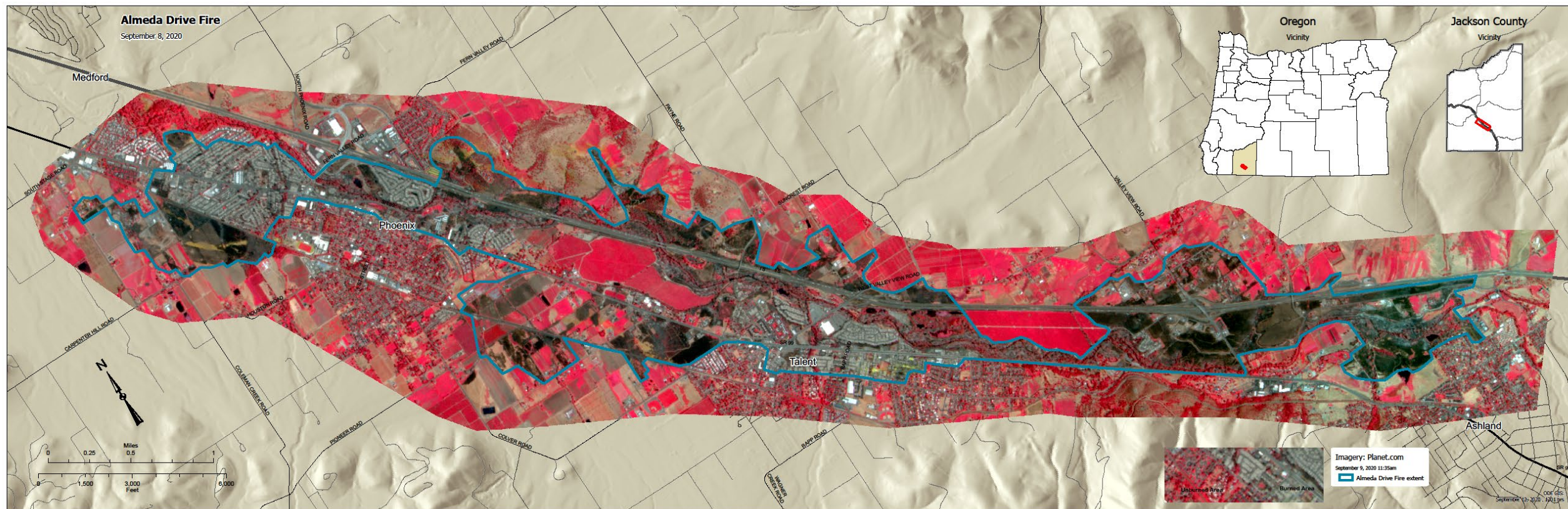# Wildfire Risk Mapping and Community Exposure

Presentation to Senate Natural Resources and Wildfire Recovery Committee
3/10/2021

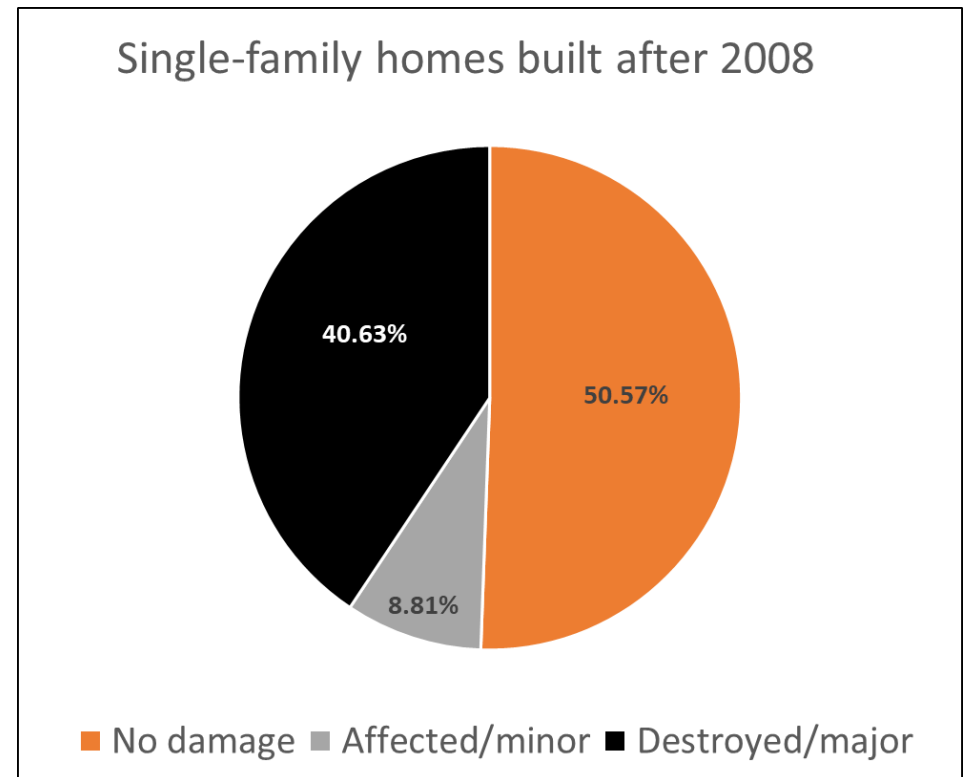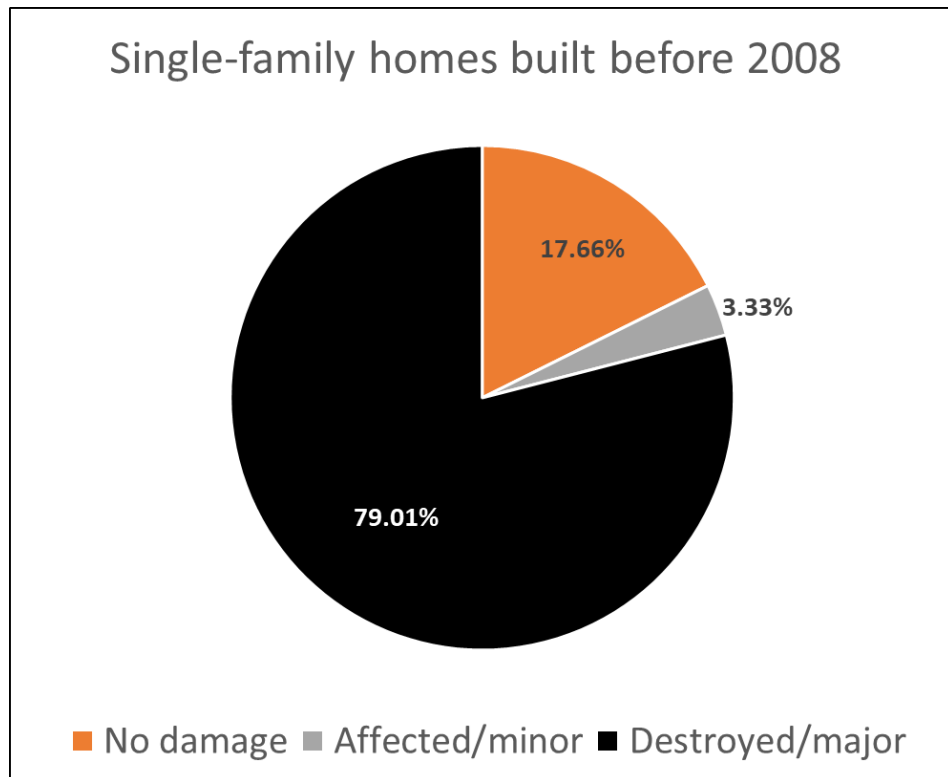**Christopher J. Dunn, PhD**   chris.dunn@oregonstate.edu, Oregon State University, Corvallis, OR.

State of Washington adopted WUI code in 2004, updated to the 2018 International Wildland Urban Interface Code

State of California adopted new codes in 2007, took effect on new construction in 2008

Single-family homes built before 2008

- 17.66%
- 3.33%
- 79.01%

■ No damage ■ Affected/minor ■ Destroyed/major

Single-family homes built after 2008

- 40.63%
- 50.57%
- 8.81%

■ No damage ■ Affected/minor ■ Destroyed/major

https://www.sacbee.com/news/california/fires/article227665284.html

2020 Holiday Farm fire

Wildfire risk

Probability

Intensity

Susceptibility
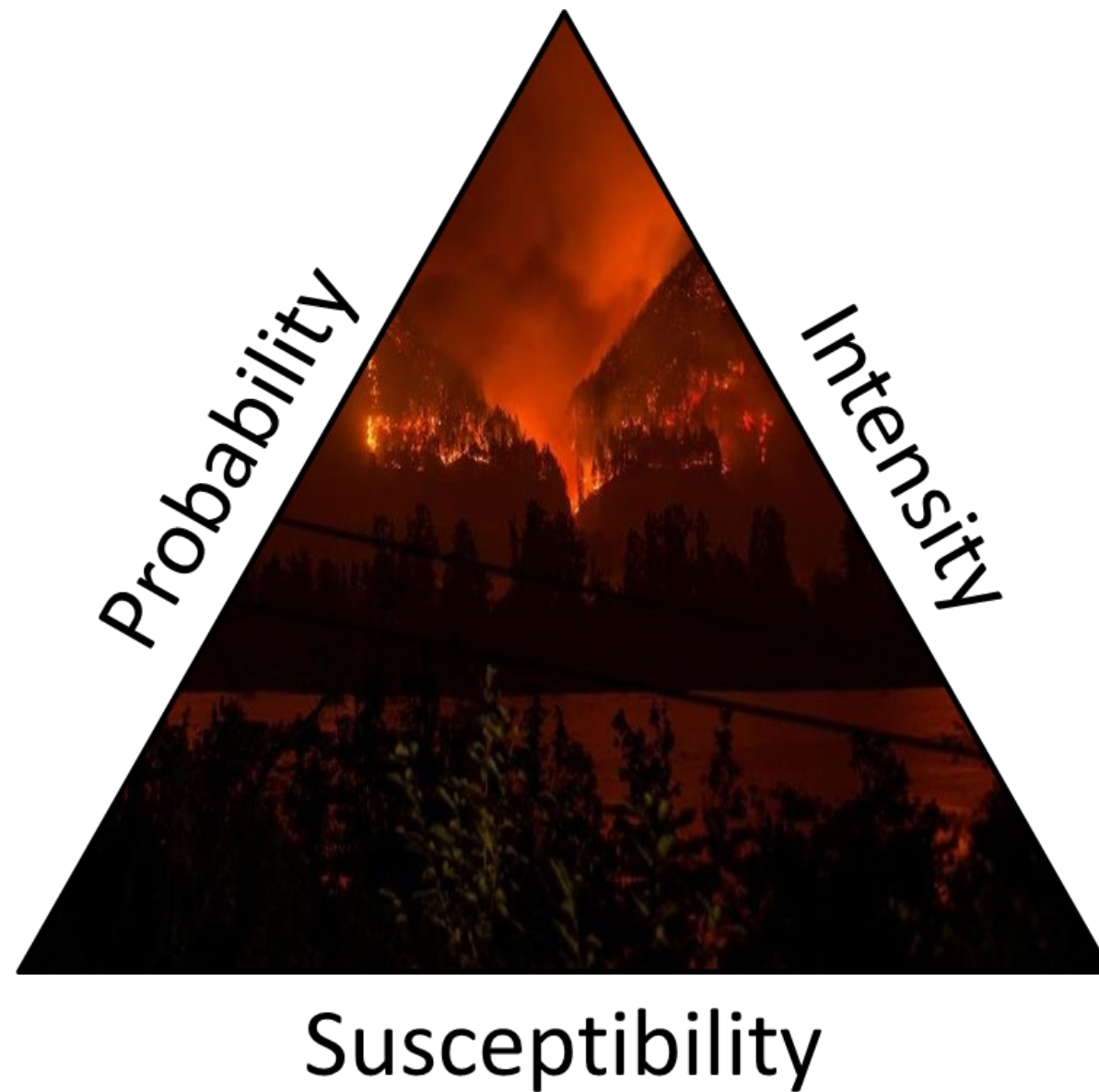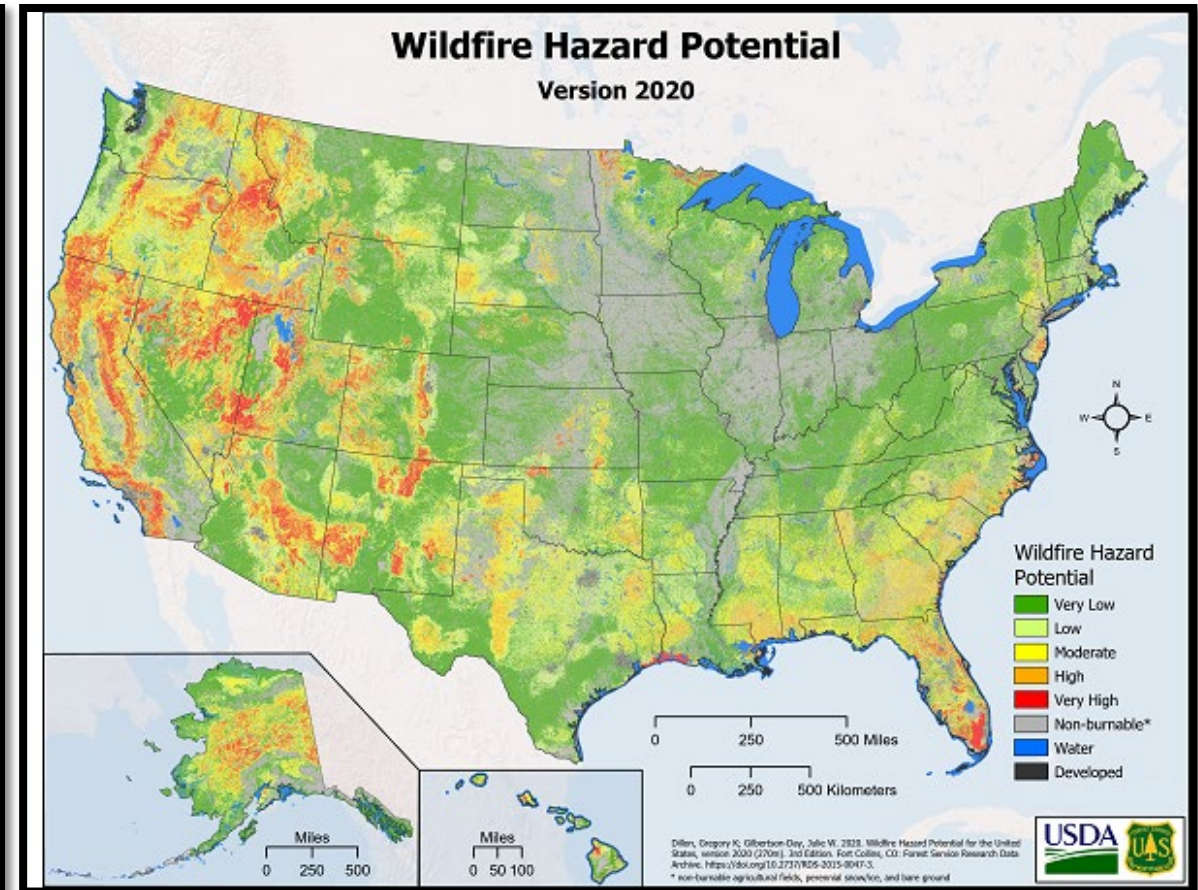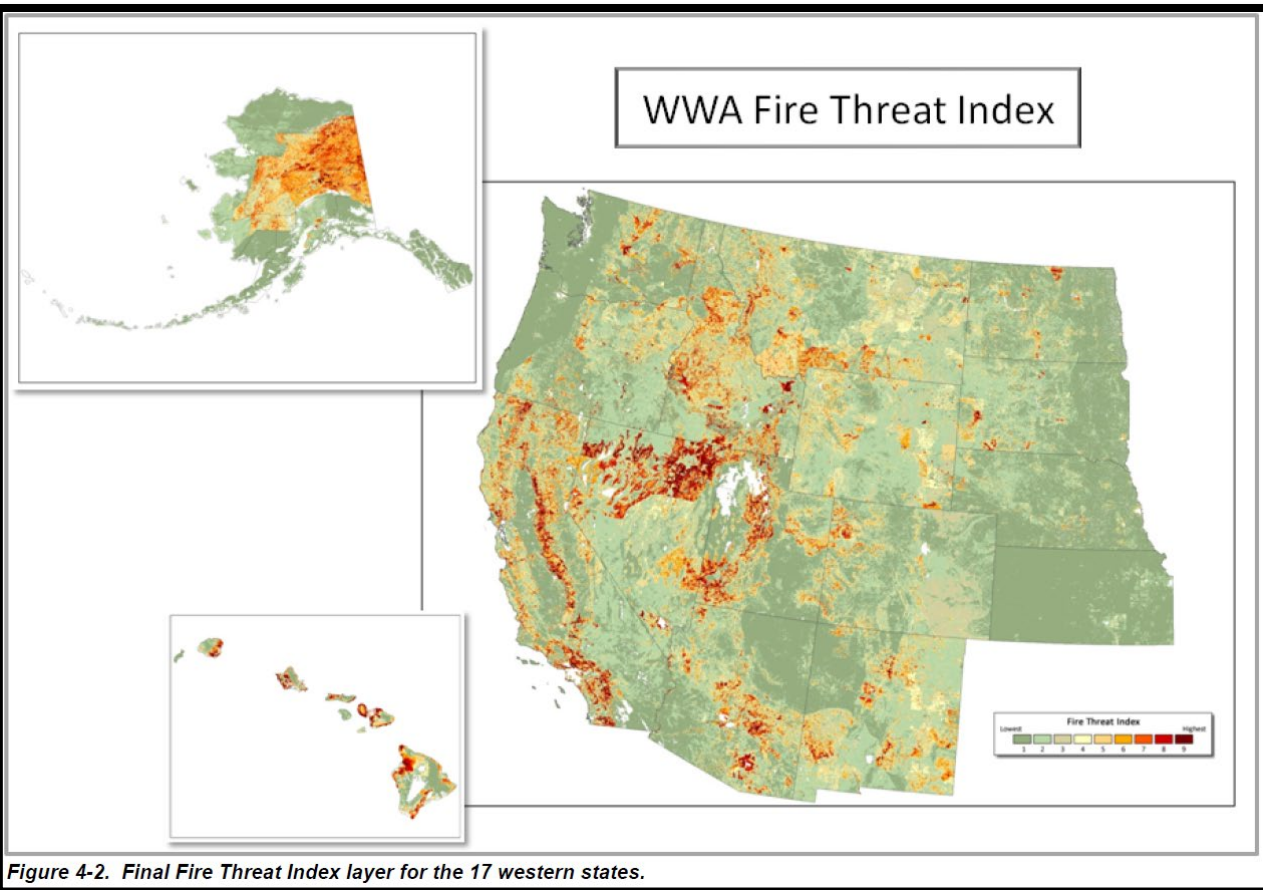
Wildfire Risk Assessments expanding in use

1. 2013 West Wide Wildfire Risk Assessment

2. 2016 The Rogue Basin Cohesive Forest Restoration Strategy – QRA

3. 2017 PNW Quantitative Wildfire Risk Assessment

4. 2020 Wildfire Hazard Potential

5. National Wildfire Risk Assessment to Forest Service Lands

6. Coastal Mountain Resource Area – Northern California and Southern Oregon (primarily focused on US Forest Service Forest Plan revision)
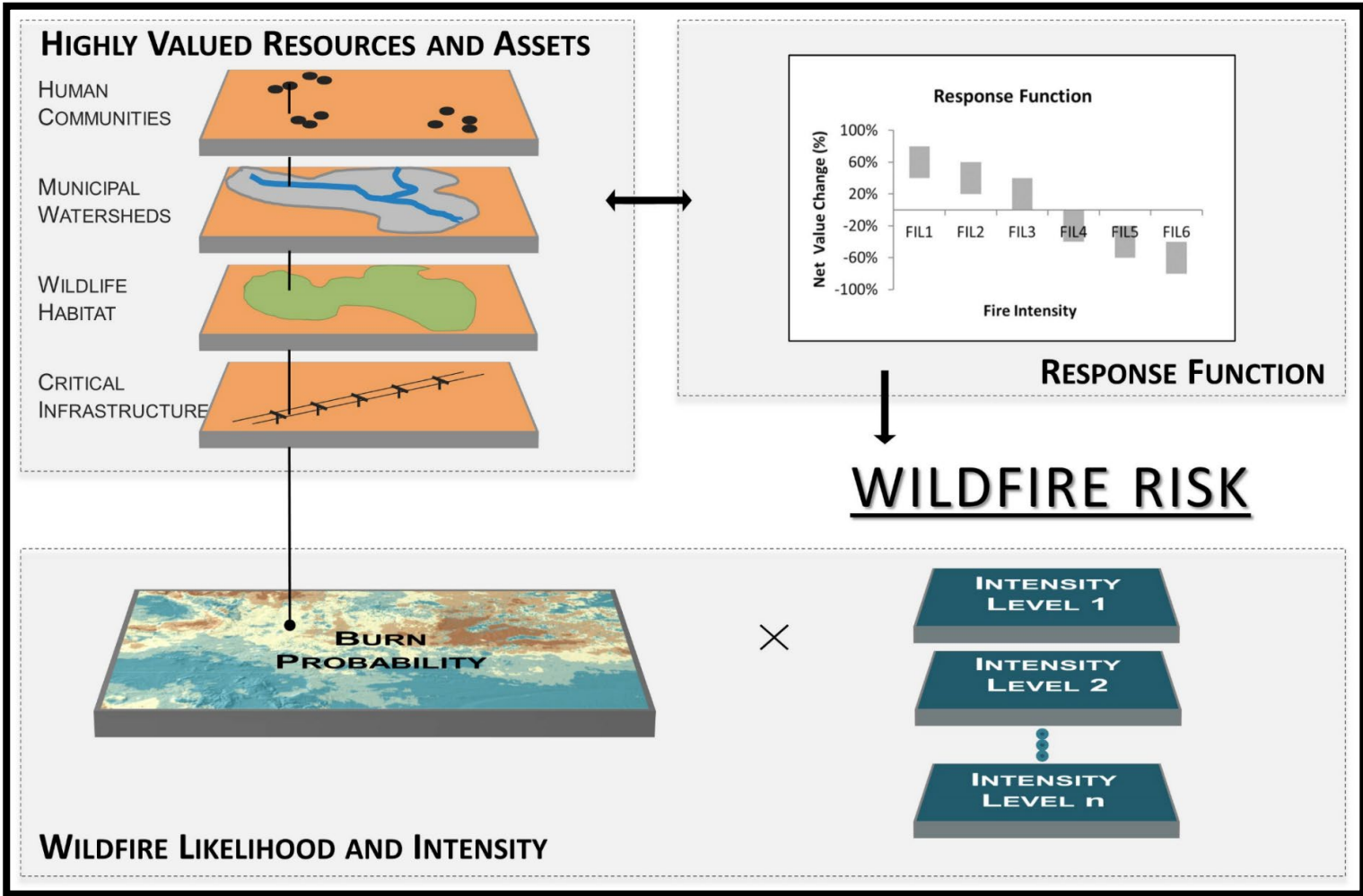
Figure 4-2. Final Fire Threat Index layer for the 17 western states.

https://www.thewflc.org/resources/west-wide-wildfire-risk-assessment-final-report

"Our specific objective with the WHP map is to depict the relative potential for wildfire that would be difficult for suppression resources to contain."

"Areas mapped with higher WHP values represent fuels with a higher probability of experiencing torching, crowning, and other forms of extreme fire behavior under conducive weather conditions.."

https://www.firelab.org/project/wildfire-hazard-potential

PNW Quantitative wildfire risk assessment methods can help address multiple objectives

Scott et al. 2013

Burn Probability

2001 – 2017 large fires

Annual burn probability

- 0
- 0 - 0.0001
- 0.000100001 - 0.0003
- 0.0003 - 0.0006
- 0.0006 - 0.001
- 0.001000001 - 0.003
- 0.003 - 0.006
- 0.006 - 0.01
- 0.010000001 - 0.03
- 0.03 - 0.047348
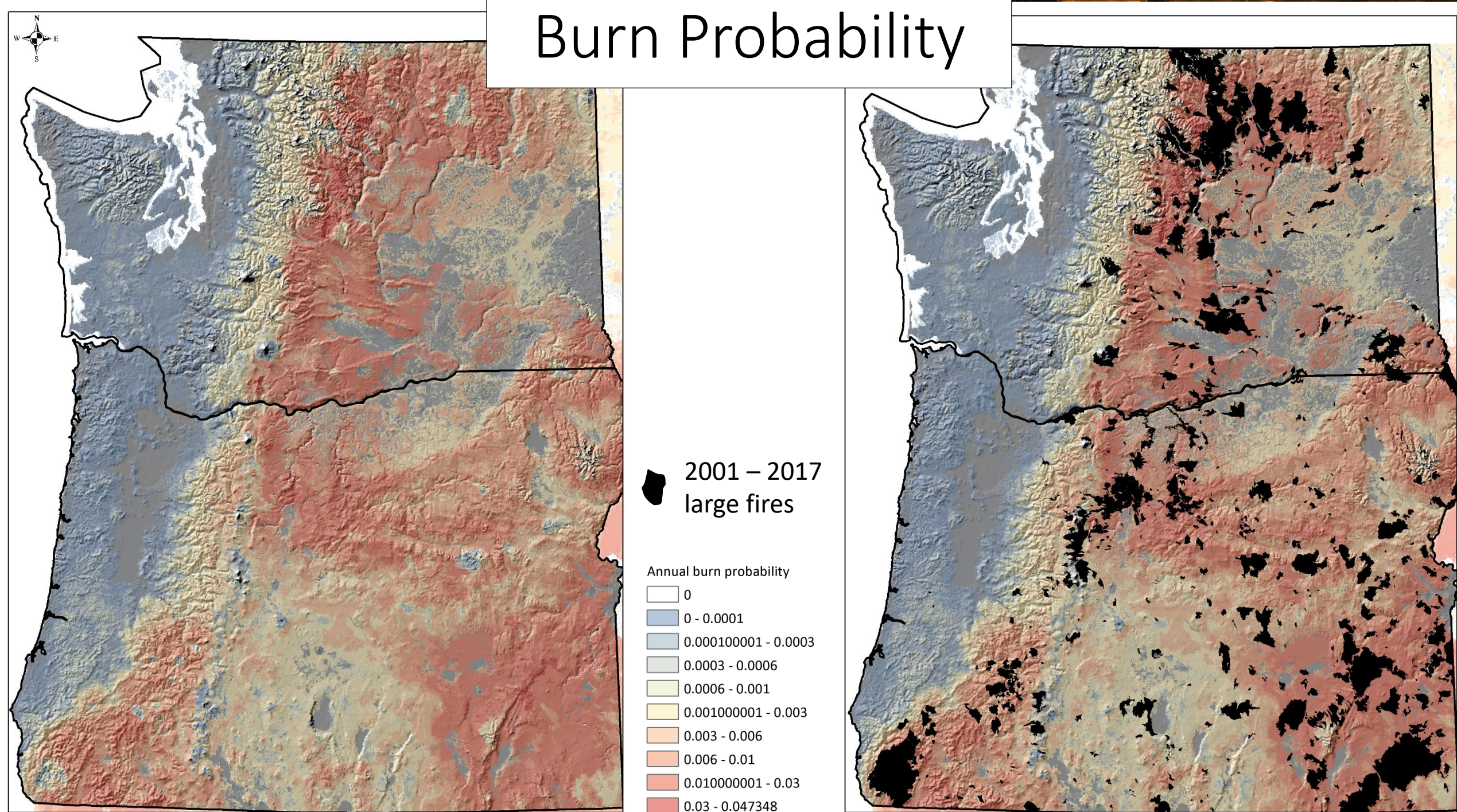
Fire intensity

– measured by flame length

Conditional flame length
Central tendancy when fire occurs

- < 2 ft
- 2 - 4 ft
- 4 - 6 ft
- 6 - 8 ft
- 8 - 12 ft
- >12 ft

Miles
0   20   40   80   120   160
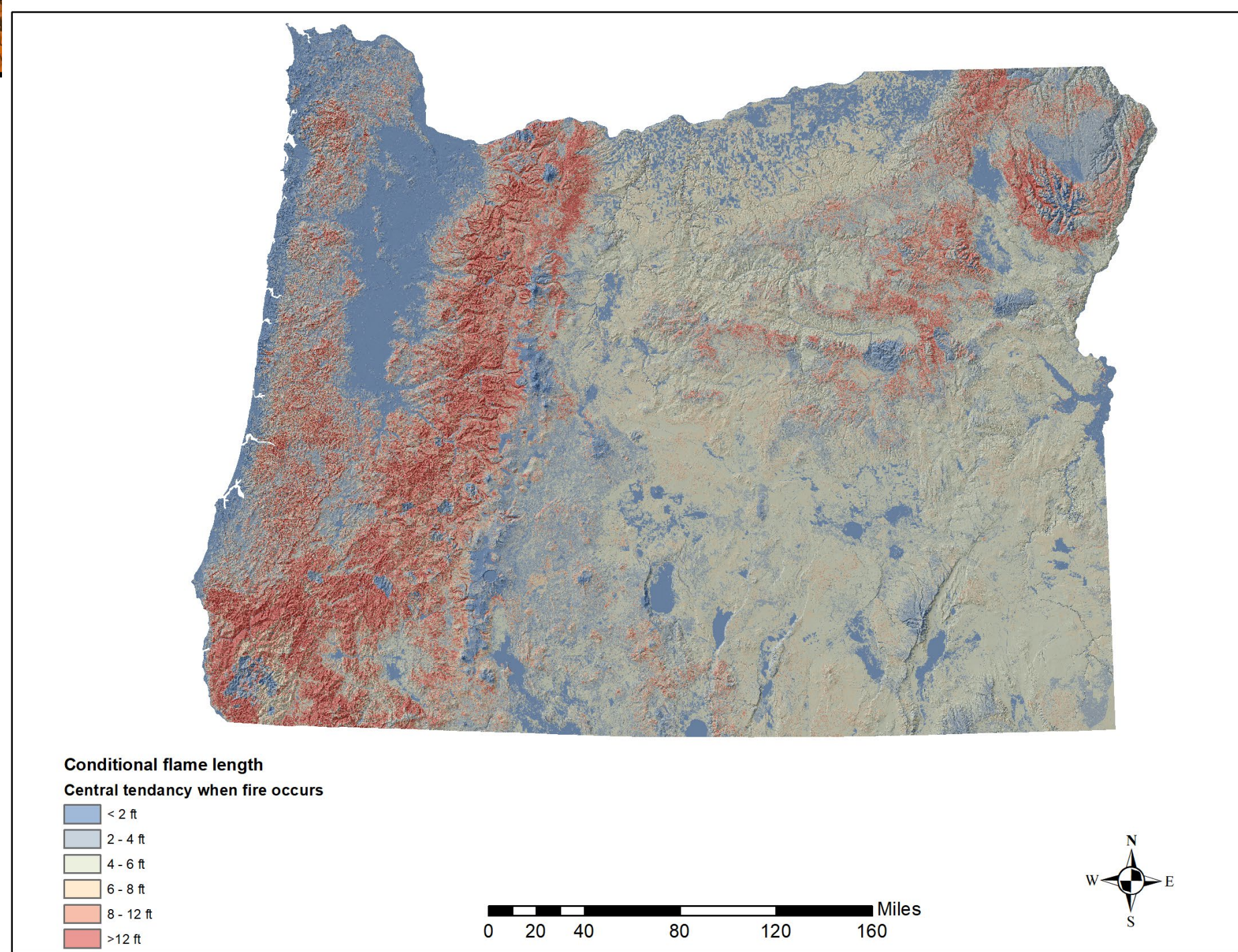
Wildland Urban Interface

1. Interface community
   a) *The Interface Community exists where structures directly abut wildland fuels.*
   b) The development density for an interface community is usually 3 or more structures per acre, with shared municipal services

2. Intermix community
   a) *The Intermix Community exists where structures are scattered throughout a wildland area.*
   b) The development density in the intermix ranges from structures very close together to one structure per 40 acres.

3. Occluded community
   a) *The Occluded Community generally exists in a situation, often within a city, where structures abut an island of wildland fuels (e.g., park or open space).*
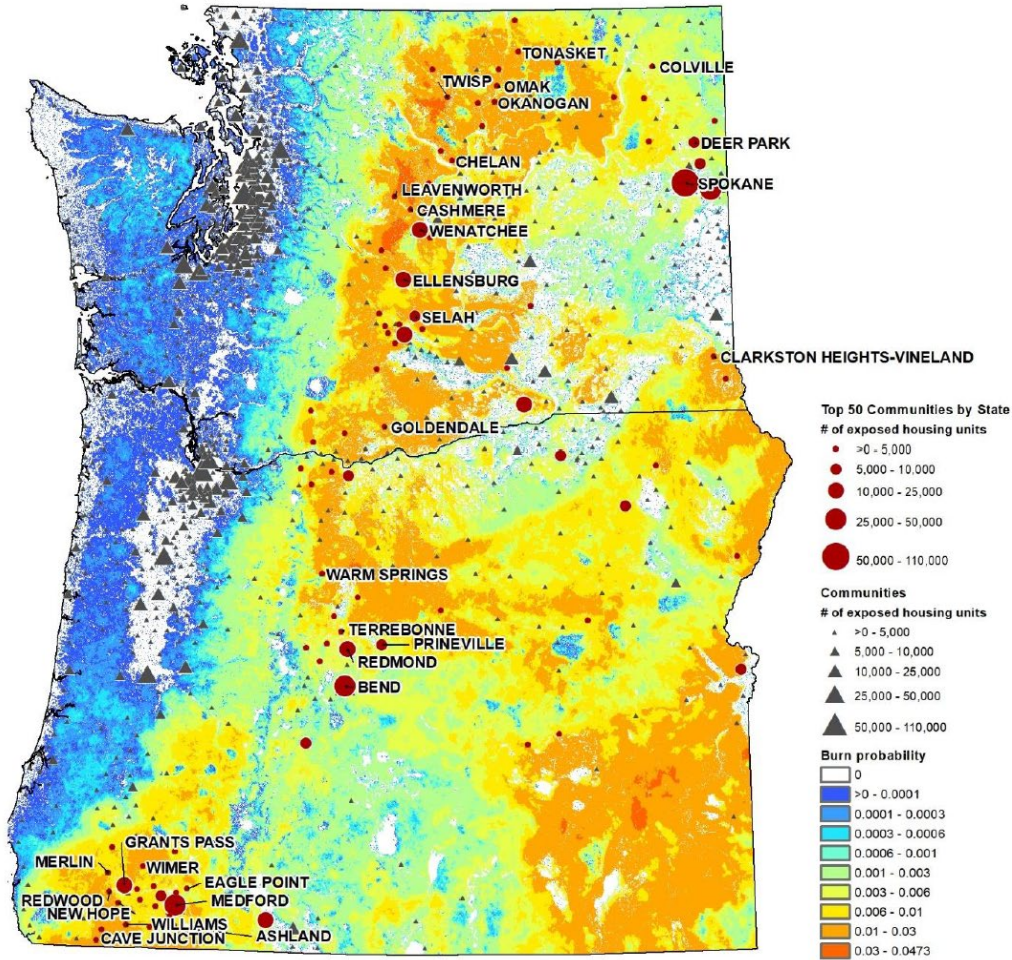
Targeting mitigation - Community exposure

Figure 1. Annual burn probability across the states of Washington and Oregon and exposed human communities in each state. The 50 most-exposed communities in each state are mapped in dark red. The most-exposed communities tend to be in areas with the highest annual burn probabilities based on the FSim modeling results.
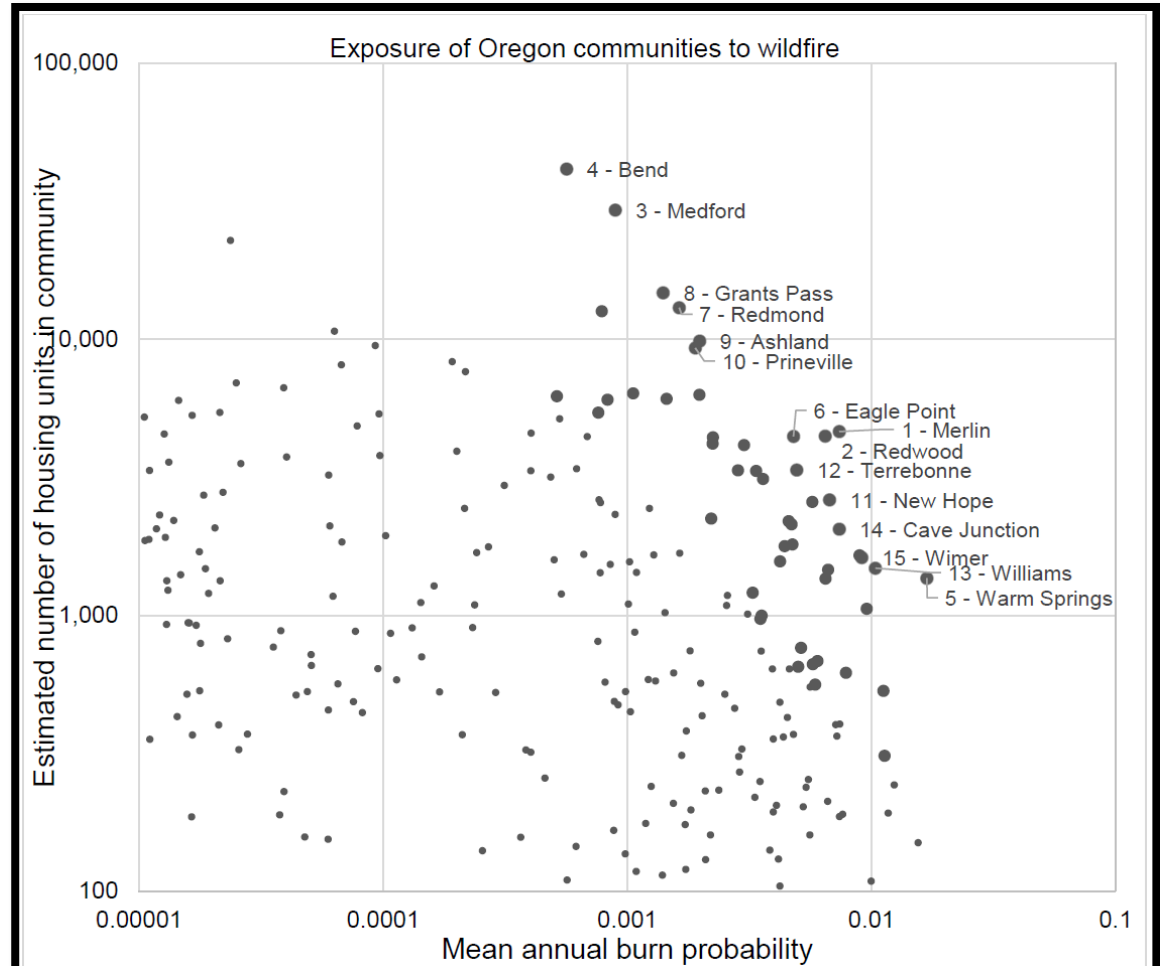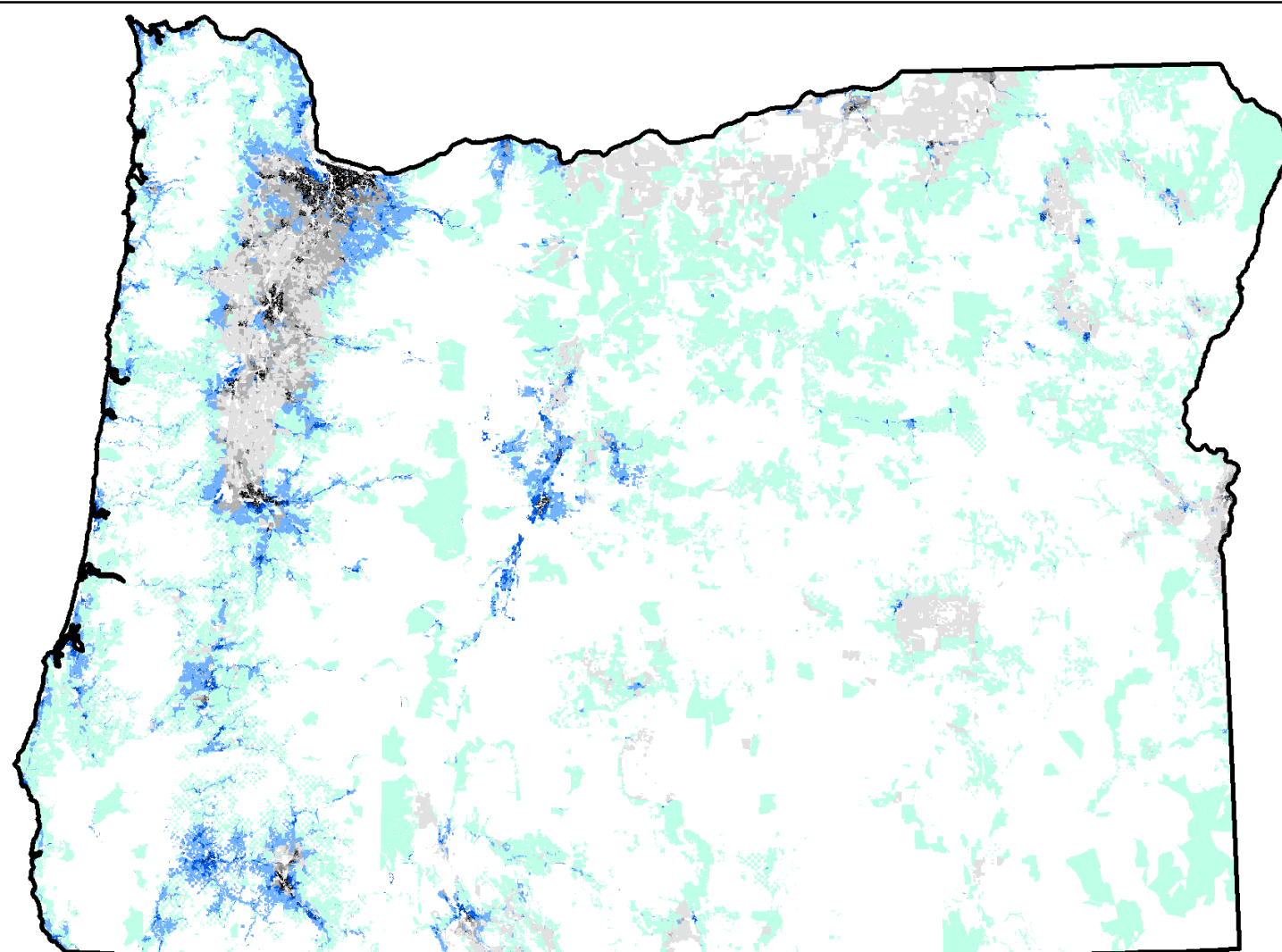

Figure 3. Exposure of Oregon communities to wildfire. The 50 most-exposed communities (by cumulative annual housing-unit exposure) are shown as larger gray dots. The top 15 are labeled with the rank and community name. See Table 2 for the names of the remaining top-50 communities. Smaller gray dots represent communities not among the 50 most exposed. Only the 244 communities with a mean burn probability greater than 0.0001 (1 in 10,000) are shown; 133 communities with a lower mean burn probability are not shown. Axes are shown on a common-log scale (base 10).

WUI Classification

Class designation

- ■ High Density Interface/Intermix
- ■ Medium Density Interface/Intermix
- ■ Low Density Interface/Intermix
- ■ Very Low Density, vegetated
- ■ High Density, not vegetated
- ■ Medium Density, not vegetated
- ■ Low Density, not vegetated
- ■ Very Low Density, not vegetated
- □ Uninhabited_NoVeg; Uninhabited_Veg; Water

Intermix = housing embedded in wildland vegetation covering >50%

Interface = housing in area with <50% wildland vegetation,
but within 1.5 miles of a wildland area with >75% vegetation cover

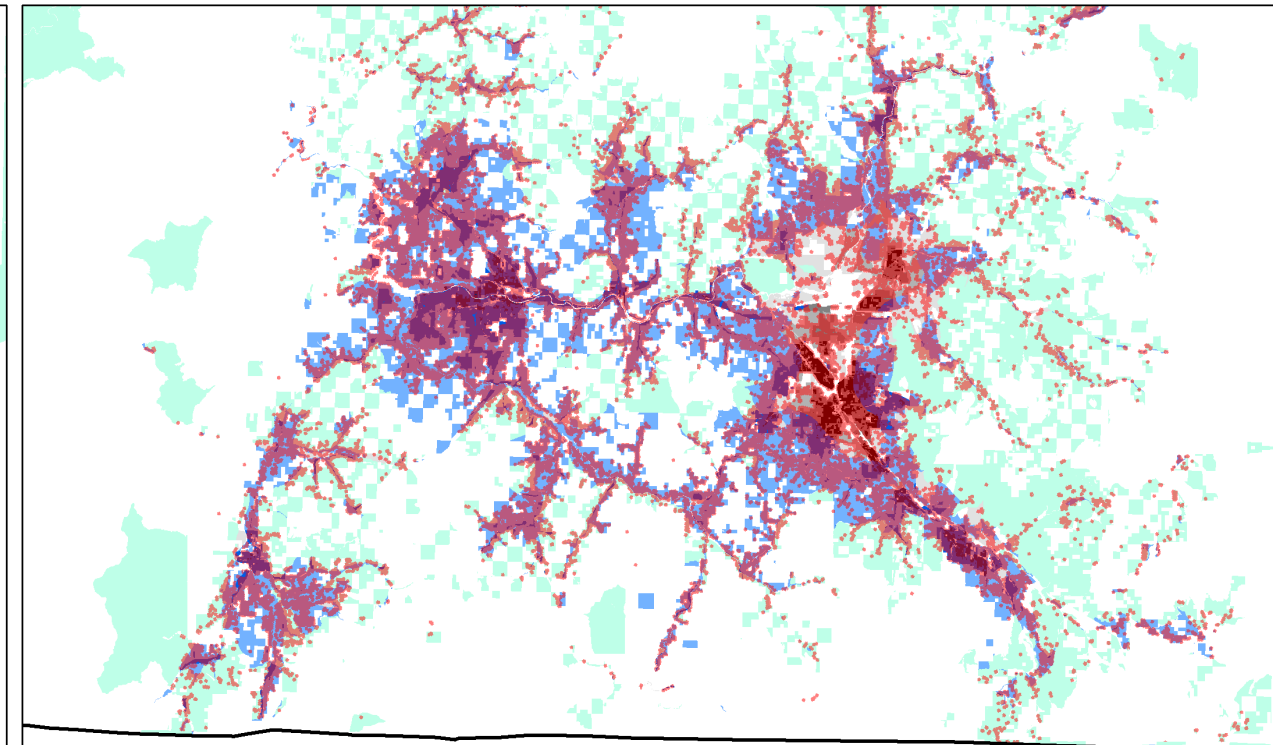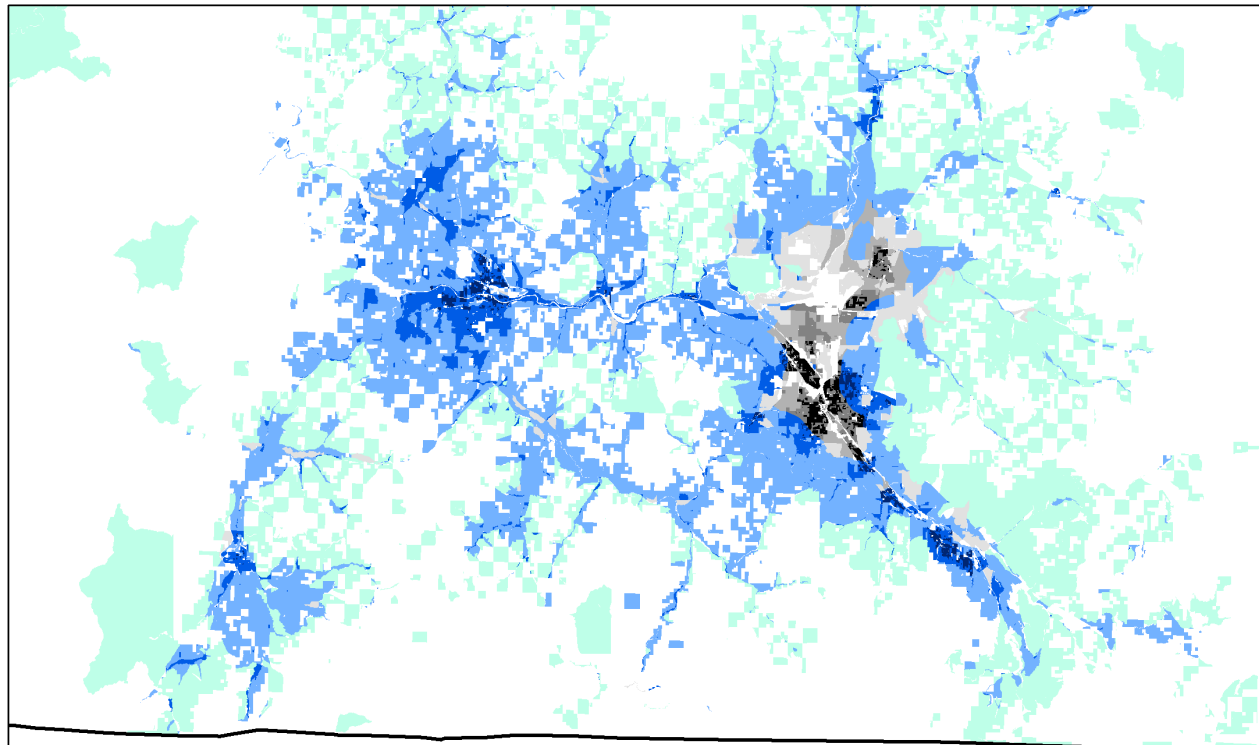Very low density = < 1 house per 40 acres (rural, often ag lands)
Low density = 1 house every 5 and 40 acres
Medium density = 1 house every 1/3 to 5 acres
High density = 1 house every 1/3 acre or less

Adjustments can be made based on new data

WUI Classification

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- Very Low Density, not vegetated
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Microsoft Building Footprint
Value
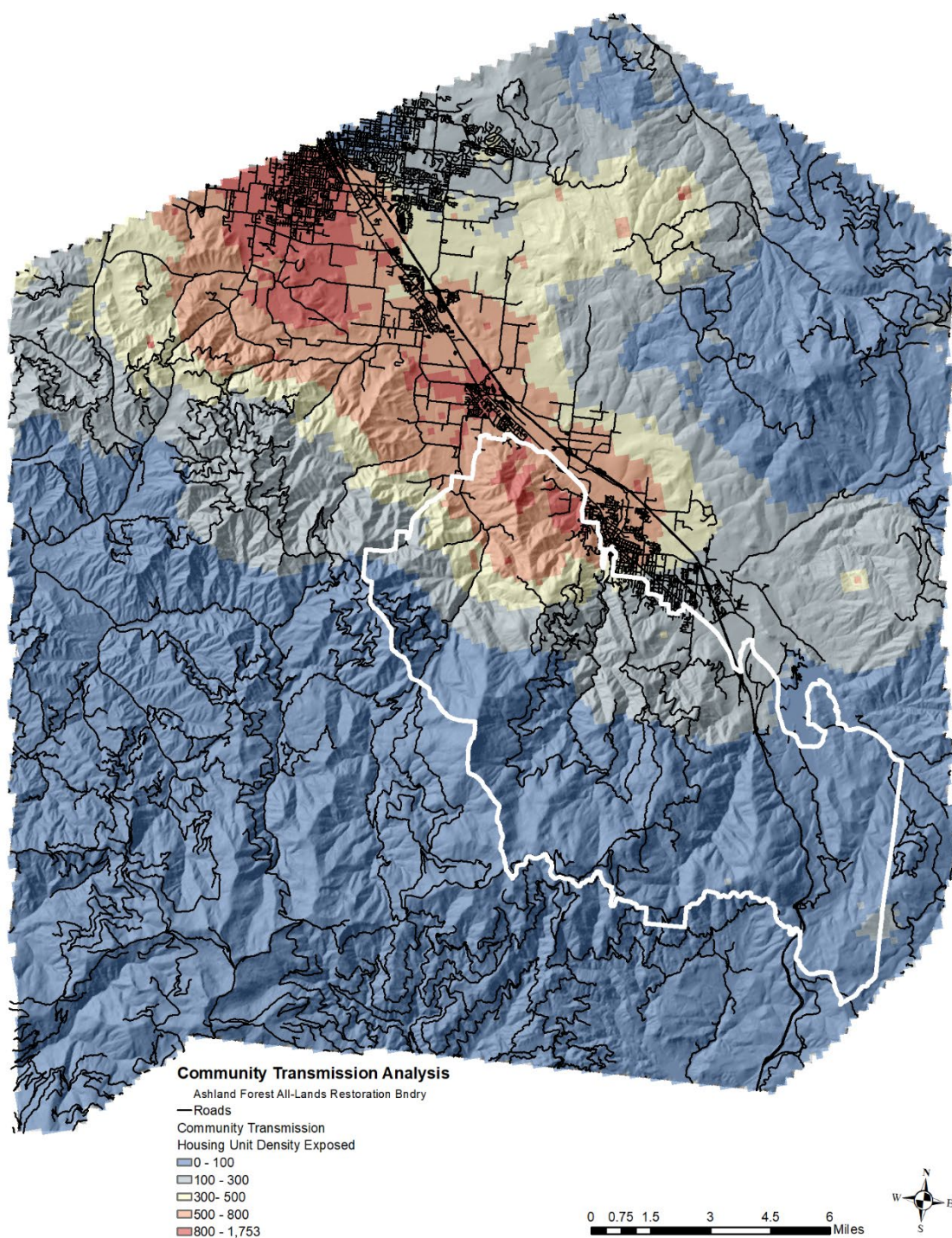- Home not present
- Home present

Intermix = housing embedded in wildland vegetation covering >50%

Interface = housing in area with <50% wildland vegetation, but within 1.5 miles of a wildland area with >75% vegetation cover

Very low density = < 1 house per 40 acres (rural, often ag lands)
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Community Transmission Analysis

Ashland Forest All-Lands Restoration Bndry
— Roads
Community Transmission
Housing Unit Density Exposed
- 0 - 100
- 100 - 300
- 300- 500
- 500 - 800
- 800 - 1,753

0 0.75 1.5   3   4.5   6
Miles

Community Transmission Analysis

1. An important objective of wildfire response and risk mitigation activities is to protect communities exposed to wildfire. The R6 QRA is a spatially explicit assessment of wildfire impacts and therefore does not directly address the potential for an ignition to spread into a nearby community.

2. Here we estimated the potential for wildfire to impact people by summing the housing unit density within each simulated fire perimeters, from the large fire simulator (FSim) results from the Region 6 Quantitative Wildfire Risk Assessment.
   a) Housing unit density is the combined estimate of people living in homes at a point across a landscape.
   b) Based on Microsoft building footprints data and most recent 5-year American Community Survey data from the Census Bureau

3. Color variation represents a smoothed surface of the number of people impacted by a large wildfire should one ignite and exceed initial attack capabilities within any area across the expanded AFAR landscape

1. The PNW Quantitative Wildfire Risk Assessment represents best practices in wildfire risk modeling. ODF uses it, the USFS uses it, researchers like myself use it, and the public has access to it via the Oregon Explorer. That information symmetry is important for actionable science that links with policy, management and education

2. That does not mean we cannot improve it, especially with what we have learned since it was released. At minimum we probably need to update it.

3. This same modeling process can provide additional tools for addressing a suite of risk-based decision support tools

4. The Wildland Urban Interface can be delineated well, but I believe we need to invest time into ensuring it meets policy and decision makers needs. For some needs fire hazard is all we need. Other purposes may require additional analyses.

5. We can provide analytics to aid this process. These policies are the right thing to do. The time is now.
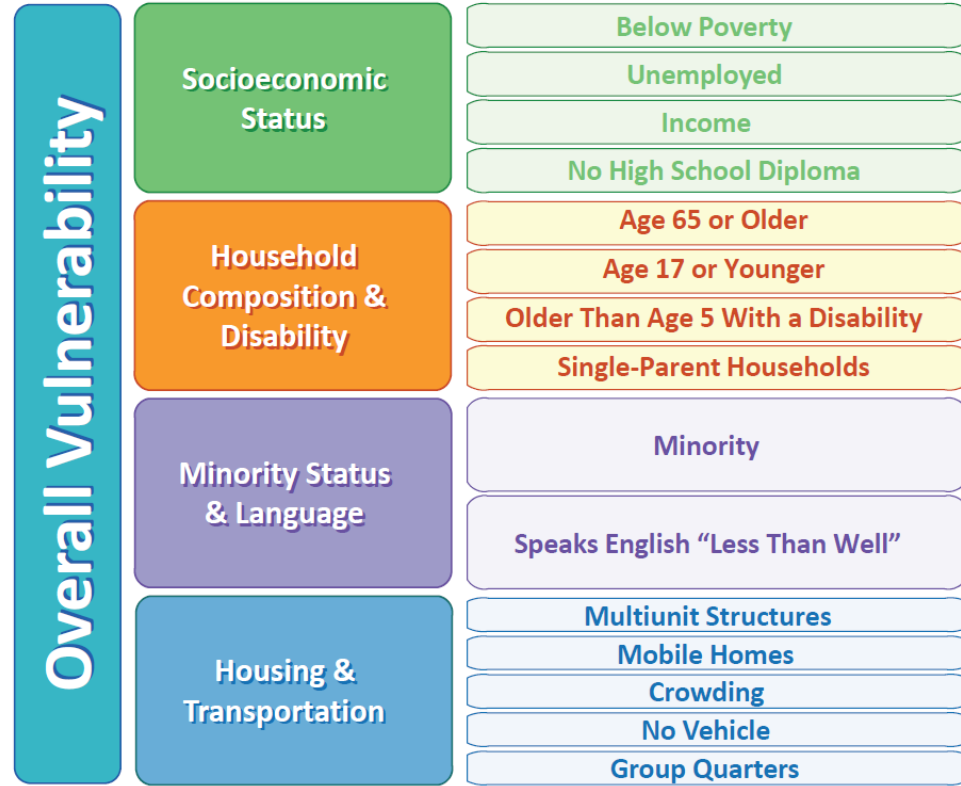
FIGURE **1**

Variables and Themes Included in the Social Vulnerability Index Databases

Overall Vulnerability

Socioeconomic Status	Below Poverty
	Unemployed
	Income
	No High School Diploma

Household Composition & Disability	Age 65 or Older
	Age 17 or Younger
	Older Than Age 5 With a Disability
	Single-Parent Households

| Minority Status & Language | Minority |
| | Speaks English "Less Than Well" |

Housing & Transportation	Multiunit Structures
	Mobile Homes
	Crowding
	No Vehicle
	Group Quarters

Social Vulnerability Index (CDC)

CDC SVI 2016
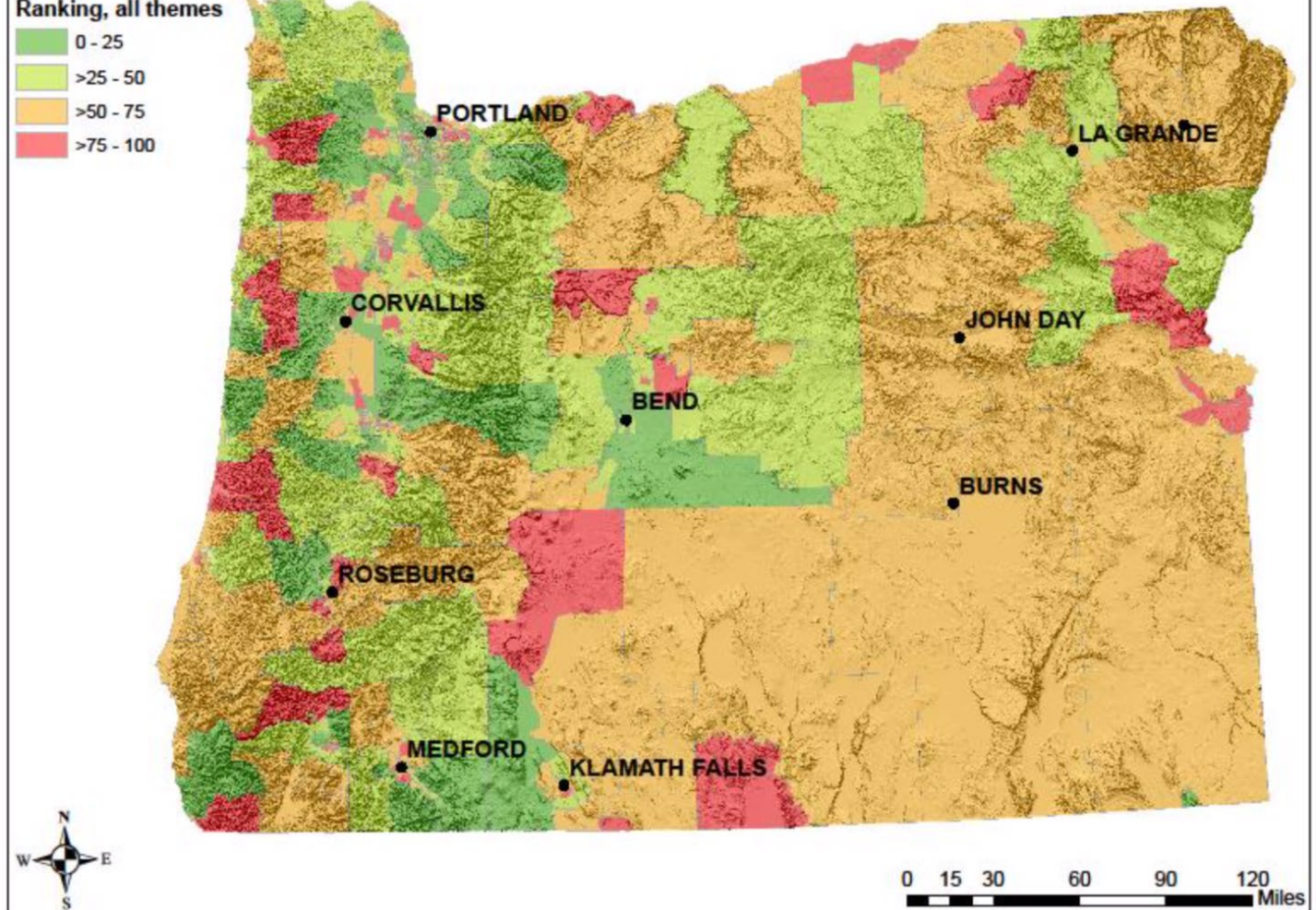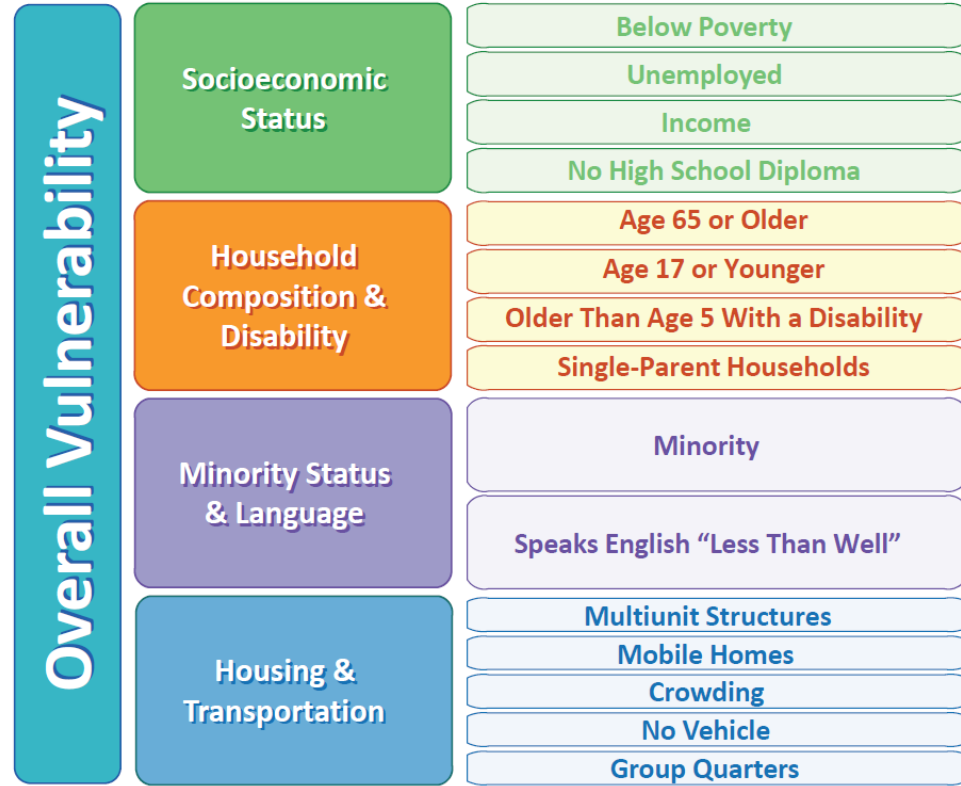**Ranking, all themes**
- 0 - 25
- >25 - 50
- >50 - 75
- >75 - 100
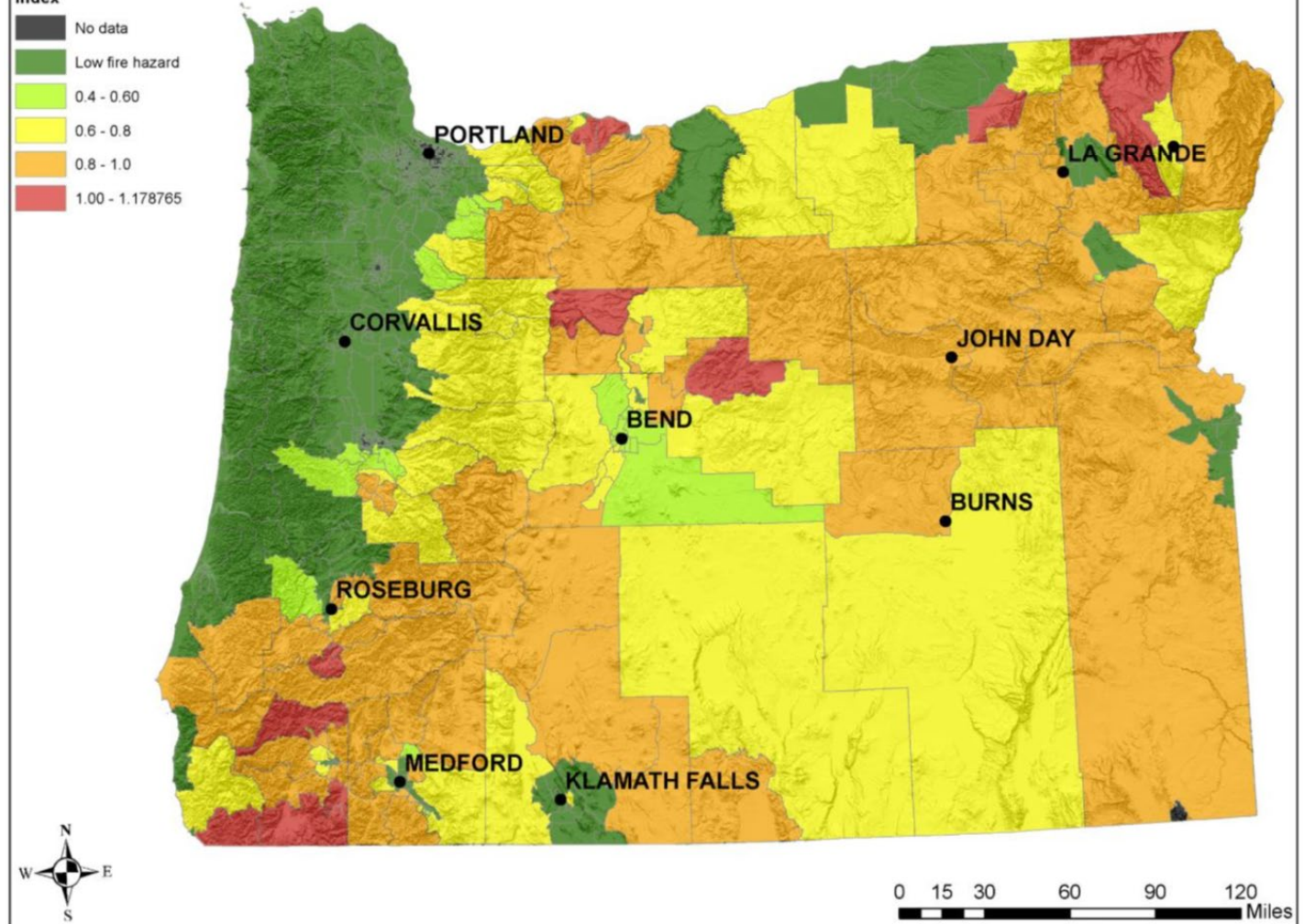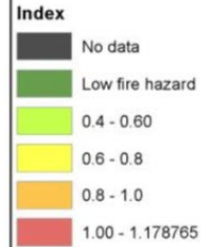
FIGURE 1

Variables and Themes Included in the Social Vulnerability Index Databases

Vulnerable Population Risk

Conditional Net Value Change (cNVC) Summarized to HU 10

cNVC
HU 10
- -236,150.17 - -160,000.00
- >-160,000.00 - -80,000.00
- >-80,000.00 - -40,000.00
- >-40,000.00 - -20,000.00
- >-20,000.00 - -10,000.00
- >-10,000.00 - -100.00
- >-100.00 - 0.00
- >0.00 - 9,943.91
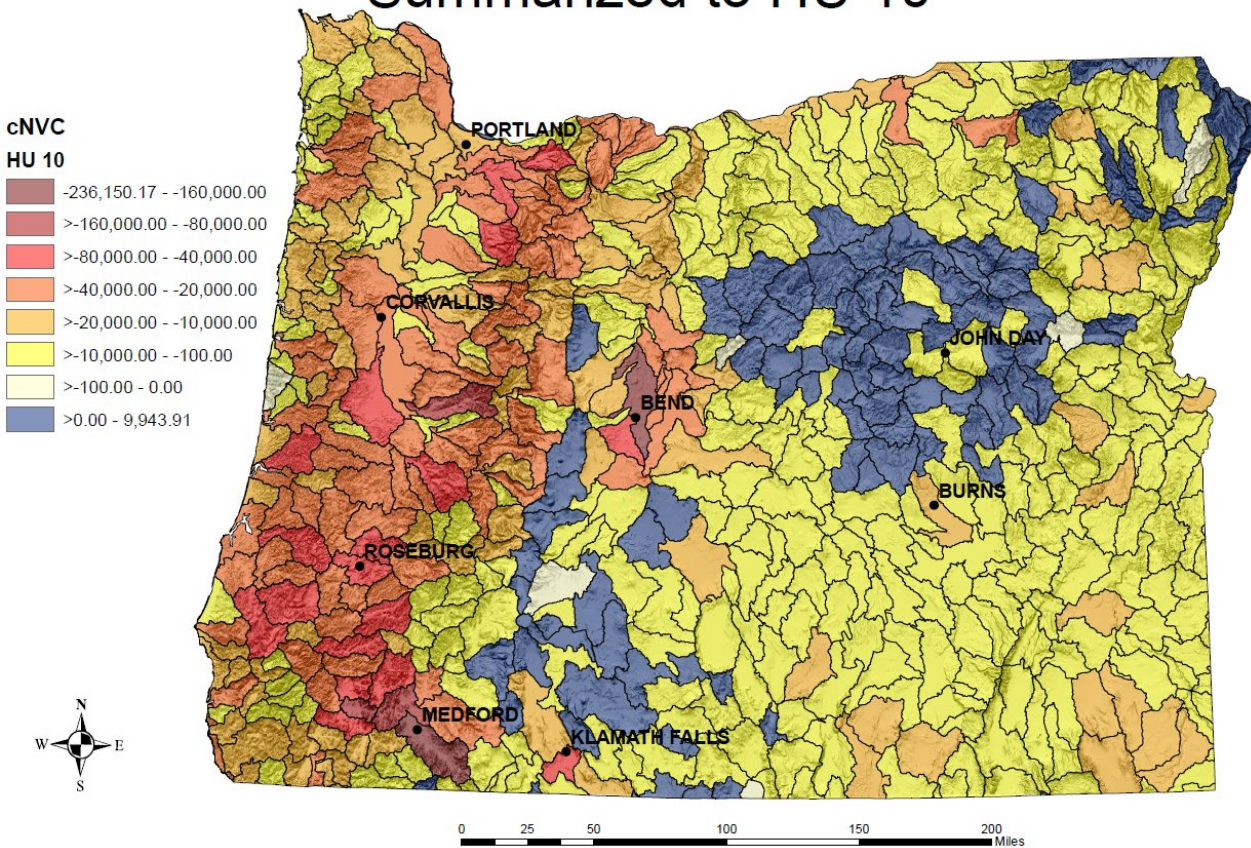
Expected Net Value Change (eNVC) Summarized to HU 10

eNVC
HU 10
- -1,052.97 - -480.00
- >-480.00 - -240.00
- >-240.00 - -120.00
- >-120.00 - -60.00
- >-60.00 - -30.00
- >-30.00 - -10.00
- >-10.00 - 0.00
- >0.00 - 42.91