Appendix H – Fire and Fuels

Issue 1 – Assumptions and Methods

Methods

Study Area

The Nature Conservancy, under an agreement with the BLM, assessed forest vegetation restoration needs across five million acres of forest across southwestern Oregon (**Figure H-1**), including 1.2 million acres of BLM-administered lands (**Figure H-2**). This geography generally includes the extent of forests with historically frequent fires within SW Oregon. These forests cover very broad climatic, edaphic, and topographic gradients with varying natural disturbance regimes.

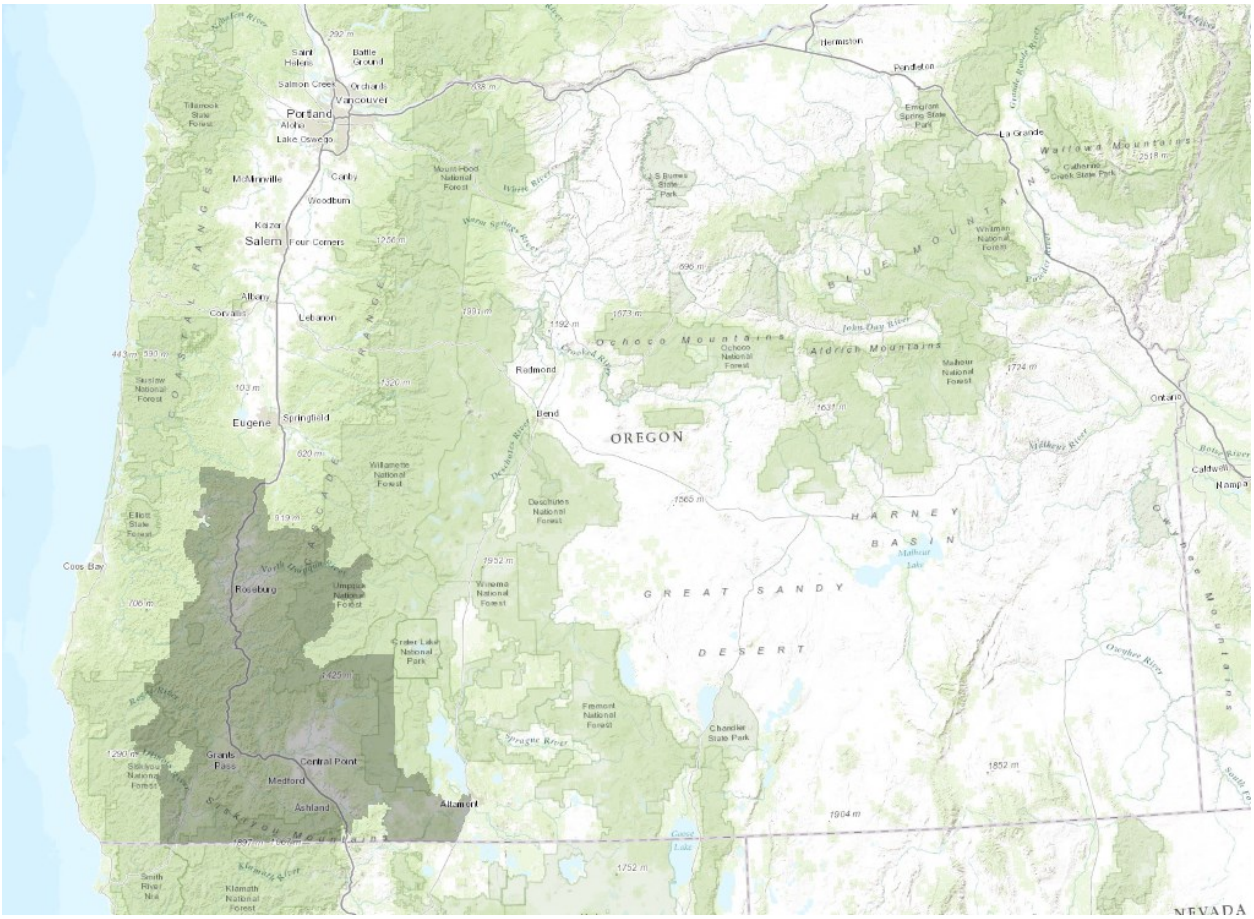

Figure H-1. Analysis area within the State of Oregon

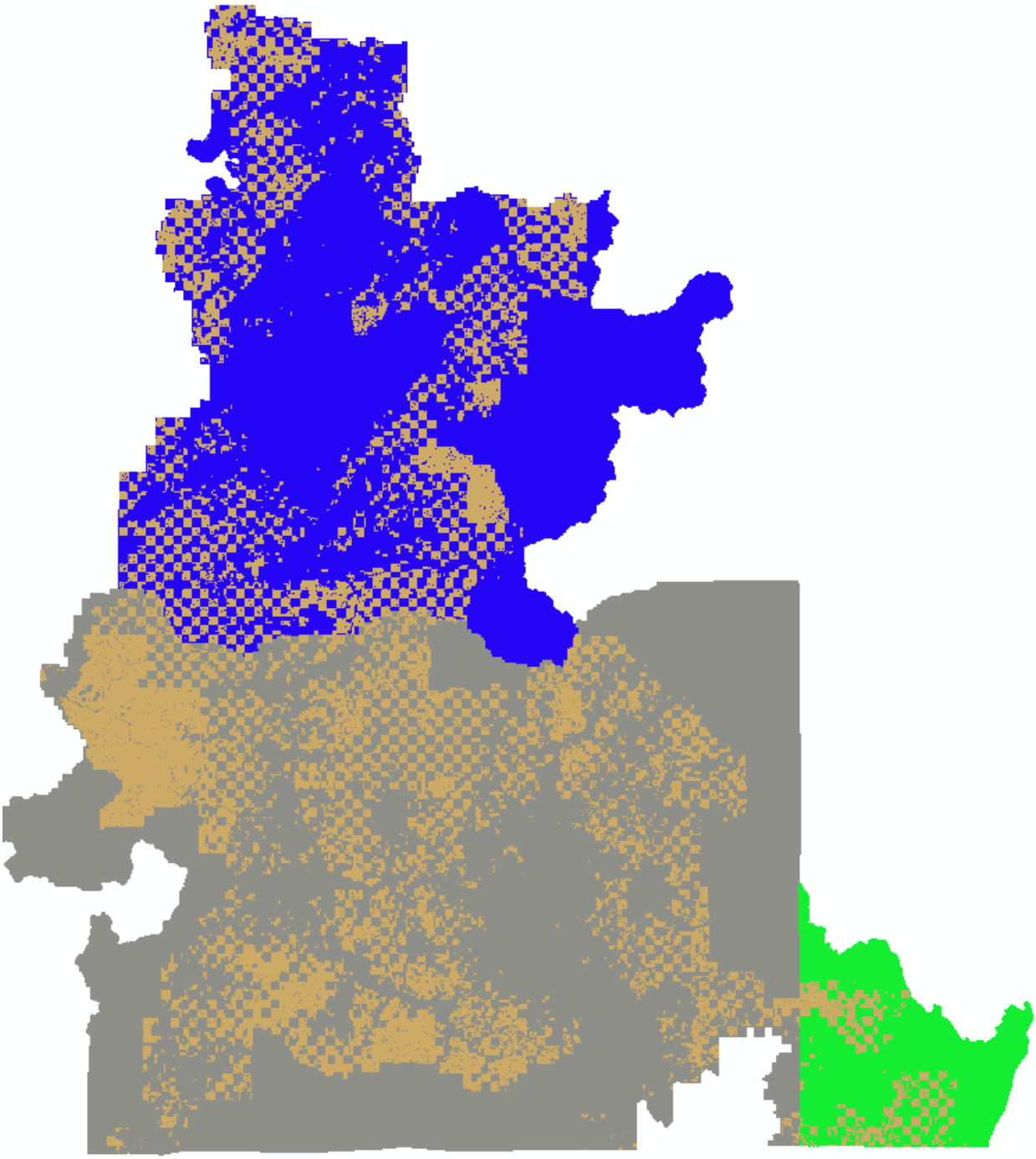

Figure H-2. BLM-administered lands within the analysis area
Note: Brown is BLM, blue is the Roseburg District, grey is the Medford District, and green is the western half of Klamath Falls Field Office.

Core Concepts and Data Sources

The Nature Conservancy built upon the conceptual framework of the LANDFIRE and Fire Regime Condition Class (FRCC) programs (Barrett *et al*. 2010, Rollins 2009) and incorporated Oregon and BLM specific datasets. The Nature Conservancy's assessment of forest vegetation departure is based on four

primary data inputs: (1) a classification and map of forested biophysical settings, (2) natural range of variability (NRV) reference conditions for each biophysical setting, (3) a delineation of 'landscape units' for each biophysical setting, and (4) a map of present day forest vegetation structure.

Mapping Forested Biophysical Settings

Biophysical settings are potential vegetation units associated with characteristic land capabilities and disturbance regimes (Barrett *et al*. 2010). Many different forested biophysical settings are found across Washington and Oregon based on vegetation, soils, climate, topography, and historic disturbance regimes (Keane *et al*. 2007, Pratt *et al*. 2006, Rollins 2009). They provide the framework for describing fire regimes. The Nature Conservancy mapped biophysical settings using the 30 m pixel Integrated Landscape Assessment Projects' Potential Vegetation Type (PVT) dataset (Halofsky *et al*. 2014), which compiled previous potential forest vegetation classification and mapping efforts including Simpson (2007) and Henderson *et al*. (2011). The Nature Conservancy also incorporated subsequent refinements to Potential Vegetation Type mapping in southwestern Oregon by Henderson (2013).

A biophysical setting model from either the LANDFIRE Rapid Assessment or the later LANDFIRE National program (Rollins 2009, Ryan and Opperman 2013) was assigned to each Potential Vegetation Type mapping unit (**Table H-1**). Assignments were made by staff in the U.S. Forest Service Pacific Northwest Region Ecology Program based upon the geographic, environmental, and biological characteristics of the biophysical setting models and the Potential Vegetation Type mapping units. The Nature Conservancy defined forests across our study area as 'forest' or 'forest and woodland' land cover class in the biophysical setting model. U.S. Forest Service National Forest System lands are typically considered 'forest' if they have > 10 percent tree canopy cover, and this generally coincides with forest, and forest and woodland land cover classes (USDA FS 2004).

Table H-1. ILAP PVTs in the analysis area to LANDFIRE BpS model crosswalk

Integrated Landscape Assessment Project Potential Vegetation Type (ILAP PVT)	LANDFIRE Biophysical Settings (BpS)
Douglas-fir-White oak	0210290
Douglas-fir–Dry	0710270
Western hemlock	R#DFHEwt
Mixed Conifer–Warm/Dry	R#MCONdy
Mixed Conifer–Moist	R#MCONms
Douglas-fir–Moist	R#MCONsw
Tan oak-Douglas-fir–Ultramafic	R#MEVG
Oregon white oak–Ponderosa pine	R#OAPI
Lodgepole pine	R#PICOpu
Ponderosa pine-Lodgepole pine	R#PIPOm
Ponderosa pine–Xeric	R#PIPOxe
Shasta red fir–Moist	R#REFI
Tan oak-Douglas-fir–Moist	R#TAOAco
Jeffery Pine	R#PIJEsp
Mixed Conifer–Cold	R#SPFI

Natural Range of Variability Reference Conditions

Each biophysical setting model is composed of a suite of 3–5 successional/structural stages (s-classes). These classes typically include: (1) Early Development, (2) Mid-development Closed Canopy, (3) Mid-development Open Canopy, (4) Late Development Open Canopy, and (5) Late Development Closed Canopy. The definition of each s-class in terms of species composition, stand structure, and stand age is unique for each biophysical setting (**Table H-2** and **Table H-3**). The percentage of a biophysical setting in each s-class will differ depending on disturbance frequencies and/or intensities. The LANDFIRE and FRCC conceptual framework assumes that, given natural processes, a biophysical setting will have a characteristic range of variation in the proportion in each s-class and that an effective indicator of 'ecological condition' for a given landscape is the relative abundance of each s-class within biophysical settings (Barrett *et al*. 2010, Keane *et al*. 2011).

Table H-2. BLM-administered lands by s-class in terms of species composition, stand structure, and stand age for each biophysical setting

Standard LANDFIRE 5–Box Models	LANDFIRE BpS	Included in BLM Dry Extent	Early Seral (A)				Mid-seral Closed (B)				Mid-seral Open (C)				Late-seral Open (D)				Late-seral Closed (E)			
			Size Class*		Canopy Closure		Size Class*		Canopy Closure		Size Class*		Canopy Closure		Size Class*		Canopy Closure		Size Class*		Canopy Closure	
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
	0210290	x	1	2	0	100	3	4	31	100	3	4	0	31	5	5	0	30	5	5	31	100
	0710270	x	1	2	0	100	3	4	41	100	3	4	0	40	5	5	0	40	5	5	41	100
	R#DFHEwt	x	1	2	0	100	3	4	61	100	3	4	0	60	5	5	0	60	5	5	61	100
	R#MCONdy	x	1	2	0	100	3	4	41	100	3	4	0	40	5	5	0	40	5	5	41	100
	R#MCONms	x	1	2	0	100	3	4	56	100	3	4	0	55	5	5	0	55	5	5	56	100
	R#MCONsw	x	1	2	0	100	3	4	41	100	3	4	0	40	5	5	0	40	5	5	41	100
	R#MEVG	x	1	2	0	100	3	4	41	100	3	4	0	40	5	5	0	40	5	5	41	100
	R#OAPI	x	1	2	0	100	3	4	31	100	3	4	0	30	5	5	0	30	5	5	31	100
	R#PICOpu	x	1	2	0	100	3	4	41	100	3	4	0	40	5	5	0	40	5	5	41	100
	R#PIPOm	x	1	2	0	100	3	4	31	100	3	4	0	30	5	5	0	30	5	5	31	100
	R#PIPOxe	x	1	2	0	100	3	4	26	100	3	4	0	25	5	5	0	25	5	5	26	100
	R#REFI	x	1	2	0	100	3	4	41	100	3	4	0	40	5	5	0	40	5	5	41	100
	R#TAOAco	x	1	2	0	100	3	4	61	100	3	4	0	60	5	5	0	60	5	5	61	100
	R#PIJEsp	x	1	2	0	100	3	4	41	100	3	4	0	40	5	5	0	40	5	5	41	100
	LAND-FIRE BpS	Included in BLM Dry Extent	Early Seral (A)				Mid-seral Closed (B)				Mid-seral Open (C)				Late-seral Open (D)				Late-seral Closed (E)			
			Size Class		Canopy Closure		Size Class		Canopy Closure		Size Class		Canopy Closure		Size Class		Canopy Closure		Size Class		Canopy Closure	
			Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
	F#SPFI	x*	1	2	0	10	1	2	11	100	3	4	41	100	3	4	0	40	5	5	0	100

* BLM size-class values are numeric representations of structure classes used to categorize early, stand establishment, young, mature, and older complex structural stages (see Vegetation Modeling – Forest Structural Stage Classification **Appendix C**). The BLM used vegetation-modeling canopy cover to determine open and closed status.
Note: The term canopy closure in this table is synonymous with canopy cover, and is based on modeled cover and not field based closure measurements.

Table H-3. Non-BLM-administered lands by s-class in terms of species composition, stand structure, and stand age for each biophysical setting

	LANDFIRE BpS	Early Seral (A)				Mid-seral Closed (B)				Mid-seral Open (C)				Late-seral Open (D)				Late-seral Closed (E)			
		Size Class		Canopy Closure		Size Class		Canopy Closure		Size Class		Canopy Closure		Size Class		Canopy Closure		Size Class		Canopy Closure	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Standard LANDFIRE 5–Box Models	0210290	1	2	0	100	3	5	31	100	3	5	0	31	6	7	0	30	6	7	31	100
	0710270	1	2	0	100	3	6	41	100	3	6	0	40	7	7	0	40	7	7	41	100
	R#DFHEwt	1	2	0	100	3	5	61	100	3	5	0	60	6	7	0	60	6	7	61	100
	R#MCONdy	1	2	0	100	3	5	41	100	3	5	0	40	6	7	0	40	6	7	41	100
	R#MCONms	1	2	0	100	3	5	56	100	3	5	0	55	6	7	0	55	6	7	56	100
	R#MCONsw	1	2	0	100	3	5	41	100	3	5	0	40	6	7	0	40	6	7	41	100
	R#MEVG	1	2	0	100	3	4	41	100	3	4	0	40	5	7	0	40	5	7	41	100
	R#OAPI	1	2	0	100	3	3	31	100	3	3	0	30	4	7	0	30	4	7	31	100
	R#PICOpu	1	2	0	100	3	5	41	100	3	5	0	40	6	7	0	40	6	7	41	100
	R#PIPOm	1	2	0	100	3	4	31	100	3	4	0	30	5	7	0	30	5	7	31	100
	R#PIPOxe	1	2	0	100	3	5	26	100	3	5	0	25	6	7	0	25	6	7	26	100
	R#REFI	1	2	0	100	3	5	41	100	3	5	0	40	6	7	0	40	6	7	41	100
	R#TAOAco	1	2	0	100	3	4	61	100	3	4	0	60	5	7	0	60	5	7	61	100
	R#PIJEsp	1	2	0	100	3	5	41	100	3	5	0	40	6	7	0	40	6	7	41	100
	LAND-FIRE BpS	Early Seral (A)				Mid-seral Closed (B)				Mid-seral Open (C)				Late-seral Open (D)				Late-seral Closed (E)			
		Size Class		Canopy Closure		Size Class		Canopy Closure		Size Class		Canopy Closure		Size Class		Canopy Closure		Size Class		Canopy Closure	
		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
	R#SPFI	1	2	0	10	1	2	11	100	3	4	41	100	3	4	0	40	5	7	0	100

Note: The term canopy closure in this table is synonymous with canopy cover, and is based on modeled cover percent and not field based closure measurements.

The Natural Range of Variability (NRV) reference models describe how the relative distribution of s-classes for a biophysical setting were shaped by succession and disturbance prior to European settlement and provide a comparison to present-day forest conditions (Keane *et al*. 2009, Landres *et al*. 1999). LANDFIRE biophysical setting models are used to develop NRV estimates using state-and-transition models incorporating pre-European settlement rates of succession and disturbance. Rates were determined through an intensive literature and expert review process (Keane *et al*. 2002, Keane *et al*. 2007, Pratt *et al*. 2006, and Rollins 2009).

The distribution of s-classes for each biophysical setting, which results from running state-and-transition models for many time-steps (**Table H-4**) does not represent a specific historical date, but instead approximates characteristic conditions that result from natural biological and physical processes operating on a landscape over a relatively long time. The NRV is frequently represented by a single value, the mean relative abundance of each s-class from a collection of Monte Carlo state-and-transition model simulations (e.g., Low *et al*. 2010, Shlisky *et al*. 2005, and Weisz *et al*. 2009). However, The Nature Conservancy developed and used ranges for each s-class resulting from the stochastic variation within the state-and-transition models. The Nature Conservancy ran 10 simulations for each biophysical setting state-and-transition model over 1,000 pixels and 1,000 annual time steps. Simulations were started with an equal portion in each s-class and it took 200–400 years for the initial trends to stabilize. The Nature Conservancy calculated the range for each s-class as ± 2 standard deviations from the mean abundance from the last 500 time steps (Provencher *et al*. 2008). Simulations were modeled using the Vegetation Dynamics Development Tool (ESSA Technologies 2007).

Table H-4. Reference condition range by Potential Vegetation Type (PVT)/Biophysical Setting (BpS)

LANDFIRE BpS	BpS Name	Early Seral (A)				Mid-seral (B)				Mid-seral (C)				Late-seral Open (D)				Late-seral Closed (E)			
		LANDFIRE RC	VDDT Mean	HRV Low	HRV High	LANDFIRE RC	VDDT Mean	HRV Low	HRV High	LANDFIRE RC	VDDT Mean	HRV Low	HRV High	LANDFIRE RC	VDDT Mean	HRV Low	HRV High	LANDFIRE RC	VDDT Mean	HRV Low	HRV High
0210290	Mediterranean California Mixed Oak Woodland	10	9.3	7	11	1	1.1	0	2	20	21.2	19	24	64	64.9	62	68	5	3.5	2	5
0710270	Mediterranean California Dry-Mesic Mixed Conifer Forest and Woodland	10	9.0	7	11	5	6.3	5	8	20	20.1	18	22	40	42.3	40	45	25	22.3	20	25
R#DFHEwt	Douglas-fir Hemlock–Wet Mesic	5	4.6	3	6	15	17.0	15	19	1	0.6	0	1	4	3.5	2	5	75	74.3	71	77
R#MCONdy	Mixed Conifer–Eastside Dry	15	14.0	12	16	1	0.7	0	1	30	31.6	29	34	40	41.5	38	45	14	12.3	10	14
R#MCONms	Mixed Conifer–Eastside Mesic	15	14.5	12	17	40	44.4	42	47	15	12.5	10	15	10	9.6	8	11	20	18.9	17	21
R#MCONsw	Mixed Conifer–Southwest Oregon	15	14.6	12	17	5	2.9	2	4	10	12.6	11	14	50	51.9	49	55	20	18.1	16	20
R#MEVG	California Mixed Evergreen North	15	16.6	14	19	10	7.5	6	9	50	51.6	48	55	20	20.5	18	23	5	3.8	3	5
R#OAPI	Oregon White Oak/Ponderosa Pine	25	25.1	22	28	5	3.8	3	5	20	19.2	17	22	47	48.7	45	52	3	3.2	2	4
R#PICOpu	Lodgepole Pine–Pumice Soils	20	21.6	19	24	15	13.9	12	16	50	47.7	45	51	10	10.9	9	13	5	5.9	4	7
R#PIJEsp	Pine Savannah–Ultramafic	15	15.0	13	17	0	1.0	0	3	45	44.0	41	47	40	39.0	36	42	0	1.0	0	2
R#PIPOm	Dry Ponderosa Pine–Mesic	10	10.8	9	13	10	6.9	5	8	35	37.2	34	40	40	42.4	39	45	5	2.8	2	4
R#PIPOxe	Ponderosa Pine–Xeric	25	23.6	21	26	5	5.8	4	7	25	22.4	20	25	40	43.2	41	46	5	4.9	4	6
R#REFI	Red Fir	10	6.9	5	8	20	22.5	20	25	15	13.2	11	15	20	21.9	19	24	35	35.5	33	39
R#TAOCco	Oregon Coastal Tanoak	10	9.7	8	12	10	12.5	10	15	50	47.4	44	51	25	26.2	23	29	5	4.2	3	5
R#SPFI	Spruce-Fir	3	3.0	2	4	22	22.3	19	25	30	24.6	22	27	20	20.6	18	23	25	29.4	27	32

Landscape Units

Following the LANDFIRE and FRCC conceptual framework, The Nature Conservancy defined discrete landscape units to compare present-day forests to modeled Natural Range of Variability reference conditions (Barrett *et al*. 2010, Pratt *et al*. 2006). Landscape units were chosen that would adequately represent the scale of disturbance of a particular Potential Vegetation Type and were composed of forested lands within a BLM management district. This would allow summarization in an accurate and usable way for managers (**Figure H-3**).

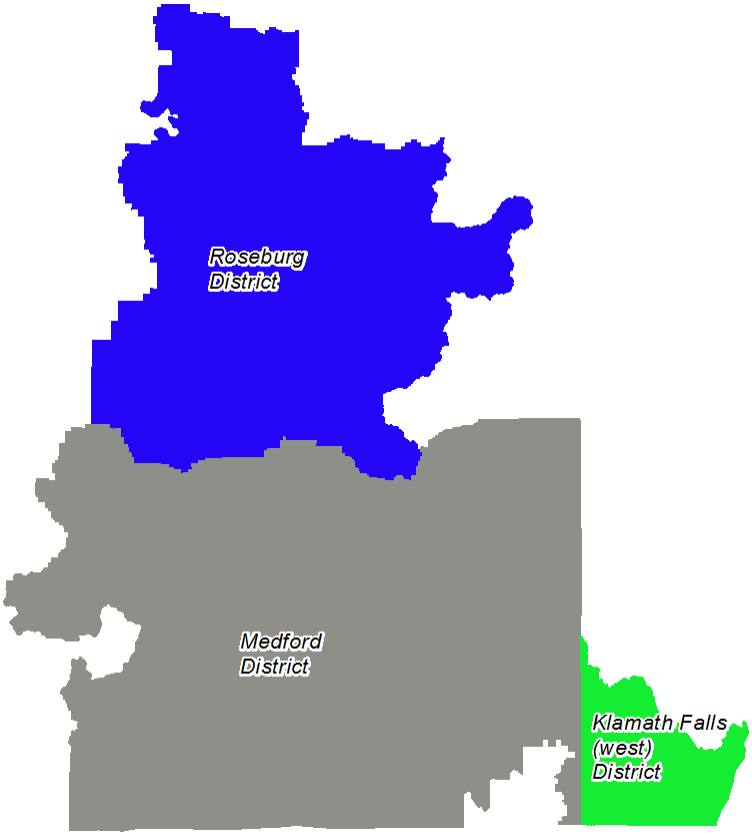

Figure H-3. Landscape units

Present-Day Forest Structure and Composition

The Nature Conservancy characterized present-day forest vegetation with the gradient nearest neighbor imputation (GNN, Ohmann and Gregory 2002, Figure 3) datasets produced by the U.S. Forest Service Pacific Northwest Research Station and Oregon State University Landscape Ecology, Modeling, Mapping, and Analysis research group (www.fsl.orst.edu/lemma) and outputs from the BLM vegetation modeling process (**Appendix C**).

All lands that are outside of BLM ownership used the GNN data for current conditions; the BLM-administered lands used the RMP data.

To compare present-day forest vegetation to the Natural Range of Variability reference conditions, The Nature Conservancy mapped the current distribution of s-classes for each biophysical setting using BLM Proposed RMP and alternatives' data for the BLM-administered lands and GNN data for all other

ownerships. S-class mapping was based upon tree canopy cover and tree size thresholds provided for each s-class in the biophysical setting model descriptions (**Table H-2** and **Table H-3**).

Departure Analysis

Departure in this project is defined as the difference between a modeled reference condition and the current conditions in acres (**Figure H-4**). In an effort to frame ecological departure appropriately, The Nature Conservancy chose to look at the whole landscape and summarize departure for each analysis area (district) by alternative and the Proposed RMP. This meant that the BLM s-class by alternative and the Proposed RMP (**Figure H-5**) was mosaicked with the base GNN data (**Figure H-6**) to create a landscape s-class layer that combined both the BLM data and the GNN data (**Figure H-7**).

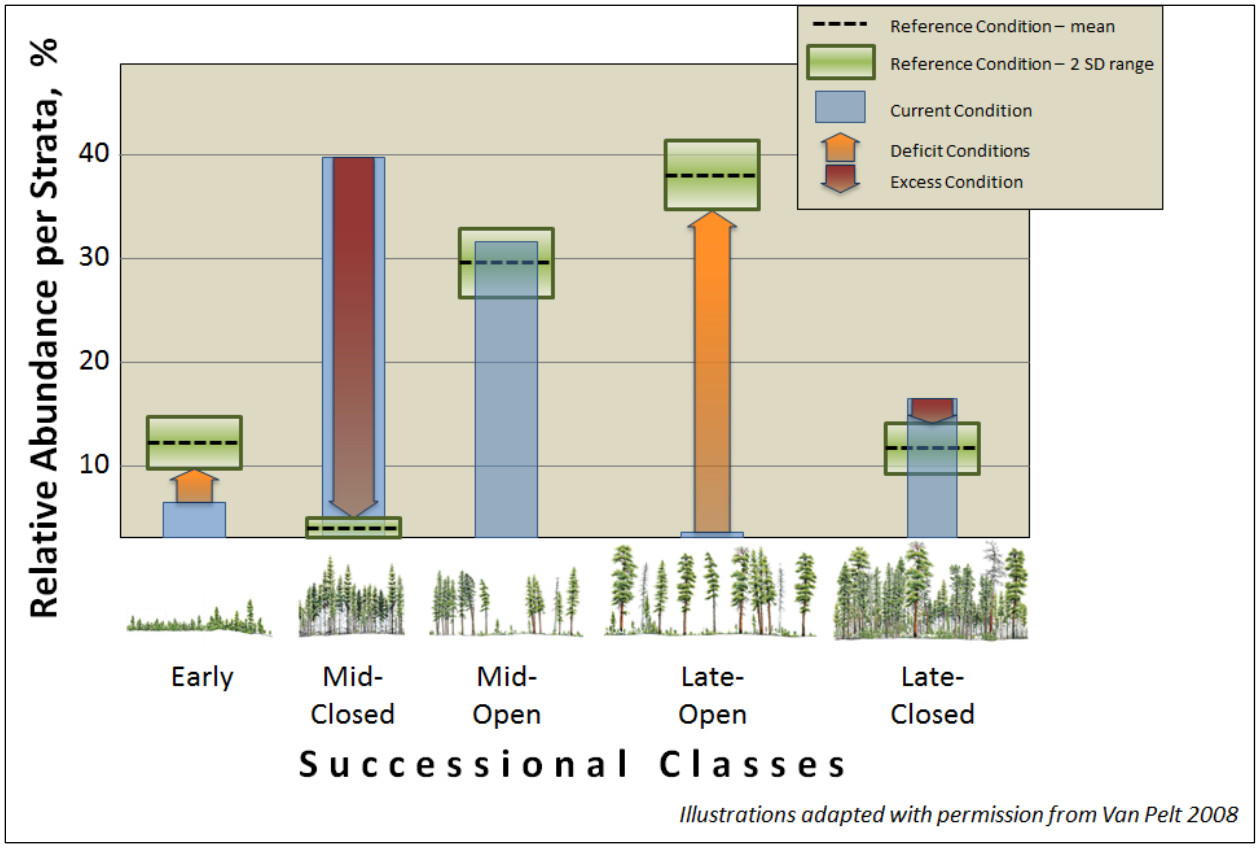

Figure H-4. Example landscape unit (strata) departure summary calculation

Figure H-5. BLM successional/structural stage (s-class) data for BLM-administered lands in the analysis area

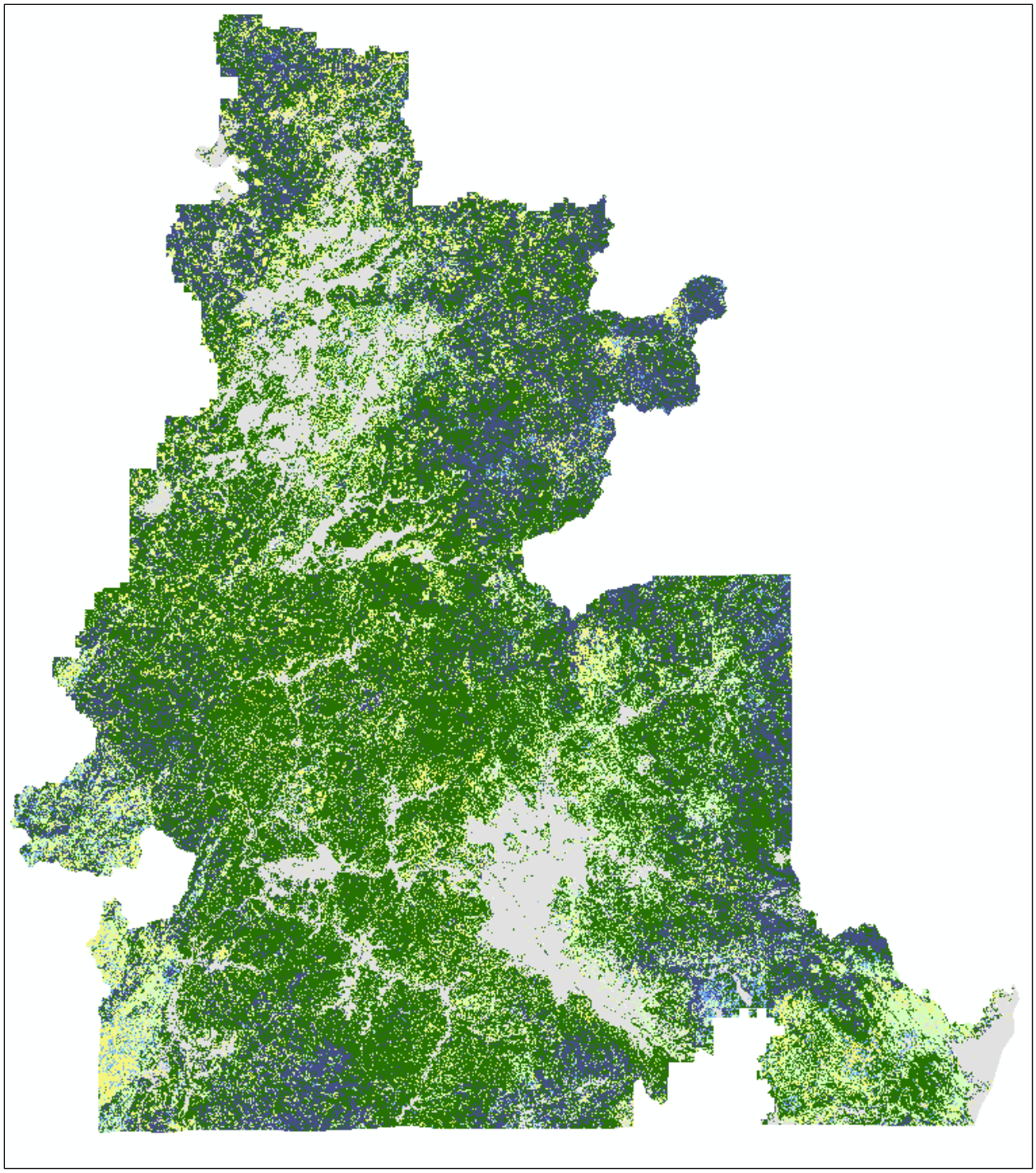

Figure H-6. Gradient nearest neighbor (GNN) s-class data for the analysis area

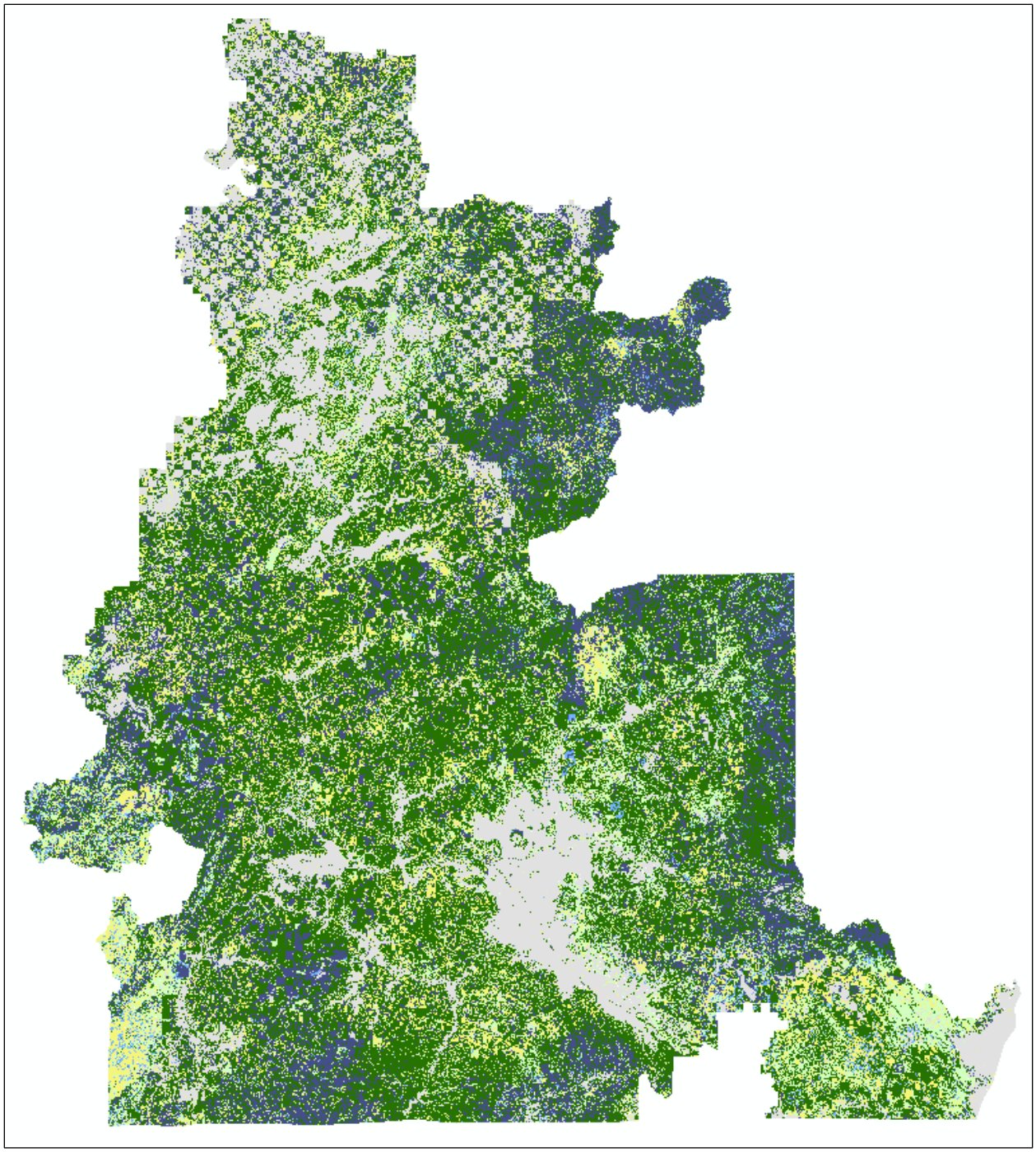

Figure H-7. BLM and GNN s-class data combined

This process of combining BLM data and GNN data was completed for each alternative and the Proposed RMP and departure was calculated for each of these mosaicked datasets. Eight different landscape s-class layers were developed: Current Condition, No Action alternative, Alternative A, Alternative B, Alternative C, Alternative D, the Proposed RMP, and the No Timber Harvest reference analysis.

Departure was calcuated for each combination of Potential Vegetation Type and landscape unit (strata) and summarized as an acre value. Departue can be summarized in a deficit or excess acres of s-class or in a combined overall departure acres; both were summarized in this analysis.

All the results were summerized by alternative and analysis unit in Excel, as well as summarys of s-class by alternative to help frame the conversation and discussion in the RMP.

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Issues 2 and 3 – Assumptions and District-specific Results

Issue 2

How would the alternatives affect fire resistance in the fire-adapted dry forests at the stand level?

Issue 3

How would the alternatives affect fire hazard at the stand – level within close proximity to developed areas?

Common Analytical Assumptions

The results of this analysis do not include effects from non-commercial hazardous fuels work taking place in forested or non-forested lands (**Table H-5**). These types of treatments would contribute toward improving fire resistance and reducing fire hazard similarly among all alternatives and the Proposed RMP.

Table H-5. Acres of current condition forested and non-forested BLM-administered lands within the planning area

District/ Field Office	Forest (Acres)	Non-Forest (Acres)	Totals (Acres)
Coos Bay	304,030	20,206	324,236
Eugene	297,222	13,841	311,063
Klamath Falls	46,773	167,312	214,084
Medford	740,110	66,565	806,675
Roseburg	399,163	24,477	423,640
Salem	374,392	24,765	399,157

Assumptions of General Stand Structural Stages and Fire Interactions

- Vegetation community structure is an important factor affecting potential fire behavior, post-fire effects, fire resistance, and fire hazard.

Early Successional

The BLM assumes that although Early Successional communities have less than 30 percent canopy cover—resulting in somewhat discontinuous surface fuel loading—this structural stage is typically comprised of highly flammable vegetation (Agee 1993). When combined with open conditions that can increase surface wind speeds and flames lengths (Pollet and Omi 2002, Rothermel 1983), in general, this structural stage presents relatively moderate resistance to replacement fire and moderate fire hazard.

Stand Establishment and Young High-density Stands

The Stand Establishment and Young High-density stand structural stages maintain low canopy base heights and a combination of highly flammable Early Successional vegetation, along with increased cover. In general, these structural stages present relatively low resistance to replacement fire and high fire hazard (Odion *et al*. 2004, Weatherspoon and Skinner 1995).

Young Low-density Stands

Although, the canopy base height may be low in Young Low-density stands, in general, there is greater separation between crowns (vertically and horizontally). This discontinuity in the fuel profile, results in relatively lower canopy bulk densities, moderate fire hazard, and moderate resistance to replacement fire within both the younger and structural legacy components of the stand.

Structural Legacies

The Stand Establishment and Young High-density stand structural stages maintain low canopy base heights and a combination of highly flammable Early Successional vegetation, along with increased cover. In general, these structural stages present relatively low resistance to replacement fire and high fire hazard (Odion *et al*. 2004, Weatherspoon and Skinner 1995). However, both Early Successional and Stand Establishment phases with Structural Legacies would have some separation of crown layers between legacy trees and understory vegetation, resulting in somewhat discontinuous ladder fuels and increased fire resistance in Structural Legacies. Pockets of heavy surface and ladder fuels may result in potential mortality to Structural Legacies from cambial damage (trees < 20" DBH have 35–70 percent mortality, USDI BLM 2008) or passive torching. This potential for cambial damage to overstory legacy structures increases along with understory vegetative cover and height (Peterson *et al*. 2005). Despite some potential separation in crown layers, in general, young high-density stands have high continuous surface and ladder fuel loading, low canopy fuel base heights, and taller vegetation, relative to Early Successional and Stand Establishment vegetation. This fuel profile in the Young High-density stands increases crown fire potential of the young stand component and structural legacies (Odion *et al*. 2004), resulting in lower relative resistance to replacement fire and higher fire hazard.

Overstory canopy cover from Structural Legacies could also partially shelter the stand, reducing surface winds and slowing the drying of fuels (NWCG 2014), and thus help moderate fire behavior. Alternatively, open stand conditions have the potential to increase drying and surface winds and thus flame lengths (Pollet and Omi 2002, Rothermel 1983). Increased winds in combination with low canopy base heights can increase torching potential and fire hazard, therefore no distinction is made between Early Successional, Stand Establishment, and Young stands with Structural Legacies in regards to fire hazard.

Mature Single-layered Canopy

In general, Mature Single-layered Canopy stands have low surface fuel loading (due to closed canopy shading inhibiting understory growth), higher canopy base heights, and thus a lower probability of torching and crown fire initiation within the stand, creating a low stand-level fire hazard condition (Jain *et al*. 2012). Although, continuous canopy cover of high canopy bulk density is susceptible to crown fire spread from adjacent stands (Scott and Reinhardt 2001, Jain and Graham 2007, Jain *et al*. 2012).

Mature Multi-layered Canopy and Structurally-complex

Mature Multi-layered Canopy and Structurally-complex forests have the potential to exhibit the full range of fire behavior (surface to crown fire). In general, these structural stages have heterogeneous composition, which can alter fire spread (Jain *et al*. 2012, Finney 2001); and a larger number of large diameter (> 20" DBH) trees with thick bark, which improve stand-level fire resistance and reduce stand-level fire hazard (Agee and Skinner 2005), potentially increasing the likelihood of burning at low- to moderate-severity (Alexander *et al*. 2006). Multi-aged closed-forest conditions can potentially create a vertical fuel ladder for surface fire to reach the canopy (North *et al*. 2009) and support accumulations of

continuous heavy surface and ladder fuels, and increase the potential for torching and crown fire, significantly reducing resistance to control. Alternatively, these structural types can create influential microclimates and shelter surface winds, harboring conditions that are more likely to result in lowered fire severity (Odion *et al*. 2004), particularly in topographic locations with low fire probability.

Ultimately, fire behavior in these structural stages will result from several factors, including weather, fuel moisture, and topographic influences, along with the vertical and horizontal continuity of the fuel profile.

Fire Resistance and Fire Hazard Ratings

- General assumptions regarding vegetation structural stage classification and the probable fire behavior based on vertical and horizontal fuel profile were used to generate relative stand-level resistance to replacement fire and fire hazard ratings (**Table H-6** and **Table H-7**).

Table H-6. BLM-defined structural stages and subdivisions, relative stand-level resistance to replacement fire ratings, and assumptions regarding overall fuel profile continuity, and vertical and horizontal fuel continuity

Structural Stages	Subdivisions	Resistance to Replacement Fire	Assumptions Behind Resistance Ratings		
			Entire Fuel Profile Continuity	Horizontal Fuel Profile Continuity	Vertical Fuel Profile Continuity
Early Successional	with Structural Legacies	Moderate	Semi-discontinuous	Semi-discontinuous	Semi-discontinuous
	without Structural Legacies	Moderate	Semi-discontinuous	Continuous	Semi-discontinuous
Stand Establishment	with Structural Legacies	Moderate	Semi-discontinuous	Semi-discontinuous	Continuous
	without Structural Legacies	Low	Continuous	Continuous	Continuous
Young High-density	with Structural Legacies	Low	Continuous	Continuous	Continuous
	without Structural Legacies	Low	Continuous	Continuous	Continuous
Young Low-density	with Structural Legacies	Moderate	Semi-discontinuous	Continuous	Semi-discontinuous
	without Structural Legacies	Moderate	Semi-discontinuous	Continuous	Semi-discontinuous
Mature	Single-layered Canopy	High	Discontinuous	Discontinuous	Continuous
	Multi-layered Canopy	Mixed	Mixed continuity	Mixed continuity	Mixed continuity
Structurally-complex	Developed Structurally-complex	Mixed	Mixed continuity	Mixed continuity	Mixed continuity
	Existing Old Forest	Mixed	Mixed continuity	Mixed continuity	Mixed continuity
	Existing Very Old Forest	Mixed	Mixed continuity	Mixed continuity	Mixed continuity

Table H-7. BLM-defined structural stages and subdivisions, relative stand-level fire hazard ratings and assumptions regarding surface fuel loading, canopy base height, and canopy fuel bulk density (continuity) as the basis for the hazard rating

<table>
<tr><th rowspan="2">Structural Stages</th><th rowspan="2">Subdivisions</th><th rowspan="2">Fire Hazard Rating</th><th colspan="3">Assumptions Behind Hazard Ratings</th></tr>
<tr><th>Surface Fuel Loading</th><th>Canopy Base Height</th><th>Canopy Fuel Bulk Density (Continuity)</th></tr>
<tr><td rowspan="2">Early Successional</td><td>with Structural legacies</td><td>Moderate</td><td rowspan="8">Low</td><td rowspan="8">Low</td><td colspan="2">Moderate</td></tr>
<tr><td>without Structural Legacies</td><td>Moderate</td></tr>
<tr><td rowspan="2">Stand Establishment</td><td>with Structural Legacies</td><td>High</td><td colspan="2" rowspan="4">High</td></tr>
<tr><td>without Structural Legacies</td><td>High</td></tr>
<tr><td rowspan="2">Young Stands–High Density</td><td>with Structural Legacies</td><td>High</td></tr>
<tr><td>without Structural Legacies</td><td>High</td></tr>
<tr><td rowspan="2">Young Stands–Low Density</td><td>with Structural Legacies</td><td>Moderate</td><td colspan="2" rowspan="3">Moderate</td></tr>
<tr><td>without Structural Legacies</td><td>Moderate</td></tr>
<tr><td rowspan="2">Mature</td><td>Single-layered Canopy</td><td>Low</td><td>Moderate</td><td>High</td></tr>
<tr><td>Multi-layered Canopy</td><td>Mixed</td><td colspan="3" rowspan="3">Mixed</td></tr>
<tr><td rowspan="3">Structurally-complex</td><td>Developed Structurally-complex</td><td>Mixed</td></tr>
<tr><td>Existing Old Forest</td><td>Mixed</td></tr>
<tr><td>Existing Very Old Forest</td><td>Mixed</td></tr>
</table>

In general, stands with higher fire resistance have reduced surface fuel loading, lower tree density, large diameter trees of fire-resistant species, increased height to live crown (Brown *et al.* 2004, Peterson *et al.* 2005, USDI BLM 2008), and discontinuous horizontal and vertical fuels.

Fire hazard refers to the ease of ignition, potential fire behavior, and resistance to control of the fuel complex, defined by the volume and arrangement of several strata, including surface, ladder, and canopy fuels (Calkin *et al.* 2010). The primary fuel characteristics associated with potential fire behavior and crown fire potential are canopy base height, canopy bulk density, and surface fuel loading (Scott and Reinhardt 2001, Jain and Graham 2007).

Issue 2 – Stand-level Fire Resistance in the Harvest Land Base by District

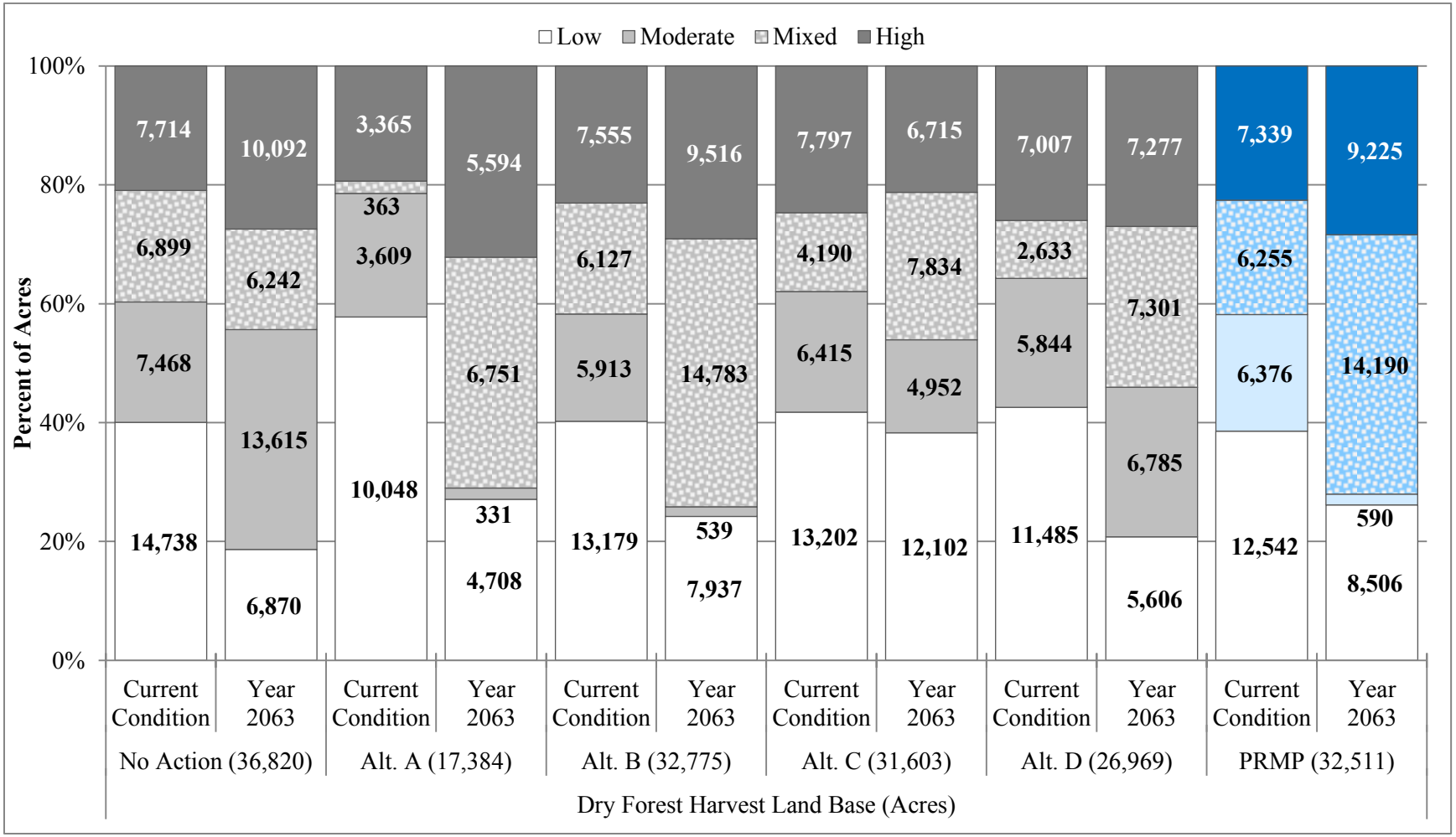

Figure H-8. Stand-level fire resistance categories in the Harvest Land Base in the dry forest in the Klamath Falls Field Office for the current condition in 50 years

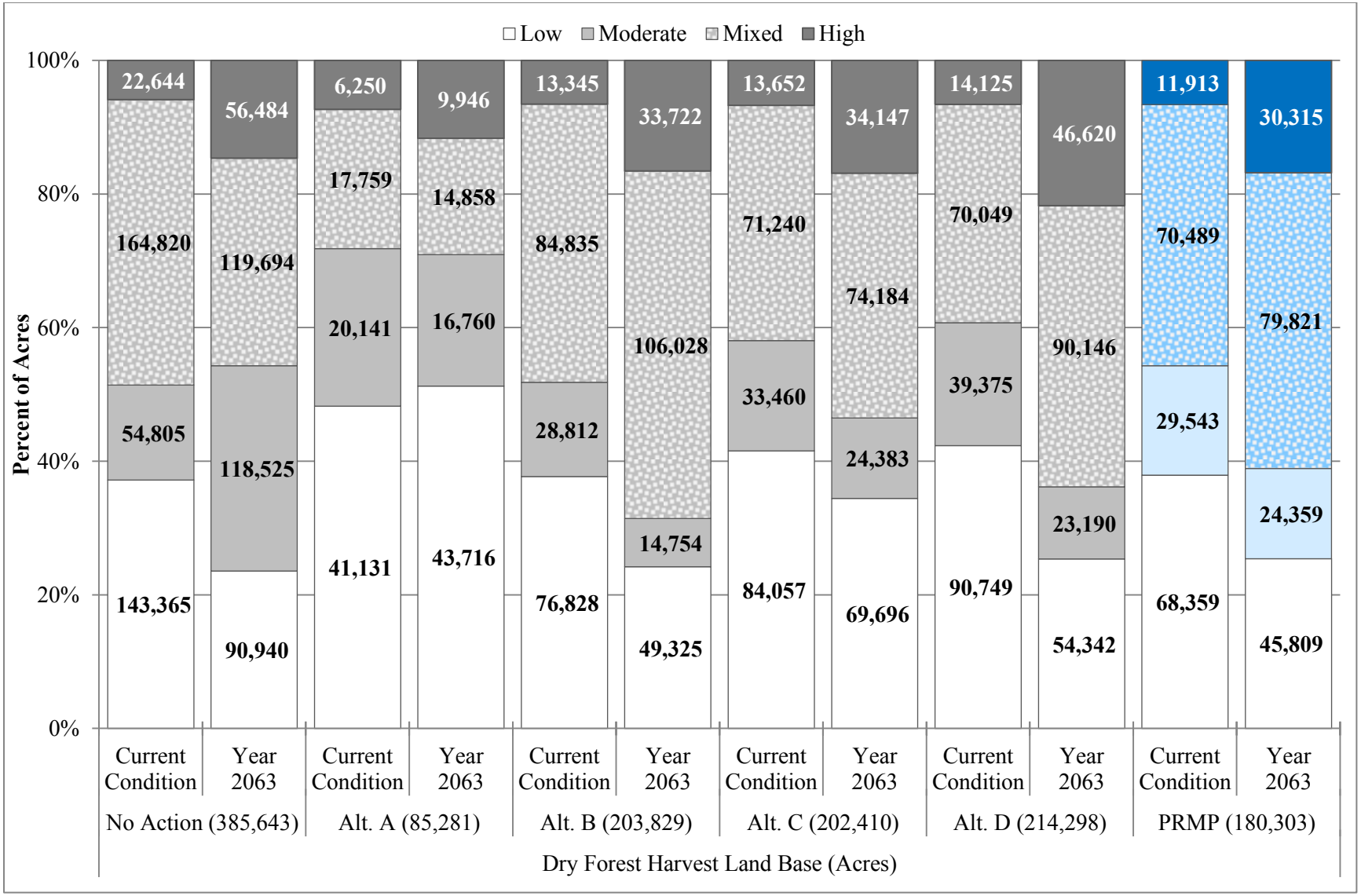

Figure H-9. Stand-level fire resistance categories in the Harvest Land Base in the dry forest on the Medford District for the current condition in 50 years

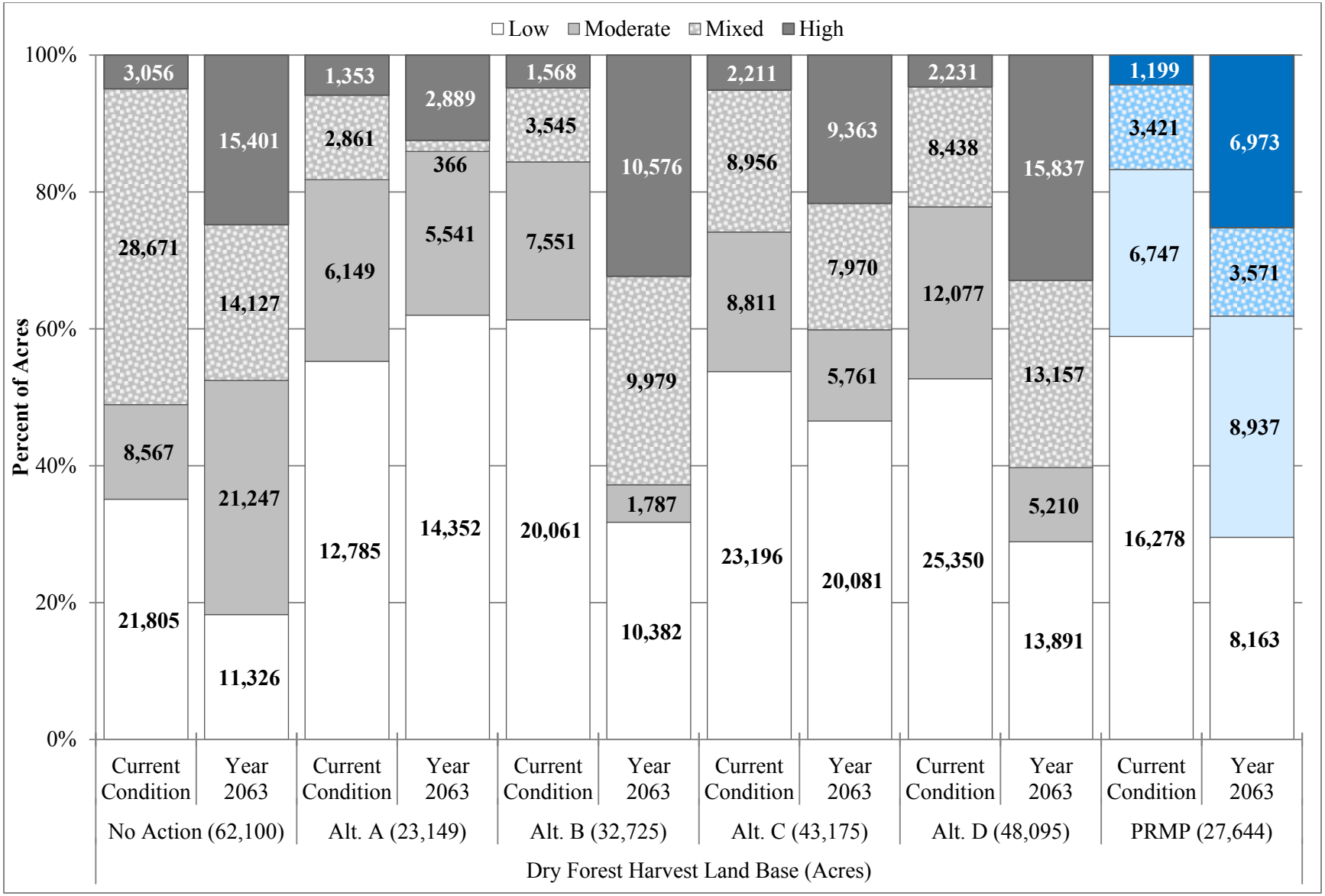

Figure H-10. Stand-level fire resistance categories in the Harvest Land Base in the dry forest on the Roseburg District in 50 years

Issue 3 – Stand-level Fire Hazard Within Wildland Developed Areas by District

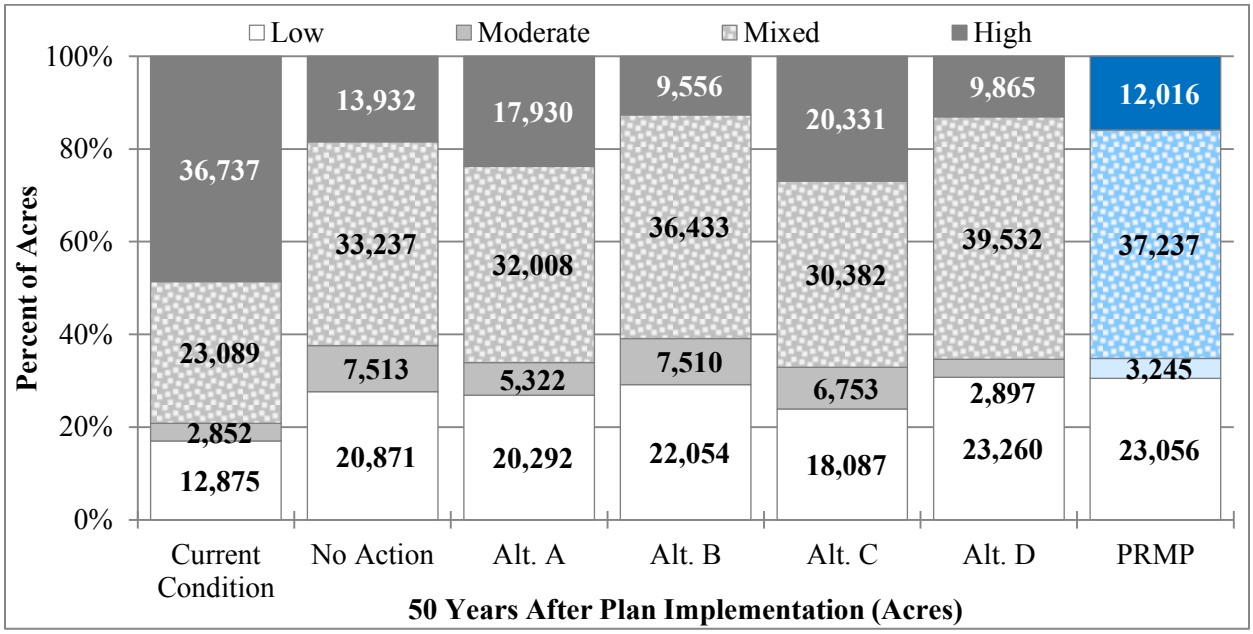

Figure H-11. Stand-level fire hazard for all BLM-administered lands on the Coos Bay District within the WDA in 2063

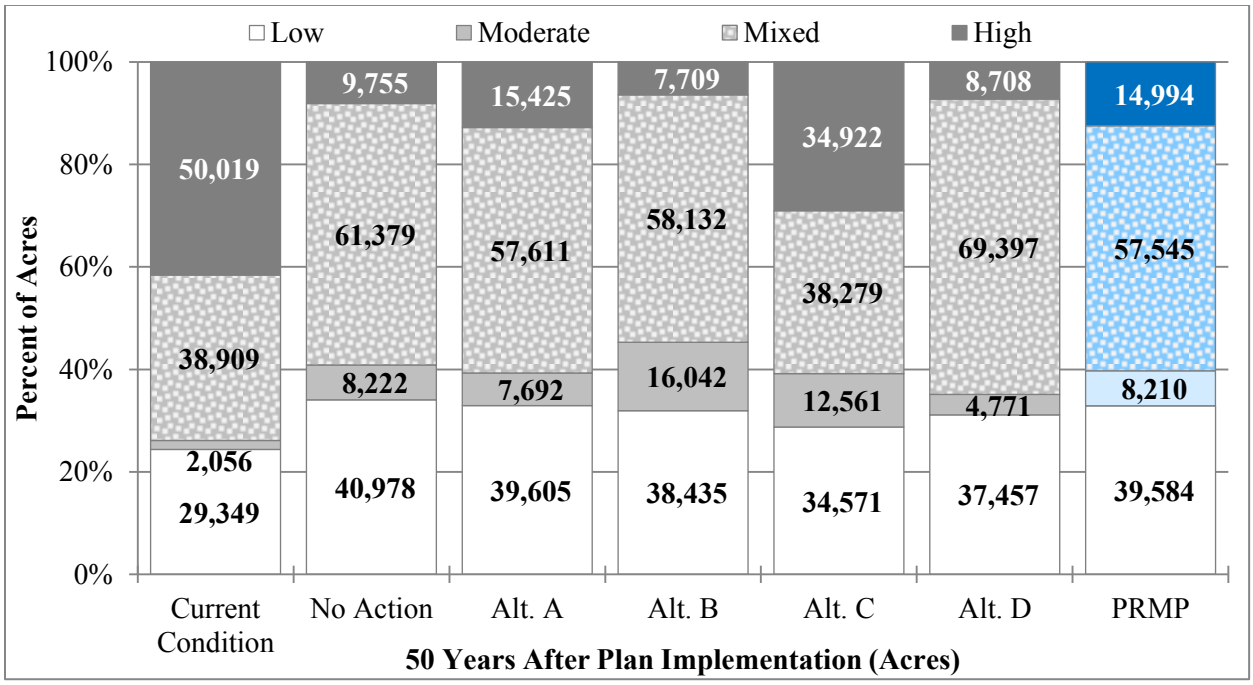

Figure H-12. Stand-level fire hazard for all BLM-administered lands on the Eugene District within the WDA in 2063

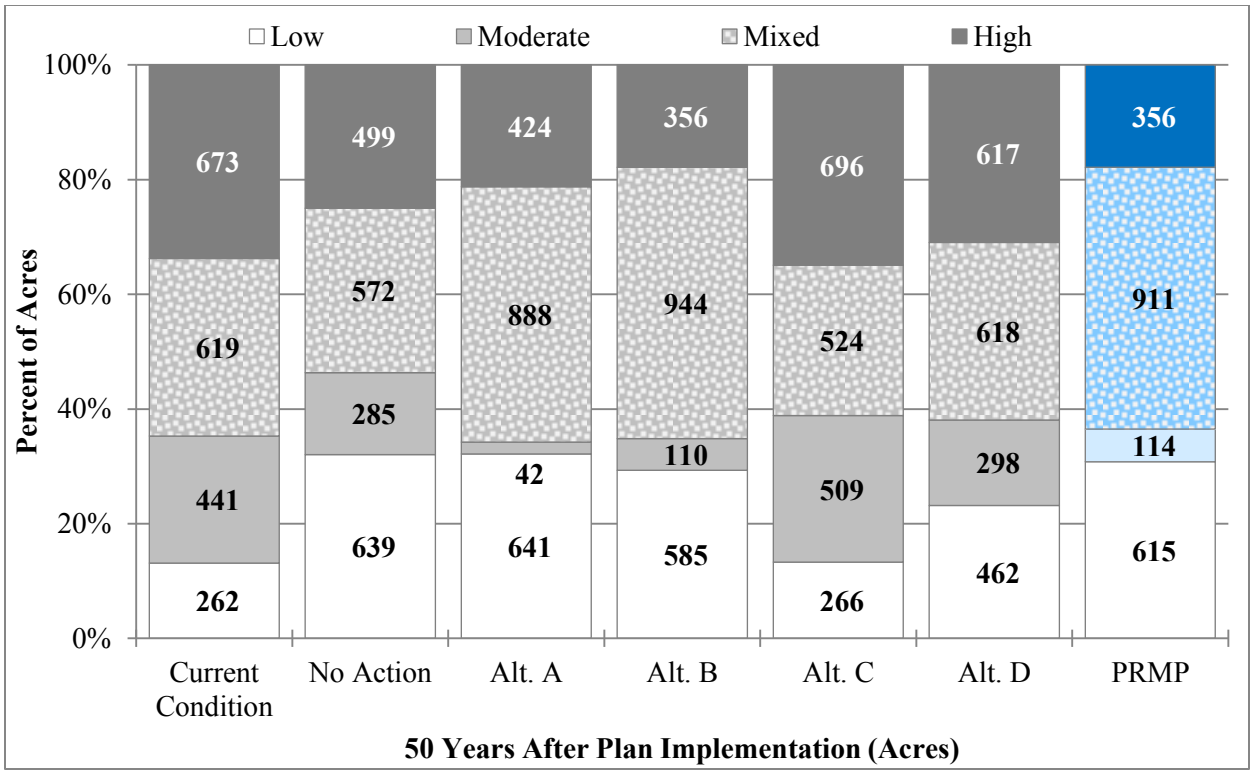

Figure H-13. Stand-level fire hazard for all BLM-administered lands on the Klamath Falls Field Office within the WDA in 2063

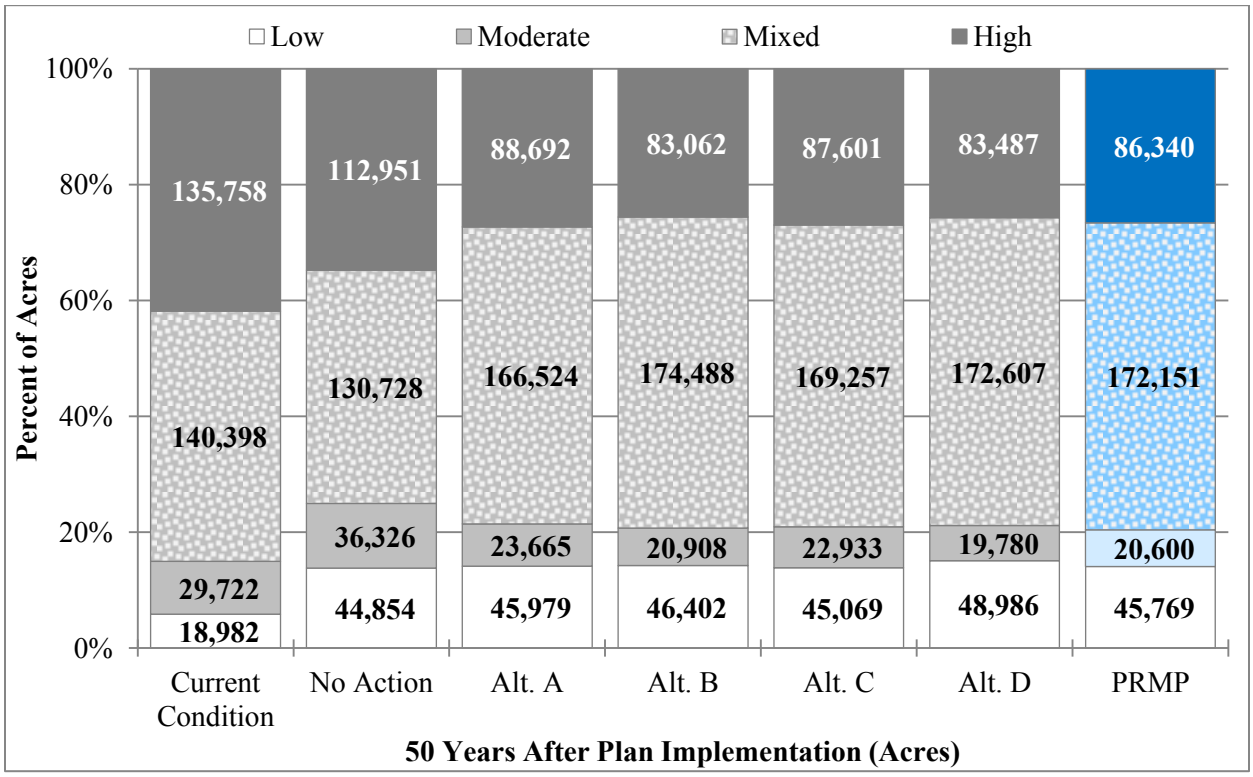

Figure H-14. Stand-level fire hazard for all BLM-administered lands on the Medford District within the WDA in 2063

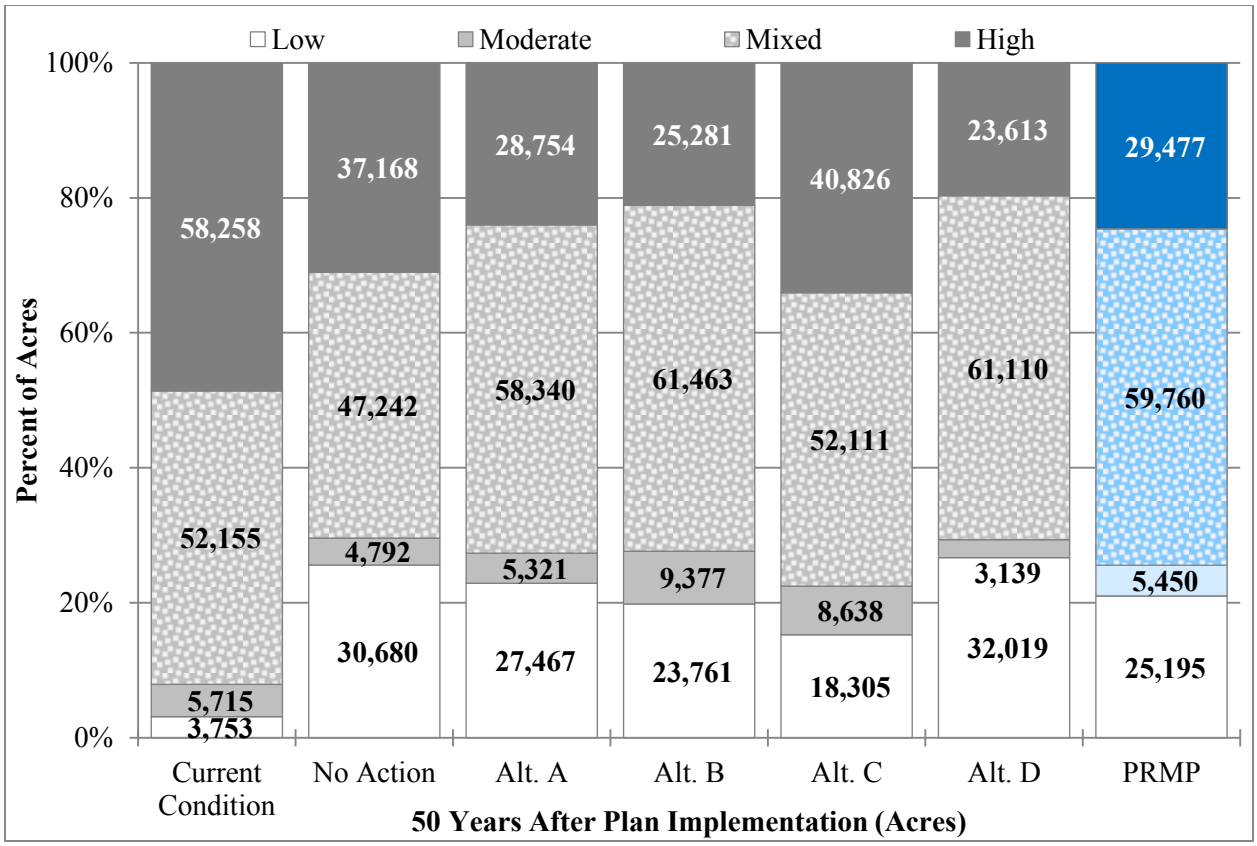

Figure H-15. Stand-level fire hazard for all BLM-administered lands on the Roseburg District within the WDA in 2063

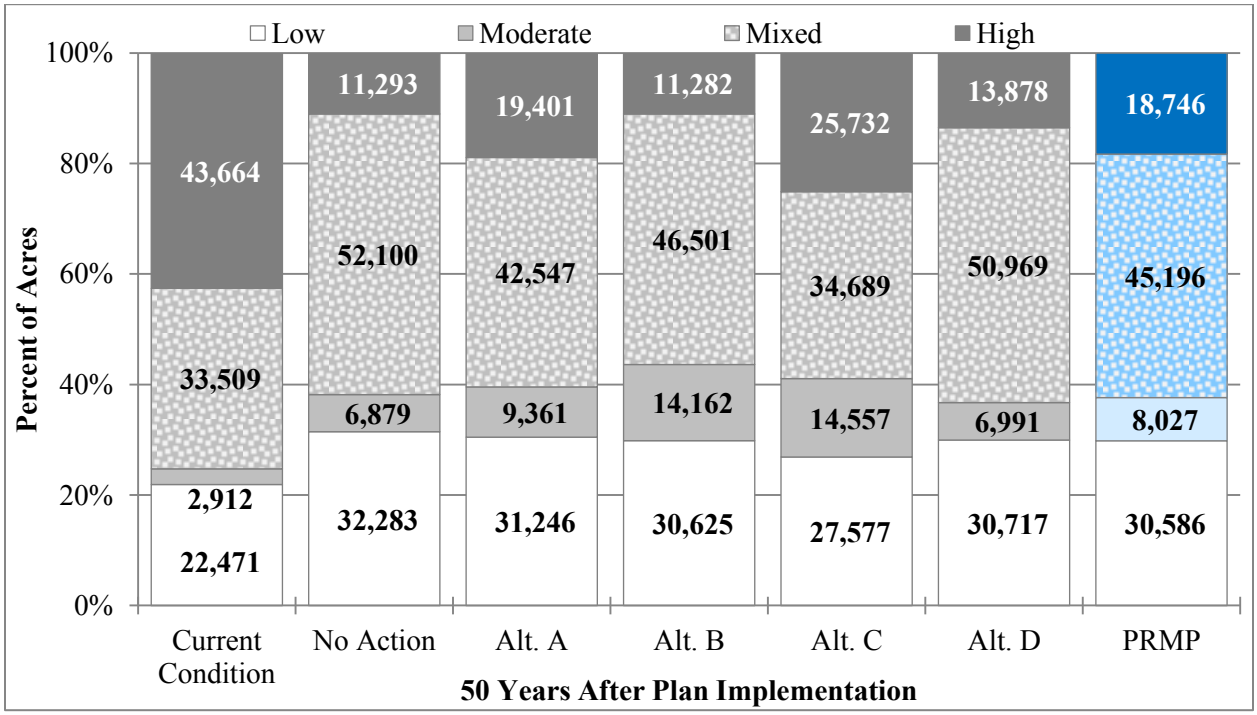

Figure H-16. Stand-level fire hazard for all BLM-administered lands on the Salem District within the WDA in 2063

Issue 3 – Stand-level Fire Hazard for Late-Successional Reserve Within Wildland Developed Areas by Planning Area Region

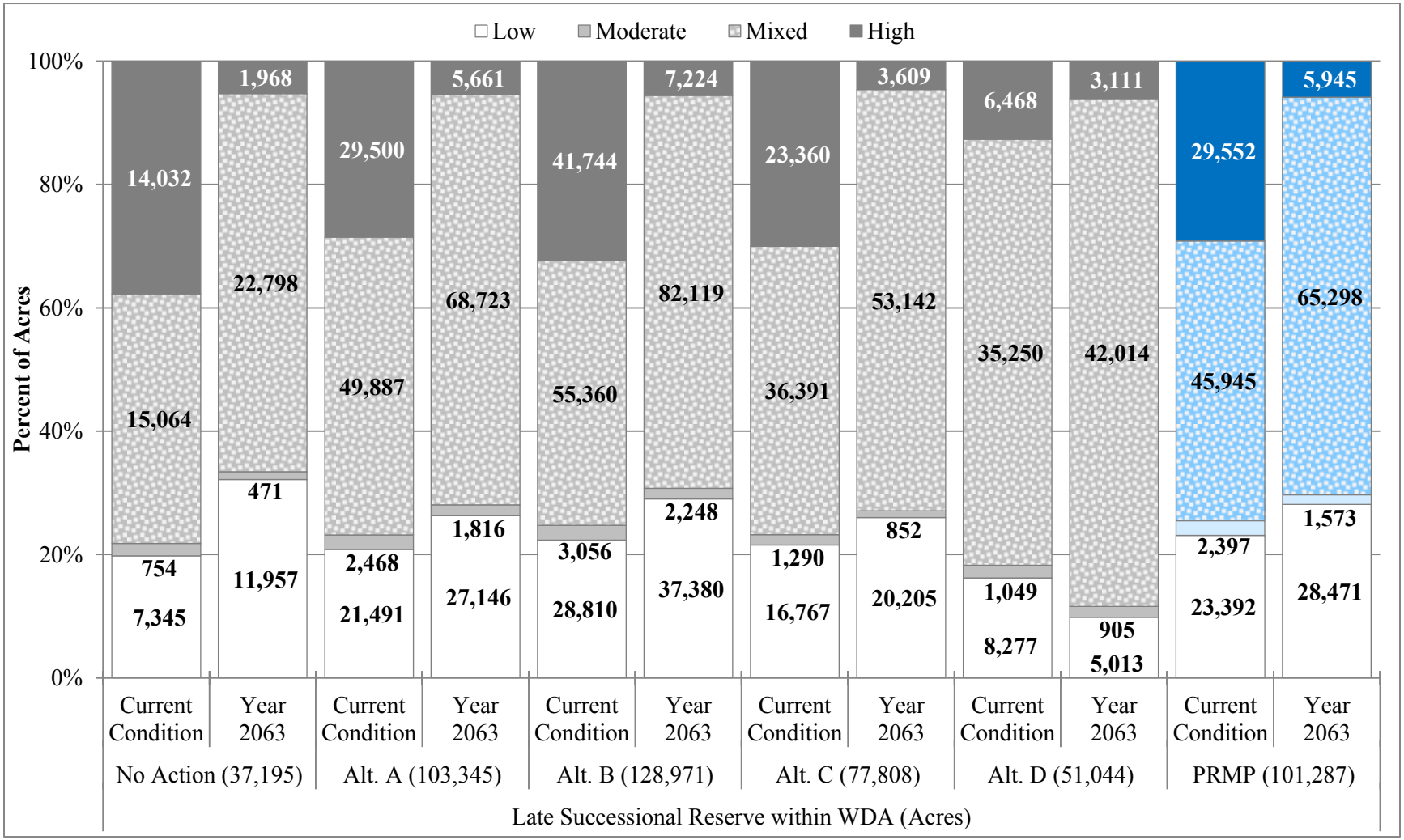

Figure H-17. Stand-level fire hazard in the Late-Successional Reserve in the dry forest in the coastal/north in 50 years

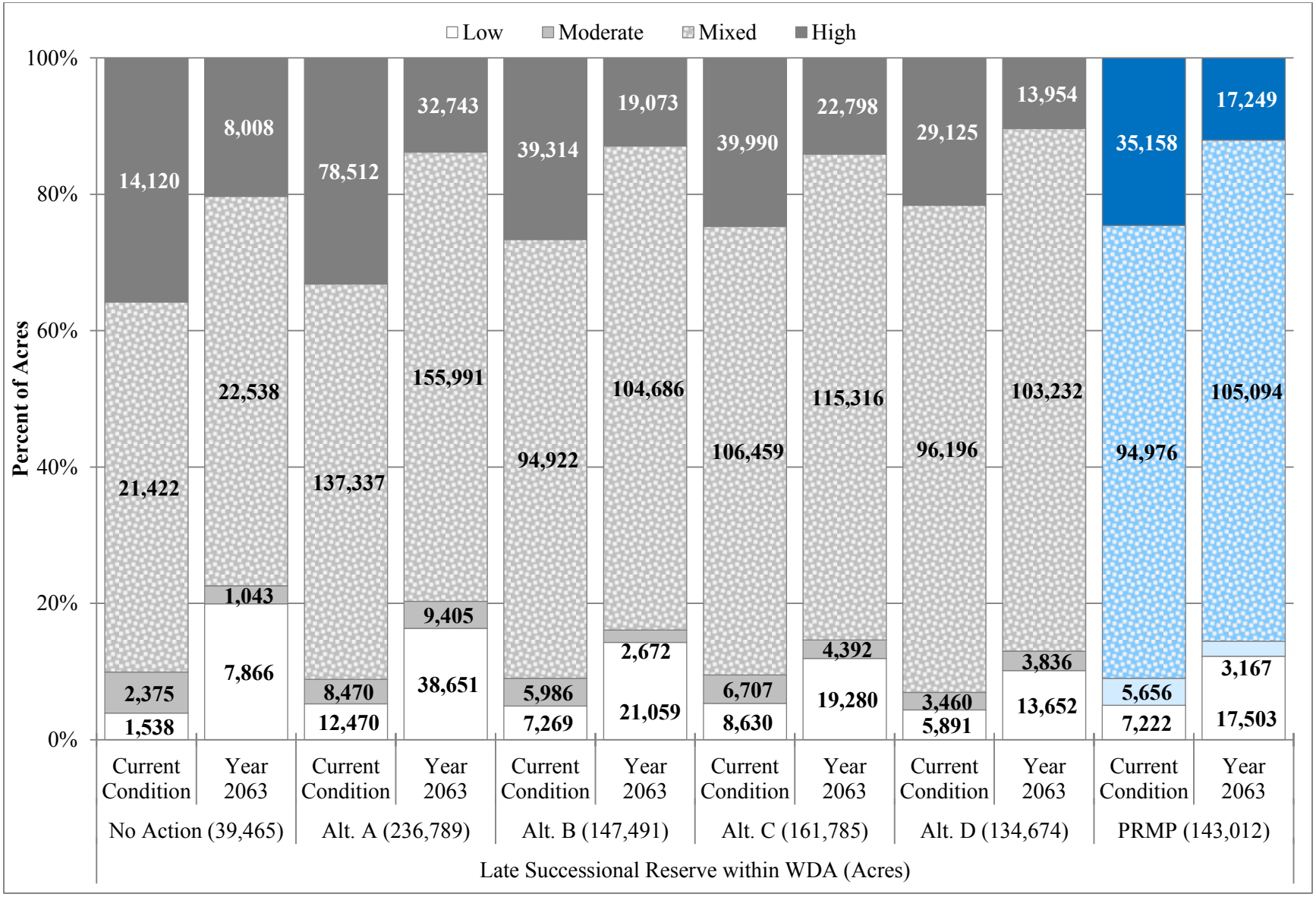

Figure H-18. Stand-level fire hazard in the Late-Successional Reserve in the dry forest in the interior/south in 50 years

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