# Colorado Smoke Management Program Evaluation

## A Question of Balance

a report by the

U.S. Forest Service, Rocky Mountain Region
to the Colorado Air Quality Control Commission

March 2011

*High mortality to mature lodgepole pines in the state of Colorado*

## Executive Summary

The Colorado Air Pollution Control Division (APCD) is required by the Colorado Healthy Forests and Vibrant Communities Act of 2009 (HB09-1199), which amended Colorado Revised Statute Section 25-7-111 by the addition of a new subsection, to report to the Colorado Air Quality Control Commission (AQCC) on the Colorado Smoke Management Program (SMP). APCD is to evaluate existing prescribed fire permit program rules and implementation so as to support, and increase where possible, appropriate responsible use of prescribed fire.

The evaluation is to include consideration of the balance between the attainment and maintenance of national ambient air quality standards and the achievement of federal and state visibility goals, with the important benefits of prescribed fire use as a land management tool, including wildfire risk mitigation, watershed protection, forest health, and reduced treatment cost.

This report reflects the United States Forest Service, Rocky Mountain Region's (USFS) position that the report completed by the APCD falls well short of providing that balance.

The native ecosystems in Colorado evolved with fire as an integral shaping element of the landscape. Due to the relatively arid and cool climate, decomposition plays only a minor role in the removal of energy stored in the accumulated vegetation. As a result, fire is the major mechanism for releasing stored energy. Aggressive fire suppression, adopted in the early 20th century, has changed the vegetative structure and composition within many western fire-adapted ecosystems and increased the energy loading across these systems. The result has been more intense, catastrophic wildfires. Under Federal Fire Policy, the appropriate response to the wildfire is determined by the circumstances under which a fire occurs and the likely consequences to firefighter and public safety and welfare, natural and cultural resources, and, values to be protected. Although the role of fire as a critical natural process is recognized, the U.S. Forest Service continues to successfully suppress over 90 percent of all wildfire ignitions. Analysis shows that in the absence of this fire suppression and other human activities, approximately 1.15 million acres on average would burn in Colorado annually, with 166,000 of those burned acres occurring within the Wildland Urban Interface (WUI). Actual acres burned in the state over the past 13 years averaged

just 13 percent of the expected natural annual total. Extrapolation over the 100-year period of fire suppression suggests that the average accumulated energy load is 90 times higher than it would be prior to fire suppression. There has also been a corresponding reduction in the natural smoke produced by these wildland fires within the state.

Global climate change and ecological change are impacting Colorado. Research shows that climate change has resulted in higher minimum temperatures and earlier and warmer springs. At the same time, analysis shows that western wildfire activity, frequency, and duration has increased markedly since the mid-1980s. Climate projections suggest temperatures will continue to increase, with summers experiencing greater warming than winters, resulting in increased evaporation, even if precipitation remains the same. Snowpacks will likely melt earlier in the year. In addition, as of 2010, the mountain pine beetle epidemic has caused forest mortality across 3.5 million acres in Colorado, further exacerbating the problem of accumulated energy loading. Although this fuel loading does not increase the likelihood of a fire occurring, it does increase the fire hazard, making fires easier to ignite, more intense, and more difficult to control. Fuel and hazard tree mitigation efforts, as a result of the pine beetle infestation, have already generated over 180,000 slash piles in Colorado which must be burned. The combination of excessive energy loads, climate change, and 3.5 million acres of dead and dying forests has set the stage for more frequent and larger catastrophic wildfires in Colorado. Prescribed fire is the most effective tool available to land managers to protect communities and maintain ecosystem health. Studies have shown that thinning alone does not adequately reduce wildfire severity but can be very effective when combined with prescribed burning.

Increased tightening of national air quality standards, combined with more restrictive state permit requirements, have made prescribed fire increasingly difficult to implement in Colorado. Many wildland urban interface areas are in need of prescribed fire treatments in order to protect public and firefighter safety, valuable property, community infrastructure, watersheds, and ecosystems. The Colorado Smoke Management Program (SMP) permit conditions for these areas are often so restrictive that it is neither practical nor cost-effective to implement prescribed fire treatments in the very areas where they are needed most. Continued fire suppression, combined with very limited prescribed burning within the WUI, will lead directly to increased risk. In fact, continued successful suppression, without vegetation management such as prescribed fire, only serves to contribute to future fires becoming more and more extreme. These extreme fire events (e.g. the Fourmile Canyon Fire in Boulder County) create a much greater and more direct threat to public and firefighter lives, health, safety, and welfare than does smoke from prescribed fires. When these extreme fires occur, they tend to release several magnitudes the smoke in a short period of time than would be released from numerous prescribed fires. Under this scenario, the public's health and welfare can be more heavily impacted from wildfires than would be the case under increased prescribed fire implementation.

The current Colorado SMP is protecting public health and welfare in the short-term at the expense of public and firefighter safety, health, and welfare over the long-term. It is impossible to remove or withhold fire from fire-dependent ecosystems, yet communities continue to expand into these ecosystems. We are now being forced to make some difficult choices regarding wildfires, prescribed fire, public safety, and public health and welfare.

The Environmental Protection Agency (EPA) has acknowledged the importance of prescribed fire in preventing fuel buildup, especially in circumstances such as pest and disease outbreaks or

lack of access for mechanical treatment alternatives. The EPA also determined that the exceedance of air quality standards resulting from prescribed fires may qualify as an exceptional event. The Colorado Air Pollution Control Division (APCD), however, has continued to tighten smoke permit standards to prevent any possible exceedance of the standards. Furthermore, the Colorado SMP does not use any objective modeling or data collection to determine whether smoke from a given prescribed burn meets or exceeds air quality standards. The Colorado SMP has based some prescribed fire restrictions on complaints from the public and local health officials.

The Forest Service believes that the current Colorado SMP and the APCD report to the Air Quality Control Commission does not meet the intent of Colorado Revised Statutes Section 25-7-111. Maintaining the status quo will not lead to success in any form. Instead, a goal of prescribed burning 1 million acres per year in Colorado is needed to approach the annual ecological fire workload. This much prescribed burning would keep us from falling farther behind. The 17,900 acres actually burned in 2010 does not come close to meeting the needs of Colorado's citizens, communities, and native ecosystems. The state of Florida has been successful in treating 150 times as many acres as Colorado despite a population of more than four times that of Colorado, suggesting that significant prescribed burning can be successfully implemented while simultaneously managing smoke concerns.

The U.S. Forest Service has a vested interest in the future viability of the prescribed fire and smoke management programs in Colorado. Over the past 10 years, the U.S. Forest Service has averaged 51 percent of the total prescribed fire work and has paid 67 percent of the total SMP fees charged to all permitees from 2002 through 2009 in Colorado.

The U.S. Forest Service is committed to partnering with the APCD to protect public health and safety. The Forest Service is currently doing this by:

- Maximizing the use of mechanical vegetation treatments.
- Managing smoke from prescribed fires and wildfires through the use of best management practices – using all available tools and the latest science and research.
- Assessing opportunities to use air curtain burners in key pine beetle areas.

In the future the U.S. Forest Service is committed to:

- Collaborating with and assisting the APCD in developing a more objective, evidence based (hybrid) SMP.
- Collaborating with APCD and others in the evaluation of smoke models in order to broaden the tools available for smoke permitting.
- Providing the necessary resources to ensure the future success of both the SMP and prescribed fire programs in Colorado.

The U.S. Forest Service is asking the Air Quality Control Commission to meet the intent of the Colorado Revised Statutes Section 25-7-111 by:

- Determining whether the current SMP meets both the short and long-term health and safety needs of the citizens of Colorado.
- Assessing the current SMP and its implementation methods to determine if smoke permit conditions are objective, verifiable, and tied directly to the NAAQS.

- Determining if the APCD is utilizing the Exceptional Events Rule for prescribed fire as the EPA intended.
- Requesting the APCD collaborate with stakeholders in examining the merits of and options for reorganizing the SMP to better meet the needs of the citizens of Colorado.
- Assessing the current process of handling smoke complaints, particularly how complaint information affects SMP implementation and identifying protocols which would allow for improvements.

Now is the time to be bold and take action. Collectively we need to do the right things, even if they may be difficult or nontraditional. It will take all of us working together – land managers, air quality regulators, special interest groups, political entities, communities, and private citizens – if we are to be successful in reducing the impacts of catastrophic wildfires on the citizens and landscapes of Colorado.

## Background

The Colorado Air Pollution Control Division (APCD) was required by the Colorado Healthy Forests and Vibrant Communities Act of 2009 (HB09-1199), which amended Colorado Revised Statute 25-7-111 by the addition of a new subsection, to report to the Colorado Air Quality Control Commission (AQCC) on the Colorado Smoke Management Program (SMP). APCD was to evaluate existing prescribed fire permit program rules and implementation so as to support, and increase where possible, appropriate responsible use of prescribed fire.

The evaluation was to include consideration of the balance between the attainment and maintenance of national ambient air quality standards and the achievement of federal and state visibility goals, with the important benefits of prescribed fire use as a land management tool, including wildfire risk mitigation, watershed protection, forest health, and reduced treatment cost.

## Introduction

The native vegetation in Colorado has been shaped by natural processes over the past millennia. Vegetation within the various ecosystems is incredibly diverse, from the short grass prairies to the alpine tundra and all of the forests and shrublands in between. One common element in the evolution of all of these ecosystems is fire. Fire functions as an integral disturbance agent in the energy cycle. As vegetation in ecosystems grows and propagates, it stores energy from the sun through photosynthesis and associated biochemical processes. Because the climate in Colorado is relatively arid and cool, decomposition plays only a very minor role in releasing stored energy. Thus, fire serves as the major agent for releasing stored energy within these native ecosystems.

Each ecosystem stores energy at a different rate depending upon environmental constraints such as sunlight, temperature, the availability of water, the length of the growing season, soil and nutrient quality, etc. As Colorado's ecosystems' energy loads increased, environmental conditions such

as weather, vegetative moisture, and topography periodically aligned to allow a fire to move across the landscape. These fires would vent much of the energy stored in the vegetative components of the ecosystem. While these fires vented stored energy, they produced smoke as a natural byproduct of the combustion process. As Colorado ecosystems evolved and adapted under this cycle of storing energy from the sun and releasing it through fire, they developed into what are now referred to as fire adapted ecosystems with natural fire regimes. The stored energy is commonly referred to as fuel.

Natural fire regimes are dependent upon the vegetation and microclimate of the ecosystem and the rate at which the system stores energy. Desert ecosystems, while often hot and dry enough to support fire, lack sufficient moisture for rapid and cumulative vegetative growth. On the other hand, high alpine ecosystems tend to have plenty of moisture, but the environment is very cool with a short growing season which slows vegetative growth. Alpine ecosystems are often too cool and moist to support fire spread. These two ecosystems tend to have fire regimes with long fire return intervals due to their limited ability to capture and store energy and propagate fire. In between these two extremes are ecosystems with longer growing seasons, warm temperatures, and adequate moisture. These ecosystems tend to produce comparatively rapid vegetative growth; thus, they accumulate and store energy at greater rates. Examples of these more mesic ecosystems in Colorado are short grass prairies, Ponderosa Pine forests, Gambel oak shrublands, and mixed conifer forests. These ecosystems tend to have fire regimes with relatively short fire return intervals and are adapted to fairly frequent fires.

Fire regimes are classified by both their frequency and fire type. Due to the multitude of environmental factors that must be in alignment for a fire to move across a vegetated landscape, actual fire return intervals at a given location can vary significantly. Thus, fire return intervals are usually stated as a Mean Fire Return Interval (MFRI), with the understanding that there can be considerable deviation from the mean when examining actual fire occurrence. Fire regimes are also classified by the type of vegetation in which the fires burn and the impact they have on that vegetation. For example, a low severity, surface fire regime tends to burn through vegetative fuels on the surface of the ground without killing most of the above-ground vegetation. In contrast, a high severity, crown fire regime tends to burn though all strata of vegetative fuel, killing all or most of the above-ground vegetation. A mixed severity fire regime tends to be a blend of the two extremes: a mixture of surface fire with some torching and crown fire creating a mosaic of high and low severity impacts to the vegetation.

When examining options for fire management in Colorado's native ecosystems, it is important to understand the social, political, and ecological contexts. The U.S. Forest Service was created in the early 20th century. In 1910, not long after the fledgling U.S. Forest Service began, a series of very large and destructive wildfires devastated the Northern Rockies. This event led the federal government to adopt a full suppression strategy for wildfires in order to protect the nation's forests and rural communities from future disasters. Over the next 70 years, the U.S. Forest Service was successful in suppressing over 90 percent of all wildfire ignitions. In the late 1970s and 1980s many ecologists and fire managers began to question whether it was wise to exclude fire from ecosystems adapted to frequent natural fires. Ecologists and fire managers were beginning to see significant changes in the vegetative structure and composition of these ecosystems as compared to historical records.

Under Federal Fire Policy, the appropriate response to the wildfire is determined by the circumstances under which a fire occurs and the likely consequences to firefighter and public safety and

Pike National Forest, 1898

Pike National Forest, 1998

welfare, natural and cultural resources, and, values to be protected. Although the role of fire as a critical natural process is recognized the U.S. Forest Service continues to successfully suppress over 90 percent of all wildfire ignitions.

In response, land managers began to increase the use of prescribed burns as a tool to manage vegetation in the native ecosystems. With the increased use of prescribed burns came the corresponding increase in smoke. Because wildfires had been mostly withheld from the landscape for over 70 years, the public, political entities, and regulatory agencies perceived the smoke production as a new, unnatural, and human caused air pollutant. Regulatory agencies such as the Environmental Protection Agency (EPA) and the Colorado Air Pollution Control Division (APCD) took action to protect the public from this seemingly new air pollution. Colorado's APCD was tasked with developing a Smoke Management Program (SMP) that protected public health and welfare and maintained compliance with the EPA's National Ambient Air Quality Standards (NAAQS).

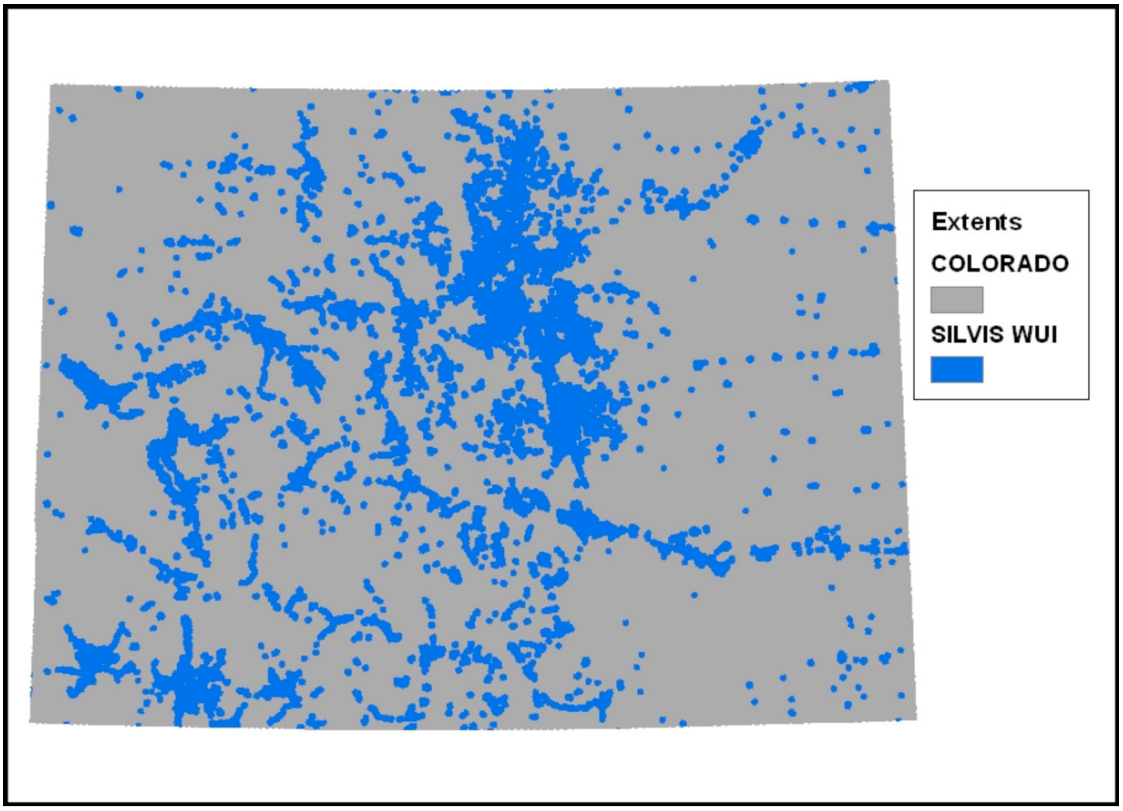
Over the past 20 years, Colorado's SMP has become progressively more restrictive in response to both increased efforts to protect the public from degrading air quality and the EPA's continuous tightening of the NAAQS due to clearer evidence of the health risks associated with smoke exposure. Over this same period, ecologists and land managers have developed a much more robust understanding of the role of fire in Colorado's native ecosystems. It is now clearly understood that if wildfires continue to be suppressed in fire adapted ecosystems, without somehow managing the vegetation and corresponding energy load, the inevitable result will be catastrophic wildfire. Research has shown that prescribed fire is the very best tool land managers possess to manage large areas of native vegetation for the protection of communities and to maintain the viability of Colorado's native ecosystems. Consequently, land managers and air quality regulators are seemingly at odds in an endless struggle to increase prescribed fire use while reducing the impact of the associated smoke on communities and sensitive individuals.

## Analysis of the Situation

### Ecological Fire Workload

In a recent analysis,  LANDFIRE data products for existing vegetation type and MFRI were used to approximate the annual average ecological fire workload for the State of Colorado. The native vegetation types and associated fire regimes across the entire state of Colorado were analyzed to calculate the average number of acres that could be expected

to naturally burn annually in Colorado. A data layer for Wildland Urban Interface (WUI) adapted from data developed by the University of Wisconsin's SILVIS Laboratory to calculate the average number of acres that could be expected to burn annually within Colorado's WUI. Refer to Appendix A for details regarding the methods used in this analysis.




http://www.landfire.gov/NationalProductDescriptions21.php

http://www.landfire.gov/NationalProductDescriptions13.php

http://www.fpa.nifc.gov/Library/Papers/Docs/FPA_2/WP_Enterprise_Data_03_09_2010.pdf

http://silvis.forest.wisc.edu/old/Projects/WUI_Main.php

Based on this analysis, it would be expected that under natural ecological conditions without human activities (e.g., fire suppression, grazing, timber harvest, landscape fragmentation, etc.), 1,154,167 acres on average would burn in Colorado annually, with 166,359 of those acres burning within the WUI. These figures represent long-term averages, while actual acres burned depend upon weather, drought, ignitions, and a host of other environmental factors that drive the scale and extent of wildland fires. During years that are especially favorable to fire spread, three to five times as many acres would be expected to burn; the opposite holds true for wetter years that are less conducive to fire spread.

Historical fire data was utilized to compare the natural ecological fire workload with the actual number of acres burned in Colorado on an annual basis. The following table displays the acres burned in wildland fires on all land ownerships within Colorado from 1998 through 2010.

### Wildland Fire Acres in Colorado

| Year | Wildfire | Prescribed Fire | Wildland Fire Use | Annual Total |
|---|---|---|---|---|
| 1998 | 23,750 | 76,115 | 0 | 99,865 |
| 1999 | 14,637 | 23,193 | 216 | 38,046 |
| 2000 | 73,068 | 41,264 | 1 | 114,333 |
| 2001 | 19,014 | 19,769 | 4,824 | 43,607 |
| 2002 | 926,502 | 10,739 | 23,212 | 960,453 |
| 2003 | 27,655 | 22,249 | 3,519 | 53,423 |
| 2004 | 24,996 | 47,788 | 9,599 | 82,383 |
| 2005 | 27,390 | 48,213 | 7,175 | 82,778 |
| 2006 | 94,484 | 36,661 | 0 | 131,145 |
| 2007 | 20,739 | 35,840 | 229 | 56,808 |
| 2008 | 141,966 | 43,048 | 2,378 | 187,392 |
| 2009 | 50,456 | 25,674 | 0 | 76,130 |
| 2010 | 40,788 | 17,903 | 0 | 58,691 |
| | | | **Total** | **1,985,054** |
| **Average RX acres** | **34,497** | | **Annual Average** | **152,696** |
| | | | **Annual Average W/O 2002** | **85,383** |
| Source: National Interagency Fire Center http://www.nifc.gov/fire_info/fire_stats.htm | | | | |

The total wildland fire annual average, 152,696 acres, represents approximately 13 percent of the average annual ecological fire workload within Colorado and includes the significant acres that burned during the long-term drought-influenced 2002 fire season. By removing the acres burned in 2002 from the average, we find that the new average of 85,383 represents only 7 percent of the average annual ecological fire workload.

The overwhelming cause of the disparity between the actual and theoretical averages is fire suppression by the various fire management agencies. When wildfires are consistently suppressed over time, especially in higher frequency fire regimes, the energy stored in the vegetative system begins to reach a critical level. Withholding fire from fire adapted ecosystems has only one eventual outcome – catastrophic wildfires, such as the 2010 Fourmile Canyon Fire in Boulder County. When fires are suppressed during more benign and moderate conditions, the energy load continues to build. At some future point, the unnaturally high energy load will align with environmental factors and a fire ignition, and the resulting energy release will be too extreme for fire management resources to successfully suppress.

Examining the past 100 years of relatively successful fire suppression in Colorado (understanding that the past 20 years represent a significant increase in the acres burned over the previous 80), we can reasonably assume that we have been burning (through wildfires and prescribed fires) approximately 10 percent of the annual acres associated with the natural ecological fire workload. If the impact of this 90 percent reduction in acres burned is additive, we expect an increase in the vegetative energy storage "in the bank" throughout Colorado by a factor of 90X with a corresponding 90X decrease in the amount of smoke produced by natural wildland fires.

While these numbers are very rough, this simple analysis helps to frame the issues before us and aid in grasping the scale to which we need to consider the use of prescribed fire on Colorado landscapes.

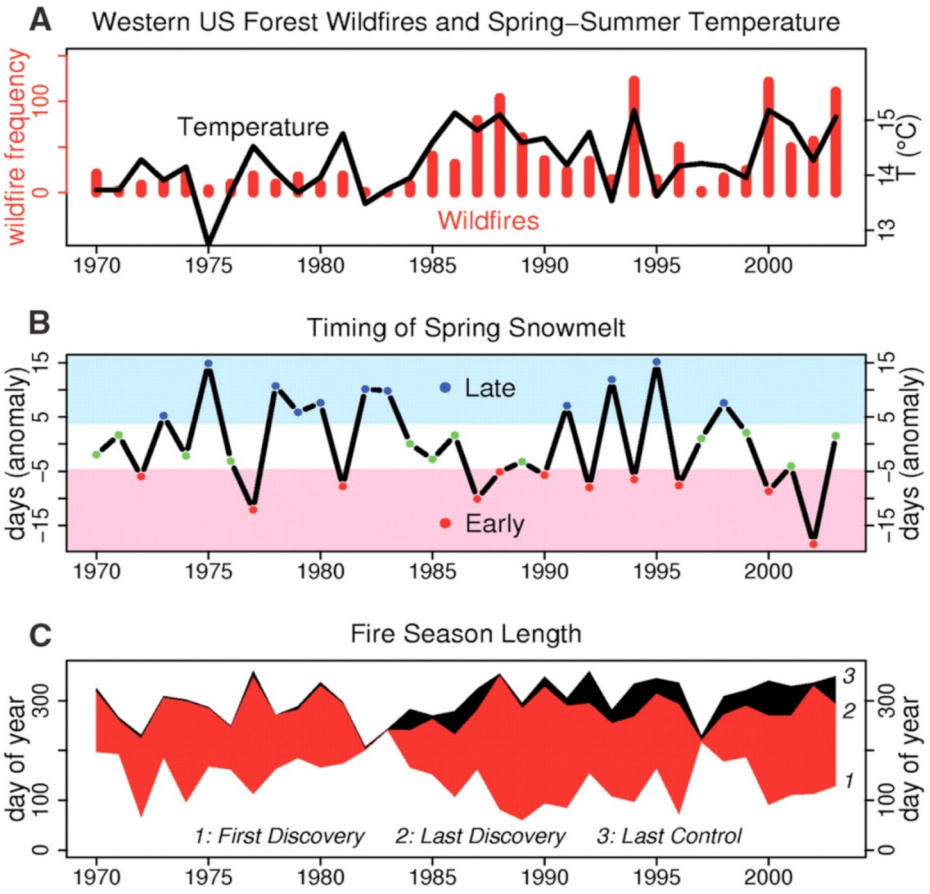
## Climate Change

Another important issue currently confronting land managers is climate change. Global climate change is impacting Colorado, and research indicates that Colorado's climate has and will continue to become both hotter and drier in the future.

> "Eleven of the last twelve years (1995-2006) rank among the twelve warmest years in the instrumental record of global surface temperature (since 1850). The 100-year linear trend (1906-2005) of 0.74 [0.56 to 0.92]°C1 is larger than the corresponding trend of 0.6 [0.4 to 0.8]°C (1901-2000) given in the Third Assessment Report (TAR). The temperature increase is widespread over the globe and is greater at higher northern latitudes. Land regions have warmed faster than the oceans." Intergovernmental Panel on Climate Change (IPCC), Fourth Assessment Report, Synthesis Report, Summary for Policy Makers (AR4), 2007.

Recent research has shown that climate change is linked to increased fire activity in the western United States. In an article published in *Science*, 18 August 2006, Westerling et al. compiled a comprehensive database of large wildfires in western United States forests since 1970 and compared the data to hydroclimatic and land-surface data. They showed that large wildfire activity increased suddenly and markedly in the mid-1980s, with higher frequencies, longer durations, and longer seasons. The greatest increases were strongly associated with increased spring and summer temperatures and earlier springs in mid-elevation Northern Rocky Mountain forests.

**Annual frequency of large (>400 ha) western U.S. forest wildfires (bars) and mean March through August temperatures for the western United States (line) (26, 30)**

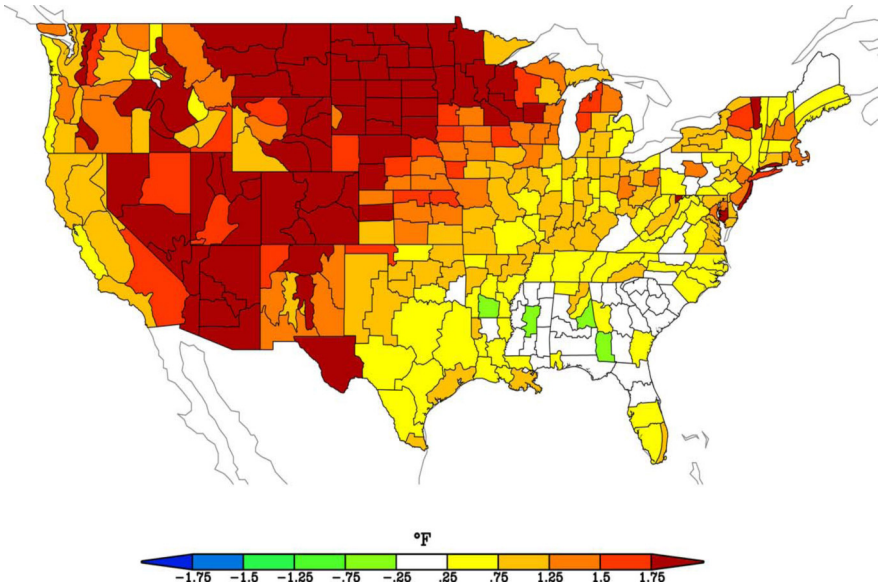



L. Westerling et al., Science 313, 940 -943 (2006)

Andrea Rae and others of the National Oceanic & Atmospheric Administration Earth System Research Laboratory (NOAA ESRL) and the University of Colorado, Cooperative Institute for Research in Environmental Sciences (CIRES) Boulder have provided some current climate summary points, based on carefully selected station data.

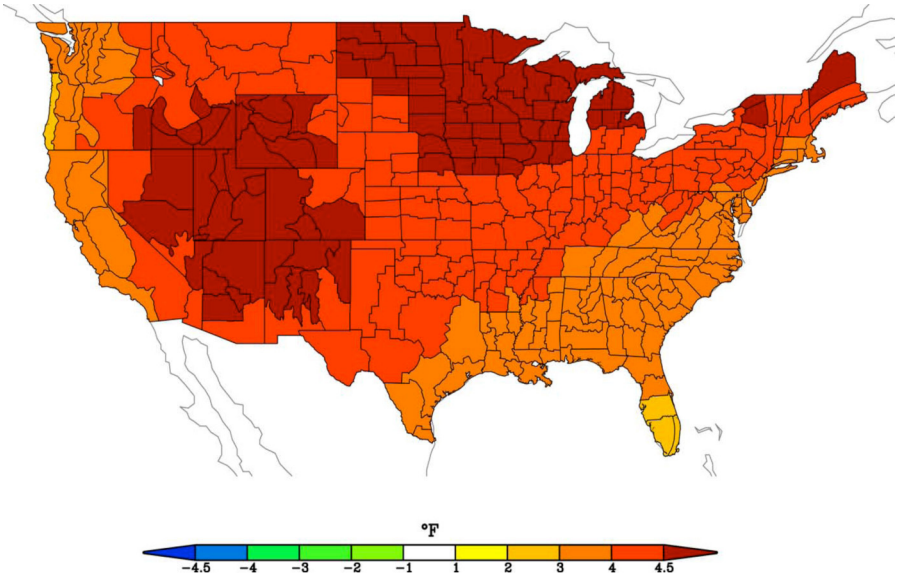
- Although there is regional variability in Colorado temperature trends, there are some commonalities that are shared across the state for the last half century:
  - The Biggest overall warming trends are for minimum compared to maximum temperatures;
  - Springs are getting significantly warmer, falls cooler, and winters and summers are more split; annual averages have been warming on the order of 1°F (2°F) per 50 years for high (low) temperatures across the state.
- Regionally, the north-central part of the state has been warming the fastest, while the eastern plains and southwest have warmed the slowest.
- Changing these analyses from the last 50 years to the last 30 years renders more striking warming trends (2-3°F per half century) that are not more significant due to year-to-year variability.

## Observed Annual Temperature Anomaly 2000-2006



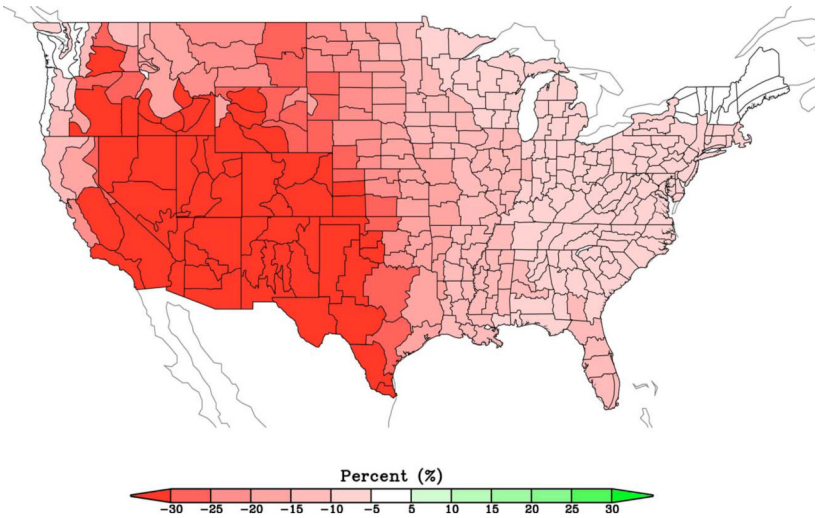

Martin Hoerling and Jon Eischeid, NOAA Earth System Research Laboratory, Climate Change Workshop 17 November, 2006

## Change in Annual Temperature 2035-2060




"Past Peak Water in the West", M. Hoerlingand, J. Eischeid, 2007 Southwest Hydrology

## (PCPN-Potential Evapotranspiration) 2035-2060




"Past Peak Water in the West", M. Hoerlingand, J. Eischeid, 2007 Southwest Hydrology

**Temperature**

- Temperatures are likely to increase by an additional 1.5 to 3.5 °F by 2025 and 2.5 to 5.5 °F by 2050.
- Summers are projected to warm more than winters. By 2050, typical average monthly temperatures in the summer are projected to be as warm as or warmer than the hottest 10% of summers from 1950 to 1999.
- The current climate of lower elevations is projected to migrate upward to higher elevations and the climate of the Desert Southwest to progress up into the valleys.

**Evaporation and Evapotranspiration**

- Due to increased temperatures, the rate at which water is evaporated from water bodies, soil, and vegetation is likely to increase.
- This will make the environment drier even if precipitation stays the same.

**Precipitation**

- Projections of change in amounts of precipitation for the region are not in consensus. Some studies indicate that annual precipitation will decrease slightly while others project an increase in the winter.
- Some models project more variable precipitation patterns with more frequent extreme events.

**Snowpack and Stream flow**

- Warming temperatures are projected to have significant effects on snowpack, timing of snowmelt, and stream flow even without a decrease in precipitation.
- It is likely that in the future more rain will fall as snow, snow packs will decrease and melt earlier, and peak stream flow will occur earlier in the spring.
- A decrease in the amount of water contained in snowpack is projected for elevations below 8,200 feet (i.e., a 20 to 60% reduction of snowpack by the period 2040 to 2069). Above 8,200 feet, the snowpack is anticipated to decrease by 10 to 20%.

La Plata County Colorado Climate and Energy Action Plan

In general climate warming will lead to denser vegetation and higher fuel loads. This climate change scenario coupled with the already extensive surplus of fuels (90X) within Colorado's vegetative ecosystems sets the stage for ever increasing catastrophic wildfire events for the future. The frequency, intensity, and amount of biomass consumed in wildfires is projected to increase.

## Wildland Urban Interface

Wildfires in the WUI have been a significant problem throughout the United States and especially in the West. The recent Fourmile Canyon Fire in Boulder County is an example of the impact such fires have on communities and residents within the WUI. The Fourmile Canyon Fire burned 6,182 acres and 177 structures. Fortunately, there were no public or firefighter lives lost. The estimated final suppression costs for the fire are over $1 million. In addition to the cost of suppression there are tremendous personal and social impacts to residents and the community. The Rocky Mountain Insurance Information Association (RMIIA) states that the insurance losses of $217 million from the Fourmile Canyon Fire dwarf the previous record of $46.1 million held by the Hayman Fire in 2002 (http://www.rmiia.org/Catastrophes_and_Statistics/Wildfire.asp). Critical utility infrastructure was damaged or destroyed and had to be replaced at great cost. Additional economic losses will include considerable loss of property tax revenue for local governments and special districts (rural fire protection and school districts) due to changes in property value assessments in the fire area. The table below shows the historical costs of some recent WUI fires and the relationship between suppression costs and other additive costs.

| | COST CATEGORY | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| FIRE | Suppression Costs | Other Direct Costs | Rehabilitation Costs | Indirect Costs | Additional Costs | Total Costs | Total / Suppression | Suppression / Total |
| Canyon Ferry Complex (MT 2000) | $9,544,627 | $400,000 | $8,075,921 | $55,310 | n/a | $18,075,858 | 1.9 | 53% |
| Cerro Grande (NM 2000) | $33,500,000 | $864,500,000 | $72,388,944 | n/a | n/a | $970,388,944 | 29.0 | 3% |
| Hayman (CO 2002) | $42,279,000 | $93,269,834 | $39,930,000 | $2,691,601 | $29,529,614 | $207,700,049 | 4.9 | 20% |
| Missionary Ridge (CO 2002) | $37,714,992 | $52,561,331 | $8,623,203 | $50,499,849 | $3,404,410 | $152,803,785 | 4.1 | 25% |
| Rodeo-Chedeski (AZ 2002) | $46,500,000 | $122,500,000 | $139,000,000 | $403,000 | n/a | $308,403,000 | 6.6 | 15% |
| Old, Grand Prix, Padua (CA 2003) | $61,335,684 | n/a | $534,593,425 | $681,004,114 | n/a | $1,276,933,224 | 20.8 | 5% |

The True Cost of Wildfire in the Western U.S. http://www.wflcenter.org

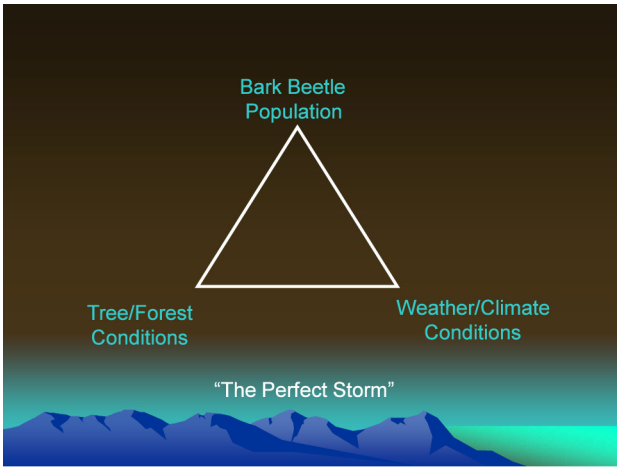
The analysis referenced above, which used LANDFIRE and SILVIS data, indicates that the annual ecological workload for wildland fire in the Colorado WUI is 166,359 acres. Due to the values at risk and the probability of a negative outcome, it is unlikely that fire management agencies will choose to manage wildfires on landscapes within or near the WUI. Full suppression of wildfires will likely continue to be the management strategy of choice in these areas. The question, then, is how to deal with the ever increasing energy load in these vegetated ecosystems in order to avert continued catastrophic events such as those experienced in Boulder County?

Due to the high social, economic, and political costs associated with wildland fires within the WUI, federal land management agencies have been directed to focus the majority of their fuel reduction and fire mitigation efforts in WUI areas. Federal, state and local agencies, as well as private citizen groups, are working collaboratively to mitigate fire risk within the WUI in response to

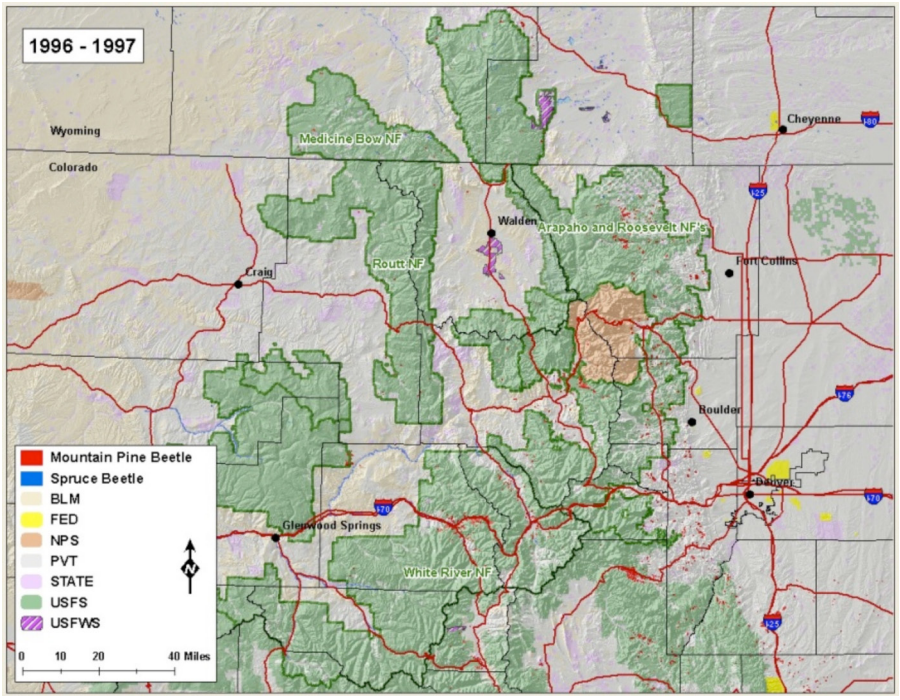
the 2000 National Fire Plan and the Healthy Forest Restoration Act of 2003. Fire and fuels mitigation efforts within the WUI in Colorado include all available tools and run the gamut from hand thinning to timber harvesting, from mowing grass to mastication of brush and timber, and from pile burning to broadcast burning. Even with this focused effort, the departure from the estimated ecological fire load becomes greater and vegetated ecosystems continue to store energy at a faster rate than it can be managed.

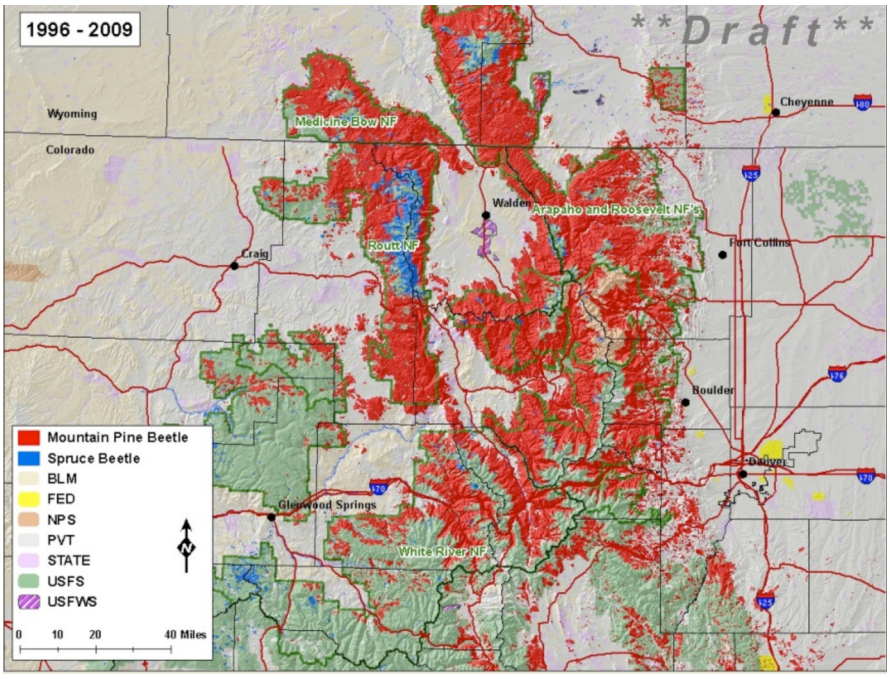
## Mountain Pine Beetle

The mountain pine beetle infestations in central and northern Colorado have been the topic of much discussion over the past several years. The current beetle epidemic is driven by several factors including initial endemic beetle populations and unnaturally homogeneous forest conditions. These factors have combined to create "The Perfect Storm."



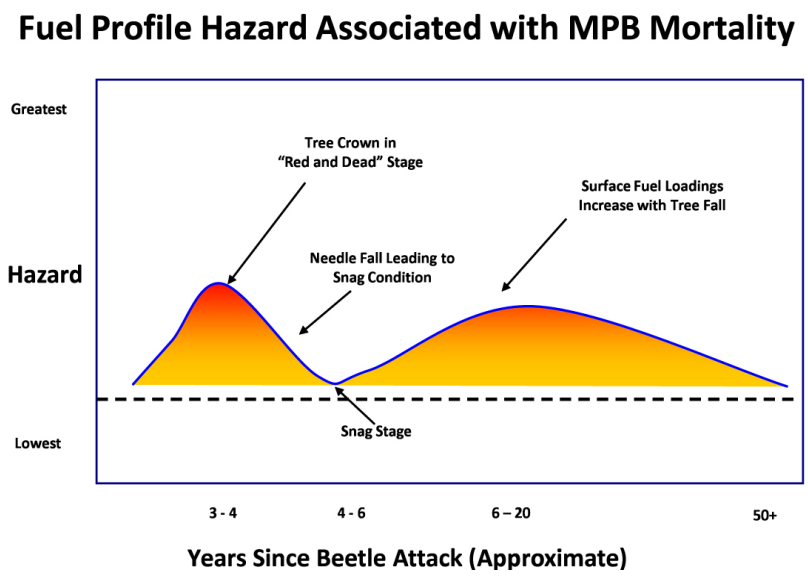
The following maps demonstrate the expansion of the pine beetle epidemic in Colorado and southern Wyoming from 1996 to 2009.



The following photos further illustrate the extent and severity of the pine beetle epidemic in Colorado.

There are numerous potential effects associated with the size and scope of the beetle epidemic and associated forest mortality. Key to this discussion is the change in forest fuels as a result of mass tree mortality in the beetle affected areas. The following chart depicts relative changes in fire hazard over time associated with dying, dead and decaying forests. Fire hazard peaks during the red needle stage and then begins to subside as the needles fall, leaving only standing dead snags. Fire hazard begins to climb toward another peak as the snags fall and provide upwards of 60 – 80 tons per acre of available dead fuel for wildfires.




Wildfire experts are just beginning to understand the relationship between bark beetle-caused forest mortality and fire. The relationship is extremely complex and varies by location and vegetation associations. What we do know is that there is an important distinction between fire risk and fire hazard — a difference that is often blurred in recent studies. Fire risk is related to the probability that there will be a fire. Weather conditions (wind speed, temperature, humidity, and drought) and a source of ignition are the primary influences on fire risk. Fire hazard is the volume, type, condition, arrangement, and location of fuel. This fuel hazard will determine the ease of fire ignition, the intensity of a fire, and a fire's resistance to control. While for the most part, the beetle epidemic will not significantly increase fire risk, it will undoubtedly change fire hazard.

Fires burning in these heavy, dead fuels release great quantities of energy (heat), which make them very difficult to control and can have excessive impact on soils and other vegetative components within the ecosystem. These types of fires can also produce tremendous volumes of smoke as they consume great masses of forest fuels. Proactive management of these beetle-ravaged forests is essential in protecting the people and communities within and adjacent to these forests. The recovery and future health of these ecosystems also depends on the use of appropriate management techniques.

The situation is dire.  Native ecosystems have accumulated a huge and unnatural energy burden (90X). Significant changes in climate are occurring, which are aligning almost perfectly with the increased energy burden to produce more frequent, larger, and more devastating wildfires. Tree mortality from the mountain pine beetle epidemic currently covers nearly 3.5 million acres and includes virtually all of Colorado's Lodgepole Pine in addition to other forest types. In addition, we have many citizens, firefighters, and communities at risk as an increasing number of people live within the over 17 million acres of WUI in Colorado.

## Prescribed Fire as a Fuels Treatment

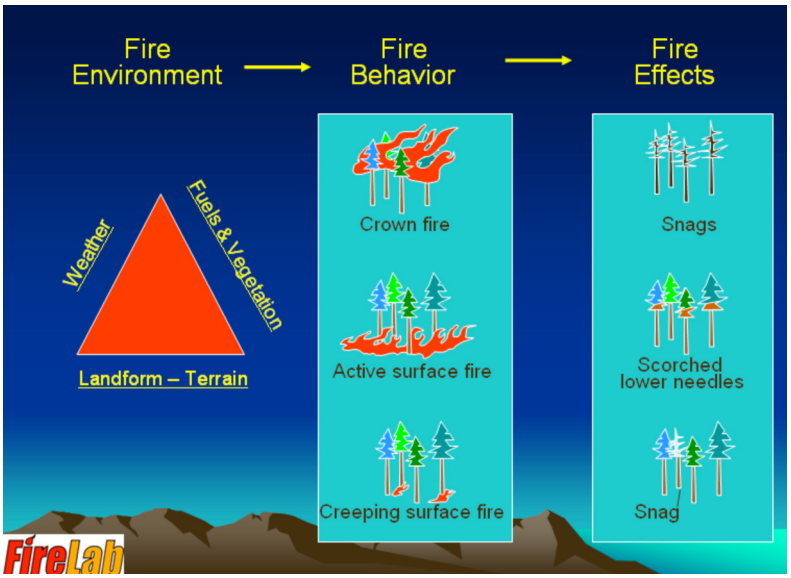
In Colorado, fire is the native ecosystems' tool to manage increasing energy loads. Every natural fire start that is suppressed is a lost opportunity to vent or manage the energy load in the ecosystem. Prescribed fires, in which land managers choose the specific conditions under which the fire will be applied to the landscape, can be used in these ecosystems to manage risk. Land managers

increase their probability of success through careful planning and development of fire prescriptions that outline the specific environmental conditions, associated fire behavior, and smoke output that will maximize the desired outcome on the landscape, while minimizing smoke impacts to the public. In 2009, Colorado experienced 1,190 wildfires, and land managers implemented 225 prescribed fires (http://www.nifc.gov/fire_info/fire_stats.htm). Similarly, in 2010 Colorado experienced 1,076 wildfires, and land managers implemented 205 prescribed fires. The overwhelming majority of these wildfires were managed under a full suppression strategy. The ratio of suppressed wildfires to prescribed fires implemented over the past 2 years is approximately 5:1, indicating how the gap continues to widen in terms of managing the energy load within our native ecosystems.

Research has shown that prescribed fire is one of the best tools land managers have for protecting communities and maintaining ecosystem health and integrity across the various vegetative and topographic landscapes in Colorado. A recent study published in the *Canadian Journal of Forest Restoration* concluded:

> "This study provides strong quantitative evidence that thinning alone does not reduce wildfire severity but that thinning followed by prescribed burning is effective at mitigating wildfire severity in dry western forests." Fuel treatments reduce the severity of wildfire effects in dry mixed conifer forest, Washington, USA: Susan J. Prichard, David L. Peterson, and Kyle Jacobson.

All fuel treatments are performed to modify burning conditions. The treatments are not performed to prevent fires, but rather to alter fuel profiles, so public and firefighter safety is improved and communities, watersheds, infrastructures, and other values-at-risk are less vulnerable to wildfire impacts. The goals of the treatments are to achieve some combination of (a) reduced flammability, (b) reduced fire intensity, (c) reduced potential for creating firebrands (spotting) and crown fires, and (d) increased firefighter safety and effectiveness.




Almost 600,000 acres of national forests in Colorado were treated for hazardous fuels reduction from fiscal year 2001 to 2009, averaging approximately 64,000 acres per year.

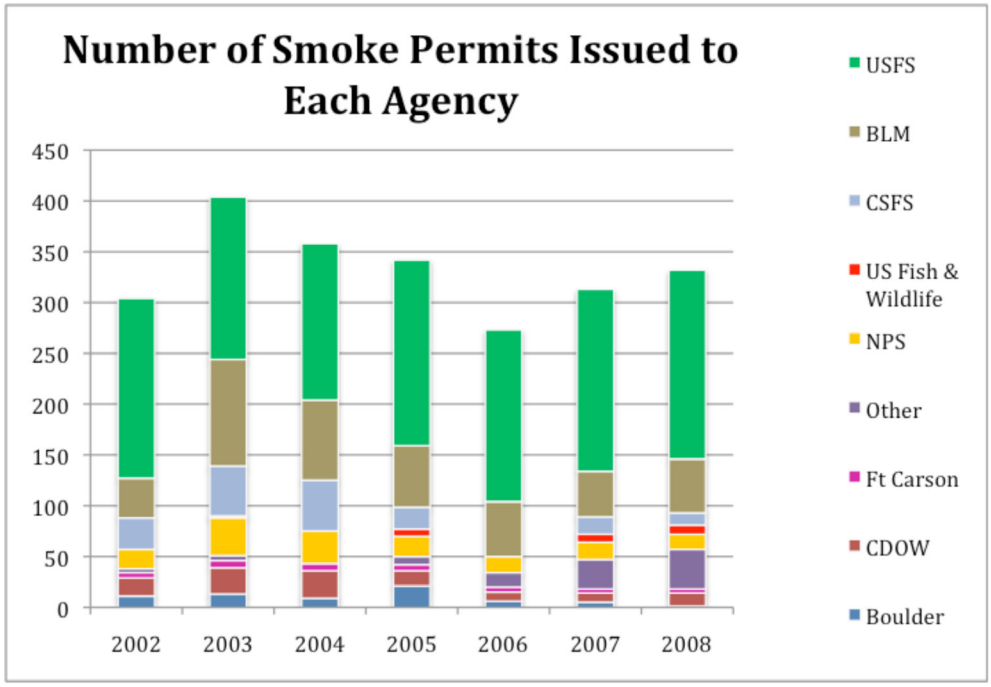
**Acres of fuel treatments completed by the U.S. Forest Service in Colorado from FY 2001-2009.**

| Unit | Fire | Mechanical | Total |
|---|---|---|---|
| Arapaho-Roosevelt NF | 50,259 | 62,128 | 112,387 |
| Grand Mesa-Unc-Gunnison NF | 48,083 | 38,634 | 86,717 |
| Manti-La Sal NF | 708 | 2,096 | 2,804 |
| Pike-San Isabel NF | 12,689 | 28,444 | 41,133 |
| Rio Grande NF | 72,716 | 80,703 | 153,419 |
| Routt NF | 17,588 | 22,514 | 40,102 |
| San Juan NF | 44,354 | 45,229 | 89,583 |
| White River NF | 41,008 | 12,211 | 53,219 |
| **Grand Total** | **287,405** | **291,959** | **579,364** |
| **Annual Average** | **31,934** | **32,440** | **64,374** |

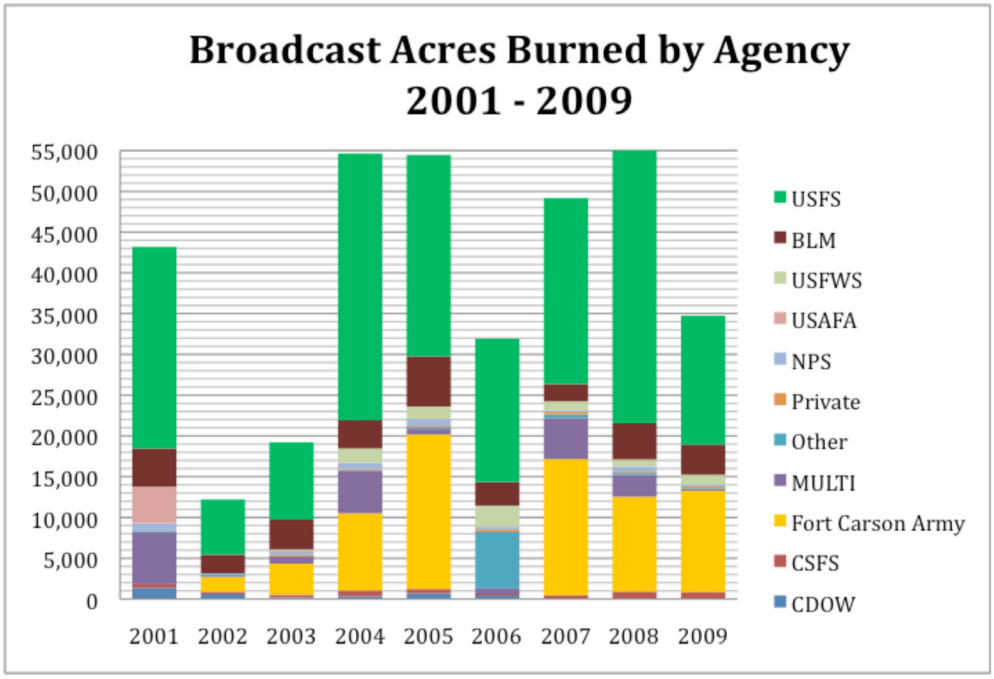
It is anticipated that most future fuels treatments would generally target community protection goals in the mountain pine beetle impacted areas, while still addressing general protection priorities for lower elevation Ponderosa Pine, Gamble oak, Douglas-fir, and dry type Lodgepole Pine WUIs. Treatments in these areas address the priorities for hazardous fuels treatments contained in *A Collaborative Approach for Reducing Wildland Fire Risks to Communities and the Environment 10-Year Comprehensive Strategy Implementation Plan – Fire And Fuels Specialist Report, Colorado Rule Making EIS*, Paul G. Langowski – Branch Chief Fuels and Fire Ecology, Angela Gee – Fuels Analyst, USDA Forest Service Rocky Mountain Region, January, 2010.

Historically the U.S. Forest Service prescribed fire program has represented 51 percent of the overall prescribed fire implementation workload throughout Colorado. As required by Regulation No. 9, the smoke management program is paid for by user fees. The U.S. Forest Service has paid 67

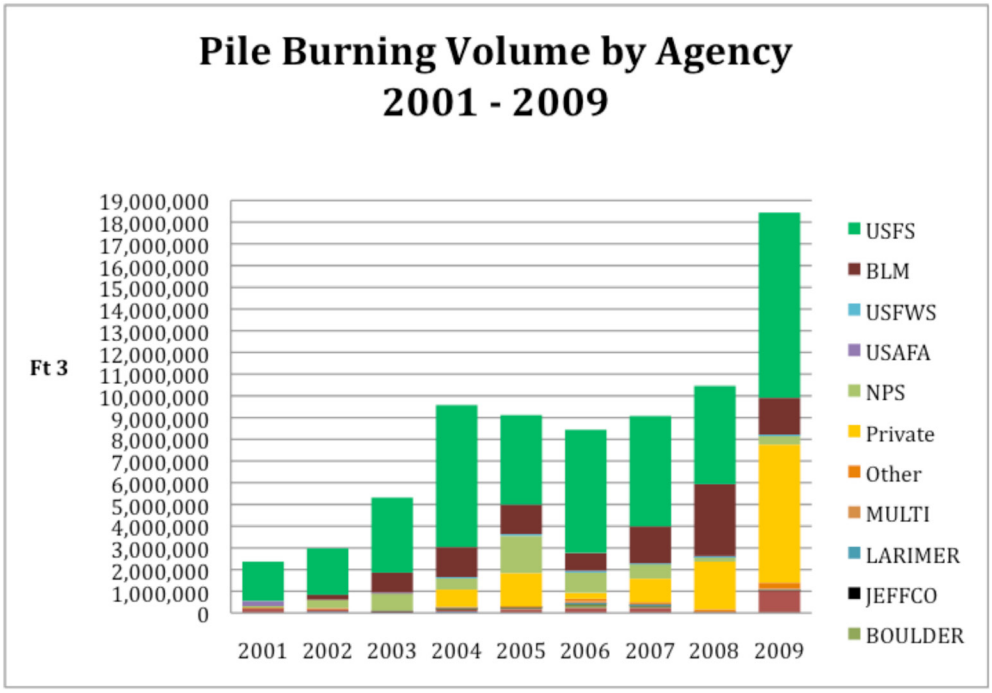
percent of the total fees charged to all permitees from 2002 through 2009. Refer to the following charts developed from data provided by the APCD for a historical breakdown of prescribed fire activity and fees paid by agency. Of significant note is the major increase in pile burning, especially by the U.S. Forest Service and private entities in 2009 due to pine beetle mitigation projects.



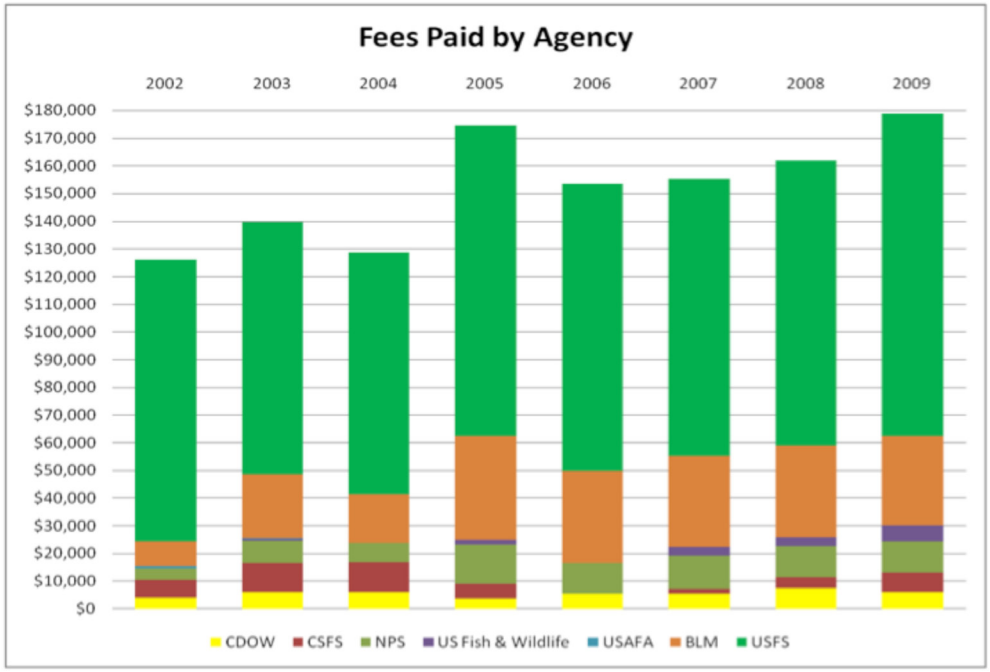

*Data provided by APCD




*Data provided by APCD




*Data provided by APCD




*Data provided by APCD

Prescribed fire has become increasingly more difficult to implement as an effective fuels treatment, especially in the WUI. Continual tightening of the NAAQS by the EPA, more restrictive permit conditions from the APCD's SMP, and increasing public intolerance for smoke from wildland fires has created a situation in which land managers are virtually unable to implement many of the most important and effective prescribed fire treatments.

In Colorado, many of the best and most important prescribed fire projects in terms of community protection are not proposed due to overly restrictive and burdensome smoke permitting. Using the Colorado SMP standard permit conditions for broadcast burns, a typical WUI burn project in timber near a community would likely fall into either the **Drainage Potential** or **Highest Smoke Hazard** category. For a typical WUI (less than 2 miles from the nearest home and less than 10 miles from a community or town), the SMP allows 40 acres per day under "good" dispersion in the Drainage Potential category and 20 acres per day under "good" dispersion in the Highest Smoke Hazard category. Most Ponderosa Pine or mixed conifer stands that have not burned for the past 100–130 years would likely have duff and litter deeper than 3 inches, placing them in the Highest Smoke Hazard category. Additionally, forests affected by the pine beetle epidemic would have 1000 hr fuel loading in excess of 10 tons/acre, placing them in the Highest Smoke Hazard category (http://www.cdphe.state.co.us/ap/smoke/).

Under such restrictions in these important WUI areas, most prescribed fire planners are unable to justify the economic, social, and ecological costs of fragmenting the landscape into 20-acre parcels to meet the SMP's permit requirements. Consequently, many projects are never planned and smoke permits are never requested. This very real and important "opportunity cost" is not addressed in the APCD's Report to the Colorado Air Quality Control Commission.

It appears that SMP permit conditions provide more capacity to burn than prescribed fire managers take advantage of, and this is one argument used by the APCD to justify the current SMP permit conditions. The following is a list of key elements that prescribed fire mangers must be mindful of when considering implementation of a prescribed fire:

- Conditions which are most conducive to good smoke dispersion, such as atmospheric instability and high winds, are the most dangerous conditions under which to implement a prescribed burn in terms of maintaining control.
- The most important consideration when implementing a prescribed burn is public and firefighter safety and ensuring the fire remains within the planned ignition area.
- Fuel conditions, weather, resource availability, fire behavior, and the associated potential for escape are the key considerations when determining whether to implement a prescribed burn on any given day. Additionally, fire effects play a major role in determining the go/no go status of a project. Fire effects must be within prescription in order to meet the projects objectives.
- Smoke management is only one filter used when deciding whether to implement a burn. If prescribed fire managers make go/no go decisions with smoke management prioritized over project safety and effectiveness, they are most certainly going to have to answer difficult questions from an incident review team.
- The more restrictive the filters (SMP permit conditions), the more likely the project will be only partially implemented, not implemented at all, or not proposed in the first place.

## Long-term and Short-term Trade-offs

Continued fire suppression, combined with very limited prescribed burning within the WUI, will lead directly to increased risk to public and firefighter safety. Continued successful suppression without vegetation management, such as prescribed fire, only serves to assure more future fires will become become more extreme events. These extreme fire events create a much greater and

more direct threat to public and firefighter lives, health, and welfare than does smoke from prescribed fires. Additionally, when these extreme fires occur, they tend to burn through all strata of forest vegetation, releasing several magnitudes the smoke in a short period of time than would be released through numerous prescribed fires. The public's health and welfare can be more heavily impacted by wildfires than by prescribed fire implementation. Ecosystem health, including longer ecological recovery time, is also more heavily impacted by wildfires.

Wildfires don't just produce more smoke and cause more damage to ecosystems; they destroy or greatly damage private property and infrastructure (e.g., municipal water sources), cause economic loss in tourism and other recreation industries, and decrease property values.

The current Colorado SMP is protecting public health and welfare in the short-term at the expense of public and firefighter safety, health, and welfare over the long-term. It is impossible to remove or withhold fire from fire dependent ecosystems, yet communities continue to expand into these ecosystems. This forces difficult choices regarding wildfires, prescribed fire, public safety, and public health and welfare.

As a product of combustion, smoke is a natural component of the ecological landscape. Smoke from wildland fires is as natural a component of the landscape in Colorado as is dust from windstorms and sediment in creeks and rivers during spring runoff. We don't try to regulate the wind in order to keep the air pure and clean; nor do we try to regulate the snowmelt to keep the water crystal clear. In Colorado, consistently clear blue summer skies without smoke from wildland fires is a misconception brought about by too many years of fire suppression. The wildland vegetation in Colorado will burn and produce smoke, regardless of whether it is a wildfire or a prescribed fire. Reduction of prescribed fire treatments directly increases the number of acres lost to wildfires without reducing, and usually increasing, the overall smoke vented into the Colorado airsheds. In the Colorado APCD's *Recommendations to the Air Quality Control Commission Regarding the Colorado Smoke Management Program in Colorado*, the APCD states:

> "The Air Division finds that federal and state air pollutant standards and programs to protect public health do serve to limit the use of prescribed fire and smoke emissions, and that these standards and programs are likely to be tightened over time." (Report to the Colorado Air Quality Control Commission, Recommendations Regarding Colorado's Smoke Management Program. Colorado

Department of Public Health and Environment, Air Pollution Control Division. PUBLIC COMMENT REVIEW DRAFT, September 20, 2010, p 6).

Choosing not to manage fire dependent vegetation on Colorado landscapes through prescribed fire and other methods will most likely lead to undesirable future outcomes. Continued tightening of standards and programs is contrary to the spirit and intent of Colorado Revised Statutes Section 25-7-111 and will only serve to increase the number and severity of wildfires in Colorado and further risk the lives and property of its citizens.

## Suggestions for the Future Smoke Management Program in Colorado

### Exceptional Events Rule

In March of 2007, the EPA addressed prescribed fires in its Exceptional Events Rule. The following statements are excerpts from the Federal Register / Vol. 72, No. 55 / Thursday, March 22, 2007 / Rules and Regulations, pp 13566-13567.

> "Consistent with historical practice governed by the guidance contained in the "Interim Air Quality Policy on Wildland and Prescribed Fires," issued on May 15, 1998, EPA approval of exceedances linked to a prescribed fire used for resource management purposes is contingent on the State certifying that it has adopted and is implementing a Smoke Management Program (SMP) as described in that policy."

> "A prescribed fire may also meet the condition of "not reasonably controllable or preventable" by examining whether there are reasonable alternatives to the use of fire in light of the needs and objectives to be served by it. For instance, there may be a significant build-up of forest fuels in a particular area that if left unaddressed would pose an unacceptable risk of catastrophic wildfire, which could result in adverse impacts of much greater magnitude, duration, and severity than would result from careful use of prescribed fire. A particular ecosystem may also be highly dependent on a natural fire return interval to maintain a sustainable natural species composition. Alternatively, pest or disease outbreaks in an area may be such that there are no reasonable alternatives to prescribed fire. In some cases, other legal requirements may preclude the use of mechanical fuel reduction methods such as in designated wilderness or National Parks. Where such ecological conditions exist or where mechanical or other treatments are not reasonably feasible for reasons that include, but are not limited to, a lack of access, or severe topography, we believe that prescribed fire qualifies as being "not reasonably controllable or preventable." Thus, we believe that a prescribed fire, conducted by Federal, State, Tribal or private wildland managers or owners, under the conditions described above may qualify as an exceptional event."

Within the language of the EPA's rule making for exceptional events, the EPA has given states with SMPs the latitude to exceed the EPA's NAAQS with emissions from prescribed fires in order to manage "a significant build-up of forest fuels in a particular area that if left unaddressed would pose an unacceptable risk of catastrophic wildfire, which could result in adverse impacts of much greater magnitude, duration, and severity than would result from careful use of prescribed fire." The Colorado APCD has made the decision not to exercise the latitude it has been afforded by the EPA. Refer to the following memo excerpts.

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

Air Pollution Control Division

TO: Wildland Fire Permittees DATE: May 8, 2008

FROM: Paul Tourangeau, Director, Colorado Air Pollution Control Division

RE: Implementation of EPA's Exceptional Events Rule

**"Overall Effect of the Rule:**

- EPA's Exceptional Events Rule does not change any prescribed or wildland fire use permitting requirements, applicable rules or regulations adopted by the Colorado Air Quality Control Commission, or operational smoke management procedures in Colorado. Regardless of the existence of EPA's Rule, burners in Colorado must comply with Colorado regulations on wildland fire burns and with their Division-issued permits."

**"Case-by-Case Consideration:**

- The Division notes that prescribed fire/wildland fire use, and smoke pollution from it, is reasonably controllable, preventable and subject to management.
  - While the Division may conduct a case-by-case review should a relevant fire event occur, the Division generally does not envision scenarios for which an exceptional event request would be generated to EPA for a prescribed fire/wildland fire use fire that resulted in an exceedance.
  - This is based both on past experience as well as the statutory definition of an exceptional event as being unpreventable and uncontrollable, yet such fires are to varying degrees preventable and controllable."
- "Except for escaped fires, however, the Division believes that good smoke management practices should and will be necessary and required to keep all prescribed fires from becoming a source of an exceedance."

The memo makes clear that the Colorado APCD does not agree with the EPA's position on prescribed fire and the exceptional events rule. It is also apparent that the APCD did not acknowledge the ecological necessity of wildland fire in Colorado's native ecosystems at the time of this memo.

We appreciate the difficulty in objectively and quantifiably measuring smoke impacts from prescribed burns. It is even more difficult to accurately forecast smoke impacts from a prescribed burn prior to implementation of the project. For these reasons, the APCD has developed a very conservative permit system that ensures the NAAQS will not be exceeded. However, this conservative approach often leaves the significant capacity for additional prescribed burning underutilized. If we were to take a more assertive approach to using the additional capacity, while at the same time implementing appropriate smoke management techniques, there would likely be some minor exceedances. The EPA has determined that any potential exceedances from these prescribed fires can be designated as exceptional events. We fully support smoke management and limiting smoke impacts to communities; however, the APCD is choosing to maintain a more restrictive SMP than the EPA requires.

Managing smoke is very much like predicting the weather, which is the major influence on smoke patterns. The National Weather Service and other agencies of the Federal Government have spent billions of dollars on weather satellites, computer software models, weather stations, and meteorolo-

gists stationed throughout the U.S.; yet we continue to have trouble obtaining accurate weather forecasts. Regardless of how good our technology is and how experienced our prescribed fire managers are, we will continue to have some unexpected and adverse results. Historically, the SMP has responded to these unexpected, adverse events by revising statewide permit conditions due to the results of a single event.

> "Another reality of SMPs is that adverse smoke impacts from a single burn can instigate revision of statewide permit conditions." (Report to the Colorado Air Quality Control Commission, Recommendations Regarding Colorado's Smoke Management Program. Colorado Department of Public Health and Environment, Air Pollution Control Division, PUBLIC COMMENT REVIEW DRAFT, September 20, 2010. P22).

Additional permit conditions have become a system of layered filters which each prescribed burn project must sift through in order to be approved by the APCD. Individual layers may not appear overly restrictive; however, when combined, these layers create a significant burden to successfully implementing a prescribed fire project. Additionally, permit conditions have been developed that instruct a manager "how to" conduct their burn operationally rather than defining a desired outcome and allowing the manager to implement a variety of actions to meet that outcome.

Over time, this pattern of response has resulted in a significant decline in the capacity to implement prescribed burns. The SMP assures that adverse events from prescribed fires will not occur, but the approach has become stifling to prescribed fire mangers' ability to implement burn projects. A better solution would be to utilize the Exceptional Events Rule for a single adverse event, while gathering data and documentation to determine if the event was anomalous or if discernible patterns develop over time that would warrant a reasonable change in permit conditions.

## Shared Risk

Through the current decision-based SMP, the APCD believes that they are sharing the risk with land managers and users of prescribed fire. This may be marginally true as it relates to the direct impact of prescribed fire smoke on the public. However, land managers are responsible for managing vast amounts of risk in the overall scheme of fire adapted ecosystems, wildfire, prescribed fire, and increasing WUI. This risk includes the physical, life, and safety risks to employees and staff while engaged in fire and fuels management activities, as well as the life and safety risks to the public and cooperating agency personnel during wildfires or escaped prescribed fires. There is risk in public and political perceptions and backlash when significant wildfire or prescribed fire events occur, such as the Cerro Grande Prescribed Fire in New Mexico and the more recent and ongoing controversies surrounding the Fourmile Canyon Fire in Colorado. There is also a great deal of risk associated with appropriately managing fire adapted ecosystems in order to maintain their future viability.

Fire exclusion affords the least risk in the short-term, but imparts the greatest overall risk over the long-term. The Colorado SMP is very heavily skewed toward reducing short-term risk, leading us down a very dangerous road of increased risk over the long-term. The APCD could choose to truly share the risk by providing regulatory support for a significant increase in prescribed fire use throughout Colorado.

## Complaint Based Program

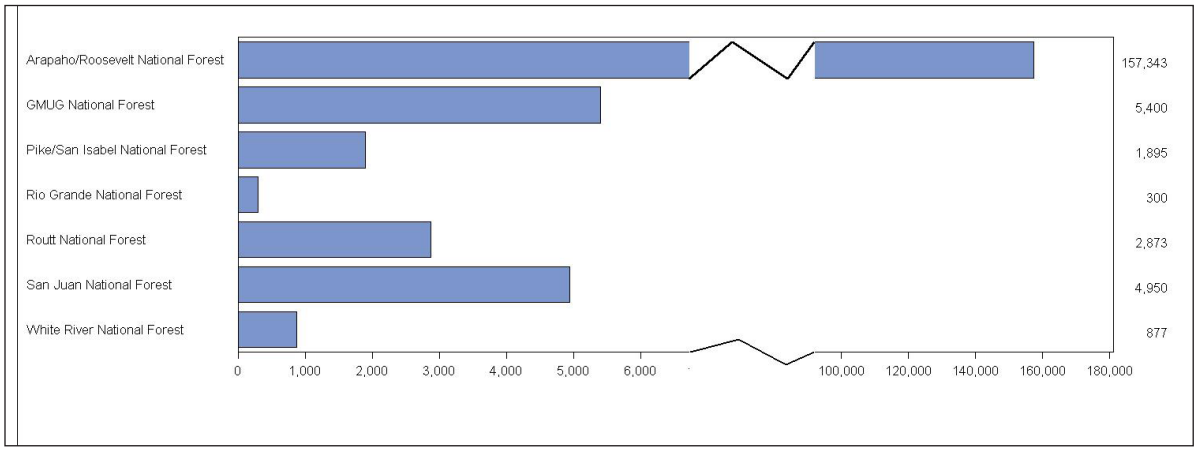
The Colorado SMP is currently a complaint based program. By their own admission, the APCD lacks quantitative information to determine whether smoke from prescribed burns exceeds public health standards. As a result, when smoke impacts from a prescribed burn elicit complaints from the public or local health officials, the APCD responds by tightening permit conditions statewide. An example of this is the recent tightening of pile burning conditions. The APCD's reasoning for tightening restrictions:

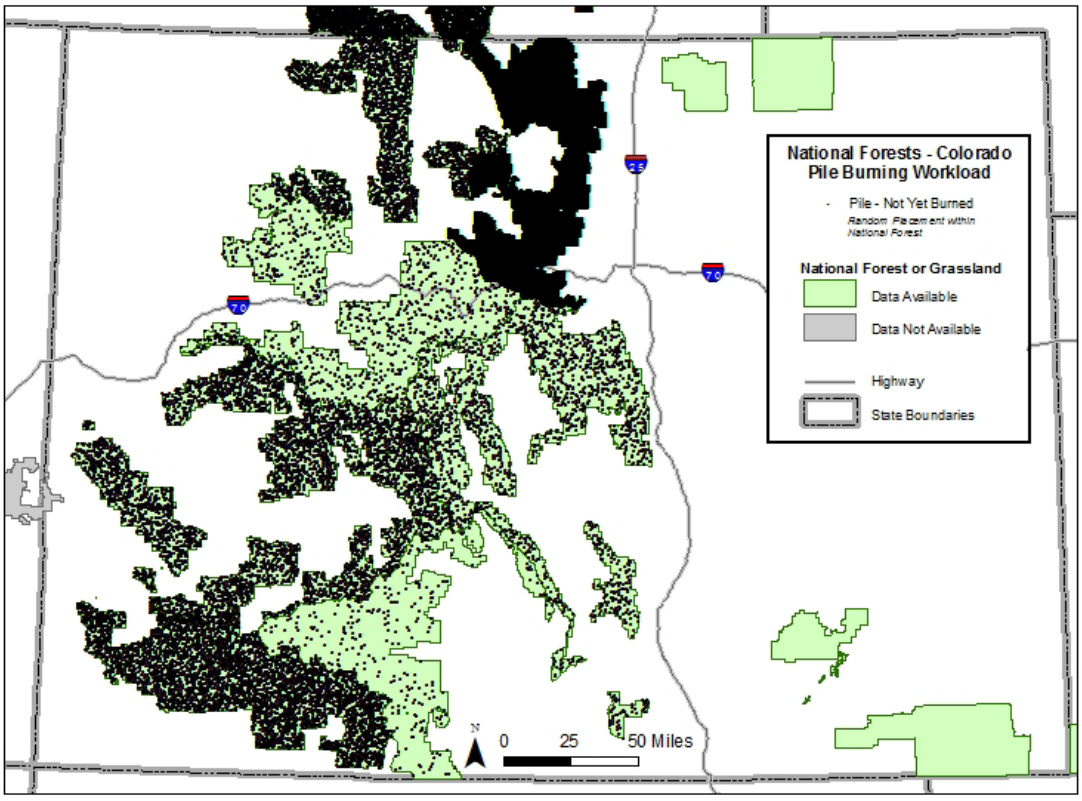
> "It has turned out, however, that the wind exemption does not sufficiently account for the need to avoid adding pollution to regionally dirty air. A year ago for small piles near homes, twice as many piles per waves were approved for the wind exemption and three waves a day, or six times as many piles per day. As one indicator of the level of problems the looser conditions could create, already last winter three counties' staffs had voiced concerns in relation to different burns. At about this time last year, we reduced the number of piles that could be burned on the wind exemption."
>
> "APCD issues few permits for piles farther than five miles from homes. Of those, some are for large logging piles."

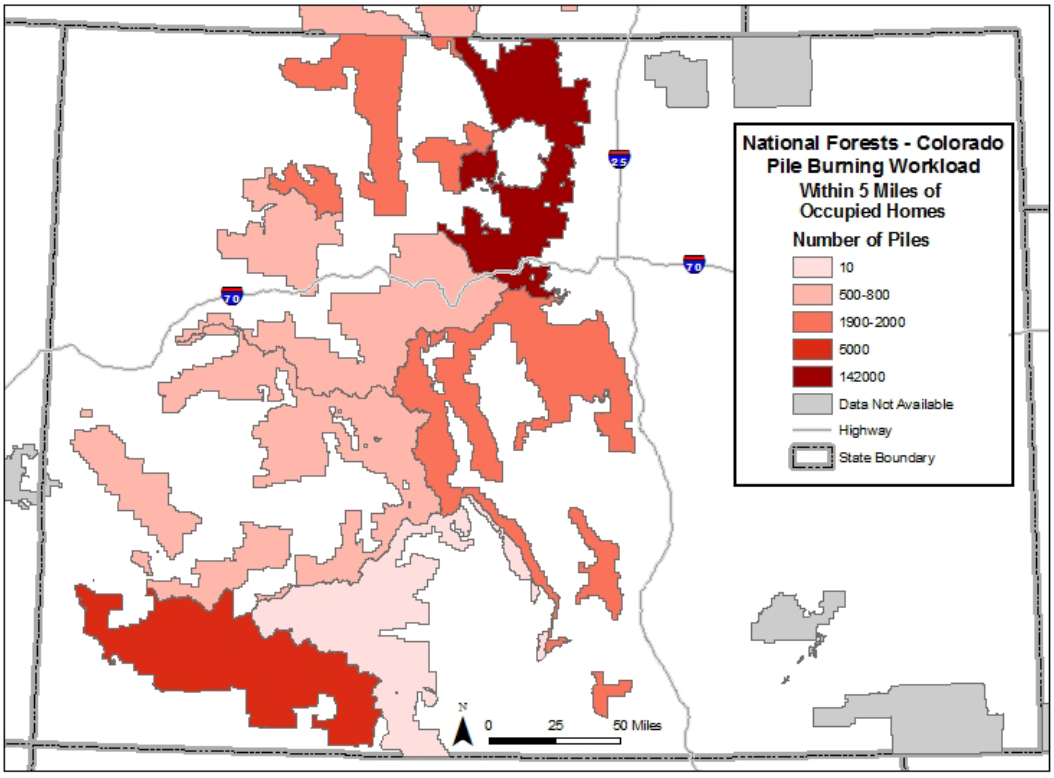
The APCD's perception of the potential impact of this restriction to the burners appears to be based on past activity and not on future needs, especially associated with pine beetle mitigation projects. This restriction also appears to be complaint based ("last winter three counties' staffs had voiced concerns") and not based upon any documented and objective criteria.

This tightening of pile burning restrictions does not meet the spirit and intent of Colorado Revised Statute Section 25-7-111. There are already over 180,000 slash piles in Colorado from work accomplished in and around critical infrastructure as a result of mountain pine beetle mitigation efforts. Within the "Pine Beetle Theater" in Colorado, there are currently close to 16,000 piles that are

### Total Number of Piles by Forest Unit



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more than 5 miles from the nearest home (as of 11/30/2010, J. Krugman, OSC Pine Beetle IMT). The burning of these piles will be significantly impacted by the recent tightening of pile burning restrictions.

Rather than an additional statewide, season-long, blanket restriction for pile burning, it would make more sense to further limit pile burning only when the conditions of concern (stagnant and regionally dirty air) occur and can be identified through objective and agreed upon criteria. This type of measurable and objective, condition-based restriction would serve to protect public health without unduly stifling land managers' efforts to reduce hazardous wildland fuels. Stagnant and dirty air does not usually remain in place for long periods of time, and air masses change as weather systems move across the state. Thus, when air quality conditions deteriorate in a given air shed and warrant either reducing or temporarily refraining from pile burning, burners and air quality managers could work together to mitigate public health risks from regionally dirty air. This could allow for significantly more burning during times when the conditions of concern are not occurring.

Interestingly, when land managers suggest relaxing some of the permit conditions in order to support the increased use of prescribed fire, the APCD responds by stating that they will do so only, "through a steady, incremental, evidence-driven approach." (Report to the Colorado Air Quality Control Commission, Recommendations Regarding Colorado's Smoke Management Program, September 20, 2010. P9). However, when the APCD receives a few complaints regarding smoke from prescribed burns, permit conditions are changed rapidly without a steady, incremental, evidence-driven approach.

## Continue to develop a "hybrid" SMP

Continued support and development of a "hybrid" SMP that uses both valid lessons learned and adaptive management, as well as the latest scientific models and monitoring instruments, will serve to significantly enhance Colorado's SMP.

The recent pilot program proposed by Dan Ely for the Durango area has some merit and the Forest Service is interested in working with the APCD to refine and implement such a program. There is concern that focusing on only one community in the state would cause us to move too slowly, and Durango may not necessarily be a good representation of the smoke management issues associated with the communities along the Front Range. We would suggest adding Woodland Park to the program. Also, a significant investment in U.S. Forest Service resources would be required to implement this proposal effectively. We would like to see the program designed in such a way as to be reasonably assured that potential changes to the SMP could be rapid and significant enough to be commensurate with the investment. For example, we would like to see specific outcomes and timelines for the program based upon the success of the pilot projects. We would also like to see a plan for expanding any successful changes developed within the test areas throughout the rest of the state.

Ely's proposal fits well into the concept of shared risk as it is less anxious over marginal NAAQS exceedances and more focused on developing prescribed fire capacity through community education, collaboration, social monitoring, and air quality monitoring. Identifying stakeholders and forging partnerships in local areas where the communities and individuals are vested in the

successful outcomes of fuels management programs would help create buy-in and reduce potential conflicts. Adaptive management strategies could be used without incurring penalties for smoke impacts exceeding expectations.

## New organizational paradigm for the Colorado SMP

While pilot projects are helpful, a thorough re-thinking of the Colorado SMP is necessary. This requires careful examination of the underlying assumptions, decision-making processes, and methods for determining risk tolerance. The current implementation strategy for Colorado's SMP is incongruent with the reality on the ground and the long-term needs of Colorado's citizens. A steady, incremental, evidence-driven approach to changing permit conditions can not address this more fundamental misalignment.

The state of Florida has a very successful prescribed fire program. Last year Florida used prescribed fire to treat 2.7 million acres throughout the state compared to Colorado's 17,900 acres. Florida was successful in implementing prescribed fire on 150 times as many acres in a state with a population of 18 million compared to Colorado's 4.9 million. According to the U.S. Census Bureau, in 2008 Colorado had 511,000 individuals aged 65 and over while Florida had 3.2 million of these individuals, who as a group tend to be more sensitive to smoke. Florida is bound by the same air quality standards as Colorado, yet they are somehow able to dwarf Colorado's prescribed fire accomplishments and are better able to protect their citizens from the multiple costs of wildfires.

A key component of Florida's success is the integration of their forest resource managers within the SMP. In Florida, the SMP is managed and operated by the Florida Division of Forestry (DOF) and certified by the EPA. This arrangement first appears to be a case of putting the fox in the hen house; however, under closer scrutiny, it provides an opportunity for the stakeholders with the most to gain or lose with the opportunity to determine their own destiny. Several other states have also integrated land management agency staff within their SMPs.

Since the Colorado SMP is a user-funded program, it may be worth examining whether a change in organization might better serve the needs of all parties. Reorganization of the SMP through integration of land management staff is an example of truly sharing risk.

## Conclusion

Never before in Colorado's history has the work of applying prescribed fire to Colorado landscapes been so important and so complex. Nearly a century of excess fuels are "banked" in our ecosystems due to fire suppression and are coinciding with climate change to make the fire management environment increasingly more explosive. Mountain pine beetle is ravaging many forests in Colorado and converting millions of acres of green forests to 80 tons per acre of fuel for wildfires. In addition, we have 11.7 million acres in Colorado where these significant fire management challenges are integrated with rural communities that constitute Colorado's WUI. Within and near many of these communities, public and firefighter lives are at risk as well as property, infrastructure, municipal watersheds, and a host of other items on which we place great value.

The U.S. Forest Service values clean air and is working diligently to manage smoke from prescribed fires and wildfires in order to reduce impacts on air quality. The forces of nature are increasingly aligning against us. Maintaining the status quo will not lead to success in any form. A goal of prescribed burning 1 million acres per year in Colorado needs to be established to approach the annual ecological fire workload. This much prescribed burning would keep Colorado's ecosystems from falling further behind due to the lack of fire. The 17,900 acres actually burned in 2010 does not come close to meeting the needs of our citizens, communities, and native ecosystems.

The U.S. Forest Service is committed to partnering with the APCD to protect public safety, health, and welfare. The Forest Service is currently doing this by:

- Maximizing the use of mechanical vegetation treatments.
- Managing smoke from prescribed fires and wildfires through the use of best management practices – using all available tools and the latest science and research.
- Assessing opportunities to use air curtain burners in key pine beetle areas.

In the future the U.S. Forest Service is committed to:

- Collaborating with and assisting the APCD in developing a more objective, evidence based (hybrid) SMP.
- Collaborating with APCD and others in the evaluation of smoke models in order to broaden the tools available for smoke permitting.
- Providing the necessary resources to ensure the future success of both the SMP and prescribed fire programs in Colorado.

The U.S. Forest Service is asking the Air Quality Control Commission to meet the intent of the Colorado Revised Statutes Section 25-7-111 by:

- Determining if the current SMP meets both the short and long-term needs of the citizens of Colorado.
- Assessing the current SMP to determine if smoke permit conditions are objective, verifiable, and tied directly to NAAQS.
- Determining if the APCD is utilizing the Exceptional Events Rule for prescribed fire as the EPA intended.
- Requesting the APCD collaborate with stakeholders in examining the merits of and options for reorganizing the SMP to better meet the needs of the citizens of Colorado.
- Assessing the current process of handling smoke complaints, particularly how complaint information affects SMP implementation and identifying protocols which would allow for improvements.

Now is the time to be bold and take action.  Collectively we need to do the right things, even if they may be difficult or nontraditional. It will take all of us working together – land managers, air quality regulators, special interest groups, political entities, communities, and private citizens – if we are to be successful in reducing the impacts of catastrophic wildfires on the citizens and landscapes of Colorado.

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# Appendix A

## LANDFIRE Data Analysis

In this analysis, we used LANDFIRE version 1.0.0 (National) data products for Existing Vegetation Type (EVT) and Mean Fire Return Interval (MFRI) to look at the annual average ecological fire workload for the state of Colorado. The ecological fire workload can be thought of as the average number of acres that would naturally burn annually in Colorado based on the native vegetation types and their associated fire regimes. For this analysis, we used a grid resolution of 30 meters, or 0.222398 acres per cell (area calculations were carried out to 12 decimal places).

We used LANDFIRE version 1.0.0 (National) as opposed to LANDFIRE version 1.0.1 (Rapid Refresh), because MFRI data is not available for Rapid Refresh. Therefore this analysis does not take into account changes in EVT and MFRI resulting from wildfires greater than 1,000 acres that have occurred between 1999 and 2007, represented in Rapid Refresh.

We used two grid extents. We clipped one grid extent to the Colorado border and used it in calculations for Colorado Acres. We clipped a second grid extent to the Fire Program Analysis (FPA) enterprise data layer for Wildland Urban Interface (WUI) which is adapted from data developed by the University of Wisconsin's SILVIS Laboratory. We used this second grid extent in calculations for WUI Acres.

http://www.landfire.gov/NationalProductDescriptions21.php

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http://www.fpa.nifc.gov/Library/Papers/Docs/FPA_2/WP_Enterprise_Data_03_09_2010.pdf

http://silvis.forest.wisc.edu/old/Projects/WUI_Main.php

We performed a series of map calculations on each grid extent using the Spatial Analyst extension in ArcMap 9.3 to assign a corresponding MFRI value to each EVT cell. Example: EVT value 2054 (Southern Rocky Mountain Ponderosa Pine Woodland) x 1000 + EVT value 11 (51 – 60 Years) = EVT_MFRI value 2054011. The resulting summary tables for each extent were used to calculate acres for each MFRI class for all EVTs. The calculated acres for each MFRI were divided by a median value for each MFRI class to arrive at the number of acres that could be expected to burn annually. Example: 203,834 total acres MFRI class 11 / 55.5 median value = 3,673 acres expected to burn annually.

| | | | NVCSORDER NVCSCLASS 2054 | Tree-dominated Open tree canopy Southern Rocky Mountain Ponderosa Pine Woodland | | | | ANNUALLY | |
|---|---|---|---|---|---|---|---|---|---|
| Value | Mean Fire Return Interval | Value | Count | All Co Acres | Value | Count | Wui Acres | All Co Acres | Wui Acres |
| 1 | 0-5 Years | | | 0 | | | 0 | 0 | 0 |
| 2 | 6-10 Years | 2054002 | 9344 | 2,078 | 2054002 | 259 | 58 | 260 | 7 |
| 3 | 11-15 Years | 2054003 | 49241 | 10,951 | 2054003 | 4223 | 939 | 842 | 72 |
| 4 | 16-20 Years | 2054004 | 143746 | 31,968 | 2054004 | 47831 | 10,637 | 1,776 | 591 |
| 5 | 21-25 Years | 2054005 | 510636 | 113,563 | 2054005 | 210606 | 46,838 | 4,938 | 2,036 |
| 6 | 26-30 Years | 2054006 | 884984 | 196,816 | 2054006 | 305669 | 67,979 | 7,029 | 2,428 |
| 7 | 31-35 Years | 2054007 | 694338 | 154,417 | 2054007 | 256554 | 57,056 | 4,679 | 1,729 |
| 8 | 36-40 Years | 2054008 | 554464 | 123,310 | 2054008 | 223755 | 49,762 | 3,245 | 1,310 |
| 9 | 41-45 Years | 2054009 | 499386 | 111,061 | 2054009 | 203335 | 45,221 | 2,583 | 1,052 |
| 10 | 46-50 Years | 2054010 | 474923 | 105,620 | 2054010 | 193318 | 42,993 | 2,200 | 896 |
| 11 | 51-60 Years | 2054011 | 916539 | 203,834 | 2054011 | 365156 | 81,209 | 3,673 | 1,463 |
| 12 | 61-70 Years | 2054012 | 775114 | 172,381 | 2054012 | 300119 | 66,745 | 2,632 | 1,019 |
| 13 | 71-80 Years | 2054013 | 643089 | 143,020 | 2054013 | 249049 | 55,387 | 1,894 | 734 |
| 14 | 81-90 Years | 2054014 | 555655 | 123,575 | 2054014 | 219534 | 48,823 | 1,445 | 571 |
| 15 | 91-100 Years | 2054015 | 389056 | 86,524 | 2054015 | 158418 | 35,231 | 906 | 369 |
| 16 | 101-125 Years | 2054016 | 628301 | 139,731 | 2054016 | 256679 | 57,084 | 1,242 | 507 |
| 17 | 126-150 Years | 2054017 | 237808 | 52,887 | 2054017 | 94967 | 21,120 | 385 | 154 |
| 18 | 151-200 Years | 2054018 | 141264 | 31,416 | 2054018 | 54542 | 12,130 | 180 | 69 |
| 19 | 201-300 Years | 2054019 | 36883 | 8,203 | 2054019 | 14204 | 3,159 | 33 | 13 |
| 20 | 301-500 Years | 2054020 | 5027 | 1,118 | 2054020 | 2385 | 530 | 3 | 2 |
| 21 | 501-1000 Years | 2054021 | 1002 | 223 | 2054021 | 676 | 150 | 0 | 0 |
| 22 | >1000 Years | 2054022 | 314 | 70 | 2054022 | 200 | 44 | 0 | 0 |
| 111 | Water | | | 0 | | | 0 | 0 | 0 |
| 112 | Snow / Ice | | | 0 | | | 0 | 0 | 0 |
| 131 | Barren | | | 0 | | | 0 | 0 | 0 |
| 132 | Sparsely Vegetated | | | 0 | | | 0 | 0 | 0 |
| 133 | Indeterminate | 2054133 | 567 | 126 | 2054133 | 543 | 121 | 0 | 0 |
| | | | 8,151,681 | 1,812,892 | | 3,162,022 | 703,217 | 39,945 | 15,021 |

We calculated the acres expected to burn annually for each MFRI for each EVT for both extents. The sum of acres for all MFRI classes represents the acres expected to burn annually for each EVT. We grouped the EVT by National Vegetation Classification System (NVCS) order and class.

We excluded EVTs that are managed for developed urban areas and agricultural crops and pasture land from the sum of acres expected to burn annually, because they do not represent native vegetation types with associated fire regimes.

| | | TOTAL ACRES BY EVT | | ANNUAL ACRES BY EVT | |
|---|---|---|---|---|---|
| | | ALL CO ACRES | WUI ACRES | ALL CO ACRES | WUI ACRES |
| **EVT CODE** | **NVCS ORDER - Herbaceous / Nonvascular-dominated<br>NVCS CLASS - Herbaceous - grassland** | | | | |
| 82 | Agriculture-Cultivated Crops and Irrigated Agriculture | 8,425,258 | 1,331,520 | 309,619 | 39,280 |
| 81 | Agriculture-Pasture and Hay | 1,575,978 | 707,727 | 22,361 | 8,490 |
| | **NVCS ORDER - No Dominant Life Form<br>NVCS CLASS - No Dominant Life Form** | | | | |
| 21 | Developed-Open Space | 1,092,221 | 380,481 | 34,296 | 9,894 |
| 22 | Developed-Low Intensity | 442,773 | 350,398 | 12,259 | 9,821 |
| 23 | Developed-Medium Intensity | 160,239 | 134,733 | 4,860 | 4,011 |
| 24 | Developed-High Intensity | 42,412 | 29,314 | 1,459 | 988 |

The following table summarizes the total acres of all existing vegetation types in Colorado for each National Vegetation Classification System (NVCS) order and class.

| National Vegetation Classification System | | All Colorado Acres | All WUI Acres | Colorado Acres Expected to Burn Annually | WUI Acres Expected to Burn Annually |
|---|---|---|---|---|---|
| Order | Class | | | | |
| **Herbaceous / Nonvascular-dominated** | | | | | |
| | Herbaceous - grassland | 26,577,065 | 3,511,945 | 591,470 | 49,913 |
| **Shrub-dominated** | | | | | |
| | Shrubland | 12,943,032 | 2,299,682 | 225,700 | 39,430 |
| | Herbaceous - shrub-steppe | 1,172,036 | 179,523 | 17,237 | 2,767 |
| | Dwarf-shrubland | 474,651 | 78,866 | 5,236 | 939 |
| **Tree-dominated** | | | | | |
| | Open tree canopy | 13,125,648 | 2,878,466 | 191,963 | 44,090 |
| | Closed tree canopy | 8,675,992 | 1,645,703 | 119,682 | 28,866 |
| | Sparse tree canopy | 37,709 | 6,871 | 572 | 113 |
| **No dominant life form** | | | | | |
| | No dominant life form | 1,737,644 | 894,925 | 0 | 0 |
| | Sparsely vegetated | 148,826 | 12,012 | 2,308 | 240 |
| **Non-vegetated** | | | | | |
| | Non-vegetated | 1,728,002 | 239,905 | 0 | 0 |
| **TOTALS** | | **66,620,605** | **11,747,898** | **1,154,167** | **166,359** |

In providing this report, written materials, presentation, and oral testimony, the United States of America, acting by and through the USDA Forest Service ("Forest Service"), does not concede, and also reserves all rights, defenses, immunities and privileges, in its position that Colorado Regulation No. 9 (open burning, prescribed fire, and permitting), and any and / or all of its implementing procedures and protocols, do not meet the requirements of the limited waivers of sovereign immunity and supremacy found in section 118(a) of the federal Clean Air Act, 42 U.S.C. §7418(a) 2010.