# Landscape Assessment to Identify and Manage Structurally Complex Stands to Meet Older-Forest Targets in Western Washington

Washington State Department of Natural Resources | May 7, 2024

## Summary

The Washington Department of Natural Resources (DNR) actively manages suitable forest stands to achieve, over time, older-forest structures across 10 to 15 percent of each 1997 *State Trust Lands Habitat Conservation Plan* (HCP) planning unit in western Washington. These "older-forest targets" are described in DNR's *Policy for Sustainable Forests* (PSF).

This document (2024 Landscape Assessment) provides updated projections on the amount of older-forest stands, as defined by the PSF and discussed in this document, that will develop in western Washington by 2100 as a result of implementing landscape-level management strategies. It describes how DNR has implemented these landscape-level management strategies at the HCP planning unit scale, and how DNR has identified and prioritized suitable stands to be managed to meet older-forest targets.

This document is an update to a landscape assessment titled "Identifying Stands to Meet Older-Forest Targets in Western Washington" dated May 11, 2021 (2021 Landscape Assessment). This 2024 Landscape Assessment:

- Utilizes the same methodologies and data sources as the 2021 Landscape Assessment, which are discussed in Part 2 of this document.
- Refines and updates conservation areas from the 2021 Landscape Assessment, including the addition of newly designated areas, to better identify areas deferred from stand replacement harvest. Conservation areas include areas being conserved under the HCP; Natural Areas such as Natural Resource Conservation Areas and Natural Area Preserves; areas deferred by the PSF; and areas conserved under the Forest Practices Act.
- Updates the results tables from the 2021 Landscape Assessment that detail DNR's projected timeline for reaching the PSF's older-forest targets to reflect the refined and updated conservation areas.

As with the 2021 Assessment, DNR identified and designated the forest stands that will contribute to older-forest targets within its GIS spatial database. The identified stands are also illustrated on the maps in Appendix 2. The identified stands comprise some existing, suitable structurally complex stands, and additional stands suitable to be managed for older-forest targets over time. The identified stands are all located within conservation areas.

# Part 1: Overview of DNR's Management Framework

Development of older-forest structures is an expected outcome of DNR's management under the HCP and a policy objective of the PSF. DNR also analyzed stand structure as part of its consideration of alternatives for the 2004 Sustainable Harvest Level calculation. For more information on older-forest structure, refer to Part 2, Identifying Older-Forest Stands.

## *Habitat Conservation Plan*

The HCP mentions stand structure in the Multispecies Conservation Strategy for Unlisted Species. Specifically, the HCP discusses the likely outcomes of DNR's management under the HCP:

> DNR has modeled the age-class distribution that will likely result from expected management under the HCP and existing policies. Results from this modeling have been used to develop a table (refer to HCP Table IV.14) of ranges of expected percentages of each of several forest habitat/structural types, using age-class as a surrogate, that would likely exist 100 years following implementation of such management (HCP pg. IV.179).

The HCP uses age classes as a surrogate for stand structure. Specifically, it utilizes an age of 150 years in the five west-side planning units, and 200 years in the Olympic Experimental State Forest (OESF) as representative of a stand in the fully functional stand stage. In the HCP's analysis, the modeling projected that forest stands in the fully functional stand stage would occur on approximately 10 to 15 percent of the five west-side planning units and the OESF after 100 years of HCP implementation (in other words, by 2097).

## *Sustainable Harvest Calculation*

The 2004 *Final Environmental Impact Statement on Alternatives for Sustainable Forest Management of State Trust Lands in Western Washington and for Determining the Sustainable Harvest Level* (2004 Sustainable Harvest FEIS) includes an analysis of forest stands over time using eight stand development stages. (Refer to Appendix 1 of this document for forest inventory queries used to identify stand development stages in the 2004 Sustainable Harvest FEIS.) The Board of Natural Resources adopted its preferred alternative, which includes a proposed policy change, in Resolution 1110:

> The proposed Preferred Alternative would target 10 to 15 percent of each westside HCP Planning Unit as older forests based on structural characteristics. The desired structural characteristics are represented by stand development classes understory development through old natural forests (as described in the Sustainable Forest Management DEIS)." (Resolution 1110, pg. 3 of Document 2). The 2004 Sustainable Harvest FEIS defined structurally complex stands as those stands in the botanically diverse, niche diversification, and fully functional stages of stand development (2004 Sustainable Harvest FEIS, pg. 4-22).

The FEIS further indicates that the preferred alternative includes a proposed policy to "Manage 10-15% of each Planning Unit in Mature Forest Component" (2004 Sustainable Harvest FEIS, pg. 4-23 Table 4.2-

12). The proposed policy was analyzed within the 2004 Sustainable Harvest FEIS, and then later adopted with the then-anticipated PSF (which was an update to the 1992 *Forest Resources Plan*):

> The policies amended through the Final Environmental Impact Statement on Alternatives for Sustainable Forest Management of State Trust Lands in Western Washington (2004) have already been analyzed and adopted by the Board of Natural Resources and will be included in the PSF" (Final Environmental Impact Statement on the Policy for Sustainable Forests [PSF FEIS] pg. 1-3).

## *Policy for Sustainable Forests*

The Board of Natural Resources adopted the PSF in 2006. The PSF contains a suite of landscape-level management strategies, including the General Silvicultural Strategy, which adopted the proposed policy analyzed in the 2004 Sustainable Harvest FEIS (PSF pg. 46). The PSF states that "DNR intends to actively manage suitable structurally complex forests to achieve older-forest structures across 10 to 15 percent of each western Washington HCP planning unit in 70 to 100 years." Meeting older-forest targets within 70 to 100 years equates to target dates of 2076 to 2106. The PSF emphasized that DNR anticipates reaching the older-forest targets over time. The PSF, relying on the analysis in the 2004 Sustainable Harvest FEIS (pg. 3-44), states, "Older-forest structures that contribute to this target are represented by stands in the fully functional or niche diversification stage of stand development." It also states that, "Through landscape assessments, the department will identify suitable structurally complex forest stands to be managed to help meet older-forest targets" (PSF pg. 47).

DNR will identify stands to be managed to achieve older-forest structures in conservation areas. As noted earlier, conservation areas include Natural Areas; areas conserved under the HCP, areas deferred from harvest by the PSF, and areas conserved under the Forest Practices Act.

# Part 2. Identifying Older-Forest Stands

## *Definitions and Query Criteria*

In the 1990s and 2000s, several research teams developed and published definitions of stand development stages for Pacific Northwest forests (for example, Carey and Curtis 1996, Oliver and Larson 1996, and Franklin and others 2002, refer to references at the end of this document). These definitions are also used in the description of the policy in the PSF FEIS.

Older-forest stands are defined as those in the "niche diversification" or "fully functional" stand-development stages (PSF FEIS pg. 3-177). However, the published literature did not provide guidance about how to identify these stands based on forest inventory data.

To address this issue, DNR developed stand-level variables and associated threshold values that can be applied to DNR's inventory data to identify forests in these two stand development stages. The variables were based on the type of inventory data that DNR collects. This work was done as part of the 2004 Sustainable Harvest FEIS and was based on scientific literature. Using these variables and threshold values, DNR was able to identify stands in these stand development stages across the landscape. Table

B.2.2-2 of the 2004 Sustainable Harvest FEIS provides the stand-development stages and representative stand-level variables and associated threshold values used in the project and is also included in Appendix 1 of this document.

DNR conducted this 2024 Landscape Assessment to monitor forest conditions existing on the landscape. For this work, DNR used the definitions of stand development stages adopted in the PSF and queried them using the identified, representative stand-level variables and associated threshold values as shown in Appendix 1.

DNR did not use descriptions or methods of identifying these forests that were produced after the 2004 Sustainable Harvest FEIS. For example, *Identifying Mature and Old Forests in Western Washington* (Van Pelt 2007), and environmental impacts statements for the *South Puget Forest Land Plan* (DNR 2010), *OESF Forest Land Plan* (DNR 2016), and the 2019 sustainable harvest level (DNR 2019) used different methods to classify stand development and older-forest stands for the purposes of those analyses. Van Pelt (2007) also provides a method to identify older-forest stands and trees in the field. The descriptions and analyses in these documents complement but do not redefine the direction set in the PSF or any of the strategies or policies contained in the PSF.

## *Identification of Suitable Stands*

The HCP projected that the 10 to 15 percent older-forest structure target will likely be achieved over time through implementation of its conservation strategies (HCP IV.179). The HCP's projection is based on the premise that fully functional structure is likely to develop in riparian zones, wildlife habitat, and other areas conserved by the HCP. The PSF directs DNR to manage suitable stands to meet older-forest targets, as defined in the PSF (PSF pg. 46). The PSF notes that "the size of the stand, its proximity to old growth or other structurally complex forest stands, or the scarcity of old growth or other structurally complex forest stands are all factors in determining whether a stand is suitable for contributing to older-forest targets" (PSF pg. 46).

DNR manages approximately 1.6 million acres of forested land in western Washington under the HCP. Approximately 681,000 acres (43 percent) of that land is permanently deferred from harvest by the HCP or PSF or has been incorporated into a Natural Area. These conserved areas provide good connectivity with other conserved and federal land, may be centered around old growth, provide optimal wildlife habitat, and contain the majority of older-forest structure on DNR-managed lands. Based on these factors, DNR has determined that conserved areas are the most suitable places to manage for older-forest targets.

While some of the forest stands DNR has identified to be managed for older-forest structure are not currently structurally complex, DNR anticipates that all identified stands will reach the niche diversification or fully functional stand development stage between 2076 and 2106. Stands within conserved areas that are capable of achieving older-forest structure within the anticipated time frame were prioritized over existing structurally complex stands in general ecological management areas (areas that are generally available for harvest) because their heightened connectivity to existing older forest make them more suitable to be managed to meet the older-forest targets.

# Analysis

Following is an updated analysis that was completed by applying the stand-development stage stand-level variables and associated threshold values from the 2004 sustainable harvest FEIS to DNR’s inventory data from 2021. The methods in this 2024 Landscape Assessment are the same as those used in the 2021 Landscape Assessment, with modifications to the conservation areas.

## Methods

In both the 2021 and 2024 landscape assessments, DNR developed queries based on the stand-level variables and associated threshold values defined in the 2004 Sustainable Harvest FEIS. These queries were applied to DNR’s forest inventory data and allowed DNR to identify stands (including older-forest stands) across the landscape.

The stand-level variables and associated threshold values in 2004 Sustainable Harvest FEIS were designed for use with DNR’s plot-based inventory. In 2017, DNR changed the inventory system from a fully plot-based system to a system called RS-FRIS that pairs plots with remote sensing data. Due to this change in methods, the data are not structured in the same manner. As a result, DNR modified the data queries to be compatible with RS-FRIS Version 3.

## Conserved Areas

For the 2021 Landscape Assessment, DNR identified conserved areas using the large data overlay. Conserved areas included Natural Areas; areas conserved under the HCP, including long-term forest cover designated under the marbled murrelet long-term conservation strategy, riparian areas, areas conserved under the multispecies conservation strategy, potentially unstable slopes, and spotted owl nest patches; areas deferred from harvest by the PSF, including old-growth forest; and areas conserved under the Forest Practices Act.

In preparing this 2024 Landscape Assessment, DNR included recently designated Natural Areas and newly identified old-growth forest in the delineated conserved areas. Further, DNR added 2,000 acres of forests designated to be set aside to the conserved areas under the fiscal year 2023-25 Capital Budget (Chapter 474, Laws of 2023, Section 3130). Lastly, DNR removed areas that are not permanently deferred, such as suitable northern spotted owl habitat that will be available for harvest once habitat thresholds are met, from the delineated conserved areas.

This 2024 Landscape Assessment confirms that DNR is on track to achieve the PSF’s older-forest targets through implementation of the HCP and other conservation strategies within 100 years, by prioritizing and designating suitable structurally complex stands within conservation areas. Accordingly, DNR has not included areas outside of conservation areas to be managed to reach the PSF’s older-forest targets.

## Key Metrics

### *Max RD Age*

A key starting point for identifying older-forest stands is "max RD age." This is the age at which unthinned stands reach their maximum relative density (RD)[1]. DNR used yield curves[2] developed for the 2019 sustainable harvest calculation to determine max RD age. These yield curves are produced by the Forest Vegetation Simulator (Dixon 2002) and adjusted to fit growing conditions on DNR-managed lands in Western Washington, based on a comparison with inventory plot data. DNR has yield curves for three cover types (Douglas-fir, red alder, and western hemlock) and four site index classes[3].

In this analysis, DNR used the max RD age for each of these cover types and site index classes. Since stands in Western Washington tend to stay at or near max RD age for many decades, DNR defined max RD age as the point at which the RD yield curve levels off. The 2004 Sustainable Harvest FEIS defined the niche diversification stage, in part, as stands at least 80 years older than the max RD age, and the fully functional stage as stands at least 160 years older than the max RD age.

**Table 1. Age of max RD for the three forest cover types and four site index classes on DNR managed land (refer to DNR 2019 Appendix F for more details).**

| Cover type | Site index class | Max RD age |
|---|---:|---:|
| Douglas fir | 1 | 43 |
| Douglas fir | 2 | 43 |
| Douglas fir | 3 | 44 |
| Douglas fir | 4 | 47 |
| Red alder | 1 | 44 |
| Red alder | 2 | 43 |
| Red alder | 3 | 43 |
| Red alder | 4 | 44 |
| Western hemlock | 1 | 46 |
| Western hemlock | 2 | 44 |
| Western hemlock | 3 | 48 |
| Western hemlock | 4 | 50 |

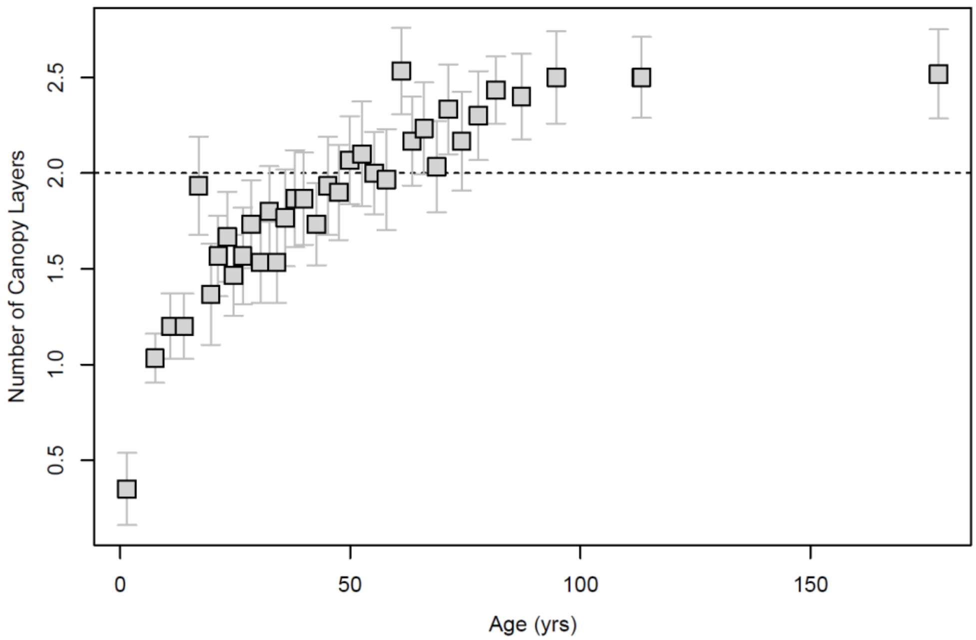
### *Canopy Layers*

Both the niche diversification and fully functional stand development stages can be defined in part by the presence of more than one canopy layer. Figure 1 shows the average number and variability of canopy

[1] Relative density (RD) is a quantification of the current density of a forest stand in comparison to a maximum level.
[2] A yield curve projects the volume growth of a forest over time.
[3] Site index describes the potential for trees to grow at a particular location.

layers in stands of different ages. By about age 80, stands average over 2 canopy layers, with 90 percent confidence intervals above 2 layers.

**Figure 1. Canopy layers by age from DNR inventory plots. Each box represents the average of 30 plots. Lines show 90 percent confidence intervals.**




### *Legacy Structures*

The niche diversification and fully functional stand development stages include biological legacies in the form of snags and woody debris. DNR's data show that stands roughly 90 years old and older average more than 3 snags per acre that are over 20 inches in diameter, with 90 percent confidence intervals extending only slightly below 3 snags per acre (Figure 2). Likewise, stands over 115 years old average more than 2,400 cubic feet of dead and down woody debris per acre (Figure 3).

**Figure 2. Number of snags greater than or equal to 20 inches by age from DNR inventory plots. Each box represents the average of 30 plots. Lines show 90 percent confidence intervals.**

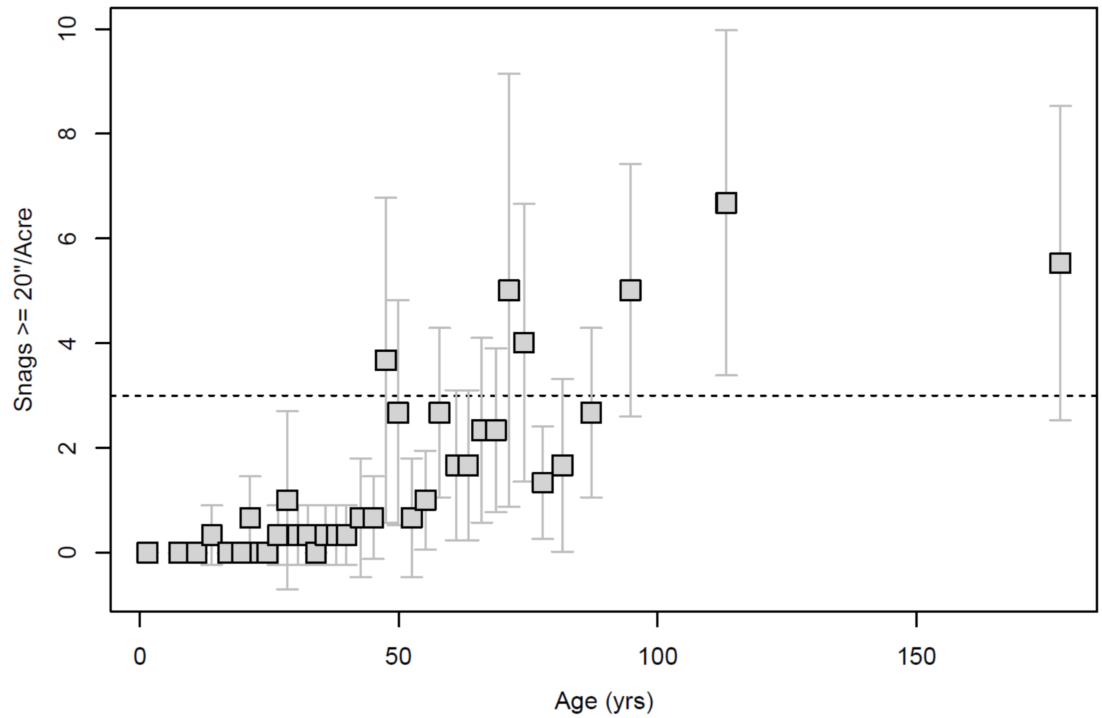
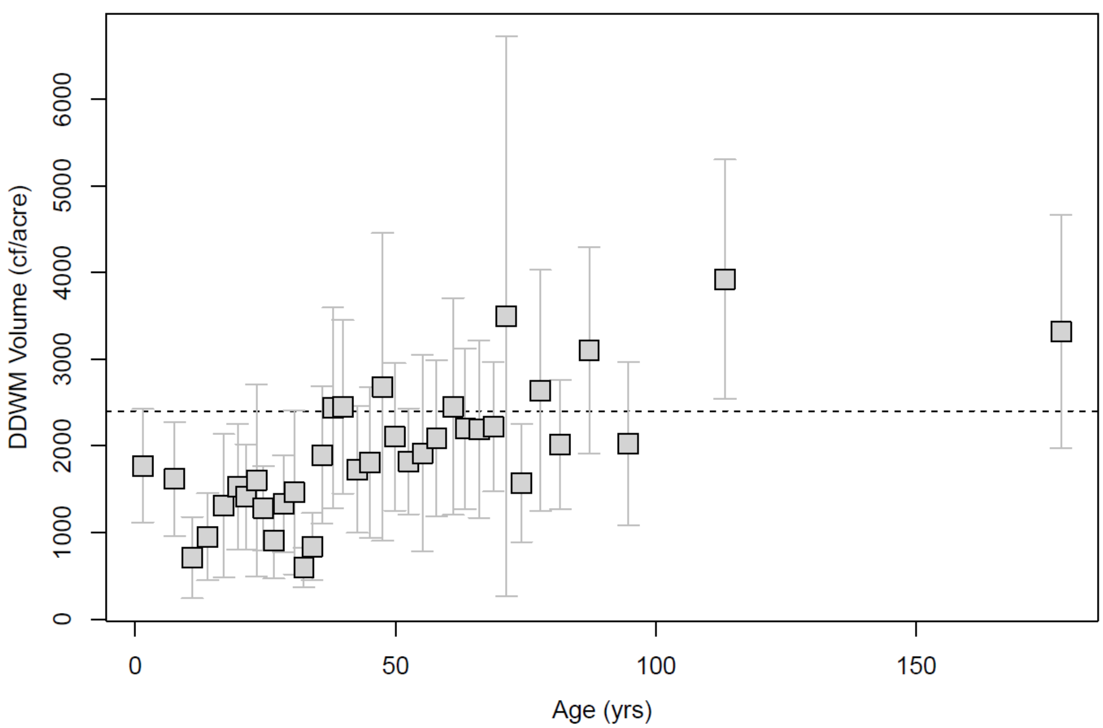



**Figure 3. Cubic feet of dead and down wood material (DDWM) by age from DNR inventory plots. Each box represents the average of 30 plots. Lines show 90 percent confidence intervals.**



## Plot Data

Figures 2 and 3 show that aggregated RS-FRIS inventory plots in stands averaging over 115 years old have the characteristics of the niche diversification stand development stage. However, at the stand level, not all characteristics are present in all stands.

DNR used data from its older, field-plot-based inventory system, FRIS, to further analyze stand-level conditions. As stated previously, the HCP uses age classes as a surrogate for stand structure. Specifically, the HCP utilizes an age of 150 years in the five west-side HCP planning units, and 200 years in the OESF, to represent a fully functional stand development stage. DNR calculated the area of each HCP planning unit that contained stands at least five acres in size that were over 150 years old (200 years old in the OESF). Sixty-eight percent of those stands with at least 5 FRIS plots that were identified as older-forest based on age alone contained the legacy components of the older-forest stand definition. To reflect this information, DNR reduced the raw projections displayed in Table 3 by 32 percent, which is termed a plot discount. These discounts are shown in Table 2.

This current analysis made no adjustment for the time since the collection of FRIS plot data, some of which is over 20 years old. Therefore, this result is likely an underestimate of older-forest conditions at the stand level.

## Disturbance

For this analysis, DNR assumed that all stands, including older-forest stands, will be subject to stand-replacing disturbances over time. As a result, not all areas projected to develop older-forest structure based on growth alone will actually achieve that structure within 100 years. In 2016, Raphael and others completed a study looking at stands that provide higher-quality marbled murrelet habitat, which is generally similar to older-forest conditions. They reported a decadal disturbance rate of 0.43 percent. DNR then assumed that disturbance rates in marbled murrelet habitat would increase by 20 percent per decade, resulting in doubling of the decadal disturbance rate over 5 decades. The marbled murrelet long-term conservation strategy disturbance rate assumption was applied across this analysis. DNR refers to this rate as a disturbance factor.

## Active Management

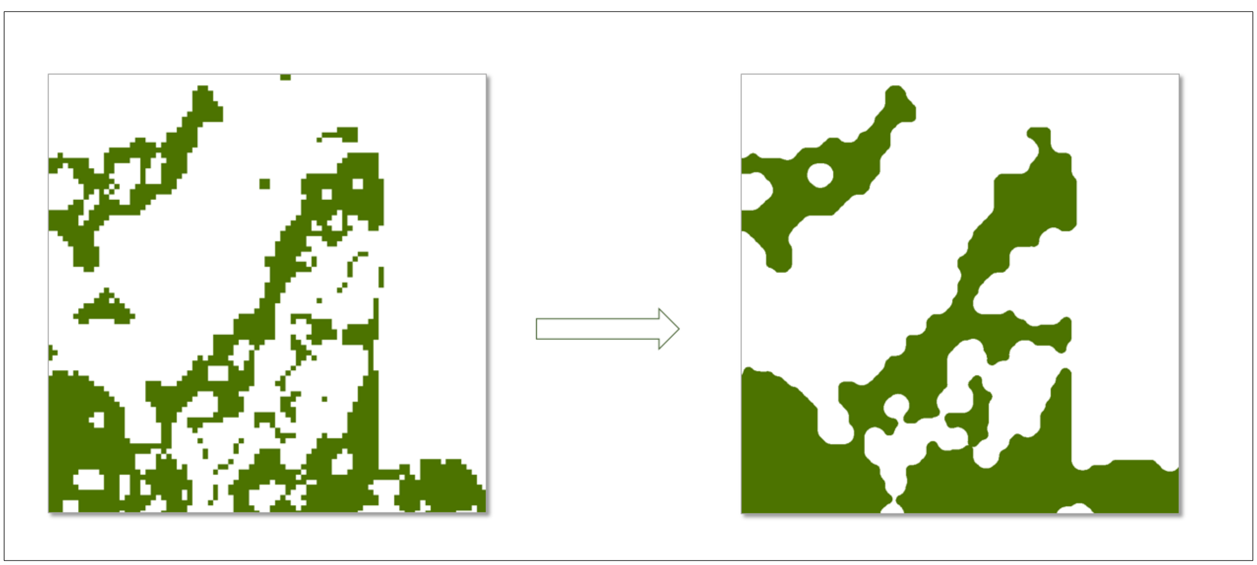
This analysis does not project the acceleration of stand development stages due to forest management. Published literature, such as Carey and Curtis (1996), indicate that active management can advance stands through stand development stages. The PSF also envisioned active management contributing to the development of older-forest structures. DNR's management in certain conservation areas is designed to accelerate older-forest structure development. For example, the goal of the Riparian Forest Restoration Strategy (RFRS) is to hasten the development of older-forest structures in riparian areas: "The main objective of silvicultural activities will be to put the Riparian Management Zone on an accelerated trajectory toward the riparian desired future conditions" (DNR 2006c, pg. 20). Based on modeling for the 2019 Sustainable Harvest FEIS, DNR anticipates over 4,000 acres of thinning will occur in riparian areas per the RFRS between 2019 and 2067, the end of the initial HCP agreement period. Thinned stands are likely to develop older-forest structures faster than if left untreated. As this acceleration is not accounted for in this analysis, the query may underestimate the actual area achieving older-forest structures.

## Identification of Stands

DNR maintains age data in both polygon and raster format. For this 2024 Landscape Assessment, DNR used the raster format to avoid misidentifying a stand's development stage based on polygons that do not precisely match stand boundaries. For this analysis, DNR used the same raster aggregation method that it uses to delineate northern spotted owl habitat.

DNR used the combined origin year raster in RS-FRIS as the source for age data. This data source shows age for all DNR-managed lands in western Washington in a 0.1-acre grid. In the delineation process, DNR calculated the median age of each cell by utilizing the age of the cell and the adjacent eight cells, and then assigned the median age to that cell. The resulting cells over a specified age are then converted to polygons, with adjacent cells dissolved into a single, larger polygon. Further processing is then done to fill gaps 132 feet across (two chains or double the width of an RS-FRIS cell), and to remove patch portions that are narrower than 132 feet. DNR then removed any stands under 5 acres identified in this process. As a result, only older-forest stands larger than 5 acres are counted towards the estimated area of older-forest stands in a given decade. DNR repeated this process for 10 decades, projecting the age of each cell forward to future years. This process creates smoothed, contiguous stands from the pixelated original data that DNR used, to estimate the area of older-forest stands in conservation areas into the future (Figure 4).

**Figure 4. An example of spatial arrangement of input data for and results of the stand identification process converting RS-FRIS grid data into stand polygons.**



# Part 3: Results

## *Older-Forest Stands*

The following tables contain the results of DNR's 2024 Landscape Assessment, utilizing the methodologies and queries described in Part 2 with updated conservation areas. As illustrated in Table 2, through implementation of the HCP and other policies and laws, over 10 percent of the OESF HCP Planning Unit currently contains older-forest stands. The North Puget HCP Planning Unit is on track to achieve 10 percent older-forest stands by 2070; South Puget, Columbia, and Straits are on track to achieve 10 percent older-forest stands by 2090; and South Coast is on track to achieve 10 percent older-forest stands by 2100. (Table 2). **DNR will meet the PSF's older-forest targets before 2106.**

**Table 2: Percent area western Washington HCP planning units with older-forest stands in conservation areas by decade through 2120. Adjusted query output with plot discounts and disturbance factor.**

| HCP Planning Unit | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2021 | 2030 | 2040 | 2050 | 2060 | 2070 | 2080 | 2090 | 2100 | 2110 | 2120 |
| Columbia | 1.1% | 1.2% | 1.4% | 1.8% | 2.6% | 4.3% | 6.8% | **10.1%** | **14.0%** | **17.3%** | **18.9%** |
| North Puget | 3.2% | 3.9% | 4.9% | 6.2% | 7.9% | **10.2%** | **13.2%** | **16.7%** | **20.6%** | **23.9%** | **25.0%** |
| OESF | **10.2%** | **10.7%** | **11.0%** | **11.7%** | **12.6%** | **13.9%** | **16.0%** | **20.1%** | **25.0%** | **28.4%** | **29.6%** |
| South Coast | 0.2% | 0.3% | 0.6% | 1.2% | 2.2% | 3.6% | 6.0% | 8.8% | **12.3%** | **16.0%** | **18.7%** |
| South Puget | 1.7% | 2.1% | 2.7% | 3.6% | 4.6% | 6.1% | 8.4% | **11.3%** | **14.4%** | **17.2%** | **18.7%** |
| Straits | 1.8% | 2.5% | 3.2% | 4.3% | 5.6% | 7.4% | 9.9% | **12.6%** | **15.0%** | **17.9%** | **19.3%** |

Table 2 represents the most conservative time estimate of DNR meeting older-forest targets. The plot discount removed query results that were determined to be "false positives;" however, it is likely that the query also produced "false negatives." In other words, the query likely eliminated stands that did not meet certain criteria from the inventory data, but do, in fact, exhibit older-forest structure. There is no way at this time to determine the rate of false negatives and so DNR did not account for them. Table 2 is the most conservative estimate of projected older-forest stands across the westside HCP Planning Units and the assessments show that DNR will meet older-forest targets in 70 to 100 years. Table 3 illustrates a less-conservative time estimate by eliminating the plot discount and disturbance factor. Refer to Appendix 3 for maps of those stands that are referenced in Table 3, year 2100.

**Table 3. Percent area Western Washington HCP planning units with older-forest stands in conservation areas by decade through 2120. Values over 10% in bold. Raw query output without plot discount or disturbance factor.**

| HCP Planning Unit | Year | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | **2021** | **2030** | **2040** | **2050** | **2060** | **2070** | **2080** | **2090** | **2100** | **2110** | **2120** |
| Columbia | 1.5% | 1.7% | 2.0% | 2.6% | 3.9% | 6.5% | **10.5%** | **15.8%** | **22.1%** | **27.8%** | **31.1%** |
| North Puget | 4.7% | 5.8% | 7.2% | 9.2% | **11.9%** | **15.6%** | **20.3%** | **26.1%** | **32.5%** | **38.5%** | **41.0%** |
| OESF | **14.9%** | **15.7%** | **16.3%** | **17.5%** | **18.9%** | **21.2%** | **24.5%** | **31.3%** | **39.6%** | **45.6%** | **48.6%** |
| South Coast | 0.3% | 0.5% | 1.0% | 1.8% | 3.2% | 5.5% | 9.2% | **13.8%** | **19.5%** | **25.8%** | **30.7%** |
| South Puget | 2.5% | 3.2% | 4.0% | 5.3% | 6.9% | 9.2% | **12.9%** | **17.7%** | **22.8%** | **27.6%** | **30.7%** |
| Straits | 2.7% | 3.7% | 4.8% | 6.3% | 8.4% | **11.2%** | **15.2%** | **19.6%** | **23.8%** | **28.8%** | **31.7%** |

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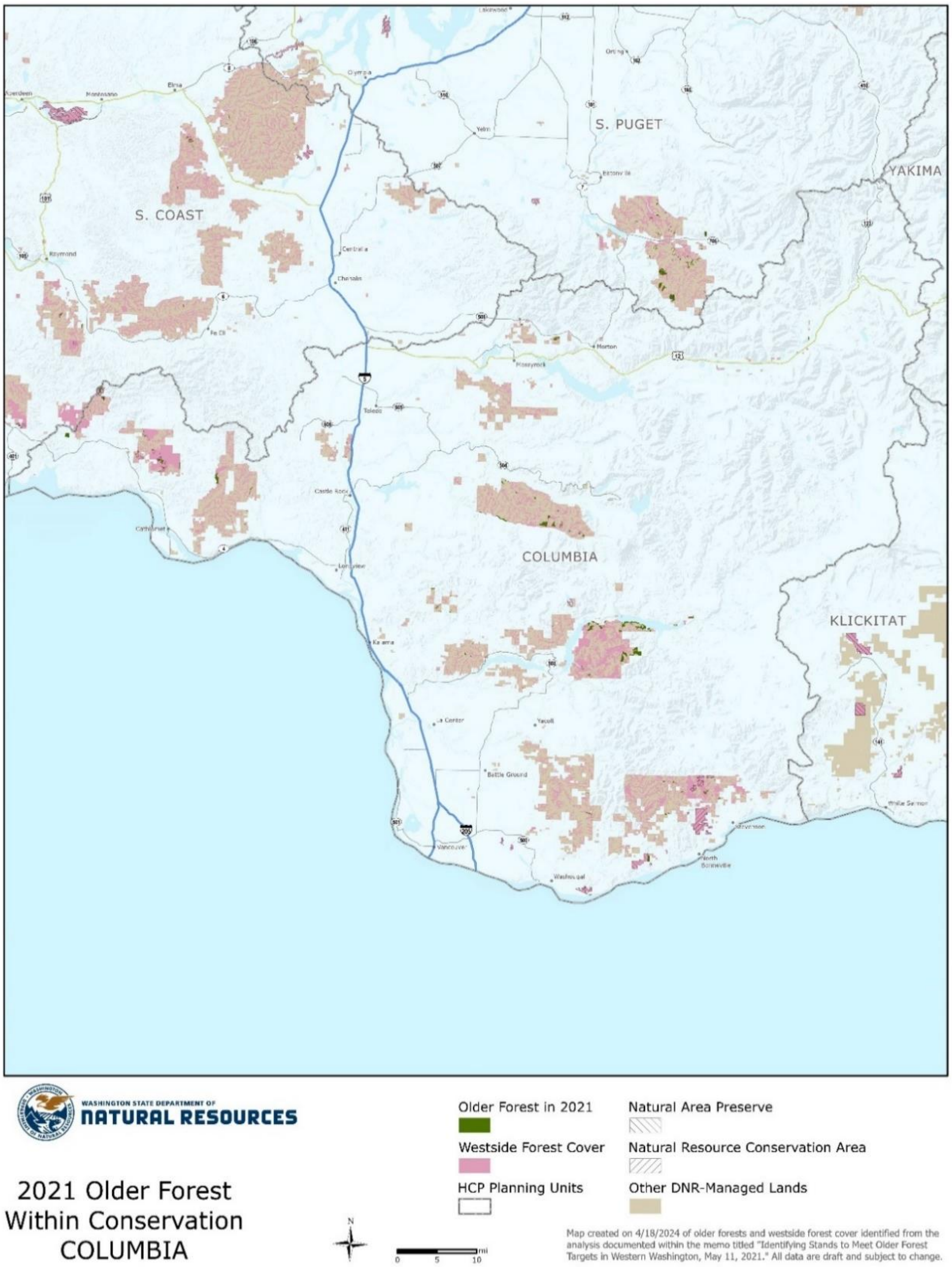
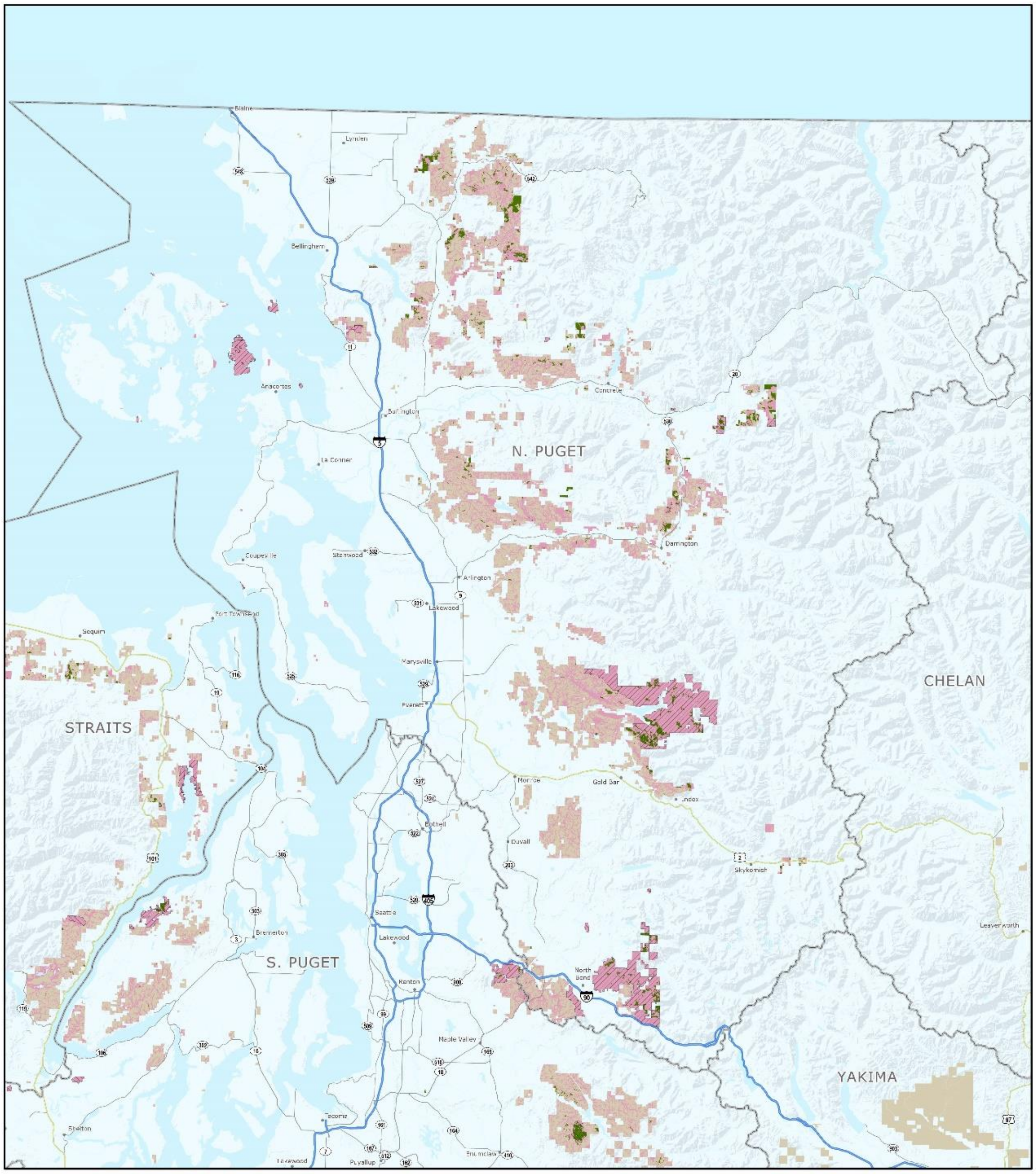
# Appendix 1: Stand Development Stage Definitions in DNR 2004

| Stages | | | Stand-level Variable and Associated Threshold Value | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Management Activity | | | | | |
| Summarized | Detailed | | QMD | Canopy Layer | RD | Stand Age | BioThin Age | Years Since BioThin | Thin Age | Years Since Thin | Snag Ratio1 | CWD |
| Ecosystem Initiation | Ecosystem Initiation | | <2 | | | | | | | | | |
| Competitive Exclusion | Sapling Exclusion | | >=2 | | | | | | | | | |
| | Pole Exclusion | | >5 | | | | | | | | | |
| | | or | | | | | | | >0 | >=0 | | |
| | Large Tree Exclusion | | >11 | | | | | | | | | |
| | | or | >11 | | | | | | >0 | >=0 | | |
| | Understory Development | | >=2 | >1 | | | | | | | | |
| | | or | >=2 | | >=MaxRD | | | | | | | |
| | | or | >=2 | | | >MaxRD Age | | | | | | |
| | | or | >=2 | | | | >0 | >=0 | | | | |
| Structurally Complex | Botanically Diverse | | >=2 | >1 | | | | | | | | |
| | | or | >=2 | >1 | | >=MaxRD Age+60 | | | | | | |
| | | or | >=2 | >1 | | | >0 | >=0 | | | | |
| | | or | >=2 | >1 | >=MaxRD | | | | | | | |
| | | or | >=2 | | >=MaxRD | >=MaxRD Age+60 | | | | | | |
| | | or | >=2 | | >=MaxRD | | >0 | >=0 | | | | |
| | | or | >=2 | | | >=MaxRD Age+60 | >0 | >=0 | | | | |
| | | or | >=2 | | | | >0 | >5 | | | | |
| | | or | >=2 | >1 | | >MaxRD Age | | | | | | |
| | | or | >=2 | | | >=MaxRD Age+60 | | | | | | |
| | | or | >=2 | | | >MaxRD Age | >0 | >5 | | | | |
| | Niche Diveris-ification | | >=2 | >1 | | >=MaxRD Age+80 | | | | | >0.07 | >2400 |
| | | or | >=2 | >1 | | >=MaxRD Age+80 | >0 | >0 | | | | |
| | | or | >=2 | >1 | | | >0 | >5 | | | | |
| | | or | >=2 | | >=MaxRD | >=MaxRD Age+80 | | | | | >0.07 | >2400 |
| | | or | >=2 | | >=MaxRD | >=MaxRD Age+80 | >0 | >0 | | | | |
| | | or | >=2 | | >=MaxRD | | >0 | >5 | | | | |
| | | or | >=2 | | | >=MaxRD Age+80 | | | | | >0.07 | >2400 |
| | | or | >=2 | | | >=MaxRD Age+80 | >0 | >0 | | | | |
| | | or | >=2 | | | >MaxRD Age | >0 | >5 | | | | |
| | | or | >=2 | | | >=MaxRD Age+80 | >0 | >=0 | | | >0.07 | >2400 |
| | | or | >=2 | | | >=MaxRD Age+80 | >0 | >0 | | | | |
| | | or | >=2 | | | | >0 | >5 | | | >0.07 | >2400 |
| | Fully Functional | | >=2 | >1 | | >=MaxRD Age+160 | | | | | >0.07 | >2400 |
| | | or | >=2 | >1 | | >=MaxRD Age+160 | >0 | >0 | | | | |
| | | or | >=2 | >1 | | | >0 | >40 | | | | |
| | | or | >=2 | | >=MaxRD | >=MaxRD Age+160 | | | | | >0.07 | >2400 |
| | | or | >=2 | | >=MaxRD | >=MaxRD Age+160 | >0 | >0 | | | | |
| | | or | >=2 | | >=MaxRD | | >0 | >40 | | | | |
| | | or | >=2 | | | >=MaxRD Age+160 | | | | | >0.07 | >2400 |
| | | or | >=2 | | | >=MaxRD Age+160 | >0 | >0 | | | | |
| | | or | >=2 | | | >MaxRD Age | >0 | >40 | | | | |
| | | or | >=2 | | | >=MaxRD Age+160 | >0 | >=0 | | | >0.07 | >2400 |
| | | or | >=2 | | | >=MaxRD Age+160 | >0 | >0 | | | | |
| | | or | >=2 | | | | >0 | >40 | | | >0.07 | >2400 |

# Appendix 2: Maps of Stands to Attain Older-forest Conditions in 2021

**Older-forest stands and westside forest cover represent stands that have been set aside to meet older-forest targets.**






WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

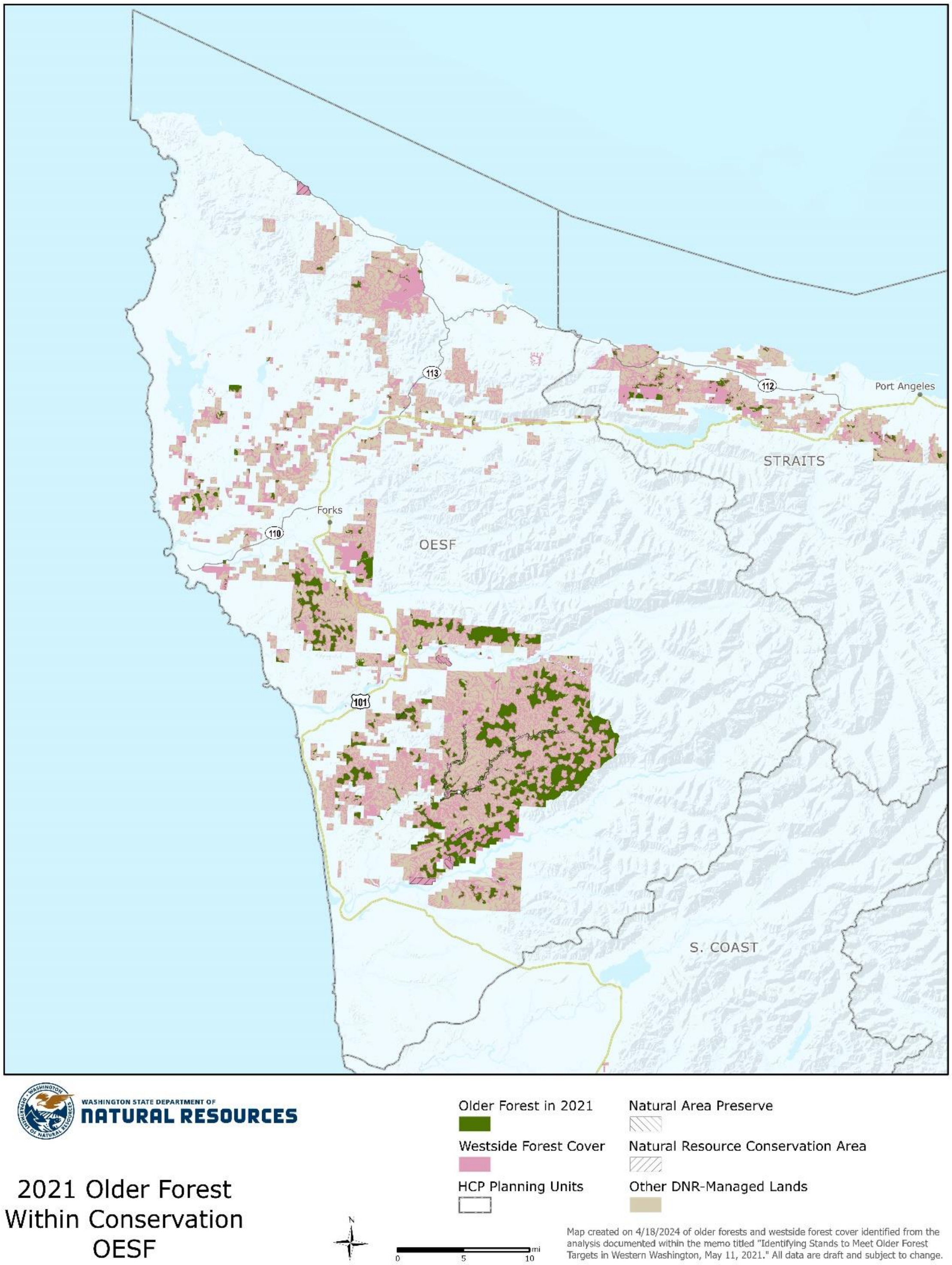
Older Forest in 2021
Westside Forest Cover
HCP Planning Units
Natural Area Preserve
Natural Resource Conservation Area
Other DNR-Managed Lands

2021 Older Forest Within Conservation N. PUGET

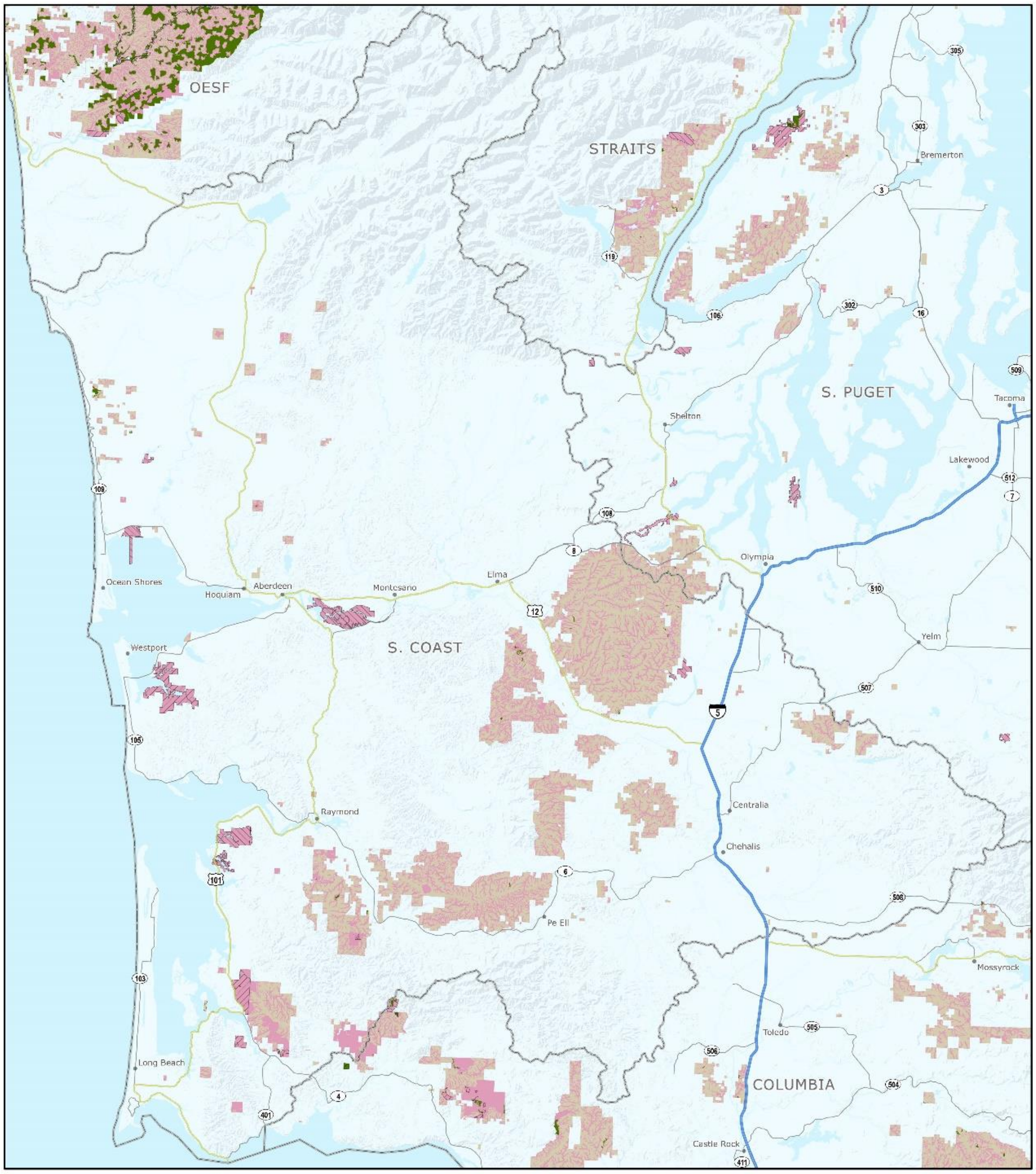
N

0 5 10 mi

Map created on 4/18/2024 of older forests and westside forest cover identified from the analysis documented within the memo titled "Identifying Stands to Meet Older Forest Targets in Western Washington, May 11, 2021." All data are draft and subject to change.




2021 Older Forest Within Conservation OESF




WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Older Forest in 2021

Westside Forest Cover

HCP Planning Units

Natural Area Preserve

Natural Resource Conservation Area

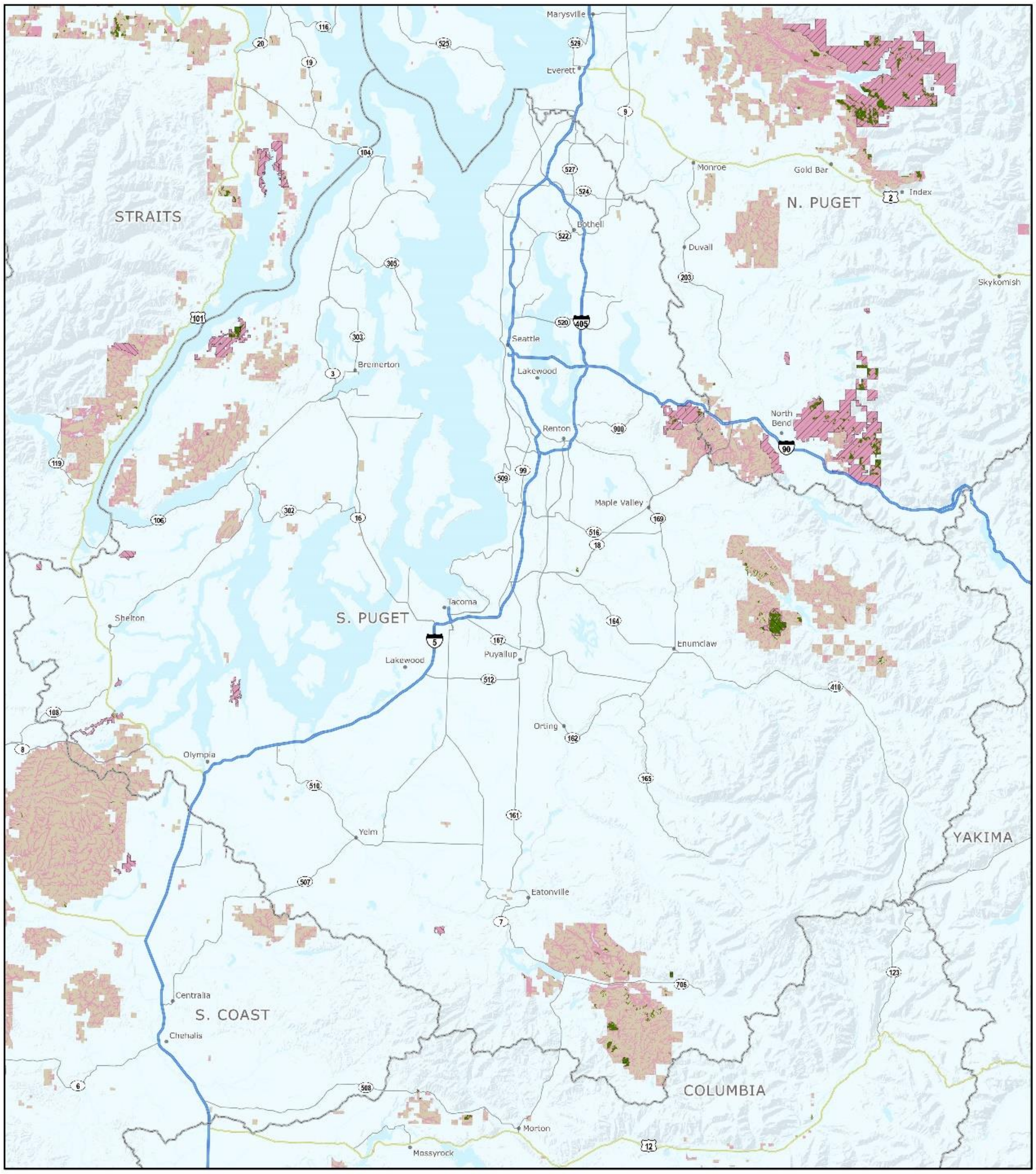
Other DNR-Managed Lands

2021 Older Forest Within Conservation S. COAST

N

0 5 10 mi

Map created on 4/18/2024 of older forests and westside forest cover identified from the analysis documented within the memo titled "Identifying Stands to Meet Older Forest Targets in Western Washington, May 11, 2021." All data are draft and subject to change.




WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Older Forest in 2021

Westside Forest Cover

HCP Planning Units

Natural Area Preserve

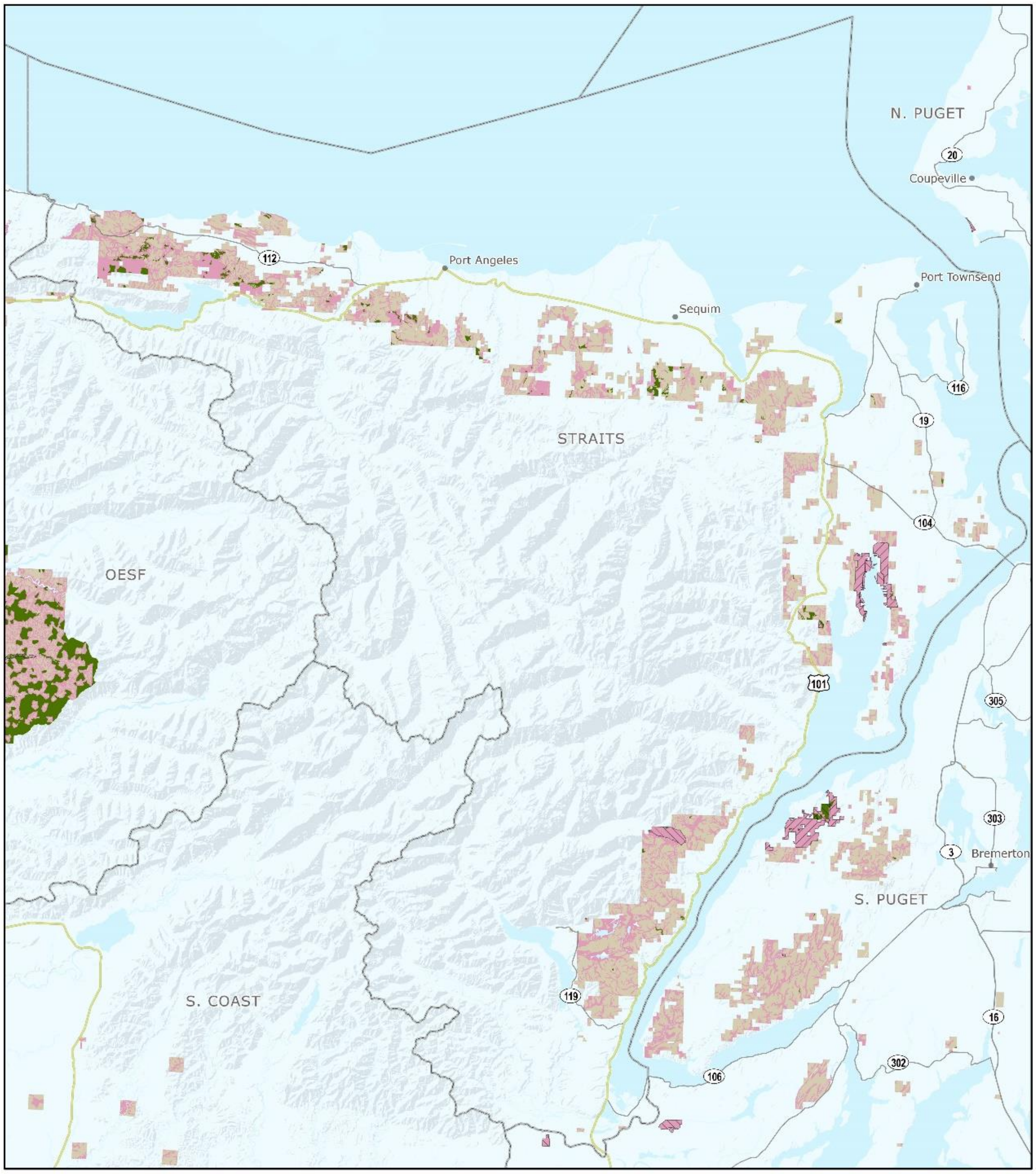
Natural Resource Conservation Area

Other DNR-Managed Lands

2021 Older Forest
Within Conservation
S. PUGET

0 5 10 mi

Map created on 4/18/2024 of older forests and westside forest cover identified from the analysis documented within the memo titled "Identifying Stands to Meet Older Forest Targets in Western Washington, May 11, 2021." All data are draft and subject to change.




WASHINGTON STATE DEPARTMENT OF NATURAL RESOURCES

Older Forest in 2021
Westside Forest Cover
HCP Planning Units
Natural Area Preserve
Natural Resource Conservation Area
Other DNR-Managed Lands

2021 Older Forest
Within Conservation
STRAITS

N

0 4.75 9.5 mi

Map created on 4/18/2024 of older forests and westside forest cover identified from the analysis documented within the memo titled "Identifying Stands to Meet Older Forest Targets in Western Washington, May 11, 2021." All data are draft and subject to change.

# Appendix 3: Maps of Projected Older-Forest Stands in 2100

**Older-forest stands are those that were set aside to meet older-forest targets.**

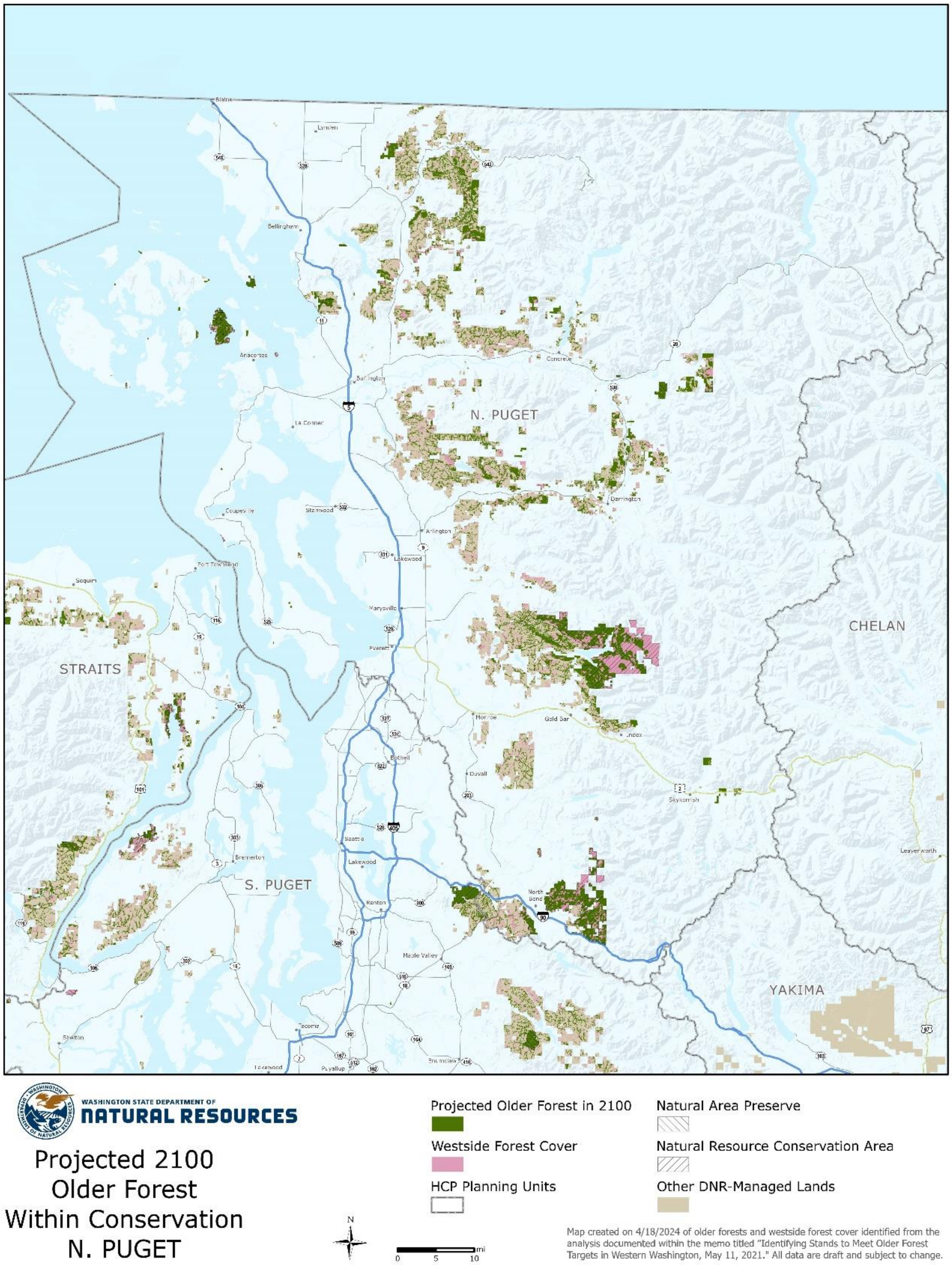

WASHINGTON STATE DEPARTMENT OF
NATURAL RESOURCES

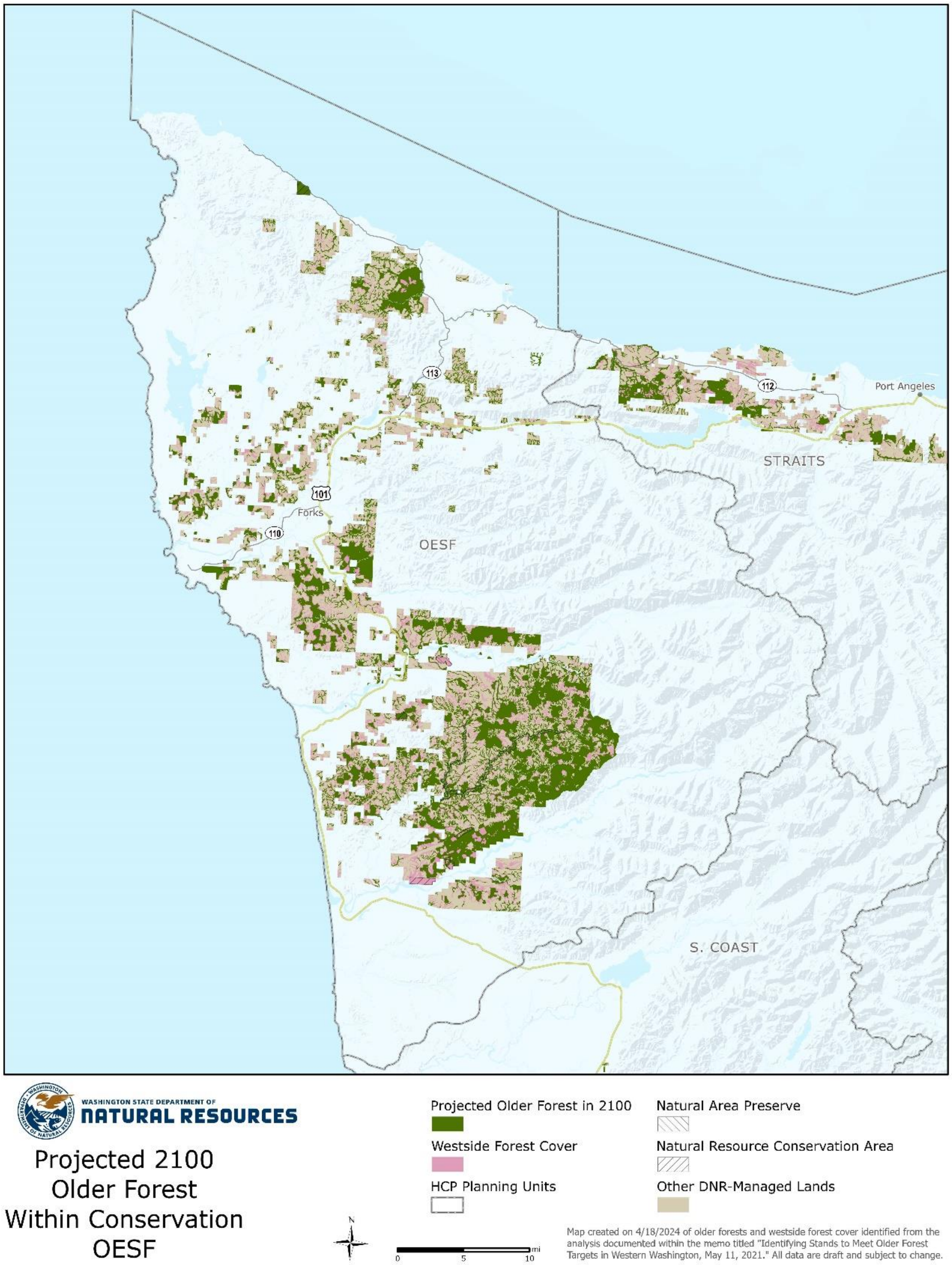
Projected 2100
Older Forest
Within Conservation
COLUMBIA

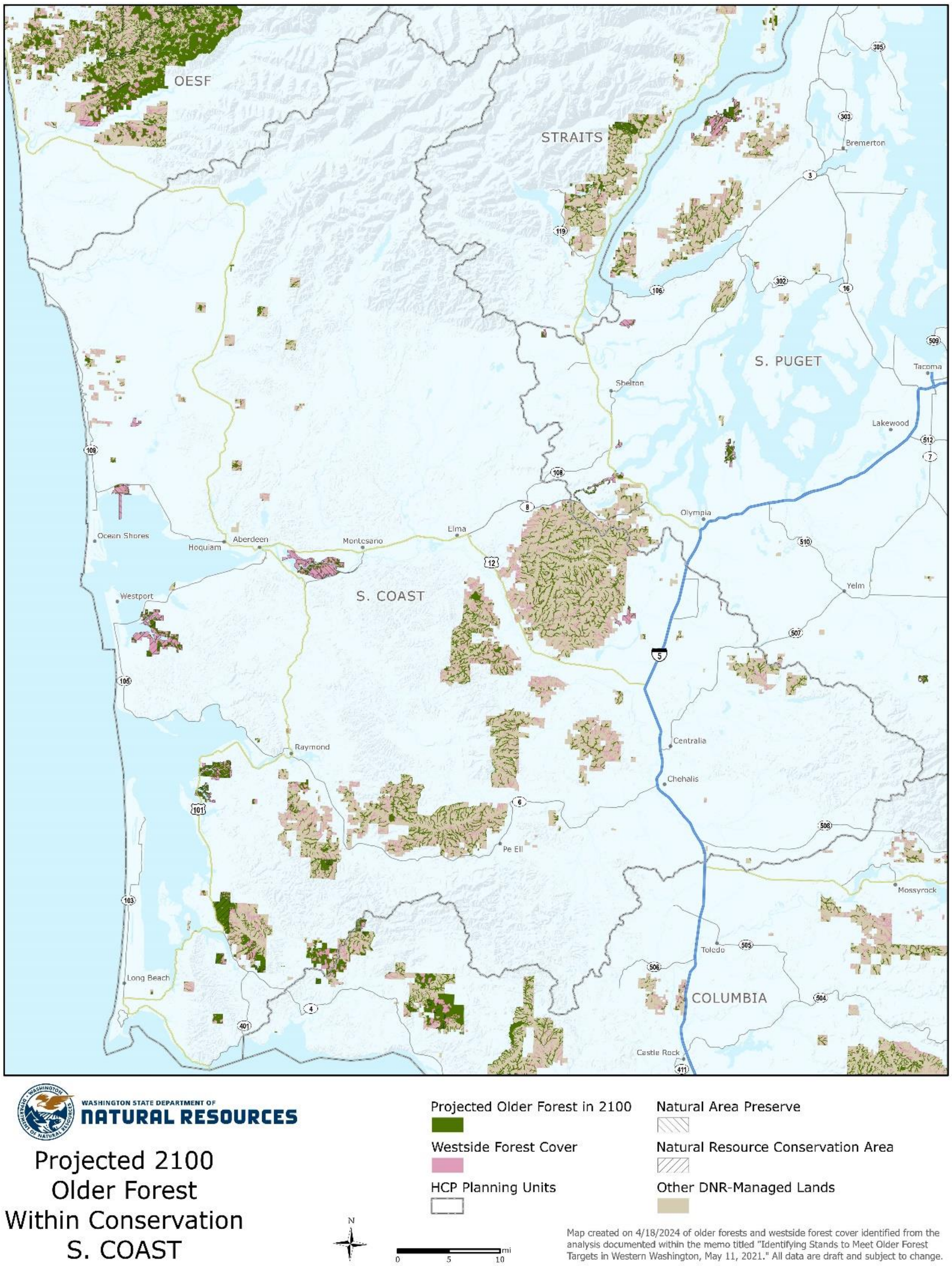
Projected Older Forest in 2100
Westside Forest Cover
HCP Planning Units
Natural Area Preserve
Natural Resource Conservation Area
Other DNR-Managed Lands

0 5 10 mi

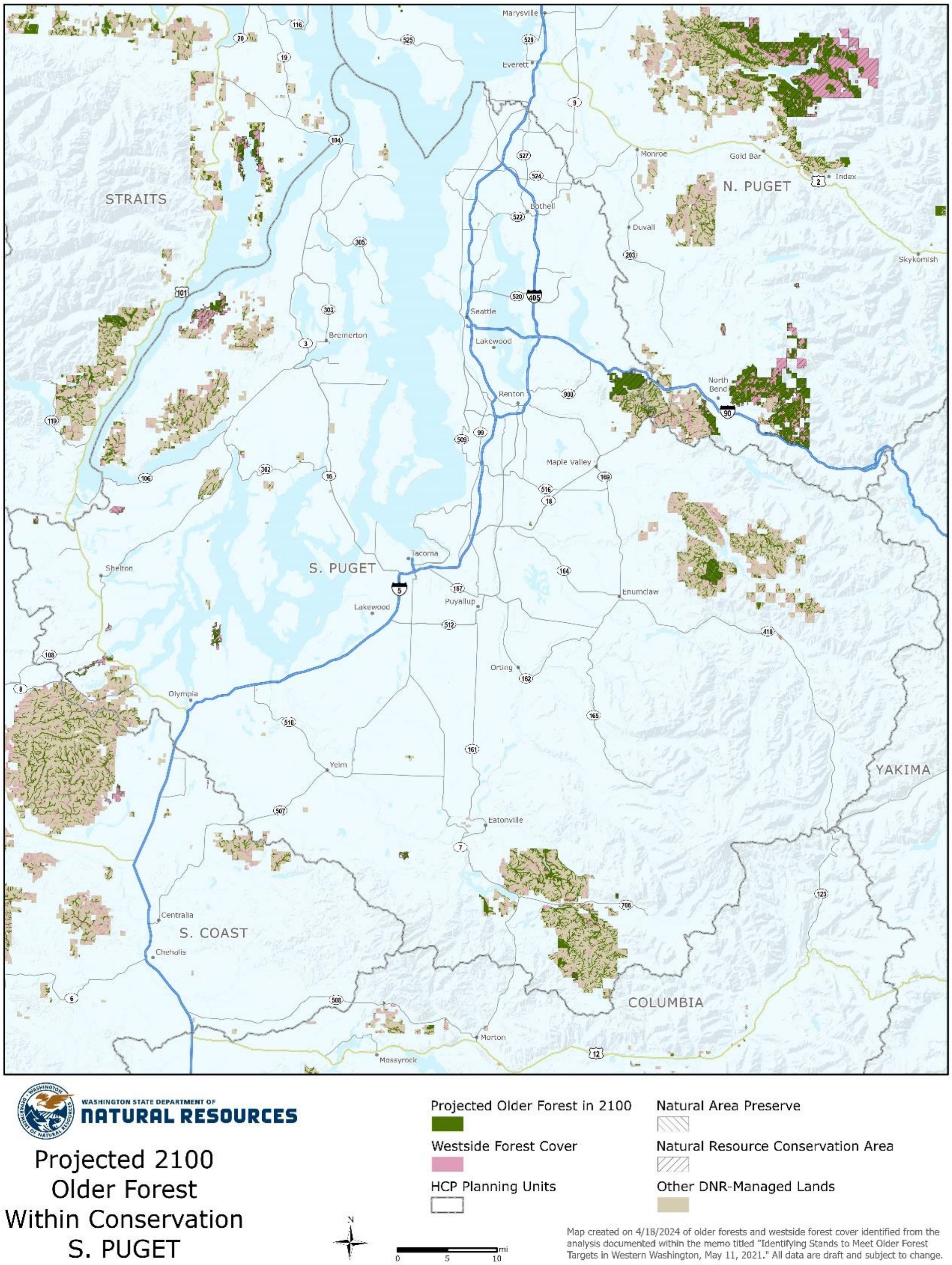
Map created on 4/18/2024 of older forests and westside forest cover identified from the analysis documented within the memo titled "Identifying Stands to Meet Older Forest Targets in Western Washington, May 11, 2021." All data are draft and subject to change.


N. PUGET
STRAITS
S. PUGET
CHELAN
YAKIMA
Bellingham
Anacortes
Burlington
La Conner
Concrete
Darrington
Arlington
Coupeville
Stanwood
Sequim
Marysville
Everett
Monroe
Gold Bar
Index
Duvall
Skykomish
Seattle
Bremerton
Lakewood
Renton
North Bend
Maple Valley
Tacoma
Puyallup
Shelton
Leavenworth
WASHINGTON STATE DEPARTMENT OF
NATURAL RESOURCES
Projected 2100
Older Forest
Within Conservation
N. PUGET
Projected Older Forest in 2100
Westside Forest Cover
HCP Planning Units
Natural Area Preserve
Natural Resource Conservation Area
Other DNR-Managed Lands
N
0 5 10 mi
Map created on 4/18/2024 of older forests and westside forest cover identified from the analysis documented within the memo titled "Identifying Stands to Meet Older Forest Targets in Western Washington, May 11, 2021." All data are draft and subject to change.

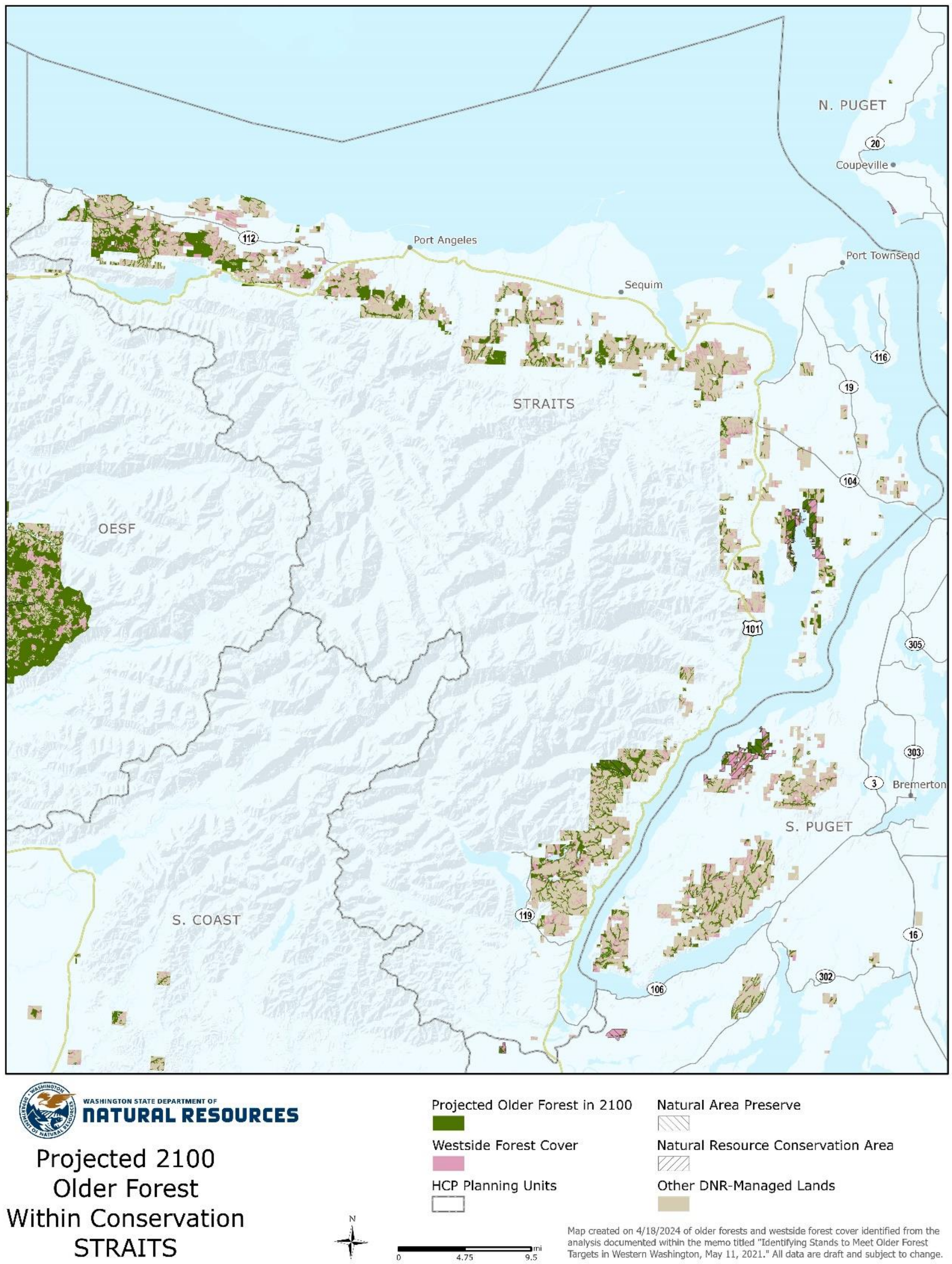

Port Angeles
STRAITS
OESF
Forks
101
110
113
112
S. COAST
WASHINGTON STATE DEPARTMENT OF
NATURAL RESOURCES
Projected 2100
Older Forest
Within Conservation
OESF
Projected Older Forest in 2100
Westside Forest Cover
HCP Planning Units
Natural Area Preserve
Natural Resource Conservation Area
Other DNR-Managed Lands
N
0 5 10 mi
Map created on 4/18/2024 of older forests and westside forest cover identified from the analysis documented within the memo titled "Identifying Stands to Meet Older Forest Targets in Western Washington, May 11, 2021." All data are draft and subject to change.




Projected 2100
Older Forest
Within Conservation
S. COAST




Projected 2100 Older Forest Within Conservation S. PUGET


N. PUGET
20
Coupeville
Port Angeles
112
Port Townsend
Sequim
116
STRAITS
19
104
OESF
101
305
303
3
Bremerton
S. PUGET
S. COAST
119
16
106
302
WASHINGTON STATE DEPARTMENT OF
NATURAL RESOURCES
Projected 2100
Older Forest
Within Conservation
STRAITS
Projected Older Forest in 2100
Westside Forest Cover
HCP Planning Units
Natural Area Preserve
Natural Resource Conservation Area
Other DNR-Managed Lands
N
0
4.75
9.5
mi
Map created on 4/18/2024 of older forests and westside forest cover identified from the analysis documented within the memo titled "Identifying Stands to Meet Older Forest Targets in Western Washington, May 11, 2021." All data are draft and subject to change.