# Landscape-Scale Wildland Fire Risk/Hazard/Value Assessment

# Carson City Consolidated Municipality, Nevada

Prepared for:

Nevada Fire Board
c/o Bureau of Land Management
Nevada State Office
1340 Financial Blvd.
Reno, NV 89520

Prepared by:

Wildland Fire Associates
2016 Saint Clair Avenue
Brentwood, MO 63144

# Landscape-Scale Wildland Fire Risk/Hazard/Value Assessment

## For

## Carson City Consolidated Municipality, Nevada

**April 21, 2008**

**Wildland Fire Associates**

**Carl Douhan**
**Esther Mandeno**
**Dan O'Brien**
**Steve Petersburg**

This project was administered by the Nevada Fire Board and funded by the Bureau of Land Management with support from other agencies. Data and recommendations developed for this project are advisory in nature and are NOT intended to replace specific site assessments. At any given time the ephemeral nature of the vegetation may affect fuel condition present within each individual county in Nevada. Wildland Fire Associates and its agents assume no liability in the event a catastrophic wildland fire damages or destroys public or private property.

# Landscape-Scale Wildland Fire Risk/Hazard/Value Assessment

## For

## Carson City Consolidated Municipality, Nevada

Submitted by: _____ Date: _____
Project Leader, Wildland Fire Associates

Reviewed by: _____ Date _____
Nevada Fire Safe Council

Reviewed by: _____ Date: _____
Bureau of Land Management

Accepted by: _____ Date: _____
Chair, Nevada Fire Board

# Table of Contents


0.0 Preface 1

1.0 Executive Summary 2

2.0 Introduction 5

2.1 Policy Guidance 5
2.2 Background and History of Accomplishments 9
2.3 Purpose of this Analysis 10
2.4 Analysis Process 10

3.0 Summary of Findings 11

4.0 Countywide Landscape Description 15

4.1 Project Location 15
4.2 General Overview 16
4.3 County Demographics 18
4.4 Values at Risk 18
4.4.1Tangible Values at Risk 18
4.4.2 Intangible Values at Risk 20
4.5 Topography 21
4.6 Climate 21
4.7 Ecosystem Types 22

5.0 Risk Assessment: Identifying and Evaluating Assets at Risk 24

5.1 Methodology 24
5.1.1 Process Overview 24
5.1.2 Data Input 24
5.1.3 GIS Model Description 24
5.1.4 Weighting the Inputs 25
5.1.5 Description of Inputs into GIS Model 26
5.1.5.1 Fuel Hazard Data Layers 26
5.1.5.2 Risk of Wildfire Occurrence Data Layers 27
5.1.5.3 Values at Risk Data Layers 29
5.1.6 Assessment Methodology 29
5.1.6.1 Fuel Hazard and Fire Behavior 29
5.1.6.2 Other Factors Affecting Fire Behavior 31
5.1.6.2.1 Invasive (Nonnative) Species Management Considerations 31
5.1.6.2.2 Pathogens 33
5.1.6.2.3 Ephemeral Nature of Fuels 33

5.1.6.3 Fuel Models 35
5.1.6.4 Environmental Factors 35
5.1.6.5 Risk of Wildfire Occurrence 36
5.1.6.6 Fire Regimes and Condition Classes (FRCC) 37
5.1.6.7 FRCC for Carson City 41
5.1.6.8 Values at Risk 45
5.2 Data Analysis 46
5.2.1 Ranking Fuel Hazard 46
5.2.2 Ranking Risk of Fire Occurrence 50
5.2.3 Ranking Values at Risk 54

6.0 Mitigation Approaches 58

6.1 Desired Future Conditions (DFC) 58
6.1.1 In Carson City 58
6.1.2 Adjacent to Carson City 59
6.2 Mitigation Goals and Objectives 59
6.2.1 Goals 60
6.2.2 Objectives 60
6.3 Available Treatment Options 60
6.3.1 Mechanical and Manual Treatment 61
6.3.1.1 Mowing/Mastication 62
6.3.1.2 Hand Thinning and Brushing 62
6.3.1.3 Chaining 62
6.3.2 Livestock Grazing 62
6.3.3 Prescribed Fire 63
6.3.4 Chemical Control (Herbicides) 63
6.3.5 Seeding 64
6.3.6 Greenstripping/Brownstripping 65
6.3.7 Use of Multiple Methods 66
6.4 Biomass Utilization 66
6.5 Compliance with the National Environmental Policy Act 66
6.6 Establishing Project Priorities 67
6.7 Recent Fuel Treatment Projects 68
6.8 Property Owner's Responsibilities 68

7.0 Analysis Summary and Future Considerations 70

8.0 Persons, Groups, and Agencies Consulted 71

9.0 References and Citations 72

**List of Figures**

Figure 1. Overall Rating of Hazard/Risk Assessment for Carson City.
Figure 2. Risk Assessment Summary—Rural Carson City.
Figure 3. Carson City and Vicinity.
Figure 4. Land Ownership—Carson City.
Figure 5. Vegetation Classes.
Figure 6. Fire Hazard/Risk/Value GIS Assessment Model.
Figure 7. Fuel Hazard Attributes Used in GIS Model.
Figure 8. Fuel Hazard Rating—GIS Model.
Figure 9. Risk of Wildfire Occurrence—GIS Model.
Figure 10. Fire Regime Groups – Interagency Standard Definitions.
Figure 11. Fire Condition Classes.
Figure 12. Fire Regime and Condition Class (FRCC).
Figure 13. Values at Risk—GIS Model.
Figure 14. Risk Assessment Summary—GIS Model.
Figure 15. Fuel Hazard—Carson City.
Figure 16. Number of Wildfires 100 Acres or Greater by Cause—Carson City.
Figure 17. Lightning Strikes—Carson City (1997-2005).
Figure 18. Fire Occurrence—Carson City.
Figure 19. Risk of Fire Occurrence—Carson City.
Figure 20. Combined Values at Risk—Carson City.

**List of Tables**

Table 1. Relationship Between Major Wildland Fire Reports and Initiatives.
Table 2. Fuel Hazard Rating.
Table 3. Risk of Fire Occurrence.
Table 4. Combined Values at Risk.
Table 5. Risk Assessment Summary.
Table 6. Land Ownership—Carson City.
Table 7. Population—Carson City (2001–2006).
Table 8. Historic Places at Risk—Carson City.
Table 9. Federal and State Listed Flora and Fauna at Risk—Carson City.
Table 10. Listing of Areas Designated for Special Use—Rural Carson City.
Table 11. Monthly Temperature and Precipitation—Carson City (7/1948-6/2007).
Table 12. Vegetative Zones—Carson City.
Table 13. Fuel Type Attributes and Crosswalk.
Table 14. Selected and Filtered Wildland Fires Reported by Agency—All Sizes/Origins.
Table 15. Selected and Filtered Wildland Fires Reported by Agency—All Origins/100 Acres or Greater.
Table 16. Guidance When Designing and Implementing Fuels Treatment Projects.
Table 17. Bark Beetle Mortality—Carson City and the State of Nevada—Calendar Year 2004.
Table 18. Vegetation by Fuel Type and FBPS Fuel Model—Carson City.
Table 19. Summary of Vegetation Type by FBPS Fuel Model—Carson City.

Table 20. Condition Class Definitions.
Table 21. Summary of Fire Frequency and Severity, Location, and Cover Types—UT-NV.
Table 22. Summary by FRCC – Carson City.
Table 23. Condition Class by Percentage—Carson City.
Table 24. Assets at Risk—Rural Carson City.
Table 25. Description of FlamMap Data Inputs.
Table 26. Weights and Reclassification Values Used for Fuel Hazard Ranking.
Table 27. Weights and Reclassification Values Used for Ranking Risk of Fire Occurrence.
Table 28. Reclassified Value—Housing Units per Acre.
Table 29. Listing of Values at Risk Data Layers Used for Statewide Analysis.
Table 30. Value Input Layer GIS Processing Summary.

**Appendixes**

Appendix A. Wildland Fire Terms.
Appendix B. Maps.
Appendix C. Federal and State Listed Flora and Fauna at Risk in Carson City.
Appendix D. Designated Noxious Weeds—State of Nevada.
Appendix E. Historical and Modern Disturbance Regimes of Pinyon-Juniper.
Appendix F. Fuels Treatment Projects—Carson City.

## 0.0 Preface

This Landscape-Scale Wildland Fire Risk/Hazard/Value Assessment is to be used as a companion document with the Nevada Community Wildfire Risk/Hazard Assessment Project for the communities within Carson City Consolidated Municipality (Carson City), completed in January 2005, and accepted by the County Commission, Fire Chief, and State Forester in March 2005. Combined, these two documents contain an assessment of the potential consequences of wildland fire for virtually all lands within Carson City.

The Nevada Fire Board and the Nevada Fire Safe Council intend that these documents be used to facilitate the collaborative planning process and assist in the implementation of other policies established by the National Fire Plan (see Section 2.1).

Together these documents should be used as a source of information and an aid to setting priorities, completing plans, and implementing effective fuels reduction projects both within and outside of the wildland urban interface in Carson City. Using the two assessments in concert with the guidelines established by the Living With Fire Program (http://www.livingwithfire.info) and the Nevada Fire Safe Council (http://www.nvfsc.org) should prove beneficial in reducing the wildfire threat and minimizing potential damage to communities and other important values in Carson City. However, these documents are not intended to replace the need for specific on-site assessments once an area is selected for fuels treatment.

## 1.0 Executive Summary

This report is a landscape-scale wildland fire risk/hazard/value assessment that covers lands within Carson City Consolidated Municipality (Carson City). This analysis assesses the threat of catastrophic wildfire to life, property, and resources on lands not previously examined in the community-focused assessment completed in 2005 (Nevada Community Wildfire Risk/Hazard Assessment for Carson City, RCI 2005).

Specific fuels treatment projects to protect values at risk or to address unusual fuel conditions are not part of this assessment. However, a listing of treatment options has been identified to achieve the primary mitigation goals. These options include mowing/mastication, livestock grazing, prescribed fire, chemical control (herbicides), seeding, greenstripping, hand thinning and brushing, mechanical treatment, biomass utilization, and/or a combination of these various methods.

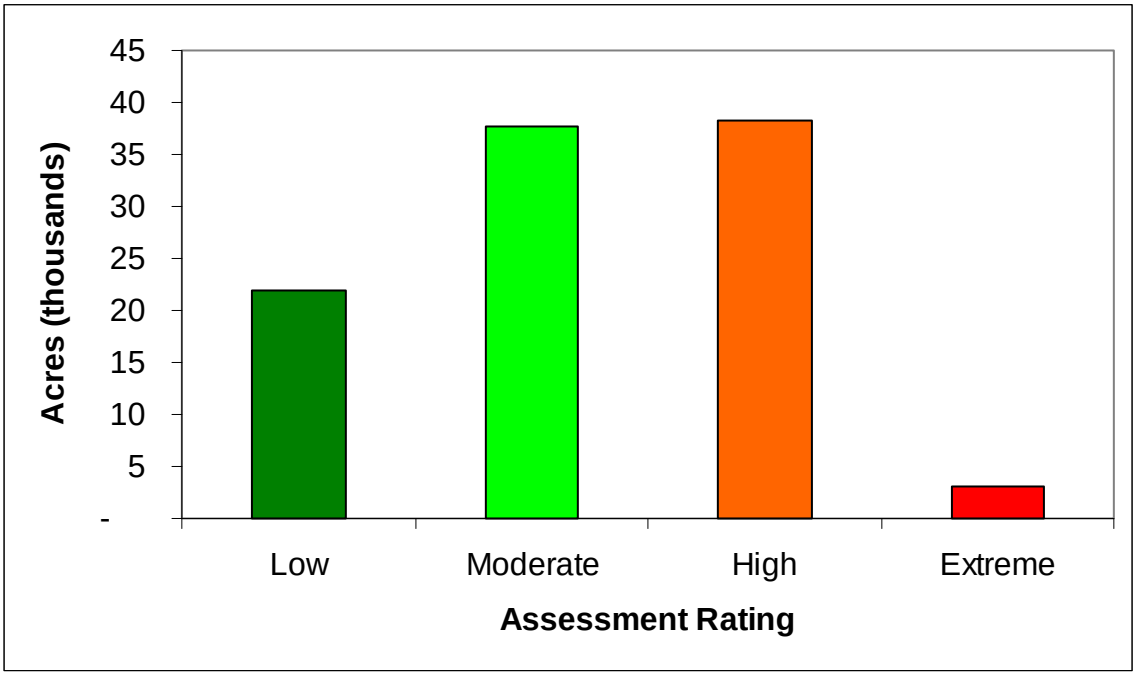
The contractor, Wildland Fire Associates (WFA), was commissioned by the Nevada Fire Board of Directors and funded by the Nevada State Office of the Bureau of Land Management (BLM) to conduct this assessment. A series of meetings were held in Carson City, Nevada, and nearby communities for interested individuals and parties to provide input needed for the assessment and for all to gain a more complete understanding of the project. Some of the topics discussed were the problems facing communities in the wildland urban intermix and identification of other values at risk that are vulnerable to wildland fire, such as critical wildlife habitat, cultural concerns, and economically important infrastructure improvements.

The contractor used GIS technology and methods to analyze data supplied by the BLM and other sources to identify levels of risk within Carson City. In order to achieve the desired results, data analysis focused on three critical areas of concern: fuel hazard, risk of fire occurrence, and values at risk. These primary components of wildfire risk and hazard were combined into an overall risk assessment summary. Based on the analysis and overall level of risk, areas were assigned standardized ratings of low, moderate, high, and extreme.[1]

The results of the analysis of the three risk/hazard components were combined to produce a final Risk/Hazard Analysis Summary Map that can be used by land managers and others as an aid to prioritize proposed projects. The results of the overall rating for Carson City are displayed in Figure 1.

[1] Ratings of Low, Moderate, and High were developed by the National Association of State Foresters (NASF) as the National Standard. Their policy permitted states to assign other risk ratings, as appropriate. In Nevada, the Nevada Fire Board concurred that a rating of Extreme was appropriate because it would help managers focus on communities exposed to the most severe risk.

Figure 1. Overall Rating of Hazard/Risk Assessment for Carson City.




**Overall, wildland fire poses a moderate to high threat to 75% of the Values at Risk in Carson City.**

This assessment also addresses Desired Future Conditions (DFC) within and adjacent to the county to ensure a seamless transition from county to county. It recommends suitable goals and objectives to achieve the desired results and suggests methods that can be used to complete future projects designed to achieve DFC.

It is not realistic to assume that management actions can always reestablish the natural and historic role that fire played in shaping the plant communities and creating the wildlife habitats that covered the presettlement landscape. However, the introduction of prescribed fire will be possible in select areas to promote the presence of native plant species and discourage dominance by exotic annual plants. In other locations active manipulation of fuels in accordance with long-term fuels management and maintenance plans will reduce the wildfire threat, facilitate safe fire suppression, and assist in the protection of identified high-value assets. The creation of a fuel complex that reduces the fire threat to the landscape and communities, improves protection of valued natural and man-made resources, lowers the cost of firefighting and subsequent rehabilitation, and improves the safety of fire suppression efforts is the desired outcome of the risk/hazard assessment and mitigation project implementation process.

The ultimate goal is to create a mosaic of complex vegetation patterns and types to increase biodiversity. A highly diverse ecosystem is a sign of a healthy system, and a complex ecosystem with a wide variety of plants and animals tends to be more stable. A diverse ecosystem also supports a wider range of plants and animals, some that may be

threatened or endangered, and contributes to soil stabilization and clean water. A diverse ecosystem supports a stable economy as well.

Changes in vegetation contribute to changes in fuel type and composition. Natural variation in fuel types and composition can aid in wildland fire suppression by creating fuel breaks or by reducing fire behavior characteristics such as flame length, rates of spread, and fire intensity, thereby allowing fire managers to choose from a wider range of suppression strategies and tactics. An area with diverse vegetation is less likely to be severely impacted by a large-scale fire event and often will recover more quickly.

A healthy, robust, resilient complex of plant communities adapts to naturally changing conditions, ranging from long-term changes in climate to the relatively short-term impact of wildland fire. The purpose of this assessment is to protect and perpetuate, to the extent possible, the desirable ecosystems found in the Great Basin and Carson City.

# 2.0 Introduction

## 2.1 Policy Guidance

Though wildland fires play an integral role in many forest and rangeland ecosystems, decades of effort directed at extinguishing every fire that burned on public lands has disrupted the natural fire regimes that once existed. Moreover, as more and more communities develop and grow in areas that are adjacent to fire-prone lands in what is known as the wildland urban interface, wildland fires pose increasing threats to people and their property (USDI/USDA FS 2000).

The National Fire Plan (NFP) was developed in August 2000, following a landmark wildland fire season, with the intent of actively responding to severe wildland fires and their impacts on communities while ensuring sufficient firefighting capacity for the future. The NFP addresses five key points: firefighting, rehabilitation, hazardous fuel reduction, community assistance, and accountability (USDI/USDA FS 2000).

The NFP continues to provide invaluable technical, financial, and resource guidance and support for wildland fire management across the United States. The USDA Forest Service and the Department of the Interior are working together to successfully implement the key points outlined in the NFP by taking the following steps:

1. Assuring that necessary firefighting resources and personnel are available to respond to wildland fires that threaten lives and property.
2. Conducting emergency stabilization and rehabilitation activities on landscapes and in communities affected by wildland fire.
3. Reducing hazardous fuel (dry brush and trees that have accumulated and increase the likelihood of unusually large fires) in the country's forests and rangelands.
4. Providing assistance to communities that have been or may be threatened by wildland fire.
5. Committing to the Wildland Fire Leadership Council, an interagency team created to set and maintain high standards for wildland fire management on public lands.

Congress, the Administration, states, tribes, local governments, and many others throughout the country recognized that achieving the key points outlined in the NFP was a long-term challenge. A series of strategy documents, the Healthy Forests Initiative, and the Healthy Forests Restoration Act provided the framework necessary to lessen risks to people and restore forest and rangeland health by addressing hazardous fuel buildup on public lands and reducing the threat of wildland fire. The relationship between major wildland fire reports and initiatives prior to the latest initiative, *Protecting People and Natural Resources – A Cohesive Fuels Treatment Strategy* (2006), can be found in Table 1 at the end of this section.

A key principle—coordination—was stressed when the U.S. Department of the Interior and the U.S. Department of Agriculture prepared a joint strategy for addressing hazardous fuel to reduce the risk of catastrophic wildland fires on more than 180 million

acres of public forests, woodlands, and rangelands. The 60-page report, *Protecting People and Natural Resources – A Cohesive Fuels Treatment Strategy*, outlines a coordinated approach to fuels treatment adopted by the five major federal land management agencies: Bureau of Indian Affairs (BIA), Bureau of Land Management (BLM), U.S. Fish and Wildlife Service (USFWS), National Park Service (NPS), and USDA Forest Service (USDA FS) (USDI/USDA FS 2006). It describes practices that have worked since the agencies began collaborating on the strategy and establishes a framework for future priority-setting, accountability, and partnerships to reduce the fuel buildup that contributes to large destructive fires. Four principles guide the strategy:

1. Prioritization: First priority should be given to the wildland urban interface (WUI) and second priority to areas outside the WUI. Priority treatments must concentrate on sites where vegetation is most likely to support catastrophic fires that threaten vital resources or locations of particular value to local communities. In addition, non-WUI treatments must be applied to areas where fuel loads could quickly increase to dangerous levels without active management.

2. Coordination: Coordinating land management activities, including fuels reduction, timber sales, insect and disease eradication, habitat improvement, watershed improvement, and other vegetation management activities, is key to maximizing their combined benefits toward overall fuels management objectives and achieving a well-coordinated fuels management program.

3. Collaboration: Each year's federal program should increasingly reflect the input and priorities of local, tribal, and state interests.

4. Accountability: The strategy builds in accountability through an approved monitoring plan and state-of-the-art geographic information system, assuring continued improvement in the ability of federal land managers to systematically track and support program planning, implementation, and effectiveness.

The strategy outlined in the document provides a strategic and realistic approach for reducing fuels on federal lands by focusing on specific goals that address the multiple factors that influence fuels treatments and by working collaboratively to achieve them. These four key principles are incorporated in this risk/hazard assessment.

***The Cohesive Fuels Treatment Strategy aims to lessen risks from catastrophic wildland fires by reducing hazardous fuel buildup in forests and woodlands and by reducing threats from flammable invasive species in rangelands, with an emphasis on protecting communities.***

Table 1. Relationship Between Major Wildland Fire Reports and Initiatives.

| Report/Initiative and Date | What it Does | Relationship to Other Initiatives |
|---|---|---|
| *Federal Wildland Fire Management Policy and Program Review*, December 1995. | A response to the tragic fires of 1994. Key elements include (1) reaffirming that protection of life has the first priority, (2) recognizing wildland fire as a critical natural process, (3) requiring fire management plans be developed for all burnable acres, (4) requiring fire management decisions be consistent with approved land and resource management plans, and (5) clarifying the role of federal agencies in the wildland urban interface. | First national wildland fire policy document. |
| *Managing the Impact of Wildfires on Communities and the Environment*, September 2000. | Response to a Presidential request. Provides recommendations to the Departments of Agriculture and Interior on how best to respond to the severe fire season of 2000. Makes key recommendations, among them (1) provide additional firefighting resources, (2) restore fire-damaged landscapes and communities, (3) increase efforts to remove hazardous fuel, and (4) work directly with local communities to improve community firefighting capacity and coordination, implement restoration and fuel reduction projects, and expand education and risk mitigation efforts in the WUI. | Provided the basis and conceptual framework for the National Fire Plan and the 10-Year Comprehensive Strategy—this document was also know as the National Fire Plan, a term which now is often used in conjunction with it and later actions like the Healthy Forest Initiative. |
| *Review and Update of the 1995 Federal Wildland Fire Management Policy*, January 2001. | This review was prepared in response to a request from the Secretaries of the Interior and Agriculture to (1) review the 1995 Federal Fire Policy and its implementation, (2) address specific issues raised in the Cero Grande Prescribed Fire Investigation Report and subsequent documents, (3) provide recommendations to the Secretaries for strengthening the organizational aspect of the wildland fire management programs in the two Departments, (4) provide additional recommendations that would improve the wildland fire programs in the two Departments, and (5) recommend a management structure for completing implementation of the recommendations. | This report validated the 1995 Federal Wildland Fire Management Policy and laid the groundwork for future wildland fire policy and guidance. |

| Report/Initiative and Date | What it Does | Relationship to Other Initiatives |
|---|---|---|
| *10-Year Comprehensive Strategy,* August 2001. | A coordinated 10-Year strategy to comprehensively manage wildfire, hazardous fuels, and ecosystem restoration. Developed in collaboration with governors and in consultation with a broad range of stakeholders. Scope includes federal and adjacent state, tribal, and private lands.<br><br>Primary goals are to (1) improve prevention and suppression, (2) reduce hazardous fuels, (3) restore fire-adapted ecosystems, and (4) promote community assistance.<br><br>Core principles of the strategy: priority-setting, collaboration, and accountability. | Extends concepts of the President's report and focus of the National Fire Plan into a broader, longer-term, collaborative effort. |
| *Implementation Plan, 10-Year Comprehensive Strategy,* May 2002. | Identified 22 specific tasks to achieve the four goals identified in the 10-Year Comprehensive Strategy. Established performance measures that are interagency and interdepartmental in scope. Developed in collaboration with governors and in consultation with a broad range of stakeholders.<br><br>Emphasizes a collaborative, community-based approach to address wildland fire related issues. | Translates the conceptual framework of the 10-Year Comprehensive Strategy into specific actions identifying timeframes for completion. |
| Healthy Forests Initiative (HFI) *Healthy Forests: An Initiative for Wildfire Prevention and Stronger Communities,* August 2002. | Presidential initiative to better protect people and natural resources by lowering the procedural and process hurdles that impede the reduction of hazardous fuel on public land and to fulfill the original objectives of the Northwest Forest Plan. The initiative has legislative and administrative components.<br><br>The legislative proposal called for (1) allowing agencies to enter into stewardship contracts, (2) further streamlining of NEPA analytic requirements, and (3) assuring judges consider balance of harm between short- and long-term impacts of fuel treatments when considering any request for injunctive relief. | HFI speeds implementation of projects and improves implementation of the NFP and the 10-Year Comprehensive Strategy.<br><br>Legislative proposal requires use of collaborative process consistent with the Implementation Plan for the 10-Year Comprehensive Strategy. |

| Report/Initiative and Date | What it Does | Relationship to Other Initiatives |
|---|---|---|
| *Healthy Forests Restoration Act*, December 2003. | Earlier Congress had given stewardship authority to the Forest Service (FS) and the Bureau of Land Management (BLM), partially fulfilling a request within HFI. With HFRA, Congress addressed other issues raised in HFI and contains other changes. HFRA applies chiefly to FS and BLM. Its major provisions include (1) a streamlined environmental analysis process for fuels treatments and other activities that would remove hazardous fuels from public lands, (2) incentives for states and local communities to prepare Community Wildfire Protection Plans, (3) measures to expedite judicial review of challenges to the conduct of fuels treatment projects, and (4) a requirement that judges consider the consequences of delaying or preventing a fuels treatment compared to the impacts of conducting the treatment. | Implemented many of the legislative proposals in the HFI. |

Source: Appendix E, Cohesive Fuels Treatment Strategy (2006).

## 2.2 Background and History of Accomplishments

In the spring of 1999, Nevada's first Conference on Wildland Fire brought together a broad coalition of concerned Nevadans that recommended the creation of an independent organization focused on reducing the fire risk and increasing the survivability of at-risk communities. This recommendation, and the organizational support that followed, gave birth to the Nevada Fire Safe Council. In January 2002, following the passage of the National Fire Plan, the Nevada Fire Safe Council received a grant that allowed the organization to hire an executive director and provided support for education and fuels reduction in two high-risk communities.

A few years later, a project administered by the Nevada Fire Safe Council and funded through National Fire Plan grants from the Bureau of Land Management, USDA Forest Service, and the Nevada Division of Forestry was initiated to complete Community Wildfire Protection Plans (CWPPs) for all counties in Nevada, including Carson City. The assessments were completed specifically for communities identified in the Federal Register's (Vol. 6, pp. 751 – 754, January 3, 2001) list of communities at risk within the vicinity of federal lands that were vulnerable to the threat of wildfire.

The countywide CWPPs identified communities that were at risk from a catastrophic wildland fire and recommended actions that could be taken to mitigate risks within the core community and the 1.5 mile WUI area outside the community. **However, these**

**plans did not address threats to other traditional and nontraditional values at risk beyond the boundaries established for the communities that were evaluated.**

## 2.3 Purpose of this Analysis

When Resource Concepts, Inc. (RCI) completed the community wildfire risk and hazard assessment for Carson City in January 2005 (RCI 2005), only those communities as defined in the Federal Register (Vol. 6, pp. 751 – 754, January 3, 2001) were included. After the handbook, *Preparing a Community Wildfire Protection Plan: A Handbook for Wildland Urban Interface Communities,* was released in March 2004, it was determined that the assessment completed by RCI met the intent of a CWPP as defined by the handbook. Thus, the RCI assessment has come to be called a CWPP.

The vegetation, ecological processes, and values at risk that are unique to Carson City must be protected from catastrophic wildland fires. This landscape-scale analysis is a coordinated effort designed to look at fuel conditions, values at risk, and other factors in context with, but external to, the areas assessed by RCI in order to identify locations requiring protection. The assessed areas are assigned risk/hazard ratings to assist federal and state land managers, private landowners, and other stakeholders in making informed decisions when setting priorities for restoration and hazardous fuel management projects, regardless of ownership, population density, or jurisdictional boundaries.

This analysis achieves several objectives outlined in the *10-Year Comprehensive Strategy* and meets the intent of the *Cohesive Fuels Treatment Strategy* by setting priorities in coordination with interested stakeholders. When used as intended, this analysis provides a valuable tool to increase protection of life, property, and high-value assets as well as assisting in the long-term restoration and health of fire-prone ecosystems on a landscape-scale basis.

## 2.4 Analysis Process

The data analysis completed for this assessment is based on Geographic Information System (GIS) techniques and data. The process used for this assessment is similar to processes used throughout the United States by federal, state, and local agencies. The process starts with assembling the best available data in three key categories: fuels, fire history or occurrence, and values at risk that can be lost or damaged in the event of a wildland fire. The data layers are then ranked according to importance on a qualitative scale, in this case 1-4. This qualitative scale is numerical in nature in order to take advantage of the efficient spatial processing capabilities of GIS.

After the ranking process is completed, the resulting layers of data are entered into a weighted overlay analysis. Simply put, the data layers are assigned a weight based on relative importance in relation to each other and then added together for a numerical ranking (low to extreme).

## 3.0 Summary of Findings

This assessment used the capabilities of GIS to determine the vulnerability of a given area to wildland fire and to identify areas that would benefit from fuels treatments or other activities used to mitigate risk. The final product is a tool that can be used by land managers and others to identify areas and values that are vulnerable to wildland fire and to set priorities for fuels treatment or fire threat mitigation projects.

In order to achieve the desired results, three primary layers were produced: fuel hazard, risk of fire occurrence, and combined values at risk. These primary layers were combined into a final overlay—the risk/hazard assessment summary—which identified and ranked areas based on the severity of threat posed by wildland fire. In order to conform to standards established by the Nevada State Fire Board (see footnote in section 1.0) and to simplify the planning process, ratings of low, moderate, high, and extreme were selected. A full explanation of the process can be found in Section 5.1.6.

Fuel hazard was assessed by using FlamMap, a landscape-scale fire behavior prediction tool that determines fire behavior based on a range of factors related to fuels, weather, and topography. The key outputs—fireline intensity, flame length, and rate of spread—were rated on a scale ranging from 1 to 4; 1 being low, 2 moderate, 3 high, and 4 extreme. Slightly more than half (55%) of Carson City for which data were available fell into the high to extreme categories, while the remainder of the county fell into the low or moderate categories (Table 2).

Table 2. Fuel Hazard Rating.

| Rating Class | | Acres | Percent of Total Acres |
|---|---|---|---|
| Numeric | Adjective | | |
| 1 | Low | 22,284 | 22.0 |
| 2 | Moderate | 12,898 | 13.0 |
| 3 | High | 27,922 | 28.0 |
| 4 | Extreme | 37,757 | 37.0 |
| Total | | 100,860 | 100.0 |

Note: Due to rounding during the data gathering process, a slight difference in acreage may occur. This does not affect the outcome of the analysis. Percentage may not equal 100% due to rounding.

Risk of fire occurrence was determined by the relative frequency of wildfires within the entire assessment area based on historical fire occurrence data and lightning strike history. The levels of risk were calculated by defining the spatial location of historical fires, 100 acres or greater, caused by both humans and natural phenomena; lightning density was also factored in. It was determined that Carson City was at low to moderate risk for fire occurrence (Table 3).

Table 3. Risk of Fire Occurrence.

| Rating Class | | Acres | Percent of Total Acres |
|---|---|---|---|
| Numeric | Adjective | | |
| 1 | Low | 26,854 | 27.0 |
| 2 | Moderate | 74,006 | 73.0 |
| 3 | High | - | 0.0 |
| 4 | Extreme | - | 0.0 |
| Total | | 100,860 | 100.0 |

Note: Due to rounding during the data gathering process, a slight difference in acreage may occur. This does not affect the outcome of the analysis. Percentage may not equal 100% due to rounding.

Combined values at risk or those features, both tangible and intangible, on the landscape that could potentially be damaged by wildfire were identified, combined, and included in this model. Values at risk include essential infrastructure, community values such as significant landscapes and historic places, and wildlife habitat. Slightly more than 77% of the identified values at risk were found to be at low or no risk from the impacts of wildland fire (Table 4).

Table 4. Combined Values at Risk.

| Rating Class | | Acres | Percent of Total Acres |
|---|---|---|---|
| Numeric | Adjective | | |
| 0 | No Values at Risk | 260 | 0.3 |
| 1 | Low | 77,740 | 77.1 |
| 2 | Moderate | 18,126 | 18.0 |
| 3 | High | 4,471 | 4.0 |
| 4 | Extreme | 263 | 0.3 |
| | | 100,860 | 99.7 |

Note: Due to rounding during the data gathering process, a slight difference in acreage may occur. This does not affect the outcome of the analysis. Percentage may not equal 100% due to rounding.

The final product, entitled risk/hazard assessment summary, is a weighted overlay of each of the three individual components listed above. The components were each assigned a weight (using a numerical scale) based on the relative degree of risk or hazard before being combined for the final assessment (for methodology see Section 5.1).

When all three of the components are factored into the final output, 75% of Carson City for which data were available is considered to be at a moderate to high threat level for the occurrence of large wildland fires that could potentially impact values at risk. **It is important to note that the process used to arrive at the risk/hazard/value assessment summary (Risk Assessment Summary) may mask critically important and high-value areas of wildlife habitat or isolated communities of native plants, and it may be difficult to identify areas facing a low or extreme threat in Figure 2 or even larger scale maps due to relative size and scale.**

The results of the overall assessment are shown in Table 5 and Figure 2. A larger scale map can be found in Appendix B.

Table 5. Risk Assessment Summary.

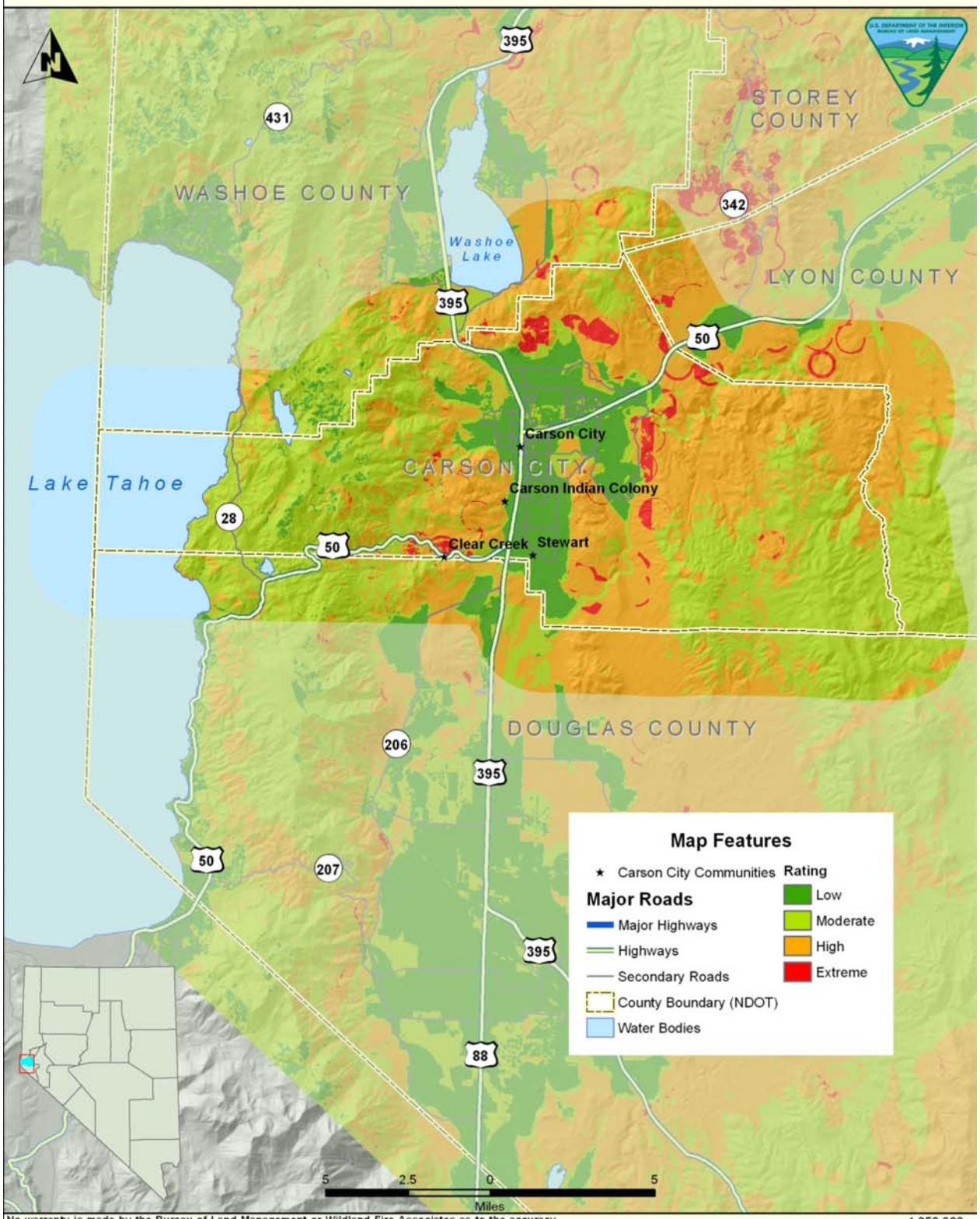
| Rating Class | | Acres | Percent of Total Acres |
|---|---|---|---|
| Numeric | Adjective | | |
| 1 | Low | 21,859 | 22.0 |
| 2 | Moderate | 37,675 | 37.0 |
| 3 | High | 38,278 | 38.0 |
| 4 | Extreme | 3,048 | 3.0 |
| Total | | 100,860 | 100.0 |

Note: Due to rounding during the data gathering process, a slight difference in acreage may occur. This does not affect the outcome of the analysis. Percentage may not equal 100% due to rounding.

Overall, three-quarters (75%) of the values at risk in Carson City are at moderate or high threat from the impacts of wildland fire.

**Figure 2: Risk Assessment Summary - Rural Carson City**
Nevada Landscape-scale Wildland Fire Assessment

**Carson City, Nevada**



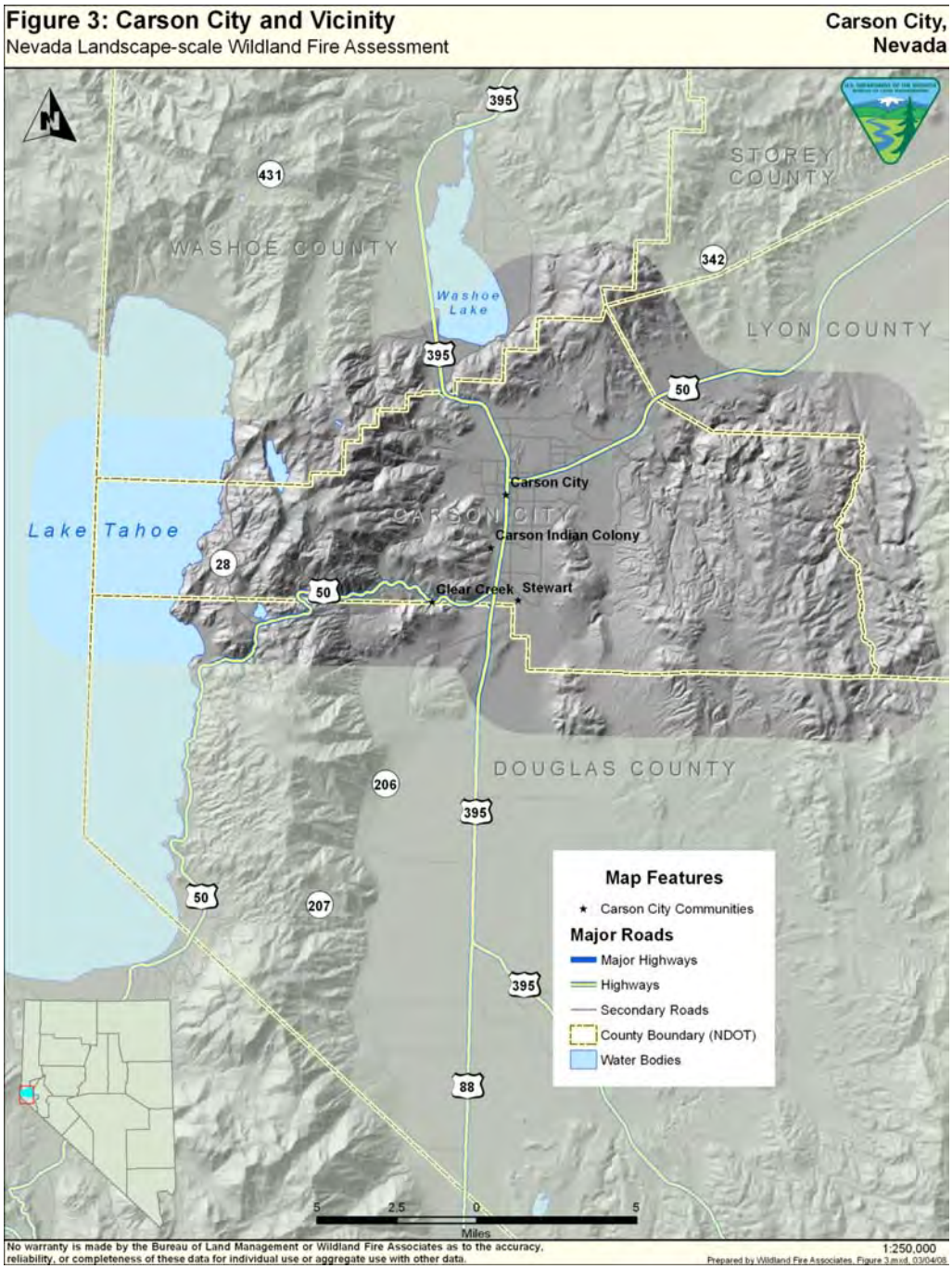

No warranty is made by the Bureau of Land Management or Wildland Fire Associates as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

1:250,000
Prepared by Wildland Fire Associates, Figure 2.mxd, 03/04/08

# 4.0 Countywide Landscape Description

## 4.1 Project Location

The Carson City Consolidated Municipality (Carson City) is located in western Nevada. The county lies north of Douglas County, east of Lyon County, and south of Washoe County. Significant physical features located within the boundaries of Carson City can be found in Figure 3.



## 4.2 General Overview

Carson City was founded as a community in 1858, only 7 years after the first settlement of Eagle Station Trading Post in 1851. In 1864, President Abraham Lincoln signed a proclamation that elevated Nevada to statehood, and Carson City was selected as the state capital at the constitutional convention and has retained that status to the present day (Carson City Home Page). Ormsby County was one of the 9 original counties established by the first Nevada Territorial Legislature in 1861, and Carson City was its county seat. In 1969, Ormsby County and Carson City were consolidated into one municipal government known as the Carson City Consolidated Municipality (Nevada Department of Cultural Affairs). Based upon its square miles, Carson City is one of Nevada's smallest counties and one of America's largest state capitals.

Carson City is comprised of approximately 100,000 acres (146 square miles). The majority of land within Carson City is administered and managed by federal agencies. The Bureau of Land Management administers approximately 41% of the land. Other federal agencies manage approximately 15.3% of the land, while the balance is private or state owned. The federal agencies' policies and decisions on lands located near the wildland urban interface areas may have direct effects on private landowners within Carson City (RCI 2004).

A breakdown of land ownership including water can be found in Table 6 and the location of these lands can be found in Figure 4.

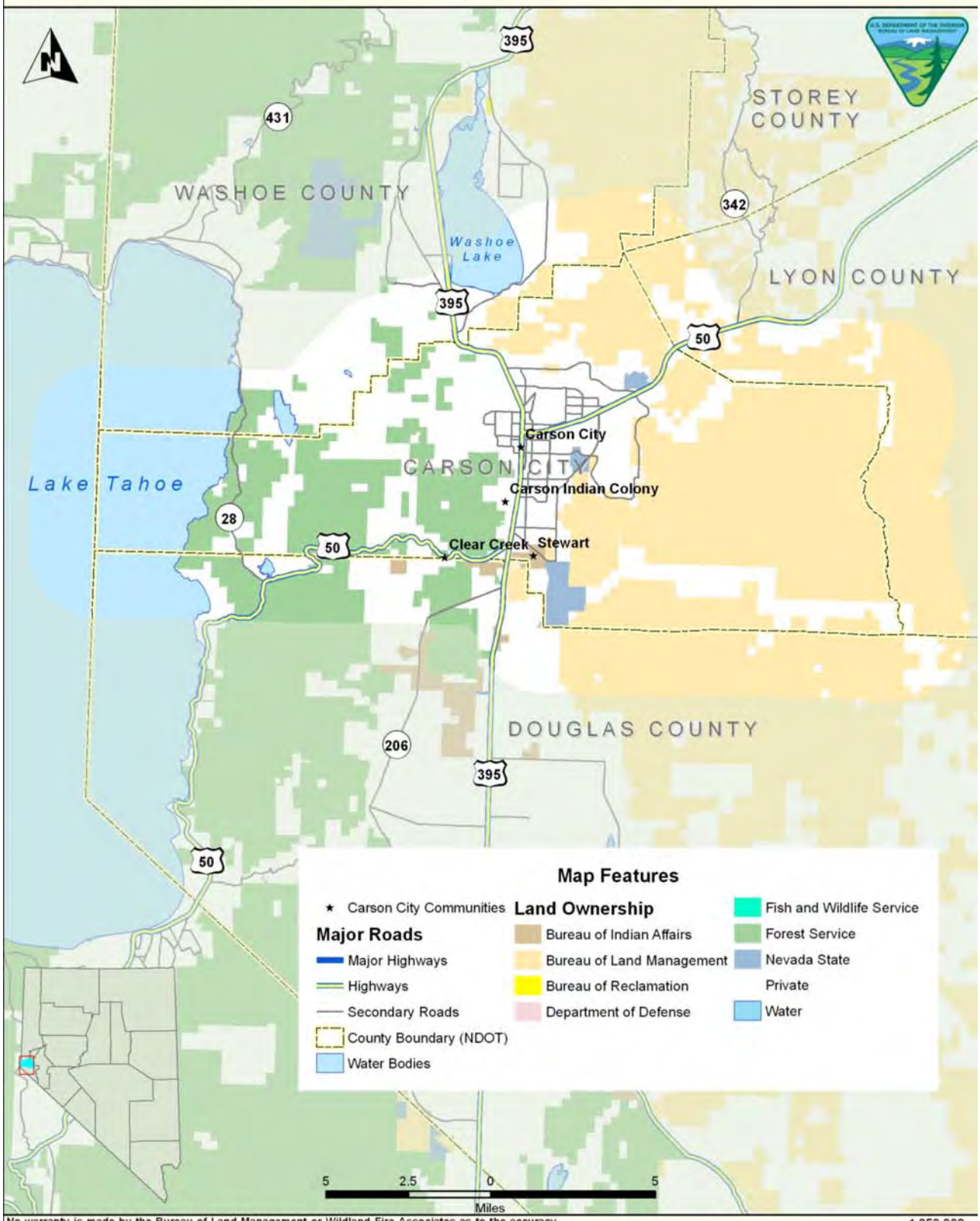
Table 6. Land Ownership – Carson City.

| Land Ownership | Approximate Acreage | Percent of Total Acres |
|---|---|---|
| Bureau of Indian Affairs | 323 | 0.3 |
| Bureau of Land Management | 41,355 | 41.0 |
| Private | 32,133 | 32.0 |
| State of Nevada | 4,139 | 4.0 |
| US Forest Service | 15,235 | 15.0 |
| Water | 7,675 | 8.0 |
| Total | 100,860 | 100.3 |

Source: Compiled from BLM's land ownership GIS layer, clipped to NDOT Carson City Boundary, 2007. Surface water is not included in the land ownership database. Percent of Total Acres rounded up.

**Figure 4: Land Ownership -- Carson City**
Nevada Landscape-scale Wildland Fire Assessment

**Carson City, Nevada**




No warranty is made by the Bureau of Land Management or Wildland Fire Associates as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

1:250,000

Prepared by Wildland Fire Associates, Figure 4.mxd, 03/04/08

### 4.3 County Demographics

The Nevada State Demographer's Office estimated the 2006 population for Carson City to be 57,701 persons. The majority of residential development is located in Eagle Valley and the surrounding foothills.

The population of Carson City is projected to increase by 22,030 persons between 2005 and 2026 (NSBCD 2007). The steady growth rate of Carson City over the past 6 years is illustrated in Table 7.

Table 7. Population – Carson City (2001-2006).

| 2001 | 2002 | 2003 | 2004 | 2005 | 2006 |
|---|---|---|---|---|---|
| 54,171 | 54,844 | 55,220 | 56,146 | 57,104 | 57,701 |

Source: Nevada State Demographer (2006).

The Nevada Department of Employment, Training, and Rehabilitation listed education, state and local government, trade, and service industries as the major employers in Carson City. The largest employers are Carson City School District, Carson Tahoe Hospital, City of Carson City, Nevada Department of Transportation, Western Nevada Community College, Casinos, Chromalloy Nevada, and Wal-Mart Supercenter.

### 4.4 Values at Risk

#### 4.4.1 Tangible Values at Risk

Critical features at risk of loss during a wildfire event are economic assets such as industrial and agricultural resources, natural resources, cultural features (such as historic structures and archaeological sites), and recreation-based resources.

Carson City's watershed is at risk from a wildfire event as evidenced by the Waterfall Fire of 2004, when approximately 5,705 acres of the 9,041 acre municipal watershed, including Kings Canyon, Ash Canyon, and Vicee Canyon subwatersheds, burned. Significant hazards and costs to Carson City's water system were incurred due to the large percentage of watershed that was impacted. Erosion and sedimentation from a wildfire event can affect the performance and maintenance of the Quill water treatment facility. Reductions in water storage capacity could occur, and costs to repair the damage could be considerable. In fact, the USDA Forest Service estimated it would cost 5 million dollars to repair the facility as a result of the Waterfall Fire of 2004 (Forest Service FSH 2509. 2004). Additionally, mudslide hazards resulting from severe burning could leave homes, roads, pipelines, and other municipal infrastructure at further risk of loss.

There are 41 sites listed on the National Register of Historical Places for Carson City, and the Nevada State Register of Historic Places lists 17 sites. The historic buildings that lie in the wildland urban interface and could be negatively impacted by wildfire are summarized in Table 8.

Table 8. Historic Places at Risk – Carson City.

| Site Name | Location | Source Register |
|---|---|---|
| Stewart Indian School | South Carson City | National Register of Historic Places |
| Wabuska Railroad Station | South Carson Street | National Register of Historic Places |

The Spooner Lake Unit of the Lake Tahoe State Park is located within both Carson City and Douglas County. There are several structures within the 2,800 acre park that are constructed of wood siding or logs.

Riverview Park and the Silver Saddle Ranch are also at risk from wildfire. Riverview Park is located on the east side of Carson City along the Carson River. The Silver Saddle Ranch is owned and operated by the Bureau of Land Management and is located in the southeastern part of Carson City off Carson River Road. It encompasses 702 acres that run along the east and west banks of the Carson River and connects public lands on Prison Hill and the Pine Nut Mountains. Both the park and the ranch feature trails, signage, wildlife viewing, historic buildings, restrooms, and corrals. A wildfire event could put these areas at risk, damage wildlife habitat, and reduce recreational activities.

There is 1 federally listed endangered species, the Carson wandering skipper, with potential habitat in Carson City. Projects implemented to protect habitat for this species require formal consultation with the US Fish and Wildlife Service. An additional 14 species are protected by the Nevada state legislation and are identified in Table 9. The Nevada Natural Heritage Program, the Nevada Division of Forestry, and the Nevada Department of Wildlife should be consulted regarding specific concerns and potential mitigation to minimize impacts to these species when implementing fuel hazard reduction activities or, if possible, in the event of a catastrophic wildfire.

Table 9. Federal and State Listed Flora and Fauna at Risk – Carson City.

| Scientific name | Common name | Legislation |
|---|---|---|
| Plants | | |
| *Rorippa subumbellata* | Tahoe yellowcress | NRS 527.260.300 |
| Insects | | |
| *Pseudocopaeodes eunus* ssp. *obscurus* | Carson wandering skipper | ESA-Listed Endangered |
| Mammals | | |
| *Aplodontia rufa* ssp. *californica* | Mono Basin mountain beaver | NRS 501 |
| *Euderma maculatum* | Spotted bat | NRS 501 |
| *Lontra canadensis* | River otter | NRS 501 |
| *Martes americana* | American marten | NRS 501 |

Table 9. Federal and State Listed Flora and Fauna at Risk—Carson City (Continued)

| Birds | | |
|---|---|---|
| *Accipiter gentilis* | Northern goshawk | NRS 501 |
| *Athene cunicularia* ssp. *hypugaea* | Western burrowing owl | NRS 501 |
| *Buteo regalis* | Ferruginous hawk | NRS 501 |
| *Buteo swainsoni* | Swainson's hawk | NRS 501 |
| *Chlidonias niger* | Black tern | NRS 501 |
| *Gavia immer* | Common loon | NRS 501 |
| *Oreortyx pictus* | Mountain quail | NRS 501 |
| *Otus flammeolus* | Flammulated owl | NRS 501 |
| *Strix occidentalis* ssp. *occidentalis* | California spotted owl | NRS 501 |

Source: RCI

### 4.4.2 Intangible Values at Risk

Carson City includes an area that stretches across the Carson Range of the Sierra Mountains to Eagle Valley and the Pine Nut Mountains. The terrain around the community rises above the Eagle Valley to form a 360 degree viewshed, described by local leaders as a visual and scenic resource, which is highly valued by the local residents. This backdrop lends credence to the city being one of the more beautiful state capitals. A wildland fire could impact the viewshed for an indeterminate period of time.

The local residents enjoy a relaxed lifestyle and prefer it to the ever rapid growth that has been prevalent in the West, including certain areas in Nevada such as neighboring Reno and Las Vegas. The Carson River, the Carson Range, and the Pine Nut Mountains draw local residents who enjoy various recreational activities that support a relaxed lifestyle. Biking, hiking, fishing, horseback riding, and birding offer renewal and relaxation to many local residents as well as visitors. The Silver Saddle Ranch is a cooperative effort between the BLM and Carson City to provide public access to the Carson River and the undeveloped Prison Hill area, the recreational and scenic quality of both areas could be impacted by a wildfire.

Key watersheds in the Carson Range provide drinking water for the community and critical habitat for wildlife species, including the Lahontan cutthroat trout. A wildfire could adversely impact the scenic beauty these watersheds provide and could contribute to diminished water quantity and quality, both which could have an adverse impact to the quality of live expected and enjoyed by local residents.

To the east, pinyon-juniper woodlands provide an area frequented for centuries by Native Americans who gathered pine nuts for sustenance and barter. This is still an important cultural and economic activity that would be lost in the event of a large-scale wildland fire. Cultural sites important to the Washoe Tribe are located throughout the area and may be known only to tribal members.

Table 10. Listing of Areas Designated for Special Use—Rural Carson City.

| Area | Remarks |
|---|---|
| Silver Saddle Ranch | Cooperative effort between BLM and Carson City. |
| Riverview Park | Carson City |
| Korean War Veterans Memorial Park | Carson City |
| Ambrose Carson River Natural Area | Cooperative effort between BLM and Carson City. |
| Spooner Lake Unit | A unit of the Nevada State Park System. |
| Kings, Ash , and Vicee Canyons | Carson City watershed and key viewshed. |
| Kings Canyon Road | One of the earliest overland roads to provide access to the west from Carson City. |

## 4.5 Topography

The highest elevation within Carson City is Snow Valley Peak which is 9,214 feet above mean sea level. The lowest elevation is 4,480 feet along the Carson River near the Lyon County border. The terrain is typical of the Great Basin with a series of valleys and mountain ranges running north to south. The major mountain ranges and mountain features are the Carson Range, the Virginia Range, C-Hill, Pine Nut Mountains, and Prison Hill. Clear Creek Canyon is at risk from a wildfire event due to the narrowness of the canyon and the possibility of a wildfire burning on both sides of the canyon (Nevada Appeal 2007). A more complete description of the topography is found in Section 5.1.6.4.

## 4.6 Climate

As is the case for most of Nevada, Carson City urban area receives little precipitation and experiences extreme temperature variations. Annual precipitation is variable and averages 10.5 inches. Most of the snow pack occurs in December and January. The summer and fall months are relatively dry with isolated thunderstorms. Dry lightning storms pose a high ignition risk. Weather data for Carson City (261485) are illustrated in Table 11.

Table 11. Monthly Temperature and Precipitation – Carson City (7/1948-6/2007).

| | Jan | Feb | Mar | Apr | May | June | July | Aug | Sep | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ave. Max. Temp. (° F) | 46 | 51 | 56 | 63 | 71 | 81 | 89 | 88 | 80 | 69 | 56 | 47 |
| Ave. Min. Temp. (° F) | 21 | 25 | 29 | 33 | 40 | 46 | 51 | 49 | 42 | 33 | 26 | 21 |
| Ave. Tot. Precip. (Inches) | 1.9 | 1.5 | 1.1 | 0.5 | 0.6 | 0.4 | 0.2 | 0.3 | 0.4 | 0.6 | 1.2 | 1.8 |

(° F) Degrees Fahrenheit. Averages rounded to nearest degree.
Source: Nevada Climate Summaries, Carson City, NV.

### 4.7 Ecosystem Types

The following 5 vegetative zones occur in Carson City and are listed with typical species in order of ascending elevation (Table 12). Sagebrush, montane, and pygmy conifer are the most widespread zones, and subalpine and alpine are the least common zones.

Periods of drought since the 1970s have made the Jeffrey pine and white fir population in the Carson Range susceptible to bark beetles, and in some areas standing dead trees comprise 90% of the forest stands.

Table 12. Vegetative Zones – Carson City.

| Vegetative Zone | Predominant Species |
|---|---|
| Alpine | Non-woody species (tundra). |
| Subalpine | Sierra lodgepole, mountain hemlock, whitebark pine. |
| Montane | Mountain-mahogany, limber pine, Jeffrey pine, California white fir, incense-cedar, Sierra red fir, western white pine, Sierra lodgepole pine, aspen. |
| Pygmy Conifer | Utah juniper, singleleaf pinyon, Sierra juniper. |
| Sagebrush | Bitterbrush, sagebrush, desert peach, Great Basin sagebrush, cheatgrass (Peko Hills). |

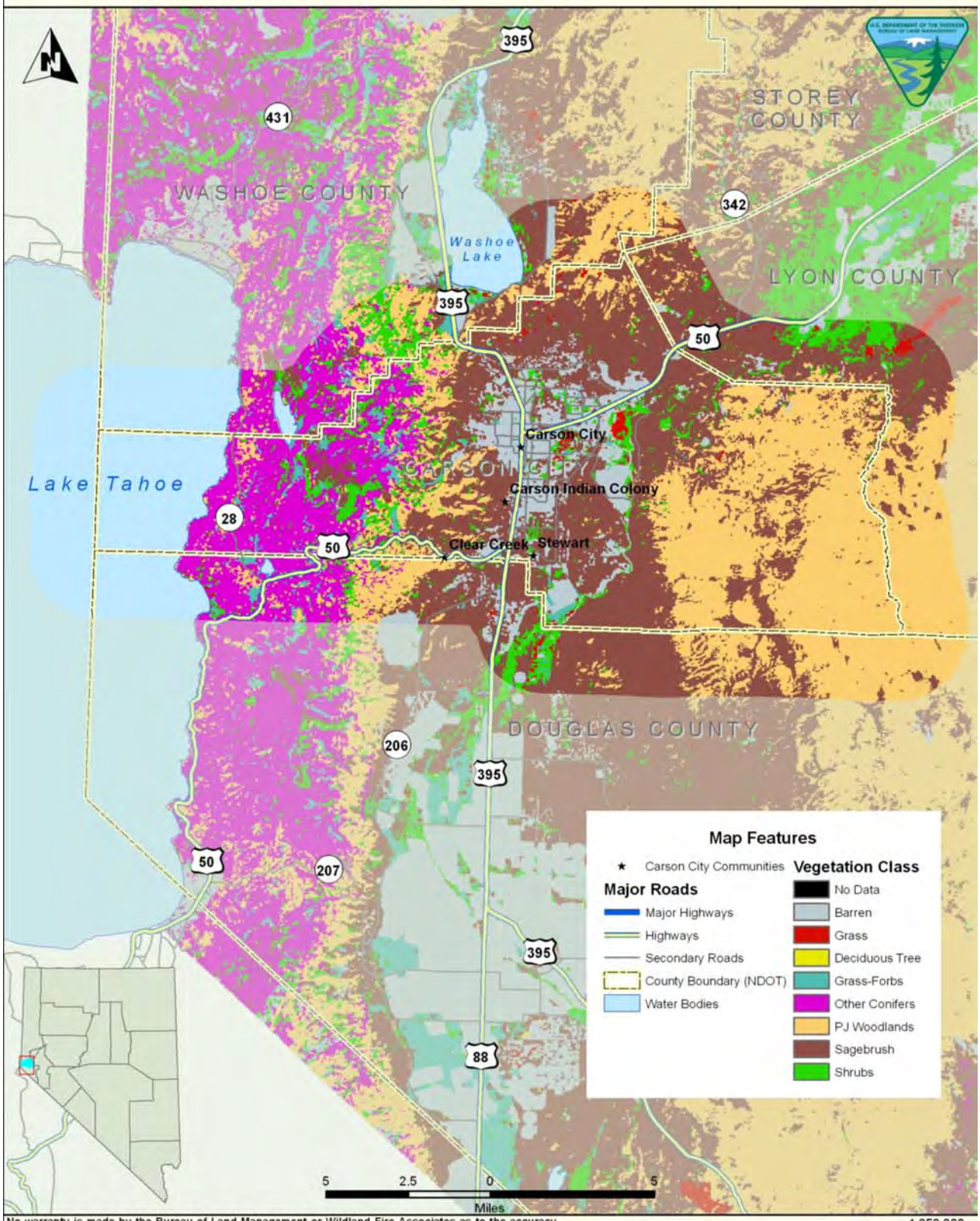
Source: Charlet, D.A. 2007. Atlas of Nevada Vegetation, Volume I: Mountains. Unpublished work in progress.

Exotic species such as cheatgrass (*Bromus tectorum*), tamarisk (*Tamarix* spp), mustards (*Descurainia spp and Sysimbrium spp*), and others have become commonplace in areas such as the highway corridors, riparian areas, and areas heavily impacted by wildland fires. These invasive species continue to increasingly alter the composition of areas currently dominated by native species. In addition, some exotic species such as cheatgrass, which is estimated to occupy approximately 2,340 acres in the county, can increase fire frequency, risk of ignition, and behavior (Tueller, et al. 2002).

The major vegetation classes found in Carson City and their locations are illustrated in Figure 5.

**Figure 5: Vegetation Classes**
Nevada Landscape-scale Wildland Fire Assessment

**Carson City, Nevada**




No warranty is made by the Bureau of Land Management or Wildland Fire Associates as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

1:250,000

Prepared by Wildland Fire Associates, Figure 5.mxd, 04/07/08

# 5.0 Risk Assessment: Identifying and Evaluating Assets at Risk

## 5.1 Methodology

### 5.1.1 Process Overview

A landscape-scale assessment is part of an overall planning process aimed at bringing together the best available data and agency knowledge to better prepare and prioritize fuels mitigation projects over a large area. It is intended to identify the locations for focused resource allocation to most effectively reduce the wildfire threat. While the threat of damage from wildfire may never be entirely eliminated, the strategic implementation of sound management practices can reduce the threat and minimize losses.

The model used in this assessment was based on similar approaches used in other planning processes, such as the Colorado Wildland Urban Interface Hazard Assessment (Colorado State Forest Service 2002). A GIS-based modeling approach was utilized with input from BLM fire management professionals. The purpose of the assessment was to develop a relative ranking for wildland fire risk and hazard, not to define specific local hazard conditions.

### 5.1.2 Data Input

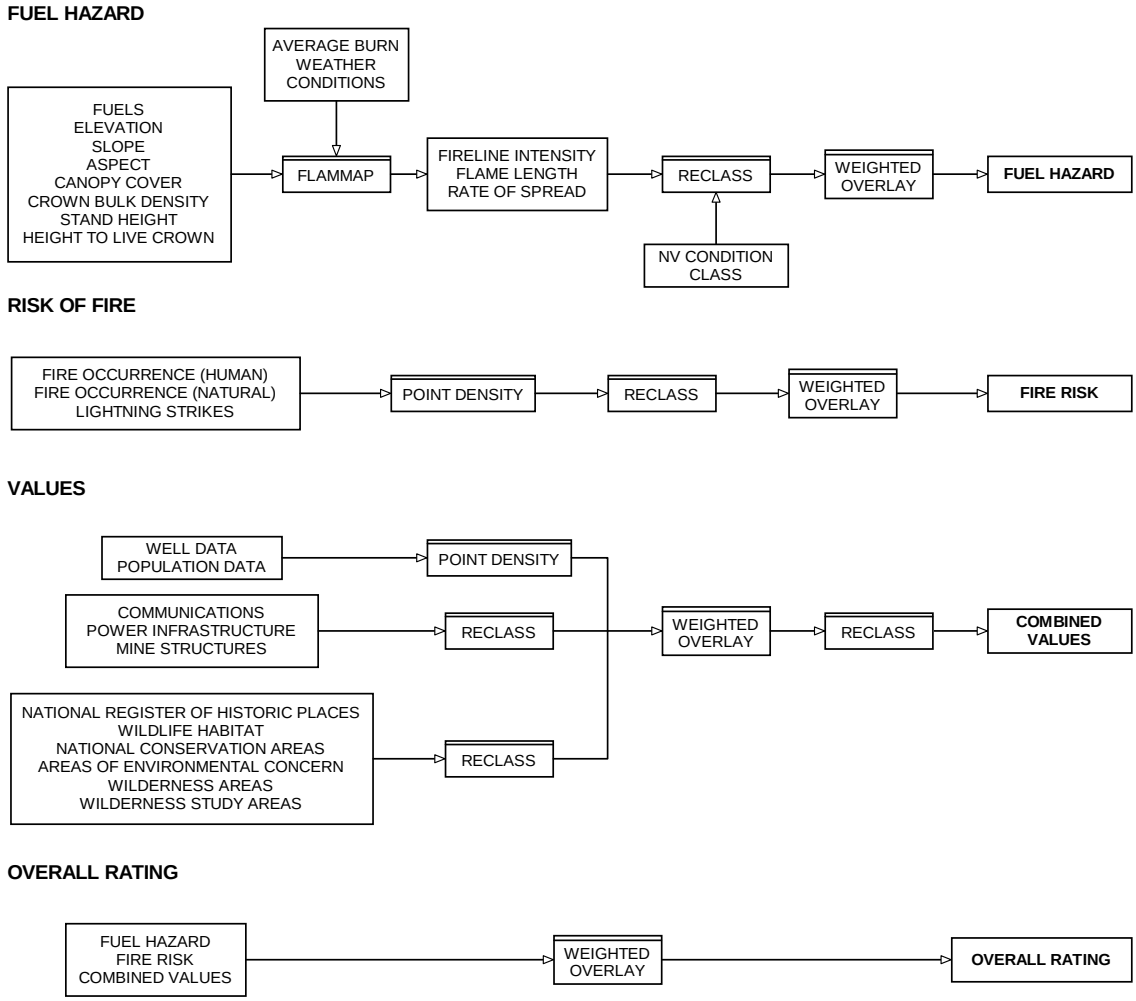
The primary source of data used to complete this assessment was the BLM Nevada State Office. However, the data layers were developed over a period of time for differing purposes resulting in varying levels of precision and accuracy. As a result, data adjustment and modification was occasionally necessary to insure a seamless database.

In cases where data were developed specifically for input into the model, every step was taken to ensure that data quality and accuracy were not compromised and that the data were consistent with that provided by the BLM. It was also necessary to revise the model several times to compensate for data availability and suitability into the GIS model. In no case were data modifications or adjustments to the basic model of sufficient magnitude to significantly alter the final risk/hazard ratings.

### 5.1.3 GIS Model Description

GIS models were developed for three general categories: fuel hazard, risk of wildfire occurrence, and values at risk. Each model was comprised of a series of input GIS data layers representing components of each category. The diagram in Figure 6 lists the data layers used for each model and how each influenced the final ranking. A final overlay was produced, which was a composite of the outputs of each of the three models.

Figure 6. Fire Hazard/Risk/Value GIS Assessment Model.




### 5.1.4 Weighting the Inputs

In order to quantify the relative significance of each of the inputs, weighting values were assigned based on data components and data layer values. These values were determined by BLM fire personnel in the BLM Nevada State Office with input solicited from other affected agencies. The weighted overlay technique applies a common measurement scale of values to diverse and dissimilar inputs to create an integrated analysis. This approach allows for the examination of multiple variables simultaneously, as well as helps to show the cumulative impact of various factors.

The following example, weighting for fuel hazard, illustrates how this process was completed for each model.

> Fuel types were classified by fuel models, canopy cover, stand height, crown bulk density, and height to live crown. These were then used to predict fire behavior using FlamMap (Finney 2006). The resulting fire characteristic layers (flame

length, fireline intensity, and rate of spread) were then assigned a numerical rating using a common scale (0-4). Each layer was then assigned a weighting value, or percentage influence, based on its importance to the model.

The total influence for all themes used in a model is equal to 100%. In the weighted overlay analysis, the reclassified cell values were multiplied by the theme weighting value and then added as one of the layers to produce the final output maps.

### 5.1.5 Description of Inputs into GIS Model

#### 5.1.5.1 Fuel Hazard Data Layers

1. Fuel Models: derived from Nevada's Interagency Fire Program Analysis (FPA) fuel type data (Table 13: Fuel Type Attributes and Crosswalk, acquired from the BLM).
2. Elevation: 30m resolution statewide data layer derived from standard USGS digital elevation models, acquired from BLM.
3. Slope: derived from elevation.
4. Aspect: derived from elevation.
5. Canopy Cover: derived from Nevada's Interagency Fire Program Analysis fuel type data.
6. Crown Bulk Density: derived from Nevada's Interagency Fire Program Analysis fuel type data.
7. Stand Height: derived from Nevada's Interagency Fire Program Analysis fuel type data.
8. Height to Live Crown: derived from Nevada's Interagency Fire Program Analysis fuel type data.

Table 13. Fuel Type Attributes and Crosswalk.

| NV FPA Fuel Types and Percent of Cover Codes | FBPS* Surface Fuel Model | % Canopy Cover | Canopy Base Ht (feet) | Stand Ht (feet) | Canopy Bulk Density kg/m3 |
|---|---|---|---|---|---|
| Aspen/Ash/Hardwood 1 | 8 | 1-20 % | 3 | 18 | 0.065 |
| Aspen/Ash/Hardwood 2 | 8 | 21-50 % | 4 | 30 | 0.078 |
| Aspen/Ash/Hardwood 3 | 8 | 51-80 % | 6 | 40 | 0.1 |
| Pinyon/Juniper Woodlands 1 | 6 | 1-20 % | 0 | 10 | 0.075 |
| Pinyon/Juniper Woodlands 2 | 6 | 21-50 % | 1 | 15 | 0.095 |
| Pinyon/Juniper Woodlands 3 | 6 | 51-80 % | 1 | 20 | 0.11 |
| Grassland (including Cheatgrass ) | 1 | | | | |
| Mountain Shrub 1 | 6 | 1-20 % | 0 | 6 | 0.07 |
| Mountain Shrub 2 | 6 | 21-50 % | 0 | 12 | 0.075 |
| Mountain Shrub 3 | 6 | 51-80 % | 0 | 12 | 0.085 |
| Mountain Shrub 2 (oak, chaparral) | 4 | 51-80 % | 0 | 6 | 0.07 |
| GB Mixed Conifer 1 | 10 | 1-20 % | 1 | 20 | 0.16 |
| GB Mixed Conifer 2 | 10 | 21-50 % | 1 | 35 | 0.19 |
| GB Mixed Conifer 3 | 10 | 51-80 % | 1 | 50 | 0.24 |
| Sagebrush | 6 | | | | |
| Sagebrush/Grass | 2 | | | | |
| Salt Desert Shrub | 5 | | | | |
| Mojave/Sonoran Shrub | 5 | | | | |
| Riparian/Riparian Woodland | 8 | 1-20 % | 4 | 20 | 0.06 |

*FBPS: Fire Behavior Prediction System. kg/m3: kilogram per cubic meter.

### 5.1.5.2 Risk of Wildfire Occurrence Data Layers

1. Local, state, and federal agencies and entities with geo-referenced databases were contacted to gather fire occurrence data – both human and natural caused—for calendar years 1997 – 2006 to build the Wildfire Occurrence Data layer. Of those contacted, the BLM, BIA, USFWS, NPS, and the USDA FS were able to provide complete fire report information through the National Fire and Aviation Management Web Applications website (http://fam.nwcg.gov/fam-web/), which is managed by the National Interagency Fire Center, National Information Systems Group. (NDF data were available but could not be used because it was not geo-referenced. Fires suppressed by volunteer fire departments were also not included.) The reports attributed to the various agencies were filtered to remove duplicate wildfires and identify fires of 100 acres or greater, the minimum parameter for fire size, regardless of cause that occurred in Carson City.

   Data were filtered using the following parameters:

   a. BLM, BIA, and NPS: only wildland fires with Fire Type/Protection Type codes of 1/1, 1/2, 1/3, 1/4, 1/9, 2/1, 2/2, 2/3, and 4/9 were selected.

b. USFWS: the same Fire Type/Protection Type codes as listed above were used. Records were individually cross-referenced to ensure that no duplicate records were used.
c. USDA FS: All records listed for Carson City were included.

2. Lightning strikes: acquired through BLM, using the strike point data for the years 1997 – 2005 gathered from the National Lightning Detection Network[2].

Table 14. Selected and Filtered Wildland Fires Reported by Agency – All Sizes/Origins (1997–2006).

| Agency | Total Number Fires | Number of Fires (natural) | Number of Fires (human) | Number of Fires (not specified) | Number of Fires Over 100ac | Average Fire Size (acres) | Largest Fire (by acres) | Total Acres |
|---|---|---|---|---|---|---|---|---|
| BIA | 6 | 1 | 5 | 0 | 1 | 27 | 160 | 162 |
| BLM | 69 | 30 | 37 | 2 | 3 | 29 | 1,000 | 1,994 |
| USFS | 16 | 4 | 12 | 0 | 2 | 585 | 8,723 | 9,360 |
| **Citywide** | **91** | **35** | **54** | **2** | **6** | **214** | **8,723** | **11,516** |
| Citywide Percentages | | 38% | 59% | 2.2% | 7% | | | |

Source: National Fire and Aviation Management Web Applications (http://fam.nwcg.gov/fam-web/).

Table 15. Selected and Filtered Wildland Fires Reported by Agency – All Origins/100 Acres or Greater (1997–2006).

| Agency | Total Number Fires | Number of Fires (natural) | Number of Fires (human) | Number of Fires (not specified) | Number of Fires Over 100ac | Average Fire Size (acres) | Largest Fire (by acres) | Total Acres |
|---|---|---|---|---|---|---|---|---|
| BIA | 1 | | 1 | | 1 | 160 | 160 | 160 |
| BLM | 3 | | 3 | | 3 | 596 | 1,000 | 1,787 |
| USFS | 2 | | 2 | | 2 | 4657 | 8,723 | 9,313 |
| **Citywide** | **6** | **0** | **6** | **0** | **6** | **1804** | **8,723** | **11,260** |
| Citywide Percentages | | 0% | 100% | 0.0% | 100% | | | |

Source: National Fire and Aviation Management Web Applications (http://fam.nwcg.gov/fam-web/).

[2] 2005 was the most recent year for which data were available.

#### 5.1.5.3 Values at Risk Data Layers

1. Structure Density: derived from 2000 census data.
2. Well points: derived from BLM's rights-of-way data layer.
3. Communication point and linear features: derived from BLM's rights-of-way data layer.
4. Power point and linear features: derived from BLM's rights-of-way data layer.
5. Mines: derived from USGS geographic place name data layer.
6. Historic Places: points registered in the National Historic Register.
7. Wildlife Habitat: combined layer representing the following species:
    a. wild horses and burros
    b. sage grouse
    c. elk
    d. pronghorn
    e. black bear
    f. bighorn sheep
    g. mule deer
    h. pygmy rabbit
    i. Lahontan cutthroat trout
    j. listed threatened and endangered species
8. National Conservation Areas: areas designated as National Conservation Areas by the BLM National Landscape Conservation System.
9. Areas of Critical Environmental Concern: areas intended to preserve unique feature types such as biological, geological, historical, or scenic as part of BLM's land use plans.
10. Wilderness Areas: designated wilderness areas as described in the BLM National Landscape Conservation System and delineated by the Humboldt-Toiyabe National Forest.
11. Wilderness Study Areas: designated wilderness study areas as described in the BLM National Landscape Conservation System.

### 5.1.6 Assessment Methodology

#### 5.1.6.1 Fuel Hazard and Fire Behavior

FlamMap was used to determine fire behavior. FlamMap is a computerized fire behavior prediction system developed by the USDA Forest Service at the Intermountain Forest Fire Research Laboratory (Finney 2006).

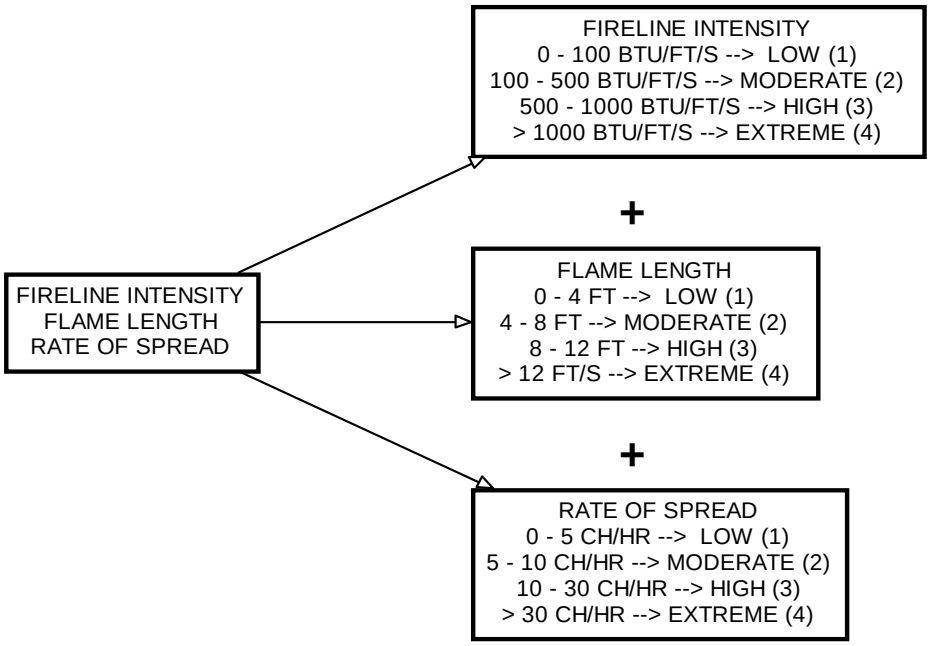
Computerized and manual systems for modeling wildland fire behavior have long been available (Rothermel 1983, Andrews 1986). These systems focus on one-dimensional behaviors and assume the fire geometry is a spreading line-fire (in contrast with point or area-source fires). Models included in these systems were developed to calculate fire spread rate (Rothermel 1972, Albini 1976), fire shape (Anderson 1983, Alexander 1985), spot fire distance (Albini 1979, 1983), and crown fire spread rate (Van Wagner 1977, Rothermel 1991). The FlamMap program was developed for extending the utility of

these models to a landscape level where the necessary inputs have been mapped using geographic information systems (GIS).

The heat-transfer formulas in FlamMap are based on the same formulas used in the software program BEHAVE (Andrews 1986). FlamMap predicts fire behavior under a fixed set of weather conditions and produces outputs that assume the entire landscape is burning.

The input layers for FlamMap included the following: fuel model, elevation, slope, aspect, canopy cover (class), crown bulk density, stand height, height to live crown, fuel moisture file, windspeed, and direction of spread. The outputs for this assessment include fireline intensity, flame length, and rate of spread. These fire behavior characteristics, i.e., flame length, forward rate of spread, and fireline intensity, were then rated on a scale from 1 to 4 or low to extreme (Figure 7).

Figure 7. Fuel Hazard Attributes Used in GIS Model.

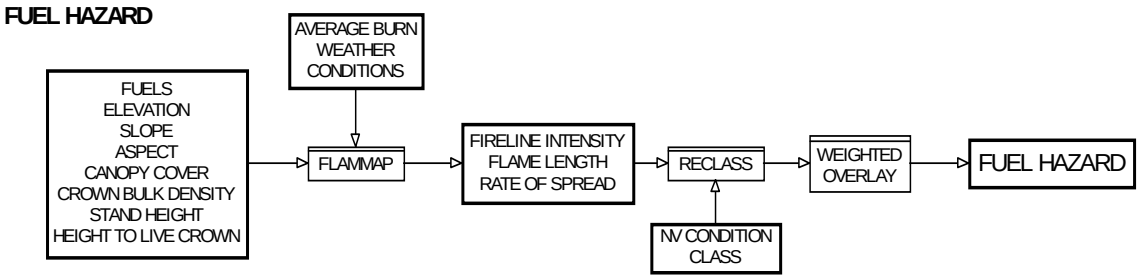



BTU/FT/S: British Thermal Units/Feet/Second; FT: Feet; FT/S: Feet/Second; CH/HR: Chains/Hour (1 Chain equals 66 feet).

Areas that were predicted to have a high fireline intensity, flame length, and forward rate of spread were rated as high or extreme. Likewise, areas that were predicted to have low fireline intensity, flame length, and forward rate of spread were rated as low or moderate.

The 3 intermediate layers were then weighted with a fourth component, fire regime condition class, resulting in a fire behavior rating (Figure 8). The final overlay can be found in Appendix B.

Figure 8. Fuel Hazard Rating - GIS Model.




### 5.1.6.2 Other Factors Affecting Fire Behavior

#### 5.1.6.2.1 Invasive (Nonnative) Species Management Considerations

When developing projects, a key element that must be considered is invasive nonnative species.

Invasive species are those species that are nonnative to a particular ecosystem and whose introduction causes or is likely to cause economic or environmental harm or harm to human health. These species are highly competitive, highly aggressive, and easily spread. They include plants designated as “noxious” and animals designated as “pests” by federal or state law. A listing of noxious weeds designated by the State of Nevada can be found in Appendix D.

The federal agencies and Carson City Weed Control Coalition administer integrated pest management programs that monitor, inventory, treat, evaluate, and re-treat areas. In addition, laws, executive orders, regulations, policies, and agreements pertaining to invasive nonnative species are available to provide guidance when designing and implementing fuels treatment projects (Table 16).

Table 16. Guidance When Designing and Implementing Fuels Treatment Projects.

| Directive | Key Guidance Element |
|---|---|
| Executive Order 11312 | Prevent and control the spread of invasive species in a cost effective and environmentally sound manner. |
| Federal Noxious and Invasive Weed Laws | Contain directives for establishing and implementing noxious weed management programs at the federal level. |
| Department of the Interior Departmental Manual 517 DM | Manage pests and use IPM principles in a manner that reduces risks from both pests and pest management activities. |
| BLM Manuals | All ground disturbing projects and any projects that alter plant communities must be assessed to determine the risk of introducing or spreading noxious weeds. |
| USDA Forest Service Forest Service National Noxious Weed Policy, FSM 2080 | Focus on working collaboratively with ourselves, our neighbors, and with each state within and bordering the particular Forest Service Region. |
| 720 FW 2, Service Responsibilities to Protect Migratory Birds, Fish And Wildlife Service Manual, U.S. Fish and Wildlife Service | Use the best available scientific information to incorporate ecosystem integrity, reduction of invasive species, and long-term adaptive management into migratory bird conservation. |
| Agreements and Contracts (such as the Memorandum of Understanding, which BLM is a signatory, with the Carson City Weed Control Coalition) | Establishes terms and conditions under which noxious weed management teams would cooperate and coordinate activities necessary to manage noxious weeds. The governing document requires that the members establish annual weed control priorities. |
| Nevada Revised Statutes and Administrative Code – Chapter 55 | Addresses the designation and control of noxious weeds and their removal from the public domain. |

The presence of cheatgrass in these communities provides a fire fuel source which increases the risk of fire and shortens the fire return interval (BLM 2007). Cheatgrass (*Bromus tectorum*)—also known as downy brome—is listed as an invasive annual grass by the BLM (BLM 2004). Nonnative cheatgrass increases in abundance and density after a fire, thereby increasing the biomass and horizontal continuity of fine fuels, conditions that favor future fires. After each fire, the fire return interval generally becomes shorter. This gives cheatgrass an even greater competitive advantage in an ecosystem that evolved with less frequent fires. Native shrubs and trees are slower to reestablish after a wildland fire and require several years to complete their lifecycles. The shorter fire return interval favors cheatgrass because the native shrubs and trees do not have adequate time to become reestablished and are lost from the system.

Cheatgrass also displaces native grasses and herbaceous plants because, as a cool-season annual, cheatgrass is able to establish earlier in the growing season than most native grasses and herbaceous plants. The earlier growing season contributes to the depletion of soil moisture, and the early growth allows cheatgrass to crowd out native species, which leads to large expanses of a fuel that contributes to wildland fires that tend to burn fast and cover large areas. Native perennial grasses may displace this species, especially under carefully managed grazing regimes (BLM 2004).

Chambers, et al. (2005) found that cheatgrass was clearly limited by temperature at higher elevations. Precipitation and its effects on available soil moisture appeared to be the primary make-or-break factor when temperature was not a consideration.

#### 5.1.6.2.2 Pathogens

There are a number of microbial and fungal pathogens that attack big sagebrush and other sagebrush species that, under the right set of conditions, can impact sagebrush stands. Due to a recent period of prolonged drought in Nevada and throughout the West, woodland health has jumped to the forefront.

In a two-year period (2003–2004), significant tree decline or mortality was observed in pinyon pine woodlands, true fir, white pine, subalpine fir, and aspen forests throughout Nevada (USDA FS 2006). In 2004, counties with the highest numbers of pinyon ips-caused tree mortality were Mineral, Nye, Lincoln, Douglas, and Lyon (USDA FS 2006). The latter two border Carson City. Heavy mortality as the result of the pinyon ips beetle infestation in Carson City was recorded in the Pine Nut Range from McTarnahan Hill west of Brunswick Canyon east to the county line, including Eldorado Canyon.

Table 17. Bark Beetle Mortality—Carson City and the State of Nevada—Calendar Year 2004.

| County | Mountain Pine Beetle | | Fir Engraver Beetle | | Pinyon Ips Beetle | | Subalpine Fir Mortality | |
|---|---|---|---|---|---|---|---|---|
| | Trees | Acres | Trees | Acres | Trees | Acres | Trees | Acres |
| Carson | - | - | - | - | 9,204 | 2,679 | - | - |
| Statewide | 13,592 | 3,804 | 276,189 | 55,083 | 4,049,708 | 720,561 | 101,464 | 15,776 |

Source: USDA FS 2006. Forest Insect and Disease Conditions in Nevada; R4-OFO-TR-06-04.

Another pathogen, dwarf mistletoe (*Arceuthobium* spp.), is considered to be the single most damaging agent to coniferous trees and remains the most widespread and frequently observed disease within the state. Pinyon ips mortality was observed in some of the heavy dwarf mistletoe-infected pinyon pine stands within Nevada. Some of the dwarf mistletoe-weakened trees died due to pinyon ips attack (USDA FS 2006).

Range and forest health is a complicated issue and is expected to become more so as the West copes with continued drought and impacts attributed to global climate change. The loss of entire stands of pinyon pine to pathogens, for example, sets in motion a series of events ranging from a change in fire behavior to habitat conversion, and with that, a decline in many of the bird and terrestrial species that depend on pinyon pine.

#### 5.1.6.2.3 Ephemeral Nature of Fuels

As stated previously, native vegetation in the Great Basin is adapted to the area's highly variable precipitation occurrence and distribution patterns. It is common for periods of drought to be followed by one or more wet years. Native perennial shrubs and grasses have adapted to these unusual conditions by developing deep root systems and other

characteristics designed to conserve moisture. The recruitment and establishment of the number of new bunch grass plants may vary by only 5 % between dry years and wet years.

In large areas of the Great Basin, cheatgrass (*Bromus tectorum*) and red brome (*Bromus rubens*) — both nonnative invasive species — have displaced native vegetation. Both are fire-adapted and respond quickly following a wildland fire, giving cheatgrass and red brome a great competitive advantage. Once established, they have the ability to convert the site to a monoculture due to frequent, recurring fires that do not give the native vegetation a chance to reestablish.

In dry years, cheatgrass will often germinate in the spring and grow to be only 5–6 inches tall. However, during periods when sufficient moisture is present and precipitation occurs during the right time of the year, cheatgrass will germinate more successfully in the fall, resulting in dense stands of new plants the following spring that are 5 times taller than during dry years (Elmore, et al., as quoted by Bradley, B.A. and J.F. Mustard 2004). After becoming established in the fall, the new plants put down roots throughout the winter when conditions are favorable. The plants' root systems are able to absorb moisture accumulated throughout the winter and start growing as soon as soil temperatures rise above freezing. Cheatgrass may grow to be 20 inches tall in wet years. Cheatgrass production in wet years can average 3,461 pounds/acre compared to 361 pounds/acre in a typical dry year (Pellant, date unknown)[3].

Cheatgrass has the ability to remain standing much longer than many native perennial grasses. This can allow the stands of grass to catch snow in the winter. The stand has a tendency to become matted as winter progresses and newly germinated grass adds to the biomass in the spring. As a result, thick layers of annual plant litter accumulate. The lack of moisture inhibits decomposition of the accumulated litter. The heavy accumulations of litter lead to continuous fuel beds, which can contribute to greater fireline intensities and longer fire residence times.

In the absence of grazing, grass biomass produced under wet conditions during the fire season may represent two years of fuel accumulation, which appears to be optimal for grassland fires (FEIS). A wildland fire ignited in an abundant, continuous cover of cheatgrass and under adverse environmental conditions such as high ambient air temperatures, low relative humidity, and moderate to high windspeeds can be very difficult to suppress.

The combined fire behavior (flame length and forward rate of spread) caused by the abnormally high fuel loading results in fires that are not only difficult to control, but also create fire effects that significantly reduce the ability of perennial grasses and shrubs to reestablish. The net effect is to further the dominance of cheatgrass.

---

[3] Hal Anderson (1982) in his publication Aids to Determining Fuel Models for Estimating Fire Behavior lists the total fuel load of fine fuel for NFFL Fuel Model 1 (Short Grass) at 0.74 tons/acre (1,480 pounds/acre), which is approximately half the amount estimated to be produced in a wet year.

Predicting the occurrence and behavior of high-severity fires would be beneficial to land managers in making resource allocations prior to the fire season. Knapp (1998, as quoted in FEIS) suggests that these large fires have distinct spatial patterns, and their occurrence can be predicted based on the previous year's moisture conditions. Summer moisture conditions in the year preceding that of a large fire year tend to be near-normal or wetter. Conversely, less than 20% of all the large fires occur when the previous summer's moisture conditions were below normal (FEIS).

### 5.1.6.3 Fuel Models

Tables 18 and 19 show the distribution of vegetation types by fuel model and acres.

Table 18. Vegetation by Fuel Type and FBPS* Fuel Model – Carson City.

| Fuel Type | Fuel Model | Acres |
|---|---|---|
| Grassland (including cheatgrass) | 1 | 2,338 |
| Mojave/Sonoran Shrub | 5 | 175 |
| Salt Desert Shrub | 5 | 3,286 |
| Sagebrush | 6 | 35,531 |
| Pinyon/Juniper Woodlands 2 | 6 | 30,828 |
| Riparian/Riparian Woodland | 8 | 1,061 |
| Aspen/Ash/Hardwood 2 | 8 | 7 |
| GB Mixed Conifer 2 | 10 | 10,076 |
| No Significant Vegetation | 99 | 17,559 |
| Total | | 100,860 |

*FBPS: Fire Behavior Prediction System
Source: Compilation of several fuel and vegetation GIS data layers acquired from the Bureau of Land Management.

Table 19. Summary of Vegetation Type by FBPS* Fuel Model – Carson City.

| Description | Fuel Model | Acres |
|---|---|---|
| Short Grass (includes cheatgrass) | 1 | 2,338 |
| Salt Desert/Mojave/Sonoran Shrub | 5 | 3,461 |
| Pinyon-Juniper/Mountain Shrub | 6 | 66,358 |
| Aspen/Ash/Hardwood/Riparian | 8 | 1,068 |
| Great Basin Mixed Conifer | 10 | 10,076 |
| No Significant Vegetation | 99 | 17,559 |
| Total | | 100,860 |

*FBPS – Fire Behavior Prediction System
Source: Descriptions of fuel models used in fire behavior as documented by Albini (1976).

### 5.1.6.4 Environmental Factors

A majority of Carson City, which includes a portion of the Tahoe Basin, is centered in a valley bounded by the Carson Range of the Sierra Nevada Mountains to the west and the 8,000 to 9,000 foot high Pine Nut Mountains to the east. The highest elevation within the county is 9,214 feet at Snow Valley Peak. Eagle Valley is situated at an elevation of approximately 4,700 feet above mean sea level. The Carson River, the primary

watercourse, is located to the east of Eagle Valley and drops approximately 200 feet in elevation as it passes through Carson City.

Soils in the Eagle Valley are quite good and support a limited agricultural base with irrigation; soils elsewhere vary from sandy to rocky and are mostly of volcanic origin. The Dab series, found in the Pine Nut Mountains, consists of very deep, well-drained gravely soils derived from volcanic rocks (Jeton, Anne E. and Douglas K. Maurer 2007).

Carson City has a pleasant, semi-desert climate and boasts an average of 265 sunny days annually. Rainfall and ambient temperatures vary greatly based on elevation. Precipitation varies throughout the year, averaging about 10.5 inches annually in Eagle Valley, with December, January, and February being the wettest months and July the driest. Annual snowfall in the city proper averages about 22 inches. The Pine Nut Mountains can receive 15-18 inches of precipitation a year, while the Sierra Nevada Mountains can receive up to 40 inches a year. Temperatures in the Eagle Valley range from an average temperature of 33.6 degrees Fahrenheit in January, the coldest month of the year, and an average temperature of 69.9 degrees Fahrenheit in July, the warmest month of the year. Daily high temperatures during the summer months are generally in the 90 degree range. Maximum extreme temperatures in Eagle Valley have exceeded 100 degrees Fahrenheit.

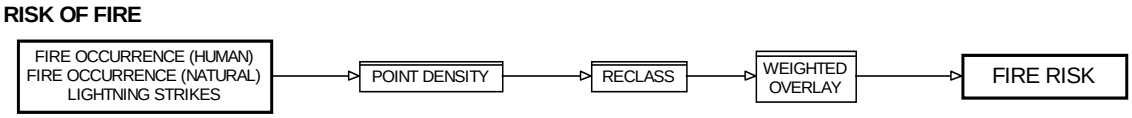
The floor of Eagle Valley has given way to mostly developed land. On the western side of the valley, bitterbrush and sagebrush cover steep alluvial fans, and manzanita and ponderosa pine are present on the slopes of the Carson Range. Alluvial fans and foothills of the Pine Nut Mountains on the eastern side of the valley are covered with sage and rabbitbrush, and pinyon and juniper grow at high altitudes.

### 5.1.6.5 Risk of Wildfire Occurrence

This portion of the assessment was determined by the relative frequency of wildfires within the entire assessment area based on historical fire occurrence data and lightning strike history. Historically, most wildfires within Nevada have resulted from natural causes, primarily lightning strike activity (see Section 5.2.2). However, human-caused fires have increased with population and proximity to urban areas.

This assessment calculates these risks by defining the spatial location of historical fires (100 acres or greater) caused by humans and natural phenomena as well as lightning strike density. The model structure is depicted below in Figure 9. The output layer is shown in Appendix B.

Figure 9. Risk of Wildfire Occurrence - GIS Model.



### 5.1.6.6 Fire Regimes and Condition Classes (FRCC)

Schmidt, et al. (2002) examined land conditions in the United States with regard to the degree of departure of fire regimes from historical fire cycles due to fire exclusion and other influences. They characterized the landscape by 5 Fire Regime Groups and 3 Condition Classes.

Appendix C of *Protecting People and Natural Resources—A Cohesive Fuels Treatment Strategy* (USDI/USDA FS 2006) provides guidance for the identification of the various fire regime groups and fire condition classes. An abridged summary of Appendix C has been included in this section to provide background information and substantiate the guidance provided by the Utah and Nevada State BLM Offices to identify examples of vegetation types in Utah and Nevada (see Section 5.1.6.3).

Characteristics and examples of the 5 Fire Regime Groups are found in Figure 10. The examples are intended to be reviewed by managers and practitioners throughout the U.S. and are not limited to vegetation types found exclusively in Nevada or Carson City.

Figure 10. Fire Regime Groups – Interagency Standard Definitions.

| FIRE REGIME GROUPS | | | | |
|---|---|---|---|---|
| Fire Regime Group | Fire Frequency | Fire Severity | Percent of (Coterminous) Federal Lands | Examples of Vegetation Types |
| I | 0-35 years | Low severity | 31% | Oak-hickory, longleaf pine, Interior West ponderosa pine. |
| II | 0-35 years | Stand replacement severity | 13% | Sierra foothill grasslands, Texas savanna, Tallgrass prairie. |
| III | 35-100+ years | Mixed severity | 36% | Southwest Oregon mixed conifer, Appalachian oak-Northern hardwood. |
| IV | 35-100+ years | Stand replacement severity | 14% | Northern hardwoods of New England, Southern California chaparral, Great Basin sagebrush. |
| V | >200 years | Stand replacement severity | 6% | Pacific Northwest western hemlock, Rocky Mountain subalpine fir. |

A fire regime is a generalized description of fire's role within a vegetative community—characterized by fire frequency, predictability, seasonality, intensity, duration, and scale. Fire combinations of fire frequency—based on fire return interval and fire severity—are the basis for the coarse-scale assessment's five Fire Regime Groups.

Source: Protecting People and Natural Resources—A Cohesive Fuels Treatment Strategy (Appendix C).

Fire regime condition classes serve as generalized wildfire risk rankings. The risk of loss of desired ecological conditions due to unwanted wildland fire increases from Condition Class 1 (lowest risk) to Condition Class 3 (highest risk).

Condition Classes are defined in terms of the relative risk of losing one or more key components that define an ecological system based on the following ecosystem attributes: vegetation characteristics (species composition, structural stages, stand age, canopy closure, and mosaic pattern); fuel composition; fire frequency, severity, and pattern; and other associated disturbances (e.g., insect and disease mortality, grazing, and drought). There are no wildland vegetation and fuel conditions or wildland fire situations that do not fit within 1 of the 3 classes.

Fire Regime Condition Class (FRCC) is an interagency standardized tool for determining the degree of departure from reference condition vegetation, fuels, and disturbance regimes and is a good indicator of forest and range conditions. It is a classification—using 3 condition classes—of the degree to which current vegetation has departed from the presumed historical vegetation reference conditions (Hann and Bunnell 2001). Condition Class definitions have been developed and incorporated into the *10-Year Comprehensive Strategy* and other wildland fire guidance documents. Explanations of each class are found in Table 20.

Table 20. Condition Class Definitions.

| Condition Class | Fire Regime Example and Management Options |
|---|---|
| Condition Class 1 | Fire regimes are within a historical range, and the risk of losing key ecosystem components is low. Vegetation attributes (species composition, structure, and pattern) are intact and functioning within a historical range. Where appropriate, these areas can be maintained within the historical fire regime by treatments such as the use of wildland fire. |
| Condition Class 2 | Fire regimes have been moderately altered from their historical range. The risk of losing key ecosystem components is moderate. Fire frequencies have departed from historical frequencies by one or more return intervals (either increased or decreased). The result is moderate changes to one or more of the following: fire size, severity, and pattern; and landscape patterns. Vegetation attributes have been moderately altered from their historical range. Where appropriate, these areas may need moderate levels of restoration treatments, such as fire use and hand or mechanical treatments, to be restored to the historical fire regime. |
| Condition Class 3 | Fire regimes have been significantly altered from their historical range. The risk of losing key ecosystem components is high. Fire frequencies have departed from historical frequencies by multiple return intervals. This departure results in dramatic changes to one or more of the following: fire size, severity, and pattern; and landscape patterns. Vegetation attributes have been significantly altered from their historical range. Where appropriate, these areas may need high levels of restoration treatments, such as hand or mechanical treatments, before fire can be used to restore the historical fire regime. |

Source: Fire Regime and Condition Class Definitions. Available on the Internet at: http://www.frcc.gov/docs/FrccDefinitionsFinal.pdf.

Fires burning in Condition Class 1 areas generally leave the soil intact and functioning normally. These fires usually pose little risk to natural resources. They have positive effects to species diversity, soil productivity, and water quality. Some species require fire

for their existence and regeneration; other species have developed adaptations to withstand periodic fires.

Maintenance of vegetation in Condition Class 1 through management actions, such as prescribed fire, mechanical treatments, wildland fire use, grazing, or preventing the invasion of nonnative plants, is required to prevent these lands from slipping into Condition Classes 2 or 3.

Condition Class 2 develops when fire return intervals are missed, and understory vegetation continues to grow and becomes increasingly dense. Condition Class 2 can also develop when highly flammable, nonnative species replace native species, become established, and alter fire return intervals.

If the accumulated vegetation or the invasion of woody or nonnative species is not treated, fires begin to burn more intensely, making them even more difficult to suppress. The damaging impact of these fires on species diversity, soil productivity, and water quality becomes more pronounced.

Condition Class 2 is classified as moderate risk because of the increasing threat it poses to people and the damage that can result to species habitats and soils when a fire burns on these lands—particularly during drought years.

In Condition Class 3 areas, fires pose relatively high risks. In drought years small trees, brush, and other vegetation may dry out and burn along with accumulated dead surface materials. The result may be severe, high-intensity wildfires. These wildfires have the potential to kill all vegetation, including the large trees that would normally survive lower fire intensities.

Fire frequency may be increased in Condition Class 3 areas which are dominated by highly flammable nonnative species. Within these areas, a new fire regime may become established, resulting in the exclusion of native species and further expansion and domination by nonnative species.

As identified by the *10-Year Comprehensive Strategy*, HFRA, and HFI for areas in Fire Regime Groups I, II, and III and Condition Class 3, high-severity fires often can consume the soil's organic layer and burn off or volatilize nutrients. When all small twigs, dead leaves and needles, and other organic litter are consumed, water runs unimpeded over the soil surface. Under these circumstances, the soil becomes more susceptible to erosion, or hydrophobic conditions may develop, resulting in soils that can easily erode.

Condition Class 3 is classified as high risk because of the threat it poses to people and the widespread, long-lasting damage likely to result to species and watersheds when wildland fires burn on these lands—even during nondrought years.

Figure 11. Fire Condition Classes.

| | | |
|---|---|---|
| <br>*Open ponderosa pine stand maintained by frequent low-severity fire is dominated by large trees. Stand is resilient to disturbance such as insects and disease outbreaks (FCC1).* | **← Fire Condition Class 1 →**<br><br>For the most part, fire regimes in this Fire Condition Class (CC1) are within historical ranges. Thus, the risk of losing key ecosystem components (such as soil, vegetation, and water quality) from the occurrence of fire remains relatively low. Maintenance management such as wildland fire use, prescribed fire, mechanical treatments, or preventing the invasion of nonnative weeds is required to prevent these lands from becoming degraded. | <br>*Wyoming big sagebrush type with considerable diversity is generally more resilient to disturbance and provides habitat for a great number of species (FCC1).* |
| <br>*Selective logging in ponderosa pine stands progressively removed the larger trees. Without periodic fire, forest openings filled with thickets of smaller understory trees (FCC2).* | **← Fire Condition Class 2 →**<br><br>Fire regimes on these lands (CC2) have been moderately altered from their historical range by either increased or decreased fire frequency. A moderate risk of losing key ecosystem components (such as soil, vegetation, and water quality) has been identified in these lands. To restore their historical fire regimes, these lands may require some level of restoration through prescribed fire, mechanical or chemical treatments, and the subsequent reintroduction of native plants. | <br>*Wyoming big sagebrush type where fire has been excluded for an extended period has reduced diversity and provides habitat for fewer species. The site is also vulnerable to future cheatgrass invasion and to wildland fire (FCC2).* |
| <br>*The dense thickets of understory trees eventually become sufficiently large enough to allow fire spread into the ponderosa pine crowns. The thickets are drought-prone (FCC 3).* | **← Fire Condition Class 3 →**<br><br>These lands (CC3) have been significantly altered from their historical range. The risk of losing key ecosystem components (e.g., soil, vegetation, and water quality) from fire is high. Consequently, these lands are at the greatest risk of catastrophic, destructive, wildland fires. To restore their historical fire regimes—before prescribed fire can be utilized to manage fuel or obtain other desired benefits—these lands may require multiple mechanical or chemical restoration treatments or reseeding. | <br>*Rangeland sites entirely dominated by cheatgrass—unlike the native vegetation that formerly occupied this site—are highly vulnerable to fast-moving, higher-intensity wildfires (FCC3).* |

Source: *Protecting People and Natural Resources—A Cohesive Fuels Treatment Strategy* (Appendix C).

### 5.1.6.7 FRCC for Carson City

In 2002, the BLM State Fire Management Officers from Utah and Nevada assigned a team to develop a map of Fire Regimes and Condition Classes (FRCC) for BLM-administered lands in Utah and Nevada. The team was comprised of BLM fuels and fire ecologists from both states and the fire GIS specialist from Utah. Great Basin Gap Vegetation GIS data[4] along with professional experience was used to categorize the vegetation layers into fire regimes and condition classes[5].

The 30 meter resolution FRCC maps for Utah and Nevada provide a strategic look at the degree of departure from historical fire regimes. This departure results in alterations of key ecosystem components on BLM-administered lands. A description of the fire frequency and severity, location, and cover types developed by the team are summarized in Table 21.

[4] Gap analysis is a scientific method for identifying the degree to which native animal species and natural plant communities are represented in our present day network of conservation lands. Those species and communities not adequately represented constitute "gaps" in conservation lands and efforts. Detailed information about the method can be found on the USGS website: http://biology.usgs.gov/bio/gap.html.

[5] It is important to recognize that there are limitations interpreting the maps developed for this process. The first limitation is the way the vegetation types were categorized in the Gap analysis; the database describes aspect dominant overstory vegetation at 30 meter resolution and does not provide information on the understory vegetation. The second limitation is the base satellite imagery was collected prior to major fire occurrences starting in 1996 in Utah and Nevada. These large fires have affected vegetation composition on approximately 4 million acres. The third limitation is the difference between Gap vegetation and actual vegetation – actual vegetation composition is based on subtleties of slope, aspect, moisture regimes, and elevation, which cannot be portrayed in Gap data. Understanding how these differences affect vegetation is critical when establishing fire regimes and condition classes on a landscape scale.

Table 21. Summary of Fire Frequency and Severity, Location, and Cover Types—UT-NV.

| Regime | Frequency & Severity | Location | Cover Types |
|---|---|---|---|
| I | 0-35 year frequency and low (surface fires most common) to mixed severity (less than 75% of the dominant overstory vegetation replaced). | Primarily in low elevation forests of pine, oak, or pinyon-juniper.[6] | Sierra yellow pine, wet and dry meadows, grasslands, ponderosa pine, oak, and desert grassland. |
| II | 0-35 year frequency and high (stand replacement) severity (greater than 75% of the dominant overstory vegetation replaced). | Primarily in low to mid-elevation rangeland, grassland, or shrubland. | Juniper, pinyon pine, pinyon-juniper, maple, mountain shrub, bitterbrush, blackbrush, mountain sagebrush, sagebrush, sagebrush/ perennial grass, and Sierra mountain shrub. |
| III | 35-100+ year frequency and mixed severity (less than 75% of the dominant overstory vegetation replaced). | Primarily in forests of mixed conifer, dry Douglas-fir, or wet ponderosa pine. | Subalpine fir, spruce-fir/mountain shrub, mountain fir/mountain shrub, low riparian. |
| IV | 35-100+ year frequency and high (stand replacement) severity (greater than 75% of the dominant overstory vegetation replaced). | Primarily in cover types dominated by mixed conifer, aspen, lodgepole pine, salt desert scrub, mountain mahogany, and mountain riparian. | Mixed conifer, aspen, lodgepole pine, salt desert scrub, mountain mahogany, and mountain riparian. |
| V | 200+ year frequency and high (stand replacement) severity. | Primarily in cover types dominated by spruce, fir, alpine tundra, creosote-bursage, grease wood, hopsage, mesquite, Mojave mixed scrub, and black brush. | Spruce, fir, alpine tundra, creosote-bursage, grease wood, hopsage, mesquite, Mojave mixed scrub, and black brush. |

Source: BLM. Fire Regime and Condition Class (FRCC) for BLM-administered lands in Utah and Nevada. Utah and Nevada State Offices. Final 2002.

[6] The low to mid-elevation range for pinyon pine and juniper is defined as occurring between 3,500 and 7,000 feet of elevation. Most pinyon-juniper woodlands in Utah and Nevada occur within these elevations; therefore, the Utah-Nevada team decided that pinyon-juniper cover types should be assigned to Fire Regime (FR) II instead of FR I on BLM lands in those states.

The fire regime and condition class (FRCC) for Carson City is summarized in Table 22 and Figure 12. Condition Class by percentage for Carson City is summarized in Table 23.

Table 22. Summary by FRCC—Carson City.

| Fire Regime and Condition Class | Acres | Percentage of Total Acres |
|---|---|---|
| Fire Regime I, Condition Class 1 | 15 | 0.01 |
| Fire Regime I, Condition Class 2 | 3,290 | 3.00 |
| Fire Regime I, Condition Class 3 | 7,052 | 7.00 |
| Fire Regime IV, Condition Class 1 | 2,519 | 2.00 |
| Fire Regime II, Condition Class 2 | 11,771 | 12.00 |
| Fire Regime II, Condition Class 3 | 47,982 | 48.00 |
| Fire Regime III, Condition Class 3 | 1,142 | 1.00 |
| Fire Regime IV, Condition Class 2 | 1,993 | 2.00 |
| Fire Regime IV, Condition Class 3 | 1,473 | 1.00 |
| No Significant Vegetation or No Data | 23,625 | 23.00 |
| Total | 100,860 | 99.01 |

Source: Bureau of Land Management.
Note: Percentage may not equal 100% due to rounding.

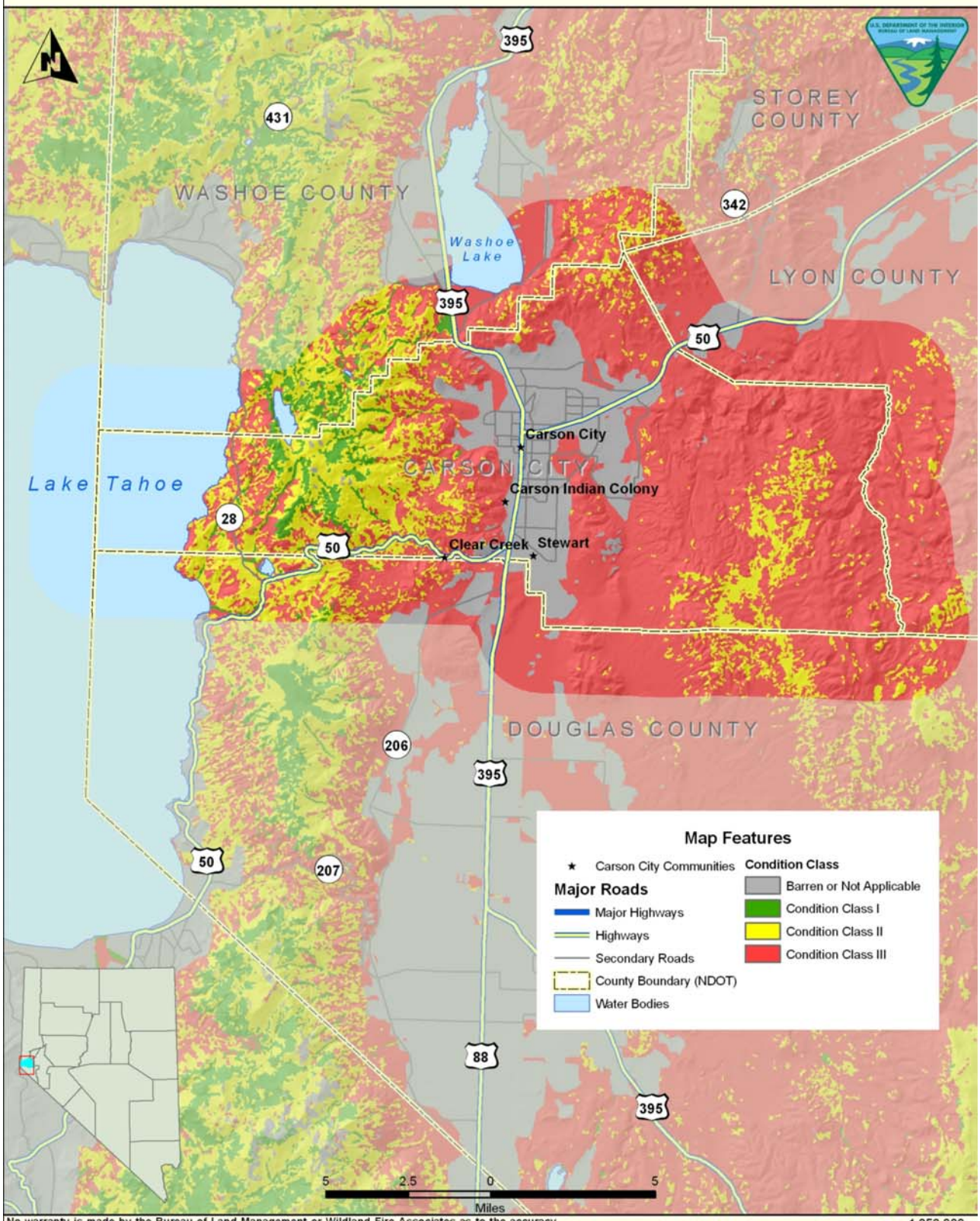
Table 23. Condition Class by Percentage—Carson City.

| Fire Regime and Condition Class | Acres | Percentage of Total Acres |
|---|---|---|
| No Significant Vegetation or No Data | 23,625 | 23.0 |
| Condition Class 1 | 2,534 | 3.0 |
| Condition Class 2 | 17,053 | 17.0 |
| Condition Class 3 | 57,649 | 57.0 |
| Total | 100,860 | 100.0 |

Note: Percentage may not equal 100% due to rounding.

**Figure 12: Fire Regime and Condition Class (FRCC)**
Nevada Landscape-scale Wildland Fire Assessment

**Carson City, Nevada**




No warranty is made by the Bureau of Land Management or Wildland Fire Associates as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

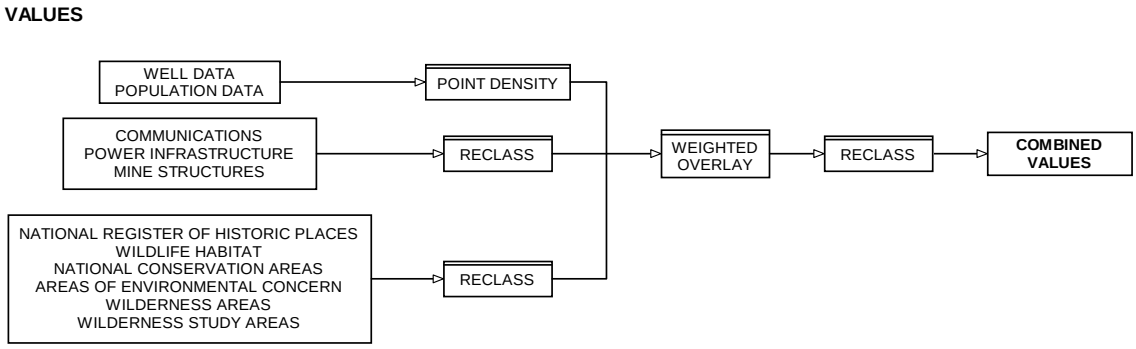
1:250,000

Prepared by Wildland Fire Associates, Figure 12.mxd, 03/04/08

### 5.1.6.8 Values at Risk

As part of this assessment, features on the landscape that could potentially be impacted or destroyed by wildfire were considered to be at risk from the impacts of wildland fire. Once identified, they were included as values at risk in the model. Examples of values at risk include community values such as significant landscapes, essential infrastructure, and property. The location of property is identified by using housing density derived from census data and well head locations. Figure 13 illustrates the model used to assess these values; the GIS output is shown in Appendix B.

Figure 13. Values at Risk - GIS Model.




The tangible and intangible values at risk, which were identified in Section 4.4 Values at Risk, have been grouped into 12 general categories. Specific examples are listed under the column titled Examples/Place Name (Table 24).

Table 24. Assets at Risk—Rural Carson City.

| Category | Examples/Place Name |
|---|---|
| Scenic | Carson Range, Kings Canyon, Pine Nut Mountains. |
| Cultural/Native American Concerns | Both the Washoe Tribe and Yerington Paiute Tribe include all or portions of the Pine Nut Mountains as part of their ancestral homelands. The Pine Nut Mountains and the forested sites contain culturally significant sites and have areas of religious importance. |
| Rangeland/Habitat | Pinion forest in Pine Nut Mountains, Clear Creek. |
| Grazing Allotments | Pine Nut Mountains, sheep grazing allotment. |
| Natural Conservation Areas | Spooner Lake, Silver Saddle Ranch. |
| Sage Grouse | The Pine Nut Mountains have been identified as having habitat suitable for Sage grouse. |
| Communications Sites | Microwave towers. |
| Homes, Structures, Ranch Sites | Silver Saddle Ranch facilities, facilities at Spooner Lake. |

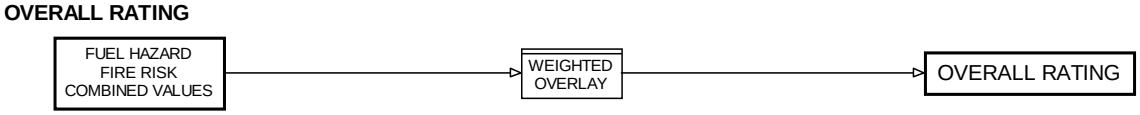
The location of the values at risk that were identified in Carson City were included on a data base layer and, as indicated in the previous section, used to determine project and priority areas for treatment (categories that were not formally identified in Carson City were not included in the assessment).

It is important to note that the process used to determine a final combined values at risk rating may mask critically important and high-value areas of wildlife habitat or isolated communities of native plants. It is the responsibility of the local land manager to ensure the identification and protection of locations where these values exist.

## 5.2 Data Analysis

Each of the previous 3 models was designed to analyze one component of wildfire threat. Each output layer found in Appendix B depicts the relative degree of risk or hazard on a numerical scale. The final overlay (Risk Assessment Summary) is a weighted overlay of each of the 3 individual models (Figure 14). The resulting layers were assigned a weight and then combined for a final assessment. The results of the overall assessment are shown in Appendix B.

Figure 14. Risk Assessment Summary - GIS Model.




### 5.2.1 Ranking Fuel Hazard

Fire behavior predictions for each fuel model and fire regime condition class were used to determine the fuel hazard rank for Carson City. As stated in the previous sections, FlamMap was used to determine fire behavior. Fuel moisture conditions and weather parameters used as input into the fire prediction model reflected conditions that might occur on an average burn day in Carson City. Because the assessment methodology needs to be consistent for all counties throughout Nevada, the chosen fuel moistures and windspeed has to reflect variable “average” environmental conditions. To accomplish this, fuel moisture values ranged from 8% for 1 Hr timelag fuel moisture to 12% for 100 Hr timelag fuel moisture and 120% for live fuel moisture were derived from a compilation of statewide National Wildfire Coordinating Group (NWCG) Fire Danger Pocket Cards (http://www.nv.blm.gov/fuels/pocketcards/ pocket2002.htm). Twenty-foot windspeed was set at 15 mph and predictions were made in the direction of maximum spread. Data inputs are summarized in Table 25.

Table 25. Description of FlamMap Data Inputs.

| Input | Value or Units | |
|---|---|---|
| Fuel Model | 1 - 13, 98, 99 | |
| Elevation | meters | |
| Slope | degrees | |
| Aspect | degrees | |
| Canopy Cover | Categories | |
| | Category 1 | 1-20% |
| | Category 2 | 21-50% |
| | Category 3 | 51-80% |
| | Category 4 | 81-100% |
| Crown Bulk Density | $Kg/m^3$ | |
| Stand Height | feet | |
| Height to Live Crown | feet | |
| Windspeed | 15 mph | |
| Wind Direction | FlamMap default for maximum spread | |
| Foliar Moisture Content | 120% | |
| Fuel Moisture Percent | 1hr | 8% |
| | 10hr | 10% |
| | 100hr | 12% |
| | Live Herbaceous | 120% |
| | Live Woody | 120% |

Three fire behavior results from FlamMap were used: fireline intensity, flame length, and forward rate of spread. Based on the Charts for Interpreting Wildland Fire Behavior Characteristics developed by Rothermel (1983), each fire behavior characteristic was reclassified into a common scale.

The weighted overlay analysis took these 3 data layers along with the fire regime condition class data layer and created a final fuel hazard layer that had values ranging from 0 to 4. The summarized values used for these reclassifications and for the weighted analysis are found in Table 26.

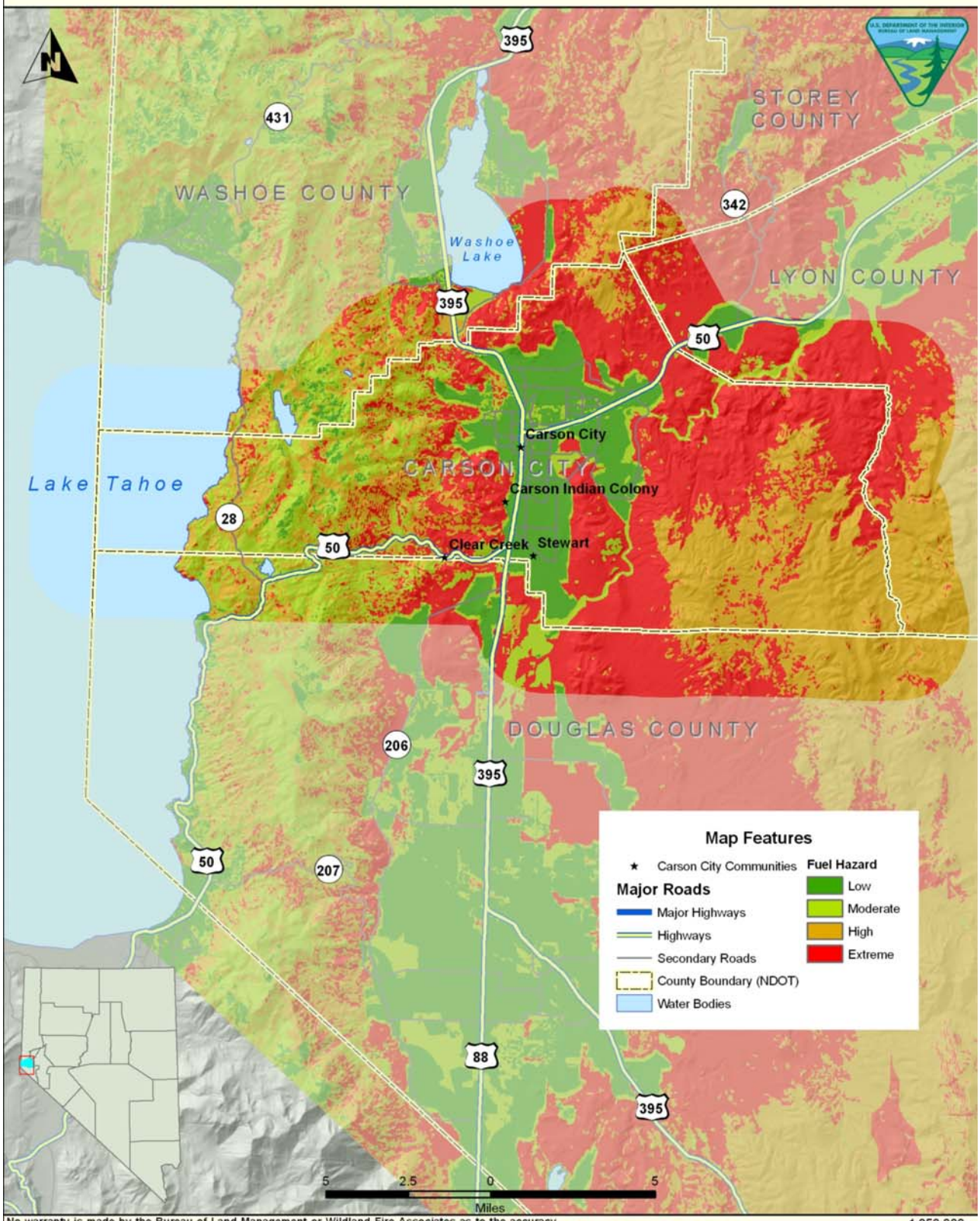
Table 26. Weights and Reclassification Values Used for Fuel Hazard Ranking.

| Fire Behavior Characteristic | Range of Values | Reclassified Value | Weight of Influence |
|---|---|---|---|
| Fireline Intensity | | | 10% |
| | 0 - 100 BTU/FT/S* | 1 | |
| | 100 - 500 BTU/FT/S* | 2 | |
| | 500 - 1000 BTU/FT/S* | 3 | |
| | > 1000 BTU/FT/S* | 4 | |
| Flame Length | | | 15% |
| | 0 - 4 Feet | 1 | |
| | 4 - 8 Feet | 2 | |
| | 8 - 12 Feet | 3 | |
| | > 12 Feet | 4 | |
| Rate of Spread | | | 40% |
| | 0 - 5 CH/HR** | 1 | |
| | 5 - 10 CH/HR** | 2 | |
| | 10 – 30 CH/HR** | 3 | |
| | > 30 CH/HR** | 4 | |
| Condition Class | | | 35% |
| | Class 1 | 2 | |
| | Class 2 | 3 | |
| | Class 3 | 4 | |

* BTU/FT/S – British Thermal Unit/Feet/Second
**CH/HR – Chains/Hour (Chain, a unit of measurement, equals 66 feet.)

**Figure 15: Fuel Hazard -- Carson City**
Nevada Landscape-scale Wildland Fire Assessment

**Carson City, Nevada**




No warranty is made by the Bureau of Land Management or Wildland Fire Associates as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

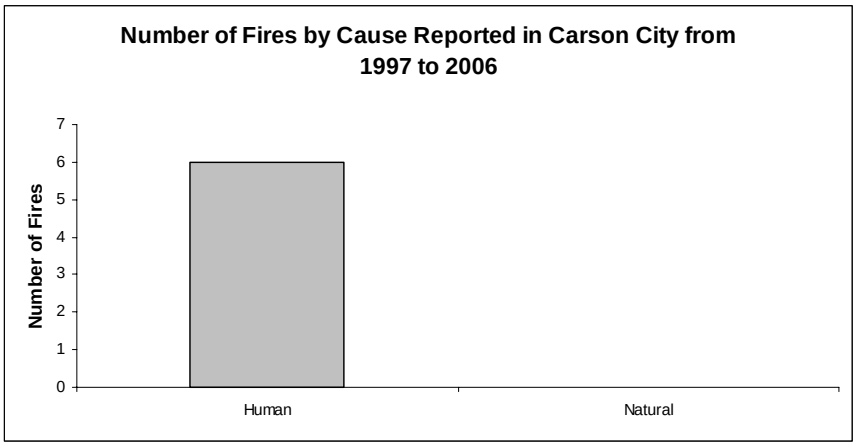
1:250,000

Prepared by Wildland Fire Associates, Figure 15.mxd, 03/04/08

### 5.2.2 Ranking Risk of Fire Occurrence

Wildfire history indicates that over half of the fires within Carson City have been caused by humans. A total of 91 fires were reported for Carson City from 1997 through 2006. Of those fires reported, 54 were caused by human activity and 35 were attributed to natural causes. The cause for two of the fires have not yet been determined.

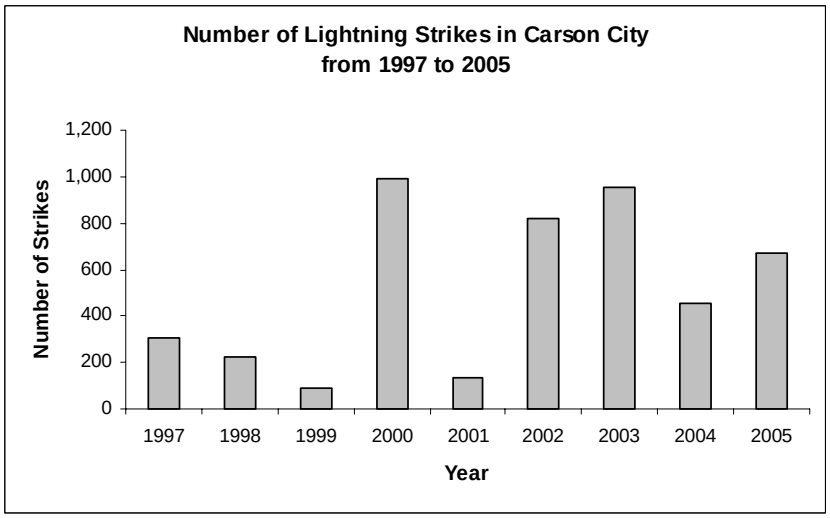
Figure 16. Number of Wildfires 100 Acres or Greater by Cause—Carson City.




Source: National Fire and Aviation Management Web Applications website (http://fam.nwcg.gov/fam-web)

Given the history of fire ignitions, it is assumed that the probability of future fires being caused by lightning is indeed possible. In order to help predict the location of future fires, a lightning probability map was created from a lightning strike point dataset that includes lightning strikes recorded in Carson City from 1997 through 2005. Point lightning strike data for Carson City is summarized in Figure 17. It is important to recognize that not all lightning strikes start fires, but the greater the number of lightning strikes in a given area the more likely lightning-caused ignitions will occur in that area.

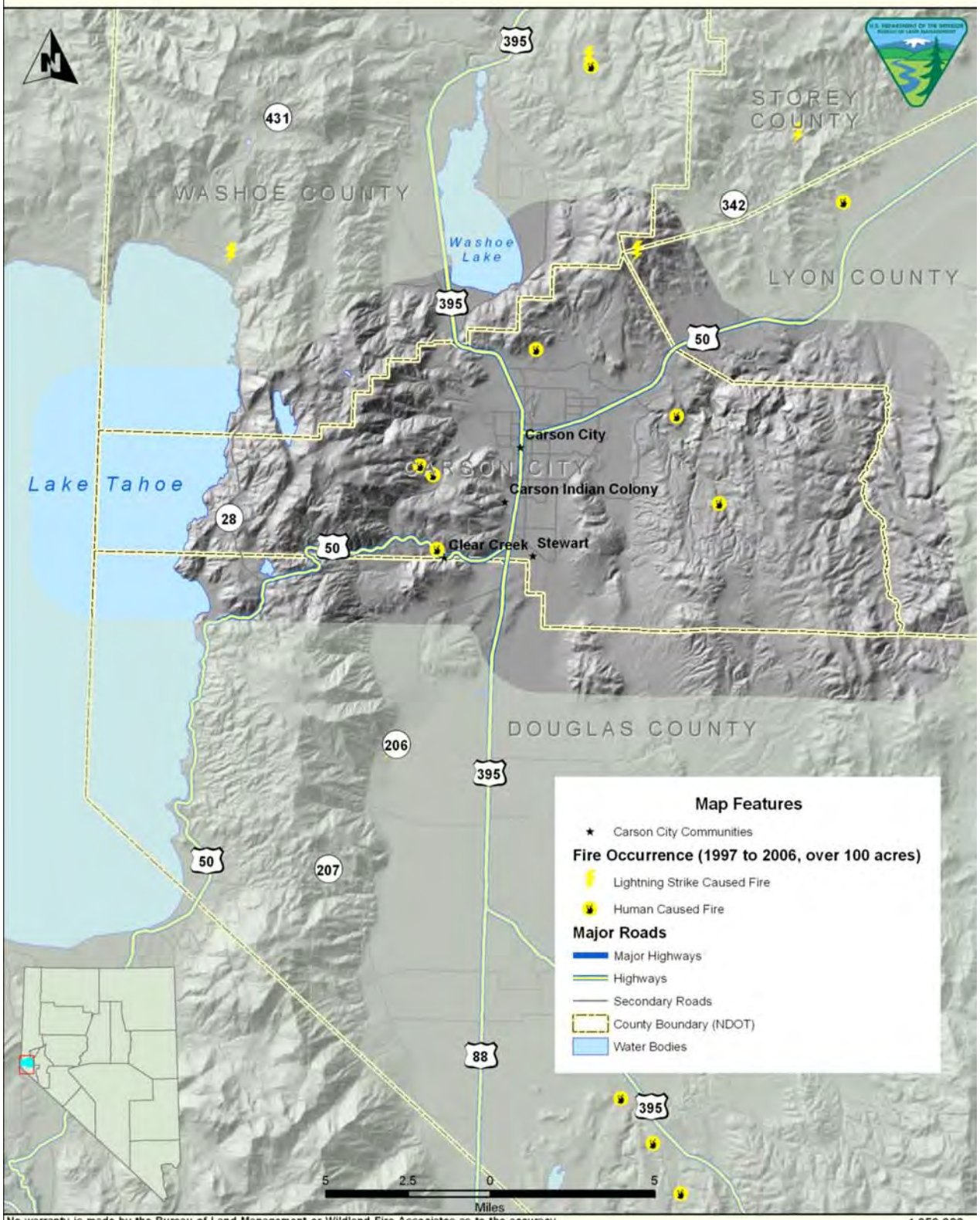
Figure 17. Lightning Strikes—Carson City (1997–2005).




Source: National Lightning Detection Network Database. 2005 is the latest year data available.

**Figure 18: Fire Occurrence -- Carson City**
Nevada Landscape-scale Wildland Fire Assessment

**Carson City, Nevada**




No warranty is made by the Bureau of Land Management or Wildland Fire Associates as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

1:250,000

Prepared by Wildland Fire Associates, Figure 18.mxd, 03/04/08

A point density process was completed for fire occurrence data, resulting in a probability map based on fire occurrence and fire cause. The developed raster layers derived from point data were based on the ArcMap (ESRI) DENSITY Command. This process calculated the density of points for a neighborhood around each raster cell. In this case, lightning strike points and fire occurrence were used. The number of each was calculated for a neighborhood with a radius of 5542 meters (10,000 ha or 100 sq.km.) around each raster cell. The resulting raster is a smoothed surface that considers the low spatial precision of the point data. In addition, the result is effectively a probability surface of lightning or fire occurrence. Fire occurrence data for fires that reached 100 acres in size or greater were used for this analysis.

The resulting layers were then reclassified into a common scale and entered into a weighted overlay analysis. The summarized values used for these reclassifications and for the weighted analysis can be found in Table 27.

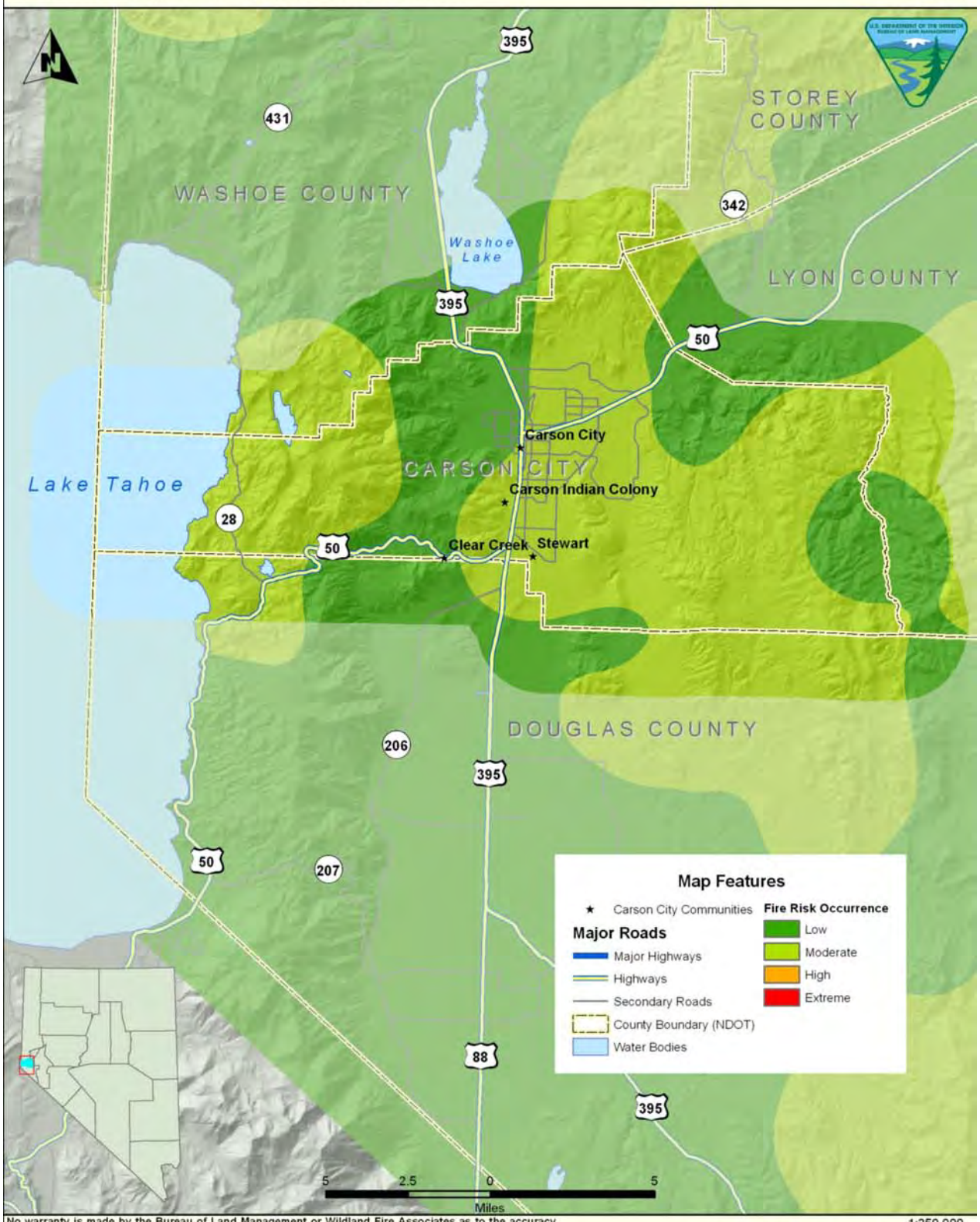
Table 27. Weights and Reclassification Values Used for Ranking Risk of Fire Occurrence.

| Data Layer | No. of Fires/Lightning Strikes per 100sq.km. | Reclass Value | Weight of Influence |
|---|---|---|---|
| Fire Occurrence - Human Caused | | | 5% |
| | 0 | 0 | |
| | < 3 | 1 | |
| | 3 - 6 | 2 | |
| | 6 - 9 | 3 | |
| | > 9 | 4 | |
| Fire Occurrence - Natural Caused | | | 15% |
| | 0 | 0 | |
| | < 3 | 1 | |
| | 3 - 6 | 2 | |
| | 6 - 9 | 3 | |
| | > 9 | 4 | |
| Lightning Strikes | | | 80% |
| | < 10 | 1 | |
| | 10 - 20 | 2 | |
| | 20 - 30 | 3 | |
| | > 30 | 4 | |

The risk of fire occurrence in Carson City is low to moderate (See Figure 19), but, as demonstrated by the Waterfall Fire, it is important to note that while the number of large fires may be low, the potential for these fires to become large is significant.

**Figure 19: Risk of Fire Occurrence -- Carson City**
Nevada Landscape-scale Wildland Fire Assessment

**Carson City, Nevada**




No warranty is made by the Bureau of Land Management or Wildland Fire Associates as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

1:250,000

Prepared by Wildland Fire Associates, Figure 19.mxd, 03/04/08

### 5.2.3 Ranking Values at Risk

The analysis of values at risk data involved assembling and processing over 20 separate data layers. Once assembled, the values were organized into three general categories.

- Infrastructure: power lines and stations, communication lines and points, and mines.
- Natural and cultural resources: National Register of Historic Places that are outside the WUI, wildlife habitat, National Conservation Areas, Areas of Critical Environmental Concern, wilderness, and wilderness study areas.
- Property: represented by housing density and well location outside the RCI WUI assessment and includes outlying ranches outside the boundaries of established communities.

The two layers that were used to determine housing density, U.S. Census Bureau housing units and well points, were processed similarly to that described in *Mapping Housing Density for Prioritization of Urban/Forest Wildfire Hazards in Colorado* (Theobald and Kneeland 2002). The method created a 30 meter resolution density map by converting the points to a density raster by using the DENSITY command in ArcMap. Using a neighborhood radius of 800 meters (approximately .5 miles), the density analysis takes known quantities of the housing density or well point locations and spreads them across the landscape based on the quantity that is measured at each location (number of housing units from the Census data and 1 for each well location representing the possibility of a rural housing unit) and the spatial relationship of the measured quantities (ESRI 2005). This was done in an effort to show where the point data were concentrated. The result is a density surface showing housing units per acre. The final result for each point layer was then averaged and reclassified to achieve value rankings of 1 to 4 (Table 28).

Table 28. Reclassified Value—Housing Units per Acre.

| Houses per Acre | Reclassified Value |
|---|---|
| 0 - 0.004 | 0 |
| 0.004 - 0.025 | 2 |
| 0.025 - 0.1 | 3 |
| 0.1 - 0.5 | 4 |
| 0.5 - 1 | 3 |
| 1 - 1999 | 1 |

Five layers were processed together to form a unified feature representing the location of tangible values at risk such as communication infrastructure and linear features, power generating stations and associated transmission lines, and locations of active mines. The original features were buffered by 1,000 feet. The separate features were combined using the UNION command in ArcMap. The resulting product delineated these elements with a common value of 3 (High).

The remaining layers are primarily polygons that represent intangible values at risk, including wildlife habitat, areas of critical environmental concern, and wilderness. With

the exception of point data, these layers were converted to a raster and assigned a uniform value of l. The point data (both location of wildlife species and historic places) were buffered by 1,000 feet and converted to raster, again all were assigned a value of 1. All of the rasters were added together to form one layer. The result is an accumulative value layer, ranging from 1 to 20 (the total number of combined values). This layer was then reclassified into a common scale (1 to 4) before being combined with the housing density layer and the tangible value layer to create the final Other Values at Risk layer. A listing of layers used and the sources are identified in Table 29.

Table 29. Listing of Values at Risk Data Layers Used for Statewide Analysis.

| Data Layer Description | Agency Source | Data Source |
|---|---|---|
| Census Block Polygon Centroids | Census Bureau | Block Polygons |
| Well Points | BLM | Right-of-Way Points |
| Mine Points (1000 foot buffer) | BLM | Places and Locations in Nevada |
| Communication Points (1000 foot buffer) | BLM | Right-of-Way Points |
| Communication Lines (1000 foot buffer) | BLM | Right-of-Way Linear Features |
| Power Points (1000 foot buffer) | BLM | Right-of-Way Points |
| Power Lines (1000 foot buffer) | BLM | Right-of-Way Linear Features |
| Wilderness Study Areas | BLM | Wilderness Study Areas |
| Wilderness Areas | BLM | Wilderness Areas |
| Wilderness Areas—Humboldt-Toiyabe NF | USDA FS | Wilderness Areas—Humboldt-Toiyabe NF |
| Areas of Critical Environmental Concern | BLM | Areas of Critical Environmental Concern |
| National Conservation Areas | BLM | National Conservation Areas |
| Wildhorse/Burro Herd Areas | BLM | Wildhorse/Burro Herd Areas |
| Elk Habitat | BLM | Elk Habitat |
| Black Bear Range/Habitat | BLM | Black Bear Range/Habitat |
| Bighorn Sheep Habitat | BLM | Bighorn Sheep Habitat |
| Sage Grouse, Winter Habitat | BLM | Sage Grouse, Winter Habitat |
| Sage Grouse, Summer Habitat | BLM | Sage Grouse, Summer Habitat |
| Sage Grouse, Nesting Habitat | BLM | Sage Grouse, Nesting Habitat |
| Pronghorn Antelope Habitat | BLM | Pronghorn Antelope Habitat |
| Mule Deer Range/Habitat | BLM | Mule Deer Range/Habitat |
| Pygmy Rabbit Points (1000 foot buffer) | BLM | Pygmy Rabbit Points |
| NNHP Threatened and Endangered Species Points (1000 foot buffer) | BLM | NNHP T & E Species Points |
| Lahontan Cutthroat Trout Points (1000 foot buffer) | BLM | Lahontan Cutthroat Trout Points |
| National Register of Historic Places (1000 foot buffer) | NPS | Spatial Geodatabase Points and Centroids |

Each layer was then processed and analyzed in a manner that best represented its relative importance and risk from fire. Table 30 summarizes how each layer was processed and incorporated into the GIS model.

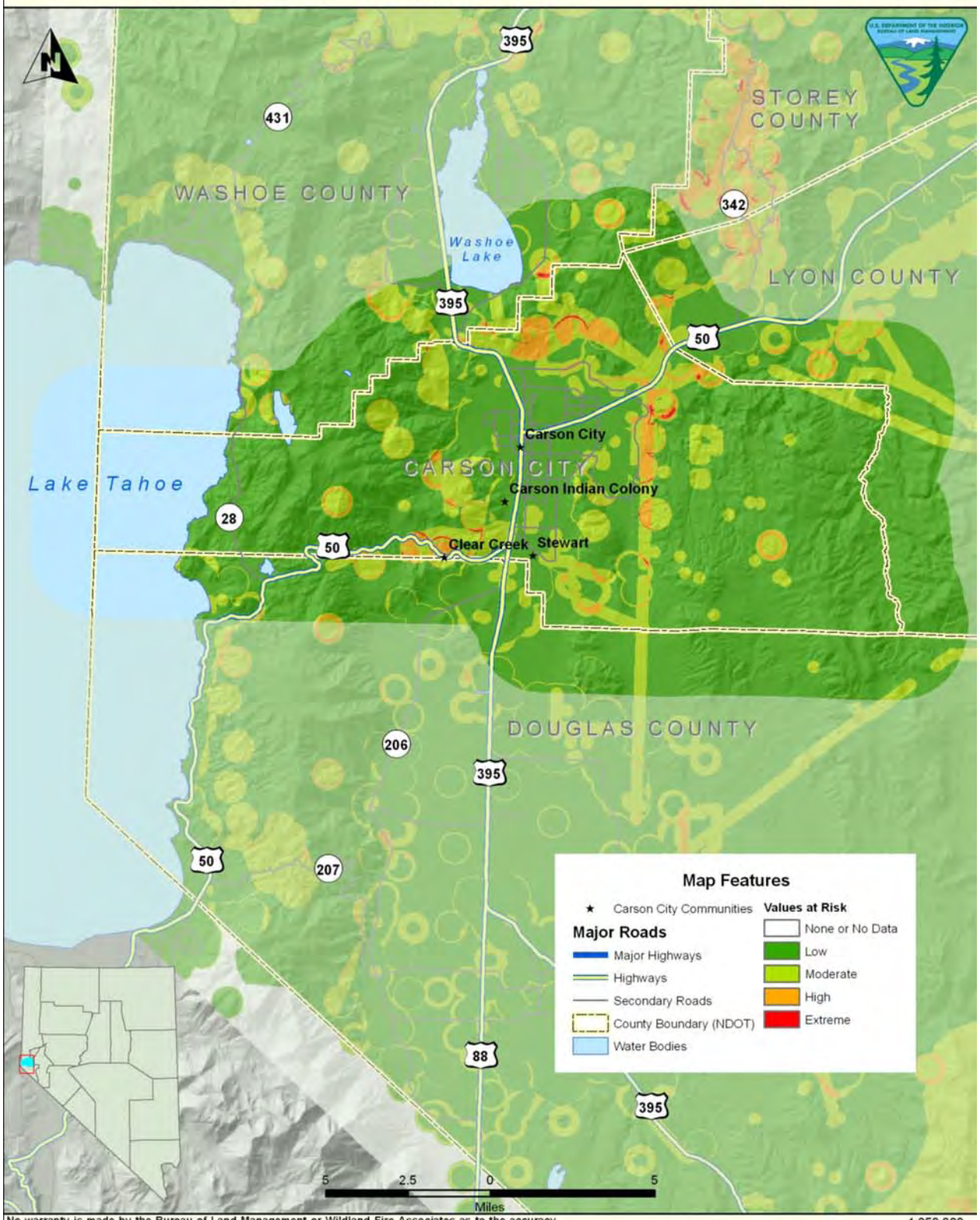
Table 30. Value Input Layer GIS Processing Summary.

| Input Layer | GIS Preprocess | GIS Analytical Process | Result |
|---|---|---|---|
| Census Block Polygon Centroids | DENSITY | MEAN | Housing Density |
| Well Points | DENSITY | MEAN | Housing Density |
| Mine Points (1000 foot buffer) | UNION | | Infrastructure Value |
| Communication Points (1000 foot buffer) | UNION | | Infrastructure Value |
| Communication Lines (1000 foot buffer) | UNION | | Infrastructure Value |
| Power Points (1000 foot buffer) | UNION | | Infrastructure Value |
| Power Lines (1000 foot buffer) | UNION | | Infrastructure Value |
| Wilderness Study Areas | | ADD | Resource Value |
| Wilderness Areas | | ADD | Resource Value |
| Wilderness Areas – Humboldt –Toiyabe National Forest | | ADD | Resource Value |
| Areas of Critical Environmental Concern | | ADD | Resource Value |
| National Conservation Areas | | ADD | Resource Value |
| Wildhorse/Burro Herd Areas | | ADD | Resource Value |
| Elk Habitat | | ADD | Resource Value |
| Black Bear Range/Habitat | | ADD | Resource Value |
| Bighorn Sheep Habitat | | ADD | Resource Value |
| Sage Grouse, Winter Habitat | | ADD | Resource Value |
| Sage Grouse, Summer Habitat | | ADD | Resource Value |
| Sage Grouse, Nesting Habitat | | ADD | Resource Value |
| Pronghorn Antelope Habitat | | ADD | Resource Value |
| Mule Deer Range/Habitat | | ADD | Resource Value |
| Pygmy Rabbit Points (1000 foot buffer) | | ADD | Resource Value |
| NNHP Threatened and Endangered Species Points (1000 foot buffer) | | ADD | Resource Value |
| Lahontan Cutthroat Trout Points (1000 foot buffer) | | ADD | Resource Value |
| National Register of Historic Places (1000 foot buffer) | | ADD | Resource Value |

The 2 intermediary layers described above and housing density were combined to create the final values at risk output, which represents the accumulated values across the landscape. This layer was then reclassified into a common scale (1 to 4) before being combined with housing density and tangible values to create the final Values at Risk layer (Figure 20).

**Figure 20: Combined Values at Risk -- Carson City**
Nevada Landscape-scale Wildland Fire Assessment

**Carson City, Nevada**




No warranty is made by the Bureau of Land Management or Wildland Fire Associates as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.

1:250,000

Prepared by Wildland Fire Associates, Figure 20.mxd, 03/04/08

# 6.0 Mitigation Approaches

## 6.1 Desired Future Conditions (DFC)

### 6.1.1 In Carson City

When describing DFC it is important to bear in mind that a return to presettlement conditions is neither practical nor probably attainable in most situations. Returning wildland fire, where appropriate, to its natural role in the environment and taking other steps to minimize hazardous fuel loading, the spread of noxious weeds, and the preservation/protection of remnant or critical habitat and other important values is most desirable and likely attainable.

It is desirable to reduce the amount of hazardous fuel near and adjacent to homes, structures, and other facilities, such as livestock feed storage areas, and to modify the vegetation structure and composition as necessary to protect life, property, and other values at risk. Landowners and homeowners need to work with their local fire department to determine the standards and methods necessary to provide a proper level of protection. When fully implemented, the altered vegetation in combination with other defensible space and fuels management practices will provide for firefighter and public safety and afford fire suppression personnel a good chance of protecting values at risk from wildland fire while respecting the aesthetic values important to the local residents (See Section 6.8 for additional information).

The Great Basin is a complex ecosystem that has experienced substantial change over time. Elevation, aspect, and slope affect the physical environment, and seasonal shifts in weather and year-to-year differences in climate result in variable factors affecting rangeland and other plant communities. All of these factors contribute to considerable variation of vegetation characteristics and wildland fire patterns over space and time.

Prior to human occupation, fire and climate interacted to determine the vegetation on the landscape. Since then, human activity, fire suppression policies, domestic animals, the expansion of the pinyon-juniper woodland, and introduced species (especially invasive plants) have been added to the equation. Fire and climate remain the major factors, but other factors, such as cheatgrass production during ephemeral years, also influence the outcome when fire occurs under various climatic conditions (NNSG 2004).

An observed phenomenon that may become more of a factor in the near future is the gradual warming of the environment. Whether or not “climate change” or “global warming” is a human-caused phenomenon, warmer and drier climatic conditions during the last decade have come on the heels of wetter and cooler conditions that had favored increases in fuel accumulation. Whatever its cause, a warm climatic cycle can contribute in any year to earlier snowmelt, drought, and heavy, isolated rainstorms. The early loss of snow cover, patchy rainfall, and low soil water absorption during intense rainstorms may contribute to lower live and dead fuel moisture during the summer months.

Based on these and other factors, it is not realistic to assume that management actions can recreate the plant communities and habitat that may have existed naturally and historically. The desired outcome of the risk/hazard assessment and subsequent mitigation project implementation is the creation of fuel complexes that reduces the fire threat, increases protection of valued natural and man-made resources, provides for firefighter and public safety, lowers the cost of firefighting and follow-up rehabilitation, and improves the effectiveness of fire suppression efforts.

Achieving the desired outcome will be a long-term process. The criteria to achieve the vegetation patterns may change in response to changing climate conditions or altered vegetation as a result of disturbance, including wildland fire, in out years. The objective is to work toward achieving a diverse vegetative mosaic on a landscape-scale that will provide suitable habitat for a wide variety of plant and animal species. It is desirable to incorporate these areas into existing biologically diverse ecosystems or areas of critical habitat and increase the amount of edge habitat favored by a wide variety of animal and bird species. As indicated in a previous section, changes in vegetative type may also aid in wildland fire suppression by creating a change in fuel type. Stand replacing crown fires in brush or woodland fuels will become ground fires in areas of grass, which may be less resistant to control.

A second objective is the creation and maintenance of strategically placed managed areas, such as greenstrips, designed to protect values at risk. Projects designed to impede the spread of wildland fire on a larger scale could incorporate fuel breaks such as roads, railroads, power transmission lines, and natural features such as water courses, areas with little vegetation, and areas of fire-resistant vegetation. Native vegetation would be favored to the extent possible and would be reintroduced when practical and when the probability of success is high.

### 6.1.2 Adjacent to Carson City

Ecosystems or vegetative communities very seldom consider roads or legal boundaries when establishing their perimeters. The process used to complete this analysis will look at vegetative types and other factors to ensure that there is a seamless transition from one county to the adjacent state.

## 6.2 Mitigation Goals and Objectives

Two important elements must be considered when identifying goals and objectives that will achieve the desired results. First, and most important, is determining the primary fuel types and condition of the fuels in Carson City. Many people have recognized that years of fire suppression and a variety of other factors have contributed to greatly altered grasslands and rangelands and unhealthy woodlands. These altered systems are prone to attack by invasive species, insects, and disease and are vulnerable to catastrophic wildfire. This analysis will focus primarily on the rangelands within and adjacent to Carson City because of their prevalence, overall economic importance, proximity to isolated facilities, and susceptibility to wildfire.

The second key element is to inform the public that lives outside of WUI areas about the hazards and risks of wildland fire and how to mitigate those risks.

### 6.2.1 Goals

The primary mitigation goals are to:

- Provide for firefighter and public safety.
- Reduce hazardous fuel accumulations on wild lands and private lands within Carson City.
- Reduce risk of wildland fire impacting isolated areas in the wildland urban intermix adjacent to federal lands.
- Protect resource-dependent economies and infrastructure assets.
- Restore and maintain healthy ecosystems on a landscape-scale that are not as vulnerable to environmental disturbances outside the historical range of variability.
- Coordinate federal and state efforts to secure adequate fuels treatment funding.
- Reduce the costs of fire suppression and subsequent rehabilitation.

### 6.2.2 Objectives

- Provide defensible space around isolated facilities and groups of isolated structures by reducing the wildland fuel load and altering vegetative patterns.
- Create different vegetative communities and vegetation patterns that are less continuous, include more random openings, and consist of a variety of age classes, as appropriate, to reduce fuel continuity and create barriers to wildland fire spread.
- Reduce the likelihood of the establishment and perpetuation of undesirable plant species.
- Coordinate federal, state, and local fuels management activities to take full advantage of fuels mitigation work completed to date.
- Create fuel breaks in appropriate locations.
- Establish lines of communication with stakeholders and other agency partners necessary to set project priorities, request and receive funding, carry out joint fuels management projects, and fully implement the key elements of the defensible space program.
- Enhance ecosystem health by reducing the fuel loading and change stand composition to more natural levels.
- Support efforts to organize community-based action groups with a mission and focus on fire prevention.

## 6.3 Available Treatment Options

Managing vegetation in the Great Basin is challenging due to soils, existing vegetation, rainfall patterns, and other weather phenomena. What may work on one site may not work on another, or a method that may work under one set of conditions at a given site may not work under different conditions at the same site. Therefore, it may be necessary

to consider a variety of treatment options in order to find the one best suited for a specific project.

Other more subtle factors can come into play as well. For example, removing brush to create a fuel break without addressing invasive species can be trading one problem for another. Soil disturbance should be kept to a minimum.

Projects and treatment options must be consistent with the goals and objectives outlined in the Fire Management Plan, the Land Use Plan and other planning documents covering the area to be treated, the 2001 Federal Fire Policy, and be viable within the limitations of federal budgets.

An important factor to consider is many of the projects, especially those involving light fuels, will require treatment in out years. There is no guarantee that managers can receive funding for out year treatment as part of the original project funding. It is often easier to receive funding for new projects than to receive funding to maintain past projects, especially if the existing project lowers wildfire risk from extreme to moderate. Therefore, it is extremely important to include a strong justification with a funding request for out year treatment project funding. Current efforts to inform lawmakers and members of their staff of the importance to fund follow-up maintenance should be continued.

### 6.3.1 Mechanical and Manual Treatment

Mechanical and manual treatment of fuels may be necessary to protect values at risk scattered throughout Carson City in woodland areas or areas of excessive fuel loading caused primarily by trees or brush. These treatments would involve the use of tools such as chainsaws or heavy equipment such as a roller-chopper (or other similar types of mechanical treatment devices) to remove smaller diameter trees and shrubs.

A common practice is to create treated strips—commonly known as shaded fuel breaks—in woodlands and areas of brush ranging from 20 - 60 feet wide, depending on the density and conditions of the fuels. The idea is to create a mosaic, preferably with uneven edges. Cultural sites should be avoided and areas necessary for the perpetuation of special status species should be excluded from the treatment area. The width of the strips can often be reduced when roads or other existing fuel breaks are incorporated into the project design. In areas dominated by grasses or grass and brush, it may be necessary to create strips up to 100 feet wide.

The result is an area that will alter fire behavior, afford fire suppression personnel a better opportunity to manage a wildland fire, and create habitat conditions favored by a wide range of wildlife species.

#### 6.3.1.1 Mowing/Mastication

The use of mowing/mastication where the terrain is favorable would involve mowing and/or grinding or crushing vegetation to reduce fuel bed continuity or create strips in grass or shrub vegetation communities. Rotary mowers are pulled by tractors or other pieces of equipment. Equipment that grinds or crushes vegetation (e.g., brushhogs) can be towed or may be mounted on a piece of equipment.

In wooded areas and brush fields, the resulting wood chips could be left in place to hold the soil and reduce the possibility of erosion. In wooded areas, once the right set of conditions are determined, a low-intensity understory burn could be used as a follow-up treatment to reduce the overall accumulation of dead and down fuel to levels more closely resembling the average fuel loading for a typical site.

#### 6.3.1.2 Hand Thinning and Brushing

Power saws can be used to thin sagebrush or pinyon-juniper stands. Although labor intensive, the target species can be selectively removed. This method provides the opportunity to selectively cut shrubs or trees in the treatment area, thereby leaving key brush species necessary for wildlife, removing unhealthy trees or less desirable tree species, creating a stand of a variety of size classes, and leaving or removing trees or shrubs to create optimum canopy spacing or openings. Lower branches from trees can be removed to reduce the likelihood of crown fires. The branches and other debris resulting from the thinning process could be allowed to remain on the ground where they fell, piled and burned, left to decay, or chipped and blown on the ground.

#### 6.3.1.3 Chaining

Chaining involves dragging a large chain between two bulldozers or other heavy equipment through a stand of vegetation to rip out large trees or shrubs. This option must be carefully analyzed based on the site to be treated because it is nonselective and the associated ground disturbance may open large areas to noxious weed infestation. This option may convert a stand of vegetation that was not too susceptible to wildland fire to one that could burn with high intensity.

### 6.3.2 Livestock Grazing

A great deal of research has been conducted in the Great Basin to determine the effect of grazing on cheatgrass and, to a lesser extent, its close relative red brome. Grazing is not the issue; it is the timing, intensity, and duration of the activity that needs to be managed (NNSG 2004). Research suggests timing of grazing may help control cheatgrass—winter grazing may be effective in reducing cheatgrass density and vigor (Emmerich, et al.1993). Steps must be taken to protect areas newly seeded with native species from grazing to allow sufficient time for recovery. Any change to established grazing permits must be closely coordinated with the appropriate permitting agency.

### 6.3.3 Prescribed Fire

Brooks and Pyke (2001) note that fire can be used to either control invasive species or restore historical fire regimes. However, the decision to use prescribed fire as a management tool must consider the potential interrelationships between fire and invasive species. The use of fire may not be a feasible or appropriate management action if fire-tolerant invasive plants are present.

Prescribed burning is an option in mountain big sagebrush and Wyoming big sagebrush sites in precipitation zones with 10 or more inches of precipitation annually (NNSG 2004). Prescribed fire may also be used to treat decadent stands of brush, certain grass species where site conditions are favorable, or stands of pinyon-juniper that are encroaching into areas of healthy sagebrush. Another appropriate use of prescribed fire may be to reduce fuel loading following other forms of treatment.

The timing and intensity of the fire, as well as the size of the fire, are important factors in achieving desired results.

### 6.3.4 Chemical Control (Herbicides)

Herbicides may help control the spread or establishment of invasive species such as cheatgrass. Herbicides may also be used to treat areas of sagebrush to rejuvenate grasslands or create openings in dense stands of sagebrush to accomplish resource management objectives.

The use of herbicides can impact fire behavior, as well. Results of a study released in 2002 by BASF and Synergy Resource Solutions, Inc. show that fire intensity was significantly reduced in cheatgrass-infested areas treated by Plateau® (Kury, et al. 2002, as quoted in NPS 2006). The study indicated flame heights and rates of spread were lowered by 88 and 95%, respectively, as compared to untreated areas.

Where cheatgrass is abundant or likely to become abundant, native plant seeds often fail to germinate or establish, and seeding alone does not necessarily decrease invasive species cover or may even reduce native perennial plant cover (Brooks 2005 as quoted in NPS 2007). Similarly, cheatgrass control is only effective when combined with treatments that establish perennial species (Harris and Goebel 1976, Klemmedson and Smith 1964, Mosley, et al. 1999 as quoted in NPS 2007). Likewise, in areas where there already is a significant component of native perennial plants present, chemicals can control cheatgrass (Mosley, et al. 1999 as quoted in NPS 2007) and allow the native plants to grow (NPS 2007). Where viable seed banks are available, native plant species in burned areas that are treated can be expected to recover and flourish after the treatment without the competition of cheatgrass (NPS 2006).

The use of Plateau® has proven effective in cheatgrass control both as a preemergent by prohibiting the germination of cheatgrass seeds and as a post-emergent herbicide applied

after the cheatgrass has started to grow[7]. In the Great Basin the application of Plateau® as a preemergent for the control of cheatgrass may be most effective in the fall, but treatment should be based on stage of plant growth and long-term weather forecasts. When Plateau® is used as a post-emergent, an additive must be included in the herbicide mixture to ensure that the herbicide penetrates the target plants. When appropriate, glyphosate (trade name Roundup®) can be added to the mix after greenup to maximize control of cheatgrass while minimizing impacts to nontarget native species (NPS 2007).

The use of selective herbicides may be more appropriate in the future as changes in the climate expand the current range of invasive species. Areas being threatened by invasive species could be treated while viable populations of native species are still present.

There are two important factors to consider when making the determination to use herbicides: 1) application drift is unpredictable and may escape from the targeted area and 2) the fuel load may be converted from live fuel with higher fuel moisture to dead dry fuel, thus increasing fire behavior and intensity (BLM 2004).

### 6.3.5 Seeding

This treatment option can be used to restore degraded rangelands, rehabilitate decadent stands of sagebrush, reestablish grasses and forbs on sites previously occupied by pinyon-juniper, and for burned area rehabilitation. Seeding will often be used in conjunction with some other treatment that is designed to prepare a suitable seedbed or to remove competing or undesirable vegetation.

The decision to use native or nonnative grass species such as crested wheatgrass, for example, is dependent on the management goals and objectives outlined in the management or activity plan(s) for the area to be treated and conditions present at the site. The use of a nonnative seed mix may be appropriate when developing greenstrips or for burned area rehabilitation, especially in areas where little precipitation is received.[8]

---

[7] Following the completion of an Environmental Impact Statement entitled *Final Programmatic Biological Assessment for Vegetation Treatments on Bureau of Land Management Lands in 17 Western States (PEIS)* and the issuance of the Record of Decision dated October 2, 2007, the BLM will approve and use in 17 western states 14 herbicide active ingredients previously approved for use in BLM RODs and for which an analysis of risks to humans and nontarget plants and animals was conducted for the PEIS by the U.S. Department of Agriculture Forest Service. These herbicide active ingredients are: 2,4-D, bromacil, chlorsulfuron, clopyralid, dicamba, diuron, glyphosate, hexazinone, imazapyr, metsulfuron methyl, picloram, sulfometuron methyl, tebuthiuron, and triclopyr. The BLM will also approve and use 4 additional herbicide active ingredients in all 17 states assessed in the PEIS: diquat, diflufenzopyr (in formulation with dicamba and known as Overdrive®), fluridone, and imazapic. In addition, the BLM will use diflufenzopyr as a stand-alone active ingredient at such time the ingredient becomes registered for use by the U.S. Environmental Protection Agency (USEPA) under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) (BLM 2007). The active ingredient in Rodeo, imazapic, has been approved for use.

[8] The EIS was completed and a Record of Decision issued on September 29, 2007.

Seedbed preparation is often necessary and the use of a rangeland drill has proven to be the most effective means of planting the seed. It may be necessary to treat the area with a preemergent herbicide prior to seeding.

### 6.3.6 Greenstripping/Brownstripping

Although they can be any size or shape, greenstrips are generally long, narrow bands of fire-tolerant vegetation that will readily establish and persist, impact fire behavior, and in some cases may be desirable wildlife and livestock forage. Greenstrips can be used to reduce the opportunity for wildland fire to start or spread, reduce the size of wildfires, and increase the effectiveness of the fire suppression effort.

Greenstrips are becoming a popular means of protecting communities and other values at risk from wildland fire. They are also being used to achieve resource management goals and objectives, such as breaking up large blocks of highly flammable, continuous annual vegetation, and are also used to protect high-value natural resources *and other values at risk* (phrase and emphasis added) (Davison and Smith 1997, NNSG 2004), such as mule deer winter range, endangered species habitat, and water sources.

The width of the greenstrip depends on site conditions. In most of Nevada sagebrush-grassland rangelands, a width of 300 feet is recommended (Davison and Smith 1997). The width may be reduced if the greenstrip is established next to a road or railway, which serves as an existing fuel break. In areas where the greenstrips are being used to create mosaics in large blocks of vegetation, the edges should be irregular and the blocks can be of irregular shapes.

Establishing a greenstrip normally requires the removal of the existing vegetation, preparing a seedbed, and seeding fire-resistant or fire-tolerant plants. The method used to prepare the seedbed should be based on the size and location of the project, the existing vegetation, availability of equipment, economic factors, etc. The seed mix should include both grasses and forbs. A rangeland drill is the most effective method to plant the seeds. A listing of the most common plants used in greenstripping projects is available on the Internet at: http://www.livingwithfire.info/pdf/WEB-Greenstrips.pdf.

Areas converted to greenstrips need to be monitored and ***maintained*** frequently enough to reduce the build up of fuel. It is also important to note that, even though the vegetation will remain resistant to fire well into the summer, the vegetation will eventually cure and become less resistant to fire.

Similar to greenstrips, brownstrips have been defined by the Northeast Nevada Stewardship Group as fuel breaks that use the existing native herbaceous vegetation. The shrubs are removed from a strip, and the native perennial herbaceous vegetation that remains is grazed to reduce the amount of standing fuel. Brownstrips use only native species (which cure out and turn brown) in the brownstrips, whereas greenstrips are not limited to only native vegetation.

### 6.3.7 Use of Multiple Methods

Ronayne reported in *Birds on the Brink* (date unknown) that at a 1999 symposium scientists from around the Northern Great Basin considered a variety of solutions to address the proliferation of cheatgrass and the resulting impact on bird species. They came up with a number of possibilities, including managing fuel by combining prescribed burns, greenstripping, herbicides, and intensive livestock grazing in various ways; broadcasting herbicides over large areas to reduce annual weed infestations; and possibly excluding livestock from specific sites to enhance and protect biological soil crusts and retard cheatgrass infestation.

## 6.4 Biomass Utilization

All hazardous fuel removal efforts should carefully consider the potential beneficial use of the biomass created. Pinyon-juniper, for example, could be made available as firewood or posts, chipped for mulch, or used for other commercial uses. Fuels treatment and maintenance projects may become a vital contributor to a feedstock stream to support an existing or expanding biomass utilization industry.

## 6.5 Compliance with the National Environmental Policy Act

The National Environmental Policy Act of 1969 (NEPA; 42 USC 4321 et seq.) requires the preparation of environmental impact statements for federal projects which may have a significant effect on the environment. NEPA requires systematic, interdisciplinary planning to integrate natural and social sciences in project design.

Environmental analysis requirements for fuels treatment projects were addressed in the Healthy Forest Initiative (HFI) and the Healthy Forests Recovery Act (HFRA). The intended purpose of both the HFI and the HFRA was to streamline the process for accomplishing hazardous fuel reduction and vegetation restoration projects on federal lands in order to improve rangeland and forest health. They call for the maintenance of appropriate environmental standards and collaboration with communities and interested publics. While some procedural requirements have been expedited, all existing environmental statutes remain in place (USDA FS 2004).

In response to the HFRA, the Departments of Agriculture and the Interior adopted a new categorical exclusion from documentation in an Environmental Assessment (EA) or Environmental Impact Statement (EIS)—an exclusion for hazardous fuels reductions (68 CFR 33814).

The HFI states that, to be categorically excluded from documentation in an EA or EIS, a proposed hazardous fuels reduction action must meet certain requirements and conditions. An example is that hazardous fuel reduction activities using prescribed fire can be categorically excluded if they do not include more than 4,500 acres. Activities using mechanical methods can be categorically excluded if they do not include more than 1,000 acres. Such activities:

- Shall be limited to areas in the wildland urban interface or to areas in Condition Classes 2 or 3 in Fire Regime Groups I, II, or III outside the wildland urban interface.
- Shall be identified through a collaborative framework.
- Shall be consistent with agency and departmental procedures and applicable resource management plans.
- Shall not be in wilderness areas or impair the suitability of wilderness study areas for preservation as wilderness.
- Shall not include the use of herbicides or pesticides or the construction of new permanent roads or other permanent infrastructure, but may include the sale of vegetative material if the primary purpose of the activity is to reduce hazardous fuel.

Categorically excluded USDA Forest Service actions are not subject to administrative appeal (36 CFR 215.4). Categorically excluded DOI BLM actions are subject to notification, protest, and administrative appeal (43 CFR Part 4, as modified by 43 CFR 5003.1 and 43 CFR 4190.1).[9]

Under the direction of the HFI, the Council on Environmental Quality provided new guidance for the preparation of EAs for fuel reduction and fire-adapted ecosystem restoration projects that streamline the process. A useful guide, *The Healthy Forests Initiative and Healthy Forests Restoration Act Interim Field Guide FS-99* (available on the Internet at http://www.fs.fed.us/projects/hfi/field-guide/), can expedite the processes by addressing covered activities identified in Title I of the HFRA for hazardous fuels treatment on BLM and USDA FS lands.

The HFRA establishes special procedures for agencies preparing EAs or EISs for authorized hazardous fuel reduction projects and restricts the use of categorical exclusions for certain projects. The HFRA emphasizes the need for public participation and collaboration when preparing hazardous fuel reduction projects. Additional information concerning the HFRA can be found at the previously cited website.

The determination to categorically exclude a project or to complete an EA/EIS for hazardous fuel reduction projects occurring on federal lands will be made by the appropriate Agency Administrator. Since many of the projects may be planned for areas outside the wildland urban interface, it will be necessary to determine and document the Condition Class and Fire Regime Group before determining the appropriate NEPA compliance response. Information concerning Condition Classes and Fire Regime Groups is available at http://www.frcc.gov/docs/FrccDefinitionsFinal.pdf.

### 6.6 Establishing Project Priorities

This risk/hazard analysis does not identify projects to be completed. Rather, its purpose is to identify areas at the greatest threat from wildland fire. The appropriate land managers and other stakeholders can use the GIS-generated products developed through

[9] More information on categorical exclusions of hazardous fuel reduction projects is available at: http://www.fs.fed.us/emc/hfi or http://elips.doi.gov/elips/release/3511.htm.

this analysis to identify areas most vulnerable to catastrophic wildfire and help establish priorities for fuels treatment projects and other management actions based on the values at risk.

A risk/hazard assessment map was produced for Carson City as part of this analysis. The map, included in Appendix B, identifies four levels of risk: low, moderate, high, and extreme. The GIS-produced map can be used when establishing project priorities. It would be appropriate in most cases to assign higher priority to projects that are located within an area identified as having an extreme rating.

This analysis is a tool. Like any tool there are limitations and assumptions. It is important that land managers and stakeholders make every effort to identify areas where healthy ecosystems exist and afford them a high level of protection.

Chambers, et al. (2005) state that the ability of invasive species to dominate Great Basin sagebrush (*Artemisia* spp.) ecosystems is dependent on environmental characteristics and is the result of several interactive factors including precipitation and temperature regimes, site conditions, past and present disturbance, and the competitive abilities of resident species. Chambers, et al. (2005) also noted that cheatgrass is clearly limited by temperature at upper elevations. If, as many scientists think, the climate is gradually warming, the available areas of healthy ecosystems suitable for colonization by cheatgrass may well increase. Proactive projects designed to enhance the health and vigor of native vegetation occurring near the current limits of cheatgrass and other invasive species should receive special consideration.

Landscape-scale projects are considered to be very expensive, and the competition for limited funding for projects is keen. It may be desirable to identify projects that reinforce or complement other projects that have already been funded or completed or to protect areas considered to be of high value. For example, it may be appropriate to support hazardous fuels management projects located outside the WUI that complement existing hazardous fuels management projects that fall within the 1.5 mile WUI Threat Area, or those projects that provide protection for ranch sites or developments near federal lands that are located in areas indicated to be at the highest threat from wildland fire.

### 6.7 Recent Fuels Treatment Projects

Since 2004, the BLM, NDF, USDA FS, and others have implemented or completed fuel treatment projects in Carson City. The various projects are listed in Appendix F, which will be updated as additional projects are completed.

### 6.8 Property Owner's Responsibilities

Before wildfire threatens, landowners or homeowners should design and landscape their home with wildfire safety in mind. Select materials and plants that can help contain a wildland fire rather than fuel it. Use fire-resistant or noncombustible materials on the roof and exterior structure of the dwelling. Plant fire-resistant shrubs and trees. For

more information on fire-safe landscaping, refer to "Living With Fire" published by University of Nevada Cooperative Extension (UNCE) (http://livingwithfire.info/).

Defensible space, the area between a house and an oncoming wildfire where the vegetation has been modified to reduce the wildfire threat, should be created to provide an opportunity for firefighters to effectively defend the house. In the event that firefighters are not available, defensible space also improves the likelihood of a home surviving without assistance. The goal of defensible space is to reduce the chances of a wildfire spreading onto a homeowner's property and igniting homes and other structures and to reduce the risk of loss from a wildfire. The Nevada Fire Safe Council recommends that homeowners follow the recommendations that are a part of the Living With Fire Program as cited in the previous paragraph.

Immediately dispose of cleared vegetation when implementing defensible space treatments and maintain defensible space annually. For additional information about creating defensible space and fire safe practices, contact the Nevada Fire Safe Council at: http://www.nvfsc.org/index.html.

## 7.0 Analysis Summary and Future Considerations

Over the past several years, factors have combined to alter the fire regimes of the Great Basin. As a result, a "normal fire year" is becoming a thing of the past. Fire season—once considered to run from May or June to September or October—is being replaced by a year-round season, marked by late winter and early spring fires that can destroy homes and other improvements and impact grazing lands and important wildlife habitat. A large part of this change is due to the loss of native vegetative communities that have been replaced by invasive, fire-prone species such as cheatgrass and red brome. Areas that at one time experienced a wildland fire reoccurrence interval of approximately 35 years are now experiencing wildland fires with return intervals as short as every 2–3 years. The short fire return intervals and the change in wildland fire intensity do not allow native vegetation to become reestablished following a stand-replacing fire.

Invasive species, such as cheatgrass or red brome, combined with ephemeral conditions are known to produce abundant fuels that contribute to wildland fire intensity, severity, and even wildland fire occurrence. When cheatgrass or red brome invade, stands of existing native vegetation or widely spaced individual native plants can become engulfed in a continuous carpet of burnable vegetation that enables wildland fires to spread rapidly.

The costs associated with dealing with fuels issues on a landscape-scale can be prohibitive. However, many things can be done on a smaller scale to protect scattered ranches, mining facilities, communications towers, and other values at risk such as grazing lands and critical habitat. For example, strategically placed small projects could be used to break up fuel continuity or to protect water sources. Taking advantage of features such as roads, changes in fuel types, and/or open lands can leverage additional returns on funds spent for fuel treatments. Other actions include managing vegetation at the base of power poles and around communications sites.

A monitoring program should be included as part of the project to determine efficacy of the treatment action. Managers should also actively seek funding in out years to conduct follow-up treatment(s).

As expressed in the previous section, the highest priority should be given to protecting and enhancing existing stands of native vegetation and to adopting a holistic approach to ecosystem management. Well-managed stands of vegetation will protect resources and values at risk from the impacts of catastrophic wildland fire and provide needed habitat for flora and fauna and the people that call Carson City and the Great Basin their home.

## 8.0 Persons, Groups, and Agencies Consulted

| Person Contacted | Title or Department | Representing |
|---|---|---|
| Stan Heinrichs | Fire Management Officer | BIA – Western NV Agency |
| Ruta Glinski | Mitigation/Education | BLM-Nevada State Office |
| Sandy Gregory | Fuels | BLM-Nevada State Office |
| E. "Butch" Hayes | Deputy State FMO | BLM-Nevada State Office |
| Rex McKnight | State FMO | BLM-Nevada State Office |
| Mark O'Brien | GIS Specialist | BLM-Nevada State Office |
| Gwenan Poirier | Fire Planning Specialist | BLM-Nevada State Office |
| Steve Edgar | Fire Mitigation/Education Specialist | BLM-Carson City |
| Tim Roide | Fuels Specialist | BLM-Carson City |
| Ken Smihula | Fire Management Officer | BLM-Carson City |
| Stacey Giomi | Fire Chief/Emergency Mgr. | Carson City Fire Department |
| Bruce Van Cleemput | Asst. Fire Chief/Fire Marshal | Carson City Fire Department |
| Ann Bollinger | Open Space Assistant | Carson City Parks and Rec. |
| Juan Guzman | Open Space Manager | Carson City Parks and Rec. |
| Marge Evans | Weed Coordinator | Carson City Weed Coalition |
| Terri Fairfield | Congressional Aide | Congressman Dean Heller |
| Pete Anderson | State Forester Firewarden | Nevada Div of Forestry |
| Michael Dondero | State FMO | Nevada Div of Forestry |
| Kacey KC | Conservation Staff Specialist | Nevada Div of Forestry |
| Roy Leach | W. Region Habitat Supv. | Nevada DOW |
| Andrew List | Executive Director | Nevada Fire Safe Council |
| Elwood Miller | Advisor to Fire Safe Council | Nevada Fire Safe Council |
| Cheryl Johnson | Biologist | USDA Forest Service |
| Davis Marlow | Vegetation, Fire, and Fuels Staff Officer | USDA Forest Service |
| Darrel Cruz | Environmental Specialist II | Washoe Tribe of NV and CA |
| Merrill Kaufmann | Fire Ecologist | Wildland Fire Associates |

## 9.0 References and Citations


Agee, J.K. 1993. Fire ecology of Pacific Northwest Forests. Island Press, Wash. DC.

Anderson, Hal E. 1982. Aids to determining fuel models for estimating fire behavior. USDA For. Serv. Gen. Tech. Rep. INT 122, 22p. Intermountain Forest and Range Experiment Station, Ogden, UT.

Andrews, P. 1986. BEHAVE: Fire Behavior Prediction and Fuel Modeling System-BURN Subsystem, Part 1. USDA For. Ser. Gen. Tech. Rep. INT-194.

Andrews, Patricia L. and Colin D. Bevins. 2003. BehavePlus fire modeling system, version 2.0: overview. Proceedings of the Second International Wildland Fire Ecology and Fire Management Congress and Fifth Symposium on Fire and Forest Meteorology. November 16-20, 2003. Orlando, FL: American Meteorological Society. P5.11.

Andrews, P.L. and R.C. Rothermel. 1982. Charts for Interpreting Wildland Fire Behavior Characteristics, US Forest Service, Intermountain Forest and Range Experiment Station, Ogden, UT, General Technical Report INT-131.

Bradley, B.A., and J.F. Mustard. 2004. Identifying land cover variability distinct from change – Cheatgrass in the Great Basin. Available on the Internet at: www.sciencedirect.com.

Brenner, J., G. Kass, J. Coen, and S. McLellan. 2001. Assessing Fire Risk in Florida Using Integrated GIS and Remote Sensing Applications. unpublished paper. Available on the Internet at: http://gis2.esri.com/library/userconf/proc01/professional/papers/pap826/p826.htm

Brooks, Jeffery J., Alexander N. Bujak, Joseph G. Champ, and Daniel R. Williams. 2006. Collaborative Capacity, Problem Framing, and Mutual Trust in Addressing the Wildland Fire Social Problem: an Annotated Reading List. General Technical Report RMRS-GTR-182Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 27p.

Brooks, M.L., and D.A. Pyke. 2001. Invasive plants and fire in the deserts of North America. Tall Timber Research Station Miscellaneous Publication No. 11:1-14

Brown, J.K. 1995. Fire regimes and their relevance to ecosystem management. *In:* Proceedings of Society of American foresters National Convention, Sept. 18 – 22, 1994, Anchorage, AK. Society of American Foresters. Washington, DC. pp 171 – 178.

BLM. 2007. Salt Wells Grazing Allotment EA. Bureau of Land Management. Carson City Field Office. Carson City, Nevada. May 2007. pp 6-9

Bureau of Land Management (BLM). 2007. Final Programmatic Biological Assessment for Vegetation Treatments on Bureau of Land Management Lands in 17 Western States (PEIS). Available on the Internet at: http://www.blm.gov/wo/st/en/prog/more/veg_eis.html [Accessed 10/22/2007]

Bureau of Land Management. 2004. Seven Mile Hazardous Fuels Reduction Project – Nye County, Nevada. Environmental Assessment NV-04-EA-03-51. Battle Mountain field Office. Battle Mountain, NV.

Bureau of Land Management. 2001. Pre-Plan Analysis and Project Management Plan – Pine Nut Mountains Plan Amendment and Environmental Impact Statement. Carson City Field Office. March 2001. Available on the Internet at: http://www.nv.blm.gov/carson/Planning_Env_Coord/PineNut/documents/PINENUT.PREP.pdf [Accessed 3/7/2008]

Bureau of Land Management. 2001. BLM Manual. Available on the Internet at: http://www.blm.gov/nhp/efoia/wo/manual/4180.pdf

Bureau of Land Management. Interagency Standard for Fire and Fire Aviation Operations and the BLM Office of Fire and Aviation. Available on the Internet at: http://www.nifc.gov/red_book/

Bureau of Land Management. Rangeland Health Standards Handbook (H-4180-1)

Bureau of Land Management. 2002. (Final) Fire Regime and Condition Class (FRCC) for BLM administered lands in Utah and Nevada. Utah and Nevada State Offices

Bureau of Reclamation (USBR). 2007. Drought Conditions in the West – Great Basin. USDOI. USBR. Upper Colorado Region. Available on the Internet at: http://www.usbr.gov/uc/feature/great_basin.html [Accessed 10/22/2007]

Carson City Home Page. Available on the Internet at: http://www/carson-city.nv.us [Accessed 03/05/2008].

Chambers, J. C. 2000a. Seed movements and seedling fates in disturbed sagebrush steppe ecosystems: implications for restoration. Ecological Applications. 10:1400-1413.

Chambers, J. C. 2000b. Using threshold and alternative state concepts to restore degraded or disturbed ecosystems. Pages 134-145. In: Proceedings - High Altitude Revegetation Workshop No. 14. Colorado Water Resources Research Institute, Colorado State University. Fort Collins, CO.

Chambers, J. C. 2000c. Great Basin Ecosystem Management Project: restoring and maintaining riparian ecosystem integrity. Pages 110-113. In H. Y. Smith, ed.

Proceedings: The Bitterroot Ecosystem Management Project--what we have learned, May 18-20, 1999. Missoula, MT. RMRS-P-17. Rocky Mountain Research Station, Fort Collins, CO.

Chambers, J. C. 1997. Restoration of alpine ecosystems in the United States. Pages 161-187. In: K. Urbanska and N. Webb (eds). Restoration ecology and sustainable development. Cambridge University Press.

Chambers, Jeanne C., Bruce A. Roundly, Robert R. Blank, Susan E. Meyer, and A. Whittaker. 2007. What makes Great Basin Sagebrush ecosystems invasible by *Bromus tectorum*? In Ecological Monograms, Ecological Society of America. 77(1) pp 117 – 145.

Chambers, Jeanne, Susan Miller, Bob Blank, Bruce Roundy, and Alison Whittaker. 2005. Susceptibility of Sagebrush Communities to Cheatgrass (*Bromus tectorum*): Effects of Native Herbaceous Species Removal and Fire. In: Chambers, Jeanne C., E. Durant McArthur, Steven B. Monson, Susan E. Meyer, Nancy L. Shaw, and Robin J. Tausch, Robert R. Blank, Steve Bunting, Richard R. Miller, Mike Pellant, Bruce A. Roundy, Scott C. Walker, Alison Whittaker. 2005. Sagebrush Steppe and Pinyon-Juniper Ecosystems - Effects of Changing Fire Regimes, Increased Fuel Loads, and Invasive Species. Joint Fire Sciences Report Project #00-1-1-03.

Chambers, J. C., K. Farleigh, R. J. Tausch, J. R. Miller, D. Germanoski, D. Martin, and C. Nowak. 1998. Understanding long- and short-term changes in vegetation and geomorphic processes: the key to riparian restoration. Pages 101-110. in D. F. Potts (ed). Proceedings: Rangeland Management and Water Resources. American Water Resources Association and Society for Range Management, May 27-29, 1998, Reno, NV.

Charlet, D.A. 2007. Atlas of Nevada vegetation, volume I: Mountains. Unpublished work in progress.

Colorado State Forest Service. 2002. Colorado Wildland Urban Interface Hazard Assessment Methodology. 8 pp. Available on the Internet at: http://csfs.colostate.edu/library/pdfs/homeandland/wuiMethodology.pdf

Cruz, Miguel G, Martin E. Alexander, and Ronald H. Wakimoto. 2003. Assessing canopy fuel stratum characteristics in crown fire prone fuel types of western North America. *In:* International Journal of Wildland Fire:12, 39-50. CSIRO Publishing. Available on the Internet at: http://www.publishing.csiro.au/journals/ijwf

Davison, Jason, and Ed Smith. 1997. Greenstrips: Another Tool to Manage Wildfire. Cooperative Extension. University of Nevada – Reno. Fact Sheet-97-36. Available on the Internet at: http://www.livingwithfire.info/pdf/WEB-Greenstrips.pdf

Deeming, J., and Lancaster, J.: Fosberg, M.; Furman, R. & Schroeder, M. Compilers. 1972. National Fire Danger Rating System. USDA For. Ser. Res. Pap. RM-84.

Emmerich, F. L., F. H. Tipton, and J.A. Young. 1993. Cheatgrass: changing perspectives and management strategies. Rangelands. 15(1): 37-40. [20463] as quoted in FEIS. Available on the Internet at: http://www.fs.fed.us/database/feis/plants

EPA. Green Book. Available on the Internet at: http://www.epa.gov/oar/oaqps/greenbook.

ESRI. 2005. ArcGIS Desktop Help Documentation.

Finney, Mark A. 2003. Fire Area Simulator (FARSITE), version 4.0.3. USDA Forest Service, Fire Sciences Laboratory, in cooperation with Systems for Environmental Management, National Interagency Fire Center; USFS Region 5; and PSW Research Station. Missoula, MT 59807

Finney, Mark A. 2006. An Overview of FlamMap Fire Modeling Capabilities. In: Andrews, Patricia L., and Bret W. Butler, comps. 2006. Fuels Management-How to Measure Success: Conference Proceedings. 28-30 March 2006; Portland, OR. Proceedings RMRS-P-41. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. p. 213-220.

Finney, Mark, Stuart Brittain, and Rob Seli. 2004. FLAMMAP, version 2.0. Sponsored by: Joint Fire Sciences Program, Rocky Mountain Research Station, US Bureau of Land Management, System for Environmental Management.

Firewise Community Program. Available on the Internet at: http://www.firewise.org

FLAMMAP, 2006. FlamMap Online Help Documentation.

Graves, Douglas A. and Leon F. Neuenschwander. Crown Fire Assessment In The Urban Intermix: Modeling The Spokane, Washington Ponderosa Pine Forests. Department of Forest Resources, University of Idaho, Moscow, Idaho 83844-1133. Available on the Internet at: http://jfsp.nifc.gov/conferenceproc/T-06Gravesetal.pdf

Grunell, George E. 2001. Fire in Sierra Nevada Forests – A Photographic Interpretation of Ecological Change Since 1849. Mountain Press Publishing Company. Missoula, Montana. 238 p.

Hann, W.J. and D.L. Bunnell. 2001. Fire and land management planning and implementation across multiple scales. Int. J. Wildland Fire. 10:389-403.

Hardy, C.C., K.M. Schmidt, J.M. Menakis, and N.R. Samson. 2001. Spatial data for national fire planning and fuel management. International Journal of Wildland Fire 10:353-372.

Hardy, Colin C., Roger D. Ottmar, Janice L. Peterson, John E. Core, and Paula Seamon. 2001. Smoke Management Guide for Prescribed and Wildland Fire 2001 Edition, PMS 420-2, NFES 1279. December 2001.

Hodgson, Ronald W. 2001. Community Wildfire Preparedness Education – How to Work with Communities in the Wildland urban Interface. Draft 03/07/2001. Fire and Aviation Management, Colorado State Office –Bureau of Land management. 20 p.

Kaczmarski, Jennifer. Date unknown. Restoration Implications of *Bromus tectorum* – Infested Grasslands of the Great Basin. Available on the Internet at: http://horticulture.coafes.umn.edu/vd/h5015/00papers/kaczmarski.htm

Living With Fire – A Guide for the Homeowner
Available on the Internet at: http://www.livingwithfire.info/

National Interagency Fire Center. Interagency Standards for Fire and Fire Aviation Operations. Available on the Internet at: http://www.nifc.gov/red_book/

National Park Service (NPS). 2007. Post-Fire Aerial Application of Herbicide EA. Zion National Park. pp 17-19. Available on the Internet at: http://parkplanning.nps.gov/zion

National Park Service (NPS). 2006. Kolob Fire Rehabilitation – Aerial Application of Herbicide Environmental Assessment. Zion National Park, Utah. pp 9-12.

Natural Heritage Program. 2007. Available on the Internet at: (http://heritage.nv.gov/index.htm

Nevada Appeal 2007. Jarid Shipley, staff writer. Can it happen here? July 1, 2007. Available on the internet at:
http://www.nevadaappeal.com/article/20070701/NEWS/107010082
[Accessed 03/05/2008].

Nevada Department of Cultural Affairs, State Historic Preservation Office. Nevada State Register of Historic Places. Available on the Internet at: http://dmla.clan.lib.nv.us/DOCS/shpo/statereg.htm [Accessed 03/05/2008].

Nevada Department of Employment and Training (DENR). 2007. Available on the Internet at: http://detr.state.nv.us/ [Accessed 12/15/2007]

Nevada Small Business Development Center (NSBDC). 2007. 2006 [Population] Estimates by County. Available on the Internet at: http://www.nsbdc.org/what/data_statistics/demographer/pubs/pop_increase

Nevada State Demographer. 2006. Nevada County Population Estimates July 1, 1990 to July 1, 2006. The Nevada State Demographer's Office. Jeff Hardcastle AICP. University of NV Reno. Reno, NV. Pp 13 and 18. Available on the Internet at: http://www.nsbdc.org/what/data_statistics/demographer/pubs/docs/nvpopul06.pdf

NFPA. Fire Protection in the Wildland urban Interface. Available on the Internet at: http://www.firewise.org/resources/everyones_resp/index.html

Northeastern Nevada Stewardship Group (NNSG). 2004. Elko County Sagebrush Ecosystem Conservation Strategy. Available on the Internet at: http://www.ndow.org/wild/conservation/sg/plan/SGPlan063004_P.pdf

Pyke, David. 1982. Project Description: Intermountain Greenstripping and Rehabilitation Research Project (Project Number 70102).

Pyne, S.P. 1982. Fire in America: A Cultural History of Wildland and Rural Fire. Princeton University Press. Princeton, New Jersey. p144.

Resource Concepts, Inc. (RCI). 2004. Nevada Community Wildfire Risk/Hazard Assessment Project: Carson City. November 2004. Available on the Internet at: http://www.rci-nv.com [Accessed 03/04/2008].

Rollins, M. Date unknown. Lightning and Fire Occurrence in Two, Large Rocky Mountain Wilderness Complexes, Final Report. unpublished paper. Available on the Internet at: http://www.firelab.org/old/fep/research/mrollins/intro.htm),

Romme, W., C. Allen, J. Bailey, W. Baker, B. Bestelmeyer, P. Brown, K Eisenhart, L. Floyd-Hanna, D. Huffman, B. Jacobs, R. Miller, E. Muldavin, T. Swetnam, R. Tausch and P. Weisberg. 2007. Historical and Modern Disturbance Regimes of Piñon-Juniper Vegetation in the Western U.S.

Ronayne, Diane. Date unknown. Birds on the Brink – Weed invasion threatens golden eagles and prairie falcons in the Snake River Birds of Prey National Conservation Area. Available on the Internet at: http://www.id.blm.gov/features/birds_brink/index.htm

Rothermel, R.C. 1983. How to predict the spread and intensity of forest and range fires. USDA For. Serv. Gen. Tech. Rep. INT-143

Rothermel, R.C. 1991. Predicting behavior and size of crown fires in the northern Rocky Mountains. USDA For. Serv. Gen. Tech. Rep. INT-438

Roundy, Bruce A.; McArthur, E. Durant; Haley, Jennifer S.; Mann, David K., comps. 1995. Proceedings: wildland shrub and arid land restoration symposium; 1993 October 19-21; Las Vegas, NV. Gen. Tech. Rep. INT-GTR-315. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station. 384p.

Schindler, Bruce, and Julie Neburka. 1997. Public Participation in Forest Planning – 8 Attributes of Success. Reprinted from The Journal of Forestry, Vol. 95, No.1, January 1997. pp.17-19.

Schmidt, K.M., J.P. Menakis, C.C. Hardy, W.J. Hann, and D.L. Bunnell. 2002. Development of coarse-scale spatial data for wildland fire and fuel management. General Technical Report, RMRS-GTR-87, U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fort Collins, CO.

Shaffer, Sandy, and Jack Shipley. 2002. Diana Coogle, Ed. Balancing Act—Living with Fire in the Applegate, Applegate Community's Collaborative Fire Protection Strategy. Applegate Partnership. Applegate, Oregon.

Sloan, Jenna (Ed). 2006. Smith Valley Thinning Project Helps Protect Expanding Wildland urban Interface Areas. BLM Snapshots. October 6, 2006. pp 2-4.

Skinner, Carl N., and Chi-Ru Chang. 1996. Fire Regimes, Past and Present. In: Sierra Nevada Ecosystem Project: Final report to Congress, vol. II, Assessments and scientific basis for management options. Davis: University of California, Centers for Water and Wildland Resources, 1996.

Society of American Foresters. 2004. (Sponsor) Preparing a Community Wildfire Protection Plan: A handbook for Wildland urban Interface communities. Available on the Internet at: www.safnet.org/policyandpress/cwpp.cfm

Tausch, R. J. 1999. Historic pinyon and juniper woodland development. Pages 12-19. in S. B. Monson and R. Stevens, comp. Proceedings: Ecology and Management of Pinyon-Juniper Communities within the Interior West. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO. RMRS-P-9.

Tausch, R. J., J. C. Chambers, R. R. Blank, and R. S. Nowak. 1995. Differential establishment of perennial grass and cheatgrass following fire on an ungrazed sagebrush/juniper site. Pages 252-257, in B. A. Roundy, E. D. McArthur, J. S. Haley and D. K. Mann (compilers). Symposium on Wildland Shrub and Arid Land Restoration.

Tausch, R., R. Miller, and S. Goodrich. 1999. Proceedings: ecology and management of pinyon-juniper communities within the interior west. 1997 Sept. 15-18, Provo, UT. Proceedings RMRS-P-9, Ogden, UT: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, 361-365

Tausch, Robin J., and R. S. Nowak. 1999. Fifty years of ecotone change between shrub and tree dominance in the Jack Springs pinyon research natural area. In: McArthur, E. D., Ostler, W.K., Wamboldt, C.L. Comps. 1999. Proceedings: Shrubland Ecotones. 1998 August 12-14, Ephraim, UT. Proceedings RMRS-P-11 pp. 71-77.

Theobald, D.M., and M. Kneeland. 2002. Mapping Housing Density for Prioritization of Urban/Forest Wildfire Hazards in Colorado, Natural Resource Ecology Lab, Colorado State University, unpublished paper.

Tuellerm, Paul T, Dick Post, and Erin Noonan. 2002. Mapping Ecosystems along Nevada Highways and the Development of Specification for Vegetation Remediation. Nevada Department of Transportation. Reno, NV. Pages 47 and 86. Available on the Internet at: http://www.nevadadot.com/pub_involvement/landscape/pdfs/RevegFnlReport.pdf USDI/

USDA Forest Service. 2006. Protecting People and Natural Resources – A Cohesive Fuels Treatment Strategy. February 2006. 25 p

USDA Forest Service. 2004. Forest Insect and Disease Conditions in Nevada. R4-OFO-TR-06-04. Available on the Internet at: http://www.fs.fed.us/r1-r4/spf/fhp/conditions/2004_NV_Conditions_Report.pdf [Accessed 03/05/2008]

USDA Forest Service. 2004. The Healthy Forests Initiative and Healthy Forest Restoration Act – An Interim Field Guide FS-99. USDA Forest Service. Missoula Technology and Development Center. February 2004. Available on the Internet at: http://www.fs.fed.us/projects/hfi/fieldguide.web [Accessed 10/22/2007]

USDA Forest Service. 2002. Rocky Mountain Research Station, Fire Sciences Laboratory. Fire Effects Information System. Available on the Internet at: http://www.fs.fed.us/database/feis/index.html

USDA Forest Service. HFI/HFRA Field Guide. 2004. Available on the Internet at http://www.fs.fed.us/projects/hfi/field-guide/

USDI/USDA Forest Service. 2006. Protecting People and Natural Resources – A Cohesive Fuels Treatment Strategy. Available on the Internet at: http://www.healthyforests.gov/CFTS_03-03-06.pdf

USDI/USDA Forest Service. 2004. Interagency Standards for Fire and Fire Aviation Operations 2004, NFES 2724

USDI/USDA Forest Service. 2001. Review and Update of the 1995 Federal Wildland Fire Management Policy, January 2001. Available on the Internet at: http://www.nifc.gov/fire_policy/index.htm

USDI/USDA Forest Service. 2000. National Fire Plan. Available on the Internet at: http://www.fireplan.gov/

USDI/USDA. 1995. Federal Wildland Fire Management Policy and Program Review. Final Report. National Interagency Fire Center. Boise, ID. 45 p.

van Wagtendonk, J.W. 2004. Fire and Landscapes: Patterns and Processes, USDA Forest Service General Technical Report RSW-GTR-193.

Zimmerman, G., and D. Bunnell. 1998. Wildland and Prescribed Management Policy – Implementation Procedures Reference Guide. National Interagency Fire Center. Boise, Idaho.

Prepared by

**WILDLAND FIRE ASSOCIATES**
2016 Saint Clair Ave.
Brentwood, MO 63149
Telephone: 303.229.4470

April 21, 2008

# APPENDIX A

# GLOSSARY OF WILDLAND FIRE TERMINOLOGY

# Glossary
# Of
# Wildland
# Fire Terminology

# (Abridged)

Prepared by

National Wildfire Coordinating Group
Incident Operations Standards Working Team

November 1996

Sponsored for NWCG publication by the Incident Operations Standards Working Team, November 1996.
Additional copies of this publication may be ordered from: National Interagency Fire Center, Great Basin Cache Supply Office, 3833 S. Development Ave., Boise, Idaho. Order: NFES #1832.

## Reference Definitions

Some of the terms within this glossary will have references or comments at the end of the definition to help broaden the understanding of the term. An explanation of those references is as follows:

Syn., means the term is synonymous with another, meaning it is the same, alike or similar.
See also, means that there are related terms that the user might also want to consult.
Also called, means there are sometimes other names used for the item or topic, which are not listed in this glossary.

---

# - *A* -

ABSOLUTE HUMIDITY: Total amount of water vapor in the air.

ACCELERANT: Any substance applied to fuel to expedite the burning process.

ACCEPTABLE BURN: Maximum average area burned over a specified period of years that is considered an acceptable loss for a specified area under organized fire suppression. (Syn. ALLOWABLE BURNED AREA)

ACCEPTABLE DAMAGE: Damage which does not seriously impair the flow of economic and social benefits from wildlands.

ACCEPTABLE FIRE RISK: The potential fire loss a community is willing to accept rather than provide resources to reduce such losses.

ACTION PLAN: Any tactical plan developed by any element of ICS in support of the incident action plan. (see also INCIDENT ACTION PLAN)

ACTIONABLE FIRE: Any fire that requires suppression, especially a fire started or allowed to spread in violation of law, ordinance, or regulation.

ACTIVE CROWN FIRE: A fire in which a solid flame develops in the crowns of trees, but the surface and crown phases advance as a linked unit dependent on each other.

ACTIVE FIRE: Any wildfire on which suppression action has not reached an extensive mopup stage. (Syn. GOING FIRE)

ACTIVITY FUELS: Fuels resulting from, or altered by, forestry practices such as timber harvest or thinning, as opposed to naturally created fuels.

AGENCY: An agency is a division of government with a specific function, or a non- governmental organization (e.g., private contractor, business, etc.) that offers a particular kind of assistance. In ICS, agencies are defined as jurisdictional (having statutory responsibility for incident mitigation), or assisting and/or cooperating (providing resources and/or assistance). (see also SUPPORTING AGENCY, and COOPERATING AGENCY)

AGENCY/AREA COORDINATION CENTER: A facility which serves as a central point for one or more agencies to use in processing information and resource requests. It may also serve as a dispatch center for one of the agencies.

AGENCY EXECUTIVE OR ADMINISTRATOR: Line officer (or designee) of the agency or jurisdiction that has responsibility for the incident. These usually include; NPS Park Superintendent, BIA Agency Superintendent, USFS Forest Supervisor, BLM District Manager, FWS Refuge Manager, State Forest Officer, Fire Chief.

AIR CONTAMINANT: An airborne dust, fume, gas, mist, odor, smoke, vapor, soot, pollen, carbon, acid or particulate matter or any combination thereof.

AIR MASS: An extensive body of air having the same properties of temperature and moisture in a horizontal plane.

AIR POLLUTION: The general term referring to the undesirable addition of substances (gases, liquids, or solid particles) to the atmosphere that are foreign to the natural atmosphere or are present in quantities exceeding natural concentrations.

AIR POLLUTION ALERT: A statement issued by an Air Quality Regulatory Agency due to high measured concentrations of pollutants. The alert remains in effect until monitoring shows a
decrease in pollutant levels. Should conditions worsen, air pollution warnings and emergencies may be issued. At each stage (alert, warning and emergency) additional emission restrictions are put into effect so as to not intensify the situation. Essentially, at the emergency level all industrial activities and auto usage stop.

AIR QUALITY: The composition of air with respect to quantities of pollution therein; used most frequently in connection with "standards" of maximum acceptable pollutant concentrations. Used instead of "air pollution" when referring to programs.

AIR QUALITY CONTROL REGION: A primary air quality administrative area, designated in accordance with the provisions of the 1970 Clean Air Act, on the basis of geographical and meteorological considerations.

AIR QUALITY MAINTENANCE AREA(AQMA): An area that has been identified by an Air Quality Regulatory Agency to have the potential for exceeding any federal or state ambient air quality standard due to projected growth and development.

AIR QUALITY MODEL: Mathematical or quantitative representation or simulation of air quality processes; e.g., emission models, receptor models, or air quality dispersion models.

AIR STAGNATION ADVISORY (ASA): A statement issued by a National Weather Service forecast office when atmospheric conditions are stable enough such that the potential exists for air pollutants to accumulate in a given area. The statement is initially issued when conditions are expected to last for at least 36 hours.

AIR TANKER: Fixed-wing aircraft certified by FAA as being capable of transport and delivery of fire retardant solutions.

AIR TRANSPORTABLE MODULAR UNIT (ATMU): A weather data collection and forecasting facility consisting of four modules, weighing a total of 282 pounds and occupying 27.1 cubic feet of space when transported. Used by incident meteorologists on an incident. (see also INCIDENT METEOROLOGIST and MICRO-REMOTE ENVIRONMENTAL MONITORING SYSTEM)

AIRBORNE PARTICULATES: Total suspended particulate matter found in the atmosphere as solid particles or liquid droplets. Chemical composition of particulates varies widely, depending on location and time of year. Airborne particulates include: windblown dust, emissions from industrial processes, smoke from the burning of wood and coal, and the exhaust of motor vehicles.

ALL TERRAIN VEHICLE (ATV): Any motorized vehicle designed for or capable of cross-country travel on or immediately over land, water, sand, snow, ice, marsh, swampland, or other terrain. (Syn. OFF-ROAD VEHICLE)

ALLOWABLE BURNED AREA: Maximum average area burned over a specified period of years that is considered an acceptable loss for a specified area under organized fire suppression. (Syn. ACCEPTABLE BURN)

AMBIENT AIR: Air of the surrounding environment.

ANCHOR POINT: An advantageous location, usually a barrier to fire spread, from which to start constructing a fireline. The anchor point is used to minimize the chance of being flanked by the fire while the line is being constructed.

ANEMOMETER: An instrument designed to measure wind speed.

ANNUAL: A plant completing its life cycle in a year or less.

ANTICYCLONE: An area of high atmospheric pressure with closed clockwise circulation. (see also SURFACE HIGH, HIGH PRESSURE RIDGE)

APPROVED: In fire service terminology, that which is inspected and listed by recognized fire-testing agencies. The term as used in National Fire Protection Association standards means approval by the authority having jurisdiction, such as the fire chief, insurance inspection department, or other agency that enforces standards or regulations.

ARAMID: The generic name for a high-strength, flame-resistant, synthetic fabric used in the shirts and jeans of firefighters. Nomex®, a brand name for aramid fabric, is the term commonly used by firefighters.

AREA IGNITION: Ignition of several individual fires throughout an area, either simultaneously or in rapid succession**,** and so spaced that they add to and influence the main body of the fire to produce a hot, fast-spreading fire condition. Also called simultaneous ignition.

AREA SOURCE: A source category of air pollution that generally extends over a large area. Prescribed burning, field burning, home heating, and open burning are examples of area sources.

ARSON FIRE: A wildfire willfully ignited by anyone to burn, or spread to, vegetation or property without consent of the owner or his/her agent. (Syn. INCENDIARY FIRE)

ASPECT: Cardinal direction toward which a slope faces. (see also EXPOSURE)

ASSISTING AGENCY: An agency directly contributing tactical or service resources to another agency. (see also AGENCY, COOPERATING AGENCY, and SUPPORTING AGENCY)

ATMOMETER: An instrument that provides an approximate measure of evapotranspiration by measuring the water loss from an artificial evaporating surface.

ATMOSPHERIC INVERSION: (1) Departure from the usual increase or decrease with altitude of the value of an atmospheric property (in fire management usage, nearly always refers to an increase in temperature with increasing height). (2) The layer through which this departure occurs (also called inversion layer). The lowest altitude at which the departure is found is called the base of the inversion. (see also INVERSION, ATMOSPHERIC STABILITY, and STABLE LAYER OF AIR)

ATMOSPHERIC PRESSURE: The force exerted by the weight of the atmosphere, per unit area.

ATMOSPHERIC STABILITY: The degree to which vertical motion in the atmosphere is enhanced or suppressed. Vertical motions and pollution dispersion are enhanced in an unstable atmosphere. Thunderstorms and active fire conditions are common in unstable atmospheric conditions. Stability suppresses vertical motion and limits pollution dispersion. (see also INVERSION, ATMOSPHERIC INVERSION, and STABLE LAYER OF AIR)

ATTACK A FIRE: Limit the spread of fire by any appropriate means.

ATTAINMENT AREA: An area considered to have air quality as good as, or better than, the National Ambient Air Quality Standards (NAAQS) as defined in the Clean Air Act.

AUTOMATIC LIGHTNING DETECTION SYSTEM (ALDS): An electronic system that detects cloud-to-ground lightning strikes by their electrical discharges and plots their locations.

AVAILABLE FUEL: (1) That portion of the total fuel that would actually burn under various environmental conditions. (2) Fuel available for use in a motor vehicle, aircraft, or other motorized equipment.

AVAILABLE FUEL ENERGY: Amount of heat released per unit area when the available fuel burns, often expressed in Btu's per square foot.

AVAILABLE RESOURCES: Resources assigned to an incident and available for assignment. (see also ALLOCATED RESOURCES, ASSIGNED RESOURCES)

AVERAGE RELATIVE HUMIDITY: Part of the National Fire Danger Rating System (NFDRS). The mathematical average of the maximum and minimum relative humidities measured at a fire weather station from one basic observation time to the next.

AVERAGE TEMPERATURE: The mathematical average of the maximum and minimum dry-bulb temperatures measured at a fire weather station from one basic observation time to the next.

AVERAGE WORST DAY: Average fire danger of the highest 15% of the days occurring in the average worst year.

AVERAGE WORST YEAR: Third worst fire season in the last ten, as determined by the sum of daily danger or burning indices during the regularly declared fire season; use the same number of days each year to determine these totals.

AVOIDANCE: A smoke emission control strategy that considers meteorological conditions when scheduling prescribed fires in order to avoid incursions into smoke sensitive areas.

AZIMUTH: Horizontal angle or bearing of a point measured clockwise from true (astronomic) north.

AZIMUTH CIRCLE: A circle graduated in 360 degrees in a clockwise direction from true (astronomic) north.

# - B -

BACK AZIMUTH: Angle or bearing 180 degrees opposite of azimuth.

BACKBURN: Used in some localities to specify fire set to spread against the wind in prescribed burning.

BACKDRAFT: Instantaneous explosion or rapid burning of superheated gases that occurs when oxygen is introduced into an oxygen-depleted confined space. It may occur because of inadequate or improper ventilation procedures.

BACKFIRE: A fire set along the inner edge of a fireline to consume the fuel in the path of a wildfire and/or change the direction of force of the fire's convection column. (see also BURN OUT)

BACKFIRING: A tactic associated with indirect attack, intentionally setting fire to fuels inside the control line to slow, knock down, or contain a rapidly spreading fire. Backfiring provides a wide defense perimeter and may be further employed to hange the force of the convection column. Backfiring makes possible a strategy of locating control lines at places where the fire can be fought on the firefighter's terms. Except for rare circumstance meeting specified criteria, backfiring is executed on a command decision made through line channels of authority.

BACKGROUND LEVEL: In air pollution control, the concentration of air pollutants in a definite area during a fixed period of time prior to the starting up, or the stoppage, of a source of emission under control. In toxic substances monitoring, the average presence in the environment, originally referring to naturally-occurring phenomena.

BACKING FIRE: Fire spreading, or ignited to spread, into (against) the wind or downslope. A fire spreading on level ground in the absence of wind is a backing fire.

BAMBI BUCKET ®: A collapsible bucket slung below a helicopter. Used to dip water from a variety of sources for fire suppression.

BAROMETER: An instrument for measuring the pressure of the atmosphere. The two principal types are the mercurial and the aneroid.

BARRIER: Any obstruction to the spread of fire. Typically an area or strip devoid of combustible fuel.

BASE: (1) The location at which primary logistics functions for an incident are coordinated and administered. There is only one base per incident. (Incident name or other designator will be added to the term "base.") The incident command post may be collocated with the base. (2) The location of initial attack forces. (see also CAMP)

BASE AREA: Part of the National Fire Danger Rating System (NFDRS). An area representative of the major fire problems on a protection unit. Base fuel model and slope class are chosen from the base area.

BASE FUEL MODEL: Part of the National Fire Danger Rating System (NFDRS). A representation of the vegetative cover and fuel in a base area. Used in the calculation of fire danger rating.

BEARING: The horizontal direction to or from any point, usually measured clockwise from true north, or some other reference point through 360 degrees.

BEAUFORT WIND SCALE: A system of estimating and reporting wind speeds. In its present form for international meteorological use it equates (a) Beaufort force (or Beaufort number), (b) wind speed, (c) descriptive term, and (d) visible effects upon land objects or sea surface.

BEHAVE: A system of interactive computer programs for modeling fuel and fire behavior, comprised of two systems: BURN and FUEL.

BELT WEATHER KIT: Belt-mounted case with pockets fitted for anemometer, compass, sling psychrometer, slide rule, water bottle, pencils, and book of weather report forms. Used to take weather observations to provide on-site conditions to the fire weather forecaster or fire behavior analyst. Observations include air temperature, wind speed and direction, and relative humidity.

BERM: A ridge of soil and debris along the outside edge of a fireline, resulting from line construction. (see also THROW OUT)

BEST AVAILABLE CONTROL MEASURES (BACM): Control measures to be developed by Environmental Protection Agency (EPA) which apply to residential wood combustion, fugitive dust, and prescribed and silvicultural burning in "serious" PM-10 non-attainment areas. BACM is more stringent than RACM. Final guidance on BACM is still being developed.

BEST AVAILABLE CONTROL TECHNOLOGY (BACT): An emission limitation based on the maximum degree of emission reduction which (considering energy, environmental, and economic impacts, and other costs) is achievable through application of production processes and available methods, systems, and techniques. In no event does BACT permit emissions in excess of those allowed under any applicable Clean Air Act provisions. Use of the BACT concept is allowable on a case-by-case basis for major new or modified emissions sources in attainment areas and applies to each regulated pollutant.

BIOLOGICAL SEVERITY: The degree of biological impact of a fire on various biotic ecosystem components.

BLACKLINE: Preburning of fuels adjacent to a control line before igniting a prescribed burn. Blacklining is usually done in heavy fuels adjacent to a control line during periods of low fire danger to reduce heat on holding crews and lessen chances for spotting across control line. In fire suppression, a blackline denotes a condition where there is no unburned material between the fireline and the fire edge.

BLOW DOWN: An area of previously standing timber which has been blown over by strong winds or storms.

BLOWUP: Sudden increase in fireline intensity or rate of spread of a fire sufficient to preclude direct control or to upset existing suppression plans. Often accompanied by violent convection and may have other characteristics of a fire storm. (see also EXTREME FIRE BEHAVIOR, FIRE STORM and FLARE-UP)

BOARD OF REVIEW: A board or committee selected to review results of fire suppression action on a given unit or the specific action taken on a given fire in order to identify reasons for both good and poor action and to recommend or prescribe ways and means of doing a more effective and efficient job. Reviews the results of a safety/accident investigation.

BOILING LIQUID EXPANDING VAPOR EXPLOSION (BLEVE): (1) The failure of a closed container as a result of over pressurization caused by an external heat source. (2) A major failure of a closed liquid container into two or more pieces when the temperature of the liquid is well above its boiling point at normal atmospheric pressure.

BOLE: The trunk of a tree.

BOUNDARY CONDITIONS: The temperature and relative humidity of the boundary layer.

BOUNDARY LAYER: The air in immediate contact with a fuel particle.

BOUNDARY VALUE: The equilibrium moisture content (EMC) commensurate with the boundary conditions and precipitation events of the preceding 24 hours.

BOX CANYON: A steep-sided, dead end canyon.

BRANCH: The organizational level having functional or geographical responsibility for major parts of incident operations. The branch level is organizationally between section and division/group in the operations section, and between section and unit in the logistics section. Branches are identified by roman numerals or by functional name (e.g. service, support).

BRITISH THERMAL UNIT (BTU): Amount of heat required to raise 1 pound of water 1 degree Fahrenheit (from 59.5 to 60.5 F), measured at standard atmospheric pressure.

BROADCAST BURNING: Intentional burning within well defined boundaries for reduction of fuel hazard, as a resource management treatment, or both.

BROWN AND BURN: Application of herbicide to desiccate living vegetation prior to burning.

BROWNSPOT CONTROL: Prescribed fire to control fungal infection (brown spot disease) of longleaf pine (Pinus palustris) in the "grass" (small seedling) stage.

BRUSH: A collective term that refers to stands of vegetation dominated by shrubby, woody plants, or low growing trees, usually of a type undesirable for livestock or timber management.

BRUSH BLADE: Blade attachment with long teeth specially suited to ripping and piling brush with minimum inclusion of soil. Also called brush rake or root rake.

BRUSH FIRE: A fire burning in vegetation that is predominantly shrubs, brush, and scrub growth.

BRUSH MANAGEMENT: Manipulation of stands of brush by manual, mechanical, chemical, or biological means or by prescribed burning for the purpose of achieving land management objectives.

BUCKET DROPS: The dropping of fire retardants or suppressants from specially designed buckets slung below a helicopter.

BUCKING: Sawing through the bole of a tree after it has been felled.

BUILD-UP: (1) The cumulative effects of long-term drying on current fire danger. (2) The increase in strength of a fire management organization. (3) The accelerated spreading of a fire with time. (4) Towering cumulus clouds which may lead to thunderstorms later in the day.

BUILDUP INDEX (BUI): A relative measure of the cumulative effect of daily drying factors and precipitation on fuels with a ten-day timelag.

BULK DENSITY: Weight per unit volume. For fuels, this is usually expressed as pounds per cubic foot; for soils, grams per cubic centimeter.

BURN: (1) An area burned over by wildland fire. (2) A reference to a working fire. (3) An injury to flesh caused by a cauterizing agent, heat from a fire, or a heated object. a) First Degree Burn: A burn which causes only pain, redness, and swelling. b) Second Degree Burn: A burn in which the skin is blistered. c) Third Degree Burn: A flesh burn in which charring occurs.

BURN BOSS: Person responsible for supervising a prescribed fire from ignition through mopup.

BURN SEVERITY: A qualitative assessment of the heat pulse directed toward the ground during a fire. Burn severity relates to soil heating, large fuel and duff consumption, consumption of the litter and organic layer beneath trees and isolated shrubs, and mortality of buried plant parts.

BURN OUT: Setting fire inside a control line to consume fuel between the edge of the fire and the control line. (see also BACKFIRE)

BURN OUT TIME: The duration of flaming and smoldering combustion phases at a specified point within a burn or for the whole burn, expressed in convenient units of time.

BURNING BAN: A declared ban on open air burning within a specified area, usually due to sustained high fire danger.

BURNING BLOCK: In prescribed burning, an area having sufficiently uniform conditions of stand and fuel to be treated uniformly under a given burning prescription. NOTE: The size ranges from the smallest that allows an economically acceptable cost per acre, up to the largest that can conveniently be treated in one burning period. (see also BLOCK PLAN)

BURNING CONDITIONS: The state of the combined factors of the environment that affect fire behavior in a specified fuel type.

BURNING INDEX: An estimate of the potential difficulty of fire containment as it relates to the flamelength at the head of the fire. A relative number related to the contribution that fire behavior makes to the amount or effort needed to contain a fire in a specified fuel type. Doubling the burning index indicates that twice the effort will be required to contain a fire in that fuel type as was previously required, providing all other parameters are held constant.

BURNING PERIOD: That part of each 24-hour period when fires spread most rapidly; typically from 10:00 AM to sundown.

BURNING PRIORITY RATING: System of rating slash to indicate the treatment objective, whether or not burning is required to meet that objective, the fuel treatment necessary to achieve successful burning, and the time of year burning should occur.

BURNING ROTATION: The planned number of years between prescribed fires on a specified area.

BURNING-INDEX METER: A device used to determine the burning index for different combinations of burning-index factors.

BURN PATTERNS: The characteristic configuration of char left by a fire; in wildland fires burn patterns are influenced by topography, wind direction, length of exposure, and type of fuel. They can be used to trace a fire's origin.

# - C -

CACHE: A pre-determined complement of tools, equipment and/or supplies stored in a designated location, available for incident use.

CALCULATION OF PROBABILITIES: Evaluation of all factors pertinent to probable future behavior of a going fire and of the potential ability of available forces to perform fire suppression operations on a specified time schedule.

CALIBRATED AIRSPEED: Indicated airspeed of an aircraft, corrected for position and instrument error. Equal to true airspeed in standard atmosphere at sea level.

CANOPY: The stratum containing the crowns of the tallest vegetation present, (living or dead) usually above 20 feet.

CARBON DIOXIDE (CO): A colorless, odorless, nonpoisonous gas, which results from fuel combustion and is normally a part of the ambient air.

CARBON MONOXIDE (CO): A colorless, odorless, poisonous gas produced by incomplete fuel combustion.

CARCINOGEN: Any substance that can cause or contribute to the production of cancer.

CARDINAL DIRECTIONS: North, south, east, west; used for giving directions and information from the ground or air in describing the fire (e.g., the west flank or east flank, not right flank or left flank).

CASUALS: Emergency firefighters employed to cope with a sudden and unexpected fire-caused emergency, or potential for extreme fire behavior, which threatens damage to property under public management. (see also EMERGENCY FIREFIGHTER)

CATEGORY DAY: A numerical index related to the ability of the atmosphere to disperse smoke. Different agencies use different scales [e.g., in South Carolina, the current scale is based on ventilation factor and ranges from 1 (poor) to 5 (excellent)].

CATFACE: Defect on the surface of a tree resulting from a wound where healing has not reestablished the normal cross-section.

CEILING: (1) Height above the earth's surface of the lowest layer of clouds or obscuring phenomena aloft that is not classified as a thin layer or partial obscuration, that together with all lower clouds or obscuring phenomena covers more than half the sky as detected from the point of observation. (2) Maximum height of a temporary flight restriction (TFR).

CELSIUS: A temperature scale with 0 as the freezing point of water and 100 as the boiling point of water at sea level.

CENTER FIRING: Method of broadcast burning in which fire is ignited in the center of the area to create a strong draft; additional fires are then ignited progressively nearer the outer control lines (sometimes in one step) as indraft increases so as to draw the flames and smoke toward the center.

CHAIN: Unit of measure in land survey, equal to 66 feet (20 M) (80 chains equal 1 mile). Commonly used to report fire perimeters and other fireline distances, this unit is popular in fire management because of its convenience in calculating acreage (e.g., 10 square chains equal one acre).

CHAIN OF COMMAND: A series of management positions in order of authority.

CHAR: (1) A charred substance or charred remains. (2) In fire simulation, a darkened area within the fire perimeter; usually indicates fire has already passed through; usually created by an opaque material blocking out a selected portion of basic scene illumination.

CHECK LINE: A temporary fireline constructed at right angles to the control line and used to hold a backfire in check as a means of regulating the heat or intensity of the backfire.

CHEVRON BURN: Burning technique in which lines of fire are started simultaneously from the apex of a ridge point, and progress downhill, maintaining position along the contour; used in hilly areas to ignite ridge points or ridge ends.

CHIEF: The ICS title for individuals responsible for command of functional sections: operations, planning, logistics and finance/administration.

CHIEF OF PARTY: The chief of party is responsible to the sending unit dispatcher until destination is reached. Chief of party is responsible for all traveling personnel assigned on the manifest list.

CIRRUS: A form of high cloud, composed of ice crystals, which seldom obscures the sun.

CLASS 1 AREA (AIR QUALITY): Geographic areas designed by the Clean Air Act where only a very small amount or increment of air quality deterioration is permissible.

CLASS II AREAS (AIR QUALITY): All areas of the country not designated Class I. A greater amount of air pollution can be added to these areas than Class I.

CLASS A FOAM: Foam intended for use on Class A or woody fuels; made from hydrocarbon-based surfactant, therefore lacking the strong filming properties of Class B foam, but possessing excellent wetting properties.

CLASS B FOAM: Foam designed for use on Class B or flammable liquid fires; made from fluorocarbon-based surfactants, therefore capable of strong filming action, but incapable of efficient wetting of Class A fuels.

CLASS OF FIRE (As to kind of fire for purpose of using proper extinguisher):

Class A - Fires involving ordinary combustible materials (such as wood, cloth, paper, rubber, and many plastics) requiring the heat absorbing (cooling) effects of water, water solutions, or the coating effects of certain dry chemicals, which retard combustion.

Class B - Fires involving flammable or combustible liquids, flammable gases, greases, and similar materials where extinguishment is most readily secured by excluding air (oxygen), inhibiting the release of combustible vapors, or interrupting the combustion chain reaction.

Class C - Fires involving live electrical equipment where safety to the operator requires the use of electrically nonconductive extinguishing agents.

Class D - Fires involving certain combustible metals (such as magnesium, titanium, zirconium, sodium, potassium, etc.) requiring a heat absorbing extinguishing medium not reactive with burning metals. (see also SIZE CLASS OF FIRE)

CLEAN AIR ACT: A federal law enacted to ensure that air quality standards are attained and maintained. Initially passed by Congress in 1963, it has been amended several times.

CLEAN BURN: Any fire, whether deliberately set or accidental, that destroys all aboveground vegetation and litter, along with the lighter slash exposing the mineral soil.

CLEAR TEXT: The use of plain English in radio communications transmissions. No Ten Codes or agency specific codes are used when using Clear Text.

CLEARING INDEX: A derived value used to indicate smoke dispersal. Formula uses the depth of the mixing layer multiplied by the average wind speed for that layer, divided by 100.

CLIMATE: The prevalent or characteristic meteorological conditions of any place or region, and their extremes.
on a fire by referring to clock directions from the aircraft's present location, with the nose of the aircraft pointing at 12:00.

CLOSED AREA: An area in which specified activities or entry are temporarily restricted to reduce risk of human-caused fires.

CLOSURE: Legal restriction, but not necessarily elimination, of specified activities such as smoking, camping, or entry that might cause fires in a given area.

CLOUD: A visible cluster of minute water/ice particles in the atmosphere.

CLOUDY: Adjective class representing the degree to which the sky is obscured by clouds. In weather forecast terminology, expected cloud cover of about 0.7 or more warrants use of this term. In the National Fire Danger Rating System, 0.6 or more cloud cover is termed "cloudy."

COLD FRONT: The leading edge of a relatively cold air mass which displaces and may cause warmer air to rise. If the lifted air contains enough moisture, cloudiness, precipitation and even thunderstorms may result. As fronts move through a region, in the Northern Hemisphere, the winds at a given location will experience a marked shift in direction. Ahead of an approaching cold front, winds will usually shift gradually from southeast to south, and on to southwest. As a cold front passes, winds shift rapidly to west, then northwest. Typical cold front windspeeds range between 15 and 30 mph but can be much higher.

COLD TRAILING: A method of controlling a partly dead fire edge by carefully inspecting and feeling with the hand for heat to detect any fire, digging out every live spot, and trenching any live edge.

COLONIZER: Species of vegetation that establish on a burned (or otherwise denuded) site from seed.

COMBUSTION: The rapid oxidation of fuel in which heat and usually flame are produced. Combustion can be divided into four phases: preignition, flaming, smoldering, and glowing.

COMBUSTION EFFICIENCY: The relative amount of time a fire burns in the flaming phase of combustion, as compared to smoldering combustion. A ratio of the amount of fuel that is consumed in flaming combustion compared to the amount of fuel consumed during the smoldering phase, in which more of the fuel material is emitted as smoke particles because it is not turned into carbon dioxide and water.

COMBUSTION PERIOD: Total time required for a specified fuel component to be completely consumed.

COMBUSTION RATE: Rate of heat release per unit of burning area per unit of time. (see also REACTION INTENSITY)

COMMAND: The act of directing, and/or controlling resources by virtue of explicit legal, agency, or delegated authority.

COMMAND STAFF: The command staff consists of the information officer, safety officer and liaison officer. They report directly to the incident commander and may have an assistant or assistants, as needed.

COMMERCIAL FOREST LAND: Land that is producing, or is capable of producing, crops of industrial wood and is not withdrawn from timber use by statute or administrative regulation.

COMPACTNESS: Spacing between fuel particles.

COMPACTS: Formal working agreements among agencies to obtain mutual aid.

COMPANY: Any piece of (fire) equipment having a full complement of personnel.

COMPASS ROSE: A circle, graduated in degrees, printed on some charts or marked on the ground at an airport or heliport. It is used as a reference to either true or magnetic direction.

COMPLEX: Two or more individual incidents located in the same general area which are assigned to a single incident commander or unified command.

COMPRESSED AIR FOAM SYSTEMS (CAFS): A generic term used to describe foam systems consisting of an air compressor (or air source), a water pump, and foam solution.

CONDENSATION: The process by which a gas becomes a liquid.

CONDITION OF VEGETATION: Stage of growth or degree of flammability of vegetation that forms part of a fuel complex. Herbaceous stage is at times used when referring to herbaceous vegetation alone. In grass areas minimum qualitative distinctions for stages of annual growth are usually green, curing, and dry or cured.

CONDUCTION: Heat transfer through a solid material from a region of higher temperature to a region of lower temperature.

CONFINE A FIRE: The least aggressive wildfire suppression strategy, typically allowing the wildland fire to burn itself out within determined natural or existing boundaries such as rocky ridges, streams, and possibly roads.

CONFLAGRATION: A raging, destructive fire. Often used to connote such a fire with a moving front as distinguished from a fire storm.

CONFLAGRATION THREAT: Likelihood that a wildfire capable of causing considerable damage will occur.

CONSTANT DANGER: Resultant of all fire danger factors that are relatively unchanging in a specific area (e.g., resource values at risk, topography, fuel type, exposure to prevailing wind).

CONSUMPTION: The amount of a specified fuel type or strata that is removed through the fire process, often expressed as a percentage of the preburn weight.

CONTAIN A FIRE: A moderately aggressive wildfire suppression strategy which can reasonably be expected to keep the fire within established boundaries of constructed firelines under prevailing conditions.

CONTAINMENT: (1) Completion of a control line around a fire and any associated spot fires which can reasonably be expected to stop the fire's spread. (2) The act of controlling hazardous spilled or leaking materials.

CONTINENTAL CLIMATE: Climate that is characteristic of the interior of a land mass of continental size, marked by large annual diurnal and day-to-day ranges of temperature, low relative humidity and irregular precipitation.

CONTOUR MAP: A map having lines of equal elevation that represent the land surface,(Topographic).

CONTROL A FIRE: To complete control line around a fire, any spot fire therefrom, and any interior island to be saved; burn out any unburned area adjacent to the fire side of the control lines, and cool down all hot spots that are immediate threats to the control line, until the lines can reasonably be expected to hold under foreseeable conditions. (Syn. CONTROLLED)

CONTROL FORCE: Personnel and equipment used to control a fire.

CONTROLLED: The completion of control line around a fire, any spot fires therefrom, and any interior islands to be saved; burned out any unburned area adjacent to the fire side of the control lines; and cool down all hot spots that are immediate

threats to the control line, until the lines can reasonably be expected to hold under the foreseeable conditions. (Syn. CONTROL A FIRE)

CONTROL LINE: An inclusive term for all constructed or natural barriers and treated fire edges used to control a fire.

CONVECTION: (1) The transfer of heat by the movement of a gas or liquid; convection, conduction, and radiation are the principal means of energy transfer. (2) As specialized in meteorology, atmospheric motions that are predominantly vertical in the absence of wind (which distinguishes this process from advection), resulting in vertical transport and mixing of atmospheric properties.

CONVECTION COLUMN: The rising column of gases, smoke, fly ash, particulates, and other debris produced by a fire. The column has a strong vertical component indicating that buoyant forces override the ambient surface wind. (see also SMOKE PLUME)

CONVECTIVE ACTIVITY: General term for manifestations of convection in the atmosphere, alluding particularly to the development of convective clouds and resulting weather phenomena, such as showers, thunderstorms, squalls, hail, tornadoes, etc.

CONVECTIVE-LIFT FIRE PHASE: The phase of a fire when most of the emissions are entrained into a definite convection column.

CONVERGENCE: The term for horizontal air currents merging together or approaching a single point, such as at the center of a low pressure area producing a net inflow of air. The excess air is removed by rising air currents. Expansion of the rising air above a convergence zone results in cooling, which in turn often gives condensation (clouds) and sometimes precipitation.

CONVERGENCE ZONE: (1) The area of increased flame height and fire intensity produced when two or more fire fronts burn together. (2) In fire weather, that area where two winds come together from opposite directions and are forced upwards often creating clouds and precipitation.

CONVERSION BURNING: Burning an area where brush has excluded forest reproduction to prepare the area for tree planting.

COOPERATIVE FIRE PROTECTION (CFP): A staff unit within the branch of State and Private Forestry or Aviation and Fire Management in the National Forest System, USDA Forest Service.

COOPERATOR: Local agency or person who has agreed in advance to perform specified fire control services and has been properly instructed to give such service.

COOPERATING AGENCY: An agency supplying assistance including but not limited to direct tactical or support functions or resources to the incident control effort (e.g. Red Cross, law enforcement agency, telephone company, etc.). (see also AGENCY, SUPPORTING AGENCY)

CO-OP FIRE: Refers to federal, state, and local cooperative fire programs.

COORDINATION: The process of systematically analyzing a situation, developing relevant information, and informing appropriate command authority of viable alternatives for selection of the most effective combination of available resources to meet specific objectives. The coordination process (which can be either intra- or interagency) does not involve dispatch actions. However, personnel responsible for coordination may perform command or dispatch functions within limits established by specific agency delegations, procedures, legal authority, etc.

COORDINATION CENTER: Term used to describe any facility that is used for the coordination of agency or jurisdictional resources in support of one or more incidents.

COORDINATED RESOURCE MANAGEMENT: A process that directly involves everyone concerned with resource management in a given planning area.

COORDINATES: The intersection of lines of reference, usually expressed in degrees/minutes/seconds of latitude and longitude, used to determine or report position or location.

CORIOLIS FORCE: An apparent force due to the rotation of the earth that causes a deflection of air to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.

COST SHARING AGREEMENTS: Agreements between agencies or jurisdictions to share

designated costs related to incidents. Cooperative Fire Protection Agreements with States, agencies, and jurisdictions outline the procedures for cost sharing.

COUNTER FIRE: Fire set between main fire and backfire to hasten spread of backfire.
Emergency firing to stop, delay, or split a fire front, or to steer a fire. Also called draft fire.

COVER: The area on the ground covered by the combined aerial parts of plants expressed as a percent of the total area.

COVER TYPE: The designation of a vegetation complex described by dominant species, age, and form.

CREEPING FIRE: Fire burning with a low flame and spreading slowly.

CRITERIA POLLUTANTS: Those air pollutants designated by the Environmental Protection Agency as potentially harmful and for which ambient air standards have been set to protect the public health and welfare. The criteria pollutants are carbon monoxide, sulfur dioxide, particulate, nitrogen dioxide, ozone, hydrocarbons and lead.

CRITICAL BURNOUT TIME: Total time a fuel can burn and continue to feed energy to the base of a forward-traveling convection column.

CROWN CONSUMPTION: Combustion of the twigs, and needles or leaves of a tree during a fire.

CROWN COVER: The ground area covered by the crown of a tree as delimited by the vertical projection of its outermost perimeter.

CROWN FIRE: A fire that advances from top to top of trees or shrubs more or less independent of a surface fire. Crown fires are sometimes classed as running or dependent to distinguish the degree of independence from the surface fire.

CROWN OUT: A fire that rises from ground into the tree crowns and advances from tree top to tree top. To intermittently ignite tree crowns as a surface fire advances.

CROWN RATIO: The ratio of live crown to tree height.

CROWN SCORCH: Browning of needles or leaves in the crown of a tree or shrub caused by heating to lethal temperature during a fire. Crown scorch may not be apparent for several weeks after the fire.

CROWN SCORCH HEIGHT: The height above the surface of the ground to which a tree canopy is scorched.

CROWNING POTENTIAL: A probability that a crown fire may start, calculated from inputs of foliage moisture content and height of the lowest part of the tree crowns above the surface.

CUMULONIMBUS: The ultimate growth of a cumulus cloud into an anvil-shaped cloud with considerable vertical development, usually with fibrous ice crystal tops, and usually accompanied by lightning, thunder, hail, and strong winds.

CUMULUS: A principal low cloud type in the form of individual cauliflower-like cells of sharp non-fibrous outline and less vertical development than cumulonimbus.

CUP TRENCH: A fireline trench on the downhill side of fire burning on steep slopes that is supposed to be built deep enough to catch rolling firebrands that could otherwise start fire below the fireline. A high berm on the outermost downhill side of the trench helps the cup trench catch material. Also called gutter trench.

CURING: Drying and browning of herbaceous vegetation or slash.

# - D -

DAILY ACTIVITY LEVEL: Part of the National Fire Danger Rating System (NFDRS). In fire danger rating, a subjective estimate of the degree of activity of a potential human-caused fire source relative to that which is normally experienced. Five activity levels are defined: none, low, normal, high, and extreme.

DEAD FUELS: Fuels with no living tissue in which moisture content is governed almost entirely by absorption or evaporation of atmospheric moisture (relative humidity and precipitation).

DEBRIS BURNING FIRE: (1) In fire suppression terminology, a fire spreading from any fire originally ignited to clear land or burn rubbish, garbage, crop stubble, or meadows (excluding incendiary fires). (2) In prescribed fire terminology, a fire used to dispose of scattered, piled, or windrowed dead woody fuel, generally in the absence of a merchantable overstory. Its purpose is to reduce unsightly fuel concentrations, or consume unwanted natural fuels to facilitate subsequent resource management or land use actions on the area.

DEEP-SEATED FIRE: A fire burning far below the surface in duff, mulch, peat, or other combustibles as contrasted with a surface fire. A fire that has gained headway and built up heat in a structure so as to require greater cooling for extinguishment.

DEEPENING: As it refers to atmospheric pressure, a decrease in the central pressure of a low.
This is usually accompanied by intensification of the cyclonic circulation (counter-clockwise wind flow around the low).

DEGRADATION: In a discussion of fire retardant slurries, deterioration of viscosity.

DELAYED AERIAL IGNITION DEVICES (DAID): Polystyrene balls, 1.25 inches in diameter, containing potassium permanganate. The balls are fed into a dispenser, generally mounted in a helicopter, where they are injected with a water-glycol solution and then drop through a chute leading out of the helicopter. The chemicals react thermally and ignite in 25-30 seconds. The space between ignition points on the ground is primarily a function of helicopter speed, gear ratio of the dispenser, and the number of chutes used (up to four). (see also AERIAL IGNITION DEVICE, HELITORCH, PING-PONG BALL SYSTEM, PLASTIC SPHERE DISPENSER)

DELEGATION OF AUTHORITY: A statement provided to the incident commander by the agency executive delegating authority and assigning responsibility. The delegation of authority can include objectives, priorities, expectations, constraints and other considerations or guidelines as needed. Many agencies require written delegation of authority to be given to incident commanders prior to their assuming command on larger incidents.

DEMOBILIZATION: Release of resources from an incident in strict accordance with a detailed plan approved by the incident commander.

DENSE LAYER: A layer of clouds whose ratio of dense sky cover to total sky cover is more than one-half.

DENSE SKY COVER: Sky cover that prevents detection of higher clouds or the sky above it.

DENSITY (Foam): The ratio of the original volume of the nonaerated foam solution to the resultant volume of foam. The inverse of expansion.

DEPLOYMENT ZONE: Used when fire conditions are such that escape routes and safety zones have been compromised. Deployment zones are last ditch areas where fire shelters must be deployed to ensure firefighter survival due to the available space and/or fire behavior conditions at the deployment zone location. (see also SAFETY ZONE)

DEPTH OF BURN (DOB): The reduction in forest floor thickness due to consumption by fire.

DEPUTY: A qualified individual who could be delegated the authority to manage a functional operation or perform a specific task. In some cases, a Deputy could act as relief for a superior. Deputies can be assigned to the incident commander, general staff, and branch directors.

DESIGNATED CONTROL BURN (DESCON): Management system used in the Southern Region of the Forest Service which permits designated personnel to accept specific wildfires as prescribed fires and handle them accordingly. Only fires burning within a specified range of environmental and fuel conditions and contributing to land management goals may be accepted as DESCON fires.

DESICCANT: Chemical that, when applied to a living plant, causes or accelerates drying of its aerial parts; used to facilitate burning of living vegetation by substantially lowering fuel moisture content within a few hours.

DESIGNATED AREA: Those areas identified as principal population centers or other areas requiring protection under state or federal air quality laws or regulations.

DESIRED PLANT COMMUNITY: A plant community which produces the kind, proportion, and amount of vegetation necessary for meeting or exceeding the land use plant goals and activity plan objectives established for the site.

DETECTION: The act or system of discovering and locating fires. (Syn. FIRE DETECTION)

DEW POINT: Temperature to which a specified parcel of air must cool, at constant pressure and water-vapor content, in order for saturation to occur. The dew point is always lower than the wet-bulb temperature, which is always lower than the dry-bulb temperature, except when the air is saturated and all three values are equal. Fog may form when temperature drops to equal the dew point.

DILUTION: A control strategy used in managing smoke from prescribed fires in which smoke concentration is reduced by diluting it through a greater volume of air, either by scheduling during good dispersion conditions or burning at a slower rate.

DIRECT ATTACK: Any treatment applied directly to burning fuel such as wetting, smothering, or chemically quenching the fire or by physically separating the burning from unburned fuel.

DIRECT PROTECTION AREA: That area for which a particular fire protection organization has the primary responsibility for attacking an uncontrolled fire and for directing the suppression action. Such responsibility may develop through law, contract, or personal interest of the firefighting agent (e.g., a lumber operator). Several agencies or entities may have some basic responsibilities (e.g., private owner) without being known as the fire organization having direct protection responsibility. (Syn. PROTECTION AREA)

DISCOVERY TIME: Elapsed time from start of fire (known or estimated) until the time of the first discovery that results directly in fire suppression action.

DISPATCH CENTER: A facility from which resources are assigned to an incident.

DISPERSION: The decrease in concentration of airborne pollutants as they spread throughout an increasing volume of atmosphere.

DISTURBANCE: A weather system usually associated with clouds, rain and/or wind.

DIURNAL: Daily, especially pertaining to cyclic actions which are completed within 24 hours, and which recur every 24 hours, such as temperature, relative humidity and wind.

DIVERGENCE: The expansion or spreading out of a horizontal wind field. Generally associated with high pressure and light winds.

DIVISION: Divisions are used to divide an incident into geographical areas of operation. Divisions are established when the number of resources exceeds the span-of-control of the operations chief. A division is located within the ICS organization between the branch and the task force/strike team. (see also GROUP)

DOZER: Any tracked vehicle with a front mounted blade used for exposing mineral soil. (see also TRACTOR)

DOZER LINE: Fireline constructed by the front blade of a dozer.

DRAFT: Drawing water from static sources such as a lake, pond, cistern, river, etc. into a pump which is above the level of the water supply. This is done by removing the air from the pump and allowing atmospheric pressure [14.7 psi (101 kPa) at sea level] to push water through a non-collapsible suction hose into the pump.

DRAPED FUELS: Needles, leaves, and twigs that have fallen from above and have lodged on lower branches or brush. Draped fuels are part of aerial fuels.

DRIFT: Effect of wind on smoke, retardant drops, paracargo, smokejumper streamers, etc.

DRIFT SMOKE: Smoke that has drifted from its point of origin and is no longer dominated by convective motion. May give false impression of a fire in the general area where the smoke has drifted.

DRIP TORCH: Hand-held device for igniting fires by dripping flaming liquid fuel on the materials to be burned; consists of a fuel fount, burner arm, and igniter. Fuel used is generally a mixture of diesel and gasoline.

DRIZZLE: Precipitation composed exclusively of water drops smaller than 0.02 inches (0.5 mm) in diameter.

DROUGHT: A period of relatively long duration with substantially below-normal precipitation, usually occurring over a large area.

DROUGHT INDEX: A number representing the net effect of evaporation, transpiration and precipitation in producing cumulative moisture depletion in deep duff or upper soil layers. (see also KEETCH-BYRAM DROUGHT INDEX)

DRY AIR MASS: A portion of the atmosphere that has a relatively low dew point temperature and where the formation of clouds, fog, or precipitation is unlikely.

DRY BULB: A name given to an ordinary thermometer used to determine the temperature of the air (to distinguish it from the wet bulb).

DRY HYDRANT: Permanent devices with fire engine threads attached to expedite drafting operations in locations where there are water sources suitable for use in fire suppression (e.g., piers, wharves, bridges over streams, highways adjacent to ponds); also permanently installed supply private fire pumps which depend upon suction sources. Also called suction pipe.

DRY LIGHTNING STORM: Thunderstorm in which negligible precipitation reaches the ground. Also called dry storm.

DRY ADIABATIC LAPSE RATE: The rate of decrease of temperature with height of a parcel of dry air lifted adiabatically through an atmosphere in hydrostatic equilibrium. Numerically equal to 9.767 C per km or about 5.4 F per thousand feet.

DRY-BULB TEMPERATURE: Temperature of the air.

DRY-BULB THERMOMETER: In a psychrometer, the thermometer not covered with muslin which is used to determine air temperature.

DUFF: The layer of decomposing organic materials lying below the litter layer of freshly fallen twigs, needles, and leaves and immediately above the mineral soil. (see also HUMUS, LITTER)

# - E -

EARLY BURNING: Prescribed burning early in the dry season before the leaves and undergrowth are completely dry or before the leaves are shed, as an insurance against more severe fire damage later on.

ECOSYSTEM: An interacting natural system including all the component organisms together with the abiotic environment and processes affecting them.

ECONOMIC FIRE PROTECTION THEORY: A concept postulating that the object of fire protection is to minimize total cost (i.e., sum of the costs of fire prevention, fire presuppression, fire detection, fire suppression, and net costs of fire damage/benefits).

EDDY: A circular-like flow of a fluid (such as air or water) drawing its energy from a flow of much larger scale, and brought about by pressure irregularities as in the downwind (lee) side of a solid obstacle. For example, wind conditions may be erratic on the downwind side of large rock outcroppings, buildings, etc.

EDGE: (1) The place where plant communities meet or where successional stages or vegetative conditions within plant communities come together. (2) The boundary between two fairly distinct fuel types.

EDGE FIRING: Method of burning in which fires are set along the edges of an area and allowed to spread inward.

EFFECTIVE WINDSPEED: The midflame windspeed adjusted for the effect of slope on fire spread.

ELAPSED TIME: The total time taken to complete any step(s) in fire suppression. NOTE: Generally divided chronologically into discovery time, report time, getaway time, travel time, attack time, control time, mop-up time, and patrol time.

EMERGENCY: Any incident which requires the response of a fire protection organization's attack units and/or support units.

EMERGENCY FIREFIGHTER(EFF): Person employed as emergency worker on forest or wildland fire which threatens damage to property under public management. Hired for the duration of the emergency only. (see also CASUALS)

EMERGENCY MANAGEMENT COORDINATOR/DIRECTOR: The individual within each political subdivision that has coordination responsibility for jurisdictional emergency management.

EMERGENCY MEDICAL TECHNICIAN (EMT): A health-care specialist with particular skills and knowledge in pre-hospital emergency medicine.

EMERGENCY OPERATIONS CENTER (EOC): A pre-designated facility established by an agency or jurisdiction to coordinate the overall agency or jurisdictional response and support to an emergency.

EMERGENCY OPERATIONS PLAN: The plan that each jurisdiction has and maintains for responding to appropriate hazards.

EMISSION: A release into the outdoor atmosphere of air contaminants such as smoke.

EMISSION FACTOR (EFp): The mass of particulate matter produced per unit mass of fuel consumed (pounds per ton, grams per kilogram).

EMISSION RATE: The amount of smoke produced per unit of time (lb./min). Emission Rate = Available Fuel x Burning Rate x Emission Factor.

EMISSION REDUCTION: A strategy for controlling smoke from prescribed fires that minimizes the amount of smoke output per unit area treated.

EMISSION STANDARD: Limitation on the release of a contaminant, or multiple contaminants, to the ambient air from a single source.

ENERGY RELEASE COMPONENT (ERC): The computed total heat release per unit area (British thermal units per square foot) within the flaming front at the head of a moving fire.

ENGINE: Any ground vehicle providing specified levels of pumping, water, and hose capacity but with less than the specified level of personnel.

ENHANCEMENT BURN: Prescribed fire for recreation and aesthetic purposes (e.g., maintain park-like stands of trees, increase number and visibility of flowering annuals and biennials).

ENTRAPMENT: A situation where personnel are unexpectedly caught in a fire behavior-related, life-threatening position where planned escape routes or safety zones are absent, inadequate, or compromised. An entrapment may or may not include deployment of a fire shelter for its intended purpose. These situations may or may not result in injury. They include "near misses."

ENVIRONMENT: The complex surroundings of an item or area of interest, such as air, water, natural resources, and their physical conditions (temperature, humidity).

ENVIRONMENTAL LAPSE RATE: The actual rate of decrease of temperature with elevation.

EPISODE (Pollution): A condition of poor contaminant dispersion which may result in concentrations considered potentially harmful to health or welfare. Episodes may also occur during periods of fairly good dispersion if the source of air contaminants is extremely large.

EQUILIBRIUM MOISTURE CONTENT: Moisture content that a fuel particle will attain if exposed for an infinite period in an environment of specified constant temperature and humidity. When a fuel particle reaches equilibrium moisture content, net exchange of moisture between it and its environment is zero.

ESCAPE ROUTE: A preplanned and understood route firefighters take to move to a safety zone or other low-risk area. When escape routes deviate from a defined physical path, they should be clearly marked (flagged).

ESCAPED FIRE: Fire which has exceeded or is expected to exceed initial attack capabilities or prescription.

ESCAPED FIRE SITUATION ANALYSIS (EFSA): A decision-making process that evaluates alternative suppression strategies against selected environmental, social, political, and economic criteria. Provides a record of decisions.

EVAPORATION: The transformation of a liquid to its gaseous state; heat is released by the liquid during this process.

EVENT: A planned, non-emergency activity. ICS can be used as the management system for a wide range of events, e.g., parades, concerts or sporting events.

EXPOSURE FIRE: Classification for a fire not originating in a building, but which ignites building(s). A fire originating in one building and spreading to another is classified under the original cause of fire.

EXPOSURE: (1) Property that may be endangered by a fire burning in another structure or by a wildfire. (2) Direction in which a slope faces, usually with respect to cardinal directions. (see also ASPECT) (3) The general surroundings of a site with special reference to its openness to winds.

EXTEND: To drop retardant in such a way that the load slightly overlaps and links a previous drop. "Extend your last drop."

EXTENDED ATTACK INCIDENT: A wildland fire that has not been contained or controlled by initial attack forces and for which more firefighting resources are arriving, en route, or being ordered by the initial attack incident commander. Extended attack implies that the complexity level of the incident will increase beyond the capabilities of initial attack incident command.

EXTERIOR FIRE PROTECTION: The protection of structures from the exterior, with no interior access or activity.

EXTRA BURNING PERIOD: For any particular fire which is neither contained nor controlled, any 24-hour period following the termination of the first burning period.

EXTREME FIRE BEHAVIOR: "Extreme" implies a level of fire behavior characteristics that ordinarily precludes methods of direct control action. One or more of the following is usually involved: high rate of spread, prolific crowning and/or spotting,

presence of fire whirls, strong convection column. Predictability is difficult because such fires often exercise some degree of influence on their environment and behave erratically, sometimes dangerously. (see also BLOWUP, FLARE-UP and FIRE STORM)

# - F -

FAHRENHEIT: A temperature scale on which 32 F denotes the temperature of melting ice, and 212 F the temperature of boiling water, both under standard atmospheric pressure.

FALLER: A person who fells trees. Also called sawyer, and cutter.

FALSE ALARM: A reported smoke or fire requiring no suppression; for example, brush burning under control, mill smoke, false smoke, etc.

FEDERAL LAND POLICY AND MANAGEMENT ACT (FLPMA): Federal Land Policy and Management Act of 1976 (Public Law 94-570, 90 Stat. 2743, 43 USC 1701).

FINE FUEL MOISTURE: The probable moisture content of fast-drying fuels which have a timelag constant of 1 hour or less; such as, grass, leaves, ferns, tree moss, pine needles, and small twigs (0-1/4").

FINE FUELS: Fast-drying dead fuels, generally characterized by a comparatively high surface area-to-volume ratio, which are less than 1/4-inch in diameter and have a timelag of one hour or less. These fuels (grass, leaves, needles, etc.) ignite readily and are consumed rapidly by fire when dry. (see also FLASH FUELS)

FINGERS OF A FIRE: The long narrow extensions of a fire projecting from the main body.

FIRE AGENCY: Official group or organization compelled and authorized under statutes or law to control fires within a designated area or upon designated lands. (see also RESPONSIBLE FIRE AGENCY, PROTECTING AGENCY)

FIRE ANALYSIS: Review of fire management actions taken on a specific fire, group of fires, or fire season in order to identify reasons for both effective and ineffective actions, and to recommend or prescribe ways and means of doing a more efficient job. Also called hot line review.

FIREBASE: Computerized bibliographic information file that stores and retrieves citations and information digests of fire related information.

FIRE BEHAVIOR: The manner in which a fire reacts to the influences of fuel, weather, and topography.

FIRE BEHAVIOR FORECAST: Prediction of probable fire behavior, usually prepared by a fire behavior analyst, in support of fire suppression or prescribed burning operations.

FIRE BEHAVIOR PREDICTION MODEL: A set of mathematical equations that can be used to predict certain aspects of fire behavior when provided with an assessment of fuel and environmental conditions.

FIRE BEHAVIOR PREDICTION SYSTEM: A system that uses a set of mathematical equations to predict certain aspects of fire behavior in wildland fuels when provided with data on fuel and environmental conditions.

FIRE BEHAVIOR ANALYST: Person responsible to the planning section chief for establishing a weather data collection system and for developing fire behavior predictions based on fire history, fuel, weather, and topography.

FIRE BENEFITS: Fire effects with positive monetary, social, or emotional value or that contribute, through changes in the resource base, to the attainment of organizational goals.

FIREBRAND: Any source of heat, natural or human made, capable of igniting wildland fuels. Flaming or glowing fuel particles that can be carried naturally by wind, convection currents, or by gravity into unburned fuels.

FIREBREAK: A natural or constructed barrier used to stop or check fires that may occur, or to provide a control line from which to work.

FIRE CACHE: A supply of fire tools and equipment assembled in planned quantities or standard units at a strategic point for exclusive use in fire suppression.

FIRECAST: Set of computerized FIREMODELS run during fire season at the operations coordination center on preselected locations to indicate possible fire spread from those points for that date.

FIRE CAUSE: For statistical purposes fires are grouped into broad cause classes. The nine general causes used in the U.S. are: lightning, campfire, smoking, debris burning, incendiary, machine use (equipment), railroad, children, and miscellaneous.

FIRE CAUSE CLASS: Any class into which wildland fires are grouped according to their origin.

FIRE CLIMATE: Composite pattern of weather elements over time that affect fire behavior in a given region.

FIRE CLIMAX: Plant community maintained by periodic fires.

FIRE CONCENTRATION (Complex): (1) Generally, a situation in which numerous fires are burning in a locality. (2) More specifically, the number of fires per unit area or locality for a given period, generally a year.

FIRE CREW: General term for two or more firefighters organized to work as a unit.

FIRE CREW WORK FORMATION: Standard crew arrangement used for fireline construction in indirect attack; consists of line locator, line cutters, rakers, torch operators, and mopup crew.

FIRE DAMAGE: Detrimental fire effects expressed in monetary or other units, including the unfavorable effects of fire-induced changes in the resource base on the attainment of organizational goals.

FIRE DAMAGE APPRAISAL: Method of determining financial or other losses resulting from a fire.

FIRE DANGER: Sum of constant danger and variable danger factors affecting the inception, spread, and resistance to control, and subsequent fire damage; often expressed as an index.

FIRE DANGER INDEX: A relative number indicating the severity of wildland fire danger as determined from burning conditions and other variable factors of fire danger.

FIRE DANGER RATING: A fire management system that integrates the effects of selected fire danger factors into one or more qualitative or numerical indices of current protection needs.

FIRE DANGER RATING AREA: Geographical area within which climate, fuel, and topography are relatively homogeneous, hence fire danger can be assumed to be uniform.

FIRDAT (Fire Data Manipulation Program): A routine of FIREFAMILY that combines historical weather records with the equations of the NFDRS to produce frequency distributions of the NFDRS indexes and components. (see also FIREFAMILY)

FIRE DAY: Standard 24-hour period beginning at 1000 hours, during which most wildfires undergo a predictable speeding up and slowing down of intensity, depending primarily on the influence of weather and fuel factors.

FIRE DEATH: Fire casualty which is fatal or becomes fatal within one year of the fire.

FIRE DETECTION: Act or system of discovering and locating fires. (Syn. DETECTION)

FIRE DISCOVERY: The act of determining that a fire exists; does not include determining its location.

FIRE DISTRICT: A rural or suburban fire organization, usually tax supported, which maintains fire companies and apparatus. It is also called a fire protection district.

FIRE DUTY: Actual physical engagement in firefighting service as distinguished from staff work at headquarters or maintenance division; work at an individual fire done by an individual firefighter or by a company.

FIRE ECOLOGY: The study of the effects of fire on living organisms and their environment.

FIRE EDGE: The boundary of a fire at a given moment.

FIRE EFFECTS: The physical, biological, and ecological impacts of fire on the environment.

FIRE ENVIRONMENT: The surrounding conditions, influences, and modifying forces of topography, fuel, and weather that determine fire behavior.

FIREFAMILY (Fire Data Program): A computer program that uses historical weather data for fire planning. Its three major routines are FIRDAT, SEASON, and FIRINF.

FIREFIGHTER: Person whose principal function is fire suppression.

FIREFIGHTING FORCES: Qualified firefighters, together with their equipment and material, used to suppress wildland fires.

FIREFIGHTING TECHNOLOGY IMPLEMENTATION PROGRAM (FIRETIP): A computer program through which the technology of FIRESCOPE is transferred to areas outside southern California, where complex, multi-agency fires and other incidents commonly occur.

FIREFINDER MAP: A map, generally mounted on a wood or metal base, that is provided with an azimuth circle at the center of which is pivoted an alidade, and forms part of an Osborne Firefinder. (see also OSBORNE FIREFINDER)

FIRELAMP (Fire and Land Management Planning): Computerized multi-resource model that simulates the effects that naturally caused prescribed fires have on the future production of natural resources such as timber, forage, wildlife, recreation, and water.

FIRELINE: The part of a control line that is scraped or dug to mineral soil. Also called fire trail.

FIRE-FLOOD CYCLE: The greatly increased rate of water run off and soil movement from steep slopes that may follow removal of the vegetative cover by burning.

FIRE FREQUENCY: The number of fires per unit time in some designated area. The size of the area must be specified (units-number/time/area).

FIRE FRONT: The part of a fire within which continuous flaming combustion is taking place. Unless otherwise specified, the fire front is assumed to be the leading edge of the fire perimeter. In ground fires, the fire front may be mainly smoldering combustion.

FIRE HAZARD: A fuel complex, defined by volume, type condition, arrangement, and location that determines the degree of ease of ignition and of resistance to control.

FIRE HAZARD INDEX: A numerical rating for specific fuel types, indicating the relative probability of fires starting and spreading, and the probable degree of resistance to control; similar to burning index, but without effects of wind speed.

FIRE HAZARDOUS AREAS: Those wildland areas where the combination of vegetation, topography, weather, and the threat of fire to life and property create difficult and dangerous problems.

FIRE INCIDENCE: The average number of fires in a specified area during a specified time period. (Syn. FIRE OCCURRENCE)

FIRE INFORMATION RETRIEVAL AND EVALUATION SYSTEM (FIRES): A personal computer (PC) program that merges fire and weather/index files, and allows plotting and analysis of fire occurrence and fire danger.

FIRELINE INTENSITY: The product of the available heat of combustion per unit of ground and the rate of spread of the fire, interpreted as the heat released per unit of time for each unit length of fire edge. The primary unit is Btu per second per foot (Btu/sec/ft) of fire front.

FIRE INTERVAL: Time (in years) between two successive fires in a designated area (i.e., the interval between two successive fire occurrences); the size of the area must be clearly specified.

FIRE INVESTIGATION: Procedure undertaken to determine, at a minimum, when, where, how a fire (or fires) started, and by whom.

FIRE LANE: Cleared path wide enough to permit single-lane vehicular access in a remote area.

FIRELINE EXPLOSIVES (FLE): Specially developed coils containing explosive powder that are detonated to create a fireline through ground fuels.

FIRELINE INTENSITY: The rate of heat release per unit time per unit length of fire front. Numerically, it is the product of the heat yield, the quantity of fuel consumed in the fire front, and the rate of spread.

FIRE LOAD: The number and size of fires historically experienced on a given unit over a given period (usually one day) at a given index of fire danger.

FIRE LOAD INDEX (FLI): Numerical rating of the maximum effort required to contain all probable fires occurring within a rating area during the rating period.

FIRE MANAGEMENT: Activities required for the protection of burnable wildland values from fire and the use of prescribed fire to meet land management objectives.

FIRE MANAGEMENT AREA: One or more parcels of land having a common set of fire management objectives.

FIRE MANAGEMENT IMPROVEMENTS: All structures built and used primarily for fire management, e.g. lookout towers, lookout cabins, telephone lines, and also firebreaks, fuelbreaks,
and roads to lookouts.

FIRE MANAGEMENT OBJECTIVE: Planned, measurable result desired from fire protection and use based on land management goals and objectives.

FIRE MANAGEMENT PLAN: Statement, for a specific area, of fire policy, objective, and prescribed action; may include maps, charts, tables, and statistical data.

FIREMODEL: Computer program which, with specified information, predicts an hourly rate of spread from a point of origin.

FIRE OCCURRENCE: The average number of fires in a specified area during a specified time period. (Syn. FIRE INCIDENCE)

FIRE OCCURRENCE MAP: A map that shows by symbols the starting points of all fires for a given period.

FIRE PERIMETER: The entire outer edge or boundary of a fire.

FIRE PLANNING: Systematic technological and administrative management process of designing organization, facilities, and procedures to protect wildland from fire.

FIRE PLOTTING MAP: A map used for determining the location of fires, commonly provided with an azimuth circle to facilitate location by cross bearings.

FIRE PRESUPPRESSION: Activities undertaken in advance of fire occurrence to help ensure more effective fire suppression; includes overall planning, recruitment and training of fire personnel, procurement and maintenance of firefighting equipment and supplies, fuel treatment, and creating, maintaining, and improving a system of fuelbreaks, roads, water sources, and control lines.

FIRE PREVENTION: Activities, including education, engineering, enforcement and administration that are directed at reducing the number of wildfires, the costs of suppression, and fire-caused damages to resources and property.

FIRE-PROOFING: Removing or treating fuel with fire retardant to reduce the danger of fires igniting or spreading (e.g., fire-proofing roadsides, campsites, structural timber). Protection is relative, not absolute.

FIRE PROGRESS MAP: A map maintained on a large fire to show at given times the location of the fire, deployment of suppression forces, and progress of suppression.

FIRE QUALIFICATIONS: Computerized interagency summary of fire suppression qualifications of listed personnel. Available information includes fire training record, fire experience record, and physical fitness testing score for each individual.

FIRE REGIME: Periodicity and pattern of naturally-occurring fires in a particular area or vegetative type, described in terms of frequency, biological severity, and area extent.

FIRE REPORT: An official record of a fire, generally including information on cause, location, action taken, damage, costs, etc., from start of the fire until completion of suppression action. These reports vary in form and detail from agency to agency.

FIRE RESISTANT TREE: A species with compact, resin-free, thick corky bark and less flammable foliage that has a relatively lower probability of being killed or scarred by a fire than a fire sensitive tree.

FIRE RESOURCES: All personnel and equipment available or potentially available for assignment to incidents.

FIRE RETARDANT: Any substance except plain water that by chemical or physical action reduces flammability of fuels or slows their rate of combustion.

FIRE RISK: (1) The chance of fire starting, as determined by the presence and activity of causative agents. (2) A causative agent. (3) A number related to the potential number of firebrands to which a given area will be exposed during the rating day (National Fire Danger Rating System).

FIRE SCAR: (1) A healing or healed injury or wound to woody vegetation, caused or accentuated by a fire. (2) The mark left on a landscape by fire.

FIRE SCAR ANALYSIS: Analysis of one or more fire scars to determine individual tree fire frequency or mean fire intervals for specified areas.

FIRE SEASON: (1) Period(s) of the year during which wildland fires are likely to occur, spread, and affect resources values sufficient to warrant organized fire management activities. (2) A legally enacted time during which burning activities are regulated by State or local authority.

FIRESCOPE: Firefighting Resources of California Organized for Potential Emergencies. A multi-agency coordination system designed to improve the capabilities of California's wildland fire protection agencies. Its purpose is to provide more efficient resources allocation and utilization, particularly in multiple or large fire situations during critical burning conditions.

FIRE SENSITIVE TREE: A species with thin bark or highly flammable foliage that has a relatively greater probability of being killed or scarred by a fire.

FIRE SERVICE: The organized fire protection service; its members, individually and collectively; allied organizations assisting protection agencies.

FIRESETTING: Igniting of incendiary fires.

FIRE SEVERITY: Degree to which a site has been altered or disrupted by fire; loosely, a product of fire intensity and residence time.

FIRE SHELTER: An aluminized tent offering protection by means of reflecting radiant heat and providing a volume of breathable air in a fire entrapment situation. Fire shelters should only be used in life threatening situations, as a last resort.

FIRE SHELTER DEPLOYMENT: The removing of a fire shelter from its case and using it as protection against fire.

FIRE SHOVEL: Type of shovel specifically designed for use in constructing a fireline; has a tapered blade with both edges sharpened for scraping, digging, grubbing, cutting, and throwing.

FIRE SIMULATOR: Training device that imposes simulated fire and smoke on a landscape image, for the purpose of instructing fire suppression personnel in different fire situations and fire suppression techniques.

FIRE SPREAD MODEL: A set of physics and empirical equations that form a mathematical representation of the behavior of fire in uniform wildland fuels.

FIRE STORM: Violent convection caused by a large continuous area of intense fire. Often characterized by destructively violent surface indrafts, near and beyond the perimeter, and sometimes by tornado-like whirls. (see also BLOWUP, EXTREME FIRE BEHAVIOR and FLARE-UP)

FIRE SUPPRESSANT: Any agent used to extinguish the flaming and glowing phases of combustion by direct application to the burning fuel.

FIRE SUPPRESSION: All work and activities connected with fire-extinguishing operations, beginning with discovery and continuing until the fire is completely extinguished.

FIRE SUPPRESSION ORGANIZATION: (1) The personnel collectively assigned to the suppression of a specific fire or group of fires. (2) The personnel responsible for fire suppression within a specified area. (3) The management structure, usually shown in the form of an organization chart of the persons and groups having specific responsibilities in fire suppression.

FIRING TECHNIQUE: Any method of igniting a wildland area to consume the fuel in a prescribed pattern; e.g., heading or backing fire, spot fire, strip-head fire, and ring fire.

FIRE TOOL CACHE: A supply of fire tools and equipment assembled in planned quantities or standard units at a strategic point for exclusive use in wildland operations.

FIRE TRAP: (1) An accumulation of highly combustible material, rendering firefighting dangerous. (2) Any situation in which it is highly dangerous to fight fire.

FIRE TREATMENT: The use of fire to accomplish a specified objective.

FIRE TRIANGLE: Instructional aid in which the sides of a triangle are used to represent the three factors (oxygen, heat, fuel) necessary for combustion and flame production; removal of any of the three factors causes flame production to cease.

FIRE WEATHER: Weather conditions which influence fire ignition, behavior, and suppression.

FIRE WEATHER FORECAST: A weather prediction specially prepared for use in wildland fire operations and prescribed fire.

FIRE WEATHER INDEX (FWI): A numerical rating in the Canadian fire danger rating system, based on meteorological measurements of fire intensity in a standard fuel type. (The standard fuel type is representative of jack pine and lodgepole pine.) The FWI is comprised of three fuel moisture codes, covering classes of forest fuel of different drying rates, and two indices that represent rate of spread and the amount of available fuel.

FIRE WEATHER STATION: A meteorological station specially equipped to measure weather elements that have an important effect on fire behavior.

FIRE WEATHER WATCH: A possible critical fire weather pattern. (The NWS has replaced Red Flag Watch with Fire Weather Watch to avoid the overuse of Red Flag Terminology). (see also RED FLAG WARNING)

FIRE WHIRL: Spinning vortex column of ascending hot air and gases rising from a fire and carrying aloft smoke, debris, and flame. Fire whirls range in size from less than one foot to over 500 feet in diameter. Large fire whirls have the intensity of a small tornado.

FIX: Geographical position determined by visual reference to the surface, by reference to one or more radio navigational aids, by celestial plotting, or by any other navigational device.

FIXED-POINT DETECTION: Detection of fires from lookout towers or other semi-permanent locations as distinguished from roving ground patrols or aerial detection.

FLAME: A mass of gas undergoing rapid combustion, generally accompanied by evolution of sensible heat and incandescence.

FLAME ANGLE: Angle between the flame at the leading edge of the fire front and the ground surface, expressed in degrees.

FLAME DEPTH: The depth of the fire front.

FLAME HEIGHT: The average maximum vertical extension of flames at the leading edge of the fire front. Occasional flashes that rise above the general level of flames are not considered. This distance is less than the flame length if flames are tilted due to wind or slope.

FLAME LENGTH: The distance between the flame tip and the midpoint of the flame depth at the base of the flame (generally the ground surface), an indicator of fire intensity.

FLAME THROWER: Device for throwing a stream of flaming liquid, used to facilitate rapid ignition during burn out operations on a wildfire or during a prescribed fire operation. (Syn. TERRA TORCH ®)

FLAMING COMBUSTION PHASE: Luminous oxidation of gases evolved from the rapid decomposition of fuel. This phase follows the pre-ignition phase and precedes the smoldering combustion phase, which has a much slower combustion rate. Water vapor, soot, and tar comprise the visible smoke. Relatively efficient combustion produces minimal soot and tar and white smoke; high moisture content also produces white smoke.

FLAMING FRONT: That zone of a moving fire where the combustion is primarily flaming. Behind this flaming zone combustion is primarily glowing or involves the burning out of larger fuels (greater than about 3 inches in diameter). Light fuels typically have a shallow flaming front, whereas heavy fuels have a deeper front. (see also FIRE FRONT)

FLAMING PHASE: That phase of a fire where the fuel is ignited and consumed by flaming combustion.

FLAMMABILITY: The relative ease with which fuels ignite and burn regardless of the quantity of the fuels. Preferred to inflammability."

FLANK FIRE: A firing technique consisting of treating an area with lines of fire set into the wind which burn outward at right angles to the wind.

FLANKING FIRE SUPPRESSION: Attacking a fire by working along the flanks either simultaneously or successively from a less active or anchor point and endeavoring to connect two lines at the head.

FLANKS OF A FIRE: The parts of a fire's perimeter that are roughly parallel to the main direction of spread.

FLARE-UP: Any sudden acceleration in rate of spread or intensification of the fire. Unlike blowup, a flare-up is of relatively short duration and does not radically change existing control plans. (see also BLOWUP, EXTREME FIRE BEHAVIOR and FIRE STORM)

FLASH FUELS: Fuels such as grass, leaves, draped pine needles, fern, tree moss and some kinds of slash, which ignite readily and are consumed rapidly when dry. (see also FINE FUELS)

FLASHOVER: (1) Rapid combustion and/or explosion of unburned gases trapped at some distance from the main fire front. Usually occurs only in poorly ventilated topography. (2) Stage of a fire at which all surfaces and objects within a space have been heated to their ignition temperature, and flame breaks out almost at once over the surface of all objects within the space.

FLY ASH: Particulate matter emitted by a fire and larger than 10 microns in diameter with a consequently short residence time in the atmosphere.

FOAM: The aerated solution created by forcing air into, or entraining air in water containing a foam concentrate by means of suitably designed equipment or by cascading it through the air at a high velocity. Foam reduces combustion by cooling, moistening and excluding oxygen.

FOAM SYSTEMS: The apparatus and techniques used to mix concentrate with water to make solution, pump and mix air and solution to make foam, and transport and apply foam. (Systems defined here include compressed air foam and nozzle aspirated.)

FOAM TYPE: A term used to describe the consistency and viscosity of low expansion foam as the combination of drain time and expansion.

FOEHN WIND: A warm, dry and strong general wind that flows down into the valleys when stable, high pressure air is forced across and then down the lee slopes of a mountain range. The descending air is warmed and dried due to adiabatic compression producing critical fire weather conditions. Locally called by various names such as Santa Ana winds, Devil winds, North winds, Mono winds, etc.

FOLDING TANK: A portable, collapsible water tank with a tubular frame. Tank capacities vary in size from 500-1500 gallons.

FORB: A plant with a soft, rather than permanent woody stem, that is not a grass or grasslike plant.

FORECAST AREA: Geographical area for which a fire weather forecast is specified.

FOREST FIRE: Variously defined for legal purposes (e.g., the State of California Public Resources Code: an uncontrolled fire on lands covered wholly or in part by timber, brush, grass, grain, or other flammable vegetation). Types of fires are ground, surface, and crown.

FOREST FLOOR: Organic surface component of the soil supporting forest vegetation; comprised of litter, fermentation, and humus layers.

FOREST PLANNING LANGUAGE AND SIMULATOR (FORPLAN): Computer program developed to facilitate the use of simulation for integrating fire into the land management planning process. FORPLAN incorporates unique characteristics of previous systems, links numerous models and data bases, allows selection of variable resolution levels, and permits discrete time simulation of disturbances on plants, fuels, and animals.

FOREST PROTECTION: That branch of forestry concerned with the prevention and control of damage to forests arising mainly from the action of humans (particularly unauthorized fire, grazing and browsing, felling, fumes and smoke) and of pests and pathogens, but also from storm, frost, and other climatic agencies.

FOREST RESIDUE: Accumulation in the forest of living or dead (mostly woody) material that is added to and rearranged by human activities such as harvest, cultural operations, and land clearing.

FOREST SERVICE: Generally understood to mean an agency of the U.S. Department of Agriculture. However, some states also use Forest Service, e.g., Colorado State Forest Service.

FORESTRY WEATHER INFORMATION SYSTEM (FWIS): A real time system which takes observations and forecasts supplied by NWS in coded numeric form, reformats that input by computer based algorithms, and distributes the reformatted information as numeric and worded diagnoses and forecasts for specialized users in localized areas.

FORWARD RATE OF SPREAD: The speed with which a fire moves in a horizontal direction across the landscape, usually expressed in chains per hour or feet per minute.

FORWARD LOOKING INFRARED (FLIR): Hand held or aircraft mounted device designed to detect heat differentials and display their images on a video screen. FLIRs have thermal resolution similar to IR line scanners, but their spatial resolution is substantially less; commonly used to detect hot spots and flareups obscured by smoke, evaluate the effectiveness of firing operations, or detect areas needing mopup.

FREE BURNING: The condition of a fire or part of a fire that has not been slowed by natural barriers or by control measures.

FREEZING RAIN: Rain that freezes upon contact with objects on the ground.

FREQUENCY OF OCCURRENCE: A quantitative expression of the presence or absence of individuals of a species in a population; the ratio between the number of sample units that contain a species and the total number of sample units.

FRICTION LAYER: The layer of the atmosphere in which the frictional force of the earth's surface exercises an appreciable influence on winds.

FRONT: In meteorology, the boundary between two air masses of differing atmospheric properties.

FROST: Crystals of ice formed and deposited like dew, but at a temperature below freezing.

FUEL: Combustible material.

FUEL ARRANGEMENT: A general term referring to the spatial distribution and orientation of fuel particles within a natural setting.

FUEL BED: An array of fuels usually constructed with specific loading, depth, and particle size to meet experimental requirements; also, commonly used to describe the fuel composition in natural settings.

FUEL BED DEPTH: Average height of surface fuels contained in the combustion zone of a spreading fire front.

FUELBREAK: A natural or manmade change in fuel characteristics which affects fire behavior so that fires burning into them can be more readily controlled.

FUELBREAK SYSTEM: A series of modified strips or blocks tied together to form continuous strategically located fuel breaks around land units.

FUEL CHARACTERISTICS: Factors that make up fuels such as compactness, loading, horizontal continuity, vertical arrangement, chemical content, size and shape, and moisture content.

FUEL CLASS: Part of the National Fire Danger Rating System (NFDRS). Group of fuels possessing common characteristics. Dead fuels are grouped according to 1-, 10-, 100-, and l000-hour timelag, and living fuels are grouped as herbaceous (annual or perennial) or woody.

FUEL CONDITION: Relative flammability of fuel as determined by fuel type and environmental conditions.

FUEL CONTINUITY: The degree or extent of continuous or uninterrupted distribution of fuel particles in a fuel bed thus affecting a fire's ability to sustain combustion and spread. This applies to aerial fuels as well as surface fuels.

FUEL DEPTH: The average distance from the bottom of the litter layer to the top of the layer of fuel, usually the surface fuel.

FUEL GROUP: An identifiable association of fuel elements of distinctive species, form, size, arrangement, or other characteristics. General fuel groups are grass, brush, timber, and slash.

FUEL LOADING: The amount of fuel present expressed quantitatively in terms of weight of fuel per unit area. This may be available fuel (consumable fuel) or total fuel and is usually dry weight.

FUEL MANAGEMENT: Act or practice of controlling flammability and reducing resistance to control of wildland fuels through mechanical, chemical, biological, or manual means, or by fire, in support of land management objectives.

FUEL MODEL: Simulated fuel complex for which all fuel descriptors required for the solution of a mathematical rate of spread model have been specified.

FUEL MODIFICATION: Manipulation or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control (e.g., lopping, chipping, crushing, piling and burning). (Syn. FUEL TREATMENT)

FUEL MOISTURE ANALOG: Device that emulates the moisture response of specific classes of dead fuels, constructed from organic or inorganic materials (e.g., half-inch ponderosa pine dowels representing ten-hour timelag fuels).

FUEL MOISTURE CONTENT: The quantity of moisture in fuel expressed as a percentage of the weight when thoroughly dried at 212 degrees F.

FUEL MOISTURE INDICATOR STICK: A specially prepared stick or set of sticks of known dry weight continuously exposed to the weather and periodically weighed to determine changes in moisture content as an indication of moisture changes in wildland fuels.

FUEL REDUCTION: Manipulation, including combustion, or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control.

FUEL SIZE CLASS: A category used to describe the diameter of down dead woody fuels. Fuels within the same size class are assumed to have similar wetting and drying properties, and to preheat and ignite at similar rates during the combustion process.

FUEL TREATMENT: Manipulation or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control (e.g., lopping, chipping, crushing, piling and burning). (Syn. FUEL MODIFICATION)

FUEL TYPE: An identifiable association of fuel elements of distinctive species, form, size, arrangement, or other characteristics that will cause a predictable rate of spread or resistance to control under specified weather conditions.

FUEL TYPE CLASSIFICATION: Division of wildland areas into fire hazard classes.

FUME: An airborne irritating, noxious, or toxic smoke, vapor, or any combination of these produced by a volatile substance or a chemical reaction.

FUNCTION: In ICS, function refers to the five major activities, command, operations, planning, logistics and finance/administration.

FUSEE: A colored flare designed as a railway warning device, widely used to ignite backfires and other prescribed fires.

# - G -

GENERAL FIRE WEATHER FORECAST: A forecast, issued daily during the regular fire season to resource management agencies, that is intended for planning of daily fire management activities, including daily staffing levels, prevention programs, and initial attack on wildfires. Also called presuppression forecast. (see also SPOT WEATHER FORECAST, INCIDENT WEATHER FORECAST)

GENERAL SERVICES ADMINISTRATION (GSA): An agency of the United States Government that includes the Federal Supply Service, the Automated Data and Telecommunications Service, the Public Buildings Service, and the National Archives and Records Service.

GENERAL STAFF: The group of incident management personnel reporting to the Incident Commander. They may each have a deputy, as needed. The General Staff consists of: Operations Section Chief, Planning Section Chief, Logistics Section Chief, and Finance/Administration Section Chief.

GENERAL WINDS: Large scale winds caused by high- and low-pressure systems but generally influenced and modified in the lower atmosphere by terrain. (see also LOCAL WINDS and SLOPE WINDS)

GEOGRAPHIC AREA: A political boundary designated by the wildland fire protection agencies, where these agencies work together in the coordination and effective utilization of resources within their boundaries. The National Interagency Mobilization Guide in Chapter 20, section 21.1, identifies the area encompassed by the eleven NWCG Geographic areas.

GEOGRAPHIC COORDINATE SYSTEM: Mapping system which utilizes degrees and minutes.

GLOBAL POSITIONING SYSTEM (GPS): A system of navigational satellites operated by the U.S. Department of Defense and available for civilian use. The system can track objects anywhere in the world with an accuracy of approximately 40 feet.

GLOWING COMBUSTION: Oxidation of a solid surface accompanied by incandescence, sometimes evolving flame above it.

GLOWING COMBUSTION PHASE: Oxidation of solid fuel accompanied by incandescence. All volatiles have already been driven off and there is no visible smoke. This phase follows the smoldering combustion phase and continues until the temperature drops below the combustion threshold value, or until only non-combustible ash remains.

GLOWING PHASE: Phase of combustion in which a solid surface of fuel is in direct contact with oxygen, and oxidation occurs, usually accompanied by incandescence, and little smoke production.

GOING FIRE: Any wildfire on which suppression action has not reached an extensive mopup stage.

GRADIENT WIND: (1) A wind that flows parallel to pressure isobars or contours and has a velocity such that the pressure gradient, Coriolis, and certrifugal force acting in the area are in balance. It does not occur at the earth's surface due to fractional influence, but occurs at a height of roughly 1,500 feet above mean terrain height. (2) Wind created by differing barometric pressures between high- and low-pressure systems. Velocity is generally five to 30 miles per hour, and wind shifts are usually gradual as systems move and shift.

GRASS FIRE: Any fire in which the predominant fuel is grass or grasslike.

GREENBELT: Irrigated, landscaped, and regularly maintained fuelbreak, usually put to some additional use (e.g., golf course, park, playground).

GREENHOUSE EFFECT: The heating effect exerted upon the earth because the atmosphere (mainly its water vapor) absorbs and emits infrared radiation.

GROUND FIRE: Fire that consumes the organic material beneath the surface litter ground, such as a peat fire.

GROUND FOG: Fog which extends vertically to less than 20 feet.

GROUND FUEL: All combustible materials below the surface litter, including duff, tree or shrub roots, punky wood, peat, and sawdust, that normally support a glowing combustion without flame.

GROUND TRUTH: Verification at the site of what has been observed and/or measured from aircraft, satellites, other aerial platforms, aerial photographs, or maps.

GROUND VISIBILITY: Horizontal visibility observed at the ground.

GROUP: Groups are established to divide the incident into functional areas of operation. Groups are composed of resources assembled to perform a special function not necessarily within a single geographic division. Groups, when activated, are located between branches and resources in the operations section. (see also DIVISION)

GUST: Rapid fluctuations in wind speed with a variation of 10 knots (11.5 mph) or more between peaks and lulls.

GYPPO: A contractor, generally on felling and primary timber conversion work. NOTE: The term, originally uncomplimentary, is said to have originated with irregular railroad gangs operating at cut rates. (Sometimes hired to do suppression work, especially tree falling.)

# - H -

HAINES INDEX: An atmospheric index used to indicate the potential for wildfire growth by measuring the stability and dryness of the air over a fire.

HAND CREW: A number of individuals that have been organized and trained and are supervised principally for operational assignments on an incident.

HANDLINE: Fireline constructed with hand tools.

HAZARD: A fuel complex defined by kind, arrangement, volume, condition, and location that forms a special threat of ignition and resistance to control.

HAZARD MAP: Map of the area of operations that shows all of the known aerial hazards, including but not limited to power lines, military training areas, hang gliding areas, etc.

HAZARDOUS AREAS: Those wildland areas where the combination of vegetation, topography, weather, and the threat of fire to life and property create difficult and dangerous problems.

HAZARDOUS MATERIALS: Substances that are identified, classified, and regulated in the Code of Federal Regulations, Title 49 and Hazardous Materials Regulations 175. A hazardous material is a substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce and which has been so designated.

HAZARD REDUCTION: Any treatment of living and dead fuels that reduces the threat of ignition and spread of fire.

HAZE: Suspension of minute dry particles in the lower atmosphere that reduces horizontal visibility.

HAZE METER: Instrument for measuring the dependable range of distance at which a standard smoke column can be detected by the unaided eye under existing haze conditions.

HEAD FIRE: A fire spreading or set to spread with the wind.

HEAD OF A FIRE: The most rapidly spreading portion of a fire's perimeter, usually to the leeward or up slope.

HEADING: The compass direction in which the longitudinal axis of the aircraft points.

HEAT CONTENT: The net amount of heat that would be given off if fuel burns when it is absolutely dry, noted as Btu per pound of fuel.

HEAT LOW: An area of low pressure caused by intense heating of the earth's surface. High surface temperature causes air to expand and rise, resulting in low atmospheric pressure and induces a weak inflow of air at the surface. Air which rises in a heat low is very dry so clouds seldom form. Rising air above a heat low produces a warm upper level high and results in a net outflow of air aloft. Heat lows remain practically stationary over areas which produce them.

HEAT OF COMBUSTION: The heat energy resulting from the complete combustion of a fuel, expressed as the quantity of heat per unit weight of fuel. The high heat of combustion is the potential available, and the low heat of combustion is the high heat of combustion minus several losses that occur in an open system (primarily heat of vaporization of moisture in the fuel) .

HEAT PER UNIT AREA: Total amount of heat released per unit area as the flaming front of the fire passes, expressed as Btu/square foot; a measure of the total amount of heat released in flames.

HEAT PROBE: Apparatus used to detect heat.

HEAT RELEASE RATE TO THE ATMOSPHERE: The amount of heat released to the atmosphere during the combustion stage of a fire per unit of time.

HEAT RELEASE RATE: (1) Total amount of heat produced per unit mass of fuel consumed per unit time. (2) Amount of heat released to the atmosphere from the convective-lift fire phase of a fire per unit time.

HEAT TRANSFER: Process by which heat is imparted from one body to another, through conduction, convection, and radiation.

HEAT TROUGH: (Heat Low, Thermal Low, Thermal Trough) A Heat Low which is elongated in shape.

HEAT VALUE: The total heat energy released during combustion, usually published as units of heat energy produced per unit mass of ovendry fuel consumed.

HEAT YIELD: The heat of combustion corrected for various heat losses, mainly the presence of moisture in the fuel. To a very close approximation, the quantity of heat per pound of fuel burned that passes through a cross section of the convection column above a fire that is burning in a neutrally stable atmosphere. Also called low heat of combustion.

HEAVY FUELS: Fuels of large diameter such as snags, logs, large limbwood, which ignite and are consumed more slowly than flash fuels. Also called course fuels.

HEIGHT: The vertical measurement of vegetation from the top of the crown to ground level.

HELD LINE: All control line that still contains the fire when mopup is completed. Excludes lost line, natural barriers not backfired, and unused secondary lines.

HELIBASE: The main location within the general incident area for parking, fueling, maintenance, and loading of helicopters. It is usually located at or near the incident base.

HELICOPTER: An aircraft that depends principally on the lift generated by one or more rotors for its support in flight. (Syn. ROTORCRAFT)

HELICOPTER COORDINATOR: Person responsible to the air attack supervisor for coordinating tactical or logistical helicopter missions on a fire incident. This individual may be airborne or ground-based. More than one helicopter coordinator may be assigned to an incident, depending on the number and type of missions to be accomplished.

HELISPOT: A natural or improved takeoff and landing area intended for temporary or occasional helicopter use.

HELITACK: The utilization of helicopters to transport crews, equipment,and fire retardants or suppressants to the fireline during the initial stages of a fire. The term also refers to the crew that performs helicopter management and attack activities.

HELITACK CREW: A crew of firefighters specially trained and certified in the tactical and logistical use of helicopters for fire suppression.

HELITORCH: An aerial ignition device hung from or mounted on a helicopter to disperse ignited lumps of gelled gasoline. Used for backfires, burnouts, or prescribed burns. (see also AERIAL IGNITION DEVICE, DELAYED AERIAL IGNITION DEVICES, PING-PONG BALL SYSTEM, PLASTIC SPHERE DISPENSER)

HERB: A plant that does not develop woody, persistant tissue but is relatively soft or succulent and sprouts from the base (perennials) or develops from seed (annuals) each year. Includes grasses, forbs and ferns.

HIDDEN FIRE SCAR: Fire scar in a tree resulting from fire injury to the cambium without destruction of the overlying bark and therefore not readily discernible.

HIGBEE CUT: Removal of the first (i.e., outside) thread of a female or male coupling to prevent crossing or mutilation of threads. Dimpled rocker on female coupling indicates beginning of Higbee Cut.

HOLDING FORCES: Resources assigned to do all required fire suppression work following fireline construction but generally not including extensive mopup.

HOLDOVER FIRE: A fire that remains dormant for a considerable time. Also called sleeper fire.

HOT SPOT: A particularly active part of a fire.

HOT-SPOTTING: Checking the spread of fire at points of more rapid spread or special threat. Is usually the initial step in prompt control, with emphasis on first priorities.

HOTSHOT CREW: Intensively trained fire crew used primarily in hand line construction (Type- 1).

HUMAN-CAUSED FIRE: Any fire caused directly or indirectly by person(s).

HUMAN-CAUSED RISK: Part of the National Fire Danger Rating System (NFDRS). A model for predicting the average number of reportable human caused fires from a given ignition component value.

HUMAN-CAUSED RISK SCALING FACTOR: Part of the National Fire Danger Rating System (NFDRS). Number relating human-caused fire incidence to the ignition component in a fire danger rating area. It is based on three to five years of fire occurrence and fire weather data that adjusts the prediction of the basic human-caused fire occurrence model to fit local experience.

HUMIDITY: General term referring to the moisture content of the atmosphere.

HUMUS: Layer of decomposed organic matter on the forest floor beneath the fermentation layer and directly above the soil. It is that part of the duff in which decomposition has rendered vegetation unrecognizable and mixing of soil and organic matter is underway. (see also DUFF, LITTER)

HYDROPHOBICITY: Resistance to wetting exhibited by some soils, also called water repellency. The phenomenon may occur naturally or may be fire-induced. It may be determined by water drop penetration time, equilibrium liquid-contact angles, solid-air surface tension indices, or the characterization of dynamic wetting angles during infiltration.

HYGROTHERMOGRAPH: Recording instrument combining, on one record, the variation of dry-bulb temperature and relative humidity as a function of time.

# - I -

IGNITION COMPONENT: Part of the National Fire Danger Rating System (NFDRS). A rating of the probability that a firebrand will cause an actionable fire.

IGNITION ENERGY: Quantity of heat or electrical energy that must be absorbed by a substance to ignite and burn.

IGNITION METHOD: The means by which a fire is ignited, such as hand-held drip torch, helitorch, and backpack propane tanks.

IGNITION PATTERN: Manner in which a prescribed fire is ignited. The distance between ignition lines or points and the sequence of igniting them is determined by weather, fuel, topography, firing technique, and other factors which influence fire behavior and fire effects.

IGNITION PROBABILITY: Chance that a firebrand will cause an ignition when it lands on receptive fuels. (Syn. IGNITION INDEX)

IGNITION TIME: Time between application of an ignition source and self-sustained combustion of a fuel.

IMPAIR WILDERNESS SUITABILITY: Refers to activities that are considered to impair an area's suitability for preservation as wilderness that do not satisfy the nonimpairment criteria.

IMPULSE: A term used in weather primarily to describe a weak disturbance that does not necessarily have an associated storm center or surface low. The disturbance usually does not create severe weather and is frequently associated with a marine air push.

INCENDIARY FIRE: A wildfire willfully ignited by anyone to burn, or spread to, vegetation or property without consent of the owner or his/her agent. (Syn. ARSON FIRE)

INCIDENT: An occurrence either human-caused or natural phenomenon, that requires action or support by emergency service personnel to prevent or minimize loss of life or damage to property and/or natural resources.

INCIDENT ACTION PLAN (IAP): Contains objectives reflecting the overall incident strategy and specific tactical actions and supporting information for the next operational period. The plan may be oral or written. When written, the plan may have a number of attachments, including: incident objectives, organization assignment list, division assignment, incident radio communication plan, medical plan, traffic plan, safety plan, and incident map. Formerly called shift plan.

INCIDENT BASE: Location at the incident where the primary logistics functions are coordinated and administered. (Incident name or other designator will be added to the term Base.) The incident command post may be collocated with the base. There is only one Base per incident.

INCIDENT COMMAND POST (ICP): Location at which primary command functions are executed. The ICP may be collocated with the incident base or other incident facilities.

INCIDENT COMMAND SYSTEM (ICS): A standardized on-scene emergency management concept specifically designed to allow its user(s) to adopt an integrated organizational structure equal to the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries.

INCIDENT COMMANDER: Individual responsible for the management of all incident operations at the incident site.

INCIDENT MANAGEMENT TEAM: The incident commander and appropriate general and command staff personnel assigned to an incident.

INCIDENT METEOROLOGIST (IMET): A specially trained meteorologist who provides site specific weather forecasts and information to an incident. Is responsible to the fire behavior analyst and the planning section chief. The IMET is usually accompanied by an ATMU and MICRO-REMS. (see also AIR TRANSPORTABLE MODULAR UNIT and MICRO-REMOTE ENVIRONMENTAL MONITORING SYSTEM)

INCIDENT OBJECTIVES: Statements of guidance and direction necessary for the selection of appropriate strategy(s), and the tactical direction of resources. Incident objectives are based upon agency administrators' direction and constraints. Incident objectives must be achievable and measurable, yet flexible enough to allow for strategic and tactical alternatives.

INCIDENT ORGANIZATION: Resources, together with a complement of overhead personnel, calculated to be sufficient to provide fire efficient incident management.

INCIDENT OVERHEAD: All supervisory positions described in the Incident Command System.

INCIDENT SUPPORT ORGANIZATION: Includes any off-incident support provided to an incident. Examples would be agency dispatch centers, airports, mobilization centers, etc.

INCIDENT WEATHER FORECAST: A special fire weather forecast for a specific incident prepared by a meteorologist on site at or near the incident area. (see also GENERAL FIRE WEATHER FORECAST, SPOT WEATHER FORECAST)

INCREMENT: Any resource or grouping of resources on which individual status is maintained.

INDEPENDENT ACTION: Fire suppression activities by other than regular fire suppression organizations or a fire cooperator.

INDEPENDENT CROWN FIRE: A fire that advances in the tree crowns alone, not requiring any energy from the surface fire to sustain combustion or movement. Also called running crown fire.

INDIRECT ATTACK: A method of suppression in which the control line is located some considerable distance away from the fire's active edge. Generally done in the case of a fast-spreading or high-intensity fire and to utilize natural or constructed firebreaks or fuelbreaks and favorable breaks in the topography. The intervening fuel is usually backfired; but occasionally the main fire is allowed to burn to the line, depending on conditions.

INDIRECTLY VISIBLE AREA: Ground, or the vegetation growing thereon, that is not directly visible to a fixed point lookout but lies at not more than a specified depth (commonly 300 feet, 91 meters) below the lookout's line of sight.

INDUCTOR: A control mechanism that allows a regulated quantity of foam concentrate to be introduced into the main hose line.

INFORMATION OFFICER: A member of the command staff responsible for interfacing with the public and media or with other agencies requiring information directly from the incident. There is only one information officer per incident. The information officer may have assistants.

INFRARED (IR): A heat detection system used for fire detection, mapping, and hotspot identification. (see also THERMAL IMAGERY)

INHIBITION: Process of extinguishing fire by the use of an agent that interrupts the chemical reactions in the combustion process.

INITIAL ATTACK: The actions taken by the first resources to arrive at a wildfire to protect lives and property, and prevent further extension of the fire.

INITIAL ATTACK CREW: Specially trained and equipped fire crew for initial attack on a fire.

INITIAL ATTACK FIRE (IAF): Fire that is generally contained by the attack units first dispatched, without a significant augmentation of reinforcements, within two hours after initial attack, and full control is expected within the first burning period.

INITIAL ATTACK INCIDENT COMMANDER (IAIC): The incident commander at the time the first attack forces commence suppression work on a fire.

INITIAL RESPONSE: Resources initially committed to an incident.

INMATE CREW: Any fire crew composed of prison inmates.

INSTRUMENT SHELTER: Naturally or artificially ventilated structure, constructed to specifications and used to shield weather measuring instruments from direct sunshine and precipitation.

INTERMITTENT SMOKE: Smoke which becomes visible only at intervals.

INTOLERABLE LOSS: Level of damage or loss greater than that which may be sustained by a given resource, cultural or natural, and still achieve management goals.

INVERSION: An increase of temperature with height in the atmosphere. Vertical motion in the atmosphere is inhibited allowing for pollution buildup. A "normal" atmosphere has temperature decreasing with height. (see also ATMOSPHERIC STABILITY, STABLE LAYER of AIR, and ATMOSPHERIC INVERSION)

ISLAND: An unburned area within a fire perimeter.

ISOBAR: A charted line connecting points of equal atmospheric pressure.

ISOTHERM: A charted line connecting points of equal temperature.

ISOTHERMAL LAYER: Layer through which temperature remains constant with elevation.

I-ZONE: The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. (Syn. URBAN INTERFACE, WILDLAND/URBAN INTERFACE)

# - J -

JURISDICTION: The range or sphere of authority. Public agencies have jurisdiction at an incident related to their legal responsibilities and authority for incident mitigation. Jurisdictional authority at an incident can be political/geographical (e.g., city, county, state or federal boundary lines), or functional (e.g., police department, health department, etc.). (see also MULTIJURISDICTION INCIDENT)

JURISDICTIONAL AGENCY: The agency having land and resource management responsibility for a specific geographical or functional area as provided by federal, state or local law.

# - K -

KEETCH-BYRAM DROUGHT INDEX(KBDI): Commonly-used drought index adapted for fire management applications, with a numerical range from 0 (no moisture deficiency) to 800 (maximum drought). (see also DROUGHT INDEX)

KINDLING POINT: Lowest temperature at which sustained combustion can be initiated for a specified substance. Also called ignition temperature.

KNOT: Nautical miles per hour, equal to 1.15 mph.

# - L -

LADDER FUELS: Fuels which provide vertical continuity between strata, thereby allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease. They help initiate and assure the continuation of crowning.

LAND OCCUPANCY FIRE: Fire started as a result of land occupancy for agricultural purposes, industrial establishment, construction, maintenance and use of rights-of-way, and residences, except equipment use and smoking.

LAPSE RATE: Decrease of an atmospheric variable (temperature unless specified otherwise) with height.

LARGE FIRE: (1) For statistical purposes, a fire burning more than a specified area of land e.g., 300 acres. (2) A fire burning with a size and intensity such that its behavior is determined by interaction between its own convection column and weather conditions above the surface.

LEACH: Removal of soluble constituents from ashes or soil by percolation of water.

LEADER: The ICS title for an individual responsible for a task force, strike team, or functional unit.

LEGITIMATE SMOKE: Smoke from any authorized use of fire (e.g., locomotive, industrial operations, permitted debris burning).

LEVEL OF SERVICE: Amount of fire prevention and fire suppression supplied; may be expressed several ways (e.g., percent of people or buildings protected, area protected, dollar value of property protected, firefighters per capita, water flow capability).

LIAISON OFFICER (LOFR): A member of the command staff responsible for coordinating with agency representatives from assisting and cooperating agencies.

LIFE-SAFETY: Refers to the joint consideration of both the life and physical well-being of individuals.

LIFTING PROCESSES: Any of the processes that lead to upward vertical motion in the atmosphere. These processes may include low level convergence, heating or thermal convection, orographic lifting over the mountains, and frontal lifting.

LIGHT BURN: Degree of burn which leaves the soil covered with partially charred organic material; heavy fuels are not deeply charred.

LIGHT (FINE) FUELS: Fast-drying fuels, generally with a comparatively high surface area-to-volume ratio, which are less than 1/4-inch in diameter and have a timelag of 1 hour or less. These fuels readily ignite and are rapidly consumed by fire when dry.

LIGHT WIND: Wind speed less than 7 mph (6 knots) measured at 20 feet above ground. At eye level, light winds are less than 3 mph (3 knots).

LIGHTNING ACTIVITY LEVEL (LAL): Part of the National Fire Danger Rating System (NFDRS). A number, on a scale of 1 to 6, which reflects frequency and character of cloud-to-ground lightning (forecasted or observed). The scale for 1 to 5 is exponential, based on powers of 2 (i.e., LAL 3 indicates twice the lightning of LAL 2). LAL 6 is a special category for dry lightning and is closely equivalent to LAL 3 in strike frequency.

LIGHTNING FIRE: Wildfire caused directly or indirectly by lightning.

LIGHTNING FIRE OCCURRENCE INDEX: Part of the National Fire Danger Rating System (NFDRS). Numerical rating of the potential occurrence of lightning-caused fires.

LIGHTNING RISK (LR): Part of the National Fire Danger Rating System (NFDRS). A number related to the expected number of cloud-to-ground lightning strokes to which a protection unit is expected to be exposed during the rating period; the LR value used in the occurrence index includes an adjustment for lightning activity experienced during the previous day to account for possible holdover fires.

LIGHTNING RISK SCALING FACTOR: Part of the National Fire Danger Rating System (NFDRS). Factor derived from local thunderstorm and lightning-caused fire records that adjusts predictions of the basic lightning fire occurrence model to local experience, accounting for factors not addressed directly by the model (e.g., susceptibility of local fuels to ignition by lightning, fuel continuity, topography, regional characteristics of thunderstorms).

LIGHTNING STROKE COUNTER: Electronic sensor used to record the number of lightning strokes within a predetermined range over a specified period of time.

LIMBING: Removing branches from a felled or standing tree, or from brush.

LIMITED CONTAINMENT: Halting of fire spread at the head, or that portion of the flanks of a prescribed fire that is threatening to exceed prescription criteria, and ensuring that this spread rate will not be encountered again; does not indicate mopup.

LINE CUTTER: Fire crew member in the progressive method of line construction who cuts and clears away brush, small saplings, vines, and other obstructions in the path of the fireline; usually equipped with ax or brush hook.

LINE FIRING: Setting fire to only the border fuel immediately adjacent to the control line.

LINE HOLDING: Ensuring that the established fireline has completely stopped fire progress.

LINE IGNITION: Setting a line of fire (e.g., backing fire) as opposed to individual spots.

LINE OFFICER: Agency Administrator.

LITTER: The top layer of forest floor, composed of loose debris of dead sticks, branches, twigs, and recently fallen leaves or needles; little altered in structure by decomposition. (see also DUFF, HUMUS)

LITTLE CHANGE: Insignificant change in wind speed, and temperature and relative humidity changes less than five degrees and five percent, respectively. When used as a general statement in a long-range forecast, all three criteria apply.

LIVE BURNING: Burning of green slash progressively as it is cut.

LIVE FUEL MOISTURE CONTENT: Ratio of the amount of water to the amount of dry plant material in living plants.

LIVE FUELS: Living plants, such as trees, grasses, and shrubs, in which the seasonal moisture content cycle is controlled largely by internal physiological mechanisms, rather than by external weather influences.

LIVE HERBACEOUS MOISTURE CONTENT: Ratio of the amount of water to the amount of dry plant material in herbaceous plants, i.e., grasses and forbs.

LIVE WOODY MOISTURE CONTENT: Ratio of the amount of water to the amount of dry plant material in shrubs.

LIVING FUELS: Naturally occurring fuels in which moisture content is physiologically controlled within the living plant.

LOCAL AGENCY: Any agency having jurisdictional responsibility for all or part of an incident.

LOCAL RESPONSIBILITY AREA: Lands on which neither the state nor the federal government has any legal responsibility for providing fire protection.

LOCAL WINDS: Winds which are generated over a comparatively small area by local terrain and weather. They differ from those which would be appropriate to the general pressure pattern. (see also GENERAL WINDS and SLOPE WINDS)

LOGGING DEBRIS: Unwanted tree parts (crowns, logs, uprooted stumps) remaining after harvest.

LOGISTICS SECTION: The Section responsible for providing facilities, services and materials for the incident.

LONG-RANGE FORECAST: Fire weather forecast for a period greater than five days in advance.

LONG-RANGE SPOTTING: Large glowing firebrands are carried high into the convection column and then fall out downwind beyond the main fire starting new fires. Such spotting can easily occur 1/4 mile or more from the firebrand's source.

LONG-TERM FIRE DANGER: The results of those factors in fire danger affecting long-term planning; involves consideration of past records and conditions and probable future trends.

LONG-TERM FIRE RETARDANT: Chemical that inhibits combustion primarily through chemical reactions between products of combustion and the applied chemicals, even after the water component has evaporated. Other chemical effects also may be achieved, such as film-forming and intumescence.

LOOKOUT: (1) A person designated to detect and report fires from a vantage point. (2) A location from which fires can be detected and reported. (3) A fire crew member assigned to observe the fire and warn the crew when there is danger of becoming trapped.

LOOKOUT(S), COMMUNICATION(S), ESCAPE ROUTE(S), AND SAFETY ZONE(S) (LCES): Elements of a safety system used by fire fighters to routinely assess their current situation with respect to wildland firefighting hazards.

LOOKOUT TOWER: Structure that elevates a person above nearby obstructions to sight for fires; generally capped by some sort of house or cupola.

LOPPING: After felling, cutting branches, tops, and unwanted boles into lengths such that resultant logging debris will lie close to the ground.

LOPPING AND SCATTERING: Lopping logging debris and spreading it more or less evenly over the ground.

LORAN: An electronic navigation and position-determining system. The (GPS) Global Positioning System is replacing LORAN as the system of choice for aircraft position determination.

LOST LINE: Any part of a fireline rendered useless by a breakover of the fire.

LOW: An area of relatively low atmospheric pressure in which winds tend to move in a counterclockwise direction, spiraling in toward the low’s center.

# - M -

MACROCLIMATE: General large-scale climate of a large area or country as distinguished from smaller scale mesoclimate and microclimate.

MAIN RIDGE: Prominent ridgeline separating river or creek drainages. Usually has numerous smaller ridges (spur) extending outward from both sides.

MAJOR STATIONARY SOURCES: Term used to determine the applicability of Prevention of Significant Deterioration ("PSD") and new source regulations. In a non-attainment area, any stationary pollutant source that has a potential to emit more than 100 tons per year is considered a major stationary source. In PSD areas, the cutoff level may be either 100 or 250 tons, depending upon the type of source.

MANAGEMENT BY OBJECTIVES: In ICS, this is a top-down management activity which involves a three-step process to achieve the incident goal. The steps are: establishing the incident objectives, selection of appropriate strategy(s) to achieve the objectives; and the tactical direction associated with the selected strategy. Tactical direction includes: selection of tactics, selection of resources, resource assignments and performance monitoring.

MANAGERS: Individuals within ICS organizational units that are assigned specific managerial responsibilities, e.g., staging area manager or camp manager.

MARINE AIR: Air which has a high moisture content and the temperature characteristics of an ocean surface due to extensive exposure to that surface. An intrusion of marine air will moderate fire conditions. Absence of marine air in coastal areas may lead to more severe fire danger.

MARINE CLIMATE: Regional climate under the predominant influence of the sea, that is, a climate characterized by marine air; the opposite of a continental climate.

MARITIME AIR: Air which has assumed high moisture content and the temperature characteristics of a water surface due to extensive exposure to that surface.

MASS FIRE: A fire resulting from many simultaneous ignitions that generates a high level of energy output.

MASS TRANSPORT: Heat carried ahead of the fire in the form of firebrands.

MASTER FIRE CHRONOLOGY: Chronological listing of the dates of fires documented in a designated area, the dates being corrected by crossdating. Size of the area must be specified. Also called composite fire interval.

MEAN FIRE INTERVAL: Arithmetic average of all fire intervals determined, in years, in a designated area during a specified time period; size of the area and the time period must be specified.

MEAN SEA LEVEL (MSL): Average height of the surface of the sea for all stages of the tide over a 19-year period. NOTE: when the abbreviation MSL is used in conjunction with a number of feet, it implies altitude above sea level (e.g., 1000 feet MSL).

MEDIUM-RANGE FORECAST: A forecast for a period extending from about two days to five days or a week in advance; there are no absolute limits to the period embraced by this definition.

MEDIVAC: Mobile medical treatment and transportation.

MICRON: One millionth of a meter, a micrometer.

MICRO-REMOTE ENVIRONMENTAL MONITORING SYSTEM (MICRO-REMS): Mobile weather monitoring station. Each unit consists of a shipping container, solar panel, battery, temperature/relative humidity sensor, wind mast, wind direction/speed sensor, data logger and radio. A MICRO-REMS usually accompanies an incident meteorologist and ATMU to an incident. (see also AIR TRANSPORTABLE MODULAR UNIT and INCIDENT METEOROLOGIST)

MID-FLAME WINDSPEED: The speed of the wind measured at the midpoint of the flames, considered to be most representative of the speed of the wind that is affecting fire behavior.

MILITARY OPERATIONS AREA (MOA): Military Operations Area found on aeronautical charts.

MILITARY TIME: The 24-hour clock system where midnight is 2400, one minute after midnight is 0001 and progresses to 2400 daily.

MILLIBAR: A unit of pressure equal to a force of 1,000 dynes per square centimeter. (A dyne is the force that would give a free mass of one gram an acceleration of one centimeter per second per second.)

MINIMUM IMPACT SUPPRESSION TECHNIQUES (MIST): The application of strategy and tactics that effectively meet suppression and resource objectives with the least environmental, cultural and social impacts.

MINERAL ASH: The residue of mineral matter left after complete combustion of wood (wood ash) or other organic material; consists largely of oxides, carbonates, and phosphates of Ca, K and Mg, together with other compounds, [formerly used as a source of potash (K2C03)].

MINERAL SOIL: Soil layers below the predominantly organic horizons; soil with little combustible material.

MISCELLANEOUS FIRE: Fire of known cause that cannot be properly classified into any of the eight standard causes of fires.

MIXING: A random exchange of air parcels on any scale from the molecular to the largest eddy.

MIXING HEIGHT: Measured from the surface upward, the height to which relatively vigorous mixing occurs due to convection. Also called mixing depth.

MIXING LAYER: That portion of the atmosphere from the surface up to the mixing height. This is the layer of air, usually a sub-inversion layer, within which pollutants are mixed by turbulence and diffusion. Also called mixed layer. (see also TRANSPORT WIND SPEED, VENTILATION FACTOR)

MOBILE RADIO: A two way radio unit on mobile apparatus (instead of base stations), usually semi-permanently attached to the apparatus.

MOBILE WEATHER UNIT FORECAST: A special fire weather forecast for a specific fire prepared by a meteorologist on site at or near the fire area.

MOBILIZATION: The process and procedures used by all organizations, federal, state and local, for activating, assembling, and transporting all resources that have been requested to respond to or support an incident.

MOBILIZATION CENTER: An off-incident location at which emergency service personnel and equipment are temporarily located pending assignment, release, or reassignment.

MOBILIZATION GUIDE: A written description of procedures used by federal, state, and local organizations for activating, assembling, and transporting resources that have been requested to respond to or support an incident.

MODEL: A quantitative and mathematical representation or simulation which attempts to describe the characteristics or relationships of physical events. Also called mathematical model.

MODEL ARSON LAW: Model legislation, recommended by the Fire Marshals' Association of North America and adopted in most states, dealing with the subject of arson.

MODEL FIREWORKS LAW: Model legislation recommended by the Fire Marshals' Association of North America and adopted by many states, regulating display of fireworks.

MODERATE BURN: Degree of burn in which all organic material is burned away from the surface of the soil, which is not discolored by heat; any remaining fuel is deeply charred. Organic matter remains in the soil immediately below the surface.

MODIFIED SUPPRESSION: Suppression action dictated by one or more management constraints that affect strategy and/or tactics.

MODULAR AIRBORNE FIREFIGHTING SYSTEM (MAFFS): A manufactured unit consisting of five interconnecting tanks, a control pallet, and a nozzle pallet, with a capacity of 3,000 gallons, designed to be rapidly mounted inside an unmodified C-130 (Hercules) cargo aircraft for use in cascading retardant chemicals on wildfires.

MOIST ADIABATIC LAPSE RATE: Rate of decrease of temperature with increasing height of an air parcel lifted at saturation via adiabatic process through an atmosphere in hydrostatic equilibrium. Rate varies according to the amount of water vapor in the parcel and is usually between 2 and 5 F per 1000 feet (3.6 AND 9.2 C per 1000 METERS).

MOISTURE OF EXTINCTION: The fuel moisture content, weighed over all the fuel classes, at which the fire will not spread. Also called extinction moisture content (EMC).

MONITORING: Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, animals, and other living things.

MONSOON CLIMATE: Climate characterized by (a) a long winter-spring dry season which includes a "cold season" followed by a short "hot season" immediately preceding the rains, (b) a summer and early autumn rainy season which is usually very wet (but highly variable from year to year), and (c) a secondary maximum of temperature immediately after the rainy season.

MOPUP: Extinguishing or removing burning material near control lines, felling snags, and trenching logs to prevent rolling after an area has burned, to make a fire safe, or to reduce residual smoke.

MOSAIC: The intermingling of plant communities and their successional stages in such a manner as to give the impression of an interwoven design.

MOST EFFICIENT LEVEL (MEL): The fire management program budget level that results in the minimum cost plus net value change.

MULTI-AGENCY COORDINATION(MAC): A generalized term which describes the functions and activities of representatives of involved agencies and/or jurisdictions who come together to make decisions regarding the prioritizing of incidents**,** and the sharing and use of critical resources. The MAC organization is not a part of the on-scene ICS and is not involved in developing incident strategy or tactics.

MULTI-AGENCY INCIDENT: An incident where one or more agencies assist a jurisdictional agency or agencies. May be single or unified command. (see also JURISDICTION)

MULTIJURISDICTION INCIDENT: An incident requiring action from multiple agencies that have a statutory responsibility for incident mitigation. In ICS these incidents will be managed under unified command. (see also JURISDICTION)

MULTIPLE FIRE SITUATION: High fire frequency over a short period of time in an administrative unit, usually overtaxing the normal initial attack capability of the unit.

MUTUAL AID AGREEMENT: Written agreement between agencies and/or jurisdictions in which they agree to assist one another upon request, by furnishing personnel and equipment.

MUTUAL AID: A system wherein two or more fire departments, by prior agreement, operate essentially as a single agency to respond routinely across jurisdictional boundaries to render mutual assistance in combating fire emergencies.

MUTUAL THREAT ZONE: A geographical area between two or more jurisdictions into which those agencies would respond on initial attack. Also called mutual response zone or initial action zone.

# - N -

NATIONAL ADVANCED RESOURCES TECHNOLOGY CENTER (NARTC): Multi-agency training facility at Pinal Air Park, Marana, Arizona, which specializes in presentation of national-level fire management training courses.

NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS): A legal limit on the level of atmospheric contamination. The level is established as the concentration limits needed to protect all of the public against adverse effects on public health and welfare, with an adequate safety margin. Primary standards are those related to health effects. Secondary standards are designed to protect the public welfare from effects such as visibility reduction, soiling, material damage and nuisances.

NATIONAL ASSOCIATION OF STATE FORESTERS (NASF): An organization consisting of the State Forester from each state and territory which promotes cooperation in forestry matters between the states and territories, the federal government and private forestry groups. It promotes legislation, programs and activities which will advance the practice of forestry and use of forest products.

NATIONAL FIRE CODES (NFC): The collected technical fire protection standards prepared by various committees of the National Fire Protection Association and published annually in 15 volumes.

NATIONAL FIRE DANGER RATING SYSTEM(NFDRS): A uniform fire danger rating system that focuses on the environmental factors that control the moisture content of fuels.

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA): Nonprofit educational and technical association formed in 1896, headquartered in Quincy, Massachusetts, and devoted to the protection of life and property from fire through development of standards of fire protection and public education.

NATIONAL FOREST LANDS: Public lands, generally forest, range, or other wildland, administered by the Forest Service, USDA.

NATIONAL FOREST SYSTEM: Consists of all national forest lands, the national grasslands and land utilization projects administered under title III of the Bankhead-Jones Farm Tenant Act, and other interests as defined in Section 9 of the National Forest Management Act of 1976.

NATIONAL FUEL APPRAISAL SYSTEM: A procedure for estimating fire hazard in wildland fuels and evaluating fuel treatment effectiveness. The system is supported by a software package that includes four independent ASCII FORTRAN computer programs called FUELBED.

NATIONAL INTERAGENCY COORDINATION CENTER (NICC): Coordinates allocation of resources to one or more coordination centers or major fires within the nation. Located in Boise, Idaho.

NATIONAL INTERAGENCY FIRE CENTER (NIFC): A facility located at Boise, Idaho, jointly operated by several federal agencies, dedicated to coordination, logistical support, and improved weather services in support of fire management operations throughout the United States.

NATIONAL INTERAGENCY FIRE MANAGEMENT INTEGRATED DATABASE (NIFMID): An ORACLE database that contains wildland fire reports and weather data. Located at the National Computer Center, Kansas City.

NATIONAL INTERAGENCY INCIDENT MANAGEMENT SYSTEM (NIIMS): An NWCG developed program consisting of five subsystems which collectively provide a total systems approach to all-risk incident management. The subsystems are: The Incident Command System, Training, Qualifications and Certification, Supporting Technologies, and Publications Management.

NATIONAL PARK: A federal reservation administered by the National Park Service of the U.S. Department of the Interior in order to conserve unique scenery, flora and fauna, and any natural and historic objects within its boundaries for public enjoyment in perpetuity.

NATIONAL PIPE STRAIGHT HOSE THREAD (NPSH): Also known as National Pipe Straight Mechanical (NPSM) thread. This is a straight (nontapered) thread standard with the same threads per inch as the appropriate size iron pipe thread. It requires a gasket to seal and is the thread standard used by most U.S. industry.

NATIONAL RESOURCE LANDS (NRL): Public lands administered by the Bureau of Land Management, U.S. Department of the Interior.

NATIONAL WILDFIRE COORDINATING GROUP (NWCG): A group formed under the direction of the Secretaries of the Interior and Agriculture to improve the coordination and effectiveness of wildland fire activities and provide a forum to discuss, recommend appropriate action, or resolve issues and problems of substantive nature.

NATIONAL WILDLIFE REFUSE SYSTEM: All lands, waters and interests therein administered by the Fish and Wildlife Service for the protection and conservation of fish and wildlife, including those that are threatened with extinction.

NATIVE SPECIES: A species which is a part of the original fauna or flora of the area in question.

NATURAL BARRIER: Any area where lack of flammable material obstructs the spread of wildfires.

NEAR MISS: Any potential accident which, through prevention, education, hazard reduction, or luck, did not occur.

NET VALUE CHANGE (NVC): The sum of the changes in the value of natural resources affected by a fire. The basis for computing NVC is each resource's fire-induced value change (pluses and minuses) as computed and expressed on a per unit basis.

NEUTRAL ATMOSPHERE: Condition in which temperature decrease with increasing altitude is equal to the dry adiabatic lapse rate (i.e., the atmosphere neither aids nor hinders large-scale vertical motion).

NICHE (habitat niche): The peculiar arrangement of food, cover, and water that meets the requirements of a particular species.

NITROGEN DIOXIDE (NO ): The result of nitric oxide combining with oxygen in the atmosphere. A major component of photochemical smog.

NITROGEN OXIDE (NO): Product of combustion from transportation and stationary sources and a major contributor to acid deposition and the formation of ground level ozone in the troposphere.

NOMEX ®: Trade name for a fire resistant synthetic material used in the manufacturing of flight suits and pants and shirts used by firefighters. Aramid is the generic name.

NON-ATTAINMENT AREA: An area identified by an air quality regulatory agency through ambient air monitoring (and designated by the Environmental Protection Agency), that presently exceeds federal ambient air standards.

NON-CONVECTIVE-LIFT FIRE PHASE: Phase of a fire when most emissions are not entrained into a definite convection column

NON-POINT SOURCE: An area identified by an air quality regulatory agency through ambient air monitoring (and designated by the Environmental Protection Agency), that presently exceeds federal ambient air standards.

NONCOMMERCIAL FOREST LAND: Forest land incapable of yielding crops of commercially useful wood because of adverse site conditions, or productive forest land withdrawn from commercial timber use through statute or administrative regulation.

NONSTATISTICAL FIRE: Any fire not posing a threat to resources or property of the jurisdictional agency, regardless of whether action was taken by the agency.

NORMAL FIRE SEASON: (1) A season when weather, fire danger, and number and distribution of fires are about average. (2) Period of the year that normally comprises the fire season.

NORMAL FIRE YEAR: The year with the third greatest number of fires in the past ten.

NOTICE TO AIRMEN (NOTAM): Notice identified as either a NOTAM or Airmen Advisory containing information concerning the establishment, condition, or change in any component of, or hazard in, the National Airspace System, the timely knowledge of which is essential to personnel concerned with flight operations.

NOZZLE ASPIRATED FOAM SYSTEM: A foam generating device that mixes air at atmospheric pressure with foam solution in a nozzle chamber.

NOZZLE OPERATOR: A person assigned to operate a fire hose nozzle, usually on a hand line.

NUTRIENT: Elements or compounds that are essential as raw materials for organism growth and development, such as carbon, oxygen, nitrogen, and phosphorus. There are at least 17 essential nutrients.

# - O -

OBSERVATION TIME: Time of day required to record meteorological data at a fire danger station.

OBSTRUCTION TO VISION: Condition in which obscuring phenomenon restricts visibility to six statute miles (10 km.) or less.

OCCURRENCE INDEX (OI): A number in the National Fire Danger Rating System related to potential fire incidence within a protection unit.

OCCLUDED FRONT OR OCCLUSION: The front that is formed when and where a cold front overtakes a warm front or a stationary front.

OFFICER: The ICS title for personnel responsible for the Command Staff positions of Safety, Liaison, and Information.

OFF-SITE COLONIZERS: Plants that germinate and establish after a disturbance from seed that was carried from off of the site.

OFF-ROAD VEHICLE (ORV): Any motorized vehicle designed for, or capable of, cross-country travel on or immediately over land, water, sand, snow, ice, marsh, swampland, or other terrain. (Syn. ALL TERRAIN VEHICLE)

OFFSHORE FLOW: Wind blowing from land to water.

ON-SITE COLONIZERS: Plants that germinate and establish after a disturbance from seed that was present on the site at the time of the disturbance.

ONE-HOUR TIMELAG FUELS: Fuels consisting of dead herbaceous plants and roundwood less than about one-fourth inch (6.4 mm) in diameter. Also included is the uppermost layer of needles or leaves on the forest floor.

ONE-HOUR TIMELAG FUEL MOISTURE (l-h TL FM): Moisture content of one-hour timelag fuels.

ONE-HUNDRED HOUR TIMELAG FUELS: Dead fuels consisting of roundwood in the size range of 1 to 3 inches (2.5 to 7.6 cm) in diameter and very roughly the layer of litter extending from approximately three-fourths of an inch (1.9 cm) to 4 inches (10 cm) below the surface.

ONE-HUNDRED HOUR TIMELAG FUEL MOISTURE (l00-h TL FM): The moisture content of the l00-hour timelag fuels.

ONE-THOUSAND-HOUR TIMELAG FUELS: Dead fuels consisting of roundwood 3-8 inches in diameter and the layer of the forest floor more than about 4 inches below the surface.

ONE-THOUSAND-HOUR TIMELAG FUEL MOISTURE (l,000-h TL FM): The moisture content of the l,000-hour timelag fuels.

ONSHORE FLOW: Wind blowing from water to land.

OPEN BURNING: Uncontrolled burning of wastes in the open or in an open dump.

OPERATIONAL PERIOD: The period of time scheduled for execution of a given set of tactical actions as specified in the Incident Action Plan. Operational Periods can be of various lengths, although usually not over 24 hours.

OPERATIONS COORDINATION CENTER (OCC): Primary facility of the Multi-agency Coordination System (MACS); houses staff and equipment necessary to perform the MACS function.

OPERATIONS SECTION: The section responsible for all tactical operations at the incident. Includes branches, divisions and/or groups, task forces, strike teams, single resources and staging areas.

ORGANIC MATTER: That fraction of the soil that includes plant and animal residues at various stages of decomposition, cells and tissues of soil organisms, and substances synthesized by the soil population.

ORGANIC SOIL: Any soil or soil horizon containing at least 30%, organic matter (e.g., muck, peat).

OROGRAPHIC: Pertaining to, or caused by mountains.

ORTHOPHOTO: Photograph obtained from the orthogonal (i.e., horizontal) projection of a correctly oriented stereoscopic model formed by two overlapping aerial photographs; an orthophoto is free of tilt and relief displacements.

ORTHOPHOTO MAPS: Aerial photographs corrected to scale such that geographic measurements may be taken directly from prints. They may contain graphically emphasized geographic features and may be provided with overlays of such features as: water systems, facility location, etc.

OSBORNE FIREFINDER: A sighting device used by lookouts to determine the horizontal bearing and sometimes the vertical angle of a fire from a lookout. (Syn. ALIDADE) (see also FIREFINDER MAP)

OUTSIDE AID: Firefighting assistance given to adjacent areas and nearby communities by contract or other agreement that covers conditions and payment for assistance rendered and services performed. Contrasted to mutual aid, in which neighboring firefighting organizations assist each other without charge.

OVERHEAD: Personnel assigned to supervisory positions, including incident commander, command staff, general staff, branch directors, supervisors, unit leaders, managers and staff.

OVERLOAD: Gross vehicle weight (GVW) in excess of the gross vehicle weight rating (GVWR) specified by the chassis manufacturer**.** Also an excess of weight over the gross axle weight rating (GAWR) specified by the chassis manufacturer.

OVERWINTERING FIRE: A fire that persists through the winter months until the beginning of fire season.

# - P -

PACKING RATIO: The fraction of a fuel bed occupied by fuels, or the fuel volume divided by bed volume.

PACK TEST: Used to determine the aerobic capacity of fire suppression support personnel and assign physical fitness scores. The test consists of walking a specified distance, with or without a weighted pack, in a predetermined period of time, with altitude corrections.

PANORAMIC PHOTOGRAPH: Photographs from a lookout point, bearing azimuth and vertical angle scales, to assist in locating fires with a firefinder.

PANORAMIC PROFILE MAP: A panoramic sketch drawn around the circumference of a firefinder map to show the profiles of the topography as it appears from the lookout.

PARALLEL ATTACK: Method of fire suppression in which fireline is constructed approximately parallel to, and just far enough from the fire edge to enable workers and equipment to work effectively, though the fireline may be shortened by cutting across unburned fingers. The intervening strip of unburned fuel is normally burned out as the control line proceeds but may be allowed to burn out unassisted where this occurs without undue delay or threat to the fireline.

PARALLEL BURNING: (1) A type of suppression fire. Igniting a narrow strip of fuel adjacent to a control line and then burning successively wider adjacent strips as the preceding strip burns out. (2) Burning only a relatively narrow strip or strips through an area of slash, leaving the remainder. (3) Burning slash in strips generally 100-300 feet wide along roads or barriers to subdivide the slash area into blocks.

PARAMETER: A variable which can be measured quantitatively; sometimes, an arbitrary constant; associated with populations. One of the unknown values that determine a model.

PARTIAL RISK: Part of the National Fire Danger Rating System (NFDRS). Contribution of a specific source to human-caused risk, derived from the daily activity level assigned a risk source and its risk source ratio.

PARTIAL RISK FACTOR: Part of the National Fire Danger Rating System (NFDRS). Contribution to human-caused risk made by a specific risk source; a function of the daily activity level assigned that risk source and the appropriate risk source ratio.

PARTIAL SLASH DISPOSAL: Slash disposal by any method or combination of methods, resulting in the destruction of only a portion of the slash on a given area.

PARTICLE SIZE: The size of a piece of fuel, often expressed in terms of size classes.

PARTICULATE MATTER: Any liquid or solid particles. "Total suspended particulates" as used in air quality are those particles suspended in or falling through the atmosphere. They generally range in size from 0.1 to 100 microns.

PARTICULATES: Fine liquid or solid particles such as dust, smoke, mist, fumes, or smog found in air or emissions.

PARTS OF A FIRE: On typical free-burning fires the spread is uneven with the main spread moving with the wind or up slope. The most rapidly moving portion is designated the head of the fire, the adjoining portions of the perimeter at right angles to the head are known as the flanks, and the slowest moving portion is known as the rear or the base of the fire.

PASSIVE CROWN FIRE: A fire in the crowns of trees in which trees or groups of trees torch, ignited by the passing front of the fire. The torching trees reinforce the spread rate, but these fires are not basically different from surface fires.

PATCH BURNING: Burning in patches to prepare sites for group planting or sowing or to form a barrier to subsequent fires.

PATROL: (1) To travel over a given route to prevent, detect, and suppress fires. (2) To go back and forth vigilantly over a length of control line during and/or after construction to prevent breakovers, suppress spot fires, and extinguish overlooked hot spots. (3) A person or group of persons who carry out patrol actions.

PATTERN: The distribution of an aerially delivered retardant drop on the target area in terms of its length, width, and momentum (velocity x mass) as it approaches the ground. The latter determines the relative coverage level of the fire retardant on fuel within the pattern. (Syn. DROP PATTERN)

PEAK FIRE SEASON: That period of the fire season during which fires are expected to ignite most readily, to burn with greater than average intensity, and to create damages at an unacceptable level.

PEAK MONTHLY AVERAGE: Highest monthly average of human-caused fires calculated for a protection unit.

PEAK WIND: The greatest 5-second average wind speed during the previous hour that exceeded 25 knots.

PERCOLATION: Passage of liquid through a porous body, as movement of water through soil.

PERENNIAL PLANT: A plant that continues to grow year after year.

PERIMETER ACCESS: Fireline suitable for vehicle travel.

PERIOD OF ALERT: Period of time when suppression crews, equipment, and aircraft are kept ready for deployment on short notice; usually employed when fire danger reaches a predetermined severity index.

PERSONAL PROTECTIVE EQUIPMENT (PPE): That equipment and clothing required to mitigate the risk of injury from or exposure to hazardous conditions encountered during the performance of duty. PPE includes but is not limited to: fire resistant clothing, hard hat, flight helmets, shroud, goggles, gloves, respirators, hearing protection, chainsaw chaps, and shelter.

PILING AND BURNING: Piling slash resulting from logging or fuel management activities and subsequently burning the individual piles.

PILOT BALLOON OPERATION (PIBAL): A method of determining winds aloft in the vicinity of an observation station by periodically reading the elevation and azimuth angles of a theodolite, usually at one-minute intervals, while tracking the ascent of a small free-lift balloon. A PIBAL is commonly used for constructing a wind profile.

PINCER ACTION: Direct attack around a fire in opposite directions by two or more attack units.

PING-PONG BALL SYSTEM: Mechanized method of dispensing DAIDs (Delayed Aerial Ignition Devices) at a selected rate. The DAIDs are polystyrene balls, 1.25 inches in diameter, containing potassium permanganate. The balls are fed into a dispenser, generally mounted in a helicopter, where they are injected with a water-glycol solution and then drop through a chute leading out of the helicopter. The chemicals react thermally and ignite in 25-30 seconds. The space between ignition points on the ground is primarily a function of helicopter speed, gear ratio of the dispenser, and the number of chutes used (up to four). (see also AERIAL IGNITION DEVICE, DELAYED AERIAL IGNITION DEVICES, HELITORCH, PLASTIC SPHERE DISPENSER)

PLAN OF ATTACK: The selected course of action and organization of personnel and equipment in fire suppression, as applied to a particular fire or to all fires of a specific type.

PLANETARY BOUNDARY LAYER: That layer of the atmosphere from the earth's surface to the gradient wind level, i.e., the friction layer.

PLANNING INTERVAL: Period of time between scheduled planning meetings.

PLANNING MEETING: A meeting held regularly throughout the duration of an incident, to select specific strategies and tactics for incident control operations and to plan for needed service and support. On larger incidents, the planning meeting is a major element in the development of the Incident Action Plan.

PLASTIC SPHERE DISPENSER (PSD): Device installed, but jettisonable, in a helicopter, which injects glycol into a plastic sphere containing potassium permanganate, which is then expelled from the machine and aircraft. This produces an exothermic reaction resulting in ignition of fuels on the ground for prescribed or wildland fire applications. (see also AERIAL IGNITION DEVICES, DELAYED AERIAL IGNITION DEVICES, HELITORCH, PING-PONG BALL SYSTEM)

PLOW LINE: Fireline constructed by a fire plow, usually drawn by a tractor or other motorized equipment. (see also DOZER, TRACTOR, TRACTOR PLOW)

PLUME: The segment of the atmosphere occupied by the emissions from a single source or a grouping of sources close together. A convection column, if one exists, forms a specific part of the plume.

PLUME-DOMINATED WILDFIRE: A wildland fire whose activity is determined by the convection column.

PLUME RISE: How high above the level of release an emission plume rises.

POCKETS OF A FIRE: Unburned indentations in the fire edge formed by fingers or slow burning areas.

POINT OF ATTACK: That part of the fire on which work is started when suppression crews arrive.

POINT OF ORIGIN: Point of original ignition of a fire.

POINT SOURCE: A permanent source of air pollution that can be distinctly identified such as a smokestack.

POINT SOURCE FIRE PREDICTIONS: Predictions that apply to an initiating fire burning during a time when conditions have been relatively constant, or where it can be assumed that the fire will maintain a basically elliptical shape.

POISE: Unit of fluid viscosity in fire retardant, defined as tangential force per unit area (dynes/square centimeter) required to maintain unit difference in velocity (1 centimeter/second) between two parallel planes separated by 1 cm of fluid (1 poise=l dyne-second/cubic centimeter).

POLLUTANT: Any substance in the atmosphere that is foreign to the natural atmosphere or that exceeds its natural concentrations in the atmosphere. The universal connotation is that a pollutant is potentially deleterious.

PORTABLE PUMP: Small gasoline-driven pump that can be carried to a water source by one or two firefighters or other conveyance over difficult terrain.

PORTATANK: Container, either with rigid frame or self supporting, which can be filled with water or fire chemical mixture from which fire suppression resources can be filled. It can also be a source for charging hose lays from portable pumps or stationary engines.

POSITIVE DISPLACEMENT PUMP: A pump which moves a specified quantity of water through the pump chamber with each stroke or cycle; it is capable of pumping air, and therefore is self-priming, but must have pressure relief provisions if plumbing or hoses have shut-off nozzles or valves. Gear pumps and piston pumps are common examples of this type.

POUNDS PER SQUARE INCH (PSI): Measurement of pressure (e.g., pump pressure, nozzle pressure, friction loss in hose, pressure loss or gain due to elevation).

PREATTACK: A planned, systematic procedure for collecting, recording, and evaluating prefire and fire management intelligence data for a given planning unit or preattack block. The planning phase is usually followed by a construction and development program integrated with other resources and activities.

PREATTACK BLOCK: Unit of wildland delineated by logical and strategic topographic features for preattack planning.

PREATTACK PLANNING: Within designated blocks of land, planning the locations of firelines, fire camps, water sources, and helispots; planning transportation systems, probable rates of travel, and constraints of travel on various types of attack units; and determining what types of attack units likely would be needed to construct particular firelines, their probable rate of fireline construction, and topographic constraints on fireline construction.

PRECIPITATION: Any or all forms of water particles, liquid or solid that fall from the atmosphere and reach the ground.

PRECIPITATION DURATION: Time, in hours and fraction of hours, that a precipitation event lasts. More precisely, for fire danger rating purposes, the length of time that fuels are subjected to liquid water.

PRECIPITATION GAUGE: Device commonly used to collect and permit measurement of any form of rain and snow sufficiently heavy to have fallen to the earth's surface. Also called rain gauge.

PREIGNITION COMBUSTION PHASE: Thermal or chemical decomposition of fuel at an elevated temperature. This is the pre-combustion stage of burning during which distillation and pyrolysis predominate. Heat energy is absorbed by the fuel which, in turn, gives off water vapor and flammable tars, pitches, and gases. These ignite when mixed with oxygen to initiate the flaming combustion phase.

PREIGNITION PHASE: Preliminary phase of combustion in which fuel elements ahead of the fire are heated, causing fuels to dry. Heat induces decomposition of some components of the wood, causing release of combustible organic gases and vapors.

PREMARKING BURN: Burning of understory brush prior to the sale of forest products to improve the efficiency of timber marking and harvesting. (Syn. ACCESSIBILITY BURN)

PREPAREDNESS: (1) Condition or degree of being ready to cope with a potential fire situation. (2) Mental readiness to recognize changes in fire danger and act promptly when action is appropriate. (see also READINESS)

PREPAREDNESS PLAN: A written plan providing for timely recognition of approaching critical fire situations, priority setting, the deployment of forces, and other actions to respond to those situations.

PRESCRIBED BURNING: Controlled application of fire to wildland fuels in either their natural or modified state, under specified environmental conditions, which allows the fire to be confined to a predetermined area, and produce the fire behavior and fire characteristics required to attain planned fire treatment and resource management objectives.

PRESCRIBED FIRE: A management ignited wildland fire that burns under specified conditions where the fire is confined to a predetermined area and produce the fire behavior and fire characteristics required to attain planned fire treatment and resource management objectives.

PRESCRIBED NATURAL FIRE: Naturally ignited wildland fire that burns under specified conditions where the fire is confined to a predetermined area and produce the fire behavior and fire characteristics to attain planned fire treatment and resource management objectives.

PRESCRIPTION: A written statement defining the objectives to be attained as well as the conditions of temperature, humidity, wind direction and speed, fuel moisture, and soil moisture, under which a fire will be allowed to burn. A prescription is generally expressed as acceptable ranges of the prescription elements, and the limit of the geographic area to be covered.

PRESSURE GRADIENT: The difference in atmospheric pressure between two points on a weather map. That is, the magnitude of pressure difference between two points at sea level, or at constant elevation above sea level. Wind speed is directly related to pressure gradient. If distance between constant pressure lines is reduced by one-half, wind speed will be doubled. Conversely, if distance between lines is doubled, wind speed will be reduced by one-half.

PRESSURE PATTERN: The distribution of surface atmospheric pressure features over an area of the earth as shown on a weather map. Surface pressure features include lines of constant pressure (isobars), highs, lows, and pressure gradient. The pressure pattern is directly related to wind speeds and directions at specific locations.

PRESUPPRESSION: Activities in advance of fire occurrence to ensure effective suppression action. Includes planning the organization, recruiting and training, procuring equipment and supplies, maintaining fire equipment and fire control improvements, and negotiating cooperative and/or mutual aid agreements.

PRETREAT: The use of water, foam or retardant along a control line in advance of the fire. Often used where ground cover or terrain is considered best for control action.

PREVENTION: Activities directed at reducing the incidence of fires, including public education, law enforcement, personal contact, and reduction of fuel hazards (fuels management).

PREVENTION OF SIGNIFICANT DETERIORATION (PSD): A program identified by the Clean Air Act to prevent air quality and visibility degradation and to remedy existing visibility problems. Areas of the country are grouped into 3 classes which are allowed certain degrees of pollution depending on their uses. National Parks and Wilderness Areas meeting certain criteria are "Class I" or "clean area" in that they have the smallest allowable increment of degradation.

PRIMARY LOOKOUT: A lookout point that must be staffed to meet planned minimum seen area coverage in a given locality. For that reason, continuous service is necessary during the normal fire season and the lookout (person) is not sent to fires.

PROBABILITY: A number representing the chance that a given event will occur. The range is from 0% for an impossible event, to 100% for an inevitable event.

PROBABILITY FORECAST: A forecast of the probability of occurrence of one or more of a mutually exclusive set of weather contingencies as distinguished from a series of categorical
statements.

PROBABILITY OF IGNITION: The chance that a firebrand will cause an ignition when it lands on receptive fuels.

PROTECTING AGENCY: Agency responsible for providing direct incident management within a specific geographical area pursuant to its jurisdictional responsibility or as specified and provide by contract, cooperative agreement, etc. (see also FIRE AGENCY, RESPONSIBLE FIRE AGENCY)

PROTECTION: The actions taken to limit the adverse environmental, social, political, and economical effects of fire.

PROTECTION AREA: That area for which a particular fire protection organization has the primary responsibility for attacking an uncontrolled fire and for directing the suppression action. Such responsibility may develop through law, contract, or personal interest of the firefighting agent (e.g., a lumber operator). Several agencies or entities may have some basic responsibilities (e.g., private owner) without being known as the fire organization having direct protection responsibility. (Syn. DIRECT PROTECTION AREA)

PROTECTION BOUNDARY: The exterior perimeter of an area within which a specified fire agency has assumed a degree of responsibility for wildland fire control. It may include land in addition to that for which the agency has jurisdiction or contractual responsibility.

PROTECTION FOREST: An area, wholly or partially covered with woody growth, managed primarily to regulate stream flow, maintain water quality, minimize erosion, stabilize drifting sand, or exert any other beneficial forest influences.

PROTECTION UNIT: A geographical area which is administratively defined and which is the smallest area for which organized fire suppression activities are formally planned.

PSYCHROMETER: The general name for instruments designed to determine the moisture content of air. A psychrometer consists of dry- and wet-bulb thermometers that give the dry- and wet-bulb temperatures, which in turn are used to determine relative humidity and dew point.

PULASKI: A combination chopping and trenching tool widely used in fireline construction, which combines a single-bitted axe blade with a narrow adze-like trenching blade fitted to a straight handle.

PULLING TOPS: Protective measure in timber harvesting area whereby unutilized treetops, with branches attached, along with accumulations of other slash, are dragged away from seed trees or advanced regeneration to reduce damage in case of accidental fires.

PUNK: Partly decayed material, such as old wood, in which fire can smolder unless it is carefully mopped up and extinguished. A good receptor for firebrands when dry.

PYROLYSIS: The thermal or chemical decomposition of fuel at an elevated temperature. This is the preignition combustion phase of burning during which heat energy is absorbed by the fuel, which, in turn, gives off flammable tars, pitches, and gases.

# - Q -

QUADRANGLE: Mapping unit which defines an area in terms of longitude and latitude distance. Two common scales are 1:24,000 quadrangles, which are 7.5' longitude x 7.5' latitude, and 1:62,500 quadrangles, which are 15' longitude x 15' latitude.

# - R -

RADIANT BURN: A burn received from a radiant heat source.

RADIANT HEAT FLUX: The amount of heat flowing through a given area in a given time, usually expressed as calories/square centimeter/second.

RADIATION: (1) Propagation of energy in free space by virtue of joint, undulatory variations in the electric or magnetic fields in space, (i.e., by electromagnetic waves). (2) Transfer of heat in straight lines through a gas or vacuum other than by heating of the intervening space.

RADIOSONDE: A device carried aloft by a balloon equipped with measuring instruments that automatically convert temperature, pressure, and humidity data into electrical impulses and transmit this information to a ground recorder. (see also SOUNDING)

RAILROAD FIRE: A fire resulting from any operation or activity of a common carrier railroad, except smoking.

RANGE FIRE: Any wildfire on rangeland.

RANGER DISTRICT: An administrative subdivision of a national forest (under a district ranger) or other tract of public land.

RATE OF SPREAD: The relative activity of a fire in extending its horizontal dimensions. It is expressed as rate of increase of the total perimeter of the fire, as rate of forward spread of the fire front, or as rate of increase in area, depending on the intended use of the information. Usually it is expressed in chains or acres per hour for a specific period in the fire's history.

RATE OF SPREAD FACTOR: A factor usually on a scale of 1 to 100 which represents a relative rate of forward spread for a specific fuel condition and fixed weather conditions (or fuel model). Factors can be used as multipliers, arguments for entering tables, or provide a ratio of values between two fuels.

RATE OF SPREAD METER: A device that computes the probable rate of spread of a fire for different combinations of fuel moisture, wind speed, and other selected factors.

RATING PERIOD: Part of the National Fire Danger Rating System (NFDRS). The period of time during which a fire danger rating value is considered valid or representative for administrative or other purposes. Normally it is 24 hours extending from midnight to midnight.

RAWINSONDE: Method of upper-air observation consisting of an evaluation of the wind speed and wind direction, temperature, pressure, and relative humidity aloft by means of a balloon-borne radiosonde tracked by a radar or radio direction-finder.

REACTION INTENSITY: The rate of heat release, per unit area of the flaming fire front, expressed as heat energy/area/time, such as Btu/square foot/minute, or Kcal/square meter/second. (see also COMBUSTION RATE)

READINESS: (1) Condition or degree of being completely ready to cope with a potential fire situation. (2) Mental readiness to recognize changes in fire danger and act promptly when action is appropriate. (see also PREPAREDNESS)

REAR (of a fire): (1) That portion of a fire spreading directly into the wind or down slope. (2) That portion of a fire edge opposite the head. (3) Slowest spreading portion of a fire edge. Also called heel of a fire.

REASONABLY AVAILABLE CONTROL MEASURES (RACM): Control measures developed by EPA which apply to residential wood combustion, fugitive dust, and prescribed and silvicultural burning in and around "moderate" PM-10 non-attainment areas. RACM is designed to bring an area back into attainment and uses a smoke management program which relies on weather forecasts for burn/no-burn days.

REBURN: (1) Repeat burning of an area over which a fire has previously passed, but left fuel that later ignites when burning conditions are more favorable; (2) An area that has reburned.

RECONNAISSANCE (RECON): To examine a fire area to obtain information about current and probable fire behavior and other related fire suppression information.

RECOVERY: The increase in fuel moisture as a result of increased relative humidity, usually occurring overnight.

RECREATION FIRE: A fire resulting from recreational use, except smoking.

RED CARD: Fire qualification card issued to fire rated persons showing their training needs and their qualifications to fill specified fire suppression positions in a large fire suppression or incident organization.

RED FLAG WARNING: Term used by fire weather forecasters to alert forecast users to an ongoing or imminent critical fire weather pattern. (see also FIRE WEATHER WATCH)

REGIONAL HAZE: Atmospheric haze over a large area with no attributable source.

REHABILITATION: The activities necessary to repair damage or disturbance caused by wildfire or the wildfire suppression activity.

REINFORCED RESPONSE: Those resources requested in addition to the initial attack resources.

REKINDLE: Reignition due to latent heat, sparks, or embers or due to presence of smoke or steam.

RELATIVE HUMIDITY (RH): The ratio of the amount of moisture in the air, to the maximum amount of moisture that air would contain if it were saturated. The ratio of the actual vapor pressure to the saturated vapor pressure.

REMOTE AUTOMATIC WEATHER STATIONS (RAWS): An apparatus that automatically acquires, processes, and stores local weather data for subsequent transmission to the GOES Satellite, from which they are retransmitted to an earth receiving station for use in the National Fire Danger Rating System.

REPEATER: A radio signal station that automatically relays a radio transmission, sometimes over a different frequency, thereby increasing the range of transmission. Repeaters are often named for the mountaintops or peaks where they are installed.

REPORTABLE FIRE: Any wildfire that requires fire suppression to protect natural resources or values associated with natural resources, or is destructive to natural resources.

RESCUE: Saving a life from fire or accident; removing a victim from an untenable or unhealthy atmosphere.

RESCUE MEDICAL: Any staffed ground vehicle capable of providing medical services.

RESERVE: In wildland fire suppression terminology resources not assigned to a specific task, but available for assignment.

RESIDENCE TIME: The time, in seconds, required for the flaming front of a fire to pass a stationary point at the surface of the fuel. The total length of time that the flaming front of the fire occupies one point.

RESIDUAL COLONIZERS: Plants that germinate after a disturbance from seed that was present on the site.

RESIDUAL COMBUSTION STAGE: The smoldering zone behind the zone of an advancing fire front.

RESIDUAL SMOKE: Smoke produced by smoldering material after the initial fire front has passed through the fuel.

RESIDUE TREATMENT: Managing, manipulating, removing, or modifying forest residue. Treatments may involve piling, chipping, crushing, burning, burying, lopping, herbicide spraying of live residues, leaving for natural deterioration, removal, or a combination of these.

RESISTANCE TO CONTROL: The relative difficulty of constructing and holding a control line as affected by resistance to line construction and by fire behavior. Also called difficulty of control.

RESISTANCE TO LINE CONSTRUCTION: The relative difficulty of constructing control line as determined by the fuel, topography, and soil.

RESOURCES: (1) Personnel, equipment, services and supplies available, or potentially available, for assignment to incidents. Personnel and equipment are described by kind and type, e.g., ground, water, air, etc., and may be used in tactical, support or overhead capacities at an incident. (2) The natural resources of an area, such as timber, grass, watershed values, recreation values, and wildlife habitat. (see also VALUES-AT-RISK)

RESOURCE ORDER: The form used by dispatchers, service personnel, and logistics coordinators to document the request, ordering or release of resources, and the tracking of those resources on an incident.

RESOURCE STATUS BOARD: Visual aid containing pertinent information regarding fire organization, current operational period resources, previous operational period resources, and next operational period resources being prepared; placed at a convenient location in fire camp for review by fireline overhead personnel on large fires.

RESOURCE VALUE-AT-RISK: Fire suppression planning tool providing a relative expression (in five classes) of fire effects on all resources (not the value of the resources themselves).

RESPIRATION: Oxidation of food in living cells, with the resulting release of energy; part of the energy is transferred to other compounds and some is used in the activation of certain cell processes.

RESPONSE: Movement of an individual firefighting resource from its assigned standby location to another location or to an incident in reaction to dispatch orders or to a reported alarm.

RESPONSIBLE FIRE AGENCY: Agency with primary responsibility for fire suppression on any particular land area. (see also FIRE AGENCY, PROTECTING AGENCY)

RETARDANT: A substance or chemical agent which reduces the flammability of combustibles.

RETARDANT COVERAGE: Area of fuel covered and degree of coverage on the fuel by a fire retardant, usually expressed in terms of gallons per hundred square feet (liters per square meter).

RHEOLOGY: Science of deformation and flow of fire retardants and other liquids, especially of the cohesiveness bodies and stress-strain relationship of their particles.

RHEOLOGIC PROPERTIES: Flow characteristics of liquid fire retardants, especially their cohesiveness or ability to hold together while falling through the air.

RIDGE: An elongated area of relatively high atmospheric pressure extending from the center of a high-pressure region. (see also SURFACE HIGH)

RING FIRE: A fire started by igniting the full perimeter of the intended burn area so that the ensuing fire fronts converge toward the center of the burn. Set around the outer perimeter of a resource to establish a protective black-line-buffer.

RISK: (1) The chance of fire starting as determined by the presence and activity of causative agents. (2) A causative agent. (3) (NFDRS) A number related to the potential of firebrands to which a given area will be exposed during the rating day.

RISK INDEX: A number related to the probability of a firebrand igniting a fire.

RISK SOURCE: Identifiable human activity that historically has been a major cause of wildfires on a protection unit; one of the eight general causes listed on the standard fire report.

RISK SOURCE RATIO: Portion of human-caused fires that have occurred on a protection unit chargeable to a specific risk source; calculated for each day of the week for each risk source.

ROLL CLOUD: A turbulent altocumulus-type cloud formation found in the lee of some large mountain barriers. The air in the cloud rotates around an axis parallel to the range. Also sometimes refers to part of the cloud base along the leading edge of a cumulonimbus cloud; it is formed by rolling action in the wind shear region between cool downdrafts within the cloud and warm updrafts outside the cloud. Also called rotor cloud.

ROTORCRAFT: An aircraft that depends principally on the lift generated by one or more rotors for its support in flight. Also called rotary wing. (Syn. HELICOPTER).

ROUGH: The accumulation of living and dead ground and understory vegetation, especially grasses, forest litter, and draped dead needles, sometimes with addition of underbrush such as palmetto, gallberry, and wax myrtle. Most often used for southern pine types.

ROUGH REDUCTION: Reduction of fire hazard in rough, usually by prescribed burning.

ROUTE CARD: Index card used by a dispatcher and frequently carried on rural fire apparatus which lists specific directions for responding to individual rural properties and frequently includes a description of the property, water sources available, and any special information pertinent to fire suppression and rescue operations. Also called running card.

RUN (of a fire): Rapid advance of the head of a fire, characterized by a marked transition in fireline intensity and rate of spread with respect to that noted before and after the advance.

RUNNING FIRE: Behavior of a fire spreading rapidly with a well defined head.

RURAL: Any area wherein residences and other developments are scattered and intermingled with forest, range, or farm land and native vegetation or cultivated crops.

RURAL FIRE DISTRICT (RFD): An organization established to provide fire protection to a designated geographic area outside of areas under municipal fire protection. Usually has some taxing authority and officials may be appointed or elected.

RURAL FIRE PROTECTION: Fire protection and firefighting problems that are outside of areas under municipal fire prevention and building regulations and that are usually remote from public water supplies.

# - S -

SADDLE: Depression or pass in a ridgeline.

.

SAFETY OFFICER: A member of the command staff responsible to the incident commander for monitoring and assessing hazardous and unsafe situations, and developing measures for assessing personnel safety.

SAFETY ZONE: An area cleared of flammable materials used for escape in the event the line is outflanked or in case a spot fire causes fuels outside the control line to render the line unsafe. In firing operations, crews progress so as to maintain a safety zone close at hand allowing the fuels inside the control line to be consumed before going ahead. Safety zones may also be constructed as integral parts of fuelbreaks; they are greatly enlarged areas which can be used with relative safety by firefighters and their equipment in the event of blowup in the vicinity. (see also DEPLOYMENT ZONE)

SAMPLE: Part of a population; that portion of the population that is measured.

SAMPLE SIZE: The number of items or observations in a sample; usually denoted by lower case letter n.

SCORCH HEIGHT: Average heights of foliage browning or bole blackening caused by a fire.

SCRATCH LINE: An unfinished preliminary control line hastily established or constructed as an emergency measure to check the spread of fire.

SEA BREEZE: A breeze (wind) blowing inland from the sea generally during daytime hours.

SEA-LEVEL PRESSURE: Pressure value obtained by the theoretical reduction or increase of station pressure to sea level. The average atmospheric pressure at sea level is 14.7 psi.

SEASONAL MONTHLY AVERAGE: Historically, the average number of human-caused fires occurring on a protection unit per month during the established fire season.

SEASONAL RISK CLASS: Objective ranking of protection units within an administrative group based on the number of human-caused fires for at least the past five years.

SECONDARY LINE: Any fireline constructed at a distance from the fire perimeter concurrently with or after a line already constructed on or near to the perimeter of the fire. Generally constructed as an insurance measure in case the fire escapes control by the primary line.

SECONDARY LOOKOUT: (1) A lookout point intermittently used to supplement the visible area coverage of the primary lookout system when required by fire danger, poor visibility, or other factors. (2) The person who occupies such a station.

SECONDARY WEATHER STATION: Station at which minimum weather measurements are taken to compute ratings of burning conditions; provides supplementary information on weather experience.

SECTION: That organizational level with responsibility for a major functional area of the incident, such as: operations, planning, logistics, finance/administration. The section is organizationally between branch and incident commander.

SECURITY WEATHER WATCH: Observers are posted at one or more strategic locations in the proximity of a fire to detect and warn fire personnel of pending critical weather changes that might significantly affect the fire.

SEEN AREA: Ground, or vegetation growing thereon, that is directly visible under specified atmospheric conditions from an established or proposed lookout point or aerial detection flight route. (see also VISIBLE AREA MAP)

SEGMENT: A geographical area in which a task force/strike team leader or supervisor of a single resource is assigned authority and responsibility for the coordination of resources and implementation of planned tactics. A segment may be a portion of a division or an area inside or outside the perimeter of an incident. Segments are identified with arabic numbers, i.e., A-1, etc. and are not to be used as radio designators.

SELF-CONTAINED BREATHING APPARATUS (SCBA): Portable air (not oxygen) tanks with regulators which allow firefighters to breathe while in toxic smoke conditions. Usually rated for 30 minutes of service. Used primarily on fires involving structures or hazardous materials. (Syn. AIR PACK) (see also RESPIRATOR)

SERIOUS AIRCRAFT INCIDENT: An incident or malfunction that could adversely affect the safety of flight.

SEROTINY: Storage of coniferous seeds in closed cones in the canopy of the tree. Serotinous cones of lodgepole pine do not open until subjected to temperatures of 45 to 50 C (113 to 122 F), causing the melting of the resin bond that seals the cone scales.

SEROTINOUS CONE: In forest fire usage, a cone that remains closed on the tree for several years and requires heat from a fire to open the scales and release the seed.

SERVICE CENTER: Point of support for items not ordered through dispatch.

SET: (1) An individual incendiary fire. (2) The point or points of origin of an incendiary fire. (3) Material left to ignite an incendiary fire at a later time. (4) Individual lightning or railroad fires, especially when several are started within a short time. (5) Burning material at the points deliberately ignited for backfiring, slash burning, prescribed burning, and other purposes.

SETTING OPPORTUNITY: The combination of physical, social and managerial attributes present on a particular land area which influences the experience obtained in a specific recreation activity such as hiking, skiing, or camping.

SEVERE BURN: Degree of burn in which all organic material is removed from the soil surface, and soil surface is discolored (usually red) by heat; organic material below the surface is consumed or charred.

SEVERITY FUNDING: Funds provided to increase wildland fire suppression response capability necessitated by abnormal weather patterns, extended drought, or other events causing abnormal increase in the fire potential and/or danger.

SEVERITY INDEX: A number that indicates the relative net effects of daily fire danger on the fire load for an area during a specified period, such as a fire season.

SHADED FUELBREAK: Fuelbreaks built in timbered areas where the trees on the break are thinned and pruned to reduce the fire potential yet retain enough crown canopy to make a less favorable microclimate for surface fires.

SHORT-LIFE SPECIES: A plant that grows several years before being replaced by a species more adapted to the changing site conditions.

SHORT-RANGE SPOTTING: Firebrands, flaming sparks, or embers are carried by surface winds, starting new fires beyond the zone of direct ignition by the main fire. The range of such spotting is usually less than 1/4 mile.

SHORT TAKEOFF OR LANDING (STOL) AIRCRAFT: An aircraft which has the capability of operating from a STOL runway in accordance with applicable airworthiness and operating regulations.

SHORT-TERM: Persons or work for which employment is less than 12 months (excluding firefighters hired for a particular fire).

SHRUB: A woody perennial plant differing from a perennial herb by its persistant and woody stem; and from a tree by its low stature and habit of branching from the base.

SIMULATION: A realistic protrayal of a task or operation that enables the operator/trainee to experience, under artificial conditions, situations likely to occur in actual performance of duty. Simulations are highly effective when dealing with hazardous or extremely expensive conditions.

SINGLE RESOURCE: An individual, a piece of equipment and its personnel complement, or a crew or team of individuals with an identified work supervisor that can be used on an incident.

SITE PREPARATION: Removal or killing of unwanted vegetation, residue, etc. by use of fire, herbicides, or mechanical treatment in preparation for reforestation and future management.

SITE PREPARATION BURNING: Fire ignited to expose adequate mineral soil and control competing vegetation until seedlings of the desired species become established.

SITUATION ANALYSIS: Analysis of factors which influence suppression of an escaped fire from which a plan of attack will be developed; includes development of alternative strategies of fire suppression and net effect of each.

SIZE CLASS OF FIRE (As to size of wildfire):

Class A - one-fourth acre or less
Class B - more than one-fourth acre, but less than 10 acres
Class C - 10 acres or more, but less than 100 acres
Class D - 100 acres or more, but less than 300 acres
Class E - 300 acres or more, but less than 1,000 acres
Class F - 1,000 acres or more, but less than 5,000 acres
Class G - 5,000 acres or more.
(see also CLASS OF FIRE)

SIZEUP: The evaluation of the fire to determine a course of action for suppression.

SKID TRAIL: Any road or trail formed by the process of skidding logs from stump to landing.

SKIDDER UNIT: A self-contained unit consisting of a water tank, fire pump, and hose specially designed to be carried on a logging skidder for use in forest fire suppression.

SKY COVER: Amount of clouds and/or other obscuring phenomena that are detectable from the point of observation.

SLASH: Debris resulting from such natural events as wind, fire, or snow breakage; or such human activities as road construction, logging, pruning, thinning, or brush cutting. It includes logs, chunks, bark, branches, stumps, and broken understory trees or brush.

SLASH DISPOSAL: Treatment of slash to reduce fire hazard or for other purposes. (Preferred to Brush Disposal).

SLASH DISPOSAL BURN: (1) In fire suppression terminology, a fire spreading from any fire originally ignited to clear land or burn rubbish, garbage, crop stubble, or meadows (excluding incendiary fires). (2) In prescribed fire terminology, a fire used to dispose of scattered, piled, or windrowed dead woody fuel, generally in the absence of a merchantable overstory. Its purpose is to reduce unsightly fuel concentrations, or consume unwanted natural fuels to facilitate subsequent resource management or land use actions on the area.

SLING PSYCHROMETER: A hand operated instrument for obtaining wet and dry bulb temperature readings and, subsequently, relative humidity.

SLOPE CLASS: Part of the National Fire Danger Rating System (NFDRS). Code which designates the most common slope encountered in the primary fire problem area on a protection unit. Slope class 1 is 0-20%, slope class 2 is 21-40%, slope class 3 is 41-55%, slope class 4 is 56-74%, and slope class 5 is 75% or greater.

SLOPE PERCENT: The ratio between the amount of vertical rise of a slope and horizontal distance as expressed in a percent. One hundred feet of rise to 100 feet of horizontal distance equals 100 percent.

SLOPE WINDS: Small scale convective winds that occur due to local heating and cooling of a natural incline of the ground. (see also GENERAL WINDS and LOCAL WINDS)

SMOG: Generally considered only photochemical air pollution. Originally meant a combination of smoke and fog.

SMOKE: A term used when reporting a fire or probable fire in its initial stages. In fire control the following types of smokes are recognized: LEGITIMATE SMOKE, FALSE SMOKE, DRIFT SMOKE, INTERMITTENT SMOKE, SMOKE HAZE, and SMOKE COLUMN.

SMOKE CANDLE: A pyrotechnical product that emits smoke of a uniform color, like that of a small fire, and at a standard rate. NOTE: Used to check the visibility of a simulated small fire and to test the alertness of lookouts.

SMOKE CONCENTRATION: The weight of combustion products (in micrograms per cubic meter) found in a specified volume of air.

SMOKE EPISODE: Period when smoke is dense enough to be an unmistakable visual nuisance or hazard to driving or flying.

SMOKE HAZE: Haze caused by smoke alone and not by water vapor, dust, or other suspended matter.

SMOKE INTRUSION: Smoke from prescribed fire entering a designated area at unacceptable levels.

SMOKEJUMPER: A specifically trained and certified firefighter who travels to wildland fires by aircraft and parachutes to the fire.

SMOKE MANAGEMENT: Application of fire intensities and meteorological processes to minimize degradation of air quality during prescribed fires.

SMOKE PALL: Extensive, thick blanket of smoke spreading more or less horizontally from a fire.

SMOKE PLUME: The gases, smoke, and debris that rise slowly from a fire while being carried along the ground because the buoyant forces are exceeded by those of the ambient surface wind. (see also CONVECTION COLUMN)

SMOKE-SENSITIVE AREA (SSA): Area in which smoke from outside sources is intolerable, for reasons such as heavy population, existing air pollution, or intensive recreation or tourist use.

SMOKE TARGET: An area that may be adversely affected by smoke from a prescribed burn. Also called smoke sensitive area.

SMOKE VENT HEIGHT: Level, in the vicinity of the fire, at which the smoke ceases to rise and moves horizontally with the wind at that level.

SMOKEY BEAR: The symbol of the Cooperative Forest Fire Prevention Program since 1945. The program was originated by the Forest Service, USDA, in cooperation with the National Association of State Foresters and the Advertising Council to fight against the waste of natural resources resulting from forest fires, 90 percent of which are caused by people.

SMOKING (as a fire cause): Wildfires caused by smokers from matches, lighters, tobacco, or other smoking material.

SMOLDERING: A fire burning without flame and barely spreading.

SMOLDERING COMBUSTION: Combustion of a solid fuel, generally with incandescence and smoke but without flame.

SMOLDERING COMBUSTION PHASE: Combined processes of dehydration, pyrolysis, solid oxidation, and scattered flaming combustion and glowing combustion which occur after the flaming combustion phase of a fire; often characterized by large amounts of smoke consisting mainly of tars. Emissions are at twice that of the flaming combustion phase.

SMOLDERING PHASE: The overall reaction rate of the fire has diminished to a point at which concentrations of combustible gases above the fuel are too low to support a persistent flame envelope. Consequently, the temperature drops and gases condense. The smoke evolved during this phase is virtually soot-free, consisting mostly of tar droplets less than a micrometer in size.

SMUDGE: Spot in a fire or along a fire edge which has not yet been extinguished, and which is producing smoke; term is commonly used during the mopup stage of a fire.

SNAG: A standing dead tree or part of a dead tree from which at least the leaves and smaller branches have fallen. Often called a stub, if less than 20 feet tall. (see also STUB)

SNAKE RIVER VALLEY (SRV) CREWS: Predominantly Spanish-speaking suppression crews based in the Snake River Valley.

SOOT: Carbon dust formed by incomplete combustion.

SORTIE: Single round trip made by an air tanker from an air attack base to a fire and return.

SOUNDING (Upper Air Sounding): A sampling of upper air conditions made by means of instruments and a small radio transmitter on a free balloon. Automatic radio signals originated by action of weather instruments are sent to a ground receiver. These signals are interpreted for use in analyzing and predicting upper air conditions over a wide area of the earth. Weather elements determined at a number of altitude points as the balloon rises are temperature, atmospheric moisture, pressure, wind direction and speed. Similar soundings may be made using fixed balloons or tethersondes. (see also RADIOSONDE)

SOURCE: A point, line, or area, at which mass or energy is added to a system, either instantaneously or continuously. Examples of sources in the context of air pollution are as follows: a smoke stack is a point source; a freeway is a line source; field or slash burning are area sources.

SPAN: Distance equal to the wingspread of the air tanker being used; used for corrections right or left of the flight path.

SPAN OF CONTROL: The supervisory ratio of from three-to-seven individuals, with five-to-one being established as optimum.

SPARK ARRESTER: A device installed in a chimney, flue, or exhaust pipe to stop the emission of sparks and burning fragments.

SPECIES COMPOSITION: A term relating the relative abundance of one plant species to another using a common measurement; the proportion (percentage) of various species in relation to the total on a given area.

SPECIFIC HEAT: The heat required to raise the temperature of 1 kg of a substance one degree Kelvin. The heat capacity of a system per unit mass; i.e., the ratio of the heat absorbed (or released) to the corresponding temperature rise (or fall).

SPEED OF ATTACK: Elapsed time from origin of fire to arrival of the first suppression force.

SPIKE-OUT: Standby crew in an area of expected high fire occurrence, generally on a day of critical fire weather.

SPLIT FLOW: A divergent wind field. Storms moving into a split field tend to lose strength. Winds are generally light in such a flow field.

SPOT BURNING: A modified form of broadcast slash burning in which the greater accumulations of slash are fired and the fire is confined to these spots. Sometimes called "Jackpot Burning" or "Jackpotting."

SPOT FIRE: Fire ignited outside the perimeter of the main fire by a firebrand.

SPOT FIRE TECHNIQUE: A method of lighting prescribed fires where ignition points are set individually at a predetermined spacing and with predetermined timing throughout the area to be burned.

SPOT WEATHER FORECAST: A special forecast issued to fit the time, topography, and weather of each specific fire. These forecasts are issued upon request of the user agency and are more detailed, timely, and specific than zone forecasts. (Usually special on-site weather observations are required for the forecasting office.) (see also GENERAL FIRE WEATHER FORECAST, INCIDENT WEATHER FORECAST)

SPOTTER: In smokejumping, rappelling, and paracargo operations, the individual responsible for selecting drop target and supervising all aspects of dropping smokejumpers, rappellers, or cargo.

SPOTTING: Behavior of a fire producing sparks or embers that are carried by the wind and which start new fires beyond the zone of direct ignition by the main fire.

SPREAD COMPONENT: Part of the National Fire Danger Rating System (NFDRS). A rating of the forward rate of spread of the head of a fire.

SPREAD INDEX: A number used to indicate relative (not actual) rate of spread.

SPREAD INDEX METER: Device for combining measured ratings of various fire danger factors into numerical classes or rates of spread.

SPUR RIDGE: A small ridge which extends finger-like from a main ridge.

SQUALL: Sudden increase in wind speed to at least 17 mph (15 knots) that is sustained for at least 1 minute but not more than 5 minutes.

SQUALL LINE: Any nonfrontal line or narrow band of active thunderstorms extending across the horizon. It is of importance to fire behavior due to accompanying strong gusty winds and the possibility of such a line passing between regular weather observation stations without being reported. Also called line squall.

STABLE ATMOSPHERE: Condition of the atmosphere in which the temperature decrease with increasing altitude is less than the dry adiabatic lapse rate. In this condition, the atmosphere tends to suppress large-scale vertical motion. Also called stable air.

STABLE LAYER OF AIR: A layer of air having a temperature change (lapse rate) of less than dry adiabatic (approximately -5.4 degrees F per 1,000 feet) thereby retarding either upward or downward mixing of smoke. (see also INVERSION, ATMOSPHERIC STABILITY, and ATMOSPHERIC INVERSION)

STAGING AREA: Locations set up at an incident where resources can be placed while awaiting a tactical assignment on a three (3) minute available basis. Staging Areas are managed by the Operations Section.

STAGNANT CONDITIONS: Atmospheric conditions under which pollutants build up faster than the atmosphere can disperse them.

STAND REPLACING FIRE: Fire which kills all or most of the living overstory trees in a forest and initiates forest succession or regrowth.

STANDARD DRYING DAY: Part of the National Fire Danger Rating System (NFDRS). Day which produces the same net drying as experienced during a 24-hour period under laboratory conditions in which dry-bulb temperature is maintained at 80 F and relative humidity is maintained at 20%.

STANDARDS (NFPA): Standards of the National Fire Protection Association are frequently adopted by insurance agencies such as the National Board of Fire Underwriters as a basis for their regulations and used as a guide for municipal, state, or provincial laws, ordinances, and regulations.

STATE FOREST: Forests owned and administered by a state, and not by a federal government.

STATE IMPLEMENTATION PLAN (SIP): A plan required by the Clean Air Act and prepared by an Air Quality Regulatory Agency, which describes how the state will attain and maintain air quality so as to not violate National Ambient Air Quality Standards.

STATE OF WEATHER: A code which expresses the amount of cloud cover, kind of precipitation, and/or restrictions to visibility being observed at the fire danger station at basic observation time.

STATE PARK: An area established by the government of a state primarily for public recreation or for the preservation of unique natural or historic resources, administrative details varying widely. NOTE: Such parks may also be established by lesser administrative units, e.g. counties, municipalities, and also by large private owners.

STATIC PRESSURE: Water pressure head available at a specific location when no water is being used so that no friction loss is being encountered. Static pressure is that pressure observed on the engine inlet gauge before any water is taken from the hydrant.

STATION PRESSURE: Pressure of the atmosphere at an assigned station location and elevation.

STATISTIC: The number that results from manipulating raw data according to a specified procedure; associated with samples.

STATISTICAL FIRE: In general, an actionable fire, on which any fire agency reports and maintains specified information (e.g., cause, date and point of origin, size, fire damage).

STATISTICS: The scientific study of numerical data based on natural phenomena.

STATUS/CHECK-IN RECORDER: Person responsible to the resources unit leader for checking-in all resources arriving at an incident. There is at least one check-in recorder at each check-in location.

STEP TEST: Five-minute test used to predict a person's ability to take in, transport, and use oxygen (aerobic capacity), the most important factor limiting the ability to perform arduous work.

STORM CENTER: The central point or area of a weather system associated with increased winds, clouds or precipitation (or any combination thereof).

STRATEGY: The general plan or direction selected to accomplish incident objectives.

STRENGTH OF ATTACK: Number of resources used to attack a fire.

STRIKE TEAM: Specified combinations of the same kind and type of resources, with common communications, and a leader.

STRINGER: A narrow finger or band of fuel that connects two or more patches or areas of wildland fuel.

STRIP BURNING: (1) Burning by means of strip firing. (2) In hazard reduction, burning narrow strips of fuel and leaving the rest of the area untreated by fire.

STRIP FIRING: Setting fire to more than one strip of fuel and providing for the strips to burn together. Frequently done in burning out against a wind where inner strips are fired first to create drafts which pull flames and sparks away from the control line.

STRIP-HEAD FIRE: A series of lines of fire ignited near and up wind (or downslope) of a firebreak or backing fire so they burn with the wind (or upslope) toward the firebreak or backing fire.

STRUCTURE (vegetative): The form or appearance of a stand; the arrangement of the canopy; the volume of vegetation in tiers or layers.

STRUCTURE FIRE: Fire originating in and burning any part or all of any building, shelter, or other structure.

STRUCTURAL FIRE PROTECTION: The protection of homes or other structures from wildland fire.

STUB: A standing section of the stem of a tree, broken off at a height of less than 20 feet (6 meters), from which the leaves and most of the branches have fallen. (see also SNAG)

SUBSIDENCE: Downward or sinking motion of air in the atmosphere. Subsiding air warms due to compression. Increasing temperature and decreasing humidities are present in subsiding air. Subsidence results in a stable atmosphere inhibiting dispersion. Subsidence is generally associated with high atmospheric pressure.

SUBSIDENCE INVERSION: An inversion caused by subsiding air often resulting in very limited atmospheric mixing conditions.

SUCCESSION: The process of vegetational development whereby an area becomes successively occupied by different plant communities of higher ecological order.

SUNNY: Part of the National Fire Danger Rating System (NFDRS). The adjective classification of the sky when 5/10 or less of the sky is obscured by clouds.

SUNSET AND SUNRISE: The mean solar times of sunset and sunrise as published in the Nautical Almanac, converted to local standard time for the locality concerned.

SUPERVISOR: The ICS title for individuals responsible for command of a division or group.

SUPPLIES: Minor items of equipment and all expendable items assigned to an incident.

SUPPORTING AGENCY: An agency providing suppression or other support and resource assistance to a protecting agency. (see also AGENCY, ASSISTING AGENCY, and COOPERATING AGENCY)

SUPPORTING MATERIALS: Refers to several attachments that may be included with an Incident Action Plan, e.g., communications plan, map, safety plan, traffic plan, and medical plan.

SUPPORT RESOURCES: Non-tactical resources under the supervision of the logistics, planning, finance/administration sections or the command staff.

SUPPRESS A FIRE: The most aggressive wildfire suppression strategy leading to the total extinguishment of a wildfire.

SUPPRESSANT: An agent that extinguishes the flaming and glowing phases of combustion by direct application to the burning fuel.

SUPPRESSION: All the work of extinguishing or confining a fire beginning with its discovery.

SUPPRESSION CREW: Two or more firefighters stationed at a strategic location for initial action on fires. Duties are essentially the same as those of individual firefighters.

SUPPRESSION FIRING: Intentional application of fire to speed up or strengthen fire suppression action on wildfires. Types of suppression firing include burning out, counter firing, and strip burning.

SURFACE AREA-TO-VOLUME RATIO: The ratio between the surface area of an object, such as a fuel particle, to its volume. The smaller the particle, the more quickly it can become wet, dry out, or become heated to combustion temperature during a fire.

SURFACE FIRE: Fire that burns loose debris on the surface, which includes dead branches, leaves, and low vegetation.

SURFACE FUEL: Fuels lying on or near the surface of the ground, consisting of leaf and needle litter, dead branch material, downed logs, bark, tree cones, and low stature living plants.

SURFACE HIGH: An area on the earth's surface where atmospheric pressure is at a relative maximum. Winds blow clockwise around highs in the Northern Hemisphere but, due to friction with the earth's face, tend to cross constant pressure lines away from the high center. Air is usually subsiding within a surface high. This causes warming due to air compression. This results in stable atmospheric conditions and light surface winds. (see also RIDGE)

SURFACE LOW: An area on the earth's surface where atmospheric pressure is at a relative minimum. Winds blow counter-clockwise around lows in the Northern Hemisphere but, due to friction with the earth's surface, tend to cross constant pressure lines toward the low center. Upon converging at the low center, air currents are forced to rise. As air rises it cools due to expansion. Cooling reduces its capacity to hold moisture; so cloudiness and precipitation are common in lows. If a low center intensifies sufficiently it will take on the characteristics of a storm center with precipitation and strong winds.

SURFACE WIND: Wind measured at a surface observing station, customarily at some distance (usually 20 feet) above the average vegetative surface to minimize the distorting effects of local obstacles and terrain.

SURGE: Rapid increase in flow which may result in an attendant pressure rise.

SURPLUS PROPERTY: Any excess personal property not required for the needs and the discharge of the responsibilities of all federal agencies as determined by the General Services Administration (GSA).

SURVIVAL ZONE: A natural or cleared area of sufficient size and location to protect fire personnel from known hazards while inside a fire shelter. Examples include rock slides, road beds, clearings, knobs, wide ridges, benches, dozer lines, wet areas, cleared areas in light fuels, and previously burned areas. These are all areas where you expect no flame contact or prolonged heat and smoke. (see also DEPLOYMENT ZONE, SAFETY ZONE)

SUSTAINED ATTACK: Continuing fire suppression action until fire is under control.

SWAMPER: (1) A worker who assists fallers and/or sawyers by clearing away brush, limbs and small trees. Carries fuel, oil and tools and watches for dangerous situations. (2) A worker on a dozer crew who pulls winch line, helps maintain equipment, etc., to speed suppression work on a fire.

SWAMPOUT: Act of clearing brush and other material from around the base of trees and where trees are to be bucked, prior to falling or bucking, as protection against saw kickback and to provide safe footing.

SYNOPTIC: Literally, at one time. Thus, in meteorological usage the weather conditions over an area at a given point in time.

SYNOPTIC CHART: In meteorology, any chart or map on which data and analyses are presented that describe the state of the atmosphere over a large area at a given moment in time.

SYSTEMATIC DISPATCHING: Pre-planned action system for initial attack utilizing packaged knowledge of available resources that will take action on a fire in a specific area under specified fire danger conditions; not intended for large fires or multiple-fire situations.

# - T -

T-CARD: Cards filled out with essential information for each resource they represent. The cards are color-coded to represent different types of resources.

TACTICAL DIRECTION: Direction given by the operations section chief which includes the tactics appropriate for the selected strategy, the selection and assignment of resources, tactics implementation, and performance monitoring for each operational period.

TACTICS: Deploying and directing resources on an incident to accomplish the objectives designated by strategy.

TASK FORCE: Any combination of single resources assembled for a particular tactical need, with common communications and a leader. A Task Force may be pre-established and sent to an incident, or formed at an incident.

TECHNICAL ADVISORY UNIT: This unit consists of advisors with special skills who are activated only when needed. Advisors may be needed in the areas of water resources, environmental concerns, resource use, and training.

TECHNICAL SPECIALISTS: Personnel with special skills that can be used anywhere within the ICS organization. These personnel may perform the same duties during an incident that they perform in their everyday job.

TEMPORARY FLIGHT RESTRICTION (TFR): A restriction requested by an agency and put into effect by the Federal Aviation Administration in the vicinity of an incident which restricts the operation of nonessential aircraft in the airspace around that incident.

TEN-HOUR TIMELAG FUEL MOISTURE (l0-h TL FM): The moisture content of the l0-hour timelag roundwood fuels.

TEN-HOUR TIMELAG FUELS: Dead fuels consisting of roundwood 1/4 to l-inch (0.6 to 2.5 cm) in diameter and, very roughly, the layer of litter extending from immediately below the surface to 3/4 inch (1.9 cm) below the surface.

TERRA TORCH ®: Device for throwing a stream of flaming liquid, used to facilitate rapid ignition during burn out operations on a wild fire or during a prescribed fire operation. (Syn. FLAME THROWER)

TEST FIRE: A prescribed fire set to evaluate such things as fire behavior, detection performance, control measures.

THERMAL BELT: An area of mountainous slope (characteristically the middle third), where the top of the radiation inversion intersects the slope. It typically experiences the least variation in diurnal temperatures and has the highest average temperatures and, thus, the lowest relative humidity. Its presence is most evident during clear weather with light wind.

THERMAL IMAGERY: The display or printout of an infrared scanner operating over a fire. Also called infrared imagery. (see also INFRARED)

THIN LAYER: Layer of clouds whose ratio of dense sky cover to total sky cover is 1/2 or less.

THIN SKY COVER: Sky cover through which higher clouds or the sky can be detected.

THREAT FIRE: Any uncontrolled fire near to or heading toward an area under organized fire protection.

THROW OUT: Soil pushed over the edge of the fireline by the fire plow. (see also BERM)

THUNDERSTORM: Localized storm characterized by one or more electrical discharge(s).

TIE-IN: Act of connecting a control line to another line or an intended firebreak.

TIMELAG (TL): Time needed under specified conditions for a fuel particle to lose about 63 percent of the difference between its initial moisture content and its equilibrium moisture content. If conditions remain unchanged, a fuel will reach 95 percent of its equilibrium moisture content after 4 timelag periods.

TIME-TEMPERATURE CURVE: Graph showing the increase in temperature at a specified point in a fire as a function of time, beginning with ignition and ending with burnout.

TINDER: Low density solids or aggregates of particles (e.g., duff, peat, rotten wood).
.
TORCH: Ignition and subsequent envelopment in flames, usually from bottom to top, of a tree or small group of trees.

TORCHING: The burning of the foliage of a single tree or a small group of trees, from the bottom up. (Syn. CANDLING)

TOTAL FUEL: All plant material both living and dead that can burn in a worst case situation.

TOTAL MOBILITY: The capability to move, position, and utilize established forces to meet existing and anticipated fire protection needs nationwide.

TOTAL RISK: Part of the National Fire Danger Rating System (NFDRS). Sum of lightning and human-caused risk values; cannot exceed a value of 100.

TOTAL SUSPENDED PARTICULATE MATTER(TSP): Particles emitted from a pollution source regardless of size. Federal and state ambient and emission standards exist for TSP.

TOXIC: Relating to a harmful effect by a poisonous substance on the human body by physical contact, ingestion, or inhalation.

TOXIC SUBSTANCE: A chemical or mixture that may present an unreasonable risk of injury to health or the environment.

TRACTOR: A rubber tired or tracked rider-controlled automotive vehicle, used in wildland fire management for pulling a disk or a plow to construct fireline by exposing mineral soil. (see also DOZER, PLOW LINE, TRACTOR PLOW)

TRACTOR PLOW: Any tractor with a plow for constructing fireline by exposing mineral soil. Also as a resource for typing purposes, a tractor plow includes the transportation and personnel for its operation. (see also DOZER, PLOW LINE, TRACTOR)

TRAINING OFFICER: The chief or other officer under the agency or department responsible for organizing and conducting a complete training program for the suppression agency.

TRAINING SPECIALIST: Person responsible to the planning section chief for coordinating the use of trainees on the incident and for assuring that the trainees meet their training objectives and receive performance evaluation reports.

TRANSPORT WIND SPEED: A measure of the average rate of the horizontal transport of air within the Mixing Layer. May also be the wind speed at the final height of plume rise. Generally refers to the rate at which emissions will be transported from one area to another. (see also MIXING LAYER, VENTILATION FACTOR)

TRANSPORTATION MAP: Base map of the planning unit showing all roads, trails, heliports, and airfields existing and programmed for construction.

TRAVEL TIME: Elapsed time from the departure of the initial attack crew until they arrive at and begin work on the fire.

TRAVEL TIME MAP: Map showing the time required for the initial attack crew to reach various parts of a protection unit from specified positions.

TREATMENT: A procedure whose effect is to be measured and compared with the effect of other procedures. Examples include a fall burned prescribed fire, an unburned "control", or an area burned with a specific ignition method or pattern.

TRENCH: A small ditch often constructed below a fire on sloping ground (undercut or underslung line) to catch rolling material.

TROUGH: An elongated area of relatively low atmospheric pressure, usually extending from the center of a low pressure system.

TRUE BEARING: Bearing by true north rather than magnetic north.

TURBULENCE: Irregular motion of the atmosphere usually produced when air flows over a comparatively uneven surface such as the surface of the earth; or when two currents of air flow past or over each other in different directions or at different speeds.

TURN THE CORNER: Contain a fire along a flank of the fire and begin containing it across the head. Refers to ground or air attack.

TURNOUT COAT: A coat with a fire resistant outer shell and a thermal and moisture barrier liner. Used primarily by structure firefighters. Also called fire coat.

TWO-WAY RADIO: Radio equipment with transmitters in mobile units on the same frequency as the base station, permitting conversation in two directions using the same frequency in turn.

TYPE: Refers to resource capability. A Type 1 resource provides a greater overall capability due to power, size, capacity, etc., than would be found in a Type 2 resource. Resource typing provides managers with additional information in selecting the best resource for the task.

# - U -

ULTRA HIGH FREQUENCY(UHF-FM): Radio frequencies from 300 MegaHertz (MHz) to 3,000 MHz with a normal range of less than 50 miles. Radio frequency common to military aircraft and used in the logistics radio system. The most common frequencies used by fire and public safety are from 406 MHz to 512 MHz.

UNACCEPTABLE FIRE RISK: Level of fire risk above which specific action is deemed necessary to protect life, property and resources.

UNCONTROLLED AIRPORT: Airport not having an approved agency with radio communications to direct aircraft take-offs and landings.

UNCONTROLLED FIRE: Any fire which threatens to destroy life, property, or natural resources, and (a) is not burning within the confines of firebreaks, or (b) is burning with such intensity that it could not be readily extinguished with ordinary tools commonly available. (see also WILDFIRE)

UNDERBURN: A fire that consumes surface fuels but not trees and shrubs.

UNDERCUT LINE: A fireline below a fire on a slope. Should be trenched to catch rolling material. Also called underslung line. (see also CUP TRENCH, GUTTER TRENCH)

UNDERSTORY BURNING: Prescribed burning under a forest canopy.

UNICOM: VHF/AM aircraft radio frequencies assigned by the FAA for use in air-to-ground communications at uncontrolled airfields. The frequencies most commonly used are 122.8 MHz and 122.85 MHz.

UNIFIED AREA COMMAND: A unified area command is established when incidents under an area command are multijurisdictional.

UNIFIED COMMAND: In ICS, unified command is a unified team effort which allows all agencies with jurisdictional responsibility for the incident, either geographical or functional, to manage an incident by establishing a common set of incident objectives and strategies. This is accomplished without losing or abdicating authority, responsibility, or accountability.

UNIFORM FUELS: Fuels distributed continuously, thereby providing a continuous path for fire to spread.

UNIT: The organizational element of an incident having functional responsibility for a specific activity in the planning, logistics, or finance/administration activity.

UNITY OF COMMAND: The concept by which each person within an organization reports to one and only one designated person.

UNLINED FIRE HOSE: Hose commonly of cotton, linen, or synthetic fiber construction without rubber tube or lining, often used for wildfires because of its light weight and self protecting (weeping) characteristics; such hose is attached to first-aid standpipes in buildings. At a specified flow, friction loss in unlined hose of a stated diameter is about twice that of lined fire hose.

UPPER LEVEL (COLD) LOW: (Upper Level Disturbance, Cold Low Aloft) A circulation feature of the upper atmosphere where pressure, at a constant altitude, is lowest. Winds blow counter-clockwise around the center in an approximately circular pattern. Upper level lows are usually quite small. The mechanics of these upper lows is such that a pool of cool moist air always accompanies their development. There is often no evidence of low pressure at the earth's surface. An upper low may exist above a surface high pressure system.

UPPER LEVEL (COLD) TROUGH: (Trough, Trough Aloft, Upper Level [Cold] Low) An elongated area of relatively low pressure, at constant altitude, in the atmosphere. The opposite of an upper level ridge. Upper level troughs are usually oriented north-south with the north end open. That is, air currents moving from west to east around the earth flow around three sides of the trough then turn eastward rather than toward the west, as in the case of a closed circulation. A large upper level trough may have one or more small upper level closed low circulation systems within it.

UPPER LEVEL HIGH: (Upper High, High Aloft, Upper Level Ridge) A circulation feature of the upper atmosphere where pressure, at a constant altitude, is higher than in the surrounding region. Winds blow clockwise around an upper level high. Air in an upper level high is usually subsiding. This results in comparatively warm dry air with light winds over a large area. An upper level high may exist without there being high pressure at the earth's surface.

UPPER LEVEL RIDGE: (Upper Level High, Ridge Aloft) An elongated area of relatively high pressure, at a constant altitude, in the atmosphere. The opposite of an upper level trough. Upper level ridges are often oriented north-south, alternating between upper level troughs, however, during summer they may assume random orientations and vast dimensions.

URBAN: Area in which residences and other human developments form an essentially solid covering of the landscape, including most areas within cities and towns, subdivisions, commercial and industrial parks, and similar developments whether inside city limits or not.

URBAN INTERFACE: The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. (Syn. I-ZONE, WILDLAND/URBAN INTERFACE)

USER'S NETWORK FOR APPLIED MODELING OF AIR POLLUTION (UNMAP): EPA supplied program tape of dispersion models used for prevention of significant deterioration (PSD) and permitting of new pollution sources.

UTILIZATION RATE: The proportion of the current year's forage production that is removed by grazing or browsing animals. It may refer to particular species or to the entire plant community and is usually expressed as a percentage.

# - V -

VALUES-AT-RISK: Natural resources, improvements, or other values that may be jeopardized if a fire occurs; estimated damages and benefits that may result from fires in a particular presuppression or suppression situation. (see also RESOURCES)

VARIABLE: Any changing characteristic; in statistics, a measurable characteristic of an experimental unit.

VARIABLE DANGER: Resultant of all fire danger factors that vary from day to day, month to month, or year to year (e.g., fire weather, fuel moisture content, condition of vegetation, variable risk)

VARIABLE SKY CONDITION: A sky condition that varies between reportable values of sky cover amounts during the period of observation.

VARIABLE VISIBILITY: A condition when the prevailing visibility is less than 3 miles (5 km) and rapidly increases and decreases by one or more reportable values during the period of observation.

VARIABLE WIND DIRECTION: Wind direction which varies by 60 degrees or more during the period of time the wind direction is being determined.

VECTORS: Directions of fire spread as related to rate of spread calculations (in degrees from upslope).

VEGETATIVE REGENERATION: Development of new aboveground plants from surviving plant parts, such as by sprouting from a root crown or rhizomes. Even if plants form their own root system, they are still genetically the same as the parent plant.

VEGETATIVE REPRODUCTION: Establishment of a new plant from a seed that is a genetically distinct individual.

VEHICLE FIRE: Fire originating in or on a vehicle or mobile equipment.

VENTILATION FACTOR: A numerical value relating the potential of the atmosphere to disperse airborne pollutants from a stationary source, calculated by multiplying the mixing height by the transport wind speed. (see also MIXING LAYER, TRANSPORT WIND SPEED)

VENTILATION INDEX: A measure of the volume rate of horizontal transport of air within the mixing layer, per unit distance, normal to the wind. Units are measured in square meters per second. The ventilation index is derived by multiplying mixing height and transport wind speed. It is similar to clearing index, except the values are less and decrease in value.

VERTICAL FUEL ARRANGEMENT: Fuels above ground and their vertical continuity, which influences fire reaching various levels or vegetation strata.

VERTICAL TEMPERATURE PROFILE: Plot of the actual dry-bulb temperature against height above the earth's surface, most commonly determined by a RAWINSONDE observation.

VERTICAL VISIBILITY: The distance that can be seen vertically upward into a surface based obscuring phenomenon.

VERY HIGH FREQUENCY (VHF-AM): Radio frequency range from 30 MHz to 299 MHz. The sub-bands most commonly used by fire are:

VHF-FM Lo band: Frequency Modulation 30 MHz - 80 MHz, of which fire frequencies are between 30 MHz and 50 MHz.

VHF-FM Hi band: Frequency Modulation 150 MHz - 174 MHz. This is the most widely used band by fire agencies.

VHF-AM: Amplitude Modulation. This band is commonly referred to as the "Victor or VHF" band. The frequency range is from 118 MHz to 136 MHz. The only authorized use of this band is for aviation. The FAA controls and assigns all frequencies within this sub-band.

VHF OMNIDIRECTIONAL RADIO RANGE (VOR): System of radio navigation in which any magnetic bearing relative to a special radio transmitter on the ground may be chosen and flown by an aircraft pilot.

VISUAL FLIGHT RULES (VFR) CONDITIONS: Basic weather conditions prescribed for flight under Visual Flight Rules: ceiling above 1,000 feet (300 m) and flight visibility in excess of 3 miles (5 km).

VIGOR: A subjective assessment of the health of individual plants in similar site and growing conditions; or a more specific measure based upon a specific facet of growth, such as seed stalk or tiller production per plant or per unit area.

VIRGA: Precipitation falling out of a cloud but evaporating before reaching the ground.

VISCOSITY: An indication in the ability of the foam to spread and cling, as well as to cling to itself, upon delivery.

VISCOUS WATER: Water that contains a thickening agent to reduce surface runoff; tends to cling to burning fuels and spread in layers that are several times thicker than plain water, thereby having an increased capacity to absorb heat, cool fuel, and exclude oxygen. Also called thickened water.

VISIBILITY: The greatest distance at which selected objects can be seen and identified, or its equivalent derived from instrumental measurements.

VISIBILITY DISTANCE: Maximum distance at which a smoke column of specified size and density can be seen and recognized as smoke by the unaided eye.

VISIBLE AREA MAP: Map showing the different classes of visible area covered by a lookout point or points; may differentiate between seen areas, indirectly visible areas, and blind areas, or only between seen areas and blind areas. Also called seen area map. (see also SEEN AREA)

VISUAL RANGE: Maximum distance at which a given object can just be seen by an observer with normal vision.

VISUAL RESOURCE MANAGEMENT(VRM): The inventory and planning actions taken to identify visual values and to establish objectives for managing those values; and the management actions taken to achieve the visual management objectives.

VISUAL RESOURCE MANAGEMENT CLASSES: Categories assigned to public lands based on scenic quality, sensitivity level, and distance zones. There are four classes. Each class has an objective which prescribes the amount of change allowed in the characteristic landscape.

VISUAL RESOURCES: The visible physical features on a landscape (e.g., land, water, vegetation, animals, structures and other features).

VOLATILES: Readily vaporized organic materials which, when mixed with oxygen, are easily ignited.

VOLUNTEER FIRE COMPANY: A fire department company or a response unit, the members of which are not paid.

VOLUNTEER FIRE DEPARTMENT (VFD): A fire department of which some or all members are unpaid.

VOLUNTEER FIREFIGHTER: Legally enrolled firefighter under the fire department organization laws who devotes time and energy to community fire service without compensation other than Worker's Compensation or other similar death and injury benefits.

VORTEX TURBULENCE: Miniature whirlwinds trailing from the wingtips of any aircraft in flight. Vortex will be in the form of a horizontal whirlwind with velocities up to 25 mph (40 km) per hour or more. Also created by action of rotor blades on helicopters; these whirlwinds tend to move downward toward the ground. If an aircraft flies low over a fire, vortices may reach the ground and suddenly cause violent and erratic fire behavior.

# - W -

WARM FRONT: The leading edge of a relatively warm air mass which moves in such a way so that warm air displaces colder air. Winds associated with warm frontal activity are usually light and mixing is limited. The atmosphere is relatively stable when compared to cold front activity.

WATER BAR: A shallow channel or raised barrier, e.g., a ridge of packed earth or a thin pole laid diagonally across the surface of a road or trail so as to lead off water, particularly storm water. (Frequently installed in firelines on steep slopes to prevent erosion.)

WATER SOURCE: Any strategically located supply of water that is readily available for pumps, tanks, trucks, helicopters, or fire camp use.

WATER SUPPLY MAP: A map showing location of supplies of water readily available for pumps, tanks, trucks, camp use, etc.

WATERSHED: Geographic area that drains into a common water course.

WAVE: A disturbance that transfers energy from one point to another point and may take the form of a deformation of pressure or temperature. In the atmosphere such disturbances may result in major storms or merely result in changes in cloud, wind and temperature conditions. Development of a wave on a front usually slows the advance of the front due to transfer of energy to the wave development and movement.

WEATHER ADVISORY: In aviation forecasting, an expression of hazardous weather conditions not predicted in the zone weather forecast, as they affect the operation of air traffic.

WEATHER INFORMATION AND MANAGEMENT SYSTEM (WIMS): An interactive computer system designed to accommodate the weather information needs of all federal and state natural resource management agencies. Provides timely access to weather forecasts, current and historical weather data, the National Fire Danger Rating System (NFDRS), and the National Interagency Fire Management Integrated Database (NIFMID).

WEATHER OBSERVER: Person responsible to the situation unit leader for collecting current weather data and information at the incident and providing them to an assigned meteorologist, fire behavior specialist, or the situation unit leader.

WEIGHT: As used in vegetation inventory and monitoring, the total biomass of living plants growing above the ground in a given area at a given time.

WEIGHTED MONTHLY OCCURRENCE: Part of the National Fire Danger Rating System (NFDRS). Number used to determine seasonal risk class for a protection unit, calculated by multiplying peak monthly average by two and adding seasonal monthly average.

WET LINE: A line of water, or water and chemical retardant, sprayed along the ground, and which serves as a temporary control line from which to ignite or stop a low-intensity fire.

WET WATER: Water with added chemicals, called wetting agents, that increase water's spreading and penetrating properties due to a reduction in surface tension.

WET-BULB DEPRESSION: The difference between the wet and dry-bulb temperatures recorded by a psychrometer; used in conjunction with the dry-bulb temperature as a measure of the relative humidity of the air.

WET-BULB TEMPERATURE: The lowest temperature to which air can be cooled by evaporating water into it at a constant pressure when the heat required for evaporation is supplied by the cooling of the air. It is measured by the wet bulb thermometer, which usually employs wetted wicking on the bulb as a cooling (through evaporation) device.

WET-BULB THERMOMETER: In a psychrometer, the thermometer with its bulb covered with a jacket of clean muslin which is saturated with distilled water before an observation.

WETTING AGENT: A chemical that when added to water reduces the surface tension of the solution and causes it to spread and penetrate exposed objects more effectively than the untreated water.

WETTING RAIN: A widespread rain that over an extended period of time significantly reduces fire danger. One-tenth of an inch may be sufficient to reduce fire danger in grass fuel models. One half inch may be necessary for timber fuels under closed canopies.

WIDOW-MAKER: A loose limb or top or piece of bark lodged in a tree, which may fall on anyone working beneath it.

WILDERNESS: An area established by the Federal Government and administered either by the Forest Service, USDA or National Park Service, Fish & Wildlife Service, or Bureau of Land Management, in order to conserve its primeval character and influence for public enjoyment, under primitive conditions, in perpetuity.

WILDERNESS INVENTORY: An evaluation of the public lands in the form of a written description and map showing those lands that meet the wilderness criteria as established under section 603(a) of FLPMA and section 2(c) of the Wilderness Act, which will be referred to as wilderness study areas (WSA's).

WILDERNESS STUDY AREA (WSA): A roadless area or island that has been inventoried and found to have wilderness characteristics as described in section 603 of FLPMA and section 2(c) of the Wilderness Act of 1964 (78 Stat. 891).

WILDFIRE: A fire occurring on wildland that is not meeting management objectives and thus requires a suppression response. (see also UNCONTROLLED FIRE, INTERAGENCY MANAGEMENT REVIEW TEAM)

WILDLAND: An area in which development is essentially non-existent, except for roads, railroads, powerlines, and similar transportation facilities. Structures, if any, are widely scattered.

WILDLAND FIRE: Any fire occurring on the wildlands, regardless of ignition source, damages or benefits.

WILDLAND/URBAN INTERFACE: The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. (Syn. I-ZONE, URBAN INTERFACE)

WIND: The horizontal movement of air relative to the surface of the earth.

WIND DIRECTION: Compass direction from which wind is blowing.

WIND-DRIVEN WILDLAND FIRE: A wildland fire that is controlled by a strong consistent wind.

WINDFALL: Tree that has been uprooted or broken off by wind.

WIND PROFILE: A chart of wind speed in relation to height, most commonly determined by a pilot balloon observation.

WINDROW BURNING: Burning slash that has been piled into long continuous rows. Also includes wildfire in vegetation planted to protect improvements or agriculture.

WINDS ALOFT: Generally, wind speeds and wind directions at various levels in the atmosphere above the domain of surface weather observations.

WIND SHEAR: A variation in wind speed and/or direction in a layer of the atmosphere or between layers. The variation may be in the horizontal or vertical dimensions and may result in significant turbulence depending upon the magnitude of the wind speed/direction differences. A strong wind shear may act like an inversion and inhibit plume rise. It may also fracture the smoke plume, not allowing smoke to rise much above terrain levels. A strong horizontal anticyclonic shear results in downward motion and may bring smoke aloft to the surface.

WIND SHIFT: A change in the average wind direction of 45 degrees or more which takes place in less than 15 minutes if the wind speed during this period is 6 knots (3 m/s) or greater.

WIND SPEED: (1) Rate of horizontal motion of air past a given point. (2) (NFDRS) Wind, in mph, measured at 20 feet above ground, or above the average height of vegetation, and averaged over at least a l0-minute period. Also called wind velocity.

WINDSPEED METER: A handheld device which indicates wind speed, usually in miles per hour.

WIND VECTORS: Wind directions used to calculate fire behavior.

WOODY VEGETATION CONDITION: Part of the National Fire Danger Rating System (NFDRS). A code reflecting the moisture content of the foliage and small twigs [less than ¼ inch (0.6 cm)] of living woody plants.

WOVEN JACKET FIRE HOSE: Fire hose of conventional construction, woven on looms from fibers of cotton or synthetic fibers. Most fire department hose is double jacketed (i.e., it has an outer jacket protecting the inner one against wear and abrasion).

WYE: A hose connection with two outlets permitting two connections of the same coupling diameter to be taken from a single supply line. (see also REVERSIBLE SIAMESE, SIAMESE)

# - X,Y,Z -

ZONE WEATHER FORECAST: A portion of the general fire weather forecast issued on a regular basis during the normal fire season specifically to fit the requirements of fire management needs; i.e., time, areas, and weather elements. These zones or areas are a combination of administrative and climatological areas, usually nearly the size of an individual forest or district.

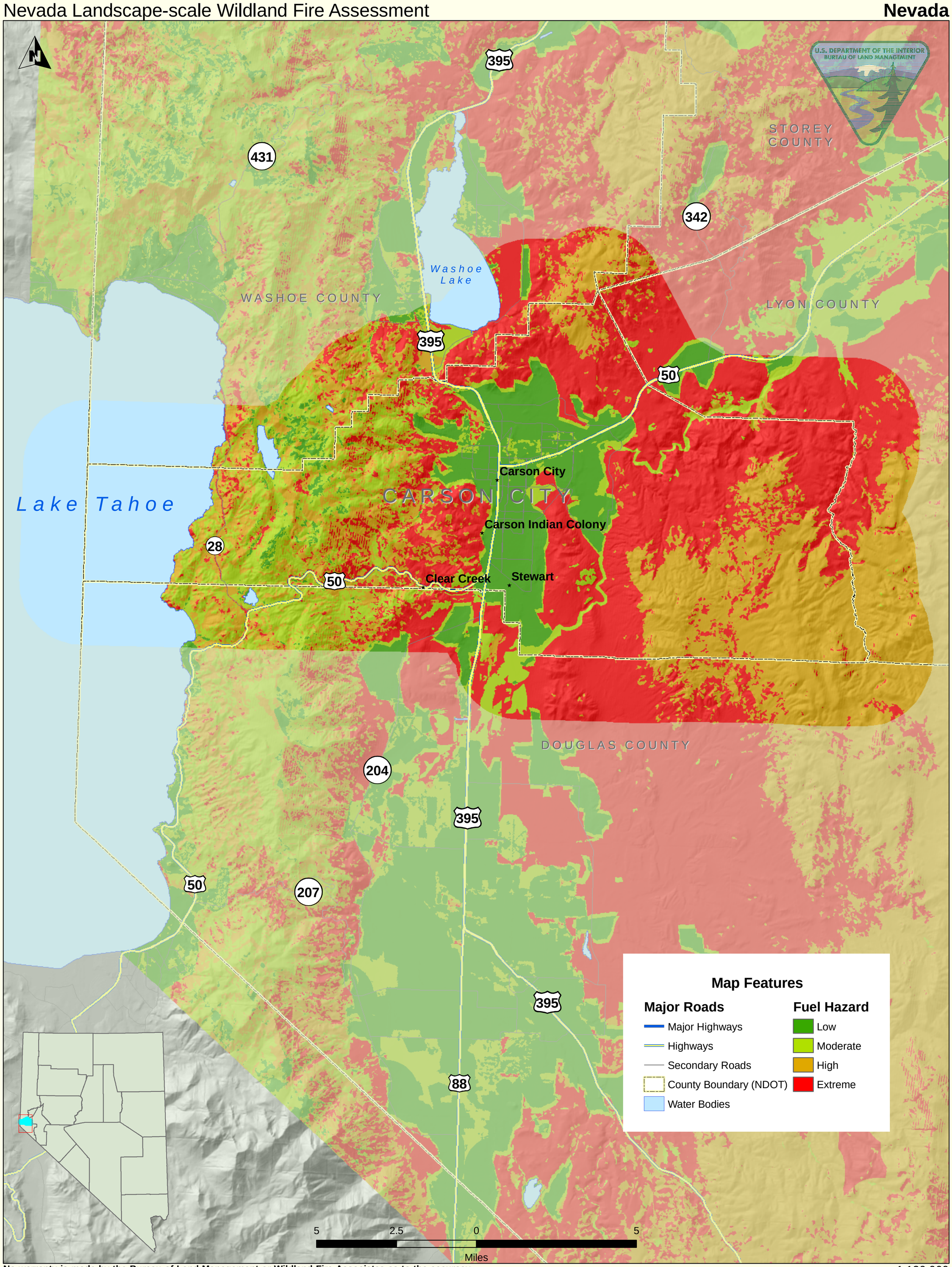
# APPENDIX B

# MAPS

# Fuel Hazard - Carson City

Nevada Landscape-scale Wildland Fire Assessment

**Carson City, Nevada**




**No warranty is made by the Bureau of Land Management or Wildland Fire Associates as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.**

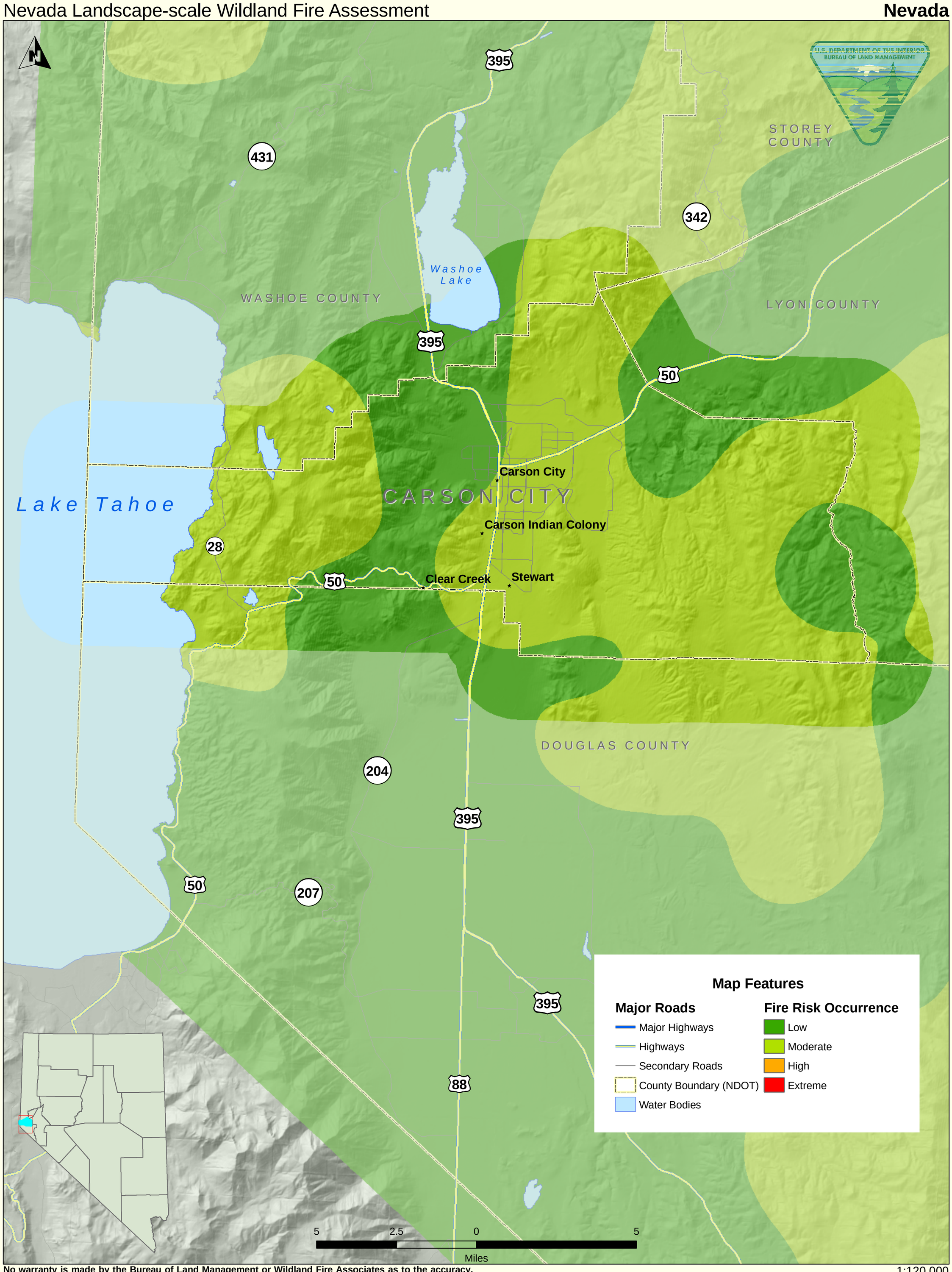
1:120,000

Prepared by Wildland Fire Associates, hazard.mxd, 04/10/08

# Risk of Fire Occurrence - Carson City

Nevada Landscape-scale Wildland Fire Assessment

**Carson City, Nevada**




**No warranty is made by the Bureau of Land Management or Wildland Fire Associates as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.**

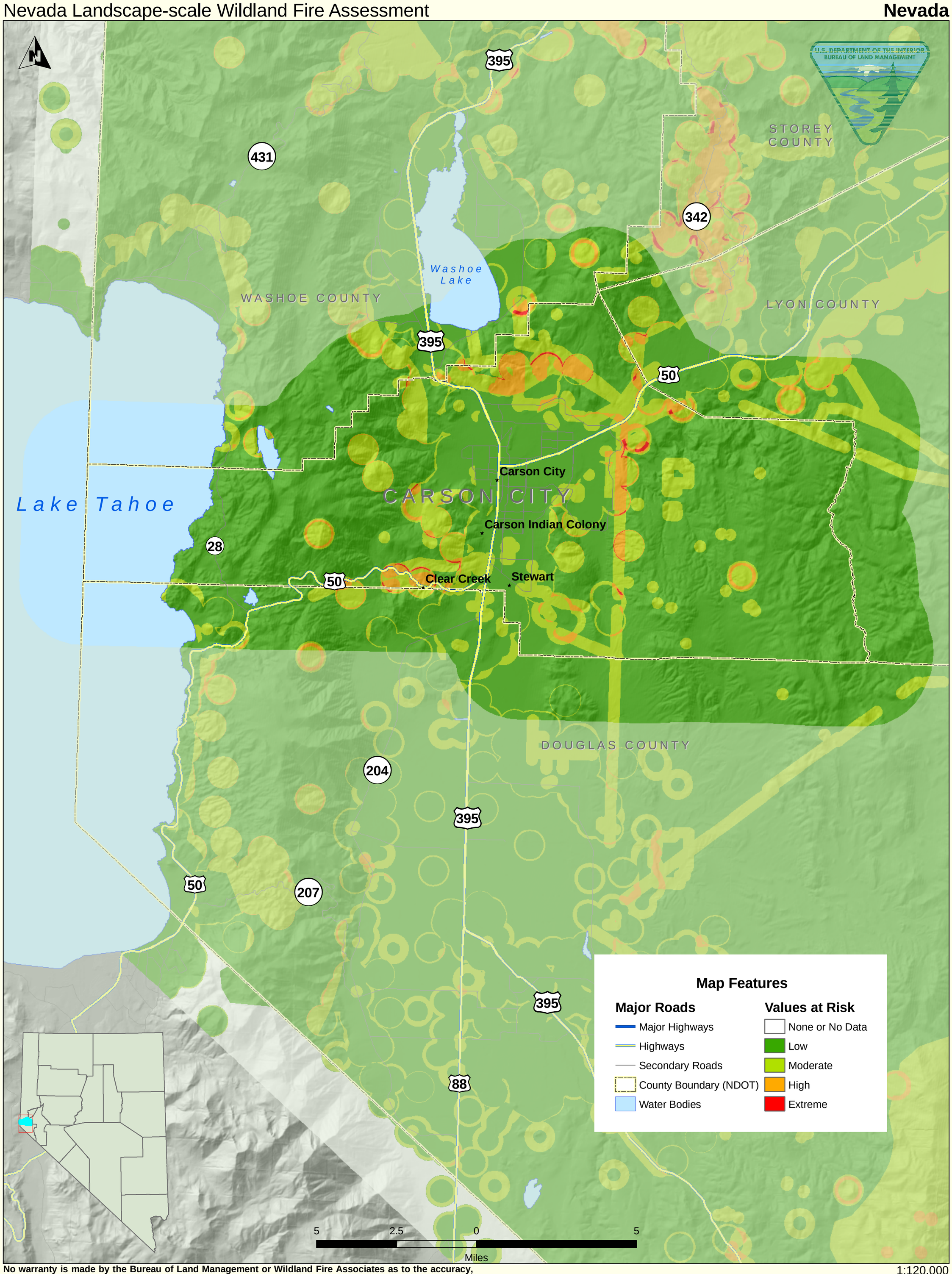
1:120,000

Prepared by Wildland Fire Associates, risk.mxd, 04/10/08

# Combined Values at Risk - Carson City

Nevada Landscape-scale Wildland Fire Assessment

**Carson City, Nevada**




**No warranty is made by the Bureau of Land Management or Wildland Fire Associates as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.**

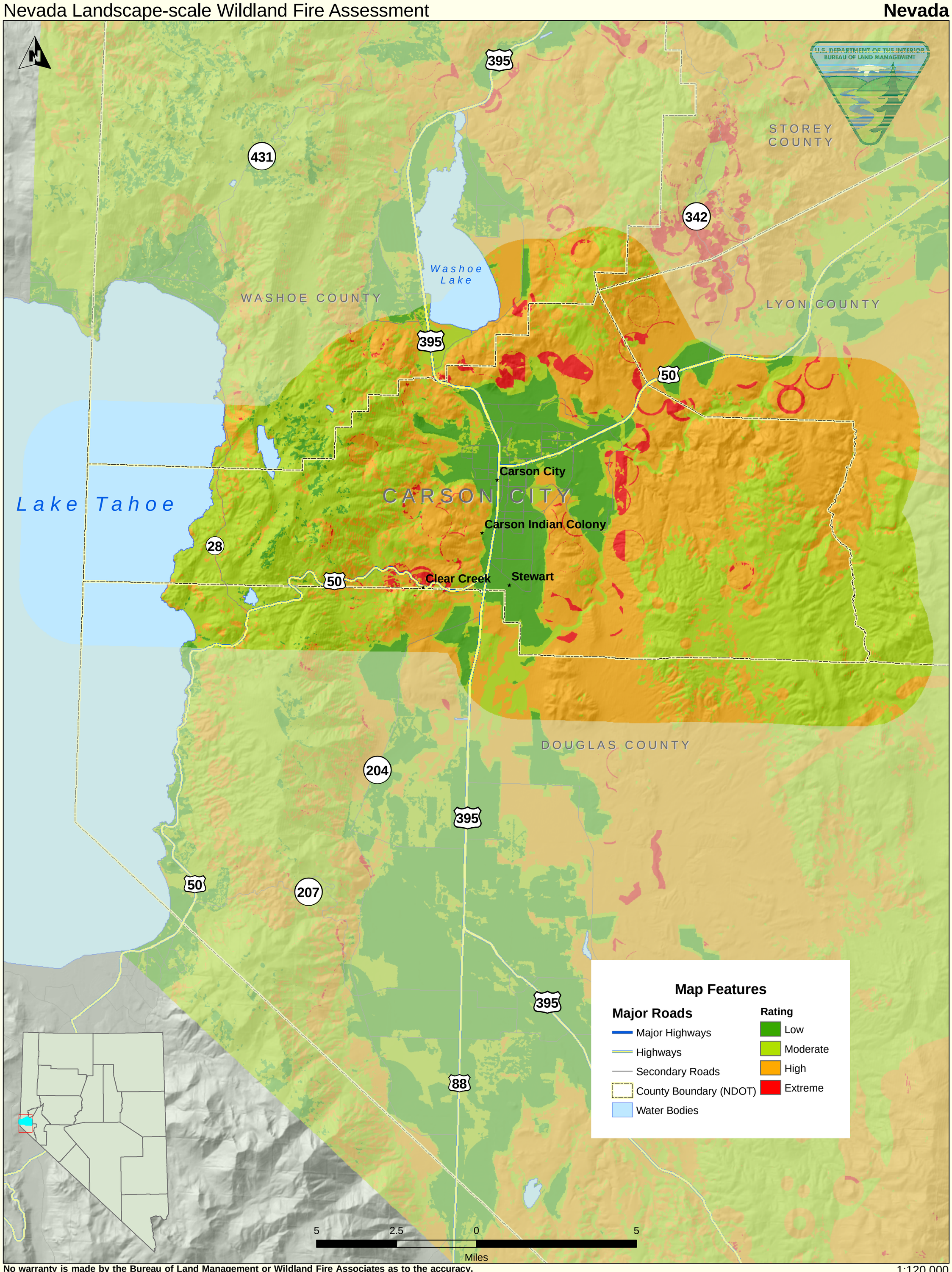
1:120,000

Prepared by Wildland Fire Associates, values.mxd, 04/10/08

# Risk Assessment Summary - Carson City

Nevada Landscape-scale Wildland Fire Assessment

**Carson City, Nevada**




**No warranty is made by the Bureau of Land Management or Wildland Fire Associates as to the accuracy, reliability, or completeness of these data for individual use or aggregate use with other data.**

1:120,000

Prepared by Wildland Fire Associates, assessment.mxd, 04/10/08

# APPENDIX C

# FEDERAL AND STATE LISTED

# FLORA AND FAUNA

# AT RISK IN

# CARSON CITY CONSOLIDATED MUNICIPALITY, NEVADA

**Federal and State Listed Flora and Fauna at Risk in Carson City Consolidated Municipality, Nevada**

| Scientific name | Common name | Legislation |
|---|---|---|
| Plants | | |
| *Rorippa subumbellata* | Tahoe yellowcress | NRS 527.260.300 |
| Insects | | |
| *Pseudocopaeodes eunus* ssp. *obscurus* | Carson wandering skipper | ESA-Listed Endangered |
| Mammals | | |
| *Aplodontia rufa* ssp. *californica* | Mono Basin mountain beaver | NRS 501 |
| *Euderma maculatum* | Spotted bat | NRS 501 |
| *Lontra canadensis* | River otter | NRS 501 |
| *Martes americana* | American marten | NRS 501 |
| Birds | | |
| *Accipiter gentilis* | Northern goshawk | NRS 501 |
| *Athene cunicularia* ssp. *hypugaea* | Western burrowing owl | NRS 501 |
| *Buteo regalis* | Ferruginous hawk | NRS 501 |
| *Buteo swainsoni* | Swainson's hawk | NRS 501 |
| *Chlidonias niger* | Black tern | NRS 501 |
| *Gavia immer* | Common loon | NRS 501 |
| *Oreortyx pictus* | Mountain quail | NRS 501 |
| *Otus flammeolus* | Flammulated owl | NRS 501 |
| *Strix occidentalis* ssp. *occidentalis* | California spotted owl | NRS 501 |

Source: Nevada Natural Heritage Program database, 2004.

# APPENDIX D

# NOXIOUS WEEDS

# DESIGNAGED BY THE

# STATE OF NEVADA

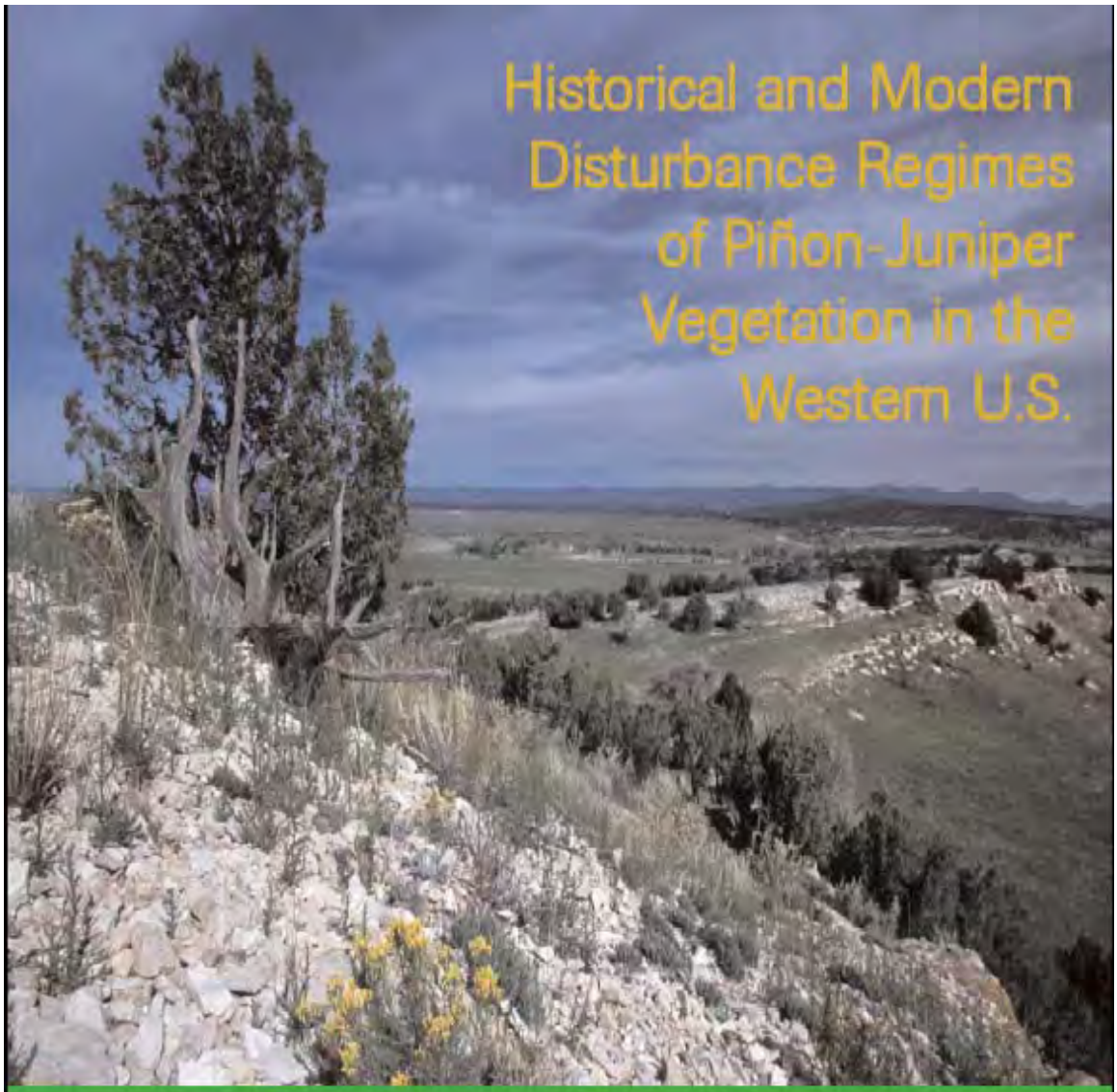
**Designated Noxious Weeds – State of Nevada NRS 555.101**

| Species | Species | Species | Species |
|---|---|---|---|
| African rue | Goats rue | Mayweed chamomile | Sulfur cinquefoil |
| Austrian fieldcress | Klamath weed | Mediterranean sage | Thistle; Canada; Musk; Scotch; Sow; Liberian star; Purple Star; and Yellow star |
| Austrian peaweed | Hemlock: Poison; and Water | Medusahead | Toadflax, dalmatian |
| Black henbane | Horse Nettle: Carolina; and White | Perennial pepperweed (Tall whitetop) | Toadflax, yellow |
| Camelthorn | Houndstongue | Puncturevine | Whitetop (hoary cress) |
| Common crupina | Hydrilla | Purple loosestrife | |
| Dyer's woad | Knapweed: Diffuse; Russian; Spotted; and Squarrose | Rush skeletonweed | |
| Erasion water-milfoil | Leafy spurge | Sorghum species, perennial | |

Source: University of Nevada-Reno; Cooperative Extension.
http://www.unce.unr.edu/tallwhitetop/page8.html.

# Appendix E

# Historical and Modern Disturbance Regimes of Pinyon-Juniper



# Historical and Modern Disturbance Regimes of Piñon-Juniper Vegetation in the Western U.S.

William Romme, Craig Allen, John Bailey, William Baker, Brandon Bestelmeyer, Peter Brown, Karen Eisenhart, Lisa Floyd-Hanna, David Huffman, Brian Jacobs, Richard Miller, Esteban Muldavin, Thomas Swetnam, Robin Tausch, Peter Weisberg

May 2007

Citation: Romme, W., C. Allen, J. Bailey, W. Baker, B. Bestelmeyer, P. Brown, K. Eisenhart, L. Floyd-Hanna, D. Huffman, B. Jacobs, R. Miller, E. Muldavin, T. Swetnam, R. Tausch and P. Weisberg. 2007. Historical and Modern Disturbance Regimes of Piñon-Juniper Vegetation in the Western U.S.

Cover photo: Piñon-juniper woodland, Walker Ranch, near Pueblo, Colorado. © Peter McBride

COLORADO FOREST RESTORATION INSTITUTE
www.cfri.colostate.edu

The Nature Conservancy
SAVING THE LAST GREAT PLACES ON EARTH

# Contents

Page

Introduction ..... 1

Piñon-Juniper: A Variable and Diverse Type of Vegetation ..... 2

What We Know About Persistent Woodlands ..... 7

What We Know About Piñon-Juniper Savannas ..... 10

What We Know About Areas of Potential Expansion and Contraction ..... 11

Tables

1. A suggested key for identifying the three historical types of piñon-juniper vegetation discussed in this paper ..... 12

2. Tips for estimating tree ages ..... 13

# Introduction

Piñon-juniper vegetation covers some 100 million acres in the western U.S., where it provides economic products, ecosystem services, biodiversity, and aesthetic beauty in some of the most scenic landscapes of North America. There are concerns, however, that the ecological dynamics of piñon-juniper woodlands have changed since Euro-American settlement, that trees are growing unnaturally dense, and that woodlands are encroaching into former grasslands and shrublands. Yet surprisingly little research has been conducted on historical conditions and ecological processes in piñon-juniper vegetation, and the research that does exist demonstrates that piñon-juniper structure, composition, and disturbance regimes were very diverse historically as well as today.

Uncertainties about historical stand structures and disturbance regimes in piñon-juniper vegetation create a serious conundrum for land managers and policy-makers who are charged with overseeing the semi-arid landscapes of the West. Calls for restoration of historical conditions (i.e., those that prevailed before the changes wrought by Euro-American settlers) are being heard with increasing frequency. However, if those historical conditions are poorly understood it is difficult or impossible to set realistic targets for restoration. In the absence of site-specific information about historical disturbance regimes and landscape dynamics, there is danger that well-meaning "restoration" efforts actually may move piñon-juniper ecosystems farther from their historical condition.

The purpose of this report is to briefly summarize our current understanding of historical stand structures, disturbance regimes, and landscape dynamics in piñon-juniper vegetation throughout the western U.S. The authors gathered for a workshop in Boulder, CO, on August 22-24, 2006, to develop the information presented here. All have conducted research in piñon-juniper vegetation, and together they have experience with a wide diversity of piñon-juniper ecosystems, from New Mexico and Colorado to Nevada and Oregon. Our summary of current knowledge is presented as a series of statements, each followed by our level of confidence in the statement and the geographical area to which it applies. High-confidence statements generally are supported by rigorous field studies; statements of moderate confidence are based on anecdotal evidence or logical deductions, but lack the rigorous studies necessary to confirm or refute the idea. We intentionally refrain from making any specific policy or management recommendations in this paper. Instead we provide the consensus among researchers of what we know (and don't know) about the science of piñon-juniper vegetation. The authors encourage managers and practitioners to give us feedback on the utility and shortcomings of this summary. There is much that we do not know about piñon-juniper vegetation, and new syntheses of this kind will be needed in the future as new knowledge becomes available.

# Piñon-Juniper: A Variable & Diverse Type of Vegetation

We identify three fundamentally different types of piñon-juniper vegetation, based primarily on canopy structure, understory characteristics, and historical disturbance regimes. There is of course great diversity within each of the three basic types, but the classification below represents much of the variability in piñon-juniper vegetation across the western U.S. Research is underway to link these vegetation types to specific soil types and other environmental characteristics that would allow for reliable prediction and mapping across large landscapes, but at present we can only identify some very general environmental correlates. Table 1 is a key for distinguishing among the three types in the field.

(1) Persistent Woodlands are found where site conditions (soils and climate) are inherently favorable for piñon and/or juniper. Canopy and understory characteristics vary considerably from place to place, from sparse stands of scattered small trees growing on poor substrates (Figure 1) to relatively dense stands of large trees on productive sites (Figure 2). Tree density and canopy cover also may fluctuate in response to disturbance and climatic variability. Nevertheless, these are plant

**Figure 1.** *Persistent woodland, growing on shallow rocky soils on the mesa tops, with deeper colluvial soils in the canyon bottom. The canopy is composed of* Pinus edulis *and* Juniperus osteosperma. *The trees are all-aged, including many old individuals, and the woodlands within this view contain no evidence of past fire. Colorado National Monument, Colorado, elevation ca. 8,000 feet. (Photo by W. Romme, 2008)*

communities in which piñon and/or juniper are dominant species, both historically and currently, unless recently disturbed by fire, clearing, or other severe disturbance. Notably, these woodlands do not represent 20th century conversion of formerly non-woodland vegetation types to woodland.

Persistent Woodlands are typically found on rugged upland sites with shallow, coarse-textured soils that support relatively sparse herbaceous cover even in the absence of heavy livestock grazing. However, they also occur in a variety of other settings, such that steep terrain and shallow or rocky substrate are not by themselves adequate indicators. This type of piñon-juniper vegetation is found throughout the West; it appears to be especially prevalent on portions of the Colorado Plateau, where moisture comes predominantly in winter. Indeed, large expanses of the Colorado Plateau are characterized by ancient, sparse-density, persistent woodlands within spectacular rocky landscapes.

(2) Piñon-juniper savannas are usually found on gentle upland and transitional valley locations, where soil conditions favor grasses (or other grass-like plants) but can support at least some tree cover. Some savannas apparently have sparse tree cover because of edaphic or climatic limitations on woody plant growth; many of these savannas have probably changed little during the past century (Figure 3).

**Figure 2.** *Persistent woodland, growing on a moderately productive site with high canopy cover and sparse herbaceous understory. The canopy is composed of* Pinus edulis *and* Juniperus osteosperma*; the major understory shrub is* Artemisia tridentata*. Trees are all-aged, including many individuals > 300 years old, and the stand contains no evidence of past fire. Navajo Point, Glen Canyon National Recreation Area, Utah, elevation ca. 7,000 feet. (Photo by W. Romme, 2005)*

Other savannas, in contrast, have site conditions that could potentially support denser tree cover, but at these locations savanna structure is maintained by herbaceous competition, recurrent fire, drought, and other disturbances; many of these savannas have converted into denser woodlands during the past century because of release from competitive effects on tree seedling establishment, favorable climatic conditions for tree survival, and lack of fire (Figure 4). Some savannas and woodlands are found today in places that were tree-less grasslands prior to 1900; such sites can sometimes be recognized by remnant grasslands soils and species composition.

Piñon-juniper savannas typically are found on moderately deep, coarse to fine-textured soils that readily support a variety of growth forms including trees, grasses, and other herbaceous plants, and in regions that receive reliable summer rainfall that fosters growth of warm-season grasses. This type of piñon-juniper vegetation appears to be especially prevalent in the basins and foothills of southern New Mexico, where a large portion of annual precipitation comes in the summer via monsoon rains. However, it is relatively rare in the Rocky Mountains, northern Colorado Plateau, and the Great Basin, where precipitation is more winter dominated.

(3) Areas of potential woodland expansion & contraction are found where site conditions are only intermittently suitable for piñon and/or juniper

**Figure 3.** *Juniper savanna, growing in fine-textured soils in a region of low precipitation where low tree density probably is a result of competition for moisture rather than fire or other disturbances. Trees are predominantly* Juniperus osteosperma, *with occasional* Juniperus monosperma *and* Pinus edulis. *Many of the trees appear to be relatively old (>150 years), i.e., crowns are flattened and branches are large and gnarly (Table 2). Evidence of past fire is scarce. San Juan Basin, northwestern New Mexico, elevation ca. 6,800 feet. (Photo by B. Jacobs, 2006)*

**Figure 4.** *Piñon-juniper savanna, growing in relatively deep soils on gentle terrain, in a region of summer-dominated precipitation. Trees are predominantly* Juniperus monosperma *with occasional* Pinus edulis. *Most trees are less than 150 years old, but there is at least one older tree per acre. Blue grama (*Bouteloua gracilis*) is the dominant grass; cholla cactus (*Opuntia imbricata*) is also present. With a well-developed herbaceous stratum within a relatively productive environment, low tree density at this site may have been maintained historically by periodic fire. However, fire history studies have not been conducted in this area to confirm or reject this hypothesis. Near Mountainair, New Mexico, elevation ca. 6,400 feet. (Photo by W. Romme, 2006)*

establishment and survival over long time scales. Trees may become more abundant during moist climatic periods or during long disturbance-free intervals, but subsequently die back during drought and associated insect outbreaks or following fire. Many woodlands of this type have a shrub-dominated understory (Figure 5). Some such areas may have a distinctive historical fire regime, and therefore could be classified as a separate piñon-juniper-shrub type if such a distinction is useful for management. This vegetation type overlaps somewhat with disturbance-maintained savannas, but refers primarily to areas that fluctuate between shrubland or grassland structure and tree dominance, as well as other sites where soils or climate are only occasionally suitable for tree growth and survival.

Areas of potential woodland expansion and contraction are found on a wide variety of substrates and climatic conditions. Such areas sometimes are located adjacent to persistent woodlands or savannas, where soil conditions gradually change from favorable to marginal for tree growth. However, precise bioclimatic conditions associated with areas of potential piñon-juniper expansion and contraction are poorly defined at this time. This type of piñon-juniper vegetation is found throughout the West; it appears to be especially prevalent in the Great Basin.

**Figure 5.** *An area of potential expansion and contraction, on fine-textured soils in a region of moderate, winter-dominated precipitation. The canopy is composed of* Pinus edulis, Juniperus osteosperma, *and* Juniperus monosperma. *The prominent shrub is* Artemisia tridentata. *The trees are all-aged. Note the relatively old-appearing (>150 years, Table 2) piñon trees in the background, with flattened crowns and large branches near the top; and the younger-appearing piñon and juniper trees in the foreground, with spire-shaped crowns. The younger trees are evidence of expansion during the past century, but contraction also has occurred during a severe regional piñon mortality event within the past decade (see Figure 7). Evidence of past fire is scarce. San Juan Basin, northwestern New Mexico, elevation ca. 6,800 feet. (Photo by B. Jacobs, 2008)*

# What We Know About Persistent Woodlands

1. Spreading, low-intensity surface fires had a very limited role in molding stand structure and dynamics of persistent piñon-juniper woodlands in the historical landscape. In very sparse woodlands, especially on rocky terrain, fires typically burned individual trees but did not spread extensively because of lack of surface fuels. Surface spread was more likely to occur in higher-density woodlands growing on more productive sites, but even here fire spread was typically from crown to crown, especially when wind-driven. Regardless of tree density, the dominant fire effect was to kill most or all trees and to top-kill most or all shrubs (Figure 6). This statement also is true of most fires today.
HIGH CONFIDENCE ... APPLIES TO PERSISTENT WOODLANDS THROUGHOUT THE WEST

2. Historical fires in persistent piñon-juniper woodlands generally did not "thin from below," i.e., they did not kill

**Figure 6.** *A recent stand-replacing burn in persistent woodlands, the ca. 25,000-acre Mustang Fire of 2002, photographed in fall of 2006. Note the sharp boundaries between burned and unburned woodlands, and the nearly complete canopy mortality within the burn perimeter — typical characteristics of large fires in persistent piñon-juniper woodlands, both historically and at present. Trees are* Pinus edulis *and* Juniperus osteosperma. *Near Flaming Gorge Reservoir, northeastern Utah, elevation ca. 6,200 feet. (Photo by C. D. Allen, 2006)*

predominantly small trees. Instead, they tended to kill all or most of the trees within the places that burned regardless of tree size. This statement also is true of most fires today.
HIGH CONFIDENCE … APPLIES TO PERSISTENT WOODLANDS THROUGHOUT THE WEST

3. Historical fire rotations (i.e., the time required for the cumulative area burned to equal the size of the entire area of interest) varied from place to place in persistent piñon-juniper woodlands, but generally were very long (e.g., two to six centuries). This statement also is true of most persistent woodlands today.
HIGH CONFIDENCE … APPLIES TO PERSISTENT WOODLANDS THROUGHOUT THE WEST

4. Some persistent woodlands are stable for hundreds or even thousands of years without fire, other than isolated lightning ignitions that burn only a single tree and produce no significant change in stand structure. Many woodlands today show no evidence of past fire, though they may have burned in the very remote past (many hundreds or thousands of years ago). This may be true especially of very sparse woodlands in rocky areas, but is also true of many higher-density woodlands growing on more productive sites.
HIGH CONFIDENCE … BUT PRECISE GEOGRAPHIC APPLICABILITY NOT ADEQUATELY KNOWN

5. In some persistent woodlands, stand dynamics are driven more by climatic fluctuation, insects, and disease than by fire. For example, a massive piñon mortality event occurred recently in the Four Corners region as a result of drought, high temperatures, and bark beetle outbreaks (Figure 7).
HIGH CONFIDENCE … BUT PRECISE GEOGRAPHIC APPLICABILITY NOT ADEQUATELY KNOWN

6. Tree density and canopy coverage have increased in many or most persistent woodlands during the 20th century.
HIGH CONFIDENCE … BUT PRECISE MAGNITUDE OF INCREASE, CAUSES, AND GEOGRAPHIC APPLICABILITY NOT ADEQUATELY KNOWN

7. The gradual increase in tree density and canopy cover during the 20th century in most persistent PJ woodlands is not due entirely, or even primarily, to fire exclusion. Effects of past livestock grazing and/or favorable climatic conditions for tree growth during most of the 20th century probably are more important mechanisms in most areas. However, we do not yet fully understand how grazing, climate, and fire exclusion interact to promote increased tree density, nor can we say with confidence which of these mechanisms is most important in any specific location. In addition, some stands that resemble persistent woodlands – i.e., with dense tree canopies, shallow rocky soils, and sparse herbaceous cover – actually may represent an eroded and degraded state of formerly lower-density woodlands that had grassy understories and could have supported

**Figure 7.** *Grey piñon skeletons illustrate the severe mortality event that occurred in* Pinus edulis *throughout much of the Four Corners region between 2002 and 2004. Tens of millions of piñon trees died from interactions among drought stress, bark beetle outbreaks, and anomalous high temperatures. Mortality was most severe in northern New Mexico, northern Arizona, southern Colorado, and southern Utah. Bandelier National Monument and Los Alamos National Laboratory, New Mexico, elevation 6,500 feet. (Photo by C. D. Allen, 2006)*

frequent fire. However, research to critically test this interpretation is lacking in most areas.
MODERATE CONFIDENCE ... BUT GEOGRAPHIC APPLICABILITY AND SITE SPECIFIC CAUSES NOT ADEQUATELY KNOWN

8. Recent large, severe fires in persistent piñon-juniper woodlands probably are normal kinds of fires, for the most part, because similar fires occurred before 1900 (as documented, e.g., at Mesa Verde and on the Kaiparowitts Plateau). However, the frequency of large severe fires appears to have increased throughout much of the West during the past 20 years, in piñon-juniper and also in other vegetation types. This increased fire activity may be a consequence of warmer temperatures and longer fire seasons, greater fuel continuity developing from increasing tree cover, invasion by highly flammable annual grasses (e.g., cheatgrass, *Bromus tectorum*), or a combination of all these causes. However, with the very long fire rotations that characterize persistent piñon-juniper woodlands, we cannot yet determine if this recent apparent trend represents real, directional change or simply a temporary episode of increased fire activity, similar to comparable episodes in the past.
MODERATE CONFIDENCE ... APPLIES TO MOST PERSISTENT WOODLANDS THROUGHOUT THE WEST

# What We Know About Piñon-Juniper Savannas

9. In many regions where a large fraction of annual precipitation comes in the summer, savannas and grasslands were more extensive historically than they are today. During the 20th century, many former savannas and grasslands in these regions have been converted to juniper or piñon-juniper woodlands of moderate to high canopy coverage, especially in parts of New Mexcio, Arizona, and perhaps also in southeastern Colorado.
HIGH CONFIDENCE … BUT PRECISE GEOGRAPHIC APPLICABILITY NOT ADEQUATELY KNOWN

10. Livestock grazing and fire exclusion since the late 1800s are important mechanisms driving the conversion of savanna to piñon-juniper woodland in at least some areas, but probably not all. Twentieth-century climatic conditions also have played a role in at least some areas, but how these potential causes interact is not well understood. On some sites with relatively high effective moisture for trees, tree cover may have become great enough to suppress herbaceous growth, thereby reducing the potential for subsequent surface fires and creating a new fire regime more similar to that of persistent woodlands than to the former savanna fire regime. Disentangling the mechanisms driving tree expansion in former grasslands and savannas is a high-priority research topic.
MODERATE CONFIDENCE … BUT PRECISE MAGNITUDE OF INCREASE, CAUSES, AND GEOGRAPHIC APPLICABILITY NOT ADEQUATELY KNOWN

# What We Know About Areas of Potential Expansion & Contraction

11. Expansion of piñon and/or juniper into previously non-wooded areas (especially former shrublands and grasslands) is occurring extensively in some regions, notably the Great Basin and parts of Arizona and New Mexico, but is of comparatively limited extent in other areas, notably western Colorado. An important consequence of this process is that formerly heterogeneous landscape mosaics — intermingled patches of woodland, shrubland, and grassland — are becoming more homogeneous as trees become established within the former shrubland and grassland patches.
HIGH CONFIDENCE … BUT PRECISE GEOGRAPHIC APPLICABILITY NOT ADEQUATELY KNOWN

12. Presence of young piñon-juniper woodlands does not necessarily imply expansion into formerly non-woodland vegetation. The young trees may instead represent recovery of persistent woodlands from previous disturbance (e.g., clearing or fire). Thus, knowledge of local history is important.
HIGH CONFIDENCE … BUT PRECISE GEOGRAPHIC APPLICABILITY NOT ADEQUATELY KNOWN

13. Near the current altitudinal and geographical limits of piñon and juniper, expansion may represent natural, long-term change in the species' range (e.g., piñon expansion in the northern Front Range of Colorado and near Flaming Gorge Reservoir in northeastern Utah during the past several centuries)
HIGH CONFIDENCE … BUT PRECISE GEOGRAPHIC APPLICABILITY NOT ADEQUATELY KNOWN

14. Expansion of piñon and/or juniper into previously non-wooded areas occurred prior to Euro-American settlement on at least some sites; it is not strictly a 20th century phenomenon, and is not necessarily an abnormal process caused by past land use or fire exclusion. Loss of piñon and/or juniper from marginal sites also occurred historically, and has occurred recently in some areas, e.g., the Four Corners region (Figure 7).
HIGH CONFIDENCE … BUT PRECISE GEOGRAPHIC APPLICABILITY NOT ADEQUATELY KNOWN

15. Expansion of piñon and/or juniper into previously non-wooded areas may have been more extensive in the 20th century than in the previous few centuries, at least in some regions. Grazing and fire exclusion probably are major causes of expansion of piñon and/or juniper into some savannas, grasslands, and shrublands, but not all. Climate change probably also plays an important role. However, we do not have a good understanding of how these potential causes interact.
MODERATE CONFIDENCE … BUT PRECISE MAGNITUDE OF INCREASE, CAUSES, AND GEOGRAPHIC APPLICABILITY NOT ADEQUATELY KNOWN

**Table 1.** A suggested key for identifying the three historical types of piñon-juniper vegetation discussed in this paper. Note: This key has not yet been extensively field tested. The authors will appreciate feedback on how well it works (or does not work).

1a. Total tree canopy cover (piñon and juniper combined) < 10 % ..... 2
1b. Total tree canopy cover (piñon and juniper combined) > 10 % ..... 6

2a. At least one old tree (over 150 years old*) per acre ..... 3
2b. Old trees (over 150 years old*) fewer than one per acre ..... 4

3a. Understory dominated by grassland species, often on deep soils and gentle topography ..... **Savanna** (*relatively stable*)
3b. Understory dominated by shrubs or other species not associated with grassland, often on shallow soils and rugged or rocky topography ..... **Persistent Woodland** (*a very sparse form of persistent woodland*)

4a. Large dead wood (> 10 inches diameter, standing or fallen), conspicuously present, showing evidence of past fire, woodcutting, or other severe disturbance ..... **Persistent Woodland** (*recovering from disturbance*)
4b. Large dead wood (> 10 inches diameter, standing or fallen), conspicuously absent ..... 5

5a. Understory dominated by grassland species, often on deep soils and gentle topography ..... former **Grassland** being converted to **Savanna**
5b. Understory dominated by shrubs or other species not associated with grassland, often on shallow soils and rugged or rocky topography ..... **Area of Potential Expansion and Contraction** (*with recent episode of expansion*)

6a. At least 10% of canopy trees are over 150 years old* ..... **Persistent Woodland**
6b. Fewer than 10% of canopy trees are over 150 years old* ..... 7

7a. Large dead wood (> 10 inches diameter, standing or fallen), conspicuously present, showing evidence of past fire, woodcutting, or other severe disturbance ..... **Persistent Woodland** (*recovering from disturbance*)
7b. Large dead wood (> 10 inches diameter, standing or fallen), conspicuously absent ..... 8

8a. Understory dominated by grassland species, often on deep soils and gentle topography ..... former **Grassland** or **Savanna** being converted to **Woodland**
8b. Understory dominated by shrubs or other species not associated with grassland, often on shallow soils and rugged or rocky topography ..... **Area of Potential Expansion and Contraction** (*with recent episode of expansion*)

* See Table 2 for assistance in estimating tree ages.

**Table 2.** Tips for estimating tree ages. Tree size is often an unreliable indicator of tree age, and the oldest trees on a site are sometimes among the smaller individuals. The best way to determine tree age is by extracting an increment core and cross-dating the rings. Piñons usually can be dated accurately if the wood is sound, but junipers generally are difficult or impossible to cross-date. Where coring and cross-dating are not feasible, other qualitative features can be used to distinguish between relatively old trees vs. relatively young trees with a moderate degree of confidence:

| Characteristic | Relatively Young Trees | Relatively Old Trees |
|---|---|---|
| Crown shape | Conical, with pointed tip and lower branches still living | Flattened top, with lower branches dead or previously shed |
| Branch structure | Branches become progressively smaller from bottom to top of tree | Large, gnarly branches throughout the living portion of the crown |
| Dead wood | Little dead wood in the bole, few dead branches, little or no sign of past wood cutting | Large dead branches, often broken off or cut by wood gatherers long ago; bark missing from portions of the bole and weathered wood exposed in these places |
| Bark | Somewhat smooth, with relatively shallow furrows | Often rough and shaggy (junipers only), with relatively deep furrows (piñons and junipers) |

# Appendix F

## Fuels Treatment Projects

# Carson City Consolidated Municipality, Nevada

Table 1. WUI Fuels Treatment Projects, Carson City (2004–Present).

| Name of Project or Description | Agency | Acres Treated |
|---|---|---|
| North Carson | BLM | 58 |
| Deer Run/Mexican Dam | BLM | 90 |
| Prison Hill | BLM | 26 |
| Silver Saddle Ranch | BLM | 88 |

BLM – Bureau of Land Management. NDF – Nevada Division of Forestry. N/A – Not Available.

Table 2. Non-WUI Fuels Treatment Projects, Carson City (2004–Present).

| Name of Project | Agency | Acres Treated |
|---|---|---|
| Brunswick | BLM | 459 |
| Brunswick Extension | BLM | 30 |

BLM – Bureau of Land Management. N/A – Not Available.

These Tables were last updated on April 5, 2008.