The long history of fire suppression combined with incidences of drought and insect-induced mortality has resulted in stands with a high concentration of hazardous fuels. This condition has increased the threat of large catastrophic fire and is indicative of a forest where many natural processes have been excluded.

Current Vegetative Conditions and Fire Regimes

The Carson Range contains a large number of vegetation types. Existing vegetation classification (source: LANDFIRE) recognizes 42 vegetation types including non-vegetated areas such as "Developed-Medium Intensity" which is in the urban area. The major vegetation types are "California Montane Jeffery Pine (Ponderosa Pine Woodland)" at 20 percent of the analysis area, "Mediterranean California Red Fir Forest" at 15 percent, and "Inter-Mountain Basins Montane Riparian Systems" at 11 percent (Table 6). Table 6 only lists vegetation types greater than or equal to 1 percent. Vegetation types not listed sum to about 3 percent of the analysis area.

Table 6. Existing vegetation types within the Carson analysis area

Existing Vegetation Type	Percent
California Montane Jeffrey Pine(-Ponderosa Pine) Woodland	20
Mediterranean California Red Fir Forest	15
Inter-Mountain Basins Big Sagebrush Shrubland	11
Agriculture-General	6
Inter-Mountain Basins Montane Riparian Systems	6
Developed-Low Intensity	5
Artemisia tridentata ssp. *vaseyana* Shrubland Alliance	5
California Montane Woodland and Chaparral	4
Inter-Mountain Basins Sparsely Vegetated Systems	3
Developed-Medium Intensity	3
Inter-Mountain Basins Montane Sagebrush Steppe	3
Mediterranean California Mesic Mixed-conifer Forest and Woodland	3
Great Basin Pinyon-Juniper Woodland	2
Developed-Open Space	2
Mediterranean California Sparsely Vegetated Systems	2
Mediterranean California Subalpine Woodland	1
California Montane Riparian Systems	1
Developed-High Intensity	1
Rocky Mountain Aspen Forest and Woodland	1
Great Basin Semi-Desert Chaparral	1
Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland	1
Sierra Nevada Subalpine Lodgepole Pine Forest and Woodland	1
Northern California Mesic Subalpine Woodland	1

Tree species found in area forests and woodlands include Jeffrey pine (*Pinus jeffreyi*), ponderosa pine (*Pinus ponderosa*), sugar pine (*Pinus lambertiana*), incense cedar (*Calocedrus decurrens*), lodgepole pine (*Pinus contorta*), white fir (*Abies concolor*), red fir (*Abies magnifica*), whitebark pine (*Pinus albicaulis*), quaking aspen (*Populus tremuloides*), pinyon pine (*Pinus monophylla*), and juniper (*Juniperus* spp.).

The vegetation types shown above form general zones based on precipitation and temperature changes with elevational changes. At the lowest elevations, non-forest shrubland vegetation types dominate. With increased elevation, the shrublands transition to coniferous woodlands. Within the generalized zones, slope, aspect, soil types, precipitation, temperature, and disturbances interact to create a very mixed landscape.

Past natural disturbances, land use, and management influenced the landscape vegetation patterns and ecosystem dynamics in the Carson Range. Human settlement in the Carson Range has potential impacts on the forest and shrubland composition and structure that subsequently contribute to the changes in fire hazard, watershed hydrology, and terrestrial habitats.

Fire suppression, grazing (conifer species are generally not grazed), and favorable climatic conditions for conifer establishment have led to high stocking levels and fuel accumulations in the coniferous forests and an increase in white fir abundance compared to historic levels (USDA Forest Service 2004; see photo, left). In some areas historically maintained as open pine-dominated stands, the density of trees has reached three to five times historic stocking levels (USDA Forest Service 1997). High densities of trees increase competition for nutrients resulting in higher tree mortality rates due directly to competition, and higher potential for mortality due to insects and diseases. During a period of reduced precipitation in the late 1980s and early 1990s, fir engraver (*Scolytus ventralis*), Jeffrey pine beetle (*Dendroctonus jeffreyi*), and mountain pine beetle (*Dendroctonus ponderosae*) induced tree mortality increased. During this time, fir engraver-induced mortality ranged from 15 to 55 percent of the trees (USDA Forest Service 1993). Since the early to mid-1990s, insect mortality has declined to more endemic (natural) levels and are building up again to epidemic levels.

Dense forests in the Carson Range

High levels of tree mortality, particularly white fir, have dramatically increased the number of standing dead trees and downed logs. Smaller mid-story trees create fuel ladders that allow fires to readily move into dense crowns. The lack of frequent, low-intensity fires has resulted in accumulations of dead fuels, increased understory shrubs, and dense young trees. As a result,

flame lengths and rates of fire spread lead to higher intensity fires (Fire Modeling 2007). Residential, commercial, and infrastructure construction have also influenced today's vegetation patterns.

Historic Fire Regime

Prior to European settlement, fires in the analysis area were ignited by lightning or members of the Washoe Tribe, who inhabited the area during the summer months. Potter (1998) estimated the historical fire return interval in pine-dominated stands to range from 5 to 20 years. In the Jeffrey pine/white fir mixed-conifer forest type, the fire return interval was estimated to be 20 to 30 years (USDA Forest Service 1997). Taylor (1998) found fire return intervals of 12 to 32 years in the Jeffrey pine/white fir forests in the Lake Tahoe Basin and surrounding areas. Because frequent fires reduced surface and ladder fuels in the pine and mixed pine/fir stands, fire intensities were generally low and there was little mortality of mature trees.

In the higher elevation, whitebark pine and lodgepole pine vegetation types, fire return intervals were longer and more variable, resulting in either slow-burning, low-intensity fires or infrequent stand-replacing fires (USDA Forest Service 2004). Estimates of fire return intervals in the red fir forest have been estimated to be 10 to 150 years (USDA Forest Service 1994b), and in the lodgepole pine forest to be between 25 and 150 years.

As Europeans settled in the area, several factors contributed to changes in the fire regime and fuel hazards. The frequent seasonal fires set by the Washoe Tribe were eliminated and being replaced by active suppression of all fires by federal land managers. Grazing by livestock reduced fine fuels and in turn reduced fire ignition and spread. Active fire suppression reduced the number of fires and fire sizes. As a result, fire return intervals have been lengthened and fires have become more intense and severe. In conclusion, disturbance by fire was a frequent and normal part of the historic vegetative condition, but conditions have changed since the 1860s.

Current Fire Regime

Previous management direction that focused on protection of natural resources by suppressing all wildfires removed a natural source of vegetation disturbance. Simulated fire behavior in the analysis area and observed fire behavior in wildfires that have occurred within the last two decades demonstrates that current fire behavior is characterized by high-intensity fires. The historic fire regime is characterized by frequent, low-intensity fires. The frequency of these fires has been altered by this management and thus has resulted in denser vegetative stands. High-intensity wildfires will result in high tree mortality in forest stands, could result in extensive property loss, and could cause large amounts of erosion and sedimentation that would adversely affect water quality.

Fire Regime Condition Class

Fire regime condition class is a national landscape classification scheme describing the degree of departure in the current fire regime from the historic fire regime. The classification scheme is based on changes in vegetative characteristics, fuel composition, and fire frequency and intensity and described as low (I), moderate (II), or high (III) departure.

- **Low (I)** condition class means vegetative characteristics and fire behavior are considered to be within the historic range of variability.
- **Moderate (II)** condition class means vegetative characteristics and fire behavior are moderately altered from historic conditions.
- **High (III)** condition class means vegetative characteristics and fire behavior are highly altered and there is a risk of losing key ecosystem functions.

Fire regime condition classes have been generalized for the area (see Figure 15). Ten percent of the project analysis area is classified in a low (I) condition class, 64 percent is classified in a moderate (II) condition class, and 7 percent is classified in a high (III) condition class. The majority of the analysis area is in condition class II. These are areas where fire behavior has been moderately altered and an intense fire could have significant impacts on the local ecosystem. Areas in condition class II are upper montane forests and alpine areas where historic fire return intervals were much longer than those in the lower montane forest.

Current Wildfire Potential

Fire behavior modeling was conducted to evaluate fire behavior and risk in the analysis area. Fuels analyses, fire history (Figure 14) and fire behavior modeling were used to predict fire susceptibility in the analysis area. Wildfire potential based on FLAMMAP (Version 3.2, 2006), predicted fire behavior characteristics such as flame lengths and fire type. The model uses spatial information on topography and fuels along with weather and wind data. It incorporates existing models for surface fire, crown fire, and rate of spread. Predicted fire behavior outcomes were determined for the analysis area using local weather conditions. This analysis found that on normal high fire days (90^{th} percentile weather conditions) approximately 55 percent of fuel conditions in the Carson Range would have flame lengths exceeding 4 feet with approximately 28 percent of the area potentially developing into passive or active crown fire (Figure 17) and approximately 56 percent of the area experiencing high-extreme rates of spread (Figure 18). Under these conditions, fire crews cannot use direct attack strategies and must rely on mechanized equipment and aerial support to suppress these fires. Under extreme fire weather conditions, these estimates would be worse.

Surface Fire - A fire that burns loose debris on the ground surface including dead branches, leaves, and low vegetation.

Passive Crown Fire – A surface fire that rises into the tree tops to consume single or small groups of trees or bushes

Active Crown Fire - A fire in which a surface fire ignites tree tops and then the fire spread is able to propagate through the tree canopy

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