# Wildfire Prevention and Risk Mitigation Exhibit

Cascade Renewable Transmission

*Wasco, Hood River, and Multnomah Counties, Oregon*

December 2025

Prepared for
Cascade Renewable Transmission, LLC

Submitted to
Oregon Energy Facility Siting Council

# Contents



# Tables



# Attachments

# Acronyms

| | |
|---|---|
| °F | degrees Fahrenheit |
| Applicant | Cascade Renewable Transmission (CRT) |
| BPA | Bonneville Power Administration |
| CWPP | Community Wildfire Protection Plan |
| FM | fuel model |
| HVAC | high-voltage alternating current |
| HVDC | high-voltage direct current |
| OAR | Oregon Administrative Rules |
| ODF | Oregon Department of Forestry |
| ODOE | Oregon Department of Energy |
| PSA | predictive service area |
| SR 197 | State Route 197 |
| WMP | Wildfire Mitigation Plan |
| WUI | wildland urban interface |

# 1 Introduction

This exhibit demonstrates that the Cascade Renewable Transmission Project (Project) meets the requirements of Oregon Administrative Rule (OAR) 345-022-0115 related to wildfire prevention and risk mitigation. This exhibit provides an overview of potential wildfire risks from the Project and outlines recommended steps to mitigate the potential risk. Taking into account mitigation, this exhibit demonstrates that Project design, construction, and operation is not likely to result in significant adverse impacts related to wildfires.

Cascade Renewable Transmission, LLC (CRT; Applicant), is proposing construction of a buried cable transmission line between the Big Eddy substation (The Dalles, Oregon) and the Harborton substation (Portland, Oregon). The Project would facilitate the transfer of up to 1,100 megawatts (MW) of renewable energy from east of the Cascades to energy load centers located west of the Cascades in Oregon and Washington. Two converter stations would be built near the project termini that convert between high-voltage alternating current (HVAC) to high-voltage direct current (HVDC). The aboveground Project components in Oregon include the converter stations, which would be located in The Dalles, Wasco County, Oregon, and in Portland, Multnomah County, Oregon. The permanent disturbance of each converter station would be approximately 5 acres and an additional 5 acres would be temporarily disturbed while used for a materials laydown area. These converter stations are located in industrially zoned areas and are consistent with local zoning. In this section, the Applicant provides an overview of potential wildfire risks within the analysis area, as described in Section 2.

In accordance with OAR 345-001-0010(35)(c) and the Project Order, the analysis area for this exhibit includes areas within and extending 0.5 mile from portions of the site boundary containing out-of-river transmission line segments and facility components, including the eastern converter station, the short segment of overhead 500-kilovolt transmission line connecting the eastern converter station to the Big Eddy substation, and the western converter station, as shown on Figure 1 (in Section 6). The site boundary is defined in detail in the Background Information Exhibit. Other out-of-river components include the HVDC and HVAC transmission cables that extend from the converter stations to the edge of the Columbia and Willamette rivers; however, because these transmission cables are in conduits and encased in concrete underground, they do not pose a wildfire risk. Therefore, the wildfire analysis area is focused on the 0.5 mile from the aboveground components.

The Applicant prepared the Project's Draft Wildfire Mitigation Plans (WMPs) for construction and operations, provided as Attachment 1a and 1b, respectively, to meet OAR 345-022-0115(1)(b). The WMPs follow the Oregon Department of Energy (ODOE) WMP templates for both the construction and operation templates.

The Wasco County Community Wildfire Protection Plan (CWPP) and Multnomah County CWPP are countywide efforts of various agencies and local jurisdictions responsible for wildfire suppression and protection to reduce wildland fire risk to communities and the environment (Wasco County 2024, Multnomah County 2023). Both of these CWPP's have been approved by the Oregon Department of Forestry (ODF), which is the state regulatory body for local government CWPPs. Stakeholder groups for the counties have agreed to and endorsed both CWPPs.

The stakeholder group for the Wasco County CWPP includes:

- Wasco County Board of Commissioners
- District Forester of the Central Oregon District for Oregon Department of Forestry (ODF)
- Wasco County Fire Defense Board Chief
- South Wasco County Fire Defense Chief

The stakeholder group for the Multnomah County CWPP includes:

- Bonneville Power Administration (BPA)
- Cascade Locks Fire Department
- Corbett Fire District
- East Multnomah Soil and Water Conservation District
- Gresham Natural Resources Program
- Lake Oswego Fire Department
- Oregon Metro Parks and Natural Areas
- Multnomah County Land Use Planning Division
- Multnomah County Office of Sustainability
- Multnomah County Transportation Division
- Oregon State Parks
- PacifiCorp
- Portland General Electric
- Portland Bureau of Emergency Management
- Portland Bureau of Development Services
- Portland Bureau of Planning and Sustainability
- Portland Office of Equity and Human Rights
- Portland State University
- Scappoose Fire District
- Tualatin Valley Fire and Rescue
- United States Forest Service

As the Application for Site Certificate for the Project had not been determined complete at the time of the effective date of this rule (July 29, 2022), OAR 345-022-0115(3) does not apply either; therefore, the standard under OAR 345-022-0115(1) applies to the Project.

# 2 Wildfire Risk (OAR 345-022-0115)(1)(a)

*(1) To issue a site certificate, the Council must find that:*

*(a) The applicant has adequately characterized wildfire risk within the analysis area using current data from reputable sources, by identifying:*

**RESPONSE**

## 2.1 Baseline Fire Risk

*(A) Baseline wildfire risk, based on factors that are expected to remain fixed for multiple years, including but not limited to topography, vegetation, existing infrastructure, and climate;*

The baseline wildfire risk within the analysis area is moderate in the area of the eastern converter station, which is predominantly urban with some low growing shrub and grass communities in the portion of the analysis area zoned for agricultural use, and topography is relatively flat. The existing infrastructure is low to non-burnable, irrigated cultivated crops such as dryland wheat and cherries, and climate is moderately continental semi-arid.

The baseline wildfire risk is low in the area of the western converter station, which is primarily covered by urban infrastructure and water, and topography is relatively flat. The existing infrastructure is very low to non-burnable, minimal agriculture, and climate is temperate oceanic.

### 2.1.1 Topography

The eastern analysis area is approximately 152 acres. The wildfire analysis area extends 0.5 mile around the eastern converter station, at the east end of the city of The Dalles, totaling approximately 3,440 acres (Figure 1 in Section 6). Elevations within the eastern wildfire analysis area range from about 75 feet above mean sea level at the Columbia River to 940 feet above mean sea level along the hills near the Big Eddy Substation.

The western analysis area is approximately 328 acres. The wildfire analysis area extends from 0.5 mile from portions of the site boundary containing out-of-river components in the industrial area of north Portland, totaling about 5,478 acres. Elevations within the western wildfire analysis area range from about 10 feet above mean sea level at the Columbia River to 710 feet above mean sea level in Forest Park.

The majority of both the eastern and western site boundaries and wildfire analysis areas are generally flat, with 85.6 percent of the eastern analysis area and 94 percent of the western analysis area having slopes less than 12 degrees (Table 1, below, and Figure 2 in Section 6). The few steeper areas in the eastern analysis area are on the hills north and south of the eastern converter station, and eastward toward the City of The Dalles. The steeper areas in the western analysis area are at the far west end in Forest Park. Potential wildfires would travel more quickly on steeper slopes and more slowly on the flatter portions of land within the wildfire analysis areas.

**Table 1. Slopes in Eastern and Western Analysis Areas.**

| Analysis Area | Slope (degrees) | Site Boundary (%) | Wildfire Analysis Area (%) |
|---|---|---|---|
| Eastern Analysis Area | 0-3 | 38.3% | 35.8% |
| | 3-7 | 30.3% | 23.1% |
| | 7-12 | 17.9% | 18.7% |
| | 12-20 | 7.5% | 12.7% |
| | 20-30 | 4.5% | 6.4% |
| | 30-40 | 1.3% | 2.5% |
| | 40-90 | <1% | <1% |
| Western Analysis Area | 0-3 | 90.1% | 90.7% |
| | 3-7 | 4.0% | 4.8% |
| | 7-12 | <1% | 1.9% |
| | 12-20 | 0.1% | <1% |
| | 20-30 | <1% | 1.1% |
| | 30-40 | <1% | <1% |
| | 40-90 | <1% | <1% |

### 2.1.2 Vegetation

As discussed in the Fish and Wildlife Habitat Exhibit, temporary and permanent impacts would occur within Category 5 and 6 habitats within the analysis area because the on land portion is mostly in developed industrial or residential lands. There are patches of shrub and grasslands in the eastern analysis area and some riparian areas and forests in the western analysis area. Agriculture, in pasture/hay or croplands, can be found within both analysis areas (see the Fish and Wildlife Habitat Exhibit for further details, Table 4 and Figure 1).

Using data from the Oregon CWPP Planning Tool (ODF and USFS 2018), vegetation types can be categorized into broad fuel model groups that are used in fire behavior modeling by tracking vegetation responsible for fire spread. Fuel model groups are broad categories of burnable fuels (grass, shrub, timber, timber litter, timber understory, and slash/blowdown) based on descriptions of living and dead surface vegetation that represent distinct fuel types, size classes, and load distributions (amounts).

The fuel model data indicate that most of the vegetation within the eastern wildfire analysis area is urban/suburban lands (Fuel Model [FM] 91), low load dry climate grass (FM 102), and moderate load dry climate grass-shrub communities (FM 122). FM 91 is located mostly around the City of The Dalles, whereas the other fuel models are in the central and eastern portions of the wildfire analysis area, around State Route 197 (SR 197), Columbia View Drive, and Big Eddy substation (Table 2, below, and Figure 3 in Section 6).

Fuel models found in smaller quantities in the eastern wildfire analysis area include FM 98 (open water), FM 101 (short grasses), and FM 121 (short grasses and shrubs less than 1 foot tall). All other fuel models are found in less than 1 percent of the eastern wildfire analysis area. Open water is considered nonburnable. The primary carrier of fire for FM 101 is sparse or discontinuous grass with some dead fuels, with both fire spread and flame length being low. The primary carriers of fire for FM 121 are both grasses and shrubs, although shrubs are less than 1 foot tall. The anticipated fire spread rate is moderate, but the flame length is low (NWCG 2024). FM 101 and FM 121 occur in scattered patches near Interstate 84 and Riverfront Park beside the Columbia River.

Within the western wildfire analysis area, most vegetation is also FM 91, but also open water (FM 98) (Table 2, below, and Figure 3 in Section 6). In the western analysis area, there is a small amount of FM 102, which has a primary fire carrier of grass where the fuel bed is more continuous. The primary carriers of fire for FM 122 are grasses and shrubs, with shrubs less than 3 feet tall and grass load is moderate. The other dominant fuel model types in both analysis areas (FM 91 and FM 98) are considered nonburnable, meaning there is no fuel load and fire will not spread (NWCG 2024). While this is true on open water, it is possible that fire could spread in urban/suburban areas by jumping from structure to structure or vegetated lawns. However, fire spread would be slower than in open, undeveloped areas, and depending on the materials with which the structure is built, may not support fire spread.

In the western analysis area, other fuel model groups that occur in more than 1 percent of the area include FM 101, FM 102, FM 161 (grasses and/or shrubs with litter), and FM 162 (shrubs and litter). The primary fire carriers for FM 161 are low load grasses or shrubs with litter with a low spread rate and flame length. The primary fire carrier for FM 162 is litter with some shrubs, having a moderate rate of spread and low flame length (NWCG 2024). FM 101, FM 102, and FM 161 are mostly found on Hayden Island, Smith and Bybee Wetlands Natural Area, around the Columbia River Slough, and near the Harborton substation. FM 162 is mostly at the western end in Forest Park.

**Table 2. Fuel model numbers present within the Eastern and Western Analysis Areas.**

| Analysis Area | Fuel Model Number | Fuel Model Name | Site Boundary (%) | Wildfire Analysis Area (%) |
|---|---|---|---|---|
| Eastern Analysis Area | 91 | Urban/suburban | 48% | 31% |
| | 93 | Agricultural field | 0% | <1% |
| | 98 | Open water | <1% | 7% |
| | 101 | Short, sparse dry climate grass | 15% | 9% |
| | 102 | Low load dry climate grass | 18% | 25% |
| | 121 | Low load dry climate grass-shrub | 5% | 3% |
| | 122 | Moderate load dry climate grass-shrub | 11% | 16% |
| | 141 | Low load dry climate shrub | 0% | <1% |
| | 142 | Moderate load dry climate shrub | <1% | <1% |
| | 143 | Moderate load humid climate shrub | 0% | <1% |
| | 144 | Low load humid climate timber-shrub | 0% | <1% |
| | 161 | Light load dry climate timber-grass-shrub | 0% | <1% |
| | 165 | Very high load dry climate timber-shrub | 0% | <1% |
| | 182 | Low load broadleaf litter | <1% | <1% |
| | 183 | Moderate load conifer litter | 2% | 2% |
| | 184 | Small downed logs | 0% | <1% |
| | 185 | High load conifer litter | <1% | 2% |
| | 186 | Moderate load broadleaf litter | <1% | 2% |
| | 188 | Long-needle litter | 0% | <1% |
| Western Analysis Area | 91 | Urban/suburban | 47% | 50% |
| | 93 | Agricultural field | <1% | <1% |
| | 98 | Open water | 31% | 29% |
| | 99 | Bare ground | 1% | <1% |
| | 101 | Short, sparse dry climate grass | 3% | 1% |
| | 102 | Low load dry climate grass | 7% | 7% |
| | 121 | Low load dry climate grass-shrub | <1% | <1% |
| | 122 | Moderate load dry climate grass-shrub | 2% | <1% |

| Analysis Area | Fuel Model Number | Fuel Model Name | Site Boundary (%) | Wildfire Analysis Area (%) |
|---|---|---|---|---|
| | 142 | Moderate load dry climate shrub | 0% | <1% |
| | 161 | Light load dry climate timber-grass-shrub | 6% | 6% |
| | 162 | Moderate load humid climate timber-shrub | <1% | 3% |
| | 165 | Very high load dry climate timber-shrub | <1% | <1% |
| | 182 | Low load broadleaf litter | 0% | <1% |
| | 183 | Moderate load conifer litter | <1% | <1% |
| | 185 | High load conifer litter | <1% | <1% |
| | 186 | Moderate load broadleaf litter | 0% | <1% |
| | 188 | Long-needle litter | <1% | <1% |
| | 189 | Very high load broadleaf litter | <1% | 1% |

The eastern wildfire analysis area is located in the Columbia Plateau Ecoregion, where the typical fire regimes of the grasslands and steppes are characterized by a fire return interval (the number of years expected between fires) of 40 to 81 years (USFS 2012). The western wildfire analysis area, in the Willamette Valley Ecoregion, has a wider return interval due to climatic variations. In Multnomah County, the modeled fire regime return interval is 35 to 200+ years, depending on the vegetation fuel group (Multnomah County 2023).

### 2.1.3 Existing Infrastructure

Within the eastern site boundary, existing infrastructure includes roadways. Within the western site boundary, existing infrastructure includes the Harborton substation, located across a highway from Forest Park, and bordered on the opposite side by the Columbia River. Both the eastern and western wildfire analysis areas include pipelines, utility distribution lines, railroads, highways, interstates, city streets, residential structures, commercial buildings, industrial facilities, agricultural structures, and other electrical grid infrastructure. Additional existing infrastructure within the eastern analysis area includes BPA Big Eddy substation, BPA Celilo converter station, and other electric utility infrastructure on the grassland hills around The Dalles.

### 2.1.4 Climate

The eastern area has a moderately continental, semi-arid climate. Based on available monthly normal climate data between 1991 and 2020 for the Dufur station, located approximately 9 miles south of the eastern wildfire analysis area, the driest months on average are June, July, August, and September, which have precipitation averages of 0.62, 0.28, 0.24, and 0.44 inches per month, respectively (Table 3; NOAA 2024). These four summer months are also the hottest months with average daily max temperatures of 78.7 degrees Fahrenheit (°F), 88.5°F, 87.9°F, and 79.3°F, respectively (Table 3; NOAA 2024). The total average annual precipitation for the area is 13.5 inches per year, which is indicative of a semi-arid climate (NOAA 2024). Additionally, the area receives approximately 21.5 inches of snow in the winter months, with the coldest month, December, having approximately 8 inches of snowfall, an average daily maximum temperature of 39°F, and an average daily minimum temperature of 27°F (Table 3; NOAA 2024).

The western area has a cooler, wetter climate. Based on available monthly normal climate data between 1991 and 2020 for the Portland International Airport station, located approximately 2.5 miles east of the western wildfire analysis area, the driest months on average are July and August, which have precipitation averages of 0.51 and 0.54 inches, respectively (Table 4; NOAA

2024). These summer months are also the hottest months with average daily max temperatures of 81.9°F and 82.3°F, respectively (Table 4; NOAA 2024). The total average annual precipitation for the area is 37 inches per year. Additionally, the area receives approximately 4 inches of snow in the winter months, with the coldest month, December, having approximately 1 inch of snowfall, an average daily maximum temperature of 47°F, and an average daily minimum temperature of 36°F (Table 4; NOAA 2024). These temperature and precipitation ranges are indicative of a temperate oceanic climate type, characterized by warm, dry summers and cold, wet winters.

**Table 3. Summary of Monthly Normal Temperature and Precipitation at Dufur, Oregon Station (1991 – 2020).**

| Month | Average Daily Maximum Temperature (°F) | Average Daily Minimum Temperature (°F) | Average Temperature (°F) | Average Precipitation (inches) |
|---|---|---|---|---|
| January | 40.5 | 27.2 | 33.8 | 1.91 |
| February | 46.6 | 28.6 | 37.6 | 1.50 |
| March | 55.8 | 31.5 | 43.7 | 1.17 |
| April | 62.8 | 35.6 | 49.2 | 1.07 |
| May | 72.2 | 41.0 | 56.6 | 1.14 |
| June | 78.7 | 45.4 | 62.0 | 0.62 |
| July | 88.5 | 50.6 | 69.6 | 0.28 |
| August | 87.9 | 50.2 | 69.0 | 0.24 |
| September | 79.3 | 44.8 | 62.1 | 0.44 |
| October | 64.0 | 37.3 | 50.6 | 1.15 |
| November | 48.1 | 30.6 | 39.3 | 1.68 |
| December | 39.2 | 26.7 | 32.9 | 2.32 |

Source: Dufur Station, OR US USC00352440 (NOAA 2024)

**Table 4. Summary of Monthly Normal Temperature and Precipitation at Portland International Airport, Oregon (1991 – 2020).**

| Month | Average Daily Maximum Temperature (°F) | Average Daily Minimum Temperature (°F) | Average Temperature (°F) | Average Precipitation (inches) |
|---|---|---|---|---|
| January | 47.5 | 36.2 | 41.9 | 5.03 |
| February | 51.5 | 36.8 | 44.1 | 3.68 |
| March | 56.8 | 39.7 | 48.3 | 3.97 |
| April | 62.0 | 43.7 | 52.8 | 2.89 |
| May | 69.3 | 49.4 | 59.4 | 2.51 |
| June | 74.3 | 54.1 | 64.2 | 1.63 |
| July | 81.9 | 58.5 | 70.2 | 0.51 |
| August | 82.3 | 58.9 | 70.6 | 0.54 |
| September | 76.7 | 54.1 | 65.4 | 1.52 |
| October | 64.4 | 46.7 | 55.6 | 3.42 |
| November | 53.5 | 40.6 | 47.1 | 5.45 |
| December | 46.9 | 36.2 | 41.6 | 5.77 |

Source: Portland International Airport, OR US USW00024229 (NOAA 2024)

### 2.1.5 Burn Probability

Burn probability is the likelihood of a wildfire greater than 250 acres burning a given location, based on wildfire simulation modeling. This is an annual burn probability adjusted for consistency with the historical annual area burned. The burn probability classes range from non-burnable (most non-burnable fuel types such as water, agriculture, or urban) to very high burn probability, which indicates greater than a 1-in-50 chance of a wildfire larger than 250 acres in a single year. Most of the eastern wildfire analysis area has burn probabilities that are either low (≤1-in-10,000) or high (1-in-500 to 1-in-100). The low burn probability areas are in the western half of the wildfire analysis area, in the urban landscape of The Dalles and the Columbia River. The high burn probability areas are in the eastern half of the wildfire analysis area, where the landscape is more open and dominated by grassy slopes.

Approximately 20 percent of the wildfire analysis area ranges between low to high burn probability, with the moderate risk zones transitioning between the west and east portions. The high burn probability area is near the Big Eddy substation and the connecting access roads where the cable would be installed, including Columbia View Drive and SR 197. There is some high burn probability area in the southern portions of the wildfire analysis area in agricultural lands and open fields (Table 5, below, and Figure 4 in Section 6). However, agriculture in these locations is mostly irrigated vineyards or tree orchards, so the burn probability might be lower than estimated in some locations. There are no high-to-very high (1-in-100 to 1-in-50) or very high (1-in-50 to 1-in-25) burn probability areas within the wildfire analysis area.

The western wildfire analysis area has low burn probabilities due to the density of urban development and water. There are no low-to-moderate, moderate, moderate-to-high, high-to-very high, or very high burn probabilities in the western wildfire analysis areas (Figure 4 in Section 6).

**Table 5. Burn probability within Eastern and Western Analysis Areas.**

| Analysis Area | Burn Probability | Site Boundary (%) | Wildfire Analysis Area (%) |
|---|---|---|---|
| Eastern Analysis Area | Low (≤ 1-in-10,000) | 55.02% | 43.73% |
| | Low - Moderate (1-in-10,000 to 1-in-5,000) | 0.31% | 1.16% |
| | Moderate (1-in-5,000 to 1-in-1,000) | 0.51% | 4.28% |
| | Moderate – High (1-in-1,000 to 1-in-500) | 19.91% | 15.04% |
| | High (1-in-500 to 1-in-100) | 31.36% | 35.78% |
| Western Analysis Area | Low (≤ 1-in-10,000) | 100.00% | 100.00% |

## 2.2 Seasonal Fire Risk

*(B) Seasonal wildfire risk, based on factors that are expected to remain fixed for multiple months but may be dynamic throughout the year, including but not limited to, cumulative precipitation and fuel moisture content;*

### RESPONSE

The Applicant evaluated seasonal wildfire risk using factors that are expected to remain fixed for multiple months but may be dynamic throughout the year, including cumulative annual and monthly precipitation, weather advisories that include fuel moisture content data, and an evaluation of average flame length. Average flame length is the average length of flames expected during a fire, given local fuel and weather conditions. There are no historic or active fire locations or perimeters within the eastern or western wildfire analysis areas (ODF and USFS 2018; NIFC 2019, NIFC 2023, NIFC 2024a). Within Wasco County, there were 691 fires that burned a total of 761,799 acres between 2008 and 2018. Approximately 10 percent of these fires were larger than 1,000 acres; most of these fires were human caused (66 percent) and none of the fires were within the wildfire analysis area (Wasco County 2024). The seasonal wildfire risk within the eastern wildfire analysis area is moderate based on the seasonally dry climate, potential for a high rate of fire spread based on average flame length, and low average rainfall during the summer months. Furthermore, the summer months in the eastern wildfire analysis area experience strong winds (up to 30 miles per hour) that last several days, which can increase the rate of fire spread (Wasco County 2024).

Wildfire patterns in Multnomah County are dynamic and typically infrequent due to the wet, cool climate. Typically, larger and more severe wildfires occur in the east side forests, although fires can occur within the City of Portland. Nearly all fires in Multnomah County are caused by humans, with an estimated 1 percent of 11,000 outdoor fires between 2016 and 2020 igniting due to natural causes (Multnomah County 2023). The seasonal wildfire risk within the western wildfire analysis area is low based on the cool, wet climate and low potential for high rate of fire spread based on average flame length. While the western side is seasonally dry during the summer, higher fuel moisture contents and the density of urban and industrial development indicates low probability of fires catching and spreading in the wildfire analysis area.

### 2.2.1 Precipitation

Based on available climate data for the Dufur station, approximately 9 miles south of the eastern wildfire analysis area, the driest months on average include June, July, August, and September, which have averages of 0.62, 0.28, 0.24, and 0.44 inches of precipitation per month, respectively (Table 3; NOAA 2024). All other months have between 1 and 2.5 inches of precipitation per month. These four summer months are also the hottest months with average daily maximum temperatures of 78.7°F, 88.5°F, 87.9°F, and 79.3°F, respectively (Table 3; NOAA 2024). The total average annual precipitation for the area is 13.5 inches per year, which is indicative of a semi-arid climate (NOAA 2024).

Based on available climate data for the Portland International Airport station, approximately 2.5 miles east of the wildfire analysis area, the two driest months on average include July and August, which have 0.51 and 0.54 inches of precipitation a month, respectively (Table 4; NOAA 2024). All other months have between 1 and 6 inches of precipitation per month. These two months are also the hottest months with average daily maximum temperatures of 81.9°F and 82.3°F, respectively (Table 4; NOAA 2024). The total average annual precipitation for the area is about 37 inches per year. These temperature and precipitation ranges are indicative of a temperate oceanic climate type (NOAA 2024).

### 2.2.2 Fuel Moisture Content

Fuel moisture content varies depending on changes in weather (both seasonally and during short periods). Determining exact fuel-moisture values at any time is complicated by both the nature of the fuels and their responses to the environment. The higher the fuel moisture content, the more difficult it is for fires to ignite and spread. Living and dead plants respond differently to weather changes; in particular, the drying and wetting processes of dead plants is strongly affected by weather changes. These moisture contents are influenced by precipitation, air moisture, air and surface temperatures, wind, cloudiness, as well as by fuel factors such as surface to volume ratio, compactness, and arrangement. Fuel moisture content is dynamic throughout the year and throughout the day (USFS 1970). Therefore, current conditions such as precipitation to date, current fuel moisture data, and local weather may increase or decrease seasonal fire risk.

The Northwest Interagency Coordination Center (NWCC) Predictive Services group provides fire weather advisories (such as Red Flag Warnings) and fuel and fire behavior advisories (including fuel status reports and fuel moisture content predictions) for each predictive service area (PSA) in the northwest. PSAs "are geographic areas for which national-level fire weather or fire danger services and products are produced by wildland fire agency meteorologists and intelligence staffs in support of resource allocation and prioritization" (NIFC 2024b). PSAs are intended to support management and planning of wildland fire resources (NIFC 2024c). The eastern wildfire analysis area is located within PSA NW06 and the western wildfire analysis area is located within PSA NW02 (NIFC 2024d).

Different types of vegetation reach the same fuel moisture value at different times. For example, annual grasses may reach a highly flammable stage when broadleaf vegetation is still in prime growth and not in a peak flammable stage (USFS 1970). Additionally, living foliage of evergreen trees and shrubs can burn even with moisture contents up to 100 percent. Fires in the Columbia River Plateau burn in fuel types that are best described as moderate load, dry climate grass-shrub (FM 122), and low load, dry climate grass (FM 102). In FM 122, fire is carried by grasses and shrubs. In FM 102, the primary fuel is grass, with shrub cover not contributing to the flaming front.

The eastern wildfire analysis area is primarily urban (FM 91), grassland (FM 102), and mixed grasses and shrubs (FM 122) (Table 2). FM 91, being nonburnable, does not have a fuel load. While anticipated to not spread fires, developed structures may still burn and spread flames depending on the type of material and proximity to vegetation and other structures. FMs 102 and 122 both have low moisture of extinction, which is a parameter used to model fire behavior that defines the level at which the fuel moisture content within vegetation will not sustain combustion (Kane and Prat-Guitard 2018). The low moisture of extinction, and low fire behavior class, indicates the flame length and spread of these fuel models is low. In the western analysis area, the primary fuel models are urban (FM 91) and water (FM 98), neither of which have moisture of extinction or fire behavior ratings, as they are considered nonburnable Fuel Models.

During construction and operation, fire danger forecasts would be monitored, and Project activities and mitigation measures would be adjusted based on their annual variations under the methods and measures identified in the Emergency Management Plan and WMPs (Attachments 1a and 1b), discussed further below.

### 2.2.3 Flame Length

Average flame length shows the average length of flames expected, given local fuel and weather conditions (ODF and USFS 2018). Flame lengths have potential to exceed the mapped values shown, even under normal weather conditions. Flame length is commonly used as a direct visual indication of fire intensity and is a primary factor to consider for firefighter safety and for gauging potential impacts to resources and assets. Most of the eastern wildfire analysis area has a modeled average flame length of 0 feet followed by 4 to 8 feet. The western wildfire analysis area has a modeled average flame length of 0 feet (89 percent) and 0 to 4 feet (10 percent) (Table 6, below, and Figure 5 in Section 6; ODF and USFS 2018).

The areas of 4 to 8 feet of average flame length are mostly in the central and eastern portions of the eastern wildfire analysis area, with the areas 4 to 8 feet concentrated in the east and southeast portions of the eastern wildfire analysis area (Table 6, below, and Figure 5 in Section 6; ODF and USFS 2018). These locations correspond to the more sloped locations that are dominated by

FM 101 (grass), FM 102 (grass with some fine dead fuel), and FM 122 (short shrubs with moderate grass load). Some of these locations occur in irrigated orchards and vineyards, which may have lower flame lengths than modeled. The areas modeled as having 0-foot flame lengths generally correspond to developed areas, both urban and industrial, as well as bodies of water. The eastern analysis areas have high portions of 4 to 8 feet of average flame length; consequently, the rate of fire spread can be high. Small discrete areas that have higher average flame lengths of 8 to 11 feet and greater than 11 feet in the eastern wildfire analysis area are mostly around Columbia View Drive.

In the western wildfire analysis area, areas of flame length modeled from 4 to 8 feet correspond to vegetated areas along the Columbia River Slough, in Smith and Bybee Wetlands Natural Area, and on Hayden Island. A small area that has a flame length of 8 to 11 feet and greater than 11 feet in the western analysis area is at the far west edge in Forest Park (Figure 5 in Section 6).

**Table 6. Average flame length in the Eastern and Western Analysis Areas.**

| Analysis Area | Average Flame Length (feet) | Site Boundary (%) | Wildfire Analysis Area (%) |
|---|---|---|---|
| Eastern Analysis Area | 0 | 51% | 41% |
| | > 0–4 | 35% | 29% |
| | 4–8 | 12% | 28% |
| | 8–11 | 1% | 1% |
| | > 11 | 1% | 1% |
| Western Analysis Area | 0 | 85% | 89% |
| | > 0–4 | 15% | 10% |
| | 4–8 | 0% | 1% |
| | 8–11 | 0% | 0% |
| | > 11 | 0% | 0% |

## 2.3 Areas of Heightened Risk and Hazard to Potential Structures

*(C) Areas subject to a heightened risk of wildfire, based on the information provided under paragraphs (A) and (B) of this subsection;*

### RESPONSE

The CWPP Planning Tool uses an analysis layer, called Hazard to Potential Structures, that quantifies areas potentially subject to heightened wildfire risk (Table 7, below, and Figure 6 in Section 6). The analysis layer shows impact levels to structures if they were within 150 meters of a burnable fuel type during a wildfire; these structures are hypothetical and called potential structures in the planning tool. Because these potential structures are hypothetical, this data layer is based on modeled vegetation and not on building construction materials. This data layer ranges from a very low hazard to potential structures, where the fuel in the area is largely non-burnable or very sparse and there is a low potential for loss of a structure, to a very high hazard to potential structures, where if a fire ignites nearby, there is a high potential for loss of a residence or a structure (Gilbertson-Day et al. 2018).

The hazard to potential structures within the eastern wildfire analysis area ranges from very low-to-moderate impacts (Figure 6 in Section 6). The areas of moderate impact to potential structures are in the middle to east portion of the eastern wildfire analysis area. As discussed in Section 2.1.2, these areas contain grasses, shrubs, and litter with predicted fire spread and flame lengths ranging from low to moderate. The small areas of high-to-very high impact to potential structures are scattered throughout this section of the analysis area, but mostly near Columbia View Drive or SR 197.

The hazard to potential structures within the western wildfire analysis area ranges from very low-to-low impact (Table 7). Most of the western analysis area is very low, with few patches of low impact to potential structures in Smith and Bybee Wetlands, Hayden Island, and Forest Park. The fuel models in these locations are areas with low to moderate litter load and may have grasses, shrubs, and a small tree understory. The predicted fire spread and flame length of these fuel models ranges from low to moderate. The remainder of the western wildfire analysis area is composed of non-burnable to very low potential hazard to structures, as most of the analysis area is dominated by human development or water.

Potential impacts to existing infrastructure within analysis areas include distribution lines, roads, residential structures, agricultural structures, commercial structures, industrial structures, and other electrical grid infrastructure. There are substations at the east (Big Eddy) and west (Harborton) ends of the analysis areas with corresponding transmission lines that intersect the analysis areas.

**Table 7. Potential hazard to structures in the Eastern and Western Analysis Areas.**

| Analysis Area | Potential Impact to Structures | Site Boundary (%) | Wildfire Analysis Area (%) |
|---|---|---|---|
| Eastern Analysis Area | Very High | 0% | 0% |
| | High | 2% | 3% |
| | Moderate | 11% | 26% |
| | Low | 45% | 35% |
| | Non-burnable/Very Low | 42% | 35% |
| Western Analysis Area | Very High | 0% | 0% |
| | High | 0% | 0% |
| | Moderate | 0% | 1% |
| | Low | 18% | 12% |
| | Non-burnable/Very Low | 82% | 84% |

According to the Wasco County CWPP, there are 10 communities at risk from wildland urban interface (WUI) fires in Wasco County. WUI considers the density of structures and wildland vegetation in an area to determine where wildfires that ignite in wildlands could cause adverse impacts to the community. These areas are at high risk due to, but not limited to, high rates of burn probability, high hazard to potential structures, moderate to high ignition risk rating, and a high wildfire risk (Wasco County 2024). These communities are Mosier, Rowena, Seven Mile, Mill Creek, Sportsman's Paradise, Rail Hollow, Friend, Sportsman's Park, Pine Hollow, and Wamic. Only Seven Mile intersects the eastern analysis area, occurring within and adjacent to The Dalles. Within the eastern wildfire analysis area, this high risk WUI community occurs along SR 197 and the riverfront area of the Columbia River.

According to the Multnomah County CWPP, the western analysis area has a low WUI hazard rating. While this indicates that the area may be susceptible to wildfires impacting local communities, the potential impacts are considered to be low (Multnomah County 2023).

## 2.4 High-Fire Consequence Areas and Overall Wildfire Risk

*(D) High-fire consequence areas, including but not limited to areas containing residences, critical infrastructure, recreation opportunities, timber and agricultural resources, and fire-sensitive wildlife habitat; and*

### RESPONSE

The CWPP data on overall wildfire risk (Figure 7 in Section 6) are used to identify high-fire consequence areas (ODF and USFS 2018). Based on the Layer Descriptions and Values spreadsheet attached to the Pacific Northwest Quantitative Wildfire Risk Assessment (PNRA) report (Gilbertson-Day et al. 2018), overall wildfire risk is the product of the likelihood and consequence of wildfire on all mapped highly valued resources and assets combined: critical infrastructure, developed recreation, housing unit density, seed orchards, sawmills, historic structures, timber, municipal watersheds, vegetation condition, and terrestrial and aquatic wildlife habitat (CBI 2020). Risk ratings range from very high where many resources are vulnerable, to beneficial, where fires may improve resources such as timber stands or wildlife habitat (CBI 2020). The percent of the site boundary that falls into each fire risk rating is identified in Table 8 and displayed on Figure 7 (in Section 6).

Areas of low wildfire risk in the eastern analysis area are primarily in the central to east portions of the analysis area, where there is less development and more shrubs, grasses, and litter. Areas of moderate to high wildfire risk are in the central part of the analysis area, with short grasses and moderate load of broadleaf litter. This section includes residential areas where people may plant broadleaves in their gardens as well as agricultural areas. There is less than one acre of high wildlife risk within the site boundary, with about 113 acres of high risk within the entire eastern wildfire analysis area. These areas of high risk occur adjacent to areas of moderate risk, in the residential and agricultural areas east of The Dalles, between the city and the Big Eddy Substation. The high wildfire risk within the site boundary occurs where the cable would be buried along Highway 197. There are about 11 acres of very high wildfire risk within the eastern wildfire analysis area, but none occur within the site boundary where work would occur. The areas of very high wildfire risk occur in small patches in the same areas as the high and moderate wildfire risk, primarily in the larger agricultural fields (Figure 7 in Section 6).

In the western analysis area, locations of low wildfire risk are near the banks of the Columbia River Slough, on Hayden Island, Smith and Bybee Wetlands Natural Area, and Forest Park. These areas have higher coverage of grasses, shrubs, litter, and in some areas, a tree understory that could increase the risk of wildfires in these locations. However, most of the western analysis area has a very low overall wildfire risk, as it is primarily in an industrial and developed area.

**Table 8. Overall wildfire risk in the Eastern and Western Analysis Areas.**

| Analysis Area | Risk | Site Boundary (%) | Wildfire Analysis Area (%) |
|---|---|---|---|
| Eastern Analysis Area | Very High | 0% | <1% |
| | High | <1% | 3% |
| | Moderate | 23% | 20% |
| | Low | 22% | 29% |
| | Non-Burnable/Very Low | 55% | 48% |
| Western Analysis Area | Low | 21% | 18% |
| | Non-Burnable/Very Low | 79% | 82% |

## 2.5 Methodology

*(E) All data sources and methods used to model and identify risks and areas under paragraphs (A) through (D) of this subsection.*

**RESPONSE**

Data from the Oregon CWPP Planning Tool was used for the analyses provided in response to OAR 345-022-0115(1)(a) (ODF and USFS 2018). The statewide wildfire risk map (that was released on June 30, 2022, as an outcome of Senate Bill 762) was developed and published with the intent to be updated and maintained per requirements under Senate Bill 762 and associated administrative rules. The map shows the assigned risk classification (extreme, high, moderate, low and no risk) for every tax lot in the state. For those tax lots that are both within the WUI and classified as at high or extreme risk, ODF will send the owners written notification and those owners may be subject to future changes to defensible space and home building codes. However, as of August 4, 2022, the statewide wildfire risk map was temporarily withdrawn for further refinement. The Oregon Explorer's data presented are from the 2018 Quantitative Wildfire Risk Assessment. The CWPP Planning Tool provides a clearinghouse of fire behavior and fire effects data to aid decision makers in charge of reducing wildfire risk in their communities. These data were analyzed within the site boundary and within the wildfire analysis area. The following Oregon CWPP Planning Tool 2018 datasets were used to inform this analysis:

- Slope
- Fuel Models,
- Average Flame Length,
- Burn Probability,
- Hazard to Potential Structures, and
- Overall Wildfire Risk

# 3 Wildfire Mitigation Plans (OAR 345 022-0115(1)(b)

*(b) That the proposed facility will be designed, constructed, and operated in compliance with a Wildfire Mitigation Plan approved by the Council. The Wildfire Mitigation Plan must, at a minimum:*

**RESPONSE**

The Applicant prepared the attached Draft Construction and Operation WMPs (Attachments 1a and 1b), following the ODOE WMP construction and operation templates, to meet applicable standards under OAR 345-022-0115(1)(b), which requires the WMPs to:

*(A) Identify areas within the site boundary that are subject to a heightened risk of wildfire, using current data from reputable sources, and discuss data and methods used in the analysis;*

**RESPONSE**

See Section 3.1 of the Draft WMPs (Attachments 1a and 1b).

*(B) Describe the procedures, standards, and time frames that the applicant will use to inspect facility components and manage vegetation in the areas identified under subsection (a) of this section;*

**RESPONSE**

See Sections 3 of the Draft WMPs (Attachments 1a and 1b ).

*(C) Identify preventative actions and programs that the applicant will carry out to minimize the risk of facility components causing wildfire, including procedures that will be used to adjust operations during periods of heightened wildfire risk;*

**RESPONSE**

See Section 3 of the Draft WMPs (Attachments 1a and 1b ).

*(D) Identify procedures to minimize risks to public health and safety, the health and safety of responders, and damages to resources protected by Council standards in the event that a wildfire occurs at the facility site, regardless of ignition source; and*

**RESPONSE**

See Sections 2 and 3 of the Draft WMPs (Attachments 1a and 1b ).

*(E) Describe methods the applicant will use to ensure that updates of the plan incorporate best practices and emerging technologies to minimize and mitigate wildfire risk.*

See Section 4 of the Draft WMPs (Attachments 1a and 1b ).

# 4 Conclusions

The data reviewed and presented here demonstrate that wildfire risk and consequences of fire in the analysis area are typical for the vegetation type and fire regime encountered in the Columbia Plateau and Willamette Valley ecoregions. Within the analysis area, assets that could currently be impacted include residential structures, commercial structures, industrial structures, agricultural areas, distribution lines, electrical substations, and roads. If a wildfire did ignite near those assets, the assets could be at risk.

During construction, the use of motorized equipment could increase the potential for wildfire risk at the eastern converter station location. The vegetation in the adjacent agricultural areas and undeveloped areas to the north, east, and south of the converter station present the greatest wildfire risk in the project area. To reduce the potential for construction-related fires, the Applicant has prepared a draft fire prevention and suppression plan to ensure that fire prevention and suppression measures are carried out in accordance with federal, state, and local regulations (Attachment 1a). In addition, the site would be cleared and graded prior to work commencing to clear vegetation. By implementing these measures, the Project is not anticipated to increase fire ignitions. During construction, the Applicant, BPA, and PGE will establish and document Joint Operating Procedures which will govern the day-to-day scheduling and coordination of the facility within the BPA and PGE systems. Coordination during wildfire events will be included in the Joint Operating Procedures, which will be based on BPA's then current Wildfire Mitigation Plan; a copy of the most current 2024 plan is appended to the Operations WMP (Attachment 1b). In addition to the Applicant implementing its vegetation management plan, recommendations from NERC's Wildfire Mitigation Reference Guide will be implemented (appended to the Operations WMP).

After construction, more assets such as additional transmission towers, converter stations, and altered vegetation could be in the path of wildfire, and overall risk within the analysis area would increase. However, the short segment of overhead transmission line from the Big Eddy substation to the eastern converter station would use transmission line structures that must meet the requirements of the Public Utility Commission of Oregon Construction Standards and the National Electric Safety Code. Fire hazards causing wildfire ignitions are more prevalent for distribution and lower-voltage transmission lines than for higher-voltage transmission lines similar to those to be used. The proposed steel towers would not burn and are designed to dissipate lightning strikes. The Applicant would test the integrity and grounding and other hardware on a regular basis during scheduled maintenance, thereby minimizing the potential for fire ignitions.

The remainder of the project would be constructed and operated in areas of existing road right-of-way and developed urban areas with little to no risk of wildfire. Other than the short section of overhead line described above, the transmission cable would be buried underground or installed in-river under water.

As outlined in the Background Information Exhibit, the converter stations would be equipped with fire protection systems and equipment in accordance with Oregon Fire Code and municipal codes in Portland and The Dalles. Given the inherent fire safety features of the converter stations, significant demands on fire protection resources are not anticipated.

In the eastern analysis area, it is anticipated that due to primarily low to moderate expected wildfire intensity as measured by average flame length, fuels, weather, and topography, post construction overall fire risk would be moderate. In the western analysis area, it is anticipated that due to primarily very low to low moderate expected wildfire intensity as measured by the same variables, post construction overall fire risk would be low. Therefore, the Energy Facility Siting Council may conclude that the Project will comply with OAR 345-022-0115.

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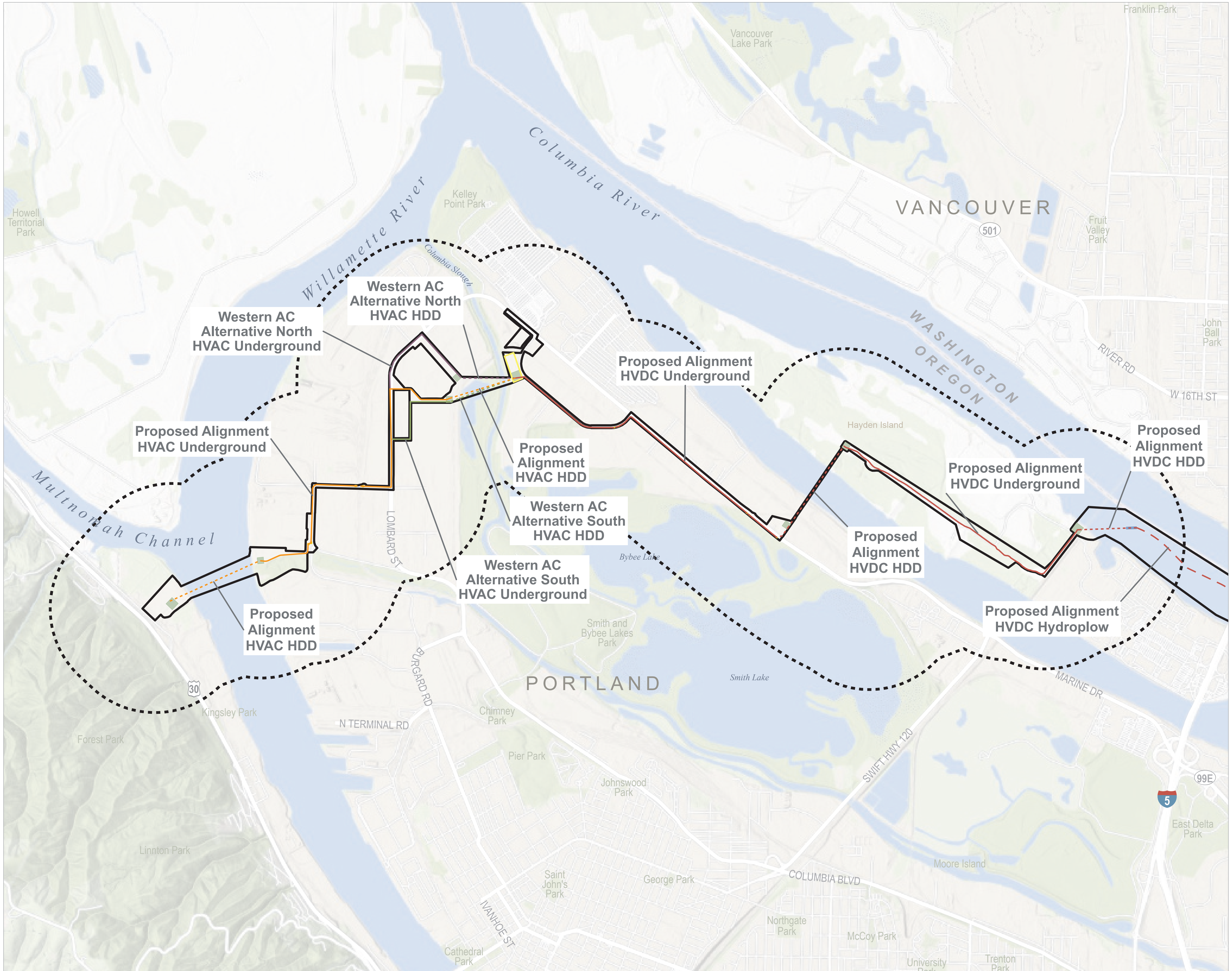
# 6 Figures

# FIGURE 1
# PROJECT OVERVIEW
# PAGE 1 OF 2

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- WESTERN AC ALTERNATIVE NORTH - HVAC UNDERGROUND
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- PROPOSED ALIGNMENT - HVDC HYDROPLOW
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- TEMPORARY HORIZONTAL AUGER BORE (HAB)
- TEMPORARY 3-SIDED WET COFFERDAM
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- STATE BOUNDARY
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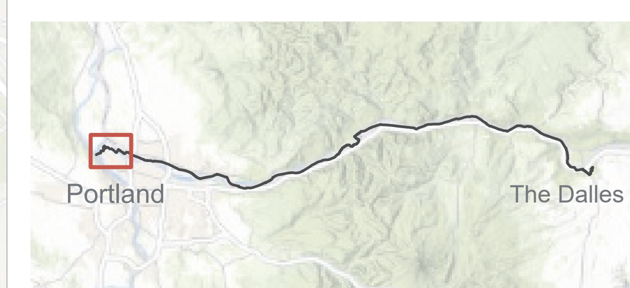


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12/11/2025 NAD 1983 State Plane Oregon North Feet Data Sources: Esri, HDR.

# FIGURE 1
# PROJECT OVERVIEW
# PAGE 2 OF 2

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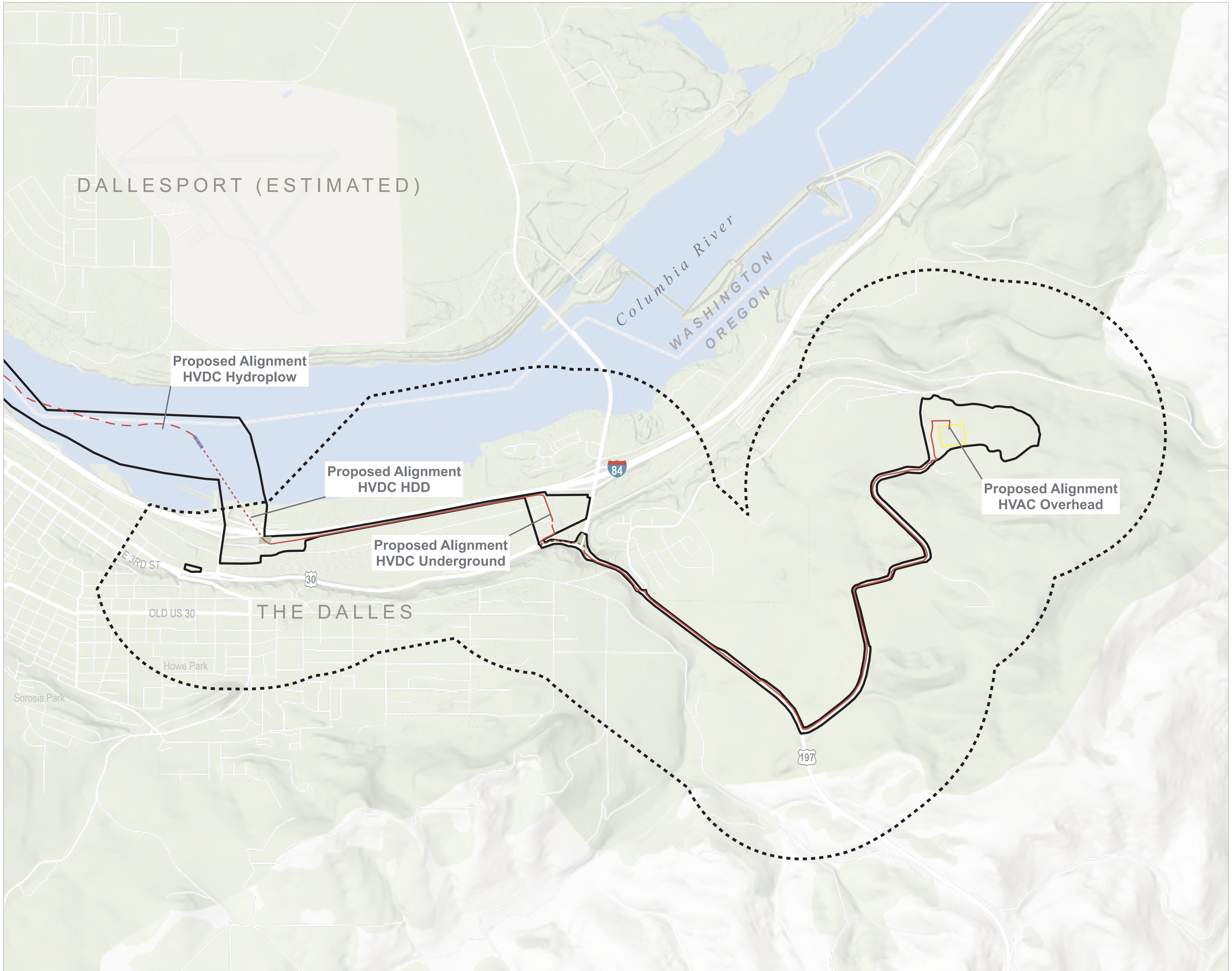


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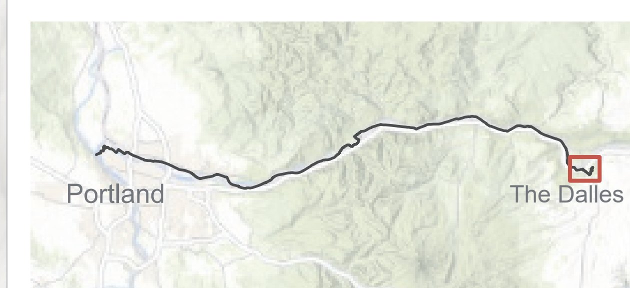


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# FIGURE 2 SLOPES WITHIN THE ANALYSIS AREA PAGE 1 OF 2

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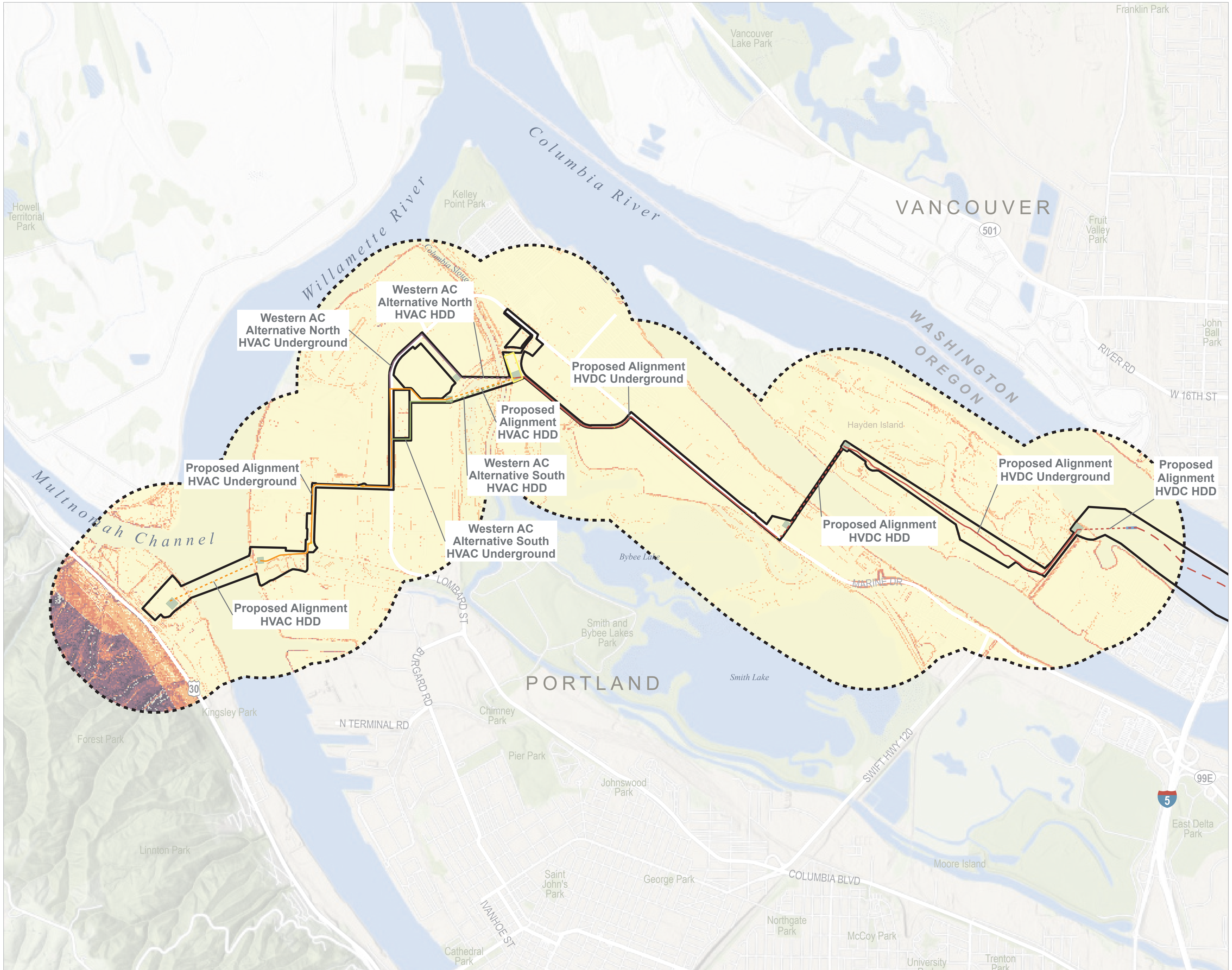


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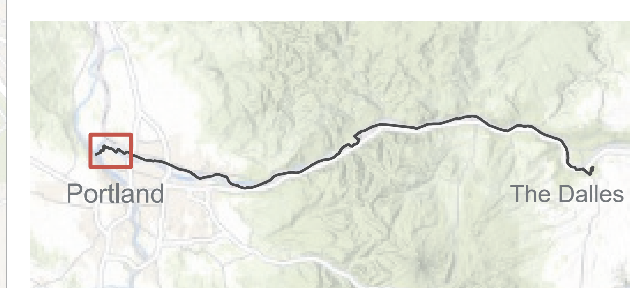
- CONVERTER STATION
- OREGON EFSC SITE BOUNDARY
- ANALYSIS AREA (0.5 MILE BUFFER)

SLOPES (DEGREES)

- 0-3%
- 3-7%
- 7-12%
- 12-20%
- 20-30%
- 30-40%

## CASCADE RENEWABLE TRANSMISSION

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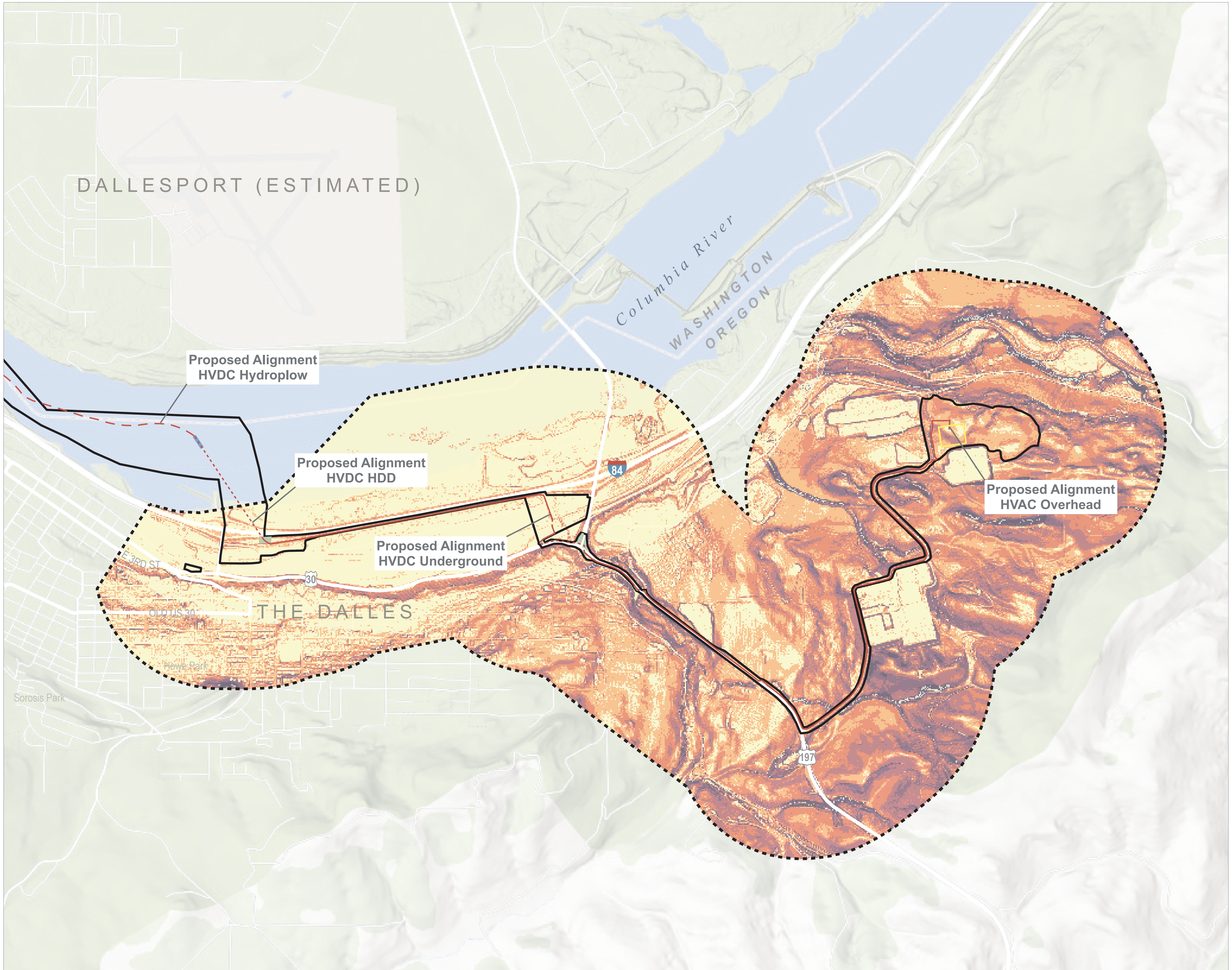


*FOR INFORMATION ONLY - CONCEPT DRAWING*

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- OREGON EFSC SITE BOUNDARY
- ANALYSIS AREA (0.5 MILE BUFFER)

SLOPES (DEGREES)

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| 7-12% | 30-40% |

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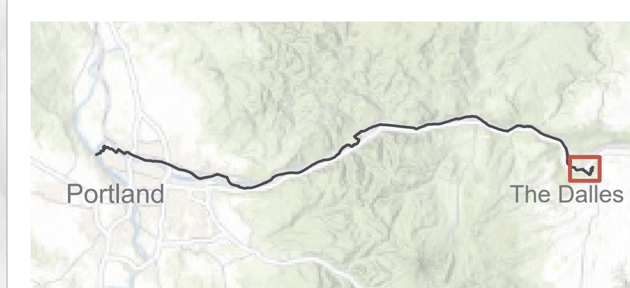


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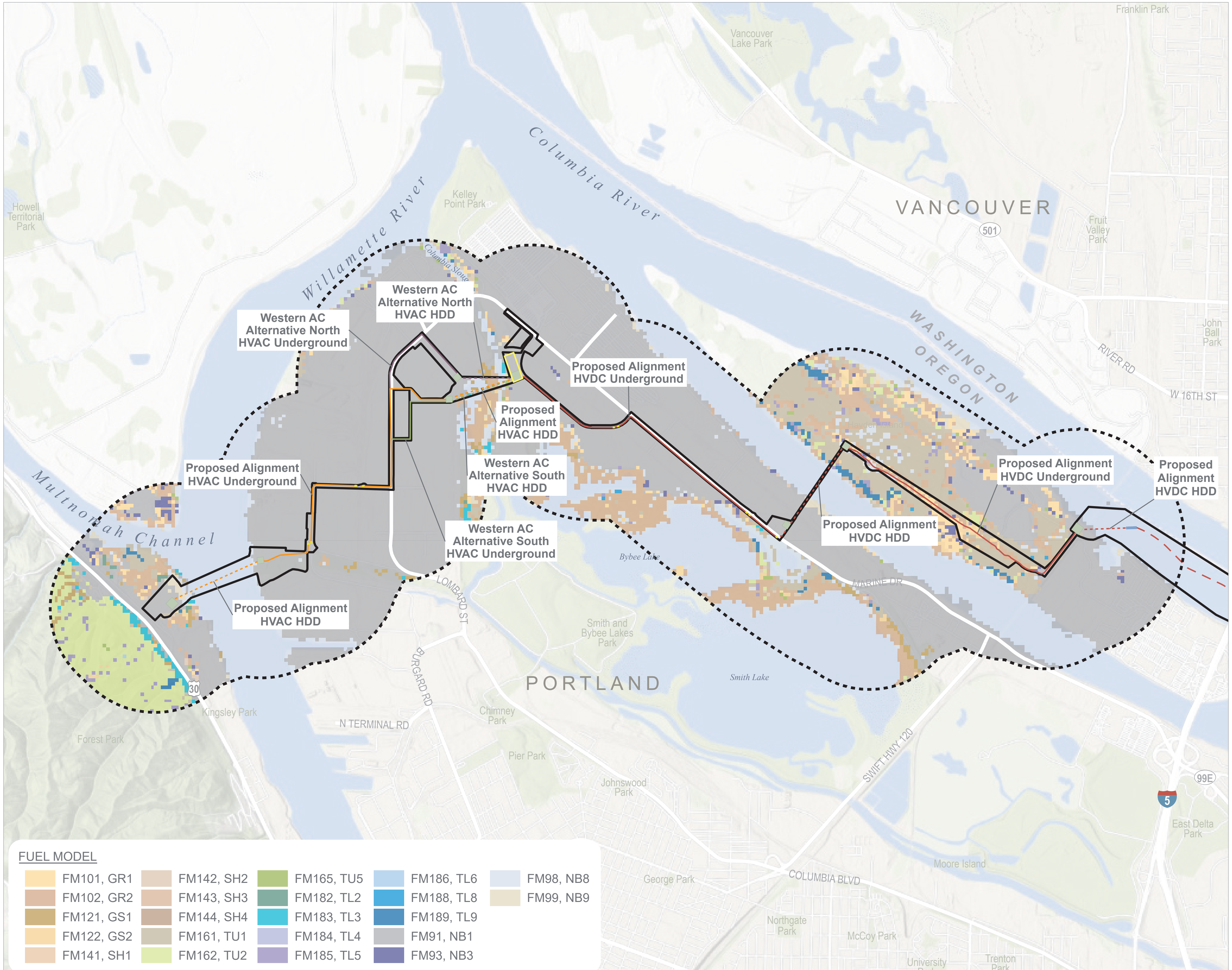
## FIGURE 3 FUEL MODELS WITHIN THE ANALYSIS AREA PAGE 1 OF 2

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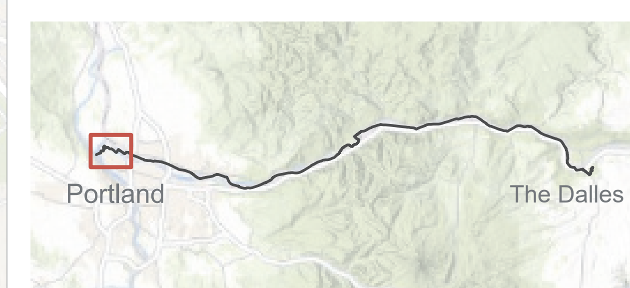
**CASCADE RENEWABLE TRANSMISSION**




HDR

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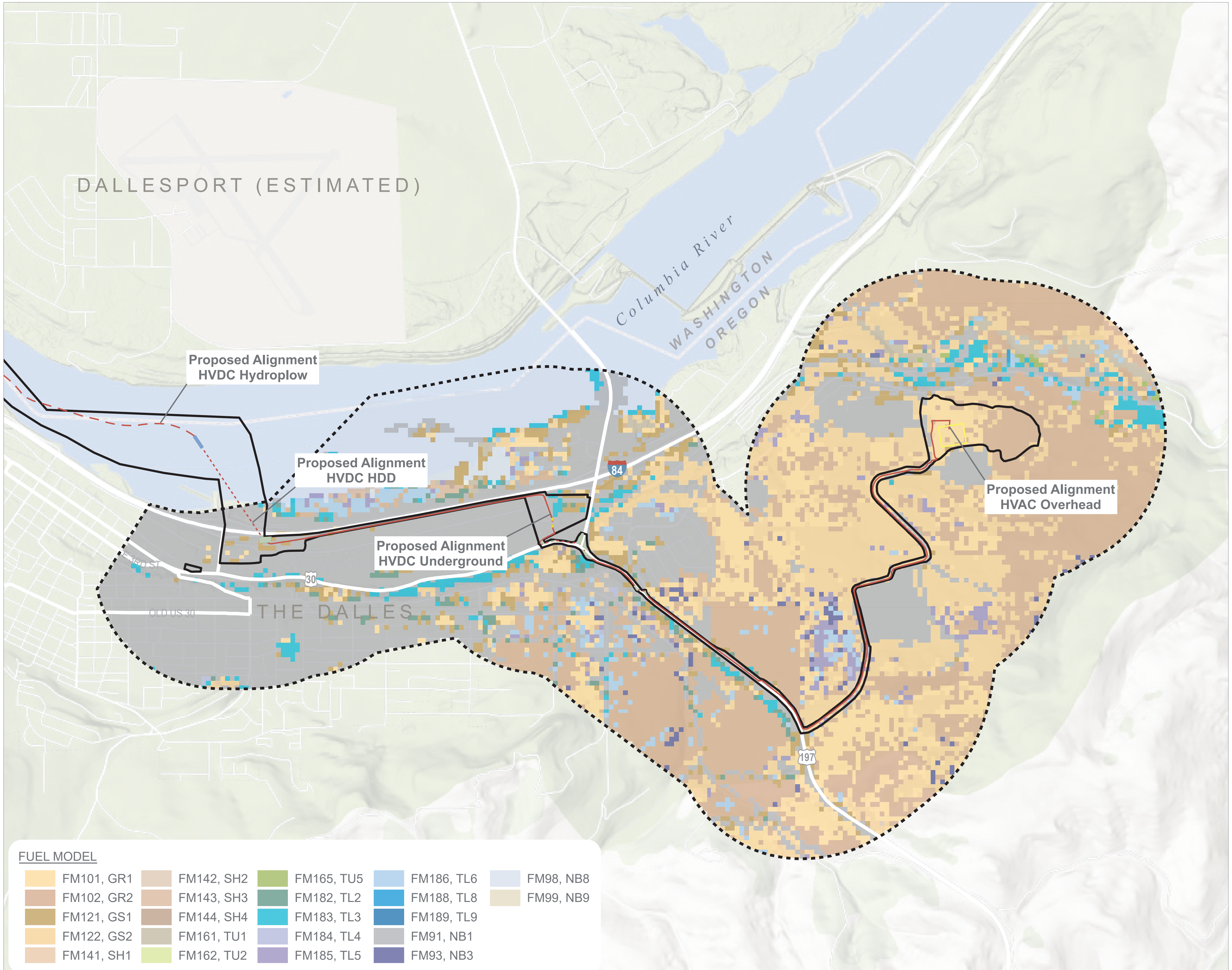
12/11/2025 NAD 1983 State Plane Oregon North Feet Data Sources: Esri, HDR, CWPP Planning Tool Oregon Explorer




12/11/2025 NAD 1983 State Plane Oregon North Feet Data Sources: Esri, HDR, CWPP Planning Tool Oregon Explorer

## FIGURE 3 FUEL MODELS WITHIN THE ANALYSIS AREA PAGE 2 OF 2

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- PROPOSED ALIGNMENT - HVDC HYDROPLOW
- PROPOSED ALIGNMENT - HVDC UNDERGROUND
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- TEMPORARY HORIZONTAL AUGER BORE (HAB)
- TEMPORARY 3-SIDED WET COFFERDAM
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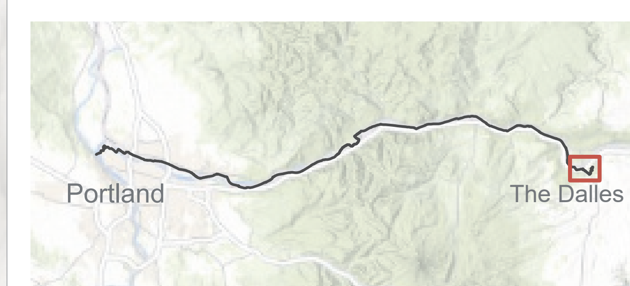


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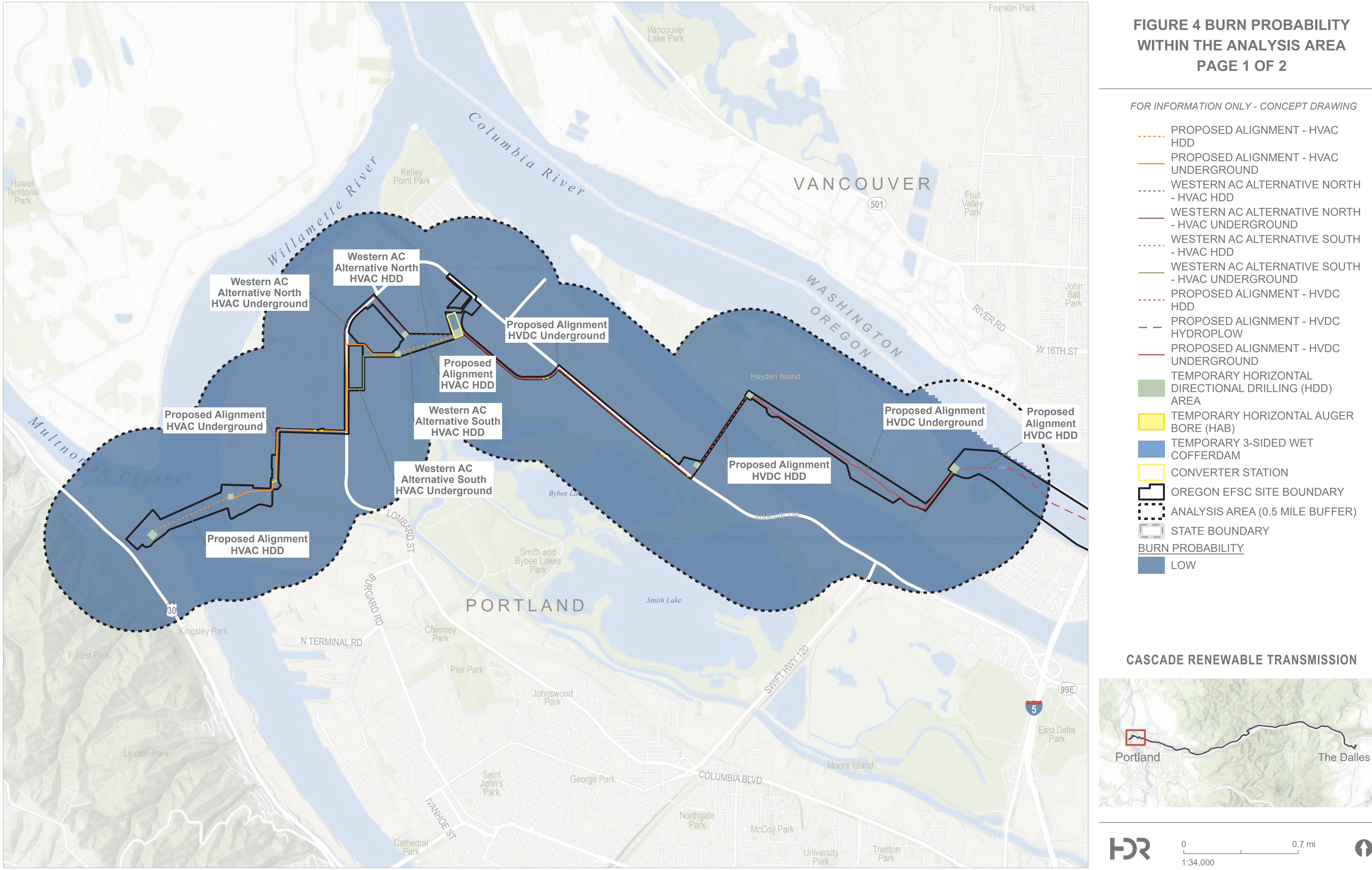
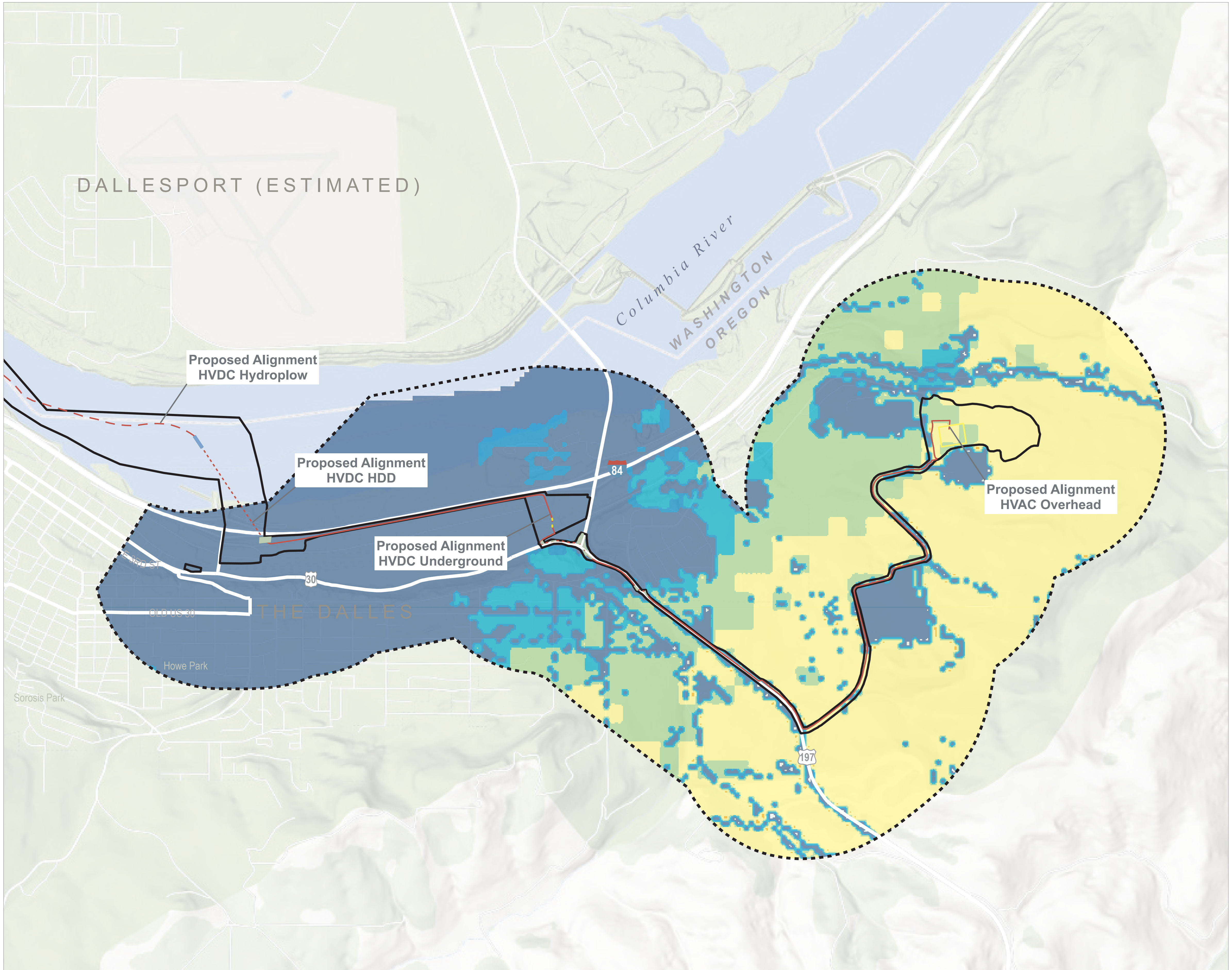
# FIGURE 4 BURN PROBABILITY WITHIN THE ANALYSIS AREA PAGE 1 OF 2

*FOR INFORMATION ONLY - CONCEPT DRAWING*




12/11/2025 NAD 1983 State Plane Oregon North Feet Data Sources: Esri, HDR, CWPP Planning Tool Oregon Explorer




# FIGURE 4 BURN PROBABILITY WITHIN THE ANALYSIS AREA PAGE 2 OF 2

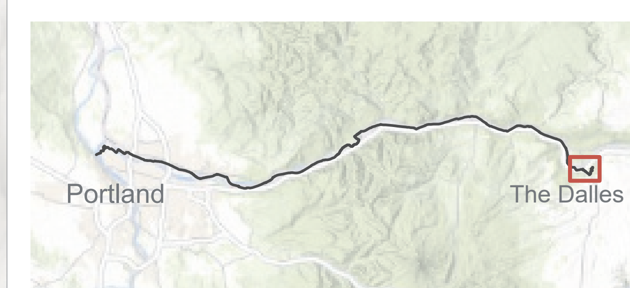
*FOR INFORMATION ONLY - CONCEPT DRAWING*

- PROPOSED ALIGNMENT - HVDC HDD
- PROPOSED ALIGNMENT - HVDC HYDROPLOW
- PROPOSED ALIGNMENT - HVDC UNDERGROUND
- TEMPORARY HORIZONTAL DIRECTIONAL DRILLING (HDD) AREA
- TEMPORARY HORIZONTAL AUGER BORE (HAB)
- TEMPORARY 3-SIDED WET COFFERDAM
- CONVERTER STATION
- OREGON EFSC SITE BOUNDARY
- ANALYSIS AREA (0.5 MILE BUFFER)
- STATE BOUNDARY

BURN PROBABILITY

- LOW
- LOW - MODERATE
- MODERATE
- MODERATE - HIGH
- HIGH
- HIGH - VERY HIGH

CASCADE RENEWABLE TRANSMISSION

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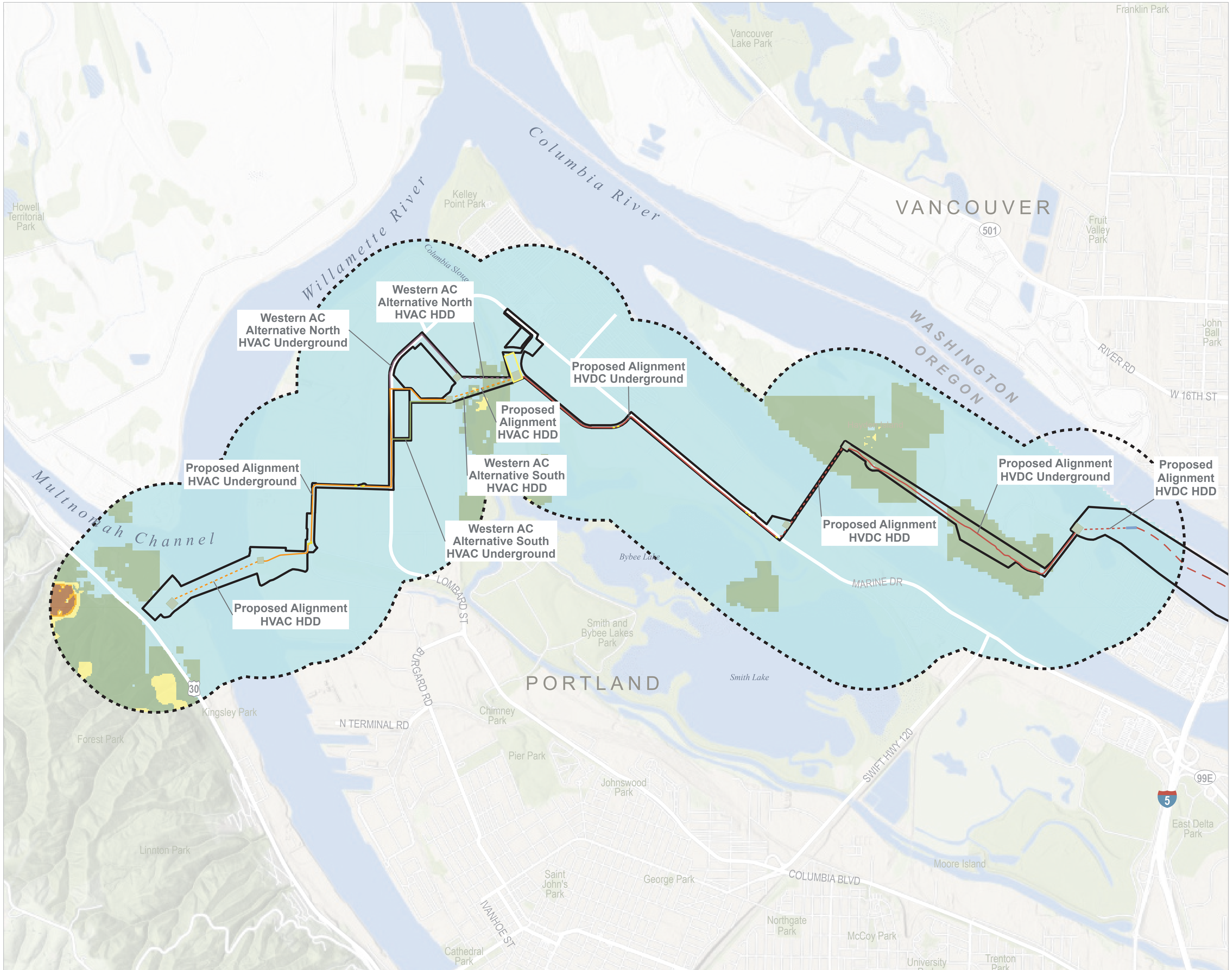
12/11/2025 NAD 1983 State Plane Oregon North Feet Data Sources: Esri, HDR, CWPP Planning Tool Oregon Explorer

## FIGURE 5 AVERAGE FLAME LENGTH WITHIN THE ANALYSIS AREA PAGE 1 OF 2



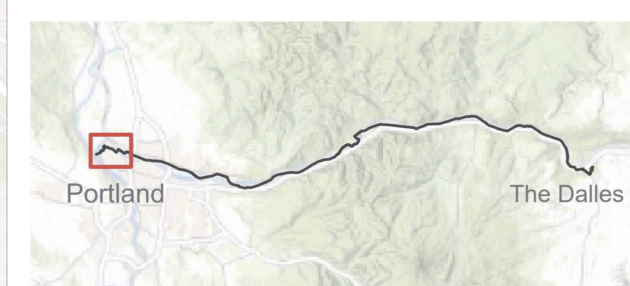

*FOR INFORMATION ONLY - CONCEPT DRAWING*

- PROPOSED ALIGNMENT - HVAC HDD
- PROPOSED ALIGNMENT - HVAC UNDERGROUND
- WESTERN AC ALTERNATIVE NORTH - HVAC HDD
- WESTERN AC ALTERNATIVE NORTH - HVAC UNDERGROUND
- WESTERN AC ALTERNATIVE SOUTH - HVAC HDD
- WESTERN AC ALTERNATIVE SOUTH - HVAC UNDERGROUND
- PROPOSED ALIGNMENT - HVDC HDD
- PROPOSED ALIGNMENT - HVDC HYDROPLOW
- PROPOSED ALIGNMENT - HVDC UNDERGROUND
- TEMPORARY HORIZONTAL DIRECTIONAL DRILLING (HDD) AREA
- TEMPORARY HORIZONTAL AUGER BORE (HAB)
- TEMPORARY 3-SIDED WET COFFERDAM
- CONVERTER STATION
- OREGON EFSC SITE BOUNDARY
- ANALYSIS AREA (0.5 MILE BUFFER)

AVERAGE FLAME LENGTH

- 0FT
- >0 - 4FT
- 4 - 8FT
- 8 - 11FT
- > 11FT

**CASCADE RENEWABLE TRANSMISSION**

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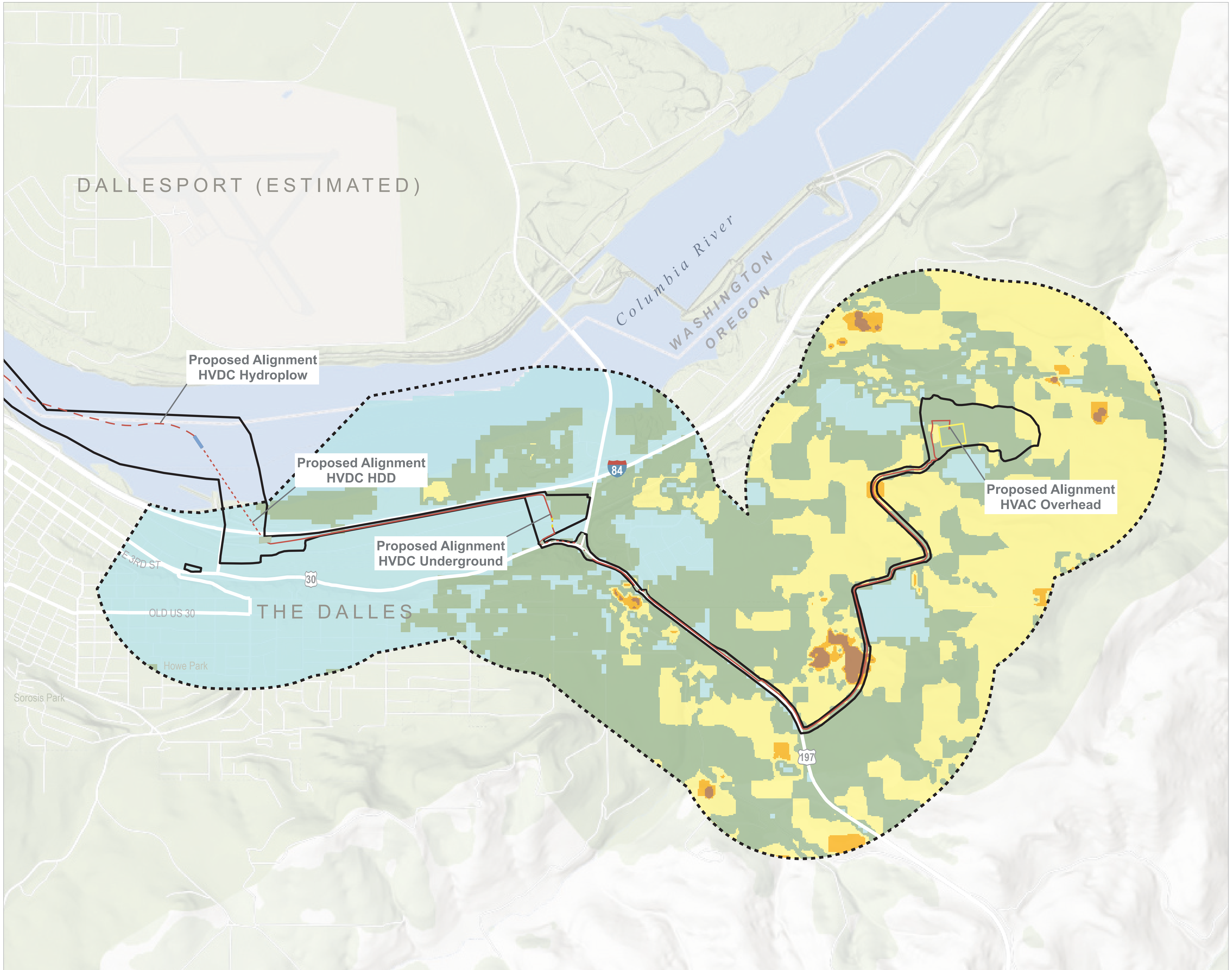
12/11/2025 NAD 1983 State Plane Oregon North Feet Data Sources: Esri, HDR, CWPP Planning Tool Oregon Explorer

# FIGURE 5 AVERAGE FLAME LENGTH WITHIN THE ANALYSIS AREA PAGE 2 OF 2

*FOR INFORMATION ONLY - CONCEPT DRAWING*




- PROPOSED ALIGNMENT - HVDC HDD
- PROPOSED ALIGNMENT - HVDC HYDROPLOW
- PROPOSED ALIGNMENT - HVDC UNDERGROUND
- TEMPORARY HORIZONTAL DIRECTIONAL DRILLING (HDD) AREA
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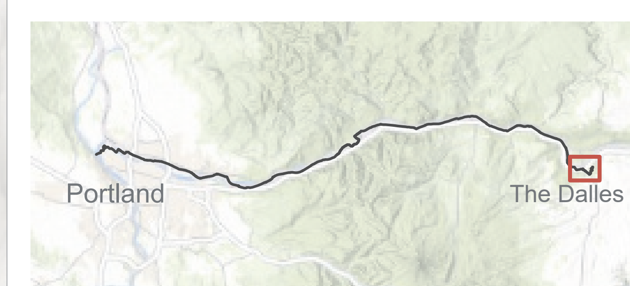
- TEMPORARY 3-SIDED WET COFFERDAM
- CONVERTER STATION
- OREGON EFSC SITE BOUNDARY
- ANALYSIS AREA (0.5 MILE BUFFER)

AVERAGE FLAME LENGTH

- 0FT
- >0 - 4FT
- 4 - 8FT
- 8 - 11FT
- > 11FT

## CASCADE RENEWABLE TRANSMISSION

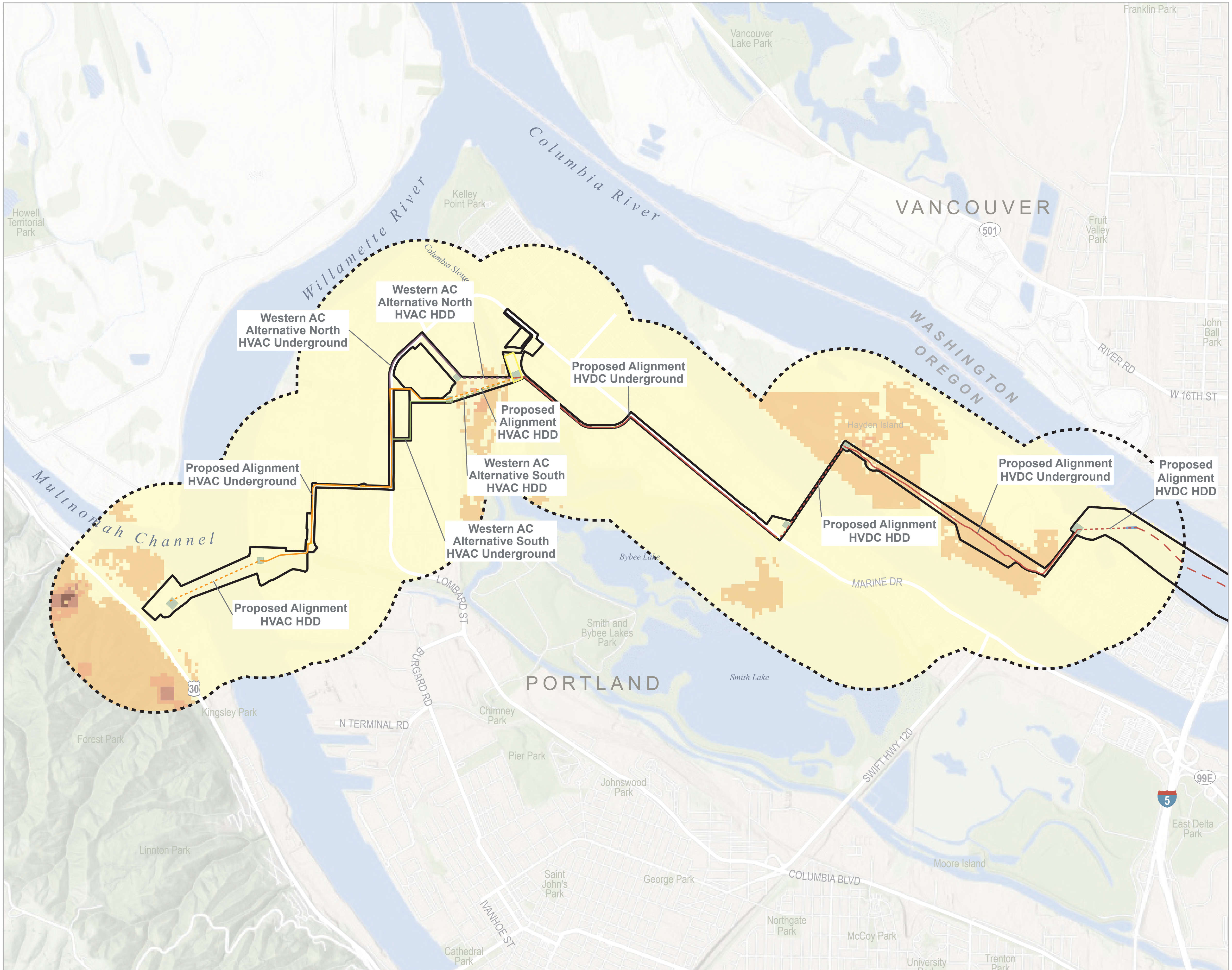



HDR

0 0.5 mi

1:25,000

12/11/2025 NAD 1983 State Plane Oregon North Feet Data Sources: Esri, HDR, CWPP Planning Tool Oregon Explorer




# FIGURE 6 HAZARD TO POTENTIAL STRUCTURES WITHIN THE ANALYSIS AREA PAGE 1 OF 2

*FOR INFORMATION ONLY - CONCEPT DRAWING*

- PROPOSED ALIGNMENT - HVAC HDD
- PROPOSED ALIGNMENT - HVAC UNDERGROUND
- WESTERN AC ALTERNATIVE NORTH - HVAC HDD
- WESTERN AC ALTERNATIVE NORTH - HVAC UNDERGROUND
- WESTERN AC ALTERNATIVE SOUTH - HVAC HDD
- WESTERN AC ALTERNATIVE SOUTH - HVAC UNDERGROUND
- PROPOSED ALIGNMENT - HVDC HDD
- PROPOSED ALIGNMENT - HVDC HYDROPLOW
- PROPOSED ALIGNMENT - HVDC UNDERGROUND
- TEMPORARY HORIZONTAL DIRECTIONAL DRILLING (HDD) AREA
- TEMPORARY HORIZONTAL AUGER BORE (HAB)
- TEMPORARY 3-SIDED WET COFFERDAM
- CONVERTER STATION
- OREGON EFSC SITE BOUNDARY
- ANALYSIS AREA (0.5 MILE BUFFER)

HAZARD TO POTENTIAL STRUCTURES

- VERY HIGH
- HIGH
- MODERATE
- LOW
- NON-BURNABLE/VERY LOW

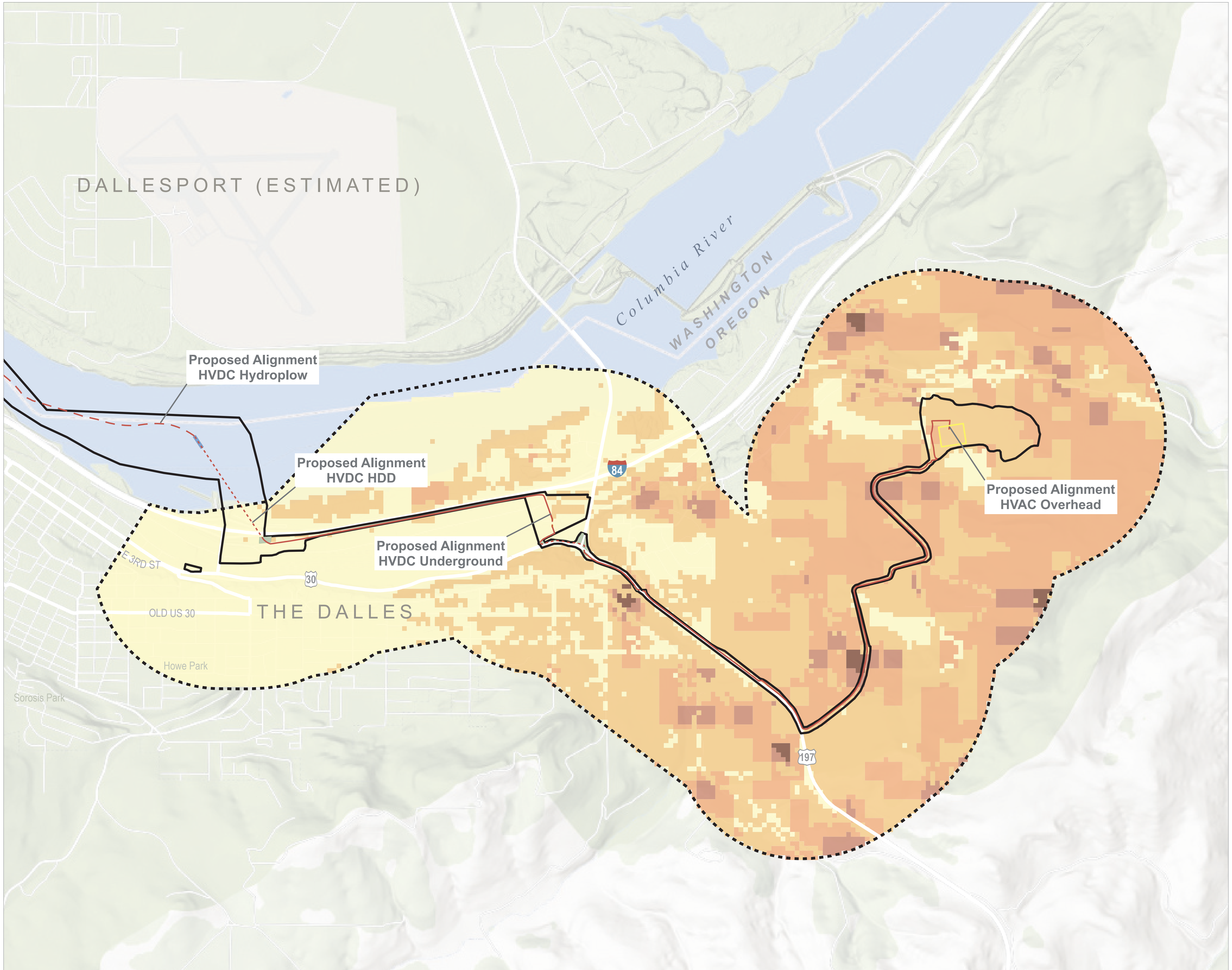
CASCADE RENEWABLE TRANSMISSION

Portland
The Dalles

HDR

0 0.7 mi
1:34,000

12/11/2025 NAD 1983 State Plane Oregon North Feet Data Sources: Esri, HDR, CWPP Planning Tool Oregon Explorer




# FIGURE 6 HAZARD TO POTENTIAL STRUCTURES WITHIN THE ANALYSIS AREA PAGE 2 OF 2

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- PROPOSED ALIGNMENT - HVDC HDD
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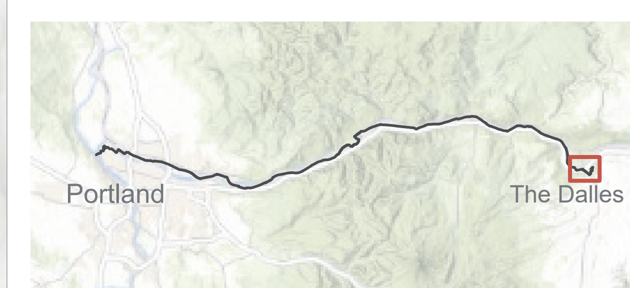
- TEMPORARY 3-SIDED WET COFFERDAM
- CONVERTER STATION
- OREGON EFSC SITE BOUNDARY
- ANALYSIS AREA (0.5 MILE BUFFER)

HAZARD TO POTENTIAL STRUCTURES

- VERY HIGH
- HIGH
- MODERATE
- LOW
- NON-BURNABLE/VERY LOW

CASCADE RENEWABLE TRANSMISSION

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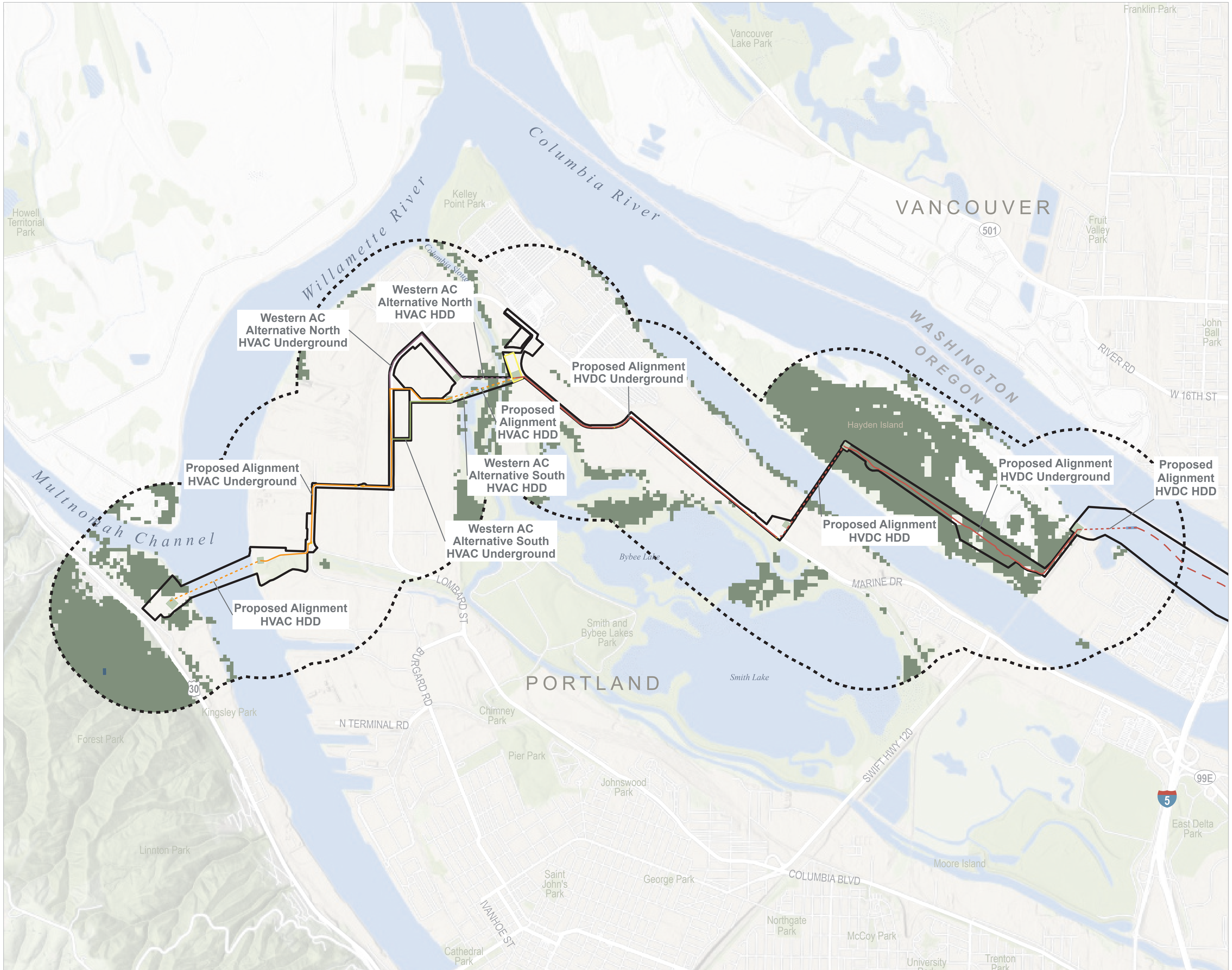
12/11/2025 NAD 1983 State Plane Oregon North Feet Data Sources: Esri, HDR, CWPP Planning Tool Oregon Explorer

# FIGURE 7 OVERALL FIRE RISK WITHIN THE ANALYSIS AREA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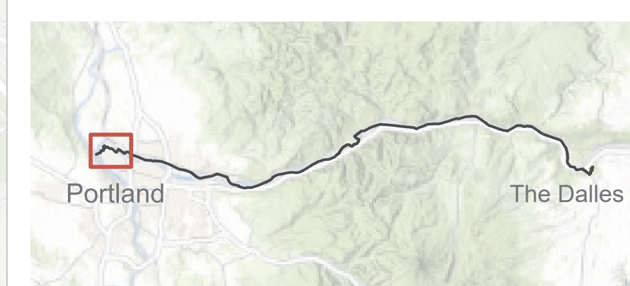
- TEMPORARY 3-SIDED WET COFFERDAM
- CONVERTER STATION
- OREGON EFSC SITE BOUNDARY
- ANALYSIS AREA (0.5 MILE BUFFER)

OVERALL FIRE RISK

- LOW BENEFIT
- LOW

**CASCADE RENEWABLE TRANSMISSION**

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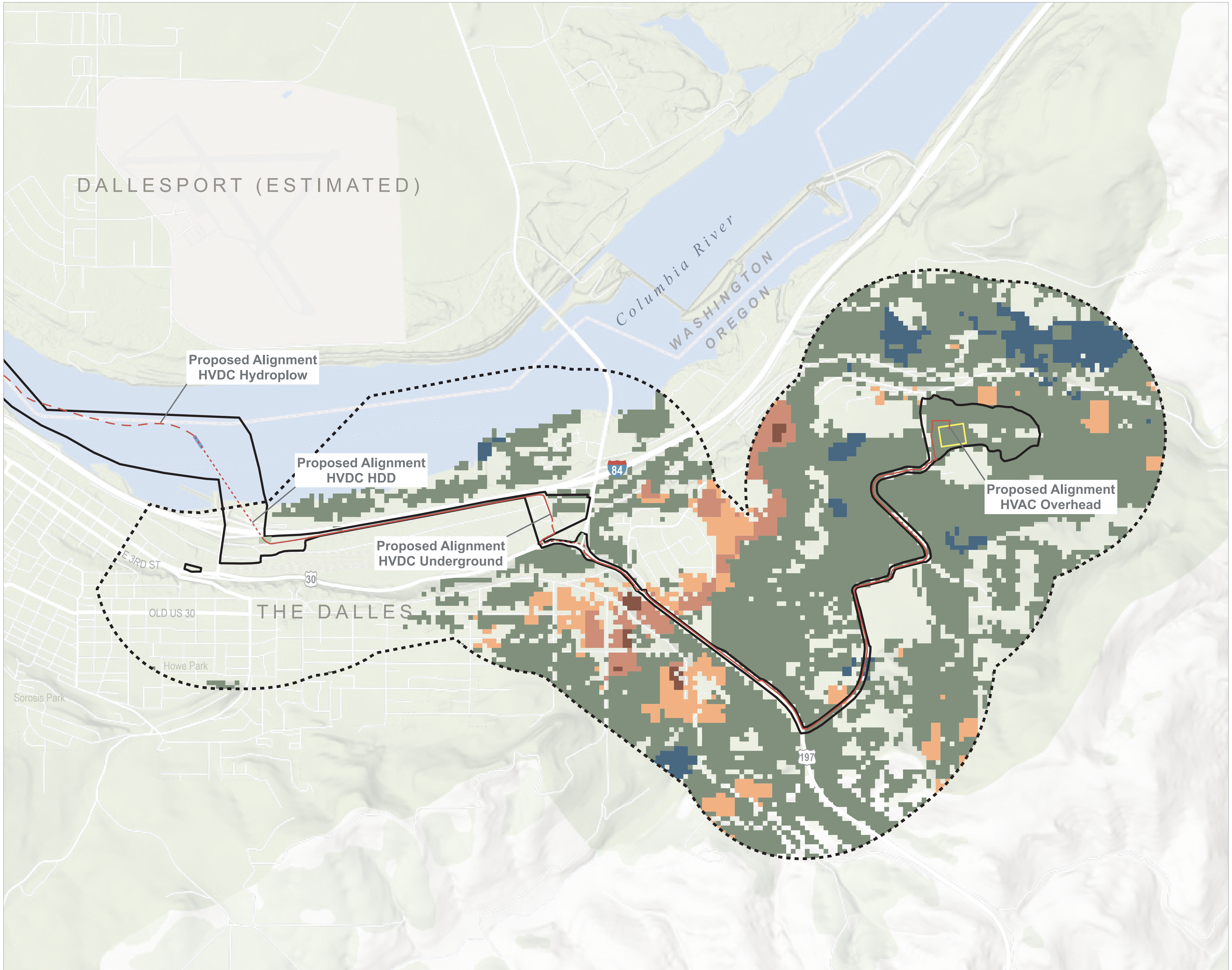
1:34,000

12/11/2025 NAD 1983 State Plane Oregon North Feet Data Sources: Esri, HDR, CWPP Planning Tool Oregon Explorer

# FIGURE 7 OVERALL FIRE RISK WITHIN THE ANALYSIS AREA PAGE 2 OF 2

*FOR INFORMATION ONLY - CONCEPT DRAWING*

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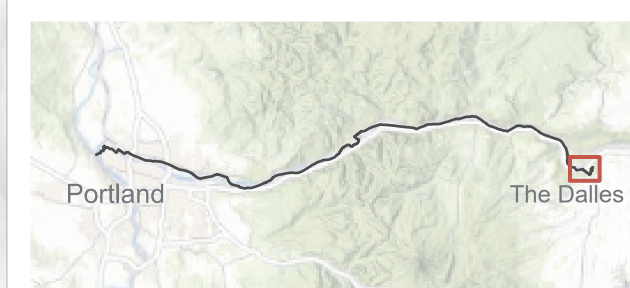
- TEMPORARY 3-SIDED WET COFFERDAM
- CONVERTER STATION
- OREGON EFSC SITE BOUNDARY
- ANALYSIS AREA (0.5 MILE BUFFER)

OVERALL FIRE RISK
- LOW BENEFIT
- LOW
- MODERATE
- HIGH
- VERY HIGH

**CASCADE RENEWABLE TRANSMISSION**




HDR

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12/11/2025 NAD 1983 State Plane Oregon North Feet Data Sources: Esri, HDR, CWPP Planning Tool Oregon Explorer

# Attachment 1a. Draft Construction Wildfire Mitigation Plan

# Draft Construction Wildfire Mitigation Plan

Cascade Renewable Transmission

*Wasco, Hood River, and Multnomah Counties, Oregon*

December 2025

Prepared for
Cascade Renewable Transmission, LLC

Submitted to
Oregon Energy Facility Siting Council

# Contents



# Tables



# Appendices

# Acronyms

| | |
|---|---|
| AC | alternating current |
| Applicant | Cascade Renewable Transmission (CRT) |
| BPA | Bonneville Power Administration |
| DC | direct current |
| EMP | Emergency Management Plan |
| HVDC | high-voltage direct current |
| kV | kilovolt |
| NERC | North American Electric Reliability Corporation |
| NFPA | National Fire Protection Association |
| OAR | Oregon Administrative Rule |
| ODF | Oregon Department of Forestry |
| ODOE | Oregon Department of Energy |
| OR EFSC | Oregon Energy Facility Siting Council |
| ORS | Oregon Revised Statute |
| PGE | Portland General Electric |
| RACE | Rescue, Alarm, Contain and Extinguish |
| SCADA | supervisory control and data acquisition |
| UV | ultraviolet |
| VESDA | very early smoke detection apparatus |
| WMP | wildfire mitigation plan |

# 1 Finalizing Wildfire Mitigation Plan Prior to Construction (PRE)

## 1.1 Update Applicable Sections of WMP

To finalize this Wildfire Mitigation Plan (WMP) prior to construction of the facility:

Update Section 3.1 based on final facility design including a brief description of areas within the site that are subject to high wildfire risk, fire prevention features at the site, such as road dimensions, setbacks, fire breaks, entry/exit locations, water truck(s) and fire protection equipment locations.

Update Section 3.2 and include in this WMP the facility site maps described in Section 3.2.

Update Section 3.3 with fire department, certificate holder, and operational manager contact information and emergency response procedures. Update Section 3.3 with analysis area residence contact information and confirm analysis area residence contact letter sent to residences within site boundary and 0.5 miles from the facility.

Update Sections 3.7.1 to describe vegetation management and areas that will be managed to be vegetation-free, noncombustible space, or gravel surface.

# 2 Prior to Construction Task List (PRE)

Prior to facility construction, complete the activities in Sections 2.1 and 2.2..

## 2.1 Training (PRE)

Construction training attendee list and training materials must be provided to the Department to demonstrate compliance.

Organize and hold an on-site training with certificate holder, contractors and construction personnel, inviting specialty contractors, local fire department(s), participating and adjacent landowners, emergency management office personnel, ODOE, and any other emergency management agency that covers:

- Description of construction phasing;
- The type, location, and proper use of fire protection equipment;
- Fire protection equipment usage and maintenance requirements;
- The location(s) of water source(s) and proper usage, storing and maintenance for the pump, hose nozzle; and water hose;
- Overview of smoking policy and locations;
- Overview of procedures and restrictions of construction maintenance activities during Fire Season and Red Flag Warnings designated in this WMP;
- Rescue, Alarm, Contain and Extinguish (RACE) procedures including:

- Rescue anyone in danger (if safe to do so);
- Alarm – call the control room, who will then determine if 911 should be alerted;
- Contain the fire (if safe to do so); and
- Extinguish the incipient fire stage (if safe to do so).

- Provide information and encourage attendees to sign up for the County's emergency management notification system.

The Applicant will document the date, attendees, and topics discussed at the on-site training, which will be provided to ODOE. Contractors and construction personnel, specialty contractors, local fire department(s), participating and adjacent landowners, emergency management office personnel, and any other emergency management agency in attendance will also reserve a copy of the construction safety documentation.

## 2.2 Facility Site Map(s) Submission

Submit updated site maps from Section 3.2 concurrently to local fire departments and ODOE.

# 3 Construction Wildfire Mitigation Plan (CON)

## 3.1 Summary of Facility Description with Design Features and Locations of Fire Protection Equipment

Cascade Renewable Transmission Project (Project) construction site preparation and grounding will include vegetation removal over a 3-month period. Clearing and grubbing vegetation will occur at the eastern and western converter station locations and at the temporary laydown area at the eastern converter station (the temporary laydown area at the western converter station is an asphalt covered parking lot).

Based on the data provided in the Wildfire Prevention and Risk Mitigation Exhibit, the relatively flat eastern site boundary has low to high overall wildfire risk and contains primarily urban development, grasses, and mixed grass/shrub communities. Approximately 55 percent of the site boundary has nonburnable or very low overall wildfire risk, 22 percent has very low overall wildfire risk, 23 percent has moderate overall wildfire risk, and less than 1percent high overall wildlife risk. The areas of nonburnable wildfire risk occur in the City of The Dalles, which is dominated by human development. Areas of very low and low overall wildfire risk in the eastern site boundary occur from the middle to east ends of the analysis area, where there is more grass and mixed grass/shrub vegetation (see Wildfire Prevention and Risk Mitigation Exhibit, Table 8 and Figure 7). Areas of moderate to high wildfire risk occur in the central area of the eastern analysis area but not within the site boundary. These areas are correlated with residential areas and orchards that may have higher densities of deciduous tree plants and litter that could spread wildfires. There is less than one acre of high wildlife risk within the site boundary. It occurs adjacent to areas of moderate risk, in the residential and agricultural areas east of The Dalles, between the city and the Big Eddy Substation. The high wildfire risk within the site boundary occurs where the cable would be buried along Highway 197.

The relatively flat western site boundary area has low overall wildfire risk and is dominated by both urban development and water. There are no areas in the western site boundary or analysis area that have moderate to very high overall wildfire risk (see Wildfire Prevention and Risk Mitigation Exhibit, Table 8 and Figure 7).

The facility converter stations will be equipped with fire protection and suppression systems in accordance with the applicable National Fire Protection Association (NFPA) codes, Oregon Fire Code, municipal codes in Multnomah and Wasco counties, and the Institute of Electrical and Electronics Engineers (IEEE) standards. In addition, the design will meet the recommendations stated in NFPA 850, "Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations."

Placement of the underground portion of the HVDC cables via trench would require construction equipment, which could include an asphalt or concrete cutting machine, backhoe, a utility truck, and a dump truck for spoilage haul. Equipment would be located adjacent to the paved portion of the roadway, off the road shoulder in the road ROW. There is risk associated with asphalt or concrete cutting equipment that may give off sparks; however, the risk would be considered low because wet cutting (water on the blade) would be used to avoid sparks and to keep the blade(s) cool and lubricated. Cable splicing utilizes propane to install certain components of the joint kit, and workers must have fire extinguishers present within the splice pit during the joining process. The following construction equipment and activities do not produce sparks, and are therefore not a fire risk.

- Excavation equipment and trucks used during excavation;
- Fusing of the conduit using a heat machine;
- Installation of the conduit along with backfill of flowable fill and native soils;
- Final pavement equipment;
- Cable installation using a cable reel trailer and puller.

The Applicant will minimize risk of wildfire during construction by implementing a number of systems and procedures. These will include requirements to conduct welding or metal cutting only in areas cleared of vegetation and maintaining emergency firefighting equipment on-site. Fire protection equipment will be onsite during construction as outlined in Section 3.4.

Subject to final design specifications, the high-voltage direct current (HVDC) voltage source converter (VSC) stations at each end of the HVDC interconnection will include the typical outside high voltage equipment such as converter transformers, switching equipment, capacitors and reactors. The eastern converter station will also include a short overhead alternating current (AC) cable connection to the interconnecting substation. The AC connection from the western converter to the interconnecting substation will be located underground and will not require fire detection and suppression. Each converter station will also contain a converter building housing the high-voltage alternating current/direct current (AC/DC) conversion equipment, terminations for the underground HVDC cables, and a control building for auxiliary power and control/protection equipment.

Preventive actions for transmission systems include disabling automatic reclosing, ordering no test orders on facilities, conducting inspections on site prior to testing faulted equipment, and conducting pre-emptive public safety power shutoffs. If faults that may cause fires are detected, transmission systems or equipment may be de-energized, loads dropped, and transmission curtailed.

During the construction window for CRT, the Applicant, BPA, and PGE will establish and document Joint Operating Procedures which will govern the day-to-day scheduling and coordination of the CRT facility within the BPA and PGE systems. Included within the Joint Operating Procedures will be coordination during wildfire events. That coordination will be based on BPA's then current Wildfire Mitigation Plan; a copy of the most current 2024 plan is attached. In addition to the Applicant implementing its vegetation management plan, recommendations from NERC's Wildfire Mitigation Reference Guide (attached) will be implemented, which are applicable to the CRT facility. All Public Safety Power Shutoff ("PSPS") will be implemented by either BPA or PGE. As the Applicant will only be the transmission line owner, the Applicant will not have any community outreach responsibility during a PSPS. PSPS community outreach will continue to be the responsibility of BPA and PGE. If each of BPA's and PGE's substations are energized during a wildfire incident, it is anticipated CRT facility will continue to operate. This is particularly critical for overall system reliability, as BPA may be required to shut off other high voltage overhead transmission lines, which, but for CRT could significantly reduce flows of electricity east-to-west across the Cascade mountains. BPA will have fire management and oversight of all its assets, including the Big Eddy substation and the Applicant will have fire management and oversight of its assets. The Applicant will have regular coordination meetings with the local fire department, with one of the topics to be discussed being wildfire coordination.

Measures for reducing the risk of fire ignition and reducing the risk of equipment damage were a wildfire to occur are discussed below, including the facility's vegetation management program (see Section 3.7.1 and 3.8.1), and through the emergency response procedures that will be described in the Emergency Management Plan (EMP). The EMP will be developed for the facility and is outlined below in Section 3.3.

The converter stations will have reduced risk for fire because these areas will have a gravel base with no vegetation within 10-feet of equipment to reduce fire risk. The facility converter stations will be equipped with fire protection and suppression systems in accordance with the applicable NFPA codes, Oregon Fire Code, and municipal codes in Multnomah and Wasco counties. In addition, the design would meet the recommendations stated in NFPA 850.

No new road dimensions, setbacks, or firebreaks are planned for the Project. An approximately 275-foot-long paved driveway will connect the southwest corner of the eastern converter station to Columbia View Drive, providing general and emergency access and egress. In Portland, general and emergency access and egress will be provided by a short curb cut driveway abutting N Leadbetter Road. The outside area of the converter stations will include fire hydrants throughout the area and standpipes to protect the yard facilities and structures, as required. In addition, the oil-filled converter transformers will be provided with detectors sensing high temperature and/or rate of rise. These detectors together with the transformer's pressure sensors and protection relays will provide a trip signal to de-energize all transformers in the event of a fault condition. Each transformer will be positioned on a secondary containment structure and separated by fire rated walls. Each secondary containment structure will be internally open to each transformer bay to contain the oil from one transformer plus additional room for stormwater, firefighting flow, and freeboard.

The converter building will house high-voltage AC/DC conversion equipment and fire detection equipment, including both ultraviolet (UV) flash detection and very early smoke detection apparatus (VESDA) equipment. A series of UV (flash) detectors will be situated in the converter building to detect an electrical flash. The UV detectors will be programmed to provide both fire alarm and high-voltage trip functions. The VESDA is a redundant and highly sensitive smoke detection system. Again, different levels of detection will provide both fire alarm and high voltage trip functions.

The control building will contain auxiliary electrical equipment, cooling, and a control and protection equipment room. The area will be provided with addressable smoke and heat detection sensors and pull stations connected to a fire panel. The detector loops will be supervised for continuity with any failure of a device indicated by a trouble alarm. The fire panel will typically report any fire alarms or troubles to a security monitoring service.

Additional protection will be provided to the control and protection room by means of an inert gas (FM-200) fire suppression system. This system is typically situated below the floor level to protect the cabling between the control and protection cubicles. The control building will also include portable fire extinguishers, as required.

The potential for wildfire within the facility site boundary will be at the eastern converter station because it will be an aboveground facility located in an agricultural area outside The Dalles city limits in Wasco County and surrounded by large undeveloped areas. The eastern converter station will be located in the Mid-Columbia Fire and Rescue District. In addition, as required in the Project Order, the Applicant has prepared this facility-specific WMP and includes it as an attachment to the Wildfire Prevention and Risk Mitigation Exhibit.

The DC and fiber optic cables connecting the converter stations at each end of the interconnection will not require fire detection and suppression. The cables will be located underground and underwater and have very sensitive and fast protection schemes to quickly trip the interconnection and remove all energy from the cable in the event of a fault.

## 3.2 Facility Site Maps

This construction WMP includes facility site maps that identify:

- The phasing for construction of facility features and components;
- Location and dimensions of facility roads;
- Location of vegetation free, noncombustible, defensible spaces;
- Wildfire risk at the site and date;
- High-fire consequence areas/resources (includes existing infrastructure, residences, sensitive habitat, or cultural resources);
- The location of facility access points;
- A description and the location of emergency access procedures, including how emergency responders and/or adjacent landowners may access site for fire protection equipment or to extinguish an on-site fire when personnel will not be onsite;
- The type and location of fire protection equipment on site; and
- The location(s) of water source(s) that will be on-site during construction

## 3.3 Facility Contact Information and Emergency Response Procedures

The Applicant and construction contractor will prepare an EMP prior to construction that will contain policies and procedures for preparing for and responding to a range of potential emergencies, including fires, which will be provided to ODOE prior to construction. Implementation of the EMP will ensure risks to public health and safety and risks to emergency responders are minimized. Trained staff with access to the facility around the clock will control any potential fires inside the converter station. These measures will help keep external fires out or internal fires in. The EMP will cover response procedures that consider the dry nature of the region and address risks on a seasonal basis. The plan will also specify communication channels the Applicant intends to pursue with local fire protection agency personnel and BPA, for example, annual meetings to discuss emergency planning, and invitations to observe any emergency drill conducted at the facility.

Fire suppression equipment will be available on site at the converter stations in a clearly marked location and during trenching and installation of the underground components. This equipment will include, at a minimum:

- Fire Extinguisher: Dry chemical, 2.5 or 2.8 pound, 1A-10B: C U/L rating, properly mounted is secured;
- Pulaski;
- Shovel;
- A fixed, large capacity (500 gallon) water source;
- Collapsible pail or backpack pump: 5-gallon capacity; and
- Drip can, 5-gallon capacity.

During the fire season (designated Fire Season or June to October each year) water truck(s)/water source, water buffalo, or tank with minimum 500-gallon capacity must be on site. The water truck or water supply shall include the following, unless approved by the Department:

- Pump should be maintained ready to operate and capable to provide a discharge of not less than 20 gallons per minute at 115 psi at pump level. Note: Volume pumps will not produce the necessary pressure to effectively attack a fire start. Pressure pumps are recommended.
- Provide enough hose (500 feet minimum) not less than 3/4" inside diameter to reach areas where power driven machinery has worked.
- Water supply, pump, and at least 250' of hose with nozzle must be maintained as a connected, operating unit ready for immediate use.

Personnel will receive training on use of fire suppression equipment.

Local fire department and county emergency management contact information:

- The Dalles
  - Mid-Columbia Fire and Rescue
    - Address: 1400 W 8th Street, The Dalles, OR 97058
    - Nonemergency number: 541-296-9445
    - Email: firemarshal@mcfr.org
  - Wasco County Emergency Management
    - Address: 511 Washington Street Suite 102, The Dalles, OR 97058
    - Phone number: 541-506-2790
    - Email: sheridanm@co.wasco.or.us
- Portland
  - Portland Fire and Rescue
    - Address: 55 SW Ash Street, Portland, OR 97204
    - Nonemergency number: 503-823-3700
    - Email: firemarshal@portlandoregon.gov
  - Multnomah County Emergency Management
    - Address: 501 SE Hawthorn Boulevard Suite 400, Portland, OR 97214
    - Phone number: 503-988-6700
    - Email: em.dutyofficer@multco.us

Fire department response times to the site:

- Mid-Columbia Fire and Rescue: 7 minutes
- Portland Fire and Rescue: 8 minutes

Certificate holder primary contact and contact of operational manager(s):

- X
- X

The landowner list will be updated and provided prior to construction.

Contact 911 in the event of:

- A fire or emergency on-site that cannot be addressed by personnel on-site and requires the assistance of fire or emergency medical personnel;
- A fire ignition on-site that spreads out of the fence line;
- Any fire off-site that does not have emergency responders on site.

## 3.4 Specifications for Fire Protection Equipment

Oregon Administrative Rule (OAR) 629-043-0020 requires specific water supply and water delivery equipment for projects that operate stationary or mobile equipment during fire season inside or within one-eighth (0.125) mile from a forest protection district. Neither converter station is inside or within 0.125 mile of a forest protection district; therefore, OAR 629-043-0020 does not apply.

All internal combustion engines must be equipped with exhaust systems, mufflers, and screens, or include an appropriate spark arrestor; and must be kept in good operating condition. All power driven machinery will be kept free of excess flammable material that may create a risk of fire. The fire suppression equipment listed in Section 3.3 will also be carried in vehicles conducting maintenance activities.

## 3.5 Use of Vehicles and Power Driven Machinery at Site

The following best management practices (BMPs) to minimize fire risk from vehicle travel, equipment use, and fueling activities will be implemented at the site during construction:

- The movement of vehicles will be planned and managed to minimize fire risk.
- The contractor(s) will be responsible for identifying and marking paths for all off-road vehicle travel. All off-road vehicle travel will be required to stay on the identified paths. No off-road vehicle travel will be permitted while working alone. Travel off road or parking in vegetated areas will be restricted during fire season as designated in this Plan.
- Areas with grass that are as tall or taller than the exhaust system of a vehicle must be wetted before vehicles travel through it.
- Workers will be instructed to shut off the engine of any vehicle that gets stuck, and periodically inspect the area adjacent to the exhaust system for evidence of ignition of vegetation. Stuck vehicles will be pulled out rather than “rocked” free and the area will be inspected again after the vehicle has been moved.
- The contractor(s) will designate a location for field fueling operations at the temporary construction yards. Any fueling of generators, pumps, etc. shall take place at this location only.
- Fuel containers, if used, shall remain in a vehicle or equipment trailer, parked at a designated location alongside a county right-of-way. No fuel containers shall be in the vehicles that exit the right-of-way except the five-gallon container that is required for the water truck pump.
- All power driven machinery will be kept free of excess flammable material which may create a risk of fire.

## 3.6 Fire Precaution Levels and Restrictions during Fire Season

### 3.6.1 Definitions

**Non-Fire Season** – Approximately October - May

**Fire Season** – Approximately June-September, formally designated by the Oregon Department of Forestry (ODF). Under Oregon Revised Statute (ORS) 478.960 (4), a Fire Chief can establish Fire Season within a Fire District when ODF, under ORS 477.505, declares Fire Season. Begins seasonal restrictions for public and industry.

**Fire Weather Watch** - A fire weather watch is issued when there is a high potential for the development of a red flag event. A watch is issued 18 to 96 hours in advance of the expected onset of criteria. Intent of a fire weather watch is to alert forecast users at least a day in advance for the purposes of resource allocation and fire fighter safety. A watch means critical fire weather conditions are possible but not imminent or occurring.

**Red Flag Weather Warning** - A red flag warning is used to warn of impending or occurring red flag conditions. Its issuance denotes a high degree of confidence that weather and fuel conditions consistent with local red flag event criteria will occur in 48 hours or less. Specific red flag criteria differ for each situation and district in Oregon. Be extremely careful with open flames and other activities that emit sparks.

**Hot Work** - Any cutting, grinding, welding, or other activity that creates spark or open flame. This would include cutting asphalt or concrete while trenching; however, the risk would be considered low because wet cutting (water on the blade) would be used to avoid sparks and to keep the blade(s) cool and lubricated.

### 3.6.2 Fire Watch Service

Designated Fire watch personnel will:

- Be physically capable and experienced to operate firefighting equipment specified in Section 3.4.
- Have facilities for transportation and communications to summon assistance.
- Observe portions of the operation on which activity occurred during the day.

Upon discovery of a fire, Firewatch personnel must, first, report the fire, summon any necessary firefighting assistance, describe intended fire suppression activities; then, after determining a safety zone and an escape route that will not be cut off if the fire increases or changes direction, immediately proceed to control and extinguish the fire, consistent with firefighting training and safety. If shutdown activities are necessary, they will be determined when fire service personnel arrive at the facility.

### 3.6.3 Fire-Prevention Measures and Restrictions Associated with Fire Season

Certificate holder shall maintain a log when construction activities are impacted by fire restrictions during Fire Season, as designed in this section. The log will include:

- The date;
- Fire Precaution Level;
- Description of actions taken, including if any measures were taken to reduce wildfire risk that are not identified in this WMP.

Fire-prevention measures and restrictions include the following:

**Non-Fire Season**

- All hot work must be conducted on roads or on non-combustible surfaces.
- Smoking in designated areas only.

**Fire Season**

- All hot work (any cutting, welding, or other activity that creates sparks or open flame) must be conducted on roads or on non-combustible surfaces.
- Water source meeting specifications in this WMP will be on site during fire season.
- Following the completion of hot work, the Certificate Holder or contractor(s) must maintain a fire watch for 60 minutes to monitor for potential ignition.
- Fire watch shall be on duty during any breaks and for 1 hour after all power driven machinery used by the operator has been shut down for the day.
- Smoking in designated areas only.

**Fire Weather Watch**

- No hot work permitted.
- Driving and parking only permitted on graveled surfaces.
- Fire watch shall be on duty during any breaks and for 1 hour after all power driven machinery used by the operator has been shut down for the day.
- No smoking on site.

**Red Flag Weather Warning**

- No hot work permitted.
- On-site personnel must be aware of Red Flag Warning.
- Driving and parking only permitted on graveled surfaces.
- Fire watch shall be on duty during any breaks and for 1 hour after all power driven machinery used by the operator has been shut down for the day.
- No smoking on site.

**Table 1: Fire Prevention Measures During Fire Season Summary**

| Requirement | Non-Fire Season | Fire Season | Fire Weather Watch | Red Flag Warning |
|---|---|---|---|---|
| Fire weather advisory | Not required | Not required | Not required | On-site personnel must be aware of Red Flag Warning. |
| On-site water source | N/A | As specified in Section 3.2 | As specified in Section 3.2 and 3.3. | As specified in Section 3.2 and 3.3. |
| Hot work | Only permitted on roads or on non-combustible surfaces. | Only permitted on roads or on non-combustible surfaces; fire watch required for 60 minutes after completion | Not Permitted | Not Permitted |
| Fire Watch Service | Not required | During breaks and for 60 minutes after all power-driven machinery has been shut down for the day. | During breaks and for 60 minutes after all power-driven machinery has been shut down for the day. | During breaks and for 60 minutes after all power-driven machinery has been shut down for the day. |
| Driving and Parking | As described in Section 3.8.4 | As described in Section 3.8.4. | Only permitted on roads or on non-combustible surfaces and Section 3.8.4 | Only permitted on roads or on non-combustible surfaces and Section 3.8.4 |
| Smoking | Designated areas only | Designated areas only | Not permitted | Not permitted |

## 3.7 Vegetation Management

### 3.7.1 Vegetation-free, Noncombustible Space, and Vegetation Standards

Vegetation within areas temporarily disturbed during facility construction will be revegetated as outlined in the Revegetation Plan. Areas disturbed by construction and restoration activities will be revegetated using a seed mix appropriate to the specific locations and at the appropriate time of planting, as required by the landowner. Revegetation will be completed as soon as is practicable in order to limit soil exposure time to wind or water. As described in the Revegetation Plan, revegetation will use mulching, hydroseeding, temporary irrigation, or other methods, as needed, based on limitations of each area that may inhibit revegetation activities. Additionally, in areas with droughty soils, which do not hold enough water in root zones, making revegetation difficult, soil surfaces will be mulched and stabilized to minimize wind erosion and conserve soil moisture.

No vegetation will be maintained within the converter station perimeter fence line. Mowing and/or herbicide application will be used to maintain a vegetation-free, noncombustible space, or gravel surface area up to 10 feet outside the converter station fence, where applicable.

## 3.8 Construction Training(s)

### 3.8.1 Safety Training

Once a year, after construction begins, the Applicant's construction contractor will organize and hold an on-site training with certificate holder and construction personnel, inviting equipment manufacturers, specialty contractors, local fire department(s), participating and adjacent landowners, emergency management office personnel, ODOE, and any other emergency management agency. The on-site training will cover:

- The location of electrical facility components and the fire safety measures associated with each component that have been constructed;
- Description of remaining construction phasing;
- The type, location, and proper use of fire protection equipment;
- Fire protection equipment usage and maintenance requirements;
- The location(s) of water source(s) and proper usage, storing and maintenance for the pump, hose nozzle; and water hose;
- Overview of smoking policy and locations;
- Overview of procedures and restrictions of construction activities during Fire Season, Fire Weather Watches, and Red Flag Warnings designated in this WMP;
- RACE procedures, including:
  - Rescue anyone in danger (if safe to do so);
  - Alarm – call the control room, who will then determine if 911 should be alerted;
  - Contain the fire (if safe to do so); and
  - Extinguish the incipient fire stage (if safe to do so).
- Information regarding the emergency management notification system.

# 4 Plan Updates: Amendments and Reporting Requirements

> *OAR 345-022-0115(1)(b)(E) Describe methods the applicant will use to ensure that updates of the plan incorporate best practices and emerging technologies to minimize and mitigate wildfire risk.*

This WMP will be updated annually and results will be provided to ODOE in the annual report required per OAR 345-026-0080. Updates to this WMP will include:

- Section 3.1 and 3.2, any changes in wildfire risk at the site or changes in facility components or preventative features.
- Section 3.3, any changes in analysis area residence/landowner addresses or contact information.
- A copy of the Fire Season Restriction Log identified in Section 3.6
- Changes in wildfire risk if different from the Site Plan provided prior to construction. Evaluation of wildfire risk will be consistent with the requirements of OAR 345-022-0115(1) using current data from reputable sources.

This information may be used to establish the performance of the WMP. If determined by certificate holder or ODOE, adjustments or improvements must be proposed to ensure the WMP provides wildfire mitigation. Any ODOE-required updates will be implemented within 14 days, unless otherwise agreed to by ODOE based on a good faith effort to address wildfire hazard.

This WMP may be amended from time to time by agreement of the certificate holder and the Oregon Energy Facility Siting Council (OR EFSC) or ODOE, acting within its delegated authority of OR EFSC. Such amendments may be made without amendment of the site certificate. OR EFSC authorizes ODOE to agree to amendments to this WMP. ODOE will notify OR EFSC of all amendments, and OR EFSC retains the authority to approve, reject, or modify any amendment of this WMP agreed to by ODOE.

# 5 References

Gilbertson-Day, J.W., R.D. Stratton, J.H. Scott, K.C. Vogler, and A. Brough. 2018. Pacific Northwest Quantitative Wildfire Risk Assessment: Methods and Results. Quantum Spatial, Pyrologix, and BLM and USFS Fire, Fuels and Aviation Management. Available online at: https://pyrologix.com/wp-content/uploads/2019/11/PNW%20Quantitiative%20Wildfire%20Risk%20Assessment%20Report%204-9-2018%20v2.pdf.

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NFPA (National Fire Protection Association). 2021. NFPA 1, Fire Code - Chapter 52 Stationary Storage Battery Systems. 2021 Edition. Quincy, MA.

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UL Solutions. 2023. UL 9540A Test Method. Available online at: https://www.ul.com/services/ul-9540a-test-method.

# Appendix A: Residence/Landowner Outreach Letter

*(placeholder for letter in the future)*

# Appendix B: BPA 2024 Wildfire Mitigation Plan

BONNEVILLE POWER ADMINISTRATION

# BPA 2024 WILDFIRE MITIGATION PLAN


**ABSTRACT**

BPA's Wildfire Mitigation Plan covers end-to-end activities related to the mitigation of wildfires across the Federal Columbia River Transmission System.

# Message from the Administrator

The Bonneville Power Administration published its inaugural Wildfire Mitigation Plan (WMP) in 2020 and added a Public Safety Power Shutoff (PSPS) procedure to the WMP released in 2022. 2024 marks the fourth year that BPA will coordinate its wildfire mitigation efforts under a distinct plan.

This year, we are building on the lessons we've learned since 2020. This updated WMP includes the following improvements:

- Lessons learned since considering and implementing PSPS implementation between 2021 and 2023.
- Evolving wildfire modeling and data integration in partnership with the Pacific Northwest National Laboratory that informs prioritization of vegetation management and maintenance work on transmission lines posing the greatest wildfire threat.
- Infusion of lessons learned applying the International Wildfire Risk Mitigation Consortium Maturity Model, which has helped our experts better understand current BPA programs and activities in relation to general utility threats. This has resulted in year-over-year improvements to our plan and activities.

In addition to improving the way we manage vegetation and repair equipment that presents a wildfire risk, we began applying fire retardant to our wood poles in 2022. This measure helps reduce the spread of wildfires that threaten our rights-of-way and adds a protective element to our transmission system.

Climate change continues to lengthen wildfire season and increase the fire-related threats to utility systems across the Pacific Northwest and the country. Wildfires are devastating to utilities and other industries, but even more so to people who lose their lives, property, and cherished belongings to these catastrophic events.

BPA is committed to continually improving its WMP to prevent, mitigate, and quickly recover from the devastation wildfires can wreak on the people and communities we serve. I am proud of the work we have done and will do as we improve the preventative measures outlined in this plan.

John Hairston

Administrator and CEO
Bonneville Power Administration

## Contents

# 1.0 Introduction/Executive summary

Bonneville Power Administration's (BPA) wildfire mitigation activities have evolved to include risk-informed business strategies and capabilities incorporated into this document. These approaches promote continuous improvement in wildfire mitigation that allow BPA to deliver value and safely operate the transmission system providing power and transmission service to utilities and other interconnection customers. This is vital to the flow of electricity across the Western Interconnection.

Fuel + Ignition Source = Fire. Looking through the lens of this wildfire equation, the 2024 Wildfire Mitigation Plan (WMP) encompasses BPA's efforts to mitigate the risk of wildfire ignitions. Specifically, the WMP includes several technical safety and preventative measures related to the materials and equipment owned and operated by BPA as the agency recognizes its potential components of the wildfire equation. The plan also includes communication and coordination tactics with local, state, and federal partners to support collaborative wildfire mitigation efforts across BPA's service territory.

BPA has long-standing operational practices that have directly or indirectly provided wildfire mitigation. This includes world-class vegetation management, customer and community relations, partnerships with wildfire experts like the Pacific Northwest National Laboratory (PNNL), and field service inspection and maintenance. These practices and relationships have served BPA, its customers, and its service territory well.

BPA is actively growing its efforts to mitigate the risk of wildfires. The agency is making significant progress in asset management value framework maturation, inclusive of factors that address wildfire ignition or fuel in BPA's asset base. BPA continues to evaluate and deploy existing and emerging solutions that enhance operational effectiveness in mitigating wildfire risk. BPA is also expanding its focus to take into consideration more local impacts to communities surrounding Public Safety Power Shutoff (PSPS) decisions.

BPA has adopted the Institute of Asset Management's methodologies as its benchmark for asset management. By making asset management an element of BPA's 2024–2028 Strategic Plan[1], it enhances abilities to develop solutions that focus on asset lifecycle management that, in turn, improves risk-reducing methodologies in reliability, resiliency, and wildfire mitigation.

BPA will continue to assess factors of climate change, community growth, and asset conditions as its wildfire mitigation program evolves and to ensure the agency applies cost-effective and risk-based solutions in a proactive way to best serve its customers.

The scope of BPA's WMP includes asset management and vegetation management programs across the entire transmission system lifecycle:

- Operations and maintenance
- Replacement
- Disposal
- Response and recovery

Additionally, the WMP covers protocols and processes for restoring service after a wildfire. The WMP will be updated in alignment with BPA's Transmission Strategic Asset Management Plan (SAMP) and Integrated Program Review (IPR).

**1/** BPA, "2024–2028 Strategic Plan." *Available at https://www.bpa.gov/-/media/Aep/about/who-we-are/strategic-plan/2024-2028-strategic-plan.pdf*

## 1.1 Bonneville Power Administration

### Asset locations

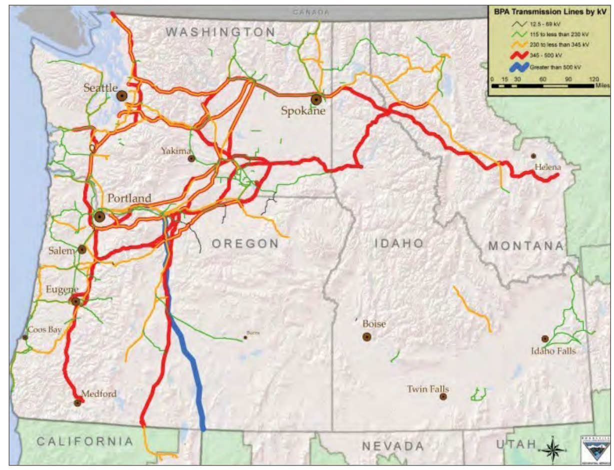


*Figure 1.*

Bonneville Power Administration (BPA) is a nonprofit federal power marketing administration based in the Pacific Northwest. Though BPA is part of the U.S. Department of Energy (DOE), it is self-funding and covers its costs by selling its products and services. BPA is one of the nation's largest public utilities with transmission assets touching several Northwest states.

BPA owns, operates, and maintains transmission facilities and equipment critical to sustaining the flow of power from generating facilities via more than 15,000 circuit miles of lines, which occupy more than 8,500 miles of rights-of-way (ROW) and pass through more than 260 substations. Its service area includes Idaho, Oregon, Washington, western Montana and small parts of eastern Montana, California, Nevada, Utah, and Wyoming.

BPA's mission is to create and deliver the best value for customers and constituents. BPA's vision is to continue being an engine of the Northwest's economic prosperity and environmental sustainability.

The terrain and climate that encompasses BPA's transmission lines, telecommunication sites, and substations varies greatly and includes coastal areas, rain forest, and high desert. Each of these areas pose unique wildfire challenges that require different mitigation strategies and solutions.

Most of the generating resources connected to the BPA transmission system provide electricity to retail customers many miles from their source. As a result, BPA operates long transmission lines and equally long ROWs. Some of these lines are located in areas with extremely strong winds, such as the Columbia River Gorge, where sustained wind speeds of 40 mph are not uncommon. Due to the diversity of its service territory with its varying climates and topography, BPA considers multiple ignition variables in the WMP.

## 1.2 Federal Columbia River Transmission System (FCRTS)

The expansive network described above covers an area totaling more than 300,000 square miles. BPA's history of providing reliable transmission at a competitive cost has attracted a wide range of interconnection customers.

BPA provides transmission service to its preference customers — approximately 140 public utility districts, municipal electric utilities, electric cooperatives, and others — independent power producers, and investor-owned utilities. Interconnected generation resources include federal and other hydroelectric projects, fossil fuel, wind, nuclear, solar, and others.

As it created this plan, BPA performed a maturity assessment using the International Wildfire Risk Mitigation Consortium (IWRMC) method to assess wildfire competencies. BPA ranked each competency with their corresponding maturity to reflect the current state of its wildfire risk mitigation capability. This analysis helped BPA recommend improvements to its physical assets, planning and operations, maintenance capability, and communications.

Consistent with the North American Electric Reliability Corporation (NERC) regulatory direction on building resiliency into utilities' asset management systems, the WMP aims to improve design and maintenance standards and improve construction activities that allow BPA to respond to a wildfire event rapidly and safely.

The plan includes assessment of new industry practices and technologies that reduce the likelihood of outage frequency and improve the restoration of service. In addition, BPA reviews and incorporates available ignition data for wildfires throughout the Northwest to build asset management plans targeting those probabilistic sources.

## 1.3 Policy statement

BPA's mission as a public service organization is to create and deliver the best value for its customers and constituents to provide an adequate, efficient, economical, and reliable power supply. BPA's vision is to advance the Northwest power system by providing high eliability and low rates consistent with sound business principles, responsible environmental stewardship, and accountability to the region.

To meet its mission and vision, BPA constructs, operates, and maintains its transmission system in a manner that minimizes wildfire risks. Iterations of this WMP will be coordinated to align with Transmission SAMP and IPR revision cycles.

## 1.4 Purpose

This WMP describes the range of policies, programs, processes, procedures, and activities to proactively mitigate threats posed by its assets for starting or contributing to the spread of a potential wildfire. This includes policies and care of its transmission assets and management of vegetation in the areas that contain BPA transmission lines and substations.

## 1.5 Objectives

The primary objectives of this WMP are to do the following:

1. Mitigate the probability that BPA's transmission assets may be the source of ignition or a fuel source of a wildfire, while continuing to provide reliable transmission service to the region and the customers served.
2. Implement a plan that prioritizes safety, situational awareness, preventative methods, and restoration.
3. Maintain a plan that improves wildfire resilient competencies and risk mitigation activities.

# 2.0 Accountability of the WMP

BPA's chief operating officer (COO) has ultimate accountability for this plan. Reporting to the COO, BPA's senior vice president of Transmission Services is the owner of the WMP and is responsible for its execution. Other BPA executives have substantive responsibilities in support of this plan, including revising and implementing policies, programs, processes, and procedures.

## 2.1 BPA responsibilities for components of this plan

The following officials and their organizations support the implementation of this plan.

- Chief Operating Officer
- Senior Vice President, Transmission Services
- Vice President, Transmission Planning and Asset Management
- Vice President, Transmission Field Services
- Vice President, Transmission Engineering and Technical Services
- Vice President, Transmission System Operations
- Vice President, Transmission Marketing and Sales
- Director, Transmission Technology
- Executive Vice President and Chief Risk Officer
- Chief Administrative Officer

## 2.2 Metrics and assumptions for measuring WMP performance

BPA has developed and continues to refine wildfire prevention measures related to the transmission system through various initiatives as outlined in the Transmission SAMP and other directional documents that impact wildfire mitigation. Some of these measures will provide input to wildfire mitigation management, such as the asset management value framework maturation and reliability standards. Other measures come from third party vendors providing products and services such as wildfire modeling. BPA's collaborative relationships with other utilities and organizations, such as PNNL, provides forums to explore meaningful metrics. As industry wildfire mitigation program standards and measures continue to evolve, BPA will identify relevant metrics to measure this plan and the agency's effectiveness.

BPA participates with a variety of peer utilities and organizations to share knowledge, data, and process development information. BPA has membership in the following organizations:

- Centre for Energy Advancement through Technological Innovation (CEATI)
- Electric Power Research Institute (EPRI)
- International Wildfire Risk Mitigation Consortium (IWRMC)
- North American Transmission Forum (NATF)

## 2.3 Maintenance performance targets

Maintenance services are established for each asset type and/or asset sub-types. The maintenance service defines the task, task type, and task frequency that are grouped into services and scheduled through the maintenance management system for the asset. The service structure can support routine maintenance and tasks that are unique for model type, age, and condition variables.

Asset condition is influenced by the efficacy, timeliness, and minimization of maintenance-induced errors. Transmission Services rigorously monitors maintenance service performance and backlog tracking for most critical assets, as described in more detail in Section 5.2.

## 2.4 System enhancement capital program

Transmission Asset Management's capital and maintenance plans are outlined in the Transmission SAMP and Asset Plan. These plans cover the long-term planning horizon for capital and the replacement/maintenance strategies for BPA's entire portfolio of assets. The plans feed directly into the IPR.

The Transmission SAMP covers the current state of assets and describes planned asset management, maturity, and competency improvements needed to effectively and efficiently manage the entire lifecycle of BPA assets that deliver electric transmission and telecommunication services. The Transmission SAMP provides alignment between the agency strategy, the Transmission Business Model, stakeholder requirements, organizational objectives, and resulting asset management objectives to ensure assets are managed and measured optimally to deliver value to the region.

## 2.5 Monitoring of the WMP

The WMP will be reviewed annually to reflect knowledge gained in the preceding year and will be modified accordingly, as needed. A more formal review will be completed in coordination with BPA's Transmission SAMP and IPR cycles. BPA prepares for annual wildfire season in advance and utilizes this plan as strategic and operational guidance.

Identified improvements will be continuously documented during the review cycle and incorporated in the WMP update. BPA specific organizational level policies, programs, processes, and procedures that support the WMP will be updated based on their respective review cycles.

## 2.6 Lessons learned

Each year, a lessons learned exercise is conducted to gather feedback from subject matter experts (SMEs) involved in the identification, response, and restoration activities involving wildfires. The exercise consists of interviews with individuals or small teams where feedback is grouped into six distinct categories. Comments are then classified as a strength (something done well), an improvement (something improved upon), or a recommendation (areas of maturity). Key takeaways are recommendations for improvement derived from the SME feedback interviews and lessons learned group discussions.

For ease in analyzing the feedback received from these interviews, the information is classified into the following six categories:

- **Communication:** Includes subject areas for customer outreach, policies/ procedures, and reporting. Communication is a large task in a major, widespread event.
- **Coordination:** Covers the interaction that occurs between numerous organizations involved with wildfire mitigation. Refers to the combination of all internal activities that would operate and interact during a wildfire event to achieve unity of action in the pursuit of managing and restoring the transmission grid.
- **Decision-making:** Includes subject areas for prioritizing data-driven decision-making, de-energizing, auto re-closing, re-energizing, and authority for making decisions.
- **Planning:** Includes subject areas for the WMP, policies, data/assessments, and documentation.
- **Support:** Includes topics relating to resources without direct transmission responsibility such as supply chain, access to locations (state of access roads, landowners, vehicles, etc.), fleet, equipment, real property, photogrammetry, logistics, and staffing levels.
- **Technology:** Covers data and information systems used for situational awareness, communication, data analysis, and decision-making.

BPA's wildfire lessons learned exercise provides valuable information that is integrated with other wildfire mitigation priorities to continuously improve wildfire competencies, programs, and plans.

**Lessons learned feedback**

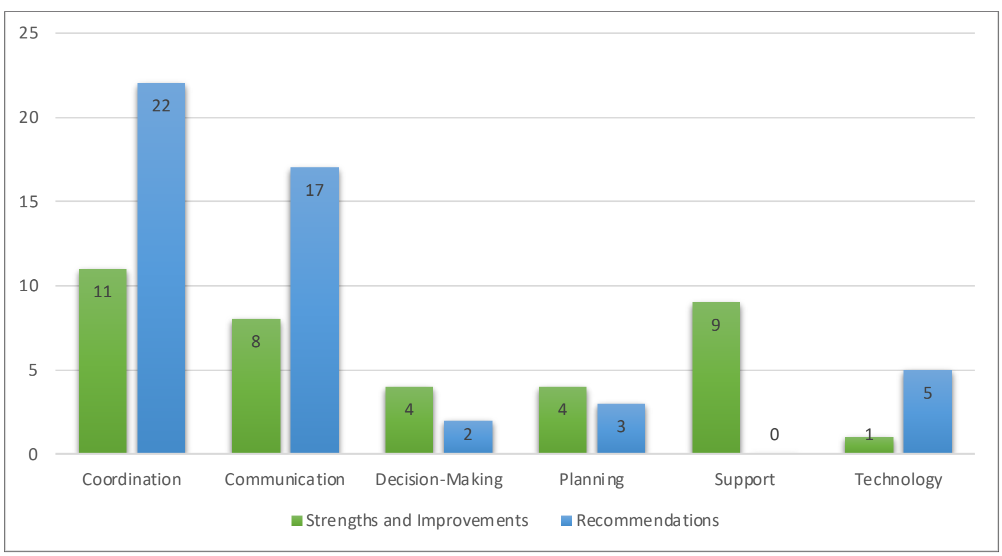


*Figure 2. Breakdown of feedback received from 2023 lessons learned interviews.*

# 3.0 Risk analysis and trends

Since early 2022, BPA has contracted with wildfire physicists, geospatial analysts, and data scientists at PNNL to develop probabilistic wildfire risk models within its service territory. A few of the many variables considered in this analysis are wind, humidity, vegetation types, and fuel volumes. Transmission Services continues to mature internal capabilities to conduct sensitivity analyses within the transmission system. The analyses help inform planned activities in coordination with local, state, and federal entities to allow for the most efficient deployment of critical resources.

BPA also voluntarily maintains tools such as the public-facing Wildfire Activity in the BPA Service Area map,[2] which communicates projected wildfire risk and conveys wildfire ignitions using federal and state data sources.

## 3.1 Contributing factors and trends

The frequency of large wildfires is influenced by a complex combination of natural and human factors, including climatic conditions such as temperature, soil moisture, relative humidity, and wind speed; vegetation (e.g. fuel density); forest management practices; and wildfire suppression techniques.[3] Wildfires have the potential to significantly impact the energy sector as they can cause both significant infrastructure damage and disrupt electricity transmission.

In recent decades, the incidence of large forest wildfires have increased and are expected to continue increasing as temperatures rise due to the climate crisis. Projected warmer and drier summers, declining snowpack, and correlated decreases in summer soil moisture will increase the risk of wildfires, particularly in forested areas where fuels are abundant.[4] Climate change is also likely to lead to increases in vegetative fuel. In the Pacific Northwest, the Cascade Mountains are one of the most at-risk areas for increasing wildfire activity. Figures 3 and 4 show general trends in wildfire incidents and burned areas in Oregon and Washington.[5,6,7]

### Wildfire incidents in Oregon and Washington, 1998–2023

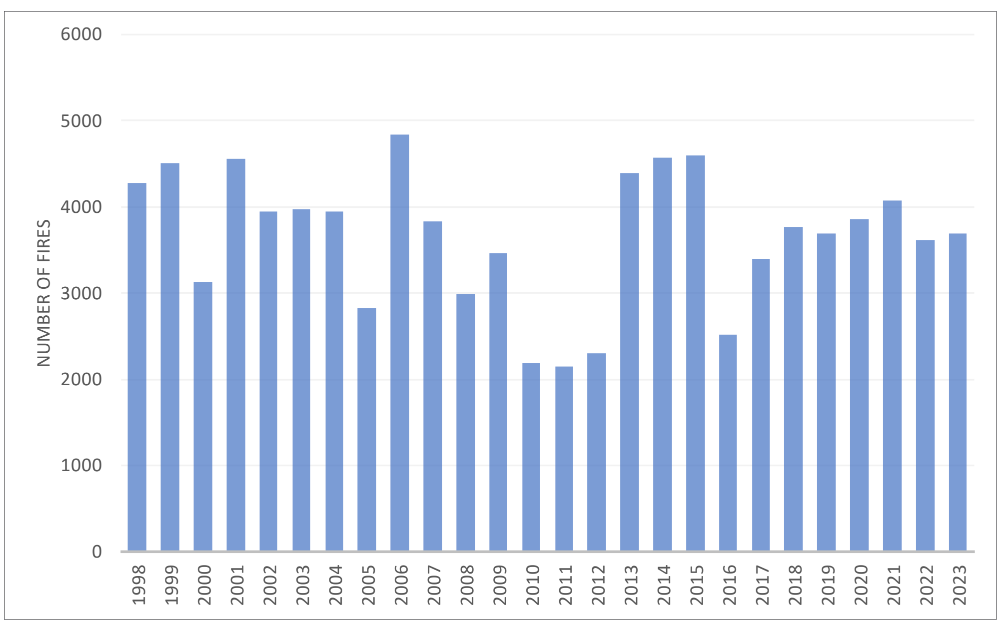


*Figure 3.*

2/ BPA, "Wildfire Activity in the BPA Service Area." Available at *https://data-bpagis.hub.arcgis.com/apps/BPAGIS::wildfire-activity-in-the-bpa-service-area-1/explore*

3/ USGCRP. U.S. Global Change Research Program. Fifth National Climate Assessment. 2023. Available at *https://nca2023.globalchange.gov/*

4/ Gergel, Diana R., Bart Nijssen, John T. Abatzoglou, Dennis P. Lettenmaier, and Matt R. Stumbaugh. "Effects of Climate Change on Snowpack and wildfire Potential in the Western USA. Climatic Change 141, no. 2 (2017): 287- 299. *https://doi.org/10.1007/s10584-017-1899-y*

5/ NICC. National Interagency Coordination Center. Wildland Fire Summary and Statistics Annual Report 2008. Available at *https://www.nifc.gov/sites/default/files/NICC/2-Predictive%20Services/Intelligence/Annual%20Reports/2008/annual_report_2008_508.pdf*

6/ NICC. National Interagency Coordination Center. Wildland Fire Summary and Statistics Annual Report 2013. Available at *https://www.nifc.gov/sites/default/files/NICC/2-Predictive%20Services/Intelligence/Annual%20Reports/2013/Annual_Report_2013_508.pdf*

7/ NICC. National Interagency Coordination Center. Wildland Fire Summary and Statistics Annual Report 2023. Available at *https://www.nifc.gov/sites/default/files/NICC/2-Predictive%20Services/Intelligence/Annual%20Reports/2023/annual_report_2023_0.pdf*

## Area burned in Oregon and Washington, 1998–2023

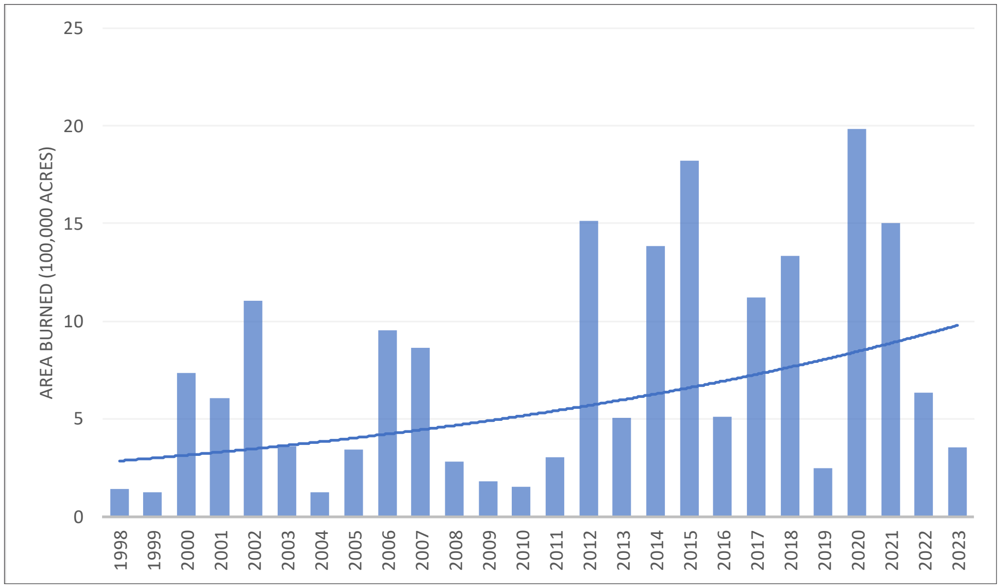


*Figure 4.*

The wildfire season is lasting longer and starting earlier.[8,9] Figure 5 shows that from 1984 to 2001, the wildfire season peaked in August, and from 2002 to 2020, it peaked in July.

## Comparison of monthly burned area due to wildfires in the United States between 1984–2001 and 2002–2020

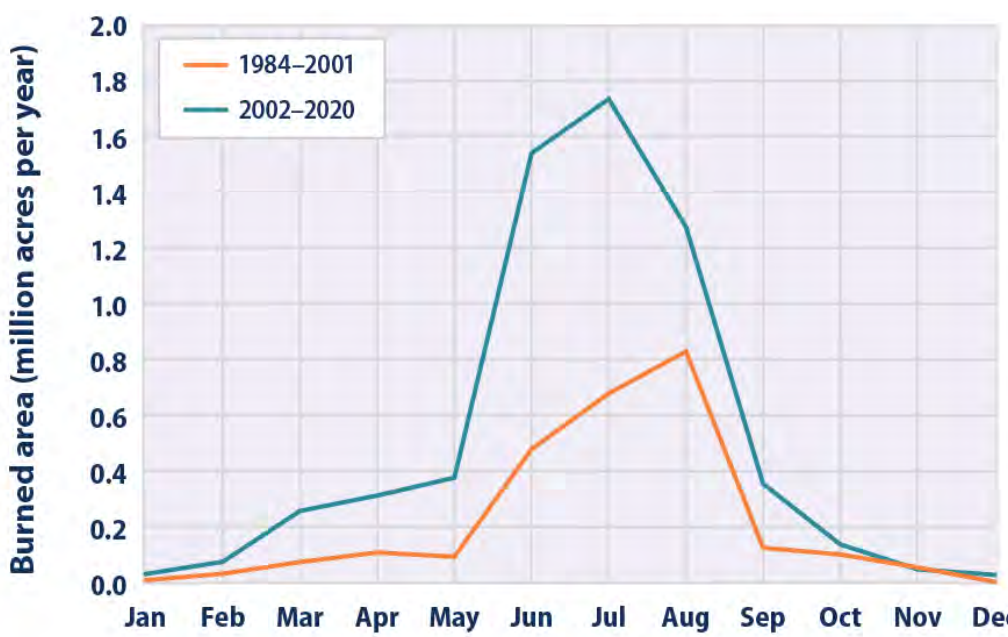


*Figure 5. Comparison of annual distribution of burned area due to wildfires in the United States between the first half of the period of measurement (1984–2001) and the second half (2002–2020).*

**8/** MTBS. Monitoring Trends in Burn Severity. 2022. Available at *www.mtbs.gov/direct-download*

**9/** EPA. United States Environmental Protection Agency. Climate Change Indicators: Wildfires. Figure 6. Available at *https://www.epa.gov/climate-indicators/climate-change-indicators-wildfires#ref28*

## 3.2 Transmission risk-based planning and prioritization process

Understanding how drivers of ignition and climate trend in time across the BPA system is a key input into the planning process and feeds how BPA quantifies risk by asset location. These trends feed the probabilistic variables overlaid with the asset locations to provide a data-informed understanding of relative wildfire risk.

## 3.3 Asset management value framework

Transmission Services is developing a risk-based decision-making value framework, capturing the organization's key value measures, financial parameters, and risks, in alignment with overall organizational goals. Transmission Services will use the value framework, when implemented systematically, to evaluate and prioritize potential investments that enable the comparison of projects across programs. Until it is automated, the value framework will be manually implemented to support subject matter assessments and discussion in a more standardized fashion.

## 3.4 Risk management

BPA uses its existing Enterprise Risk Management framework to identify and assess enterprise-level risks. This framework is built on the ISO 31000 (International Standards Organization), which takes into consideration both quantitative and qualitative factors to determine the level of a particular risk.

# 4.0 Overview of preventive strategies and programs

This WMP integrates and interfaces with various operating policies and asset management and engineering principles, which are themselves subject to change. As such, this document reflects current policies, programs, processes, and procedures as of its publication date. BPA may revise or adopt new policies and standards between publications. Subsequent versions of the WMP will reflect changes made since the issuance of the last plan and identify new or revised policies, programs, processes, and procedures.

## 4.1 Competency assessment

In 2022, BPA adopted the IWRMC Maturity Model. The purpose of the model is to better understand the current state of BPA's programs and activities in relation to general utility threats from wildfire and to build a roadmap for continuous improvement. SMEs across BPA completed self-evaluations of competencies as shown in Figure 6. BPA's overall score increased from 2022 to 2023.

Updates to mature BPA's wildfire mitigation program since the WMP last published in 2022 include, but are not limited to, the following:

- Maturation of wildfire modeling including development of enhanced geospatial tools that support planning, engineering, operations, and data-informed decision making. Also led to new retrospective wildfire analysis capabilities.
- Continued development of the PSPS program, including updates to process documentation and year over year data comparisons.
- Creation of a tool to track situational risks dependent on asset health; enables enhanced data-informed decision-making for transmission operations.

**Source** Dennison, et al. 2014)

- Continued industry engagement and benchmarking with other with external agencies, utilities, and industry peers.
- Continued proactive communication with regional customers and stakeholders to prepare for wildfire season.
- Continuation of internal PSPS and Storm & Wildfire Incidence Response table-top exercises to sustain preparedness and train personnel.
- Implementation of wood pole wildfire retardants and research into new, non-wood pole materials.
- Established additional granular expenditure tracking to enable more thorough, accurate financial reporting.
- Enhanced internal BPA team collaboration to help expedite planning and execution of asset repair and replacement projects to prioritize wildfire mitigation activities.

**2022 BPA IWRMC Maturity Model, results by category**


*Figure 6.*

## 4.2 Overview of wildfire mitigation hierarchy

The wildfire mitigation hierarchy depicted in Figure 7 reflects the holistic enterprise efforts surrounding how BPA mitigates wildfire risk. These efforts include system hardening, situational awareness modeling, wildfire season-specific relay/control practices, extreme risk days, and finally, PSPS as a last resort.

Activities, such as long-term planning and investment tactics using new wildfire resiliency metrics, demonstrate BPA's proactive, ongoing system hardening efforts. With the maturation of situational awareness tools improving system condition visibility, BPA scales resources as needed. Finally, as a last resort, during the most extreme risk days, BPA can decide to enact a targeted PSPS de-energization.

## Wildfire mitigation hierarchy

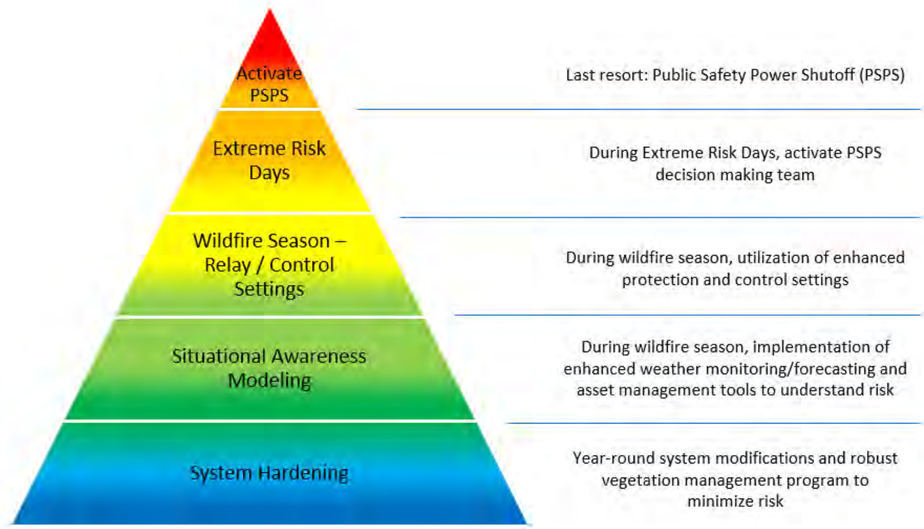


*Figure 7.*

# 5.0 Wildfire mitigation measures

BPA has a proven history of holistic measures to address potential wildfire risks. Some of the activities BPA engages in are listed below:

| Risk Factor | Activity |
|---|---|
| Fuel | Vegetation management |
| | Fuels reduction |
| | Data-informed decisions based on Light Detection and Ranging (lidar), multi-spectral imagery, and wildfire models |
| Asset failure | Transmission line detailed inspections and annual patrol |
| | Routine maintenance |
| | Focused design and construction standards to reduce ignition probabilities |
| | No re-closing during fire season on specific circuits |
| | Non-expulsion fuses and arrestors |
| | Intrusive pole testing and pole replacement |
| | De-energization of lines during certain conditions |
| Contact from objects | Animal/bird guards |
| | Wire spacing to reduce phase-to-phase contact |
| | Proactive vegetation management |
| | Line ratings and clearance analysis through lidar |
| Other | BPA worker/contractor education on fire ignition sources from normal work activities |
| | Wildfire watch 30 minutes after work completion in high-risk areas |
| | Pre-positioning wildfire suppression equipment (e.g., water trailers) to get waivers to work |
| | Coordination and collaboration with local fire wildfire fighting districts or emergency services entities and county offices year-round to prepare for high-risk wildfire events |

BPA vigilantly manages the trees, brush, and other vegetation on its ROWs. BPA uses lidar combined with aerial photographs to help identify spots where inspection and potential vegetation clearing are necessary, preventing foliage from encroaching on designed clearance boundaries and inadvertently sparking a fire.

During wildfire season in dry areas conducive to wildfires, BPA selectively disables automatic re-closers as a preventative measure and deploys field staff to visually inspect lines prior to re-energization. BPA uses, analyzes, and modifies the practice of disabling select automatic re-closing as necessary. BPA discloses use of this practice in its outage communication plans to ensure customers and other stakeholders are informed of the potential for a line to stay de-energized until it can be visually inspected. While power may be interrupted for longer than usual, this practice significantly decreases the risk of fire posed by auto reclosing or manual testing.

## 5.1 Transmission operations during wildfire season

BPA Real-Time Operations uses situational awareness tools at its disposal to respond appropriately to wildfire threats. The team evaluates information such as ground reports, Geographic Information System (GIS) data, asset condition data from field maintenance and planning organizations, wildfire weather reporting, and other resources.

Real-Time Operations takes procedure-established actions that may include, but are not limited to, the following:

- Preventative Actions
  - Disabling automatic re-closing
  - Order no test orders on facilities
  - Requiring onsite inspection before testing faulted equipment
  - Pre-emptive public safety power shutoffs
- Responsive Actions
  - De-energize equipment due to fire
  - Dropping load
  - Curtailing transmission

## 5.2 Transmission line inspections and observations

BPA has a multi-prong approach to inspecting its transmission lines and observing surrounding conditions. First and foremost, BPA deploys field crews to inspect the safety, reliability, and condition of its lines and facilities. Additionally, BPA identifies and responds to threats in its ROWs created by landowners or the public that could cause wildfires.

### 5.2.1 Asset inspections

BPA performs routine infrastructure inspections to inform planning and scheduling of future asset maintenance for system reliability. BPA's planning and engineering teams use reported field condition assessments to prioritize maintenance and replacement needs. Areas of inspection include, but are not limited to, the following:

- Wood poles, crossarms, and cross braces
- Steel structures
- Disconnect switches
- Guy systems and anchor rods
- Conductors and accessories
- Insulators
- Fiber-optic cables and accessories
- Grounding
- Obstruction marking and lighting

### 5.2.1 Land use inspections

Several external factors exist that can increase the risks of causing or contributing to wildfires. For example, external risks can arise when transmission lines cross over or are near retail businesses, suburban backyards, construction sites, agricultural land, rural homes, thick forests, trails and campgrounds, arid plains, and deep canyons.

Even though public and private property owners, businesses, and contractors take precautions, their equipment can come in contact with transmission lines. Routine activities can also contribute to wildfires; for instance, smoke from burning brush piles can conduct electricity and refueling vehicles under lines without proper precautions may cause arcing. While often unintentional, these contacts or activities may damage transmission lines, poles, and other equipment; cause sparks and trigger wildfires in the vicinity; and/or pose public safety and electrocution risks. BPA equipment or ROWs can also be vandalized and damaged, which may cause sparks and wildfires.

BPA field staff conduct annual patrols of ROWs to report incompatible uses and encroachments. The agency also has a land use review process that allows developers or landowners to get their planned activities reviewed in advance. BPA evaluates if these plans can be safely conducted under or near the transmission lines.

## 5.3 Vegetation management

BPA manages, directly or by agreement, all vegetation on BPA transmission line ROWs, fee-owned lands, and easements to establish and maintain the safety and reliability of its facilities. BPA's Vegetation Management program complies with applicable federal reliability standards. The program uses cost effective methods to proactively manage vegetation and to establish low-growing plant communities along the ROW to minimize the development of potentially threatening or incompatible vegetation. The goal of vegetation clearing in BPA ROWs is to manage vegetation that supports transmission reliability and reduces wildfire risks, while also adhering to BPA's commitment to environmental stewardship.

BPA performs vegetation patrols annually, which includes inspecting and removing vegetation within and outside of its ROWs where tree or branch failure would potentially damage transmission line assets. The Vegetation Management program strives to ensure all vegetation on ROWs, easements, and fee-owned land is managed according to BPA's legal rights and applicable standards to establish and maintain the safety and reliability of its facilities.

The program covers both routine scheduled maintenance of the transmission lines, access roads, and other facilities as well as emergency or imminent threat vegetation removal.

The program sets clearance distances from any vegetation to the transmission line (a conductor). Since conductors move horizontally and vertically based on dynamics such as operating temperature, wind, and loading, clearance is evaluated from all conductor positions. Clearance also accounts for vegetation that would fall, grow, bend, or swing into a clearance distance if not removed.

BPA establishes and maintains vegetation with a mature height or growth that is 25 feet below the maximum sag of the transmission lines. In situations where this standard cannot be achieved due to legal or physical constraints, BPA has subject matter experts set a maximum allowable clearance distance for the specific circumstances. BPA's vegetation management team and transmission line workers conduct ground patrols to minimize vegetation-related wildfire hazards and remove flammable materials around wood structures.

Proactive maintenance during routine operations and prompt action during emergency events maintain system reliability and safe work environments while mitigating wildfire risk.

BPA uses lidar, aerial, and ground patrols to monitor vegetation around its facilities. Lidar data is typically acquired on a portion of BPA's circuits annually and the data is provided to aerial and/or ground patrol staff.

Prior to the completion of a construction project, all vegetation clearances must be verified to ensure the vegetation management activities meet BPA's standards prior to the line being energized. Certain targeted high-risk areas are re-evaluated to ensure vegetation clearances are upheld.

## 5.4 Emerging technologies and operational practices

BPA is committed to developing an industry-leading asset management program consistent with its 2024–2028 Strategic Plan. Part of that effort includes ongoing benchmarking and incorporating best practices that range from business transformation to modern technologies that help inform asset-related decisions. BPA explores new capabilities and risk mitigation practices, and when possible, incorporates them into its operations.

**Fire retardant wrap applied to wood pole**

*Figure 8.*

### 5.4.1 Wildfire mitigation design

BPA has built and organized a library of standards and specifications for design and construction with review cycles to allow it to adopt best practice improvements and incorporate modern technologies. As BPA learns more about its system's highest wildfire risk areas, the agency explores modifying design standards to best prepare for wildfire events.

One design standard update undertaken focuses on increasing the resiliency of wood poles and pole structures along transmission lines. Guided by wildfire risk models and inherent knowledge of field conditions, BPA Transmission Engineering devised a data-informed decision procedure to determine where wildfire retardants or non-wood pole options should be installed. These alternatives are explored during the design and standards review processes, allowing modification of metrics and internal controls to further mitigate the agency's wildfire concerns.

Furthermore, researching multiple protective measures for wood pole structures led BPA to select employable wildfire retardant methods based on the following criteria: climbing capability, potential to trap water, ease of installation, usable life, and ability to repair. An environmental review and cost analysis were also completed.

One of the recommendations includes an intumescent-coated fiberglass mesh wrap designed to protect all wood species and treatments of wood utility poles from wildfire damage. The wrap expands when exposed to extreme heat, and tests have proven it provides excellent flame resistance and can withstand years of outdoor weathering.

### 5.4.2 System capital improvements

BPA's ratepayers and stakeholders expect reliable service at the lowest possible transmission rates consistent with a sustainable business model. BPA's strategic plan dictates that it must balance the cost-effectiveness of its construction and maintenance of its capital assets with risk management. To deliver on these requirements, Transmission Services must assess effective methodologies for investment evaluation and decisions.

### 5.4.3 Fire prevention strategies, regulations, restrictions, precaution levels and pre-suppression

Federal statutory obligations require BPA to reliably operate and maintain its transmission facilities.[10] Agency modeling of wildfire threats, in combination with its geospatial and asset data, will continue to inform its maintenance and construction work planning and scheduling strategies. When circumstances such as weather, environmental restrictions, and the logistics of managing 15,000 line miles contained within 8,500 miles of ROWs allow, routine and non-emergency work will be scheduled during the lowest risk times of the year in high-wildfire-risk areas. When routine or non-emergency work is impossible, or when urgent, BPA takes the "fire safe" approach by completing unplanned maintenance in order to proactively protect public safety and prevent the spark and spread of wildfire.

Additionally, BPA adopted a Wildfire Smoke Exposure Program because smoke from wildfires is comprised of many components, including particulates small enough to enter the lungs. The Air Quality Index considers the number of particulates contained in smoke and helps to identify stages where strategies must be considered to mitigate health issues. The purpose of the program is to establish guidance that BPA managers consider prior to assigning staff to work in areas where wildfire smoke is present.

This "fire safe" approach is incorporated into BPA's situational awareness methods, operational practices, and asset management and vegetation management strategies. BPA employs the approach throughout the year, but particularly during wildfire season, for planning critical work, and uses the approach in its stakeholder cooperation and community engagement strategy.

BPA is aware of varying jurisdictional regulations on federal, state, local, and private lands. The applicability of these various standards generally depends on who owns the land, but as a federal agency, BPA is only required to follow federal regulations. BPA has acquired real property rights that include the rights to construct, operate, and maintain its transmission lines on private land, and has acquired similar rights via ROW permits or agreements on federal and state public lands. BPA is currently evaluating the need for enhanced wildfire mitigation and prevention training for all field staff.

BPA has over 2,000 miles of transmission lines on federal public lands administered by the United States Forest Service (USFS) or the Bureau of Land Management (BLM) and is required to follow federal wildfire regulations on these lands.[11] The regulations require ROW holders to adhere to public use, industrial use, and other wildfire precautions and

**10/** 16 USC §838b; 16 USC §824o; NERC Reliability Standard FAC-003-4.

**11/** The Federal Land Policy and Management Act (FLPMA) and other federal laws require Bonneville to follow the land managers' wildfire regulations on federal land.

restrictions. Except when responding to an emergency, BPA may request waivers or variances to undertake activities that would otherwise be restricted. Prior to making a request, BPA evaluates possible ignition risks associated with delaying maintenance and considers potential risks of starting a wildfire while the repair or maintenance is being conducted during high wildfire risk times. The federal land manager has the discretion to grant a variance or waiver when appropriate criteria are met and mitigations are in place. Federal land managers routinely work with BPA to issue waivers to allow for important maintenance work with conditions and restrictions in place.

Wildfire mitigation modeling and analysis helps BPA explain to federal land managers how timely preventive maintenance and repairs of specific transmission line equipment and vegetation in and along a ROW reduce the risk of wildfire, even if the work requires issuance of waivers. If BPA identifies urgent work that needs to be expedited, the agency's wildfire risk analysis and modeling help it quantify any increased wildfire risks if the work is delayed.

Federal law requires BPA to conduct emergency work to restore power or remove vegetation or obstacles from contact with the line. BPA will, however, coordinate in advance with public land managers whenever time permits.

Notably, BPA's 2017 Memorandum of Understanding (MOU) with the USFS requires advance coordination on maintenance activities and includes a wildfire prevention and suppression plan designed to prevent and minimize wildfire. BPA also follows BLM's regulation that requires all ROW permit holders to do everything reasonable to prevent and suppress wildfires on or in the immediate vicinity of the ROW area.[12]

As a federal agency, BPA is not governed by state or local wildfire regulations on non-federal lands. Pursuant to state law and administrative regulations, state and local agencies may oversee wildfire management on forest and rangeland primarily in rural areas outside of city boundaries. This state and local work is undertaken along with private forest and range landowners, who are often required to either pay wildfire protection fees, perform assessments, or provide their own wildfire protection plans and resources. BPA's WMP demonstrates to landowners that precautions are being taken in planning and carrying out work.

BPA's transmission line maintenance crews and vegetation management specialists are the primary owners of this "fire safe" operational strategy to maintain access to federal public land and to coordinate with nonfederal public and private landowners. Additionally, BPA staff who issue contracts for vegetation management, construction, and maintenance work will assure these contracts provide adequate wildfire pre-suppression measures and require appropriate coordination with the applicable wildfire agencies.

### 5.4.4 Risk-Informed vegetation management

BPA will continue to evaluate its Vegetation Management program, examine industry best practices, and identify any additional risk-informed strategies that could advance its work to minimize wildfire risks. The Vegetation Management program will use risk assessment tools, geospatial data, and other risk-based evaluation tools acquired by BPA in the future to achieve improvement. This risk-informed approach may result in BPA reprioritizing or adding resources to address high-risk wildfire areas, such as modifying the frequency of inspections or taking additional measures to reduce fuel levels.

**12/** CFR §2805.12(a.4).

# 6.0 Emergency response and preparedness

As a federal power marketing administration, BPA follows federal guidance including the Federal Emergency Management Agency (FEMA) and DOE directives and orders for emergency response activities. Implementation of the National Incident Management System (NIMS) and Incident Command System (ICS) are imbedded in the planning efforts and documentation followed by personnel when responding to wildfires and other incidents.

BPA interacts with other emergency management agencies within its service territory at multiple levels. General coordination of wildfire response efforts across the BPA service territory involve actions with its control centers to mitigate impacts to customers and equipment. BPA's control centers dispatch resources from operations and maintenance districts for local safety and alignment of efforts. Local responses are commonly performed by the relevant district employees. For larger or multiple impacts to BPA's transmission system in the same period, BPA will elevate the level of its response coordination accordingly. This can mean BPA raises coordination from a local response to an agencywide response.

The local wildfire department or the National Wildfire Coordinating Group (NWCG) notifies BPA's control centers when a wildfire is approaching BPA's infrastructure. BPA's Weather and Streamflow Forecasting workgroup provides real-time weather data that includes National Weather Service Red Flag Warning (NWS RFW) areas and thunder and lightning storms. The group also monitors wildfires in the service territory and provides notifications to the control centers. Dispatched BPA personnel act as agency representatives for the incident management team established to address the event. BPA also provides liaisons for federal, state, tribal, and local governments who regularly coordinate efforts and share information.

Rerouting power during outages and securing impacted equipment are BPA's primary means of reducing the risk of its equipment igniting a wildfire or preventing existing wildfires from damaging transmission assets. BPA regularly communicates to customers and other stakeholders through many channels regarding curtailments and restoration timelines. BPA supports many customers, including some that perform critical processes and would cost the customer resources if power is disrupted. In some instances, BPA is the only entity capable of transmitting power to specific locations where outages can affect vulnerable entities and communities. Extended power outages require active communication with customers and coordination with other responding entities.

BPA Communications manages awareness via social media and provides communications products and assistance about ongoing and available resources for customers and federal, state, tribal, and local governments. BPA also coordinates with entities to prepare for and respond to potential emergency events. Interested individuals are encouraged to access www.bpa.gov to learn more about BPA's wildfire response and mitigation efforts.

BPA establishes and maintains contact with customers and other stakeholders to keep them informed when preparing for a potential or imminent PSPS. BPA has specific personnel assigned to contact federal, state, tribal, and local agencies and has account executives assigned to all customers.

## 6.1 Continuity support for wildfires

BPA adopted the ICS to help coordinate response, restoration, and recovery efforts. BPA's Continuity of Operations and Emergency Management staff participate in national, state, and local transmission-related tabletop exercises and contain vast knowledge of BPA's transmission system and operating protocols.

Emergency management specialists are involved in BPA's general wildfire response and provide situational awareness during severe wildfire seasons and respond to wildfires as necessary. Continuity of Operations and Emergency Management staff continue to work with BPA transmission dispatch and field operations in support of wildfire mitigation and response.

### 6.2 Event communications

When practical, BPA will provide notice to customers when it is necessary to interrupt load due to a wildfire. BPA will notify its transmission customers of curtailments of transmission due to wildfire through the normal reliability curtailment processes. It is BPA's goal to provide advanced notice, but often this is not practical when addressing safety and reliability issues.

BPA interacts with emergency management officials from federal, state, tribal, and local governments and agencies to keep them updated on wildfire mitigation efforts. BPA also works with stakeholders on collaboration and partnership opportunities when developing and implementing strategies. BPA's Continuity of Operations and Emergency Management Office tests and maintains the agency's emergency notification system for BPA decision-makers and incident support staff to accurately respond.

## 7.0 Public Safety Power Shutoff (PSPS)

During wildfire season, typically May through October, there may be extreme conditions or weather triggers that require BPA to de-energize transmission assets to reduce the risk of ignition. These extreme weather triggers are based on industry best practices that address imminent wildfire danger and geospatial analysis of wind and humidity. BPA's criteria for standing-up its PSPS team to decide whether to de-energize assets proactively are when wind gusts exceed 60 mph within NWS RFW areas as the conditions correlate to warm temperatures and low humidity.[13] BPA has calibrated these variables to its robust design standards.

BPA uses data from internal and external sources to make PSPS decisions. Examples include vegetation types, urban density, asset density, asset health, ignition probability, wildfire behavior, wind, humidity, and line/load criticality.

BPA recognizes the impacts to the region that come with a PSPS de-energization and is committed to making these decisions in a timely and data-informed manner. BPA's Transmission Operations organization and NERC-certified dispatchers retain the right to de-energize assets proactively for any reason, based on system conditions. As Figure 7 illustrates, PSPS de-energization is a last resort. If a PSPS decision is enacted, BPA will initiate its communication processes to its impacted utility wholesale customers and regional outreach.

In the event of a PSPS, BPA's constituent and tribal account executives will communicate information to federal, state, local elected officials, tribes, and other important stakeholders. BPA does its best to avoid overlaps with other utility outreach to state, local elected, and emergency management officials by coordinating communication efforts with the affected utilities.

As the event unfolds, BPA will work with impacted utilities and, if asked, augment customer utility outreach through providing information to local media and social media channels to ensure residents and others are aware of the situation. BPA will not engage in any other outreach efforts to end-use customers (residents, businesses, etc.) unless a customer utility specifically requests it.

13/ National Weather Service, "What Is a Red Flag Warning?" available at https://www.weather.gov/media/lmk/pdf/what_is_a_red_flag_warning.pdf, accessed Nov. 9, 2023.

Re-energization after a PSPS event begins after the extreme weather event has passed and line crews are cleared to enter the area. BPA crews then patrol the de-energized lines and inspect for obvious damage and vegetation within the ROW that may prevent safe re-energization. When field crews find damages, they will isolate the impacted area(s) and perform repairs as quickly and safely as possible. In some instances, temporary solutions to restore power may be implemented while permanent repairs are planned. Depending on the extent of damage, utility customers may need to perform repairs on their facilities prior to having full electric service restored; these efforts are coordinated on an as-needed basis. Once the lines and structures are safe to operate, re-energization occurs followed by communications procedures similar to de-energization messaging.

# Appendix

| List of acronyms | |
|---|---|
| BLM | Bureau of Land Management |
| BPA | Bonneville Power Administration |
| DOE | Department of Energy |
| ICS | Incident Command System |
| IPR | Integrated Program Review |
| IWRMC | International Wildfire Risk Mitigation Consortium |
| NERC | North American Electric Reliability Corporation |
| NWS RFW | National Weather Service Red Flag Warning |
| PNNL | Pacific Northwest National Laboratory |
| PSPS | Public Safety Power Shutoff |
| ROW | Right-of-Way |
| SAMP | Strategic Asset Management Plan |
| SME | Subject Matter Expert |
| USFS | United States Forest Service |
| WMP | Wildfire Mitigation Plan |

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# Appendix C: NERC Wildfire Mitigation Reference Guide (January 2021)

NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

# Wildfire Mitigation Reference Guide

January 2021

## Introduction

Electricity is a vital component of the fabric of modern society. The Electric Reliability Organization (ERO) Enterprise, which consists of the North American Electric Reliability Corporation[1] (NERC) and the six Regional Entities,[2] serves to strengthen that fabric for the benefit of nearly 400 million citizens of North America. The ERO Enterprise pursues its mission of assuring the effective and efficient reduction of risks to the reliability, resilience, and security of the bulk power system (BPS) by working with users, owners, and operators of BPS assets, government partners, and other stakeholders and industry participants.

The Reliability Issues Steering Committee describes and prioritizes risks to the reliable operation of the BPS in a biannual report[3] to the NERC Board of Trustees that includes recommendations regarding the approach the ERO Enterprise and industry should take to enhance reliability and manage those risks. Wildfires pose risks because they can disrupt the reliable generation and delivery (transmission and distribution) of electricity to customers. Electric utilities in high fire-threat areas should have plans or strategies to address and mitigate the threat of electrical infrastructure or equipment causing ignitions that could lead to wildfires and/or being impacted or damaged by wildfires.

## Preface

Wildfires[4] are generally defined as unplanned, uncontrolled fires fueled by an area of combustible vegetation and, like all fires, require three fundamental elements to exist: fuel, oxygen, and heat. The fuel supply across North America has increased over the past few decades due to political policies around fire suppression and forest management, the introduction of non-native grasses, and dryer climates and droughts that left forests damaged by insects and disease. The oxygen often comes in the form of high winds that can spread the fires quickly. The sparks that initiate the fires are primarily generated from human activities and weather, but about 10% of wildfire ignitions[5] are sparked by faults on electrical infrastructure or electric equipment failure. In recent years, wildfires have emerged as a significant risk to public safety and to the BPS assets that serve the Western Interconnection of North America.

WECC[6] promotes BPS reliability and security in the Western Interconnection. WECC extends from Canada to Mexico and includes the provinces of Alberta and British Columbia, the northern portion of Baja California, Mexico, and all or portions of the 14 western states between. These western states and the two

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[1] North American Electric Reliability Corporation
[2] Regional Entities
[3] 2019 ERO Reliability Risk Priorities Report
[4] National Geographic - Wildfires
[5] 2019 California Redbook
[6] WECC

Canadian provinces have experienced numerous catastrophic wildfires in the recent past, and the fires are getting larger and more intense. In 2020, California experienced five of its largest (acreage burned) fires in recorded history. Wildfire seasons are getting longer and the fires are increasing in frequency and severity. Since 2017, California has experienced thirteen of its most destructive (structures destroyed) fires and eight of its most deadly.[7]

### Wildfire Mitigation Plans

Wildfires initiated by electric utility infrastructure prompted the state of California to enact legislation[8] in 2018 that required each electrical corporation, local publicly owned electric utility, and electrical cooperative to do two things: construct, maintain, and operate its electrical lines and equipment in a manner that will minimize the risk of catastrophic wildfire posed by those electrical lines and equipment and prepare and submit wildfire mitigation plans[9] (WMPs) on an annual basis for review and approval by the California Public Utility Commission (CPUC). The WMPs required by the CPUC contain up to 20 mandated elements that create a comprehensive strategy and defense against wildfire initiation by the utility's electrical lines and equipment.

In general, WMPs describe how the utilities' electric systems are designed, constructed, operated, inspected, and maintained to promote wildfire safety, prevention, mitigation, and recovery. The CPUC requires utilities under its purview to organize the information into the following categories:

1. Risk Assessment and Mapping
2. Situational Awareness and Forecasting
3. Grid Design and System Hardening
4. Asset Management and Inspections
5. Vegetation Management and Inspections
6. Grid Operations and Protocols
7. Data Governance
8. Resource Allocation Methodology
9. Emergency Planning and Preparedness
10. Stakeholder Cooperation and Community Engagement

One of the most effective and highly scrutinized mitigation measures is the public safety power shutoff (PSPS). Allowed under California law, a PSPS is the proactive de-energization of power lines that are forecasted to be in the path of critical fire weather conditions. For utilities that strive to provide reliable electric energy to customers 100% of the time, intentionally turning off the power is a last resort, but removing these vulnerable lines from service eliminates the risk of ignition. Although effective in protecting customers, first responders, and property, PSPS events are extremely disruptive to customers' lives.

[7] California Fire Statistics
[8] California Senate Bill 901
[9] Wildfire Mitigation Plans

Consequently, electric utilities have undertaken risk-based initiatives to limit the scope, duration, and frequency of PSPS events to minimize their impacts. Descriptions of these initiatives, such as system hardening, installing additional sectionalizers, installing weather stations and high definition cameras, installing microgrids, and using data to predict the highest fire threat areas and the fire's potential spread are included in the WMPs.

WMPs detail the electric utility's initiatives and activities for reducing the risks of its lines and equipment igniting wildfires in the high fire risk areas of its service territory. The risks associated with the equipment vary depending upon several factors: age and condition, population density (ingress and egress), surrounding climate, terrain and vegetation, voltage class and type of construction, and policies and regulations around land/forest management. New technologies and increasing data capture have enabled companies to perform risk analysis at the asset level, allowing them to prioritize activities and develop initiatives for specific lines and equipment. This granularity provides for more effective and efficient mitigations. While each utility's risks are unique, general metrics have been developed for various aspects of the plan that enable the utility and the CPUC to assess the outcomes and measure the performance of the individual initiatives. Identifying successes and deficiencies within the plan ensures that the iterative process of plan development is one of continuous improvement. For example, the CPUC developed its 2021 guidelines[10] for wildfire mitigation plans after the CPUC's Wildfire Safety Division completed its annual review of the utility plans, including evaluating best practices and lessons learned from 2020 wildfire mitigation plans.

## Conclusion

Although catastrophic wildfires have predominantly been a western experience, the threat of wildfires is a growing concern for other areas of North America. Ever-changing more extreme weather and the abundance of dry fuels provide two of the three necessary elements for wildfires. Due to the presence of electric current, electrical infrastructure and equipment have the potential to provide the ignition spark. While completely eliminating the risk of being the source is not possible, it is incumbent on electric utilities to proactively minimize that risk. To accomplish this, electric utilities across North America located in heightened fire-threat areas could develop and implement wildfire mitigation plans.

NERC and WECC developed this document with the goal of creating more awareness across all Interconnections of the knowledge and experience gained by western utilities on wildfire preparedness and mitigation. Research and development efforts by the Department of Energy (DOE) National Laboratories in partnership with electric utilities and other stakeholders on many facets of wildfire mitigation, situational awareness, and pre- and post-fire analyses are also highlighted in the document.

[10] WMP Guidelines

# References

The links provided below will connect the reader to information and tools helpful for developing a comprehensive wildfire mitigation plan. *Note: These references are not a comprehensive listing.*

## Wildfire Mitigation Plans

### North American Utilities: United States

- Pacific Gas and Electric
- Southern California Edison
- San Diego Gas & Electric
- Liberty Utilities
- Bear Valley
- Horizon West
- Trans Bay Cable
- Sacramento Municipal Utility District
- Los Angeles Department of Water and Power
- Anza Electric Cooperative
- PacifiCorp
- Bonneville Power Administration

### North American Utilities: Canada

- BC Hydro Wildfire Safety
- Altalink Wildfire Safety Booklet

## Bushfire Mitigation Plans and Fire Safety

### Australia

- Jemena
- Powercor
- AusNet Services
- Transgrid
- AGL Hydro
- Powerlink - Queensland | Australia
- Western Power - Western Australia

## Organizations

The websites below link to organizations involved in various aspects of wildfire prevention and mitigation, management and recovery, and research and development.

### State of California

- California Public Utilities Commission (CPUC)
- Wildfire Safety Division
- California Department of Forestry and Fire Protection (CAL FIRE)

### Federal Agencies

- United States Forest Service
- United States Department of Agriculture
- National Wildfire Coordinating Group
- United States Fire Administration
- National Interagency Fire Center
- Forests and Rangelands
- U.S. Department of the Interior (Bureau of Land Management)
- U.S. Department of Energy (Grid Modernization Lab Consortium)
- U.S. National Parks Service
- National Weather Service

### Canadian Federal Agencies

- Canadian Electricity Association (CEA)
- Natural Resources Canada
- Canadian Interagency Forest Fire Centre (CIFFC)

### Associations, Forums, and Councils

Note: EEI, NATF, APPA, NRECA, CEATI, and EPRI are "Members Only"; however, each has a public-facing webpage that can be searched using the keyword "wildfire." For example, EPRI has public reports referenced in this document:

- Electricity Subsector Coordinating Council (ESCC)
- Edison Electric Institute (EEI)
- North American Transmission Forum (NATF)
- American Public Power Association (APPA)
- National Rural Electric Cooperative Association (NRECA)
- Electric Power Research Institute (EPRI)

- CEATI International
- Society for the Protection of Forests Against Fire (SOPFEU)
- Wildland Fire Leadership Council
- International Association of Wildland Fire (IAWF)

### Websites

- Wildfire Today
- Wildfire Risk to Communities
- LANDFIRE
- Portugal wildfires

### Publications

- Utility Wildfire Mitigation Guide 2020
- 2019–2020 Bushfires Quick Guide
- Wildfire Risk Reduction Methods
- Distribution Protection Options to Reduce Damage and Improve Public Safety
- Wildfire and the Oregon Electricity System

### Webinars and Conferences

- WECC Wildfire Webinar Series - Wildfires in the West
- WECC Wildfire Webinar Series - Best Practices and Lessons Learned
- WECC Wildfire Webinar Series - Compliance Open Webinar
- West Coast Utility Commissions - Wildfire Dialogue

## Research and Development

- Electric Power Research Institute (EPRI)
- Texas A&M University

### Department of Energy (DOE) National Laboratories

In November 2019, the Office of Electricity sent a request for information on projects regarding wildfire capabilities to 13 DOE laboratories and received responses from the following:

- Argonne National Laboratory
- Lawrence Berkeley National Laboratory
- Lawrence Livermore National Laboratory
- Oak Ridge National Laboratory

- Pacific Northwest National Laboratory
- Sandia National Laboratory
- SLAC National Accelerator Laboratory

The responses identify capabilities with the potential of being used immediately or being adapted for use within a few months. This list was updated in August 2020 to capture progress and include newly added capabilities that meet the aforementioned requirements. The point of contact at the DOE for this information is Stewart Cedres.[11]

## Area of Research: Sensing and Detection

### Distribution Arcing Fault Signature Library (ORNL)

This project between Oak Ridge National Laboratory (ORNL), Lawrence Livermore National Laboratory, and Pacific Gas & Electric Company will install a high-fidelity sensor cluster on an electric distribution feeder (substation outlet) to capture grid signatures that can be used as early indicators of arcing to identify and mitigate fire risk. In order to capture real signatures, the sensor cluster will be installed in an operational utility service area. The novelty of the project is in both the high-fidelity sensor technology and analytical methodology on a custom purpose platform.

### Monitoring Structural Health of High Voltage Transmission Lines (ORNL)

ORNL has developed a "smart patch" technology, which incorporates piezoelectric transducers and electromechanical impedance analysis to monitor the structural health of compression connectors used in high-voltage transmission lines that tend to fail as a result of thermal aging and thermal fatigue.

### Real-time Aerial Sensors for Extreme Environments (ORNL)

ORNL is working with the United States forestry services on the development of real-time airborne and ground asbestos sensors for application during forest fire operations. There are concerns pertaining to EPA superfund sites and the implications of wildfires pertaining to the release of toxins in the air. Demonstration of unmanned-aerial-systems-based measurement of grid components (pole mounted transformers, intelliruptors) with live visual, thermal, and sensor reading feeds was completed with the utility control center at the Electric Power Board of Chattanooga.[12]

### Multi-modal Autonomous Vehicle NETworks (ORNL)

ORNL created Multi-modal Autonomous Vehicle NETworks (MAVNET) to provide reliable and robust command, control, communication, and computing (C4) for unmanned vehicles. MAVNet is particularly well-suited for beyond visual line of sight C2, swarm operations, and a secure implementation of the Internet of Drones. Through the development of advanced sensors along with the integration of MAVNet, a situational awareness platform can be created to assist in developing solutions. This includes the potential of pulling real-time thermal and earth observation video/images from both UAS and manned aircraft to

[11] Stewart Cedres

[12] Link is to an early survey of best practices for the use of small unmanned aerial systems (UAS) by electric utilities: https://info.ornl.gov/sites/publications/Files/Pub73072.pdf

identify fire locations and evaluate post-fire damage along with integration into visualization platforms like Eagle-I.

ORNL links of unmanned aerial systems technology for search and rescue in the Smokies:

- ORNL Drones help Smokies search and rescue[13]
- ORNL drones find lifesaving lessons in Smokies[14]

### Distributed Wildfire Detection (ANL)

The Argonne Waggle platform supports customized sensor arrays, edge computing, and image analysis code that can be programmed to detect specific types of objects, movements, or phenomena (e.g., a flash of lightning). Argonne has deployed Waggle systems for wildfire prediction for the power grid and has developed field capabilities for detection of wildfires and wildfire conditions, including real-time control of cameras. The field test for this project is WIFIRE[15], a network of towers in Southern California operated by the University of California-San Diego (UCSD) and is in use by wildfire emergency responders. ANL has been working with the UCSD San Diego Supercomputer Center to develop computer vision/deep learning algorithms to use the camera network to spot fires.[16]

## Area of Research: Situational Awareness

### EAGLE-I (ORNL)

EAGLE-I is a next-generation situational awareness tool for advanced energy-sector monitoring and analysis in the United States. The operational system is hosted and managed by the ORNL for DOE's Infrastructure Security and Energy Restoration division. Built-in capabilities include energy-sector data collection, integration, and monitoring; modeling and analysis; and immediate, strategic dissemination of vital information. The tool integrates real-time data on electricity, natural gas, and petroleum in an interactive web platform, enhancing the nation's energy infrastructure awareness and allowing for organized, coordinated, and rapid emergency response and recovery efforts.

*Note: ORNL has every building mapped for the CONUS (supporting FEMA) for wildfire risk assessment. ORNL also have capabilities for smoke and haze detection from very high-resolution satellite imagery as well as damage assessment.*[17]

### ForWarn (ORNL)

ForWarn provides near-real-time tracking of vegetation changes across landscapes in the United States. This system produces maps every 8 days that enable detection of vegetation disturbances. Useful for both monitoring disturbance events as well as year-to-year variability, derived products can also be used to develop insights into seasonal and inter-annual dynamics. An opportunity could be to change the detection that could be overlaid with electrical grid to determine risk and possible vulnerabilities.[18]

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[13] https://www.youtube.com/watch?v=eVIrygh9tnQ
[14] https://www.wbir.com/article/news/local/ornl-drones-find-lifesaving-lessons-in-smokies/51-25209a52-a069-4573-a7e0-11ea30c695c4
[15] WIFIRE
[16] https://www.anl.gov/mcs/waggle-an-open-platform-for-intelligent-attentive-sensors
[17] https://eagle-i.doe.gov/login
[18] https://forwarn.forestthreats.org

### PlanetSense (ORNL)

PlanetSense is a platform for geospatial intelligence that is built to harness the existing power of archived data along with the dynamics of real-time streams, seamlessly integrated with sophisticated data mining algorithms and analytics tools for generating operational intelligence on the fly. The platform has four main components: GeoData Cloud, a data architecture for storing and managing disparate datasets; a mechanism to harvest real-time streaming data; a data analytics framework; and a presentation and visualization through web interface and RESTful services. Using two case studies, we underpin the necessity of our platform in modeling ambient population and building occupancy at scale. PlanetSense capability (National Geospatial-Intelligence Agency) allows us to collect Open Source data, including images to provide real-time situational awareness of the changing scenarios.

*Note: ORNL demonstrated this capability during the Gatlinburg fire in 2016.*[19]

### Water Extreme Lookup Library (PNNL)

The Water Extreme Lookup Library provides a truly unique data source in which previously run simulations can be used to support both the rapid-response situational awareness and provide the data to support planned studies. This library includes dam failure simulations available and developed methods to include riverine flood simulations.

*Note: The Water Extreme Lookup Library is operational but it would take 1–3 months to incorporate more fire information into the repository.*

### Proximity Analysis Tool (PNNL)

The Proximity Analysis Tool uses geospatial clustering methods to determine important critical infrastructure assets or clusters of these assets. This clustering approach can help determine if a group of components can be identified that will lead to severe degradation in performance of infrastructure systems if damaged or destroyed.

*Note: This tool is expected to be operational in 6–12 months; it is currently a prototype.*

### High Power/Low Power Arc and Ground Fault Detection/Mitigation (SNL)

Work on arc-fault and ground fault detection and mitigation for photovoltaic dc systems that could potentially be ported over to ac systems. The Sandia Photovoltaic Arc and Ground Fault Detection and Mitigation program ran from 2010–2015 and made a number of significant contributions to the field of photovoltaic system safety and reliability. During the course of the program, Sandia worked with over a dozen solar and original equipment manufacturers and investigated series and parallel arc-fault detection methods; improvements to the draft arc-fault circuit interrupter certification standard, UL 1699B; arc plasma physics models and burn characteristics; array electrical behavior during ground faults (including those constituting the detection “blind spot”); and recommendations for novel and traditional ground fault detectors.

[19] https://planetsense.ornl.gov/webps/

### Multi-Source Multi-Time-Scale Wildfire Data Warehouse and Visualization Platform (ANL)

Argonne's situational analysis and wildfire risk analysis draws on data pipelines and a data warehouse that pull three types of data: climate and environmental factors (e.g., fuel buildup), weather conditions, and power delivery operations. The dataset includes publicly available data sources (e.g., NOAA) and Argonne's data on wildfire indices and transmission line temperature and sag, for example. The platform synthesizes these key datasets used in wildfire modeling and mitigation into a single visualization tool that is updated in real-time. This allows decision-makers to easily see the real-time changes in data that affect the ignition and propagation of wildfires, highlighting the geographical location of power system components and wildfire-related metrics (e.g., wildfire indices, temperature, humidity, wind speed).

### Risk and Crisis Communication–National Public Affairs Academy (ANL)

Communicating with the public clearly and effectively beforehand about wildfire risk and then providing timely and accurate information during a wildfire emergency are both critical to mitigating its effects. The National Public Affairs Academy at Argonne National Laboratory offers more than two dozen training courses and workshops that address a wide range of communication and emergency public information topics from media relations and risk and crisis communication to social media technology and digital communication and participating in an area Joint Information System/Center with partner agencies. All National Public Affairs Academy courses are fully customizable and can be specifically adapted to address wildfire hazards, helping utility operators to communicate more effectively with their stakeholders.[20] [21]

## Area of Research: Modeling and Analytical Tools

### Dynamic Contingency Analysis Tool for Extreme Wildfire Event Planning (PNNL)

Partnered with Electric Reliability Council of Texas, Siemens, General Electric, Bonneville Power Administration, and EPRI, PNNL developed a hybrid dynamic and steady-state approach to mimic the cascading failure process that includes both fast dynamic and slower events. Integrated dynamic models with protection schemes models.

*Note: PNNL is working with General Electric to integrate into PSLF toolsets used in WECC.*[22] [23]

### Sustainable Forest Biomass for Fire Mitigation (PNNL)

PNNL developed decision support tools that support optimization of fire mitigation activities by linking systems of spatial, forest, fuel/fire/economic and hydrological models to characterize wildfire potential.

*Note: This is not an electric equipment fire mitigation technology, but it is a tool that can be used to identify critical zones where wildfire could propagate.*

### Multi-Sensor Data Exploitation for Wildfire Damage Assessment (PNNL)

PNNL has developed algorithms that exploit best-available satellite and airborne sensor data to perform automated characterization of high-risk vegetation (ignition/fuel/risk); vegetation management priorities

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[20] Argonne Fusion Cell public affairs research and training facility: https://pastfusion.egs.anl.gov/
[21] NPAA 2020 Course Catalog: https://pastfusion.egs.anl.gov/wp-content/uploads/2020/04/CATALOG_0220-Final.pdf
[22] https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-26197.pdf
[23] https://www.youtube.com/watch?v=IhsVNTBPozI

for critical infrastructure; active hot-spots/fire lines (thermal sensing); burned area/impacted infrastructure.

### Standard Unified Modeling, Mapping, and Integration Toolkit (SNL)

The Standard Unified Modeling, Mapping, and Integration Toolkit (SUMMIT) is a modeling & simulation framework for decision support. The California Fire and Rescue Training Authority deployed SUMMIT to help agencies exercise their responses to emergency scenarios, including wildfires, chlorine releases from railcars, and radiological dispersal devices. Equally important, SUMMIT can link multiple models in a single template to more fully simulate complex scenarios. SUMMIT allows the models and data to work together seamlessly, generating results that can be visualized in many different formats and exported for other uses. As a further benefit, the templates can be used repeatedly and customized with new input data, increasing planning efficiency.

### FASTMap (SNL)

FASTMap is a web-based mapping tool that displays any infrastructure data on a map, can include overlays of areas of interest or risk, and can perform analysis on other infrastructure, population, economic activity in the vicinity of a scenario or actual disruption. While FASTMap can depict any infrastructure and areas of interest or concern, it has capabilities that can be leveraged specifically in strategy for reduction of electric power fire hazards, and actual emergency response or response planning. FASTMap can maintain and visually depict the status of transmission or distribution lines, identification of areas of high flammability hazard, evacuation zones, inspection and survey progress, and status classifications.

*Note: FASTMap is a web and tablet based mapping application that browses national infrastructure and emergency resources data that generates maps and reports of assets at risk within any area of disruption or any analysis area. FASTMap can depict any geospatial datasets (currently National Geospatial-Intelligence Agency's HSIP Gold infrastructure data) and provides immediate data access through a fully symbolized, publication-quality interactive mapping interface available to browsers and mobile tablets.*

### LANDFIRE (SNL)

Develop a forest risk analysis by applying LANDFIRE and Monitoring Trends in Burn Severity indicators and other contemporary earth science data and process models to forest wildfire risk management decisions, and conduct a value of information impact assessment of the application of satellite and other contemporary earth observation data to forest risk management decisions.

### Physics-Informed Machine Learning Emulators of Wildfire Spread (LBNL)

This technology accelerates the simulation of wildfire spread scenarios by 2–3 orders of magnitude compared to standard fire physics models, while incorporating dynamic conditions on the ground such as wind fields, humidity, elevation maps, vegetation maps etc. By simulating many more scenarios of wildfire spread with ignition points along utility equipment, the technology better characterize the risk dynamic wildfire risk profiles at high spatial resolution (~250m to 30m), temporal resolution (daily or better), and over large areas. A wildfire model has been developed that takes real-time updated meteorological data (wind, temperature, relative humidity, etc.), local topography, and vegetation as inputs and predicts the probability of large wildfire growth. The model is high-resolution (1km) covering all of California and is aimed at assessing evolving wildfire risk. LBNL has validated the model against historical fire data (2002–

2019) and has shown that it is predictive of fire size, burned area extent, and overall burn probability. This work has been published in scientific journals and LBNL is actively exploring potential commercial use cases in energy and insurance sectors.

*Note: LBNL is also actively developing an additional model layer aimed at predicting ignition probability that takes into account a number of geospatial features including proximity to roads and power lines, but this component is still under development. Preliminary discussions are underway with grid operators to evaluate the model.*[24] [25]

### XAI Models of Wildfire Risk and Risk Management (LBNL)

This technology enables the modeling of wildfire risk by using available satellite imaging data, including hyperspectral and synthetic LIDAR, to model wildfire risk as a function of local vegetation patterns. Further, the resulting models are amenable to constrained optimization, modeling wildfire risk as an emergent ecosystem service, and providing ecological engineering solutions to vegetation management. These solutions include modeling ecosystem dynamics to enable passive (planting-based) solutions to wildfire risk mitigation.

*Note: XAI is ready for testing on fire data.*

### Predictability of Fire Behavior and Effects in the Wildland Urban Interface in California (LBNL)

This model uses Geostationary Operational Environmental Satellite Network imagery and machine learning for early detection, monitoring, and realistic predictions of fire behavior and effects in the wildland urban interface. It is ready to use but might need to be calibrated depending on the ecosystem characteristics and topography. The model can evaluate how fire spreads, how the extent and/or severity are directly relevant for the grid exposure, and how model outcomes on vegetation mortality and community change help predict future fire risk around specific grid infrastructure. The rapid detection and real-time prediction collaborators are LBNL-ETA, CALFIRE, the US Forest Service, and UC Berkeley. This work will address the following question: what are the critical mechanistic interactions of climate, vegetation, and topographic variables driving the spatial and temporal predictability of fire behavior (spread rate and intensity) and fire effects in the wildland urban interface (WUI) in California? This mechanistic understanding will be derived from wildfire behavior and effects data and complex bio-geophysical data in a machine learning framework. Remote sensing and machine learning can be adapted in 6–10 months.[26] [27]

### Climate Modeling for California Planning (LBNL)

LBNL is developing two new projects in close coordination with electric utilities for the CA Energy Commission to develop the next generation of regional climate projections, analytics, and a data platform for supporting electricity sector climate resilience planning. These two activities consist of *Development of*

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[24] https://e3sm.org/wp-content/uploads/2020/05/200514_Q_Zhu_reduced.pdf
[25] https://acme-climate.atlassian.net/wiki/spaces/ECM/pages/1929707601/2020-10+Meeting+Oral+Presentations?preview=/1929707601/1945471073/E3SM%20PI%20meeting%20QING%20ZHU.pdf
[26] https://ylfeng.users.earthengine.app/view/fireca
[27] https://caralyngorman.users.earthengine.app/view/camp-fire-sliding-map-3-9-19

*Climate Projections for California and Identification of Priority Projections* and *A Co-Produced Climate Data and Analytics Platform to Support California's Electricity Resilience Investments*.

*Note: Work is in collaboration with the following utilities: PG&E, SDG&E, SCE, and PacifiCorp.*[28]

### Attention-Based Long-Short-Term-Memory Model (LBNL)

This is a recurrent neural network framework with an attention mechanism that is designed to predict wildfire activity with relatively long leading time in wildland urban interface. The model is ready to be used but may require calibration. This model can also be used to evaluate how fire spreads and to predict risk around the grid infrastructure. For more information can be found here:

- Wildfire modeling with E3SM and machine learning techniques[29]
- Trial by Fire FATES-SPITFIRE[30]
- Importance of size structure and fuels for fire: FATES-SPITFIRE[31]
- The NGEET FATES model[32]

### Data-Driven Wildfire Risk Model and Optimal Grid De-energization Strategies (LBNL)

The ongoing project funded by the University of California, office of president aims to investigate the changes in fire-weather regimes in California, determine wildfire risks associated with extreme weather conditions (e.g., high winds) and electric power line ignitions using unique datasets of climate observations and weather/fire simulations, and develop optimal de-energization (power shut-off) strategies given the wildfire risks as inputs and evaluate the reliability and economics implications of various fire-related planning and operation policies. The development is based on real-world distribution and transmission circuits. The derived risk model and de-energization rules will be incorporated into an integrated decision-making framework, which will be ready for use in 6–10 months. The team is having exploratory conversations with PG&E and SCE on data sharing and integration of this work with the utility practices.

*Note: Forthcoming web site will provide data and preliminary results for public.*[33]

[28] https://docs.google.com/presentation/d/1JNlfQPHr95rwrQe0h7BAaMH9H-5i8yY3i9_MI_fU7gs/edit#slide=id.p1
[29] https://e3sm.org/wp-content/uploads/2020/05/200514_Q_Zhu_reduced.pdf
[30] www.cesm.ucar.edu/events/workshops/ws.2017/presentations/bgcwg/shuman.pdf
[31] http://www.cesm.ucar.edu/events/workshops/ws.2018/presentations/bgcwg/shuman.pdf
[32] The model is at this website: https://github.com/NGEET/fates
[33] http://smartcity.lbl.gov/wildfire

### Grid Resilience and Intelligence Platform (GRIP) – (SLAC)

SLAC is working in collaboration with LBNL, Southern California Edison, the Presence Product Group, Packetized Energy, and NRECA to develop and deploy a suite of novel software tools to anticipate, absorb, and recover from extreme events. The wildfire portion of the tool is being coordinated with SCE. GRIP's goal is to respond to electric grid events by demonstrating machine learning and artificial intelligence from different data sources to anticipate grid events, validating controls for distributed energy resources for absorbing grid events, and reducing recovery time by managing distributed energy resources in the case of limited communications. The project builds on previous efforts to collect massive amounts of data and uses it to fine-tune grid operations, including other Grid Modernization Lab Consortium projects on distributed controls and cyber security.

*NOTE: GRIP is a suite of different capabilities and some are ready for deployment and commercialization within 6–10 months.*

### Argonne Wildfire Threat Model: Risk Assessment for Interdependent Power and Telecommunications Systems (ANL)

ANL has assembled a database of major historical fire events with GIS features for animated depictions of daily burn progression over the entire temporal occurrence of the empirical event. Through the Argonne probabilistic Wildfire Threat Model, the empirical daily fire behavior can be modified in both direction and intensity to fit a scenario that would allow for the assessment of performance of strongly coupled power and telecommunications systems in the context of a specified wildfire event. Performance assessment includes identification of multiple at-risk electric and telecom assets and the quantification of the possible cascading failures and outages that could occur both in terms of geospatial extent and depth of impact (MW loss and number of customers affected). Argonne's EPfast and TELCO fast tools are used to assess electric and telecommunications system performance and to quantify impacts, and the Wildfire Threat Model is used to define scenarios and fire behavior. Wildfire fragility curves for transmission lines, power plants, microwave towers, cells towers, and fiber optics cables are used to determine damage levels of the assets as the fire progresses and fire intensity increases. Integration of the tools into a coupled system would require additional effort.[34] [35]

### Wildfire Risk Modeling (ANL)

Argonne has developed a thermal overloading risk quantification model based on a semi-analytical probabilistic approach. The model can assess system uncertainty in, for example, renewable energy resources or loads. The model is used to compute the probability of a line current violation and can be integrated into other decision-making processes as a chance-constraint relaxation. Moreover, wildfire risk analysis based on wide-area modeling of power line temperature evolution and monitoring of line sag is incorporated into the existing modeling framework.

In the next six months, Argonne will extend the capability by integrating additional risk quantification into the framework. The objective is to provide comprehensive risk analysis of wildfire while considering multiple impact factors related to ignition and spread of wildfires.

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[34] For more information, go to this website: https://www.anl.gov/dis/infrastructure-science

[35] Argonne Wildfire Probabilistic Threat Model: https://www.anl.gov/sites/www/files/2020-11/Argonne_Wildfire_Probabilistic_Threat_Model.pdf

### Operations and Planning for Wildfire Risk Mitigation (ANL)

Argonne has developed a wildfire mitigation decision support tool for both operations (e.g., optimal Public Safety Power Shutoff programs) and planning (e.g., risk-informed expansion planning). The capability includes a transmission expansion planning framework that uses historical fire potential data to place new electric power infrastructure for wildfire mitigation, and a daily dispatch tool used to reduce the probability of a wildfire ignited by electric power infrastructure through transmission switching and power flow reductions. In the next six months, Argonne will expand the capability to include an Argonne Operational Wildfire Mitigation Tool, a daily dispatch tool used to reduce the probability of a wildfire ignited by electric power infrastructure through targeted de-energizing and power flow reduction while minimizing load shed.

*Note: The Argonne Operational Wildfire Mitigation Tool referenced above is being developed to aid the PSPS (Public Safety Power Shutoff) program in California to more intelligently identify the electric power infrastructure most likely to ignite fires, and use stochastic optimization methods to determine the optimal operational scheme to reduce fire risk while limiting load shedding.*

### Geospatial Analysis Tool Kit for Regional Climate Datasets (ANL)

ANL has developed a GIS analysis tool named Geospatial Analysis Tool Kit for Regional Climate Datasets (GATOR) to provide easy access to a large database of regional scale climate projections to a variety of users. Data layers include temperature, precipitation, soil conditions and other relevant weather/climate parameters obtained from a high-resolution regional scale climate model dataset developed at ANL. The lab has also developed a wildfire risk indicator database for current and future climate conditions for the mid and end of the century. This database and the tools for calculating the fire risk indicators can be combined into a GATOR-FIRE for long-term planning by industry. GATOR-FIRE for long-term planning will be available for industry use in 6 months. Adapting GATOR-FIRE for short-term fire forecasting is a second activity. Argonne leads the community Python ARM Radar Toolkit (Py-ART), which is used by hundreds of institutions to gain insight from weather radar. Py-ART has been used to study wildfires using both research radars and open data from operational radar networks. GATOR-FIRE will be adapted to use weather forecast data (0–5-day forecasts from the NOAA High-Resolution Rapid Refresh (HRRR) model). By integrating radar data with HRRR forecasts in the GATOR-FIRE GIS platform, the lab will stand up a tool for identifying and studying the propagation of wildfires (in 6–12 months) that will use the radar data. GATOR-FIRE will provide near-term risk assessments with forecasting, analysis, and real-time monitoring capabilities.[36]

### National Preparedness Analytics Center (ANL)

ANL's National Preparedness Analytics Center (NPAC) is a national leader in the provision of science-informed technical assistance for all-hazards evacuation and shelter-in-place planning, including for wildfire events. As an example, NPAC is funded by the Federal Emergency Management Agency to examine human behavior in protective action decision-making related to hazard-driven evacuations or shelter-in-place decisions (including individual and organization decisions); partner with local governments and infrastructure owners and operators to develop consequence-informed and time-bounded protective action plans, tools, and guidance; support operational decision-making related to hazard-based

[36] For more information, go to this website: https://www.evs.anl.gov/research-areas/environmental-systems/

evacuations; and conduct training sessions, workshops, and symposia that bring industry and government together to plan for disasters (e.g., wildfires) that could cause evacuation or shelter-in-place operations to occur.[37]

## Area of Research: Post Fire Analysis

### Rapid Inundation Flood Tool (PNNL)

The Rapid Inundation Flood Tool provides rapid predictive flood analytics for infrastructure situational awareness. This tool can easily simulate post-fire flooding events to determine the impact of heavy rainfall. Following a major fire, the flood risk greatly increases because of less vegetation to slow runoff down and the soil can become hydrophobic, meaning that the soil will repel water. PNNL employs two approaches to provide this situational awareness: the near real-time modeling and simulation and the development of a simulation archive, the Water Extreme Lookup Library.[38] [39]

## Area of Research: Fire Testing Capabilities

### Thermal Test Complex (SNL)

The Thermal Test Complex comprises multiple test cells, ovens, and a laser lab for controlled fire experiments. Tests range in size from small-scale experiments that use lasers to large-scale tests that burn custom-made structures and models. Team members change variables such as temperatures, wind speed, and materials to see how the test objects fare under abnormal and extreme conditions.[40]

### Testing of Wildland Ignitions from High-Flux Sources (SNL)

Sandia has recently been involved with a multi-million dollar multi-year test campaign that used concentrated solar power to evaluate the fire behavior of materials in response to high heat flux. A moderate portion of this test campaign has involved materials and configurations highly relevant to wildland fire ignition. SNL has particular expertise in ignition from high flux scenarios as may be relevant to the problem at hand. Prior to this experimental work, SNL has significant legacy experience in pyrolysis, transport, and reaction behaviors relevant to wildland fires and high flux scenarios including several journal papers and many conference and institutional reports. Further data exists in the Official Use Only form that could be communicated as necessary.[41]

[37] For more information, see the following website: https://www.anl.gov/dis
[38] https://www.pnnl.gov/news/release.aspx?id=4466
[39] https://www.pnnl.gov/news-media/high-tech-damage-assessment-speeds-disaster-recovery
[40] http://tours.sandia.gov/TTC/ttc_info.html
[41] https://www.youtube.com/watch?v=P4So-SwuqA0

# Attachment 2b. Draft Operation Wildfire Mitigation Plan

# Draft Operation Wildfire Mitigation Plan

Cascade Renewable Transmission

*Wasco, Hood River, and Multnomah Counties, Oregon*

December 2025

Prepared for
Cascade Renewable Transmission, LLC

Submitted to
Oregon Energy Facility Siting Council

# Contents



# Tables



# Appendices

# Acronyms

| | |
|---|---|
| AC | alternating current |
| Applicant | Cascade Renewable Transmission (CRT) |
| BPA | Bonneville Power Administration |
| DC | direct current |
| EMP | Emergency Management Plan |
| HVDC | high-voltage direct current |
| kV | kilovolt |
| NERC | North American Electric Reliability Corporation |
| NFPA | National Fire Protection Association |
| OAR | Oregon Administrative Rule |
| ODF | Oregon Department of Forestry |
| ODOE | Oregon Department of Energy |
| OR EFSC | Oregon Energy Facility Siting Council |
| ORS | Oregon Revised Statute |
| PGE | Portland General Electric |
| RACE | Rescue, Alarm, Contain and Extinguish |
| SCADA | supervisory control and data acquisition |
| UV | ultraviolet |
| VESDA | very early smoke detection apparatus |
| WMP | wildfire mitigation plan |

# 1 Finalizing Wildfire Mitigation Plan Prior to Operation

## 1.1 Update Applicable Sections of WMP

To finalize this Wildfire Mitigation Plan (WMP) prior to construction and operation of the facility:

Update Section 3.1 based on final facility design, including a brief description of areas within the site that are subject to high wildfire risk, fire prevention features at the site, such as road dimensions, setbacks, fire breaks, entry/exit locations, water truck(s) and fire protection equipment locations. Describe fire detection, fire suppression, and emergency shut-off systems that will be activated in the event of a fire.

Update Section 3.2 and include in this WMP the facility site maps described in Section 3.2.

Update Section 3.3 with fire department, certificate holder, and operational manager contact information and emergency response procedures. Update Section 3.3 with analysis area residence contact information and confirm analysis area residence contact letter sent to residences within site boundary and 0.5 miles from the facility.

Update Sections 3.7.1 and 3.8.1 to describe vegetation management and areas that will be managed to be vegetation-free, noncombustible space, or gravel surface.

Update Section 3.8.3 with any additional details about facility monitoring.

Update Section 4 with any additional standards for future review and plan updates. The Oregon Department of Energy (ODOE) will use a maintenance schedule, like the one provided in Appendix A, to establish the performance of the WMP. If determined by certificate holder or ODOE, adjustments or improvements must be proposed to ensure the WMP provides wildfire mitigation.

# 2 Prior to Operation Task List (PRO)

Prior to facility operation, complete the activities in Sections 2.1 and 2.2.

## 2.1 Training (PRE)

Operation training attendee list and training materials must be provided to the Department to demonstrate compliance.

Organize and hold an on-site training with operational personnel, inviting equipment manufacturers, specialty contractors, local fire department(s), participating and adjacent landowners, emergency management office personnel, ODOE, and any other emergency management agency that covers:

- Compliance with local and state regulations;
- The location of electrical facility components and the fire safety measures associated with each component;

- Battery-specific safety protocols, including how to appropriately address chemical fires, in the event of an emergency;
- The type, location, and proper use of fire protection equipment;
- Fire protection equipment maintenance requirements;
- The location(s) of water source(s) and proper usage, storing and maintenance for the pump, hose nozzle; and water hose;
- Overview of smoking policy and locations;
- Overview of procedures and restrictions of operational maintenance activities during Fire Season and Red Flag Warnings designated in this Plan;
- Rescue, Alarm, Contain and Extinguish procedures; and
- Provide information and encourage attendees to sign up for the Wasco County and Multnomah County emergency management notification system.

The Applicant will document the date, attendees, and topics discussed at the on-site training, which will be provided to ODOE. Operational personnel, inviting specialty contractors, local fire department(s), participating and adjacent landowners, emergency management office personnel, and any other emergency management agency in attendance will also reserve a copy of the construction safety documentation.

#### 2.1.1.1 ELECTRICAL SAFETY PROGRAM

All operational workers will be trained in electrical safety and the specific hazards of the facility. This training will address:

- Minimum experience requirements to work on different types of electrical components;
- Lockout/tagout procedures;
- Electrical equipment testing and troubleshooting;
- Switching system;
- Provisions for entering high voltage areas;
- Minimum approach distances;
- Required personal protective equipment; and
- Special safety protocols for work around transmission lines.

## 2.2 Facility Site Map(s) Submission

Submit updated site maps from Section 3.2 concurrently to local fire departments and ODOE.

# 3 Wildfire Mitigation Plan

## 3.1 Summary of Facility Description with Design Features and Locations of Fire Protection Equipment

Cascade Renewable Transmission Project (Project) construction site preparation and grounding will include vegetation removal over a 3-month period. Clearing and grubbing vegetation will occur at the eastern and western converter station locations and at the temporary laydown area at the eastern converter station (the temporary laydown area at the western converter station is an asphalt covered parking lot).

Based on the data provided in the Wildfire Prevention and Risk Mitigation Exhibit, the relatively flat eastern site boundary has low to high overall wildfire risk and contains primarily urban development, grasses, and mixed grass/shrub communities. Approximately 55 percent of the site boundary has nonburnable or very low overall wildfire risk, 22 percent has very low overall wildfire risk, 23 percent has moderate overall wildfire risk, and less than 1percent high overall wildfire risk. The areas of nonburnable wildfire risk occur in the City of The Dalles, which is dominated by human development. Areas of very low and low overall wildfire risk in the eastern site boundary occur from the middle to east ends of the analysis area, where there is more grass and mixed grass/shrub vegetation (see Wildfire Prevention and Risk Mitigation Exhibit, Table 8 and Figure 7). Areas of moderate to high wildfire risk occur in the central area of the eastern analysis area but not within the site boundary. These areas are correlated with residential areas and orchards that may have higher densities of deciduous tree plants and litter that could spread wildfires. There is less than one acre of high wildlife risk within the site boundary that is located adjacent to areas of moderate risk, in the residential and agricultural areas east of The Dalles, between the city and the Big Eddy Substation. Within the high wildfire risk area, the cable would be buried along Highway 197 within the site boundary.

The relatively flat western site boundary area has low overall wildfire risk and is dominated by both urban development and water. There are no areas in the western site boundary or analysis area that have moderate to very high overall wildfire risk (see Wildfire Prevention and Risk Mitigation Exhibit, Table 8 and Figure 7).

The facility converter stations will be equipped with fire protection and suppression systems in accordance with the applicable National Fire Protection Association (NFPA) codes, Oregon Fire Code, municipal codes in Multnomah and Wasco counties, and the Institute of Electrical and Electronics Engineers (IEEE) standards. In addition, the design will meet the recommendations stated in NFPA 850, “Fire Protection for Electric Generating Plants and High Voltage Direct Current Converter Stations.” (NFPA 2020)

Subject to final design specifications, the high-voltage direct current (HVDC) voltage source converter (VSC) stations at each end of the HVDC interconnection will include the typical outside high voltage equipment such as converter transformers, switching equipment, capacitors and reactors. The eastern converter station will also include a short overhead alternating current (AC) cable connection to the interconnecting substation. The AC connection from the western converter to the interconnecting substation will be located underground and will not require fire detection and suppression. Each converter station will also contain a converter building housing the high-voltage alternating current/direct current (AC/DC) conversion equipment, terminations for the underground HVDC cables, and a control building for auxiliary power and control/protection equipment.

Preventive actions for transmission systems include disabling automatic reclosing, ordering no test orders on facilities, conducting inspections on site prior to testing faulted equipment, and conducting pre-emptive public safety power shutoffs (PSPS). If faults that may cause fires are detected, transmission systems or equipment may be de-energized, loads dropped, and transmission curtailed. Either BPA or PGE will implement a PSPS. The Applicant will own only the transmission line and will not have any community outreach responsibility during a PSPS. PSPS community outreach will continue to be the responsibility of BPA and PGE. If the Big Eddy and Harborton substations are energized during a wildfire incident, it is anticipated that the CRT facility would continue to operate, which is particularly critical for overall system reliability, because BPA may be required to shut off other high-voltage overhead transmission lines, which could significantly reduce flows of electricity east-to-west across the Cascade mountains. BPA will have fire management and oversight of all its assets, including the Big Eddy substation and the Applicant will have fire management and oversight of its assets. The Applicant will have regular coordination meetings with the local fire department, and wildfire coordination would be discussed.

The Applicant will minimize risk of facility components causing wildfire through preventative actions. Prior to operation, the Applicant will conduct a Fire Risk Analysis detailing facility fire protections such as fire alarm locations and detector type, fire protectant materials, and barriers. The Applicant developed a Fire Risk Analysis for a previous HVDC transmission project and will develop a similar analysis for this project's facilities. The Applicant will implement design considerations and best practices outlined in Table 1 to minimize electrical fire risk from facility components. The Operational Plan will be updated based on the results of the Fire Risk Analysis and a copy will be provided to ODOE.

**Table 1. Design Considerations for Fire Safety by Facility Component.**

| Consideration | Converter Stations | Overhead Transmission Line |
|---|---|---|
| Electrical connections by qualified electricians | X | X |
| Inspections for mechanical integrity prior to energizations | X | X |
| Lightning protection | X | X |
| Corrosion protection | | |
| Strain relief of connecting cabling | X | X |
| Grounding systems | X | X |
| Safety setback from structures | X | X |
| Technology specific design standards | X | X |
| Fencing for security and protection | X | |
| Vegetation management | X | X |

Measures for reducing the risk of fire ignition and reducing the risk of equipment damage in the event of a wildfire are discussed below, including the facility's vegetation management program (see Section 3.7.1 and 3.8.1), and through the emergency response procedures that will be described in the Emergency Management Plan (EMP). The EMP will be developed for the facility and is outlined below in Section 3.3.

The converter stations will have reduced risk for fire because these areas will have a gravel base with no vegetation within 10-feet of equipment to reduce fire risk. The facility converter stations will be equipped with fire protection and suppression systems in accordance with the applicable NFPA codes, Oregon Fire Code, and municipal codes in Multnomah and Wasco counties. In addition, the design would meet the recommendations stated in NFPA 850 (NFPA 2020).

No new road dimensions, setbacks, or firebreaks are planned for the Project. An approximately 275-foot-long paved driveway will connect the southwest corner of the eastern converter station to Columbia View Drive, providing general and emergency access and egress. In Portland, general and emergency access and egress will be provided by a short curb cut driveway abutting N Leadbetter Road. The outside area of the converter stations will include fire hydrants throughout the area and standpipes to protect the yard facilities and structures, as required. In addition, the oil-filled converter transformers will be provided with detectors sensing high temperature and/or rate of rise. These detectors, together with the transformer's pressure sensors and protection relays, will provide a trip signal to de-energize all transformers in the event of a fault condition. Each transformer will be positioned on a secondary containment structure and separated by fire-rated walls. Each secondary containment structure will be internally open to each transformer bay to contain the oil from one transformer, plus additional room for rain, firefighting flow, and freeboard.

The converter building will house high-voltage AC/DC conversion equipment and fire detection equipment, including both ultraviolet (UV) flash detection and very early smoke detection apparatus (VESDA) equipment. A series of UV (flash) detectors will be situated in the converter building to detect an electrical flash. The UV detectors will be programmed to provide both fire alarm and high-voltage trip functions. The VESDA is a redundant and highly sensitive smoke detection system. Again, different levels of detection will provide both fire alarm and high voltage trip functions.

The control building will contain auxiliary electrical equipment, cooling, and a control and protection equipment room. The area will be provided with addressable smoke and heat detection sensors and pull stations connected to a fire panel. The detector loops will be supervised for continuity with any failure of a device indicated by a trouble alarm. The fire panel will typically report any fire alarms or troubles to a security monitoring service.

Additional protection will be provided to the control and protection room by means of an inert gas (FM-200) fire suppression system. This system is typically situated below the floor level to protect the cabling between the control and protection cubicles. The control building will also include portable fire extinguishers, as required.

The potential for wildfire within the facility site boundary will be at the eastern converter station because it will be an aboveground facility located in an agricultural area outside The Dalles city limits in Wasco County and surrounded by large, undeveloped areas. The eastern converter station will be located in the Mid-Columbia Fire and Rescue District (ODF and USFS 2018).

Bonneville Power Administration (BPA) will require the eastern converter station, or any component of the facility on BPA-owned land, to adhere to the BPA WMP (BPA 2024). During construction, the Applicant, BPA, and PGE will establish and document Joint Operating Procedures, which will govern the day-to-day scheduling and coordination of the facility within the BPA and PGE systems. Coordination during wildfire events will be included in the Joint Operating Procedures, which will be based on BPA's then current Wildfire Mitigation Plan; a copy of the most current 2024 plan is included as Appendix B. In addition to the Applicant implementing its vegetation management plan, recommendations from NERC's Wildfire Mitigation Reference Guide (Appendix C) will be implemented.

In addition, as required in the Project Order, the Applicant has prepared this facility-specific WMP and includes it as an attachment to the Wildfire Prevention and Risk Mitigation Exhibit.

The DC and fiber optic cables connecting the converter stations at each end of the interconnection will not require fire detection and suppression. The cables will be located underground and underwater and have very sensitive and fast protection schemes to quickly trip the interconnection and remove all energy from the cable in the event of a fault.

## 3.2 Facility Site Maps

This construction and operational WMP includes facility site maps that identify:

- The phasing for construction of facility features and components;
- Location and dimensions of facility roads;
- Location of vegetation free, noncombustible, defensible spaces;
- Wildfire risk at the site and date;
- High-fire consequence areas/resources (includes existing infrastructure, residences, sensitive habitat, or cultural resources);
- The location of facility access points;
- A description and the location of emergency access procedures, including how emergency responders and/or adjacent landowners may access the site for fire protection equipment or to extinguish an on-site fire when personnel will not be on-site;
- The type and location of fire protection equipment on-site; and
- The location(s) of water source(s) that will be on-site during operations.

## 3.3 Facility Contact Information and Emergency Response Procedures

The Applicant will prepare an EMP prior to construction that will contain policies and procedures for preparing for and responding to a range of potential emergencies, including fires, which will be provided to ODOE prior to operation. Implementation of the EMP will ensure that risks to public health and safety, and risks to emergency responders are minimized. Trained staff with access to the facility around the clock will control any potential fires inside the converter station. These measures will help keep external fires out or internal fires in. The EMP will cover response procedures that consider the dry nature of the region and address risks on a seasonal basis. The plan will also specify communication channels the Applicant intends to pursue with local fire protection agency personnel and BPA, for example, annual meetings to discuss emergency planning, and invitations to observe any emergency drill conducted at the facility. At the beginning of facility operations, a copy of the site plan indicating the arrangement of facility structures and access points will be provided to the local fire district.

Fire suppression equipment will be housed on site at the converter stations in a clearly marked location.

The outside area of the converter stations would include fire hydrants throughout the area and standpipes to protect the yard facilities and structures, as required. In addition, the main oil-filled AC transformers would be provided with detectors sensing high temperature and/or rate of rise. These detectors, together with the transformer's pressure sensors and protection relays, would provide a trip signal to de-energize all transformers in the event of a fault condition. Each AC transformer would be positioned on an oil containment foundation and separated by fire rated walls. All transformer pits would be internally open to each other to contain the oil amount from one transformer, plus additional room for rain, firefighting flow, and freeboard.

The converter building would house high-voltage AC/DC conversion equipment and fire detection equipment, including both ultraviolet (UV) flash detection and very early smoke detection apparatus (VESDA) equipment. A series of UV (flash) detectors would be situated in the converter building to detect an electrical flash. The UV detectors would be programmed to provide both fire alarm and high-voltage trip functions. The VESDA is a redundant and highly sensitive smoke detection system. Again, different levels of detection would provide both fire alarm and high voltage trip functions.

The control building would contain auxiliary electrical equipment, cooling, and a protection equipment room. The area would be provided with addressable smoke and heat detection sensors and pull stations connected to a fire panel. The detector loops would be supervised for continuity with any failure of a device indicated by a trouble alarm. The fire panel would typically report any fire alarms or troubles to a security monitoring service.

Additional protection would be provided to the control and protection room by means of an inert gas (FM-200) fire suppression system. This system is typically situated below the floor level to protect the cabling between the control and protection cubicles.

Personnel will receive training on the use of suppression equipment.

Local fire department and county emergency management contact information:

- The Dalles
  - Mid-Columbia Fire and Rescue
    - Address: 1400 W 8th Street, The Dalles, OR 97058
    - Nonemergency number: 541-296-9445
    - Email: firemarshal@mcfr.org
  - Wasco County Emergency Management
    - Address: 511 Washington Street Suite 102, The Dalles, OR 97058
    - Phone number: 541-506-2790
    - Email: sheridanm@co.wasco.or.us
- Portland
  - Portland Fire and Rescue
    - Address: 55 SW Ash Street, Portland, OR 97204
    - Nonemergency number: 503-823-3700

- Email: firemarshal@portlandoregon.gov

- o Multnomah County Emergency Management
  - Address: 501 SE Hawthorn Boulevard Suite 400, Portland, OR 97214
  - Phone number: 503-988-6700
  - Email: em.dutyofficer@multco.us

Fire department response times to the site:

- Mid-Columbia Fire and Rescue: 7 minutes
- Portland Fire and Rescue: 8 minutes

Certificate holder primary contact and contact of operational manager(s):

- X
- X

The landowner list will be updated and provided prior to construction.

Contact 911 in the event of:

- A fire or emergency on-site that cannot be addressed by personnel on-site and requires the assistance of fire or emergency medical personnel;
- A fire ignition on-site that spreads out of the fence line;
- Any fire off-site that does not have emergency responders on-site.
  - o To the extent that operational personnel can safely assist and/or provide equipment to help extinguish off-site fires until emergency responders are on site, it is encouraged to do so to assist in preventing the spread of the fire, loss of life, property and damage to the environment.

## 3.4 Specifications for Fire Protection Equipment

Oregon Administrative Rule (OAR) 629-043-0020 requires specific water supply and water delivery equipment for projects that operate stationary or mobile equipment during fire season inside or within one-eighth (0.125) mile from a forest protection district. Neither converter station is inside or within 0.125 mile of a forest protection district; therefore, OAR 629-043-0020 does not apply.

All internal combustion engines must be equipped with exhaust systems, mufflers, and screens, or include an appropriate spark arrestor; and must be kept in good operating condition. All power driven machinery will be kept free of excess flammable material that may create a risk of fire. The fire suppression equipment listed in Section 3.3 will also be carried in vehicles conducting maintenance activities during operation of the Facility.

## 3.5 Fire Precaution Levels and Restrictions during Fire Season

### 3.5.1 Definitions

- **Non-Fire Season** – Approximately October - May

**Fire Season** – Approximately June-September, formally designated by the Oregon Department of Forestry (ODF). Under Oregon Revised Statute (ORS) 478.960 (4), a Fire Chief can establish Fire Season within a Fire District when ODF, under ORS 477.505, declares Fire Season. Begins seasonal restrictions for public and industry.

**Fire Weather Watch** - A fire weather watch is issued when there is a high potential for the development of a red flag event. A watch is issued 18 to 96 hours in advance of the expected onset of criteria. The intent of a fire weather watch is to alert forecast users at least a day in advance for the purposes of resource allocation and firefighter safety. A watch means critical fire weather conditions are possible, but not imminent or occurring.

**Red Flag Weather Warning** - A red flag warning is used to warn of impending or occurring red flag conditions. Its issuance denotes a high degree of confidence that weather and fuel conditions consistent with local red flag event criteria will occur in 48 hours or less. Specific red flag criteria differ for each situation and district in Oregon. Be extremely careful with open flames and other activities that emit sparks.

**Hot Work** - Any cutting, grinding, welding, or other activity that creates a spark or open flame.

### 3.5.2 Fire Watch Service

The facility will have Designated Fire watch personnel that will:

- Be physically capable and experienced to operate firefighting equipment specified in Section 3.4.
- Have facilities for transportation and communications to summon assistance.
- Observe portions of the operation on which activity occurred during the day.

Upon discovery of a fire, Firewatch personnel must, first, report the fire, summon any necessary firefighting assistance, describe intended fire suppression activities; then, after determining a safety zone and an escape route that will not be cut off if the fire increases or changes direction, immediately proceed to control and extinguish the fire, consistent with firefighting training and safety. If shutdown activities are necessary, they will be determined when fire service personnel arrive at the facility.

### 3.5.3 Fire-Prevention Measures and Restrictions Associated with Fire Season

Certificate holder shall maintain a log when operational activities are impacted by fire restrictions during Fire Season, as designed in this section. The log will include:

- The date;
- Fire Precaution Level;
- Description of actions taken, including if any measures were taken to reduce wildfire risk that are not identified in this WMP.

Fire-prevention measures and restrictions include the following:

**Non-Fire Season**

- All hot work must be conducted on roads or on non-combustible surfaces.
- Smoking in designated areas only.

## Fire Season

- All hot work (any cutting, welding, or other activity that creates a spark or open flame) must be conducted on roads or on non-combustible surfaces.
- Water source meeting specifications in this WMP will be on-site during fire season.
- Following the completion of hot work, the Certificate Holder or contractor(s) must maintain a Fire watch for 60 minutes to monitor for potential ignition.
- Fire watch shall be on duty during any breaks and for 1 hour after all power driven machinery used by the operator has been shut down for the day.
- Smoking in designated areas only.

## Fire Weather Watch

- No hot work permitted.
- Driving and parking only permitted on graveled surfaces.
- Fire watch shall be on duty during any breaks and for 1 hour after all power driven machinery used by the operator has been shut down for the day.
- No smoking on site.

## Red Flag Weather Warning

- No hot work permitted.
- On-site personnel must be aware of Red Flag Warning.
- Driving and parking only permitted on graveled surfaces.
- Fire watch shall be on duty during any breaks and for 1 hour after all power driven machinery used by the operator has been shut down for the day.
- No smoking on site.

**Table 2: Fire Prevention Measures During Fire Season Summary**

| Requirement | Non-Fire Season | Fire Season | Fire Weather Watch | Red Flag Warning |
|---|---|---|---|---|
| Fire weather advisory | Not required | Not required | Not required | On-site personnel must be aware of Red Flag Warning. |
| On-site water source | N/A | As specified in Section 3.2 | As specified in Section 3.2 and 3.3. | As specified in Section 3.2 and 3.3. |

**Table 2: Fire Prevention Measures During Fire Season Summary**

| Requirement | Non-Fire Season | Fire Season | Fire Weather Watch | Red Flag Warning |
|---|---|---|---|---|
| Hot work | Only permitted on roads or on non-combustible surfaces. | Only permitted on roads or on non-combustible surfaces; fire watch required for 60 minutes after completion | Not Permitted | Not Permitted |
| Fire Watch Service | Not required | During breaks and for 60 minutes after all power-driven machinery has been shut down for the day. | During breaks and for 60 minutes after all power-driven machinery has been shut down for the day. | During breaks and for 60 minutes after all power-driven machinery has been shut down for the day. |
| Driving and Parking | As described in Section 3.8.4 | As described in Section 3.8.4. | Only permitted on roads or on non-combustible surfaces and Section 3.8.4 | Only permitted on roads or on non-combustible surfaces and Section 3.8.4 |
| Smoking | Designated areas only | Designated areas only | Not permitted | Not permitted |

## 3.6 Vegetation Management

The areas in and immediately around the converter station will be graveled with no vegetation present. The areas within the transmission line right-of-way will be cleared of vegetation and surveyed quarterly to maintain vegetation growth. Per the North American Electric Reliability Corporation (NERC), transmission line owners must include protocols for vegetation that may cause a transmission line outage (imminent threat vegetation). The short span of 500-kilovolt (kV) transmission that will connect the eastern converter station to the Big Eddy substation will be subject to NERC's Transmission Vegetation Management standard FAC-003-5 (NERC 2024). Ongoing vegetation management to ensure that vegetation does not grow in the graveled areas around the converter stations is outlined in 3.7.1.

#### 3.6.1.1 VEGETATION STANDARDS, SURVEYS, AND MANAGEMENT

No vegetation will be maintained within the converter station perimeter fence line. Mowing and/or herbicide application will be used to maintain a vegetation-free, noncombustible space, or gravel surface area up to 10 feet outside the converter station fence, where applicable.

In The Dalles area, Oregon Department of Transportation (ODOT) and BPA will be responsible for maintaining road ROWs where the underground HVDC is located within their ROWs.

### 3.6.2 Inspections and Maintenance

*OAR 345-022-0115(1)(b)(B) Describe the procedures, standards, and time frames that the applicant will use to inspect facility components and manage vegetation in the areas identified under subsection (a) of this section;*

Inspections of the converter station components will occur on a weekly, monthly, or semi-annual basis, depending on the component. Corrective maintenance tasks are identified from these inspections, and may include testing, monitoring, repair, or replacement. Spare and replacement parts kept on site are also inventoried and inspected for conditions. Fire alarm and suppression systems will be inspected annually by specialty contractors and the local fire departments will conduct annual permit inspections. The Operational Plan will provide a more detailed schedule of inspections and protocols, and a copy of the plan will be provided to ODOE.

The eastern converter station, which has a short segment of 500-kV aboveground transmission line and a lattice tower, will be inspected weekly during the converter station inspection and will have thermal testing performed periodically. To minimize potential ignition of the overhead transmission system, line inspections and system monitoring for abnormalities will be performed. Transmission line assessments include inspections of conductors, accessories (dampers, spacers, etc.), insulators, overhead groundwire, and aerial lighting and markings. Steel structures are typically inspected visually from the ground, with a climbing inspection every 10 years. Detailed inspections can also be performed with a high-powered spotting scope to inspect for defects, rather than climbing the tower. Inspections of transmission lines will follow guidelines in TLM-STD-4-1-11 Conductor and Accessories Inspection Criteria and inspections of steel towers will follow guidelines in TLM-STD-4-1-15 Visual Inspection of Steel Structures.

Adjacent public and private property owners may engage in activities that pose fire risk or have equipment that can come into contact with transmission systems. These activities may include burning brush piles, refueling vehicles under transmission lines, and parking vehicles over dried vegetation. These and any other observed activities that may cause fires should be reported if observed during facility inspections. Minimizing improper land use and encroachments can help reduce the risk of fire near facilities. These operational monitoring and maintenance measures are also discussed in Section 4.

Facility components will be inspected and maintained as designated in iMaint, a maintenance and service management software that the Applicant uses for other projects. This software is used to record maintenance activities for each piece of equipment as well as scheduling maintenance for the next year. It tracks information such as the frequency of inspections, expected number of inspections per year, dates of last and next inspection occurrences, and maintenance descriptions. An example of the Applicant’s current use of iMaint for their existing Neptune project is included in Appendix A. As designated in Section 4 of this WMP, this table maintenance schedule will be submitted to demonstrate compliance with the WMP and used to determine if changes to the WMP are necessary. Other maintenance schedules may be provided prior to operation and in the annual review of the WMP, as approved by ODOE.

Manufacturers’ recommendations, or excerpts for inspections and maintenance, will be included as Appendix E to the WMP.

#### 3.6.2.1 LOCK OUT/TAG OUT PROGRAM

An annual “scheduled maintenance outage” will be conducted for each converter station, during which personnel will carry out both corrective and preventative maintenance tasks. These outages typically last 3 to 5 days, during which the station will not operate, allowing careful inspection and testing of components and systems that are inaccessible during normal operation. During maintenance activities, electrical equipment is de-energized and physically locked or tagged in the de-energized positions to avoid inadvertent events that could result in arc flash.

### 3.6.3 Facility Monitoring

The supervisory, control, and data acquisition (SCADA) system collects operating and performance data from the facility as a whole. The Applicant will have operators with appropriate training and certification in accordance with NERC standards monitor the facility components 24 hours a day, 7 days a week.

Smoke and fire detectors are placed throughout the facility, will be connected to the SCADA system, and will contact local firefighting services, if needed.

The facility has remote shutdown capabilities through the SCADA system.

### 3.6.4 Operational Training(s)

Operational annual or biannual safety training and electrical safety program are discussed in Section 2.1.2.

# 4 Plan Updates: Amendments and Reporting Requirements

*OAR 345-022-0115(1)(b)(E) Describe methods the applicant will use to ensure that updates of the plan incorporate best practices and emerging technologies to minimize and mitigate wildfire risk.*

This WMP will be updated annually and results will be provided to ODOE in the annual report required per OAR 345-026-0080. Updates to this WMP will include:

- Section 3.1 and 3.2, any changes in wildfire risk at the site or changes in facility components or preventative features.
- Section 3.3, any changes in local fire protection agency personnel and operational managers.
- Section 3.3, any changes in analysis area residence/landowner addresses or contact information.
- Changes in wildfire risk if different from the Site Plan provided prior to operations. Evaluation of wildfire risk will be consistent with the requirements of OAR 345-022-0115(1) using current data from reputable sources.
- Changes in wildfire risk if different from the Site Plan provided prior to operation. Evaluation of wildfire risk will be consistent with the requirements of OAR 345-022-0115(1) using current data from reputable sources.
- Changes in standards, policies, future technologies or best practices that may be implemented at the facility to address wildfire prevention or protection, including but not limited to those identified in Table 3.

This information may be used to establish the performance of the WMP. If determined by certificate holder or ODOE, adjustments or improvements must be proposed to ensure the WMP provides wildfire mitigation. Any ODOE-required updates will be implemented within 14 days, unless otherwise agreed to by ODOE based on a good-faith effort to address wildfire hazard.

This WMP may be amended from time to time by agreement of the certificate holder and the Oregon Energy Facility Siting Council (OR EFSC) or ODOE, acting within its delegated authority of OR EFSC. Such amendments may be made without amendment of the site certificate. OR EFSC authorizes ODOE to agree to amendments to this WMP. ODOE will notify OR EFSC of all amendments, and OR EFSC retains the authority to approve, reject, or modify any amendment of this WMP agreed to by ODOE.

**Table 3. Standards for Future Review**

| Reference | Description | Method |
|---|---|---|
| Avian Powerline Interaction Committee (APLIC) | Suggested Practices for Avian Protection on Power Lines. | The applicant will follow APLIC guidelines for the overhead transmission line component of the facility. |
| National Electric Reliability Corporation (NERC) | National Energy Reliability Corporation develops electrical standards for large energy facilities. | The applicant will follow NERC Standard FAC-003-0 for its vegetation management program of transmission lines[2], or updates to this standard as approved by NERC. |
| Oregon Specialty Building Codes (OSBC) | Building codes applicable to inhabitable spaces, including the O&M building and the converter station enclosure. | Remodeling to the O&M and enclosure structure that requires permits will follow any updates to the OSBC at that time. |
| Oregon Fire Code | The Oregon State Fire Marshal adopts the Oregon Fire Code, establishing minimum fire prevention and protection systems requirements applicable to certain structures, including but not limited to, energy systems. | The applicant will adhere to any applicable standards of the Oregon Fire Code and will incorporate features necessary to meet those standards into the design of the facility. Certificate holder will annually review and apply applicable standards that may apply to an operational facility. |
| National Fire Protection Association (NFPA) Codes and Standards | NFPA publishes codes and standards intended to minimize the possibility and effects of fire and other risks. | The applicant will identify and adhere to any applicable codes and standards and will incorporate features necessary to meet those standards into the design of the facility. Certificate holder will annually review and apply applicable standards that may apply to an operational facility. |
| Oregon Revised Statute (ORS) chapter 477, OAR chapter 629-043 | Standards and rules for fire prevention in forest and range land administered by Oregon Department of Forestry (ODF). | The applicant will be familiar with and operate consistently with the applicable standards, including any updates to rules or standards and will provide a summary of standards that are updated and implemented at the facility. |
| Oregon Administrative Rule (OAR) chapter 860, division 024 | Safety standards for transmission lines adopted by Oregon Public Utilities Commission (PUC). | The applicant will maintain consistency with any applicable vegetation clearance requirements, pruning standards, and high fire risk zone safety standards and will provide a summary of standards that are updated and implemented at |

1. Link to ACP Standards & Practices: https://cleanpower.org/resources/types/standards-and-practices/.

2. NERC FAC-003-0: https://www.nerc.com/pa/Stand/Reliability%20Standards/FAC-003-0.pdf.

3. Link to APLIC member organization: https://www.aplic.org/member_websites.php.

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NFPA (National Fire Protection Association). 2020. NFPA 850 – Recommended Practice for Fire Protection for Electrical Generating Plants and High Voltage Direct Current Converter Stations. Available online at: https://nfpanorm.com/wp-content/preview/850%202020.pdf

# Appendix A: Example Maintenance Schedule (from Applicant's Neptune project)

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# Sayreville 2024

| Period | Category | Area of Inspection or Maintenance | Expected # of Occurances per Year | Actual # of times performed for current year | Discrepancy | 2023 Work Order # | Year last performed | Year of next occurrence | 2024 Work Order # | Maintenance Procedure | Maintenance Document ID | NRTS Man-Hours (per site) | Contractor Man-Hours (per site) | Device Outage Req'd? | Station Outage Req'd? |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 Month | 261 | Station Service Batteries + Charger | 2 | | 2 | 2023-1253 | 2023 | 2024 | | | SAY_MD_381_6M_C&P_MEASURING_MAINT_R1 | | | No | No |
| | 381 | C&P Measuring Maintenance | 2 | | 2 | | | | | | SAY_MD_391_12M_HMI_CABINET_CLEANING_R1 | | | No | No |
| | 391 | HMI System | 2 | | 2 | 2023-1337 | 2023 | 2024 | | | SAY_MD_421_6M_PLC_FILT_CORONA_SCAN_R0 | | | No | No |
| | 421 | PLC Filter | 2 | | 2 | 2023-1039/1294/1437 | 2023 | 2024 | | | SAY_MD_731_6M_1ST-2ND_FLOOR_HVAC_MAINT_R1 | | | No | No |
| | 731 | HVAC | 2 | | 2 | 23-1042 to 1045/1440 to 14 | 2023 | 2024 | | | | | | Yes | No |
| | 741 | Fire Detection System | 2 | | 2 | | | | | | SAY_MP_842_6M_ELEVATOR_INSPECTION_R1 | | | Yes | No |
| | 842 | Elevator | 2 | | 2 | 2023-1046/1443 | 2023 | 2024 | | | SAY_MD_857_6M_ACCESS_GATE_CODE_CHG_R1 | | | Yes | No |
| | 857 | Site Access Gate | 2 | | 2 | 2023-1047/1444 | 2023 | 2024 | | | SAY_MD_863_6M_LANDFILL_INSPECTION_R1 | | | No | No |
| 12 Month (1Y) | 111 | Thyristor Valve and Equipment | 1 | | 1 | 2023-1048 | 2023 | 2024 | | | SAY_MD_111_12M_GRADING ELECTRODE CHECK_R0 | | | Yes | Yes |
| | 121 | Valve Cooling System | 1 | | 1 | 2023-1049/1050 | 2023 | 2024 | | | SAY_MD_121_12M_VALVE_COOLING_MAINT_R1 | | | Yes | Yes |
| | 139 | DC Cable Termination | 1 | | 1 | 2023-1051/1052 | 2023 | 2024 | | | SAY_MD_139_12M_DC_HV_CABLE_END_R0 | | | Yes | Yes |
| | 150 | AC Filter (10D01) | 1 | | 1 | 2023-1053 | 2023 | 2024 | | | | | | Yes | No |
| | 150 | AC Filter (10D02) | 1 | | 1 | 2023-1054 | 2023 | 2024 | | | | | | Yes | No |
| | 150 | AC Filter (10D04) | 1 | | 1 | 2023-1055 | 2023 | 2024 | | | | | | Yes | No |
| | 150 | AC Filter (10D05) | 1 | | 1 | 2023-1056 | 2023 | 2024 | | | | | | Yes | No |
| | 150 | AC Filter (10D06) | 1 | | 1 | 2023-1057 | 2023 | 2024 | | | | | | Yes | No |
| | 154 | Shunt Reactor | 1 | | 1 | 2023-1058 | 2023 | 2024 | | | SAY_MD_154_12M_SHUNT_REACTOR_TUMA_R1 | | | Yes | Yes |
| | 169 | AC Cable Termination | 1 | | 1 | 2023-1059 | 2023 | 2024 | | | SAY_MD_165_60M_AC_DISC_GRD_SW_R1 | | | Yes | Yes |
| | 171 | Converter Transformer | 1 | | 1 | 2023-924/1112/1120 | 2023 | 2024 | | | SAY_MD_171_12M_CONV_TRANSF_TUMA_R2 | | | Yes | Yes |
| | 181 | Smoothing Reactor | 1 | | 1 | 2023-1060 | 2023 | 2024 | | | SAY_MD_181_12M_SMOOTHING_REACTOR_R1 | | | Yes | Yes |
| | 211 | Station Service Transformer | 1 | | 1 | 2023-1061 | 2023 | 2024 | | | SAY_MD_211_12M_STN_SERV_TRANSF_MAINT_R1 | | | No | No |
| | 261 | Station Service Batteries + Charger | 1 | | 1 | 2023-889/890 | 2023 | 2024 | | | SAY_MD_261_12M_NERC_INTERCELL_CONNECTIONS_R1 | | | No | No |
| | 321 | Station Control System | 1 | | 1 | 2023-1062 | 2023 | 2024 | | | SAY_MD_321_12M_STATON_CONTROL_BACKUP_BATTERY_R0 | | | Yes | Yes |
| | 331 | Transient Fault Recorder | 1 | | 1 | 2023-1063 | 2023 | 2024 | | | SAY_MD_331_12M_TFR_CABINET_CLEANING_R1 | | | Yes | Yes |
| | 341 | Pole Control System | 1 | | 1 | 2023-1064 | 2023 | 2024 | | | SAY_MD_341_12M_POLE_CONTROL_BACKUP_BATTERY_R0 | | | Yes | Yes |
| | 352 | AC Filter Main Protection | 1 | | 1 | 2023-1642 | 2023 | 2024 | | | SAY_MD_352_12M_AC_FILTER_MAIN_PROT_BACKUP_BATTERY_R0 | | | Yes | Yes |
| | 391 | HMI System | 1 | | 1 | 2023-1066 | 2023 | 2024 | | | `SAY_MD_391_12M_HMI_CABINET_CLEANING_R1 | | | No | No |
| | 421 | PLC Filter | 1 | | 1 | 2023-1067 | 2023 | 2024 | | | SAY_MD_421_12M_AC_PLC_FILTER_MAINT_R1 | | | Yes | Yes |
| | 511 | DC Surge Protectors | 1 | | 1 | 2023-1068 | 2023 | 2024 | | | SAY_MD_511_12M_DC_SURGE_ARRESTER_R1 | | | Yes | Yes |
| | 515 | AC Surge Protectors | 1 | | 1 | 2023-1069 | 2023 | 2024 | | | SAY_MD_515_12M_AC_SURGE_ARRESTER_R1 | | | Yes | Yes |
| | 550 | Insulators | 1 | | 1 | 2023-1070/1071 | 2023 | 2024 | | | SAY_MD_551_12M_DC_INSULATOR_R1 | | | Yes | Yes |
| | 611 | Voltage Transformer | 1 | | 1 | 2023-1072 | 2023 | 2024 | | | SAY_MD_611_12M_ACVT_R1 | | | Yes | Yes |
| | 621 | Current Transformer | 1 | | 1 | 2023-1073 | 2023 | 2024 | | | SAY_MD_621_12M_IOSK_ACCT_R1 | | | Yes | Yes |
| | 631 | DC Voltage Divider | 1 | | 1 | 2023-1074 | 2023 | 2024 | | | SAY_MD_631_12M_HV_VOLT_DIVIDER_R1 | | | Yes | Yes |
| | 641 | DC Current Measuring Device | 1 | | 1 | 2023-1065/1076 | 2023 | 2024 | | | SAY_MD_641_12M_CURRENT_MEAS_DEVICE_INSP_R1 | | | Yes | Yes |
| | 731 | HVAC | 1 | | 1 | 2023-1077 to 1079/1445/144 | 2023 | 2024 | | | SAY_MD_731_12M_1ST_FLOOR_HVAC_MAINT_R1 | | | Yes | No |
| | 741 | Fire Detection System | 1 | | 1 | 2023-927/1081 | 2023 | 2024 | | | | | | Yes | Yes |
| | 868 | Vegetation Management | 1 | | 1 | 2023-1082 | 2023 | 2024 | | | SAY_MP_868_12M_STN_GROUNDS_R1 | | | Yes | Yes |
| | 895 | Backflow Preventers | 1 | | 1 | 2023-1083 | 2023 | 2024 | | | | | | No | No |
| 18 Month | 251 | DC Distribution + DC/DC Converter | 1 | | 1 | 2022-601 | 2022 | 2024 | | | SAY_MD_251_18M_NERC_BATT_CHGR_FLOAT_VOLT_R0 | | | No | No |
| 24 Month (2Y) | 111 | Thyristor Valve and Equipment | 0 | | 0 | 2023-1084 | 2023 | 2025 | | | SAY_MD_111_24M_THYRISTOR_VALVES_R0 | | | Yes | Yes |
| | 112 | Valve Base Electronics | 0 | | 0 | 2023-1085 | 2023 | 2025 | | | SAY_MD_112_24M_VALVE_BASE_ELECTRONICS_R0 | | | Yes | Yes |
| | 121 | Valve Cooling System | 0 | | 0 | 2023-1086/1087 | 2023 | 2025 | | | SAY_MP_121_24M_3WAY_VALVE_REBUILD_R0 | | | Yes | Yes |
| | 150 | AC Filter (10D01) | 0 | | 0 | 2023-1088/1115 | 2023 | 2025 | | | SAY_MD_152_24M_AC_FILT_REAC_MAINT_20C03_R0 | | | Yes | No |
| | 150 | AC Filter (10D02) | 0 | | 0 | 2023-1089/1116 | 2023 | 2023 | | | | | | Yes | No |
| | 150 | AC Filter (10D04) | 0 | | 0 | 2023-1090/1117 | 2023 | 2023 | | | | | | Yes | No |
| | 150 | AC Filter (10D05) | 0 | | 0 | 2023-1091/1118 | 2023 | 2023 | | | | | | Yes | No |
| | 150 | AC Filter (10D06) | 0 | | 0 | 2023-1092/1119 | 2023 | 2023 | | | SAY_MD_153_24M_AC_FILT_RESIST_MAINT_20C03_R0 | | | Yes | No |
| | 641 | DC Current Measuring Device | 0 | | 0 | 2023-1093 | 2023 | 2025 | | | SAY_MD_641_24M_CURRENT_MEAS_DEVICE_MAINT_R1 | | | Yes | Yes |
| | 741 | Fire Detection System | 0 | | 0 | 2022-602 | 2022 | 2024 | | | | | | Yes | Yes |
| 36 Month (3Y) | 121 | Valve Cooling System | 0 | | 0 | 2023-1095 | 2023 | 2026 | | | SAY_MP_121_36M_MTR_BRG_REPACK_R0 | | | Yes | Yes |
| | 241 | AC Distribution | 0 | | 0 | 2023-1096 | 2023 | 2026 | | | SAY_MP_241_36M_POWER_CENTER_BKR_MAINT_R0 | | | Yes | Yes |
| | 331 | Transient Fault Recorder | 0 | | 0 | 2022-605 | 2022 | 2025 | | | SAY_MD_331_36M_TFR_BACKUP_BATTERY_R0 | | | No | Yes |
| | 391 | HMI System | 0 | | 0 | 2022-606 | 2022 | 2025 | | | SAY_MD_391_36M_HMI_BACKUP_BATTERY_R0 | | | Yes | No |
| | 611 | Voltage Transformer | 0 | | 0 | 2023-1097 | 2023 | 2026 | | | SAY_MD_611_36M_ACVT_CLEAN_&_TEST_R1 | | | Yes | Yes |
| 48 Month (4Y) | 138 | DC Wall Bushing | 0 | | 0 | 2022-607 | 2022 | 2026 | | | SAY_MD_138_48M_WALL_BUSHING_R1 | | | Yes | Yes |
| | 271 | Inverter / UPS | 0 | | 0 | 2020 | 2020 | 2024 | | | SAY_MP_271_48M_UPS_INVERTER_FAN_REPLACE_R1 | | | Yes | Yes |
| 60 Month (5Y) | 121 | Valve Cooling System | 0 | | 0 | 2023-1098 to 1101 | 2023 | 2028 | | | SAY_MD_121_60M_VCS_COMPENSATORS_R0 | | | Yes | Yes |
| | 154 | Shunt Reactor | 0 | | 0 | 2023-1102 | 2023 | 2028 | | | SAY_MP_154_60M_SHUNT_REACTOR_TESTING_R0 | | | Yes | Yes |
| | 165 | AC Disconnect/Ground Switch | 0 | | 0 | 2022-608 | 2022 | 2027 | | | SAY_MD_165_60M_AC_DISC_GRD_SW_R1 | | | Yes | Yes |
| | 171 | Converter Transformer | 0 | | 0 | 2023-1103 | 2023 | 2028 | | | SAY_MP_171_60M_CXTX_TESTING_R0 | | | Yes | Yes |
| | 241 | AC Distribution | 0 | | 0 | 2020 | 2020 | 2025 | | | SAY_MD_241_60M_AC_POWER_CENTER_MAINT_R0 | | | Yes | Yes |

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# 2024 SAYREVILLE MAINTENANCE LIST

| Conditional Maintenance | Run Hou | Cycle Tim | Time Peri | Equipment Class | Equipment Designation | Inspection/Maintenance | Equipment Subsystem | Equipment Sub-Subsystem (if applicable) | Maintenance Description | Equipment Outa | Plant Outag |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | 1W | 000 | 000-WeeklyWDwn | 1 Week Converter Station Walkdown Inspection | N/A | N/A | 1) Weekly inspection of site and equipment conditions | No | No |
| | | | 12M | 111 | 11B01-V1 11B01-V2<br>11B01-V3 11B01-V4 | 12 Month Thyristor Valve and Equipment Maint. | Thyristor MVU | Grading Electrodes | Inpsect all grading electrodes with known scaling accumulations and 10% of other electrodes. Remove, check, and reinsert electrode according to detailed procedure in section 8.3.3. The volume of the platinum pin shall be more than 60 % of the original volume. If the volume is down to 60 % or below, all electrodes shall be checked. Electrodes with a volume of the platinum pin down to 50 % of original shall be replaced. | Yes | Yes |
| | | | 24M | 111 | 11B01-V1 11B01-V2<br>11B01-V3 11B01-V4 | 2 Year Thyristor Valve and Equipment Maint. | Buswork | N/A | 1) Ensure all buswork looks the same throughout the MVU | Yes | Yes |
| | | | 24M | 111 | 11B01-V1 11B01-V2<br>11B01-V3 11B01-V4 | | | | 2) Inspect buswork for discolored connections (indicating loose bolts) | Yes | Yes |
| | | | 24M | 111 | 11B01-V1 11B01-V2<br>11B01-V3 11B01-V4 | | | | 3) Torque check once thyristor module per MVU each 24 month period (20% checked per period) | Yes | Yes |
| | | | 24M | 111 | 11B01-V1 11B01-V2<br>11B01-V3 11B01-V4 | | Contamination | N/A | 1) Check the surface of long rod insulators in the valve tower and the grading capacitors, the insulators and valve reactor supports in the thyristor modules. Due to pressurisation of the valve hall and filtering of makeup air, no major contamination is expected.<br>In case of heavy contamination, clean with a dry, clean cloth of lint-free material. Do not distribute the dirt, but change continuously to clean areas of the cloth. Use ethyl alcohol in case of severe contamination. | Yes | Yes |
| | | | 24M | 111 | 11B01-V1 11B01-V2<br>11B01-V3 11B01-V4 | | Cooling Circuit Fittings | N/A | 1) For this inspection, the cooling water pump shall be operating to<br>provide pressure in the cooling circuit. Check for leaks and tighten, if necessary. Tightening<br>torque: Nut 1.5 Nm, fitting 2.5 Nm. Fittings for plastic piping shall only be tightened in case of<br>leakage. Do not tighten too much. Replace the fitting if tightening does not work (refer to enclosure 2). | Yes | Yes |
| | | | 24M | 111 | 11B01-V1 11B01-V2<br>11B01-V3 11B01-V4 | | Grading Capacitor | N/A | 1) Check for a clean surface of the insulating part of the body. | Yes | Yes |
| | | | 24M | 111 | 11B01-V1 11B01-V2<br>11B01-V3 11B01-V4 | | Valve Reactor | N/A | 1) Watch for cracks and discolouring of the epoxy and for deformation or leakage of the water piping in and close to the reactor. In case of irregularities, replace the reactor. | Yes | Yes |
| | | | 24M | 112 | 11VR31+U31 | 24 Months Valve Base Electronics Maintenance | Valve Based Electronics | N/A | 1) The position of optical fibres and the plug-on connections should be checked. Any dust deposits should be removed with a vacuum cleaner. | Yes | Yes |
| | | | 24M | 112 | 11VR31+U31 | | | | 2) The LEDs on the front panels of the different modules within the VBE subracks and the LEDs on the other components such as relay modules or undervoltage detection within the VBE cubicle should also be checked. | Yes | Yes |
| | | | 24M | 112 | 11VR31+U31 | | | | 3) Check the proper function of the rack mounted fan units, located at the back doors of the cubicle. Check the red indication LED (should be off) and test it by pushing the "reset" key of each fan unit. | Yes | Yes |
| | | | 24M | 112 | 11VR31+U31 | | | | 4) It should be checked, that all the 24 V DC power supplies of the VBE are still within the specified range. | Yes | Yes |
| | | | 96M | 116 | 11B02-Q55<br>11B02-Q54<br>11B01-Q51-L1<br>11BO1-Q51-L2<br>11B01-Q51-L3<br>11B01-Q52-L1<br>11BO1-Q51-L2<br>11B01-Q51-L3 | 96 Month Valve Hall Ground Swtches | Ground Switch and Motor Drive | | Visual check for damage by inadmissible external influences | Yes | Yes |
| | | | | | 11B02-Q55<br>11B02-Q54<br>11B01-Q51-L1 | | | | | | |

# Appendix B: BPA 2024 Wildfire Mitigation Plan

BONNEVILLE POWER ADMINISTRATION

# BPA 2024 WILDFIRE MITIGATION PLAN


## ABSTRACT

BPA's Wildfire Mitigation Plan covers end-to-end activities related to the mitigation of wildfires across the Federal Columbia River Transmission System.

# Message from the Administrator

The Bonneville Power Administration published its inaugural Wildfire Mitigation Plan (WMP) in 2020 and added a Public Safety Power Shutoff (PSPS) procedure to the WMP released in 2022. 2024 marks the fourth year that BPA will coordinate its wildfire mitigation efforts under a distinct plan.

This year, we are building on the lessons we've learned since 2020. This updated WMP includes the following improvements:

- Lessons learned since considering and implementing PSPS implementation between 2021 and 2023.
- Evolving wildfire modeling and data integration in partnership with the Pacific Northwest National Laboratory that informs prioritization of vegetation management and maintenance work on transmission lines posing the greatest wildfire threat.
- Infusion of lessons learned applying the International Wildfire Risk Mitigation Consortium Maturity Model, which has helped our experts better understand current BPA programs and activities in relation to general utility threats. This has resulted in year-over-year improvements to our plan and activities.

In addition to improving the way we manage vegetation and repair equipment that presents a wildfire risk, we began applying fire retardant to our wood poles in 2022. This measure helps reduce the spread of wildfires that threaten our rights-of-way and adds a protective element to our transmission system.

Climate change continues to lengthen wildfire season and increase the fire-related threats to utility systems across the Pacific Northwest and the country. Wildfires are devastating to utilities and other industries, but even more so to people who lose their lives, property, and cherished belongings to these catastrophic events.

BPA is committed to continually improving its WMP to prevent, mitigate, and quickly recover from the devastation wildfires can wreak on the people and communities we serve. I am proud of the work we have done and will do as we improve the preventative measures outlined in this plan.

John Hairston

Administrator and CEO
Bonneville Power Administration

# Contents

# 1.0 Introduction/Executive summary

Bonneville Power Administration's (BPA) wildfire mitigation activities have evolved to include risk-informed business strategies and capabilities incorporated into this document. These approaches promote continuous improvement in wildfire mitigation that allow BPA to deliver value and safely operate the transmission system providing power and transmission service to utilities and other interconnection customers. This is vital to the flow of electricity across the Western Interconnection.

Fuel + Ignition Source = Fire. Looking through the lens of this wildfire equation, the 2024 Wildfire Mitigation Plan (WMP) encompasses BPA's efforts to mitigate the risk of wildfire ignitions. Specifically, the WMP includes several technical safety and preventative measures related to the materials and equipment owned and operated by BPA as the agency recognizes its potential components of the wildfire equation. The plan also includes communication and coordination tactics with local, state, and federal partners to support collaborative wildfire mitigation efforts across BPA's service territory.

BPA has long-standing operational practices that have directly or indirectly provided wildfire mitigation. This includes world-class vegetation management, customer and community relations, partnerships with wildfire experts like the Pacific Northwest National Laboratory (PNNL), and field service inspection and maintenance. These practices and relationships have served BPA, its customers, and its service territory well.

BPA is actively growing its efforts to mitigate the risk of wildfires. The agency is making significant progress in asset management value framework maturation, inclusive of factors that address wildfire ignition or fuel in BPA's asset base. BPA continues to evaluate and deploy existing and emerging solutions that enhance operational effectiveness in mitigating wildfire risk. BPA is also expanding its focus to take into consideration more local impacts to communities surrounding Public Safety Power Shutoff (PSPS) decisions.

BPA has adopted the Institute of Asset Management's methodologies as its benchmark for asset management. By making asset management an element of BPA's 2024–2028 Strategic Plan[1], it enhances abilities to develop solutions that focus on asset lifecycle management that, in turn, improves risk-reducing methodologies in reliability, resiliency, and wildfire mitigation.

BPA will continue to assess factors of climate change, community growth, and asset conditions as its wildfire mitigation program evolves and to ensure the agency applies cost-effective and risk-based solutions in a proactive way to best serve its customers.

The scope of BPA's WMP includes asset management and vegetation management programs across the entire transmission system lifecycle:

- Operations and maintenance
- Replacement
- Disposal
- Response and recovery

Additionally, the WMP covers protocols and processes for restoring service after a wildfire. The WMP will be updated in alignment with BPA's Transmission Strategic Asset Management Plan (SAMP) and Integrated Program Review (IPR).

**1/** BPA, "2024–2028 Strategic Plan." *Available at https://www.bpa.gov/-/media/Aep/about/who-we-are/strategic-plan/2024-2028-strategic-plan.pdf*

## 1.1 Bonneville Power Administration

Bonneville Power Administration (BPA) is a nonprofit federal power marketing administration based in the Pacific Northwest. Though BPA is part of the U.S. Department of Energy (DOE), it is self-funding and covers its costs by selling its products and services. BPA is one of the nation's largest public utilities with transmission assets touching several Northwest states.

### Asset locations

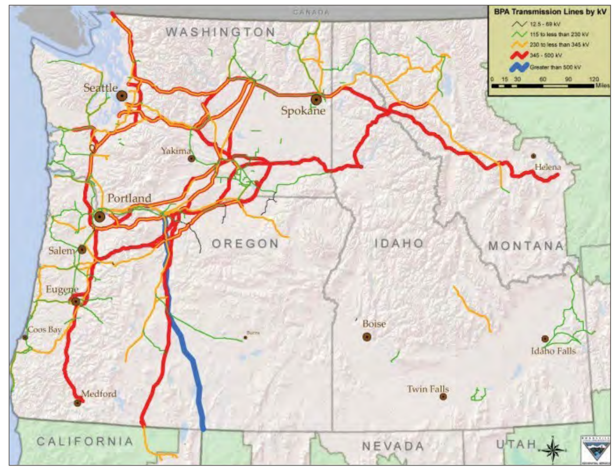


*Figure 1.*

BPA owns, operates, and maintains transmission facilities and equipment critical to sustaining the flow of power from generating facilities via more than 15,000 circuit miles of lines, which occupy more than 8,500 miles of rights-of-way (ROW) and pass through more than 260 substations. Its service area includes Idaho, Oregon, Washington, western Montana and small parts of eastern Montana, California, Nevada, Utah, and Wyoming.

BPA's mission is to create and deliver the best value for customers and constituents. BPA's vision is to continue being an engine of the Northwest's economic prosperity and environmental sustainability.

The terrain and climate that encompasses BPA's transmission lines, telecommunication sites, and substations varies greatly and includes coastal areas, rain forest, and high desert. Each of these areas pose unique wildfire challenges that require different mitigation strategies and solutions.

Most of the generating resources connected to the BPA transmission system provide electricity to retail customers many miles from their source. As a result, BPA operates long transmission lines and equally long ROWs. Some of these lines are located in areas with extremely strong winds, such as the Columbia River Gorge, where sustained wind speeds of 40 mph are not uncommon. Due to the diversity of its service territory with its varying climates and topography, BPA considers multiple ignition variables in the WMP.

## 1.2 Federal Columbia River Transmission System (FCRTS)

The expansive network described above covers an area totaling more than 300,000 square miles. BPA's history of providing reliable transmission at a competitive cost has attracted a wide range of interconnection customers.

BPA provides transmission service to its preference customers — approximately 140 public utility districts, municipal electric utilities, electric cooperatives, and others — independent power producers, and investor-owned utilities. Interconnected generation resources include federal and other hydroelectric projects, fossil fuel, wind, nuclear, solar, and others.

As it created this plan, BPA performed a maturity assessment using the International Wildfire Risk Mitigation Consortium (IWRMC) method to assess wildfire competencies. BPA ranked each competency with their corresponding maturity to reflect the current state of its wildfire risk mitigation capability. This analysis helped BPA recommend improvements to its physical assets, planning and operations, maintenance capability, and communications.

Consistent with the North American Electric Reliability Corporation (NERC) regulatory direction on building resiliency into utilities' asset management systems, the WMP aims to improve design and maintenance standards and improve construction activities that allow BPA to respond to a wildfire event rapidly and safely.

The plan includes assessment of new industry practices and technologies that reduce the likelihood of outage frequency and improve the restoration of service. In addition, BPA reviews and incorporates available ignition data for wildfires throughout the Northwest to build asset management plans targeting those probabilistic sources.

## 1.3 Policy statement

BPA's mission as a public service organization is to create and deliver the best value for its customers and constituents to provide an adequate, efficient, economical, and reliable power supply. BPA's vision is to advance the Northwest power system by providing high eliability and low rates consistent with sound business principles, responsible environmental stewardship, and accountability to the region.

To meet its mission and vision, BPA constructs, operates, and maintains its transmission system in a manner that minimizes wildfire risks. Iterations of this WMP will be coordinated to align with Transmission SAMP and IPR revision cycles.

## 1.4 Purpose

This WMP describes the range of policies, programs, processes, procedures, and activities to proactively mitigate threats posed by its assets for starting or contributing to the spread of a potential wildfire. This includes policies and care of its transmission assets and management of vegetation in the areas that contain BPA transmission lines and substations.

## 1.5 Objectives

The primary objectives of this WMP are to do the following:

1. Mitigate the probability that BPA's transmission assets may be the source of ignition or a fuel source of a wildfire, while continuing to provide reliable transmission service to the region and the customers served.
2. Implement a plan that prioritizes safety, situational awareness, preventative methods, and restoration.
3. Maintain a plan that improves wildfire resilient competencies and risk mitigation activities.

# 2.0 Accountability of the WMP

BPA's chief operating officer (COO) has ultimate accountability for this plan. Reporting to the COO, BPA's senior vice president of Transmission Services is the owner of the WMP and is responsible for its execution. Other BPA executives have substantive responsibilities in support of this plan, including revising and implementing policies, programs, processes, and procedures.

## 2.1 BPA responsibilities for components of this plan

The following officials and their organizations support the implementation of this plan.

- Chief Operating Officer
- Senior Vice President, Transmission Services
- Vice President, Transmission Planning and Asset Management
- Vice President, Transmission Field Services
- Vice President, Transmission Engineering and Technical Services
- Vice President, Transmission System Operations
- Vice President, Transmission Marketing and Sales
- Director, Transmission Technology
- Executive Vice President and Chief Risk Officer
- Chief Administrative Officer

## 2.2 Metrics and assumptions for measuring WMP performance

BPA has developed and continues to refine wildfire prevention measures related to the transmission system through various initiatives as outlined in the Transmission SAMP and other directional documents that impact wildfire mitigation. Some of these measures will provide input to wildfire mitigation management, such as the asset management value framework maturation and reliability standards. Other measures come from third party vendors providing products and services such as wildfire modeling. BPA's collaborative relationships with other utilities and organizations, such as PNNL, provides forums to explore meaningful metrics. As industry wildfire mitigation program standards and measures continue to evolve, BPA will identify relevant metrics to measure this plan and the agency's effectiveness.

BPA participates with a variety of peer utilities and organizations to share knowledge, data, and process development information. BPA has membership in the following organizations:

- Centre for Energy Advancement through Technological Innovation (CEATI)
- Electric Power Research Institute (EPRI)
- International Wildfire Risk Mitigation Consortium (IWRMC)
- North American Transmission Forum (NATF)

## 2.3 Maintenance performance targets

Maintenance services are established for each asset type and/or asset sub-types. The maintenance service defines the task, task type, and task frequency that are grouped into services and scheduled through the maintenance management system for the asset. The service structure can support routine maintenance and tasks that are unique for model type, age, and condition variables.

Asset condition is influenced by the efficacy, timeliness, and minimization of maintenance-induced errors. Transmission Services rigorously monitors maintenance service performance and backlog tracking for most critical assets, as described in more detail in Section 5.2.

## 2.4 System enhancement capital program

Transmission Asset Management's capital and maintenance plans are outlined in the Transmission SAMP and Asset Plan. These plans cover the long-term planning horizon for capital and the replacement/maintenance strategies for BPA's entire portfolio of assets. The plans feed directly into the IPR.

The Transmission SAMP covers the current state of assets and describes planned asset management, maturity, and competency improvements needed to effectively and efficiently manage the entire lifecycle of BPA assets that deliver electric transmission and telecommunication services. The Transmission SAMP provides alignment between the agency strategy, the Transmission Business Model, stakeholder requirements, organizational objectives, and resulting asset management objectives to ensure assets are managed and measured optimally to deliver value to the region.

## 2.5 Monitoring of the WMP

The WMP will be reviewed annually to reflect knowledge gained in the preceding year and will be modified accordingly, as needed. A more formal review will be completed in coordination with BPA's Transmission SAMP and IPR cycles. BPA prepares for annual wildfire season in advance and utilizes this plan as strategic and operational guidance.

Identified improvements will be continuously documented during the review cycle and incorporated in the WMP update. BPA specific organizational level policies, programs, processes, and procedures that support the WMP will be updated based on their respective review cycles.

## 2.6 Lessons learned

Each year, a lessons learned exercise is conducted to gather feedback from subject matter experts (SMEs) involved in the identification, response, and restoration activities involving wildfires. The exercise consists of interviews with individuals or small teams where feedback is grouped into six distinct categories. Comments are then classified as a strength (something done well), an improvement (something improved upon), or a recommendation (areas of maturity). Key takeaways are recommendations for improvement derived from the SME feedback interviews and lessons learned group discussions.

For ease in analyzing the feedback received from these interviews, the information is classified into the following six categories:

- **Communication:** Includes subject areas for customer outreach, policies/procedures, and reporting. Communication is a large task in a major, widespread event.
- **Coordination:** Covers the interaction that occurs between numerous organizations involved with wildfire mitigation. Refers to the combination of all internal activities that would operate and interact during a wildfire event to achieve unity of action in the pursuit of managing and restoring the transmission grid.
- **Decision-making:** Includes subject areas for prioritizing data-driven decision-making, de-energizing, auto re-closing, re-energizing, and authority for making decisions.
- **Planning:** Includes subject areas for the WMP, policies, data/assessments, and documentation.
- **Support:** Includes topics relating to resources without direct transmission responsibility such as supply chain, access to locations (state of access roads, landowners, vehicles, etc.), fleet, equipment, real property, photogrammetry, logistics, and staffing levels.
- **Technology:** Covers data and information systems used for situational awareness, communication, data analysis, and decision-making.

BPA's wildfire lessons learned exercise provides valuable information that is integrated with other wildfire mitigation priorities to continuously improve wildfire competencies, programs, and plans.

**Lessons learned feedback**

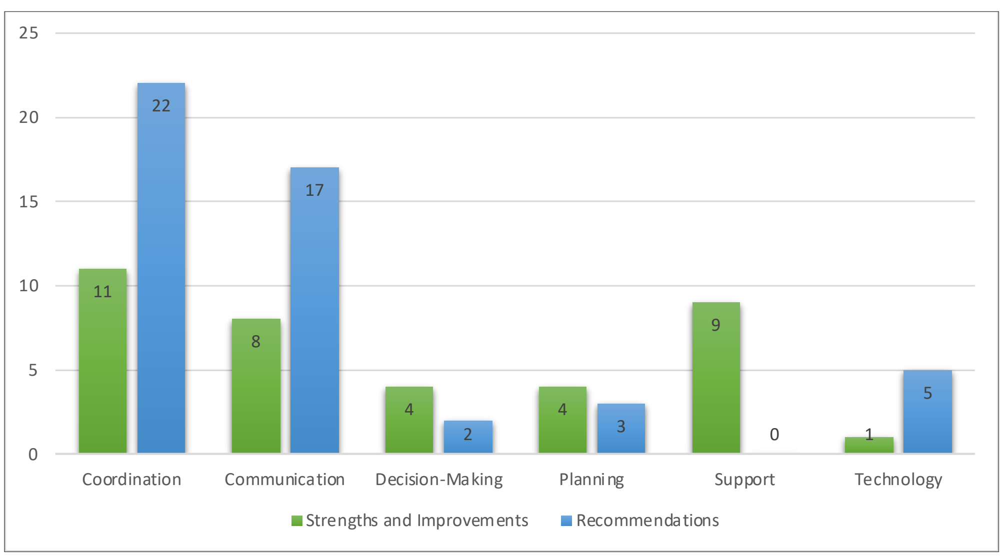


*Figure 2. Breakdown of feedback received from 2023 lessons learned interviews.*

## 3.0 Risk analysis and trends

Since early 2022, BPA has contracted with wildfire physicists, geospatial analysts, and data scientists at PNNL to develop probabilistic wildfire risk models within its service territory. A few of the many variables considered in this analysis are wind, humidity, vegetation types, and fuel volumes. Transmission Services continues to mature internal capabilities to conduct sensitivity analyses within the transmission system. The analyses help inform planned activities in coordination with local, state, and federal entities to allow for the most efficient deployment of critical resources.

BPA also voluntarily maintains tools such as the public-facing Wildfire Activity in the BPA Service Area map,[2] which communicates projected wildfire risk and conveys wildfire ignitions using federal and state data sources.

## 3.1 Contributing factors and trends

The frequency of large wildfires is influenced by a complex combination of natural and human factors, including climatic conditions such as temperature, soil moisture, relative humidity, and wind speed; vegetation (e.g. fuel density); forest management practices; and wildfire suppression techniques.[3] Wildfires have the potential to significantly impact the energy sector as they can cause both significant infrastructure damage and disrupt electricity transmission.

In recent decades, the incidence of large forest wildfires have increased and are expected to continue increasing as temperatures rise due to the climate crisis. Projected warmer and drier summers, declining snowpack, and correlated decreases in summer soil moisture will increase the risk of wildfires, particularly in forested areas where fuels are abundant.[4] Climate change is also likely to lead to increases in vegetative fuel. In the Pacific Northwest, the Cascade Mountains are one of the most at-risk areas for increasing wildfire activity. Figures 3 and 4 show general trends in wildfire incidents and burned areas in Oregon and Washington.[5,6,7]

### Wildfire incidents in Oregon and Washington, 1998–2023

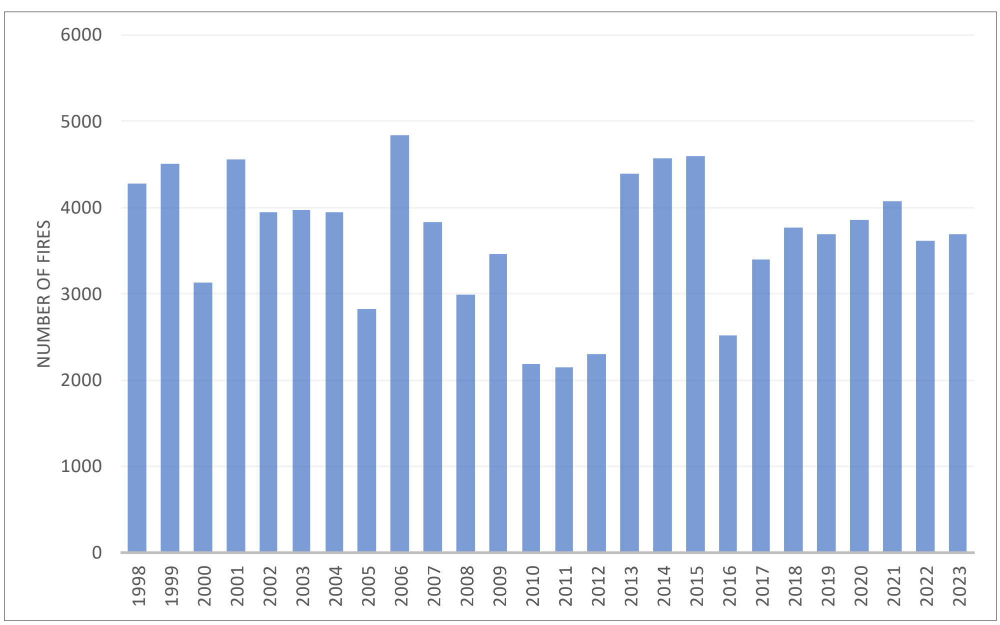


*Figure 3.*

**2/** BPA, "Wildfire Activity in the BPA Service Area." Available at *https://data-bpagis.hub.arcgis.com/apps/BPAGIS::wildfire-activity-in-the-bpa-service-area-1/explore*

**3/** USGCRP. U.S. Global Change Research Program. Fifth National Climate Assessment. 2023. Available at *https://nca2023.globalchange.gov/*

**4/** Gergel, Diana R., Bart Nijssen, John T. Abatzoglou, Dennis P. Lettenmaier, and Matt R. Stumbaugh. "Effects of Climate Change on Snowpack and wildfire Potential in the Western USA. Climatic Change 141, no. 2 (2017): 287- 299. *https://doi.org/10.1007/s10584-017-1899-y*

**5/** NICC. National Interagency Coordination Center. Wildland Fire Summary and Statistics Annual Report 2008. Available at *https://www.nifc.gov/sites/default/files/NICC/2-Predictive%20Services/Intelligence/Annual%20Reports/2008/annual_report_2008_508.pdf*

**6/** NICC. National Interagency Coordination Center. Wildland Fire Summary and Statistics Annual Report 2013. Available at *https://www.nifc.gov/sites/default/files/NICC/2-Predictive%20Services/Intelligence/Annual%20Reports/2013/Annual_Report_2013_508.pdf*

**7/** NICC. National Interagency Coordination Center. Wildland Fire Summary and Statistics Annual Report 2023. Available at *https://www.nifc.gov/sites/default/files/NICC/2-Predictive%20Services/Intelligence/Annual%20Reports/2023/annual_report_2023_0.pdf*

## Area burned in Oregon and Washington, 1998–2023

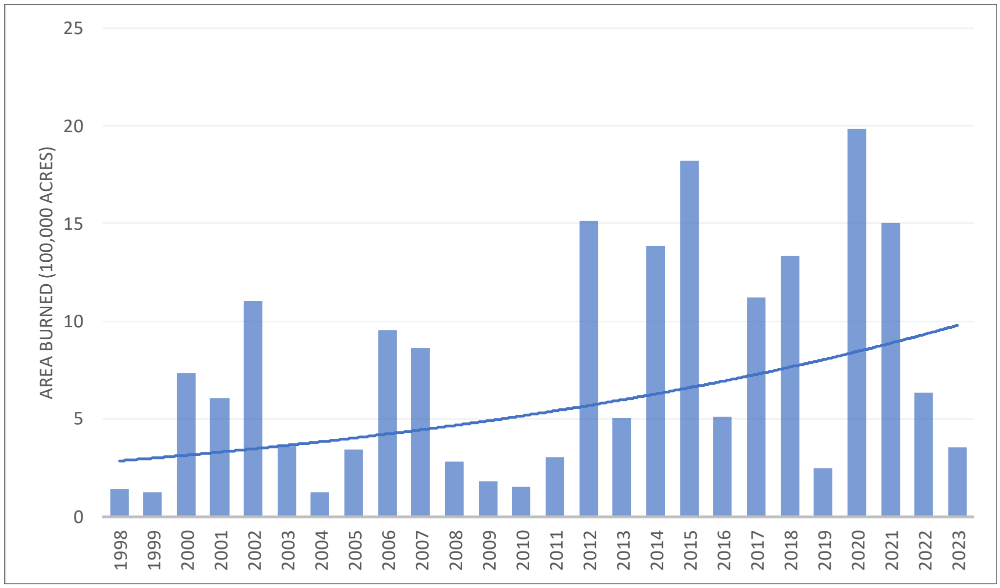


*Figure 4.*

The wildfire season is lasting longer and starting earlier.[8,9] Figure 5 shows that from 1984 to 2001, the wildfire season peaked in August, and from 2002 to 2020, it peaked in July.

## Comparison of monthly burned area due to wildfires in the United States between 1984–2001 and 2002–2020

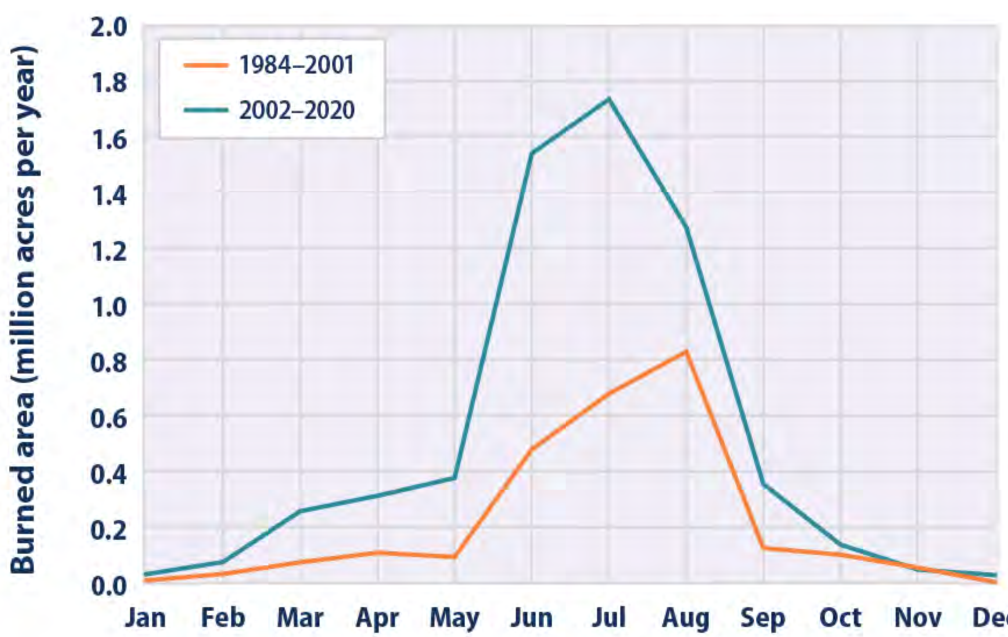


*Figure 5. Comparison of annual distribution of burned area due to wildfires in the United States between the first half of the period of measurement (1984–2001) and the second half (2002–2020).*

**8/** MTBS. Monitoring Trends in Burn Severity. 2022. Available at *www.mtbs.gov/direct-download*

**9/** EPA. United States Environmental Protection Agency. Climate Change Indicators: Wildfires. Figure 6. Available at *https://www.epa.gov/climate-indicators/climate-change-indicators-wildfires#ref28*

## 3.2 Transmission risk-based planning and prioritization process

Understanding how drivers of ignition and climate trend in time across the BPA system is a key input into the planning process and feeds how BPA quantifies risk by asset location. These trends feed the probabilistic variables overlaid with the asset locations to provide a data-informed understanding of relative wildfire risk.

## 3.3 Asset management value framework

Transmission Services is developing a risk-based decision-making value framework, capturing the organization's key value measures, financial parameters, and risks, in alignment with overall organizational goals. Transmission Services will use the value framework, when implemented systematically, to evaluate and prioritize potential investments that enable the comparison of projects across programs. Until it is automated, the value framework will be manually implemented to support subject matter assessments and discussion in a more standardized fashion.

## 3.4 Risk management

BPA uses its existing Enterprise Risk Management framework to identify and assess enterprise-level risks. This framework is built on the ISO 31000 (International Standards Organization), which takes into consideration both quantitative and qualitative factors to determine the level of a particular risk.

# 4.0 Overview of preventive strategies and programs

This WMP integrates and interfaces with various operating policies and asset management and engineering principles, which are themselves subject to change. As such, this document reflects current policies, programs, processes, and procedures as of its publication date. BPA may revise or adopt new policies and standards between publications. Subsequent versions of the WMP will reflect changes made since the issuance of the last plan and identify new or revised policies, programs, processes, and procedures.

## 4.1 Competency assessment

In 2022, BPA adopted the IWRMC Maturity Model. The purpose of the model is to better understand the current state of BPA's programs and activities in relation to general utility threats from wildfire and to build a roadmap for continuous improvement. SMEs across BPA completed self-evaluations of competencies as shown in Figure 6. BPA's overall score increased from 2022 to 2023.

Updates to mature BPA's wildfire mitigation program since the WMP last published in 2022 include, but are not limited to, the following:

- Maturation of wildfire modeling including development of enhanced geospatial tools that support planning, engineering, operations, and data-informed decision making. Also led to new retrospective wildfire analysis capabilities.
- Continued development of the PSPS program, including updates to process documentation and year over year data comparisons.
- Creation of a tool to track situational risks dependent on asset health; enables enhanced data-informed decision-making for transmission operations.

**Source** Dennison, et al. 2014)

- Continued industry engagement and benchmarking with other with external agencies, utilities, and industry peers.
- Continued proactive communication with regional customers and stakeholders to prepare for wildfire season.
- Continuation of internal PSPS and Storm & Wildfire Incidence Response table-top exercises to sustain preparedness and train personnel.
- Implementation of wood pole wildfire retardants and research into new, non-wood pole materials.
- Established additional granular expenditure tracking to enable more thorough, accurate financial reporting.
- Enhanced internal BPA team collaboration to help expedite planning and execution of asset repair and replacement projects to prioritize wildfire mitigation activities.

**2022 BPA IWRMC Maturity Model, results by category**


*Figure 6.*

## 4.2 Overview of wildfire mitigation hierarchy

The wildfire mitigation hierarchy depicted in Figure 7 reflects the holistic enterprise efforts surrounding how BPA mitigates wildfire risk. These efforts include system hardening, situational awareness modeling, wildfire season-specific relay/control practices, extreme risk days, and finally, PSPS as a last resort.

Activities, such as long-term planning and investment tactics using new wildfire resiliency metrics, demonstrate BPA's proactive, ongoing system hardening efforts. With the maturation of situational awareness tools improving system condition visibility, BPA scales resources as needed. Finally, as a last resort, during the most extreme risk days, BPA can decide to enact a targeted PSPS de-energization.

### Wildfire mitigation hierarchy

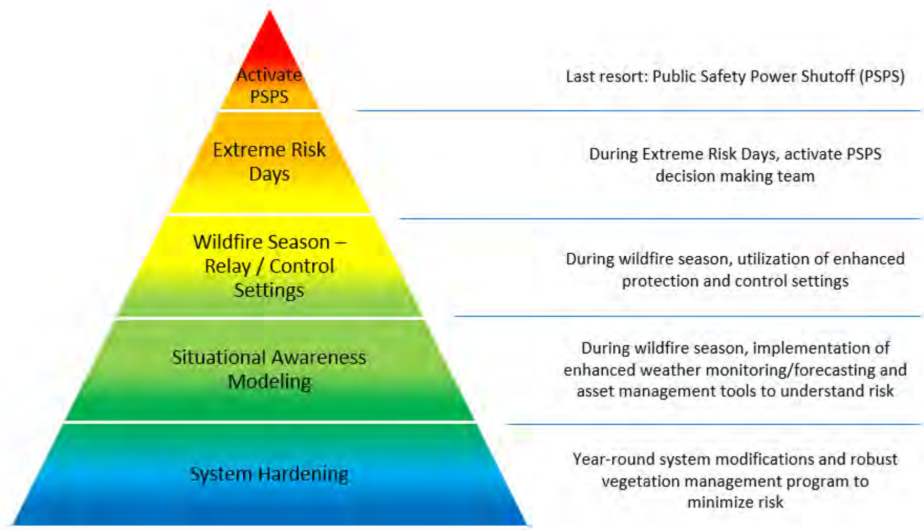


*Figure 7.*

## 5.0 Wildfire mitigation measures

BPA has a proven history of holistic measures to address potential wildfire risks. Some of the activities BPA engages in are listed below:

| Risk Factor | Activity |
|---|---|
| Fuel | Vegetation management |
| | Fuels reduction |
| | Data-informed decisions based on Light Detection and Ranging (lidar), multi-spectral imagery, and wildfire models |
| Asset failure | Transmission line detailed inspections and annual patrol |
| | Routine maintenance |
| | Focused design and construction standards to reduce ignition probabilities |
| | No re-closing during fire season on specific circuits |
| | Non-expulsion fuses and arrestors |
| | Intrusive pole testing and pole replacement |
| | De-energization of lines during certain conditions |
| Contact from objects | Animal/bird guards |
| | Wire spacing to reduce phase-to-phase contact |
| | Proactive vegetation management |
| | Line ratings and clearance analysis through lidar |
| Other | BPA worker/contractor education on fire ignition sources from normal work activities |
| | Wildfire watch 30 minutes after work completion in high-risk areas |
| | Pre-positioning wildfire suppression equipment (e.g., water trailers) to get waivers to work |
| | Coordination and collaboration with local fire wildfire fighting districts or emergency services entities and county offices year-round to prepare for high-risk wildfire events |

BPA vigilantly manages the trees, brush, and other vegetation on its ROWs. BPA uses lidar combined with aerial photographs to help identify spots where inspection and potential vegetation clearing are necessary, preventing foliage from encroaching on designed clearance boundaries and inadvertently sparking a fire.

During wildfire season in dry areas conducive to wildfires, BPA selectively disables automatic re-closers as a preventative measure and deploys field staff to visually inspect lines prior to re-energization. BPA uses, analyzes, and modifies the practice of disabling select automatic re-closing as necessary. BPA discloses use of this practice in its outage communication plans to ensure customers and other stakeholders are informed of the potential for a line to stay de-energized until it can be visually inspected. While power may be interrupted for longer than usual, this practice significantly decreases the risk of fire posed by auto reclosing or manual testing.

## 5.1 Transmission operations during wildfire season

BPA Real-Time Operations uses situational awareness tools at its disposal to respond appropriately to wildfire threats. The team evaluates information such as ground reports, Geographic Information System (GIS) data, asset condition data from field maintenance and planning organizations, wildfire weather reporting, and other resources.

Real-Time Operations takes procedure-established actions that may include, but are not limited to, the following:

- Preventative Actions
  - Disabling automatic re-closing
  - Order no test orders on facilities
  - Requiring onsite inspection before testing faulted equipment
  - Pre-emptive public safety power shutoffs
- Responsive Actions
  - De-energize equipment due to fire
  - Dropping load
  - Curtailing transmission

## 5.2 Transmission line inspections and observations

BPA has a multi-prong approach to inspecting its transmission lines and observing surrounding conditions. First and foremost, BPA deploys field crews to inspect the safety, reliability, and condition of its lines and facilities. Additionally, BPA identifies and responds to threats in its ROWs created by landowners or the public that could cause wildfires.

### 5.2.1 Asset inspections

BPA performs routine infrastructure inspections to inform planning and scheduling of future asset maintenance for system reliability. BPA's planning and engineering teams use reported field condition assessments to prioritize maintenance and replacement needs. Areas of inspection include, but are not limited to, the following:

- Wood poles, crossarms, and cross braces
- Steel structures
- Disconnect switches
- Guy systems and anchor rods
- Conductors and accessories
- Insulators
- Fiber-optic cables and accessories
- Grounding
- Obstruction marking and lighting

### 5.2.1 Land use inspections

Several external factors exist that can increase the risks of causing or contributing to wildfires. For example, external risks can arise when transmission lines cross over or are near retail businesses, suburban backyards, construction sites, agricultural land, rural homes, thick forests, trails and campgrounds, arid plains, and deep canyons.

Even though public and private property owners, businesses, and contractors take precautions, their equipment can come in contact with transmission lines. Routine activities can also contribute to wildfires; for instance, smoke from burning brush piles can conduct electricity and refueling vehicles under lines without proper precautions may cause arcing. While often unintentional, these contacts or activities may damage transmission lines, poles, and other equipment; cause sparks and trigger wildfires in the vicinity; and/or pose public safety and electrocution risks. BPA equipment or ROWs can also be vandalized and damaged, which may cause sparks and wildfires.

BPA field staff conduct annual patrols of ROWs to report incompatible uses and encroachments. The agency also has a land use review process that allows developers or landowners to get their planned activities reviewed in advance. BPA evaluates if these plans can be safely conducted under or near the transmission lines.

## 5.3 Vegetation management

BPA manages, directly or by agreement, all vegetation on BPA transmission line ROWs, fee-owned lands, and easements to establish and maintain the safety and reliability of its facilities. BPA's Vegetation Management program complies with applicable federal reliability standards. The program uses cost effective methods to proactively manage vegetation and to establish low-growing plant communities along the ROW to minimize the development of potentially threatening or incompatible vegetation. The goal of vegetation clearing in BPA ROWs is to manage vegetation that supports transmission reliability and reduces wildfire risks, while also adhering to BPA's commitment to environmental stewardship.

BPA performs vegetation patrols annually, which includes inspecting and removing vegetation within and outside of its ROWs where tree or branch failure would potentially damage transmission line assets. The Vegetation Management program strives to ensure all vegetation on ROWs, easements, and fee-owned land is managed according to BPA's legal rights and applicable standards to establish and maintain the safety and reliability of its facilities.

The program covers both routine scheduled maintenance of the transmission lines, access roads, and other facilities as well as emergency or imminent threat vegetation removal.

The program sets clearance distances from any vegetation to the transmission line (a conductor). Since conductors move horizontally and vertically based on dynamics such as operating temperature, wind, and loading, clearance is evaluated from all conductor positions. Clearance also accounts for vegetation that would fall, grow, bend, or swing into a clearance distance if not removed.

BPA establishes and maintains vegetation with a mature height or growth that is 25 feet below the maximum sag of the transmission lines. In situations where this standard cannot be achieved due to legal or physical constraints, BPA has subject matter experts set a maximum allowable clearance distance for the specific circumstances. BPA's vegetation management team and transmission line workers conduct ground patrols to minimize vegetation-related wildfire hazards and remove flammable materials around wood structures.

Proactive maintenance during routine operations and prompt action during emergency events maintain system reliability and safe work environments while mitigating wildfire risk.

BPA uses lidar, aerial, and ground patrols to monitor vegetation around its facilities. Lidar data is typically acquired on a portion of BPA's circuits annually and the data is provided to aerial and/or ground patrol staff.

Prior to the completion of a construction project, all vegetation clearances must be verified to ensure the vegetation management activities meet BPA's standards prior to the line being energized. Certain targeted high-risk areas are re-evaluated to ensure vegetation clearances are upheld.

## 5.4 Emerging technologies and operational practices

BPA is committed to developing an industry-leading asset management program consistent with its 2024–2028 Strategic Plan. Part of that effort includes ongoing benchmarking and incorporating best practices that range from business transformation to modern technologies that help inform asset-related decisions. BPA explores new capabilities and risk mitigation practices, and when possible, incorporates them into its operations.

**Fire retardant wrap applied to wood pole**

*Figure 8.*

### 5.4.1 Wildfire mitigation design

BPA has built and organized a library of standards and specifications for design and construction with review cycles to allow it to adopt best practice improvements and incorporate modern technologies. As BPA learns more about its system's highest wildfire risk areas, the agency explores modifying design standards to best prepare for wildfire events.

One design standard update undertaken focuses on increasing the resiliency of wood poles and pole structures along transmission lines. Guided by wildfire risk models and inherent knowledge of field conditions, BPA Transmission Engineering devised a data-informed decision procedure to determine where wildfire retardants or non-wood pole options should be installed. These alternatives are explored during the design and standards review processes, allowing modification of metrics and internal controls to further mitigate the agency's wildfire concerns.

Furthermore, researching multiple protective measures for wood pole structures led BPA to select employable wildfire retardant methods based on the following criteria: climbing capability, potential to trap water, ease of installation, usable life, and ability to repair. An environmental review and cost analysis were also completed.

One of the recommendations includes an intumescent-coated fiberglass mesh wrap designed to protect all wood species and treatments of wood utility poles from wildfire damage. The wrap expands when exposed to extreme heat, and tests have proven it provides excellent flame resistance and can withstand years of outdoor weathering.

### 5.4.2 System capital improvements

BPA's ratepayers and stakeholders expect reliable service at the lowest possible transmission rates consistent with a sustainable business model. BPA's strategic plan dictates that it must balance the cost-effectiveness of its construction and maintenance of its capital assets with risk management. To deliver on these requirements, Transmission Services must assess effective methodologies for investment evaluation and decisions.

### 5.4.3 Fire prevention strategies, regulations, restrictions, precaution levels and pre-suppression

Federal statutory obligations require BPA to reliably operate and maintain its transmission facilities.[10] Agency modeling of wildfire threats, in combination with its geospatial and asset data, will continue to inform its maintenance and construction work planning and scheduling strategies. When circumstances such as weather, environmental restrictions, and the logistics of managing 15,000 line miles contained within 8,500 miles of ROWs allow, routine and non-emergency work will be scheduled during the lowest risk times of the year in high-wildfire-risk areas. When routine or non-emergency work is impossible, or when urgent, BPA takes the "fire safe" approach by completing unplanned maintenance in order to proactively protect public safety and prevent the spark and spread of wildfire.

Additionally, BPA adopted a Wildfire Smoke Exposure Program because smoke from wildfires is comprised of many components, including particulates small enough to enter the lungs. The Air Quality Index considers the number of particulates contained in smoke and helps to identify stages where strategies must be considered to mitigate health issues. The purpose of the program is to establish guidance that BPA managers consider prior to assigning staff to work in areas where wildfire smoke is present.

This "fire safe" approach is incorporated into BPA's situational awareness methods, operational practices, and asset management and vegetation management strategies. BPA employs the approach throughout the year, but particularly during wildfire season, for planning critical work, and uses the approach in its stakeholder cooperation and community engagement strategy.

BPA is aware of varying jurisdictional regulations on federal, state, local, and private lands. The applicability of these various standards generally depends on who owns the land, but as a federal agency, BPA is only required to follow federal regulations. BPA has acquired real property rights that include the rights to construct, operate, and maintain its transmission lines on private land, and has acquired similar rights via ROW permits or agreements on federal and state public lands. BPA is currently evaluating the need for enhanced wildfire mitigation and prevention training for all field staff.

BPA has over 2,000 miles of transmission lines on federal public lands administered by the United States Forest Service (USFS) or the Bureau of Land Management (BLM) and is required to follow federal wildfire regulations on these lands.[11] The regulations require ROW holders to adhere to public use, industrial use, and other wildfire precautions and

10/ 16 USC §838b; 16 USC §824o; NERC Reliability Standard FAC-003-4.

11/ The Federal Land Policy and Management Act (FLPMA) and other federal laws require Bonneville to follow the land managers' wildfire regulations on federal land.

restrictions. Except when responding to an emergency, BPA may request waivers or variances to undertake activities that would otherwise be restricted. Prior to making a request, BPA evaluates possible ignition risks associated with delaying maintenance and considers potential risks of starting a wildfire while the repair or maintenance is being conducted during high wildfire risk times. The federal land manager has the discretion to grant a variance or waiver when appropriate criteria are met and mitigations are in place. Federal land managers routinely work with BPA to issue waivers to allow for important maintenance work with conditions and restrictions in place.

Wildfire mitigation modeling and analysis helps BPA explain to federal land managers how timely preventive maintenance and repairs of specific transmission line equipment and vegetation in and along a ROW reduce the risk of wildfire, even if the work requires issuance of waivers. If BPA identifies urgent work that needs to be expedited, the agency's wildfire risk analysis and modeling help it quantify any increased wildfire risks if the work is delayed.

Federal law requires BPA to conduct emergency work to restore power or remove vegetation or obstacles from contact with the line. BPA will, however, coordinate in advance with public land managers whenever time permits.

Notably, BPA's 2017 Memorandum of Understanding (MOU) with the USFS requires advance coordination on maintenance activities and includes a wildfire prevention and suppression plan designed to prevent and minimize wildfire. BPA also follows BLM's regulation that requires all ROW permit holders to do everything reasonable to prevent and suppress wildfires on or in the immediate vicinity of the ROW area.[12]

As a federal agency, BPA is not governed by state or local wildfire regulations on non-federal lands. Pursuant to state law and administrative regulations, state and local agencies may oversee wildfire management on forest and rangeland primarily in rural areas outside of city boundaries. This state and local work is undertaken along with private forest and range landowners, who are often required to either pay wildfire protection fees, perform assessments, or provide their own wildfire protection plans and resources. BPA's WMP demonstrates to landowners that precautions are being taken in planning and carrying out work.

BPA's transmission line maintenance crews and vegetation management specialists are the primary owners of this "fire safe" operational strategy to maintain access to federal public land and to coordinate with nonfederal public and private landowners. Additionally, BPA staff who issue contracts for vegetation management, construction, and maintenance work will assure these contracts provide adequate wildfire pre-suppression measures and require appropriate coordination with the applicable wildfire agencies.

### 5.4.4 Risk-Informed vegetation management

BPA will continue to evaluate its Vegetation Management program, examine industry best practices, and identify any additional risk-informed strategies that could advance its work to minimize wildfire risks. The Vegetation Management program will use risk assessment tools, geospatial data, and other risk-based evaluation tools acquired by BPA in the future to achieve improvement. This risk-informed approach may result in BPA reprioritizing or adding resources to address high-risk wildfire areas, such as modifying the frequency of inspections or taking additional measures to reduce fuel levels.

**12/** CFR §2805.12(a.4).

# 6.0 Emergency response and preparedness

As a federal power marketing administration, BPA follows federal guidance including the Federal Emergency Management Agency (FEMA) and DOE directives and orders for emergency response activities. Implementation of the National Incident Management System (NIMS) and Incident Command System (ICS) are imbedded in the planning efforts and documentation followed by personnel when responding to wildfires and other incidents.

BPA interacts with other emergency management agencies within its service territory at multiple levels. General coordination of wildfire response efforts across the BPA service territory involve actions with its control centers to mitigate impacts to customers and equipment. BPA's control centers dispatch resources from operations and maintenance districts for local safety and alignment of efforts. Local responses are commonly performed by the relevant district employees. For larger or multiple impacts to BPA's transmission system in the same period, BPA will elevate the level of its response coordination accordingly. This can mean BPA raises coordination from a local response to an agencywide response.

The local wildfire department or the National Wildfire Coordinating Group (NWCG) notifies BPA's control centers when a wildfire is approaching BPA's infrastructure. BPA's Weather and Streamflow Forecasting workgroup provides real-time weather data that includes National Weather Service Red Flag Warning (NWS RFW) areas and thunder and lightning storms. The group also monitors wildfires in the service territory and provides notifications to the control centers. Dispatched BPA personnel act as agency representatives for the incident management team established to address the event. BPA also provides liaisons for federal, state, tribal, and local governments who regularly coordinate efforts and share information.

Rerouting power during outages and securing impacted equipment are BPA's primary means of reducing the risk of its equipment igniting a wildfire or preventing existing wildfires from damaging transmission assets. BPA regularly communicates to customers and other stakeholders through many channels regarding curtailments and restoration timelines. BPA supports many customers, including some that perform critical processes and would cost the customer resources if power is disrupted. In some instances, BPA is the only entity capable of transmitting power to specific locations where outages can affect vulnerable entities and communities. Extended power outages require active communication with customers and coordination with other responding entities.

BPA Communications manages awareness via social media and provides communications products and assistance about ongoing and available resources for customers and federal, state, tribal, and local governments. BPA also coordinates with entities to prepare for and respond to potential emergency events. Interested individuals are encouraged to access www.bpa.gov to learn more about BPA's wildfire response and mitigation efforts.

BPA establishes and maintains contact with customers and other stakeholders to keep them informed when preparing for a potential or imminent PSPS. BPA has specific personnel assigned to contact federal, state, tribal, and local agencies and has account executives assigned to all customers.

## 6.1 Continuity support for wildfires

BPA adopted the ICS to help coordinate response, restoration, and recovery efforts. BPA's Continuity of Operations and Emergency Management staff participate in national, state, and local transmission-related tabletop exercises and contain vast knowledge of BPA's transmission system and operating protocols.

Emergency management specialists are involved in BPA's general wildfire response and provide situational awareness during severe wildfire seasons and respond to wildfires as necessary. Continuity of Operations and Emergency Management staff continue to work with BPA transmission dispatch and field operations in support of wildfire mitigation and response.

## 6.2 Event communications

When practical, BPA will provide notice to customers when it is necessary to interrupt load due to a wildfire. BPA will notify its transmission customers of curtailments of transmission due to wildfire through the normal reliability curtailment processes. It is BPA's goal to provide advanced notice, but often this is not practical when addressing safety and reliability issues.

BPA interacts with emergency management officials from federal, state, tribal, and local governments and agencies to keep them updated on wildfire mitigation efforts. BPA also works with stakeholders on collaboration and partnership opportunities when developing and implementing strategies. BPA's Continuity of Operations and Emergency Management Office tests and maintains the agency's emergency notification system for BPA decision-makers and incident support staff to accurately respond.

# 7.0 Public Safety Power Shutoff (PSPS)

During wildfire season, typically May through October, there may be extreme conditions or weather triggers that require BPA to de-energize transmission assets to reduce the risk of ignition. These extreme weather triggers are based on industry best practices that address imminent wildfire danger and geospatial analysis of wind and humidity. BPA's criteria for standing-up its PSPS team to decide whether to de-energize assets proactively are when wind gusts exceed 60 mph within NWS RFW areas as the conditions correlate to warm temperatures and low humidity.[13] BPA has calibrated these variables to its robust design standards.

BPA uses data from internal and external sources to make PSPS decisions. Examples include vegetation types, urban density, asset density, asset health, ignition probability, wildfire behavior, wind, humidity, and line/load criticality.

BPA recognizes the impacts to the region that come with a PSPS de-energization and is committed to making these decisions in a timely and data-informed manner. BPA's Transmission Operations organization and NERC-certified dispatchers retain the right to de-energize assets proactively for any reason, based on system conditions. As Figure 7 illustrates, PSPS de-energization is a last resort. If a PSPS decision is enacted, BPA will initiate its communication processes to its impacted utility wholesale customers and regional outreach.

In the event of a PSPS, BPA's constituent and tribal account executives will communicate information to federal, state, local elected officials, tribes, and other important stakeholders. BPA does its best to avoid overlaps with other utility outreach to state, local elected, and emergency management officials by coordinating communication efforts with the affected utilities.

As the event unfolds, BPA will work with impacted utilities and, if asked, augment customer utility outreach through providing information to local media and social media channels to ensure residents and others are aware of the situation. BPA will not engage in any other outreach efforts to end-use customers (residents, businesses, etc.) unless a customer utility specifically requests it.

**13/** National Weather Service, "What Is a Red Flag Warning?" available at *https://www.weather.gov/media/lmk/pdf/what_is_a_red_flag_warning.pdf*, accessed Nov. 9, 2023.

Re-energization after a PSPS event begins after the extreme weather event has passed and line crews are cleared to enter the area. BPA crews then patrol the de-energized lines and inspect for obvious damage and vegetation within the ROW that may prevent safe re-energization. When field crews find damages, they will isolate the impacted area(s) and perform repairs as quickly and safely as possible. In some instances, temporary solutions to restore power may be implemented while permanent repairs are planned. Depending on the extent of damage, utility customers may need to perform repairs on their facilities prior to having full electric service restored; these efforts are coordinated on an as-needed basis. Once the lines and structures are safe to operate, re-energization occurs followed by communications procedures similar to de-energization messaging.

## Appendix

| List of acronyms | |
|---|---|
| BLM | Bureau of Land Management |
| BPA | Bonneville Power Administration |
| DOE | Department of Energy |
| ICS | Incident Command System |
| IPR | Integrated Program Review |
| IWRMC | International Wildfire Risk Mitigation Consortium |
| NERC | North American Electric Reliability Corporation |
| NWS RFW | National Weather Service Red Flag Warning |
| PNNL | Pacific Northwest National Laboratory |
| PSPS | Public Safety Power Shutoff |
| ROW | Right-of-Way |
| SAMP | Strategic Asset Management Plan |
| SME | Subject Matter Expert |
| USFS | United States Forest Service |
| WMP | Wildfire Mitigation Plan |

www.bpa.gov

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# Appendix C: NERC Wildfire Mitigation Reference Guide 2021

NERC

NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

# Wildfire Mitigation Reference Guide

January 2021

## Introduction

Electricity is a vital component of the fabric of modern society. The Electric Reliability Organization (ERO) Enterprise, which consists of the North American Electric Reliability Corporation[1] (NERC) and the six Regional Entities,[2] serves to strengthen that fabric for the benefit of nearly 400 million citizens of North America. The ERO Enterprise pursues its mission of assuring the effective and efficient reduction of risks to the reliability, resilience, and security of the bulk power system (BPS) by working with users, owners, and operators of BPS assets, government partners, and other stakeholders and industry participants.

The Reliability Issues Steering Committee describes and prioritizes risks to the reliable operation of the BPS in a biannual report[3] to the NERC Board of Trustees that includes recommendations regarding the approach the ERO Enterprise and industry should take to enhance reliability and manage those risks. Wildfires pose risks because they can disrupt the reliable generation and delivery (transmission and distribution) of electricity to customers. Electric utilities in high fire-threat areas should have plans or strategies to address and mitigate the threat of electrical infrastructure or equipment causing ignitions that could lead to wildfires and/or being impacted or damaged by wildfires.

## Preface

Wildfires[4] are generally defined as unplanned, uncontrolled fires fueled by an area of combustible vegetation and, like all fires, require three fundamental elements to exist: fuel, oxygen, and heat. The fuel supply across North America has increased over the past few decades due to political policies around fire suppression and forest management, the introduction of non-native grasses, and dryer climates and droughts that left forests damaged by insects and disease. The oxygen often comes in the form of high winds that can spread the fires quickly. The sparks that initiate the fires are primarily generated from human activities and weather, but about 10% of wildfire ignitions[5] are sparked by faults on electrical infrastructure or electric equipment failure. In recent years, wildfires have emerged as a significant risk to public safety and to the BPS assets that serve the Western Interconnection of North America.

WECC[6] promotes BPS reliability and security in the Western Interconnection. WECC extends from Canada to Mexico and includes the provinces of Alberta and British Columbia, the northern portion of Baja California, Mexico, and all or portions of the 14 western states between. These western states and the two

[1] North American Electric Reliability Corporation
[2] Regional Entities
[3] 2019 ERO Reliability Risk Priorities Report
[4] National Geographic - Wildfires
[5] 2019 California Redbook
[6] WECC

Canadian provinces have experienced numerous catastrophic wildfires in the recent past, and the fires are getting larger and more intense. In 2020, California experienced five of its largest (acreage burned) fires in recorded history. Wildfire seasons are getting longer and the fires are increasing in frequency and severity. Since 2017, California has experienced thirteen of its most destructive (structures destroyed) fires and eight of its most deadly.[7]

### Wildfire Mitigation Plans

Wildfires initiated by electric utility infrastructure prompted the state of California to enact legislation[8] in 2018 that required each electrical corporation, local publicly owned electric utility, and electrical cooperative to do two things: construct, maintain, and operate its electrical lines and equipment in a manner that will minimize the risk of catastrophic wildfire posed by those electrical lines and equipment and prepare and submit wildfire mitigation plans[9] (WMPs) on an annual basis for review and approval by the California Public Utility Commission (CPUC). The WMPs required by the CPUC contain up to 20 mandated elements that create a comprehensive strategy and defense against wildfire initiation by the utility's electrical lines and equipment.

In general, WMPs describe how the utilities' electric systems are designed, constructed, operated, inspected, and maintained to promote wildfire safety, prevention, mitigation, and recovery. The CPUC requires utilities under its purview to organize the information into the following categories:

1. Risk Assessment and Mapping
2. Situational Awareness and Forecasting
3. Grid Design and System Hardening
4. Asset Management and Inspections
5. Vegetation Management and Inspections
6. Grid Operations and Protocols
7. Data Governance
8. Resource Allocation Methodology
9. Emergency Planning and Preparedness
10. Stakeholder Cooperation and Community Engagement

One of the most effective and highly scrutinized mitigation measures is the public safety power shutoff (PSPS). Allowed under California law, a PSPS is the proactive de-energization of power lines that are forecasted to be in the path of critical fire weather conditions. For utilities that strive to provide reliable electric energy to customers 100% of the time, intentionally turning off the power is a last resort, but removing these vulnerable lines from service eliminates the risk of ignition. Although effective in protecting customers, first responders, and property, PSPS events are extremely disruptive to customers' lives.

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[7] California Fire Statistics
[8] California Senate Bill 901
[9] Wildfire Mitigation Plans

Consequently, electric utilities have undertaken risk-based initiatives to limit the scope, duration, and frequency of PSPS events to minimize their impacts. Descriptions of these initiatives, such as system hardening, installing additional sectionalizers, installing weather stations and high definition cameras, installing microgrids, and using data to predict the highest fire threat areas and the fire's potential spread are included in the WMPs.

WMPs detail the electric utility's initiatives and activities for reducing the risks of its lines and equipment igniting wildfires in the high fire risk areas of its service territory. The risks associated with the equipment vary depending upon several factors: age and condition, population density (ingress and egress), surrounding climate, terrain and vegetation, voltage class and type of construction, and policies and regulations around land/forest management. New technologies and increasing data capture have enabled companies to perform risk analysis at the asset level, allowing them to prioritize activities and develop initiatives for specific lines and equipment. This granularity provides for more effective and efficient mitigations. While each utility's risks are unique, general metrics have been developed for various aspects of the plan that enable the utility and the CPUC to assess the outcomes and measure the performance of the individual initiatives. Identifying successes and deficiencies within the plan ensures that the iterative process of plan development is one of continuous improvement. For example, the CPUC developed its 2021 guidelines[10] for wildfire mitigation plans after the CPUC's Wildfire Safety Division completed its annual review of the utility plans, including evaluating best practices and lessons learned from 2020 wildfire mitigation plans.

## Conclusion

Although catastrophic wildfires have predominantly been a western experience, the threat of wildfires is a growing concern for other areas of North America. Ever-changing more extreme weather and the abundance of dry fuels provide two of the three necessary elements for wildfires. Due to the presence of electric current, electrical infrastructure and equipment have the potential to provide the ignition spark. While completely eliminating the risk of being the source is not possible, it is incumbent on electric utilities to proactively minimize that risk. To accomplish this, electric utilities across North America located in heightened fire-threat areas could develop and implement wildfire mitigation plans.

NERC and WECC developed this document with the goal of creating more awareness across all Interconnections of the knowledge and experience gained by western utilities on wildfire preparedness and mitigation. Research and development efforts by the Department of Energy (DOE) National Laboratories in partnership with electric utilities and other stakeholders on many facets of wildfire mitigation, situational awareness, and pre- and post-fire analyses are also highlighted in the document.

[10] WMP Guidelines

# References

The links provided below will connect the reader to information and tools helpful for developing a comprehensive wildfire mitigation plan. *Note: These references are not a comprehensive listing.*

## Wildfire Mitigation Plans

### North American Utilities: United States

- Pacific Gas and Electric
- Southern California Edison
- San Diego Gas & Electric
- Liberty Utilities
- Bear Valley
- Horizon West
- Trans Bay Cable
- Sacramento Municipal Utility District
- Los Angeles Department of Water and Power
- Anza Electric Cooperative
- PacifiCorp
- Bonneville Power Administration

### North American Utilities: Canada

- BC Hydro Wildfire Safety
- Altalink Wildfire Safety Booklet

## Bushfire Mitigation Plans and Fire Safety

### Australia

- Jemena
- Powercor
- AusNet Services
- Transgrid
- AGL Hydro
- Powerlink - Queensland | Australia
- Western Power - Western Australia

## Organizations

The websites below link to organizations involved in various aspects of wildfire prevention and mitigation, management and recovery, and research and development.

### State of California

- California Public Utilities Commission (CPUC)
- Wildfire Safety Division
- California Department of Forestry and Fire Protection (CAL FIRE)

### Federal Agencies

- United States Forest Service
- United States Department of Agriculture
- National Wildfire Coordinating Group
- United States Fire Administration
- National Interagency Fire Center
- Forests and Rangelands
- U.S. Department of the Interior (Bureau of Land Management)
- U.S. Department of Energy (Grid Modernization Lab Consortium)
- U.S. National Parks Service
- National Weather Service

### Canadian Federal Agencies

- Canadian Electricity Association (CEA)
- Natural Resources Canada
- Canadian Interagency Forest Fire Centre (CIFFC)

### Associations, Forums, and Councils

Note: EEI, NATF, APPA, NRECA, CEATI, and EPRI are "Members Only"; however, each has a public-facing webpage that can be searched using the keyword "wildfire." For example, EPRI has public reports referenced in this document:

- Electricity Subsector Coordinating Council (ESCC)
- Edison Electric Institute (EEI)
- North American Transmission Forum (NATF)
- American Public Power Association (APPA)
- National Rural Electric Cooperative Association (NRECA)
- Electric Power Research Institute (EPRI)

- CEATI International
- Society for the Protection of Forests Against Fire (SOPFEU)
- Wildland Fire Leadership Council
- International Association of Wildland Fire (IAWF)

### Websites

- Wildfire Today
- Wildfire Risk to Communities
- LANDFIRE
- Portugal wildfires

### Publications

- Utility Wildfire Mitigation Guide 2020
- 2019–2020 Bushfires Quick Guide
- Wildfire Risk Reduction Methods
- Distribution Protection Options to Reduce Damage and Improve Public Safety
- Wildfire and the Oregon Electricity System

### Webinars and Conferences

- WECC Wildfire Webinar Series - Wildfires in the West
- WECC Wildfire Webinar Series - Best Practices and Lessons Learned
- WECC Wildfire Webinar Series - Compliance Open Webinar
- West Coast Utility Commissions - Wildfire Dialogue

## Research and Development

- Electric Power Research Institute (EPRI)
- Texas A&M University

### Department of Energy (DOE) National Laboratories

In November 2019, the Office of Electricity sent a request for information on projects regarding wildfire capabilities to 13 DOE laboratories and received responses from the following:

- Argonne National Laboratory
- Lawrence Berkeley National Laboratory
- Lawrence Livermore National Laboratory
- Oak Ridge National Laboratory

- Pacific Northwest National Laboratory
- Sandia National Laboratory
- SLAC National Accelerator Laboratory

The responses identify capabilities with the potential of being used immediately or being adapted for use within a few months. This list was updated in August 2020 to capture progress and include newly added capabilities that meet the aforementioned requirements. The point of contact at the DOE for this information is Stewart Cedres.[11]

## Area of Research: Sensing and Detection

### Distribution Arcing Fault Signature Library (ORNL)

This project between Oak Ridge National Laboratory (ORNL), Lawrence Livermore National Laboratory, and Pacific Gas & Electric Company will install a high-fidelity sensor cluster on an electric distribution feeder (substation outlet) to capture grid signatures that can be used as early indicators of arcing to identify and mitigate fire risk. In order to capture real signatures, the sensor cluster will be installed in an operational utility service area. The novelty of the project is in both the high-fidelity sensor technology and analytical methodology on a custom purpose platform.

### Monitoring Structural Health of High Voltage Transmission Lines (ORNL)

ORNL has developed a “smart patch” technology, which incorporates piezoelectric transducers and electromechanical impedance analysis to monitor the structural health of compression connectors used in high-voltage transmission lines that tend to fail as a result of thermal aging and thermal fatigue.

### Real-time Aerial Sensors for Extreme Environments (ORNL)

ORNL is working with the United States forestry services on the development of real-time airborne and ground asbestos sensors for application during forest fire operations. There are concerns pertaining to EPA superfund sites and the implications of wildfires pertaining to the release of toxins in the air. Demonstration of unmanned-aerial-systems-based measurement of grid components (pole mounted transformers, intelliruptors) with live visual, thermal, and sensor reading feeds was completed with the utility control center at the Electric Power Board of Chattanooga.[12]

### Multi-modal Autonomous Vehicle NETworks (ORNL)

ORNL created Multi-modal Autonomous Vehicle NETworks (MAVNET) to provide reliable and robust command, control, communication, and computing (C4) for unmanned vehicles. MAVNet is particularly well-suited for beyond visual line of sight C2, swarm operations, and a secure implementation of the Internet of Drones. Through the development of advanced sensors along with the integration of MAVNet, a situational awareness platform can be created to assist in developing solutions. This includes the potential of pulling real-time thermal and earth observation video/images from both UAS and manned aircraft to

[11] Stewart Cedres
[12] Link is to an early survey of best practices for the use of small unmanned aerial systems (UAS) by electric utilities: https://info.ornl.gov/sites/publications/Files/Pub73072.pdf

identify fire locations and evaluate post-fire damage along with integration into visualization platforms like Eagle-I.

ORNL links of unmanned aerial systems technology for search and rescue in the Smokies:

- ORNL Drones help Smokies search and rescue[13]
- ORNL drones find lifesaving lessons in Smokies[14]

### Distributed Wildfire Detection (ANL)

The Argonne Waggle platform supports customized sensor arrays, edge computing, and image analysis code that can be programmed to detect specific types of objects, movements, or phenomena (e.g., a flash of lightning). Argonne has deployed Waggle systems for wildfire prediction for the power grid and has developed field capabilities for detection of wildfires and wildfire conditions, including real-time control of cameras. The field test for this project is WIFIRE[15], a network of towers in Southern California operated by the University of California-San Diego (UCSD) and is in use by wildfire emergency responders. ANL has been working with the UCSD San Diego Supercomputer Center to develop computer vision/deep learning algorithms to use the camera network to spot fires.[16]

## Area of Research: Situational Awareness

### EAGLE-I (ORNL)

EAGLE-I is a next-generation situational awareness tool for advanced energy-sector monitoring and analysis in the United States. The operational system is hosted and managed by the ORNL for DOE's Infrastructure Security and Energy Restoration division. Built-in capabilities include energy-sector data collection, integration, and monitoring; modeling and analysis; and immediate, strategic dissemination of vital information. The tool integrates real-time data on electricity, natural gas, and petroleum in an interactive web platform, enhancing the nation's energy infrastructure awareness and allowing for organized, coordinated, and rapid emergency response and recovery efforts.

*Note: ORNL has every building mapped for the CONUS (supporting FEMA) for wildfire risk assessment. ORNL also have capabilities for smoke and haze detection from very high-resolution satellite imagery as well as damage assessment.*[17]

### ForWarn (ORNL)

ForWarn provides near-real-time tracking of vegetation changes across landscapes in the United States. This system produces maps every 8 days that enable detection of vegetation disturbances. Useful for both monitoring disturbance events as well as year-to-year variability, derived products can also be used to develop insights into seasonal and inter-annual dynamics. An opportunity could be to change the detection that could be overlaid with electrical grid to determine risk and possible vulnerabilities.[18]

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[13] https://www.youtube.com/watch?v=eVIrygh9tnQ
[14] https://www.wbir.com/article/news/local/ornl-drones-find-lifesaving-lessons-in-smokies/51-25209a52-a069-4573-a7e0-11ea30c695c4
[15] WIFIRE
[16] https://www.anl.gov/mcs/waggle-an-open-platform-for-intelligent-attentive-sensors
[17] https://eagle-i.doe.gov/login
[18] https://forwarn.forestthreats.org

### PlanetSense (ORNL)

PlanetSense is a platform for geospatial intelligence that is built to harness the existing power of archived data along with the dynamics of real-time streams, seamlessly integrated with sophisticated data mining algorithms and analytics tools for generating operational intelligence on the fly. The platform has four main components: GeoData Cloud, a data architecture for storing and managing disparate datasets; a mechanism to harvest real-time streaming data; a data analytics framework; and a presentation and visualization through web interface and RESTful services. Using two case studies, we underpin the necessity of our platform in modeling ambient population and building occupancy at scale. PlanetSense capability (National Geospatial-Intelligence Agency) allows us to collect Open Source data, including images to provide real-time situational awareness of the changing scenarios.

*Note: ORNL demonstrated this capability during the Gatlinburg fire in 2016.*[19]

### Water Extreme Lookup Library (PNNL)

The Water Extreme Lookup Library provides a truly unique data source in which previously run simulations can be used to support both the rapid-response situational awareness and provide the data to support planned studies. This library includes dam failure simulations available and developed methods to include riverine flood simulations.

*Note: The Water Extreme Lookup Library is operational but it would take 1–3 months to incorporate more fire information into the repository.*

### Proximity Analysis Tool (PNNL)

The Proximity Analysis Tool uses geospatial clustering methods to determine important critical infrastructure assets or clusters of these assets. This clustering approach can help determine if a group of components can be identified that will lead to severe degradation in performance of infrastructure systems if damaged or destroyed.

*Note: This tool is expected to be operational in 6–12 months; it is currently a prototype.*

### High Power/Low Power Arc and Ground Fault Detection/Mitigation (SNL)

Work on arc-fault and ground fault detection and mitigation for photovoltaic dc systems that could potentially be ported over to ac systems. The Sandia Photovoltaic Arc and Ground Fault Detection and Mitigation program ran from 2010–2015 and made a number of significant contributions to the field of photovoltaic system safety and reliability. During the course of the program, Sandia worked with over a dozen solar and original equipment manufacturers and investigated series and parallel arc-fault detection methods; improvements to the draft arc-fault circuit interrupter certification standard, UL 1699B; arc plasma physics models and burn characteristics; array electrical behavior during ground faults (including those constituting the detection "blind spot"); and recommendations for novel and traditional ground fault detectors.

[19] https://planetsense.ornl.gov/webps/

### Multi-Source Multi-Time-Scale Wildfire Data Warehouse and Visualization Platform (ANL)

Argonne's situational analysis and wildfire risk analysis draws on data pipelines and a data warehouse that pull three types of data: climate and environmental factors (e.g., fuel buildup), weather conditions, and power delivery operations. The dataset includes publicly available data sources (e.g., NOAA) and Argonne's data on wildfire indices and transmission line temperature and sag, for example. The platform synthesizes these key datasets used in wildfire modeling and mitigation into a single visualization tool that is updated in real-time. This allows decision-makers to easily see the real-time changes in data that affect the ignition and propagation of wildfires, highlighting the geographical location of power system components and wildfire-related metrics (e.g., wildfire indices, temperature, humidity, wind speed).

### Risk and Crisis Communication–National Public Affairs Academy (ANL)

Communicating with the public clearly and effectively beforehand about wildfire risk and then providing timely and accurate information during a wildfire emergency are both critical to mitigating its effects. The National Public Affairs Academy at Argonne National Laboratory offers more than two dozen training courses and workshops that address a wide range of communication and emergency public information topics from media relations and risk and crisis communication to social media technology and digital communication and participating in an area Joint Information System/Center with partner agencies. All National Public Affairs Academy courses are fully customizable and can be specifically adapted to address wildfire hazards, helping utility operators to communicate more effectively with their stakeholders.[20] [21]

## Area of Research: Modeling and Analytical Tools

### Dynamic Contingency Analysis Tool for Extreme Wildfire Event Planning (PNNL)

Partnered with Electric Reliability Council of Texas, Siemens, General Electric, Bonneville Power Administration, and EPRI, PNNL developed a hybrid dynamic and steady-state approach to mimic the cascading failure process that includes both fast dynamic and slower events. Integrated dynamic models with protection schemes models.

*Note: PNNL is working with General Electric to integrate into PSLF toolsets used in WECC.*[22] [23]

### Sustainable Forest Biomass for Fire Mitigation (PNNL)

PNNL developed decision support tools that support optimization of fire mitigation activities by linking systems of spatial, forest, fuel/fire/economic and hydrological models to characterize wildfire potential.

*Note: This is not an electric equipment fire mitigation technology, but it is a tool that can be used to identify critical zones where wildfire could propagate.*

### Multi-Sensor Data Exploitation for Wildfire Damage Assessment (PNNL)

PNNL has developed algorithms that exploit best-available satellite and airborne sensor data to perform automated characterization of high-risk vegetation (ignition/fuel/risk); vegetation management priorities

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[20] Argonne Fusion Cell public affairs research and training facility: https://pastfusion.egs.anl.gov/
[21] NPAA 2020 Course Catalog: https://pastfusion.egs.anl.gov/wp-content/uploads/2020/04/CATALOG_0220-Final.pdf
[22] https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-26197.pdf
[23] https://www.youtube.com/watch?v=IhsVNTBPozI

for critical infrastructure; active hot-spots/fire lines (thermal sensing); burned area/impacted infrastructure.

### Standard Unified Modeling, Mapping, and Integration Toolkit (SNL)

The Standard Unified Modeling, Mapping, and Integration Toolkit (SUMMIT) is a modeling & simulation framework for decision support. The California Fire and Rescue Training Authority deployed SUMMIT to help agencies exercise their responses to emergency scenarios, including wildfires, chlorine releases from railcars, and radiological dispersal devices. Equally important, SUMMIT can link multiple models in a single template to more fully simulate complex scenarios. SUMMIT allows the models and data to work together seamlessly, generating results that can be visualized in many different formats and exported for other uses. As a further benefit, the templates can be used repeatedly and customized with new input data, increasing planning efficiency.

### FASTMap (SNL)

FASTMap is a web-based mapping tool that displays any infrastructure data on a map, can include overlays of areas of interest or risk, and can perform analysis on other infrastructure, population, economic activity in the vicinity of a scenario or actual disruption. While FASTMap can depict any infrastructure and areas of interest or concern, it has capabilities that can be leveraged specifically in strategy for reduction of electric power fire hazards, and actual emergency response or response planning. FASTMap can maintain and visually depict the status of transmission or distribution lines, identification of areas of high flammability hazard, evacuation zones, inspection and survey progress, and status classifications.

*Note: FASTMap is a web and tablet based mapping application that browses national infrastructure and emergency resources data that generates maps and reports of assets at risk within any area of disruption or any analysis area. FASTMap can depict any geospatial datasets (currently National Geospatial-Intelligence Agency's HSIP Gold infrastructure data) and provides immediate data access through a fully symbolized, publication-quality interactive mapping interface available to browsers and mobile tablets.*

### LANDFIRE (SNL)

Develop a forest risk analysis by applying LANDFIRE and Monitoring Trends in Burn Severity indicators and other contemporary earth science data and process models to forest wildfire risk management decisions, and conduct a value of information impact assessment of the application of satellite and other contemporary earth observation data to forest risk management decisions.

### Physics-Informed Machine Learning Emulators of Wildfire Spread (LBNL)

This technology accelerates the simulation of wildfire spread scenarios by 2–3 orders of magnitude compared to standard fire physics models, while incorporating dynamic conditions on the ground such as wind fields, humidity, elevation maps, vegetation maps etc. By simulating many more scenarios of wildfire spread with ignition points along utility equipment, the technology better characterize the risk dynamic wildfire risk profiles at high spatial resolution (~250m to 30m), temporal resolution (daily or better), and over large areas. A wildfire model has been developed that takes real-time updated meteorological data (wind, temperature, relative humidity, etc.), local topography, and vegetation as inputs and predicts the probability of large wildfire growth. The model is high-resolution (1km) covering all of California and is aimed at assessing evolving wildfire risk. LBNL has validated the model against historical fire data (2002–

2019) and has shown that it is predictive of fire size, burned area extent, and overall burn probability. This work has been published in scientific journals and LBNL is actively exploring potential commercial use cases in energy and insurance sectors.

*Note: LBNL is also actively developing an additional model layer aimed at predicting ignition probability that takes into account a number of geospatial features including proximity to roads and power lines, but this component is still under development. Preliminary discussions are underway with grid operators to evaluate the model.*[24] [25]

### XAI Models of Wildfire Risk and Risk Management (LBNL)

This technology enables the modeling of wildfire risk by using available satellite imaging data, including hyperspectral and synthetic LIDAR, to model wildfire risk as a function of local vegetation patterns. Further, the resulting models are amenable to constrained optimization, modeling wildfire risk as an emergent ecosystem service, and providing ecological engineering solutions to vegetation management. These solutions include modeling ecosystem dynamics to enable passive (planting-based) solutions to wildfire risk mitigation.

*Note: XAI is ready for testing on fire data.*

### Predictability of Fire Behavior and Effects in the Wildland Urban Interface in California (LBNL)

This model uses Geostationary Operational Environmental Satellite Network imagery and machine learning for early detection, monitoring, and realistic predictions of fire behavior and effects in the wildland urban interface. It is ready to use but might need to be calibrated depending on the ecosystem characteristics and topography. The model can evaluate how fire spreads, how the extent and/or severity are directly relevant for the grid exposure, and how model outcomes on vegetation mortality and community change help predict future fire risk around specific grid infrastructure. The rapid detection and real-time prediction collaborators are LBNL-ETA, CALFIRE, the US Forest Service, and UC Berkeley. This work will address the following question: what are the critical mechanistic interactions of climate, vegetation, and topographic variables driving the spatial and temporal predictability of fire behavior (spread rate and intensity) and fire effects in the wildland urban interface (WUI) in California? This mechanistic understanding will be derived from wildfire behavior and effects data and complex bio-geophysical data in a machine learning framework. Remote sensing and machine learning can be adapted in 6–10 months.[26] [27]

### Climate Modeling for California Planning (LBNL)

LBNL is developing two new projects in close coordination with electric utilities for the CA Energy Commission to develop the next generation of regional climate projections, analytics, and a data platform for supporting electricity sector climate resilience planning. These two activities consist of *Development of*

[24] https://e3sm.org/wp-content/uploads/2020/05/200514_Q_Zhu_reduced.pdf
[25] https://acme-climate.atlassian.net/wiki/spaces/ECM/pages/1929707601/2020-10+Meeting+Oral+Presentations?preview=/1929707601/1945471073/E3SM%20PI%20meeting%20QING%20ZHU.pdf
[26] https://ylfeng.users.earthengine.app/view/fireca
[27] https://caralyngorman.users.earthengine.app/view/camp-fire-sliding-map-3-9-19

*Climate Projections for California and Identification of Priority Projections* and *A Co-Produced Climate Data and Analytics Platform to Support California's Electricity Resilience Investments*.

*Note: Work is in collaboration with the following utilities: PG&E, SDG&E, SCE, and PacifiCorp.*[28]

### Attention-Based Long-Short-Term-Memory Model (LBNL)

This is a recurrent neural network framework with an attention mechanism that is designed to predict wildfire activity with relatively long leading time in wildland urban interface. The model is ready to be used but may require calibration. This model can also be used to evaluate how fire spreads and to predict risk around the grid infrastructure. For more information can be found here:

- Wildfire modeling with E3SM and machine learning techniques[29]
- Trial by Fire FATES-SPITFIRE[30]
- Importance of size structure and fuels for fire: FATES-SPITFIRE[31]
- The NGEET FATES model[32]

### Data-Driven Wildfire Risk Model and Optimal Grid De-energization Strategies (LBNL)

The ongoing project funded by the University of California, office of president aims to investigate the changes in fire-weather regimes in California, determine wildfire risks associated with extreme weather conditions (e.g., high winds) and electric power line ignitions using unique datasets of climate observations and weather/fire simulations, and develop optimal de-energization (power shut-off) strategies given the wildfire risks as inputs and evaluate the reliability and economics implications of various fire-related planning and operation policies. The development is based on real-world distribution and transmission circuits. The derived risk model and de-energization rules will be incorporated into an integrated decision-making framework, which will be ready for use in 6–10 months. The team is having exploratory conversations with PG&E and SCE on data sharing and integration of this work with the utility practices.

*Note: Forthcoming web site will provide data and preliminary results for public.*[33]

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28 https://docs.google.com/presentation/d/1JNlfQPHr95rwrQe0h7BAaMH9H-5i8yY3i9_MI_fU7gs/edit#slide=id.p1
29 https://e3sm.org/wp-content/uploads/2020/05/200514_Q_Zhu_reduced.pdf
30 www.cesm.ucar.edu/events/workshops/ws.2017/presentations/bgcwg/shuman.pdf
31 http://www.cesm.ucar.edu/events/workshops/ws.2018/presentations/bgcwg/shuman.pdf
32 The model is at this website: https://github.com/NGEET/fates
33 http://smartcity.lbl.gov/wildfire

### Grid Resilience and Intelligence Platform (GRIP) – (SLAC)

SLAC is working in collaboration with LBNL, Southern California Edison, the Presence Product Group, Packetized Energy, and NRECA to develop and deploy a suite of novel software tools to anticipate, absorb, and recover from extreme events. The wildfire portion of the tool is being coordinated with SCE. GRIP's goal is to respond to electric grid events by demonstrating machine learning and artificial intelligence from different data sources to anticipate grid events, validating controls for distributed energy resources for absorbing grid events, and reducing recovery time by managing distributed energy resources in the case of limited communications. The project builds on previous efforts to collect massive amounts of data and uses it to fine-tune grid operations, including other Grid Modernization Lab Consortium projects on distributed controls and cyber security.

*NOTE: GRIP is a suite of different capabilities and some are ready for deployment and commercialization within 6–10 months.*

### Argonne Wildfire Threat Model: Risk Assessment for Interdependent Power and Telecommunications Systems (ANL)

ANL has assembled a database of major historical fire events with GIS features for animated depictions of daily burn progression over the entire temporal occurrence of the empirical event. Through the Argonne probabilistic Wildfire Threat Model, the empirical daily fire behavior can be modified in both direction and intensity to fit a scenario that would allow for the assessment of performance of strongly coupled power and telecommunications systems in the context of a specified wildfire event. Performance assessment includes identification of multiple at-risk electric and telecom assets and the quantification of the possible cascading failures and outages that could occur both in terms of geospatial extent and depth of impact (MW loss and number of customers affected). Argonne's EPfast and TELCO fast tools are used to assess electric and telecommunications system performance and to quantify impacts, and the Wildfire Threat Model is used to define scenarios and fire behavior. Wildfire fragility curves for transmission lines, power plants, microwave towers, cells towers, and fiber optics cables are used to determine damage levels of the assets as the fire progresses and fire intensity increases. Integration of the tools into a coupled system would require additional effort.[34] [35]

### Wildfire Risk Modeling (ANL)

Argonne has developed a thermal overloading risk quantification model based on a semi-analytical probabilistic approach. The model can assess system uncertainty in, for example, renewable energy resources or loads. The model is used to compute the probability of a line current violation and can be integrated into other decision-making processes as a chance-constraint relaxation. Moreover, wildfire risk analysis based on wide-area modeling of power line temperature evolution and monitoring of line sag is incorporated into the existing modeling framework.

In the next six months, Argonne will extend the capability by integrating additional risk quantification into the framework. The objective is to provide comprehensive risk analysis of wildfire while considering multiple impact factors related to ignition and spread of wildfires.

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[34] For more information, go to this website: https://www.anl.gov/dis/infrastructure-science

[35] Argonne Wildfire Probabilistic Threat Model: https://www.anl.gov/sites/www/files/2020-11/Argonne_Wildfire_Probabilistic_Threat_Model.pdf

### Operations and Planning for Wildfire Risk Mitigation (ANL)

Argonne has developed a wildfire mitigation decision support tool for both operations (e.g., optimal Public Safety Power Shutoff programs) and planning (e.g., risk-informed expansion planning). The capability includes a transmission expansion planning framework that uses historical fire potential data to place new electric power infrastructure for wildfire mitigation, and a daily dispatch tool used to reduce the probability of a wildfire ignited by electric power infrastructure through transmission switching and power flow reductions. In the next six months, Argonne will expand the capability to include an Argonne Operational Wildfire Mitigation Tool, a daily dispatch tool used to reduce the probability of a wildfire ignited by electric power infrastructure through targeted de-energizing and power flow reduction while minimizing load shed.

*Note: The Argonne Operational Wildfire Mitigation Tool referenced above is being developed to aid the PSPS (Public Safety Power Shutoff) program in California to more intelligently identify the electric power infrastructure most likely to ignite fires, and use stochastic optimization methods to determine the optimal operational scheme to reduce fire risk while limiting load shedding.*

### Geospatial Analysis Tool Kit for Regional Climate Datasets (ANL)

ANL has developed a GIS analysis tool named Geospatial Analysis Tool Kit for Regional Climate Datasets (GATOR) to provide easy access to a large database of regional scale climate projections to a variety of users. Data layers include temperature, precipitation, soil conditions and other relevant weather/climate parameters obtained from a high-resolution regional scale climate model dataset developed at ANL. The lab has also developed a wildfire risk indicator database for current and future climate conditions for the mid and end of the century. This database and the tools for calculating the fire risk indicators can be combined into a GATOR-FIRE for long-term planning by industry. GATOR-FIRE for long-term planning will be available for industry use in 6 months. Adapting GATOR-FIRE for short-term fire forecasting is a second activity. Argonne leads the community Python ARM Radar Toolkit (Py-ART), which is used by hundreds of institutions to gain insight from weather radar. Py-ART has been used to study wildfires using both research radars and open data from operational radar networks. GATOR-FIRE will be adapted to use weather forecast data (0–5-day forecasts from the NOAA High-Resolution Rapid Refresh (HRRR) model). By integrating radar data with HRRR forecasts in the GATOR-FIRE GIS platform, the lab will stand up a tool for identifying and studying the propagation of wildfires (in 6–12 months) that will use the radar data. GATOR-FIRE will provide near-term risk assessments with forecasting, analysis, and real-time monitoring capabilities.[36]

### National Preparedness Analytics Center (ANL)

ANL's National Preparedness Analytics Center (NPAC) is a national leader in the provision of science-informed technical assistance for all-hazards evacuation and shelter-in-place planning, including for wildfire events. As an example, NPAC is funded by the Federal Emergency Management Agency to examine human behavior in protective action decision-making related to hazard-driven evacuations or shelter-in-place decisions (including individual and organization decisions); partner with local governments and infrastructure owners and operators to develop consequence-informed and time-bounded protective action plans, tools, and guidance; support operational decision-making related to hazard-based

[36] For more information, go to this website: https://www.evs.anl.gov/research-areas/environmental-systems/

evacuations; and conduct training sessions, workshops, and symposia that bring industry and government together to plan for disasters (e.g., wildfires) that could cause evacuation or shelter-in-place operations to occur.[37]

## Area of Research: Post Fire Analysis

### Rapid Inundation Flood Tool (PNNL)

The Rapid Inundation Flood Tool provides rapid predictive flood analytics for infrastructure situational awareness. This tool can easily simulate post-fire flooding events to determine the impact of heavy rainfall. Following a major fire, the flood risk greatly increases because of less vegetation to slow runoff down and the soil can become hydrophobic, meaning that the soil will repel water. PNNL employs two approaches to provide this situational awareness: the near real-time modeling and simulation and the development of a simulation archive, the Water Extreme Lookup Library.[38] [39]

## Area of Research: Fire Testing Capabilities

### Thermal Test Complex (SNL)

The Thermal Test Complex comprises multiple test cells, ovens, and a laser lab for controlled fire experiments. Tests range in size from small-scale experiments that use lasers to large-scale tests that burn custom-made structures and models. Team members change variables such as temperatures, wind speed, and materials to see how the test objects fare under abnormal and extreme conditions.[40]

### Testing of Wildland Ignitions from High-Flux Sources (SNL)

Sandia has recently been involved with a multi-million dollar multi-year test campaign that used concentrated solar power to evaluate the fire behavior of materials in response to high heat flux. A moderate portion of this test campaign has involved materials and configurations highly relevant to wildland fire ignition. SNL has particular expertise in ignition from high flux scenarios as may be relevant to the problem at hand. Prior to this experimental work, SNL has significant legacy experience in pyrolysis, transport, and reaction behaviors relevant to wildland fires and high flux scenarios including several journal papers and many conference and institutional reports. Further data exists in the Official Use Only form that could be communicated as necessary.[41]

[37] For more information, see the following website: https://www.anl.gov/dis
[38] https://www.pnnl.gov/news/release.aspx?id=4466
[39] https://www.pnnl.gov/news-media/high-tech-damage-assessment-speeds-disaster-recovery
[40] http://tours.sandia.gov/TTC/ttc_info.html
[41] https://www.youtube.com/watch?v=P4So-SwuqA0

# Appendix D: Manufacturers' Inspection/Maintenance Recommendations (provided in the future)