



Technical Guide: Mapping Wildland Urban Interface (WUI) to Support Implementation of Oregon's 2021 Senate Bill 762

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PURPOSE

This document describes the process used by Oregon State University (OSU) scientists to map the wildland urban interface (WUI)³, as required by Section 7 of 2021 Senate Bill 762 (SB762). It is intended to be a reference for state agencies and partners to aid development of communications products and support planning related to SB762.

The methods, data and figures in this document are updated as of June 24, 2022. Questions about this document or any other data produced by OSU to support SB762 can be directed to osuwildfirerisk@oregonstate.edu.

All of OSU's data products, including the statewide WUI map, will be publicly available on the Oregon Wildfire Risk Explorer (<https://oregonexplorer.info/wildfirerisk>) on June 30, 2022. The public will be able to access a version of this document at <http://osuwildfireriskmap.forestry.oregonstate.edu> on June 30, 2022.

BACKGROUND

Under SB762, OSU is responsible for developing three specific data products that will be used to support implementation of SB762 (Figure 1). The three data products include:

1. Development and maintenance of a comprehensive statewide map of wildfire risk (Section 7(1-5)).
2. A map of the wildland urban interface, as defined in ORS 477.015, consistent with national standards (Section 7(7)(c)).
3. A map of the locations of socially and economically vulnerable communities (Section 7(7)(d)).

To support risk-informed decision-making, the WUI map will be used in conjunction with the statewide map of wildfire risk to potential structures⁴ and other human development⁵ (hereafter "buildings") to do the following:

³ The geographic area where structures and other human development meets or intermingles with wildland or vegetative fuels

⁴ A permitted building on a lot that is used as a place where one or more people sleep.

⁵ Essential facilities (ORS 455.447) that support community functions, public communication, energy and transportation in excess in size 400 square feet.

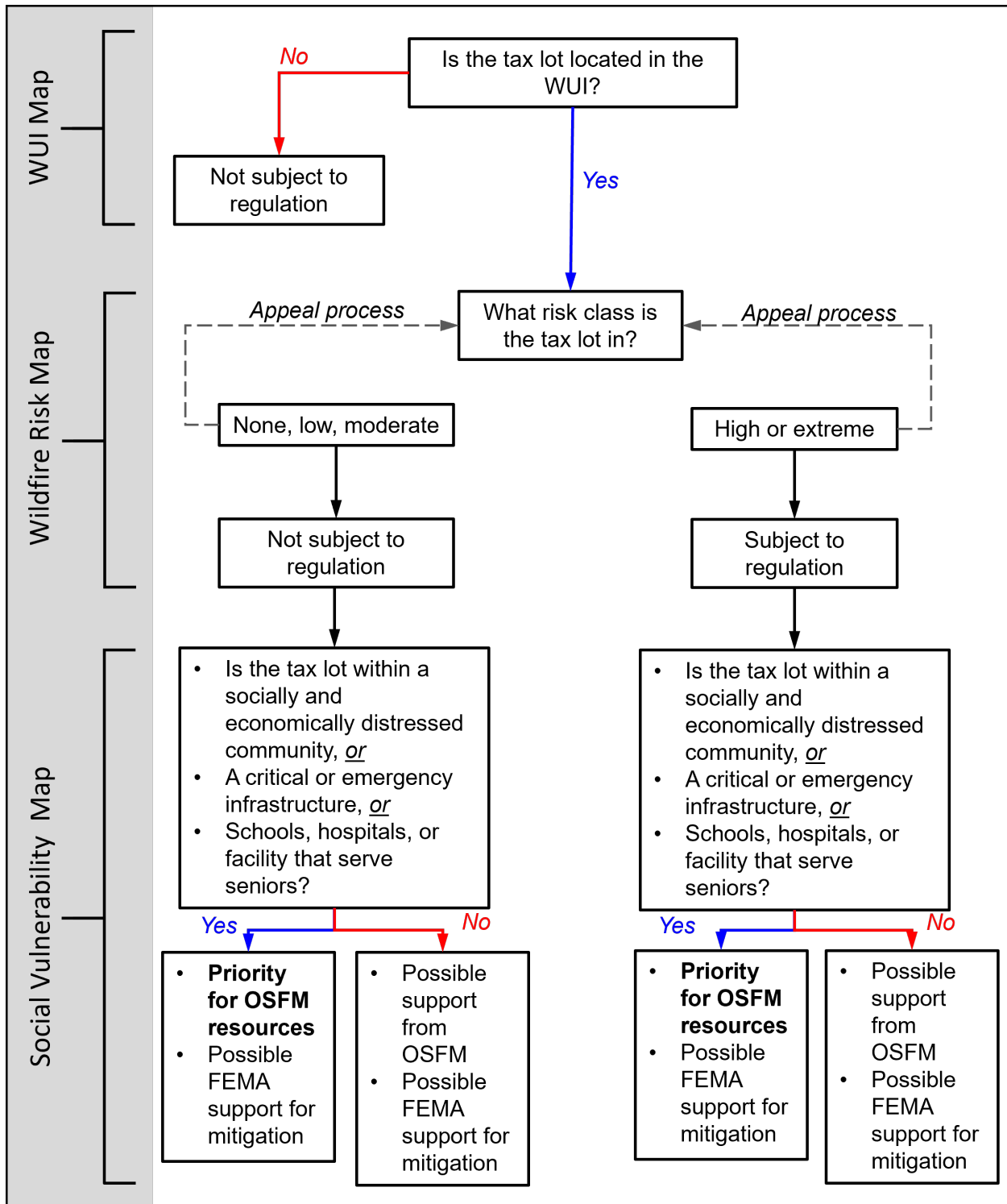


Figure 1. Simplified flowchart of how the three data products developed by OSU will be used together to develop and enforce defensible space rules established under Section 8 of SB762. This is one example of how the three maps will be used in conjunction, but there are other examples from SB762.

- Under Section 8a(1), “The State Fire Marshal shall establish minimum defensible space requirements for wildfire risk reduction on lands in areas identified on the statewide map of wildfire risk described in section 7 of this 2021 Act as within the wildland-urban interface.”
- Under Section 11(2), “the Department of Land Conservation and Development shall identify updates to the statewide land use planning program and local comprehensive plans and zoning codes that are needed in order to incorporate wildfire risk maps and minimize wildfire risk, including the appropriate levels of state and local resources necessary for effective implementation.”
- Under Section 12(1), “for extreme and high wildfire risk classes in the wildland-urban interface that are identified pursuant to section 7 of this 2021 Act, the Department of Consumer and Business Services shall adopt wildfire hazard mitigation building code standards that apply to new dwellings and the accessory structures of dwellings, as described in section R327 of the 2021 Oregon Residential Specialty Code.”

During more than 60 hours of planning, the Rules Advisory Committee (RAC), comprised of agency personnel, OSU scientists and stakeholders, developed science-based guidance for development of the statewide WUI map. We used peer-reviewed methods and definitions based on the International Wildland Urban Interface Code (IWUIC) and the federal register to create a statewide WUI map that meets the expectations of the RAC and the rules adopted by the Board of Forestry on June 8, 2022 (Bar-Massada et al., 2013; Caggiano et al., 2020; Carlson et al., 2022; *Executive Order 13728*, 2016; International Code Council, 2020; Li et al., 2022).

WUI MAPPING METHODS

Creating a statewide map of the WUI involved two general steps (Figure 2):

1. Determine which areas met the minimum building density requirements to be classified as WUI
2. Buildings that met the minimum density threshold were further classified as either intermix, interface or occluded WUI, or determined not to be in the WUI based on their proximity to wildland or vegetative fuels.

Step 1. Develop a potential WUI map of all areas that meet the minimum density of structures and other human development

According to OAR 629-044-1011, the boundary of Oregon’s WUI is defined by any area within an Urban Growth Boundary (UGB) and all areas with a minimum building density of one building per 40 acres, the same threshold defined in the federal register (*Executive Order 13728*, 2016). Step One characterizes all the locations in Oregon that could be considered for inclusion in the WUI on building density alone. The result of Step One was a map of potential WUI which was then further refined into final WUI map based on fuels density and proximity in Step Two.

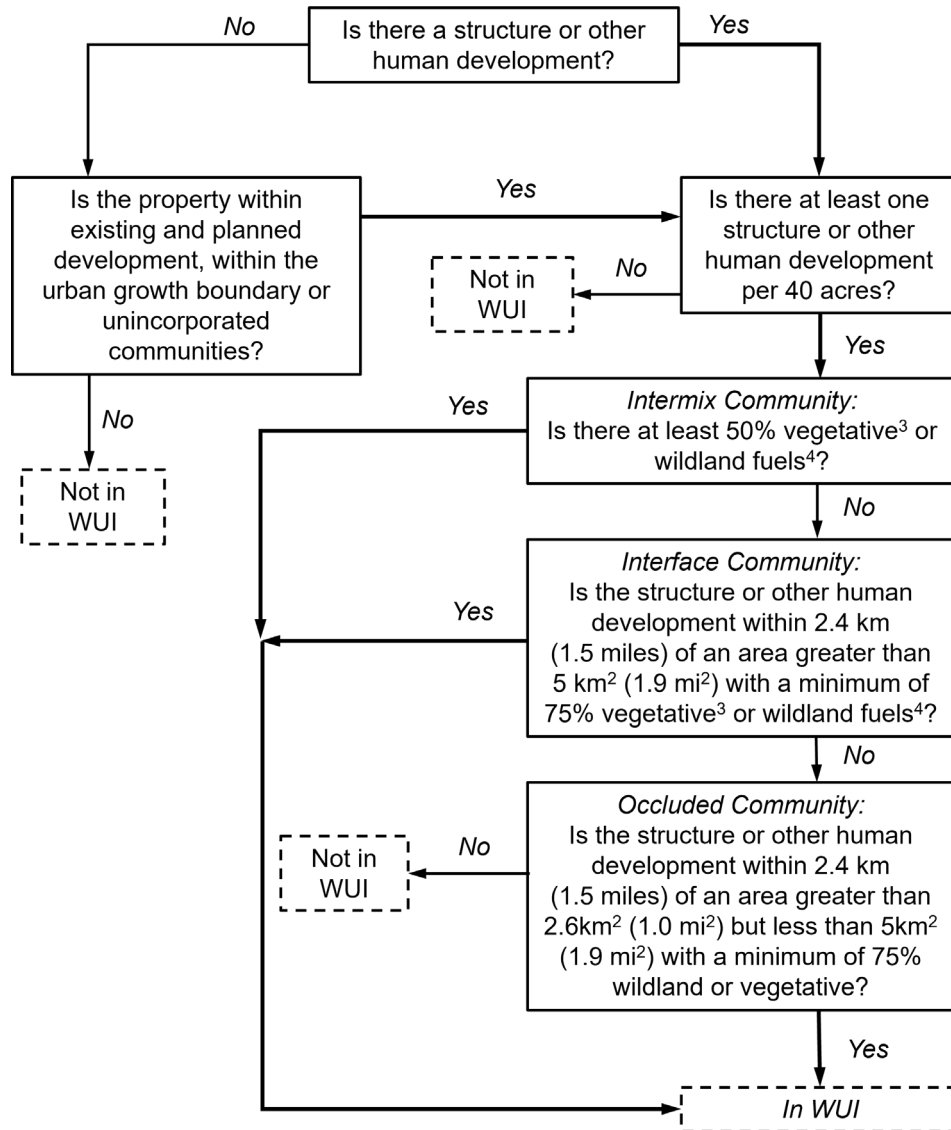


Figure 2. A detailed flowchart illustrating how the WUI is defined. This flowchart was developed by the Rules Advisory Committee and is part of a more comprehensive flowchart that describes how the WUI, wildfire risk, and social vulnerability maps developed by OSU will be used to implement SB762 (see Appendix A).

Step 1a. Compile statewide tax lots. OSU scientists assembled a comprehensive dataset of Oregon tax lots. Tax lot data was collected from the Geospatial Enterprise Office (GEO), a program within the Oregon Department of Administrative Services (<https://www.oregon.gov/GEO/Pages/Index.aspx>). In the case of five counties whose tax lots were not included in the GEO data, OSU scientists worked directly with the counties to access geospatial tax lot data and incorporate it with the GEO data. This data is subject to Data Sharing Agreements and therefore cannot be shared without prior consent from the county or state agency providing the data.

Step 1b. Map all eligible structures and other human development. OSU scientists mapped all structures in Oregon using the Statewide Building Footprint of Oregon (SBFO) data developed by the Oregon Dept. of Geology and Mineral Industries (Figure 3; Williams, 2021). The statewide building footprint dataset consists of more than 2.1 million building footprints that have been compiled from

multiple sources, including remote sensing and municipal/county data. We excluded all building footprints less than 400 square feet. Other human development is generally included within the SBFO data since they are typically buildings, but to be sure that other human development was specifically accounted for we added additional point data that meet the definition of other human development and which were available from Homeland Security (U.S. Department of Homeland Security, 2021). See Appendix B for specific datasets included.

Step 1c. Assign buildings to tax lots and simplify to one building per tax lot. We assigned each building to a tax lot. In compliance with OAR 629-044-1011, all of the buildings on a single tax lot were simplified down to a single building footprint in an effort to minimize the chance that clusters of non-residential buildings (e.g., barns, storage facilities, etc.) would lead to over-mapping of the WUI, particularly on rural properties

Step 1d. Calculate building density and map potential WUI. At each location on the landscape, we calculated the density of buildings per acre using a search radius of 744.73 ft. A density of 1 building per 40 acres based on this search radius results in a density of 0.025 buildings per acre. To remove isolated properties, we assessed building density using a search radius of 746 ft. (1.25 feet wider), which equates to an area just larger than 40 acres (40.14 acres). By doing so, isolated properties had a density of 0.024915 structures per acre which is just below the density threshold. Any structures that did not meet or exceed the density threshold were removed from consideration within the WUI boundary based on building density alone.

After mapping the potential WUI, we observed many small, isolated areas of WUI created by two buildings despite being otherwise remote. Upon investigation, these buildings often barely met the density criteria and were sometimes included because of common geospatial rectification errors that occur during assembly of large data sets. Consequently, we consulted with ODF and decided that any potential WUI area needs to have at least three buildings to be considered a geographic area (Figure 4).

Step 1e. Add Urban Growth Boundary to the WUI. According to OAR 629-044-1011, the WUI also includes all lands within a UGB with a minimum density of one building per 40 acres, or do not meet that minimum density but have planned development that will meet the minimum density. After mapping the potential WUI based on building density, we added all UGB polygons to the map.

Example 1: typical residential buildings



Example 2: large machinery excluded from SBFO



Example 3: truck trailers can appear very similar to buildings



Example 4: hoop-houses are excluded from SBFO



Figure 3. (From Williams, 2021). Examples of how satellite imagery was used to identify and map structures and other human development. Verified buildings included in the final dataset are shown in green; examples of objects removed from the final dataset are circled in red

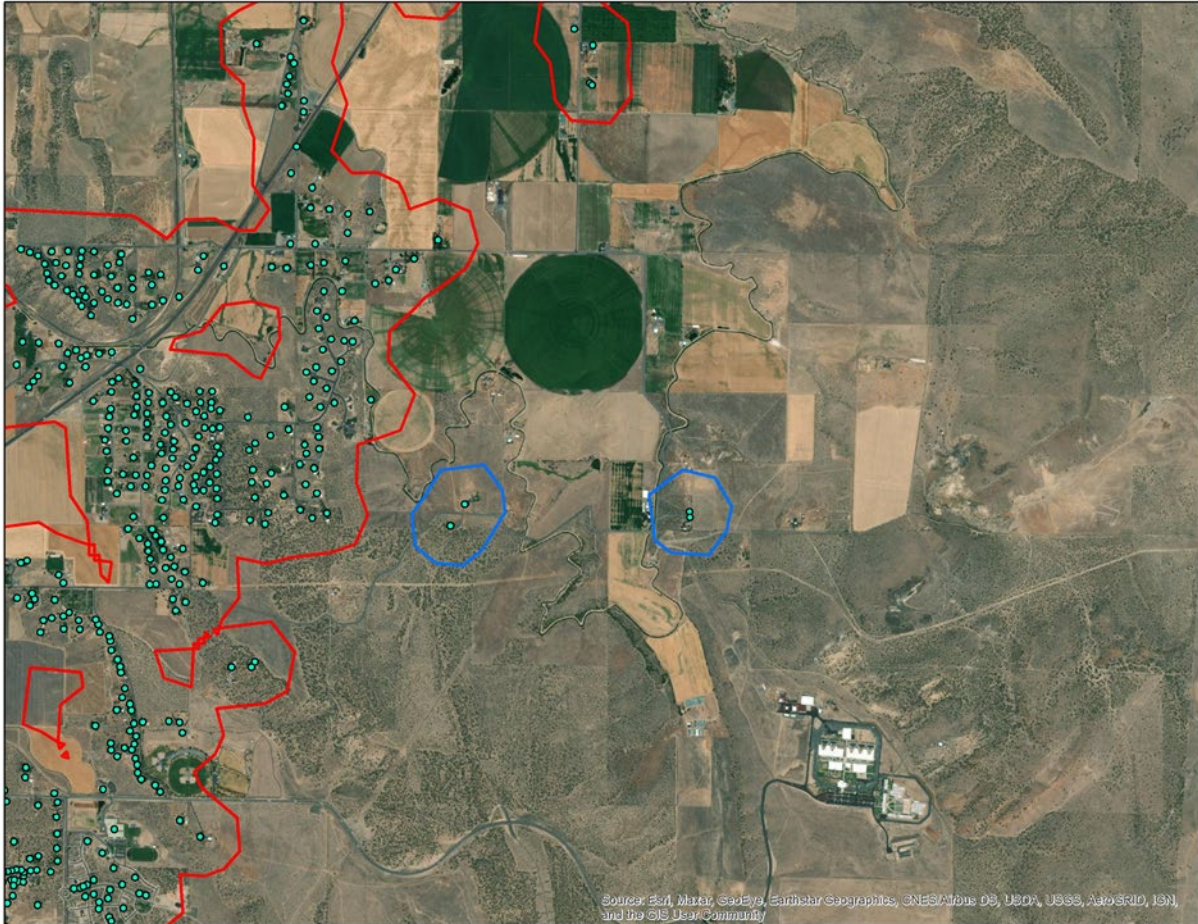


Figure 4. Example of where isolated WUI comprised of just two buildings was removed from the potential WUI map. The blue circles are areas that met the minimum building density threshold despite including just two buildings. The buildings in blue circles were removed from the potential WUI map leaving only the adjacent are in red within the WUI.

Step 2: Further classify the WUI map into three classes based on the proximity and density of fuel.

The WUI is also defined by the density and proximity of wildland⁶ and vegetative fuels⁷ (“fuels”; Figure 2). By including density and proximity of fuels in the definition of the WUI, the urban core is excluded, and the focus is placed on those areas with sufficient building density *and* sufficient fuels to facilitate a WUI conflagration. Consistent with national standards, we further classified the WUI into three general classes to inform effective risk management strategies (Figure 5). The following describes how we refined the potential WUI output from step one into the final WUI map.

Vegetative and wildland fuels were mapped using LANDFIRE data updated to current conditions (LANDFIRE 2.0, 2019). Fire modeling experts and regional fuel specialists updated and adjusted LANDFIRE fuel models to account for recent disturbance and reflect burnable landscapes across Oregon,

⁶ 629-044-1005(k): “Wildland fuels” means natural vegetation that occurs in an area where development is essentially non-existent, including grasslands, brushlands, rangelands, woodlands, timberlands, or wilderness. Wildland fuels are a type of vegetative fuels.

⁷ 629-044-1005(j): “Vegetative fuels” means plants that constitute a wildfire hazard.

creating a burnable landscape that includes all wildland and vegetative fuels and excludes non-burnable areas including barren landscapes, ice and snow, some types of agriculture and much of the urban core.

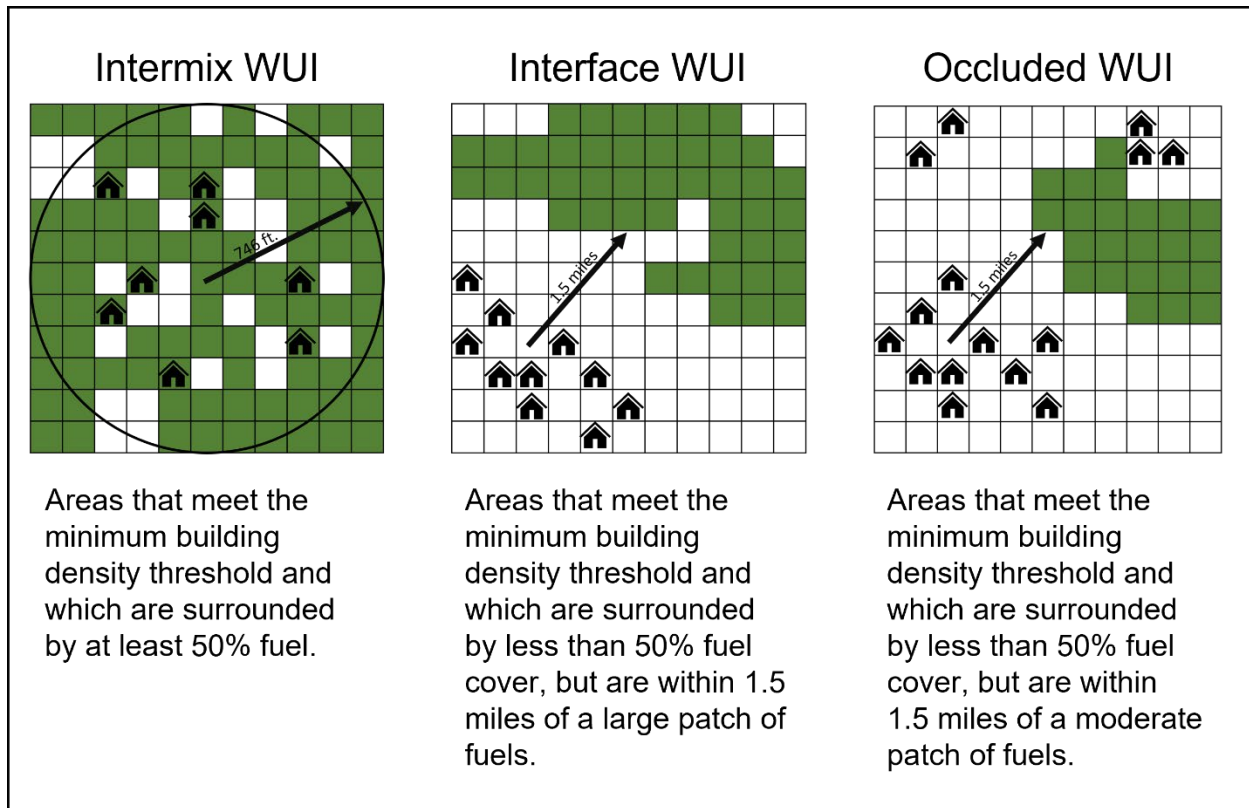


Figure 5. Illustration of the three types of WUI adapted from Bar-Massada (2013). Green squares indicate vegetation.

Step 2a. Map the Intermix WUI. Areas that met the minimum building density threshold in step one *and* which had at least 50% vegetative or wildland fuel cover were classified as Intermix WUI. Intermix WUI is usually small groups of structures in relatively rural settings and on the margins of larger communities. For example, Intermix WUI might include agricultural communities, small and moderate resorts, or rural residential development.

Step 2b. Map the Interface WUI. Interface WUI includes areas that met the minimum building density threshold in step one, *and* which had less than 50% vegetative and/or wildland fuel cover but were within 1.5 miles of a large patch (≥ 2 sq. miles) of at least 75% vegetation and/or wildland fuels. In other words, buildings in Interface WUI are not as intermingled with vegetation as Intermix WUI but are nearby to large blocks of vegetation. Interface WUI is often described as the “rind” around the urban core.

Step 2c. Map the Occluded WUI. Occluded WUI includes areas that met the minimum building density threshold in step one, *and* which had less than 50% vegetative and/or wildland fuel cover but were within 1.5 miles of a moderate patch (1 – 2 sq. miles) of at least 75% vegetation and/or wildland fuels. Similar to Intermix WUI, Occluded areas are not as intermingled with vegetation as Intermix WUI but are nearby to contiguous patches of vegetative and/or wildland fuels. However, the patches of nearby vegetation in Occluded areas are smaller than in Interface WUI.

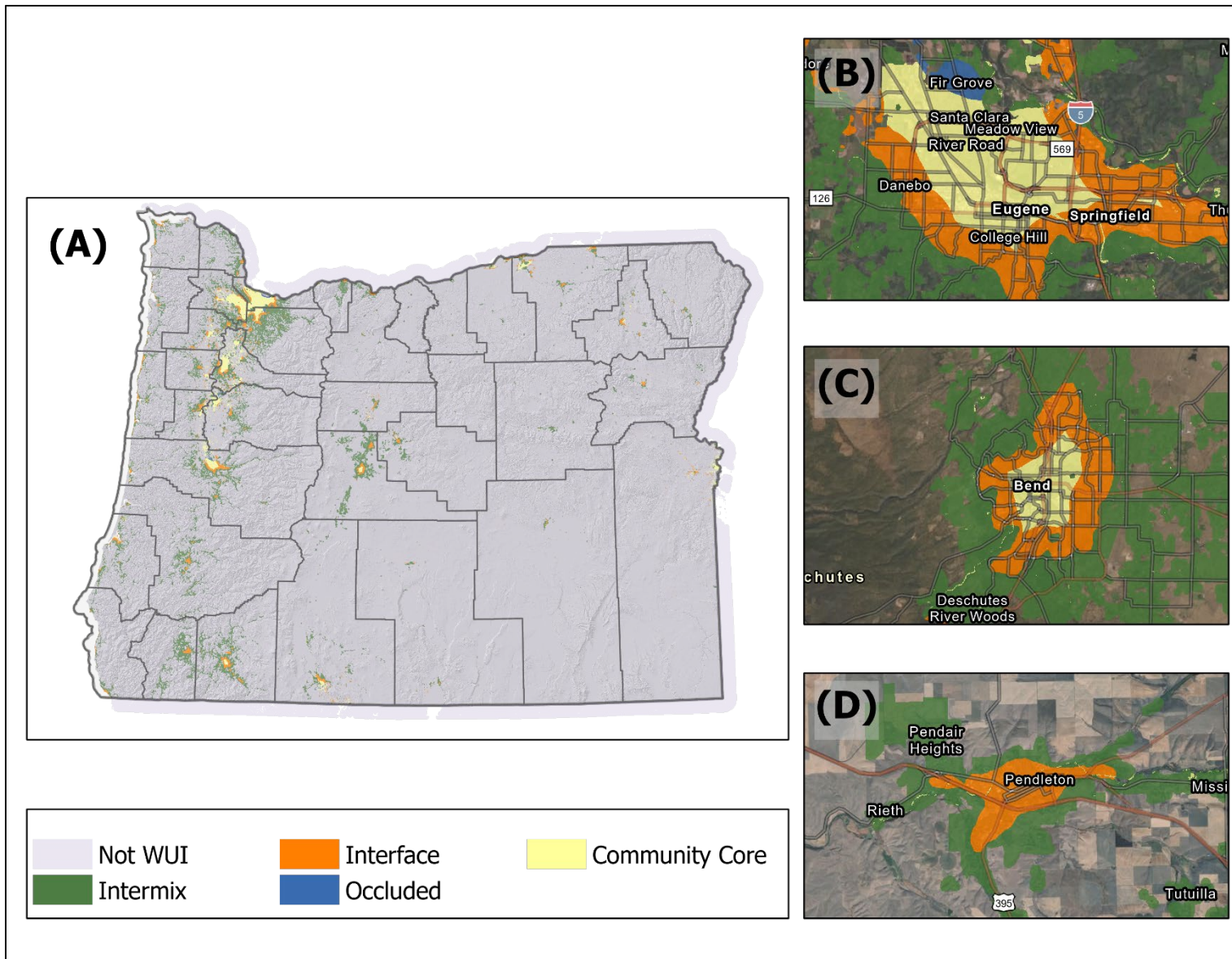


Figure 6. (A) Classified version of the WUI. Areas classified as Intermix, Interface and Occluded are within the WUI. (B) WUI around Eugene includes all three classes as well as an urban core (yellow) that is excluded from the WUI. (C) WUI around Bend includes only Intermix and Interface around a community core. (D) WUI around Pendleton does not have a community core because development is not dense enough to be classified as non-burnable.

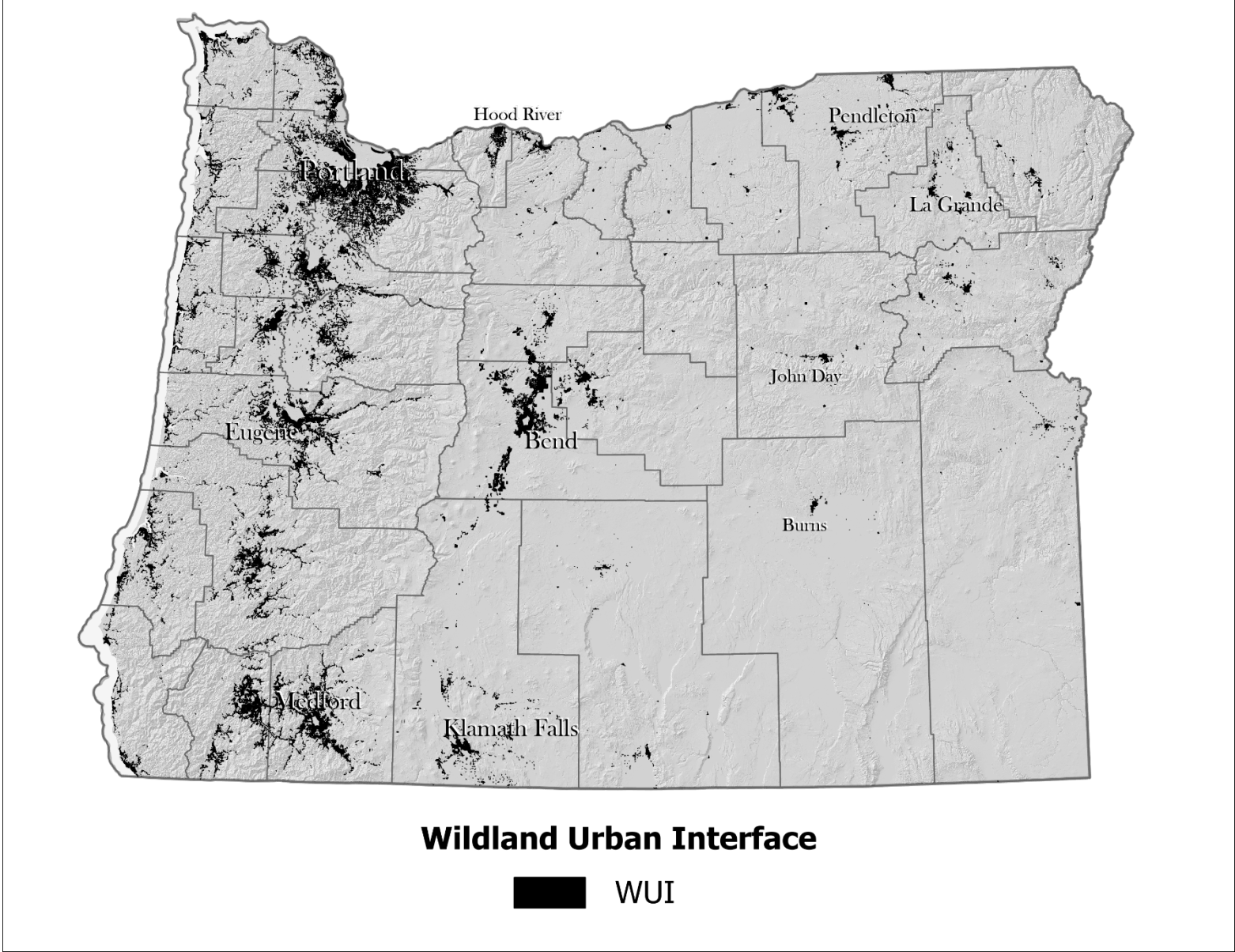


Figure 7. Final map of the WUI across Oregon.

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Frequently Asked Questions

What is the wildland-urban interface (WUI)?

The wildland-urban interface (WUI) refers to the geographic area where structures and other human developments meet or intermingle with vegetative fuels or border up against wildland fuels. SB 762 defines vegetative fuels as any plant that constitutes a wildfire hazard, while wildland fuels are a subset of vegetative fuels that specifically occur in undeveloped areas such as rangelands, timberlands, or wilderness.

Oregon's WUI definitions are consistent with the International Wildland Urban Interface Code and the federal register and was mapped using the most up to date geospatial data and peer-reviewed

How is the WUI map included in the wildfire risk assessment?

The WUI map and map of risk to structures and other human development are two distinct data products developed by OSU through separate processes. The WUI map illustrates where structures and other human development meet or intermingle with vegetation in a way that could facilitate significant damage or loss to structures or other human development. The statewide map of risk to structures and other human development illustrates where wildfire likelihood and potential fire behavior pose the greatest threat to structures and other human development. The two maps will be used in conjunction to identify the properties and communities vulnerable to a disaster to inform risk-based policies, regulation and incentives designed to protect communities.

Why was the WUI classified into three different categories?

Classifying the WUI into intermix, interface and occluded types is consistent with national standards, the International Wildland Urban Interface Code and the federal register.

How does this WUI map differ from other WUI maps of Oregon?

There are numerous maps of WUI for Oregon and the surrounding region. Other WUI maps may differ from the WUI map developed by OSU for SB762 due to alternative methods, different data, or because they were designed for a different purpose. Specifically, many previous WUI maps were based on interpolated census data whereas the WUI map developed by OSU scientists was made using building locations (i.e. Bar-Massada et al., 2013) which have been used to more accurately identify areas where structures are most susceptible to wildfire impacts (Caggiano et al., 2020).

Why are rural areas mapped in the wildland "urban" interface?

Oregon's 2021 SB762 specifically requires a map of the "wildland-urban interface" (WUI) because that term has been adopted by international communities of wildfire, natural hazard, emergency, and land use professionals. However, the word "urban" is misleading. For the purpose of this map,, the WUI refers to *all* places on a landscape where vegetation and structures meet or intermingle, thereby increasing the potential for wildfires to damage or destroy structures. The Rules Advisory Committee developed guidance for the creation of the WUI map based on relevant science, and that guidance was applied objectively to all parts of Oregon by OSU scientists.

Why do neighboring tax lots have different WUI designations?

The WUI map was developed using an objective set of rules and analytical techniques. WUI classifications were influenced by the location of buildings within each tax lot, the density and proximity

of adjacent buildings, as well as the density and proximity of vegetation. The unique setting of the buildings informs whether or not it is in the WUI and its estimated wildfire risk.

When new structures are built, will the map be updated?

Structures and other human development constructed after June 30, 2022 will be incorporated into the WUI map updates. The WUI and structure risk map will be updated at least every five years.

Why were the building footprints simplified to a single footprint per tax lot?

Many tax lots across Oregon have multiple structures, particularly in rural and agricultural areas where a residence is frequently accompanied by barns, garages, storage facilities, etc. If all buildings were included in the analysis then many rural tax lots would be classified as WUI even though there was only a single remote residence.

Where can questions about the wildfire risk map be directed?

Inquiries can be sent to osuwildfirerisk@oregonstate.edu

Glossary

Wildland Urban Interface

The geographic area where structures and other human development meets or intermingles with wildland or vegetative fuels

Structure

A permitted building on a lot that is used as a place where one or more people sleep.

Other human development

Essential facilities (ORS 455.447) that support community functions, public communication, energy and transportation in excess in size 400 square feet.

Burn probability

The probability that a wildfire will burn a specific location over a specified period of time. The SB762 risk map presents annual burn probability. Burn probability is usually expressed as a value between 0 and 1.

Fire Intensity

The amount of energy produced at the flaming front of a fire. Fire intensity is frequently expressed as flame length, where longer flame lengths indicate greater intensity.

Flame Length

The length of the flame measured at the front of the fire. Flame length is used as a measurement of intensity and is estimated from wildfire behavior models.

Wildfire Risk

The magnitude of expected annual damage to structures and other human development at a specific location.

Susceptibility

The propensity of a structure or other human development to experience damage as a result of burning at a given level of wildfire intensity.

Wildfire intensity

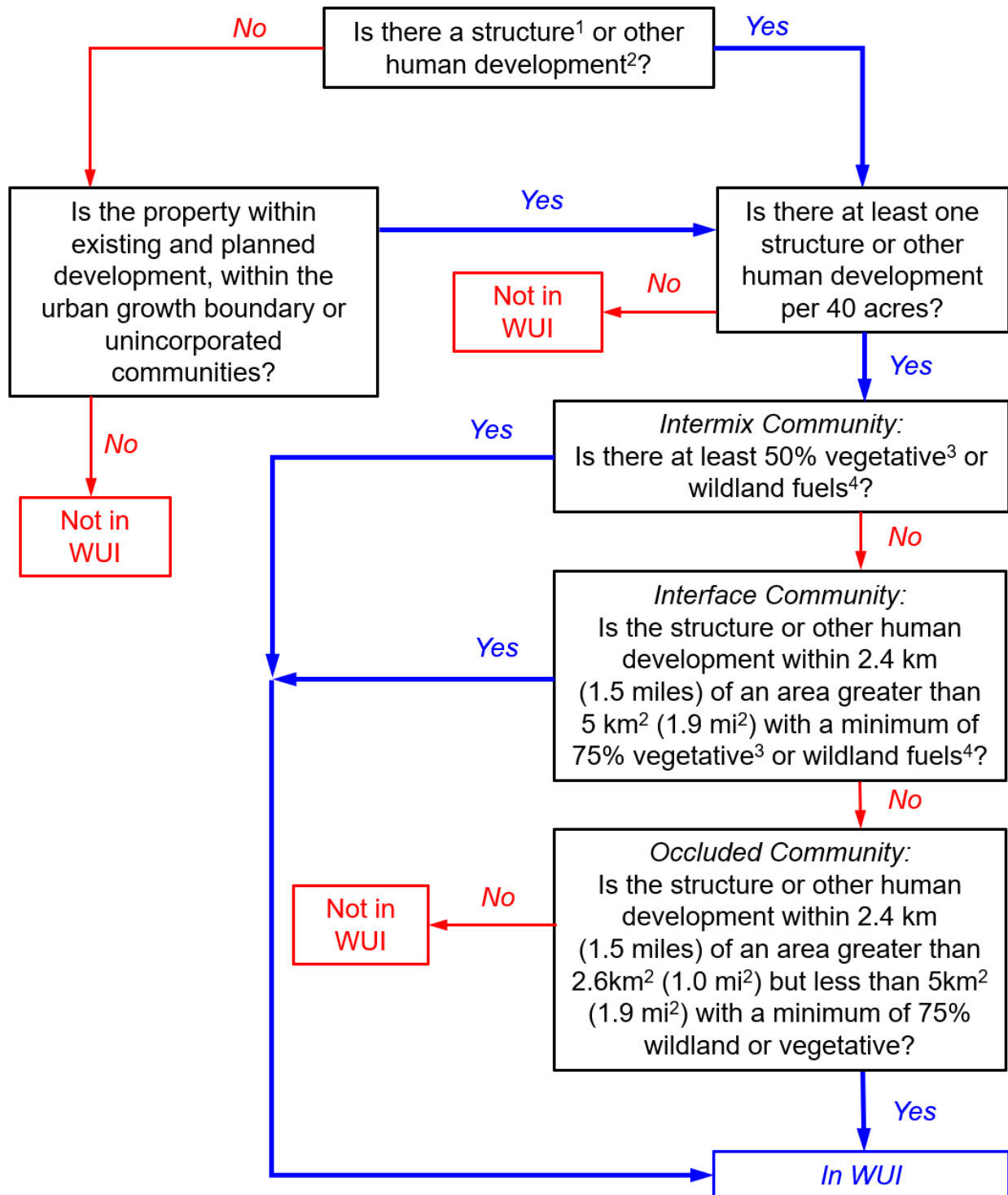
The rate of energy release of a wildfire at a point on a fire perimeter, typically measured as flame length.

Building footprint

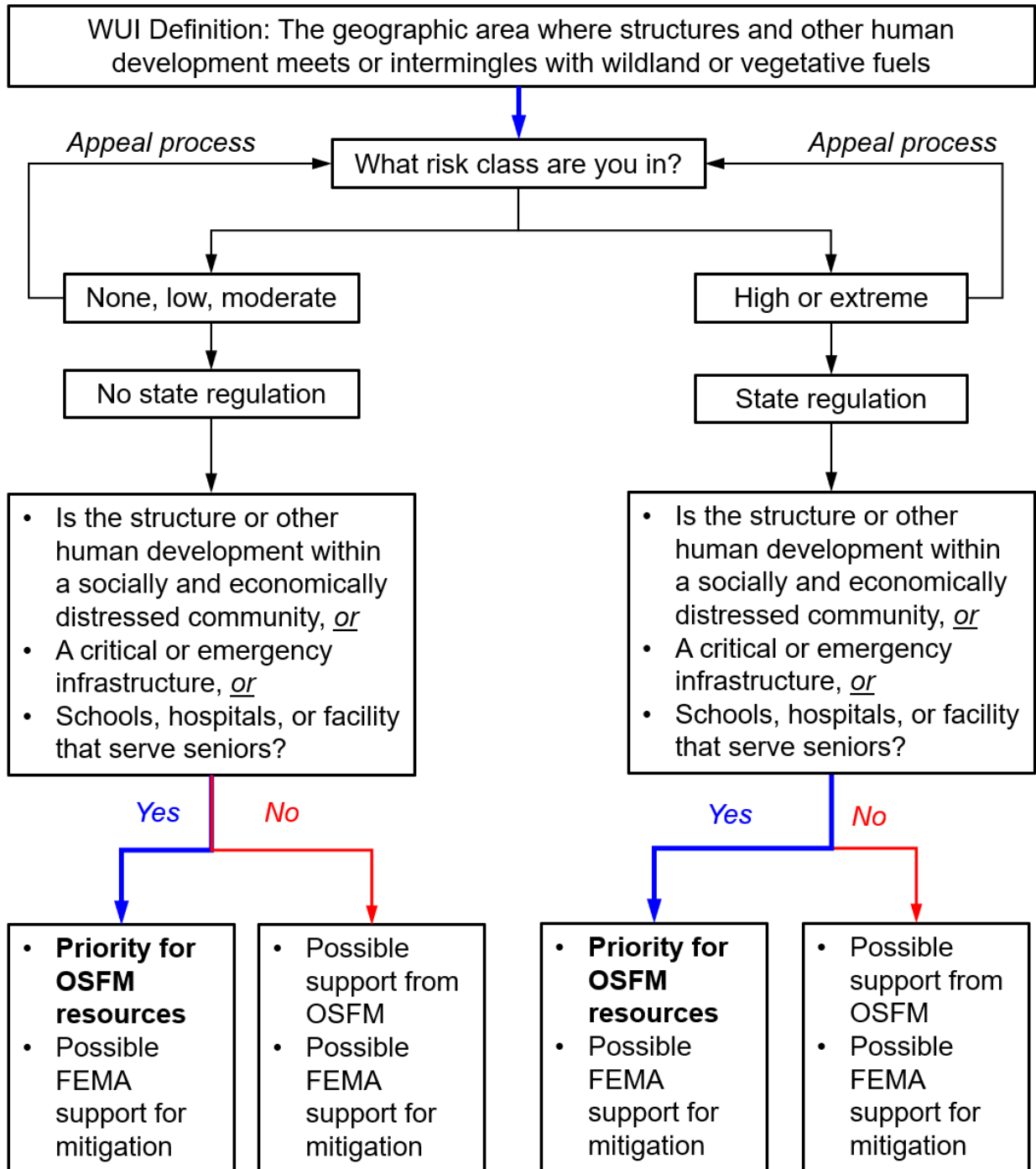
A digital representation of a structure or other human development derived from satellite images.

Appendix A.

Step One: Map the Wildland Urban Interface (WUI)



Step Two: For areas within the WUI, use the statewide wildfire risk map to characterize the wildfire risk and identify properties that are in the High and Extreme risk categories. Use the social vulnerability map to identify communities for targeted risk reduction investments.



Appendix B.

The definition of wildland urban interface (WUI)⁸ adopted by the SB762 Rules Advisory Committee (RAC) requires the identification of both structures⁹ and other human development¹⁰. In order to map the WUI, scientists referred to the Statewide Building Footprints of Oregon¹¹ data issued by the Oregon Dept. of Geology and Mining Industries. The following datasets were combined to represent other human development.

Accessed from the Interagency Fuel Treatment Decision Support Center¹²

Communication towers

Electric substations

Power plants

Access from Homeland Security's online data portal¹³

Hospitals

Fire Stations

Shelter system

Local law enforcement

Emergency medical service stations

Public schools

Electric substations

Power plants

Solid waste landfill facilities

Natural gas processing plants

Petroleum ports

Nursing homes

Biodiesel plants

Urgent Care facilities

EMS stations

Colleges and universities / supplemental colleges

Private schools

Wastewater treatment sites

Emergency operation centers

EPA emergency response facility

Port facilities

Childcare centers

Oil and natural gas wells

Natural gas storage facilities

LNG import/export terminals

Public transit centers

Public health departments

State government buildings

⁸ The geographic area where structures and other human development meets or intermingles with wildland or vegetative fuels

⁹ A permitted building on a lot that is used as a place where one or more people sleep.

¹⁰ Essential facilities (ORS 455.447) that support community functions, public communication, energy and transportation in excess in size 400 square feet.

¹¹ Williams, M.C., 2021. Statewide Building Footprints for Oregon, Release 1.0 (No. SBFO-1), Digital Data Series. Oregon Dept. of Geology and Mineral Industries, Portland, OR.

¹² IFTDSS Reference Data: <https://iftdss.firenet.gov/firenetHelp/help/pageHelp/content/10-mapstudio/files/referencelayers.htm>

¹³ Homeland Security: <https://hifld-geoplatform.opendata.arcgis.com/search>