RESOURCES

NATURAL

Staff Report
Forest Health
Technical Advisory Committee

July 2012

WASHINGTON STATE DEPARTMENT OF
Natural Resources
Peter Goldmark - Commissioner of Public Lands

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Contents

Figures

1.0 Introduction

The 2007 Legislature updated Washington's Forest Health Law (RCW 76.06) to establish additional authority for implementing an effective statewide forest health program. The Department of Natural Resources (DNR) was designated as the lead agency responsible for implementing a comprehensive program to improve forest health statewide.

The law defines "forest health" broadly as: the condition of a forest being sound in ecological function, sustainable, resilient, and resistant to insects, diseases, fire and other disturbance, and having the capacity to meet landowner objectives.

DNR maintains the capacity to deliver insect and disease monitoring and technical assistance activities to all forest landowners in Washington State. These education, outreach, and detection services and voluntary management activities are collectively referred-to as "Tier 1" of the system under state law. The Forest Health Law also provided DNR broader authority to effectively address insect and disease issues that are not remedied through normal program activities.

When forest health conditions in an area deteriorate despite the best efforts of DNR and landowners to implement preventative forest health improvements, the Commissioner may initiate action under the system laid out in statute. A technical advisory committee, comprised of forest management practitioners and scientific experts, is appointed to evaluate forest health threats and potential remedial actions. Upon the committee's recommendation, the Commissioner of Public Lands may issue a "Forest Health Hazard Warning." This action is voluntary and advisory for all landowners and managers within the affected area, but represents an official finding by the Commissioner and is designed to motivate action. DNR is required, for example, to prioritize technical assistance and project coordination within areas affected by a warning.

In response to the continued deterioration in the health of Washington's forests, Commissioner of Public Lands Peter Goldmark appointed members to a Forest Health Technical Advisory Committee in January 2012. The purpose of the committee is to advise the Commissioner on the severity of the threats, areas of the state where corrective actions would be best prioritized, and what kind of actions would be most effective. This report documents the proceedings and deliberations of the committee, and is a companion to the recommendations developed by the committee in June 2012.

1.1 FOREST HEALTH TECHNICAL ADVISORY COMMITTEE MEMBERSHIP

Name	Committee Position	Title	Organization
Aaron Everett	Chair	State Forester	WA DNR
Reese Lolley	Forest Ecologist	E. Washington Forest Program Director	The Nature Conservancy
Greg Morris	Aquatic Ecologist	Fisheries Habitat Biologist	Yakama Nation
Bill Gaines	Wildlife Biologist	Wildlife Ecologist	WA Conservation Science Institute
Robert Gara	Insect/Disease Risk Specialist	Professor Emeritus, Forest Entomology	University of Washington
Connie Mehmel	Insect/Disease Risk Specialist	Forest Entomologist	US Forest Service
Dave Peterson	Fuels Specialist	Research Team Leader, Fire Applications	US Forest Service
Scott Ketchum	Forester/Silviculturist	Northern Inland Region Manager	Forest Capital Partners
Doug Daoust	Ex Officio	Asst. Director, State and Private Forestry	US Forest Service

1.2 ROLE OF THE FOREST HEALTH TECHNICAL ADVISORY COMMITTEE

The state forest health law establishes several specific roles of the technical advisory committee, which include:

- Evaluate the threat to forest health and make a timely report to the commissioner on its nature, extent and location. RCW 76.06.170 (2)
- Consider the need for action to reduce the threat and alternative methods of achieving the desired results, including the environmental risks associated with the alternatives and the risks associated with no action. RCW 76.06.170 (2)(a)
- The committee shall also recommend potential approaches to achieve the desired results for forest land ownerships of fewer than ten acres and for forests owned for scientific study, recreational or other uses not compatible with active management. RCW 76.06.170 (2)(b)
- The committee shall recommend to the commissioner whether a forest health hazard warning or forest health hazard order is warranted based on the factors in RCW 76.06.180 (2) or when otherwise determined by the committee to be warranted. RCW 76.06.170 (2)(c)
- When the commissioner issues a forest health hazard warning or forest health hazard order, the committee shall monitor the progress and results of activities to address the hazard, and periodically report its findings to the commissioner. RCW 76.06.170 (2)(d)

2.0 Methodology

In order to evaluate the threats to forest health, the committee held a series of meetings from February 2012 through June 2012. The committee's analysis focused on forest health threats in eastern Washington only. Insect and disease damage is ubiquitous throughout eastern Washington (Figure 1), so the committee utilized a process of coarse-scale and fine-scale analysis to prioritize areas.

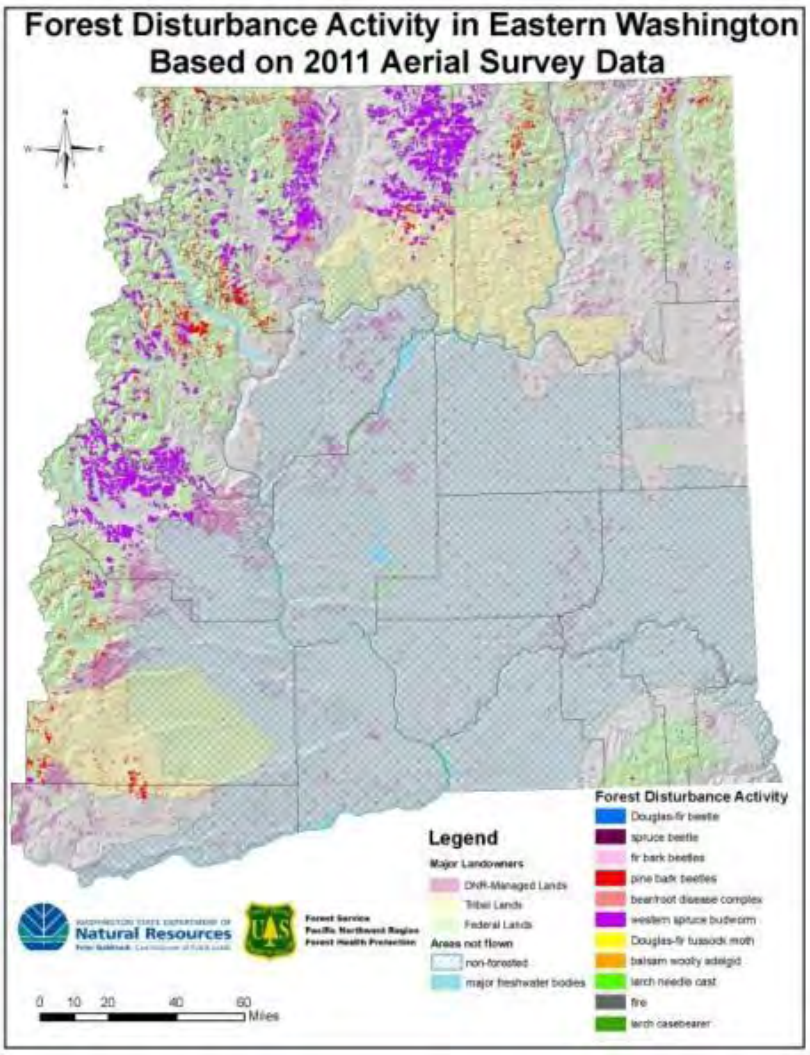


Figure 1. 2011 Forest Health Aerial Survey Map.

The committee first conducted a coarse-scale analysis to determine the best confluence of actual damage, predicted damage, potentially high-risk forest conditions, coincidence with wildfire hazards and efficacy considerations that would enable further action under state law to be successful. This coarse-scale analysis identified five priority landscapes that contained high to moderate levels of actual and predicted damage, significant levels of high-risk forest conditions and a majority of forestland available for active management.

These priority landscapes were then subjected to a fine-scale analysis to determine if the specific criteria for a forest health hazard warning, as outlined in state law, were met:

> "*A decision to issue a forest health hazard warning may be based on existing forest stand conditions and:*
>
> *(a) The presence of an uncharacteristic insect or disease outbreak that has or is likely to (i) spread to multiple forest ownerships and cause extensive damage to forests; or (ii) significantly increase forest fuel that is likely to further the spread of uncharacteristic fire;" [RCW 76.06.180(2)]*

2.1 COARSE-SCALE ANALYSIS OF FOREST HEALTH PRIORITY AREAS

A wide variety of data were utilized by the committee to analyze existing forest stand conditions and evaluate the threats to forest health in eastern Washington at the landscape scale. The scale of initial landscape analysis was selected as state-delineated Watershed Resource Inventory Areas (WRIAs). WRIAs with small amounts of forestland were excluded from the comparative analysis, and forestland data from some adjoining WRIAs were combined in order to somewhat normalize the size of the landscapes.

Spatial data layers were analyzed to produce acreage values for four major variables:

1. Cumulative acres of tree mortality for the period between 1996 and 2010 in which 10-35 trees per acre were observed dead. Figure 2.
    a. Source: Annual aerial insect & disease damage surveys conducted by DNR & US Forest Service, aggregated with a US Forest Service program called Mortality Mapper.
    b. Utility: A measure of elevated insect & disease activity indicating that a significant amount of damage has occurred, but not so much damage as to indicate near-total tree loss.

2. Cumulative acres of tree defoliation in at least two years for the period between 2007 and 2011. Figure 3.
    a. Source: Annual aerial insect & disease damage surveys conducted by DNR & USFS, aggregated by DNR Forest Health Program staff.
    b. Utility: A measure of elevated defoliator activity indicating that a significant amount of sustained damage has occurred.

3. National Insect & Disease Risk Map (NIDRM) acres projected to experience the loss of 20% or greater of the stand basal area over a 15-year period. Figure 4.
    a. Source: National Insect & Disease Risk Map produced by the US Forest Service. http://www.fs.fed.us/foresthealth/technology/nidrm.shtml
    b. Utility: NIDRM is the compilation of individual insect and disease risk models to produce a forward-looking aggregated damage estimate based on FIA plot inventory information.

4. LANDFIRE Vegetation Condition Class acres in moderate (VCC2) or high (VCC3) "departure" from historic reference conditions. Figure 5.
    a. Source:LANDFIRE Project, a joint venture of the US Forest Service and the US Department of the Interior. http://www.landfire.gov/NationalProductDescriptions10.php
    b. Utility: VCC quantifies the amount that current vegetation has departed from the simulated historical vegetation reference conditions, calculated based on changes to species composition, structural stage, and canopy closure. Extensive "departed" forest conditions indicate a potentially heightened risk of forest loss to disturbances like insects, diseases and wildfires.

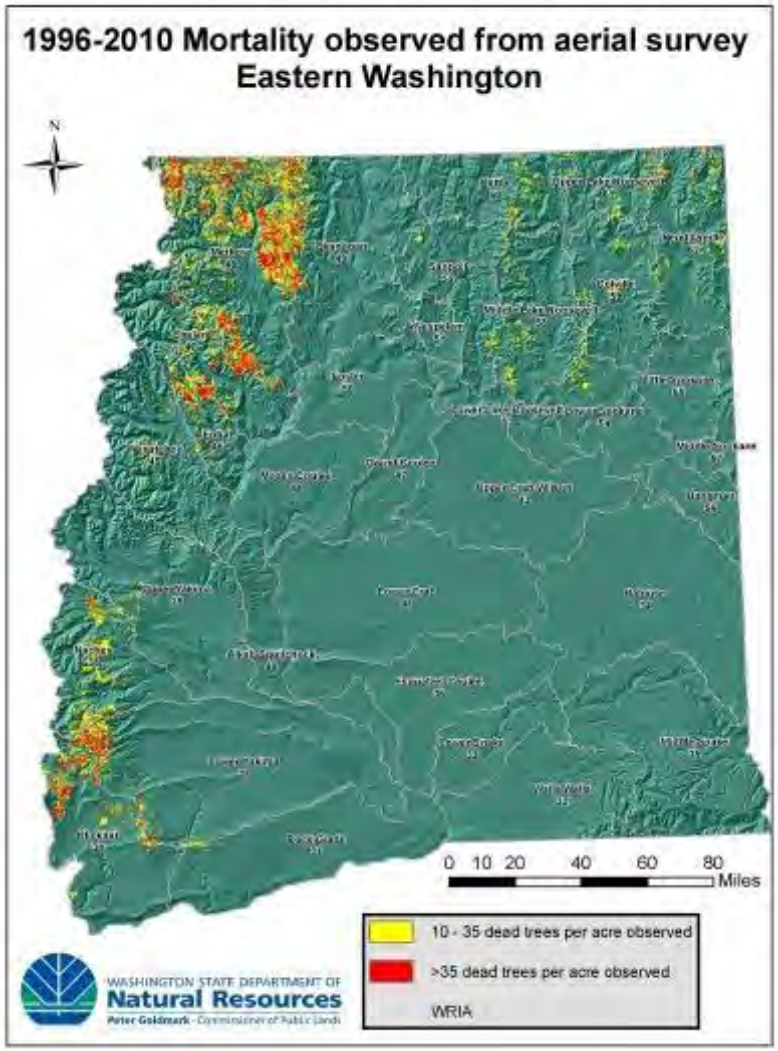


Figure 2. Cumulative Tree Mortality 1996 to 2011.

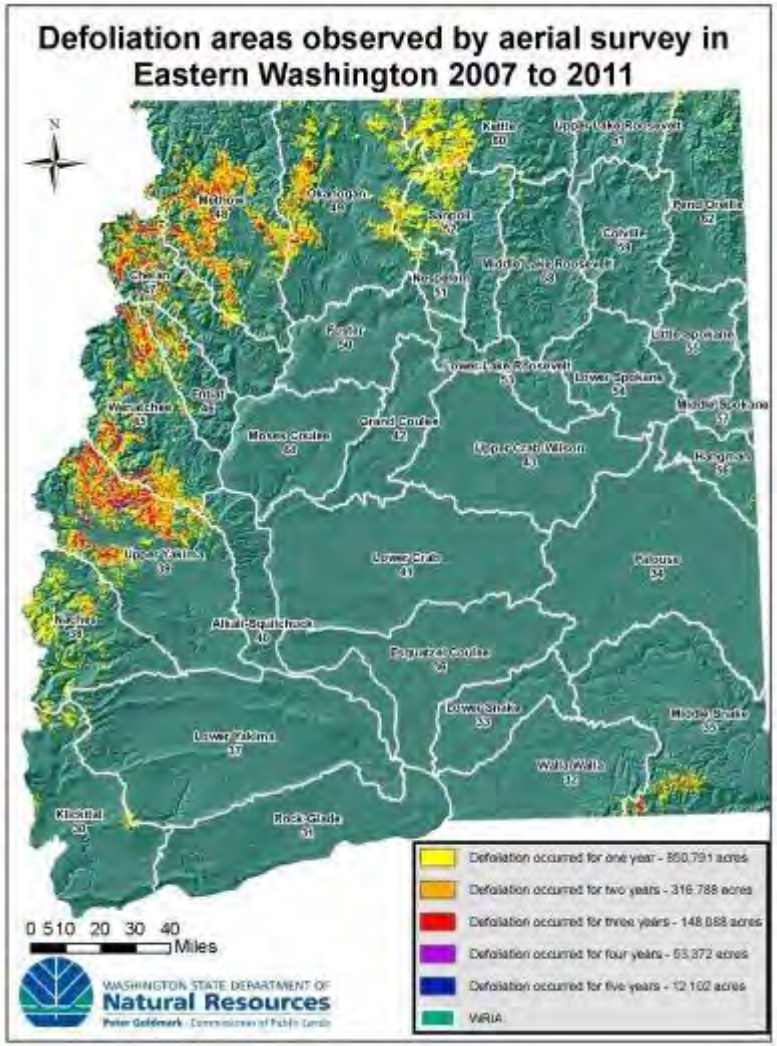


Figure 3. Defoliation from 2007 to 2011.

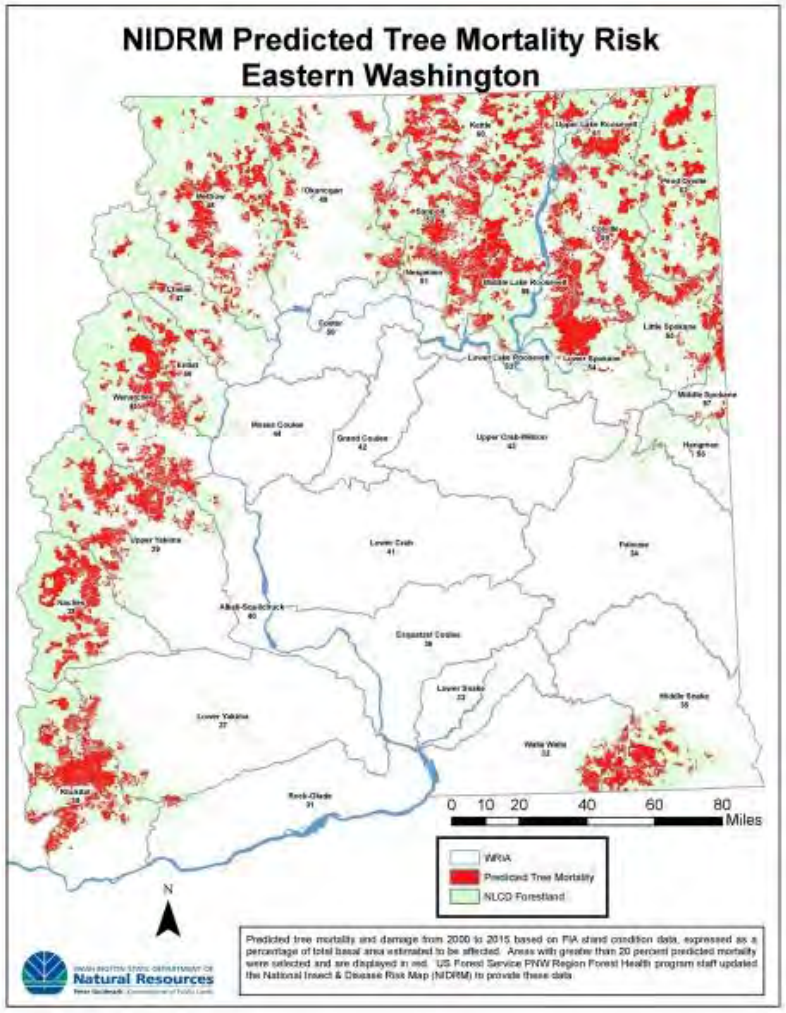


Figure 4. 2006 National Insect and Disease Risk Map (NIDRM).

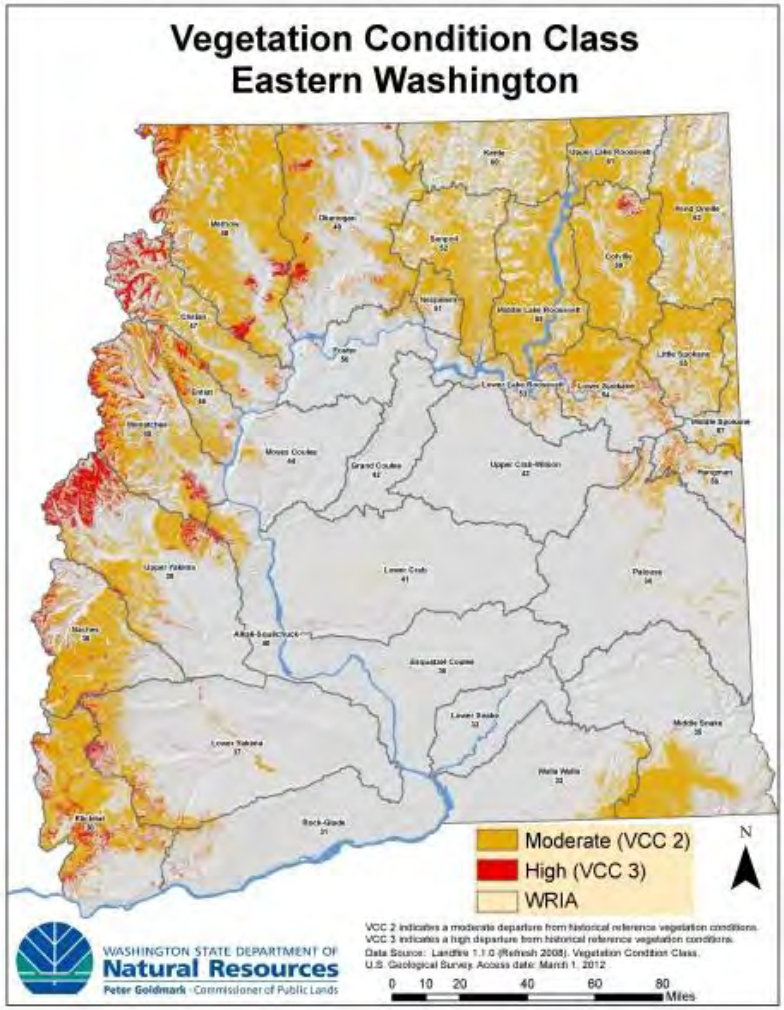


Figure 5. Vegetation Condition Class.

Acres of each variable were reported by WRIA (Table 1), and within each WRIA, the forestland in reserved and unreserved status (Figure 6) is differentiated. The purpose of this differentiation is to understand the proportion of the landscape on which active management may take place, as a measure of efficacy. Forests along the eastern flank of the Cascades are experiencing significant levels of mortality and damage from insects and disease. However, as depicted in the table and map below, the majority of forests in the eastern Cascades are federally managed and classified as reserve areas, greatly limiting active management opportunities.

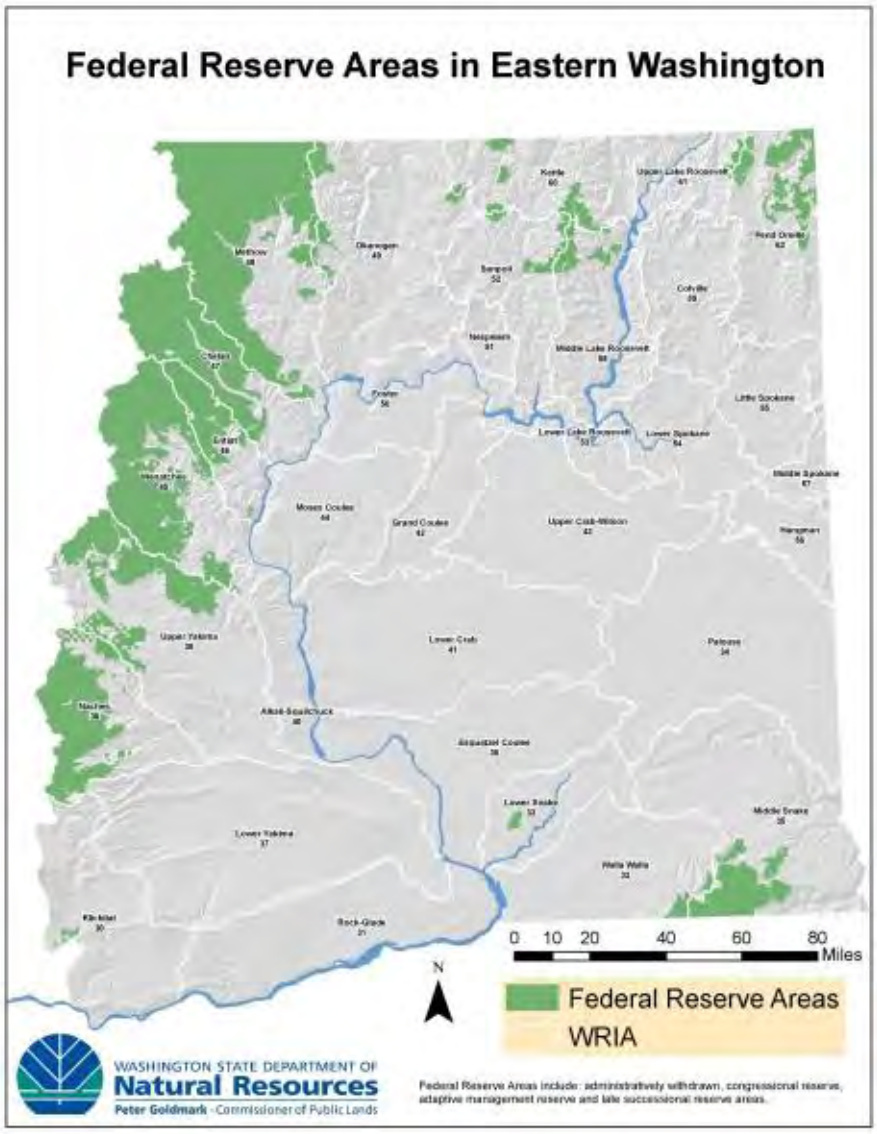


Figure 6. Federal Reserve Areas.

Table 1. Acreage of four variables (mortality, defoliation, NIDRM and VCC) used in coarse-scale analysis for each Watershed Resource Inventory Area (WRIA) in Eastern Washington.

		Total Forestland	1996-2010 Cumulative Mortality Ac. (10-35 TPA)			2007-11 Cumulative Defoliation 2+ yrs			Risk Projection -- NIDRM			2008 Refresh VCC 2 & 3		
WRIA#	WRIA_NM		Total	Reserved	Non-Reserved	Total	Reserved	Non-Reserved	Total	Reserved	Non-Reserved	Total	Reserved	Non-Reserved
60	Kettle	476,666	20,008	4,426	15,583	17,669	1,759	15,910	200,107	25,510	174,596	216,226	18,077	198,149
30	Klickitat	488,246	52,390	90	52,300	1,491	21	1,470	214,239	423	213,816	426,714	1,942	424,772
51/52	Nespelem-Sanpoil	539,650	10,143	1,254	8,888	9,098	1,484	7,614	246,316	14,204	232,112	379,671	16,522	363,149
54	Low er Spokane	252,382	6,858	0	6,858	0	0	0	99,783	0	99,783	226,956	0	226,956
59	Colville	476,462	14,039	0	14,039	11	0	11	183,441	0	183,441	438,054	0	438,054
49	Okanogan	468,426	53,092	18,946	34,146	51,683	1,152	50,530	132,227	10,518	121,709	442,286	43,364	398,922
37	Low er Yakima	198,112	26,257	190	26,068	370	0	370	47,202	0	47,202	179,135	404	178,731
58	Middle Lake Roosevelt	549,697	26,542	2,283	24,259	0	0	0	186,242	8,789	177,453	399,227	15,656	383,571
55/6/7	Little-Mid-Spoke-Hang	317,834	1,092	0	1,092	463	0	463	95,556	0	95,556	338,120	0	338,120
45	Wenatchee	533,961	13,334	10,661	2,674	84,885	71,071	13,815	188,618	98,832	89,786	366,912	277,065	89,847
39/40	Up-Yak-Alk-Squilch	555,042	10,334	5,048	5,287	150,484	110,847	39,637	180,892	97,811	83,081	404,199	172,760	231,439
61	Upper Lake Roosevelt	299,644	13,483	1,445	12,038	0	0	0	94,718	479	94,239	211,128	1,015	210,113
48	Methow	828,220	238,017	188,082	49,935	120,755	83,555	37,200	222,406	128,349	94,057	812,657	585,320	227,336
62	Pend Oreille	632,218	31,662	11,499	20,163	222	107	115	150,202	28,058	122,144	310,029	20,333	289,695
38	Naches	470,397	53,541	34,013	19,528	11,146	6,507	4,640	156,832	80,281	76,551	341,084	200,798	140,286
32/35	Walla M. Snake	378,287	1,312	680	632	11,310	7,922	3,389	139,867	82,497	57,370	294,650	139,832	154,818
46/47	Entiat-Chelan	433,452	58,524	48,790	9,734	70,763	67,133	3,630	78,141	63,642	14,499	374,245	278,783	95,462

Landscapes (WRIAs) were ranked against one another for each variable (mortality, defoliation, risk/predicted damage and vegetation condition class), and rating points were assigned according to rank – a ranking in the top 1/3 highest acres earned a rating score of "4," middle 1/3 earned a "2," and bottom 1/3 lowest acres earned a "1." Landscapes that contained all or part of a designated US Forest Service Collaborative Forest Landscape Restoration (CFLR) project area received a supplemental rating point of "1." These areas represent a concerted focus of management for US Forest Service-managed land, as well as a greater degree of public support for management activities and therefore a higher efficacy potential.

Each ranking evaluation process was performed on five iterations: (Appendix A)

-Ranking on the basis of unreserved acres for each variable
-Ranking on the basis of total acres for each variable
-Ranking on the basis of all variables ("composite")
-Ranking to emphasize tree mortality (by removing defoliation rating)
-Ranking to emphasize defoliation (by removing mortality rating)

In all evaluations, the NIDRM risk/predicted damage variable was weighted 50% extra (1.5 weight). The purpose of the supplemental weight was to focus the evaluation on anticipated future damage for which preventive management action may be warranted.

The number of times a landscape appeared in the top tier of the scoring iterations was summed, and the top five ranked landscapes were selected for supplemental fine-scale analysis. These priority landscapes were: Klickitat, Okanogan, Middle Lake Roosevelt, Kettle and Sanpoil WRIAs.

2.2 FINE-SCALE ANALYSIS OF PRIORITY LANDSCAPES

As a result of the coarse-scale analysis, the committee selected the following WRIAs as priorities for further analysis: Klickitat, Okanogan, Sanpoil, Kettle and Middle Lake Roosevelt. The committee selected data to help assess seven considerations to make a determination as to whether a forest health hazard warning was warranted: existing forest stand conditions, presence of an uncharacteristic outbreak, extent/likelihood of spread to multiple ownerships, extent/likelihood of significantly increased forest fuels, Tier 1 actions and forest management treatments, values at risk and efficacy. The criteria correspond to specific considerations enumerated in state law, or additional considerations requested by the committee.

Table 2. Technical Advisory Committee Forest Health Hazard Warning Considerations and Data Points

Consideration	Origin of Consideration	Data Points
Existing forest stand conditions	RCW 76.06.180(2)	-Forest structural stage by cover type -Degree of departure from historic range of variability -National Insect & Disease Risk Map predicted mortality -Potential Vegetation Type -Fire Regime Group
Presence of an uncharacteristic outbreak	RCW 76.06.180(2)(a)	-Aerial insect and disease survey -Suitable host area for budworm and pine bark beetles with recent aerial survey damage detections -Historical reference data on past outbreaks
Extent/likelihood of spread to multiple ownerships	RCW 76.06.180(2)(a)(i)	-Aerial survey damage by ownership -Distribution of susceptible forest types
Extent/likelihood of significantly increased forest fuels[1]	RCW 76.06.180(2)(a)(ii)	-Fuel Characteristic Classification System -Aerial survey damage -Proximity to wildland-urban interface
Values at risk	RCW 76.06.170(2)(a) Technical Advisory Committee	-Wildlife species & habitats of concern -Existing impaired water quality -Salmonid stock status -Priority watersheds for the Upper Columbia Salmon Recovery Board -Timber & economic values (infrastructure)
Tier 1 actions and forest management treatments	Technical Advisory Committee	-Recently completed & planned treatment acres by landowners/managers -Technical assistance/outreach
Efficacy considerations	Technical Advisory Committee	-Proportion of host area in reserve status -Timber market proximity -Organizational implementation capacity -Ability to leverage federal resources -Existing multi-jurisdictional/stakeholder collaborative -Existing forest roads infrastructure

[1] Consideration of Increased Forest Fuels: Based on the available body of scientific research, the interactions between bark beetle tree mortality, fuels configuration and wildfire behavior are highly variable and unclear (Hicke et. al 2012). Similarly mixed findings have been associated with defoliation from western spruce budworm (Hummel, 2003). While intuition would suggest that an increase in fuels would lead to more severe fire behavior, the literature provides contradictory conclusions. Fire behavior impacts depend on preexisting conditions, the site-specific type of insect damage, and the length of time that has elapsed since the damage occurred. The TAC reviewed baseline quantifiable fire behavior characteristics of locally-adjusted fuel types in the Fuels Characterization Classification System (FCCS) data set. However, there is no practically available means to quantify the change in fire behavior as a result of bark beetle mortality and budworm defoliation. Therefore the TAC utilized the amount of Community Wildfire Protection Plan (CWPP) priority treatment areas as a proxy to measure the concern associated with potential insect mortality and wildfire interactions. Areas where CWPP priority treatment areas coincide with forest stands susceptible to bark beetles and/or western spruce budworm were determined by the TAC to represent a precautionary concern for increased fuel loading.

References for Data Points

Aerial Insect and Disease Survey. Washington Department of Natural Resources and the US Forest Service. Every year since 1947, aerial detection surveys have recorded forest damage from insects and disease in Washington.

Community Wildlfire Protection Plans (CWPP). Washington Department of Natural Resources. The TAC utilized the amount of Community Wildfire Protection Plan (CWPP) priority treatment areas as a proxy to measure the concern associated with potential

insect mortality and wildfire interactions. Areas where CWPP priority treatment areas coincide with forest stands susceptible to bark beetles and/or western spruce budworm were determined by the TAC to represent a precautionary concern for increased fuel loading.

Priority Habitat and Species (PHS). Washington Department of Fish and Wildlife. The PHS is a database of habitats and species considered to be priorities for conservation and management. Priority species include state endangered, threatened, sensitive, and candidate species. A list of priority species was created for each of the five landscapes (WRIAs) in the TAC fine-scale analysis.

Impaired Water Quality. Washington Department of Ecology. This dataset is an inventory of impaired water quality.

Salmonid Stock Inventory. Washington Department of Fish and Wildlife and native Indian Tribes of western Washington. These data allowed the TAC to assess the location and intensity of non-healthy salmonid stocks.

Priority Watersheds. Upper Columbia Salmon Recovery Board. This dataset identifies watersheds that are a priority for salmon habitat restoration and protection as identified by the Upper Columbia Salmon Recovery Board.

Several key elements of the statutory wording were interpreted to limit the committee's discretion in recommending a warning. By the process utilized, substantially all the statutory considerations in Table 7 needed to be aligned in order to warrant a warning recommendation to the Commissioner. RCW 76.06.180 reads as follows:

1) *Prior to issuing a forest health hazard warning or forest health hazard order, the commissioner shall consider the findings and recommendations of the forest health technical advisory committee and shall consult with county government officials, forest landowners and forest land managers, consulting foresters, and other interested parties to gather information on the threat, opportunities or constraints on treatment options, and other information they may provide. The commissioner, or a designee, shall conduct a public hearing in a county within the geographical area being considered.*

2) *The commissioner of public lands may issue a forest health hazard warning when he or she deems such action is necessary to manage the development of a threat to forest health or address an existing threat to forest health. A decision to issue a forest health hazard warning may be based on existing forest stand conditions and:*

    a. *The presence of an uncharacteristic insect or disease outbreak that has or is likely to (i) spread to multiple forest ownerships and cause extensive damage to forests; or (ii) significantly increase forest fuel that is likely to further the spread of uncharacteristic fire;*

    b. *When, due to extensive physical damage from wind or ice storm or other cause, there are (i) insect populations building up to large scale levels; or (ii) significantly increased forest fuels that are likely to further the spread of uncharacteristic fire; or*

    c. *When otherwise determined by the commissioner to be appropriate."*

The committee considered portions of Subsection (1) and all of section (2)(a) in its deliberations. Subsection (b) was not applicable to the landscapes that were evaluated, and the committee members are not afforded independent discretion such as in (c).

Subsection (2)(a) was split into three separate considerations for the purposes of TAC proceedings. The first requires the "presence" of an "uncharacteristic" outbreak. The "presence" criterion is straightforward to assess but constrained the committee in some important respects.

In several cases outbreaks are occurring at currently low intensity levels, or occurred in the last few years at levels that appeared to be upward-trending followed by a leveling-off or decrease in intensity reported for 2011 aerial survey data. In these cases the "presence" criteria are not strictly satisfied and therefore do not meet the criteria for recommending a warning, although the committee considered additional mortality and damage inevitable given the forest conditions present.

Assessing the "uncharacteristic" nature of individual outbreaks is difficult, because it inherently requires choices about the period of time for comparison. The term "uncharacteristic" is defined at RCW 76.06.020(16) as, "ecologically atypical for a forest or vegetation type or plant association and refers to fire, insect or disease events that are not within a natural range of variability." Compared within the last 50-100 years, many outbreaks could be considered "uncharacteristic." If one lengthens the time of comparison, it grows to include much more variability and many outbreaks would not be considered "uncharacteristic." Furthermore, one may not truly assess the context of natural variability without the benefit of hindsight. Yet waiting until the end of an outbreak would largely abdicate the TAC's purpose under statute, and render moot any recommended corrective actions. For the purposes of the TAC deliberations the "uncharacteristic" criterion was considered fulfilled where an extensive, upward-trending outbreak that coincided with extensive forest conditions that were both, a) suitable to the host insect and, b) significantly departed from historical reference conditions.

The second consideration under 2(a)(i) requires that said outbreak has or is likely to spread to "multiple forest ownerships and cause extensive damage." Because the location of certain host trees, such as lodgepole pine, is often confined to high-elevation lands on few forest ownership categories (generally US Forest Service or DNR), it is difficult to satisfy this criterion. The location of host trees for western spruce budworm, in contrast, is such that public, tribal, small private and industrial forestlands can all be affected. The language referring to both multiple ownerships and extensiveness suggests that these criteria are linked. In other words, if an outbreak spread from a single owner onto another, but the damage did not have the potential to be "extensive," the legislative intent would not be satisfied.

The third consideration under 2(a)(ii) serves as an alternative to the multi-landowner and extensiveness considerations; the language under 2(a) suggests that either consideration (i) or (ii) may be met in designating a warning area. Based on the available body of scientific research, the interactions between bark beetle tree mortality, fuels configuration and wildfire behavior are highly variable and unclear (Hicke et. al 2012). Similarly mixed findings have been associated with defoliation from western spruce budworm (Hummel, 2003). While intuition would suggest that an increase in fuels would lead to more severe fire behavior, the literature provides contradictory conclusions. Fire behavior impacts depend on preexisting conditions, the site-specific type of insect damage, and the length of time that has elapsed since the damage occurred. The TAC reviewed baseline quantifiable fire behavior characteristics of locally-adjusted fuel types in the Fuels Characterization Classification System (FCCS) data set. However, there is no practically available means to quantify the change in fire behavior as a result of bark beetle mortality and budworm defoliation without site-specific measurements. Therefore the TAC utilized the amount of Community Wildfire Protection Plan (CWPP) priority treatment areas as a proxy to measure the concern associated with potential insect mortality and

wildfire interactions. Areas where CWPP priority treatment areas coincide with forest stands susceptible to bark beetles and/or western spruce budworm were determined by the TAC to represent a precautionary concern for increased fuel loading. This, however, means that satisfying criteria 2(a)(ii) as a substitute for, or in the absence of, criteria (i) would be extraordinarily difficult.

2.2.1 Data Sets and Their Utility

Specific data sets were selected to inform the committee on statutorily required considerations and criteria, as displayed in Table 7. For each of the five priority WRIAs the following data sets were analyzed:

1. Current Vegetation. Figures 7-11.
    a. Source: GNN Current Vegetation developed by Landscape Ecology Modeling, Mapping and Analysis project (LEMMA), a collaborative research group of the US Forest Service PNW Research Station and Oregon State University. This data set uses Gradient Nearest Neighbor (GNN) to model current vegetation from US Forest Service Forest Inventory & Analysis system of field plots and satellite imagery at 30-meter spatial resolution. http://www.fsl.orst.edu/lemma/main.php?project=imap&id=home
    b. Utility: Describes current forest species composition and structure.

2. Suitable Host Area, recent damage and population trajectory for Western Spruce Budworm. Figures 12-15.
    a. Source: GNN Current Vegetation developed by LEMMA. GNN Current Vegetation data set was queried by DNR Forest Health Program staff to select areas with the following attributes: 40% or greater of total stand basal area comprised of host species (grand fir, subalpine fir and Douglas-fir), two or more canopy layers, and total stand basal area of 120 ft^2 or greater.
    b. Source: DNR/US Forest Service annual aerial survey of insect & disease damage.
    c. Source: DNR/US Forest Service pheromone trapping of adult budworm moths.
    d. Utility: Delineates areas that are suitable for western spruce budworm damage.

3. Suitable Host Area and recent damage for Pine Bark Beetles (lodgepole and ponderosa pine). Figures 16, 17.
    a. Source: GNN Current Vegetation developed by LEMMA. GNN Current Vegetation data set was queried by DNR Forest Health Program staff to select areas with the following attributes: 30% or greater of total stand basal area comprised of host species (lodgepole pine or ponderosa pine), quadratic mean diameter of 8 inches or greater, and total stand basal area of 120 ft^2 per acre or greater.
    b. Source: DNR/US Forest Service annual aerial survey of insect & disease damage.
    c. Utility: Delineates lodgepole pine or ponderosa pine areas that are suitable for pine bark beetle infestation.

4. LANDFIRE Fire Regime Group (FRG). Figure 18.
    a. Source: LANDFIRE Project, a joint venture of the US Forest Service and the US Department of the Interior. http://www.landfire.gov/NationalProductDescriptions12.php
    b. Utility: FRG characterizes the presumed historical fire regimes within landscapes based on interactions between vegetation dynamics, fire spread, fire effects and spatial context.

5. Intersection of LANDFIRE Fire Regime Group (FRG) I and III and Vegetation Condition Class (VCC) 2 and 3. Figure 18, 19.
    a. Source:LANDFIRE Project, a joint venture of the US Forest Service and the US Department of the Interior. GIS analysis of data layers performed by DNR Forest Health Program staff. http://www.landfire.gov/NationalProductDescriptions12.php
    b. Utility: The intersection of FRG I and III with VCC 2 and 3 delineates forested portions of the landscape which have historically experienced frequent disturbance from fire and are currently departed from the historical reference vegetation condition. FRG I are areas that have fire return intervals of less than 35 years with low to mixed severity fires. FRG III are areas with fire return intervals of 35 to 200 years with low to mixed severity fires. VCC 2 are areas with a moderate departure from historical reference vegetation conditions. VCC 3 are areas with a high departure from historical reference vegetation conditions. The TAC used the most recent LANDFIRE Refresh 2008 datasets in all of its analysis. LANDFIRE Refresh 2008 datasets updated 2001 data to incorporate disturbance and its severity, both managed and natural, which occurred on the landscape from 2001 to 2008. Specific examples of disturbance are: fire, vegetation management, weather, and insects and diseases. Disturbances were mapped using a combination of satellite imagery and disturbance databases.

6. Potential Vegetation Type. Figure 20, 21.
    a. Source: Interagency Mapping and Assessment Project (IMAP), US Forest Service Pacific Northwest Research Station http://ecoshare.info/imap/
    b. Utility: Delineates potential vegetation types. Potential vegetation types typically represent the climax vegetation for a location given natural succession in the absence of disturbance.

7. GNN/VDDT states crosswalk (state class).
    a. Source: Interagency Mapping and Assessment Project (IMAP), US Forest Service Pacific Northwest Research Station http://ecoshare.info/imap/
    b. Utility: Provides a summary of current conditions: cover type, size class and canopy cover. Based on a crosswalk of GNN current vegetation layer and modeled potential vegetation states using the Vegetation Dynamics Development Tool (VDDT). VDDT software models how vegetation might change over time given certain assumptions about the typical natural disturbances and growth rates for an ecological region.

Table 3. Summary of current vegetation conditions from GNN/VDDT state class for Klickitat WRIA.

Klickitat WRIA 30	Stateclass								
Cover Type	**Sap/Pole (0-10" DBH)**			**Middle (10-20")**			**Large (20"+)**		
	10-40%	**40-60%**	**60%+**	**10-40%**	**40-60%**	**60%+**	**10-40%**	**40-60%**	**60%+**
Douglas-fir/Grand Fir	2,578	2,686	1,175	9,492	5,219	39,103	12,151	25,876	45,375
Grand Fir	2,719	106	1,290	5,637	7,686	18,808	6,622	5,194	28,600
Lodgepole Pine	1	173	0	1,445	52	2,231	1,034		
Mountain Hemlock	706	874	2,689	3,061	1,480	22,443	1,680	3,214	24,562
Ponderosa Pine	7,812	3,094	4,850	65,551	70,064	13,573	77,183	37,742	14,143
Silver Fir/Doug-fir	122	591	36	417	295	3,065	49	34	548
Subalpine Parkland	791	90	1,338	495	2,374	6,262	218	143	418

Table 4. Summary of current vegetation conditions from GNN/VDDT state class for Okanogan WRIA.

Okanogan WRIA 49	Stateclass								
Cover Type	**Sap/Pole (0-10" DBH)**			**Middle (10-20")**			**Large (20"+)**		
	10-40%	**40-60%**	**60%+**	**10-40%**	**40-60%**	**60%+**	**10-40%**	**40-60%**	**60%+**
Subalpine fir/Douglas-fir	76	2,136	545	703	8,566	23,095	397	838	8,482
Douglas-fir	4,539	3,677	10,493	16,712	42,320	80,788	11,275	21,593	24,103
Douglas-fir mix	538	130	2,589	717	1,864	9,285	390	1,492	7,165
Douglas-fir/Grand fir	112		490	200	4,184	4,404	1,724	4,639	1,116
Lodgepole pine/Larch	5,586	8,702	7,110	4,381	7,648	6,414	33		
Mountain Hemlock					106	371			139
Subalpine Parkland	104	599	475	645	990	514	888	13	64
Ponderosa Pine	8,107	11,203	1,273	33,537	21,423	10,213	9,734	6,715	836

Table 5. Summary of current vegetation conditions from GNN/VDDT state class for Middle Lake Roosevelt WRIA.

Middle Lake Roosevelt WRIA 58	Stateclass								
Cover Type	**Sap/Pole (0-10" DBH)**			**Middle (10-20")**			**Large (20"+)**		
	10-40%	**40-60%**	**60%+**	**10-40%**	**40-60%**	**60%+**	**10-40%**	**40-60%**	**60%+**
Subalpine fir/Douglas-fir	456	240	1,734	699	490	1,988	2	547	534
Douglas-fir	1,125	7,882	4,123	14,253	53,631	75,219	8,360	18,108	10,331
Douglas-fir mix	640	2,603	2,420	4,403	6,025	21,666	1,789	3,702	4,872
Douglas-fir/Red cedar	286	1,279	1,660	1,558	2,958	6,571	562	536	629
Lodgepole pine/Larch	1,797	3,786	4,303	3,100	4,651	3,325	662	15	198
Ponderosa Pine	10,111	1,767	1,856	48,838	37,481	4,800	33,604	11,591	1,464

Table 6. Summary of current vegetation conditions from GNN/VDDT state class for Kettle WRIA.

Kettle WRIA 60	Stateclass								
Cover Type	**Sap/Pole (0-10" DBH)**			**Middle (10-20")**			**Large (20"+)**		
	10-40%	**40-60%**	**60%+**	**10-40%**	**40-60%**	**60%+**	**10-40%**	**40-60%**	**60%+**
Subalpine fir/Douglas-fir	92	416	2,689	1,553	2,289	7,286	24	1,271	3,521
Douglas-fir	5,216	5,100	10,348	15,375	44,062	93,034	14,966	26,228	27,286
Douglas-fir mix	2,391	1,355	4,847	4,021	12,619	26,885	2,686	6,812	7,756
Douglas-fir/Red cedar	1,332	2,067	6,302	2,746	6,323	21,955	1,069	4,375	3,952
Lodgepole pine/Larch	5,260	5,451	11,374	2,966	11,021	4,233	1,262		
Ponderosa Pine	1,959	3,145	4,474	10,676	8,385	1,559	5,447	1,190	89

Table 7. Summary of current vegetation conditions from GNN/VDDT state class for Sanpoil WRIA.

Sanpoil WRIA 52	Stateclass								
Cover Type	Sap/Pole (0-10" DBH)			Middle (10-20")			Large (20"+)		
	10-40%	40-60%	60%+	10-40%	40-60%	60%+	10-40%	40-60%	60%+
Subalpine fir/Douglas-fir	345	94	2,227	524	2,158	4,057	22	163	1,603
Douglas-fir	3,739	5,944	9,400	13,450	41,197	88,176	12,820	26,307	32,094
Douglas-fir mix	1,439	1,506	2,794	3,146	6,634	16,863	2,615	5,191	10,452
Subalpine parkland	96	167	174	108	217	224	27	5	24
Lodgepole pine/Larch	2,552	2,369	2,401	3,619	6,912	4,978	451	2	2
Ponderosa Pine	8,507	6,356	2,881	27,675	19,419	9,347	16,752	9,700	7,250

8. Completed and Planned Forest Management Treatments. Figures 22-25.
a. Source: Okanogan Wenatchee National Forest, Colville National Forest, Colville Agency Bureau of Indian Affairs, Yakama Nation Tribal Forestry, Washington Department of Natural Resources State Lands, Washington Department of Natural Resources Forest Practices Applications, and grant-funded hazard reduction projects administered by DNR on private forestlands.
b. Utility: Provides a summary of completed forest management treatments from 2000 to 2011 for US Forest Service, state, and private landowners. Colville Reservation treatments are from 1985 to 2008. Yakama Reservation treatments are from 2003 to 2011. Treatments include commercial, non-commercial and fuels activities. Also includes WA DNR planned treatments from 2011 to 2023, Yakama Reservation planned treatments from 2012 to 2020 and USFS planned treatments from 2011 to 2021.

9. Fuels Characteristic Classification System (FCCS). Figures 26-30.
    a. Source: LANDFIRE Project, a joint venture of the US Forest Service and the US Department of the Interior. http://www.landfire.gov/NationalProductDescriptions25.php
    b. Utility: FCCS provides standardized descriptions of fuelbeds and fire hazard metrics. FCCS calculates the relative fire hazard of each fuelbed including: flame length, surface fire behavior, crown fire and available fuel potentials.

10. Community Wildfire Protection Plan (CWPP) priority treatment areas. Figure 31.
    a. Source: DNR & local communities develop CWPPs to assess fire hazards and values at risk. Communities establish priorities for areas with homes at risk of wildfires, which may then receive grant assistance for hazard reduction activities. http://www.dnr.wa.gov/RecreationEducation/Topics/PreventionInformation/Pages/rp_burn_countymitigation_plans.aspx
    b. Utility: Reviewing FCCS data and relevant published literature revealed that there is considerable variability in how or whether insect and disease damage affects forest fuels. CWPP-identified priority areas with homes at risk from wildfires were therefore employed as a proxy that describes locations where interactions between insect damage and wildfires would be least desirable.

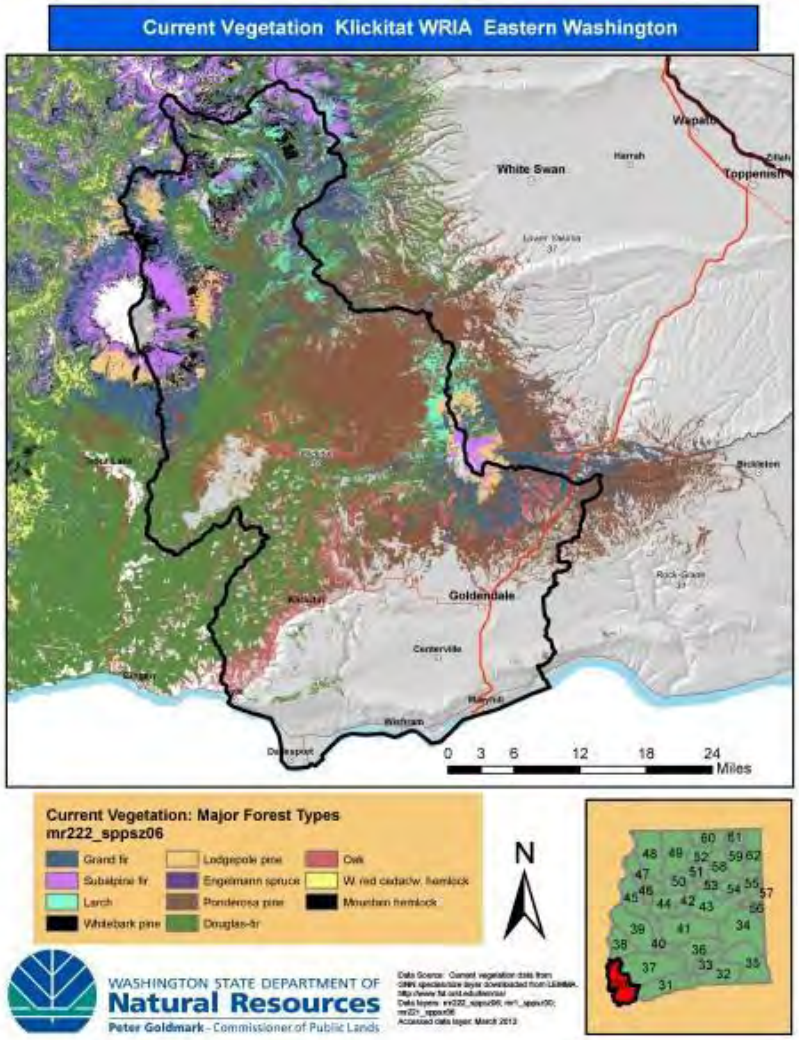


Figure 7. Current Vegetation Klickitat WRIA.

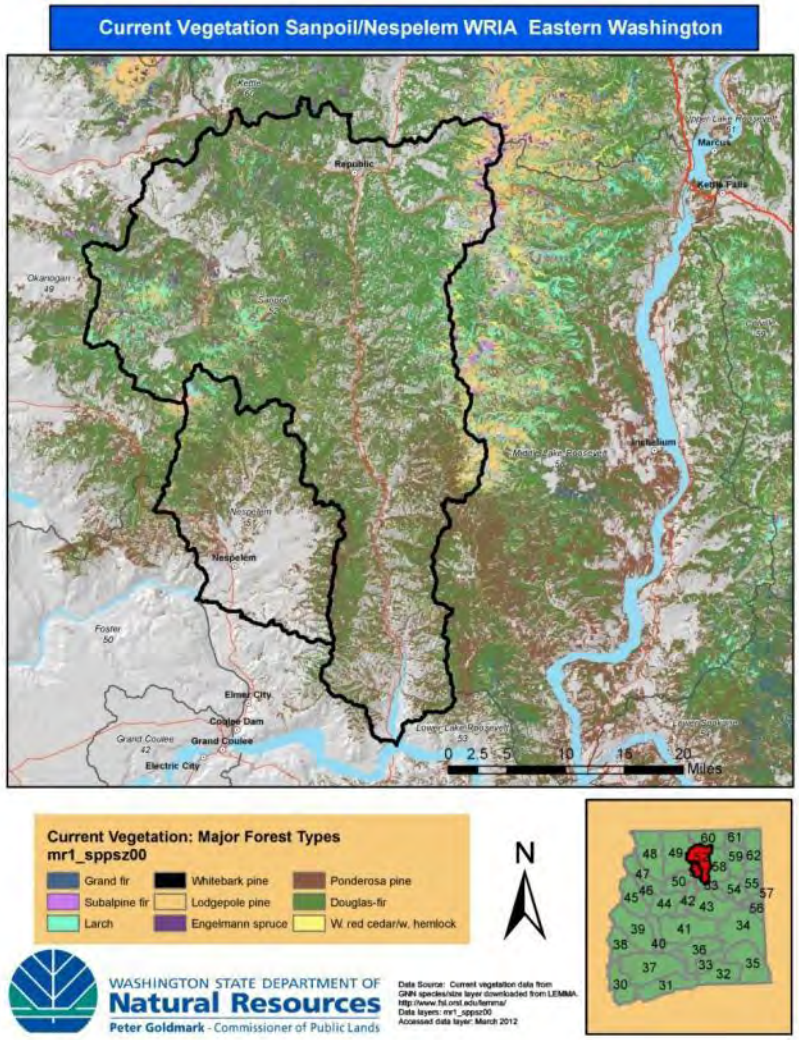


Figure 8. Current Vegetation Sanpoil & Nespelem WRIAs.

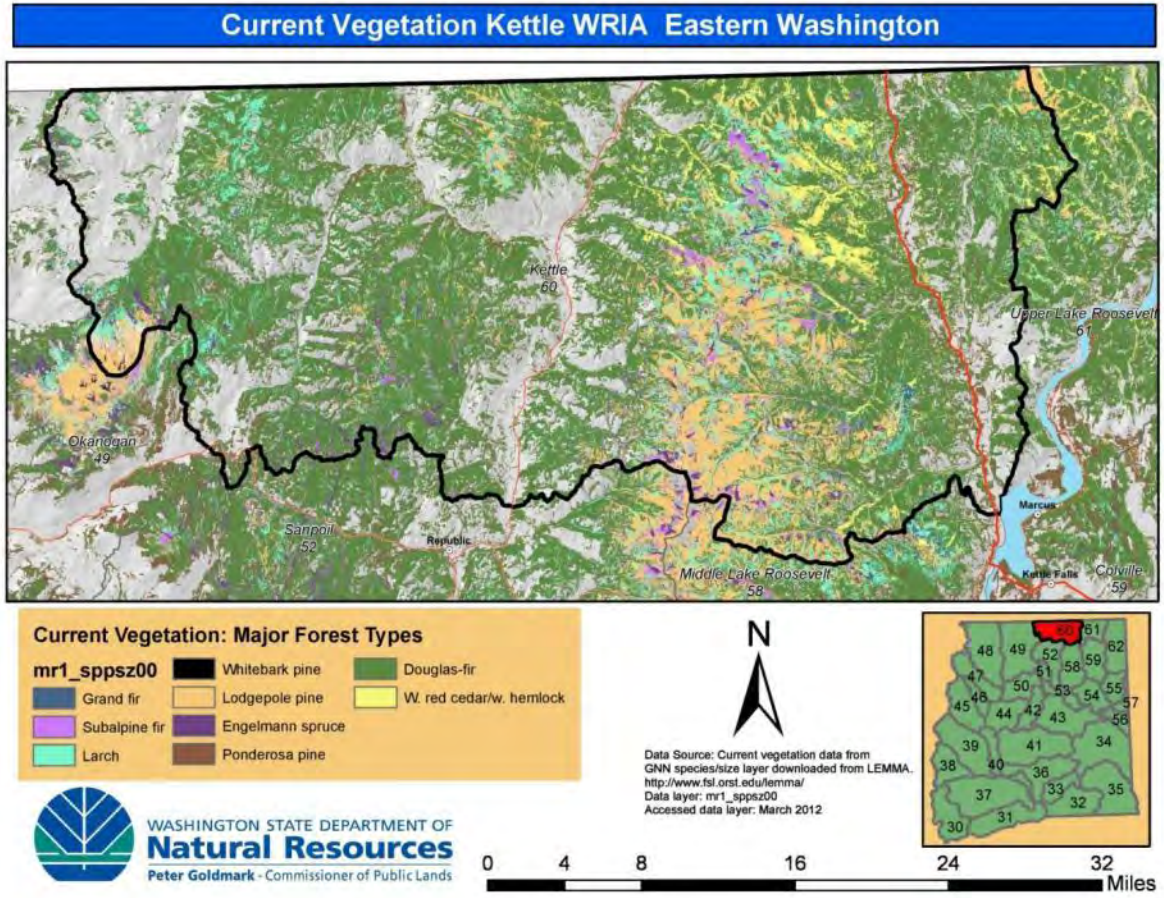


Figure 9. Current Vegetation Kettle WRIA.

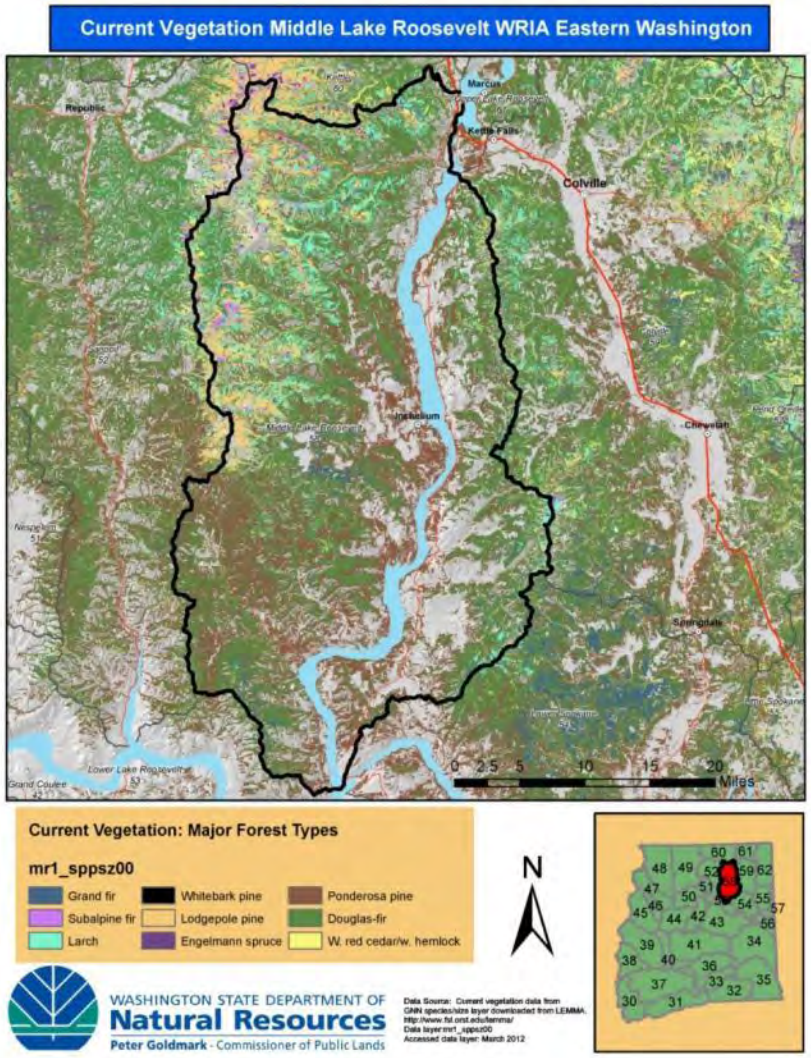


Figure 10. Current Vegetation Middle Lk. Roosevelt WRIA.

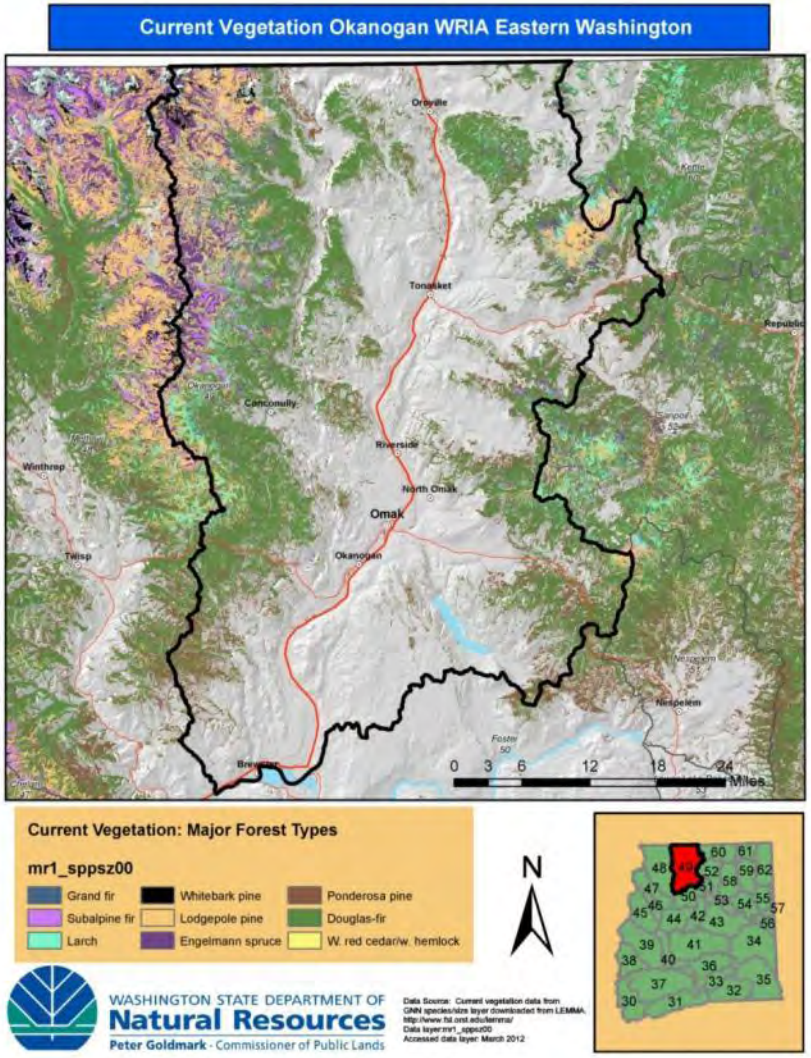


Figure 11. Current Vegetation Okanogan WRIA.

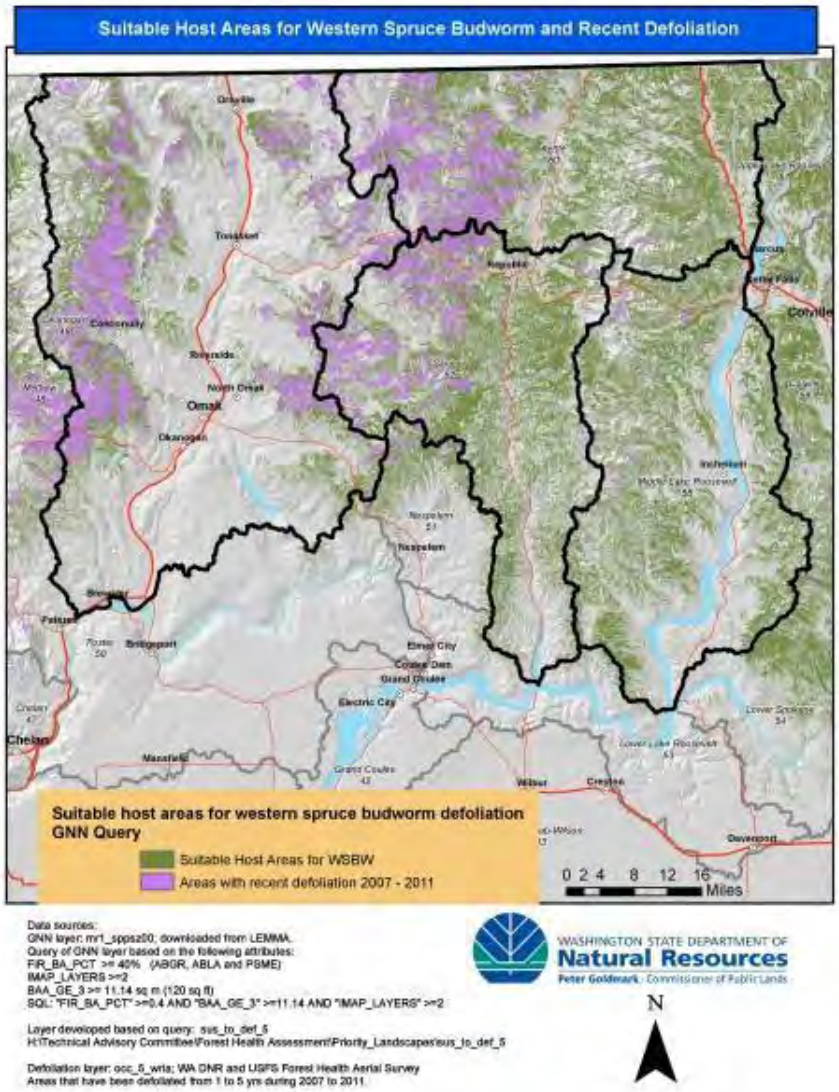


Figure 12. Suitable Host Areas for Western Spruce Budworm and Recent Defoliation Okanogan, Kettle, Sanpoil and Middle Lake Roosevelt WRIAs.

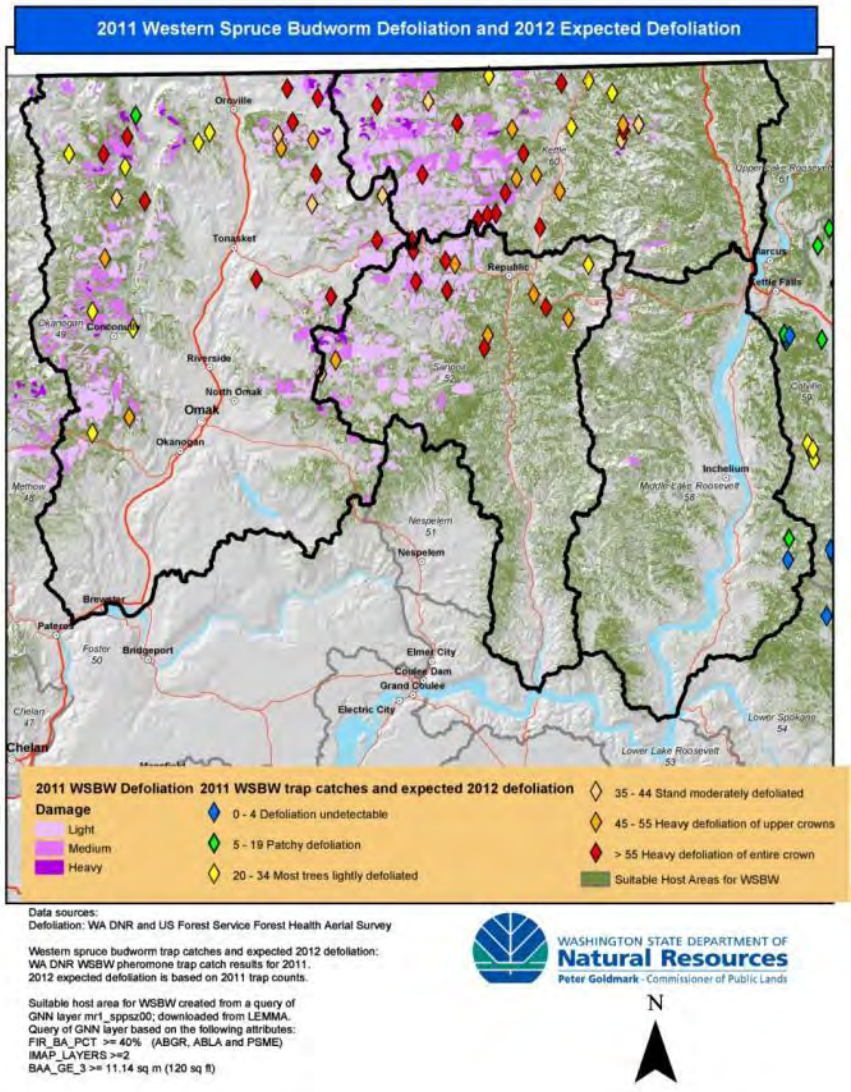


Figure 13. 2011 Western Spruce Budworm Defoliation and 2012 Expected Defoliation. Okanogan, Kettle, Sanpoil and Middle Lake Roosevelt WRIAs.

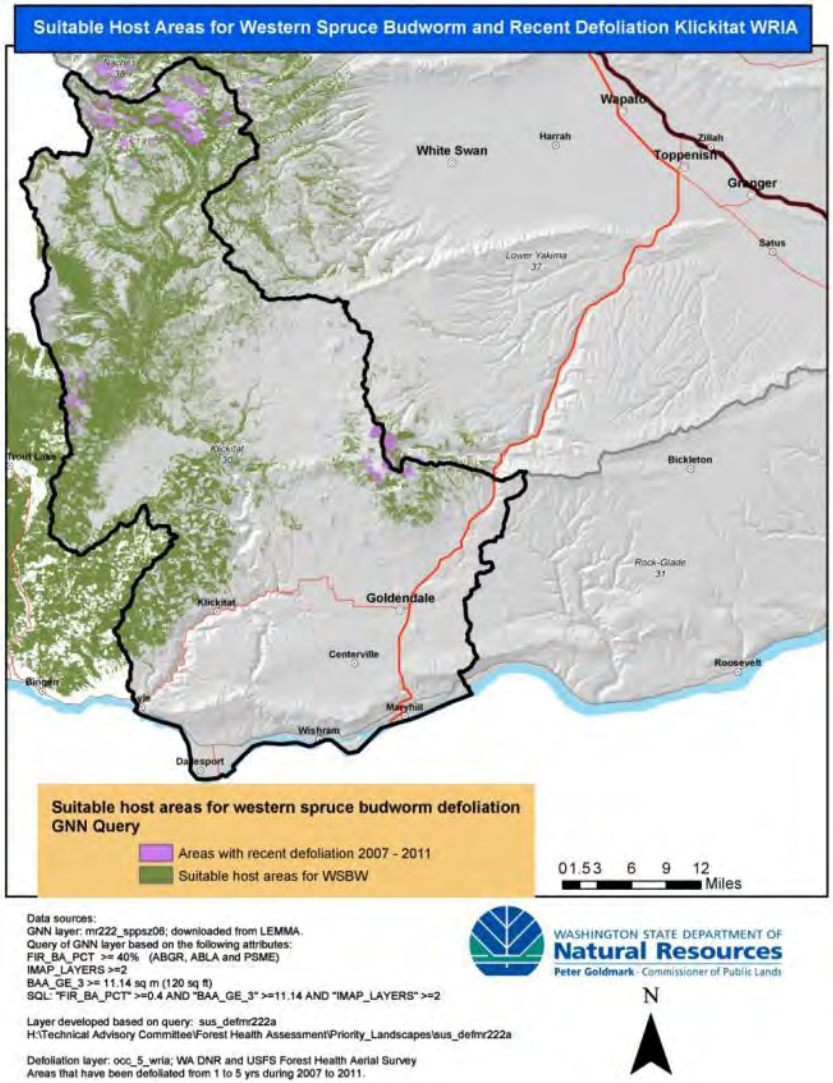


Figure 14. Suitable Host Areas for Western Spruce Budworm and recent defoliation in Klickitat WRIA

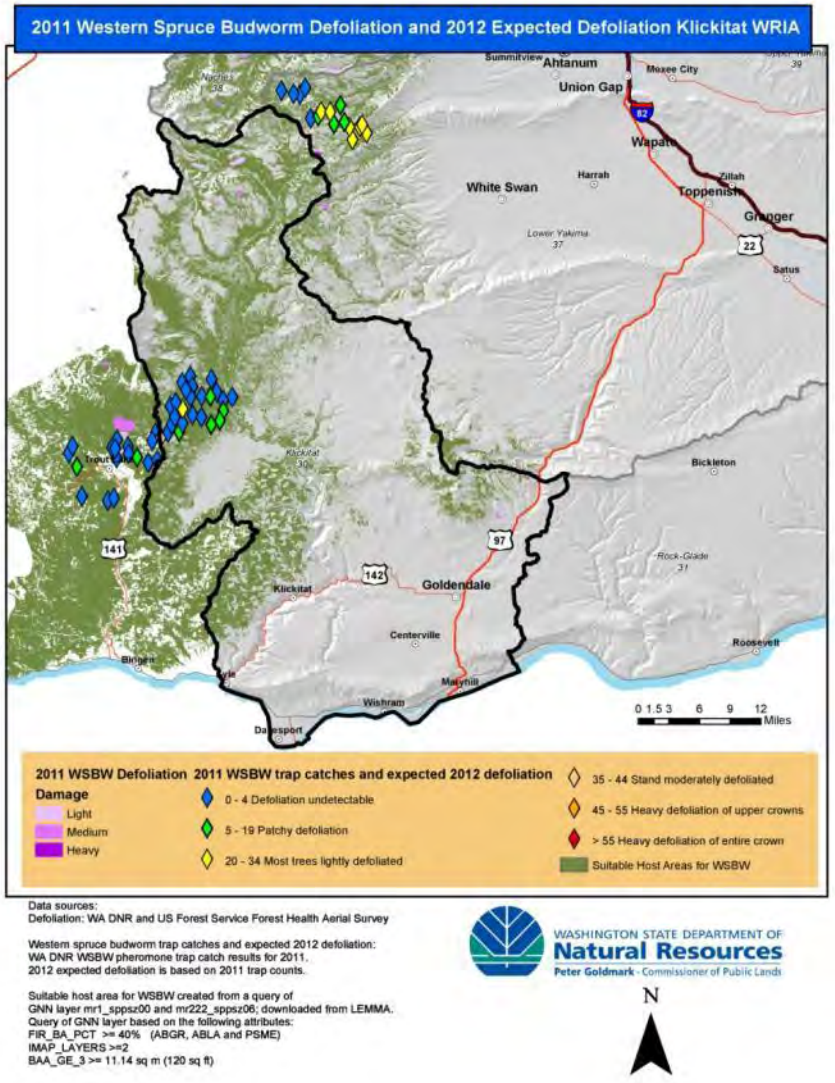


Figure 15. 2011 Western Spruce Budworm Defoliation and 2012 Expected Defoliation in Klickitat WRIA

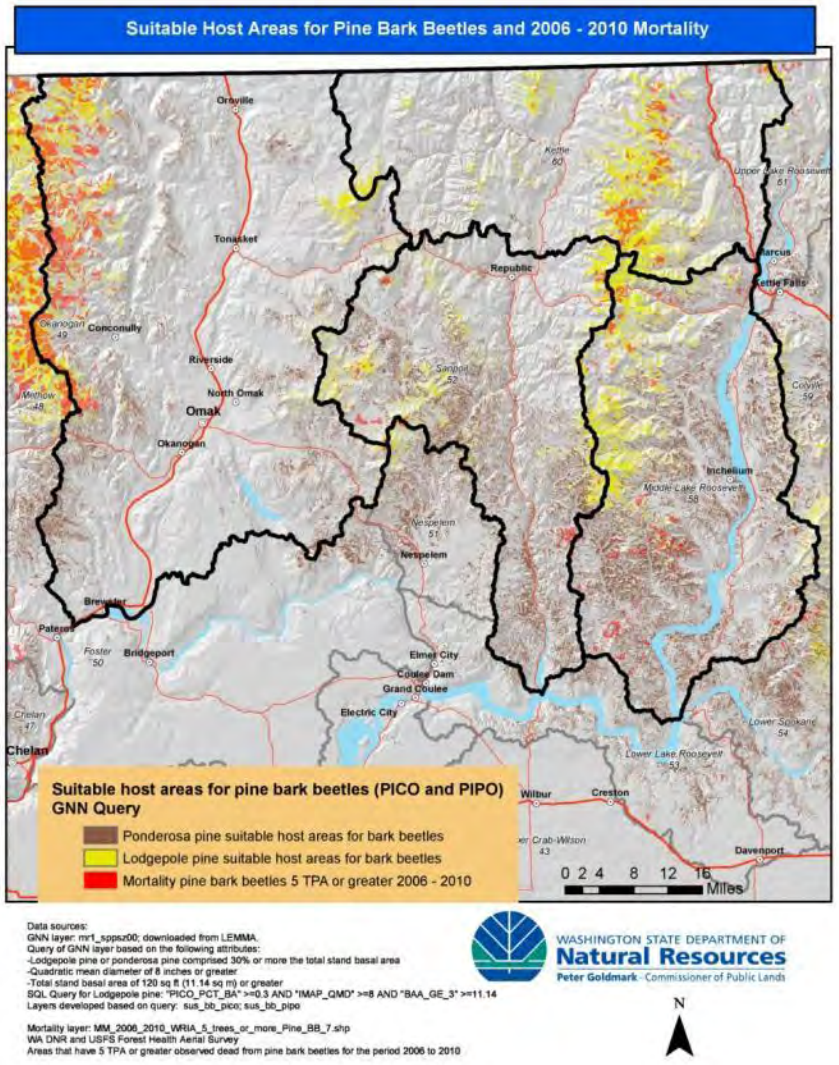


Figure 16. Suitable Host Areas for pine bark beetles and recent mortality in Okanogan, Kettle, Sanpoil and Middle Lk. Roosevelt WRIAs

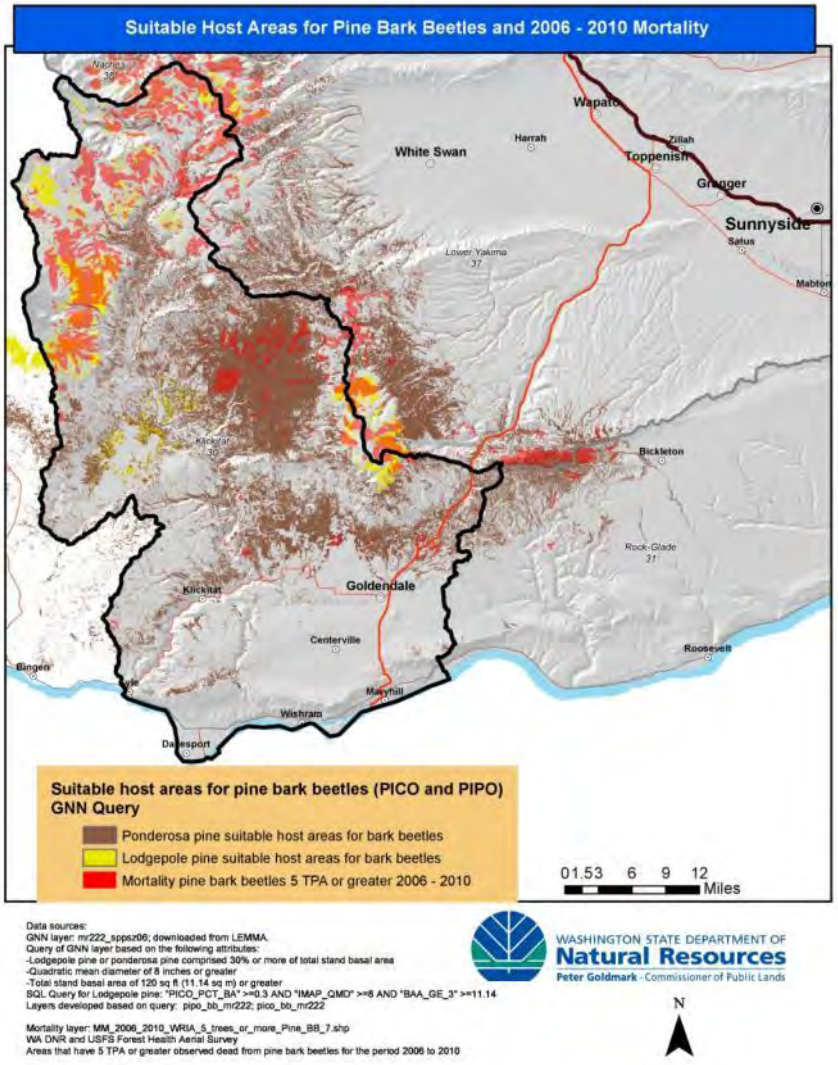


Figure 17. Suitable host areas for pine bark beetles and recent mortaliy in Klickitat WRIA

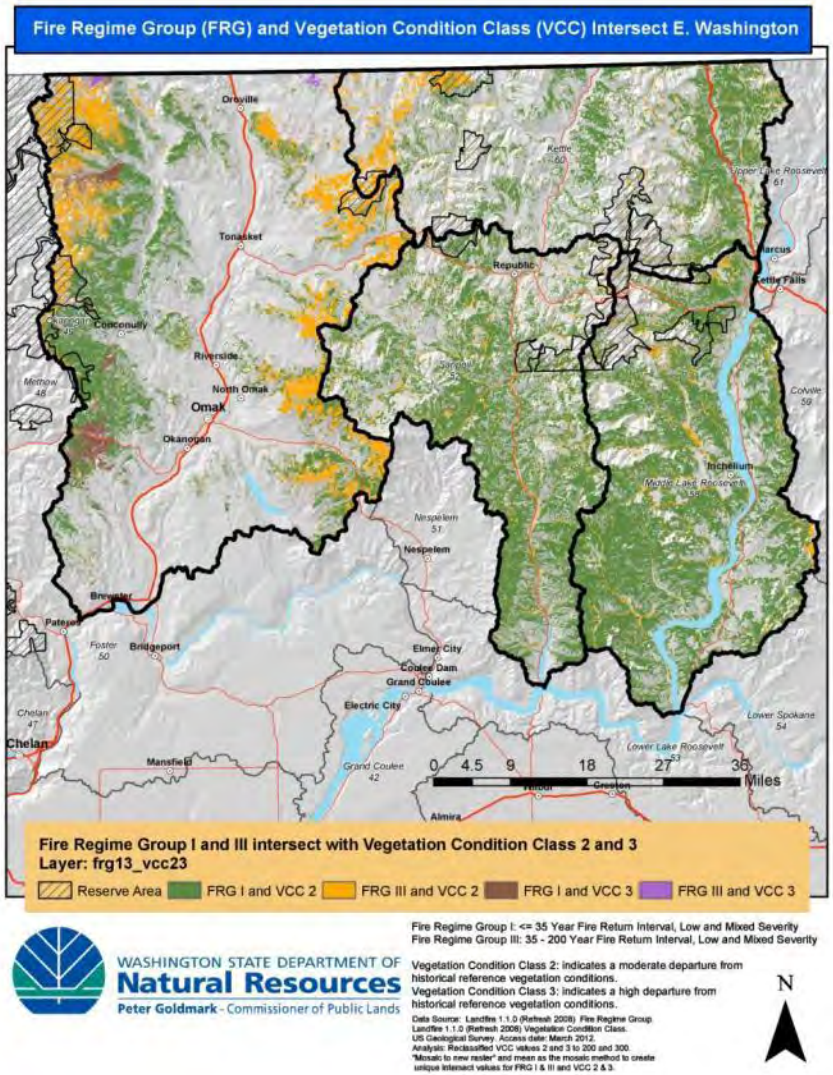


Figure 18. Intersection of Fire Regime Group (FRG) I and III with Vegetation Condition Class (VCC) 2 and 3 in the Okanogan, Kettle, Sanpoil and Middle Lk. Roosevelt WRIAs.

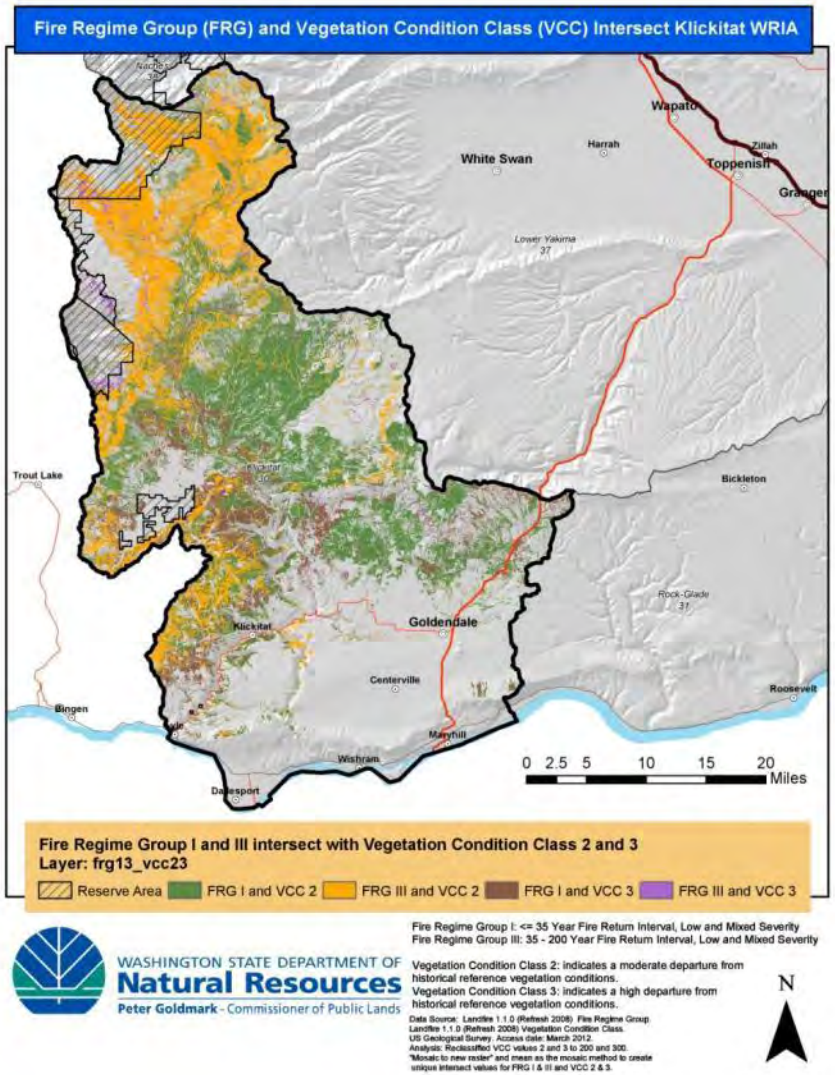


Figure 19. Intersection of Fire Regime Group (FRG) I and III with Vegetation Condition Class (VCC) 2 and 3 in the Klickitat WRIA.

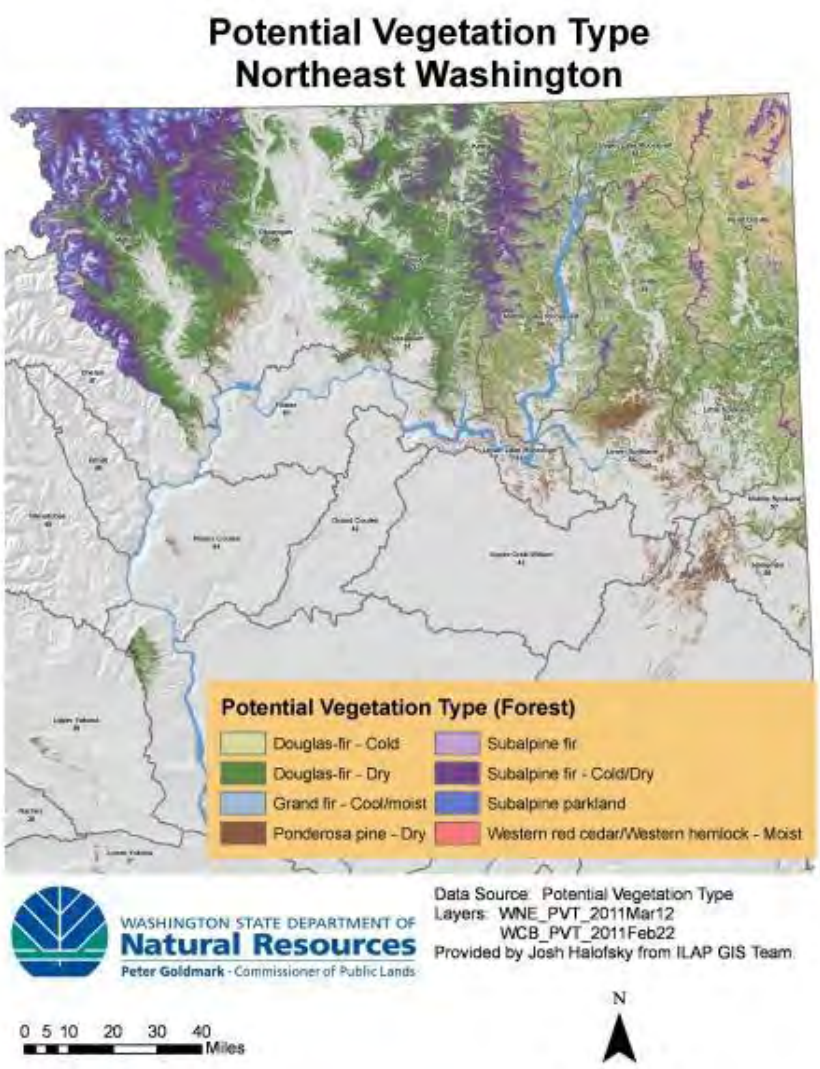


Figure 20. Potential Vegetation Type in Northeast Washington

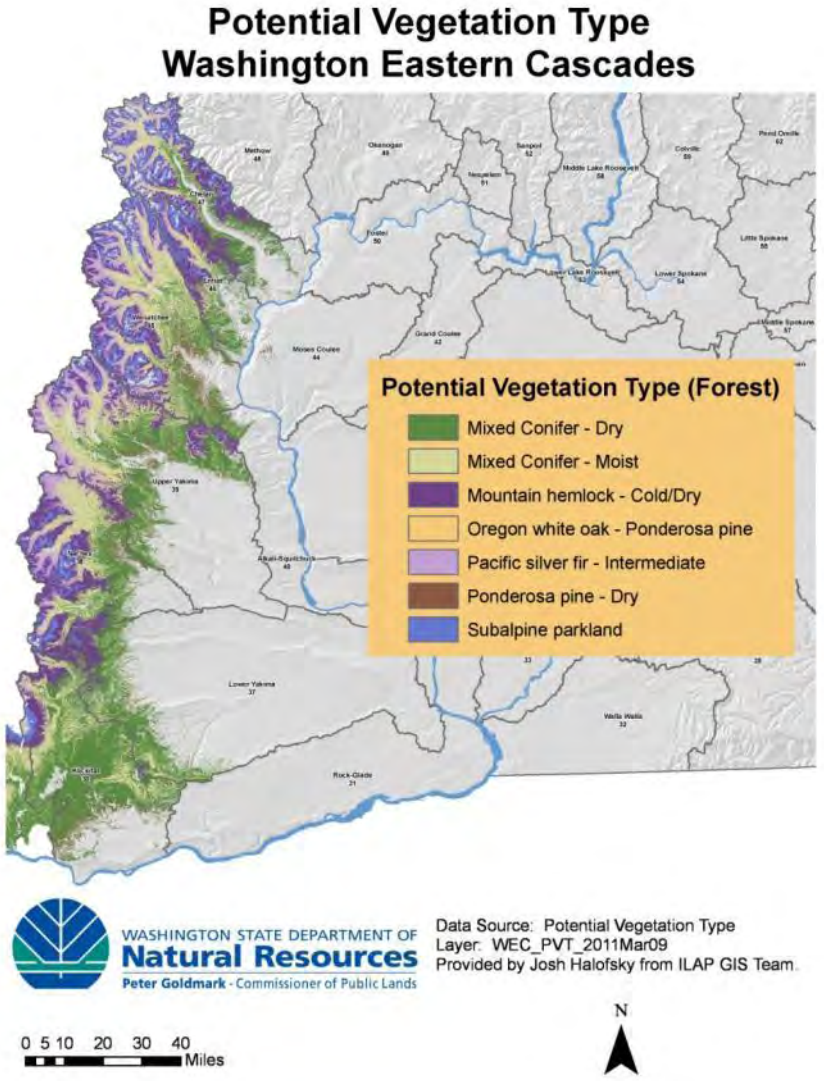


Figure 21. Potential Vegetation Type in Eastern Washington Cascades

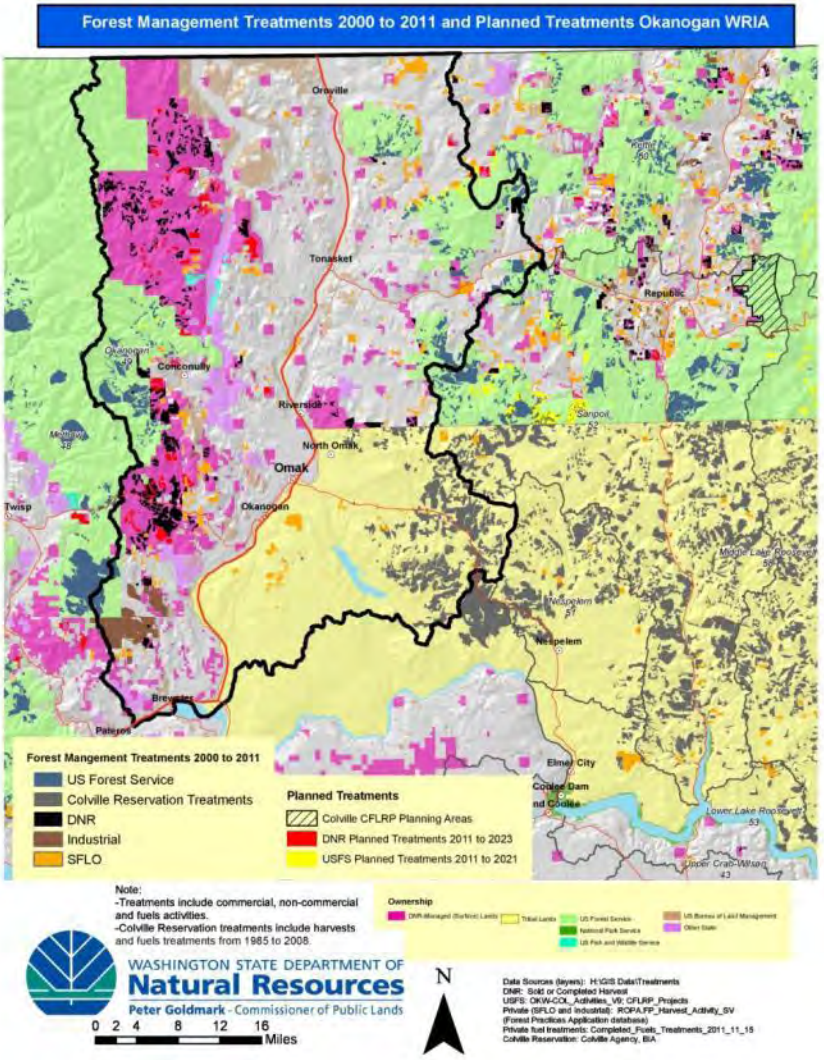


Figure 22. Recently completed and planned treatments, Okanogan WRIA.

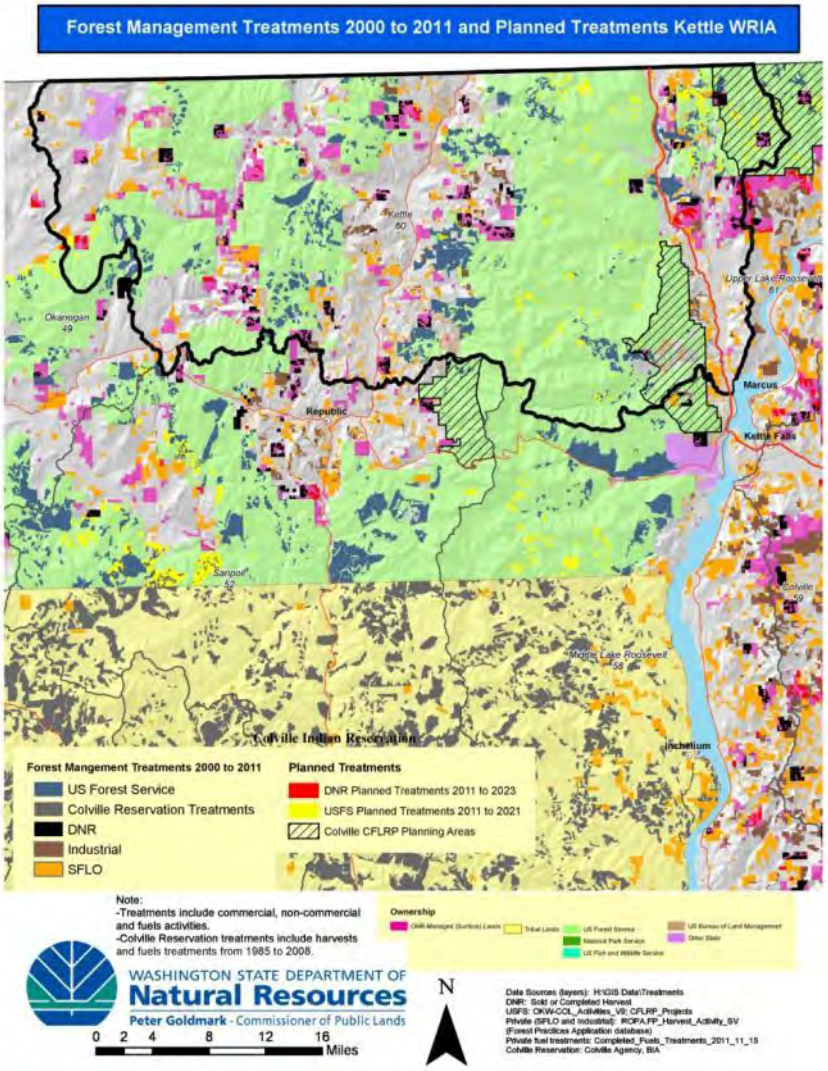


Figure 23. Recently completed and planned treatments, Kettle WRIA.

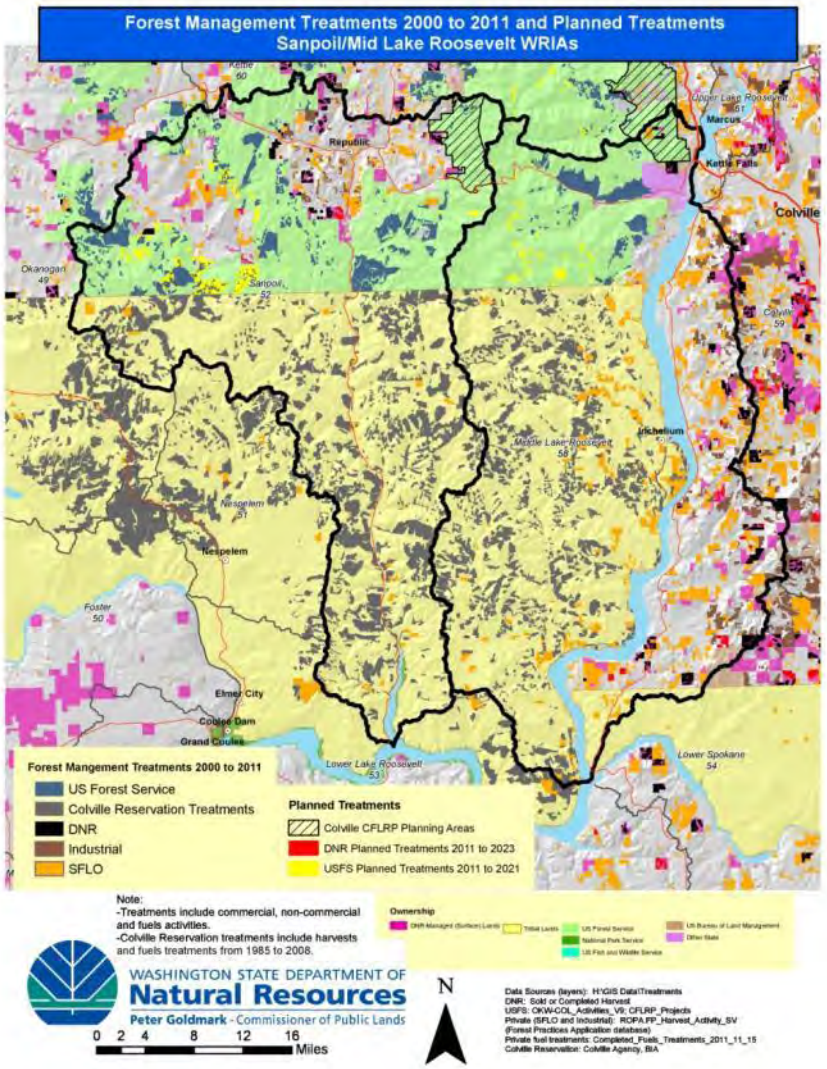


Figure 24. Recently completed and planned treatments, Sanpoil & Middle Lk. Roosevelt WRIAs.

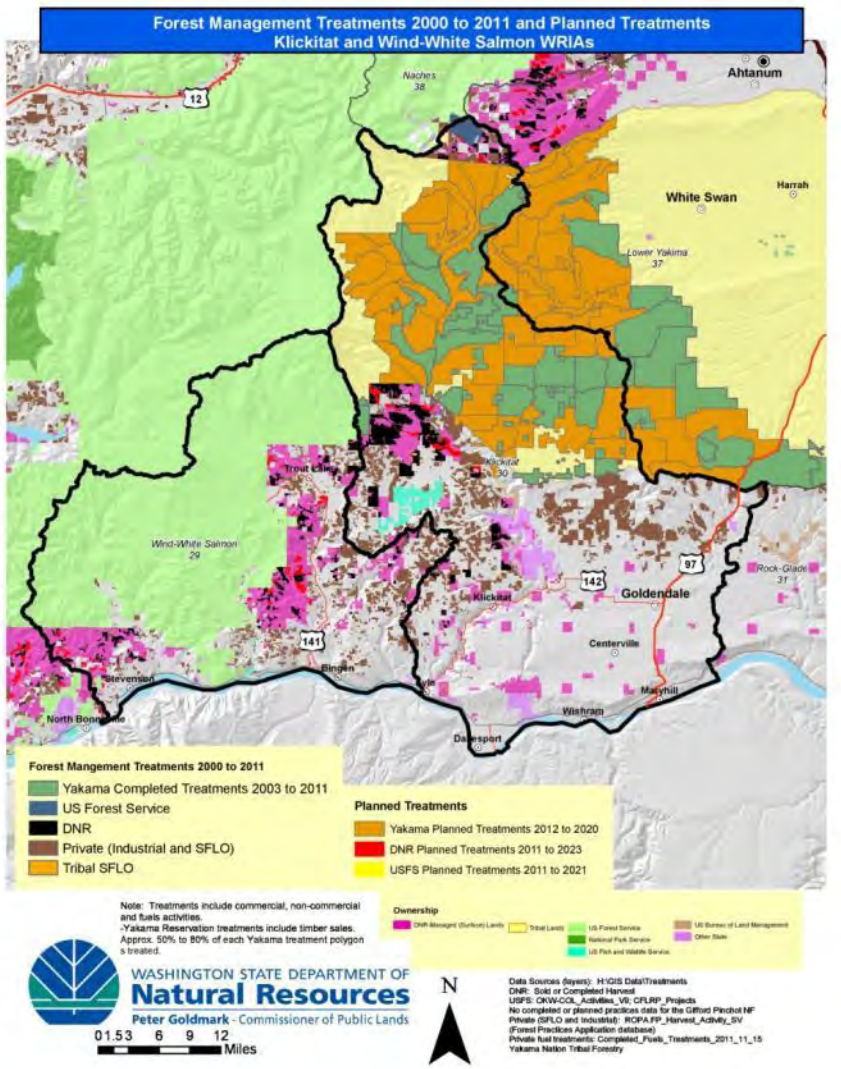


Figure 25. Recently completed and planned treatments, Klickitat WRIA.

Figure 26. Fuel Characteristic Classification System Fuelbeds for Eastern Washington.

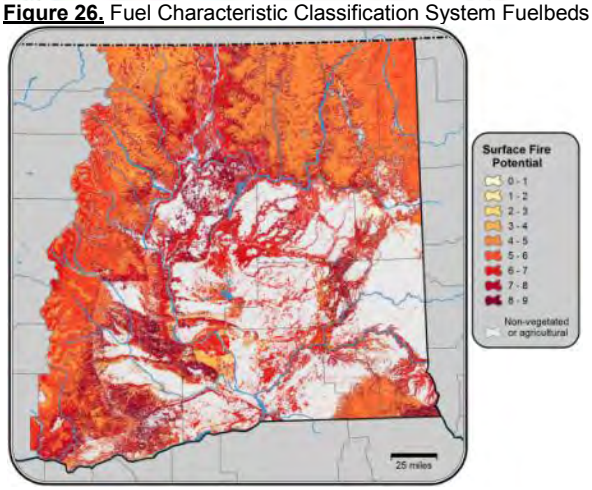


Figure 27. Surface Fire Potential for Eastern Washington.

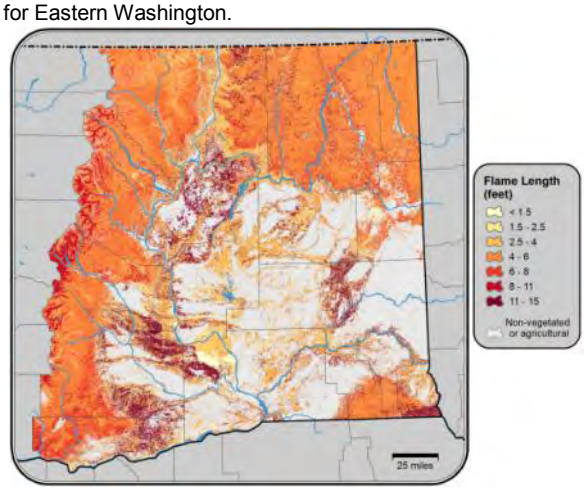


Figure 28. Flame Length for Eastern Washington.

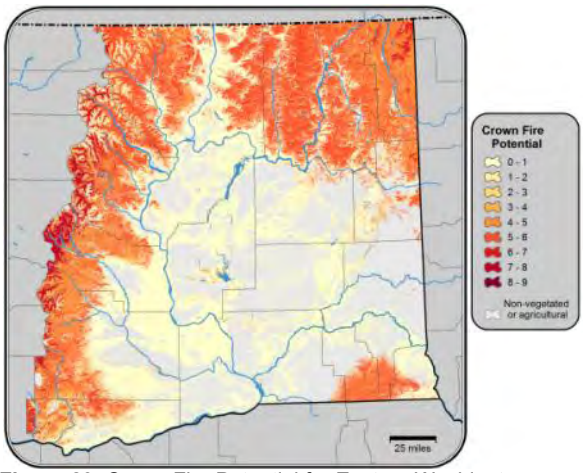


Figure 29. Crown Fire Potential for Eastern Washington.

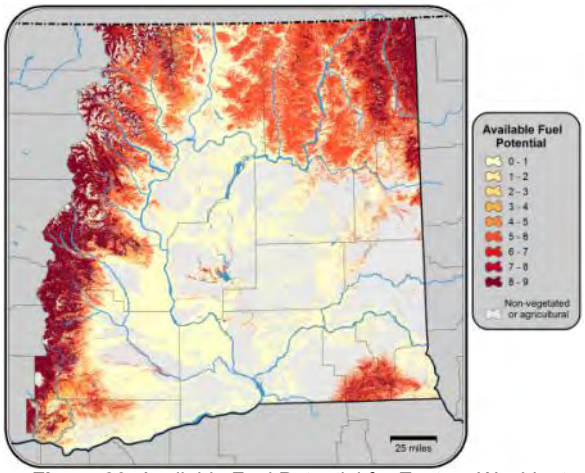


Figure 30. Available Fuel Potential for Eastern Washington.

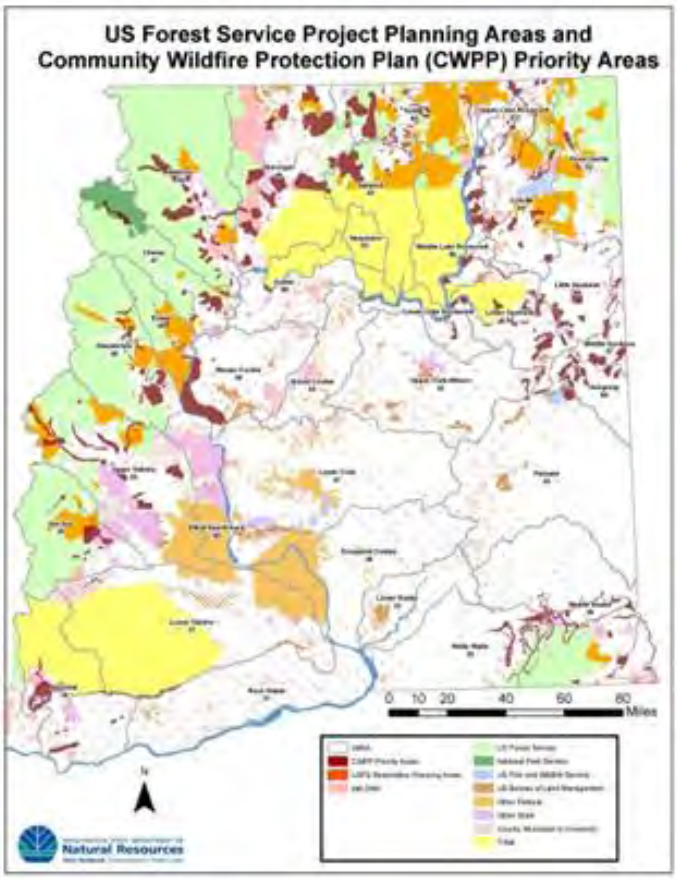


Figure 31. Community Wildfire Protection Plan (CWPP) Priority Areas and US Forest Service Project Planning Areas.

2.2.2 Warning Determination Process

The committee established that three pests were the primary sources of recent and projected future damage in the high-priority areas: mountain pine beetle in lodgepole pine; pine bark beetles in ponderosa pine; and western spruce budworm in Douglas-fir, grand fir and true firs. To facilitate the evaluation process, the high priority landscapes were divided into sub-areas that were evaluated separately. Table 8 describes the sub-landscapes and committee determinations for each pest.

Table 8. Okanogan and Ferry County Sub-Landscapes Forest Health Hazard Warning Considerations and Determinations.

Sub-Landscape	**Central Okanogan County**			**E. Okanogan/W. Ferry County**			**East Ferry County**		
	(West of Hwy 97)			(Between Hwy 97 and Hwy 21)			(Between Hwy 21and Columbia R./Hwy 395)		
Agent	MPB-Lodgepole Pine	MPB-Ponderosa Pine	Western Spruce Budworm	MPB-Lodgepole Pine	MPB-Ponderosa Pine	Western Spruce Budworm	MPB-Lodgepole Pine	MPB-Ponderosa Pine	Western Spruce Budworm
	Technical Advisory Committee determination if consideration was met			Technical Advisory Committee determination if consideration was met			Technical Advisory Committee determination if consideration was met		
Existing forest conditions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Presence of an uncharacteristic outbreak	Yes	No	Yes	No	No	Yes	Yes	No	No
Extent/likelihood of spread to multiple ownerships	Yes	Yes	Yes	No	No	Yes	No	Yes	Yes
Extent/likelihood of significantly increased forest fuels	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Tier 1 actions and forest management treatments	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Values at risk	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Efficacy Considerations	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Committee Determination	*No Warning Warranted*	*No Warning Warranted*	***Warning Warranted***	*No Warning Warranted*	*No Warning Warranted*	***Warning Warranted***	*No Warning Warranted*	*No Warning Warranted*	*No Warning Warranted*

Table 9. Klickitat and Yakima County Sub-Landscape Forest Health Hazard Warning Considerations and Determinations.

Sub-Landscape	**Klickitat and Yakima County**		
Agent	MPB-Lodgepole Pine	MPB-Ponderosa Pine	Western Spruce Budworm
	Technical Advisory Committee determination if consideration was met		
Existing forest conditions	Yes	Yes	Yes
Presence of an uncharacteristic outbreak	No	No	No
Extent/likelihood of spread to multiple ownerships	No	Yes	Yes
Extent/likelihood of significantly increased forest fuels	No	Yes	Yes
Tier 1 actions and forest management treatments	Yes	Yes	Yes
Values at risk	Yes	Yes	Yes
Efficacy Considerations	Yes	Yes	Yes
Committee Determination	*No Warning Warranted*	*No Warning Warranted*	*No Warning Warranted*

Sub-landscape 1: Central Okanogan County (West of Hwy 97 to the Okanogan WRIA boundary)

Mountain Pine Beetle-Lodgepole Pine: This landscape contains a significant amount of lodgepole pine stands that are suitable host area for the mountain pine beetle. There is also extensive moderate departure from the historical reference vegetation conditions. The vast majority of the suitable host area for mountain pine beetle is on the Loomis State Forest and the Okanogan-Wenatchee National Forest. This landscape contains extensive recent and historical mortality from mountain pine beetle in lodgepole pine. Damage is currently confined to DNR land and US Forest Service land. Spread to other ownerships will be very limited due to a lack of suitable host area (Figures 9 & 13). There is a limited amount of interface between lodgepole pine stands and CWPP priority treatment areas in this landscape, and therefore a limited potential for exacerbating wildfire hazard. Significant silvicultural treatments have occurred on portions of DNR land. Reserved areas on both DNR and US Forest Service land, as well as Canada lynx habitat management considerations, limit the potential efficacy of treatments in this landscape.

> Committee Determination: No warning warranted; recommend as an area of concern (Figures 34 & 35).

Mountain Pine Beetle-Ponderosa Pine: This landscape contains a moderate amount of ponderosa pine stands that are suitable host areas for mountain pine beetle. There is also extensive moderate/high departure from the historical reference vegetation conditions. Mortality from bark beetles in ponderosa pine is best characterized as light and there have been no major recent outbreaks. There is a significant amount of interface between ponderosa pine stands and CWPP priority treatment areas in this landscape. The potential exists for damage to spread to multiple ownerships as ponderosa pine stands can be found on state, federal, industrial and small private lands.

> Committee Determination: No warning warranted; recommend as an area of concern (Figures 34 & 35).

Western Spruce Budworm: This landscape contains a significant amount of Douglas-fir and true fir stands that are suitable host areas for western spruce budworm (WSBW). Approximately 57% of the Douglas-fir component is closed canopy. Defoliation from WSBW is widespread and is predicted to continue in 2012 based on high pheromone trap counts. All landowners have been impacted by the defoliation (state, federal, industrial and small private). There is a significant amount of interface between Douglas-fir stands and CWPP priority treatment areas in this landscape. No large-scale landowner collaborative exists, which may constrain efficacy on federal lands. However, little of the host area is affected by reserve designations.

> Committee Determination: ***Warning Warranted*** (Figures 32 & 33).

Sub-Landscape 2: East Okanogan and West Ferry County (Between Hwy 97 and Hwy 21)

Mountain Pine Beetle-Lodgepole Pine: Extent of lodgepole pine suitable host area is limited. Lodgepole pine stands in this landscape are currently experiencing low levels of damage from mountain pine beetle. Susceptible lodgepole pine stands primarily exist on the Colville Reservation and US Forest Service land. There is a limited amount of interface between

lodgepole pine stands and CWPP priority treatment areas in this landscape. A significant portion of the suitable host area on US Forest Service land is reserved, limiting management options.

> Committee Determination: No warning warranted. Criteria for likelihood of spread to other ownerships and "presence" of an outbreak are not satisfied, and efficacy potential is low.

Mountain Pine Beetle-Ponderosa Pine: This landscape contains a significant amount of ponderosa pine stands that are suitable habitat for mountain pine beetle. There is also extensive moderate departure from the historical reference vegetation conditions. Mortality from bark beetles in ponderosa pine is best characterized as light and there have been no major outbreaks. The vast majority of ponderosa pine suitable host area is confined to the Colville Reservation so there is a low likelihood of spread to multiple ownerships. The Colville Reservation has implemented extensive silvicultural treatments in ponderosa pine suitable host areas.

> Committee Determination: No warning warranted; recommend as an area of concern (Figures 34 and 35).

Western Spruce Budworm: This landscape contains a significant amount of Douglas-fir and true fir stands that are suitable habitat for western spruce budworm (WSBW). Over 50% of the Douglas-fir component is closed canopy. Defoliation from WSBW is widespread and is predicted to continue in 2012 based on high trap counts. All landowners have been impacted by the defoliation (state, federal, industrial and small private). There is a significant amount of interface between budworm susceptible Douglas-fir stands and CWPP priority treatment areas in this landscape. A portion of the landscape is in a landowner collaborative.

> Committee Determination: ***Warning Warranted*** (Figures 32 and 33).

Sub-Landscape 3: East Ferry County (Between Hwy 21 and Columbia River/Hwy 395)

Mountain Pine Beetle-Lodgepole Pine: This landscape contains a significant amount of lodgepole pine stands that are suitable host area for the mountain pine beetle. However, most of the lodgepole pine stands in the host area are not departed from the historical reference vegetation conditions. This area has recently experienced moderate intensity lodgepole pine mortality in isolated pockets. With the extensive amount of suitable host area there is some potential for an uncharacteristic outbreak to occur if the population trend increases. Susceptible lodgepole pine stands exist wholly on US Forest Service land north of Highway 20, and on the Colville Reservation and US Forest Service land south of Highway 20. There is a limited amount of interface between lodgepole pine stands and CWPP priority treatment areas in this landscape. A significant proportion of susceptible lodgepole pine stands – substantially all suitable host from Profanity Peak south to the Colville Reservation boundary on US Forest Service land – are reserve areas. Much of this landscape is designated as a US Forest Service Collaborative Forest Landscape Restoration (CFLR) area.

> Committee Determination: No warning warranted. Criteria for likelihood of spread to other ownerships and "presence" of an uncharacteristic outbreak are not satisfied, and efficacy potential is low.

Mountain Pine Beetle-Ponderosa Pine: This landscape contains a significant amount of ponderosa pine stands that are suitable habitat for mountain pine beetle. There is also extensive moderate departure from the historical reference vegetation conditions. The southern portion of this area has recently experienced moderate amounts of ponderosa pine mortality and with the extensive amount of suitable host area there is high potential for an uncharacteristic outbreak to occur. Susceptible ponderosa pine stands primarily exist on the Colville Reservation and US Forest Service land. There is a limited amount of interface between ponderosa pine stands and CWPP priority treatment areas in this landscape. There have been extensive silvicultural treatments implemented on the Colville Reservation. Much of this landscape is designated as a US Forest Service Collaborative Forest Landscape Restoration (CFLR) area.

> Committee Determination: No warning warranted; recommend as an area of concern (Figures 34 & 35).

Western Spruce Budworm: This landscape contains a significant amount of Douglas-fir and true fir stands that are suitable habitat for western spruce budworm (WSBW). 50% to 60% of the Douglas-fir component is closed canopy. There have been low levels of recent WSBW defoliation, however, high trap counts predict there will be a large increase in defoliation in portions of this area in 2012. The extensive amount of suitable host area leads to a high potential for an uncharacteristic budworm outbreak over the next few years. . Suitable host areas for WSBW exist on all ownerships in the landscape including tribal, state, federal and private lands so the potential for spread to multiple ownerships is high. Much of this landscape is designated as a US Forest Service Collaborative Forest Landscape Restoration (CFLR) area. There is a significant amount of interface between budworm susceptible Douglas-fir stands and CWPP priority treatment areas in this landscape.

> Committee Determination: No warning warranted; recommend as an area of concern (Figures 34 & 35).

Sub-Landscape 4: Klickitat and Yakima County

Mountain Pine Beetle-Lodgepole Pine: This landscape contains a moderate amount of lodgepole pine stands that are suitable host areas for mountain pine beetle. From 2006 to 2009, portions of this landscape experienced moderate to heavy lodgepole pine mortality from mountain pine beetle. However, 2010 and 2011 saw a major reduction in the amount of lodgepole pine acreage damaged by mountain pine beetle. The vast majority of susceptible lodgepole pine stands occur on the Yakama Reservation and some on DNR land so the potential for damage to spread to multiple ownerships is low. There is very limited interface between lodgepole pine stands and CWPP priority treatment areas in this landscape. Both the Yakama Reservation and DNR have recently implemented significant silvicultural treatments to reduce lodgepole pine stand susceptibility. Some of the susceptible lodgepole pine stands in the western portion of the Yakama Reservation near Mt. Adams are in reserve status greatly limiting management options and DNR is subject to the Habitat Conservation Plan for spotted owl in the area as well.

> Committee Determination: No warning warranted.

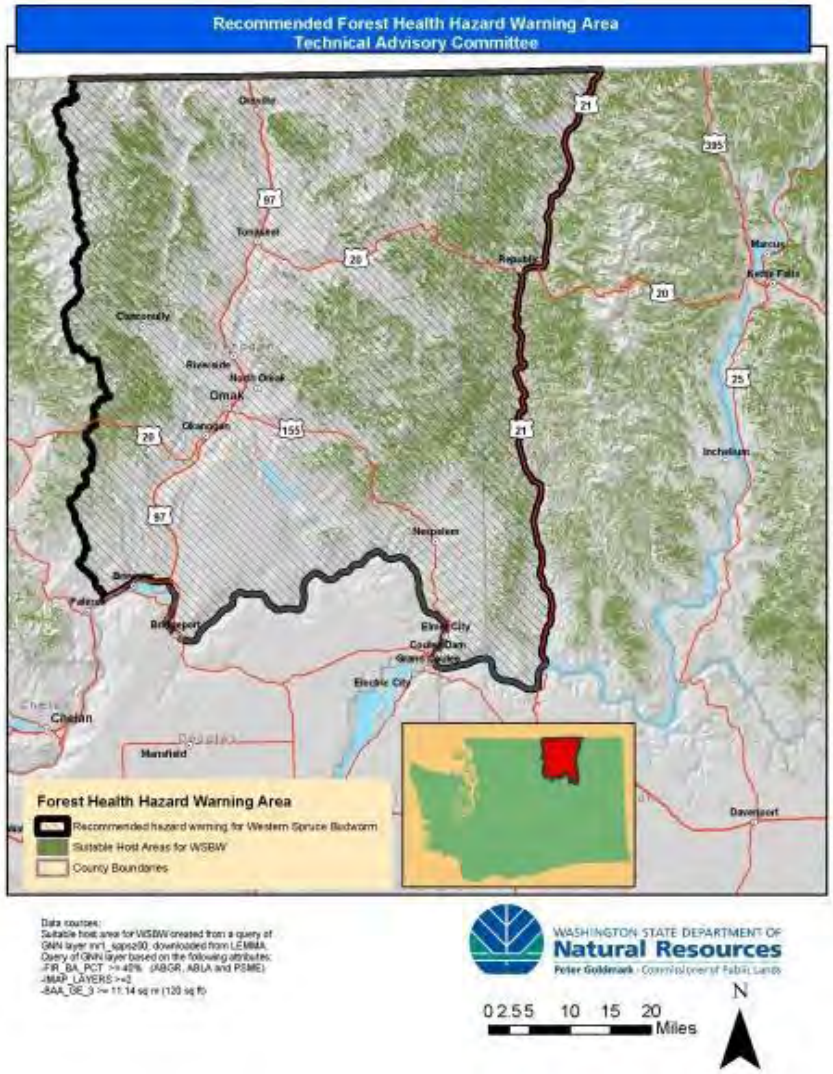
Mountain Pine Beetle-Ponderosa Pine: This landscape contains a significant amount of ponderosa pine stands that are suitable habitat for pine bark beetles. There is also extensive

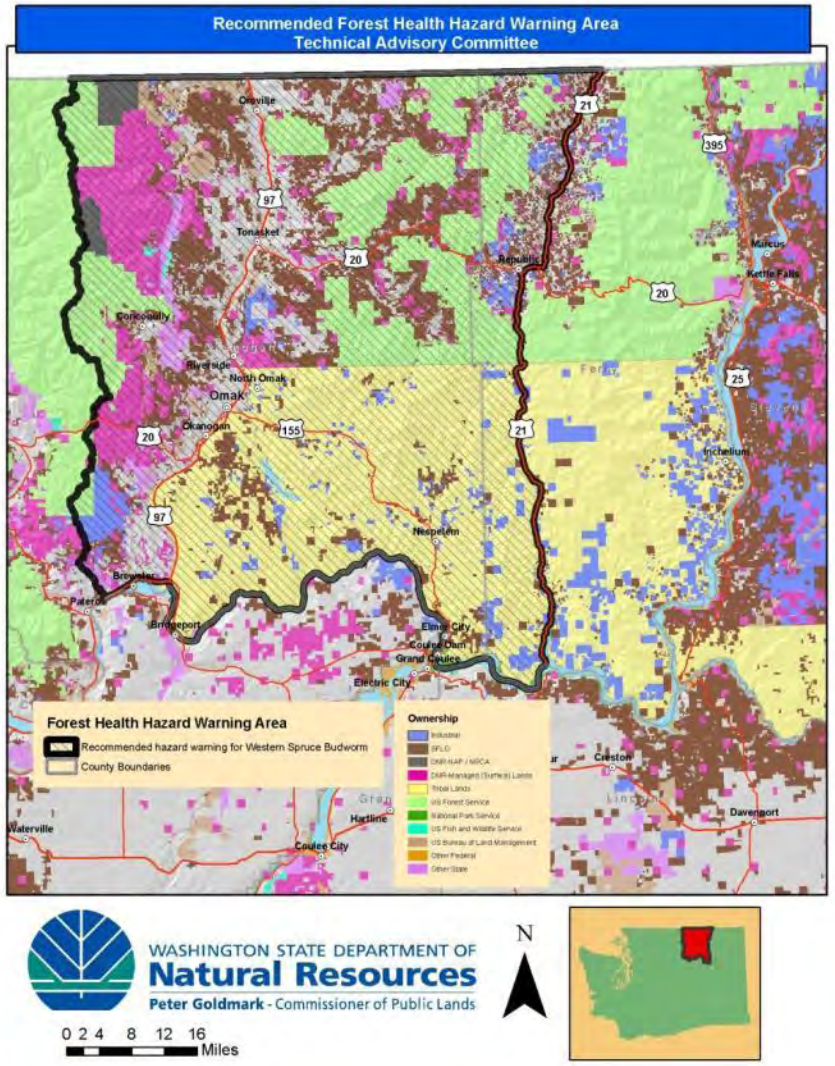
moderate/high departure from the historical reference vegetation conditions. There have been light to moderate areas of ponderosa pine mortality in this landscape from 2006 to 2011, however, like lodgepole pine, the acreage of damage greatly decreased in 2010 and 2011. Susceptible ponderosa pine stands exist on all ownerships in the landscape including tribal, state, federal and private lands so the potential for spread to multiple ownerships is high. There is a limited amount of interface between ponderosa pine stands and CWPP priority treatment areas in this landscape. The Yakama Reservation has recently implemented significant silvicultural treatments in ponderosa pine stands. DNR is subject to the Habitat Conservation Plan for spotted owl in the area.

Committee Determination: No warning warranted; recommend as an area of concern (Figures 36 and 37).

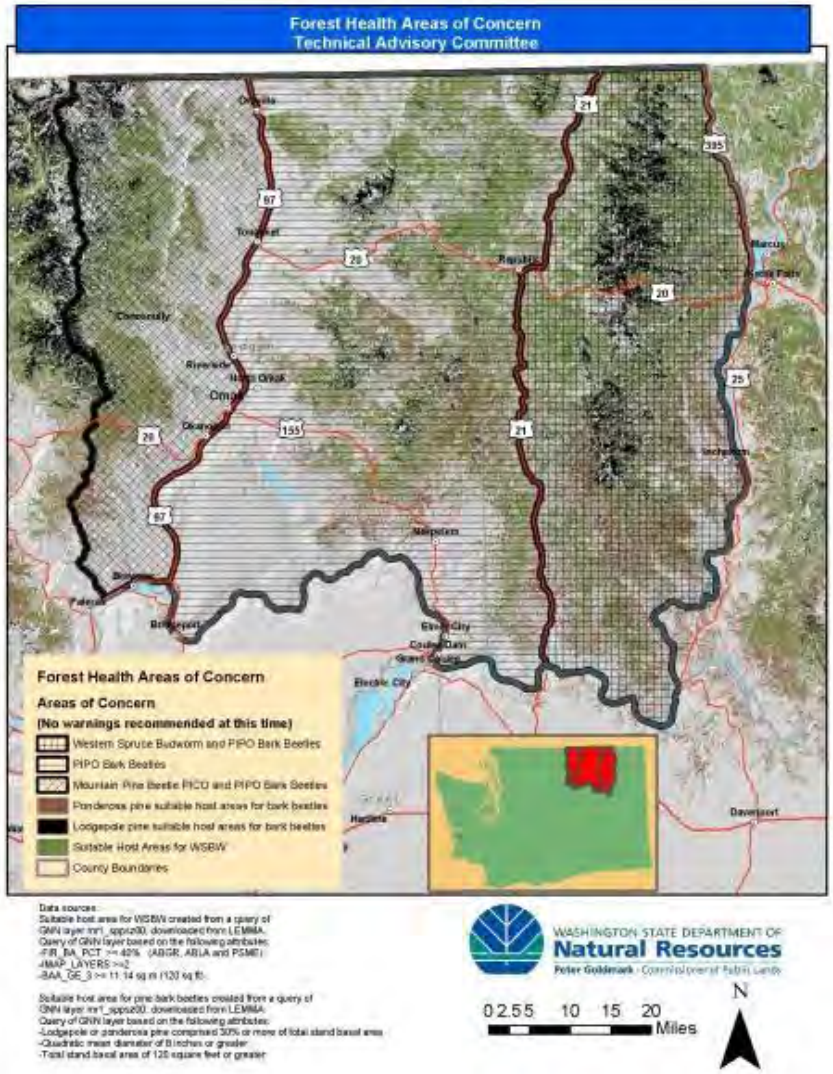
Western Spruce Budworm: This landscape contains a significant amount of Douglas-fir and true fir stands that are suitable habitat for western spruce budworm (WSBW). Current WSBW defoliation is light and very limited in extent . There have been extensive WSBW outbreaks historically in this landscape. Suitable host areas for WSBW exist on all ownerships in the landscape including tribal, state, federal and private lands so the potential for spread to multiple ownerships is high. There is a limited amount of interface between WSBW suitable host areas and CWPP priority treatment areas. DNR is subject to the Habitat Conservation Plan for spotted owl in the area.

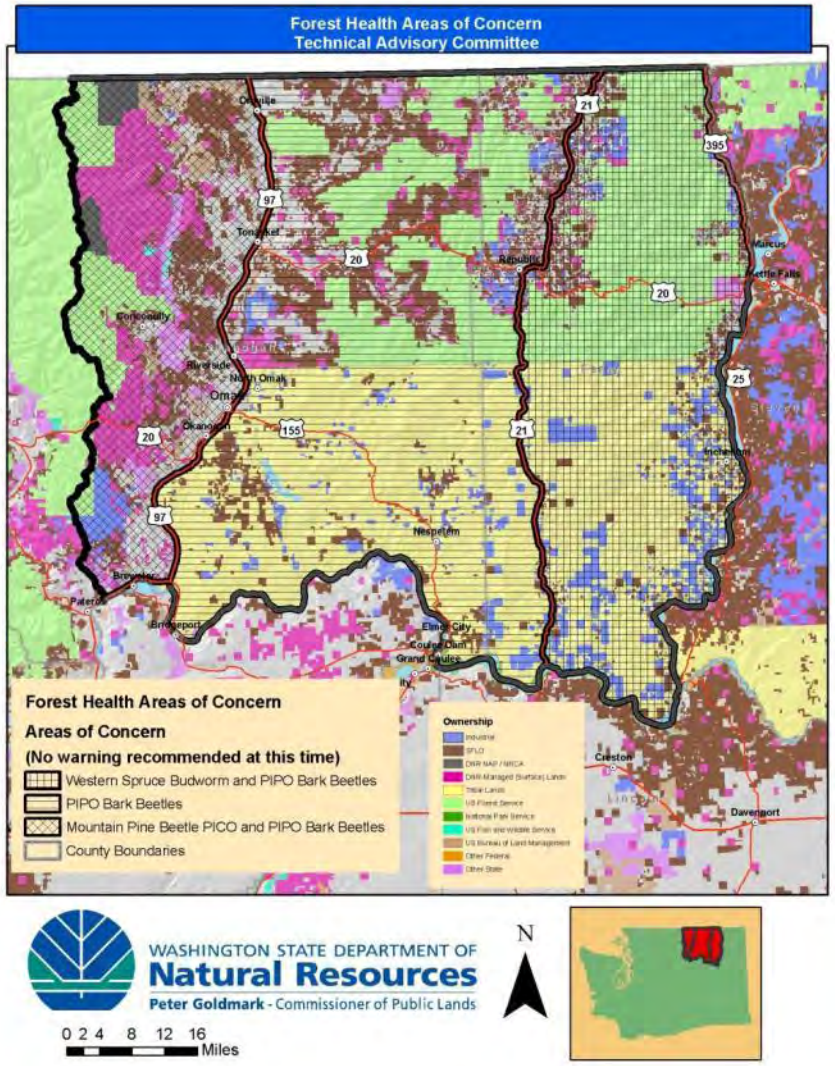
Committee Determination: No warning warranted.



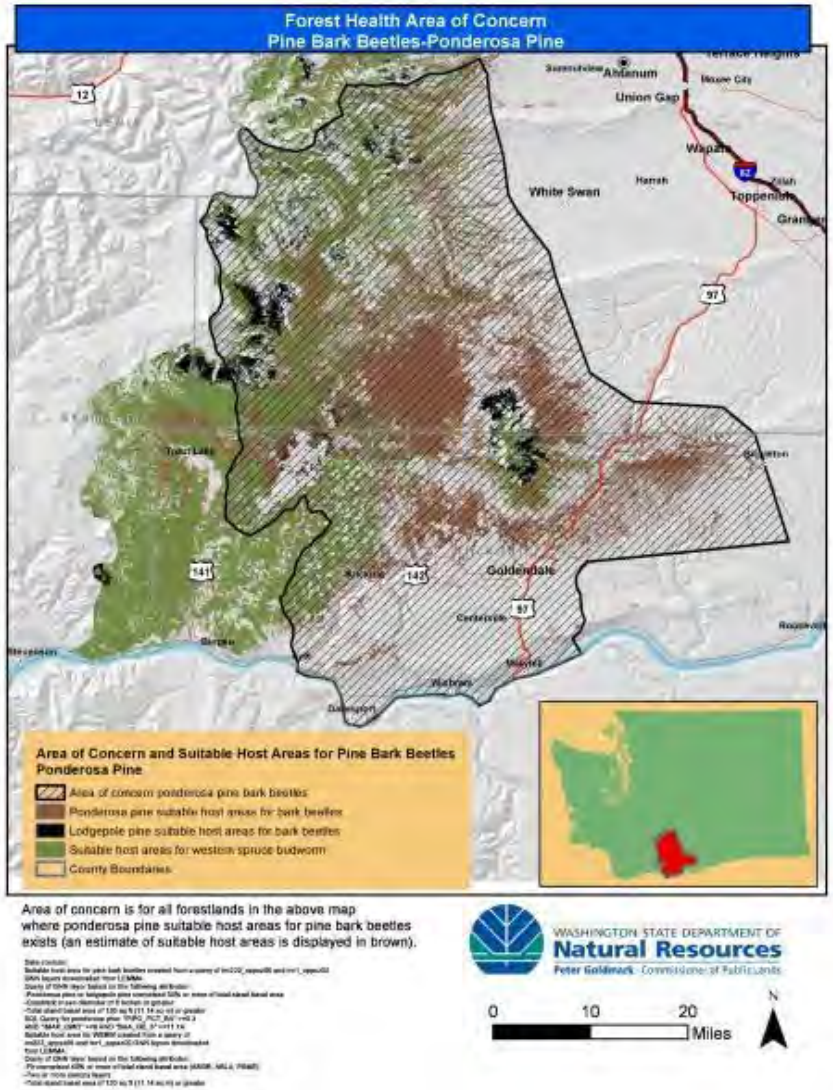


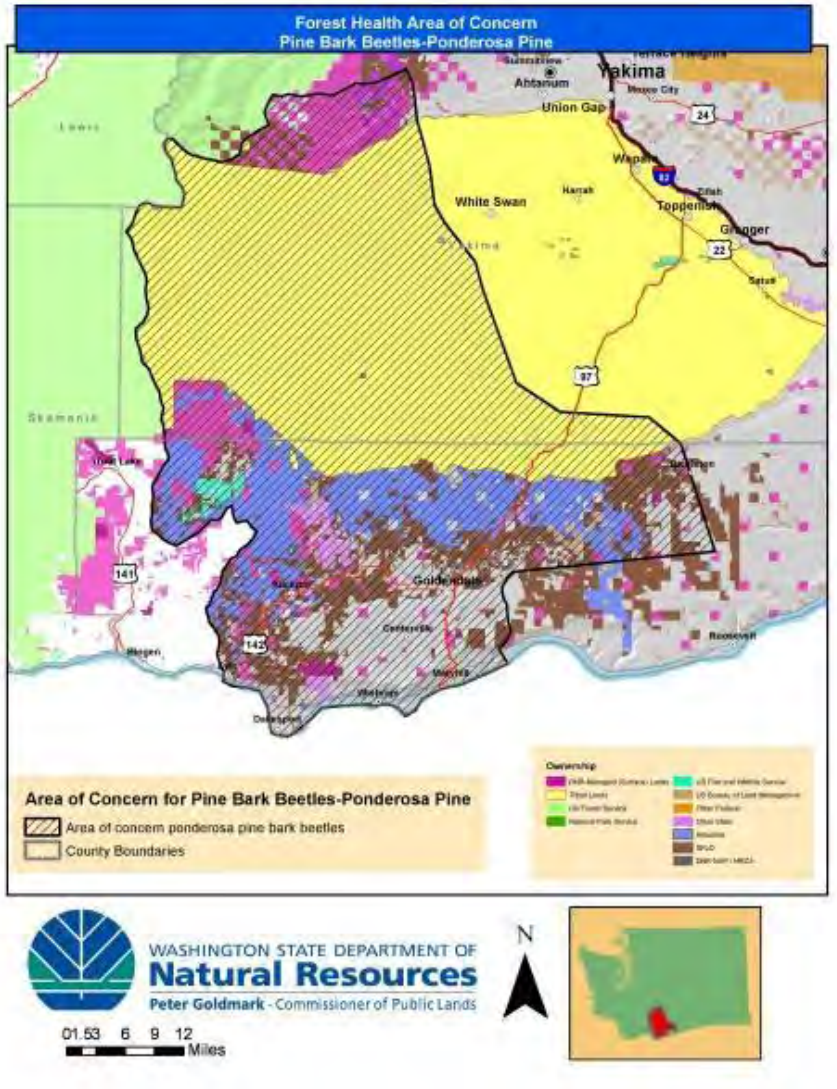
Figures 32 and 33. Forest health hazard warning for western spruce budworm in East Okanogan/West Ferry County.





Figures 34 and 35. Areas of concern for forest health damage agents in Eastern Okanogan and Ferry County.





Figures 36 and 37. Area of concern for pine bark beetles-ponderosa pine in Klickitat and Yakima County.

2.2.3 Management Recommendations

The TAC developed recommended actions to respond to the proposed warning area for western spruce budworm in Okanogan and Ferry County, as well as a number of areas of concern related to other insects. These recommendations were formulated to address forest conditions at the landscape scale (i.e., the range of forest conditions across the warning area) and the stand scale (i.e., site-specific actions that can be taken to reduce hazards).

Stand scale recommendations are relatively straightforward actions, documented in scientific literature, which professional foresters can routinely assist landowners in carrying out. However, the choice of stand scale actions is entirely dependent on landowner objectives, the options afforded by the existing condition of the forest, and often, economic considerations. Furthermore, from a forest management and ecological perspective, applying the same recommended action to every suitable host acre within the warning and areas of concern would be neither practicable nor desirable.

Thus, a broad landscape scale objective was needed to complement and guide stand scale actions. The development of landscape scale recommendations was designed to quantify:

- the characteristics of a forest that would be more resilient to insect damage;
- the amount of work that may be necessary to move from current conditions to more resilient conditions;
- a basis for monitoring the long-term success of actions under a warning or area of concern.

This required comparing existing forest conditions against some benchmark condition that would be less susceptible to widespread damage. Many of the factors that render current forest conditions susceptible to severe damage can be traced to past management decisions, successful suppression of low-intensity wildfires, and other changes in forest composition and structure that have occurred in the last century. The Vegetation Condition Class information utilized in the coarse- and fine-scale analysis is based on a comparison of current forest conditions with historical reference conditions. These data were therefore used to form the basis of landscape scale recommendations.

Landscape Recommendation Development

The TAC established landscape scale goals to improve forest health for the warning area by analyzing current vegetation conditions in comparison to historical reference conditions. According to LANDFIRE: "The Biophysical Settings (BpS) layer represents the vegetation that may have been dominant on the landscape prior to Euro-American settlement and is based on both the current biophysical environment and an approximation of the historical disturbance regime." To develop landscape scale goals, current succession classes (SCLASS) for each major conifer biophysical setting (BpS) were compared to the historical reference condition of succession classes for each major conifer BpS model in the warning area. Please see Appendix B for a complete description of BpS models used to create landscape goals.

Biophysical Settings (BpS). Figures 38, 39.

a. Source:LANDFIRE Project, a joint venture of the US Forest Service and the US Department of the Interior. http://www.landfire.gov/NationalProductDescriptions20.php
b. Utility: BpS represents the vegetation that may have been dominant on the landscape prior to Euro-American settlement and is based on both the current biophysical environment and an approximation of the historical disturbance regime. Biophysical settings serve as the best representation of historical, pre-European, forest conditions.

Succession Class (SCLASS). Figures 40, 41.

a. Source:LANDFIRE Project, a joint venture of the US Forest Service and the US Department of the Interior. http://www.landfire.gov/NationalProductDescriptions17.php
b. Utility: SCLASS characterizes current vegetation conditions with respect to the vegetation species composition, cover, and height ranges of successional states that occur within each biophysical setting.

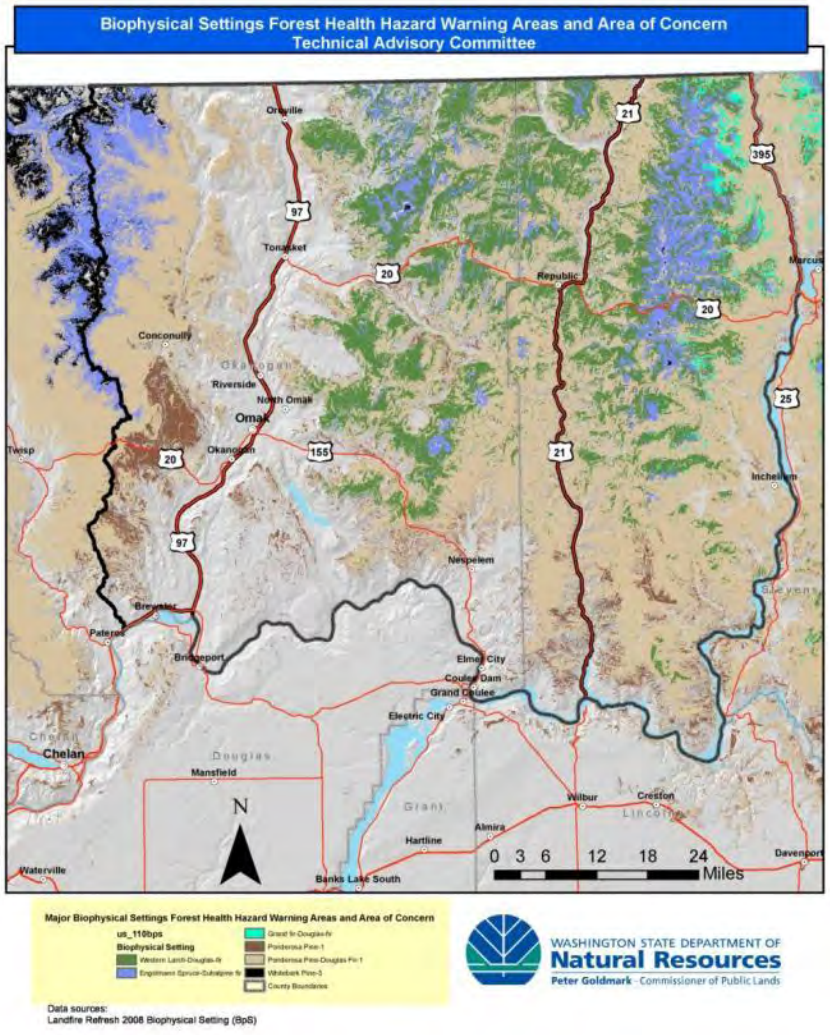


Figure 38. Major forest Biophysical Settings (BpS) East Okanogan and Ferry County

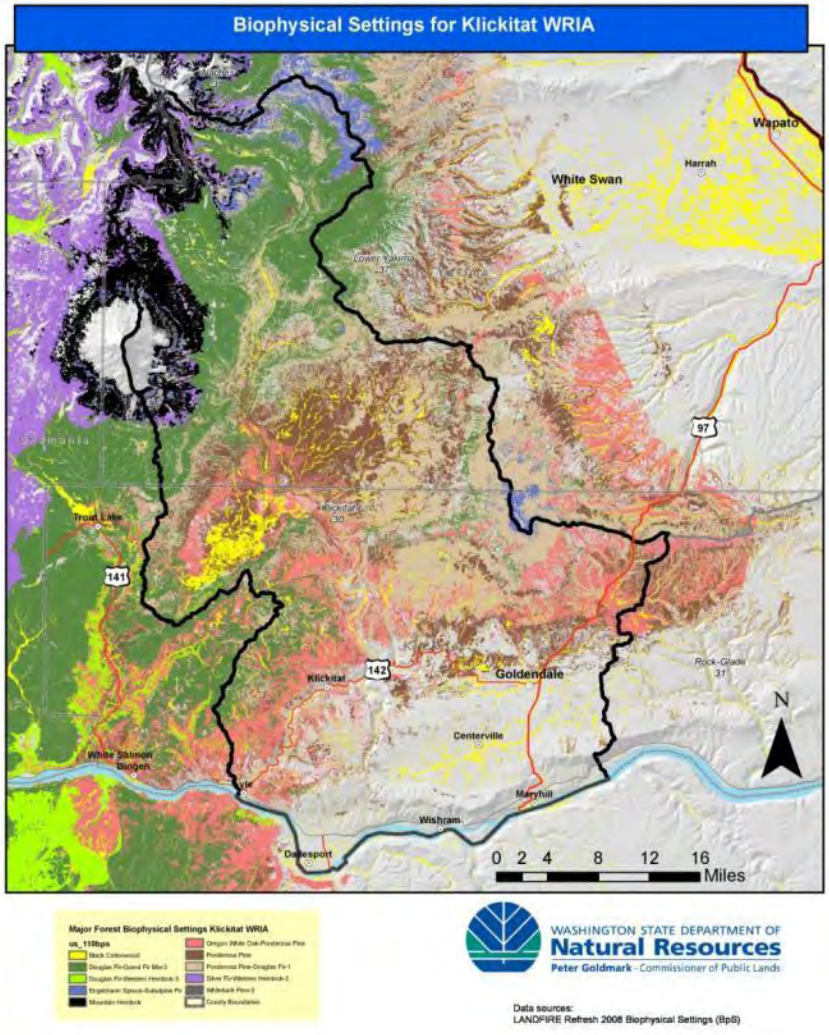


Figure 39. Major forest Biophysical Settings (BpS) in Klickitat Landscape.

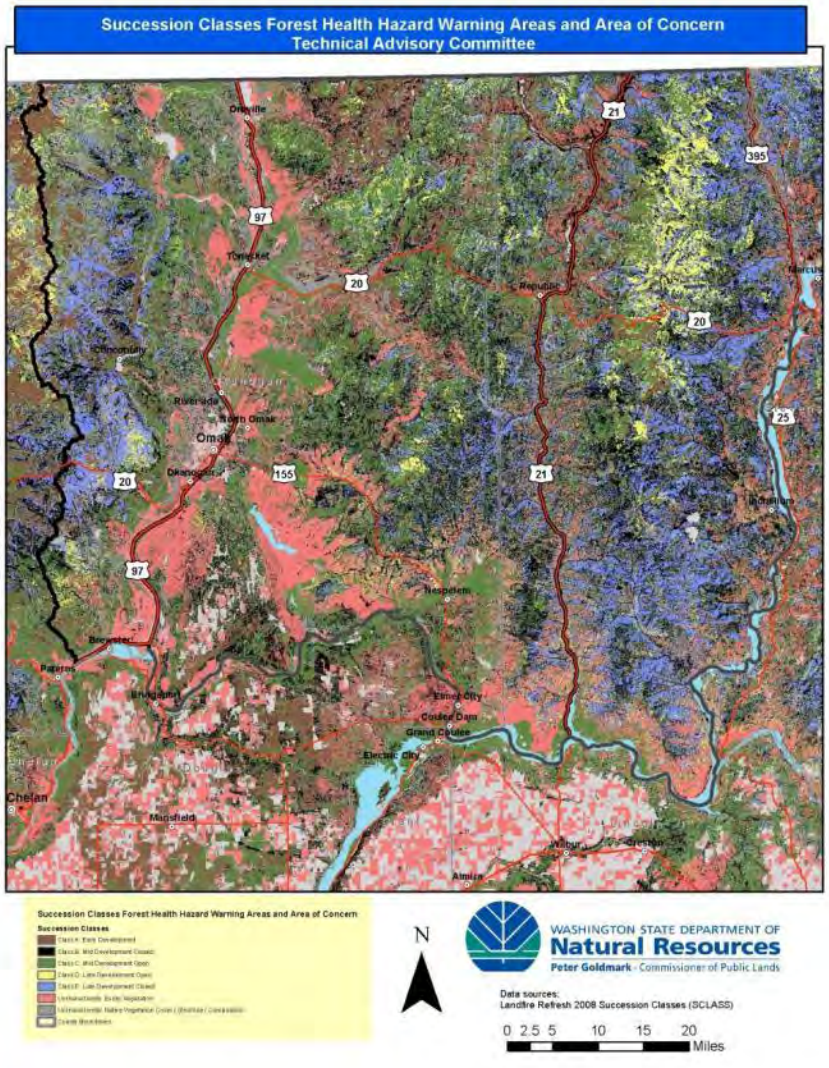


Figure 40. Distribution of Succession Classes East Okanogan and Ferry County

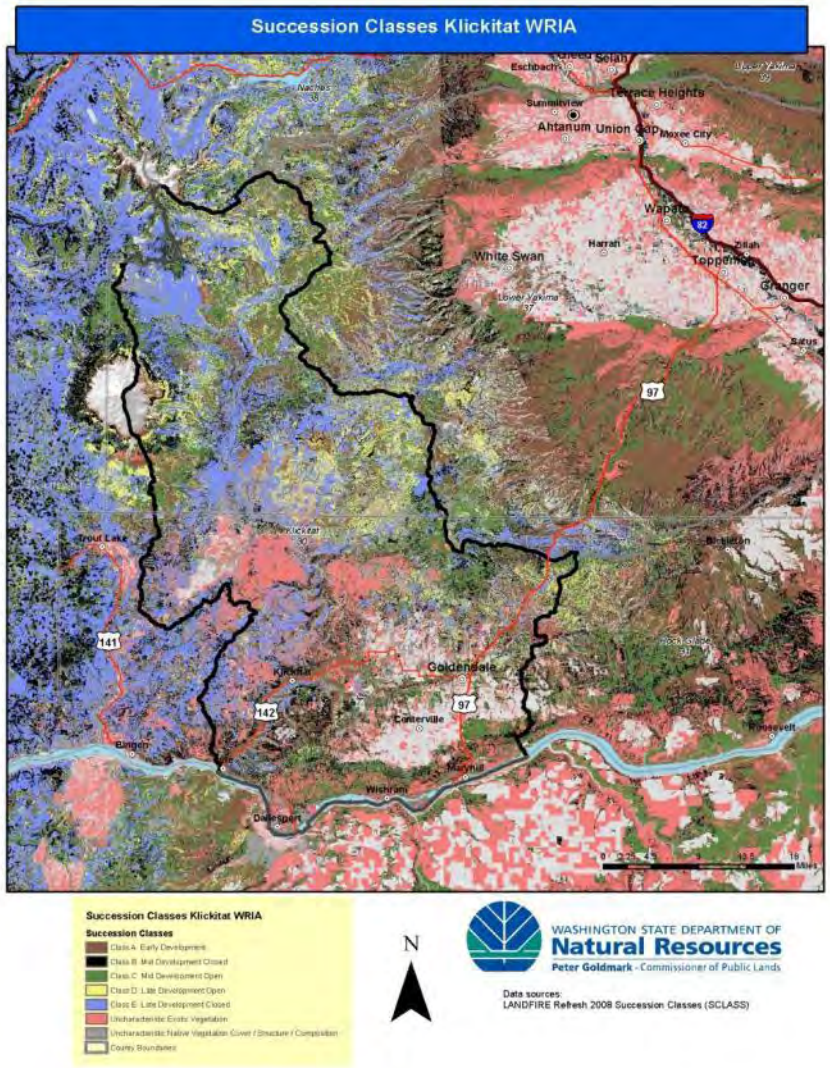


Figure 41. Distribution of Succession Classes in Klickitat Landscape.

Table 10: Summary of succession classes for major forest biophysical settings in the East Okanogan and West Ferry County western spruce budworm forest health hazard warning area.

BpS Group Name (136)	**Western Larch-Douglas-Fir-3**		
Succession Class	**Acres**	**Current Condition Landscape Percentage**	**Reference Condition Landscape Percentage**
A (Early Development)	51,718	16.31%	10.00%
B (Mid Development Closed)	28,964	9.13%	15.00%
C (Mid Development Open)	175,486	55.34%	25.00%
D (Late Development Open)	26,088	8.23%	30.00%
E (Late Development Closed)	34,835	10.99%	20.00%
Total	317,091	BpS Source Model 1010452	

BpS Group Name (265)	**Douglas-Fir-Ninebark-3**		
Succession Class	**Acres**	**Current Condition Landscape Percentage**	**Reference Condition Landscape Percentage**
A (Early Development)	531	15.57%	10.00%
B (Mid Development Closed)	2	0.05%	10.00%
C (Mid Development Open)	13	0.39%	10.00%
D (Late Development Open)	1,518	44.50%	50.00%
E (Late Development Closed)	1,347	39.49%	20.00%
Total	3,412	BpS Source Model 2111660	

BpS Group Name (136)	**Western Larch-Douglas-Fir-3**		
Succession Class	**Canopy Cover**	**Size Class**	**Height**
A (Early Development)	0 to 100%	Sapling <5" DBH	0 to 5.0m
B (Mid Development Closed)	41% to 100%	Medium 9-21" DBH	5.1m to 25m
C (Mid Development Open)	0% to 40%	None	5.1m to 25m
D (Late Development Open)	0% to 40%	None	25.1m to 50m
E (Late Development Closed)	41% to 100%	None	25.1m to 50m

BpS Group Name (265)	**Douglas-Fir-Ninebark-3**		
Succession Class	**Canopy Cover**	**Size Class**	**Height**
A (Early Development)	0 to 100%	Sapling <5" DBH	0 to 5 m
B (Mid Development Closed)	41% to 100%	Pole 5-9" DBH	5.1m to 10m
C (Mid Development Open)	21% to 40%	Pole 5-9" DBH	5.1m to 10m
D (Late Development Open)	21% to 40%	Large 21-33" DBH	10.1m to 50m
E (Late Development Closed)	41% to 100%	Large 21-33" DBH	10.1m to 50m

BpS Group Name (150)	**Ponderosa Pine-1**		
Succession Class	**Acres**	**Current Condition Landscape Percentage**	**Reference Condition Landscape Percentage**
A (Early Development)	29,361	25.21%	5.00%
B (Mid Development Closed)	1,491	1.28%	15.00%
C (Mid Development Open)	3,619	3.11%	15.00%
D (Late Development Open)	45,154	38.76%	55.00%
E (Late Development Closed)	36,858	31.64%	10.00%
Total	116,484	BpS Source Model 2910540	

BpS Group Name (135)	**Ponderosa Pine-Douglas-Fir-1**		
Succession Class	**Acres**	**Current Condition Landscape Percentage**	**Reference Condition Landscape Percentage**
A (Early Development)	98,003	16.66%	10.00%
B (Mid Development Closed)	165,017	28.05%	5.00%
C (Mid Development Open)	185,801	31.59%	30.00%
D (Late Development Open)	16,802	2.86%	45.00%
E (Late Development Closed)	122,604	20.84%	10.00%
Total	588,227	BpS Source Model 0910450	

BpS Group Name (150)	**Ponderosa Pine-1**		
Succession Class	**Canopy Cover**	**Size Class**	**Height**
A (Early Development)	0 to 60%	Seedling	0 to 3.0m
B (Mid Development Closed)	51% to 100%	Pole 5-9" DBH	0 to 10m
C (Mid Development Open)	0% to 50%	Pole 5-9" DBH	0 to 10m
D (Late Development Open)	0% to 50%	Large 21-33" DBH	10.1m to 25m
E (Late Development Closed)	51% to 100%	Large 21-33" DBH	10.1m to 25m

BpS Group Name (135)	**Ponderosa Pine-Douglas-Fir-1**		
Succession Class	**Canopy Cover**	**Size Class**	**Height**
A (Early Development)	0 to 20%	Sapling <5" DBH	0 to 5.0m
B (Mid Development Closed)	41% to 100%	Medium 9-21" DBH	5.1m to 25m
C (Mid Development Open)	11% to 40%	Medium 9-21" DBH	5.1m to 25m
D (Late Development Open)	11% to 40%	Very Large > 33" DBH	25.1m to 50m
E (Late Development Closed)	41% to 100%	Very Large > 33" DBH	25.1m to 50m

Table 10 (cont'd): Summary of succession classes for major forest biophysical settings in the East Okanogan and West Ferry County western spruce budworm forest health hazard warning area.

BpS Group Name (151)	Engelmann Spruce-Subalpine Fir-3		
Succession Class	**Acres**	**Current Condition Landscape Percentage**	**Reference Condition Landscape Percentage**
A (Early Development)	5,476	18.10%	15.00%
B (Mid Development All Structures)	33	0.11%	35.00%
C (Late Development 1 Closed)	21,675	71.64%	20.00%
D (Late Development 2 Closed)	3,071	10.15%	30.00%
Total	30,256	BpS Source Model 2010550	

BpS Group Name (154)	Engelmann Spruce-Subalpine Fir-Menziesia-3		
Succession Class	**Acres**	**Current Condition Landscape Percentage**	**Reference Condition Landscape Percentage**
A (Early Development)	2,909	25.58%	20.00%
B (Mid Development All Structs.)	632	5.55%	10.00%
C (Mid Development All Structs.)	21	0.18%	40.00%
D (Late Development 1 All Structs.)	3,864	33.98%	25.00%
E (Late Development 2 All Structs.)	3,946	34.70%	5.00%
Total	11,371	BpS Source Model 0110560	

BpS Group Name (151)	Engelmann Spruce-Subalpine Fir-3		
Succession Class	**Canopy Cover**	**Size Class**	**Height**
A (Early Development)	0 to 100%	Sapling <5" DBH	0 to 5 m
B (Mid Development All Structures)	21% to 100%	Pole 5-9" DBH	5.1m to 10m
C (Late Development 1 Closed)	21% to 100%	Medium 9-21" DBH	10.1m to 25m
D (Late Development 2 Closed)	21% to 100%	Large 21-33" DBH	5.1m to 25m

BpS Group Name (154)	Engelmann Spruce-Subalpine Fir-Menziesia-3		
Succession Class	**Canopy Cover**	**Size Class**	**Height**
A (Early Development)	0 to 100%	Sapling <5" DBH	0 to 3.0m
B (Mid Development 2 All Structs.)	0 to 100%	Medium 5-15" DBH	5.1m to 25m
C (Mid Development 1 All Structs.)	0 to 100%	Pole 5-9" DBH	5.1m to 10m
D (Late Development 1 All Structs.)	0 to 100%	Medium 9-21" DBH	10.1m to 25m
E (Late Development 2 All Structs.)	0 to 100%	Very Large>33" DBH	25.1m to 50m

BpS Group Name (153)	Engelmann Spruce-Subalpine Fir-4		
Succession Class	**Acres**	**Current Condition Landscape Percentage**	**Reference Condition Landscape Percentage**
A (Early Development)	652	18.58%	15.00%
B (Mid Development Closed)	0	0.00%	35.00%
C (Mid Development Open)	42	1.18%	10.00%
D (Late Development Open)	1,269	36.14%	10.00%
E (Late Development Closed)	1,549	44.10%	30.00%
Total	3,511	BpS Source Model 2910550	

BpS Group Name (155)	Engelmann Spruce-Subalpine Fir-Menziesia-4		
Succession Class	**Acres**	**Current Condition Landscape Percentage**	**Reference Condition Landscape Percentage**
A (Early Development)	10,695	23.55%	15.00%
B (Mid Development Closed)	21	0.05%	30.00%
C (Mid Development Open)	12,342	27.18%	10.00%
D (Late Development Closed)	22,352	49.22%	45.00%
Total	45,410	BpS Source Model 1910560	

BpS Group Name (153)	Engelmann Spruce-Subalpine Fir-4		
Succession Class	**Canopy Cover**	**Size Class**	**Height**
A (Early Development)	0 to 100%	Seedling	0 to 5m
B (Mid Development Closed)	41% to 100%	Sapling <5" DBH	5.1m to 10m
C (Mid Development Open)	0 to 40%	Pole 5-9" DBH	5.1m to 10m
D (Late Development Open)	0 to 40%	Medium 9-21" DBH	10.1m to 25m
E (Late Development Closed)	41% to 100%	Pole 5-9" DBH	10.1m to 25m

BpS Group Name (155)	Engelmann Spruce-Subalpine Fir-Menziesia-4		
Succession Class	**Canopy Cover**	**Size Class**	**Height**
A (Early Development)	0 to 100%	Sapling <5" DBH	0 to 5m
B (Mid Development Closed)	41% to 100%	Pole 5-9" DBH	5.1m to 10m
C (Mid Development Open)	0 to 40%	Pole 5-9" DBH	5.1m to 50m
D (Late Development Closed)	41% to 100%	Large 21-33" DBH	10.1m to 50m

Table 11. Comparison of current forest condition with historical reference conditions, East Okanogan/ West Ferry Proposed Warning Area for western spruce budworm

	Forest Biophysical Setting					
	Ponderosa Pine-Douglas-fir			Western Larch-Douglas-fir		
Succession Class	**Current Acres**	**Current Percent**	**Ref. Condition Percent**	**Current Acres**	**Current Percent**	**Ref. Condition Percent**
Early Development	98,003	17%	**10%**	51,718	16%	**10%**
Mid Development Closed	165,017	28%	**5%**	28,964	9%	**15%**
Mid Development Open	185,801	32%	**30%**	175,486	55%	**25%**
Late Development Closed	122,604	21%	**10%**	34,835	11%	**20%**
Late Development Open	16,802	3%	**45%**	26,088	8%	**30%**
Total	**588,227**			**317,091**		

Table 12. Comparison of current forest condition with historical reference conditions, East Ferry County Area of Concern for western spruce budworm

	Forest Biophysical Setting					
	Ponderosa Pine-Douglas-fir			Western Larch-Douglas-fir		
Succession Class	**Current Acres**	**Current Percent**	**Ref. Condition Percent**	**Current Acres**	**Current Percent**	**Ref. Condition Percent**
Early Development	34,393	7%	10%	15,789	8%	10%
Mid Development Closed	145,400	31%	5%	35,328	19%	15%
Mid Development Open	113,912	25%	30%	73,535	39%	25%
Late Development Closed	157,543	34%	10%	49,443	26%	20%
Late Development Open	13,736	3%	45%	14,199	8%	30%
Total	**464,984**			**188,295**		

Table 13. East Okanogan and Ferry County area of concern comparison of current forest conditions with historical reference conditions in ponderosa pine biophysical setting.

Succession Class	**Current Acres**	**Current Percent**	**Ref. Condition Percent**
Early Development	34,209	23%	**5%**
Mid Development Closed	1,628	1%	**15%**
Mid Development Open	3,882	3%	**15%**
Late Development Closed	49,973	33%	**10%**
Late Development Open	60,226	40%	**55%**
Total	**149,918**		

Table 14. Klickitat, Lower Yakima and Rock Glade WRIAs area of concern comparison of current forest conditions with historical reference conditions in ponderosa pine biophysical setting.

Succession Class	**Current Acres**	**Current Percent**	**Ref. Condition Percent**
Early Development	21,544	13%	**5%**
Mid Development Closed	6,813	4%	**15%**
Mid Development Open	5,949	4%	**15%**
Late Development Closed	61,285	38%	**10%**
Late Development Open	65,633	41%	**55%**
Total	**161,224**		

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Appendix A

Coarse Scale Analysis of Forest Health Priority Areas

Landscape Ranking Tables (Watershed Resource Inventory Areas, WRIAs)

Table 1. Summation of five ranking iterations, top 5 WRIAs became priority landscapes.

WRIA	Name	# Top Rnk
30	Klickitat	12
49	Okanogan	6
58	Middle Lake Roosevelt	6
60	Kettle	5
51/52	Nespelem-Sanpoil	4
48	Methow	4
59	Colville	4
45	Wenatchee	3
54	Lower Spokane	3
37	Lower Yakima	2
62	Pend Oreille	1
32/35	Walla M. Snake	0
38	Naches	0
39/40	Up-Yak-Alk-Squilch	0
46/47	Entiat-Chelan	0

Table 2. Composite absolute rank by unreserved acres.

WRIA	Name	Score
30	Klickitat	17
51/52	Nespelem-Sanpoil	17
58	Middle Lake Roosevelt	16
49	Okanogan	15
60	Kettle	15
48	Methow	13
59	Colville	13
62	Pend Oreille	13
45	Wenatchee	10
55/6/7	Little-Mid-Spoke-Hang	10
39/40	Up-Yak-Alk-Squilch	9.5
37	Lower Yakima	9.5
61	Upper Lake Roosevelt	9
38	Naches	7.5
54	Lower Spokane	7
46/47	Entiat-Chelan	6.5
32/35	Walla M. Snake	5.5

Table 3. Composite absolute rank by total acres.

WRIA	Name	Score
48	Methow	18
30	Klickitat	17
45	Wenatchee	15
49	Okanogan	15
60	Kettle	14
58	Middle Lake Roosevelt	14
39/40	Up-Yak-Alk-Squilch	13
51/52	Nespelem-Sanpoil	12
38	Naches	12
46/47	Entiat-Chelan	11.5
59	Colville	10
62	Pend Oreille	10
37	Lower Yakima	7.5
32/35	Walla M. Snake	7
55/6/7	Little-Mid-Spoke-Hang	6.5
61	Upper Lake Roosevelt	6.5
54	Lower Spokane	4.5

"Composite" ratings reflect 4, 2, 1 ranking coefficients for all four variables.

Table 4: Composite area weighted rank by unreserved acres.

WRIA	Name	Score
30	Klickitat	17
60	Kettle	15
49	Okanogan	15
37	Lower Yakima	14
51/52	Nespelem-Sanpoil	14
58	Middle Lake Roosevelt	14
54	Lower Spokane	13
59	Colville	13
48	Methow	11
55/6/7	Little-Mid-Spoke-Hang	10
45	Wenatchee	10
38	Naches	10
39/40	Up-Yak-Alk-Squilch	10
61	Upper Lake Roosevelt	9
62	Pend Oreille	8
46/47	Entiat-Chelan	7
32/35	Walla M. Snake	6

Table 5. Composite area weighted rank by total acres.

WRIA	Name	Score
30	Klickitat	15
60	Kettle	14
49	Okanogan	13.5
48	Methow	13.5
54	Lower Spokane	13
59	Colville	13
37	Lower Yakima	12.5
38	Naches	12
46/47	Entiat-Chelan	11.5
51/52	Nespelem-Sanpoil	11
39/40	Up-Yak-Alk-Squilch	11
32/35	Walla M. Snake	11
55/6/7	Little-Mid-Spoke-Hang	10
45	Wenatchee	10
58	Middle Lake Roosevelt	9
61	Upper Lake Roosevelt	8
62	Pend Oreille	5.5

"Composite" ratings reflect 4, 2, 1 ranking coefficients for all four variables

Table 6. Mortality absolute rank by unreserved acres.

WRIA	Name	Score
30	Klickitat	15
58	Middle Lake Roosevelt	15
51/52	Nespelem-Sanpoil	13
59	Colville	12
62	Pend Oreille	12
49	Okanogan	11
60	Kettle	11
48	Methow	9
55/6/7	Little-Mid-Spoke-Hang	8
61	Upper Lake Roosevelt	8
37	Lower Yakima	7.5
45	Wenatchee	6
54	Lower Spokane	6
39/40	Up-Yak-Alk-Squilch	5.5
38	Naches	5.5
46/47	Entiat-Chelan	4.5
32/35	Walla M. Snake	3.5

Table 7. Mortality absolute rank by total acres.

WRIA	Name	Score
30	Klickitat	15
48	Methow	14
58	Middle Lake Roosevelt	13
49	Okanogan	11
45	Wenatchee	11
51/52	Nespelem-Sanpoil	10
60	Kettle	10
38	Naches	10
59	Colville	9
62	Pend Oreille	9
39/40	Up-Yak-Alk-Squilch	9
46/47	Entiat-Chelan	7.5
61	Upper Lake Roosevelt	5.5
37	Lower Yakima	5.5
32/35	Walla M. Snake	5
55/6/7	Little-Mid-Spoke-Hang	4.5
54	Lower Spokane	3.5

"Mortality" ratings reflect 4, 2, 1 ranking coefficients for all variables, eliminating the rating points for defoliation

Table 8. Mortality area weight rank by unreserved acres.

WRIA	Name	Score
30	Klickitat	15
58	Middle Lake Roosevelt	13
37	Lower Yakima	12
54	Lower Spokane	12
59	Colville	12
60	Kettle	11
49	Okanogan	11
51/52	Nespelem-Sanpoil	10
55/6/7	Little-Mid-Spoke-Hang	8
61	Upper Lake Roosevelt	8
38	Naches	8
62	Pend Oreille	7
48	Methow	7
45	Wenatchee	6
39/40	Up-Yak-Alk-Squilch	6
46/47	Entiat-Chelan	5
32/35	Walla M. Snake	4

Table 9. Mortality area weight rank by total acres.

WRIA	Name	Score
30	Klickitat	13
54	Lower Spokane	12
59	Colville	12
37	Lower Yakima	10.5
60	Kettle	10
38	Naches	10
49	Okanogan	9.5
48	Methow	9.5
51/52	Nespelem-Sanpoil	9
32/35	Walla M. Snake	9
58	Middle Lake Roosevelt	8
55/6/7	Little-Mid-Spoke-Hang	8
46/47	Entiat-Chelan	7.5
61	Upper Lake Roosevelt	7
39/40	Up-Yak-Alk-Squilch	7
45	Wenatchee	6
62	Pend Oreille	4.5

"Mortality" ratings reflect 4, 2, 1 ranking coefficients for all variables, eliminating the rating points for defoliation.

Table 10. Defoliation absolute rank by unreserved acres.

WRIA	Name	Score
30	Klickitat	15
58	Middle Lake Roosevelt	15
51/52	Nespelem-Sanpoil	13
59	Colville	12
62	Pend Oreille	12
49	Okanogan	11
60	Kettle	11
48	Methow	9
61	Upper Lake Roosevelt	8
55/6/7	Little-Mid-Spoke-Hang	8
37	Lower Yakima	7.5
45	Wenatchee	6
54	Lower Spokane	6
38	Naches	5.5
39/40	Up-Yak-Alk-Squilch	5.5
46/47	Entiat-Chelan	4.5
32/35	Walla M. Snake	3.5

Table 11. Defoliation absolute rank by total acres.

WRIA	Name	Score
30	Klickitat	15
48	Methow	14
58	Middle Lake Roosevelt	13
49	Okanogan	11
45	Wenatchee	11
51/52	Nespelem-Sanpoil	10
60	Kettle	10
38	Naches	10
59	Colville	9
62	Pend Oreille	9
39/40	Up-Yak-Alk-Squilch	9
46/47	Entiat-Chelan	7.5
61	Upper Lake Roosevelt	5.5
37	Lower Yakima	5.5
32/35	Walla M. Snake	5
55/6/7	Little-Mid-Spoke-Hang	4.5
54	Lower Spokane	3.5

"Defoliation" ratings reflect 4, 2, 1, ranking coefficients for all variables, eliminating the rating points for mortality

Table 12. Defoliation area weight rank by unreserved acres.

WRIA	Name	Score
60	Kettle	13
30	Klickitat	13
51/52	Nespelem-Sanpoil	13
54	Lower Spokane	11
59	Colville	11
49	Okanogan	11
37	Lower Yakima	10
58	Middle Lake Roosevelt	10
55/6/7	Little-Mid-Spoke-Hang	9
45	Wenatchee	9
39/40	Up-Yak-Alk-Squilch	9
61	Upper Lake Roosevelt	7
48	Methow	7
62	Pend Oreille	6
38	Naches	6
32/35	Walla M. Snake	5
46/47	Entiat-Chelan	5

Table 13. Defoliation area weight rank by total acres.

WRIA	Name	Score
60	Kettle	12
30	Klickitat	11
54	Lower Spokane	11
59	Colville	11
51/52	Nespelem-Sanpoil	10
32/35	Walla M. Snake	10
39/40	Up-Yak-Alk-Squilch	10
49	Okanogan	9.5
48	Methow	9.5
55/6/7	Little-Mid-Spoke-Hang	9
45	Wenatchee	9
37	Lower Yakima	8.5
38	Naches	8
46/47	Entiat-Chelan	7.5
58	Middle Lake Roosevelt	7
61	Upper Lake Roosevelt	6
62	Pend Oreille	3.5

"Defoliation" ratings reflect 4, 2, 1, ranking coefficients for all variables, eliminating the rating points for mortality

Appendix B

Biophysical Setting (BpS) Model Descriptions

This appendix includes all biophysical setting (BpS) model descriptions that the TAC used to create landscape level targets for the warning area and area of concerns.

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. Gen. Tech. Rep. RMRS-GTR-87. Fort Collins, CO: USDA Forest Service, Rocky Mountain Research Station. 41 pp. + CD.

Steele, R., S.V. Cooper, D.M. Ondov, D.W. Roberts and R.D. Pfister. 1983. Forest habitat types of eastern Idaho and western Wyoming. Gen. Tech. Rep. INT-144. Ogden, UT: USDA Forest Service, Intermountain Mountain Research Station. 122 pp.

Tande, G.F. 1979. Fire history and vegetation pattern of coniferous forests in Jasper National Park, Alberta. Canadian Journal of Botany 57: 1912-1931.

USDA Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (2002, December). Fire Effects Information System, [Online]. Available: http://www.fs.fed.us/database/feis/ [Accessed 5/22/03].

Wadleigh, L. and M.J. Jenkins. 1996. Fire frequency and the vegetative mosaic of a spruce-fir forest in northern Utah. Great Basin Naturalist 56: 28-37.

Williams, C.K., B.F. Kelley, B.G. Smith and T.R. Lillybridge. 1995. Forest plant associations of the Colville National Forest. Gen. Tech. Rep. PNW-GTR-360. Portland, OR: USDA Forest Service, Pacific Northwest Research Station. 375 pp.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

LANDFIRE Biophysical Setting Model

Biophysical Setting **2910540** **Southern Rocky Mountain Ponderosa Pine Woodland**

☐ *This BPS is lumped with:*
☐ *This BPS is split into multiple models:*

General Information

Contributors (also see the Comments field) **Date** 6/13/2006

Modeler 1	Cody Wienk	cody_wienk@nps.gov	**Reviewer**	Peter Brown	pmb@rmtrr.org
Modeler 2	Jeff DiBenedetto	jdibenedetto@fs.fed.us	**Reviewer**	Deanna Reyher	dreyher@fs.fed.us
Modeler 3	Chris Thomas	cthomas@fs.fed.us	**Reviewer**	Bill Schaupp	bschaupp@fs.fed.us

Vegetation Type
Forest and Woodland

Map Zone
29

Model Zone
☐ Alaska ☑ N-Cent.Rockies
☐ California ☐ Pacific Northwest
☐ Great Basin ☐ South Central
☐ Great Lakes ☐ Southeast
☐ Northeast ☐ S. Appalachians
☐ Northern Plains ☐ Southwest

Dominant Species*

PIPO	JUCO6
PRVI	MARE11
ROWO	TORY
ORAS	ARUV

General Model Sources
☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range
This type would be in MZ 29, 30 and 20. In MZ29, sections M331I, M331B and 342A; subection 342Fb. . It also occurs in Bighorns in WY. This is the ponderosa pine woodland that is in the Rocky Mountain range. In WY, it is basically found in the Laramie and Bighorn Ranges and west.

Biophysical Site Description
North and northeast aspect slopes outside of Laramie Peak (section M331). Soils range from sandy loams to loams (Hansen and Hoffman 1988). The underlying substrate would be predominantly sedimentary. Elevation would be at approximately 3000-4000ft.

This BpS is found on all aspects of Laramie Peak above ponderosa pine savanna (BpS 1117) (generally 4000-6000ft), predominately on the lower limestone plateau and material weathered from metamorphic rocks. This type is generally on sites with sandy loam to clayey loam soils.

Vegetation Description
Ponderosa pine, chokecherry, Saskatoon serviceberry, aspen, Ribes species, rose species, hawthorn, Oregon grape, raspberry, littleseed ricegrass, Canada wildrye, needlegrasses, sideoats grama, sedges, common juniper and poison ivy are common.

Plant communities for Laramie Peak:
1) Pinus ponderosa/Arctostaphylos uva-ursi with Mahonia repens, Rosa woodsii and Symphoricarpos albus; 2) Pinus ponderosa/Carex rossii with Purshia tridentata; and 3) Pinus ponderosa/Carex geyeri with Arctostaphylos uva-ursi, Mahonia repens and Juniperus communis.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100-year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement sev

Disturbance Description

Generally frequent fire return interval with surface fire. The presence of abundant fire-scarred trees in multi-aged stands supports a prevailing historical model for ponderosa pine forests in which recurrent surface fires affected heterogeneous forest structure (Brown 2006). Mixed severity fire occurs if fire return intervals are missed, and stand replacement fire is infrequent. Some speculate that stand replacing fire in the Black Hills is less frequent than outside. The Black Hills stand replacement frequency is thought to be approximately 300yrs+. Some speculate that the stand replacement frequency outside the Black Hills is thought to be approximately 150-200yrs (and is thought to be as such for the Laramie Peak area). With the Native American influence outside of the Black Hills, the replacement fire interval could be even more frequent than the 300yr interval. However, due to lack of evidence for a different interval outside of the Black Hills, the 300yr interval was chosen for this model and supported by review.

Laramie Peak area is subject several different weather patterns maybe tied to the El Niño/Southern Oscillation (ENSO). Sometimes it gets its weather from the southwest –eg, like AZ monsoons, other years it gets its weather from the Northern Great Plains –colder dryer, then some years it gets its weather from the Southern Great Plains influenced by the Gulf of Mexico. Also Laramie Peak area has more elevation differences and topographic effects because of its steepness. Forest Service Region 2 considers ponderosa pine on Laramie Peak area to be more similar to Colorado Front Range ponderosa pine which doesn't prune branches as readily nor get as big as fast as Black Hills ponderosa pine.

There is considerable debate over the role of mixed severity and surface fires in the historical range of variability in this and other ponderosa pine forests in the northern and central Rockies (Baker and Ehle 2001, 2003, Barrett 2004, Veblen et al. 2000).

Brown (in press) argues that surface fire was dominant mode of disturbance.

Snead (2005) reported a MFRI of 4-42yrs on northern side of Ashland Ranger District; on southern 4-63.

Precipitation is concentrated in April through June, but occurs throughout the growing season, resulting in good pine regeneration and dense patches of saplings. Elk, and to a lesser extent, bison, were important ungulates. Windthrow, storm damage and mountain pine beetles were important disturbances in this type, especially when stands reached high densities, as evidenced in mountain pine beetle outbreaks occuring from 2000 through present and still increasing. USDA Forest Service 2006 map.

The Laramie Peak had a mountain pine beetle outbreak in ponderosa pine in the early 90s followed by some large fires that were stand replacing in areas - now there is not much activity.

Insect/disease disturbance occurs, but unsure of frequency. It was modeled at a very infrequent rate. Frequency could be related to density; therefore, modeled in the late closed and open stages. For additional information on insects in the Black Hills see the Phase II Amendment (USDA Forest Service 2005).

Disturbance from mountain pine beetles was frequent locally and rare area-wide. Current research indicates highest probability of infestation occurs in areas with trees denser than 120 sq ft per acre (possibly 100) and averaging seven inches DBH or greater.

The occurrence of area wide mountain pine beetles epidemics is dependent on favorable weather and abundant food supplies in the form of adjacent susceptible areas.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100-year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement sev

Adjacency or Identification Concerns

This type occurs at elevations above ponderosa pine savanna. This type differs from Northwestern Great Plains Highland Spruce Woodland and Ponderosa Pine- Black Hills (BpS 2910480) because it has been documented to have more frequent surface fires, less frequent replacement fires and less closed canopy forest. (Brown 2003)

This system could be difficult to distinguish from 1117, Ponderosa Pine Savanna. They will be adjacent to each other. It could also be adjacent to grassland and shrubland systems/associated with prairie systems. It might also be adjacent to and intermingled with green ash/woody draw systems. And at the lowest margins grassland invasion has occurred. Distinguishing features can be found by aspect (see Biophysical Site Description).

This system will be difficult to distinguish from Northwestern Great Plains-Black Hills Ponderosa Pine Woodland and Savanna - Low Elevation Woodland (1179); it is only distinguished by geography.

Currently, there have probably been at least five fire cycles that have been missed due to suppression, grazing, etc. (In the Laramie Peak area, however, there have been numerous wildfires since the 1990s, so this claim cannot be made for that area.) Therefore, the system today would look much more like the late closed stage with approximately 70-90% canopy closure. Increased ladder fuel as a result of missed fire cycles increases the probability of a stand replacement fire.

Expansion into grasslands both at prairie margins and into interior meadows; timber harvest and removal of larger size classes from all areas; stand infilling and thickening due to fire exclusion.

The absence of dwarf mistletoe also distinguishes this ponderosa pine system from most others in the country.

This model for 1054 for MZ29 seems to differ slightly from 1054 in MZ20 (adjacent mapzone), due to distinctness of Black Hills ponderosa pine (which was originally modeled for 291054). However, in general, overall FRI similar with mostly low severity fires. And general amounts in the successional classes are similar, with similar cover/height distinctions. Some of the other disturbance probabilities differ, due to more information provided in literature for MZ29.

In this system, as in many others, non-native grass species may be providing different surface fire effects. For example, litter produced by Kentucky bluegrass, Japanese brome, and downy brome is much finer and has different characteristics for burning, insulation and moisture retention. This would change the effects of fires, even if they occurred at historic frequencies. The most likely change is in composition of surface vegetation, although longer term effects to the soil may also occur.

Native Uncharacteristic Conditions

The Laramie Peak area has numerous areas where canopy closure will never get above 40% and other areas where canopy closure will never get above 60%. There is so much rock that ponderosa pine grows in "flower pots" between the rocks.

Scale Description

Disturbance patch size probably ranged from 10s-10,000s of acres.

Outside of the Black Hills and Missouri Breaks, this BpS would have been 10s-1000ac.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100 year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement sev

Issues/Problems

Comments

This BpS was originally modeled for MZs 29 and 30 including the Black Hills. However, post-model-review-and-delivery, the new BpS, Northwestern Great Plains-Black Hills Ponderosa Pine Woodland and Savanna - Low Elevation Woodland (1179) was created by NatureServe. Therefore, this model 1054 was retained as-is for a portion of MZs 29 and 30, based on geography, and this model 1054 was also copied as-is for a different portion of MZs 29 and 30, based on geography, and used for the Northwestern Great Plains-Black Hills Ponderosa Pine Woodland and Savanna - Low Elevation Woodland (1179) split.

This model for MZs 29 and 30 was adapted from the model from the Rapid Assessment R0PIPObl Ponderosa Pine Woodlands and BH Low Elevation developed by Kelly Pohl, Cody Wienk and Carolyn Sieg. Other modelers for MZs 29 and 30 were Paul Mock, Dave Overcast and Kim Reid. Other reviewers for MZs 29 and 30 were Carolyn Sieg, Gwen Sanchez-Lipp, Kathy Roche and Mary Lata.

RA quantitative model was developed post-workshop by Kelly Pohl with input from Cody Wienk and Carolyn Sieg. Additional input was provided during the workshop by Deanna Reyher, Blaine Cook and Bill Baker and factored into the model development. Because of the model's late development it received no peer review.

Vegetation Classes

Class A **5%**

Early Development 1 All Structure

Upper Layer Lifeform

- ☐ Herbaceous
- ☑ Shrub
- ☐ Tree

Fuel Model

Indicator Species* and Canopy Position	
PRVI	Mid-Upper
AMAL	Mid-Upper
PIPO	Middle
	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	60 %
Height	Shrub 0m	Shrub 3.0m
Tree Size Class	Seedling <4.5ft	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Herbaceous/shrubby post-replacement class, persists 0-15yrs.

Outside of the Black Hills, associated with grass/forb, chokecherry, serviceberry, leadplant, raspberry, rose, Oregon grape, snowberry and currant.

Shrubs are typically greater than one meter but chokecherry can reach heights of over three meters.

This class is generally expected to succeed to a mid-open stage in approximately 15yrs, although without fire for 13yrs or other distubances, it may succeed to a mid-closed stage.

Replacement fire occurs every 300yrs, and low severity fire every 20yrs. (This class was originally modeled with replacement fire occurring every 200yrs and low severity every 30yrs; however, upon review, it was decided and confirmed that those intervals should be changed - based on Brown 2006 and other studies.)

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100 year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement sev

Class B **15 %**

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIPO	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	51 %	100 %
Height	Tree 0m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Pole ponderosa pine (dog hair), generally persists 15-50yrs. (Because Laramie Peak area is so rocky, it rarely gets dog hair ponderosa pine.) Very few understory species present due to canopy closure. This class may succeed to a late closed stage if not affected by fire or insect outbreaks.

Replacement fire occurs every 300yrs, and low severity fire every 20yrs, but causes no transition. (This class was originally modeled with replacement fire occurring every 200yrs and low severity every 30yrs; however, upon review, it was decided and confirmed that those intervals should be changed - based on Brown 2006 and other studies.)

Class C **15 %**

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIPO	Upper
PRVI	Middle
AMAL	Middle
	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	50 %
Height	Tree 0m	Tree 10m
Tree Size Class	Pole 5-9" DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

This class persists 15-50yrs. Surrounding this class are other trees/stands that are over 100yrs old.

Understory species would be similar to those in class A. Snowberry will also become more prevalent.

This class succeeds to a late open stage, although without fire for 25yrs, this class can move to a mid-closed stage.

Replacement fire occurs every 300yrs, low severity fire every 20yrs and mixed fire every 200yrs, but low and mixed do not cause a transition. (This class was originally modeled with replacement fire occurring every 200yrs and low severity every 30yrs; however, upon review, it was decided and confirmed that those intervals should be changed - based on Brown 2006 and other studies.)

Class D **55 %**

Late Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIPO	Upper
PRVI	Middle
AMAL	Middle
	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	50 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Large 21-33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100 year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement sev

Description

Open canopy stand; persists 50yrs+. Patches of dense doghair and 200yrs+ trees persist. Common juniper and rough leaf ricegrass common in Black Hills.

Other understory species same as in class C and A.

In the absence of fire, drought or insect outbreaks for 60yrs, this class may be expected to succeed to a late development closed stage.

Insect/disease outbreaks functioning as minor mortality incidents not causing a transition to another class, can occur every 20yrs (reviewers speculated between 15-25yrs and 30-50yrs). Moderate mortality incidents can cause a transition to a mid-open stage every 100-200yrs (modeled every 250yrs), and catastrophic mortality which causes a change back to an early stage occurs every 200-300yrs (modeled as every 333yrs).

It is thought that class D should occupy approximately 60% of the historical landscape (see figure 3 in Brown and Cook (2006) for some rough numbers, which found that ~60% of the reconstructed historical stands had approximately <20m^2/ha basal area which would probably be late open.)

Replacement fire occurs every 300yrs. Low severity fire occurs every 20yrs but does not cause a transition. (This class was originally modeled with replacement fire occurring every 200yrs and low severity every 30yrs; however, upon review, it was decided and confirmed that those intervals should be changed - based on Brown 2006 and other studies.). Mixed severity fire occurs approximately every 200yrs overall, half the time causing a transition to a mid stage and half the time causing no transition. Mixed severity fires are patchy.

Class E **10 %**

Late Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIPO	Upper
JUCO	Low-Mid

Structure Data (for upper layer lifeform)

	Min	*Max*
Cover	51 %	100 %
Height	Tree 10.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Closed canopy, multi-layer stand, persists 50yrs+. At >70% canopy closure, mountain pine beetle outbreaks occur, opening up the canopy. Insect/disease outbreaks functioning as minor mortality incidents not causing a transition to another class, can occur every 40yrs (reviewers speculated between 15-25yrs and 30-50yrs). Moderate mortality incidents can cause a transition to a late-open stage every 100-200yrs (modeled every 100yrs), and catastrophic mortality which causes a change back to an early stage occurs every 200-300yrs (modeled as every 333yrs).

Understory species the same but fewer numbers. Common or Rocky Mountain juniper might be present with lack of disturbance. Outside of Black Hills, sun sedge and littleseed ricegrass may be present.

Mixed fire occurs approximately every 200yrs, half the time causing a transition to a mid development stage (75% open, 25% closed), and half the time staying within the late development stage (75% open, 25% closed).

Replacement fire occurs every 300yrs, and low severity fire every 20yrs and brings this class to a late open

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stage. (This class was originally modeled with replacement fire occurring every 200yrs and low severity every 30; however, upon review, it was decided and confirmed that those intervals should be changed - based on Brown 2006 and other studies.)

See figure 5 in Brown (2006); closed canopy conditions were probably transient due to regional synchronous recruitment forced by climate (i.e., the distinction between fire history and fire regime).

Disturbances

Fire Regime Group:** I

Historical Fire Size (acres)

Avg
Min 1
Max 100000

Sources of Fire Regime Data

- [x] Literature
- [ ] Local Data
- [ ] Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	300	100	400	0.00333	6
Mixed	270	50	400	0.00370	6
Surface	20	5	50	0.05	88
All Fires	18			0.05704	

Fire Intervals (FI):

Fire interval is expressed in years for each fire severity class and for all types of fir combined (All Fires). Average FI is central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inver of fire interval in years and is used in reference condition modeling. Percent of all fires is the percent of all fires in that severity class.

Additional Disturbances Modeled

- [x] Insects/Disease
- [ ] Native Grazing
- [ ] Other (optional 1)
- [ ] Wind/Weather/Stress
- [ ] Competition
- [ ] Other (optional 2)

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100-year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement sev

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**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100 year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement sev

LANDFIRE Biophysical Setting Model

Biophysical Setting: **0910450** **Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest**

☐ *This BPS is lumped with:*
☐ *This BPS is split into multiple models:*

General Information

Contributors (also see the Comments field) **Date** 10/5/2005

Modeler 1 Mike Simpson	mlsimpson@fs.fed.us	**Reviewer**	Bruce Hostetler	bhostetler@fs.fed.us
Modeler 2 Dave Powell	dcpowell@fs.fed.us	**Reviewer**		
Modeler 3 Rod Clausnitzer	rclausnitzer@fs.fed.us	**Reviewer**		

Vegetation Type
Forest and Woodland

Map Zone
9

Model Zone

☐ Alaska	☐ N-Cent.Rockies
☐ California	☑ Pacific Northwest
☐ Great Basin	☐ South Central
☐ Great Lakes	☐ Southeast
☐ Northeast	☐ S. Appalachians
☐ Northern Plains	☐ Southwest

Dominant Species*

PIPO	CARU
ABGR	SYAL
PSME	SPBE2
CAGE2	

General Model Sources
☑ Literature
☑ Local Data
☑ Expert Estimate

Geographic Range
Modal population is in north-central Rockies (MZ10); also occurs in Blue Mountains OR and WA, Ochoco Mountains OR, Wallowa-Snake province in OR/WA. There may be trickles of this type in the foothills of Yakima and Klickitat county, especially on stream slopes, also in the SE of MZ08 on stream and river canyons in the foothills of the Blues.

Biophysical Site Description
Elevation range in eastside WA about 2000ft to about 6000ft, but most stands occur between 3000-4500ft. This forest type occurs just above ponderosa types on a moisture gradient.

Vegetation Description
Ponderosa pine overstory is typical in fire-maintained stands. Older stands tend to be of large, widely spaced ponderosa pine or Douglas-fir. Early seral forests are often open stands of mostly ponderosa pine. Lack of wildfire causes fill in of understory conifers, mainly ponderosa pine, Douglas-fir and grand fir. Western larch is locally important.

Disturbance Description
Typical disturbance regimes under natural conditions include frequent, low-intensity under-burns that maintain open stands of fire resistant trees. Much more infrequent mixed-severity and stand replacement wildfire occurred and tended to generate mosaics of older, larger trees and younger regeneration. Endemic bark beetles produced patch mortality. Rarer epidemic bark beetle outbreaks caused larger-scale overstory mortality and released understory trees. Defoliator outbreaks also caused fir mortality in some areas. Defoliation by spruce budworm is now more widespread than historically. Root diseases may play a significant role in later seral forests in this environment.

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**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Adjacency or Identification Concerns

This biophysical setting occurs below the more mesic mixed conifer forest types, and often occurs above ponderosa pine forests.

This BpS includes the following plant associations: PSME/elk sedge, PSME/pinegrass, PSME/snowberry, PSME/ninebark and similar types and grand fir (or grand fir-white fir hybrids) with similar associated species. It does not include moister PSME and ABGR types (e.g. PSME/HODI, PSME/ACGL, ABGR/CLUN, ABGR/VAME, ABGR/LIBO and similar moist types). White fir occurs in this type in southeastern OR.

Native Uncharacteristic Conditions

If these late successional classes exceed 50m height, the stand may be the 1047 MCON type.

Scale Description

Dry mixed conifer forests that often occur in large areas (hundreds to thousands of acres) that, due to fire and insect disturbances, often contained mosaics of older, larger trees and smaller trees.

Issues/Problems

Comments

Dave Swanson dswanson@fs.fed.us was another author on this model. This model was modified from Rapid Assessment model R#MCONdy. Review by Miles Hemstrom,Ed Uebler, Bill McArthur and Beth Willhite.

Vegetation Classes

Class A **10%**

Early Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position	
PIPO	Upper
PSME	Upper
LAOC	Upper
CAGE2	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0%	20%
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Open stand of ponderosa pine and other tree seedlings mixed with grasses and shrubs. Early seral dominant species include, ceanothus, scouler willow, Bromus, some sedges and grasses. We use Comp/Maintenance to hold a portion of this class back in an extended shrub-dominated stage. Also, we use AltSucc. without TSD to allow a portion of this type to succeed to class B - mid-closed.

Class B **5%**

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position	
PIPO	Upper
PSME	Mid-Upper
LAOC	Mid-Upper
ABGR	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	41%	100%
Height	Tree 5.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Closed stands of 5-20in DBH early seral tree species. Forests in this type rarely if ever exceed 80% canopy closure even in closed, dense conditions.

Class C **30 %**

Mid Development 1 Open

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIPO	Upper
PSME	Mid-Upper
LAOC	Mid-Upper
ABGR	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	11 %	40 %
Height	Tree 5.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Open stands of 5-20in DBH early seral tree species. Dominant understory plants include elk sedge, pinegrass, common snowberry, rose, mountain mahogany (wetter), heartleaf arnica and lupines. This class has low probability of replacement fire due to discontinuous fuel in these open stands. A small portion of the class succeeds to class E - late-closed.

Class D **45 %**

Late Development 1 Open

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model

Indicator Species* and Canopy Position

PIPO	Upper
PSME	Mid-Upper
LAOC	Mid-Upper
ABGR	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	11 %	40 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	Very Large >33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Open stands of 20in+ DBH early seral tree species. Dominant understory plants include elk sedge, pinegrass, common snowberry, rose, mountain mahogany (wetter), heartleaf arnica and lupines.

Class E **10 %**

Late Development 1 Closed

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model 8

Indicator Species* and Canopy Position

PIPO	Upper
PSME	Upper
ABGR	Mid-Upper
LAOC	Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	41 %	100 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	Very Large >33"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Closed stands of 20in+ DBH early seral tree species. Forests in this PNVG rarely if ever exceed 80% canopy closure even in closed, dense conditions. This class has relatively high probability of replacement fires, due to the dense understory, though it is less than the probability of replacement fire in the mid-closed.

Disturbances

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Fire Regime Group:** I

Historical Fire Size (acres)

Avg 1000
Min
Max

Sources of Fire Regime Data

- ☑ Literature
- ☑ Local Data
- ☑ Expert Estimate

Additional Disturbances Modeled

- ☑ Insects/Disease
- ☑ Wind/Weather/Stress
- ☐ Native Grazing
- ☑ Competition
- ☐ Other (optional 1)
- ☐ Other (optional 2)

Fire Intervals	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	135	70	200	0.00741	15
Mixed	110	70	175	0.00909	18
Surface	30	20	35	0.03333	67
All Fires	20			0.04983	

Fire Intervals (FI):

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inverse of fire interval in years and is used in reference condition modeling. Percent of all fires is the percent of all fires in that severity class.

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**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

LANDFIRE Biophysical Setting Model

Biophysical Setting: **1010452** **Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest - Larch**

☐ *This BPS is lumped with:*

☑ *This BPS is split into multiple models: This BpS is split into three types based on dominance: one dominated by ponderosa pine with Douglas-fir; one dominated by western larch; and one dominated by grand fir.*

General Information

Contributors (also see the Comments field) **Date** 11/18/2005

Modeler 1 Cathy Stewart	cstewart@fs.fed.us	**Reviewer** Steve Barrett	sbarrett@mtdig.net
Modeler 2 Rolan Becker	rolanb@cskt.org	**Reviewer** Catherine Phillips	cgphillips@fs.fed.us
Modeler 3 Dan Leavell	dleavell@fs.fed.us	**Reviewer** Steve Rawlings	srawlings@fs.fed.us

Vegetation Type

Forest and Woodland

Map Zone

10

Model Zone

☐ Alaska ☑ N-Cent.Rockies
☐ California ☐ Pacific Northwest
☐ Great Basin ☐ South Central
☐ Great Lakes ☐ Southeast
☐ Northeast ☐ S. Appalachians
☐ Northern Plains ☐ Southwest

Dominant Species*

LAOC
PICO
PSME
ABLA

General Model Sources

☑ Literature
☐ Local Data
☑ Expert Estimate

Geographic Range

Western MT and northern ID, west of the Continental Divide.

Biophysical Site Description

Montane and lower subalpine zones, approximately 3000-6000ft primarily on north-facing aspects west of the Continental Divide. Lower subalpine sites typically occur as relatively moist subalpine fir habitat types.

Vegetation Description

Western larch occurs on more mesic/northerly Douglas-fir habitat types and more moist, productive subalpine fir habitat types. Larch is mixed in with seral Douglas-fir, lodgepole pine or some ponderosa pine in the overstory. At lower elevations within this BpS, lodgepole pine can be the dominant seral species and will persist in areas where the fire return intervals are <~80yrs (Williams et al. 1995, observation of White Mountain 1988 fire area in the Colville National Forest). Longer fire intervals promote the development of Engelmann spruce and subalpine fir stands. Mountain pine beetles often reduce the lodgepole pine component, possibly promoting mixed severity fires and inclusions of stand-replacing fires.

Understory species include: Vaccinium globulare, Clintonia uniflora, Menziesia ferruginia, Linnea borealis, Alnus sinuata and Physocarpus malvaceus.

Disturbance Description

Fire Regime Group III, with a mean fire return interval of approximately 40yrs. The fire regime is dominated by mixed severity fire, with more rare replacement fire and occasional small, patchy surface fires.

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Mountain pine beetle will reduce canopy cover of lodgepole pine. Mistletoe may affect western larch stands, but is not included in the quantitative model.

Adjacency or Identification Concerns

The mixed conifer zone in the Northern Rockies is broad, and represents a moisture gradient that affects fire regimes and species dominance. The Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland system was thus split into three BpS to represent differences in species dominance and fire regimes. 10451 represents the drier sites and is dominated by ponderosa pine and Douglas-fir with a very frequent, low severity fire regime. 10452 is dominated by western larch and represents slightly more mesic sites. The fire regime is dominated by moderately frequent, mixed severity fires. 10453 is dominated by grand fir and represents more mesic, cool sites with longer mixed severity fire regimes.

This system equates with Pfister et al. (1977) moist Douglas-fir, subalpine fir and mesic grand fir habitat types: ABLA/CLUN, all phases, ABLA/LIBO, ABLA/MEFE, ABGR/CLUN, PSME/PHMA, PSME/VAGL and PSME/LIBO (PSME habitat types apply only to MT, not to ID).

Native Uncharacteristic Conditions

Scale Description

Scale can be in small patches of 50ac but generally is hundreds to thousands of acres (due to stand replacing fires requiring dry conditions or being wind driven).

Issues/Problems

Comments

Additional author was Ed Lieser (elieser@fs.fed.us). Dan Leavell and Cathy Steward provided additional post-workshop review of this model.

This model was originally conceived for the BpS "Northern Rocky Mountain Western Larch Woodland" and was revised slightly to be a split within the Dry-Mesic Mixed Conifer BpS (Pohl 11/18/2005).

Peer review of this model resulted in minor changes to the model description and the VDDT model. Reviewers agreed that mean fire return intervals should be more frequent (from 60yrs to 40yrs) with the inclusion of more frequent mixed severity fire. Two reviewers agreed that surface fire should be included at a low probability. The results of these changes was less class E, more class D and a more frequent MFI.

Based on the Rapid Assessment model R0WLLPDF, developed by Cathy Stewart (cstewart@fs.fed.us) and reviewed by Steve Barrett (sbarrett@mtdig.net).

For the Rapid Assessment, review comments incorporated on 3/16/2005. As a result of the peer-review process, this type was modified to increase the amount of mixed severity fire to 70% (from 60%) and the age ranges of late-development classes were adjusted to begin at 80yrs (from 65yrs). The end results were more late-development conditions (E) and more closed conditions (B and E).

Vegetation Classes

*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Class A 10%

Early Development 1 All Structures

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

LAOC	Upper
PICO	Upper
PSME	Upper
ABLA	Lower

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0%	100%
Height	Tree 0m	Tree 5m
Tree Size Class	Sapling >4.5ft; <5"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Young larch and lodgepole establish with some Douglas-fir. In some cases, lodgepole pine may dominate following stand replacement fire and may persist for 60-100yrs before western larch begins to dominate.

Recent observations of this succession stage in the White Mountain 1988 fire area in the Colville National Forest show Alnus sinuata, Salix scouleriana and western larch dominating upper layers at higher elevations; at lower elevations lodgepole pine and Salix scouleriana dominate. Abies lasiocarpa and Picea engelmannii are present at low cover values in the lower canopy at all elevations (Colville National Forest ecology data).

Class B 15%

Mid Development 1 Closed

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

LAOC	Upper
PICO	Upper
PSME	Upper
ABLA	Middle

Structure Data (for upper layer lifeform)

	Min	Max
Cover	41%	100%
Height	Tree 5.1m	Tree 25m
Tree Size Class	Medium 9-21"DBH	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Larch, lodgepole and Douglas-fir (poles to medium trees) continue to dominate. Without disturbance, Douglas-fir can increase in understory. Subalpine fir may be present. Canopy cover rarely >60%.

Class C 25%

Mid Development 1 Open

Upper Layer Lifeform

- ☐ Herbaceous
- ☐ Shrub
- ☑ Tree

Fuel Model

Indicator Species* and Canopy Position

LAOC	Upper
PSME	Upper
PICO	Upper
ABLA	Middle

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0%	40%
Height	Tree 5.1m	Tree 25m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Larch, with some Douglas-fir, lodgepole and subalpine fir. Open condition is created by disturbance (fire, insect or disease), which opens up more closed conditions (ie, B or E).

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*Dominant Species are from the NRCS PLANTS database. To check a species code, please visit http://plants.usda.gov.
**Fire Regime Groups are: I: 0-35 year frequency, surface severity; II: 0-35 year frequency, replacement severity; III: 35-100+ year frequency, mixed severity; IV: 35-100+ year frequency, replacement severity; V: 200+ year frequency, replacement severity.

Class D 30 %

Late Development 1 Open

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model

Indicator Species* and Canopy Position

LAOC	Upper
PSME	Upper
PICO	Mid-Upper
ABLA	Middle

Structure Data (for upper layer lifeform)

	Min	Max
Cover	0 %	40 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Large larch and Douglas-fir, favored by disturbance. Subalpine fir, grand fir and lodgepole pine will be reduced or eliminated by fire, insect or disease.

Class E 20 %

Late Development 1 Closed

Upper Layer Lifeform

☐ Herbaceous
☐ Shrub
☑ Tree

Fuel Model

Indicator Species* and Canopy Position

ABLA	Upper
PSME	Upper
LAOC	Upper
ABGR	Mid-Upper

Structure Data (for upper layer lifeform)

	Min	Max
Cover	41 %	100 %
Height	Tree 25.1m	Tree 50m
Tree Size Class	None	

☐ Upper layer lifeform differs from dominant lifeform.

Description

Large diameter larch and Douglas-fir dominate overstory, subalpine fir and grand fir are present in the middle and understory. Lodgepole pine will be largely absent.

Canopy cover will rarely >60%.

Disturbances

Fire Regime Group:** III

Historical Fire Size (acres)

Avg
Min
Max

Sources of Fire Regime Data

☑ Literature
☑ Local Data
☑ Expert Estimate

Fire Intervals

	Avg FI	Min FI	Max FI	Probability	Percent of All Fires
Replacement	200	50	250	0.005	20
Mixed	65	20	140	0.01538	62
Surface	225			0.00444	18
All Fires	40			0.02483	

Fire Intervals (FI):

Fire interval is expressed in years for each fire severity class and for all types of fire combined (All Fires). Average FI is central tendency modeled. Minimum and maximum show the relative range of fire intervals, if known. Probability is the inverse of fire interval in years and is used in reference condition modeling. Percent of all fires is the percent of all fires in that severity class.

Additional Disturbances Modeled

☑ Insects/Disease ☐ Native Grazing ☐ Other (optional 1)
☑ Wind/Weather/Stress ☑ Competition ☐ Other (optional 2)

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