C. Vegetative Wildfire Fuels

The fuels assessment is used to explain the local fire situation. This can help focus attention on fuels management related solutions. These fuels are identified as defined in the "Aids to Determining Fuel Models for Estimating Fire Behavior" NEFS 1574 by Hal E. Anderson.

Fuel models for the National Fire Danger Rating System (NFDRS) have increased to 20, while fire predictions and applications have utilized the 13 fuel models tabulated by Rothermal (1972) and Albini (1976). These fuels have been classified into four groups- grasses, brush, timber and slash.

In the fire plan, we use these fuel models to develop assessments considering the current flammability of wildland fuels, given the location on the slope, the average fire weather severity conditions, ladder fuels and crown density. Each fuel has its own burning characteristic based on various inherent factors, such as fuel moisture content, arrangement and volume. All of these contribute to how a fire will spread in intensity, and ultimately, threaten assets.

Fuel loading is measured in tons per acre; grass is considered a light fuel with approximately ¾ tons per acre. Conversely, thick heavy brush, a heavy fuel, can have a volume of over 21 tons per acre. Fire intensity is directly related to the fuel loading over the landscape. Grass will burn rapidly with short periods of intense and maximum heat output and brush will produce greater heat output for a longer period of time, thus increasing the difficultly to control.

The arrangement of these wildland fuels is critical to how the fuel behaves during a wildfire. Un-compacted fuels, such as grass, will allow for rapid fire spread since more of its surface can be heated at one time. Compacted fuels, such as pine litter, burn slower because heat and air reach only the top of the fuel.

Fuel Types

Vertical arrangement refers to a fuel's ability to spread upward into the treetops. These are called ladder fuels and are influential factors in fire spread. The ignition of ladder fuels allows the fire to spread from the ground into the treetops. Crown or canopy refers to the tops of trees or the limb cover of the vegetation. It is very important during a timber fire, as fire has the potential of using ladder fuels to gain access to the tops of the trees and become a moving crown fire. These fires can spread as fast as a grass fire from treetop to treetop.

(Note: See Appendix F for Fuels Map)

Common Fuel Models within Lassen Modoc Unit

Fuel Model 1
Grass

The fine, very porous, and continuous herbaceous fuels that have cured or are nearly cured govern fire spread. Fires are surface fires that move rapidly thought the cured grass and associated material. Very little shrub or timber is present, generally less than one third of the area.

- Total fuel load, <3" dead and live, tons/acre = .74
- Dead fuel load, ¼", tons/acre=. 74
- Live fuel load, foliage tons/acre = 0
- Fuel bed depth, feet = 1.0

Fuel Model 2
Grass and Pine

Fire spread is primarily through the fine herbaceous fuels, either curing or dead. These are surface fires where the herbaceous material, in addition to litter and dead-down stem wood from the open shrub or timber over story, pine stands may include clumps of fuels that generate higher intensities and that may produce firebrands.

- Total fuel load, greater than 3" dead and live, tons/acre = 4.0
- Dead fuel load, ¼", tons/acre = 2.0
- Live fuel load, foliage, tons/acre = 0.5
- Fuel bed depth, feet = 1.0

Fuel Model 4
Brush

Fire intensity and fast-spreading fires involve the foliage and live and dead fine woody material in the crowns of a nearly continuous secondary over story. Stands of mature shrubs, 6 or more feet tall, such as California mixed chaparral. Besides flammable foliage, dead woody materials in the stands significantly contribute to the fire intensity. Height of stands qualifying for this model depends on local conditions. A deep litter layer may also hamper suppression efforts.

- Total fuel load, < 3" dead and live, tons/acre = 13.0
- Dead fuel load, ¼", tons/acre = 5.0
- Live fuel load, foliage, tons/acre = 5.0
- Fuel bed depth, feet = 6.0

Fuel Model 5
Brush

Litter cast by shrubs in the understory carries fire in this brush model. The fires do not burn intensely (4 foot flame lengths), or rapidly since the young shrubs are green and the foliage does not burn. Usually shrubs are short and almost totally cover the area. Young green stands with no dead wood would qualify.

- Total fuel load, < 3" dead and live, tons/acre = 3.5
- Dead fuel load, ¼" tons/acre = 1.0
- Live fuel load, foliage, tons/acre = 2.0
- Fuel bed depth, feet = 2.0

Fuel Model 6
Brush

Unlike the fuel model 5, fires in this model will burn in the foliage of standing vegetation, but only when wind speeds are greater than 8 mph. Fires burn with an average flame length of 6 feet and spread at a rate of 2,112 feet feet/hour. Interior live oak, young chamise and Pinyon-juniper with sagebrush are all associated with this fuel model. In many instances a fuel model 5 will evolve into this model by the latter part of the summer.

- Total fuel load, <3" dead and live, tons/acre = 6.0
- Dead fuel load, ¼", tons/acre = 1.5
- Live fuel load, foliage, tons/acre = 0
- Fuel bed depth, feet = 2.5

Fuel Model 8
Timber

Slow burning ground fires with low flame lengths are generally the case, although the fire may encounter an occasional "jackpot" or heavy fuel concentration that can flare up. Only under severe weather conditions involving high temperature, low humidity, and high wind do the fuels pose fire hazards. Closed canopy stands of short – needle conifers or hardwoods that have leafed out support fire in the compact litter layer. This layer is mainly needles, leaves, and occasionally twigs because little undergrowth is present in the stand. Representative conifer types are white pines and lodgepole pine.

- Total fuel load, <3" dead and live, tons/acre = 5.0
- Dead fuel load, ¼", tons/acre = 1.5
- Live fuel load, foliage, tons/acre = 0
- Fuel bed depth, feet = 0.2

Fuel Model 9
Timber

Fires in this model also burn in needle or leaf fall under a conifer or hardwood canopy, but at a faster rate than in a fuel model 8 and more intensely. Concentrations of heavier dead material add to the possibility of the fire spreading to the crowns of trees. This model is found in a wide range of areas under timber stands which have been treated for fuel reduction, or have seen low intensity fires over the last decade. Concentrations of dead-down woody material will contribute to possible torching out of trees, spotting, and crowing.

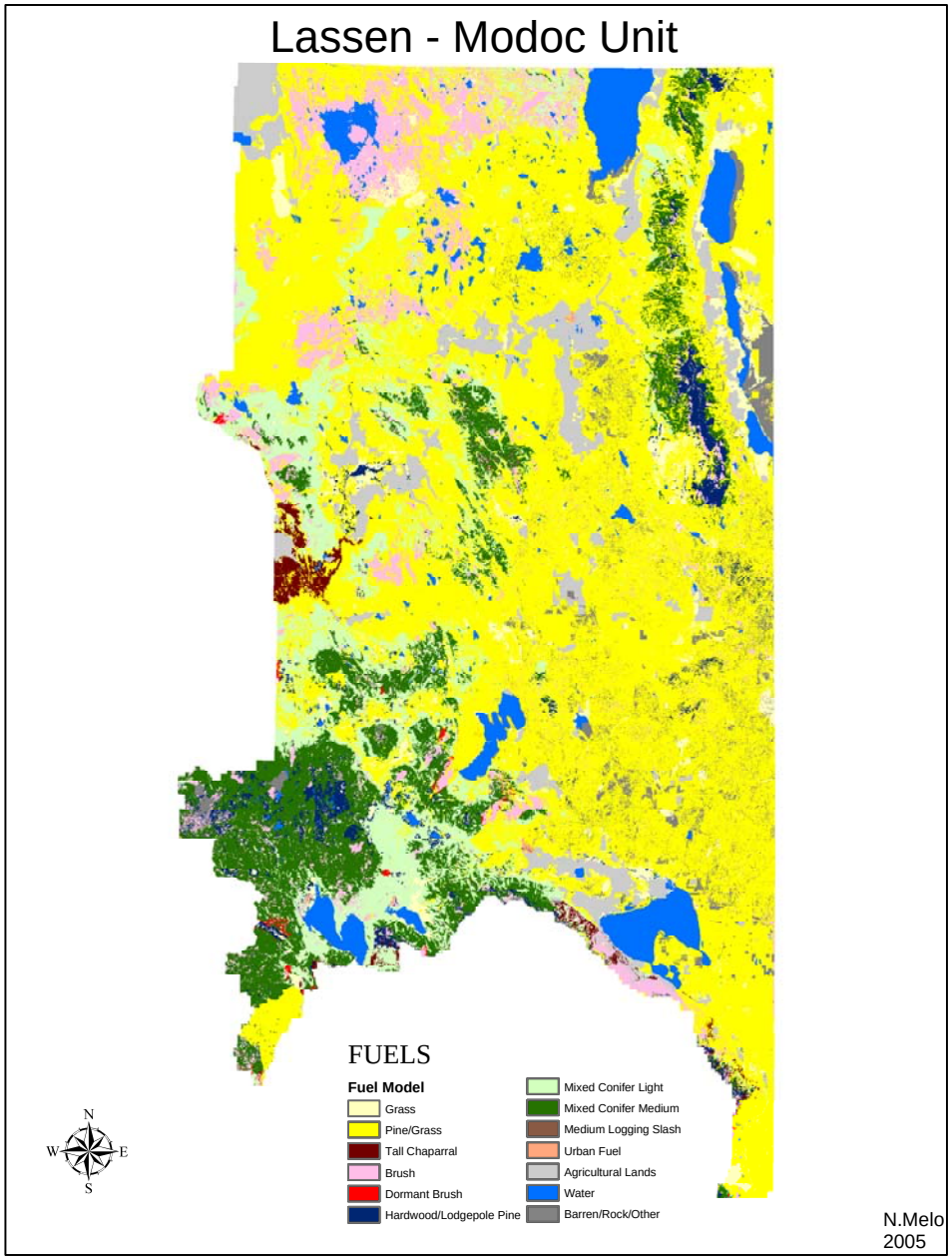
- Total fuel load, < 3" dead and live tons/acre = 3.5
- Dead fuel load, ¼" tons/acre = 2.9
- Live fuel load, foliage, tons/acre = 0
- Fuel bed depth, feet = 0.2

Fuel Model 10
Timber

Fires burn in the surface and ground fuels with greater fire intensity than the other timber litter models. Dead-down fuels include greater quantities of 3-inch or larger limb wood resulting from over maturity or on the forest floor. Crowning out, spotting, and torching lead to potential fire control difficulties. Any forest type may be considered if heavy down material is present; examples are insect- or disease-ridden stands, wind thrown stands, over mature situations with deadfall, and aged light thinning or partial-cut slash.

- Total fuel load, < 3" dead and live tons/acre = 12.0
- Dead fuel load, ¼", tons/acre = 3.0
- Live fuel load, foliage, tons/acre = 2.0
- Fuel bed depth, feet = 1.0

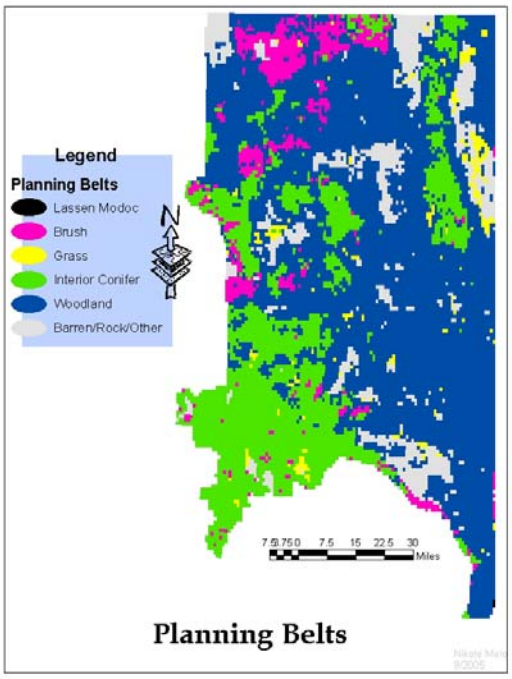
Appendix F


Lassen - Modoc Unit
FUELS
Fuel Model
Grass
Pine/Grass
Tall Chaparral
Brush
Dormant Brush
Hardwood/Lodgepole Pine
Mixed Conifer Light
Mixed Conifer Medium
Medium Logging Slash
Urban Fuel
Agricultural Lands
Water
Barren/Rock/Other
N
W
E
S
N.Melo
2005

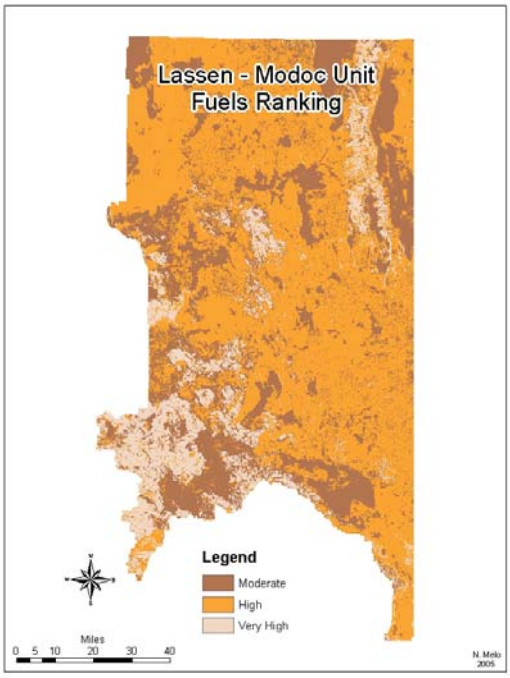
FIRE MANAGEMENT PLAN 2005
Lassen – Modoc Unit

Determining and Defining Hazardous Fuels

The first step in defining hazardous fuels is the development of vegetation coverage for Lassen Modoc Unit in GIS. Vegetation coverage's are described as planning belts which are areas consisting of similar vegetation types. These zones have similar fire behavior characteristics that impact fire suppression activities and are based on the Fire Behavior Prediction System (FBPS) fuel modeling. The Unit has four planning belt types: Grass, Brush, Conifer and Woodland.



The vegetation types within the planning belts are categorized into the FPBS fuel model coverage as shown in the National Wildfire Coordinating Group Fuel Model as described above. After vegetation coverage's were identified, the past fire history for the unit was overlain on the vegetation coverage. Through analysis, surface fuel characteristics that result from past fires were factored into the creation of a final map, which displays a more accurate account of vegetation coverage, and thus, FPBS fuel characteristics.



The final phases of determining fuel hazard ratings for the Lassen -Modoc Unit involves the combining of crown fuel characteristics and surface fuel characteristics. The method describes additional ladder and crown fuel indices to surface fuels on a given area. If the vegetation data provides sufficient structural detail, the method imputes these additional indices from the data. If the vegetation data lacks structural detail, the method imputes indices based on the fuel model. The majority of indices are based on the FPBS fuel models.

In areas where applicable, the ladder and crown fuel indices convey the relative abundance of the fuel types. The indices take values ranging from 0 to 2, with 0 indicating absent, 1 representing present but spatially limited, and 2 indicating widespread. These indices indicate the probability that torching and crown fires would occur if the stand were subjected to a wildfire under adverse environmental conditions.

The assessment method calculates fire behavior that can be expected for unique combinations of topography and fuels under given weather condition. BEHAVE (Andrews 1986) provides estimates of fire behavior under severe fire weather conditions for FPBS fuel models located on six slope classes. Each fuel model combined with each slope class receives a surface hazard rank.

The total hazard rating includes not only hazards posed by surface fire, but also hazards by involvement of canopy fuels. The hazard ranking method includes this additional hazard component by adjusting the surface hazard rank according to the value of the ladder and crown fuel indices. Specifically, the surface hazard rank increases a maximum of one class in all situations where the sum of the ladder and crown fuel indices is greater than or equal to two.

The potential fire behavior drives the hazard ranking. A rank is attributed to each Q81st in SRA within the unit. The ranking method portrays hazard ratings as moderate, high or very high. The final map displays the fuel hazard ranks within the Unit used as another factor for determining pre-fire management target areas, fire size potentials and information for stakeholders with interests in ecosystem management, fuels management, and pre-fire management.

Knowledge of fire behavior in a given fuel type is essential for designing a defense plan against wildfire. Fires in brush often burn with an intensity that prevents fire crews from safely applying water to the flame front. Timber fires can ignite new fires (called spot fires) miles ahead of the main blaze, making control efforts nearly useless. Only wide scale pre-fire management programs can prevent a potential wildfire catastrophe.

National Wildfire Coordinating Group Fuel Models
Lassen - Modoc Unit Description

Fuel Model #	Fuel bed depth (feet)	Tons per Acre (live)	Tons per Acre (dead)	Flame Length (feet)	Spread Rate (feet/hour)	Comments
1	1	0	.74	4	5195	Dry grass. Not a common fuel found in the unit as found in the foothills and valleys of the Sacramento Valley
2	1	.5	4	6	2331	Dry grass with 1/3 to 2/3 brush or tree canopy. Very common throughout the unit.
3	2.5	2.5	3.01	12	6926	Grass model, not found locally.
4	6	5.01	16.03	19	4995	Thick brush with heavy dead component.
5	2	2	3.5	4	1199	Young or green brush with fire in the litter only.
6	2.5	2.5	6	6	2131	Mature or dry brush with foliage that will burn when exposed to wind.
7	2.5	2.5	4.87	5	1332	Brush model, not found locally.
8	.2	.2	5	1	107	Timber or hardwood with fire burning in light litter underneath.
9	.2	.2	3.48	2.6	499	Timber with fire in slightly heavier litter then model 8
10	1	1	12.02	4.8	526	Timber with heavy dead material underneath.
11	1	1	11.52	3.5	400	Light logging slash from a partial thinning operation
12	2.3	2.3	34.57	8	866	Moderate logging slash
13	3	3	58.1	10.5	899	Heavy logging slash

The local distribution of the fuel models is illustrated in the above map. Model 2 (grass) is found throughout the unit at various elevations; brush is found interspersed among the grass and then migrates into the timbered areas. The average elevation in the unit is approximately 5000 with higher mountain peaks. The entire unit is located on the northeastern plateau of California and the rainfall varies

throughout. The Westwood and Bieber area, where predominately heavy timber is found, receives larger amounts of precipitation as compared to the balance of the unit. On the eastern portion of the unit the climate is more arid and the fuels consist primarily of sage and grass, interspersed with pine and juniper.

D. Description of Severe Weather Analysis

Severe fire weather is defined using the Fire Weather Index (FWI) developed by the USDA Forest Service Riverside Fire Lab. The FWI combines air temperature, relative humidity, and wind speed into a one number score. The FWI gives wildland fire managers an index that indicates relative changes in fire behavior due to the weather (fuel and topography conditions are not included in the calculation). Severe fire weather occurs when the FWI, calculated from the hourly weather measurement, exceeds a predetermined threshold.

The threshold FWI is derived from average bad fire weather of (approximately) 95° F, 20% relative humidity, and a 7 mph eye-level wind speed. Frequency of Severe Fire Weather is defined as the percent of time during the budgeted fire season that the weather station records severe fire weather. Individual weather stations are ranked as low, medium, or high frequency of severe fire weather. This ranking can then be applied to the area on the ground represented by the weather station.

Severe Weather Analysis Parameters

FWI CUTOFF	START LOW RANK	START MED RANK	START HIGH RANK
29.725	0%	5%	20%

STATION	OWNER	LAT	LON	ELEV	WXSCORE	RANK
Ladder Butte	USFS	40.80722	-121.29667	5644	3	L
Ravendale	BLM	40.75417	-120.33333	5491	6	M
Rush Creek	USFS	41.2844444	-120.8524999	4720	3	L
Summit (Hat Mtn.)	NPS	40.50167	-121.423	6850	1	L
Ash Valley	BLM	41.05194	-120.6861	5100	10	M
Bogard RS	USFS	40.59805	-121.08304	5686	1	L
Bull Flat	BLM	40.48083	-120.11388	4395	10	M
Canby	USFS	41.43417	-120.86778	4312	19	M
Chester	USFS	40.28972	-121.08721	4530	3	L
Devils Garden	CDF	41.521	-120.668	5000	8	M
Doyle	USFS	40.02222	-120.10555	4240	5	M
Juniper Creek	BLM	41.33222	-120.47249	4372	11	M
Buffalo Creek	BLM	40.58194	-119.79	4894	14	M
MDF05	USFS	41.4961111	-120.5502777	4370	0	L
MDF03	USFS	41.2844444	-120.8524999	4720	0	L
R504 Portable	USFS	40.46167	-121.35611	7000	1	L
LN3	USFS	40.28333	-121.2	0	0	L
Timber Mountain	USFS	41.63472	-121.30083	5140	9	M
Surprise Portable	BLM	41.17083	-120.05833	5200	2	L
Alturas Portable	BLM	40.9745	-120.72499	6000	0	L
MDF04	USFS	41.49583	-120.55027	4737	0	L
MDF06	USFS	41.49611	-120.55027	4370	1	L
Laufman	USFS	41.13667	-120.345	4858	0	L
Grasshopper	CDF	40.78	-120.77833	6050	1	L
Blue Door	BLM	41.05472	-120.33749	5615	1	L
Horse Lake	BLM	40.63055	-120.50277	5100	9	M
Gordon	USFS	40.7586111	-120.8961111	6200	0	L
LN4	USFS	40.25	-121.08333	0	0	L
Barrell Springs	BLM	41.91111	-119.93889	5835	10	M
Westwood	CDF	40.29889	-120.89167	5800	1	L

WxSCORE

[Severe Wx]/[Wx In Season]. The percent of time a weather station is experiencing severe weather. Non-fire season data is thrown out at this point. The assumption is that during winter the fuels aren't ready to burn regardless of the weather. There are exceptions to this, but trying to count every possible contingency would weaken the result we are trying to achieve.

WxRANK

The Wx SCORE intensity rating is lumped into three categories to create a severe fire weather frequency ranking.