patterns.

One adjustment was made to the 2014 fire data to better represent the actual period when emissions occurred. The Funny River fire started in May but was not declared out until December resulting in the template assigning the emissions to August. However, the majority of the emissions occurred as the fire burned rapidly in late May so the emissions were reassigned to May in the inventory.

2.4 Prescribed Fires

Two sources provide information on prescribed fires: the AICC data set and post burn reports submitted to DEC by organizations that conduct burns. The AICC dataset showed 8 prescribed burns over 40 acres with a total of 59,552 acres burned and six burns under 40 acres totaling 120 acres. For 2014, DEC received 14 post burn reports totaling 61,044 acres.

Discussion with fire agency staff revealed that some of the 14 prescribed fires in the AICC dataset actually represented fires reported in multiple post burn reports. Fire agency staff also explained that where information differed between the AICC and DEC post burn reports, DEC's post burn report information is likely more accurate. Thus, post burn report data was substituted for some AICC data for prescribed fires.

The final area for all prescribed fires, regardless of size, was 61,164 acres.

3 2014 EMISSIONS

The following sections report the 2014 Alaska wildland fire emissions.

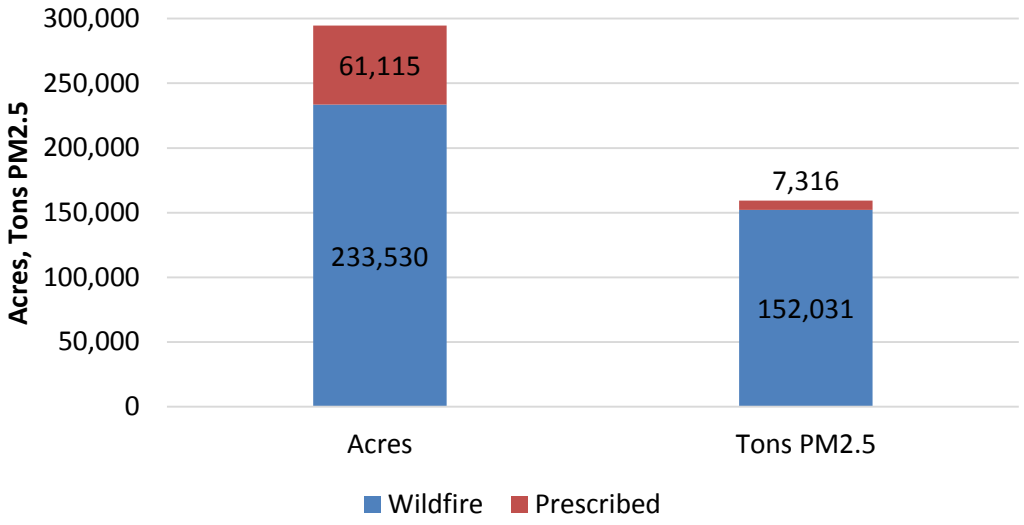
3.1 Total Acres and Emissions

During 2014, wild and prescribed fires burned approximately 294,645 acres. The emissions and area are shown in Exhibit 5.

The prescribed fires produced proportionally fewer emissions than the wildfires for two main reasons:

- Prescribed fires are intentionally carried out under controlled conditions to produce fewer emissions.
- This year's prescribed fires were largely grass fires, which produce fewer emissions than fires that have more fuel to consume.

Exhibit 5 – Wild and Prescribed Area Burned and $PM_{2.5}$ Emissions Released

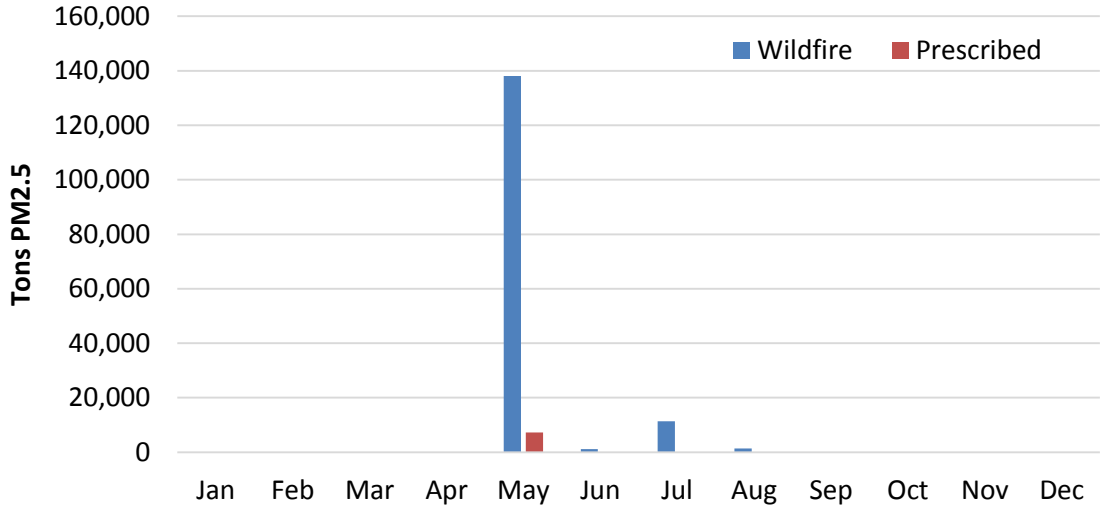


3.2 Temporal Emissions Distribution

The following exhibit, 6, shows the temporal distribution of emissions from both wildfires and prescribed fires. The majority of the prescribed fire emission occurred in May and came from the Oklahoma Range fire. Most of the wildfire emissions occurred in May and June, primarily from the Funny River fire with some contributions from the 100 Mile fire and a number of smaller fires.

As mentioned in section 2.3, the Funny river fire was not declared out until December, but the emissions from the fire were distributed evenly over May and June, when the fire was actively burning.

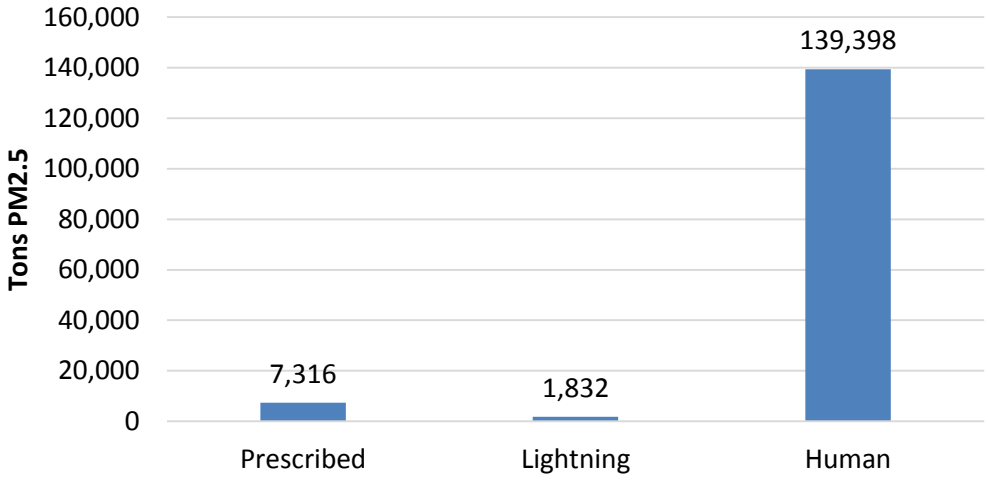
Exhibit 6 – Wildfire and Prescribed Fire Emissions Temporal Distribution



3.3 Emissions by Fire Cause

Historically, most fires in Alaska are ignited by lightning. However, in 2014, a large majority of wildland fire emissions came from fires started by people instead of emissions from lightning-started fires. Again, this is because the human-caused Funny River fire dominated the fire season. Exhibit 7 displays emissions by cause of the fire.

Exhibit 7 – $PM_{2.5}$ Emissions by Fire Cause

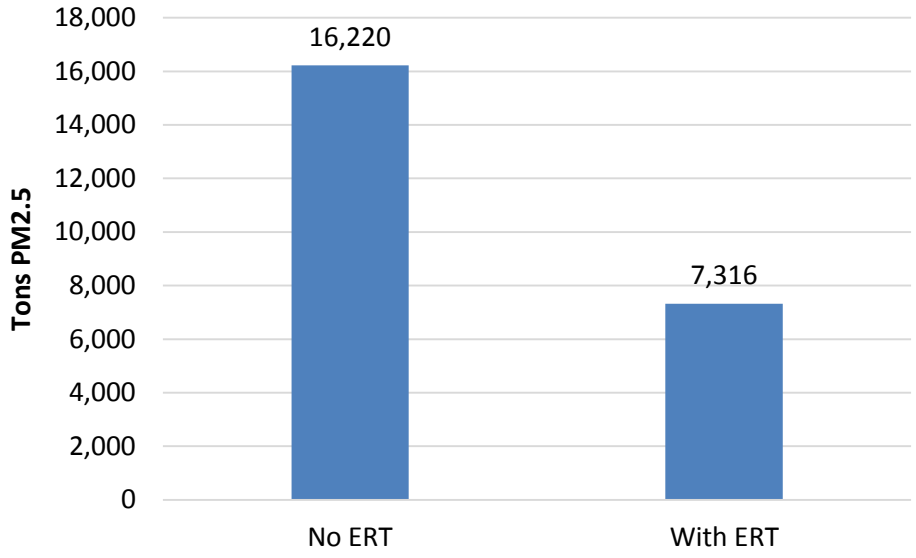


3.4 Emission Reduction Techniques

Emission Reduction Techniques (ERTs) are used to reduce emissions from prescribed fires. Examples include using multiple ignition points, igniting under weather conditions that promote good plume rise, and ensuring the vegetation is dry.

In 2014, the application of ERTs reduced emissions by over 9,000 tons of $PM_{2.5}$, which is over 50 percent of the emissions that could have occurred from the same areas during an uncontrolled burn; see Exhibit 8. In addition to reduced emissions from the area that burns, prescribed fires are also used to reduce fuel load and create firebreaks, thereby preventing larger uncontrolled burns from occurring and potentially reducing emissions by many times more than is calculated.

Exhibit 8 – $PM_{2.5}$ Emission Reductions from Emission Reduction Techniques



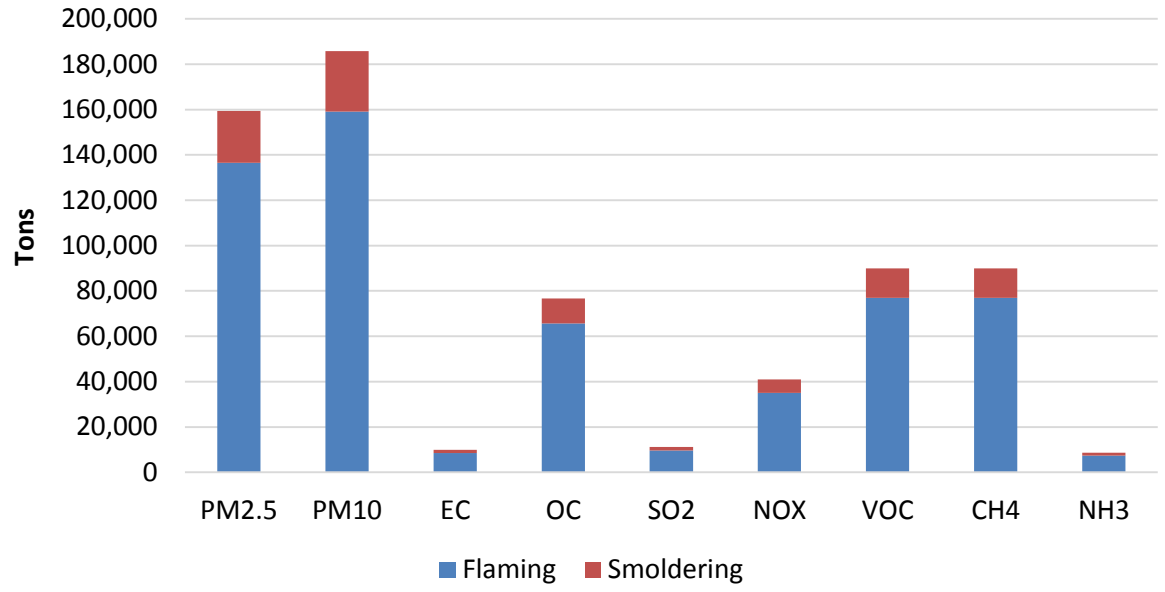
3.5 All Pollutants

Exhibit 9 shows the quantities of all the pollutants inventoried for this report. Exhibit 10 displays the same information graphically. (Carbon monoxide is not shown in the Exhibit 10 because the quantity of it is so much greater than the other pollutants.)

Exhibit 9 – Quantities of all Pollutants

Pollutant	Abbreviation	Flaming (tons)	Smoldering (tons)
Fine particulate matter	$PM_{2.5}$	137,302	22,731
Coarse particulate matter	PM_{10}	160,091	26,504
Elemental carbon	EC	8,546	1,415
Organic carbon	OC	66,087	10,941
Sulfur dioxide	SO_2	9,685	1,603
Oxides of nitrogen	NO_X	35,322	5,848
Volatile organic compounds	VOC	77,482	12,828
Methane	CH_4	77,482	12,828
Ammonia	NH_3	7,406	1,226
Carbon monoxide	CO	1,646,484	272,587

Exhibit 10 – All Pollutants



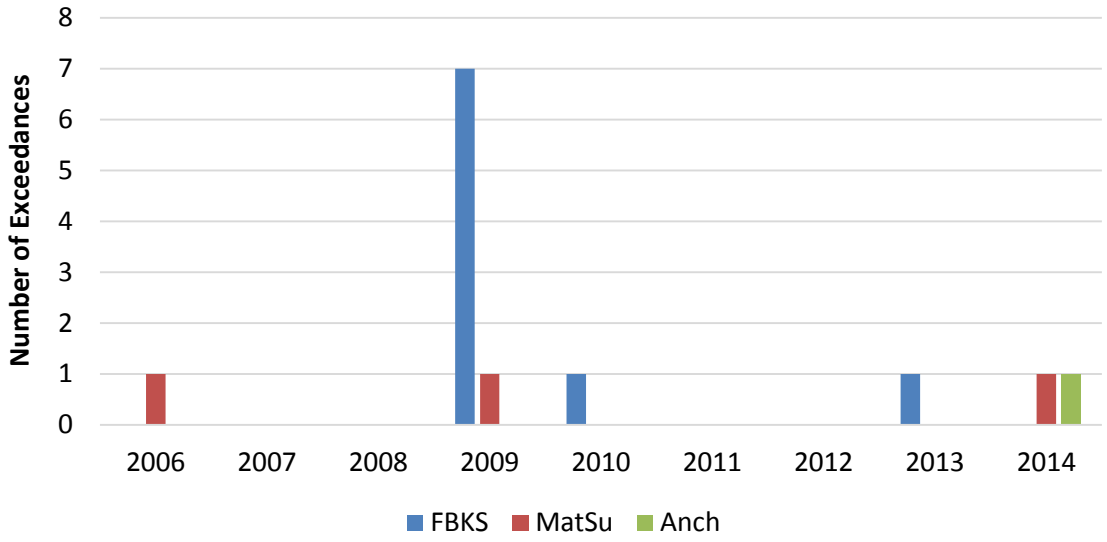
4 AIR QUALITY STANDARDS AND EXCEEDANCES

EPA sets National Ambient Air Quality Standards (NAAQS) for six criteria pollutants to protect human health. $PM_{2.5}$ is the criteria pollutant of primary concern from wildland fires. An exceedance of the $PM_{2.5}$ ambient air quality standard occurs when the 24-hour average concentration, measured in micrograms per cubic meter ($\mu g/m^3$), exceeds 35 $\mu g/m^3$. In Alaska, fine particulate matter is measured in the major population areas and one or two remote locations that can vary from year to year. Regulatory monitoring is conducted every third day, which means that smoke events can occur that are not captured in the monitoring data.

Exhibit 11 shows the number of exceedances recorded from 2006 to 2014 that were caused by wildfire. In 2014, exceedances were recorded in Anchorage and the Matsu communities of Palmer, Wasilla, and Butte on May 22 from the Funny River and Tyonek fires. DEC is planning to prepare an exceptional events waiver request for the exceedances recorded during these fires.

$PM_{2.5}$ levels most certainly exceeded the standard for multiple days in Soldotna during the most active phase of the Funny River fire, as well; unfortunately, the Soldotna monitor experienced technical difficulties during that period and did not record data.

Exhibit 11 – Summer Exceedances of Air Quality Standards by Area



5 AIR QUALITY ADVISORIES

DEC issues air quality advisories during times of widespread elevated pollution levels, which typically result from wildland fire smoke, windblown dust, volcanic ash, or high levels of wintertime particulate matter. Advisories use the Air Quality Index, or AQI, to normalize air quality readings across multiple pollutants and issue standard cautionary statements. Exhibit 12 shows the AQI levels for $PM_{2.5}$ and the associated cautionary statements.

Exhibit 12 – Air Quality Index Levels

24-Hour $\mu g/m^3$ $PM_{2.5}$	AQI Score	AQI Category	AQI Cautionary Statements
0.0 to 12.0	0-50	Good	None
12.1 to 35.4	51-100	Moderate	Unusually sensitive people should consider reducing prolonged or heavy exertion.
35.5 to 55.4	101-150	Unhealthy for Sensitive Groups	People with respiratory or heart disease, the elderly, and children should limit prolonged exertion.
55.5 to 150.4	151-200	Unhealthy	People with respiratory or heart disease, the elderly, and children should avoid prolonged exertion; everyone else should limit prolonged exertion.
150.5 to 250.4	201-300	Very Unhealthy	People with respiratory or heart disease, the elderly, and children should avoid any outdoor activity; everyone else should avoid prolonged exertion.
greater than 250.5	301-500	Hazardous	Everyone should avoid any outdoor exertion; people with respiratory or heart disease, the elderly, and children should remain indoors.

Multiple air quality advisories may be issued on the same day for different areas of the state, and advisories may be issued for multiple days, not just for 24 hours. In 2014, DEC issued 7 advisories covering the 11-day period from May 20 through May 30. In addition to DEC, the Fairbanks North Star Borough, the Matanuska Susitna Borough, and the Municipality of Anchorage sometimes issue their own advisories. During 2014, the Matanuska Susitna Borough issued 2 advisories covering 7 days and the Municipality of Anchorage issued 1 advisory covering 7 days. No advisories were issued for the Fairbanks

area during the 2014 fire season. Exhibit 13 and 14 show the numbers of advisories DEC issued compared to wildfire emissions and by month, respectively.

Exhibit 13 demonstrates that the number of AQ advisories is not necessarily dependent on the acreage burned in a year; but also related to factors such as fire location, duration, intensity, wind direction, and wind speed.

Exhibit 13 – Air Quality Advisories Issued due to Smoke and Wildfire Emissions

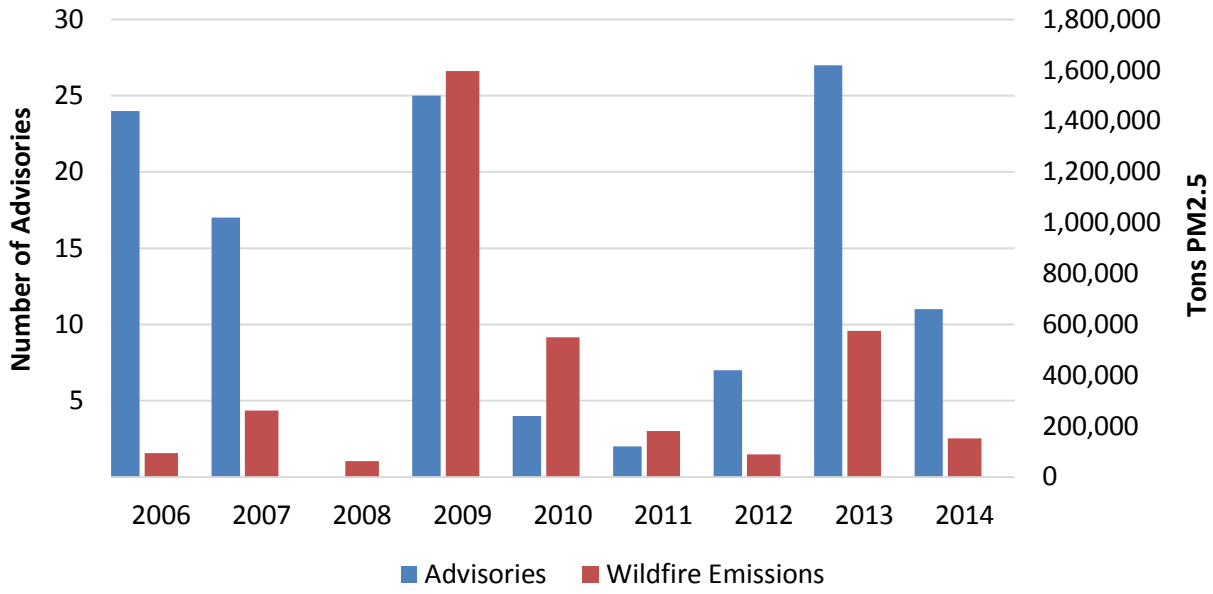
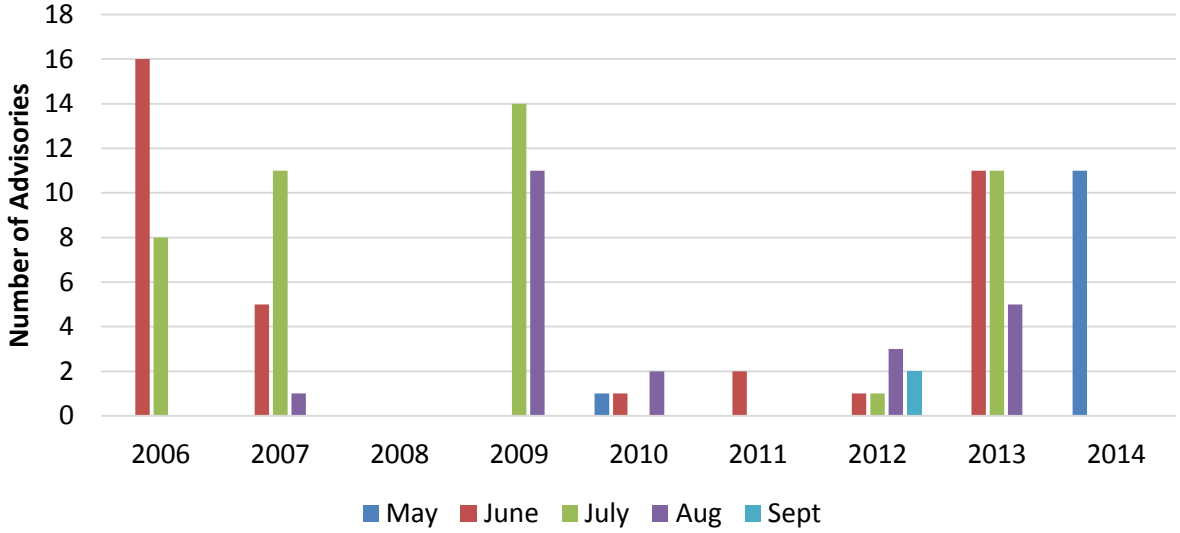


Exhibit 14 – Number of Air Quality Advisories Issued by Month



6 EMISSIONS OVER TIME

Exhibits 15 and 16 compare prescribed and wildfire emissions to the area burned for the last ten years. Both categories of fire can vary widely from year to year. For prescribed fires, this variation depends on need and the agencies' ability to accomplish the fires. Having the right weather conditions plays an important role in agencies' decisions to burn. In 2014, a much larger area was burned than in the recent past. The Oklahoma Range fire was over 56,000 acres, bumping the total for the year to almost 60,000 acres.

The area burned each year by wildfire varies even more than the area burned by prescribed fires, historically ranging from under 10,000 acres to several million. With just over 276,000 acres, 2014 was a relatively low year for wildfires and associated emissions were also relatively low. A wetter than normal summer in the interior, where most wildfire activity in Alaska occurs, along with fewer lightning strikes than normal, kept the area burned to a minimum.

Exhibit 15 – Prescribed Area and Emissions 2005 through 2014

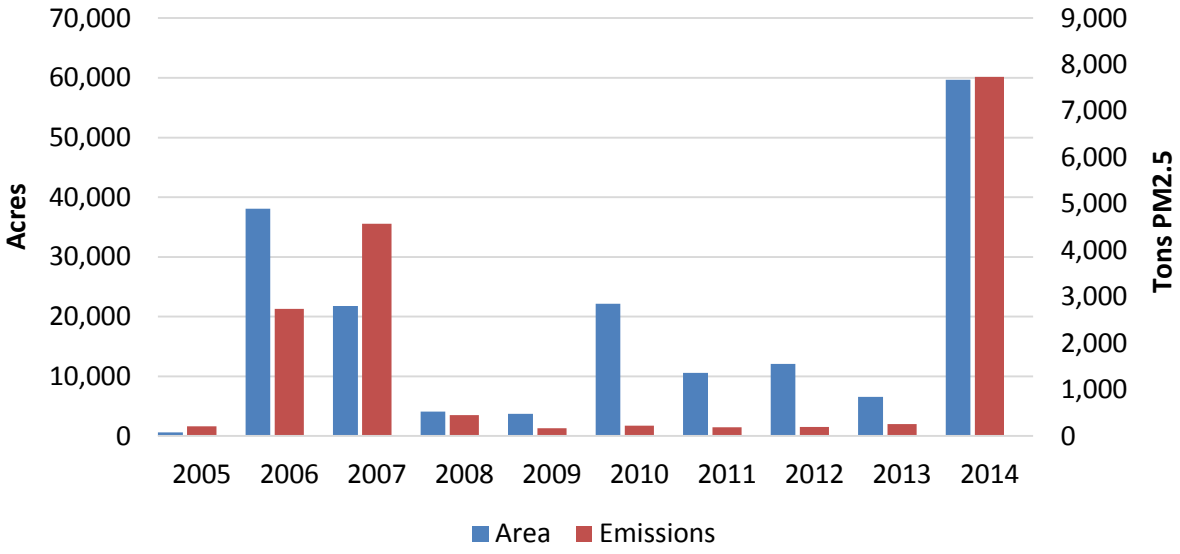
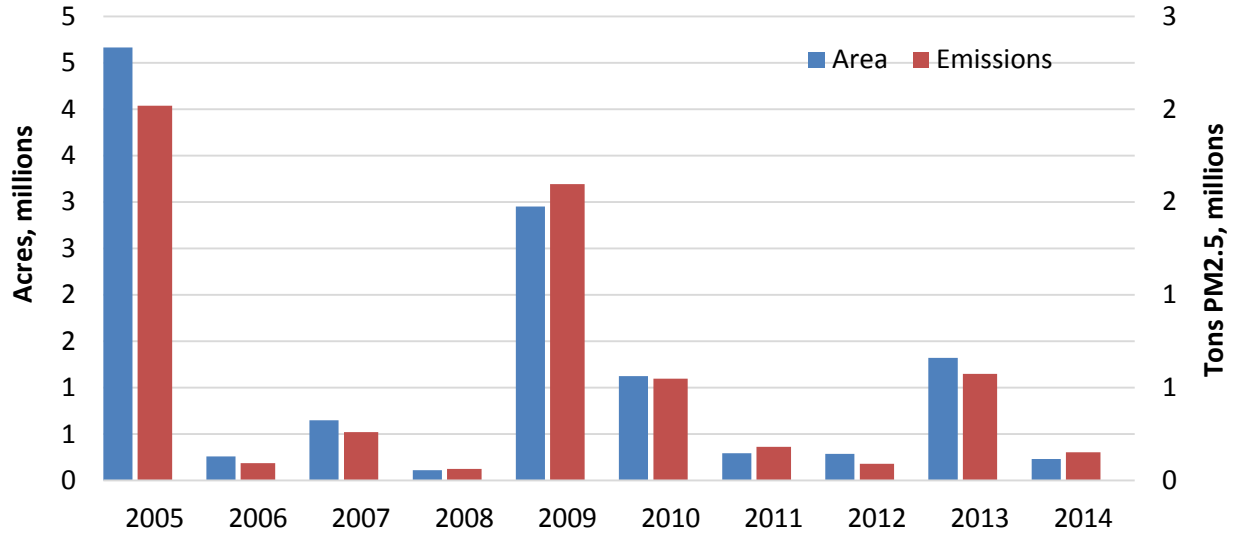


Exhibit 16 – Wildfire Area and Emissions 2005 through 2014



Appendix 1 – LANDFIRE Vegetation Types and Fuel Factors

LANDFIRE Vegetation Types and Fuel Factors

Vegetation Type Name	Fuel Factor Name 1	Fuel Factor Name 2	Fuel Factor
Barren	None	None	0
Boreal Sparsely Vegetated	None	None	0
Open Water	None	None	0
Snow-Ice	None	None	0
Ag-Cultivated Crops and Irrigated Agriculture	Western grasses (perennial)	Western grasses (perennial)	0.75
AK Arctic Mesic Herbaceous Meadow	Western grasses (perennial)	Western grasses (perennial)	0.75
AK Subboreal and Maritime Alpine Mesic Herbaceous Meadow	Western grasses (perennial)	Western grasses (perennial)	0.75
Arctic Herbaceous Wetlands	Western grasses (perennial)	Western grasses (perennial)	0.75
Arctic Sedge Meadows	Intermediate brush	Western grasses (perennial)	0.75
Boreal Aquatic Beds	Western grasses (perennial)	Western grasses (perennial)	0.75
Boreal Herbaceous Wetlands	Western grasses (perennial)	Intermediate brush	0.75
Developed-Low Intensity	Western grasses (perennial)	Western grasses (perennial)	0.75
W N Am. Boreal Alpine Mesic Herbaceous Meadow	Intermediate brush	Western grasses (perennial)	0.75
W N Am. Boreal Dry Grassland	Western grasses (perennial)	Western grasses (perennial)	0.75
W N Am. Subboreal Mesic Bluejoint Meadow	Western grasses (perennial)	Western grasses (perennial)	0.75
AK Arctic Dwarf-Shrubland	Intermediate brush	Western grasses (perennial)	7.875
AK Arctic Scrub Birch-Ericaceous Shrubland	Intermediate brush	Western grasses (perennial)	7.875
AK Subboreal Avalanche Slope Shrubland	Intermediate brush	Western grasses (perennial)	7.875
AK Subboreal Mesic Subalpine Alder Shrubland	Intermediate brush	Western grasses (perennial)	7.875
AK Pacific Maritime Alpine Dwarf-Shrubland	Intermediate brush	Western grasses (perennial)	7.875
Boreal Dwarf Shrub Wetland	Intermediate brush	Western grasses (perennial)	7.875
Boreal Shrub Swamp	Intermediate brush	Western grasses (perennial)	7.875
W N Am. Boreal Alpine Dryas Dwarf-Shrubland	Intermediate brush	Western grasses (perennial)	7.875

Vegetation Type Name	Fuel Factor Name 1	Fuel Factor Name 2	Fuel Factor
W N Am. Boreal Alpine Dwarf-Shrub Summit	Intermediate brush	Western grasses (perennial)	7.875
W N Am. Boreal Alpine Dwarf-Shrub-Lichen Shrubland	Intermediate brush	Western grasses (perennial)	7.875
W N Am. Boreal Alpine Ericaceous Dwarf-Shrubland	Intermediate brush	Western grasses (perennial)	7.875
W N Am. Boreal Mesic Scrub Birch-Willow Shrubland	Short needle (heavy dead)	Intermediate brush	29.25
Arctic Shrub-Tussock Tundra	Tundra	Tundra	19.3
Boreal Shrub-Tussock Tundra	Tundra	Tundra	19.3
Boreal Tussock Tundra	Tundra	Tundra	19.3
AK Arctic Acidic Dwarf-Shrub Lichen Tundra	Tundra	Tundra	19.3
Arctic Floodplains	Tundra	Tundra	19.3
Arctic Peatlands	Tundra	Intermediate brush	17.15
Boreal Floodplains	Intermediate brush	Western grasses (perennial)	7.875
Boreal Peatlands	Western grasses (perennial)	Intermediate brush	7.875
AK Subboreal White-Lutz Spruce Forest and Woodland	Alaskan black spruce	Alaskan black spruce	57.57
Boreal Riparian Stringer Forest and Shrubland	Intermediate brush	Intermediate brush	15
W N Am. Boreal Dry Aspen-Steppe Bluff	Short needle (heavy dead)	Short needle (heavy dead)	43.5
W N Am. Boreal Mesic Birch-Aspen Forest	Short needle (heavy dead)	Short needle (heavy dead)	43.5
W N Am. Boreal Subalpine Balsam Poplar-Aspen Woodland	Short needle (heavy dead)	Intermediate brush	29.25
W N Am. Boreal Treeline White Spruce Woodland	Alaskan black spruce	Alaskan black spruce	57.57
W N Am. Boreal White Spruce Forest	Alaskan black spruce	Alaskan black spruce	57.57
Boreal Coniferous Woody Wetland	Alaskan black spruce	Western grasses (perennial)	29.16
W N Am. Boreal Spruce-Lichen Woodland	Short needle (heavy dead)	Western grasses (perennial)	22.125
AK Subboreal White Spruce-Hardwood Forest	Alaskan black spruce	Alaskan black spruce	57.57
W N Am. Boreal White Spruce-Hardwood Forest	Alaskan black spruce	Alaskan black spruce	57.57
Boreal Coniferous-Deciduous Woody Wetland	Alaskan black spruce	Alaskan black spruce	57.57
W N Am. Boreal Mesic Black Spruce Forest	Alaskan black spruce	Alaskan black spruce	57.57

Vegetation Type Name	Fuel Factor Name 1	Fuel Factor Name 2	Fuel Factor
AK Boreal Hardwood Forest	Alaskan black spruce	Alaskan black spruce	57.57
AK Boreal White Spruce Forest	Alaskan black spruce	Alaskan black spruce	57.57
AK Boreal White Spruce-Hardwood Forest	Alaskan black spruce	Alaskan black spruce	57.57
AK Subboreal Hardwood Forest	Alaskan black spruce	Alaskan black spruce	57.57
AK Subboreal Mtn. Hemlock-White Spruce Forest	Alaskan black spruce	Alaskan black spruce	57.57
AK Subboreal White Spruce Forest	Alaskan black spruce	Alaskan black spruce	57.57
AK Pacific Maritime Mountain Hemlock Forest	Alaskan black spruce	Alaskan black spruce	57.57
AK Pacific Maritime Subalpine Alder-Salmonberry Shrubland	Intermediate brush	Western grasses (perennial)	7.875
Boreal Forested Floodplains	Alaskan black spruce	Intermediate brush	36.285
Boreal Forest-Tussock Tundra	Alaskan black spruce	Tundra	38.435
Boreal Herbaceous Floodplains	Intermediate brush	Western grasses (perennial)	7.875
Boreal Shrub Floodplains	Intermediate brush	Western grasses (perennial)	7.875
Developed-Open Space	Western grasses (perennial)	Western grasses (perennial)	0.75
Pacific Maritime Herbaceous Wetlands	Western grasses (perennial)	Intermediate brush	7.875
Pacific Maritime Shrub Floodplains	Western grasses (perennial)	Intermediate brush	7.875
Recently Burned-Tree Cover	Short needle (heavy dead)	Short needle (heavy dead)	43.5