Wildfire Mitigation Committee

Dr. Christopher Dunn and Andrew Spaeth

Priority Mapping

Purpose

Identify and prioritize geographic areas for wildfire risk mitigation activities and investments based on current wildfire risk and ecological, social, and economic values.

Principles and approach

Incorporate and meaningfully address the ten objectives identified by the Governor's Council for Wildfire Response.

Effectively represent statewide interests by conducting the process across all-lands and all regions of the state.

Utilize best available science and data.

Objectives for today

1. Provide background and context to ensure the Wildfire Council has a shared understanding of the data and map products being used by the Mitigation Committee

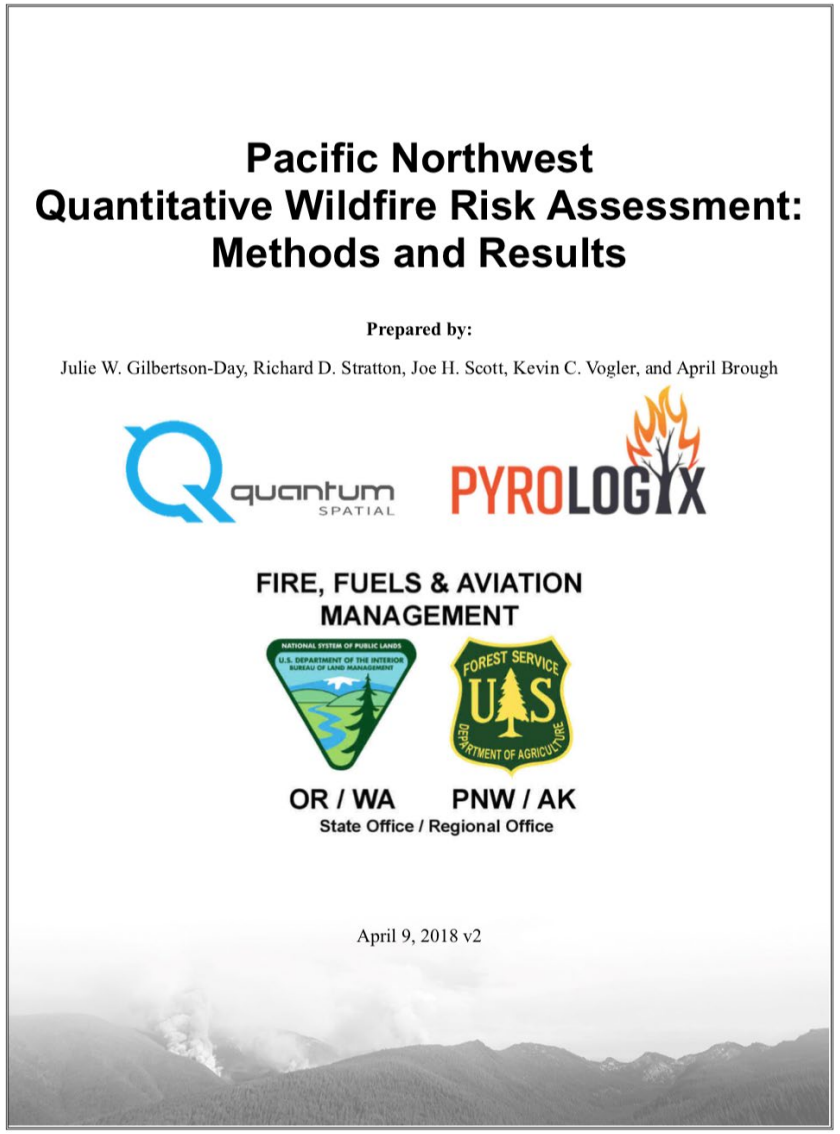
2. Receive initial feedback from the Wildfire Council on maps and results

3. Answer any additional questions

Council Objectives

1. Human Safety
2. Human Health
3. Social Justice
4. Critical Infrastructure /Asset Security
5. Vibrant, Stable Communities
6. Healthy & Resilient Ecosystems
7. Climate Change Benefits
8. Protection of Existing Business
9. Growth and Diversification of Economy
10. Revenues for Critical Public Services (County and State)

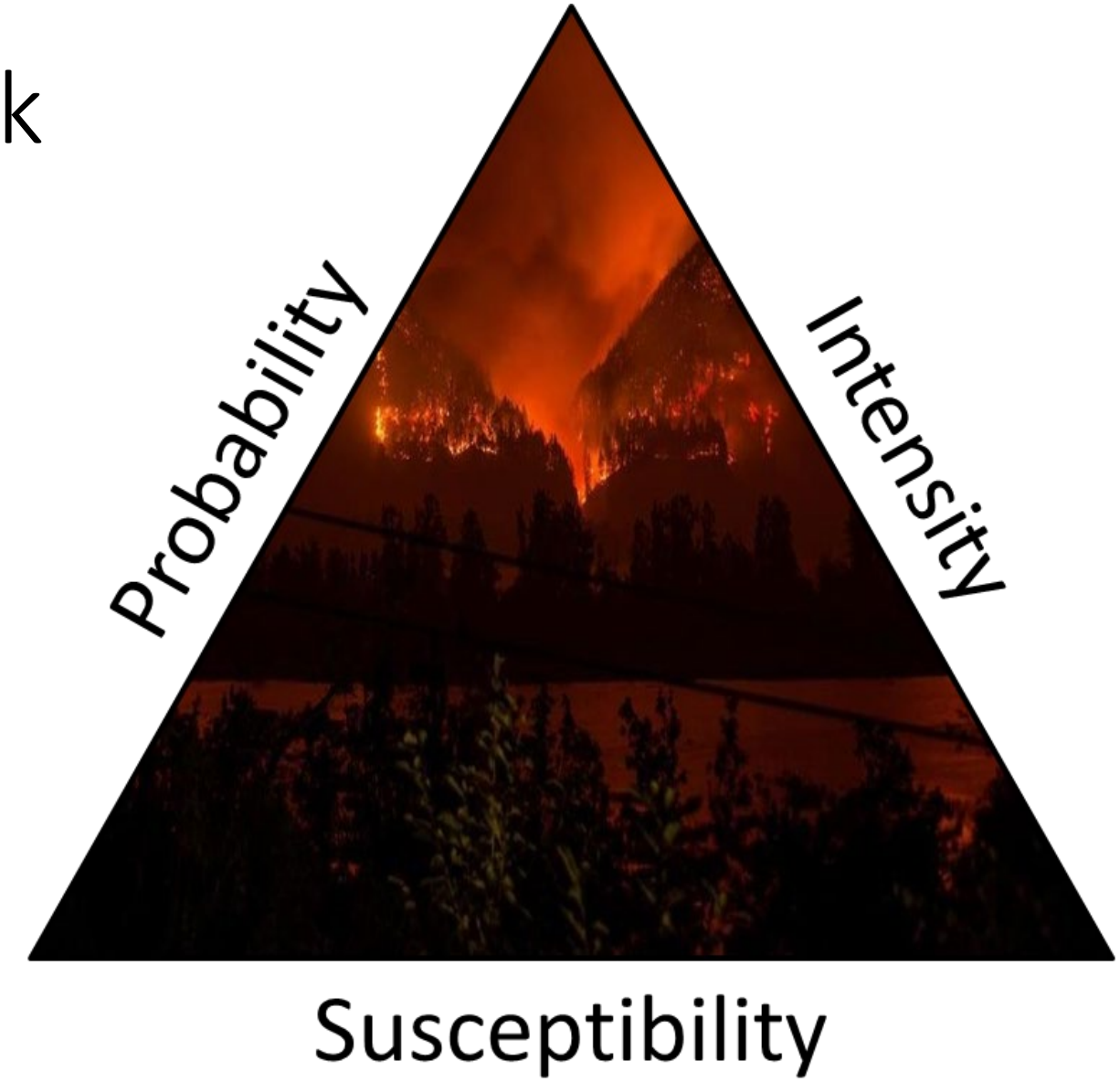
Quantitative Risk Assessment (QRA)



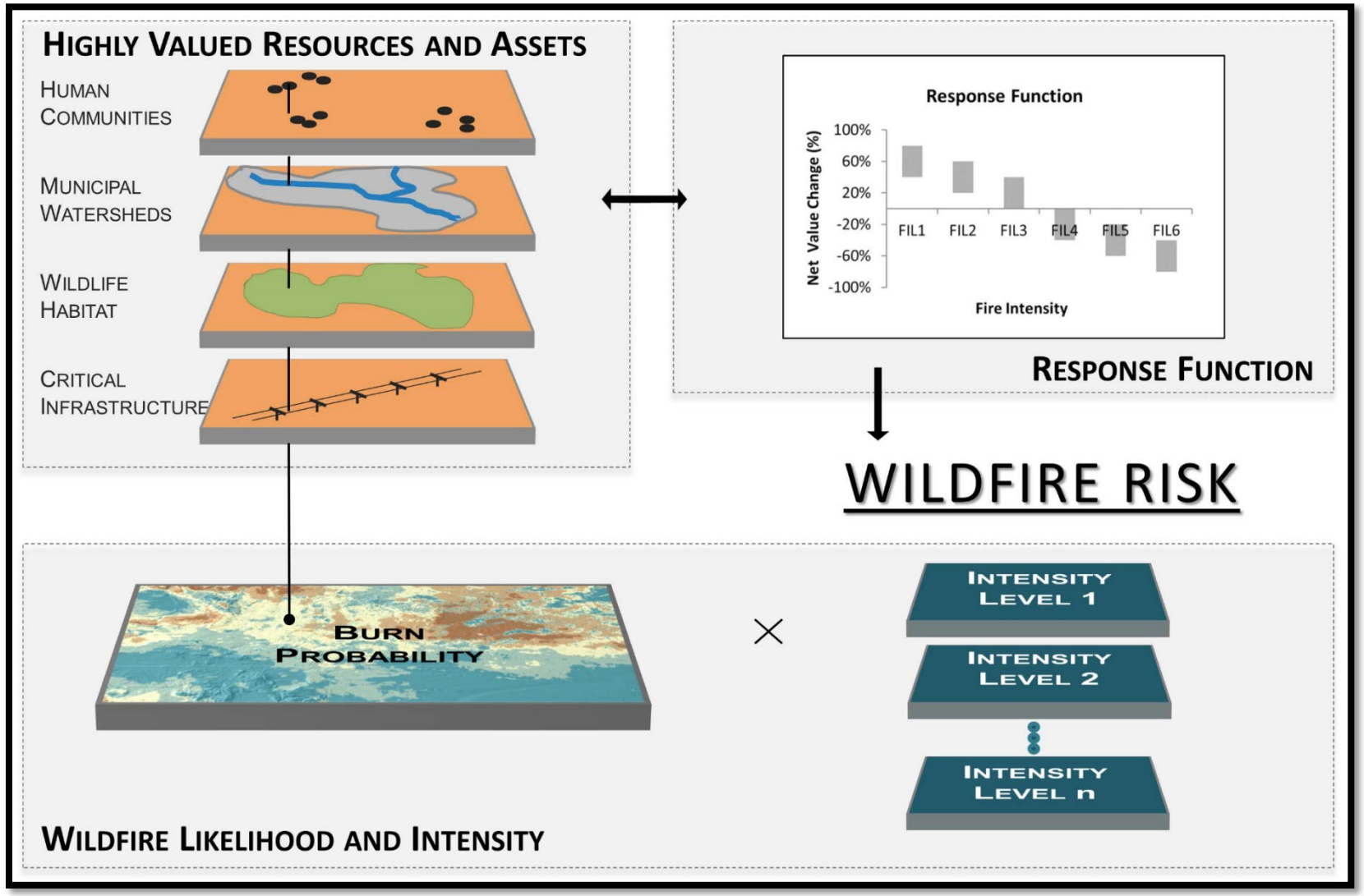
"The purpose of the USFS Pacific Northwest Region Wildfire Risk Assessment (PNRA) is to provide foundational information about wildfire hazard and risk to highly valued resources and assets across Oregon and Washington".

"A wildfire risk assessment is a quantitative analysis of the assets and resources across a specific landscape and how they are potentially impacted by wildfire."

Quantifying wildfire risk



Quantitative wildfire risk assessment: cNVC a formal system for quantifying fire risk



Scott et al. 2013

QRA Partners and Process

3.1 HVRA identification

A set of HVRA were identified through a workshop held at the Pacific Northwest Region Regional Office on November 4, 2016. A group consisting of Fire/Fuel Planners, Resource Specialists, Wildlife Biologists, Geospatial Analysts, and representatives from Oregon Department of Forestry (ODF) and Washington Department of Natural Resources (DNR) identified six HVRA in total: two assets and four resources. The complete list of HVRA and their associated data sources are listed in Table 4.

3.2 Response functions

Each HVRA selected for the assessment must also have an associated response to fire, whether it is positive or negative. We relied on input from Regional Resource Specialists, the Fuels Program Staff, along with Nature Conservancy, BLM, and DNR representatives at a workshop held February 28-March 1, 2017 at the Regional Office. In these workshops, the group discussed how each resource or asset responded to fires of different intensity levels and characterized the HVRA response using values ranging from -100 to +100. The flame length values corresponding to the fire intensity levels reported by FSim are shown in Table 5. The response functions (RFs) used in the risk results are shown in Table 6 through Table 35 below.

QRA Partners and Process

3.3 Relative importance

The relative importance (RI) assignments are needed to integrate results across all HVRAs. Without this input from leadership, all HVRAs would be weighted equally. The RI workshop was held at the Regional Office on May 16, 2017 and was attended by Line Officers or representatives from the states of Oregon and Washington; BLM Field, District or State Office; and Forest Service Ranger, Forest, or Regional Office. The focus of this workshop was to establish the importance and ranking of the primary HVRA relative to each other. The People and Property HVRA received the greatest share of RI at 33 percent, followed by the Municipal Watersheds and Infrastructure HVRAs, each receiving 18 percent of the total importance. Timber was allocated 12 percent and Wildlife received 10 percent. Finally, Vegetation Condition received 9 percent of the total landscape importance (Figure 8). These importance percentages reflect the importance per unit area of all mapped HVRA.

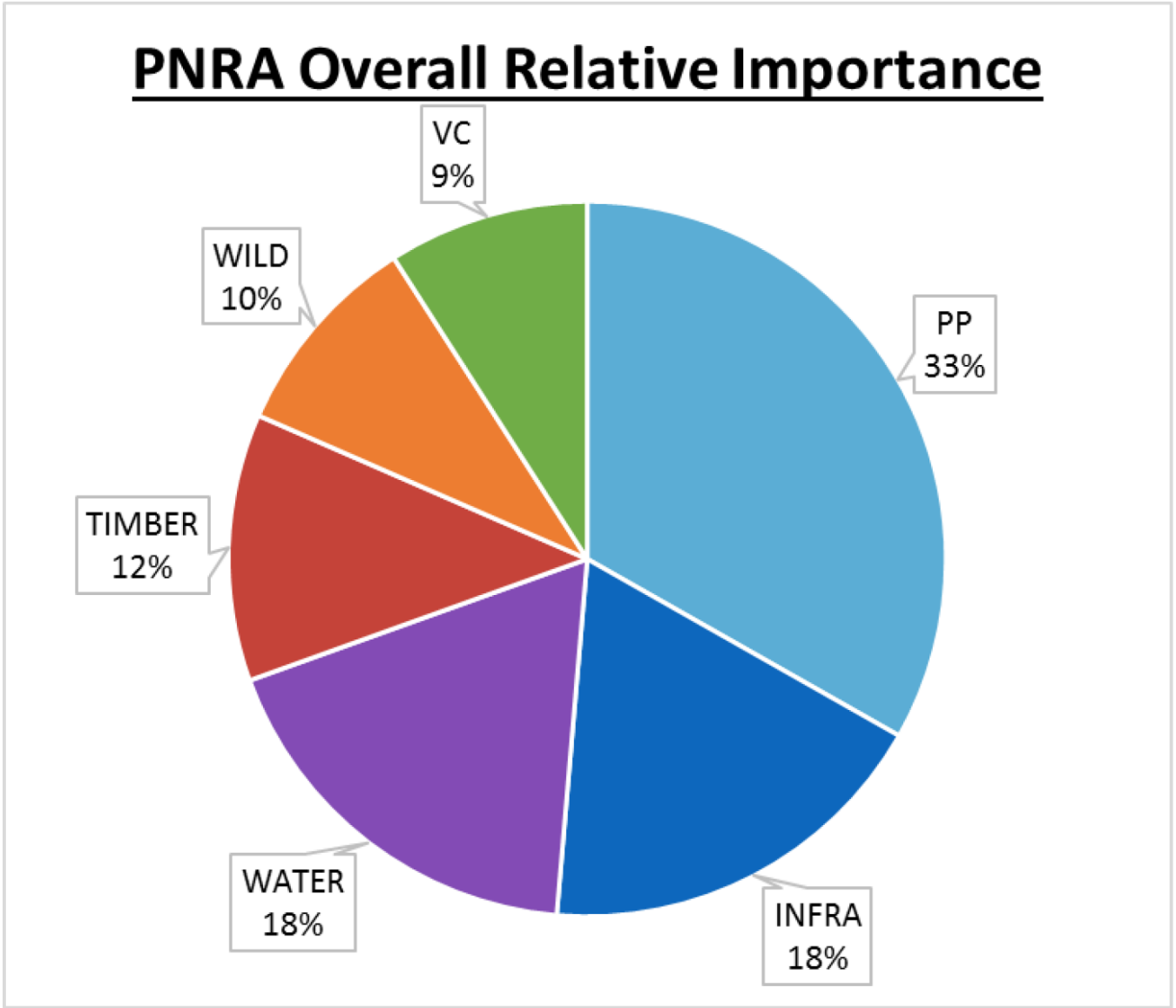


Figure 8. Overall HVRA Relative Importance for the primary HVRAs included in PNRA

Table 4. HVRA and sub-HVRA identified for the Pacific Northwest Region wildfire risk assessment and associated data sources.

HVRA & Sub-HVRA	Data source
Infrastructure	
Electric transmission lines – high & low voltage	Electric Power Transmission Lines extracted from the Homeland Security Infrastructure Program (HSIP) database.
Railroads	Railroad features extracted from the Homeland Security Infrastructure Program (HSIP) database.
Roads – Interstates and State highways	Interstates and highways extracted from the Homeland Security Infrastructure Program (HSIP) database. Removed smaller roads (SHIELD_CL=0) from highways.
Communication sites and cell towers	Communication sites, towers, and antennas and cell towers extracted from the Homeland Security Infrastructure Program (HSIP) database.
Seed orchards	Extracted from the Pacific Northwest Region Corporate database to represent seed orchard assets across the Region.
Sawmills	Wood Product Manufacturing Facilities extracted from the Homeland Security Infrastructure Program (HSIP) database.
High and low developed rec sites	Recreation sites/structures mapped by USFS, USFWS, NPS, BLM, ODF, and DNR and including state, county, and local parks and campgrounds. High vs. low investment level assigned based on dataset attributes.
Ski Areas	OR and WA ski area boundaries, digitized outer edge and infrastructure using Google Earth imagery
Historic buildings	Historic buildings as recorded by the National Register of Historic Places
People and Property	
Where People Live (WPL) by density class	Housing density classes as developed by the West Wide Wildfire Risk Assessment project
USFS Private Inholdings	Private inholdings on USFS lands extracted from the Basic Ownership layer by querying "NON-FS". NPS lands were removed from the NON-FS lands before including in this dataset. Refined to private ownership using BLM Ownership (OWNERSHIP_POLY) and BLM Surface Management Agency (BLM_SMA_FS_update).

Timber	
USFS Active Management and NWFP Matrix Lands	A Spatial Database for Restoration Management Capability on National Forests in the Pacific Northwest USA, (Ringo *et al.*, 2016). Matrix lands in OR and WA from Northwest Forest Plan.
Tribal Owned/Colville Reservation Commercial Timber	American Indian/Alaska Native/Native Hawaiian (AIANNH) Areas Shapefile from U.S. Census Bureau as Tribal ownership overlay along with Colville Reservation Commercial forestland
Private Industrial	Privately owned, industrial timber lands extracted from the Atterbury Consultants ownership maps for Oregon and Washington (selected attributes containing IFPC, REIT, and TIMO)
BLM Harvestable/Potential	Harvest Land Base from the ROD for western OR, O&C lands, Coos Bay Wagon Rd, Public Domain lands, and the BLM-owned polygons from the E. WA Resource Management Plan.
State owned for Oregon and Washington	State-owned lands in OR and WA excluding State Parks, State Fish and Wildlife lands, and Parks and Recreation lands.
Fire Regime Groups 1,3,4/5	R6 Forest Structure Restoration Needs Update Analysis – (DeMeo *et al.*, In Press)
Size classes <10in., 10-20in., >20in.	R6 Forest Structure Restoration Needs Update Analysis – (DeMeo *et al.*, In Press)
Vegetation Condition	
Seral state departure by FRG group	R6 Forest Structure Restoration Needs Update Analysis – (DeMeo *et al.*, In Press)

Table 4. (Continued) HVRA and sub-HVRA identified for the Pacific Northwest Region wildfire risk assessment and associated data sources.

Watersheds	
Watersheds	Washington Drinking Water System Boundaries for watershed boundaries and surface water intake locations Oregon Surface Drinking Water Source Areas and intake locations from EPA Safe Drinking Water Information System (SDWIS)
Erosion potential	Developed by USFS Remote Sensing Applications Center (RSAC)
Wildlife	
Marbled murrelet	U.S. Fish and Wildlife Service, Endangered Species Program, ECOS Joint Development Team
Northern spotted owl	Predicted habitat suitability map (Glenn *et al.*, 2017)
Sage grouse habitat	Wildland Fire Decision Support System (WFDSS) - 2015 greater sage grouse (GRSG) Land Use Plan (LUPs) Allocations
Resistance/Resilience class	USDA - Natural Resources Conservation Service, Index of Relative Ecosystem Resilience and Resistance across Sage-Grouse Management Zones
Bull trout	StreamNet Generalized Fish Distribution, Bull Trout (January 2012)
Chinook salmon	U.S. Fish and Wildlife Service, Endangered Species Program, ECOS Joint Development Team
Coho salmon	U.S. Fish and Wildlife Service, Endangered Species Program, ECOS Joint Development Team
Steelhead trout	U.S. Fish and Wildlife Service, Endangered Species Program, ECOS Joint Development Team
Redband trout	Non-Anadromous Redband Trout (RBT) Range-wide Database - ODFW
Coastal cutthroat trout	StreamNet Generalized Fish Distribution, Coastal Cutthroat Trout (January 2012) -
Lahontan cutthroat trout	StreamNet Generalized Fish Distribution, Lahontan Cutthroat Trout (January 2012)

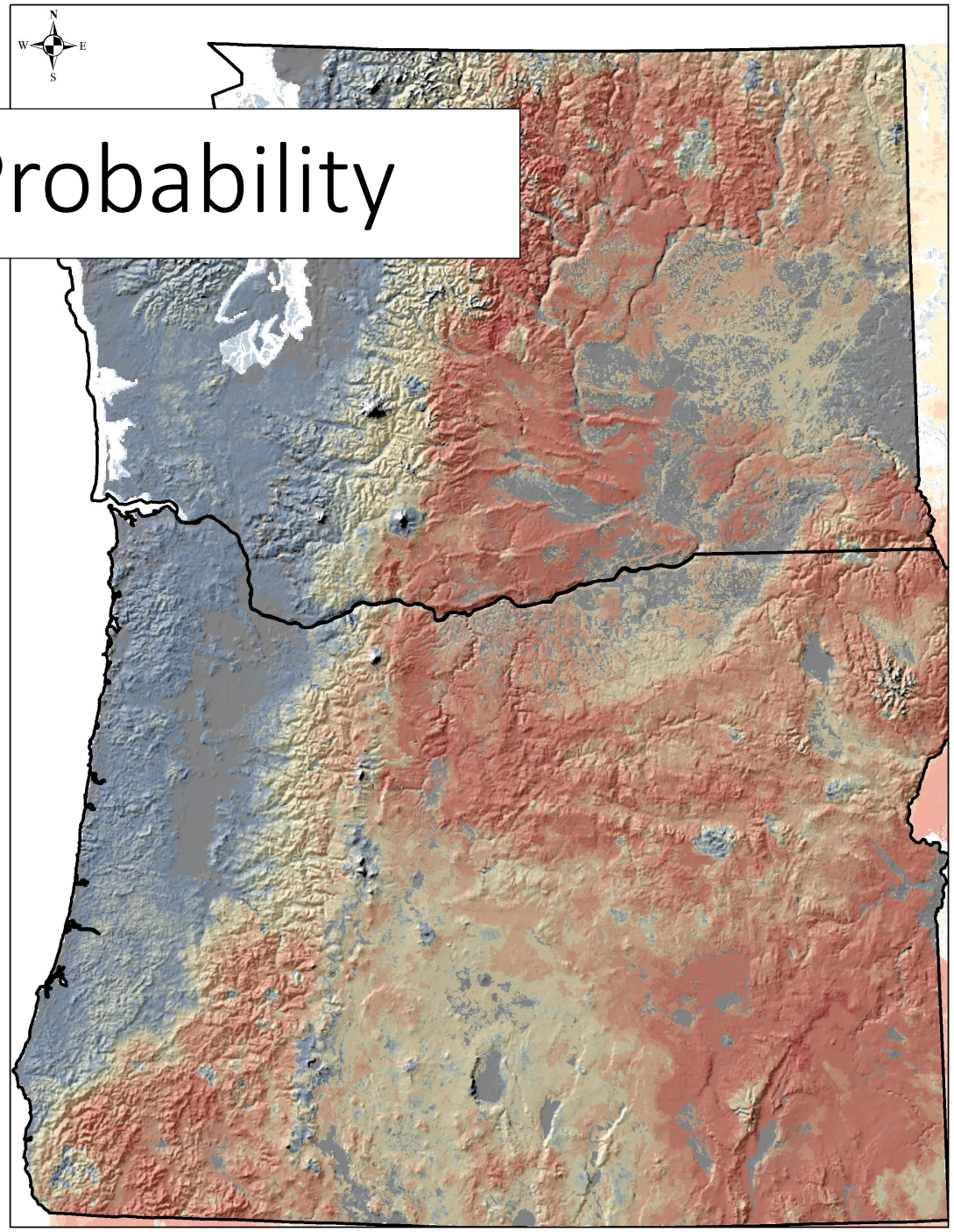
Table 6. Response functions for the Infrastructure HVRA to highlight electric transmission lines.

Sub-HVRA	FIL1	FIL2	FIL3	FIL4	FIL5	FIL6	Share of RI[1]	Acres
Trans-Line- High voltage	10	0	0	-10	-50	-70	40.86%	905,585
Trans-Line- Low voltage	-10	-20	-50	-70	-80	-90	16.79%	743,972
Railroads	-10	-20	-30	-40	-50	-50	16.57%	612,073
Interstates	0	-5	-10	-15	-20	-30	4.74%	175,191
State Highways	0	-5	-10	-15	-20	-30	12.98%	958,745
Communication Sites/Cell Towers	-10	-30	-60	-80	-100	-100	3.65%	80,924
Seed Orchards	-50	-90	-100	-100	-100	-100	0.02%	2,704
Sawmills	-10	-20	-30	-40	-60	-80	0.10%	1,448
Ski Areas	0	-10	-20	-40	-60	-80	0.44%	16,175
Recreation High Developed	-10	-30	-70	-90	-100	-100	1.93%	26,793
Recreation Low Developed	-10	-30	-70	-90	-100	-100	1.17%	129,886
Historic Structures	-30	-50	-70	-100	-100	-100	0.73%	8,140

[1] Within-HVRA relative importance.

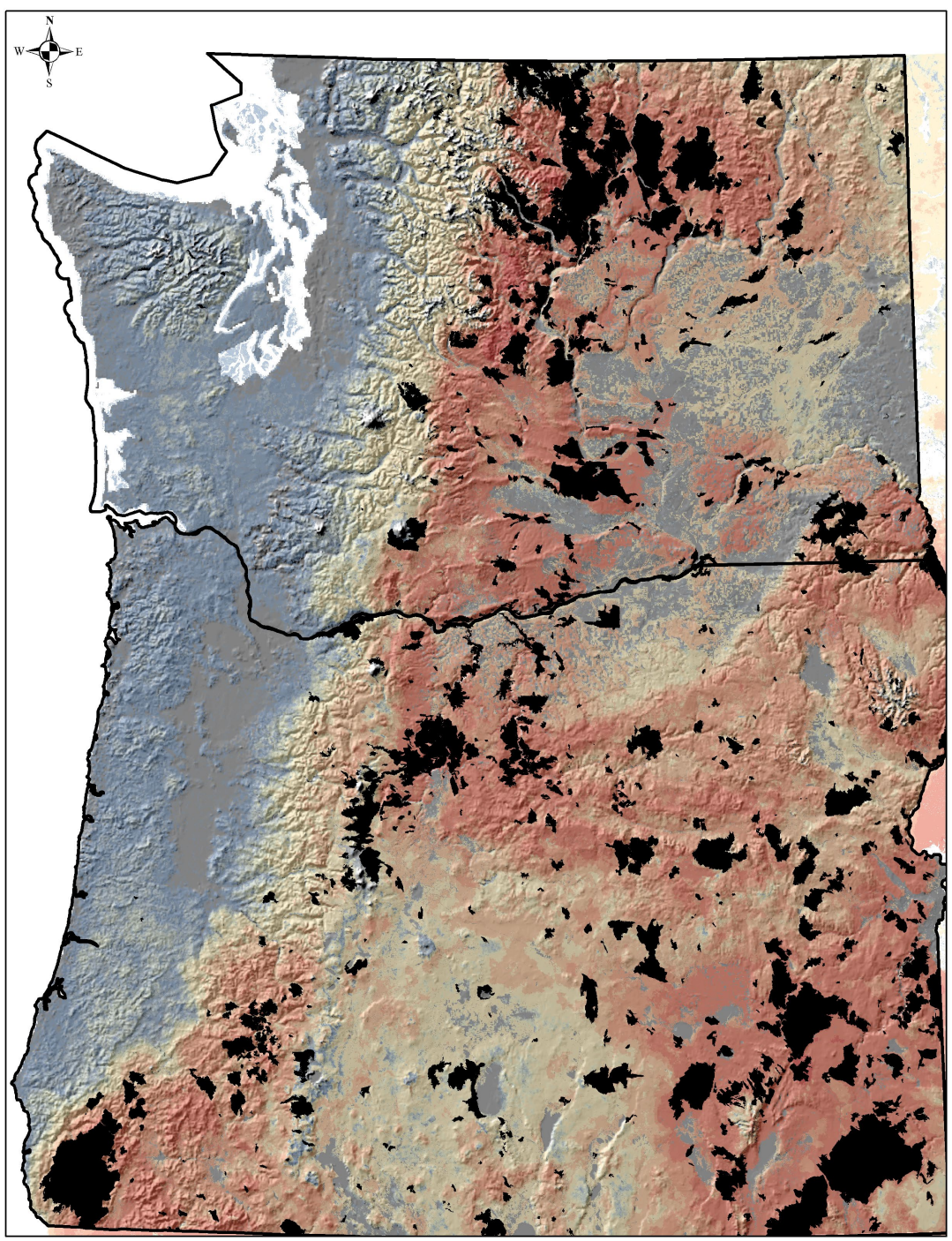
The share of HVRA importance is based on relative importance per unit area and mapped extent.

Burn Probability

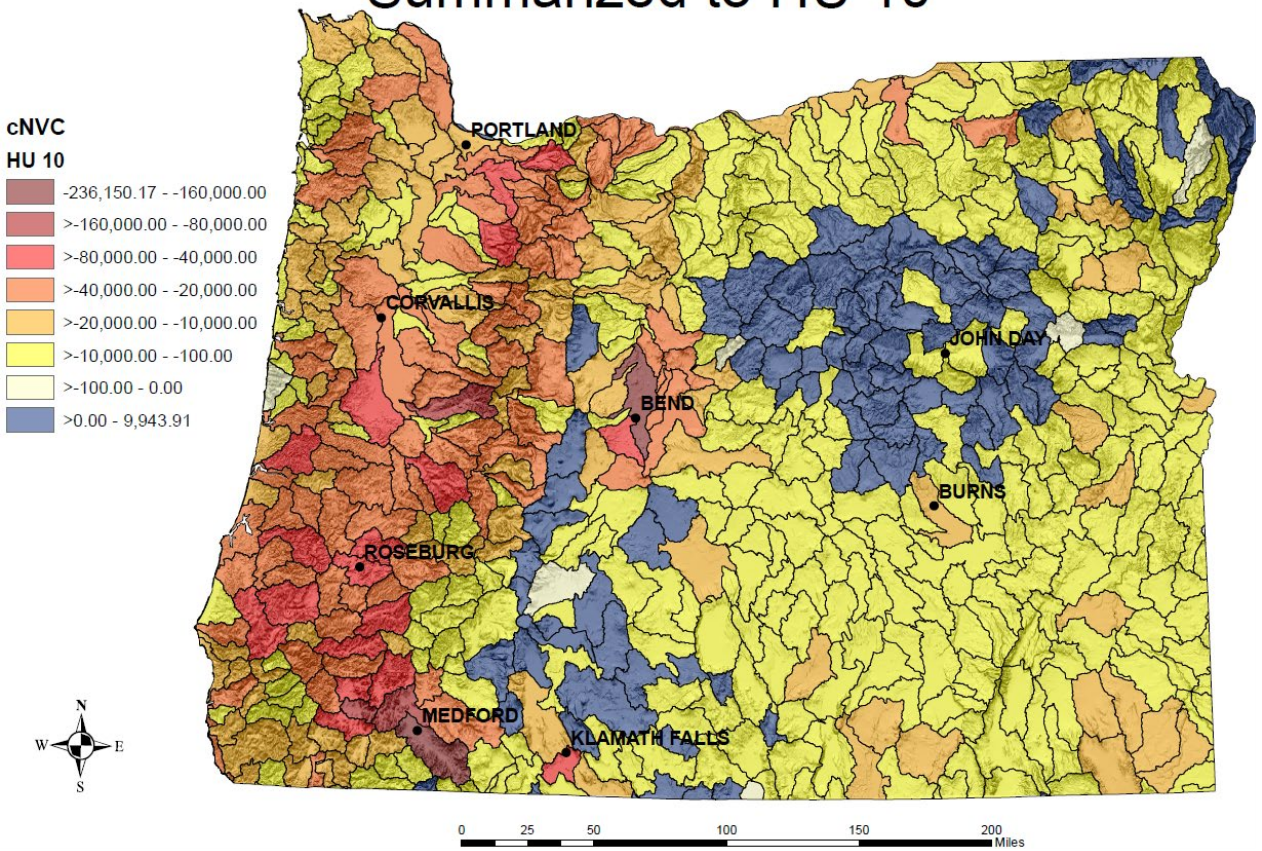


Annual burn probability

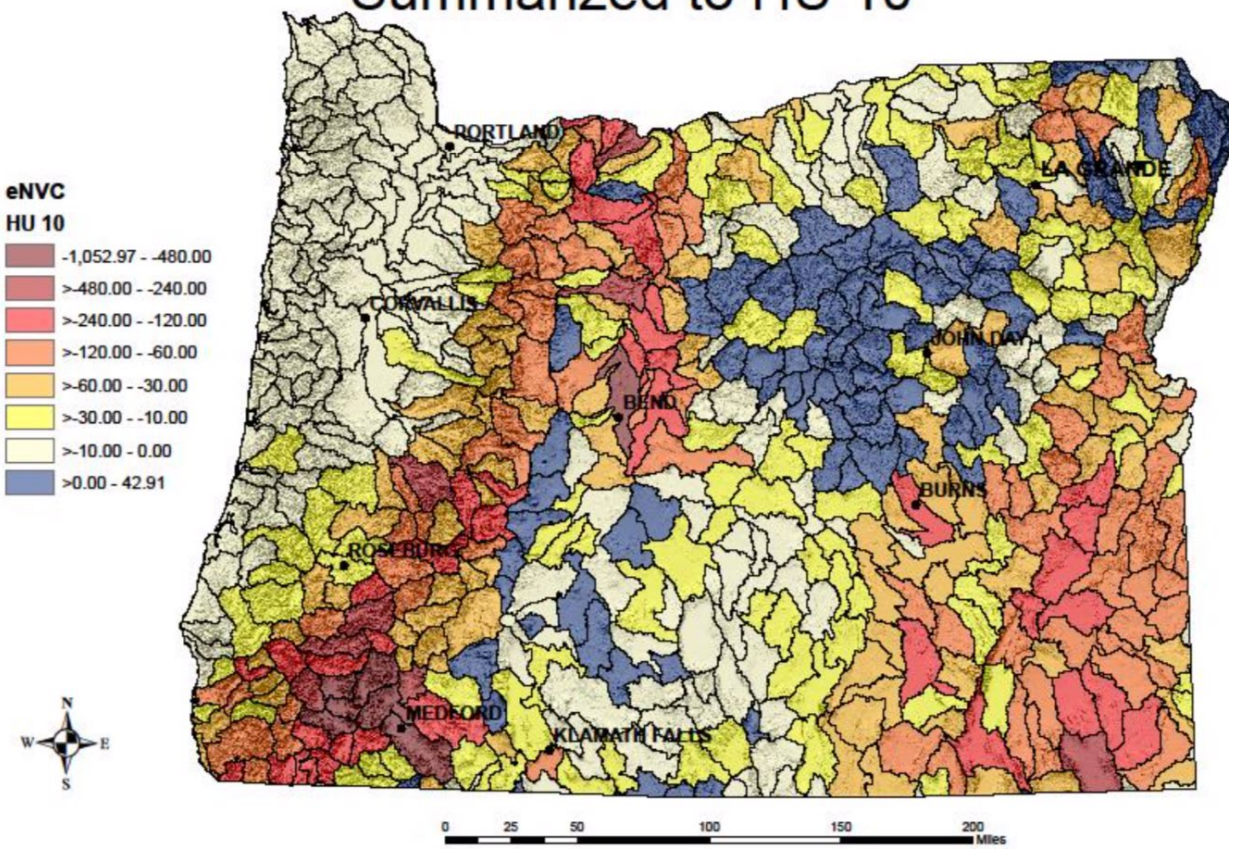
- 0
- 0 - 0.0001
- 0.000100001 - 0.0003
- 0.0003 - 0.0006
- 0.0006 - 0.001
- 0.001000001 - 0.003
- 0.003 - 0.006
- 0.006 - 0.01
- 0.010000001 - 0.03
- 0.03 - 0.047348



Conditional Net Value Change (cNVC) Summarized to HU 10



Expected Net Value Change (eNVC) Summarized to HU 10



Targeting mitigation - Community exposure

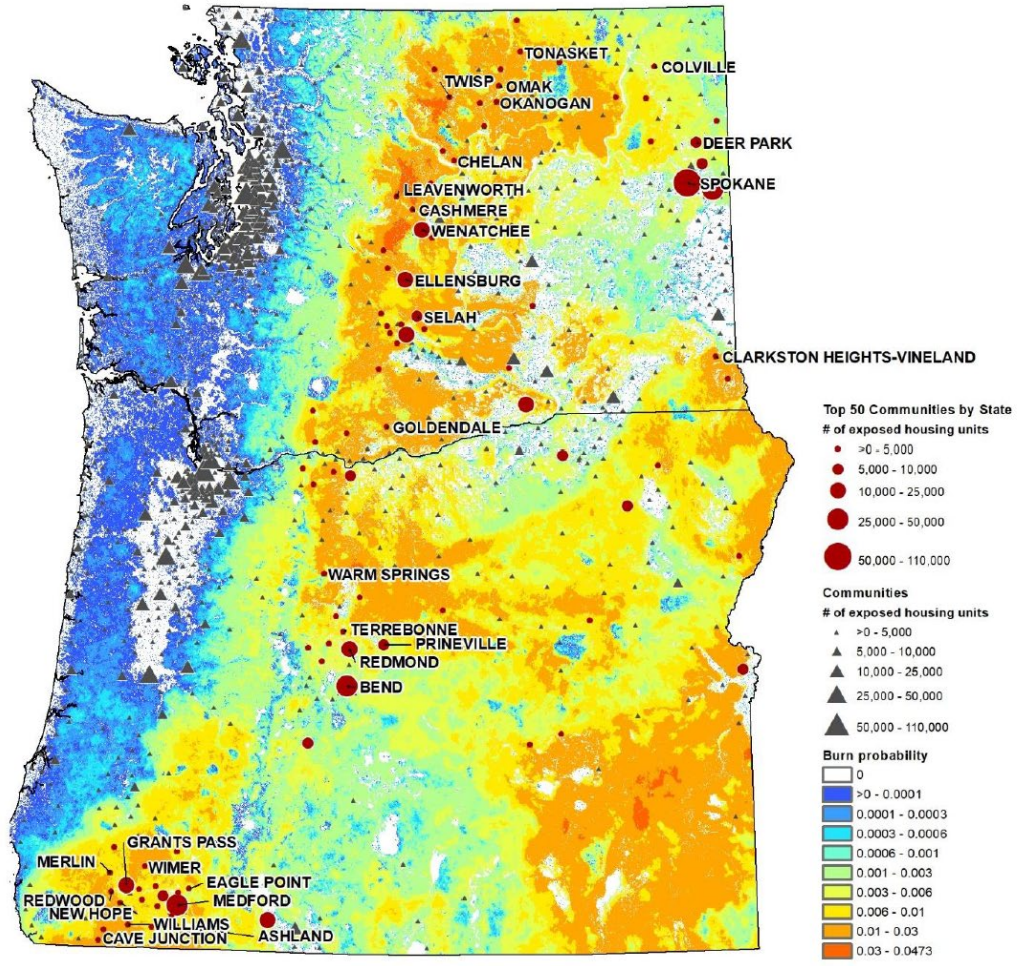


Figure 1. Annual burn probability across the states of Washington and Oregon and exposed human communities in each state. The 50 most-exposed communities in each state are mapped in dark red. The most-exposed communities tend to be in areas with the highest annual burn probabilities based on the FSim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

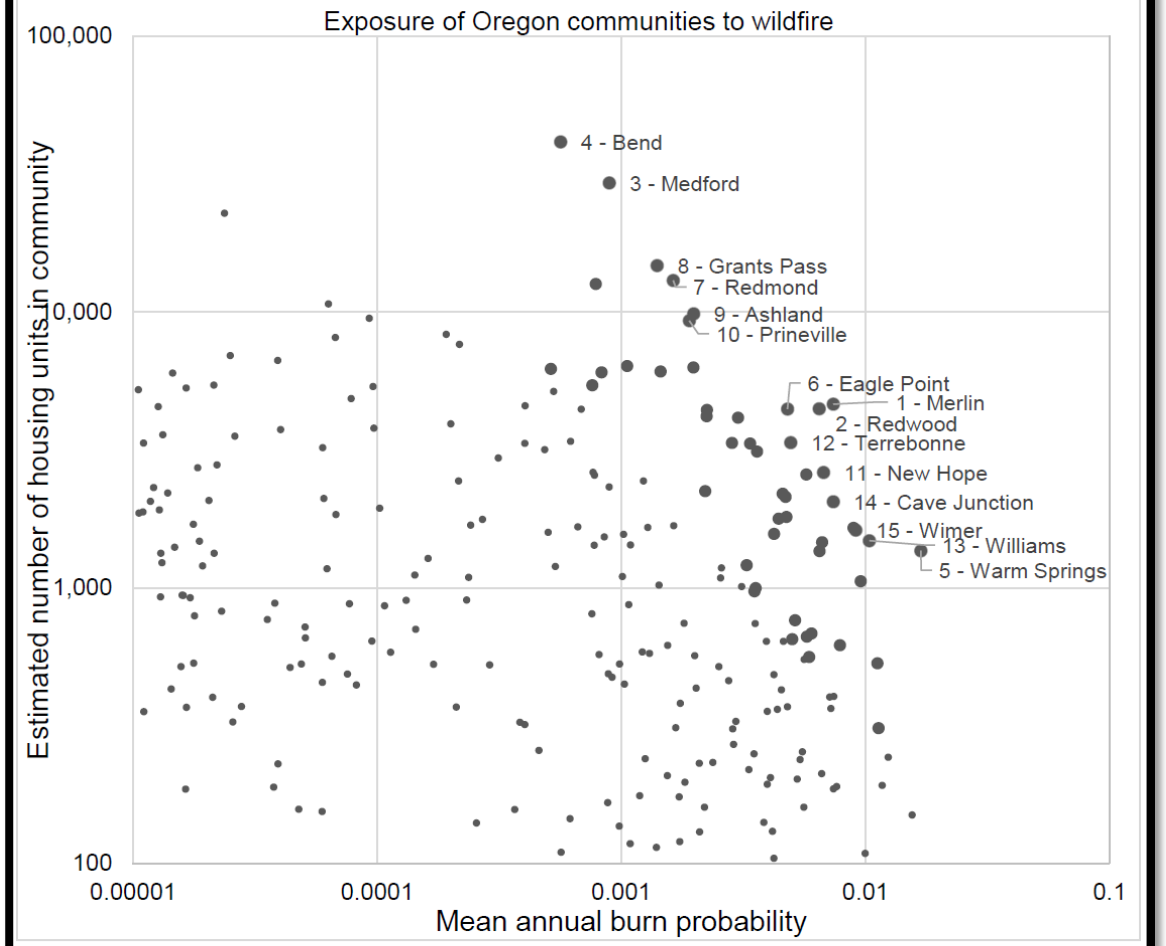


Figure 3. Exposure of Oregon communities to wildfire. The 50 most-exposed communities (by cumulative annual housing-unit exposure) are shown as larger gray dots. The top 15 are labeled with the rank and community name. See Table 2 for the names of the remaining top-50 communities. Smaller gray dots represent 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).

Targeting mitigation - Community exposure

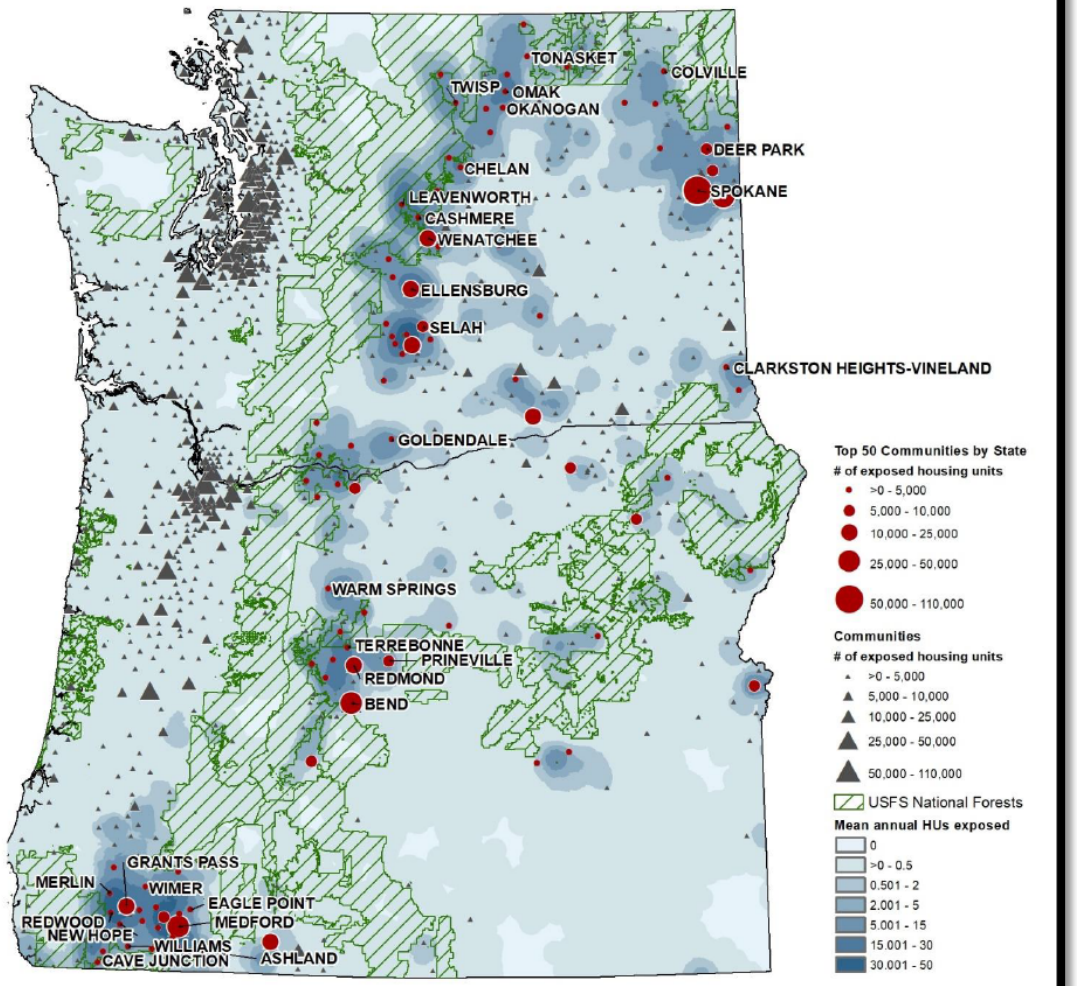
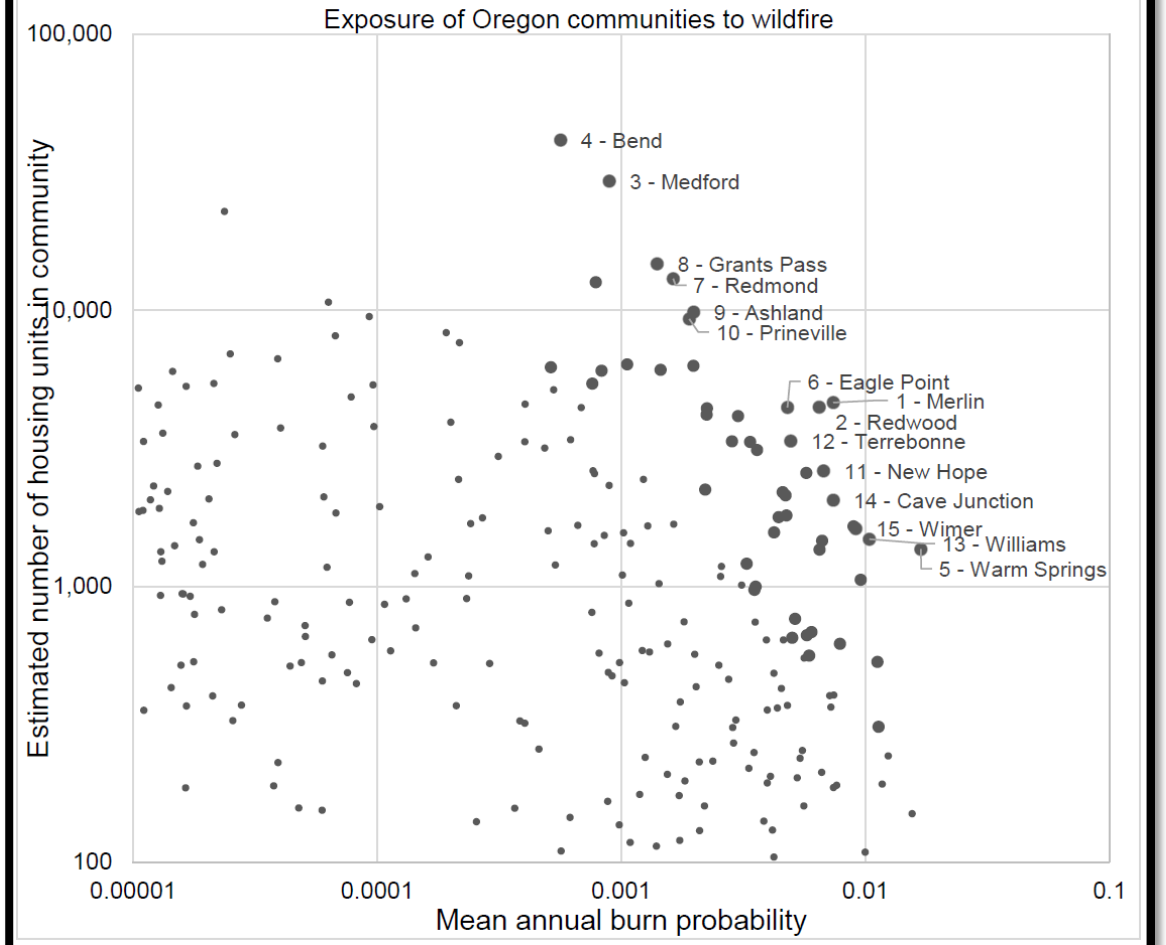


Figure 4. Sources of housing-unit exposure to wildfire across Washington and Oregon and exposed communities across the two states. The fifty most exposed communities in each state are shown in dark red, the remaining communities in gray. Dark blue areas of the map tend to produce greater annual housing-unit exposure.



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Summary: Quantitative Risk Assessment (QRA)

1. Currently best available data and analysis to summarize wildfire risk in Oregon

2. Utilizes 28 data layers that address 6 of 10 Council Objectives

3. Anticipated update in 2021, opportunity for further advancement

4. Proposed to be used as ”base” layer for Wildfire Mitigation Committee

Part II: Additional considerations

- Social Justice
- Community Health
- Protection of existing businesses
- Diversification of economies

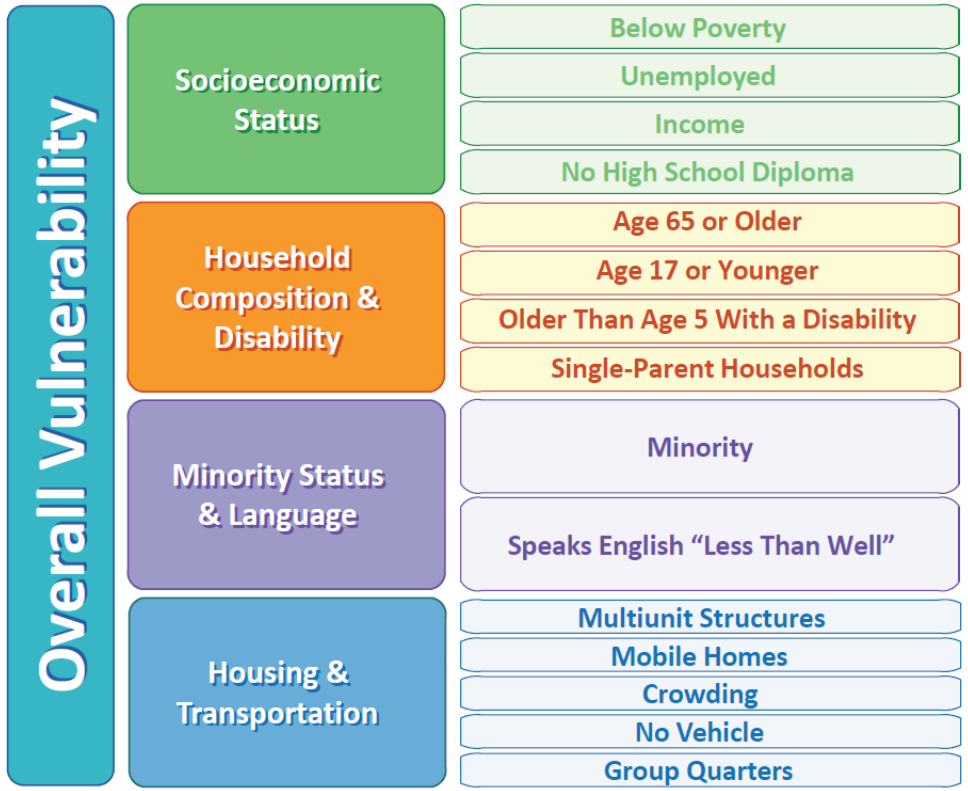
Paradise, CA

Social Justice

Davies et al. 2018

FIGURE **1**

Variables and Themes Included in the Social Vulnerability Index Databases



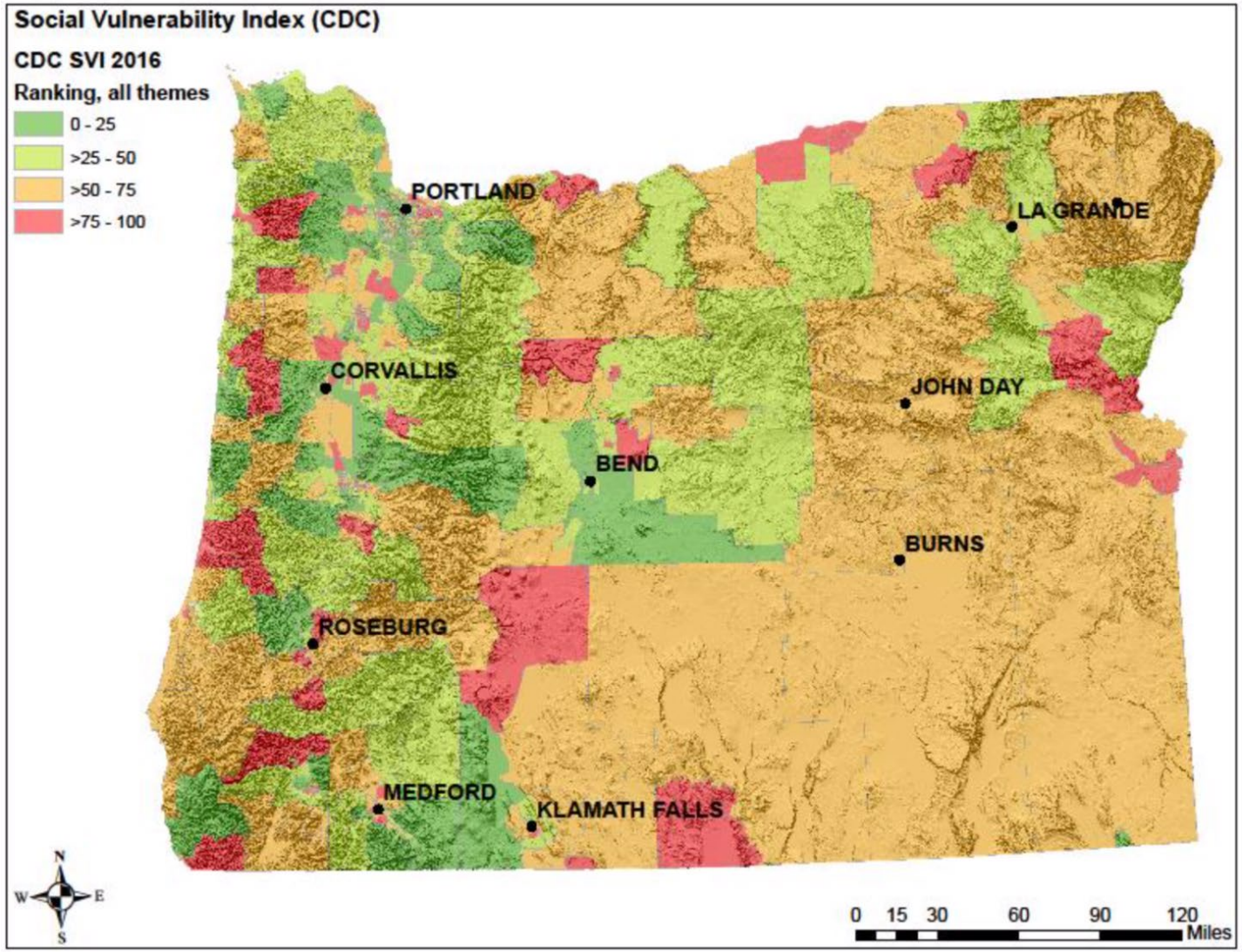
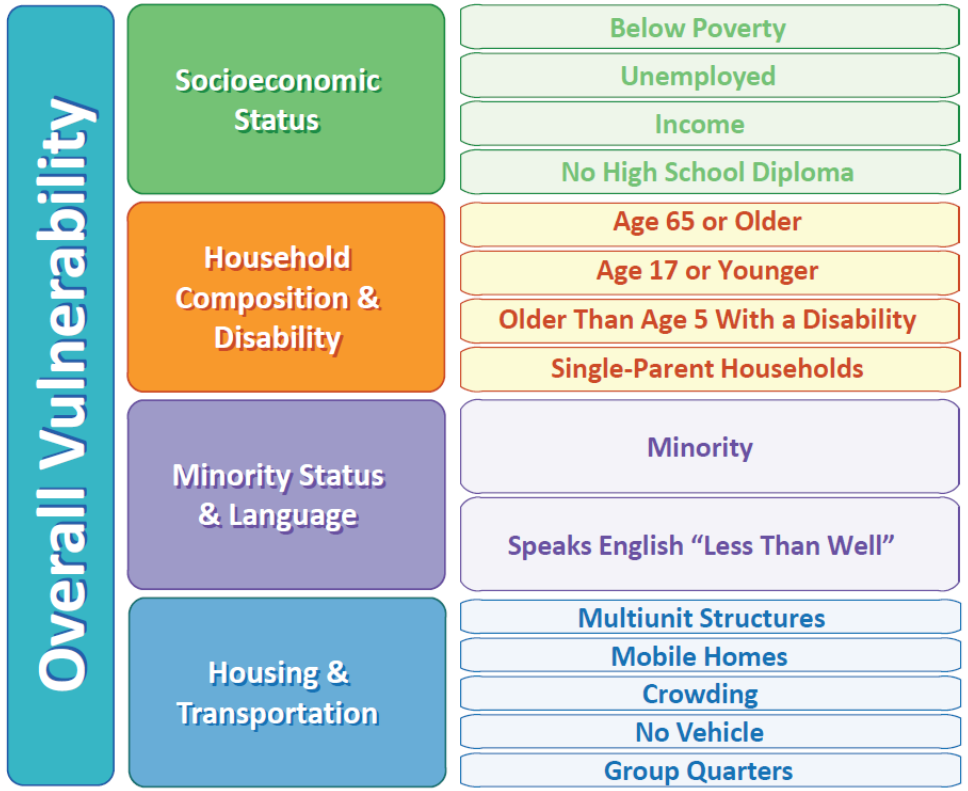
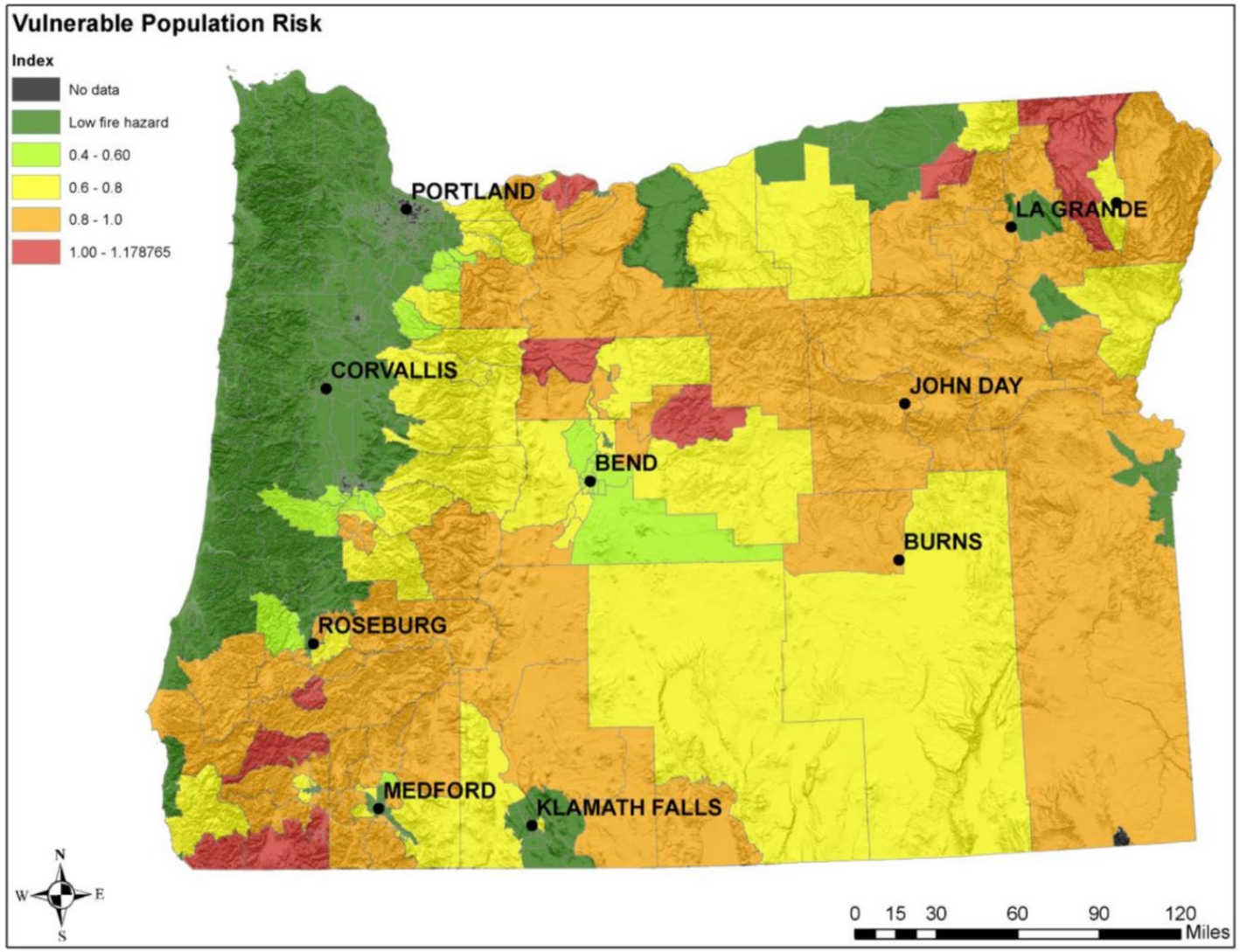
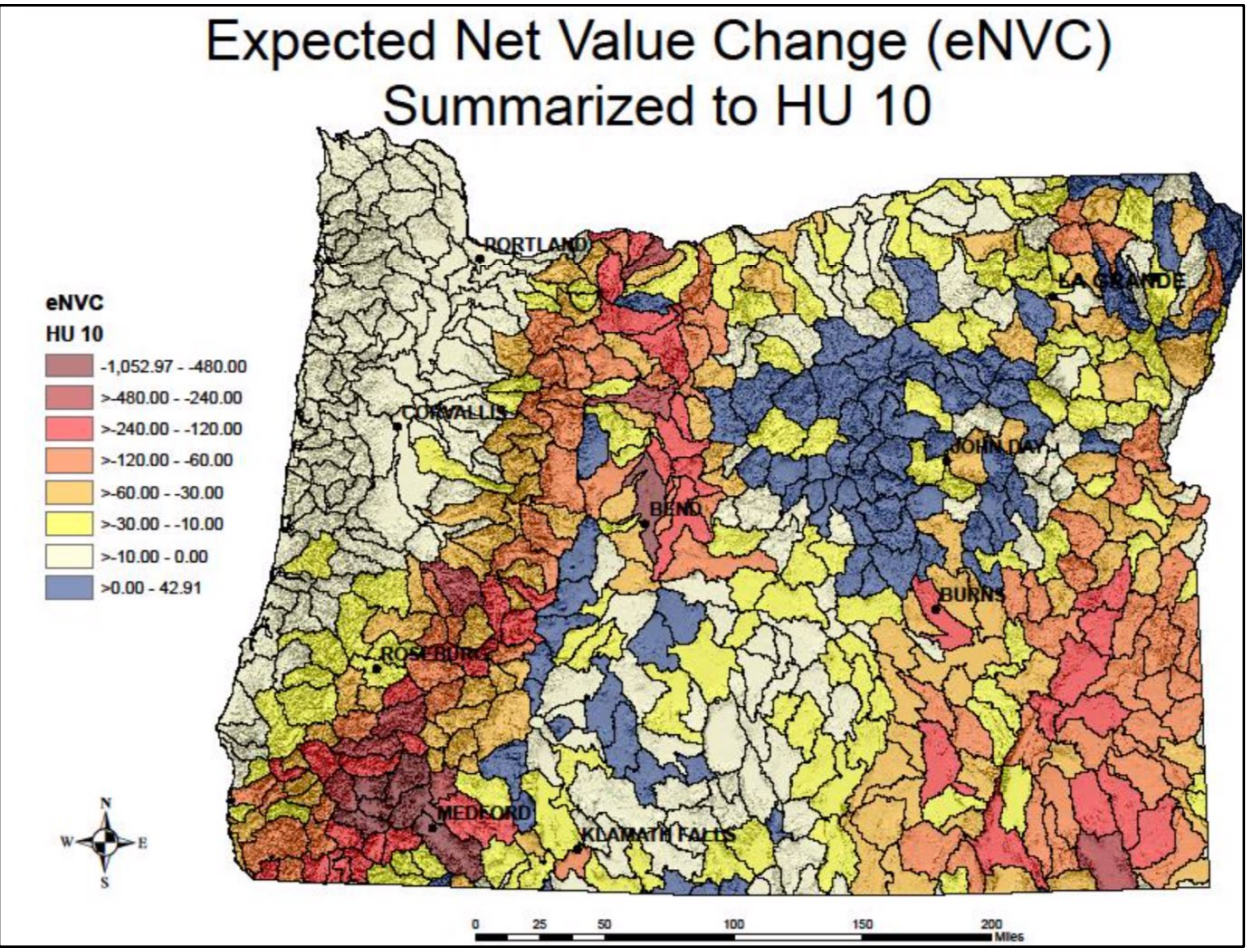


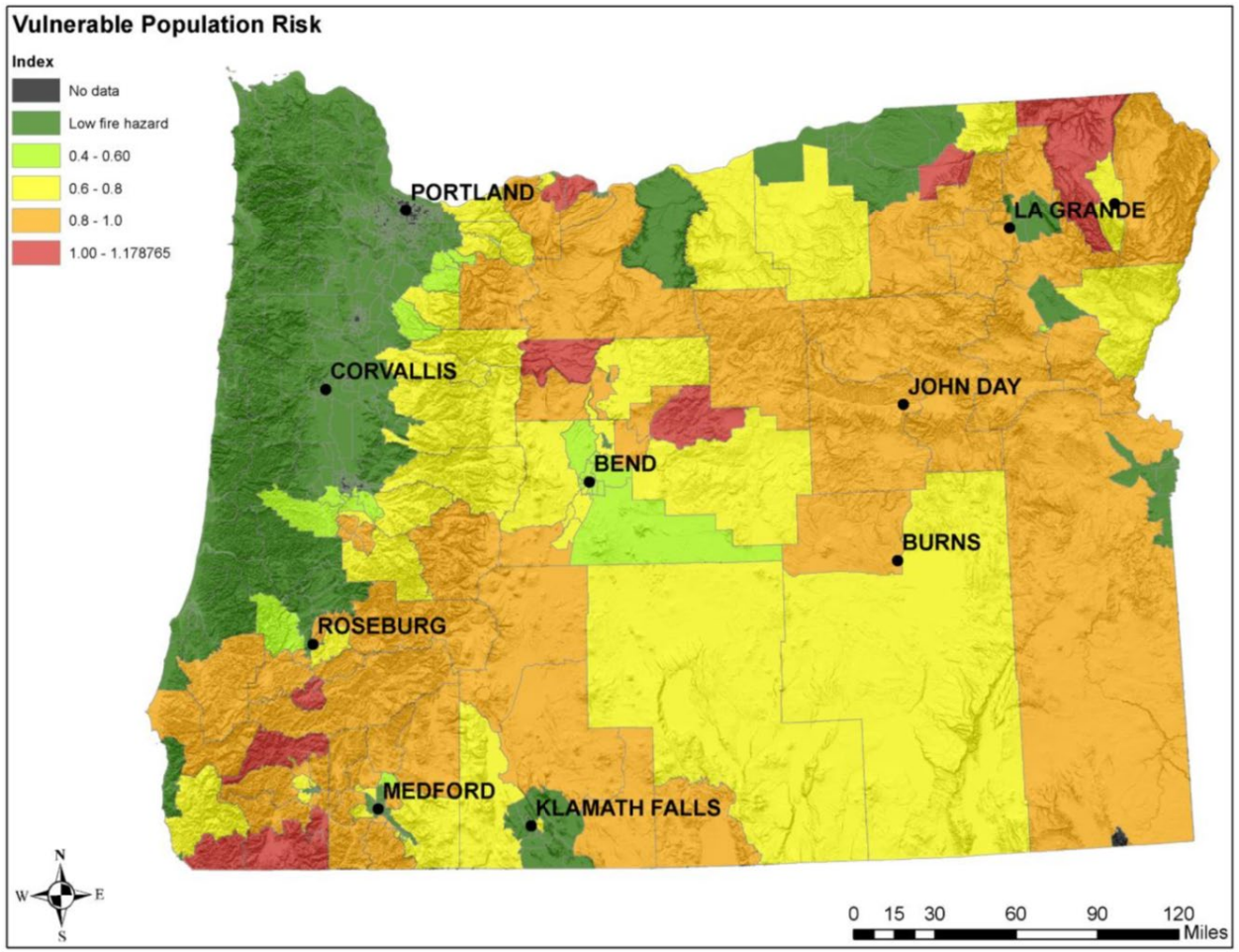
FIGURE **1**

Variables and Themes Included in the Social Vulnerability Index Databases





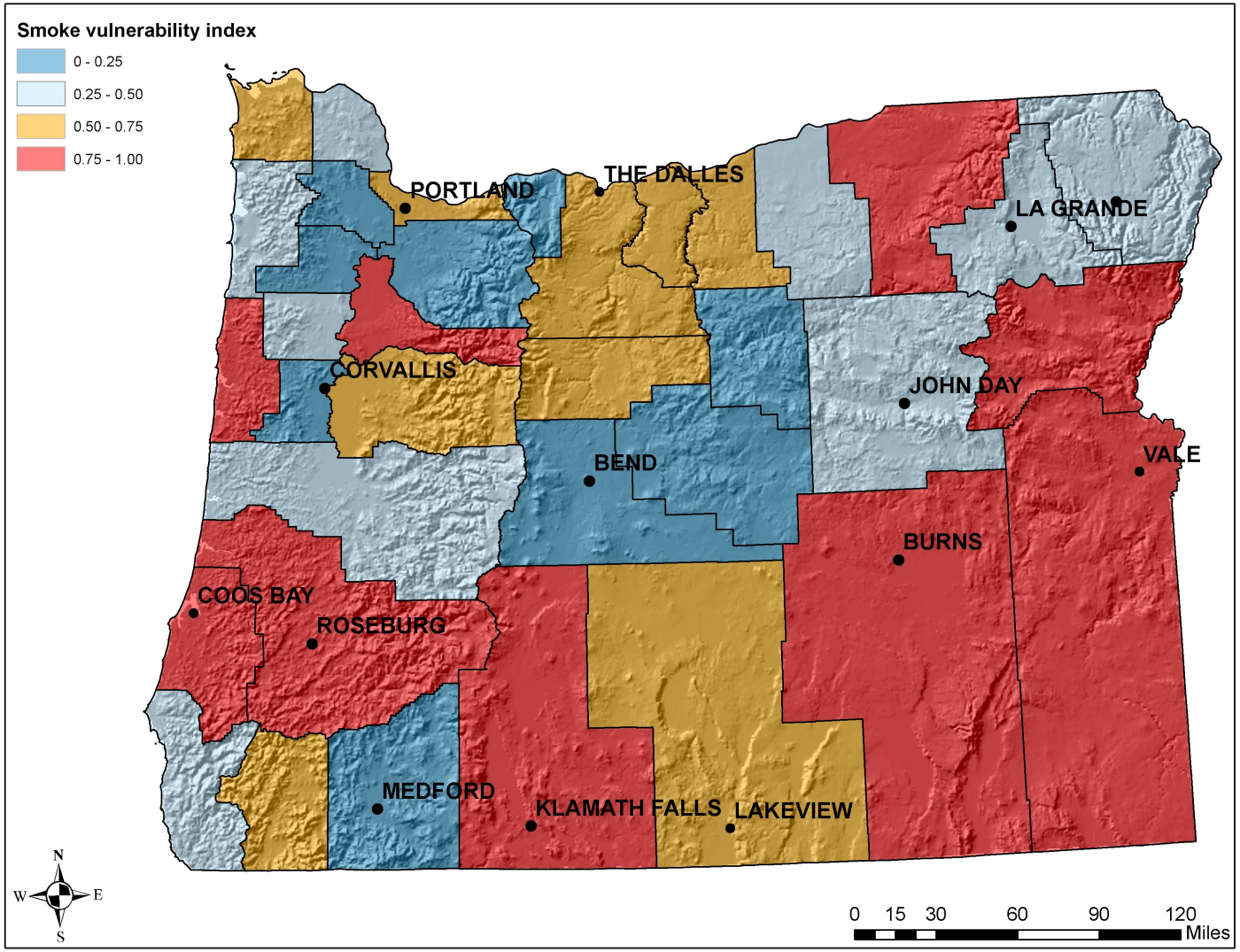

Expected Net Value Change (eNVC)
Summarized to HU 10
eNVC
HU 10
-1,052.97 - -480.00
>-480.00 - -240.00
>-240.00 - -120.00
>-120.00 - -60.00
>-60.00 - -30.00
>-30.00 - -10.00
>-10.00 - 0.00
>0.00 - 42.91
PORTLAND
LA GRANDE
CORVALLIS
JOHN DAY
BEND
BURNS
ROSEBURG
MEDFORD
KLAMATH FALLS
N
W
E
S
0 25 50 100 150 200
Miles


Vulnerable Population Risk
Index
No data
Low fire hazard
0.4 - 0.60
0.6 - 0.8
0.8 - 1.0
1.00 - 1.178765
PORTLAND
LA GRANDE
CORVALLIS
JOHN DAY
BEND
BURNS
ROSEBURG
MEDFORD
KLAMATH FALLS
N
W
E
S
0 15 30 60 90 120
Miles

Human Health

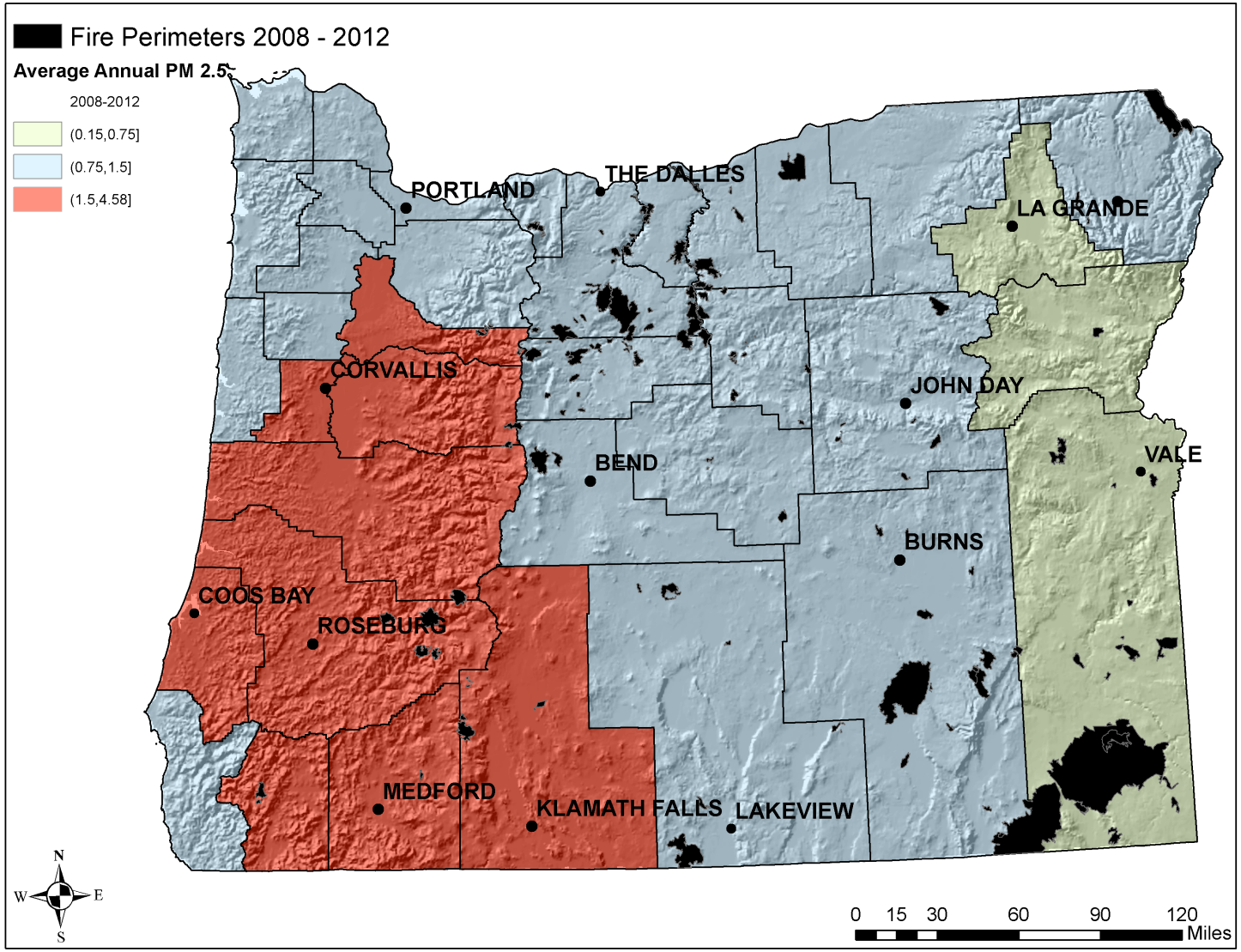
Potential smoke impacts

1. Education level
2. Poverty level
3. Household age
4. COPD rates
5. Adult/child asthma rates
6. Hypertension rates
7. Obesity rates
8. Medical diabetes rates



Rappold, A.G., Reyes, J., Pouliot, G., Cascio, W.E. and Diaz-Sanchez, D., 2017. Community vulnerability to health impacts of wildland fire smoke exposure. *Environmental science & technology*, *51*(12), pp.6674-6682.

Unhealthy smoke

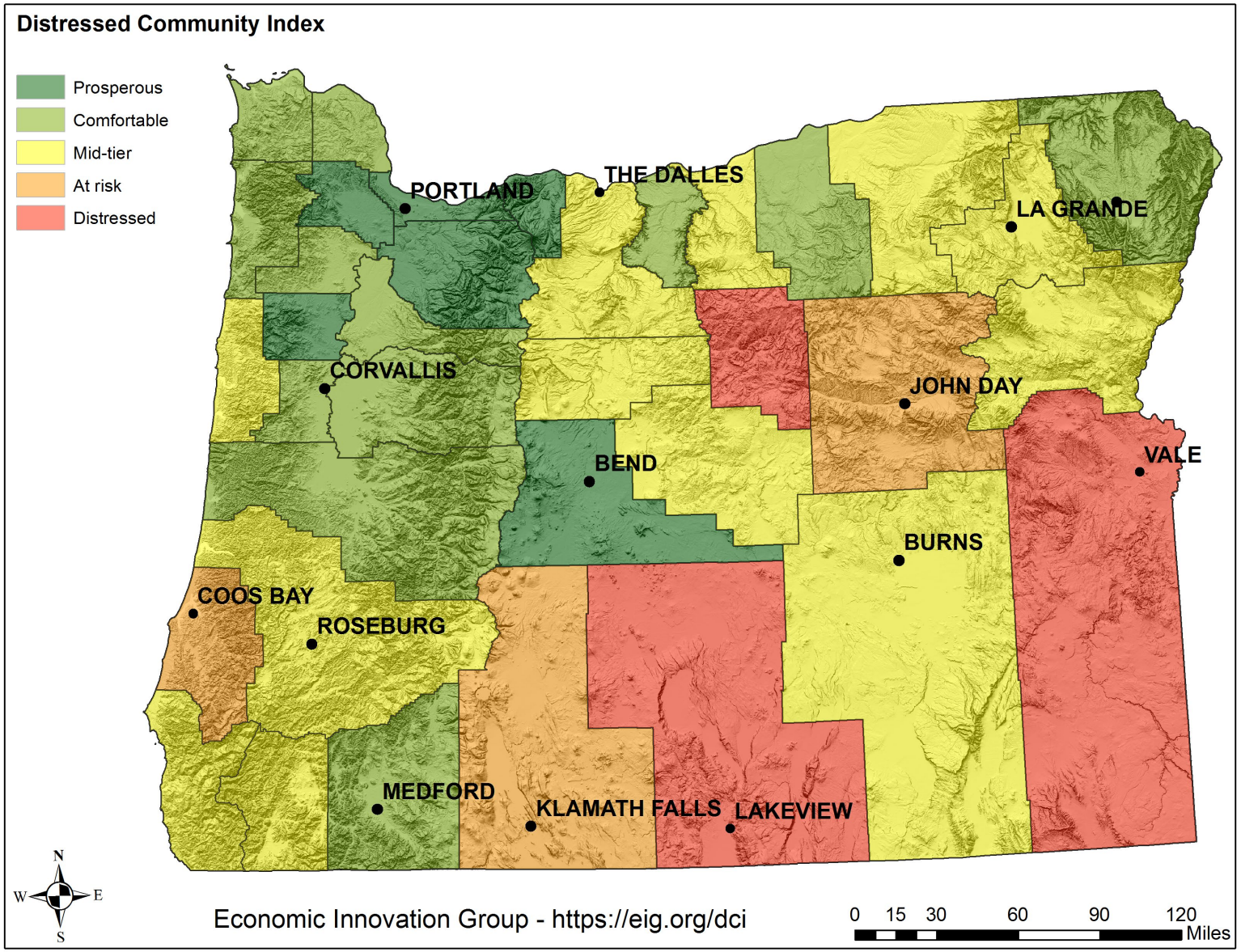


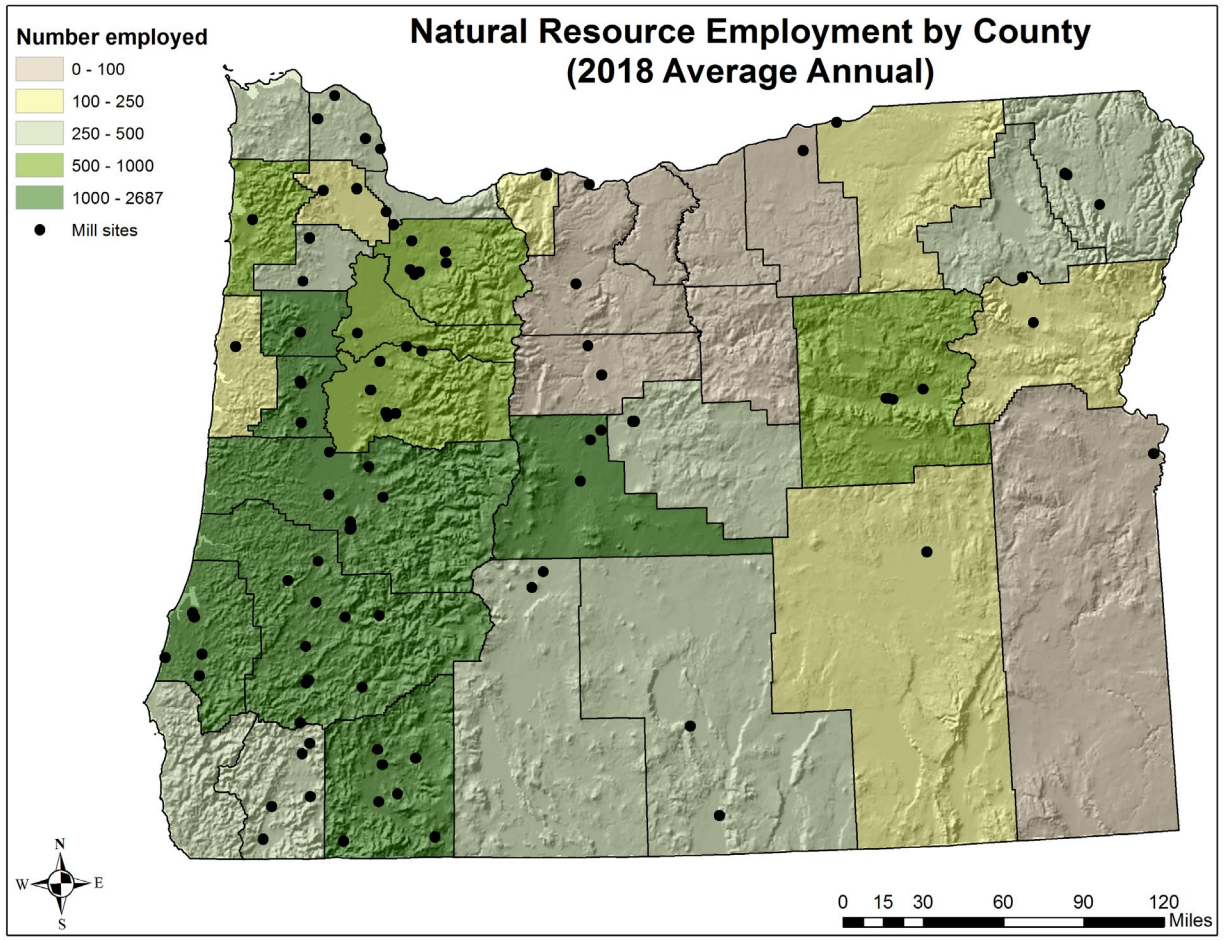
Economics

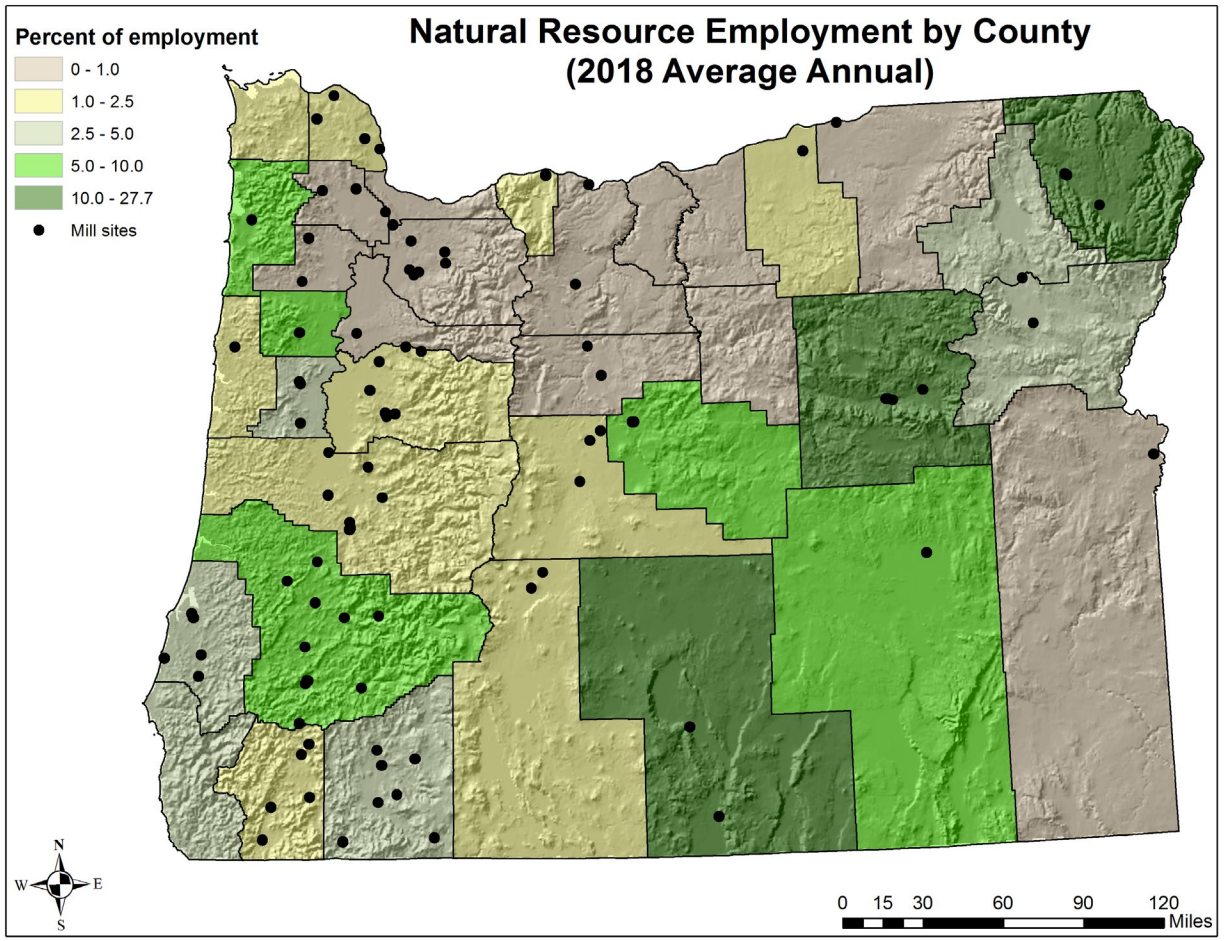
- Distressed Communities Index
- Natural Resource Employment
- Tourism, Travel, and Hospitality Employment
- Agriculture employment

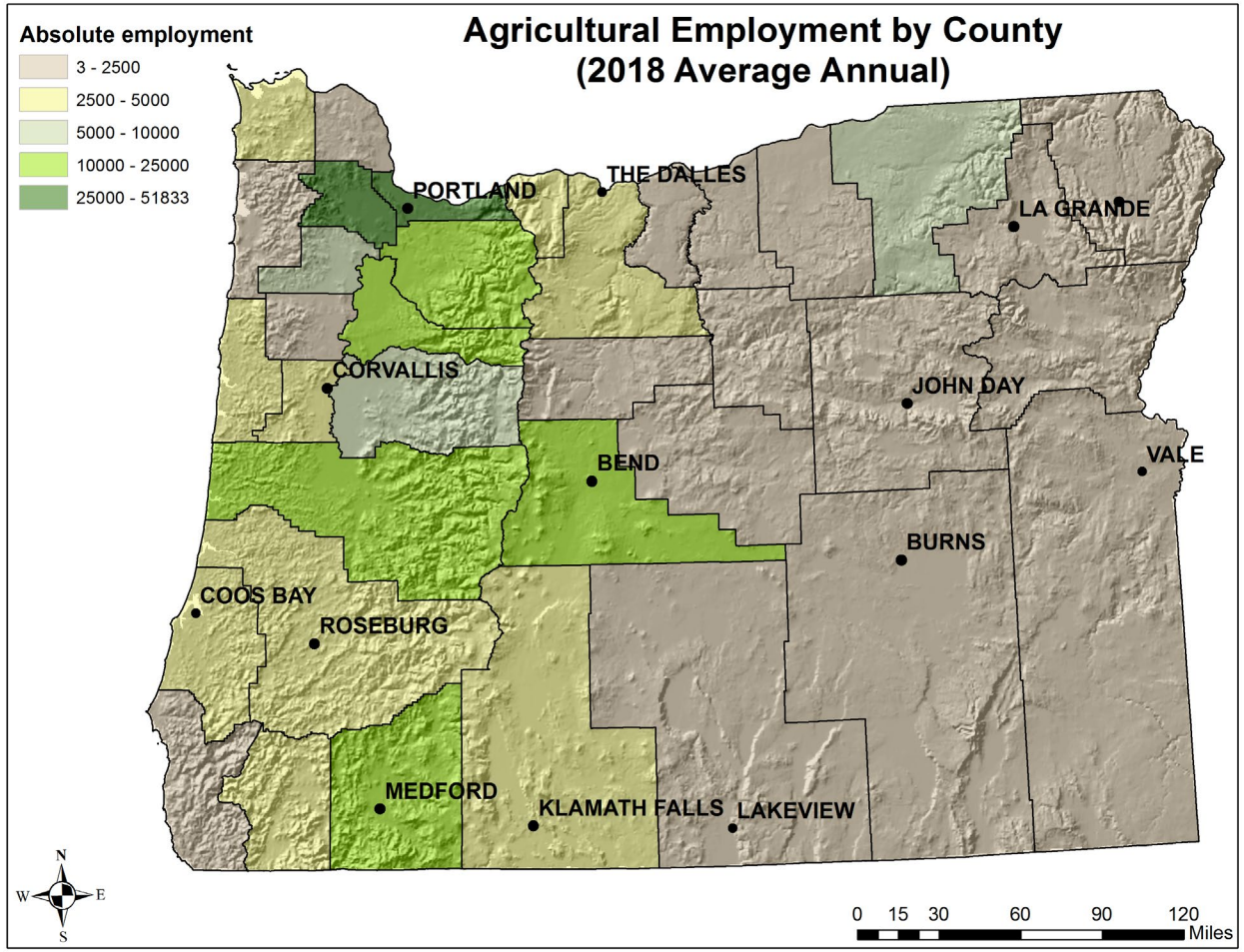
1. Percent of adults with high school diploma
2. Housing vacancy rates
3. Adults not working
4. Poverty rate
5. Median income ratio (relative to state)
6. Change in employment
7. Change in establishments

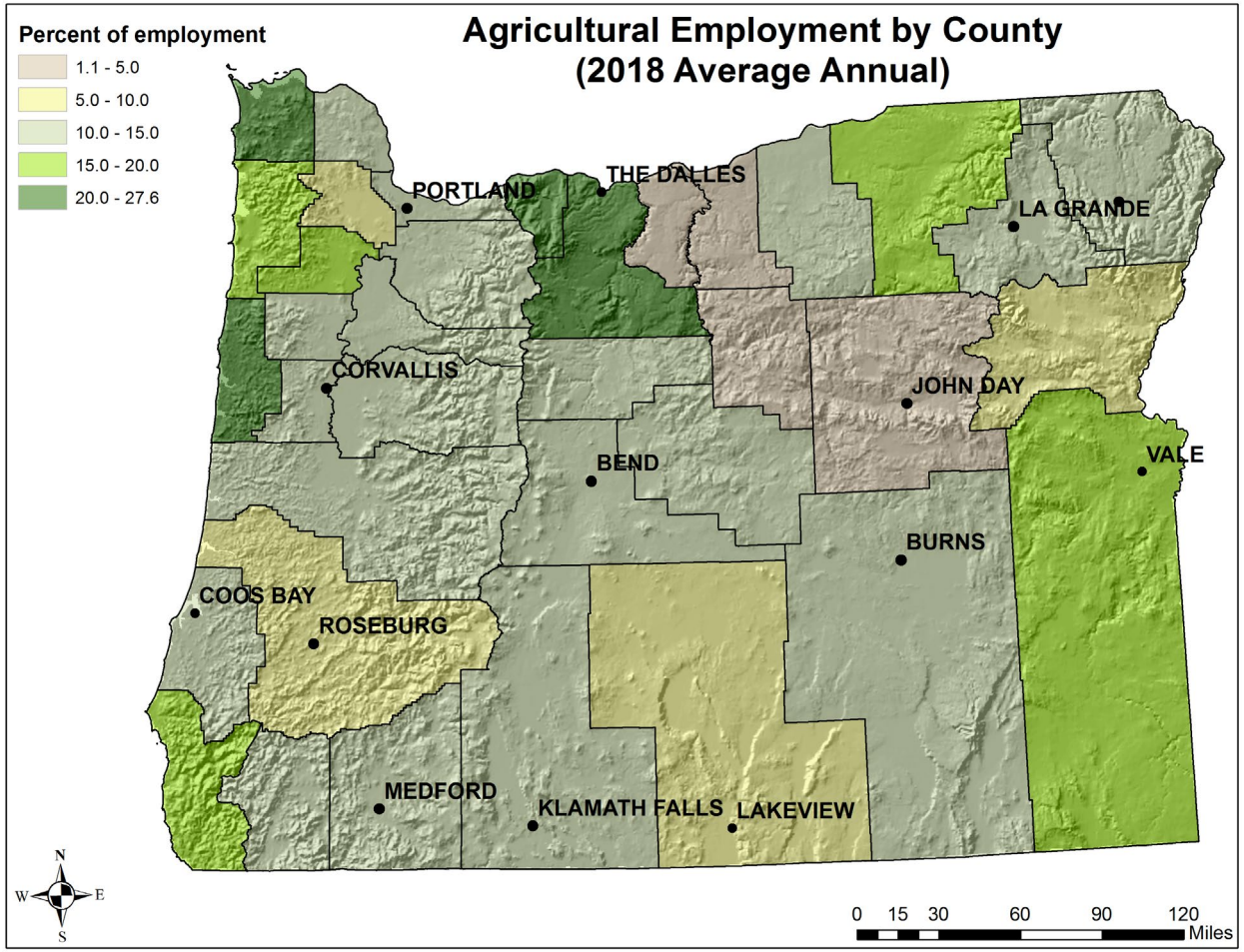
*Classification is based on ranking across the nation

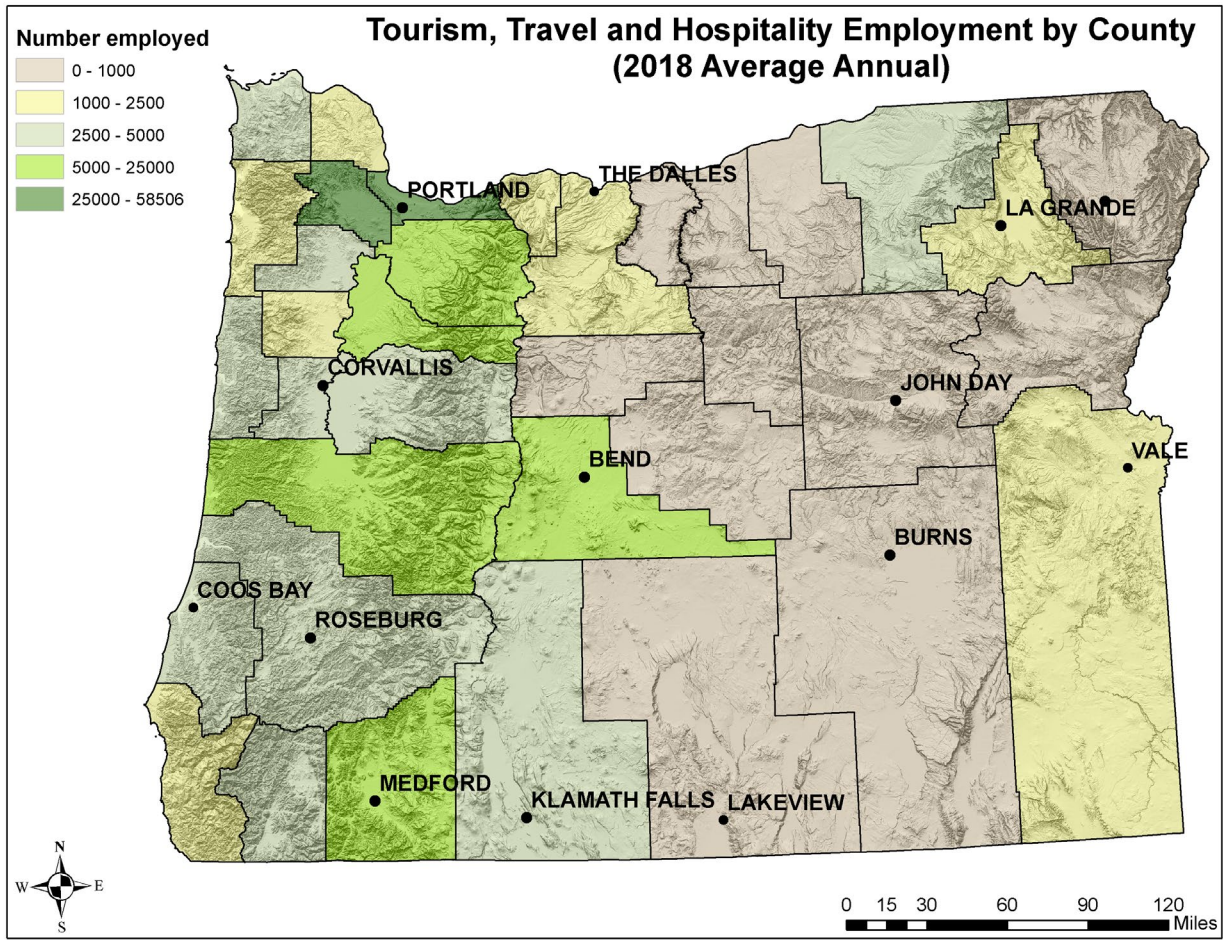


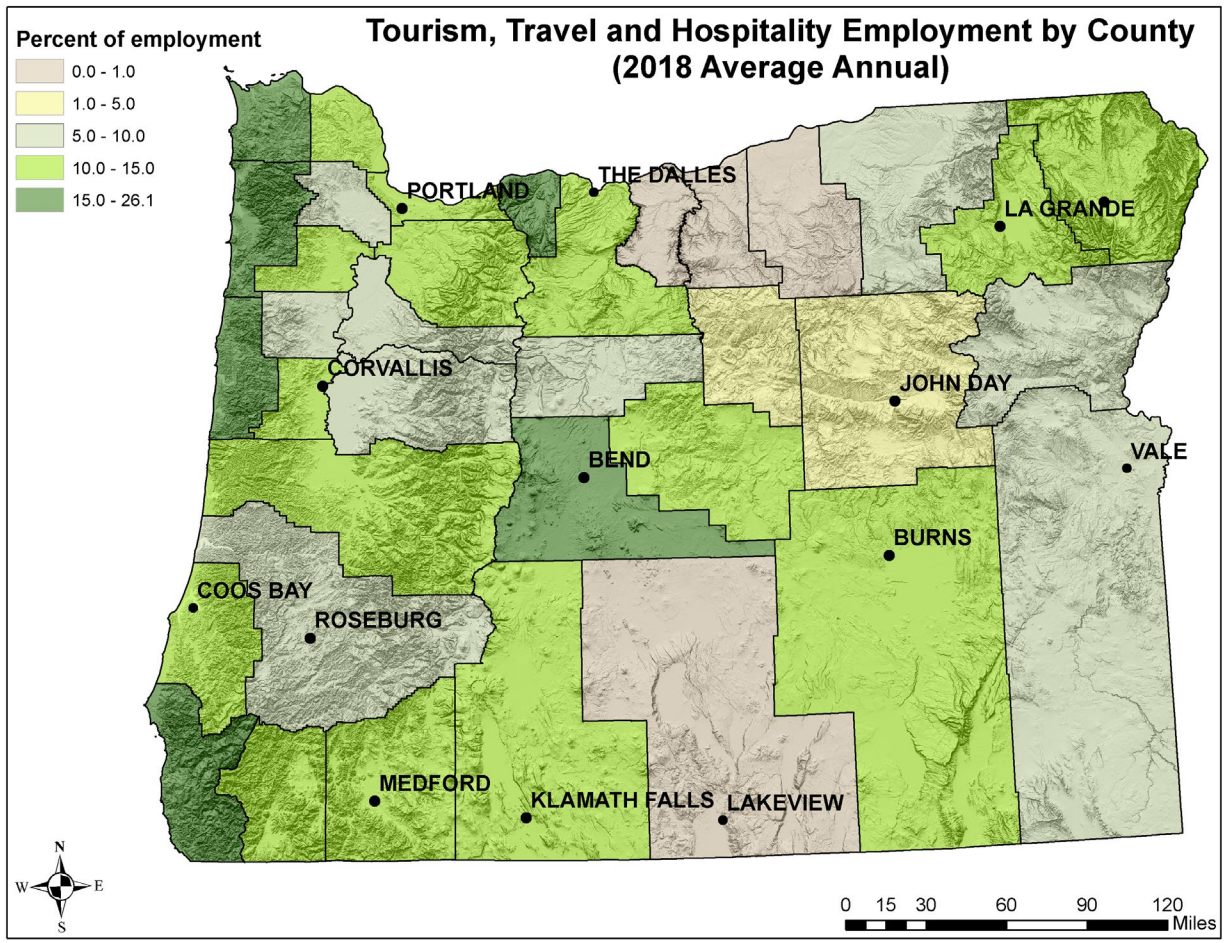

Natural Resource Employment by County
(2018 Average Annual)
Number employed
0 - 100
100 - 250
250 - 500
500 - 1000
1000 - 2687
Mill sites
N
W
E
S
0 15 30 60 90 120
Miles


Natural Resource Employment by County
(2018 Average Annual)
Percent of employment
0 - 1.0
1.0 - 2.5
2.5 - 5.0
5.0 - 10.0
10.0 - 27.7
Mill sites
N
W
E
S
0 15 30 60 90 120
Miles


Absolute employment
3 - 2500
2500 - 5000
5000 - 10000
10000 - 25000
25000 - 51833
Agricultural Employment by County
(2018 Average Annual)
PORTLAND
THE DALLES
LA GRANDE
CORVALLIS
JOHN DAY
BEND
VALE
BURNS
COOS BAY
ROSEBURG
MEDFORD
KLAMATH FALLS
LAKEVIEW
N
W
E
S
0 15 30 60 90 120
Miles


Percent of employment
1.1 - 5.0
5.0 - 10.0
10.0 - 15.0
15.0 - 20.0
20.0 - 27.6
Agricultural Employment by County
(2018 Average Annual)
PORTLAND
THE DALLES
LA GRANDE
CORVALLIS
JOHN DAY
BEND
VALE
BURNS
COOS BAY
ROSEBURG
MEDFORD
KLAMATH FALLS
LAKEVIEW
N
W
E
S
0 15 30 60 90 120
Miles

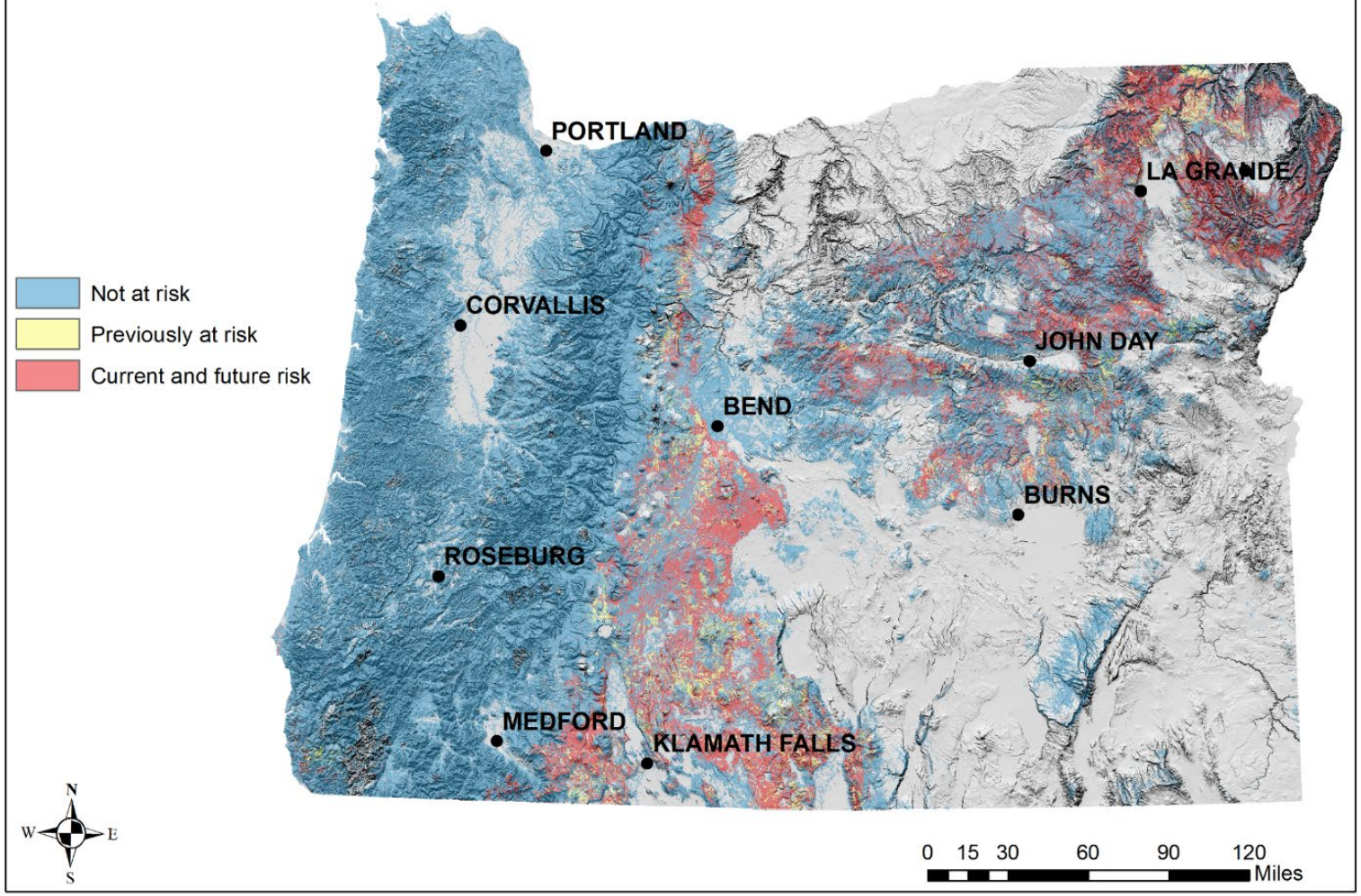

Tourism, Travel and Hospitality Employment by County
(2018 Average Annual)
Number employed
0 - 1000
1000 - 2500
2500 - 5000
5000 - 25000
25000 - 58506
PORTLAND
THE DALLES
LA GRANDE
CORVALLIS
JOHN DAY
BEND
VALE
BURNS
COOS BAY
ROSEBURG
MEDFORD
KLAMATH FALLS
LAKEVIEW
N
W
E
S
0 15 30 60 90 120
Miles


Tourism, Travel and Hospitality Employment by County
(2018 Average Annual)
Percent of employment
0.0 - 1.0
1.0 - 5.0
5.0 - 10.0
10.0 - 15.0
15.0 - 26.1
PORTLAND
THE DALLES
LA GRANDE
CORVALLIS
JOHN DAY
BEND
VALE
BURNS
COOS BAY
ROSEBURG
MEDFORD
KLAMATH FALLS
LAKEVIEW
N
W
E
S
0 15 30 60 90 120
Miles

Forest Health Indicators

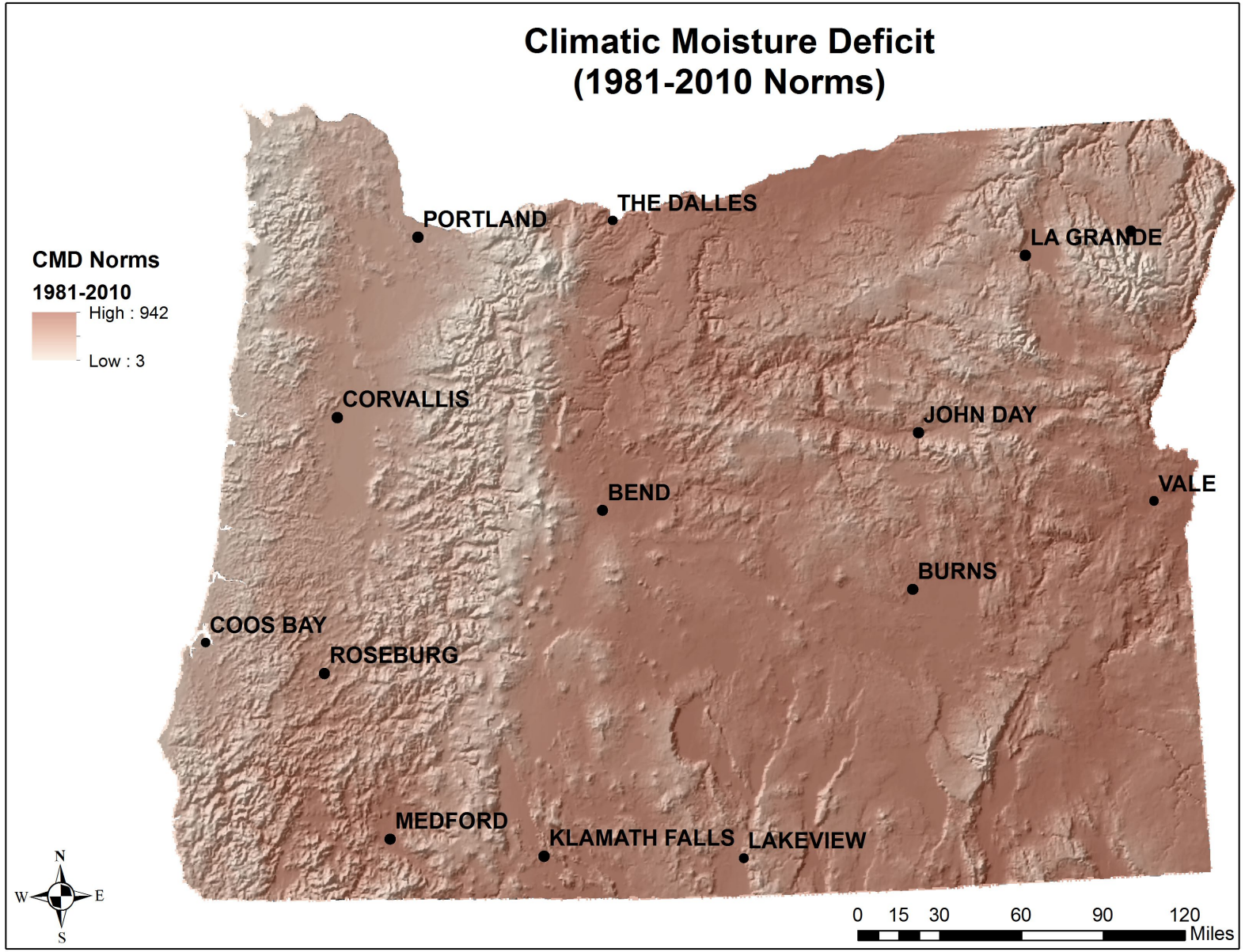
- Insect and Disease Risk
- Drought Stress

National Insect and Disease Potential Map: Oregon

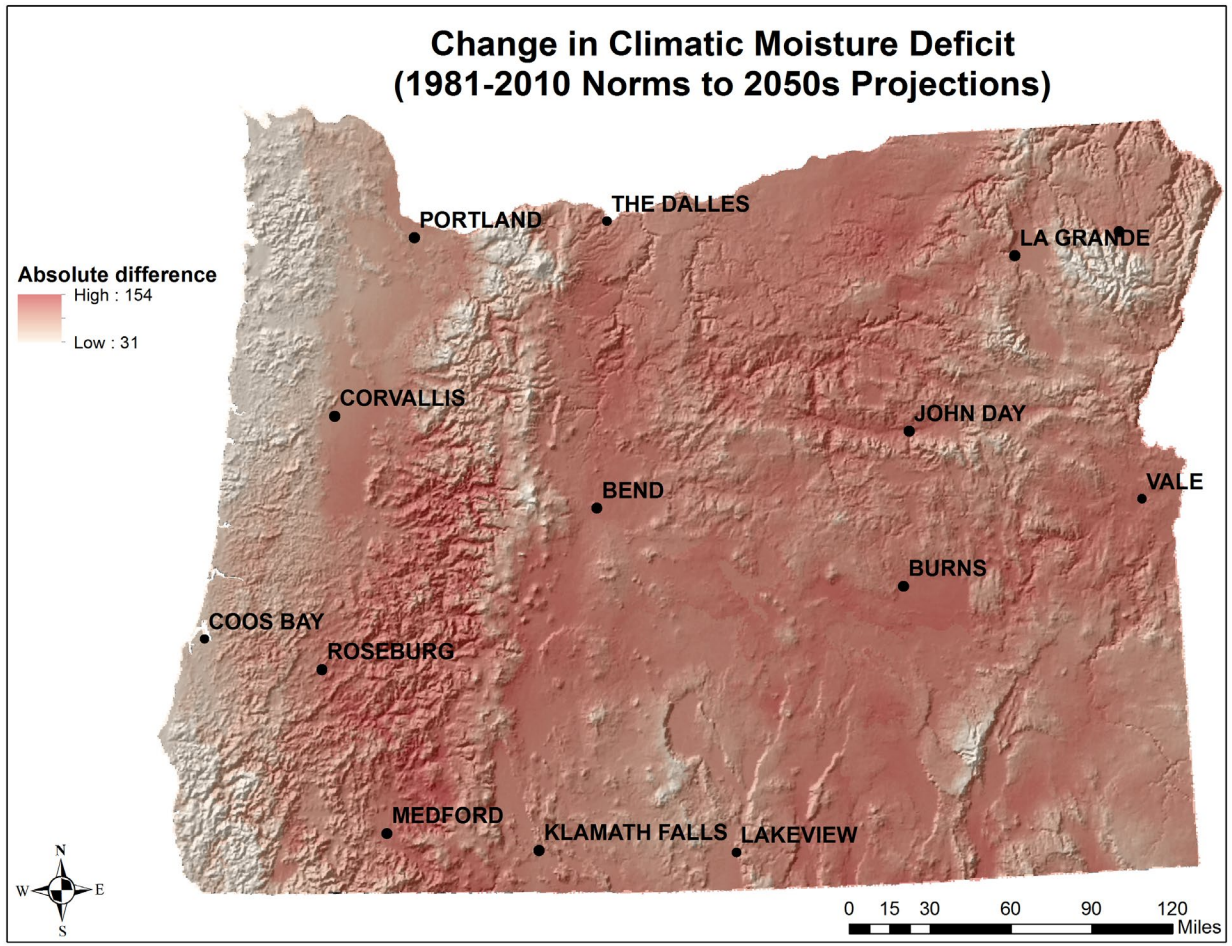


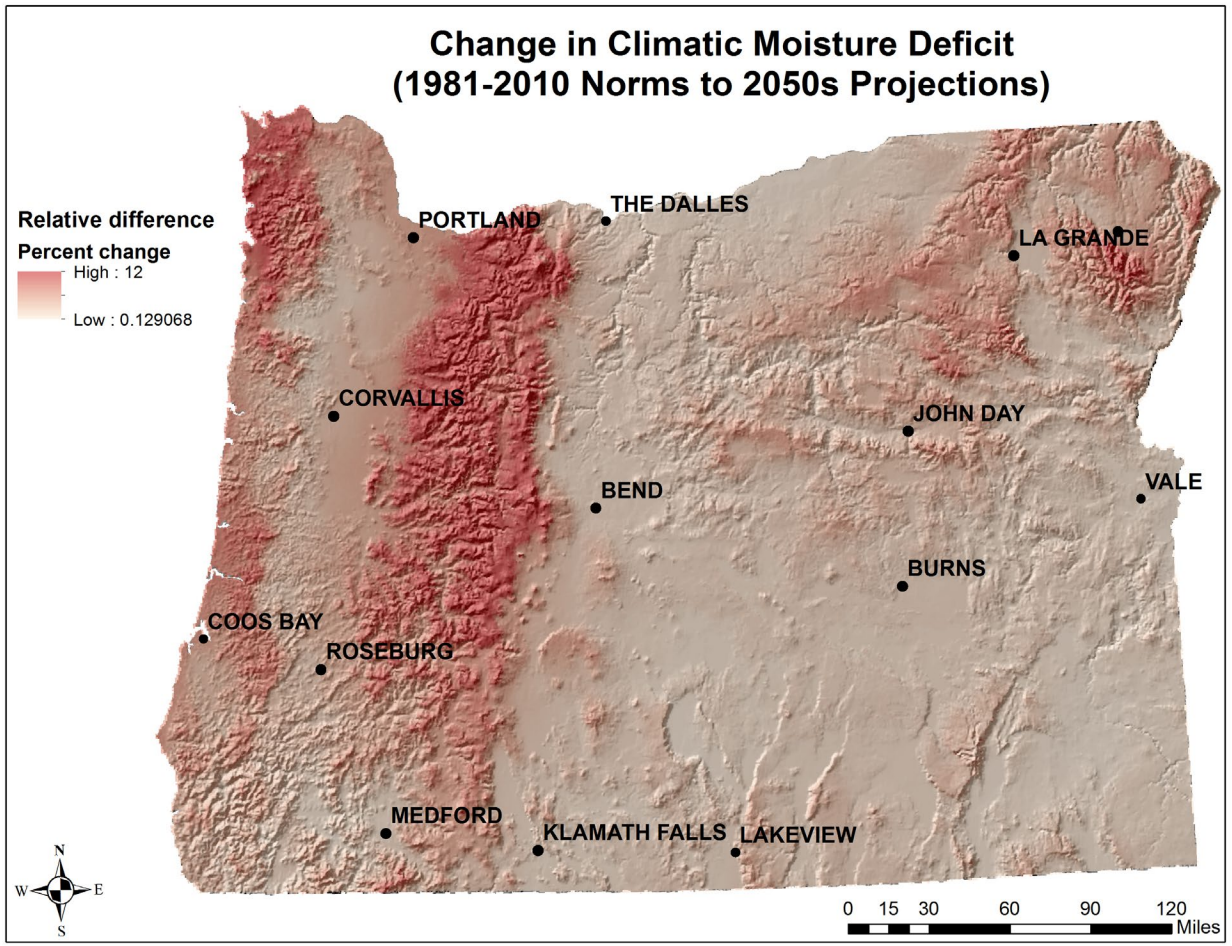
https://www.fs.fed.us/foresthealth/applied-sciences/mapping-reporting/national-risk-maps.shtml

Drought Stress

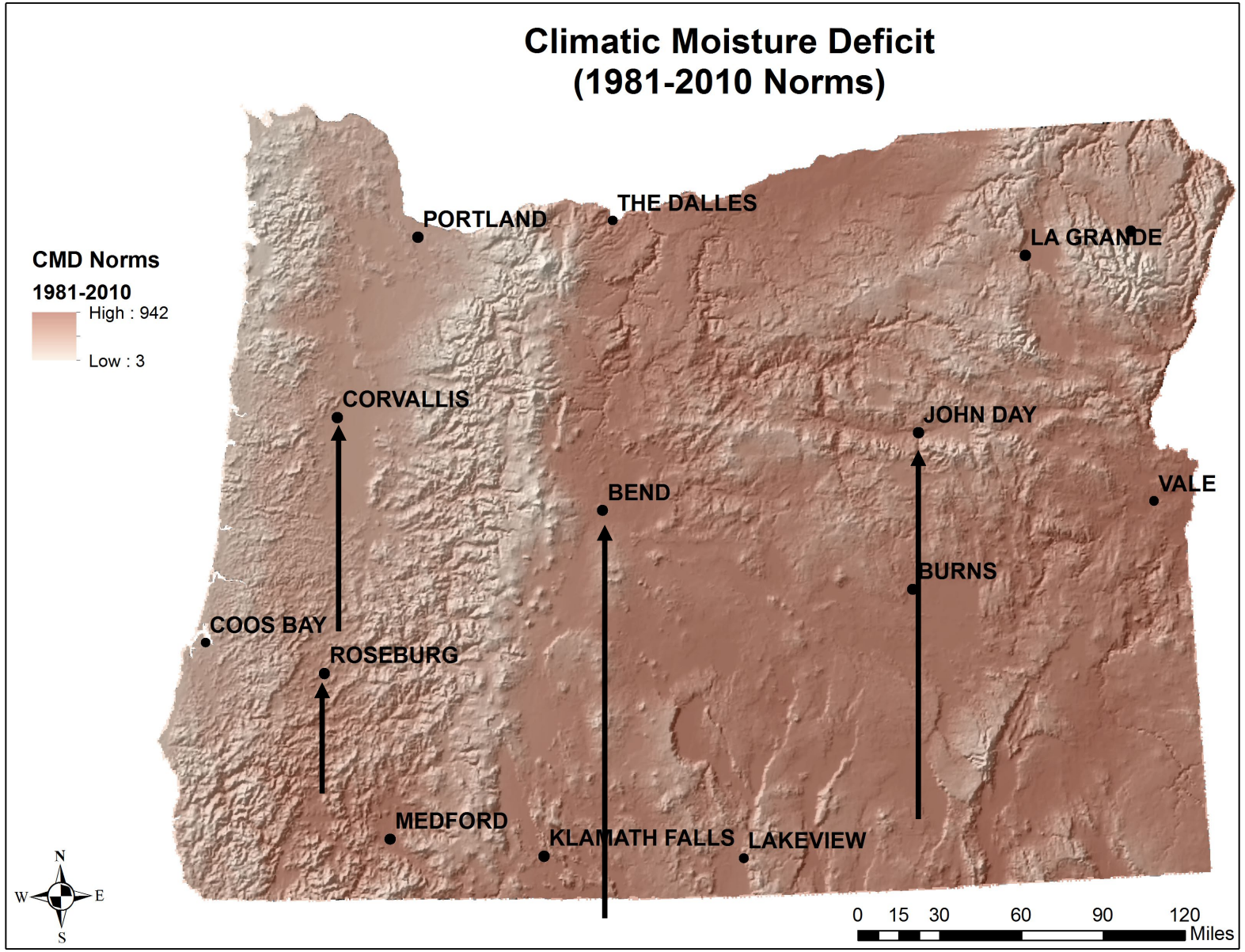


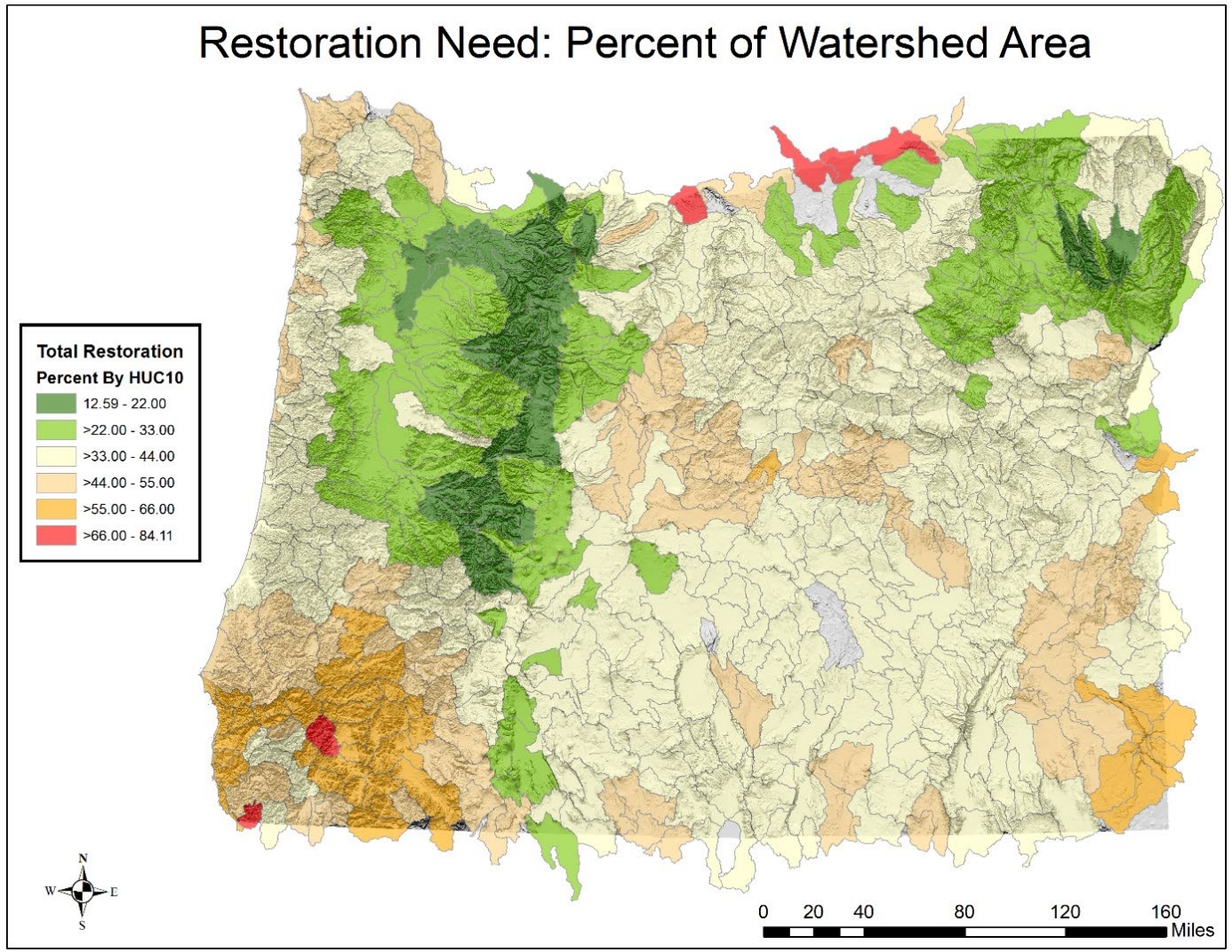
Drought Stress – changing climate





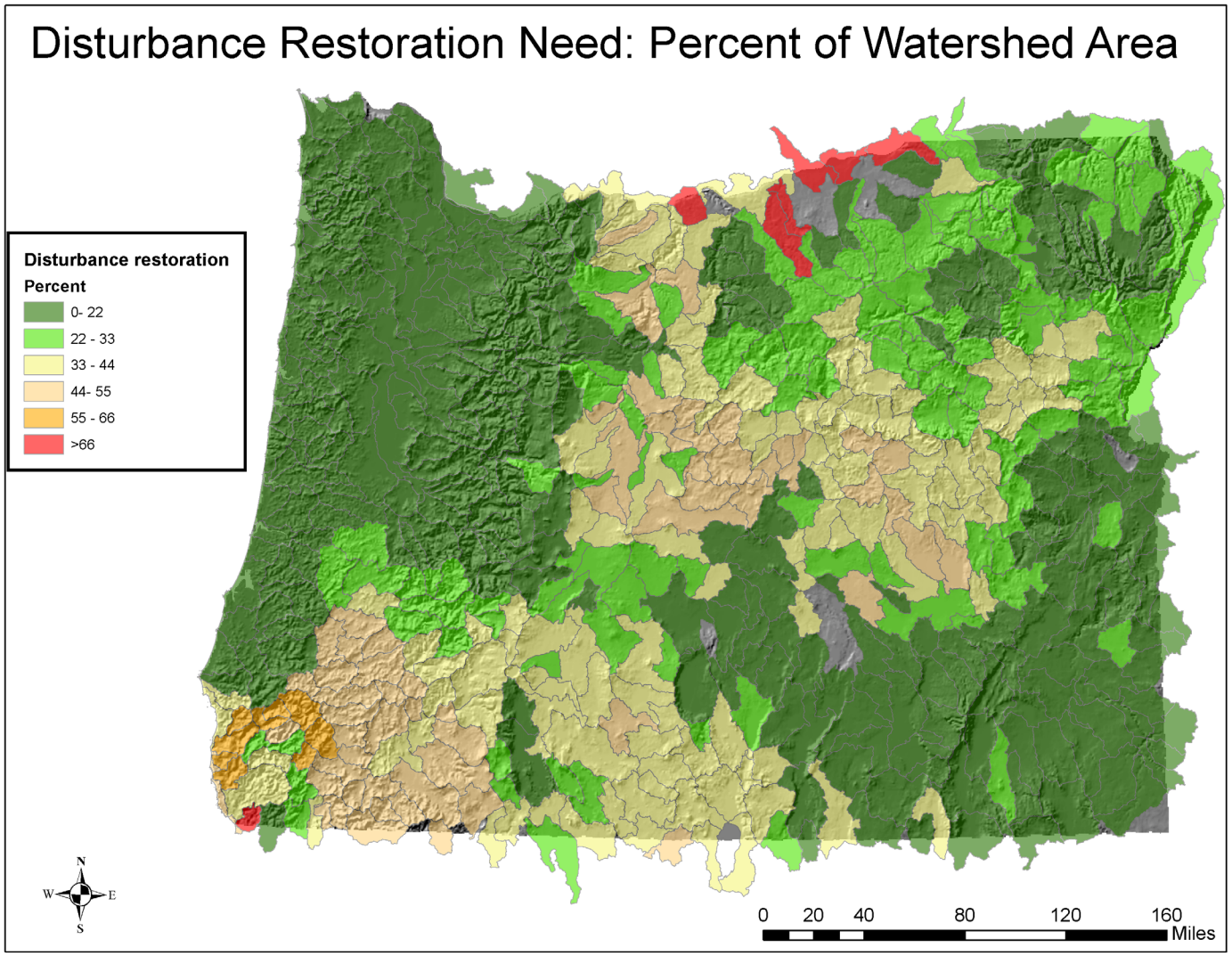
Drought Stress

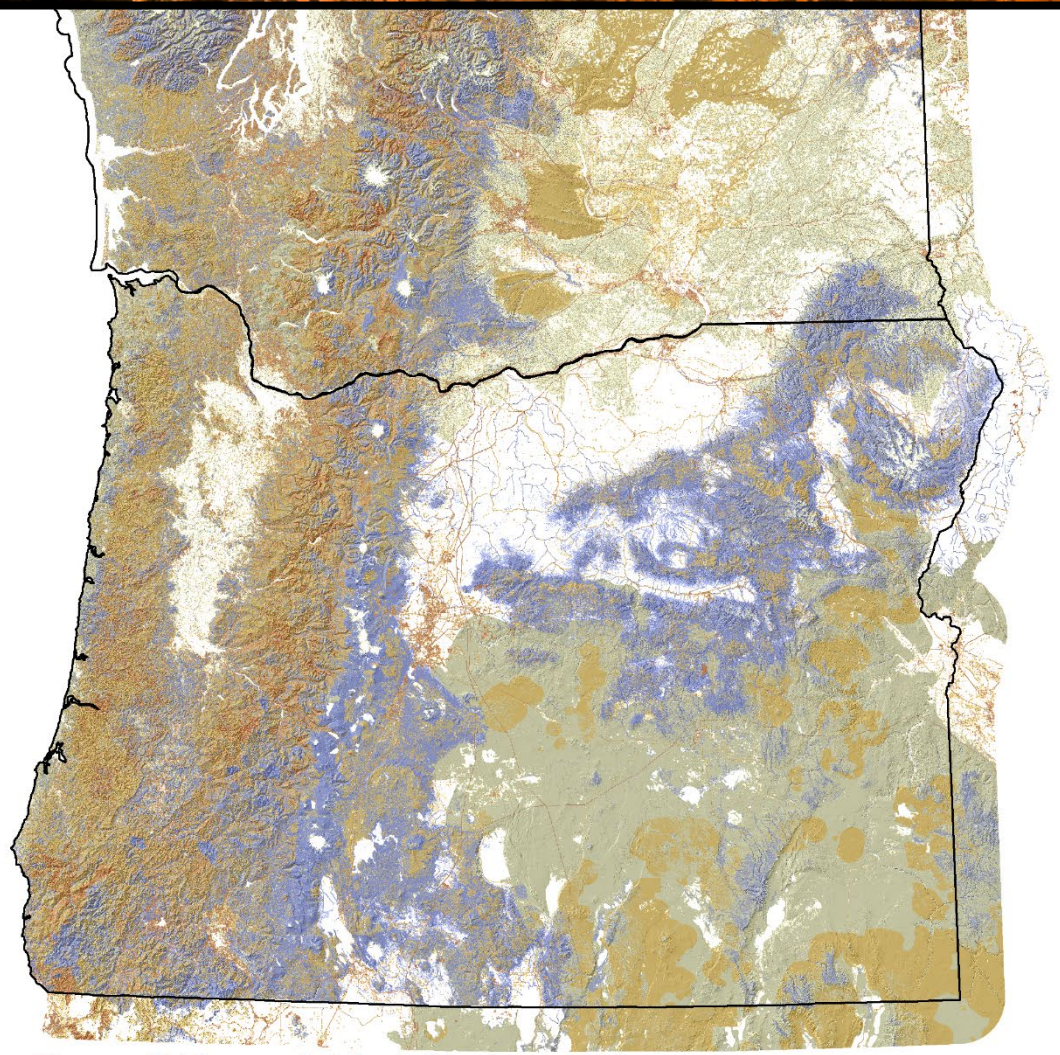




DeMeo, T., Haugo, R., Ringo, C., Kertis, J., Acker, S., Simpson, M. and Stern, M., 2018. Expanding our understanding of forest structural restoration needs in the Pacific Northwest. *Northwest science*, *92*(1), pp.18-36.

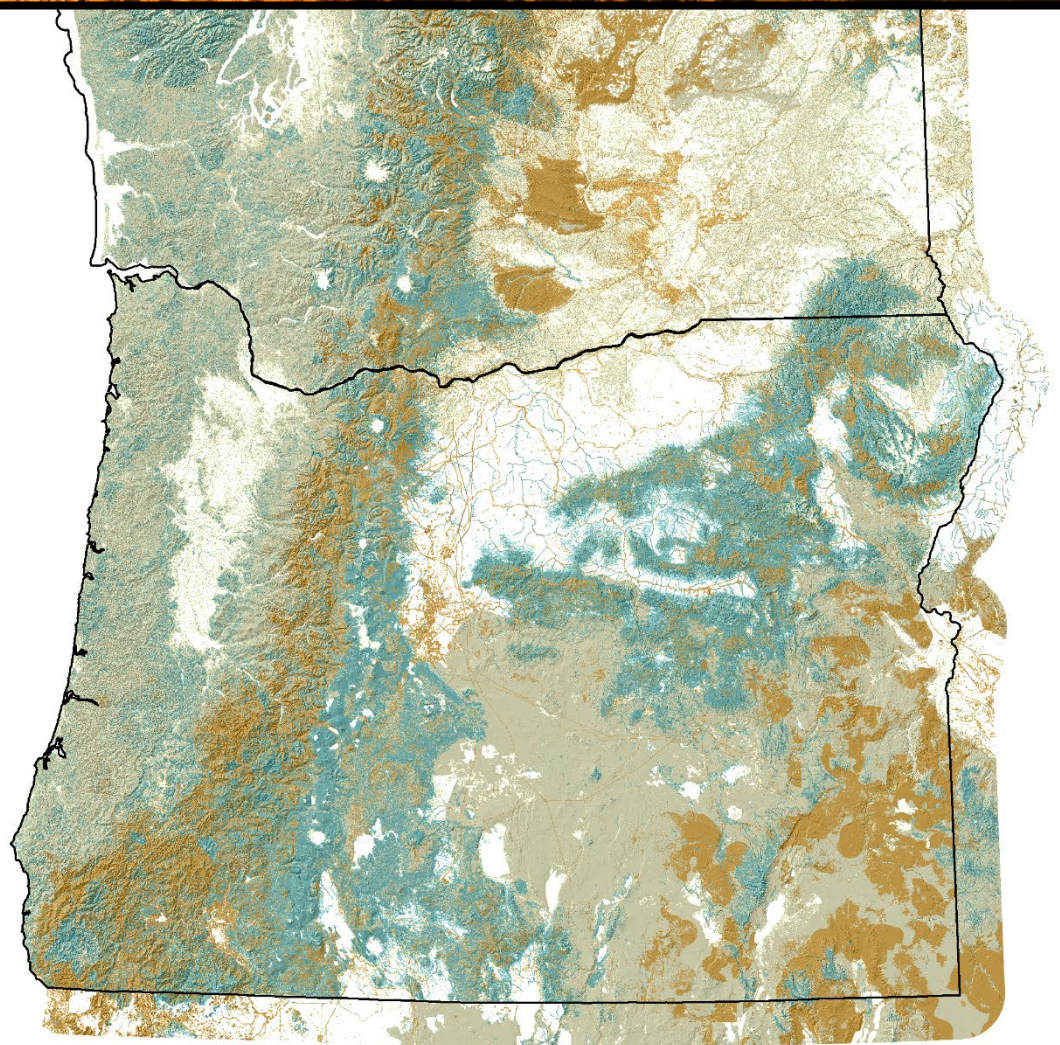
Disturbance Restoration Need: Percent of Watershed Area





Conditional Net Value Change

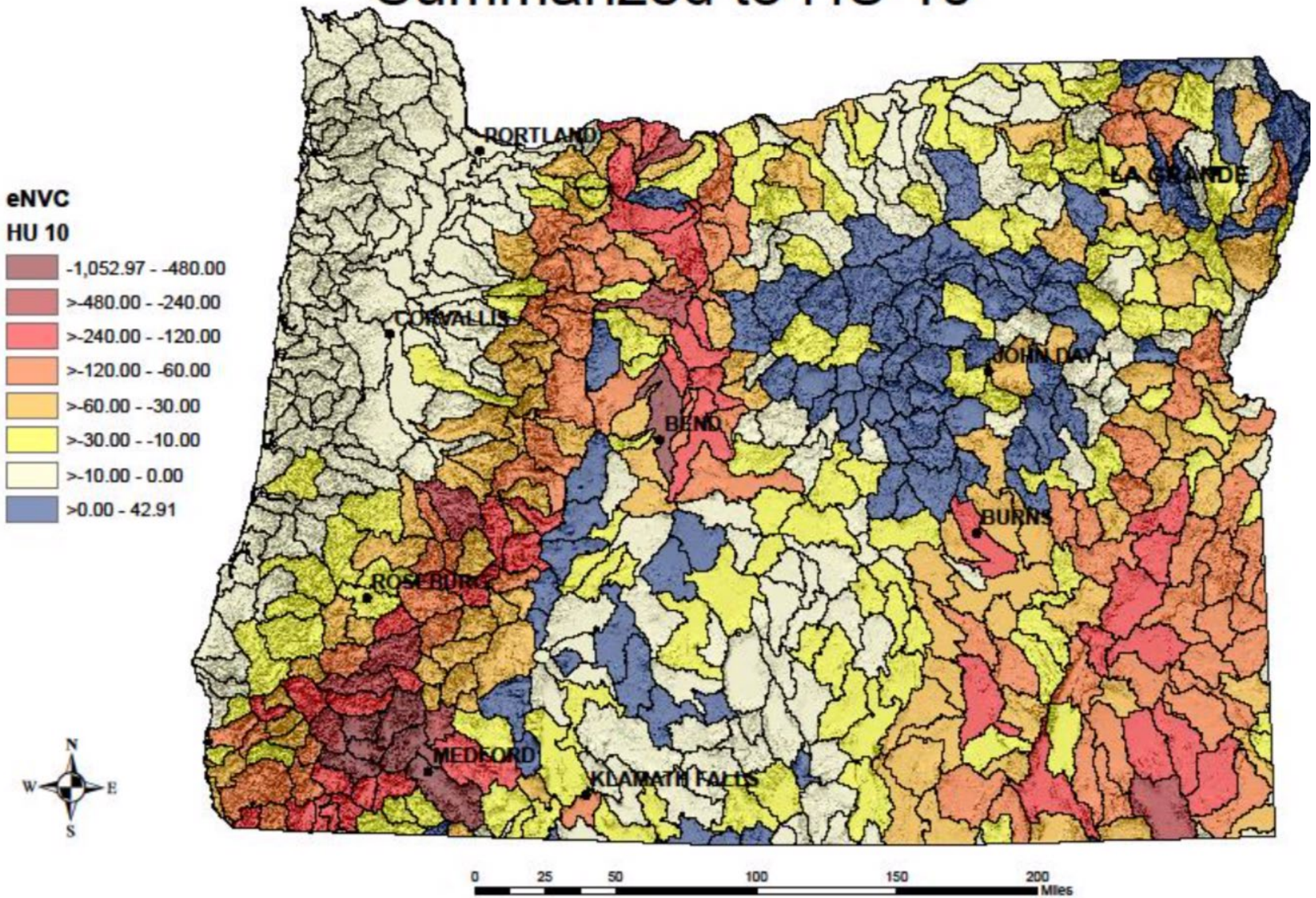
-284.97 - -18.12	>-0.1 - -0.01	>0.01 - 0.10
-18.12 - -0.32	>-0.01 - 0	>0.10 - 0.32
-0.32 - -0.1	>0 - 0.01	



Expected Net Value Change

-0.23 - -0.10	-0.005 - -0.0001	0 - 0.001
-0.10 - -0.01	-0.0001 - 0	0.001 - 0.0033
-0.01 - -0.005	0	0.0033 - 0.005

Expected Net Value Change (eNVC) Summarized to HU 10



Integrating HVRAs with differing units of measure (for example, habitat vs. homes) requires relative importance (RI) values for each HVRA/sub-HVRA. These values were identified in the RI workshop, as discussed in Section 3. The final importance weight used in the risk calculations is a function of overall HVRA importance, sub-HVRA importance, and relative extent (pixel count) of each sub-HVRA. This value is therefore called relative importance per pixel (RIPP).

The RF and RIPP values were combined with estimates of the flame-length probability (FLP) in each of the six flame-length classes to estimate conditional NVC (cNVC) as the sum-product of flame-length probability (FLP) and response function value (RF) over all the six flame-length classes, with a weighting factor adjustment for the relative importance per unit area of each HVRA, as follows:

$$cNVC_j = \sum_{i}^{n} FLP_i * RF_{ij} * RIPP_j$$

where i refers to flame length class (n = 6), j refers to each HVRA, and RIPP is the weighting factor based on the relative importance and relative extent (number of pixels) of each HVRA. The cNVC calculation shown above places each pixel of each resource on a common scale (relative importance), allowing them to be summed across all resources to produce the total cNVC at a given pixel:

$$cNVC = \sum_{j}^{m} cNVC_j$$

where cNVC is calculated for each pixel in the analysis area. Finally, eNVC for each pixel is calculated as the product of cNVC and annual BP:

$$eNVC = cNVC * BP$$