Exhibit H

Geologic and Soil Stability

Biglow Canyon Wind Farm
February 2025

Prepared for

Portland General Electric Company

Prepared by

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Acronyms and Abbreviations

AC	alternating current
ASCE	American Society of Civil Engineers
BCWF or Existing Facility	Biglow Canyon Wind Farm
BESS	battery energy storage system
BIGL or Project Developer	BIGL bn, LLC
bgs	below ground surface
BMP	best management practice
Certificate Holder or PGE	Portland General Electric Company
Council or EFSC	Oregon Energy Facility Siting Council
DOGAMI	Department of Geology and Mineral Industries
ESCP	Erosion and Sediment Control Plan
FEMA	Federal Emergency Management Agency
IBC	International Building Code
IEEE	Institute of Electrical and Electronics Engineers
MW	megawatt
NRCS	Natural Resources Conservation Service
OAR	Oregon Administrative Rules
ODOE	Oregon Department of Energy
OSSC	Oregon Structural Specialty Code
RFA	Request for Amendment
SLIDO	Statewide Landslide Database
Site Certificate	Site Certificate on Amendment 3
Solar Components	photovoltaic solar energy generation and battery storage
USGS	U.S. Geological Survey

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1.0 Introduction

The Portland General Electric Company (PGE or Certificate Holder) submits this Request for Amendment (RFA) 4 to the Site Certificate on Amendment 3, issued October 31, 2008 (Site Certificate) for the Biglow Canyon Wind Farm (BCWF or Existing Facility) to add photovoltaic solar energy generation and battery storage (Solar Components) to the operating BCWF.

BCWF, owned and operated by PGE, is located within an approved site boundary comprising approximately 25,000 acres, approximately 2.5 miles northeast of the town of Wasco in Sherman County, Oregon. The BCWF operates under the Site Certificate from the Oregon Energy Facility Siting Council (Council or EFSC) as administered by the Oregon Department of Energy (ODOE). BCWF currently consists of 217 wind turbines, with a maximum blade tip height of 445 feet, and a peak generating capacity of 450 megawatts (MW).

In RFA 4, PGE proposes to add up to 385 MW alternating current (AC) generating capacity from photovoltaic solar arrays and 375 MW in battery storage capacity. RFA 4 seeks to expand the BCWF site boundary to include the Solar Components in portions of the existing site boundary and in the proposed expanded site boundary (together, Solar Micrositing Area or RFA 4 Site Boundary[1]).

The Solar Micrositing Area is approximately 3,980 acres and provides a conservative estimate of the maximum area needed for development, micrositing, and temporary disturbances from the Solar Components during construction, rather than the anticipated disturbance footprint. Solar Components will include solar arrays, inverters, battery energy storage system (BESS) facilities and their subcomponents (i.e., inverters), two collector substations, a total of approximately 3 miles of 230-kilovolt generation tie transmission lines, medium voltage collector lines, operations and maintenance structures, site access roads, internal roads, perimeter fencing, facility entry gates, and temporary laydown areas. The maximum generating capacity from the Solar Components will be 385 MW AC and construction may take place in phases.

PGE will own and operate the Solar Components as a part of the BCWF (together, Amended Facility or Facility), which, to date, have been developed by BIGL bn, LLC (BIGL or Project Developer). BIGL, in its capacity as the project developer, supports PGE in this RFA 4 and may construct and temporarily operate the Solar Components on behalf of PGE under a Build-Transfer Agreement.

Exhibit H provides the information required by Oregon Administrative Rules (OAR) 345-021-0010(1)(h) in support of RFA 4. Analysis in this exhibit incorporates and/or relies on reference information, analysis, and findings from previous geotechnical investigations performed for the areas within the Amended Site Boundary in addition to new geotechnical investigations completed in the Solar Micrositing Area to demonstrate that the Facility, as modified by RFA 4, continues to

[1] Note, as described in further detail in Section 4.1.1.2 of the RFA 4 Division 27 document, the Solar Micrositing Area is the equivalent of the RFA 4 Site Boundary.

comply with applicable Site Certificate Conditions and applicable laws, standards, and rules, providing evidence to support findings by the Council as required by OAR 345-022-0020.

2.0 Analysis Area

Consistent with OAR 345-027-0360(3), ODOE concurred with the Certificate Holder's use of a defined portion of the approved BCWF site boundary and the proposed expanded site boundary (i.e., Solar Micrositing Area/RFA 4 Site Boundary) to establish study area boundaries for RFA 4 under OAR 345-001-0010(35). The RFA 4 Site Boundary reflects the Solar Micrositing Area, and all study areas within the meaning of ORS 345-001-0010(35) are measured from the RFA 4 Site Boundary. The analysis area for structural standards is the area within the Solar Micrositing Area[2] (Figure H-1). The analysis area for historical and potentially active faults and earthquakes includes a 50-mile buffer around the Solar Micrositing Area (Figure H-2).

3.0 Geologic Report – OAR 345-021-0010(1)(h)(A)

> *OAR 345-021-0010(1)(h) Information from reasonably available sources regarding the geological and soil stability within the analysis area, providing evidence to support findings by the Council as required by OAR 345-022-0020, including:*
>
>> *OAR 345-021-0010(1)(h)(A) A geologic report meeting the Oregon State Board of Geologist Examiners geologic report guidelines. Current guidelines must be determined based on consultation with the Oregon Department of Geology and Mineral Industries, as described in paragraph (B) of this subsection;*

<u>Response</u>: The required geological report is provided through the information in this exhibit, which includes analysis and findings from previous geotechnical investigations performed for areas within the Amended Site Boundary. Current geologic report guidelines were determined based on consultation with the Oregon Department of Geology and Mineral Industries (DOGAMI) as described in Section 4.0 and Attachment H-1. Information previously provided for the Facility in previous geotechnical investigations, the Application for Site Certificate, and prior RFAs has been fully updated in this exhibit to provide current information and in conformance with updated requests from DOGAMI and ODOE.

[2] ODOE concurred with excluding the remaining BCWF site boundary that does not overlap with the Solar Micrositing Area from analysis in RFA 4 because no changes are proposed to any BCWF components in the remaining BCWF site boundary as part of RFA 4.

3.1 Previous Geotechnical Investigations

Previous investigations have been completed in the vicinity of the Amended Site Boundary:

- Initial Geotechnical Investigations Phase I Development, Biglow Canyon Wind Farm, Sherman County, Oregon, prepared by Cornforth Consultants for PGE, October 2006 (Cornforth 2006). This investigation was conducted in an area northwest of the Solar Micrositing Area.
- Report of Geotechnical Exploration, Biglow Canyon Wind Farm Phase I, northwest Wasco, Oregon, prepared by GN Northern, Inc., Consulting Geotechnical Engineers for Blattner & Sons, Inc., April 2007 (GN Northern 2007). This investigation was conducted in large portions of the Solar Micrositing Area.
- Report of Geotechnical Exploration, Biglow Canyon Wind Farm Phase II, northwest Wasco, Oregon, prepared by GN Northern, Inc., Consulting Geotechnical Engineers for Blattner & Sons, Inc., July 2008 (GN Northern 2008a). This investigation was conducted in large portions of the Solar Micrositing Area.
- Report of Geotechnical Exploration, Biglow Canyon Wind Farm Phase III, northwest Wasco, Oregon, prepared by GN Northern, Inc., Consulting Geotechnical Engineers for Blattner & Sons, Inc., November 21, 2008 (GN Northern 2008b). This investigation was conducted in large portions of the Solar Micrositing Area.

The following geotechnical investigation has been completed in the vicinity of and within the Solar Micrositing Area:

- Biglow Solar & BESS Preliminary Geotechnical Engineering Report, prepared by Terracon Consultants, Inc., for Bright Night, LLC, June 3, 2024 (Terracon 2024).

The geotechnical report scope of work included completion of 51 borings to depths of 5 to 51.5 feet below ground surface (bgs), laboratory testing, field electrical resistivity testing, pile load testing, engineering analysis, and preparation of the report.

3.2 Geologic Conditions

The topographic and geologic setting within the Solar Micrositing Area is described in the following sections.

3.2.1 Topographic Setting

The Solar Micrositing Area is in rural Sherman County, approximately 1 mile east of Wasco, Oregon, and approximately 4 miles south of the Columbia River. The topography is mainly influenced by drainages, including some drainages denoted as canyons, that have relatively gentle to moderate slopes. Steeper slopes are located along Biglow Canyon and a tributary to Biglow Canyon that bound the northeastern portion of the Solar Micrositing Area.

The Solar Micrositing Area occupies slopes from 0 to 36 percent, with an average of 4.4 percent. Elevations within the Amended Site Boundary range from 736 to 1,621 feet above mean sea level.

3.2.2 Geologic Setting

The geologic setting of the Solar Micrositing Area is located in the Columbia Plateau province (NPS 2023). The topography in the province is dominated by geologically young lava flows that have occurred within the last 17 million years. Over 170,000 cubic kilometers of basaltic lava, known as the Columbia River basalts, cover the western part of the province. The native terrain within the Solar Micrositing Area is gently sloping downhill to the north toward the Columbia River. This sloping terrain is interrupted occasionally by geologic folds, one of which is Poverty Ridge.

Cataclysmic floods repeatedly swept through this area at the end of the last ice age, or about 13,000 to 15,000 years ago. These floods are named the Missoula floods and were the result of glacial damming of water in western Montana. Figure H-1 (DOGAMI 2024a and USGS 2024a) provides a geologic map for the Solar Micrositing Area. Surficial deposits are mapped as Holocene and Quaternary cultivated loess (USGS 2024a). Bedrock is mapped as the Tertiary Wanapum Basalt Frenchman Springs Member.

The geologic descriptions below are summarized from the DOGAMI geologic maps and publications (DOGAMI 2024a), U.S. Geological Survey (USGS) publications (USGS 2023a), as well as a geotechnical investigation (see Section 5.0) conducted within the Solar Micrositing Area.

3.2.2.1 Surficial Geologic Units

Surficial deposits generally consist of loess soil overlying alluvial soil. The site is underlain by Quaternary loess which consists of eolian (wind-deposited) silt to fine sand (Terracon 2024). Loess deposits are made up of a semi-stable soil structure commonly referred to as a "honeycomb" structure. This loess unit can often be broken into three units consisting of younger loess which was encountered during the geotechnical investigation underlying topsoil and extended to a maximum depth of 30 feet. A transition layer between younger and older loess extended to a maximum depth of 40 feet.. The older loess was also encountered at ground level in some areas and extended to a depth of 32 feet. The older loess is also described as semi-consolidated with strong calcium carbonate contents (referred to as cementation). This older unit is also referred to as caliche loess.

The loess is generally underlain by a layer of recent alluvium, consisting of unconsolidated silt, sand, and gravel generally derived from local sources (Terracon 2024). A summary of geotechnical boring log data from the Terracon (2024) geotechnical investigation is provided in Table H-1.

Table H-1. General Subsurface Materials Layers

Stratum	Material Description	Consistency/Density
Loess	Silt with various amounts of sand to silty clay, moist.	Very soft to very stiff
Loess or Caliche Loess	Silt with various amounts of sand to silty sand, moist	Very stiff or medium dense
Caliche Loess	Silt with various amounts of sand to silty sand, moist	Hard or dense
Alluvium	Silt with various amounts of sand to silty sand, moist	Hard or dense
Bedrock	Basalt - highly to extremely fractured, moderately weathered	Medium strong

Previous geotechnical investigations (GN Northern Inc. 2007, 2008a, 2008b) generally confirm the geological materials. Surface materials were generally found to be loess and caliche, and basalt bedrock was encountered in borings from 2.5 to 60 bgs. Highly to completely weathered bedrock was encountered as very thin layers above the more competent bedrock and as thicker units.

Groundwater was not observed in the test borings to the maximum depth explored of 51 feet bgs except in borehole B-32 at 15 feet bgs (Terracon 2024). However, it is noted that the water encountered is indicated to be seepage and not a static groundwater condition. Based on the data collected, the seepage is indicated to be from localized perched groundwater. Groundwater was not encountered in borings for previous geotechnical investigations (GN Northern, Inc. 2007, 2008a, 2008b).

3.2.2.2 Bedrock Geologic Units

The alluvium is underlain by the Columbia River Basalt Group. The Columbia River Basalt consists of numerous fine-grained lava flows that primarily erupted from fissures in eastern Washington and Oregon and western Idaho from approximately 23.8 to 5.3 million years ago. Many individual flows are interbedded with thin paleosols formed during periods of volcanic inactivity. Basalt flows near and within the Solar Micrositing Area are mapped as the Wanapum basalt formation Frenchman Springs Member of the Tertiary Columbia River Basalt Group (DOGAMI 2024a; USGS 2024a). The Frenchman Springs Member is entirely mapped within the Solar Micrositing Area. The Wanapum Basalt formation consists of flows of gray to dark-gray, medium-grained, commonly plagioclase porphyritic basalt, and generally exhibits blocky to platy jointing. The Frenchman Springs Member is approximately 300 to 500 feet thick in the area of the Columbia Plateau.

3.2.2.3 Soils

Soils were evaluated within the Solar Micrositing Area. Eighty percent of the soils overlying the geologic bedrock units are silt loam soils with thicknesses greater than 7 feet with the other 20 percent having thicknesses of 12 to 40 inches to lithic bedrock. Permeability of the soils within the Amended Site Boundary is moderate with slow to rapid runoff potential. At least 40 percent of soils within the Amended Site Boundary have a severe hazard for erosion in terms of undeveloped roads.

Wind and water erosion susceptibility are generally moderate to moderately high. Less than 1 percent of the soils has a low compaction resistance.

4.0 Evidence of Consultation with DOGAMI – OAR 345-021-0010(1)(h)(B)

OAR 345-021-0010(1)(h)(B) A summary of consultation with the Oregon Department of Geology and Mineral Industries regarding the appropriate methodology and scope of the seismic hazards and geology and soil-related hazards assessments, and the appropriate site-specific geotechnical work that must be performed before submitting the application for the Department to determine that the application is complete;

Response: A meeting with DOGAMI was held on November 1, 2024, as documented in Attachment H-1. Meeting attendees included DOGAMI representatives, an ODOE representative, the Certificate Holder and their geotechnical contractor, and the consultant for the Certificate Holder. A brief presentation included an overview of the Amended Biglow Canyon Wind Farm and geologic hazards studies' findings, as well as an overview of the planned pre-construction geotechnical studies. DOGAMI provided feedback regarding the findings and presentation. The DOGAMI representatives provided additional resources including a digital dataset link and a Wasco County landslide publication link, requested that the latest earthquake data be included, and requested that a specific potentially active fault (Luna Butte Fault) be reviewed. DOGAMI also stated that the final geotechnical study plan should include more specific information such as field boring locations. DOGAMI was otherwise satisfied with the information and general conclusions presented.

5.0 Site-Specific Geotechnical Investigation – OAR 345-021-0010(1)(h)(C)

OAR 345-021-0010(1)(h)(C) A description and schedule of site-specific geotechnical work that will be performed before construction for inclusion in the site certificate as conditions;

Response: A summary of relevant conclusions and recommendations from the previous geotechnical investigations performed for areas within the Amended Site Boundary is included below, followed by the Certificate Holder's plan for future site-specific geotechnical work to be performed prior to construction.

5.1 Geotechnical Investigations

Three geotechnical reports were completed for the Biglow Canyon Wind Project Phases I-III in large portions of the Solar Micrositing Area (GN Northern, Inc. 2007, 2008a, 2008b). A field exploration program consisting of 78 exploratory borings, soil sampling, electrical resistivity testing, and seismic testing was completed in February and March 2007. PGE requested that GN Northern explore Alternate Sites 1 through 4 as potential backup sites; thus, four additional borings were added to the original scope. A second (Phase II) field exploration program consisting of 81 exploratory borings, soil sampling, electrical resistivity testing, and seismic testing was completed in June 2008. Borings were completed at 74 proposed turbine sites and 7 alternate sites. A third (Phase III) field exploration program consisting of 76 exploratory borings, soil sampling, electrical resistivity testing, and seismic testing was completed in September and October 2008. Borings were completed at 76 proposed turbine sites.

Terracon Consultants, Inc., prepared the Biglow Solar & BESS Preliminary Geotechnical Engineering Report for Bright Night, LLC, on June 3, 2024 (Terracon 2024). The geotechnical report scope of work included completion of 51 borings to depths of 5 to 51.5 feet bgs, laboratory testing, field electrical resistivity testing, pile load testing, engineering analysis, and preparation of the report. The geotechnical report identified earthwork considerations; predrilling considerations for the solar array; footing construction considerations for solar arrays, substations, and transmission line structures; shallow foundation and mat/slab foundation considerations; earthwork considerations; and considerations for access roads and parking areas. Based on the geotechnical report, the Solar Components can be constructed within the Solar Micrositing Area in consideration of the proper application of construction methods.

5.2 Future Geotechnical Investigation

The Certificate Holder will conduct a site-specific geological and geotechnical investigation (tentatively planned to occur between Q2 and Q4 2025) before beginning construction and will provide draft and final reports to DOGAMI and ODOE consistent with Site Certificate Condition 66 in the Third Amended Site Certificate (Council 2008). The site-specific geotechnical investigations and Solar Components design will comply with the following conditions from the Third Amended Site Certificate: Conditions 112, 113, and 114 (Council 2008). The scope for this investigation is expected to be substantially similar to that identified in the preliminary geotechnical investigation report identified above. The quantity of samples collected and testing locations is likely to increase to reflect the greater level of granularity needed in foundation design. Nevertheless, the testing types, sampling methodologies, and analysis protocols are all expected to be consistent with the previous geotechnical investigation performed at the site.

6.0 Transmission Lines and Pipelines – OAR 345-021-0010(1)(h)(D)

OAR 345-021-0010(1)(h)(D) For all transmission lines, and for all pipelines that would carry explosive, flammable or hazardous materials, a description of locations along the proposed route where the applicant proposes to perform site specific geotechnical work, including but not limited to railroad crossings, major road crossings, river crossings, dead ends (for transmission lines), corners (for transmission lines), and portions of the proposed route where geologic reconnaissance and other site specific studies provide evidence of existing landslides, *marginally stable slopes or potentially liquefiable soils that could be made unstable by the planned construction or experience impacts during the facility's operation;*

Response: The Solar Components do not include pipelines carrying hazardous substances as described in OAR 345-021-0010(1)(h)(D). The Solar Components will include two collector substations, a 230-kilovolt generation tie transmission line, and medium voltage collector lines. The Certificate Holder proposes geotechnical work in the areas of substations, the transmission line, and the collector lines.

7.0 Seismic Hazard Assessment – OAR 345-021-0010(1)(h)(E)

OAR 345-021-0010(1)(h)(E) An assessment of seismic hazards, in accordance with standard-of-practice methods and best practices, that addresses all issues relating to the consultation with the Oregon Department of Geology and Mineral Industries described in paragraph (B) of this subsection, and an explanation of how the applicant will design, engineer, construct, and operate the facility to avoid dangers to human safety and the environment from these seismic hazards. Furthermore, an explanation of how the applicant will design, engineer, construct and operate the facility to integrate disaster resilience design to ensure recovery of operations after major disasters. The applicant must include proposed design and engineering features, applicable construction codes, and any monitoring and emergency measures for seismic hazards, including tsunami safety measures if the site is located in the DOGAMI-defined tsunami evacuation zone; and

Response:

7.1 Methods

Available reference materials were reviewed, and a desktop seismic-hazard assessment was conducted. Topographic and geologic conditions and hazards within the Solar Micrositing Area were evaluated using topographic and geologic maps, aerial photographs, existing geologic reports, and data from DOGAMI, the Oregon Water Resources Department, the USGS, and the Natural Resources Conservation Service (NRCS).

A desktop seismic-hazard analysis characterized seismicity in the Solar Components' vicinity to evaluate potential seismic impacts. This work was based on the potential regional and local seismic activity described in the existing scientific literature and on subsurface soil and groundwater conditions found in the desktop evaluations. The seismic-hazard analysis consisted of the following tasks:

1. Detailed review of USGS, National Geophysical Data Center, and DOGAMI literature and databases;
2. Identification of potential seismic events and characterization of those events in terms of a series of design events;

3. Evaluation of seismic hazards, including potential fault rupture, earthquake-induced landslides, liquefaction and lateral spread, settlement, and subsidence;
4. Review of previous geotechnical investigation conducted in the Amended Site Boundary and immediate vicinity; and
5. Mitigation recommendations based on the characteristics of the subsurface soils and design earthquakes, including specific seismic events that might have a significant effect on the site, potential for seismic energy amplification at the site, and the site-specific acceleration response spectrum.

As described in Section 5.0 and in accordance with Site Certificate Condition 66, appropriate site-specific geotechnical investigations will be conducted prior to construction to inform the final design. Results of the investigations will be reported to DOGAMI following the Oregon State Board of Geologist Examiners' Guideline for Preparing Engineering Geologic Reports (Oregon State Board of Geologist Examiners 2014).

7.2 Maximum Considered Earthquake Ground Motion under IBC 2021

Overall, the DOGAMI Oregon HazVu: Statewide Geohazards Viewer mapping tool (DOGAMI 2024b) indicates that the Cascadia earthquake hazard is moderate, and the general earthquake hazard in the Solar Micrositing Area is rated strong in most of the Solar Micrositing Area with an area rated very strong in a portion of the southwestern Solar Micrositing Area. The USGS Seismic Hazard Mapping Model (USGS 2024a) developed ground motions using a probabilistic seismic hazard analysis that covered the Amended Site Boundary. Though these motions are not site-specific, they reasonably estimate the ground motions within the Solar Micrositing Area. For new construction, the site should be designed for the maximum considered earthquake, according to the most recently updated International Building Code (IBC; ICC 2021) supplemented by the Oregon Structural Specialty Code (OSSC; State of Oregon 2022). The USGS earthquake hazard tool analysis was run for the Solar Micrositing Area, and the design event (6.61 magnitude earthquake) has a 2 percent probability of exceedance in 50 years, or a 2,475-year return period. This event has a peak ground acceleration of 0.2482 acceleration from gravity at the bedrock surface for the Solar Micrositing Area. The values of peak ground acceleration on rock are an average representation of the acceleration most likely to occur at the site for all seismic events (crustal, intraplate, or subduction).

Based on a review of the 2021 Oregon Seismic Hazard Database (DOGAMI 2021), the Solar Micrositing Area is located in an area of strong perceived shaking, light potential damage, and slight damage to buildings for an earthquake that has a 2 percent chance of occurring within the next 50 years; a light to moderate perceived shaking, none to very light potential damage, and very slight damage to buildings for an 9 magnitude Cascadia earthquake; and a very low probability of damaging shaking over the next 50 years.

Seismic design parameters were developed following IBC 2021. Using current information, the Solar Components will be designed for Site Class D, according to IBC requirements (Table H-2). Table H-2 shows the seismic design parameters based on Site Class D reflecting the worst-case scenario surficial geology mapped within the Solar Micrositing Area. Site Class D represents the loess (eolian sand) deposits that are rated very strong. Eolian deposits are also rated as Site Class D by DOGAMI (2021).

Table H-2. Seismic Design Parameters – Maximum Considered Earthquake

Location	Site Class	Earthquake Magnitude	Peak Horizontal Ground Acceleration	Return Period
Solar Micrositing Area	D	6.61	0.2482g	2,475 years
Solar Micrositing Area	D	6.69	0.1137g	475 years
Source: USGS 2024c				

7.2.1 Earthquake Sources

In northern Oregon, seismicity is generated when the Juan de Fuca Plate and the North American Plate converge at the Cascadia Subduction Zone. These plates converge at a rate of 1 to 2 inches per year, accumulating large amounts of stress that release abruptly in earthquake events. The four sources of earthquakes and seismic activity in this region are crustal, intraplate, volcanic, and the deep subduction zone (DOGAMI 2010).

Overall, earthquakes in Oregon are associated with active faults in four regional seismicity zones: the Cascade seismic zone, the Portland Hills zone (the Portland, Oregon, and Vancouver, Washington, metropolitan area), the south-central zone (Klamath Falls), and northeastern Oregon zone (Niewendorp and Newhouse 2003). Faults are considered active if there has been displacement in the last 10,000 years, and potentially active if there has been movement over the last Quaternary period (1.6 million years). Regionally, seismicity has been attributed to crustal deformation from the Cascadia Subduction Zone and volcanism. More than 6,000 earthquakes—most less than magnitude 3—have occurred in Oregon since 1981, with 75 percent of these recorded since March 1993 (Wong and Bott 1995).

Earthquakes are caused by movements along crustal faults, generally in the upper 10 to 15 miles of the earth's crust. In the vicinity of the Solar Micrositing Area, earthquakes occur within the crust of the North American tectonic plate when built-up stresses near the surface are released through fault rupture.

There are no faults mapped within the Solar Micrositing Area. Numerous undifferentiated, Quaternary-age, and Class B faults are mapped within 25 miles of the Amended Site Boundary (Figure H-2). These faults are potentially active. The DOGAMI Oregon HazVu: Statewide Geohazards Viewer earthquake hazard layer (DOGAMI 2024b) and the USGS Geologic Hazards Science Center (USGS 2024b; Figure H-2) show that the nearest potentially active faults (undifferentiated and mid- to late Quaternary) are about 5 miles north along the Columbia River. Class B potentially active faults are located approximately 12 miles south/southeast of the Solar Micrositing Area. Class B faults have geologic evidence that demonstrates the existence of a fault or suggests Quaternary deformation, but either (1) the fault might not extend deeply enough to be a potential source of significant earthquakes, or (2) the currently available geologic evidence is too strong to confidently assign the feature as a Class C (insufficient geologic evidence) but not strong enough to assign it to Class A (active fault) (USGS 2024b). The potentially active faults shown in Figure H-2, within 50 miles of the Solar Micrositing Area, present the largest potential for seismic contribution to the Solar Components.

The site-specific geotechnical investigation will assess the potential for any regional faults to affect the Solar Components, as described in Section 5.0. The investigation will include a description of any potentially active faults, their potential risk to the Solar Components, and any additional mitigation measures the Certificate Holder will employ to design, construct, and operate the Solar Components safely.

The 2013 Oregon Resilience Plan by the Oregon Seismic Safety Policy Advisory Commission (OSSPAC 2013) simulated the impact of a magnitude 9.0 Cascadia earthquake scenario. This plan places the Solar Micrositing Area into the "very light" shaking category. This means that a magnitude 9.0 Cascadia scenario earthquake would produce a very light shaking event that would be felt outdoors, wake sleepers, disturb or spill liquids, upset small unstable objects, and potentially swing doors or move pictures (OSSPAC 2013).

Probabilistic seismic-hazard disaggregation at 475-year intervals is shown in Attachment H-2 and at 2,475-year intervals in Attachment H-3.

7.2.2 Recorded Earthquakes

Figure H-2 displays the location and approximate magnitude of all recorded earthquakes within approximately 50 miles of the Solar Micrositing Area. The seismic events are grouped by magnitude and displayed with differently sized symbols based on the event's strength.

Table H-3 summarizes the earthquakes greater than magnitude 3.5 recorded within 50 miles of the Solar Micrositing Area. One earthquake greater than magnitude 4.5 was recorded approximately 40 miles southwest of the Solar Micrositing Area. The nearest earthquake is magnitude 2.5 to 3.5 and is located less than 5 miles north of the Amended Site Boundary. Earthquakes between magnitude 3 and 4 are generally equivalent to a Modified Mercalli Intensity III associated with shaking that is "noticeable indoors but may not be recognized as an earthquake" (USGS 2024d).

Table H-3. Significant Historical Earthquakes within 50 Miles of the Solar Components by Magnitude*

Year	Month	Day	Latitude	Longitude	Moment Magnitude	Miles from Solar Micrositing Area
1975	7	1	45.62799835	-120.0019989	3.5	28.13
1975	7	1	45.60533142	-120.0161667	3.6	27.54
1976	10	10	45.27033234	-120.4994965	3.6	22.67
1976	4	17	45.15850067	-120.8473358	4	30.70
1976	4	13	45.07566833	-120.8588333	4.6	36.36
1979	2	17	46.1641655	-119.932663	3.6	45.91
1981	2	2	46.26283264	-120.9889984	4	44.83
1985	2	10	45.70449829	-119.6344986	3.9	45.81
1988	9	29	45.84983444	-120.2596664	3.5	19.59
1992	8	7	45.86033249	-119.5895004	3.9	49.58
1997	11	18	46.14316559	-120.4708328	3.9	32.58
1997	3	22	45.19733429	-120.0671692	3.9	38.16
1998	10	9	46.20366669	-120.7083359	4	36.79
1999	8	31	45.1863327	-120.0908356	3.5	37.93
2000	2	1	45.18999863	-120.1126633	3.6	37.03
2000	1	30	45.19716644	-120.1248322	4.1	36.27
2007	3	1	45.1238327	-120.934166	3.6	34.38
2007	6	14	45.12566757	-120.9440002	3.8	34.44
2008	12	27	45.13100052	-120.9513321	3.6	34.25
2008	4	5	45.13000107	-120.9424973	3.6	34.14
2008	7	14	45.12866592	-120.9499969	4.2	34.37
2009	4	20	45.13349915	-120.9550018	3.6	34.16
2010	12	30	45.13150024	-120.9319992	3.6	33.85
2010	1	2	45.13700104	-120.9554977	3.6	33.95
2010	6	17	46.10883331	-120.7429962	4.2	30.72

*Magnitude of 3.5 or greater

Source: USGS 2024d

The Ground Response Spectra Assessment (Attachment H-4) assessed the design response spectrum given in the 2021 IBC using the ASCE 7 Hazard Tool (ASCE 2024). Response spectra are provided for the maximum considered earthquake at the Solar Micrositing Area location. For the maximum considered earthquake, separate response spectra modified by the amplification factors for Site Class D are provided. Due to the presence of loess and stiff soils at depths up to 20 feet (Terracon 2024) in the Solar Micrositing Area, the Solar Components should be designed for the most conservative Site Class D.

7.2.3 Hazards Resulting from Seismic Events

Potential seismic hazards from a design seismic event for the Solar Components include seismic shaking or ground motion, fault displacement, instability from landslides or subsurface movement, and adverse effects from groundwater or surface water. These risks are discussed below. Since the Solar Components are far from the Oregon coast, and not in a DOGAMI-defined tsunami evacuation zone (DOGAMI 2024c), tsunami inundation is not considered a hazard.

7.2.4 Seismic Shaking or Ground Motion

The Solar Components will be designed to withstand the maximum risk-based design earthquake ground motions developed for the design seismic event that has a 2,475-year recurrence interval. The State of Oregon has adopted the IBC 2021 code for structural design. Specifically, this is Chapter 16, Section 1613 (Earthquake Loads) of the 2022 OSSC (State of Oregon 2022). Building codes are frequently updated; the IBC is updated every 3 years. The Certificate Holder will design, engineer, and construct the Proposed Facility following the latest IBC, OSSC, and building codes adopted by the State of Oregon at the time of construction.

Based on soil data provided by the NRCS Web Soil Survey (Exhibit I), and geologic and geotechnical information, the surficial materials in the Amended Site Boundary range from Site Class C to Class D. As described above, Site Class D (silt loess, stiff soil) is the most conservative class appropriate for the Solar Components (Attachment H-4).

Based on site-specific analyses, the original equipment manufacturer will provide the structural engineer with site-specific foundation loads and requirements. The structural engineer then completes the foundation analyses based on the design site-specific parameters. The geotechnical studies and analyses provide site-specific parameters, including but not limited to moisture content and density, soil/bedrock bearing capacity, bedrock depth, settlement characteristics, structural backfill characteristics, soil improvement (if required), and dynamic soil/bedrock properties, including shear modulus and Poisson's ratio of the subgrade. The foundation design engineer will use these parameters to design a suitable foundation and verify that the foundation/soil interaction meets or exceeds the original equipment manufacturer's site-specific, minimum requirements.

7.2.5 Fault Rupture

Fault displacement is unlikely because there are no active faults within the Amended Site Boundary. The nearest known active or potentially active faults are approximately 5 miles north and 12 miles south/southeast of the Solar Micrositing Area as shown on Figure H-2. Concern was expressed at the DOGAMI meeting (Attachment H-1) regarding the possible extension of the Luna Butte Fault located north/northeast of the Solar Micrositing Area as shown on Figure H-2. Review of DOGAMI LiDAR mapping (DOGAMI 2024b) indicates that this fault could extend farther south/southeast and that the fault could be located within approximately 4.5 miles east of the Solar Micrositing Area. There is a mapped unnamed fault located about 0.5 to 1 mile north of the Solar Micrositing Area (Figure H-1). The fault is not considered active within recent geologic time.

7.2.6 Liquefaction

Liquefaction is when saturated and cohesionless soils are subjected to dynamic forces like intense or prolonged ground shaking and temporarily lose their strength and liquefy. There is no evidence of historic liquefaction or alluvial fan deposits within the Solar Micrositing Area. The soils in the Solar Micrositing Area are generally cohesive and unsaturated. Although eolian deposits within the Solar Micrositing Area have a relatively high liquefaction potential (DOGAMI 2021), groundwater is indicated to be at least 100 feet bgs within the bedrock based on the geotechnical investigation (Terracon 2024). Along with the relatively moderate seismic event potential, this indicates that soil liquefaction within the Solar Micrositing Area is unlikely. Using Oregon HazVu: Statewide Geohazards Viewer (DOGAMI 2024b), the Amended Site Boundary is not located within an area susceptible to liquefaction (Figure H-2). In addition, no 100-year floodplains are mapped within the Solar Micrositing Area or immediate vicinity as shown in Figure H-4.

7.2.7 Seismically Induced Landslides

While regional seismicity could potentially trigger landslides and mass wasting processes in the Solar Micrositing Area, the risk is considered low to moderate for expected shaking in a Cascadia 9.0 magnitude event (DOGAMI 2024d) as depicted on Figure H-3. The landslide database does not show any historic landslides within the Solar Micrositing Area or within the immediate vicinity (DOGAMI 2024d). Construction will avoid steep slopes that are most susceptible to landslides. The site-specific geotechnical investigation will review evidence of active faults and landslides, which will inform the final design and layout. More detailed discussion on the location and type of landslides is included in Section 8.1.

7.2.8 Subsidence

Subsidence is the sudden sinking or gradual downward settling of surface land, often caused by groundwater drawdown, compaction, tectonic movements, mining, or explosive activity. The geotechnical investigation (Terracon 2024) has shown that the soils that are present on most of the Solar Micrositing Area are not saturated and groundwater is indicated to be at least 100 feet bgs within bedrock. Subsidence due to a seismic event is unlikely in the Solar Micrositing Area as the overlying soils are unsaturated where the Solar Components will be constructed.

Subsidence may also occur due to introduction of moisture into desiccated collapsible soils present in loess. Drainage changes produced by grading and site development can induce moisture changes in the subsurface that can cause collapse of loess that is at a very low natural moisture content. Collapsible soils are discussed in Section 8.6. Design of site drainage will prevent ponding or other concentration of surface water flows, especially near structures. Development over existing drainage ways will be avoided wherever possible. If development over existing drainage ways cannot be avoided, rerouting of surface water will also be avoided so as to not induce potential subsidence.

7.2.9 Seismic Hazard Mitigation

The State of Oregon uses the 2021 IBC, with current amendments by the OSSC. Pertinent design codes relating to geology, seismicity, and near-surface soil are found in OSSC Chapter 16, Section 1613 (State of Oregon 2022). The Solar Components infrastructure will be designed to meet or exceed all current design code standards. Substation equipment will meet all requirements in the latest version of the Institute of Electrical and Electronics Engineers (IEEE) 693-2018 standard (which directs the design and qualification of equipment installed in substations and its ability to withstand a seismic event.). The region has a high to very high seismicity potential; however, the solar arrays and battery storage infrastructure will be designed to resist seismic loads.

As discussed in Section 5.0, site-specific geotechnical exploration will provide data that will guide the Solar Components infrastructure design to mitigate potential seismic-event hazards. The hazard of a surficial rupture along a fault is low, given the seismic history of the site displayed in geologic mapping. Because the Solar Components are in a sparsely populated area, there is minimal human safety and environmental risk. Mitigation for potential fault rupture is not needed. No structures will be built on steep slopes prone to instability, thus avoiding potential impacts. Disaster resilience design guidelines are further described in Section 9.0.

8.0 Non-Seismic Geological Hazards – OAR 345-021-0010(1)(h)(F)

OAR 345-021-0010(1)(h)(F) An assessment of geology and soil-related hazards which could, in the absence of a seismic event, adversely affect or be aggravated by the construction or operation of the facility, in accordance with standard-of-practice methods and best practices, that address all issues relating to the consultation with the Oregon Department of Geology and Mineral Industries described in paragraph (B) of this subsection. An explanation of how the applicant will design, engineer, construct and operate the facility to adequately avoid dangers to human safety and the environment presented by these hazards, as well as:

(i) An explanation of how the applicant will design, engineer, construct and operate the facility to integrate disaster resilience design to ensure recovery of operations after major disasters; and

(ii) An assessment of future climate conditions for the expected life span of the proposed facility and the potential impacts of those conditions on the proposed facility.

Response: Non-seismic geologic hazards in the Columbia Plateau region include landslides, volcanic eruptions, collapsing soils, and erosion. The area within the Solar Micrositing Area is primarily relatively flat and includes loess deposits, with the exception of several canyon drainages. The Solar Components will be constructed within a flat-lying portion of the Solar Micrositing Area. It will avoid steep slopes and drainages that could experience landslides and soil creep. A discussion of potential non-seismic geologic hazards is presented below.

8.1 Landslides

In 2021, DOGAMI released an update to the Oregon Statewide Landslide Database (SLIDO-4.4; DOGAMI 2024d). SLIDO is a statewide database of known landslides compiled from published maps. The database includes landslides, debris flows, alluvial fans, and colluvium or talus. The primary sources of this historical landslide information are published geologic reports and geologic hazard studies by the USGS and DOGAMI. The SLIDO-4.4 landslide database was used to overlay landslide areas or landslide-related features on Figure H-3; there are no mapped landslides within the Solar Micrositing Area, and most of the area is mapped as low susceptibility for landslides. Areas of moderate landslide susceptibility are mapped along drainages within the Solar Micrositing Area. Areas of high susceptibility for landslides are mapped along the drainages/canyons in the northern portion of the Solar Micrositing Area. In addition, based on an evaluation of geologic material class and slope during both dry and wet conditions (DOGAMI 2021), most of the Solar Micrositing Area is located in an area of low susceptibility to dry landslides and low to moderate susceptibility to wet landslides. Small areas along steeper drainages and the drainages and canyons along the northeastern boundaries are rated moderate to moderately high for susceptibility to dry landslides and high to very high for susceptibility to wet landslides. Site construction will follow appropriate IBC regulations for construction and avoid steep slopes.

Slopes within the vicinity of the Solar Micrositing Area range from approximately zero to 36 percent, with an average slope of 4.4 percent. If slope stability issues are identified in the final design geotechnical investigations, the structures will either be relocated during the micrositing process, or remedial measures will be implemented to improve slope stability.

Additional review was conducted from the DOGAMI Landslide Inventory and Risk Reduction of the North and Central Portions of Wasco County, Oregon (DOGAMI 2023). The Solar Micrositing Area is located east of the study area evaluated in this report.

8.2 Volcanic Activity

Volcanic activity in the Cascade Range is driven by the subduction of the Juan de Fuca Plate beneath the North American Plate. The closest volcano to the Solar Micrositing Area is Mount Hood (approximately 50 miles west/southwest). Most of the potential volcanic hazard impacts would occur within a 50-mile radius of the erupting volcano. Depending on the prevailing wind direction at the time of the eruption and the source of the eruption, ash fallout in the region surrounding the

Solar Components may occur. Because of the distance to the nearest volcanoes, the Solar Components' impacts from volcanic activity would be indirect and likely limited to ash fallout. In addition, the Solar Components are not located near any streams that would be subject to pyroclastic flows from a volcanic eruption from these close volcanoes. It is unlikely that there would be any adverse effects from volcanic activity on the construction or operation of the Solar Components.

8.3 Erosion

Erosion can occur when soils are increasingly exposed to wind or water. Wind erosion is influenced by wind intensity, vegetative cover, soil texture, soil moisture, the grain size of the unprotected soil surface, topography, and the frequency of soil disturbance. Wind erosion hazard is generally high to very high. Control measures will be implemented to mitigate wind and water erosion potential as identified in Exhibit I. Water erosion is primarily a function of soil type, vegetative cover, precipitation, and slope inclination. If left unmitigated, erosion from rainfall would be a hazard during construction. The runoff potential and water erosion hazard for site soils is generally moderately low. Slopes in the Solar Micrositing Area have an average slope of 4.4 percent; it is noted that slopes greater than 15 percent have a greater erosion risk. The hazard for erosion across the Solar Micrositing Area ranges from slight to severe. The general average annual rainfall for nearby Moro, Oregon (approximately 7.6 miles south/southwest of the Solar Micrositing Area) is 10.38 inches of precipitation and 16 inches of snowfall (US Climate 2024). Additional precipitation data is provided in Exhibit J (see Attachment J-1 to Exhibit J). The erosion potential and available precipitation make site soils sensitive to water erosion during winter and spring, particularly on steep slopes. A draft Erosion and Sediment Control Plan (ESCP) has been developed to reduce the potential for soil erosion (see Attachment I-1 to Exhibit I). The ESCP includes structural and nonstructural best management practices (BMP). Structural BMPs include the installation of silt fences or other physical controls to divert flows from exposed soils or otherwise limit runoff and pollutants from exposed areas. Nonstructural BMPs include the implementation of materials handling procedures, disposal requirements, and spill prevention methods.

The engineering, procurement, and construction (EPC) contractor will apply for a National Pollutant Discharge Elimination System stormwater construction permit though the Your DEQ Online platform. In addition, Exhibit I contains a comprehensive list of mitigation measures to avoid wind and water erosion and soil impacts.

8.4 Flooding

Federal Emergency Management Agency (FEMA) National Flood Hazard data (FEMA 2024) were compared to the temporary and permanent disturbance areas in the Amended Site Boundary to evaluate flood hazards. Figure H-3 provides a map of FEMA floodplains (FEMA 2024). Additional DOGAMI floodplain mapping was not available (DOGAMI 2024b). No canyons or drainages within the Solar Micrositing Area are mapped within the 100-year floodplain. The Solar Components will not impact floodplain hazards.

Seasonal thunderstorms can result in concentrated stormwater runoff and localized flooding. The Solar Components will be designed and engineered to comply with zoning ordinances and building codes that establish flood protection standards for all construction to avoid dangers to the infrastructure, as well as human safety and the environment, including criteria to ensure that the foundation will withstand flood forces. The engineered access roads and drainages will direct stormwater runoff away from structures and into drainage ditches and culverts as required in the ESCP. Therefore, the risks and potential impacts to the Solar Components, human safety, and the environment from flood hazards are expected to be low.

8.5 Shrinking and Swelling Soils

Clayey soils are the most susceptible to shrinking and swelling. These soils were not found in the Existing Facility soil data (see Exhibit I). Previous geotechnical reports did not identify shrinking and swelling soils as a concern within the Amended Site Boundary (Terracon 2013; Cornforth 2006). The shrink-swell potential of the soils will be evaluated during the site-specific geotechnical investigations and laboratory testing and analysis during the detailed engineering phase of the Solar Components. If shrinking or swelling soils are present at foundation locations or along road alignments, soil improvement will be necessary. Soil improvement can include reworking and compacting onsite soils, over-excavating soils with shrink-swell potential and replacing with compacted structural fill, constructing impermeable barriers to prevent saturation, or mixing soils to reduce the potential for shrinking and swelling.

8.6 Collapsing Soils

The Terracon (2024) geotechnical investigation found that the primary geotechnical consideration is collapsible soils in the upper 10 feet of loess. These soils are very soft to medium stiff and could be susceptible to collapse. Structures founded directly on these soils could experience total and differential settlements exceeding 1 inch. These soils, deposited by wind and the soil particles, are generally considered to be oriented in a "honeycomb"-like structure, which can make them susceptible to high volumetric strains due to collapse of the soil structure. The collapse of the honeycomb structure is typically instigated by wetting and/or loading. Based on laboratory collapse testing from the Shelby tube samples of the near-surface loess, this soil is susceptible to collapse upon loading and wetting generally ranging from 0.2 to 0.5 percent strain at full saturation. However, based on comparison testing at other nearby sites where block samples were collected, it is anticipated there would be two to six times that amount (due to the disturbance caused by Shelby tube sample extrusion). It is estimated that this hazard equates to about 1.2 to 3.6 inches of potential if the loess were to remain in place and be utilized for support. Collapsible soils were also identified as a geotechnical hazard in the previous Phase I-III geotechnical investigations for the BCWF (GN Northern, Inc. 2007, 2008a, 2008b).

Terracon (2024) concluded that proposed structures to be supported by shallow or mat foundations will likely require some level of soil improvement to reduce total and differential settlements to acceptable levels. Based on a foundation embedment depth of 2 feet for frost protection, the following alternatives for subgrade improvement beneath new structures would be considered:

Complete Removal and Recompaction: Where total settlements need to be limited to less than 1 inch and mitigation of all collapse-related settlements, soft loess soils should be over excavated to expose very stiff to hard loess. The surface of the underlying soils should be scarified, wetted, and compacted prior to placement of new structural fill. The native soils encountered at the site are not suitable for reuse as structural fill.

Partial Removal and Recompaction: Where structures can tolerate total settlements of 3 inches, a partial over excavation could be implemented where the site soils are removed to a depth of 5 feet below the bottom of footing elevation (7 feet below site grades) and recompacted as described above. As an alternative to remove and replace, the alternative compaction techniques such as deep dynamic compaction, rapid impact compaction, or high-energy impact compaction could also be used to improve the minimum 5-foot-thick zone below footings. This option does not reduce potential collapse-related settlements as much as the first option, since some of the soft loess soils would remain in place.

9.0 Disaster Resilience

Pertinent design codes related to geology, seismicity, and near-surface soils are contained in OSSC Chapter 16, Section 1613 (Earthquake Loads) (State of Oregon 2022). The Solar Components will be designed to meet or exceed the minimum standards required by these design codes. The Certificate Holder acknowledges that DOGAMI encourages, but does not require, design and build for disaster resilience and future climate conditions using science, data, and community wisdom to protect against and adapt to risks. With this in mind, the Certificate Holder has extensive experience building energy facilities and designing projects to withstand non-seismic geologic hazards from a structural perspective.

The Solar Components will be designed, engineered, and constructed to meet all current standards to adequately avoid potential dangers to human safety presented by seismic hazards. A qualified engineer will assess and review the seismic, geologic, and soil hazards associated with the Solar Components infrastructure construction. Construction requirements will be modified, as needed, based on the site-specific characterization of seismic, geologic, and soil hazards. Substation structures will be designed under the current version of the OSSC. Substation, transmission line, and collector line equipment will be specified by the latest version of the IEEE standard (currently IEEE 693-2018). The Solar Components infrastructure will be in sparsely populated areas; therefore, the risks to human safety and the environment due to seismic hazards will be minimal.

The Solar Components infrastructure will be designed, engineered, and constructed to meet or exceed all current standards. The Certificate Holder proposes to design, engineer, and construct the Solar Components to avoid dangers to human safety-related and non-seismic hazards in many ways, including conducting site-specific geotechnical evaluations (see Section 5.0). Typical mitigation measures for non-seismic hazards include avoiding potential hazards, conducting subsurface investigations to characterize the soils to adequately plan and design appropriate mitigation measures, creating detailed geologic hazard maps to aid in laying out facilities, providing warnings in the event of hazards, and purchasing insurance to cover the Solar Components in the event of hazards. Should Existing Facility elements like access roads be damaged, they will be assessed and repairs made quickly to ensure recovery of operations after a major storm event.

10.0 Climate Change

The University of Washington conducted a study to assess climate vulnerability and adaptation in the Columbia River Plateau, where the Solar Components will be located (Michalak et al. 2014). The study involved downscaling five climate models (CCM3, CGM3.1, GISS-ER, MIROC3.2, and Hadley). Climate projections were downscaled to approximately a 1-kilometer resolution for over 40 different direct (mean annual temperature/precipitation) and derived (number of growing-degree days, actual and potential evapotranspiration) climate variables (Michalak et al. 2014). The downscaling of the climate models for this area led to future projections of greater annual average and summer temperatures, and more severe storm events and wildfires, among other changes. These specific changes are expected to increase stress on power lines in the region.

Reinforcing the local electric grid with solar power and battery energy storage increases energy grid resilience in this part of Oregon. This reinforcement will be direct, by upgrading a system that is anticipated to experience higher loads under rising temperatures and related increases in power demand for summer cooling. It is also indirect by supporting the delivery of power generated through various sources, minimizing the potential reduction in hydropower's role under future conditions. All aspects of the Solar Components support resiliency in the face of future climate change and will be designed to withstand extreme events as explained above in Section 9.0.

11.0 Conclusions

The risk of seismic hazards to human safety at the Solar Components is low to moderate with the implementation of geotechnical mitigation measures. The Certificate Holder reviewed regional geologic information and performed a site-specific desktop analysis of potential seismic, geologic, and soils hazards. In addition, a geotechnical investigation has been conducted within areas of the Solar Micrositing Area that has evaluated seismic risk. A further and more robust site-specific geotechnical investigation will be conducted prior to construction, allowing the Certificate Holder to design, engineer, and construct the Solar Components to the most current standards at the time of construction (Condition 66, Council 2022). The site-specific geotechnical investigations and Solar Components design will comply with the following conditions from the Third Amended Site Certificate: Conditions 112, 112, and 114 (Council 2008). This exhibit reflects input from DOGAMI and demonstrates that the Certificate Holder can design, engineer, and construct the Solar

Components to avoid dangers to human safety. The following supporting evidence is provided, with the remaining evidence to be provided before construction:

- The risk of seismic hazards to human safety at the Solar Components is considered low because the Certificate Holder will conduct an additional geotechnical investigation and follow the required design parameters for the Solar Components. The Certificate Holder has adequately characterized the seismic hazard risk of the site under OAR 345-022-0020(1)(a) and considered seismic events and amplification for the Facility's site-specific subsurface profile. The Solar Components include solar modules, transformers, generators, site access roads, BESS facilities, operation and maintenance structures, and two onsite substations with equipment. The proposed operations and maintenance building will be staffed; however, the probability of a large seismic event occurring while the operations and maintenance building is occupied is much lower than for a typical building or facility because the Solar Components will only be occupied periodically. This very low probability results in minimal risk to human safety. During preconstruction geotechnical investigations, any potentially active faults in the vicinity will be surveyed.
- The Certificate Holder has demonstrated that the Solar Components can be designed, engineered, and constructed to avoid dangers to human safety and the environment in case of a design seismic event by adhering to the most recently updated IBC requirements, following OAR 345-022-0020(1)(b). These standards require that for the design seismic event, the factors of safety used in the Solar Components design exceed specific values. For example, in the case of slope design, a factor of safety of at least 1.1 is usually required during seismic stability evaluation. This safety factor is introduced to account for uncertainties in the design process and ensure that performance is acceptable. If slope stability safety factors are not met, the Solar Components will either be relocated during the micrositing process or remedial measures to improve slope stability will be implemented. For slope stability, the remedial measures could include the use of ground improvement methods (such as retaining structures) to limit the movement to acceptable levels. Given the relatively low level of risk for the Solar Components, adherence to the IBC requirements will ensure that appropriate protection measures for human safety are taken.
- The Certificate Holder has provided appropriate site-specific information and demonstrated (per OAR 345-022-0020(1)(c)) that the construction and operation of the Solar Components, in the absence of a seismic event, will not adversely affect or aggravate the geological or soil conditions of the Existing Facility site or vicinity. The risks posed by non-seismic geologic hazards are generally considered low because the Solar Components can be designed to minimize or avoid the hazards of landslides and soil erosion. Landslide and slope stability issues will be identified during the final design and mitigated. Erosion hazard resulting from soil and wind action will be minimized by implementing an erosion control plan. The Certificate Holder will notify ODOE in the event that site investigations or trenching reveal conditions in the foundation rock different from what was evaluated, or if

shear zones, artesian aquifers, deformations, or clastic dikes are found in the vicinity of the site.

- The Certificate Holder has demonstrated that the Solar Components can be designed, engineered, and constructed to avoid human safety and environment impacts from geological and soil hazards, per OAR 345-022-0020(1)(d). Accordingly, given the relatively small risks these hazards pose to human safety, standard methods of practice (including implementation of the current IBC) will be adequate for the design and construction of the Solar Components. Site-specific studies will be conducted, additional geotechnical work will be completed once the final locations of the structures are selected, and adequate measures will be implemented to control erosion.
- Finally, the Certificate Holder has assessed future climate conditions for the expected life span of the Solar Components, and the potential impacts of those conditions on the Solar Components.

Therefore, for the reasons outlined in this exhibit, the construction and operation of the proposed Solar Components will comply with the structural standards as outlined in OAR 345-022-0020, as well as the standard in OAR 345-021-0010(1)(h).

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Figures

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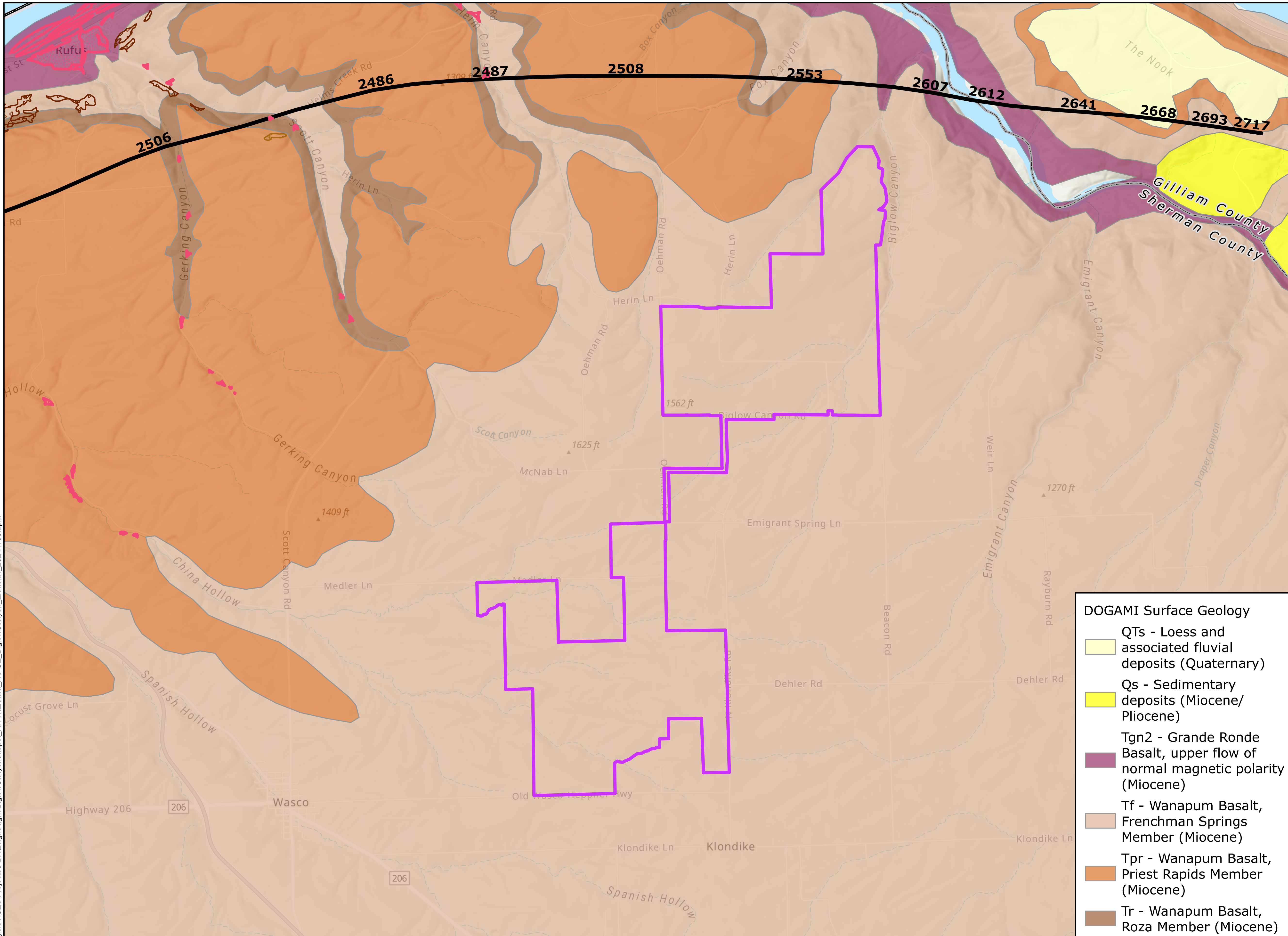
Biglow Canyon Wind Farm Request for Amendment #4

Figure H-1 Geologic Map

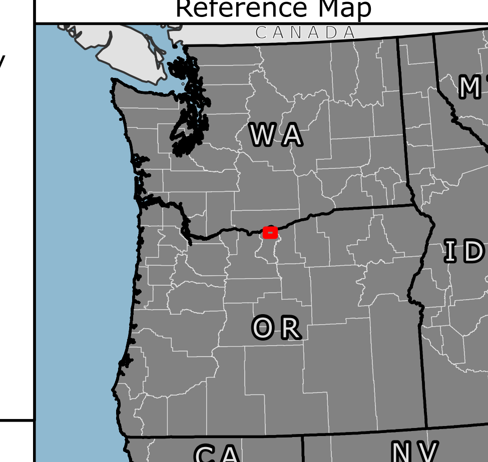
SHERMAN COUNTY, OR



Solar Micrositing Area
County Boundary
State Boundary
Fault Line (USGS SGMC)
DOGAMI Landslide Deposits
Fan
Landslide
Talus-Colluvium

TETRA TECH
PGE

Reference Map



1:55,000 WGS 1984 UTM Zone 10N

0 0.5 1 2 Miles

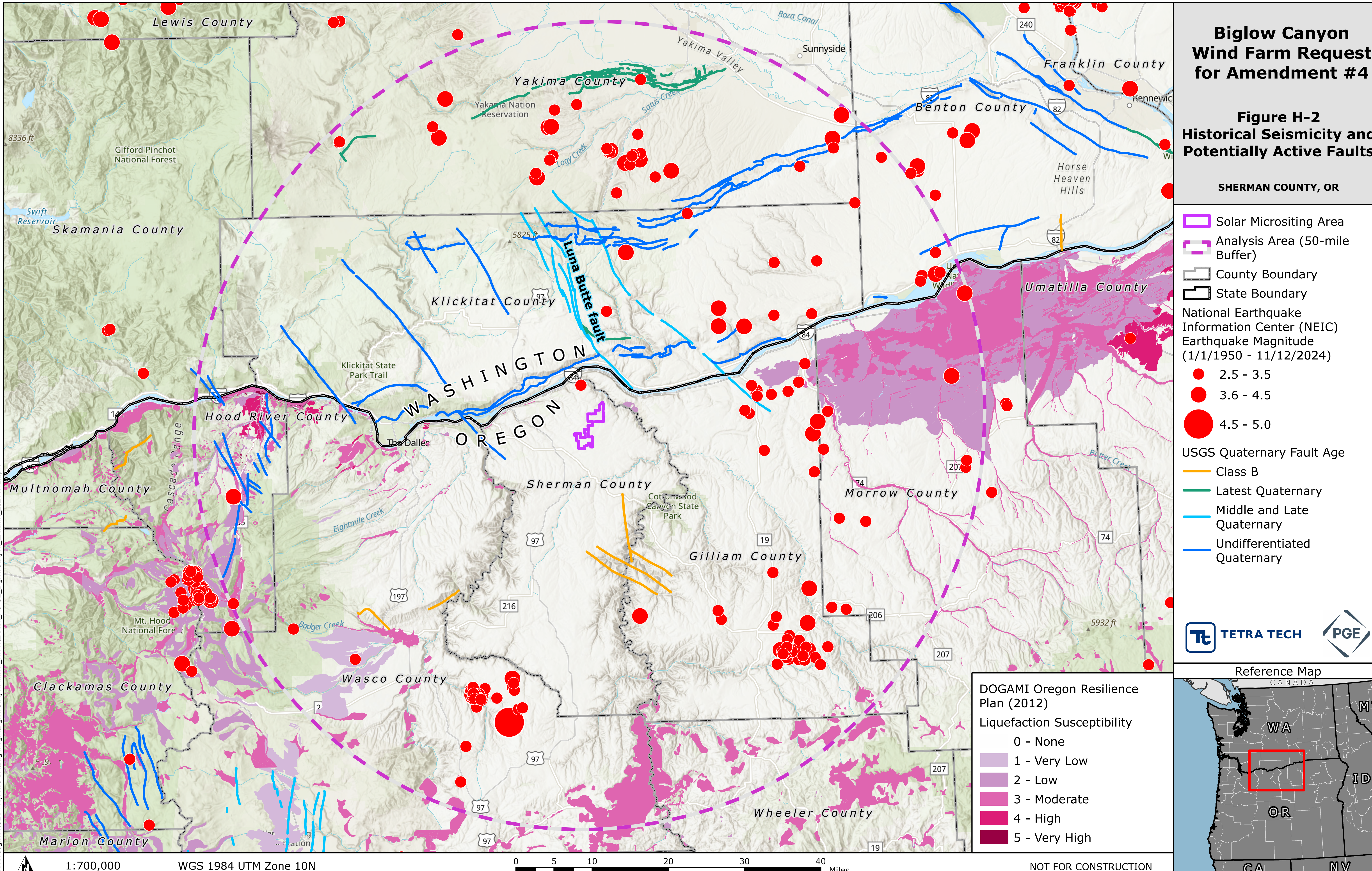
NOT FOR CONSTRUCTION

\\cess706gisfs1\CES\Projects\PDX\BrightNight\BiglowCanyon\Maps_RFA4\Exhibit_H\PGE_BiglowCanyon_ExhibitH_20241108.aprx

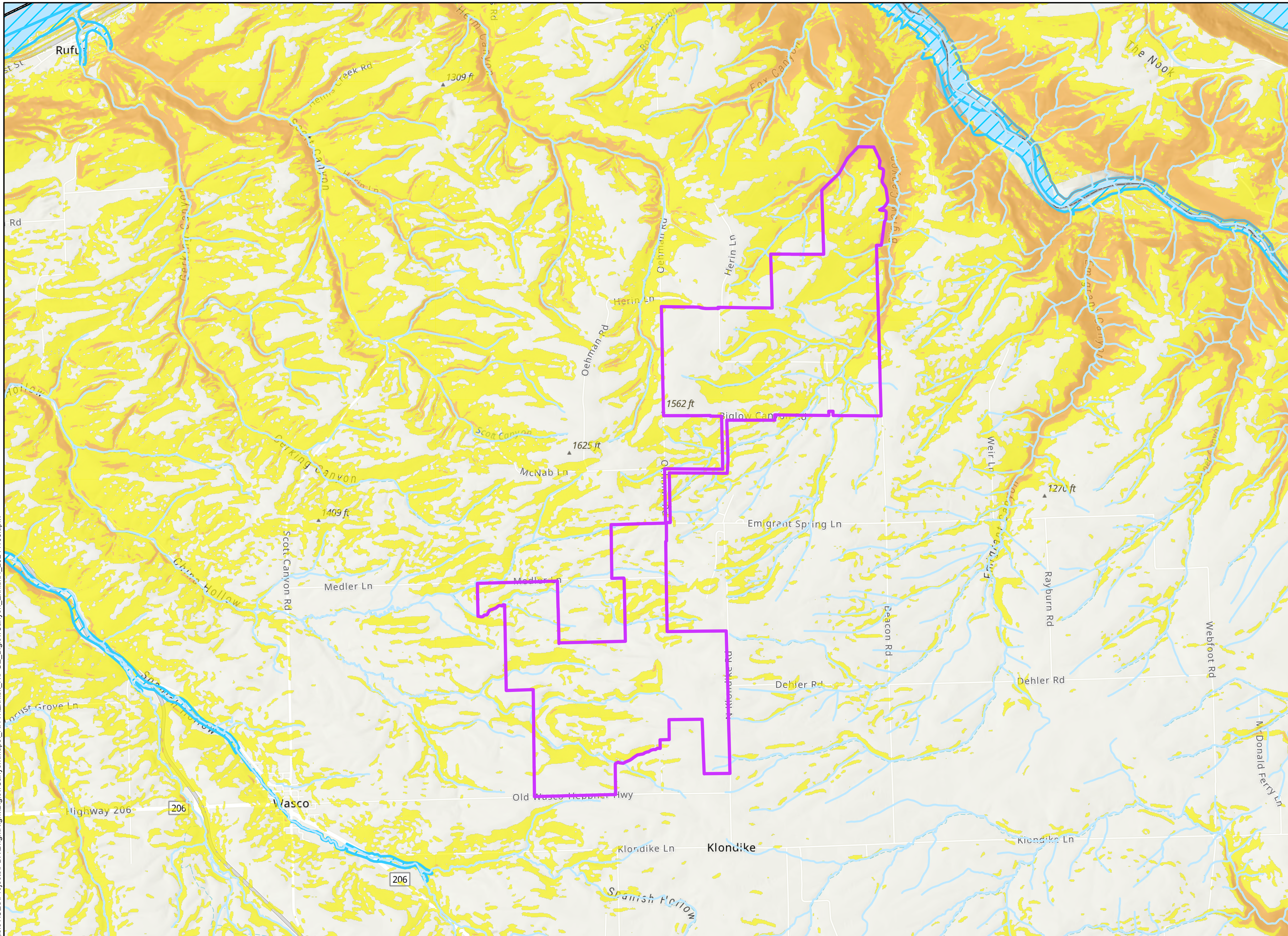
Biglow Canyon Wind Farm Request for Amendment #4

Figure H-2 Historical Seismicity and Potentially Active Faults

SHERMAN COUNTY, OR



TETRA TECH PGE



Biglow Canyon Wind Farm Request for Amendment #4

Figure H-3 Special Flood Hazards and Landslide Hazards

SHERMAN COUNTY, OR

- Solar Micrositing Area
- County Boundary
- State Boundary
- Stream/River (NHD)

Non-Effective FEMA Flood Hazard Areas*

- Zone A/AE (100-Year Floodplain)
- Zone X (Area of Minimal Flood Hazard)

DOGAMI Landslide Susceptibility

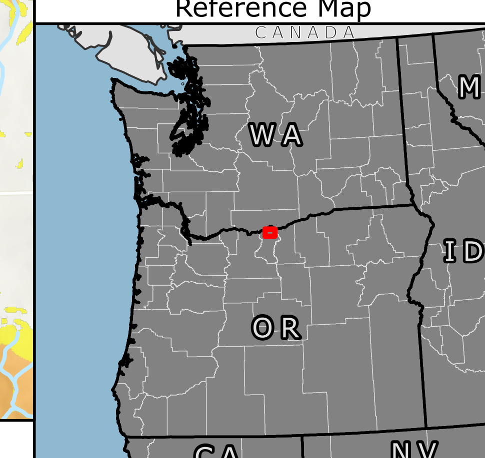
- Low
- Moderate
- High

**Effective FEMA Special Flood Hazard Areas digital data not available for this area; data presented for guidance only*

TETRA TECH

PGE

Reference Map



1:55,000

WGS 1984 UTM Zone 10N

0 0.5 1 2 Miles

NOT FOR CONSTRUCTION

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Attachment H-1.
Record of Correspondence with DOGAMI

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Memorandum

Meeting Date: November 1, 2024
Project: Biglow Canyon Wind Farm – RFA 4
Subject: DOGAMI Consultation for EFSC process (Exhibit H)

<u>Virtual Meeting with Oregon Department of Geology and Mineral Industries (DOGAMI) and Oregon Department of Energy (ODOE), November 1, 2024, at 2:00 pm PST</u>

A virtual meeting was held with DOGAMI and ODOE on November 1, 2024, 2:00 pm PST with the following attendees present: Lalo Guerrero (DOGAMI), Jason McClaughry (DOGAMI), Christopher Clark (ODOE), Lenna Cope (PGE), Betsy Biesty (BrightNight), Todd Ellwood (BrightNight), Arturo Alvarez (BrightNight), Colin Canon (BrightNight), Cory Pollpeter (BrightNight), Kiana Ziola (Tetra Tech), and Rachel Miller (Tetra Tech).

Introductions were made for the meeting participants. The following Project information was presented (including a PowerPoint presentation) from the draft Exhibit H for the Biglow Canyon Wind Farm Request for Amendment (RFA) 4:

- Lenna Cope and Betsy Biesty provided a Project overview including a map of the overall Project features and vicinity.
- Rachel Miller discussed the resources and methods used for the geology and geologic hazards analyses that included a slide presentation.
- Rachel Miller discussed the geologic hazards studies including maps of the geology of the area, a map of seismic information including earthquakes and faults, and a map of landslide and floodplains hazards.
- Arturo Alvarez provided an overview of planned geotechnical studies at the site prior to construction.

The following feedback was received from DOGAMI:

- Lalo provided an additional online resource (https://pubs.oregon.gov/dogami/dds/p-OSHD-1.htm) and publication (pubs.oregon.gov/dogami/ofr/O-23-02/O-23-02_report.pdf) to include in the evaluation. These resources include additional seismic information and additional landslide information for Wasco County. Rachel stated that the information would be reviewed, and discussion added to Exhibit H.

- Lalo also discussed potential concerns that a potentially active fault (Luna Butte Fault) might have suggestion of recent activity, and that Lidar data indicates the fault might extend farther southeast than what is currently mapped. Available information will be reviewed and documented in Exhibit H.
- Lalo also requested confirmation to ensure the most recent earthquake data is mapped on the seismic figure and that the figure provide the data range and data source information. Kiana agreed that GIS staff will double check and update the figure.
- Christopher requested that more detailed future geotechnical study information be provided in Exhibit H prior to submittal of the application. This information will be included in Exhibit H.

ACTION ITEMS

ACTION ITEMS	RESPONSIBLE PARTY
Draft memo of meeting for DOGAMI Review	Tetra Tech
Submit Draft of Exhibit H for DOGAMI Review	Tetra Tech

Attachment H-2.
Probabilistic Seismic Hazard Disaggregation – 475-Year Return Time

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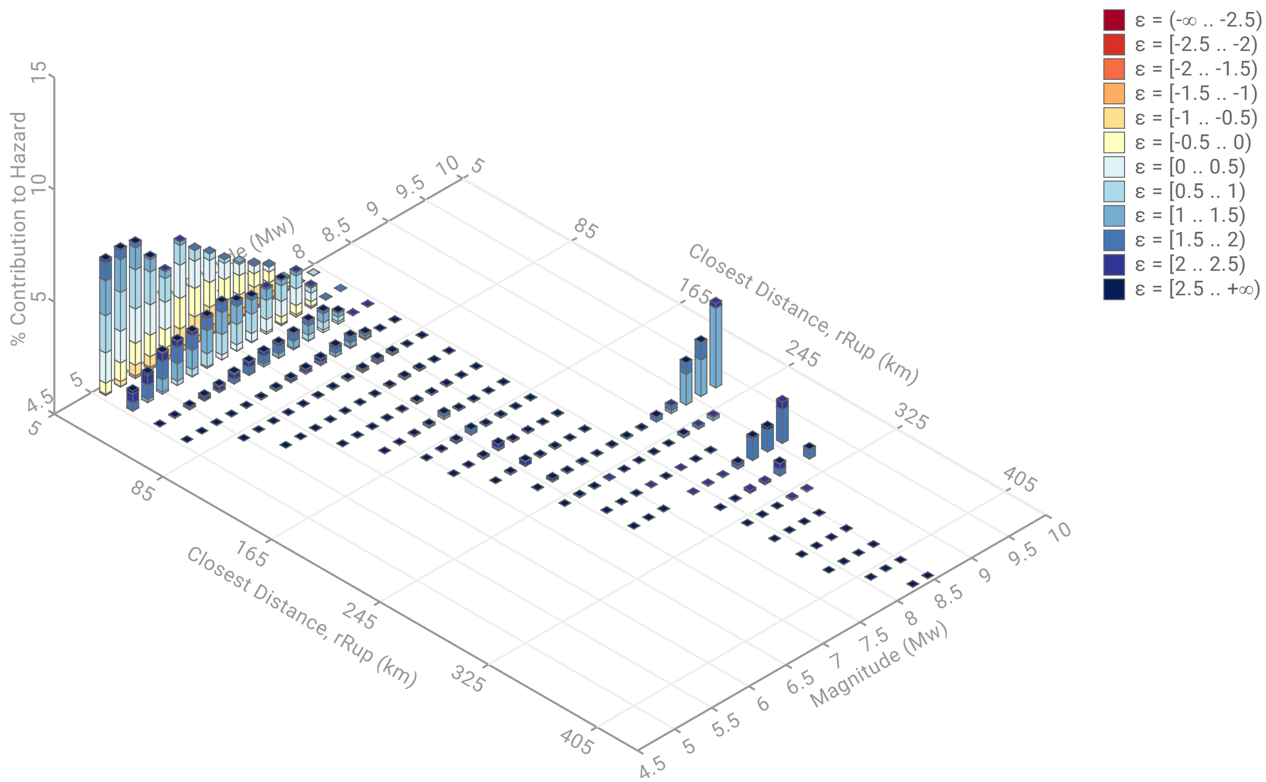
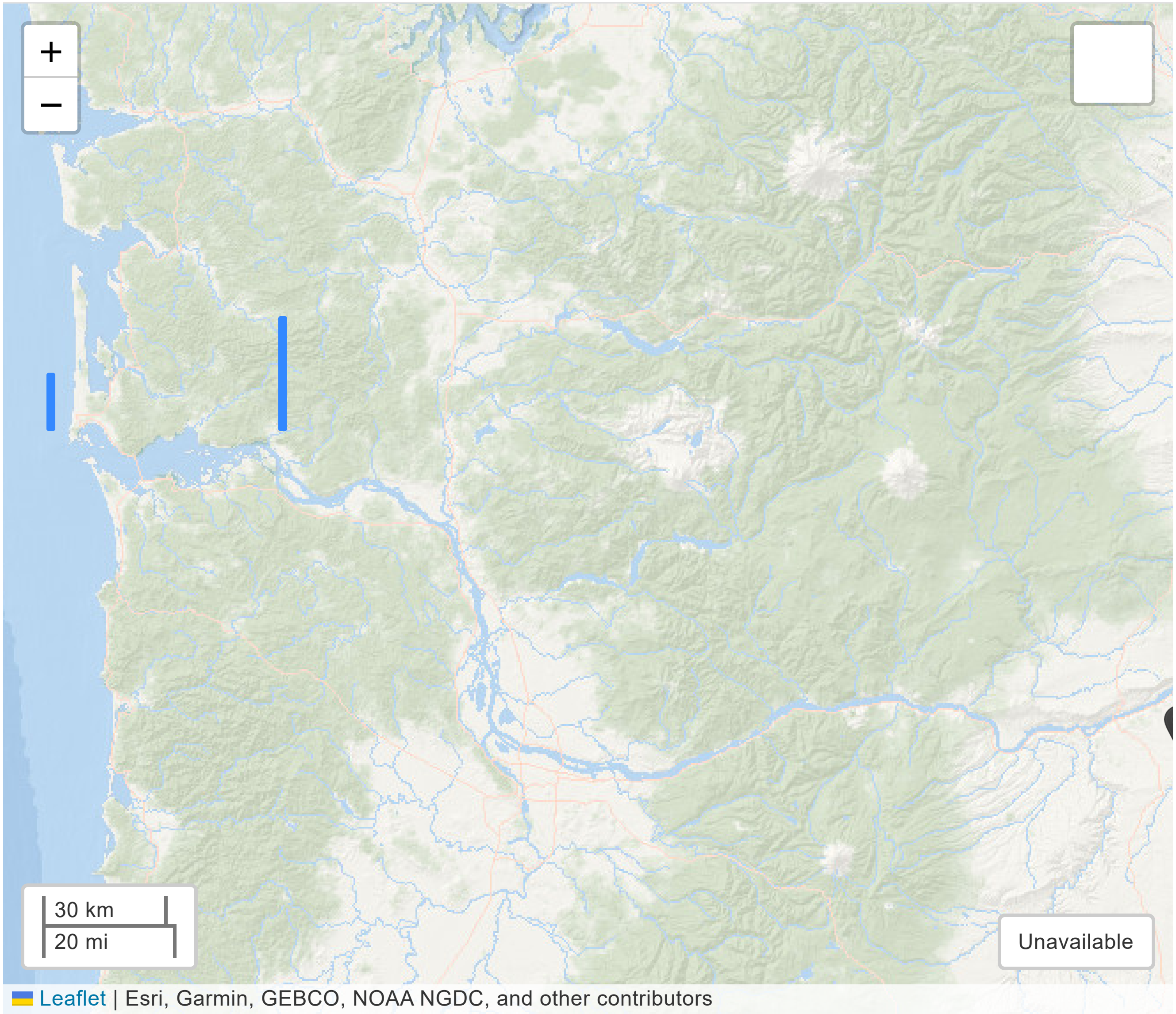
Disaggregation Report

Disaggregation



Geographical Disaggregation



Parameter Summary

Model: NSHM Conterminous U.S. 2018

Latitude: 45.6072°

Longitude: -120.6351°

Site Class: D (Vs30 260)

Intensity Measure Type: PGA

Return Period: 2475 (2% in 50)

Component: Total

Disaggregation Summary

Disaggregation targets

Return period : 2475 yrs

Exceedance rate : 4.040e-4 yr^{-1}

PGA ground motion : 2.482e-1 g

Recovered targets

Return period : 2431.5666 yrs

Exceedance rate : 4.113e-4 yr^{-1}

Totals

Binned : 100 %

Residual : 0 %

Trace : 0.68 %

Mean (over all sources)

m : 6.61

r : 59.33 km

ε_0 : 0.77 σ

Mode (largest m-r bin)

m : 5.3

r : 11.11 km

ε_0 : 0.64 σ

Contribution : 6.13 %

Mode (largest m-r-ε_0 bin)

m : 9.34

r : 228.76 km

ε_0 : 1.17 σ

Contribution : 3.55 %

Discretization

r : min = 0.0, max = 1000.0, Δ = 20.0 km

m : min = 4.4, max = 9.4, Δ = 0.2

ε : min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0 : [-∞ .. -2.5)

ε1 : [-2.5 .. -2.0)

ε2 : [-2.0 .. -1.5)

ε3 : [-1.5 .. -1.0)

ε4 : [-1.0 .. -0.5)

ε5 : [-0.5 .. 0.0)

ε6 : [0.0 .. 0.5)

ε7 : [0.5 .. 1.0)

ε8 : [1.0 .. 1.5)

ε9 : [1.5 .. 2.0)

ε10 : [2.0 .. 2.5)

ε11 : [2.5 .. +∞]

Disaggregation Contributions

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
Compressional - WA,OR (fixed) (opt)	Grid							24.48
Compressional - No Puget (fixed) (opt)	Grid							24.48
Compressional - No Puget (adaptive) (opt)	Grid							16.66
Compressional - WA,OR (adaptive) (opt)	Grid							16.6
Cascadia (full, bottom)	Interface							7.76
Cascadia (full, bottom)		228.76	9.13	1.35	123.413°W	46.300°N	290.73	7.76
Cascadia (full, middle)	Interface							3.76
Cascadia (full, middle)		281.81	8.94	1.78	124.137°W	46.300°N	287.14	3.76
WA Intraslab	Slab							1.17

Application Metadata

Application: Disaggregation
URL: https://earthquake.usgs.gov/nshmp/hazard/disagg

Repository: nshmp-apps
Version: 2.0.1
URL: https://code.usgs.gov/ghsc/nshmp/nshmp-apps

Repository : nshmp-haz
Version: 2.4.11
URL: https://code.usgs.gov/ghsc/nshmp/nshmp-haz

Repository : nshmp-lib
Version: 1.4.22
URL: https://code.usgs.gov/ghsc/nshmp/nshmp-lib

Repository : nshmp-utils-java
Version: 0.4.0
URL: https://code.usgs.gov/ghsc/nshmp/nshmp-utils-java

Repository : nshm-conus
Version: 5.2.2
URL: https://code.usgs.gov/ghsc/nshmp/nshms/nshm-conus

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Attachment H-3.
Probabilistic Seismic Hazard Disaggregation – 2,475-Year Return Time

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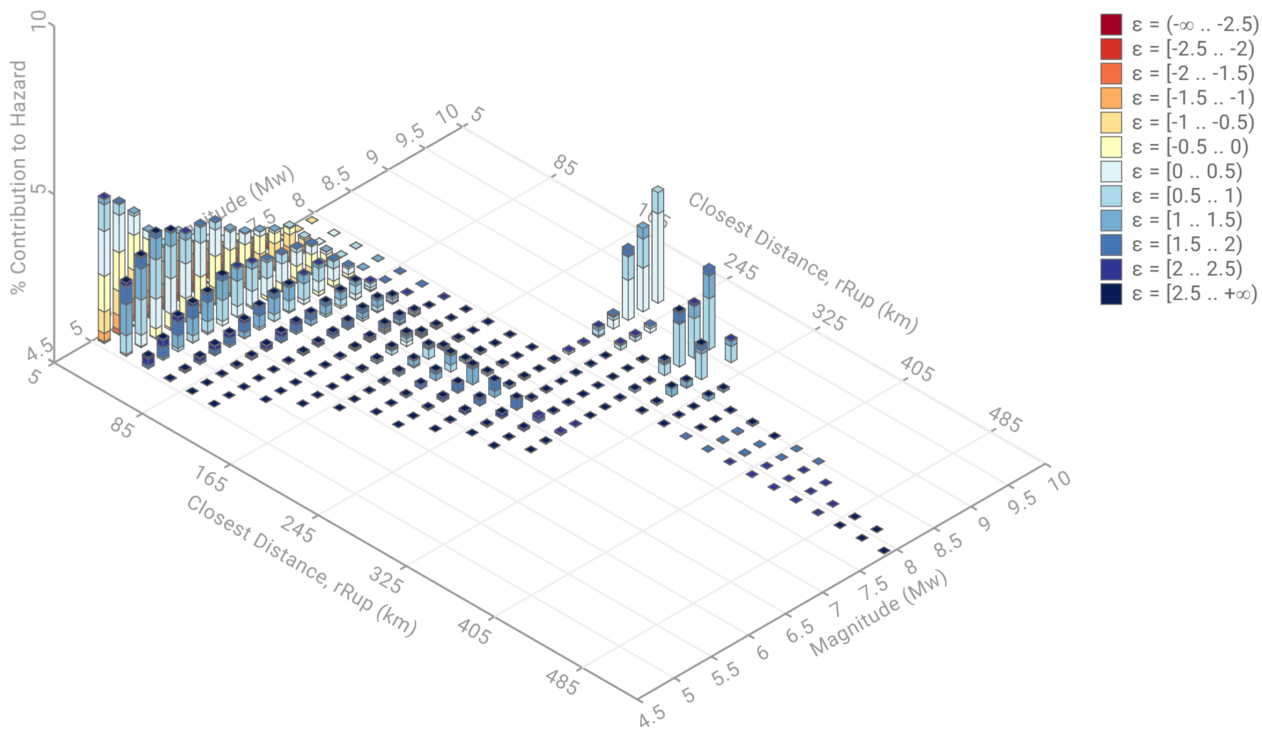
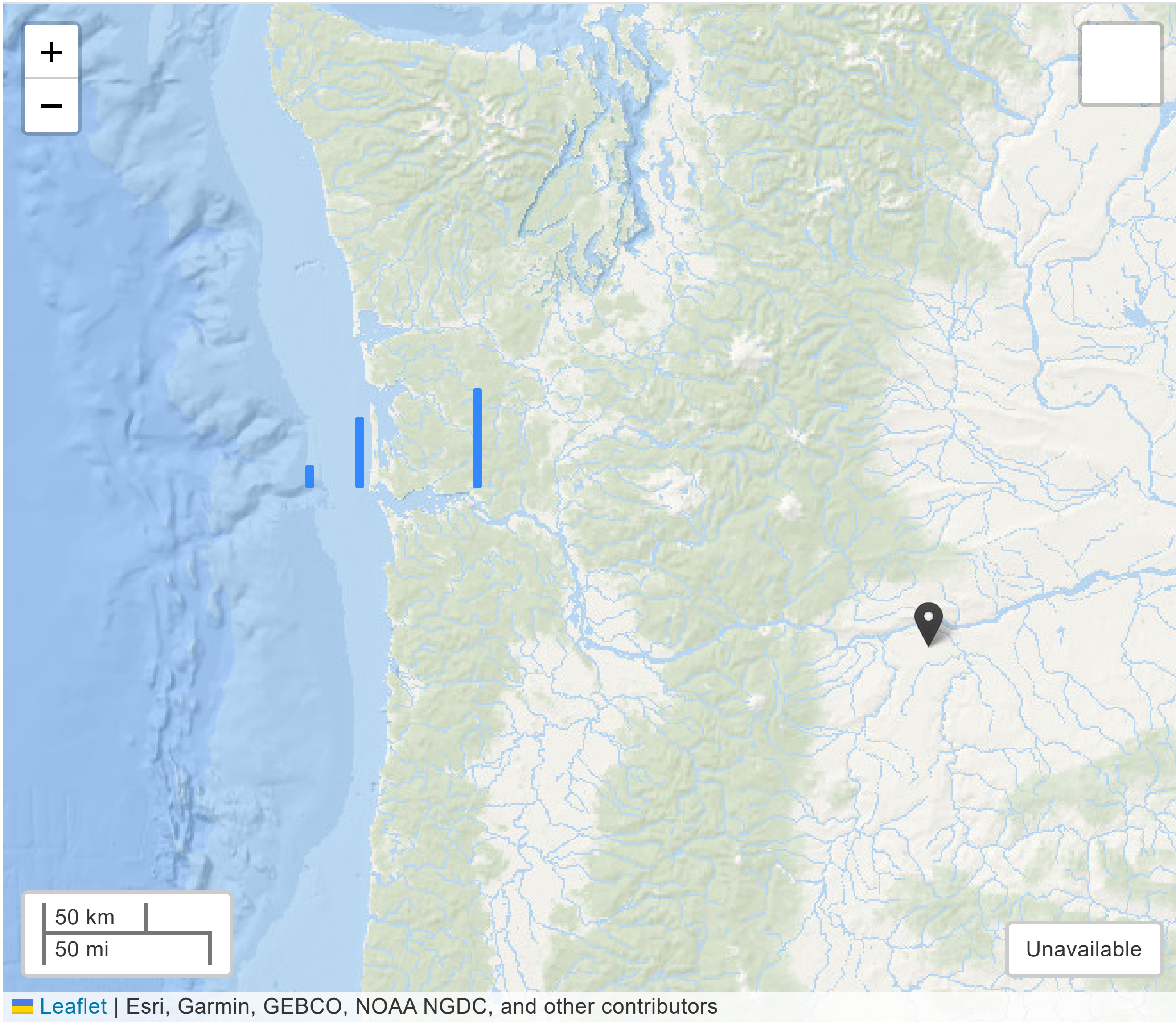
Disaggregation Report

Disaggregation



Geographical Disaggregation



Parameter Summary

Model: NSHM Conterminous U.S. 2018

Latitude: 45.6072°

Longitude: -120.6351°

Site Class: D (Vs30 260)

Intensity Measure Type: PGA

Return Period: 475 (10% in 50)

Component: Total

Disaggregation Summary

Disaggregation targets

Return period : 475 yrs

Exceedance rate : 2.105e-3 yr^{-1}

PGA ground motion : 1.137e-1 g

Recovered targets

Return period : 469.84671 yrs

Exceedance rate : 2.128e-3 yr^{-1}

Totals

Binned : 100 %

Residual : 0 %

Trace : 1.12 %

Mean (over all sources)

m : 6.69

r : 87.47 km

ε_0 : 0.35 σ

Mode (largest m-r bin)

m : 5.1

r : 12.16 km

ε_0 : 0 σ

Contribution : 4.28 %

Mode (largest m-r-ε_0 bin)

m : 9.34

r : 228.76 km

ε_0 : 0.12 σ

Contribution : 2.65 %

Discretization

r : min = 0.0, max = 1000.0, Δ = 20.0 km

m : min = 4.4, max = 9.4, Δ = 0.2

ε : min = -3.0, max = 3.0, Δ = 0.5 σ

Epsilon keys

ε0 : [-∞ .. -2.5)

ε1 : [-2.5 .. -2.0)

ε2 : [-2.0 .. -1.5)

ε3 : [-1.5 .. -1.0)

ε4 : [-1.0 .. -0.5)

ε5 : [-0.5 .. 0.0)

ε6 : [0.0 .. 0.5)

ε7 : [0.5 .. 1.0)

ε8 : [1.0 .. 1.5)

ε9 : [1.5 .. 2.0)

ε10 : [2.0 .. 2.5)

ε11 : [2.5 .. +∞]

Disaggregation Contributions

Source Set ↳ Source	Type	r	m	ε_0	lon	lat	az	%
Compressional - WA,OR (fixed) (opt)	Grid							22.12
Compressional - No Puget (fixed) (opt)	Grid							22.11
Compressional - No Puget (adaptive) (opt)	Grid							14.91
Compressional - WA,OR (adaptive) (opt)	Grid							14.85
Cascadia (full, bottom)	Interface							7.57
↳ Cascadia (full, bottom)		228.76	9.11	0.41	123.413°W	46.300°N	290.73	7.57
Cascadia (full, middle)	Interface							5.32
↳ Cascadia (full, middle)		281.81	8.92	0.88	124.137°W	46.300°N	287.14	5.32
WA Intraslab	Slab							3.87
Cascadia (full, top)	Interface							1.45
↳ Cascadia (full, top)		301.98	8.82	1.03	124.439°W	46.300°N	286.04	1.45
OR Intraslab	Slab							1.4

Application Metadata

Application: Disaggregation
URL: https://earthquake.usgs.gov/nshmp/hazard/disagg

Repository: nshmp-apps
Version: 2.0.1
URL: https://code.usgs.gov/ghsc/nshmp/nshmp-apps

Repository : nshmp-haz
Version: 2.4.11
URL: https://code.usgs.gov/ghsc/nshmp/nshmp-haz

Repository : nshmp-lib
Version: 1.4.22
URL: https://code.usgs.gov/ghsc/nshmp/nshmp-lib

Repository : nshmp-utils-java
Version: 0.4.0
URL: https://code.usgs.gov/ghsc/nshmp/nshmp-utils-java

Repository : nshm-conus
Version: 5.2.2
URL: https://code.usgs.gov/ghsc/nshmp/nshms/nshm-conus

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Attachment H-4.
Response Spectrum – Site Class D "Stiff Soil"

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REPORT SUMMARY

Site Information

Elevation:	1560 ft (NAVD 88)
Lat:	45.617747
Long:	-120.627927
Standard:	ASCE/SEI 7-22
Risk Category:	I
Soil Class:	D - Stiff Soil

Seismic Data

S_S	0.43
S_1	0.15
S_{MS}	0.6
S_{M1}	0.39
S_{DS}	0.4
S_{D1}	0.26
T_L	16
PGA_M	0.25
V_{S30}	260
Seismic Design Category	D
Note	Where values of the multi-period 5%-damped MCER response spectrum are not available from the USGS Seismic Design Geodatabase, the design response spectrum shall be permitted to be determined in accordance with Section 11.4.5.2

ASCE HAZARD TOOL

Measure Basemap Share

Location

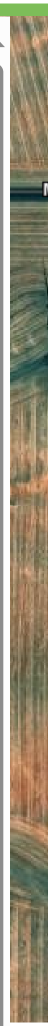
Elevation	1560 ft with respect to North American Vertical Datum of 1988 (NAVD 88)
Lat:	45.617747
Long:	-120.627927
Standard:	ASCE/SEI 7-22
Risk Category:	I
Soil Class:	D - Stiff Soil

Seismic Overlay

Risk Category I DETAILS

FULL REPORT SUMMARY

All data are per the requirements of published ASCE standards; local requirements may vary



Seismic Details

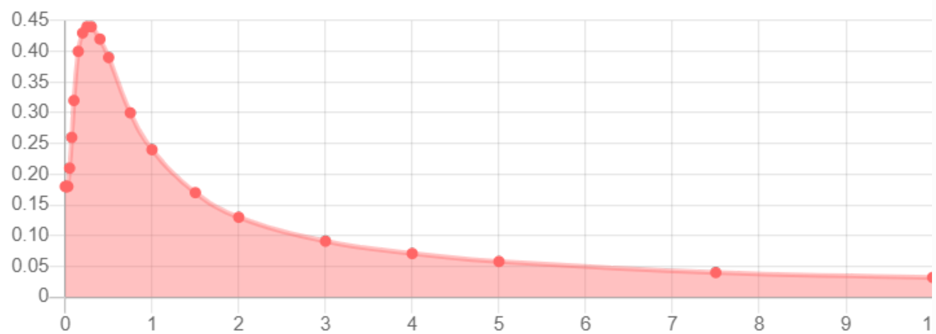
Risk Category I

S_S	0.43	S_1	0.15	S_{MS}	0.6	S_{M1}	0.39
S_{DS}	0.4	S_{D1}	0.26	T_L	16	PGA_M	0.25
V_{S30}	260						

Seismic Design Category D

Multi-Period Design Spectrum

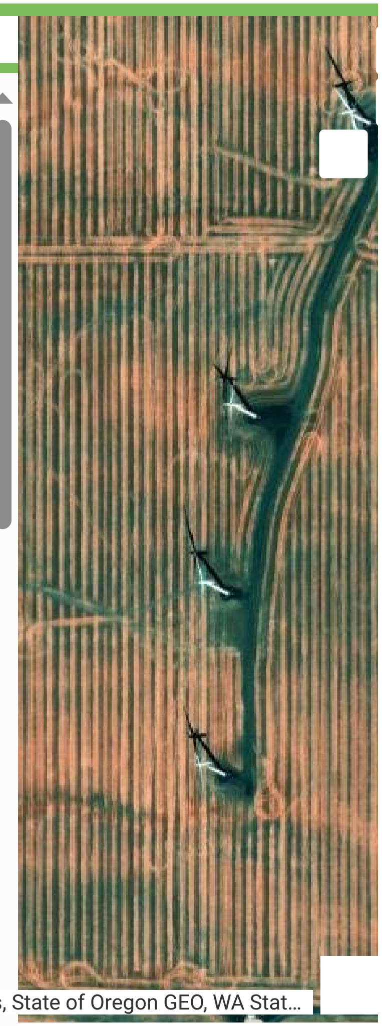
GRAPH TABLE CSV



Multi-Period MCE_R Spectrum

GRAPH TABLE CSV

Maxar | Esri Community Maps Contributors, Oregon State Parks, State of Oregon GEO, WA Stat...



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Select data to display