2011 Alaska
Wildfire Emissions Inventory

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Contents Page

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Summary

The Department of Environmental Conservation (DEC) in coordination with the Alaska Wildland Fire Coordinating Group (AWFCG) developed the Alaska Enhanced Smoke Management Plan (ESMP) to reduce wildfire smoke impacts in Alaska. The 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 statewide pre- and post-burn data for annual ESMP emissions inventory reports to be distributed to the AWFCG, the U.S. Environmental Protection Agency and the Western Regional Air Partnership (WRAP).[1]

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

This report accomplishes the Department of Environmental Conservation's responsibility for reporting 2011 prescribed fire emissions as required by the Enhanced Smoke Management Plan. It also reports on the statewide wildfire emissions occurring in 2011.

In 2011, 26 prescribed fires were conducted, burning a total of 10,585 acres. The largest number of prescribed acres burned occurred in May and June 2011 and were conducted by or for the military. The same summer 515 wildfires burned a total of 293,018 acres. The wildfire acreage burned was the second lowest of the past 10 years. One wildfire was reported in February and four in March, but the majority of reported fires occurred in May, June, and July in the northern half of the state.

The ten wildfires producing the most $PM_{2.5}$ emissions created approximately 137,354.9 tons of $PM_{2.5}$, which was close to 75.9% of the total tons of $PM_{2.5}$ produced by all 515 wildfires. Those same ten wildfires burned approximately 230,713.8 acres which was about 78.7% of the total acres burned.

The Alaska Interagency Coordination Center (AICC) is the Geographic Area Coordination Center for Alaska. Located on Ft. Wainwright, near Fairbanks, the AICC serves as 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. [2]

The AICC operates on an interagency basis - cooperators include the Bureau of Land Management, State of Alaska Department of Natural Resources (including the Division of Forestry), USDA Forest Service, National Park Service, Bureau of Indian Affairs, and the Fish and Wildlife Service.[3] The AICC collects most wildfire related data into daily situation reports, available on their website: http://fire.ak.blm.gov/predsvcs/intel.php

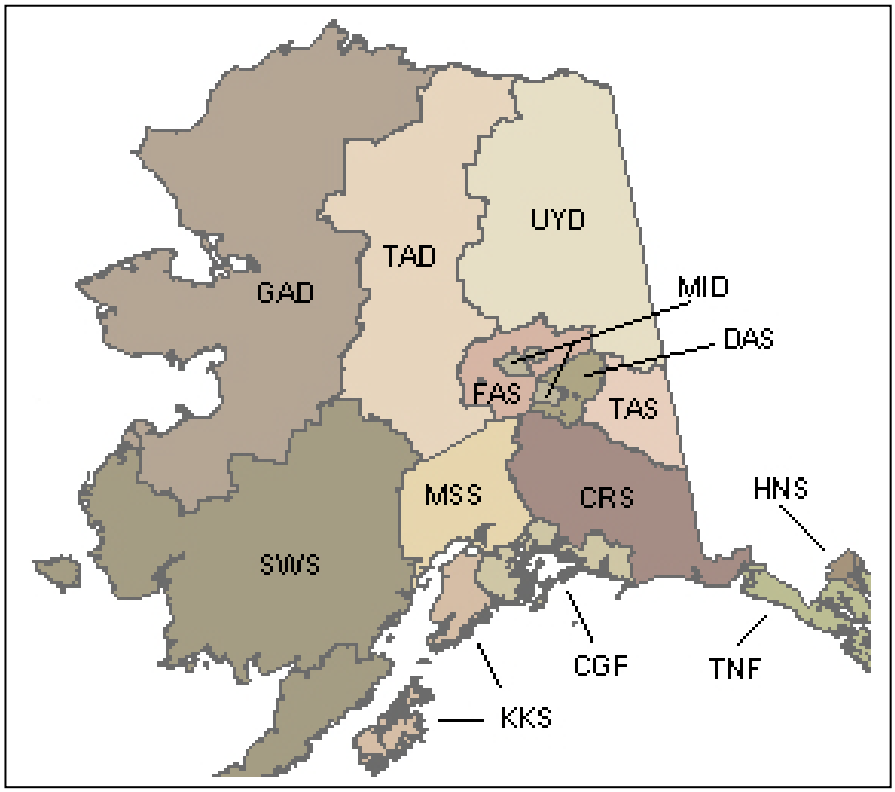
Alaska has 14 Fire Management Zones. Fire management planning, preparedness, suppression operations, prescribed fire, and related activities are coordinated on an interagency basis (i.e., the AICC). The Division of Forestry, Bureau of Land Management, and the U.S. Forest Service fight fires within their protection areas on all land ownerships which reduces the duplication of facilities and services. The state

[1] Alaska Enhanced Smoke Management Plan for Planned Fire, Procedures Manual, Executive summary, June 2009
[2] Alaska Interagency Coordination Center website: http://fire.ak.blm.gov/aicc.php
[3] ibid

and federal agencies routinely utilize each other's personnel and resources to both manage and fight fires for efficiency and cost effectiveness.[4]

The 14 Alaska Fire Management Zones are shown on the map below. These zones are as follows:

- 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)
- 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)



[4] Division of Forestry Fire Program webpage: http://forestry.alaska.gov/fire/

Method for 2011 Alaska Wildfire Emissions Inventory

The Wildland Fire Emission Template prepared in 2006 by Air Sciences, Inc. for the Department of Environmental Conservation (DEC) was used to prepare the 2011 wildfire inventory. The template, after input of appropriate data, graphs and summarizes the fire and emissions data. Using the template provides a consistent analysis of fire data from year to year.

A summary of the 2011 fires, their type, start and end dates, 'owner', locations, and acreages was provided to DEC by the Division of Forestry. The data was copied into the template. The dates were re-entered to conform to the requirements of the template. The 'emission factor' for each fire, as determined by either the vegetative type listed on the Excel spreadsheet (saved weekdays from the AICC website) or the description on the 2011 daily AICC situation reports, was also input. One 'short cut' was taken: 314 fires were less than 0.2 acre in size. After reviewing approximately 25 of those listed as 0.1 to 0.2 acre and determining most of them had been grass fires, the emission factor of 0.75 (grass) was used for all fires listed as 0.2 acres or less. This was accomplished using EXCEL. These 314 fires totaled 34.0 acres, or approximately 0.0116% of the total acreage burned in 2011. The wildfire acreage and numbers in the Emission Inventory template matched the acreage and numbers in the AICC for the 2011 wildfires.

The fires in the emission inventory are categorized into two groups: Prescribed Fires and Wildfires. The category of "Wildland Fire Use" is now obsolete and has not been used by agencies since the 2008 fire season in describing and tracking fires. In the past, this category described the management of either wildfire or prescribed fire to meet resource objectives or benefits. The National Wildfire Coordinating Group ceased to use this term because a wildland fire may be concurrently managed for one or more objectives and objectives can change as fire moves across the landscape. As a result, this category is no longer recorded as a separate category.[5]

The following definitions are taken from the 2009 Alaska Enhanced Smoke Management Plan for Planned Fire.

- **Prescribed Fire**, or controlled burn, is any fire ignited by management actions to meet specific objectives. A written, approved prescribed fire plan must exist. In a federal action, National Environmental Policy Act requirements must be met prior to ignition. Prescribed fire is a type of open burning.

- **Wildfire** is any non-structure fire, other than prescribed fire, that occurs in the Wildland. Wildland is an area where development is generally limited to roads, railroads, power lines, and widely scattered structures. The land may be neglected altogether or managed for such purposes as wood or forage production, wildlife, recreation, wetlands or protective plant cover.

[5] NWCG Memorandum Ref# NWCG024-2010, Terminology Updated Resulting from Release of the *Guidance for the Implementation of Federal Wildland Fire Management Policy (2009)*, April 30, 2010.

Discussion of Results

The Fire Emission Template presents results through 10 graphs. Figures 1 through 10 are discussed on this and the following pages. A listing of the emission factors used for vegetation groups is provided after Figure 10.

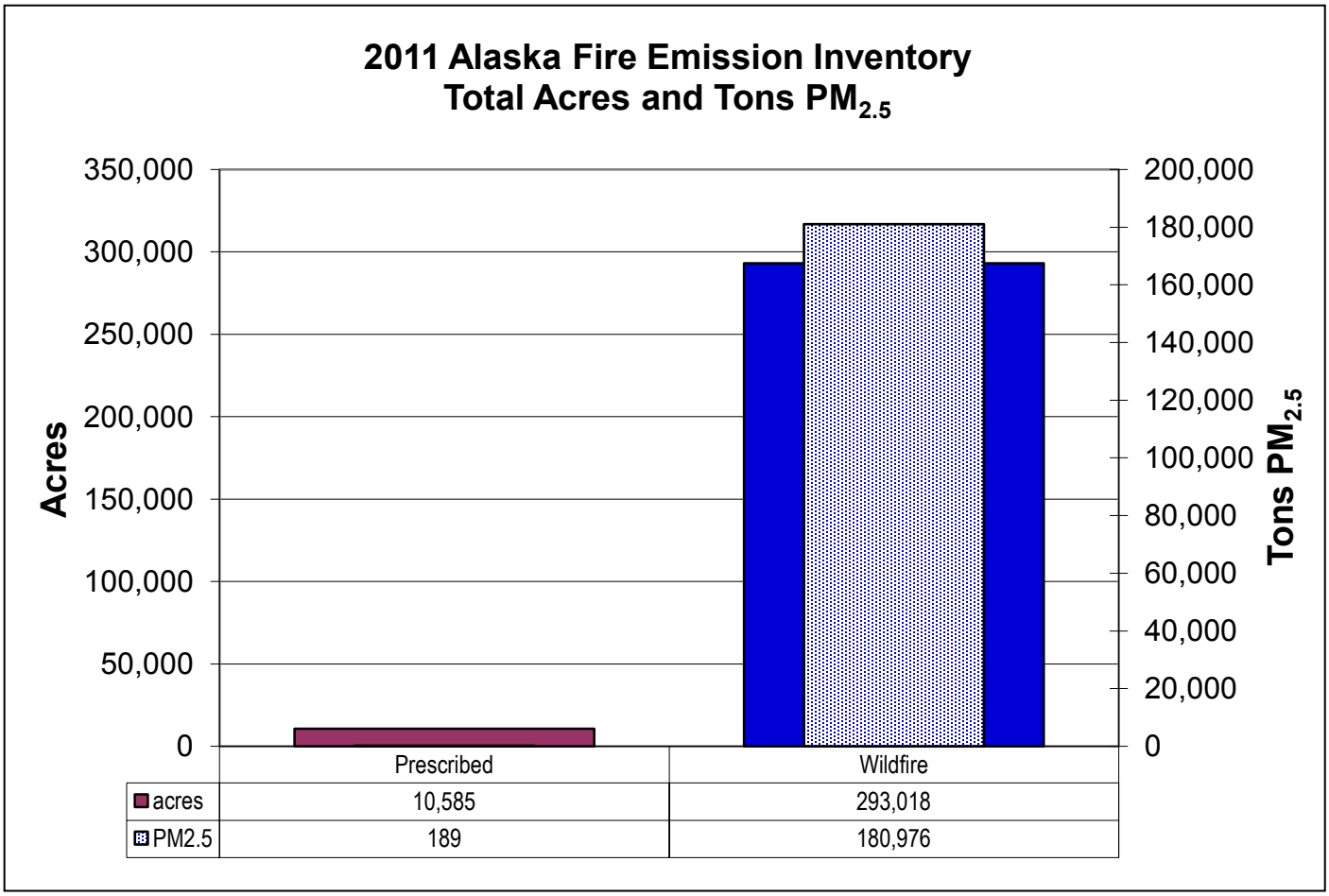
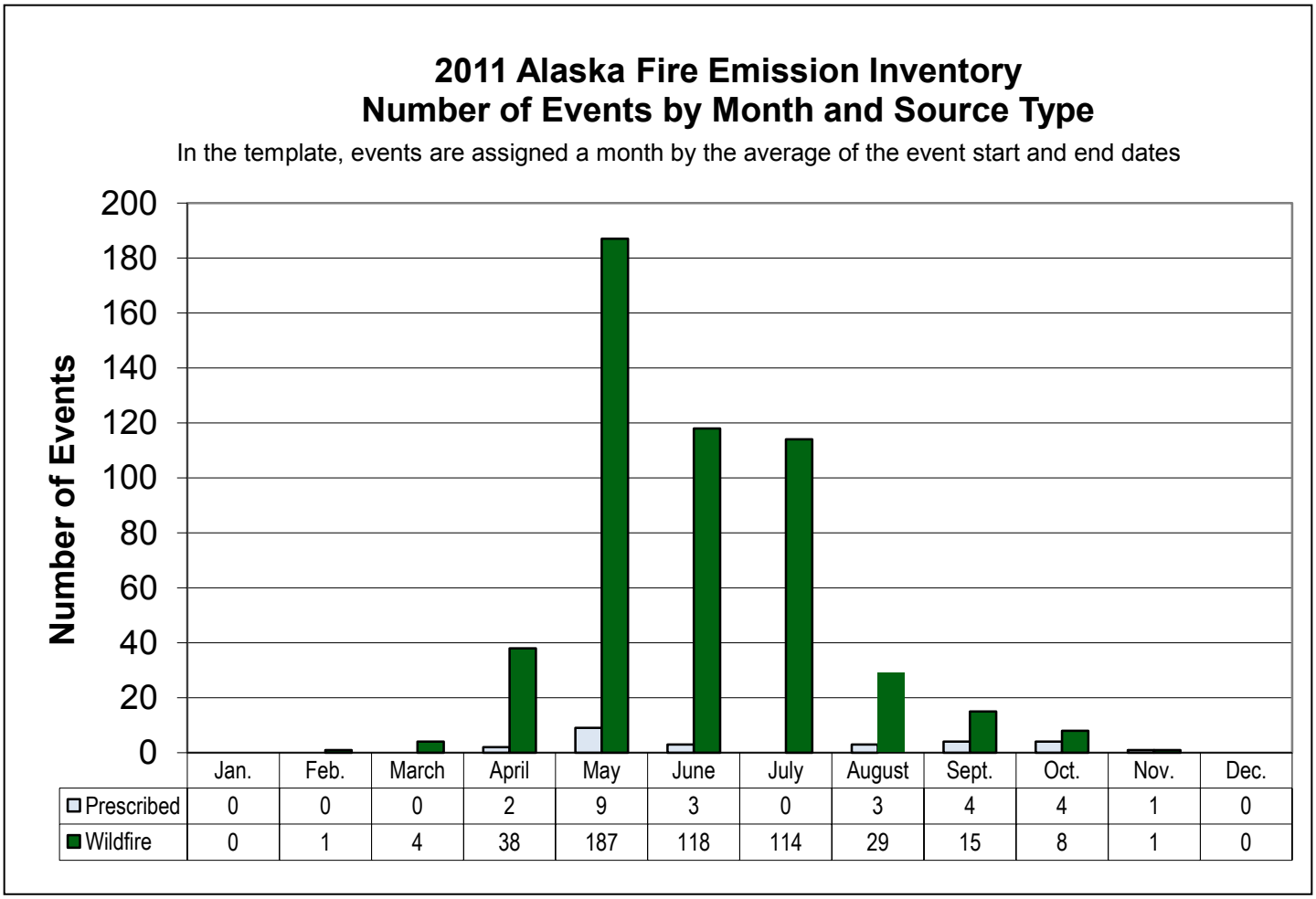


FIGURE 1

Figure 1 shows the number of acres burned and the tons of PM2.5 produced for both fire types (prescribed and wildfire) during the 2011 season.

- Prescribed fires were approximately 3.5% (10,585 acres) of the total 2011 Alaskan fires, producing 189 tons of $PM_{2.5}$ (approximately 0.1%) of the total $PM_{2.5}$ produced.

- Wildfires were approximately 96.5% (293,018 acres) of the total 2011 Alaskan fires, producing 180,976 tons of $PM_{2.5}$ (approximately 99.9%) of the total $PM_{2.5}$ produced.



	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
Prescribed	0	0	0	2	9	3	0	3	4	4	1	0
Wildfire	0	1	4	38	187	118	114	29	15	8	1	0

FIGURE 2

Figure 2 shows the total number of wildfires in 2011, by month and type of fire, prescribed or wildfire.

The month with the most prescribed burns in 2011 was May (9 burns, 34.6%). The other prescribed burns occurred in April, June, August, September, and October for a total of 17 burns or 65.4%.

Most of the wildfires occurred during the summer months of May, June, and July (81.4%, 419 fires), with a couple of fires in February through April (8.3%, 43 fires) and 53 fires spread from August through November (10.3%). Most of the fires in the first couple weeks of May were small, escaped residential grass fires or small burn pile fires.

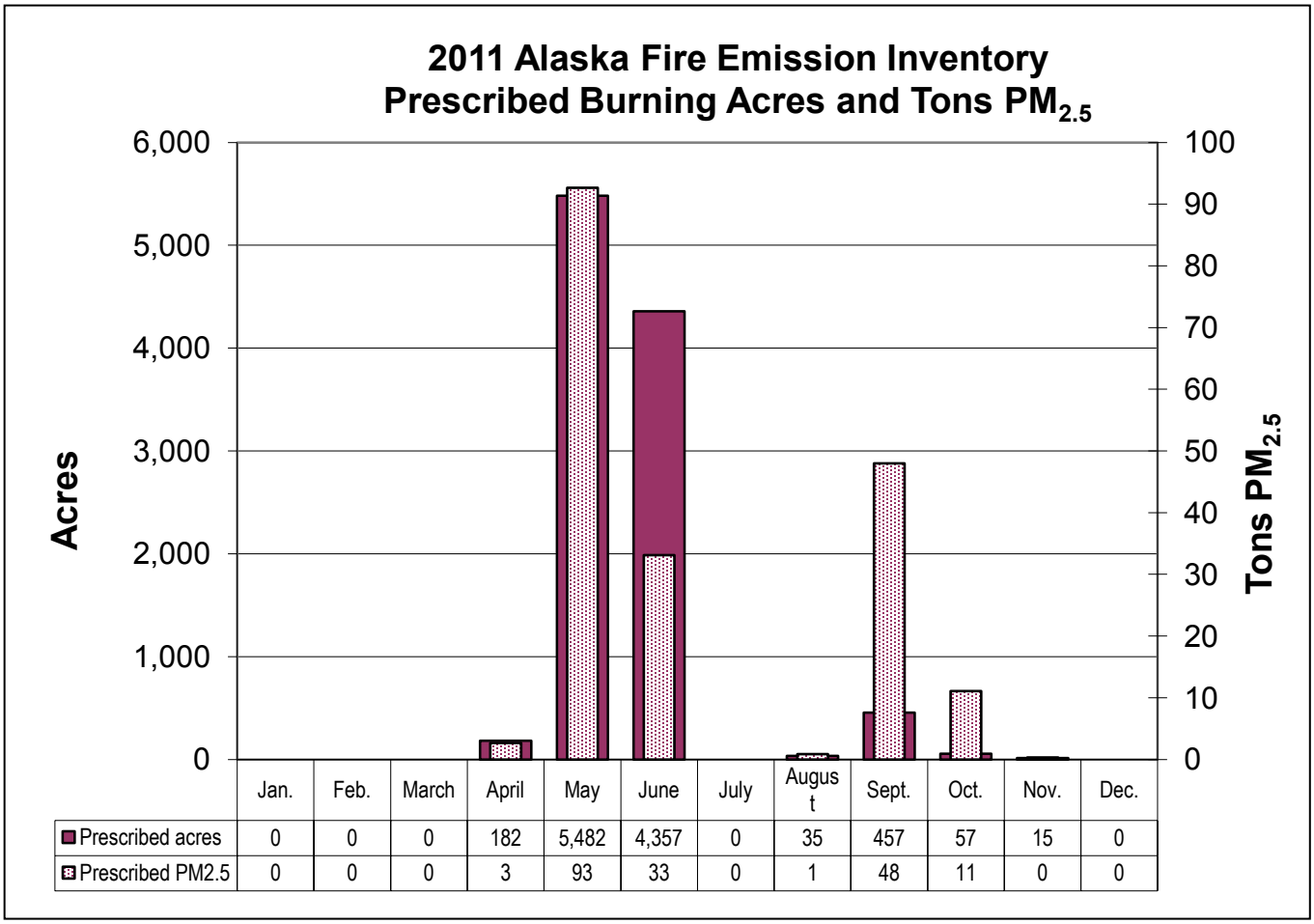
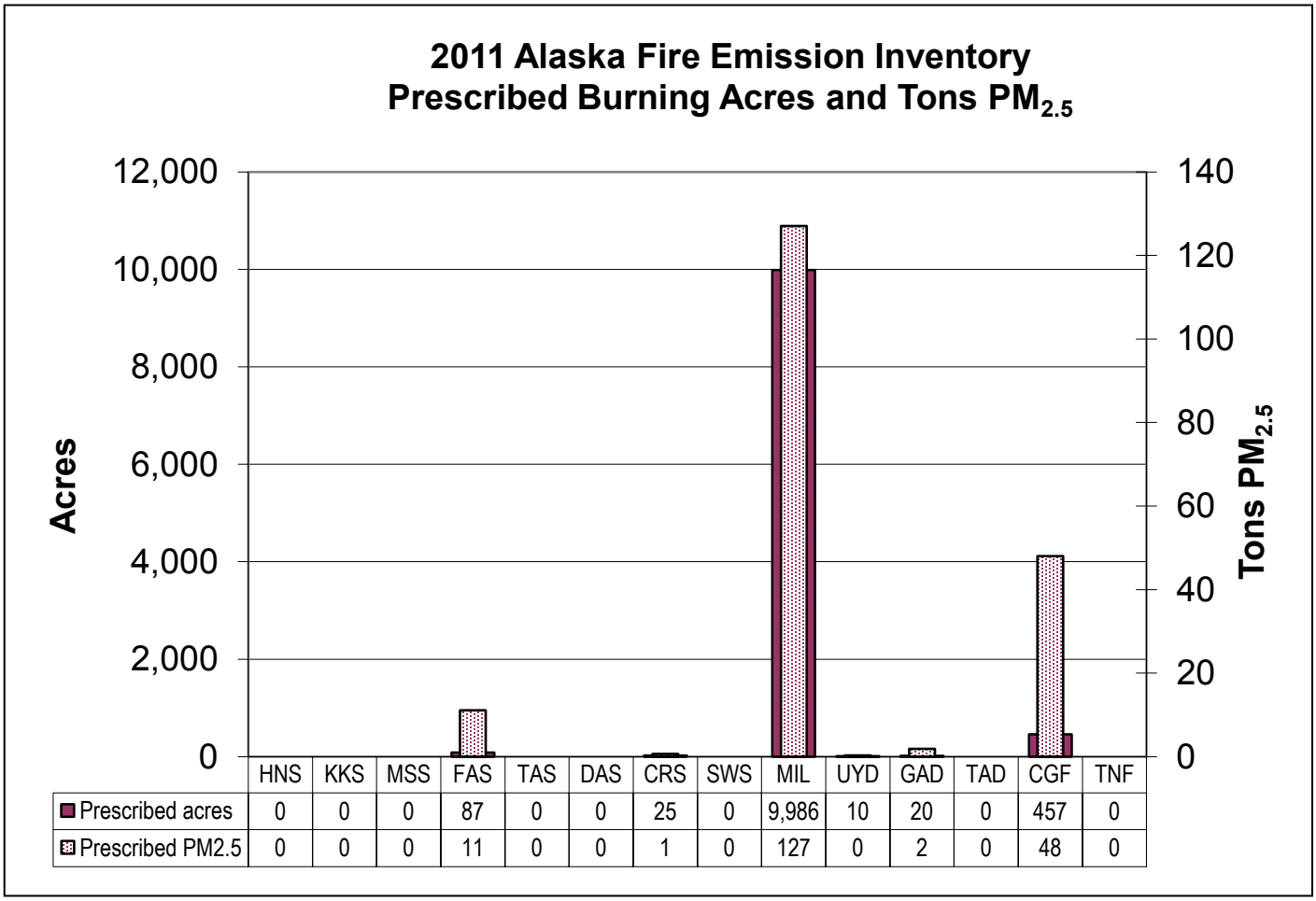


FIGURE 3

Figure 3 shows the acres of prescribed burns and tons of $PM_{2.5}$ produced in 2011.

Almost all of the prescribed fire burn acreage occurred in May and June (9839 acres, 92.9%), producing the largest amounts of $PM_{2.5}$ (126 tons, 66.6%). September with 457 acres (4.3%) and 48 tons of $PM_{2.5}$ (25.4%) was the third largest month for prescribed burns in 2011.

Most of the April, May and June burns were broadcast (fire burned in mostly grassland, areas with little or no forest stand present); 12 were predominately vegetated with grass, 1 with timber. The September and October burns were primarily timber pile burns, leading to the additional emissions shown by the graph.



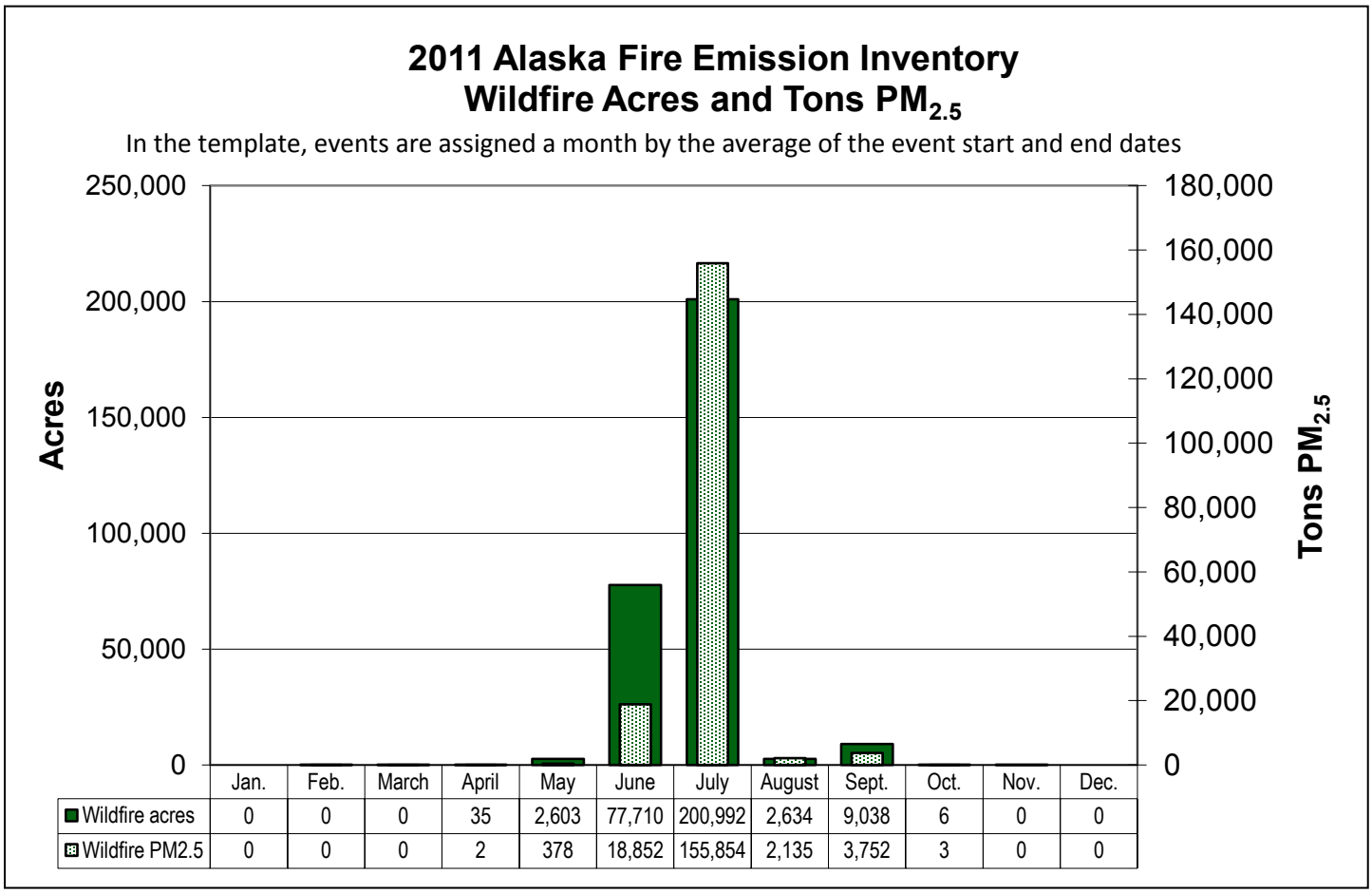
	HNS	KKS	MSS	FAS	TAS	DAS	CRS	SWS	MIL	UYD	GAD	TAD	CGF	TNF
Prescribed acres	0	0	0	87	0	0	25	0	9,986	10	20	0	457	0
Prescribed PM2.5	0	0	0	11	0	0	1	0	127	0	2	0	48	0

FIGURE 4

Figure 4 shows the acres of prescribed burns and the tons of $PM_{2.5}$ produced by Fire Management Zone. A map of the Fire Management Zones is on Page 5.

The Military burned most of the reported prescribed burn acres in 2011 (9,986 acres or 94.3%) and consequently produced most of the tons of $PM_{2.5}$ (127 tons or 67.2%).

The Chugach National Forest had the 2nd highest prescribed burn acreage (457 acres or 4.3%) and $PM_{2.5}$ tons (48 tons or 25.4%) produced in 2011.



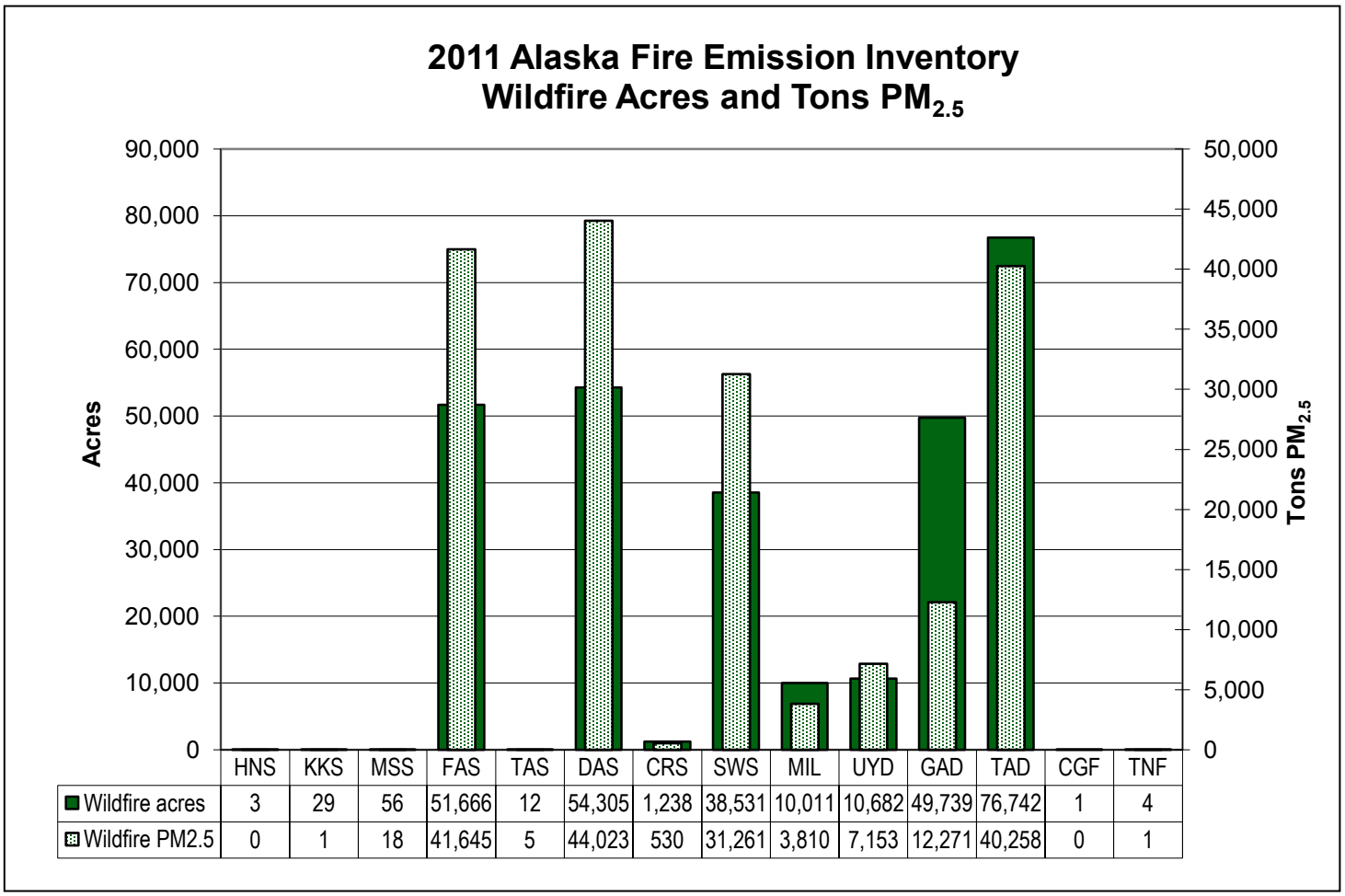
	Jan.	Feb.	March	April	May	June	July	August	Sept.	Oct.	Nov.	Dec.
Wildfire acres	0	0	0	35	2,603	77,710	200,992	2,634	9,038	6	0	0
Wildfire PM2.5	0	0	0	2	378	18,852	155,854	2,135	3,752	3	0	0

FIGURE 5

Figure 5 shows the wildfire acres and tons of $PM_{2.5}$ by month.

Wildfire starts occurred February through November in 2011, but the acreages were so small in February, March and November, they do not show on the template graph (less than 0.5 acre). June and July were the months calculated by the template to have the largest acreage burned (278,702 acres or 95.1%) and tons of $PM_{2.5}$ produced (174,706 tons or 96.5%). September had the third largest wildfire acreage burned: 9,038 acres burned (3.1%) and 3,752 tons of $PM_{2.5}$ produced (2.1%). The other months accounted for 5,278 (1.8%) acres burned and produced 2,518 (1.4%) tons of $PM_{2.5}$.

As noted on the graph, the template averages the 'month' of the fire between the start and end dates, i.e., a fire with a start in June may not be called out until August; the template would call this fire a 'July' fire whether or not most of the active burning was in June, July, or August. This leads to a discrepancy between the 2011 AICC fire report and this report. In the AICC 2011 Fire Season report, May (not July as shown in the template graph above) was the month with the most acreage burned. The AICC report for 2011 and the template (Figure 2, page 9) both show May with the most number of fires.



	HNS	KKS	MSS	FAS	TAS	DAS	CRS	SWS	MIL	UYD	GAD	TAD	CGF	TNF
Wildfire acres	3	29	56	51,666	12	54,305	1,238	38,531	10,011	10,682	49,739	76,742	1	4
Wildfire PM2.5	0	1	18	41,645	5	44,023	530	31,261	3,810	7,153	12,271	40,258	0	1

FIGURE 6

Figure 6 shows the wildfire acres and tons of $PM_{2.5}$ by Fire Management Zone. A map of the Fire Management Zones is on Page 5.

All 14 Fire Management Zones reported wildfires. Seven zones reported wildfires totaling over 10,000 acres. Six zones - Haines (HNS), Kenai-Kodiak (KKS), Mat-Su/Southwest (MSS), Tok (TAS), Chugach National Forest (CGF), and Tongass National Forest (TNF) - reported less than 60 acres.

The five Fire Management Zones reporting the most acreage burned by wildfire were Fairbanks (FAS) 51,666 acres or 17.67%; Delta (DAS) 54,305 acres or 18.5%; Southwest District (SWS) 38,531 acres or 13.1%; Galena Fire District (GAD) 49,739 acres or 17.0%; and the Tanana Fire Management Zone (TAD) 76,742 acres or 26.2%. The preceding five Management Zones also produced the most tons $PM_{2.5}$:

- FAS produced 41,645 tons $PM_{2.5}$ or 23.0%,
- DAS produced 44,023 tons $PM_{2.5}$ or 24.3%,
- SWS produced 31,261 tons $PM_{2.5}$ or 17.3%,
- GAD produced 12,271 tons $PM_{2.5}$ or 6.8%, and
- TAD produced 40,258 tons $PM_{2.5}$ or 22.2%

The remaining 9 Fire Management Zones (HNS, KKS, MSS, TAS, CRS, MIL, UYD, CGF, and TNF) reported 7.6% of the total acreage burned and 6.4% of the $PM_{2.5}$ produced.

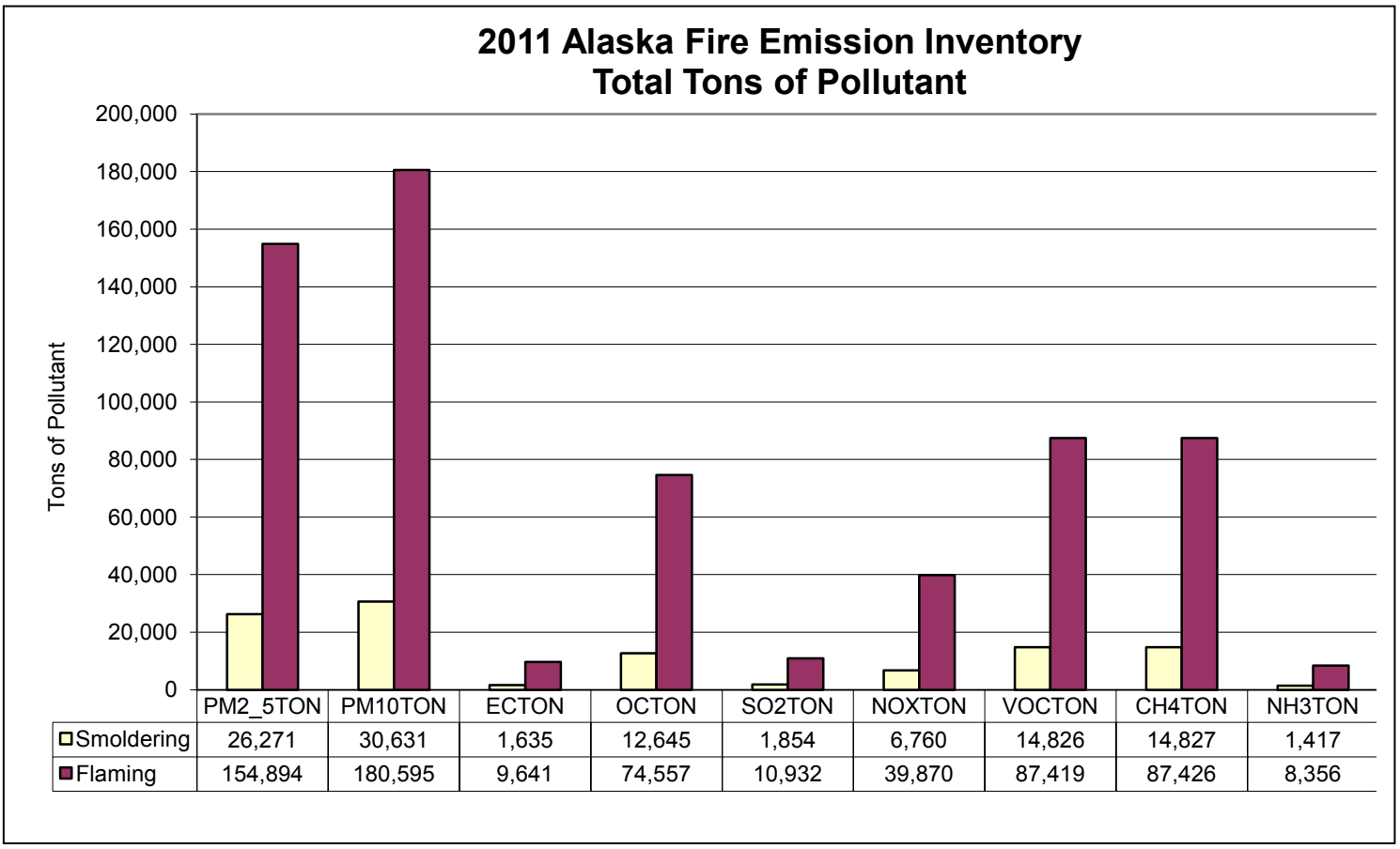


FIGURE 7

Figure 7 shows the total tons of pollutant produced by the 2011 fires for nine different air pollutants. The above graph shows the flaming and smoldering tons of the nine air quality pollutants from the 2011 wildfires and prescribed burns. The emission factors (EF) shown below, and used in the template, are based on the Western Regional Air Partnership (WRAP) Phase II 2002 fire emissions inventory (Air Sciences, Inc., 2004, 2005).

Pollutant	**Symbol**	**Name in Figure 7**	**EF Broadcast Burns (lbs/ton)**	**EF Piled Burns (lbs/ton)**
fine particulate matter	$PM_{2.5}$	PM2_5TON	24.1	8.0
coarse particulate matter	PM_{10}	PM10TON	28.1	8.0
elemental carbon	EC	ECTON	1.5	0.6
organic carbon	OC	OCTON	11.6	4.3
sulfur dioxide	SO_2	SO2TON	1.7	1.7
nitrogen oxides	NO_X	NOXTON	6.2	6.2
volatile organic compounds	VOC	VOCTON	13.6	6.3
methane	CH_4	CH4TON	13.6	7.7
ammonia	NH_3	NH3TON	1.3	0.5

The template calculated smoldering tons only if the acreage of the fire was 5 acres or greater.

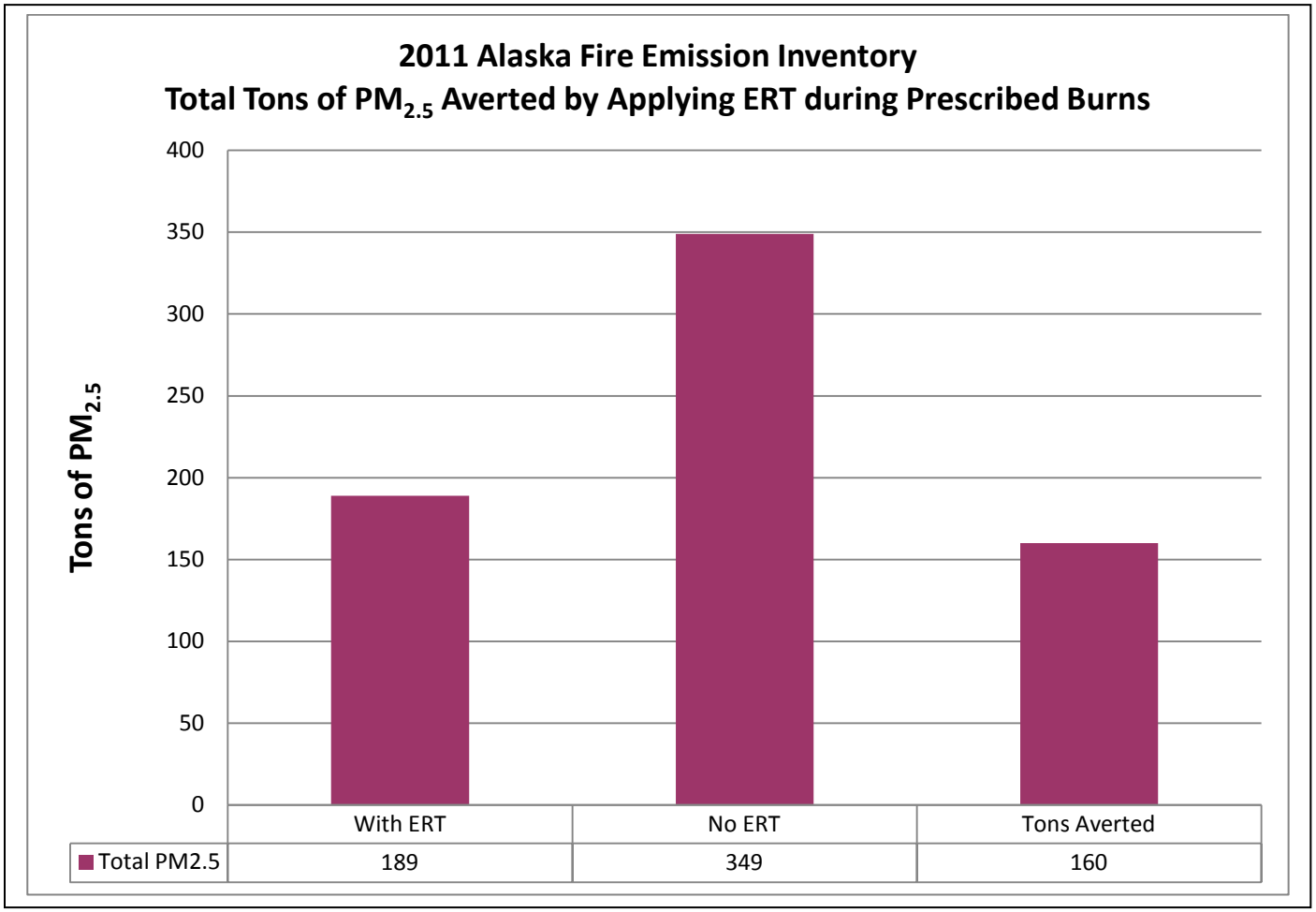


FIGURE 8

Figure 8 shows the total tons of $PM_{2.5}$ averted by applying an Emission Reduction Technique (ERT) before or during a prescribed burn.

The graph shows the total tons of $PM_{2.5}$ with Emission Reduction Techniques, what the numbers would have been without ERTs, and the 160 tons of $PM_{2.5}$ (45.8 %) averted with the use of ERTs during prescribed burns. The emission reduction techniques used during prescribed burns greatly reduce the tons of $PM_{2.5}$ produced.

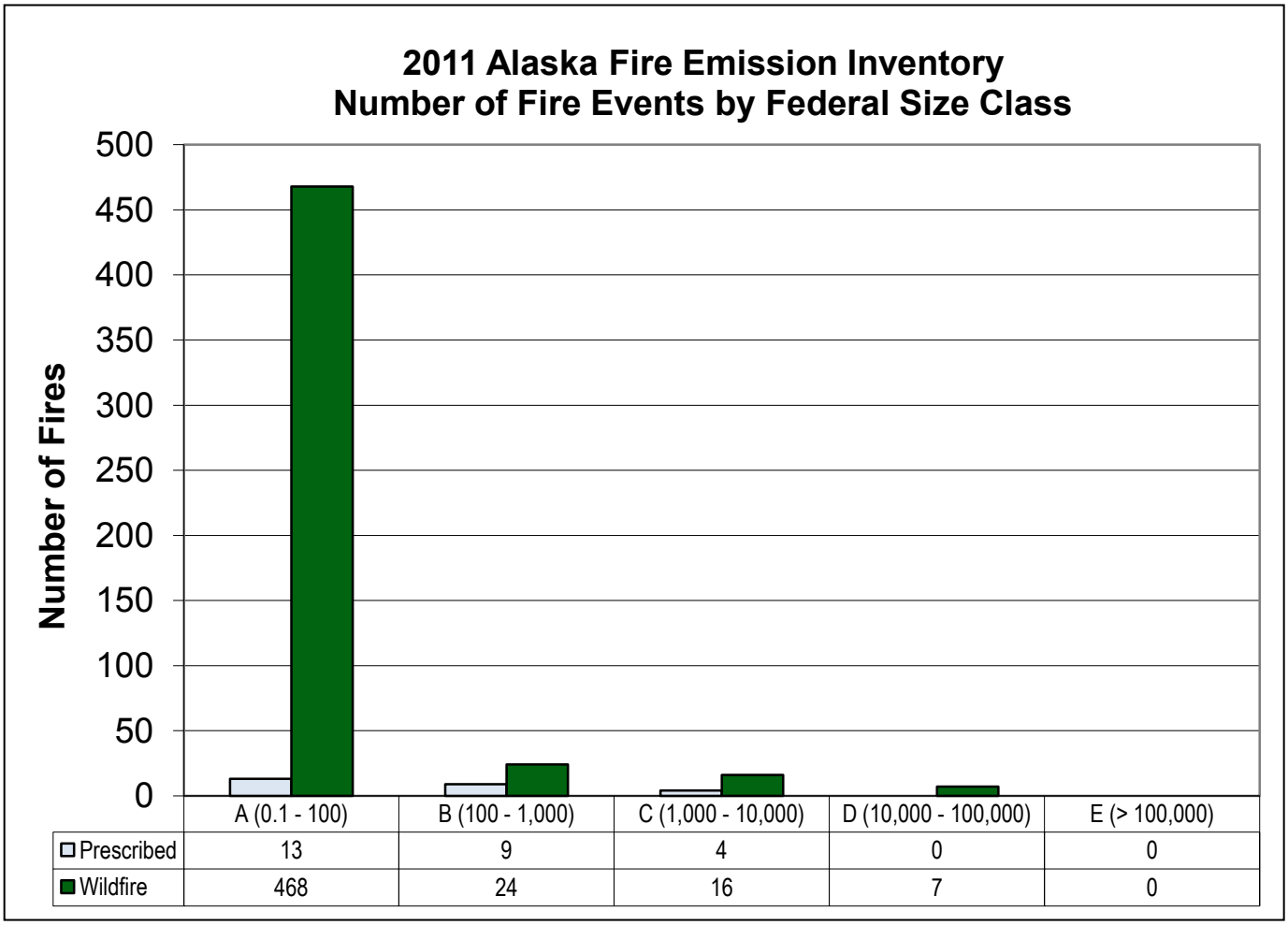


FIGURE 9

Figure 9 shows the number of fire events by federal size class.

The wildfire category is the larger in each of the federal fire size classes, ranging from Class A (0.1 to 100 acres) to Class E (greater than 100,000 acres).

In 2011, there were a total of 481 fires (88.9%) in the Class A size (less than 100 acres); 7 fires (1.3%) in Class D (10,000 to 100,000 acres), and no fires (0%) in Class E (greater than 100,000 acres).

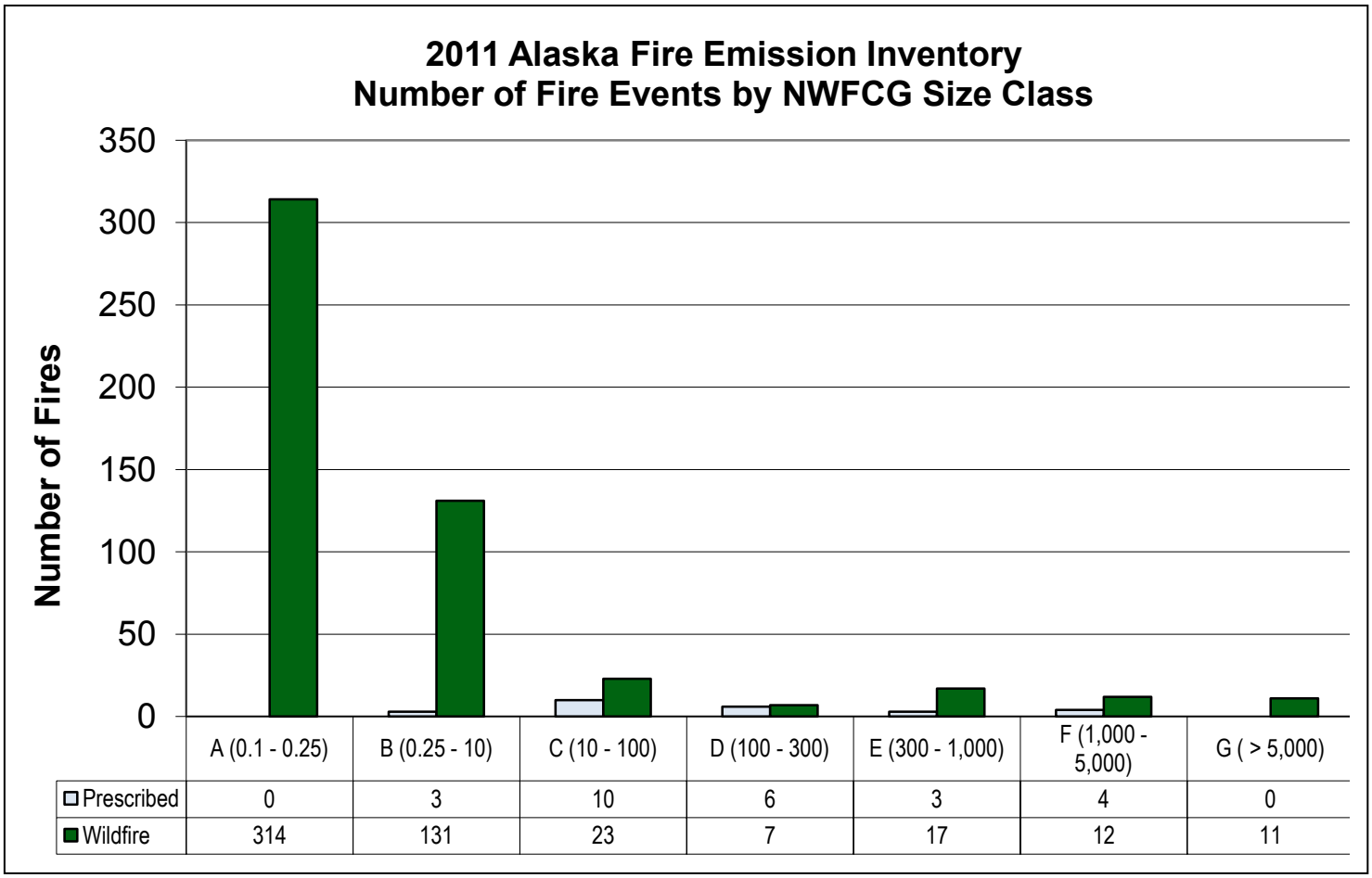


FIGURE 10

Figure 10 shows the number of fire events by National Wildland Fire Coordinating Group (NWFCG) size class.

The wildfire category is also the larger in each of the NWFCG fire size classes, ranging from Class A (0.1 – 0.25 acres) to class G (greater than 5,000 acres.)

Class size A (314 fires) and Class size B (134 fires) were the two largest classes in 2011: 82.8% of the fires were less than 10 acres, and 58.0% were less than 0.25 acre. There were 11 fires (2.0%) larger than 5,000 acres.

Emission Factors Used

The following Emission Factors (tons/acre) were used for the various vegetation types and mixes shown below. When two vegetation types were listed in the AICC situation report for a specific fire, the two vegetation emission factors (EF) were added together and roughly divided by two, to come up with an average emission factor for the fire.

The Canadian Forest Fire Danger Rating System (CFFDRS) served as the primary source of fuels information as it is used by the BLM Alaska Fire Service.[6]

	Wildfire EF	Prescribed EF
Grasses - Western perennial	0.75	0.75
Intermediate brush	15	15
Black spruce Alaskan	57.57	48.76
Black spruce (57.57) and brush (15)	36	
Black spruce (57.57) and tundra (12)	34.5	
Black spruce (57.57) and grass (0.75)	29	
Black spruce (57.57) and white spruce (30.35)	45	
Spruce and hardwoods estimate	44	
Tundra (~avg 19.05 and 4.45)	12	
Tundra (12) and grass (0.75)	6.5	
Tundra (12) and brush (15)	15	
Tundra (12) and white spruce (30.35)	24	
Brush (15) and grass (0.75)	8	
Grass (0.75) and hardwoods (30.35) estimate[7]	6	
Grass (0.75) and slash (14.35)	7.5	
Tussocks / peat estimate	5	
old burn estimate	20	
unknown vegetation type estimate	20 or 30*	
unknown pile estimate	10	
“light fuels” estimate	10	

* Previous years used “30” as the emission factor estimate for an unknown vegetation type. During the 2011 fire season, an emission factor of either “20” or “30” was used depending upon location (i.e., predominant vegetation type) of the fire. Fires located in the SWS or GAD were estimated to have an emission factor of “20”, the rest were estimated as “30.” Overall, only a small percentage of fires did not list at least one vegetative type that could be used for an emission factor.

[6] 2005 Alaska Wildland Fire Emissions Inventory and Wildland Fire Emissions Inventory Template, prepared by Air Sciences, Inc., for the Alaska Department of Environmental Conservation, project no. 217-2, June 2007, section 1.4.
[7] estimate “low” as only grass/slash understory may burn

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Appendix

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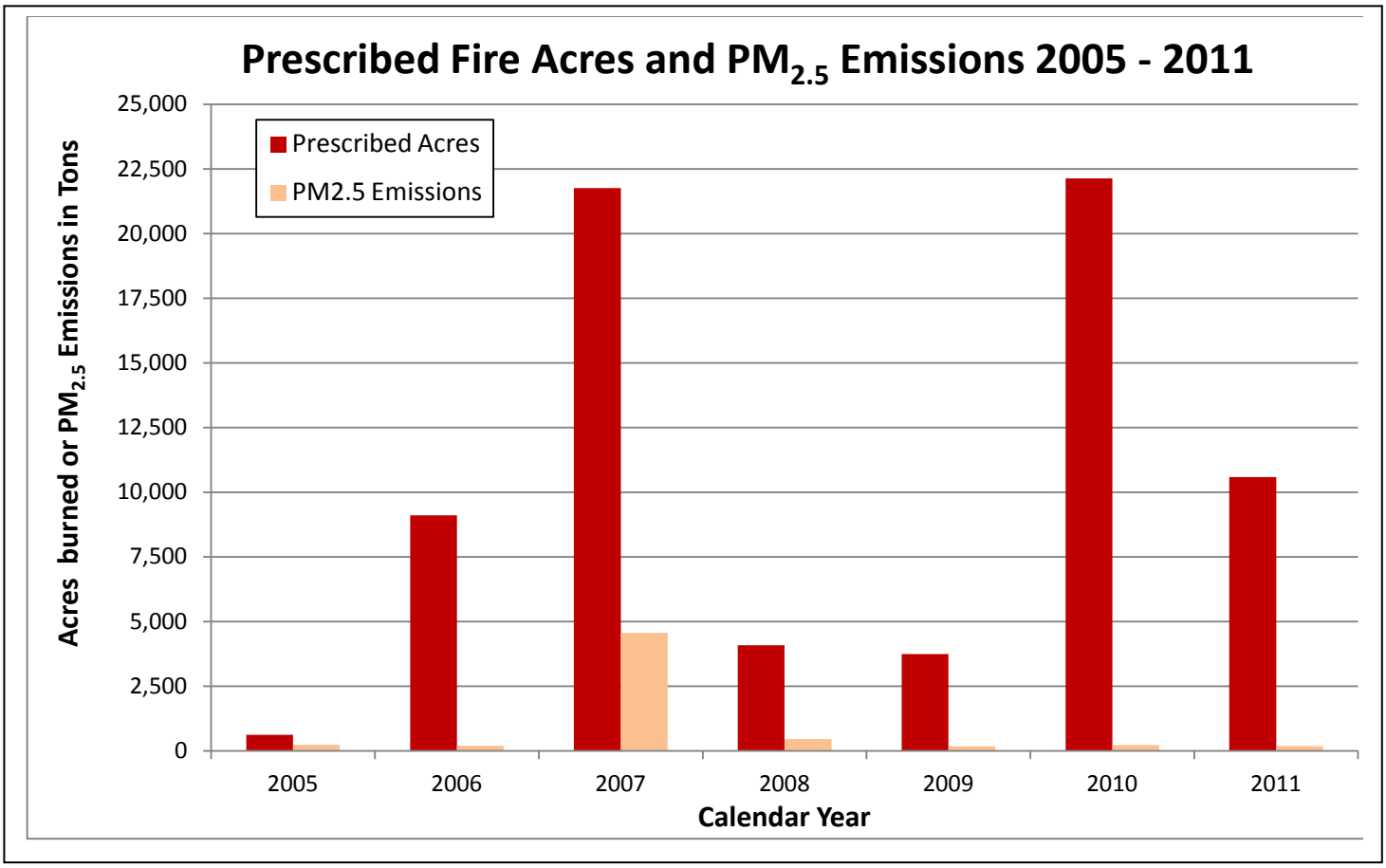
A. Comparison of Yearly Prescribed Burn Acres and Emissions

The graph below shows seven years of acreage burned and $PM_{2.5}$ emissions from prescribed fire for the years 2005 through 2011.



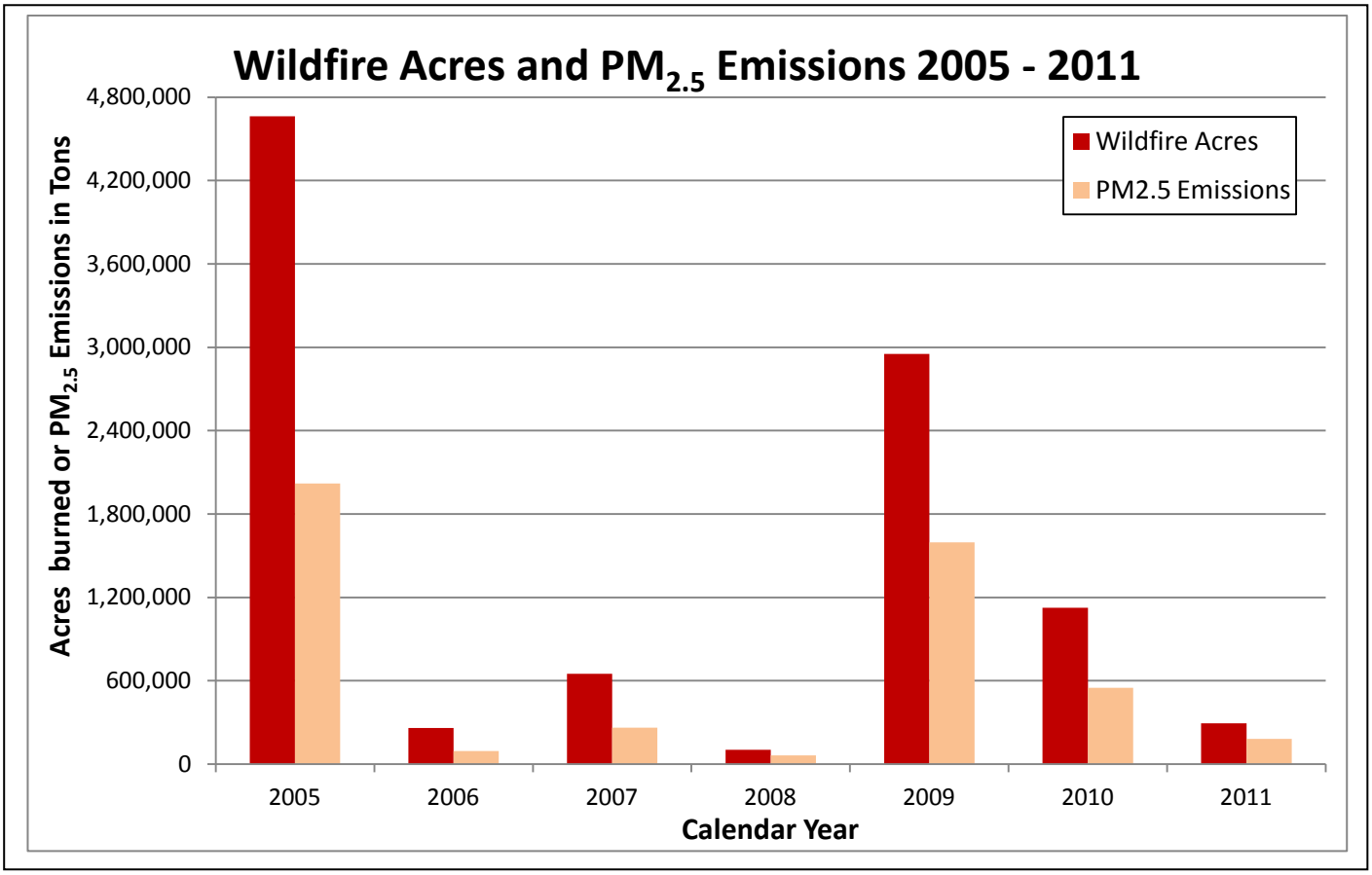
Graph details are below:

Calendar Year	2005	2006	2007	2008	2009	2010	2011
Acres	626	9,110	21,761	4,081	3,740	22,136	10,585
Tons $PM_{2.5}$	231	200	4570 *	454	172	227	189

* The tons $PM_{2.5}$ for 2007 have been revised downward from the previous total of 8,230 tons due to re-calculating with a lower emission factor for one fire, Oklahoma Range. No vegetation types had been listed in the AICC daily report, so a value of "30", for unknown vegetation type, was originally used. The original value appeared high compared to other years, and after further research the vegetation types were found and the emission factor was calculated to be 16.

B. Comparison of Yearly Wildfire Acres and Emissions

The yearly wildfire acreage burned and $PM_{2.5}$ emissions for the past seven years are shown on the graph below. The Wildland Fire Use category acreage was added to the wildfire acreage for years 2005 through 2008 for consistency in the graph. The detailed numbers following the graph include the acreage and $PM_{2.5}$ emissions for Wildland Fire Use. The category was discontinued after 2008.

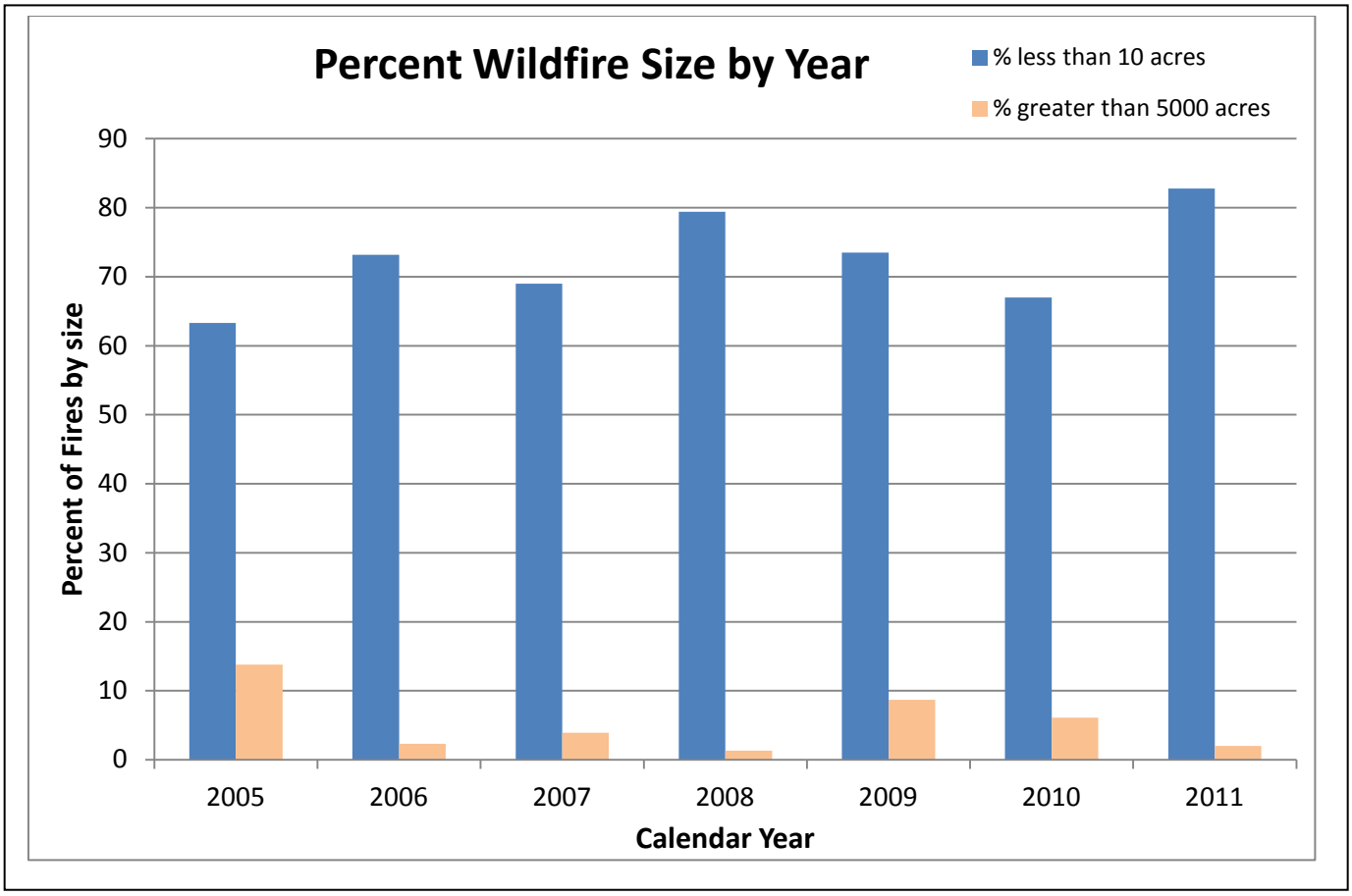


Graph details are below. From 2009 on, the discontinued category of Wildland Fire Use is included within the Wildfire category.

Calendar Year	2005	2006	2007	2008	2009	2010	2011
Wildfire Acres	4,493,846	258,529	536,180	62,650	2,951,598	1,125,499	293,018
Wildfire Tons $PM_{2.5}$	1,951,531	93,409	207,428	35,785	1,597,149	549,494	180,976
Wildland Fire Use Acres	169,956	1,613	113,235	40,999	N/A	N/A	N/A
Wildland Fire Use Tons $PM_{2.5}$	67,353	40	54,232	27,091	N/A	N/A	N/A

C. Percent Fires by size by year

A comparison between the number of small fires (less than 10 acres) and the number of larger fires (5000 acres or larger) is shown below. The percentage of fires by size and year are in table form below the graph.



Numeric details for the above graph:

Calendar Year	2005	2006	2007	2008	2009	2010	2011
% less than 10 acres	63.3	73.2	69	79.4	73.5	67	82.8
% greater than 5000 acres	13.8	2.3	3.9	1.3	8.7	6.1	2