20-Year Forest Health Strategic Plan
Eastern Washington

Planning Area Prioritization

Methodology and Documentation

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WASHINGTON STATE DEPT OF
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Introduction

Washington's 20 Year Strategic Plan sets a goal of treating 1,250,000 acres over the next 20 years to improve the resilience of forests in eastern Washington. To accomplish this ambitious target, the Washington Department of Natural Resources (DNR) will work with landowners and stakeholders to select and treat 125,000 acres each biennium. The plan lays out a process for the DNR to strategically identify planning areas where state funding for forest health and restoration projects will be focused[1]. Planning areas will generally be a HUC 6 watershed (5000 ~ 25,000 acres), but may be several watersheds in some cases.

The selection process for planning areas has a number of steps. First, the DNR has assessed fire risk, restoration need, aquatic function, economic potential, wildlife habitat, and other resources across all forested HUC 6 watersheds in eastern Washington. Based on this assessment of multiple resources, a data driven ranking of watersheds has been completed. DNR staff and local stakeholders (land management agencies, forest collaboratives, tribes, private landowners, etc) will combine this information with local priorities and ongoing planning efforts to select candidate planning areas for each collaborative area. These candidate areas will then be submitted to the Forest Health Advisory Committee and then to the Commissioner of Public Lands for final selection. A new set of planning areas will be selected each biennium.

The purpose of this document is to describe in detail the methodology used to assess and rank HUC 6 watersheds across Eastern Washington. This methodology is very similar to the methods used to prioritize HUC 5 watersheds for the 20 Year Plan, but has some important differences and updated datasets. The focus of the HUC 5 prioritization in the 20 Year Plan was to analyze, rank and display risks and treatment need across Eastern Washington. The focus of the HUC 6 assessment described in this document is to select smaller scale planning areas. We combine documentation from the 20 Year Plan[2] where relevant with new information where different information sources or methods were used.

Collaborative Zones in Eastern Washington

The active engagement of Forest Collaboratives in the implementation of the 20 Year Plan is critical to its success. The DNR cannot achieve the goals of the plan without local stakeholders who are directly involved in the selection, implementation, and monitoring of projects. In addition, the HUC 5 prioritization done for the 20 Year Plan shows that high priority watersheds occur across all of Eastern Washington. The selection of candidate planning areas will thus be conducted within each collaborative area or zone. Based on the geographic coverage of each collaborative, five zones were created for Eastern Washington and are shown in figure 1. The boundaries of 5 zones were created by placing each HUC 5 watershed, and all the HUC 6 watersheds within them, into one of the zones. This map will be used to help organize the evaluation and selection of planning areas

[1] For a full description of this process, see Appendix 1-II of the 20 Year Forest Health Strategic Plan. https://www.dnr.wa.gov/ForestHealthPlan

[2] See appendix 1.I of the the 20 Year Forest Health Strategic Plan.

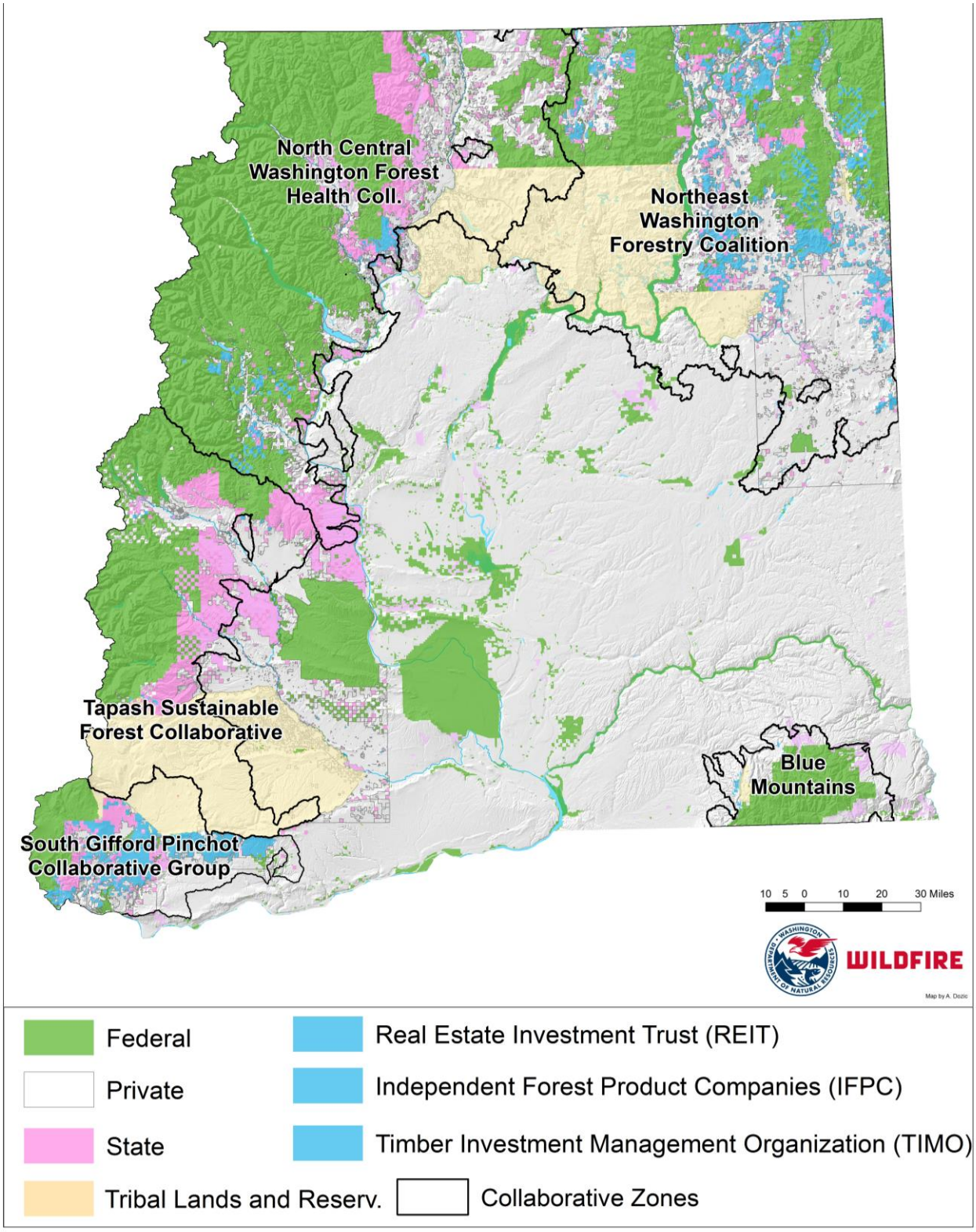

***Figure 1**:* Map of 5 collaborative zones in Eastern Washington. Note that some boundaries are approximate as there is potential overlap between zones in a few places.

Selection Process for Forest Health Projects

Once the final planning areas are selected for the 2017-2018 biennium, landscape evaluations will be conducted in each planning area to assess forest health conditions and determine treatment needs. A landscape evaluation is a data driven approach to understanding the current conditions of a landscape and its level of resilience to future disturbances and climatic change. In watersheds where similar types of evaluations have recently been completed by other landowners (e.g. US Forest Service NEPA planning), the DNR will seek to complement the existing evaluations where needed. The information and data from the evaluations will then by synthesized into a landscape prescription that lays out treatment targets and identifies potential treatment locations. The final steps will be to field verify and refine treatment locations and types as needed and then develop a final list of recommended treatments for the planning area. These will be submitted to the Forest Health Advisory Committee and then packaged into an appropriations request to the state legislature.

The DNR will rely on partnerships with local land management agencies, forest collaboratives, tribes, and other stakeholders to select planning areas and forest health projects. The timeline for selecting the 2018 projects is short. A number of meetings and check-in points with local partners will be needed in the next 8 months. A timeline of the process and meeting dates is shown below (Figure 2)

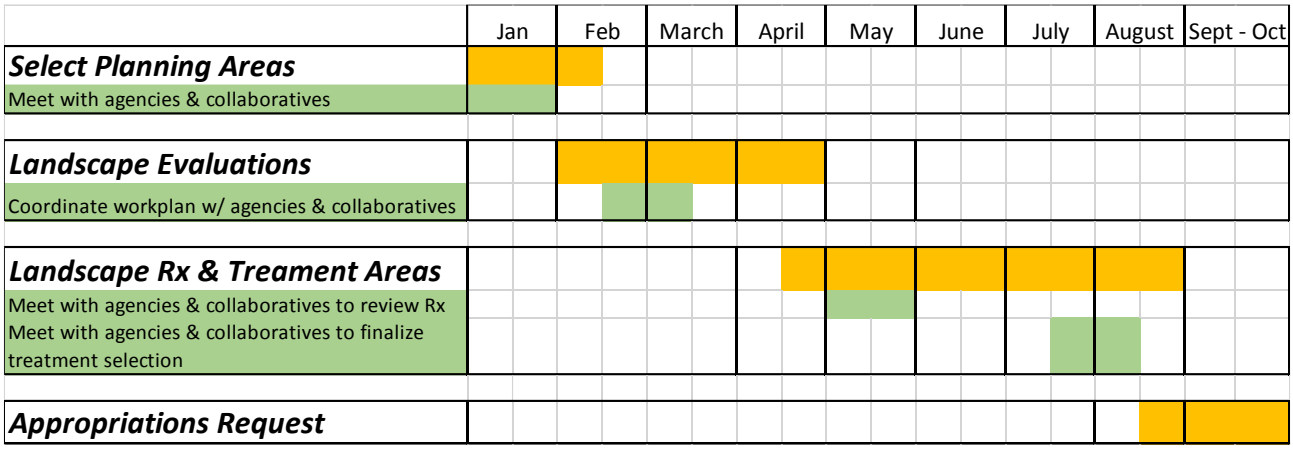

Figure 2: Timeline for selecting planning areas and forest health treatment projects

Methodology to Combine Metrics and Rank HUC 6 Watersheds

Tiered Organization

This assessment uses the same two tier structure to organize and rank different resources that was used in the 20 Year Plan to prioritize HUC 5 watersheds. Tier 1 includes metrics that represent forest health conditions such as probability of major fire or insect and disease disturbances as well as departure from historical conditions. Tier 2 metrics represent natural and human values at risk from major, uncharacteristic disturbances or declines in forest health.

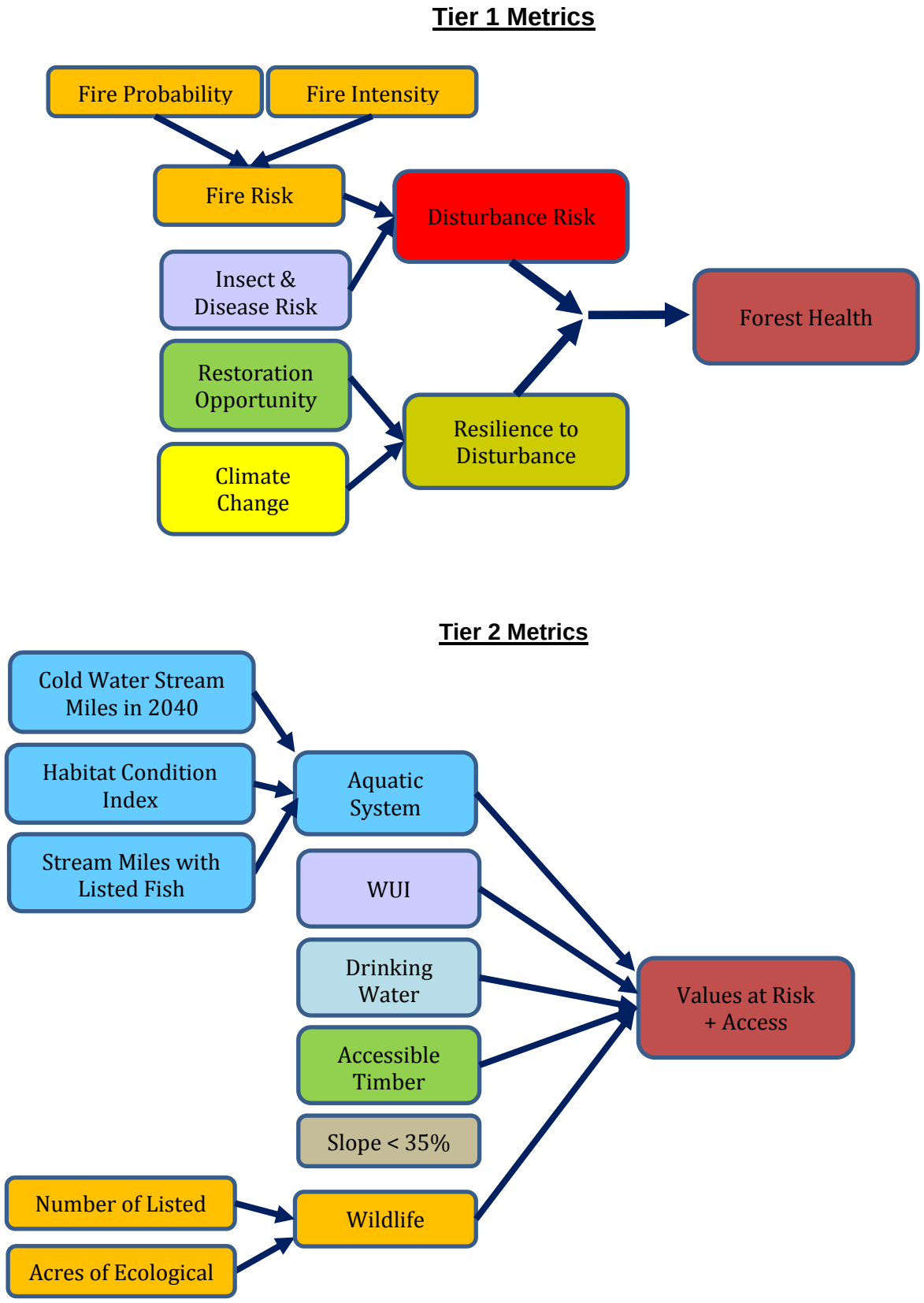

Figure 3: Metrics for two tiers used in assessment of HUC 6 watersheds.

The two tiers were used to allow for separate evaluations of each tier and to ensure equal weighting between the two sets of metrics. Scores for each metric were derived from one or more datasets that represent the best available science that is publically available. A number of updated datasets were available for this assessment compared to what was used for the HUC 5 prioritization in May of 2017. Road access considerations were added to Tier 2 to factor in the feasibility of treating specific watersheds, based on feedback from a number of advisory committee members. All metrics were summarized at the HUC 6 level in order to combine them into Tier 1 and Tier 2 scores. Figure 3 displays the metrics and how they are organized into the two Tiers.

Screens

In addition to the Tier 1 and Tier 2 metrics, HUC 6 watersheds were screened based on acres. HUC 6 watersheds with less than 2500 acres of forest were removed from consideration as they do not contain sufficient acres to be a planning area. Watersheds with less than 2500 acres outside of wilderness and roadless areas, as well as recent moderate and high severity fire (2012-2015), were also flagged. These flagged watersheds were included in the assessment as they may have significant forest health issues. However, many of the data layers used in the assessment do not reflect the 2012-2015 fires. Thus these watersheds can be evaluated by the planning teams to determine if including them in part of planning area is appropriate.

Combining metrics into composite ranks

In order to rank and prioritize HUC 6 watersheds for treatment need, the datasets making up Tier 1 and Tier 2 were combined together using the process described below. Note that all scores are relative. A low score does not mean that a watershed has no forest health issues or need for treatment. Instead, it means that metrics and overall needs are lower relative to other watersheds. In combing metrics into composite scores, we used the simplest, most transparent approaches possible unless a clear need and advantage for a more complicated approach existed. We did not apply any weights to the metrics and the metrics were equal within each Tier.

1. *Derive HUC 6 scores:* For each dataset (see figure 2), the value of pixels or smaller polygons across each HUC 6 were aggregated to derive a single score for each HUC 6. This was done in three different ways for different datasets. For the fire, climate change, and habitat condition index metrics, the values of pixels or catchments were averaged across the HUC 6. For restoration opportunity, insect and disease, WUI, accessible timber, ESOC, listed fish miles, and cold water miles in 2040, the total number of acres or stream miles was summed. Drinking water and listed wildlife species were obtained at the HUC 6 level. For all relevant metrics, a non-forest mask was first applied to remove all pixels that are non-forested. Wildlife, aquatics, and fire had multiple datasets that were combined to create a single score for each HUC 6. To do this, the scores were first standardized and then averaged.

2. *Rank watersheds for each metric:* A simple ranking approach was used to convert the HUC 6 scores derived for each dataset onto a standardized 0-1 scale. For each dataset or metric, values for the HUC 6 watersheds were first ranked with ties allowed. The ranks were then standardized by dividing by the highest rank for each dataset. The watershed with the highest value for a dataset has a score of 1 and the lowest value a score of 0. Maps showing the ranks

for each metric across all watersheds are provided in Appendix 2. This relative approach resulted in similar contributions of each metric to the composite scores.

Before calculating the ranking, raw scores for all metrics were first rounded to a specified numeral for each metric, based on the distribution of that metric. For example, increase in deficit was rounded to the nearest 0. (e.g. 121, 118, 115). Fire probability was rounded to the nearest thousandth (e.g. 0.001, 0,021), and all acre metrics to the nearest 100 (e.g. 800, 2100, 5500). Rounding created tied rankings for watersheds that had close scores. This removed artificial differentiation from small differences in scores.

3. *Calculate composite rankings:* Rankings for all Tier 1 metrics were averaged together and standardized (dividing by the maximum value to get a 0-1 score) to generate a rank for Tier 1. The same process was used for Tier 2. The last step was to add Tier 1 and Tier 2 together to obtain a final, composite ranking. We explored more complex approaches to combining the two tiers, but determined that this simpler approach worked as well as any of the others. In particular, no watersheds with low Tier 1 score received a high priority composite ranking. All high priority watersheds had either a high Tier 1 and medium Tier 2, or a medium Tier 1 and high Tier 2.

   These final scores, as well as the tier 1 and tier 2 scores, were then placed into low, medium, and high priority categories based on percentiles. For example, watersheds with the top 33% scores were given a high priority rank. Each category was broken into 2 or 3 sub-categories on maps to allow for more in depth visualization of relative rankings. The Tier 1, Tier 2, and final composite prioritization of all HUC 6 watersheds are shown in figures 4-6. The composite prioritization maps each collaborative zone are provided in Appendix 1.

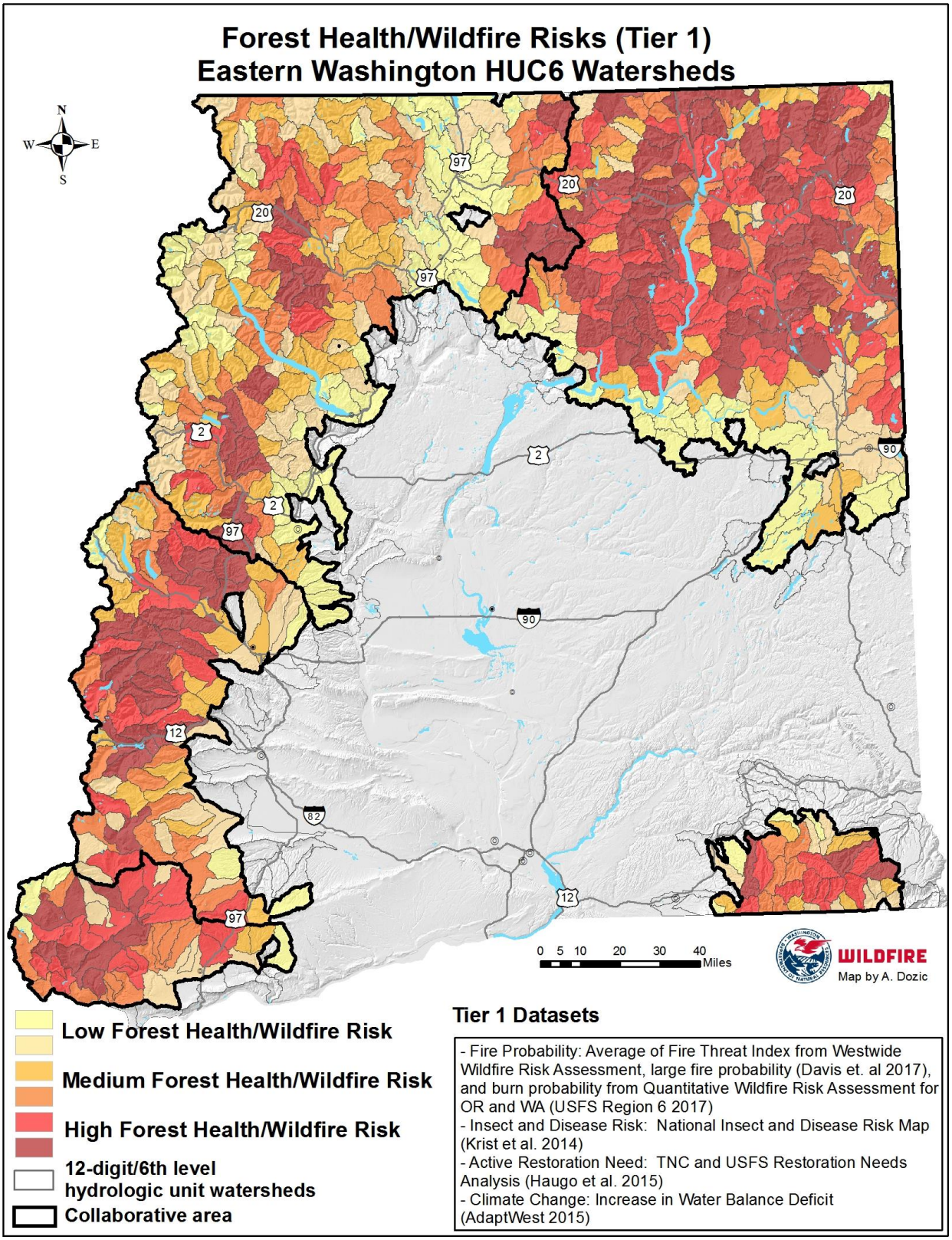

Figure 4: Tier 1 prioritization for HUC 6 forested watersheds in eastern Washington

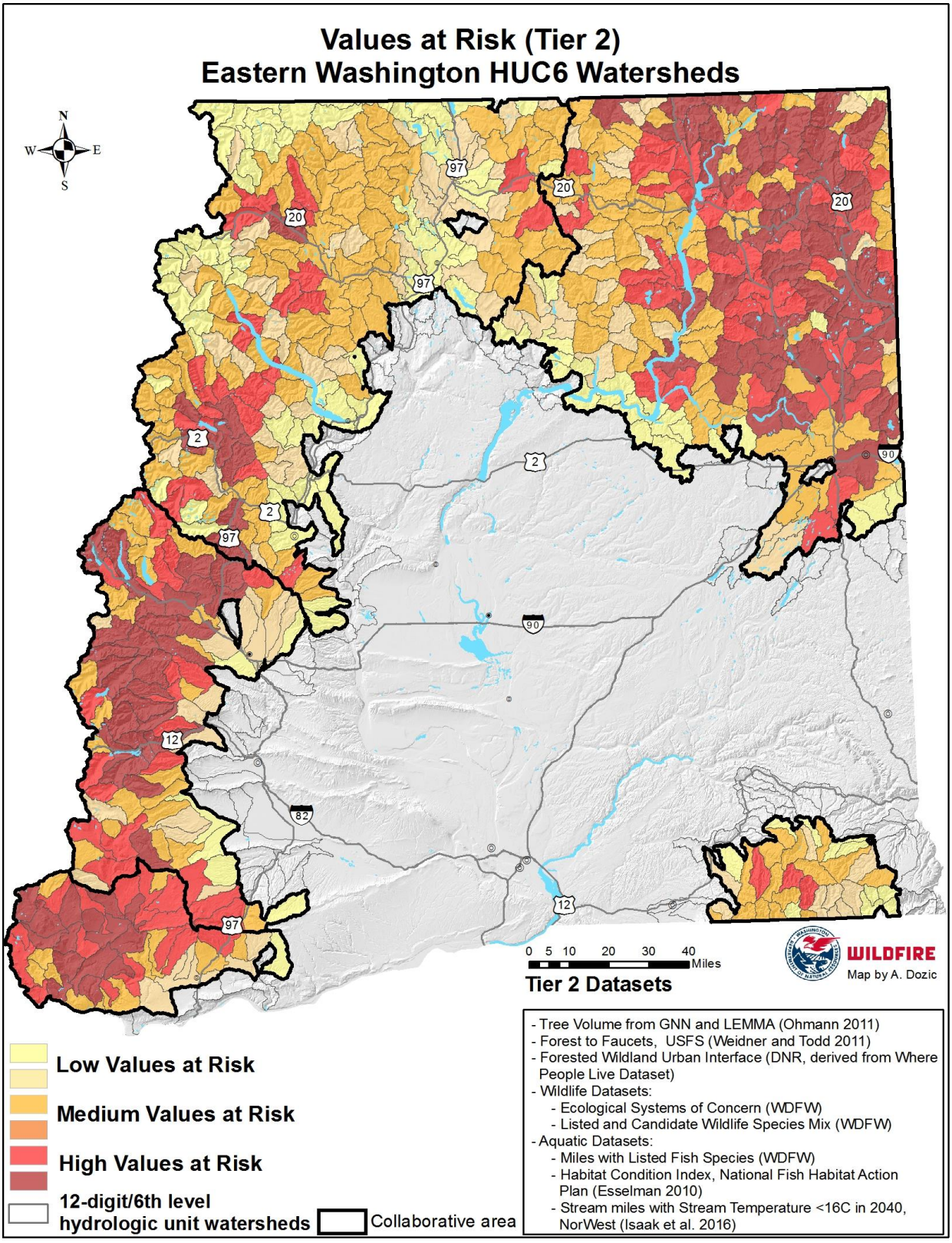

Figure 5: Tier 2 prioritization for HUC 6 forested watersheds in eastern Washington.

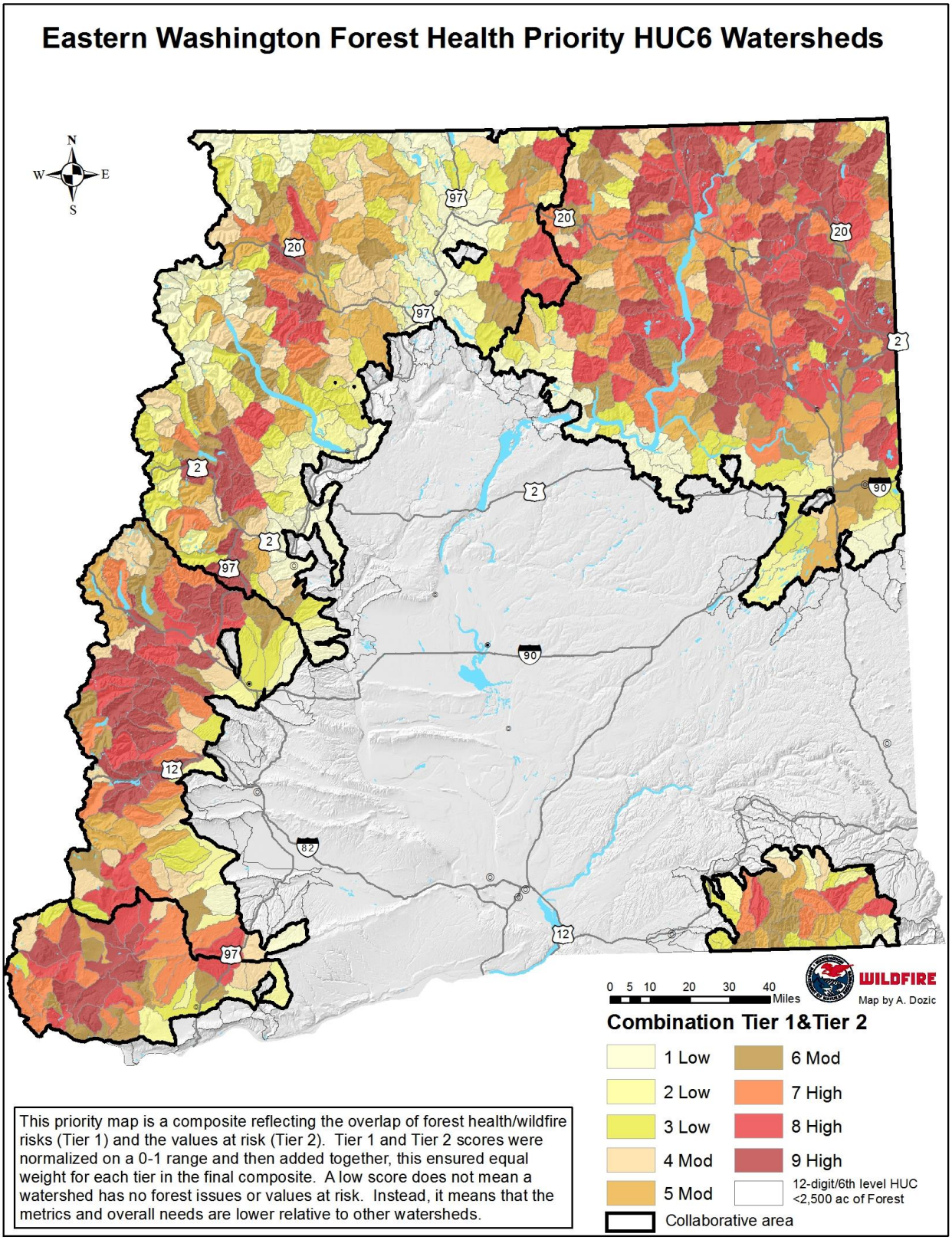

Figure 6: Combined prioritization for HUC 6 forested watersheds in eastern Washington.

Data Sources

All of the data sources used are publically available, although the most recent versions for a few metrics were obtained directly from the producers of the data. Maps for each data layer are provided in Appendix 3.

Tier 1: Forest Health

1. *Fire Risk:* This metric combines two datasets for fire probability with two datasets for fire intensity. Probability is the annual probability that a pixel will burn, while intensity is measured by the flame length of fires that burn each pixel. Flame length is a good measure of how severe a fire is. As higher intensity and severity fires threaten homes and other resources, combining these two aspects of fire provides a better estimate of fire risk that probability alone. Three of the datasets come from quantitative wildfire risk assessment recently produced for Oregon and Washington by Rick Stratton of the USFS (Stratton In Prep) using the FSim fire modeling system (Finney et al. 2011). These include burn probability, probability of flame lengths greater than 8 feet, and average flame length for 120m pixels. The forth dataset dataset predicts large fire probability for 140 acre pixels based on a statistical model (MaxEnt model) developed from past fire events (up to the year 2015), fuel conditions, climate, and topography for current and future time periods using downscaled climate projections (Davis et al. 2017). To capture areas most at risk from increasing fire probability due to climate change, we used the change in fire probability from the current period 1981 – 2010 to the future 2041- 2070 period. The final step was to create a single fire risk score for each HUC 6. To do this, the mean value for each of the four fire datasets was calculated for each HUC 6. These four scores were then each standardized. The final step was to average all four standardized datasets together to create a single fire risk score for each HUC 6.

2. *Insect and Disease Risk.* The National Insect and Disease Risk Map was used (Krist et al. 2014). This dataset quantifies the hazard or probability of tree mortality from different insects and diseases based on current forest conditions, climate, proximity to known insect and disease disturbances, soils, topography, and other factors. The combined risk of all insect and disease agents was used. Risk values are based on vegetation conditions in 2012. A threshold mortality risk of 25% or greater was used based on recommendations from the creators of the model. To calculate a risk value for each HUC 6, the percentage of 30m pixels with 25% or greater risk of mortality in the watershed was derived.

3. *Restoration Opportunity:* This data comes from an update to Haugo et al. (2015), which was the data source used to estimate restoration need in the 20 Year Plan. The updated departure assessment used for this round (DeMeo et al. In Press), compares estimated historical ranges of five structure classes with current conditions to quantify how departed or "out of whack" a watershed is. The analysis is done for different biophysical settings (BPS), which are similar to potential vegetation groups (e.g. dry mixed conifer, etc). Based on these departures, the percent of acres in a HUC 5 that need mechanical and/or prescribed fire treatments to align with historical conditions was derived. However, departure information and percent of acres needing treatment is not available at the HUC 6 level. Thus we created a different metric using the following steps: (1) We determined which structure classes x BPS were departed for each HUC 5 watershed and by how many acres; (2) We summed the total number of acres in each departed structure class x BPS for every HUC 6; (3) If this number was higher than the number of departed acres in the respective HUC 5 for that structure class x BPS, the HUC 5 number of departure acres was used for that structure class x BPS in that HUC 6 instead of the value from

step 2; (4) The final step was to sum up all the acres from steps 2 and 3 for each HUC 6. This total is the number of acres in a HUC 6 that could be treated to move the larger HUC 5 towards alignment with historical conditions. It is not the number of acres that need to be treated to restore that HUC 6, but potential acres to restore conditions at the HUC 5 level. The purpose of this metric is to identify the greatest relative opportunities among HUC 6 watersheds to restore departed conditions.

4. *Climate Change:* The projected increase in water balance deficit was included to capture the projected changes in climate that will exacerbate forest health issues. Water balance deficit, or deficit, is a measure of moisture stress that plants face and thus constrains were different plant species can grow (Stephenson 1998). Increases in deficit elevate fire behavior and make forests more susceptible to insect and disease outbreaks (Littell et al. 2010). Downscaled climate projections from the AdaptWest Project (AdaptWest 2015) were used, which is based on climate data from Climate North America (Wang et al. 2016). Future projections are based on an Ensemble of 15 Global Circulation Models under the R8.5 emissions scenario. The difference between for the 1981–2010 and 2041–2070 time periods was calculated for 1km pixels and then averaged across each watershed to get a single score for each HUC 6. Absolute change in deficit was used instead of proportional change. The Hargreave's method of calculating water balance deficit was used as it is readily available on the AdaptWest site.

Tier 2: Values at Risk

1. *Aquatic System Health:* Three different datasets were used to rate both riparian conditions and fish habitat. HUC 6s with higher scores have higher functioning aquatic systems that could be degraded by uncharacteristic high severity fires, thus potentially warranting forest restoration treatments in portions of the watershed. Within a HUC 6, areas more suitable for no-management, treatment as well as aquatic related restoration activities will be identified during landscape evaluations. The first dataset is the number of stream miles in each HUC 6 with listed fish species and was provided by WDFW. The second dataset is the Habitat Condition Index (HCI) from the National Fish Habitat Assessment which quantifies the overall level of human disturbance (e.g. road density, stream crossings, percent in agriculture, percent in developed areas, etc) by catchment (smaller than HUC 6) (Esselman et al. 2010). The third dataset is projected stream temperature in 2040 from the NorWest Stream Temperature Modeling project to capture future cold water fish habitat (Isaak et al. 2016). The total miles of stream with projected maximum temperatures less than 16 C was used as the metric for each HUC 6. Scores from the three datasets were standardized and then averaged together to create a single score for each HUC 6.

2. *Wildland Urban Interface*: This dataset was created by DNR staff by buffering all values of the Where People Live dataset used in the West Wide Wildfire Risk Assessment by 0.5 miles and then intersecting the buffered Where People Live dataset with forestland (Oregon Dept. of Forestry 2013). This dataset is a good approximation of where there are forests and structures to represent the forested WUI. The Where People Live dataset estimates the number of housing units per acre and was developed using advanced modeling techniques based on the LandScan population count data available from the Department of Homeland Security, HSIP Freedom Dataset.

3. *Drinking Water:* The Forest to Faucets dataset was used to identify forest areas most important to surface drinking water (Weidner and Todd 2011). Scores are based on the number of people that derive water from a watershed and the amount of water supply. High scores mean that more people rely on the watershed for drinking water and the overall amount of water supplied is higher.

4. *Accessible Timber:* To estimate both timber value at risk and potential for commercial treatments that can generate revenue, the number of acres with greater than 12,000 board feet within 1500' of a road was calculated. For volume, the regional 2014 GNN forest inventory dataset from LEMMA (Ohmann and Gregory 2002, Ohmann et al. 2011) was used. The DNR road layer for Washington was used, but first cross referenced with current road layers for the Okanogan NF and Colville NF.

5. *Percent of Watershed with Slope Less than 35%:* This metric was generated to factor in topographic complexity and the corresponding feasibility and economic cost of both mechanical and prescribed fire treatments. Treatments on slopes over 35% are certainly possible. However, they are more expensive and challenging to implement due to greater complexity with temporary road building, elevated fire behavior, need to cable yard, greater potential for negative aquatic impacts, and fewer number of available contractors to conduct the work.

6. *Wildlife*: Two datasets were averaged together to identify overall wildlife habitat importance for each HUC 6. The first was the number of listed and candidate wildlife species. The second was the number of acres in "ecological systems of concern", which are habitats that are at risk and support a high number of species. Scores were obtained at the HUC 6 level from WDFW. The two datasets were standardized and averaged together to create a single wildlife score. No attempt was made to distinguish between species that require dense, closed canopy forest vs. more open forest. This will be done during landscape evaluations, where a finer scale approach can be used to identify portions of watersheds best suited to sustain dense forest habitats vs. more open forest habitat.

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