

Forest Health Treatment Prioritization and Implementation

On State Trust Lands in Eastern Washington

A Report to the Washington State Legislature

Prepared by
Washington State Department
of Natural Resources

Office of the Commissioner of Public Lands, Hilary Franz
Forest Resources Division
December 2020



WASHINGTON STATE DEPARTMENT OF
NATURAL RESOURCES

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All photos courtesy DNR

Table of Contents

Table of Contents	5
List of Figures	6
List of Tables	6
Introduction.....	7
Trends in Forest Health Conditions	7
Legislative Direction.....	9
DNR’s History of Forest Health Management Activities.....	10
DNR’s Prioritization Process.....	12
Determining Forest Health Treatments.....	16
Other Trust Lands Management Objectives and Constraints	17
Progress on the 2019-2021 Biennium Prioritization List	21
Coordination with Nearby Landowners and Statewide DNR Assessments	23
Forest Health Treatment Case Study	26
Updating and Adjusting Prioritization	27
Funding.....	27
Next Steps.....	29
APPENDIX A: 2-Year Forest Health Treatments Prioritization	30
APPENDIX B: 6-Year Prioritization.....	32
APPENDIX C: 20-Year Prioritization.....	33
APPENDIX D: Forest Structure	35
APPENDIX E: DNR’s Landscapes in Eastern Washington.....	37
APPENDIX F: DNR’s Landscapes and 20-Year Forest Health Strategic Plan Priority Planning Areas ...	38
APPENDIX G: Commercial and Non-Commercial Forest Health Treatment Descriptions.....	39
APPENDIX H: Aerial Insect and Disease Detection Survey Methods and Reporting Categories	41

List of Figures

Figure 1. State Trust Lands Damaged by Insects and Disease Agents in Eastern Washington 2010-2019

Figure 2. Large Fires in Eastern Washington 2000-2020 (through 9/18/2020)

Figure 3. DNR Trust Land High, Medium, and Low 2020 Priority Landscapes

Figure 4. Forest Health Treatments on DNR State Trust Lands for the 2019-2021 Biennium and the 2021-2023 Biennium with the 20-year Forest Health Strategic Plan Priority Planning Areas

List of Tables

Table 1. Commercial and Non-Commercial Forest Health Treatments FY 2015-2021 *(as of 10/19/2020)*

Table 2. Eastern Washington DNR Trust Lands - Landscape Priority and Ranking

Table 3. Forested State Trust Lands Acres by Forest Structure Category and Landscape Priority

Table 4. Commercial and Non-Commercial Treatments

Table 5. DNR Landscapes with NSO Habitat Management Areas in Southeast Region

Table 6. DNR Landscapes with Lynx Habitat Management Areas in Northeast Region

Table 7. Acres of commercial and non-commercial treatments planned for the 2019-2021 biennium ([As shown in the 2018 Forest Health Treatment Prioritization and Implementation Legislative Report](#))

Table 8. Adjusted Planned Forest Health Treatment Acres for the 2019-2021 Biennium

Table 9. Progress on Forest Health Treatment Acres on DNR Trust Lands for the 2019-2021 Biennium by 2020 Landscape Priority

Table 10. Planned Commercial and Non-Commercial Forest Health Treatment Acres on DNR Trust Lands for the 2021-2023 biennium by 2020 Landscape Priority

Table 11. Forest Health Budget FY 2018-2020

Table 12. Forest Health Revolving Account End of Calendar Year Balances

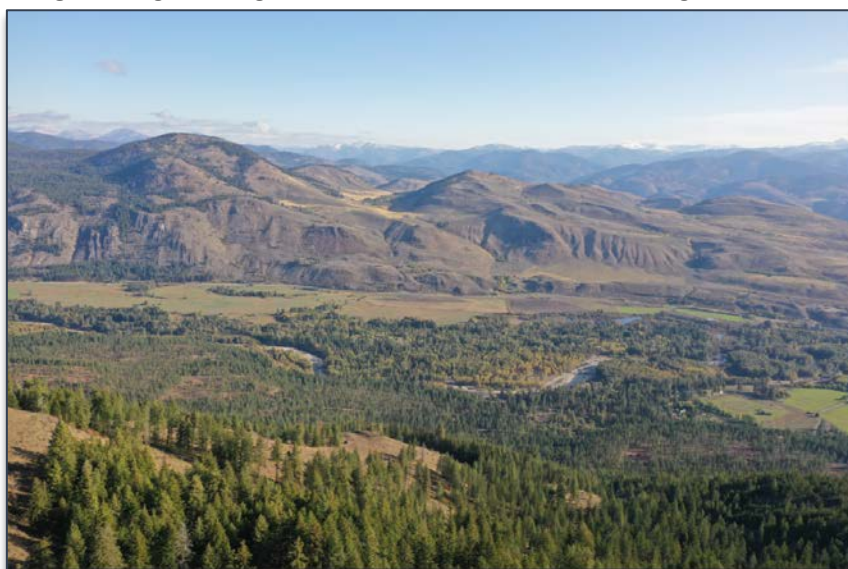
Table 13. Forest Health Budget Requests and Projected Costs for the 2021-2023 Biennium

Introduction

The Washington State Department of Natural Resources (DNR) manages more than 1 million acres of state trust land east of the Cascade Mountains. About 750,000 acres of these lands are forested and interspersed among federal, private, tribal, municipal, state, and commercial forestlands.

As part of being a prudent trust land manager, DNR manages these lands to fulfill multiple objectives, such as revenue generation, providing fish and wildlife habitat and recreation opportunities, and protecting ecosystem services. The health of these forests is vital to meeting these objectives and supporting rural economies.

Image 1. Virginia Ridge Timber Sale, DNR's Northeast Region



Forest health is defined in [RCW 76.060.020](#) as “the condition of a forest being sound in ecological function, sustainable, resilient, and resistant to insects, disease, fires and other disturbance, and having the capacity to meet landowner objectives.”

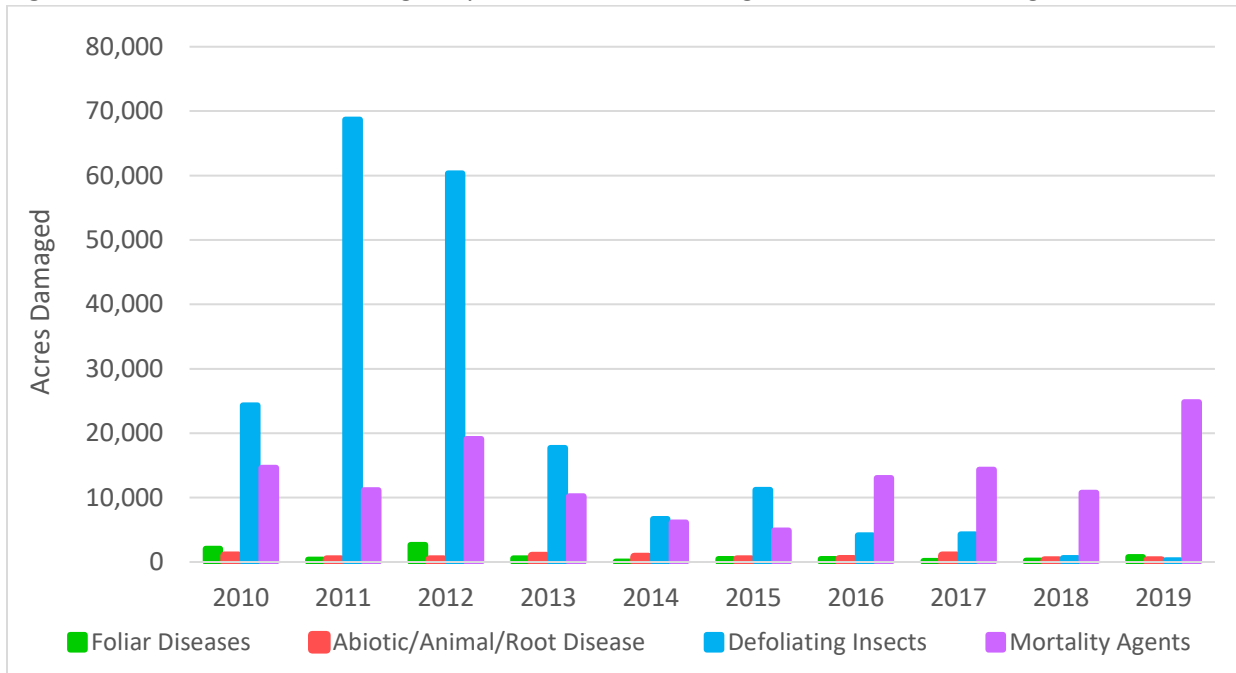
This report is written to meet the requirements of [Engrossed Second Substitute House Bill 1711](#), which specifies that DNR will report to the Legislature every even-numbered year on efforts to improve forest health on state trust lands in eastern Washington.

Trends in Forest Health Conditions

Over the past century, land use patterns and fire exclusion policies have altered natural fire regimes and ecosystem characteristics. Some forests have become more homogenized, with unnaturally high accumulations of live and dead fuels, and many have lost the old, fire-tolerant trees as well. Forests with high stand densities on relatively dry sites have increased water usage, increasing regional dryness and susceptibility to drought. Other less prominent changes include the local extinction of wildlife and native plants, and reduction in understory diversity.

These changes have led to forests that are less resistant to disease and insect outbreaks, and are more susceptible to large wildfires.

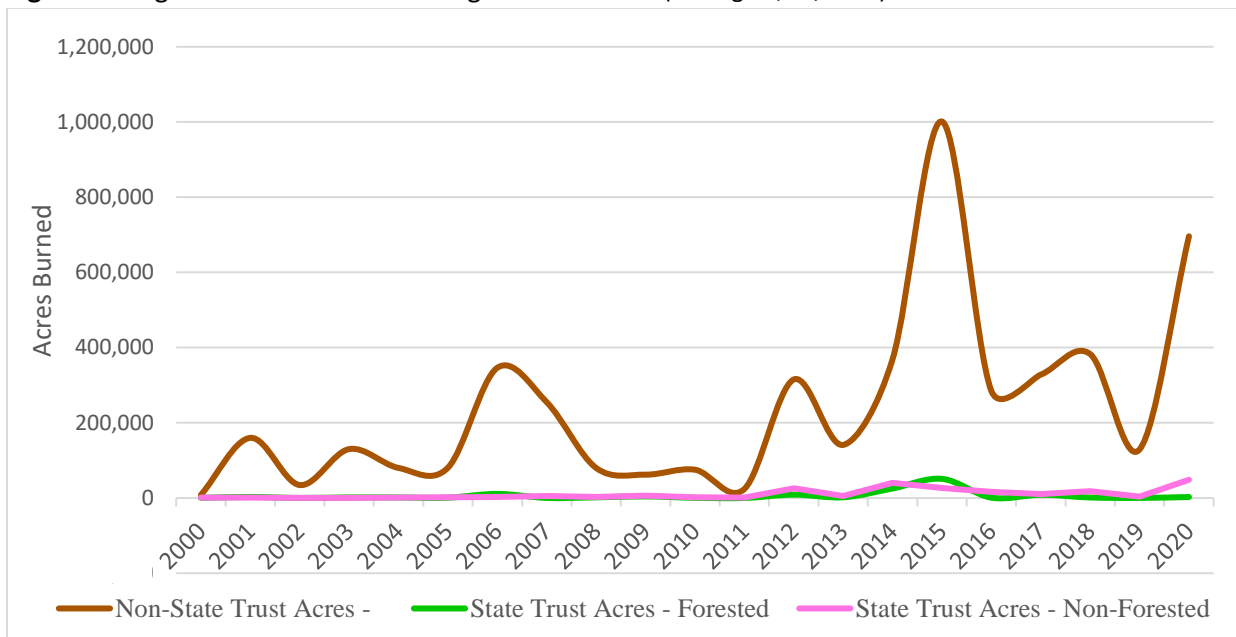
Figure 1. State Trust Lands Damaged by Insects and Disease Agents in Eastern Washington 2010-2019



Source: [USDA Forest Service in cooperation with DNR, March 2020.](#)

In Figure 1, some of the damaged acres listed may have more than one pest or pathogen present, but the graph reports only the most damaging agent so as to eliminate double counting of affected forest acres. For a description of the detection surveys and categories of damaging insects and disease, please see Appendix H.

Figure 2. Large Fires in Eastern Washington 2000-2020 (through 9/18/2020)



Source: [WA Large Fires Database, WA DNR Wildfire Division, 2020](#)

Healthy, productive forests in eastern Washington provide many benefits, including timber, recreation, clean water, and other ecosystem services. To improve overall health and protect forests from catastrophic fire and other disturbance, treatments such as thinning and prescribed fire are needed to reduce and maintain forest density at desired levels.

Legislative Direction

E2SHB 1711

In 2017, the Legislature passed [Engrossed Second Substitute House Bill 1711 \(E2SHB 1711\)](#) *Prioritizing lands to receive forest health treatments*, directing DNR to develop and implement a policy for prioritizing investments in forest health treatments to protect state lands and state forestlands. The intent of the legislation and corresponding work is to reduce wildfire risk and losses from wildfire, reduce insect infestation and disease, and achieve the cumulative impact of improved forest health and resilience at a landscape scale.

The prioritization policy has to consider whether the state lands are within an area subject to forest health hazard warning.

The prioritization must be based on an evaluation of the economic and noneconomic value of:

- Timber or other commercial forest product removed during mechanical treatments
- Timber or other commercial forest products likely to be spared from damage by wildfire
- Homes, structures, agricultural products, and public infrastructure likely to be spared from damage by wildfire
- Impacts to recreation and tourism
- Ecosystem services such as water quality, air quality, or carbon sequestration.

DNR also was directed to identify state lands and state forestlands that would benefit from forest health treatments at the landscape level for the next 20 years, ones that would benefit most during the following six years and, prioritize and list specific lands for treatment during the subsequent biennium. DNR was directed to update the list by November 15 of each even-numbered year.

2SSB 5546

Also passed in 2017, [Second Substitute Senate Bill 5546 \(2SSB 5546\)](#) *Concerning proactively addressing wildfire risk by creating a forest health treatment assessment* directed DNR to establish a forest health assessment and treatment framework designed to proactively and systematically address the forest health issues facing the state across all land ownerships.

As part of 2SSB 5546, DNR's Forest Health and Resiliency Division is required to identify and select statewide forest health priority planning areas each biennium for landscape evaluations and treatment prescriptions.

Appendix F shows the overlap of the DNR trust land prioritized landscapes under E2SHB 1711, and the 20-Year Forest Health Strategic Plan Priority Planning Areas identified under 2SSB 5546. For more information on the progress of this legislation and greater details about the work, please see DNR's legislative report "Forest health assessment and treatment framework (RCW 76.06.200)".

DNR's History of Forest Health Management Activities

The Legislature defines forest health treatments as "actions taken by the department to restore forest health including, but not limited to, sublandscape assessment and project planning, site preparation, reforestation, mechanical treatments including timber harvest, road realignment for fire protection and aquatic improvements, and prescribed burning ([RCW 79.10.520](#))."

Although forest health continues to be a concern in Washington, there are forests that have been restored or have remained healthy. DNR has been working to build on those healthy forests and continue to improve conditions for increased forest resilience and ecosystem health.

DNR has implemented a variety of treatments and silvicultural techniques to reduce fuels and competing vegetation, thin overstocked stands, and promote resilience to disturbance. These treatments have reduced stand densities and promoted appropriate species to increase the forests' resilience to wildfire and pathogens while also improving future revenue potential for trust beneficiaries. These treatments take into account stand conditions and objectives while complying with DNR's *Policy for Sustainable Forests*, the *State Trust Lands Habitat Conservation Plan*, the *Lynx Management Plan*, the *Loomis State Forest Final Landscape Plan*, trust manager responsibilities, and other relevant regulations.

The various treatments and silvicultural techniques fall into two main categories: commercial and non-commercial treatments. Commercial treatments are those which generate revenue from the forest products removed from the forest (though sometimes they can lose money or just breakeven). Non-commercial treatments are those which produce little or no valuable products that can offset the costs of treatments, yet they may move a stand towards a more desirable future condition.

FOREST IMPROVEMENT TREATMENT ACTIVITIES

From Fiscal Year (FY)¹ 2005-2017, DNR completed roughly 50,000 acres of forest health treatments on state trust lands through the Forest Improvement Treatment (FIT) program. The FIT program leveraged DNR's contract harvest revolving account to fund treatments that would not normally be financially viable due to the low or negative value of the wood. This program was discontinued due to the Legislature's creation of the Forest Health Revolving Account in 2017.

Additionally, DNR has used trust management funds, capital funding from the Legislature, and the Forest Health Revolving Account to complete an additional 262,000 acres of non-commercial forest health treatments since FY 2005.

Together, these treatments have reduced densities and promoted appropriate species to increase the forests' resilience to wildfire and pathogens while also improving future revenue potential for beneficiaries. It should be noted that some of these non-commercial treatments have occurred within the same footprint as FIT treatments and other commercial harvests. This is because managing for forest health is a continual activity across time and large landscapes.

FOREST HEALTH ACTIVITIES

Starting in FY 2018 under E2SHB 1711, all revenues generated by forest health activities on state trust lands have gone into the Forest Health Revolving Account. This funding has been used to cover commercial and non-commercial treatment costs. Since FY 2018, DNR has completed more than 68,000 acres of commercial and non-commercial treatments.

Table 1 lists the acres of sold and completed commercial treatments and completed non-commercial treatments on state trust lands under both the FIT and the Forest Health Programs from FY 2015 through the first part of FY 2021. Many of the planned treatment acres in FY 2021 will occur throughout the rest of the fiscal year.

Table 1. Commercial and Non-Commercial Forest Health Treatments FY 2015-2021 (as of 10/19/2020)

Fiscal Year	Commercial Treatment Acres	Non-Commercial Treatment Acres	Total Treatment Acres
2015	9,860	25,099	34,959
2016	10,906	13,574	24,480
2017	6,293	15,919	22,212
2018	7,646	12,821	20,467
2019	6,366	13,872	20,238
2020	7,167	14,381	21,548
2021	572	6,078	6,650
Total	48,809	101,551	150,552

Source: DNR's Land Resource Management System

¹ DNR's Fiscal Year (FY) begins on July 1 of the previous year and ends on June 30 of the stated year. For example, FY 2018 began on July 1, 2017, and ended on June 30, 2018.

DNR'S Prioritization Process

To implement E2SHB 1711, DNR developed a prioritization process for state trust lands.

The first step in this process was to group blocks of forested state trust lands into landscapes. (DNR landscapes are different than the 20-year Forest Health Strategic Plan Priority Planning Areas, which are identified and prioritized under 2SSB 5546). See Appendix E for DNR's landscapes.

The second step was to develop a geographic information system (GIS) model and use it to prioritize each landscape in a way that reflects DNR's management objectives. For example, as a trust lands manager, DNR is concerned with the value of timber as well as forest health. DNR designed a model that computed individual, weighted scores for forest health and for other values at risk:

- Forest health scores were computed from individual, weighted scores for wildfire risk (includes both the probability of a wildfire occurring and the potential severity should it occur), risks from insects and diseases, restoration opportunities, and climatic change influences.
- Values at risk represents criteria such as the timber value of commercial forest products, proximity of public and private infrastructure, and ecosystem services, such as community watersheds, recreation opportunities, and fish-bearing waters. Each criteria also had an individual, weighted score.

Forest health and values at risk scores were combined into a single score for each pixel in each landscape. These scores were then aggregated to derive a final priority index score for each landscape, enabling DNR to rank all landscapes into an order of priority.

The third step was to prioritize landscapes within each of DNR's two eastern Washington regions (Northeast Region and Southeast Region). Within each region, the landscapes were divided into three prioritization categories (high, medium, and low priority) based on their priority index scores and on the total landscape acreage in each region (Table 2).

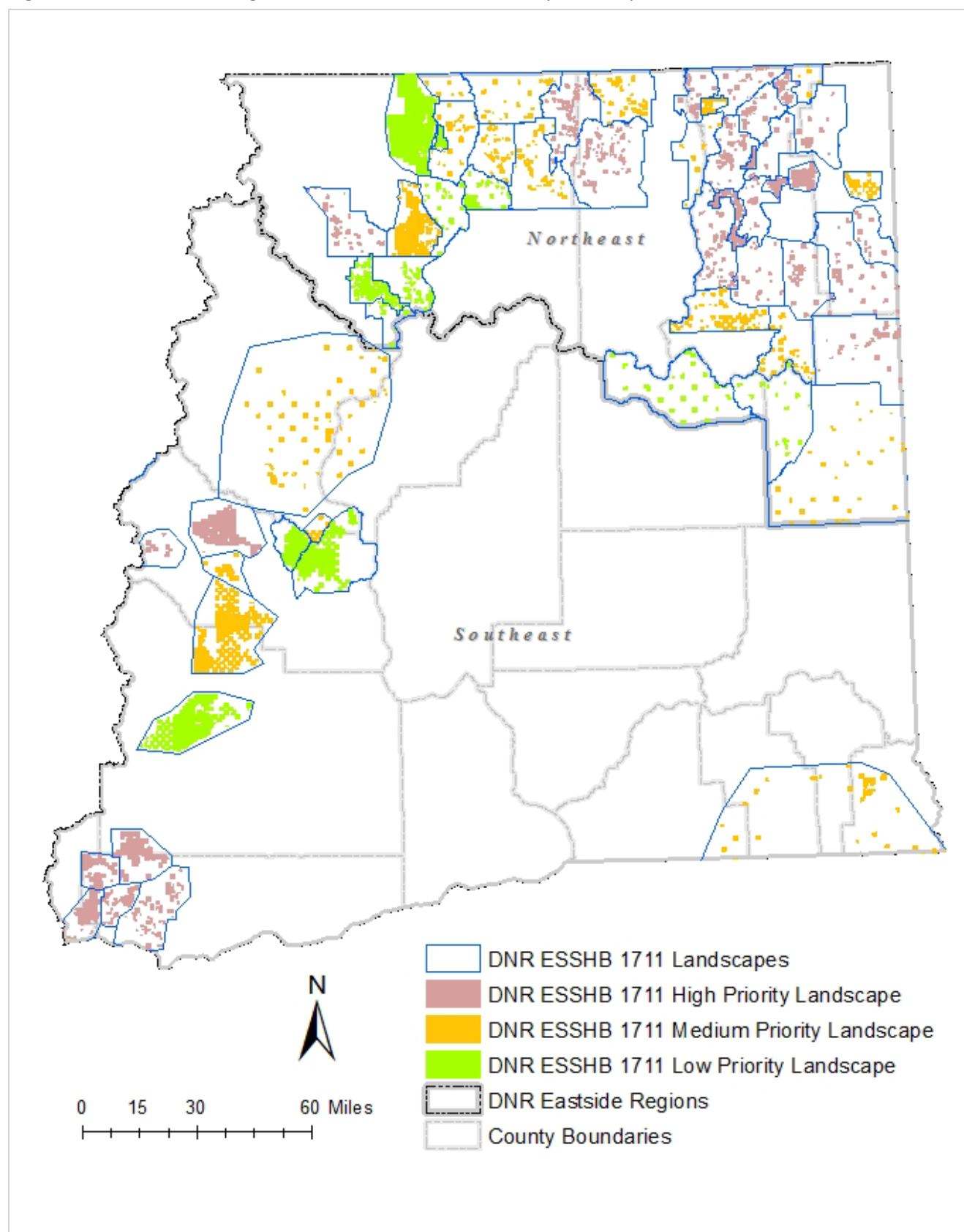
It is important to note that the priority ranking is only relative in comparison to other DNR landscapes on this list, and the landscape priority is only in comparison to the other landscapes within the same region. (That is why you might see, for example, medium-priority landscapes in one region in the middle of a list of high-priority landscapes in another region.)

Table 2. Eastern Washington DNR Trust Lands - Landscape Priority and Ranking

DNR Landscape	Region	2020 Landscape Priority	2020 Priority Ranking	Priority Index Score	Total Landscape Acres	Forested Landscape Acres
Buck Creek	Southeast	High	1	7.267	21,691	20,430
Trout Lake	Southeast	High	2	6.765	18,567	17,067
Rattlesnake Creek	Southeast	High	3	5.992	9,868	8,954
Appleton	Southeast	High	4	5.415	15,291	12,767
Cabin Creek	Southeast	High	5	5.266	3,879	3,544
Marble	Northeast	High	6	5.014	5,649	4,927
Teanaway	Southeast	High	7	4.969	52,518	47,969
Little Pend Oreille	Northeast	High	8	4.914	17,598	16,509
Glenwood	Southeast	High	9	4.903	36,273	35,146
Taneum	Southeast	Medium	10	4.828	8,340	7,071
Cottonwood	Northeast	High	11	4.824	8,795	8,024
Evans	Northeast	High	12	4.822	11,913	10,628
Elk	Northeast	High	13	4.811	10,384	9,434
Furport	Northeast	High	14	4.762	3,513	3,260
Usk	Northeast	High	15	4.743	10,499	9,156
Wenatchee	Southeast	Medium	16	4.738	27,273	14,234
Republic	Northeast	High	17	4.728	13,486	9,998
Dunn	Northeast	High	18	4.709	21,773	18,575
Rice	Northeast	High	19	4.688	11,025	9,521
Lime	Northeast	High	20	4.687	8,469	7,997
Narcisse	Northeast	High	21	4.628	7,834	7,420
Orin	Northeast	High	22	4.575	2,518	2,094
Bodie	Northeast	High	23	4.559	15,154	10,511
Patterson	Northeast	High	24	4.558	5,061	4,407
Douglas	Northeast	High	25	4.551	6,044	5,237
Carrs Corner	Northeast	High	26	4.548	4,465	3,917
Three Forks	Northeast	High	27	4.456	2,473	2,347
Twisp	Northeast	High	28	4.352	8,359	2,947
Orient	Northeast	High	29	4.271	6,294	5,111
Ione	Northeast	High	30	4.248	5,460	5,267
LeClerc	Northeast	Medium	31	4.242	10,753	10,218
Tum Tum	Northeast	Medium	32	4.221	9,655	8,210
Curlew	Northeast	Medium	33	4.218	11,638	9,309
Jumbo	Northeast	Medium	34	4.213	8,871	7,188
Boyds	Northeast	Medium	35	4.213	1,783	1,333
Cayuse	Northeast	Medium	36	4.169	6,963	837

DNR Landscape	Region	2020 Landscape Priority	2020 Priority Ranking	Priority Index Score	Total Landscape Acres	Forested Landscape Acres
Aeneas	Northeast	Medium	37	4.155	8,832	5,862
Naches/Wenas	Southeast	Medium	38	4.127	88,548	48,514
Stemilt	Southeast	Medium	39	4.053	4,583	3,525
Blue Mountains	Southeast	Medium	40	4.029	15,810	2,258
Fruitland	Northeast	Medium	41	3.985	21,684	20,215
Tonasket	Northeast	Medium	42	3.910	7,657	1,825
Molson	Northeast	Medium	43	3.904	6,160	3,384
Nighthawk	Northeast	Medium	44	3.898	1,986	276
Leadpoint	Northeast	Medium	45	3.893	1,817	1,687
Loup Loup	Northeast	Medium	46	3.757	57,328	46,585
Rockford	Northeast	Medium	47	3.755	9,286	4,101
Loomis	Northeast	Low	48	3.714	134,524	112,763
Ahtanum	Southeast	Low	49	3.696	82,650	57,019
Colockum	Southeast	Low	50	3.652	60,970	33,422
Pateros	Northeast	Low	52	3.551	3,239	390
Espanola	Northeast	Low	53	3.512	5,222	2,280
Knowlton	Northeast	Low	54	3.453	30,847	9,656
Riverside	Northeast	Low	55	3.367	5,992	933
Miles	Northeast	Low	56	3.269	11,474	4,585
Brewster	Northeast	Low	57	3.228	8,836	1,690
Naneum	Southeast	Low	58	3.204	29,021	23,280
Synarep	Northeast	Low	59	2.987	13,136	5,650
Grand Total					1,039,728	751,465

Figure 3. DNR Trust Land High, Medium, and Low 2020 Priority Landscapes



Another important factor to understand is that the landscape priority, priority index score, and priority ranking do not necessarily reflect the potential diversity of the on-the-ground forest health conditions across the landscape. Also, these landscapes been compared to forested lands under ownership other than DNR. For example, if forest health conditions on DNR trust lands are better than conditions under other forest ownerships, then it is possible that a medium-priority DNR landscape may be a lower priority in the all-lands prioritization under 2SSB 5546.

The fourth step was to assess forest structure and conditions to determine the areas with the highest priority for treatment within each landscape. DNR assessed forest structure using forest metrics from its Remote Sensing – Forest Resource Inventory System (RS-FRIS) data. Gradient nearest neighbor (GNN) data were used for a small percentage of the total areas that lacked RS-FRIS data (Ohmann et al. 2013²). These data enabled DNR to categorize state trust lands by forest structure category such as open or closed canopy. Closed canopy stands are usually considered higher priority for treatment as those stands are typically most at risk of loss from pests, pathogens, and catastrophic wildfire.

The fifth and final step was to prioritize treatment needs for the next 2, 6, and 20 years (Appendices A, B, and C, respectively). The schedule of treatments for the next biennium (July 2021 through June 2023) was done using forest surveys of stand conditions along with the landscape and treatment needs prioritizations. (Although these forest surveys are an important part of the development of the prioritized treatment list for the next biennium, they are not included as treatment acres in this report.)

Determining Forest Health Treatments

FOREST STRUCTURE CLASSES

As discussed in the fourth step in the prioritization process above, forest structure and conditions on DNR trust lands were assessed to help prioritize areas for treatment. Forest structure and conditions change over time due to a number of factors including natural growth, completed commercial and non-commercial forest health treatments, mortality from insects and disease, and natural disturbance such as wind throw and wildfire. Additionally, advances in survey technology and updates to forest inventory and conditions will be reflected in the amount of forested acres in each structure category.

In general, closed forest structure classes are considered to be at somewhat higher risk of impacts from forest stand disturbances such as wildfire, pests, and disease. This does not mean that all

² Ohmann, J. L., M. J. Gregory, E. B. Henderson, and H. M. Roberts. 2011. Mapping gradients of community composition with nearest-neighbor imputation: Extending plot data for landscape analysis. *Journal of Vegetation Science* 22:660-676.

closed forests are considered unhealthy; field surveys are needed to make site-specific forest condition assessments, and to develop appropriate treatment prescriptions if needed.

Table 3 shows the approximate acres of state trust lands in each forest structure category by landscape prioritization. See Appendix D for a more in-depth discussion of the factors that help determine forest structure.

Table 3. Forested State Trust Lands Acres by Forest Structure Category and Landscape Priority

Landscape Priority	Early Open	Mid Open	Late Open	Early Closed	Mid Closed	Late Closed	Grand Total
High Priority	44,196	146,581	117	4,573	101,290	6,406	303,164
Medium Priority	57,281	120,702	24	445	18,182		196,633
Low Priority	66,335	150,414		3,729	31,178	11	251,668
Grand Total	167,812	417,697	141	8,748	150,650	6,417	751,465

Source: RS-FRIS Forest Inventory System, WA DNR Forest Resources Division

COMMERCIAL AND NON-COMMERCIAL TREATMENTS

As discussed previously, DNR uses a variety of commercial and non-commercial treatments to meet landscape and forest health objectives. Table 4 lists some example forest health treatments that may be used on DNR-managed lands. This list is not exhaustive of all treatment types. For descriptions of commercial and non-commercial treatments, please see Appendix E.

Table 4. Commercial and Non-Commercial Treatments

Commercial Treatments	Non-Commercial Treatments
Uneven-aged management	Shaded fuel breaks/hazard abatement
Variable density thinning	Pre-commercial thinning
Commercial thinning	Prescribed burning
Variable retention harvest	Reforestation
	Site preparation
	Pruning
	Vegetation management

Other Trust Lands Management Objectives and Constraints

State trust lands are managed to achieve multiple objectives, including generating trust revenue, implementing its Habitat Conservation Plan, protecting water quality, providing fish and wildlife

habitat, offering public access and recreation opportunities, as well as attaining overall forest health and environmental health goals.

In managing state trust lands in eastern Washington, DNR has and will continue to implement a variety of treatments and silvicultural techniques to reduce fuels, competing vegetation, stand densities, and risk from disturbances. These treatments take into account current stand conditions and objectives while also considering DNR's [*Policy for Sustainable Forests*](#), [*State Trust Lands Habitat Conservation Plan*](#), [*Lynx Habitat Management Plan*](#), [*Loomis State Forest Final Landscape Plan*](#), and fiduciary responsibilities, which incorporates the common law duties of a trustee.

Each DNR landscape has a unique mix of management objectives as well as policy, legal, and operational constraints. Examples include riparian areas, fish and wildlife habitat objectives, and areas that are deferred from harvest such as natural areas, old-growth stands, research plots, and areas without operational access.

It is important to understand the conditions and the various objectives and constraints of a given forest stand because they directly affect the locations and types of forest health treatments that can be implemented. Stands with closed canopy structure are typically more at risk of pests, pathogens, and large wildfires. Treatments in the “mid-closed” and “late closed” structure classes are generally considered to have greater commercial potential than those in the mid-open and late open classes. Treatments in the early classes are considered non-commercial.

NORTHERN SPOTTED OWL MANAGEMENT

One notable example among these various objectives and constraints are the habitat requirements for the northern spotted owl. The northern spotted owl is strongly associated in much of its range with late successional and old-growth forest habitats (with higher canopy closure). Areas of state trust lands that have been identified for development and retention of northern spotted owl habitat may be intentionally managed to maintain or develop a closed canopy structure. This can significantly limit the types and amounts of forest health treatments that can occur in these areas.

Table 5 shows the landscapes where DNR manages to provide northern spotted owl areas in the Southeast Region and the acres of northern spotted owl management areas. There are three main types of northern spotted owl management areas that are defined in the Habitat Conservation Plan:

- *Nesting, Roosting, and Foraging (NRF)* – These management areas are intended to provide the appropriate cover and stand conditions for owls and their prey. Nesting, roosting, and foraging management areas typically require 50 percent of the area to be in either a suitable or near-habitat condition. In the Klickitat, two-thirds of the area is either in a suitable habitat condition or on a trajectory toward becoming habitat. These condition account for much of the mid-closed and late closed canopy stands in these landscapes.

- *Dispersal (DISP)* – These management areas are found in stands between areas of nesting, roosting, and foraging areas and large federal reserves, and are managed to provide enough cover to protect owls traveling (or dispersing) through these areas from predation. 50 percent of the acres in these areas are required to meet habitat conditions, which is a condition generally between mid-open and mid-closed forest structure.
- *Desired Future Conditions (DFC)* – These management areas seek to provide a modified dispersal condition that is tailored to be ecologically stable based on forest cover types. Desired future conditions areas provide cover for owls from predation and require a 50 percent habitat condition. This condition can be found in both the mid-open to mid-closed forest structure.
- Additionally, there are *Ponderosa Pine Desired Future Condition (PPDFC)* areas that are also managed in these landscapes. Although they are associated with northern spotted owl management, these stands generally do not support owl habitat. They are actively managed for long-term ecologically stable conditions for the ponderosa pine.

Table 5. DNR Landscapes with Northern Spotted Owl Habitat Management Areas in Southeast Region

DNR Landscape Name	Landscape Priority	DFC	DISP	NRF	PPDFC	Total Acres Managed for NSO*	Total Landscape Acres
Ahtanum	Low		30,879	2,604		33,483	82,650
Buck Creek	High	489		19,107		19,596	21,691
Cabin Creek	High		625	1,365		1,990	3,879
Glenwood	High	7,463		7,883	15,965	31,310	36,273
Naches/Wenas	Medium			2,814		2,814	88,548
Naneum	Low			4,056		4,056	29,021
Rattlesnake Creek	High	3,963			16	3,979	9,868
Taneum	Medium			336		336	8,340
Teaway	High		1,252	1,895		3,148	52,518
Trout Lake	High	4,077		12,377		16,454	18,567
Wenatchee	Medium			5,557		5,557	27,273
Grand Total		15,991	32,756	57,994	15,981	122,721	378,628

*Though exact targets vary by landscape and northern spotted owl management category, in general 50-67% of the total northern spotted owl management acres will be maintained in a habitat condition. Forest health treatments can be conducted within some of these habitat areas, though there are limits on how much live and dead woody material can be removed.

Image 2. Northern Spotted Owl**Image 3.** Canada Lynx

CANADA LYNX MANAGEMENT

In the Northeast Region, DNR landscapes with lynx habitat objectives may also have significant constraints on the locations, timing, and types of forest health treatments that may be implemented. Constraints associated with lynx habitat management per the [Lynx Habitat Management Plan for DNR-Managed Lands, April 2006](#) include maintaining ratios of different lynx habitat components, limitations on how much forested lynx habitat can be converted out of habitat status within a 10-year period, restrictions on harvest size and configuration, surveying of habitat conditions prior to harvest activities, and pre-commercial thinning restrictions that effectively prohibit this non-commercial treatment in some locations. In addition, there is interim guidance ([Okanogan Lynx Management Zone Interim Management Guidelines and Recommendations](#)) within the Okanogan Lynx Management Zone requiring additional management considerations prior to forest management activities to ensure there is no net loss of high-quality foraging habitat.

Table 6. DNR Landscapes with Lynx Habitat Management Areas in Northeast Region

DNR Landscape Name	Landscape Priority	Total Acres Managed for Lynx	Total Landscape Acres
Little Pend Oreille	High	14,484	17,598
Loomis	Low	92,305	134,524
Narcisse	High	769	7,834
Grand Total		107,558	159,956

For more information on habitat requirements and management actions associated with the northern spotted owl, see the [1997 State Trust Lands Habitat Conservation Plan \(HCP\)](#) and [HCP Amendment No. 1 – Administrative Amendment to the Northern Spotted Owl Conservation Strategy for the Klickitat HCP Planning Unit](#). For more information on lynx habitat and management requirements, please see the [Lynx Habitat Management Plan for DNR-Managed Lands, April 2006](#) and the [Okanogan Lynx Management Zone Interim Management Guidelines and Recommendations](#).

The northern spotted owl, Canada lynx, and other landscape objectives and constraints present challenges in meeting forest health goals. It will require work from DNR moving forward to resolve conflicts and synergize goals as opportunities present themselves. DNR will continue to implement forest health treatments as appropriate and look for new ways to simultaneously improve forest health and meet other land management goals.

Progress on the 2019-2021 Biennium Prioritization List

As directed in E2SHB 1711, this report provides a brief summary of the department's progress toward treating the state lands and state forestlands included in the previous biennium's prioritization list. The 2-year prioritization list from the 2018 report is summarized in Table 7.

Table 7. Acres of Commercial and Non-Commercial Treatments Planned for the 2019-2021 Biennium ([As shown in the 2018 Forest Health Treatment Prioritization and Implementation Legislative Report](#))

Fiscal Year	2018 Landscape Priority	Planned Commercial Treatment Acres	Planned Non-commercial Treatment Acres	Total Treatment Acres	% of Fiscal Year
2020	High	3,822	9,481	13,303	47%
	Medium	3,731	2,975	6,706	24%
	Low	454	8,041	8,495	30%
	Total	8,007	20,497	28,504	
2021	High	4,149	8,788	12,934	50%
	Medium	3,957	4,153	8,110	31%
	Low	555	4,450	5,005	19%
	Total	8,661	17,391	26,049	
Planned Biennium Total		16,668	37,888	54,556	

The criteria for non-commercial forest health treatment acres has changed somewhat since the 2018 Legislative Report. DNR no longer counts natural regeneration or grass seeding as a non-commercial forest health treatment in its planned or completed activities. In Table 7, acres of natural regeneration and grass seeding were counted in the planned non-commercial treatment acres, which resulted in a larger estimation of the planned acres for non-commercial treatments.

Table 8 shows the total planned commercial treatments and the adjusted non-commercial forest health treatment acres for the 2019-2021 biennium after the removal of natural regeneration and grass seeding acres.

Table 8. Adjusted Planned Forest Health Treatment Acres for the 2019-2021 Biennium

Fiscal Year	Planned Commercial Treatment Acres	Previous Planned Non-Commercial Treatment Acres	Natural Regeneration acres no longer included	Grass Seeding acres no longer included	Adjusted Planned Non-Commercial Treatment Acres	Adjusted Planned Total Treatment Acres
2020	8,007	20,497	-1,832	-170	18,495	26,502
2021	8,661	17,391	-774	-160	16,457	25,118
Adjusted Biennium Total	16,668	37,888	-2,606	-330	34,952	51,620

Table 9 provides a summary of the progress made towards the 2019-2021 biennium's planned forest health activities. The data collection for this progress summary was completed October 19, 2020, a bit more than halfway through the 2019-2021 biennium. Much of the planned treatment acres for FY 2021 will occur throughout the remainder of the fiscal year.

Table 9. Progress on Forest Health Treatment Acres on DNR Trust Lands for the 2019-2021 Biennium by 2020 Landscape Priority

Fiscal Year	2020 Final Landscape Priority	Completed/Sold Commercial Treatment Acres	Completed Non-Commercial Treatment Acres	Total Treatment Acres	% of FY Treatment Acres
2020	High	3,448	6,169	9,617	45%
	Medium	2,907	6,391	9,298	43%
	Low	809	1,815	2,624	12%
	Total	7,164	14,381	21,545	
2021 (as of 10/19/2020)	High	572	3,106	3,678	55%
	Medium		1,671	1,671	25%
	Low		1,299	1,299	20%
	Total	572	6,077	6,649	
Grand Total		7,736	20,895	28,631	

E2SHB 1711 also directed DNR to provide a new 2-year prioritization for 2021-2023 biennium as shown in Table 10. A list of planned commercial and non-commercial forest health treatments for 2021-2023 biennium by DNR landscape and treatment type is provided in Appendix A.

Table 10. Planned Commercial and Non-Commercial Forest Health Treatment Acres on DNR Trust Lands for the 2021-2023 Biennium by 2020 Landscape Priority

Fiscal Year	2020 Landscape Priority	Planned Commercial Treatment Acres	Planned Non-Commercial Treatment Acres	Planned Total Treatment Acres	% of FY Planned Treatment Acres
2022	High	2,940	7,805	10,745	40%
	Medium	2,381	7,135	9,515	35%
	Low	1,115	5,562	6,677	25%
	Total	6,435	20,502	26,938	
2023	High	3,020	2,838	5,857	28%
	Medium	2,562	5,173	7,735	37%
	Low	989	6,463	7,453	35%
	Total	6,571	14,474	21,045	
Planned Biennium Total		13,006	34,976	47,982	

Some of the treatment acres reported in Tables 7 through Tables 10 may include multiple treatments on the same area of land. For example, a variable retention harvest may occur with a follow-up site preparation and planting on some or all of the same footprint.

Coordination with Nearby Landowners and Statewide DNR Assessments

Consistent with direction in E2SHB 1711, DNR has consulted with and taken into account the land management plans and activities of nearby landowners in planning, collaborative implementation, and monitoring of forest health work.

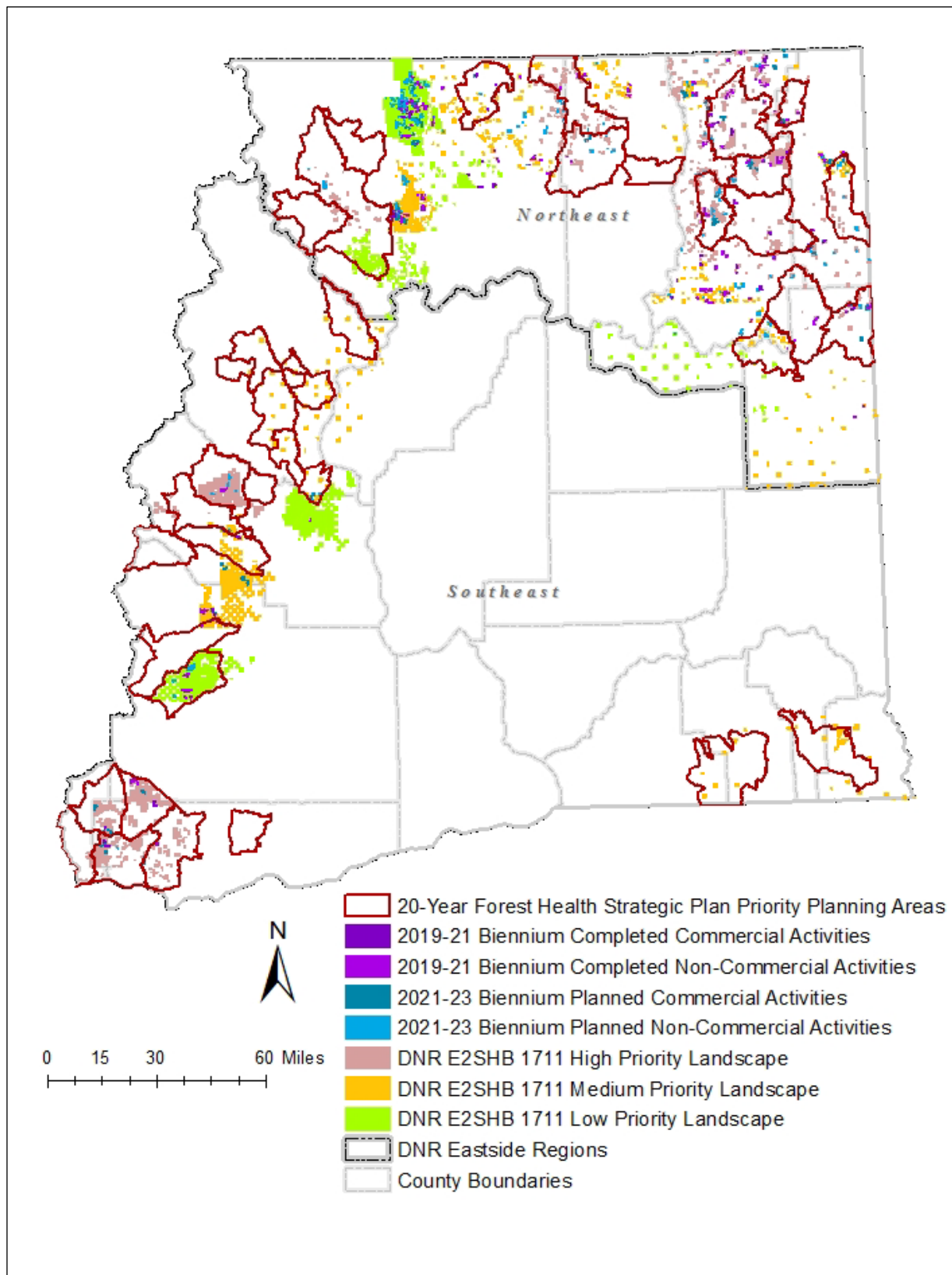
DNR's [20-Year Forest Health Strategic Plan](#) for eastern Washington takes an all-lands, all-hands approach that integrates the management of DNR state trust lands and that provides a collaborative setting to forest health prioritization and treatments on state trust lands. The forest health assessments at the regional and priority planning area scale identify and prioritize the treatment need across all-land ownerships. The monitoring and treatment tracking for the 20-Year Forest Health Strategic Plan for eastern Washington also increases agency awareness of planned and completed forest health treatments on adjacent state, federal, private, municipal, and tribal lands.

In addition, DNR staff at the Division and Region level engage directly with partners in forest collaboratives, fire-adapted communities, and direct partner coordination. For example, DNR is a founding signatory organization to the Tapash Sustainable Forest Collaborative in the Southeast Region alongside Washington Department of Fish and Wildlife, Yakama Nation, U.S. Forest

Service, and The Nature Conservancy. DNR's work with its partners - whether through a formal collaborative body, community engagement, or direct coordination - informs and integrates the work on state lands into a collective strategy to increase forest health and reduce wildfire risk across eastern Washington. For further information on DNR's all-lands approach to forest health, see DNR's legislative report "Forest health assessment and treatment framework (RCW 76.06.200)".

Figure 7 illustrates the nexus of DNR's completed and sold forest health treatments on state lands for 2019-2021 biennium and planned forest health treatments for 2021-2023 biennium in relation to the 20-year Forest Health Strategic Plan Priority Planning Areas.

Figure 4. Forest Health Treatments on DNR State Trust Lands for the 2019-2021 Biennium and the 2021-2023 Biennium with the 20-year Forest Health Strategic Plan Priority Planning Areas



Forest Health Treatment Case Study

A great example of collaborative forest health work has been happening in DNR's Southeast Region in the Elk Heights area between Cle Elum and Ellensburg. To date there have been three timber sales that were identified by the Tapash Sustainable Forest Collaborative as priority treatments in the Manastash-Taneum cross-boundary project. The most recent timber sale was used to head off a tussock moth outbreak that was killing Douglas-fir trees before it could become established on private nearby timberlands.

Image 4. Tussock Moth Outbreak on DNR State Trust Lands



By implementing these timber sales, some additional pre-commercial thinnings, and a fuel break in this area, DNR has improved forest health conditions and further protected several nearby communities from damage due to catastrophic wildfires in the coming years. Additionally, implementing these treatments created an improved road network, which will help recovering aquatic species, prevent sediment delivery to streams, and eliminate fish passage barriers.

Image 5. Tussock Moth Caterpillar



Image 6. After Timber Harvest and Pre-Commercial Thinning



Updating and Adjusting Prioritization

The DNR trust lands forest health landscape prioritization in this report reflects new information based on completed forest health activities, updated forest inventory, and changing conditions in the criteria that measure forest health. Due to these updates, landscapes may have changed priority or rankings since 2018.

As forest health treatments continue, and new information becomes available, it is likely that future reports will also have adjustments to the DNR trust lands forest health prioritization. Forest conditions can also change due to a number of factors outside of DNR's control, such as climate change, wildfire, and storm events. Future 6-year and 20-year prioritization lists are also likely to reflect these changes.

Funding

E2SHB 1711 ([RCW 79.64.130](#)) created the Forest Health Revolving Account, which directed all receipts from the proceeds of forest health treatment sales (as defined in the bill) and legislative transfers, gifts, grants, and federal funds to be deposited into the account.

The following is a summary of forest health related revenues and expenses, including those in the Forest Health Revolving Account, for FY 2018-2020.

Table 11. Forest Health Budget FY 2018-2020

Forest Health Revolving Account	FY18	FY19	FY20
Starting balance	-	\$4,115,121	\$12,131,878
Gross revenue	\$13,970,693	\$17,177,283	\$14,993,101
Commercial harvest contractor	\$8,026,011	\$6,806,439	\$5,661,632
DNR commercial	\$1,829,533	\$2,038,427	\$ 4,895,709
DNR non-commercial	\$29	\$315,660	\$2,329,039
Ending balance	\$4,115,121	\$12,131,878	\$14,238,599
Operating	FY18	FY19	FY20
DNR commercial	\$1,589,073	\$483,358	\$70,906
DNR non-commercial	\$1,934,832	\$349,600	\$26,611
Capital - State Building Construction Account	FY18	FY19	FY20
DNR commercial	-	\$224,198	\$137,703
DNR non-commercial	\$521,498	\$3,175,117	\$936,615

Also directed in E2SHB 1711 ([RCW 79.64.130](#)), any unobligated amounts less than \$10 million at the end of the *calendar year* are not subject to disbursement, but any unobligated amounts in

excess of \$10 million at the end of the calendar year must be disbursed to the appropriate trust beneficiaries.

Table 12 shows the ending balances of the Forest Health Revolving Account for calendar year (CY) 2017-2019. At the end of CY 2019, the ending balance exceeded \$10 million, but the obligated funds for CY 2020 resulted in the unobligated funds being below the \$10 million threshold.

Table 12. Forest Health Revolving Account End of Calendar Year Balances

Calendar Year	Forest Health Revolving Account ending balance	Unobligated Funds subject to disbursement	Obligated Funds towards the following calendar year
2017	\$0	N/A	N/A
2018	\$9,295,743	N/A	N/A
2019	\$15,304,870	N/A	\$7,630,933*

*Not including contractor payments

Table 13 provides recommended funding amounts required to carry out the listed planned treatment acres for the 2021-2023 biennium, including non-timber revenue sources.

Table 13. Forest Health Budget Requests and Projected Costs for the 2021-2023 Biennium

Forest Health Revolving Account	FY22	FY23
Starting balance	\$15,370,850	\$16,562,248
Gross revenue	\$14,500,000	\$14,100,000
Commercial harvest contractor	\$5,600,000	\$5,600,000
DNR commercial	\$3,743,462	\$3,743,462
DNR non-commercial	\$3,965,140	\$3,965,140
Ending balance	\$16,562,248	\$17,353,646
Operating	FY22	FY23
DNR commercial	\$75,000	\$75,000
DNR non-commercial	\$166,900	\$166,900
Total	\$241,900	\$241,900
Capital - State Building Construction Account	FY22	FY23
DNR commercial	\$115,000	\$115,000
DNR non-commercial	\$1,910,000	\$1,910,000
Post-wildfire research and monitoring	\$125,000	\$125,000
Total	\$2,150,000	\$2,150,000

Next Steps

DNR will continue to implement forest health treatments, conduct surveys, update data, and coordinate with nearby landowners towards achieving better forest health conditions on state trust lands and throughout eastern Washington as a whole. With continued resolve, hard work, and collaboration, DNR strives toward a future with healthy forests, robust rural economies, and valuable partnerships.

APPENDIX A: 2-Year Forest Health Treatments Prioritization

Forest health treatments on state trust lands in eastern Washington prioritized in the 2021-2023 biennium, listed by landscape, landscape priority, treatment type, and acres.

Non-commercial treatments include pre-commercial thinning (PCT), pruning (PRUNE), reforestation-hand planting (REFOR), site preparation, (SITE PREP), and vegetation management (VEG MGMT). See Appendix E for descriptions of forest health treatments.

DNR Landscape	2020 Landscape Priority	Commercial Treatment Acres Total	Non Commercial Treatment Acres					Non-Commercial Treatment Acres Total
			PCT	PRUNE	REFOR	SITE PREP	VEG MGMT	
Aeneas	Medium		567		107	470	901	2,045
Ahtanum	Low		1,536					1,536
Appleton	High	183						
Bodie	High		299		80	544	135	1,057
Buck Creek	High	576						
Carrs Corner	High		165		55	165		384
Cayuse	Medium				233		67	300
Cottonwood	High			31	28	142	27	228
Curlew	Medium		88					88
Douglas	High				249	498		746
Dunn	High	915	160		52	287		499
Elk	High	556	84		617	622	13	1,336
Espanola	Low		310				279	589
Evans	High	602			498	916		1,414
Fruitland	Medium	245	1,554		275	565	217	2,611
Furport	High		447					447
Glenwood	High	309						
Ione	High	508						
Jumbo	Medium	679	388		104	104		596
Leadpoint	Medium	186	429					429
LeClerc	Medium	487	498	159	8	121	22	808
Lime	High	193	317			47		364
Little Pend Oreille	High		209					209
Loomis	Low	2,104	5,027	50	1,240	1,364	1,029	8,709
Loup Loup	Medium	1,720	310		475	64	58	907
Miles	Low		65					65
Molson	Medium		52		80	233	356	721

DNR Landscape	2020 Landscape Priority	Commercial Treatment Acres Total	Non Commercial Treatment Acres					Non-Commercial Treatment Acres Total
			PCT	PRUNE	REFOR	SITE PREP	VEG MGMT	
Naches/Wenas	Medium	1,248	468					468
Narcisse	High	565	422					422
Orient	High	25						
Orin	High		184	19		0		204
Patterson	High					10		10
Rattlesnake Creek	High				47			47
Republic	High	501			299	403	22	724
Rice	High		198	20	0	0		218
Stemilt	Medium	378	679					679
Synarep	Low				292	835		1,127
Taneum	Medium				183		77	260
Teanaway	High		477					477
Three Forks	High	59						
Tonasket	Medium				23	114	204	341
Trout Lake	High	619						
Tum Tum	Medium		150		394	1,497	14	2,055
Twisp	High						672	672
Usk	High	349	415		150	618		1,183
Grand Total		13,007	15,499	279	5,490	9,617	4,092	34,976

APPENDIX B: 6-Year Prioritization

DNR landscapes in eastern Washington prioritized for forest health treatments over the next six years.

Landscape	Landscape Acres	Forested Acres	2020 Priority Ranking	2020 Landscape Priority	20-Year Forest Health Priority Planning Areas*
Ahtanum	82,650	68,842	49	Low	Ahtanum, Tieton
Appleton	15,291	13,426	4	High	Klickitat, White Salmon
Bodie	15,154	10,406	23	High	Toroda-Tonata
Buck Creek	21,691	21,518	1	High	Little White, Trout Lake, White Salmon
Colockum	60,983	37,866	50	Low	Stemilt
Curlew	11,638	9,395	33	Medium	Toroda-Tonato
Dunn	21,773	20,000	18	High	Chewelah, Stranger
Elk	10,384	8,989	13	High	Mt. Spokane, Deer Park
Evans	11,913	10,806	12	High	Mill Creek
Fruitland	21,684	18,639	41	Medium	
Furport	3,513	2,846	14	High	Trail
Glenwood	36,273	35,929	9	High	Glenwood, Klickitat, Trout Lake
LeClerc	10,753	10,061	31	Medium	Trail
Little Pend Oreille	17,598	16,797	8	High	Mill Creek, Little Pend Oreille
Loomis	134,524	115,010	48	Low	
Loup Loup	57,328	48,419	46	Medium	Methow Valley
Naches/Wenas	88,548	62,590	38	Medium	Tieton, Manastash Taneum
Narcisse	7,834	7,161	21	High	Mill Creek, Little Pend Oreille
Rattlesnake Creek	9,868	9,694	3	High	Glenwood, Trout Lake, White Salmon
Republic	13,486	9,835	17	High	Republic, Toroda-Tonata
Rockford	9,286	3,854	47	Medium	
Stemilt	4,583	3,870	39	Medium	Stemilt
Taneum	8,340	7,906	10	Medium	Cle Elum, Teanaway, Manastash Taneum
Twisp	8,359	3,951	28	High	Methow Valley, Twisp River
Usk	10,499	9,330	15	High	Chewelah, Deer Park

*Indicates an overlap between DNR-managed landscapes and 20-Year Forest Health Strategic Plan Priority Planning Areas, which are watersheds prioritized under 2SSB 5546.

APPENDIX C: 20-Year Prioritization

DNR landscapes in eastern Washington prioritized for forest health treatments over the next twenty years.

DNR Landscape	Region	2020 Landscape Priority	Priority Rank	Landscape Acres	Forested Acres	20-Year Forest Health Priority Planning Areas*	Sum of Early-Closed and Mid-Closed Acres
Buck Creek	Southeast	High	1	21,691	20,430	Little White, Trout Lake, White Salmon	14,225
Trout Lake	Southeast	High	2	18,567	17,067	Glenwood, Trout Lake, White Salmon	10,677
Rattlesnake Creek	Southeast	High	3	9,868	8,954	Little White, Trout Lake, White Salmon	6,147
Appleton	Southeast	High	4	15,291	12,767	Klickitat, White Salmon	5,776
Cabin Creek	Southeast	High	5	3,879	3,544	Cle Elum	1,495
Marble	Northeast	High	6	5,649	4,927	Mill Creek	1,251
Teanaway	Southeast	High	7	52,518	47,969	Cle Elum, Teanaway, Upper Swauk	14,428
Little Pend Oreille	Northeast	High	8	17,598	16,509	Mill Creek, Little Pend Oreille	7,047
Glenwood	Southeast	High	9	36,273	35,146	Glenwood, Klickitat, Trout Lake	7,192
Cottonwood	Northeast	High	11	8,795	8,024	Chewelah, Deer Park	1,547
Evans	Northeast	High	12	11,913	10,628	Mill Creek	1,523
Elk	Northeast	High	13	10,384	9,434	Mt. Spokane, Deer Park	3,018
Usk	Northeast	High	15	10,499	9,156	Chewelah, Deer Park	2,968
Wenatchee	Southeast	Medium	16	27,273	14,234	Chumstick to LP, Mad Roaring Mills, Nason Creek, Stemilt, Tillicum, Upper Wenatchee, Chelan, Mission	1,756
Dunn	Northeast	High	18	21,773	18,575	Chewelah, Stranger	4,087
Rice	Northeast	High	19	11,025	9,521	Stranger	1,106
Lime	Northeast	High	20	8,469	7,997		2,136
Narcisse	Northeast	High	21	7,834	7,420	Mill Creek, Little Pend Oreille	1,939
Patterson	Northeast	High	24	5,061	4,407		2,359

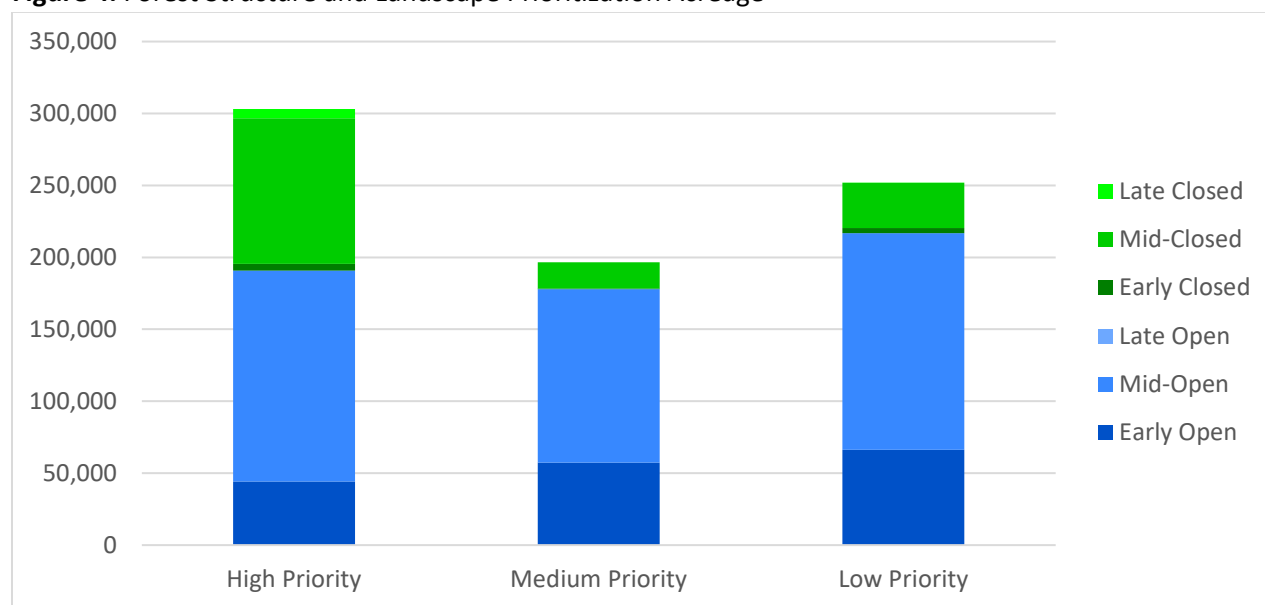
DNR Landscape	Region	2020 Landscape Priority	Priority Rank	Landscape Acres	Forested Acres	20-Year Forest Health Priority Planning Areas*	Sum of Early-Closed and Mid-Closed Acres
Douglas	Northeast	High	25	6,044	5,237	Mill Creek	1,176
Ione	Northeast	High	30	5,460	5,267	Ione	1,340
LeClerc	Northeast	Medium	31	10,753	10,218	Trail	3,122
Curlew	Northeast	Medium	33	11,638	9,309	Toroda-Tonata	2,065
Jumbo	Northeast	Medium	34	8,871	7,188		1,102
Naches/Wenas	Southeast	Medium	38	88,548	48,514	Tieton, Manastash Taneum	3,767
Fruitland	Northeast	Medium	41	21,684	20,215		1,191
Loomis	Northeast	Low	48	134,524	112,763		16,828
Ahtanum	Southeast	Low	49	82,650	57,019	Ahtanum, Tieton	7,795

**Indicates an overlap between DNR-managed landscape and 20-Year Forest Health Strategic Plan Priority Planning Areas, which are watersheds prioritized under 2SSB 5546.*

APPENDIX D: Forest Structure

The first factor used to determine forest structure is canopy cover. An “Open” canopy is defined as having less than 60% canopy cover, and “Closed” is defined as stands with greater than 60 percent canopy cover. Canopy cover is a measure of the proportion of ground surface area that contains tree canopy directly above the ground at any height with a maximum value of 100 percent. Stands with greater canopy cover often contain larger trees and/or a greater number of trees per acre. In both cases, as the canopy cover increases the between-tree competition for resources in the stand increases, which can lead to decreased growth, increased risk of mortality, and decreased resilience to pathogens.

Figure 4. Forest Structure and Landscape Prioritization Acreage



Source: RS-FRIS Forest Inventory System, WA DNR Forest Resources Division

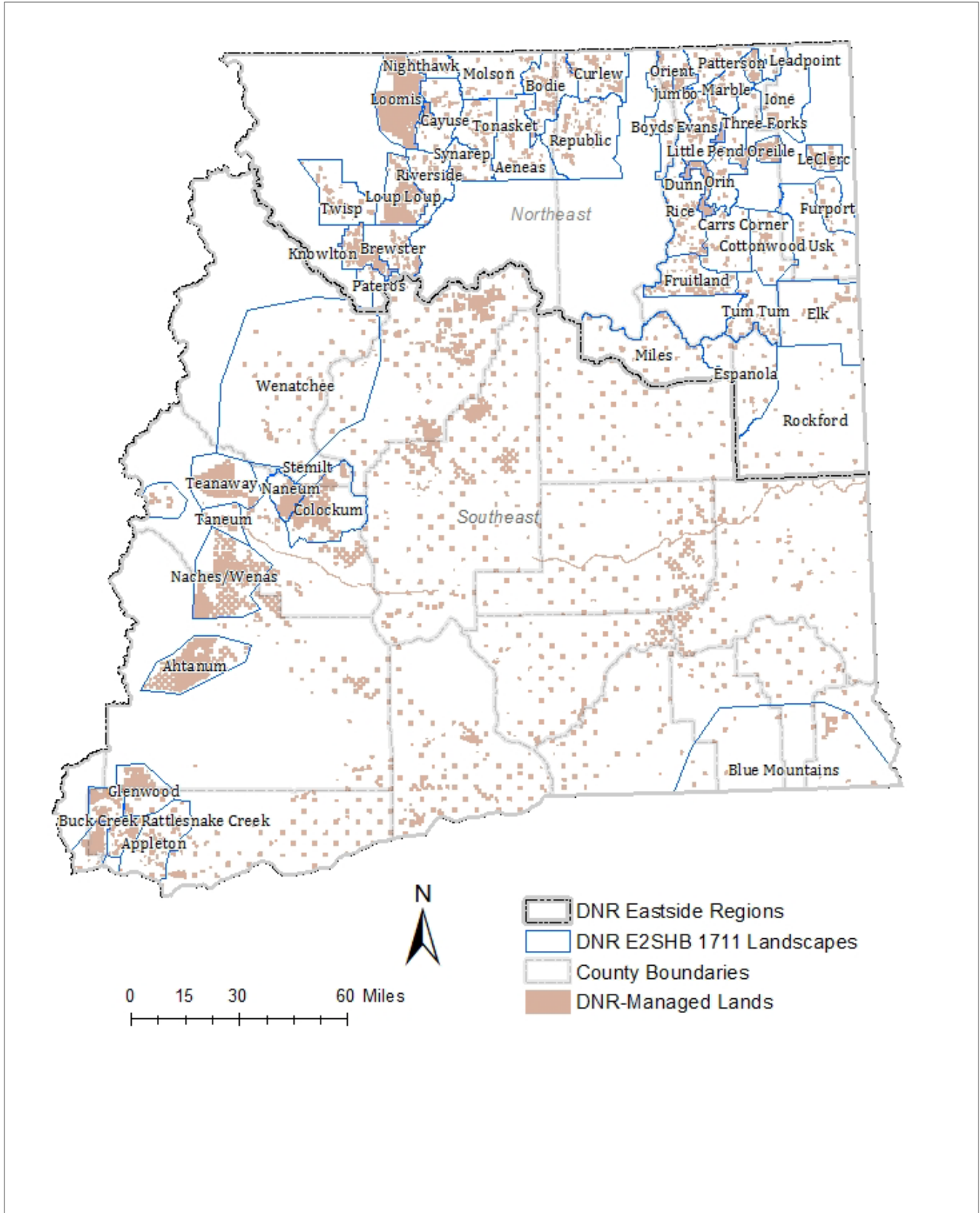
Canopy cover can be reduced with various commercial and non-commercial treatments including variable retention harvest, pre-commercial thinning, commercial thinning, variable density thinning, and shaded fuel breaks. The use of pruning or prescribed fire may also reduce canopy cover though canopy cover reduction is generally not the primary goal of these treatments.

Another key element in determining forest structure in this analysis is the stage of forest succession. Forest succession is a natural process of growth and change after a major disturbance such as timber harvest or wildfire. This analysis measures the quadratic mean diameter (QMD) of the average tree in a stand at breast height (4.5 feet above soil surface). QMD can be used as a surrogate for age as it reflects the biologic condition of the forest when used with other metrics such as canopy cover.

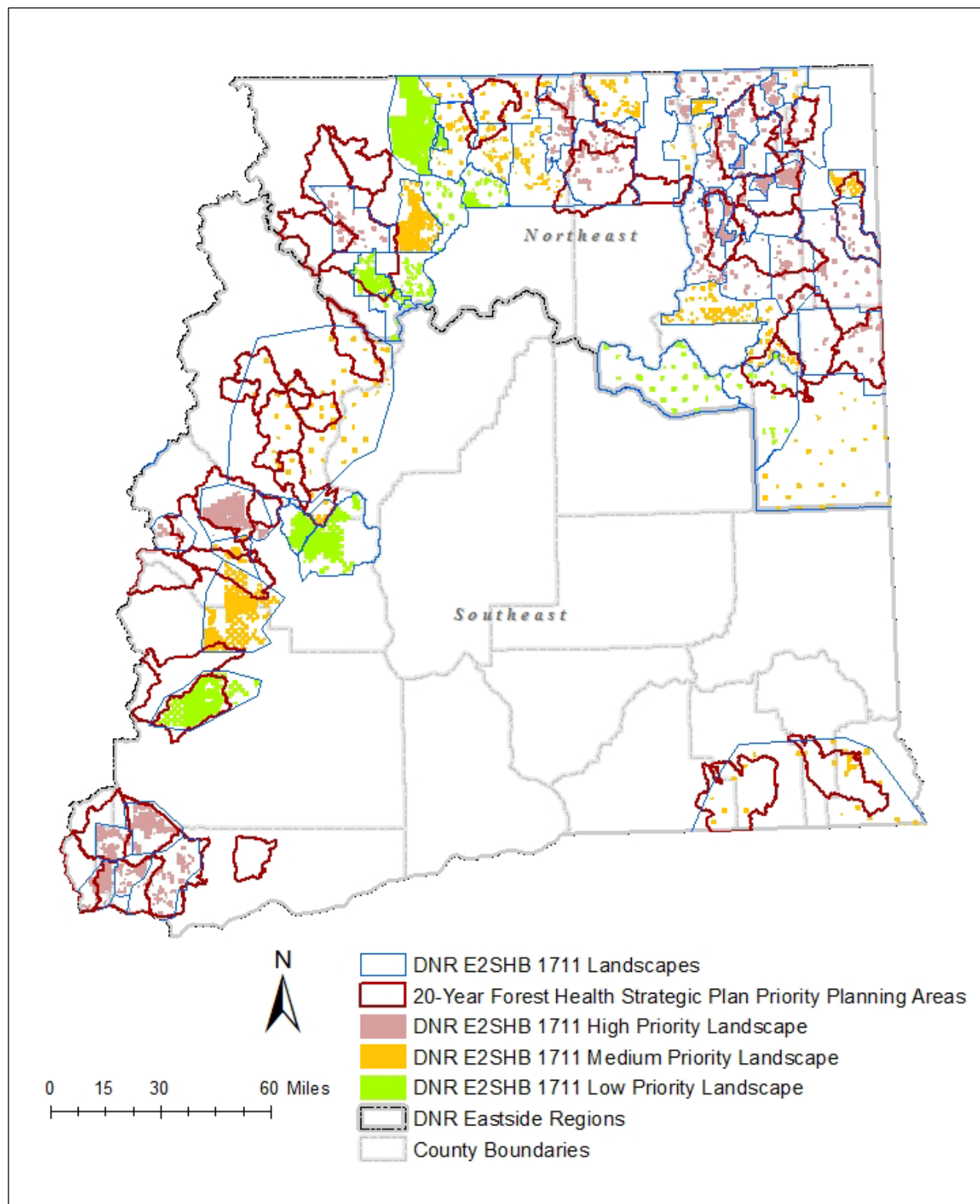
Stands with a QMD less than 10 inches are considered “Early” and are generally only suitable for non-commercial treatments such as pre-commercial thinning, pruning, and possibly prescribed burning. The small size of the trees in these stands does not allow for commercial utilization of logs from these treatments. Stands with a QMD between 10 inches and 20 inches are considered “Mid-” while stands with a QMD greater than 20 inches are considered “Late”.

Stands in the “Mid-” and “Late” categories are more likely to be suitable for commercial treatments, such as commercial thinning, variable density thinning, and regeneration harvest. They might also be suitable for non-commercial treatments, such as prescribed burning, road realignment and maintenance, as well as shaded fuel breaks. Stands in the “Early” categories are more likely to be considered for non-commercial treatments. Proper treatment selection within these categories relies upon the knowledge of local field staff to assess the stand condition, species present, and forest health concerns, as well as operability and market feasibility.

APPENDIX E: DNR's Landscapes in Eastern Washington



APPENDIX F: DNR's Landscapes and 20-Year Forest Health Strategic Plan Priority Planning Areas



APPENDIX G: Commercial and Non-Commercial Forest Health Treatment Descriptions

Commercial thinning – A commercial thinning reduces stand density prior to competition-induced mortality occurring within the stand. Trees removed are of commercial value and are removed from the site. In general, commercial thinnings remove the smaller trees, leaving the biggest and healthier crop trees or remove trees of all size classes. Residual trees are selected based upon species priorities, individual tree health, and growth potential, as well as habitat potential.

Pest management – Monitoring and managing forest pests using preventative, biological, cultural, and/or chemical techniques to reduce pest damage below levels of concern.

Pre-commercial thinning (PCT) – Stand density reduction treatment conducted in young stands that do not yet contain merchantable-size trees (generally less than 6 inch diameter at stump height) with the objective of removing trees which will likely succumb to competition-induced mortality and allow for greater resource allocation (water, nutrients, and sunlight) to remaining trees.

Prescribed burning – The intentional, controlled application of fire to a forested areas to accomplish specific objectives, including site preparation, understory maintenance, influence overstory species composition, and reduce fuel loading

Pruning – Removing branches flush with the tree trunk to improve health of tree, increase commercial value, hasten maturity, and reduce certain forest health and fine fuels risks.

Reforestation – Following a stand-replacing disturbance, the stand will be “regenerated” through natural or artificial methods. Natural regeneration relies upon residual trees and seed banks to populate the freshly bare ground with seedlings. Although natural regeneration uses seed from local trees, the seed distribution and seed germination success can be highly variable. Following timber harvest, the most common method of regeneration is hand planting of seedlings. The seedling specie is chosen based upon the natural conditions of the site to ensure success in obtaining stand objectives. Seeds for the planted seedlings are from a similar geographic location and elevation to ensure genetic resources that are consistent with local conditions. Although natural regeneration results in a range of <50 trees per acre to more than 1000 trees per acre artificial regeneration, usually requires hand planting of 150 to 550 trees per acre, depending upon species and site conditions.

Shaded fuel breaks/hazard abatement – Used to mitigate the threat of wildfire in areas where natural fire regimes have been suppressed, leading to a dangerous buildup of combustible vegetation. This can be described as a strategically located wide block or strip in which dense, heavy, or highly flammable vegetation is removed or changed to one of lower fuel volume or reduced flammability. This can be done by altering surface fuels, increasing the height to the base of the live crown, and opening the tree canopy. These are different from a firebreak, which tends to be narrower than a shaded fuel break.

Site preparation – Site preparation is used to prepare planting spots and control competing vegetation to allow for increased water, nutrients, and light to planted trees to increase survival and growth in the first two to three years after planting. Site preparation can include manual weed cutting, mechanical treatments such as mastication, tilling, or brush pulling, as well as herbicide treatments.

Uneven-aged management – A silvicultural system in which multiple thinning treatments are implemented over several decades with the intent of managing for total stand density to reduce competition induced mortality while providing openings for natural or planted seedlings to grow with an end goal of a stand with multiple age classes, crown levels, and species.

Variable density thinning – Variable density thinnings can be an intermediate treatment when utilizing even-aged or uneven-aged management. Variable density thinnings are often conducted after trees have reached at least 40 years old and are designed to reduce stand density while encouraging vertical and horizontal heterogeneity by leaving “skips” in which no trees are removed and “gaps” in which all trees are removed with the intent of reforestation or recruitment of desired shrub species within the “gap”. Residual trees are generally selected to retain desired species, larger trees, and trees with potential wildlife habitat value. Variable density thinnings often result in removal of merchantable pulp and saw logs.

Variable retention harvest – Harvest technique based on the natural model of biological tendencies that are typically left behind following natural disturbances such as wildfire, wind, and flood. It is the primary silvicultural approach used by DNR, which emphasizes retaining at least 20 trees per hectare (6 trees per acre) in a mix of dispersed and aggregated spatial patterns, providing no major voids within timber units. The overall objective is to maintain and promote large, structurally unique trees, snags, and down wood over time.

Vegetation management – Vegetation management is the removal of competing species from young stands to allow for increased water, nutrients, and light for planted and naturally regenerated trees, usually conducted within the first decade after a regeneration harvest.

APPENDIX H: Aerial Insect and Disease Detection Survey Methods and Reporting Categories

The annual insect and disease aerial detection survey (ADS) in Washington is conducted by the USDA Forest Service (USFS) in cooperation with DNR and has been ongoing since 1947.

From a fixed-wing aircraft, observers record polygons (fixed areas) or points where recently killed or defoliated trees are visible from the air. Polygons are coded with the most likely damage-causing agent and a measure of damage intensity. Some polygons may be coded with more than one damage agent. The damage codes assigned are inferred from “signatures” of tree size, species, crown color, and pattern of damage. Signature recognition is developed through training and ground observations. Unknown signatures are prioritized for ground-checking, but most damage polygons are not ground-checked. Some damage signatures attributed to a specific pest may have other causes. It is challenging to accurately identify and record damage observations at this large scale. Mistakes can occur and sometimes the wrong pest may be identified.

For reporting purposes, damage agents are assigned to four damage type categories: mortality agents, defoliating insects, foliar diseases, and abiotic/animal/root disease.

Mortality agents are primarily nine different species of tree-killing bark beetles that include mountain pine beetle, western pine beetle, Douglas-fir beetle, fir engraver, spruce beetle, and others. This category also includes mortality in tree species that are rarely killed by bark beetles that can't be attributed to a specific causal agent. These include the “dying hemlock” and “dying cedar” codes. Balsam woolly adelgid is an aphid-like sucking insect that is sometimes categorized as a mortality agent.

Defoliating insects are a wide variety of insect pests that feed on tree foliage by chewing, sucking sap, or mining inside foliage, causing enough damage and discoloration to the crown that it is visible from the air. Chewing defoliators are primarily moth caterpillars such as western spruce budworm, Douglas-fir tussock moth, larch casebearer, western hemlock looper, and tent caterpillars, but also include sawfly larvae. Sucking defoliators include aphids, scale insects, and adelgids such as spruce aphid, black pineleaf scale, and balsam woolly adelgid. Leaf or needle miners include aspen leaf miner and ponderosa needle miner.

Foliar diseases include needle casts, needle blights, and rusts caused by fungal pathogens that discolor foliage, such as Swiss needle cast, larch needle cast, pine needle casts, larch needle blight, poplar rust, and white pine blister rust. This category also includes hardwood declines that cause crown dieback attributed to more than one agent, such as Pacific madrone decline, maple decline, aspen decline, and oak decline.

The **abiotic/animal/root disease** category includes several weather-related or non-biological causes of tree mortality, such as windthrow, flooding, frost damage, hail damage, landslides, and wildfire. Wildfire damage is often only recorded in aerial survey if it is associated with other damage agents, such as bark beetles. This category also includes bear damage, which results in scattered mortality in young conifer stands; that signature is also seen frequently due to root disease. Mortality from root diseases in mature stands is difficult to detect from the air, but is also included in this category. Damage polygons coded as bark beetles may sometimes be related to root disease centers.