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To: GordonDerr LLP

2025 First Avenue, Suite 500
Seattle, WA 98121

From: Nichole Seidell
CH2M HILL
2020 SW 4th Avenue
Suite 300
Portland, OR 97201

Attn: Anna M. Nelson

Date: June 2, 2010

Re: Teanaway Solar Reserve Submittal

We Are Sending You:

Method of shipment: FedEx

X Attached

Under separate cover via

Shop Drawings	<u>Documents</u>	Tracings
Prints	Specifications	Catalogs
Copy of letter	Other:	

Quantity	Description
1	Bound document containing the following: 2009 Aerials SEPA Site Section Maps Electric and Magnetic Fields (EMF) Analysis for the Teanaway Solar Reserve Project Memo Updated Teanaway Solar Reserve Hydrologic Analysis Report TSR Substation Location Memo Updated Site Plan

If the material received is not as listed, please notify us at once.

Remarks:

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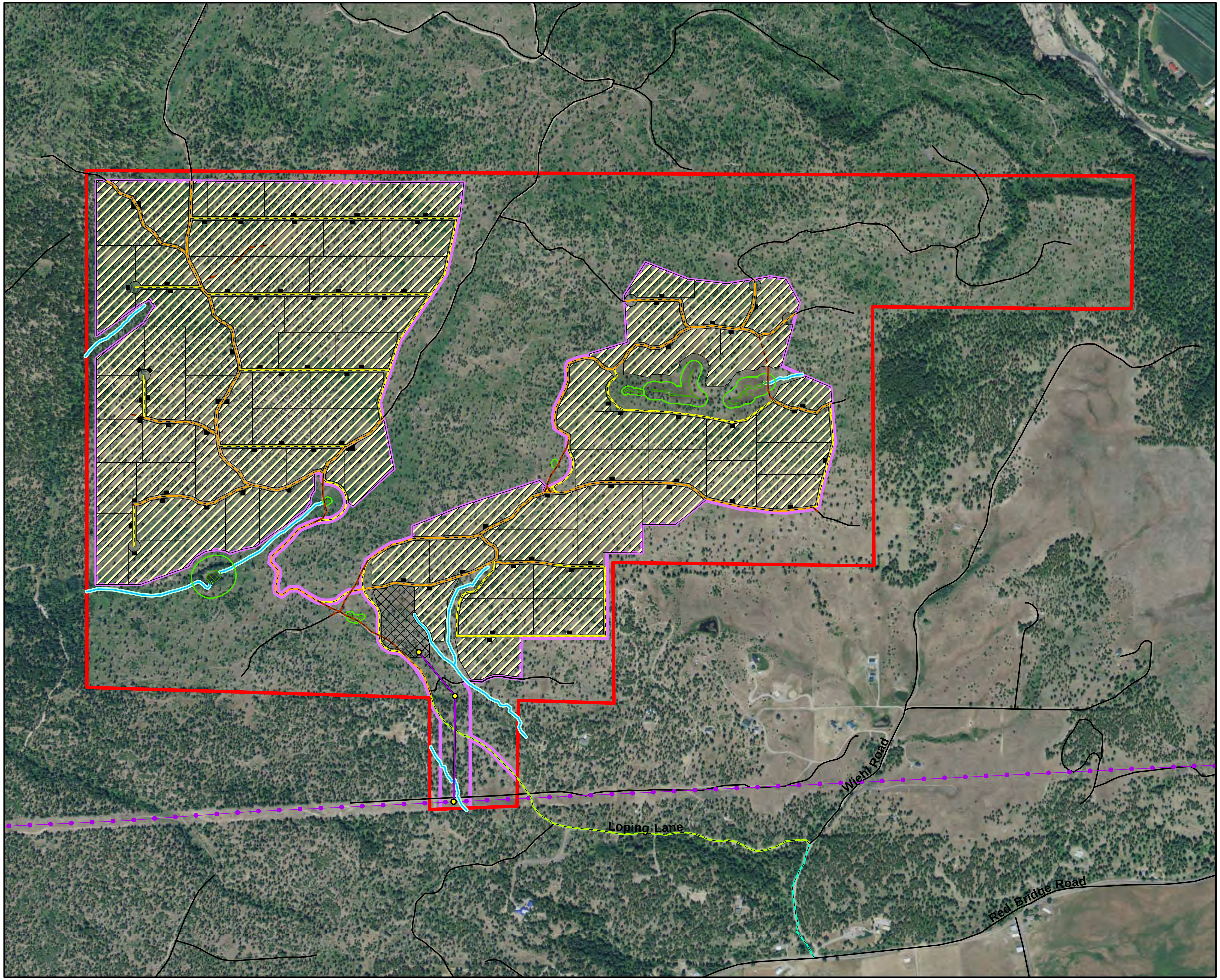
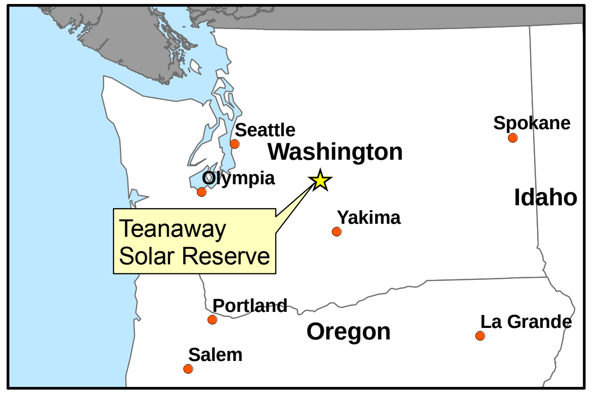


VICINITY MAP



LEGEND

Proposed Project Features

- Proposed Project Area (982 Acres)
- Proposed Project Site (477 acres)
- Proposed PV Array Block
- Proposed Field Inverter and Field Transformer
- Proposed Substation/O&M Facility
- Proposed Transmission Line[1]
- Proposed Transmission Structure
- Proposed Maintenance Road
- Proposed Improved Maintenance Road
- Existing Maintenance Road (Planned Decommissioning)
- Proposed Improved County Access Road
- Proposed Improved Private Access Road

Existing Features

- Existing BPA Transmission Line and ROW
- Existing Road
- Stream
- Stream Buffer
- Wetland
- Wetland Buffer

Note:
1. TSR has delineated a 300' area within which the BPA transmission line could be sited. Of this 300' area, a maximum of 200' will be cleared for the placement of the BPA transmission line. Final design and placement to be determined by BPA.

N

0 1,000
Feet

1 inch = 1,000 feet

Proposed Site Layout

Teanaway Solar Reserve
Kittitas County, Washington

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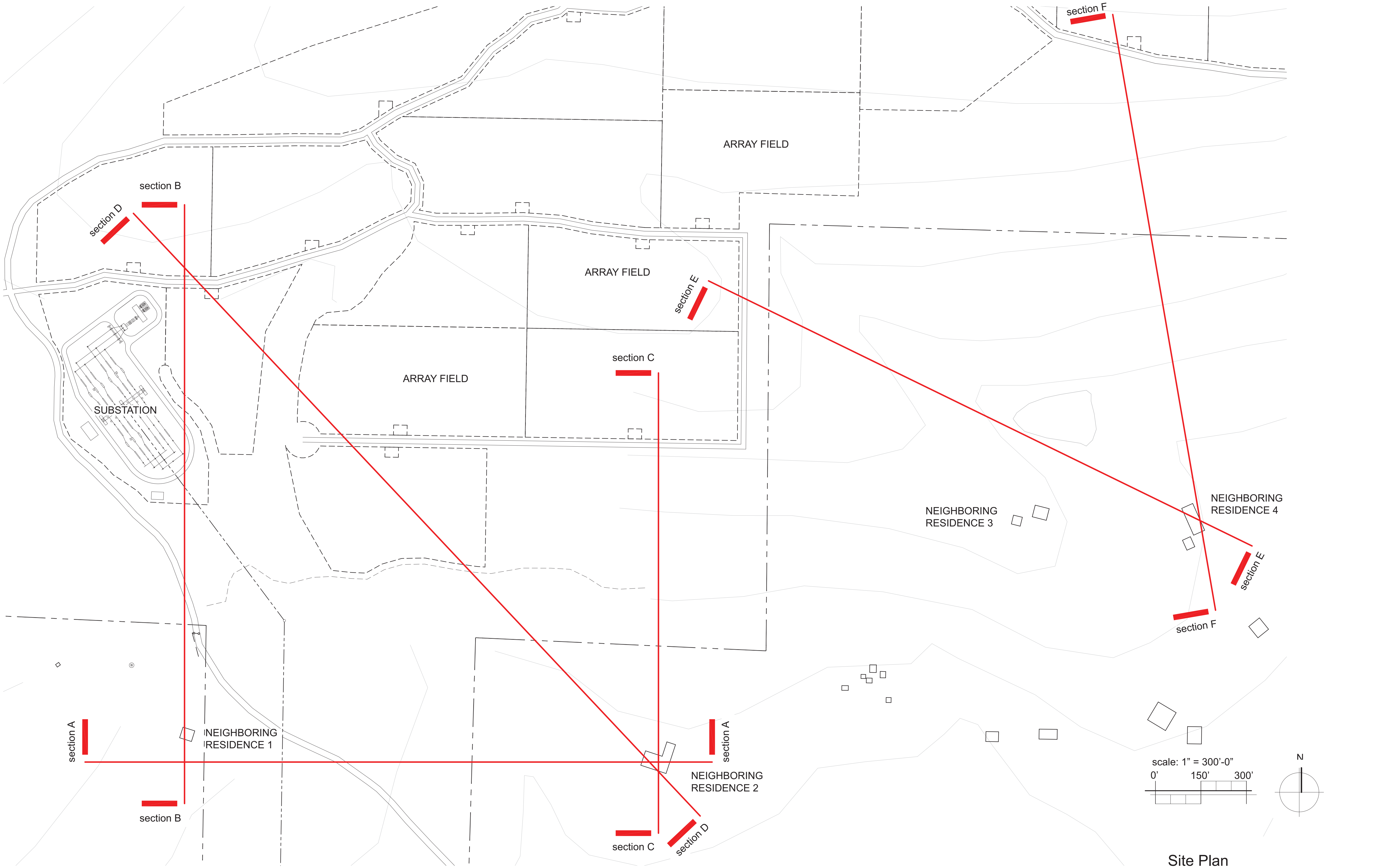
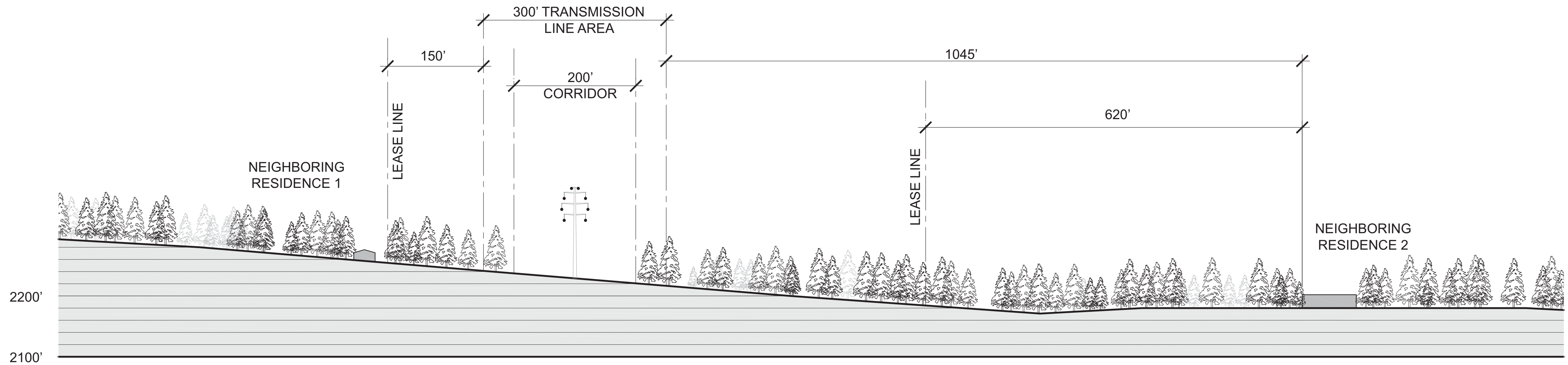
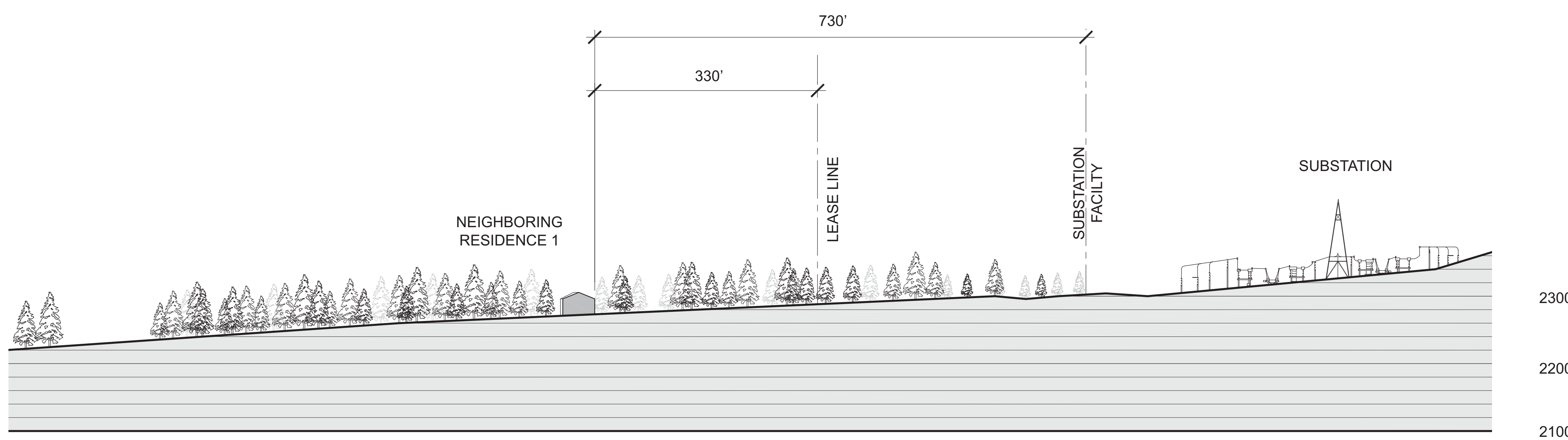


Site Plan
Teanaway Solar Reserve
Kittitas County, Washington



SECTION A



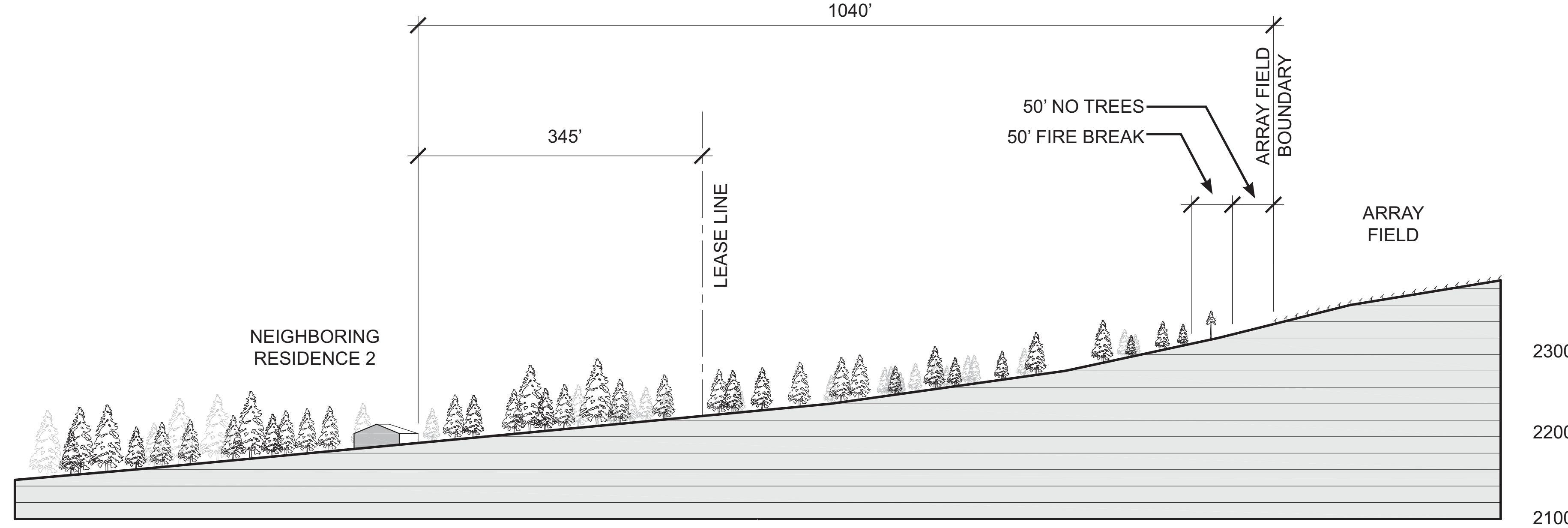
SECTION B

scale: 1" = 200'-0"
0' 100' 200'

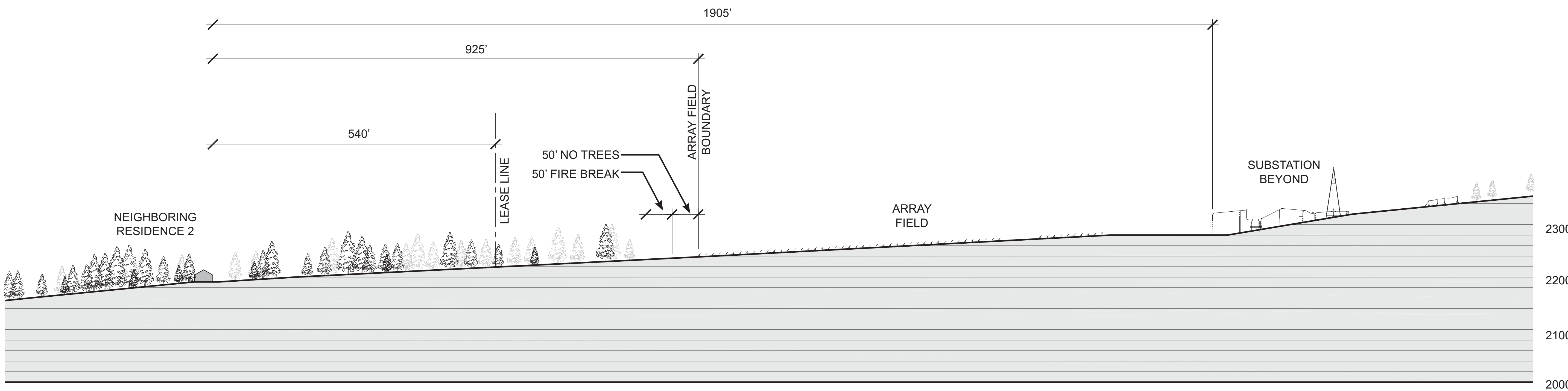
NOTE:
The location of the proposed improvements and the distances between existing and proposed improvements presented in the site section are approximations based upon the current proposal and are for illustrative purposes only. Actual location of the array fields, substation, and transmission line may differ from this depiction. Actual location is dependant upon final approval, site conditions, and design requirements among other things.

Site Sections A-B

Teanaway Solar Reserve
Kittitas County, Washington



SECTION C

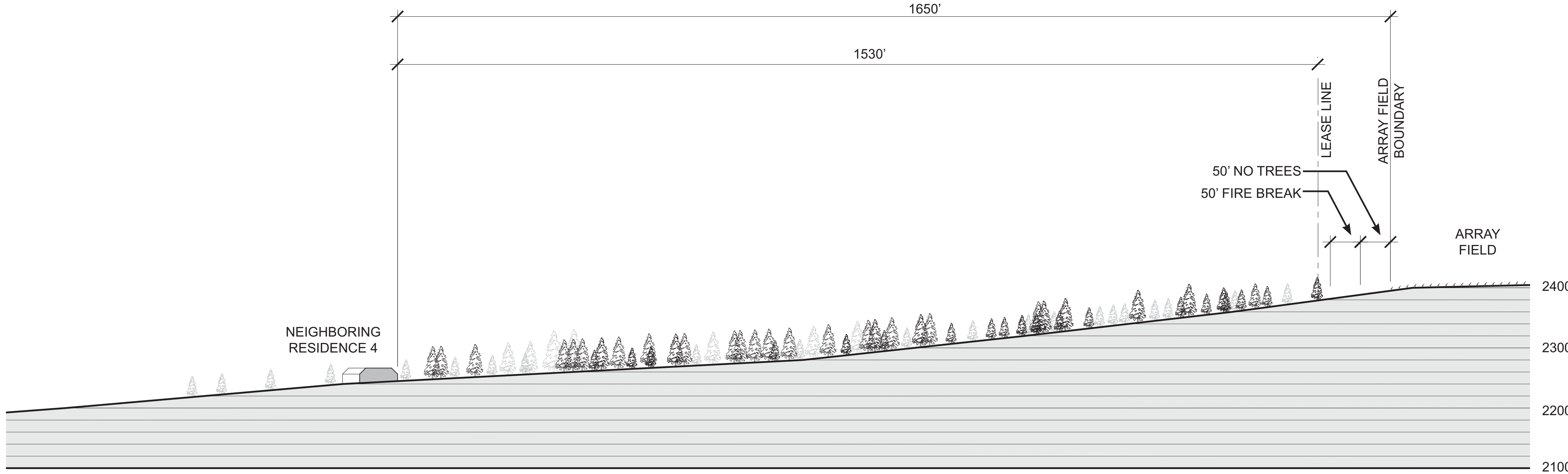


SECTION D

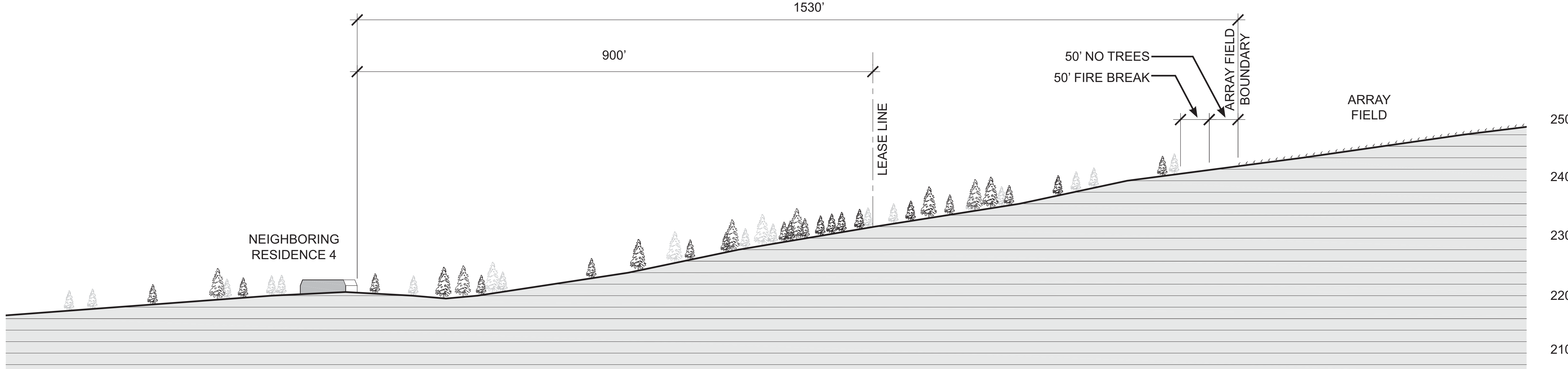
scale: 1" = 200'-0"
0' 100' 200'

NOTE:
The location of the proposed improvements and the distances between existing and proposed improvements presented in the site section are approximations based upon the current proposal and are for illustrative purposes only. Actual location of the array fields, substation, and transmission line may differ from this depiction. Actual location is dependant upon final approval, site conditions, and design requirements among other things.

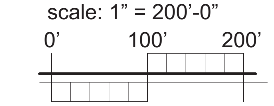
Site Sections C-D
Teanaway Solar Reserve
Kittitas County, Washington



SECTION E



SECTION F



NOTE:
The location of the proposed improvements and the distances between existing and proposed improvements presented in the site section are approximations based upon the current proposal and are for illustrative purposes only. Actual location of the array fields, substation, and transmission line may differ from this depiction. Actual location is dependant upon final approval, site conditions, and design requirements among other things.

Site Sections E-F

Teanaway Solar Reserve

Kittitas County, Washington

Electric and Magnetic Fields (EMF) Analysis for the Teanaway Solar Reserve Project

PREPARED FOR: Dan Valoff, Kittitas County

PREPARED BY: CH2M HILL

DATE: June 2, 2010

Introduction

The purpose of this technical memorandum is to address potential health and safety issues related to electrical effects from the proposed Teanaway Solar Reserve (TSR) Project (Project). The TSR proposes to construct and operate the Project on approximately 982 acres of private land within the Forest and Range (F&R) zoning district in an unincorporated area of Kittitas County, Washington. The Project will generate up to 75 direct current megawatts (MWdc) of photovoltaic (PV) solar energy utilizing approximately 477 acres of land within the proposed Project area. This memorandum describes the electric and magnetic fields (EMFs) that can be produced by proposed Project's electric components and the impact those EMFs can have on public health and safety.

Project Background

The Project was conceived in response to the growing importance of and need for sustainable energy sources. In 2001, Kittitas County recognized the importance of facilitating new alternative energy facilities, as proclaimed in Kittitas County Ordinance No. 2001-12). The County amended its land use code to, among other things, allow alternative energy facilities as conditional uses in a number of zones (Kittitas County Code Chapter 17.61).

The State of Washington also recognizes the importance of locally produced renewable energy. For example, the State of Washington's Renewable Electricity Standard, Revised Code of Washington (RCW) Title 19, mandates that by the year 2020, the state's largest electric utilities meet 15 percent of their retail electric load with renewable electricity (for example, wind and solar energy). The standard first takes effect in 2012 with a requirement of 3 percent through 2015, then 9 percent from 2016 through 2019, and 15 percent thereafter.

The proposed Project site is located approximately 4 miles northeast of Cle Elum, Washington, in Township 20N, Range 16E, within Sections 22, 23, and 27 (Figure 1 for the site location). The site is located on the eastern slopes of the Cascade Mountains on Cle Elum Ridge, which runs generally from east to west at elevations ranging from approximately 2,200 to 2,600 feet. The Teanaway River is approximately 1 mile to the northeast of Cle Elum Ridge. The site is accessed from Highway 970 by way of County roads such as Red Bridge Road, and private roads such as Loping Lane. The site is also

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accessed via Wiehl Road, which is a dedicated public road but is not maintained by the County; it is maintained privately.

Description of Electric and Magnetic Fields

EMFs are found around any electrical wiring, including household wiring and electrical appliances and equipment. Electric fields are measured in units of volts per meter (V/m) or kilovolts per meter (thousands of volts per meter, kV/m). Throughout a home, the electric field strength from wiring and appliances is typically less than 0.01 kV/m. Magnetic fields are measured in units of gauss (G) or milligauss (thousandths of a gauss, mG). Typical household magnetic field levels range from less than 1 mG to above 200 mG near certain appliances. According to a study by Electric Power Research Institute (EPRI), the magnetic field in an average home, away from appliances, is approximately 1 mG (NIESH/NIH, 2002).

EMFs are produced when electricity flows through a conducting material or is used by an electrical device or appliance. In particular, electric fields are a result of the force (voltage) that drives the electrical current and magnetic fields are the result of electrons moving (current) through a conductor or electrical device. Voltage, the force that drives the current, is the source of the electric field. Current, the flow of electric charge in a wire, produces the magnetic field. The strength of EMFs depends on the design of the transmission line and on the distance from the transmission line. Field strength decreases rapidly with distance.

Proposed Electrical Facilities

The electrical facilities for the proposed Project consist of three major components:

- The solar modules would produce electric power at approximately 29 volts (V)
- The collection system that would operate at 34.5 kilovolts (kV, thousand volts)
- The interconnecting transmission system that would operate at 345 kV

The transmission system that receives the power would determine the voltage of the interconnecting transmission line. Transformers, protection equipment, and control equipment would be located in a fenced substation. The power would enter the substation on the 34.5-kV collection lines, be increased to the transmission voltage by the transformers, and flow out of the substation on the overhead interconnection transmission line.

Key electrical components are described in the following subsections.

Solar Modules

Solar modules in a metal frame on supporting mounting structures will be used for the proposed Project. Approximately 399 acres of modules will be installed within the 982-acre proposed Project area. The solar modules are manufactured offsite and will be delivered to the site by truck in wooden crates or cardboard boxes. Typical modules measure approximately 65 inches by 38 inches (5.4 feet by 3.2 feet). Modules are rated at approximately 216 watts (in the case of Sharp Electronics 2009, for example) and are

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mounted so that they are at least 4 feet above the ground surface. The solar modules for the project would be mounted in a fashion that orients the modules toward the sun.

The modules will be arranged in 1-MW fields and up to 75 fields will be installed at the Project site.

Field Inverters and Transformers

Up to 80 field inverters will be needed for the Project. The inverters will be placed outdoors in enclosures to attenuate noise and protect the equipment from the elements.

Up to 80 field transformers will be required for the solar field arrays. The field transformers are approximately 8 feet by 6 feet and 8 feet in height. They may be contained within prefabricated cabinets that will rest on concrete pads.

Electrical Conductors

Underground 34.5-kV electrical conductors will connect the solar array field transformers and the proposed Bonneville Power Administration (BPA) substation transformers. These will be installed in trenches along improved maintenance roads onsite at depths of 36 inches or greater (Kittitas County Code Chapter 12.24.040). Conductors will be direct burial or in a polyvinyl chloride (PVC) conduit.

Electrical conductors from the array field to the field inverters will be supported aboveground within the solar module framework and installed per National Electrical Code (NEC) standards.

Electrical Substation and Switchyard

TSR proposes to construct, in compliance with design and installation requirements from BPA, an electrical substation that will interconnect the solar field with the existing 345-kV BPA transmission line. It has yet to be determined if certain elements of the line and substation will be owned and constructed by BPA, but for the purposes of this memorandum, all elements of the line and the substation (up to the point of interconnection with BPA's existing transmission line) are proposed as part of the Project. The substation will be located in the southern part of the Project site, to minimize the size of the associated transmission line. The substation will require a level, fenced area of approximately 6 acres. The 6-acre area will be graveled with no vegetation. The substation will contain a small control house, transformer(s), circuit breakers and switches, steel support structures, a dead-end tower structure, and overhead electrical bus work. The control house will be up to 16 feet high, 60 feet long, and 30 feet wide. The dead-end tower structure will be up to 120 feet high. Transformers and oil-filled equipment will be underlain with appropriate containment structures. The appearance of the substation will be similar to that of many other substations throughout the Pacific Northwest.

Overhead Interconnection Transmission Line

A new 345-kV transmission line is required to connect the new substation to the existing BPA line and up to 200 feet of clearance will be needed for the proposed overhead line. Similar to the substation, it has yet to be determined if certain elements of the transmission line will be owned and constructed by BPA, but for the purposes of this memorandum, all

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elements of the line and the substation (up to the point of interconnection with BPA's existing transmission line) are proposed as part of the Project. TSR cannot specify the exact placement of the overhead line and the transmission structures at this time. TSR has delineated a 300-foot area within which the BPA transmission line could be sited. Of this 300-foot area, a maximum of 200 feet will be cleared for the transmission line. In April 2006, the North American Electric Reliability Corporation (NERC) issued mandatory standards that govern the height of vegetation growing near certain high-voltage power lines. NERC is in charge of improving the reliability and management standards for electric transmission lines. NERC has authority over eight regional entities in North America, known as regional reliability organizations, which include all segments of the electric industry: investor-owned utilities; federal power agencies; rural electric cooperatives; state, municipal and provincial utilities; independent power producers; power marketers; and end-use customers. The regional entity that has jurisdiction over Washington State is the Western Electric Coordinating Council (WECC) (Puget Sound Energy Fact Sheet 2007).

Along with the regional reliability organizations, NERC has the legal authority to enforce compliance with NERC reliability standards. NERC achieves compliance through a rigorous program of monitoring, audits and investigations, and the imposition of financial penalties and other enforcement actions for non-compliance (Puget Sound Energy Fact Sheet 2007).

New NERC vegetation standards, effective June 2007, require utilities to actively manage vegetation in all transmission line corridors that operate at more than 200 kV. Vegetation that matures at a height of more than 15 feet must be removed from the areas underneath and beside transmission rights-of-way. These areas are known as the wire and border zones (Puget Sound Energy Fact Sheet 2007). Per the BPA *Business Plan Environmental Impact Statement* (BPEIS, DOE and BPA 1995), typical right-of-way widths for 230-kV transmission lines are 105 to 115 feet on either side of the line, for a total of 210 to 230 feet. Typical right-of-way widths for 500-kV transmission lines are 120 to 170 feet on either side of the line, for a total of 240 to 340 feet (DOE and BPA 1995). Typical right-of-way widths for 345-kV lines are not outlined in the BPEIS.

A new BPA structure will be required to replace the existing lattice tower located within the BPA easement. The BPA replacement tower would reroute the three existing 345-kV power lines via an existing 200–foot-wide right-of-way within the leasehold through the substation and back to the replacement BPA tower. Two additional grounding lines may be required by BPA to bring the total number of power lines between the replacement tower and substation to eight. In addition to the replacement structure, two new transmission structures will be required to support the new transmission lines between the replacement BPA tower and the substation. New transmission structures, which will be steel monopole structures, are indicated on the site plan.

Impact Analysis

This section analysis describes public health and safety concerns such as electrical shocks, the effects of EMF, and electromagnetic interference related to solar panels and the electrical facilities.

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As with all facilities involving electricity, there are safety concerns regarding potential harm to humans. Direct contact with transmission lines or any electrical line can kill or seriously injure people. Furthermore, electric fields near high-voltage transmission lines can cause perceivable nuisance shocks. Large, metal structures such as solar panels and transmission towers can cause interference with reception of broadcast television and radio signals.

Accurate estimates of the expected EMFs from transmission and distribution lines require detailed electrical and physical information. Such information is not yet available for the collector system and interconnection line of the proposed Project. Therefore, estimates of fields and impacts are based on fields from existing lines at similar voltage levels.

Solar fields, like all electric devices and equipment, emit EMF. EMF would be associated with the Project's solar panels, transformers, the underground collection system, the substations, and the overhead 345-kV transmission lines. Although there have been numerous studies on the potential health effects from EMF, the studies remain inconclusive, showing no or weak associations with effects on health.

Under transmission lines, such as the existing transmission lines on the Project site, the magnetic field varies as the current on the line varies. Under the existing 345-kV lines maximum magnetic fields can exceed 200 mG at maximum current. The predicted field levels are only indicators of how the proposed Project might affect the magnetic-field environment. They are not measures of risk or impacts on health.

Under 345-kV transmission lines, such as the existing transmission lines on the Project site, the electric fields can exceed 5 kV/m. Under low-voltage distribution lines, the fields are much lower.

Impact levels are dependent on public and occupational use of the land. The potential for public health and safety impacts increases in areas where human activities take place.

- A high impact would occur if the Project-related EMF concerns precluded the use of the area for pre-existing activities.
- A moderate impact would occur if the Project altered pre-existing activities.
- A low impact would occur if the Project would not produce a change in activities.

Potential Impacts during Operation and Maintenance

Electric and Magnetic Fields

Possible effects associated with the interaction of EMFs from transmission lines (or similar electrical sources) with people on and near overhead lines fall into two categories:

- Short-term acute effects that can be perceived and may represent a nuisance
- Possible long-term chronic health effects.

Short-term effects and the levels of EMFs near the proposed transmission lines are discussed below. In addition, the U.S. Department of Energy provides a booklet on this topic (Questions and Answers about EMF, published in 1995).

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The issue of whether there are long-term health effects associated with exposure to fields from transmission lines and other sources has been investigated for several decades. There is little evidence that electric fields cause long-term health effects. Estimates of magnetic-field exposures have been associated with certain health effects in studies of residential and occupational populations. Research in this area is continuing to determine whether such associations might reflect a causal relationship.

National and international organizations have established public and occupational EMF exposure guidelines (IEEE 2002) on the basis of short-term stimulation effects, rather than long-term health effects. In so doing, these organizations did not find data sufficient to justify the setting of a standard to restrict long-term exposures to EMFs.

EMFs associated with the Project would be comparable to those already present on the site due to the existing transmission line. The power collection lines connecting major areas of the Project with the substation would be located underground and away from residences within existing rights-of-way. Similarly, the overhead line used to connect the Project substation with an existing transmission line operated by BPA would not be located closer than 250 feet from residences or human activity areas. Incremental changes in exposures to EMFs would be small to non-existent for the public. Therefore, impacts associated with EMFs on possible long-term health effects are highly unlikely.

Short-Term Effects, Electric Fields

Electric fields from high-voltage transmission lines can cause nuisance shocks when a grounded person touches an ungrounded object under a line, such as a barbed wire fence, or when an ungrounded person touches a grounded object. These effects are generally associated with lines operating at voltages of 345-kV or higher. If the transmission line voltage is 230 kV, there is a possibility for perception of nuisance shocks; at 115 kV, the potential for nuisance shocks would be minimal. Grounding fences and other metal structures within the right-of-way would limit the potential for nuisance shocks, especially if the line operated at the higher voltage. Since the line would be remote from residences and other human activity it is highly unlikely that the above-mentioned effects would impact residents.

The electric fields from 34.5-kV overhead connector lines (if any sections of overhead line are needed, based on site-specific constraints) would be similar to those from existing distribution lines on the site. These fields are too low to have an impact. As discussed above, the principal safety concern for the distribution lines and the collector lines is inadvertent contact with the lines. The underground collector facilities and the 575-V DC cables from the solar panels would not produce electric fields.

Short-term Effects, Magnetic Fields

Magnetic fields from transmission lines can induce currents and voltages on long conducting objects parallel to the lines. These voltages can also serve as a source of nuisance shocks. However, the effects are well understood and can be mitigated by grounding and other measures. The interconnection line for the Project, which would have a maximum length of approximately 1,500 feet, would be too short for such effects to occur.

Magnetic fields from transmission lines (and other sources) can distort the image on computer monitors. The threshold for interference depends on the type and size of monitor.

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Historically, this phenomenon is reported at magnetic-field levels at or above 10 mG, but some more sensitive monitors may exhibit image distortion at lower levels. For 115- and 230-kV transmission lines, interference from magnetic fields is generally not a problem except very close to the right-of-way. The proposed interconnection would be located well away from residences on existing rights-of-way and this type of interference is not anticipated. Magnetic fields from the 34.5-kV collection system are anticipated to be lower than those from the transmission line, and of insufficient magnitude to interfere with monitors.

Audible Noise and Radio and Television Interference

A 345-kV transmission line operating at the elevation of about 2,000 feet will produce audible noise and possible interference to radio and television signals through corona discharge from the transmission conductors. Under transmission lines, such as the existing lines on the Project site, audible noise can exceed 50 acoustic decibels (dBA) in wet weather. During wet or foul weather conditions, the conductor will produce the greatest amount of corona noise due to the increased number of raindrops, fog, and condensation accumulated on the conductor surface. However, during heavy rain, the noise generated by the falling rain drops hitting the ground will typically be greater than the noise generated by corona and, thus, will mask the audible noise from the transmission line. Corona-generated radio interference is most likely to affect the amplitude modulation (AM) radio broadcast band (535 to 1,605 kilohertz); frequency modulation (FM) radio is rarely affected. Only AM receivers located very near to transmission lines that are tuned to a weak station have the potential to be affected by radio interference. Moderate corona-generated television interference may occur during wet weather at the edge of the right-of-way. The amount of time this may happen will depend on the strength of the television signal at the receiving location, the sensitivity of the digital tuner for the television set, the quality of the television antenna and the amount of time that wet weather occurs in the area. Televisions located more than 200 feet from the right-of-way should not be affected. Televisions receiving signals from a satellite dish will not be affected.

Representative Projects

Numerous EMF analyses have been conducted for wind projects with 34.5-kV collection systems and overhead transmission lines connecting the wind projects to existing electric grids. For overhead 34.5-kV collection systems, the maximum electric field (located under the line) has been estimated at 0.3 kV/m, depending on the structure type and circuitry, and the maximum magnetic field (located under the line) has been estimated at 136 mG, depending on the structure type, circuitry, and current. For the overhead transmission lines, the voltage is typically 230-kV; therefore, the maximum electric field (located under the line) has been estimated at 1.5 kV/m, depending on the structure type and circuitry, and the maximum magnetic field (located under the line) has been estimated at 200 mG, depending on the structure type, circuitry, and current.

Conclusions

Impacts associated with EMFs on possible long-term health effects are highly unlikely. EMFs associated with the Project would be comparable to those already present on the site

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due to the existing transmission line. The power collection lines connecting major areas of the Project with the substation would be located underground and away from residences within existing rights-of-way. Similarly, the overhead line used to connect the Project substation with an existing transmission line operated by BPA would not be located closer than 250 feet from residences or human activity areas. Incremental changes in exposures to EMFs would be small to non-existent for the public.

Short-term EMF impacts to residents are highly unlikely. The potential for nuisance shocks produced by electric fields from the overhead lines would be limited by grounding fences and other metal structures within the right-of-way. The underground collector facilities and the 575-V DC cables from the solar panels would not produce electric fields. Magnetic fields can cause induced currents and voltages on long conducting objects parallel to the lines; however the interconnection line for the Project would be too short for such effects to occur. Monitor interference from magnetic fields is not anticipated. There is a moderate potential for corona-generated audible noise, radio and television interference, however only during wet or foul weather in particular and in close proximity to the lines.

The proposed interconnection would be located well away from residences on existing rights-of-way and this type of interference is not anticipated.

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Report

Teanaway Solar Reserve Hydrologic Analysis Kittitas County, Washington

Prepared for

Teanaway Solar Reserve, LLC

June 2010

Prepared by

CH2MHILL

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Contents

Figures (*Provided in Appendix A*)

1.0 Introduction

At the request of Teanaway Solar Reserve, LLC (TSR) a hydrologic analysis for the proposed project site has been completed and is described in this memorandum. Background information was collected on the existing site conditions and used to create a pre-development model using the U.S. Army Corps of Engineers HEC-HMS 3.1.0 software. A model was also created to simulate the proposed site conditions. The models were then used to determine pre- and post-development peak rainfall runoff rates and volumes for 2-, 10-, and 100-year 3-hour storm events and 10-, 25-, and 100-year, 24-hour storm events. The pre- and post-development runoff rates were then compared to determine the hydrologic impact of the development.

Using the Center for Watershed Protection's methodology presented in the Stormwater Management Manual for Eastern Washington in Section 4.2.7: Rain-on-Snow and Snowmelt Design, an analysis was also completed to determine the pre- and post-development rain-on-snow volumes.

2.0 Background

The proposed 982-acre project site is located approximately 4 miles northeast of Cle Elum, Washington, in Township 20N, Range 16E, within Sections 22, 23, and 27 (see Figure 1 in Appendix A for the site location). This site is located on the eastern slopes of the Cascade Mountains on Cle Elum Ridge, which runs generally east to west at elevations ranging from approximately 2,200 to 2,600 feet. The Teanaway River is approximately 1 mile to the northeast of Cle Elum Ridge. The site is accessed from Highway 970 by way of county roads such as Red Bridge Road, private roads such as Loping Lane, and Wiehl Road, which is a dedicated public road that is maintained privately and not by the county. A description of the existing conditions is provided below.

2.1 Watersheds

Rainfall runoff from the proposed project site flows down the ridge through unnamed streams and eventually discharges to the Teanaway River. The Teanaway River is located in the Yakima River Basin and flows to the Yakima River. At its confluence with the Yakima River, the Teanaway River has a drainage area of 207 square miles. The peak 100-year flow as listed in the Flood Insurance Study (FIS) produced by the Federal Emergency Management Agency (FEMA) in 1981 is 7,350 cubic feet per second (cfs) at its confluence with the Yakima River.

Flood Insurance Rate Maps (FIRMs) from FEMA were used to determine the areas of special flood hazard near the proposed project site. The most recent available mapping comes from the 1981 FIS (map numbers 5300950254B, 5300950258B, 5300950262B, and 5300950266B). The data provided by the FIRMs only show the extent of the 100-year floodplain of the Teanaway River. The Teanaway River floodplain is located just downstream of the proposed site. See Figure 2 in Appendix A for a map of the 100-year floodplain in the vicinity of the project.

2.1.1 January 2009 Flooding Event

A major rain-on-snow flood event occurred in January 2009 downstream of the proposed project site when heavy rain in the mountains and unseasonably warm temperatures turned the deep snow pack into flood waters. The flooding caused landslides and affected several landowners at the base of the ridge in the Teanaway River Valley. A letter written by GeoEngineers, Inc. on October 5, 2009, suggests that the cause of this flood event is most likely the result of anthropogenic activity down gradient from the project site rather than hydrologic issues on the proposed project site itself (see Appendix B).

Drainages from the project site have been characterized as ephemeral, vegetated swales. A field reconnaissance completed by a professional hydrologist from GeoEngineers after the flooding event showed the drainages that emanate from the project site were in stable condition. No excessive erosion, lateral shifting, or incision was evident in the drainages around the project site. This confirms that the drainages from the project site are hydraulically stable and capable of handling runoff from significant flooding events. The vegetation in the drainages helps reduce the velocity and erosional forces of the water as it runs off hill slopes and flows into concentrated areas.

Moreover, interviews with local residents were also conducted as a part of the field reconnaissance. One resident, a Mr. Jesse Geiger, told GeoEngineers personnel that another area resident had used excavating equipment to trench into and disturb the streambed of an unnamed small drainage in an effort to reroute flows into irrigation pipes and ultimately into an existing delivery system. According to Mr. Geiger, the channel was never armored or re-vegetated after the soil disturbance and channel realignment. As a result, high flows in January 2009 destabilized the unprotected channel and breached the weak soil dam that had been erected adjacent to Red Bridge Road. Notably, the condition of the channel upstream of the disturbed area was not subject to erosion or damage; rather, only the disturbed reach was destabilized, causing a debris torrent to spill into the road and the subsequent flooding and damage to the road. Field observations of the drainage correlate with the description of events recounted by area residents, as evidenced by comparing the condition of this drainage to the drainage adjacent to Wiehl Road.

2.2 Site-Specific Drainage Basins

There are two major drainage basins on the proposed project site. These drainage basins are referred to as the South drainage basin and the North drainage basin for the purposes of this report. Figure 3 in Appendix A is a map showing the location of the drainage basins on the proposed project site. Multiple drainage paths leave the site. Flow rates are comparative, but do not provide detail of flow distribution by sub-basin. Drainage basins were delineated for this analysis to assess the impact the project is expected to have on major receiving waters. A more detailed analysis of the small, natural drainage basins on the site will be completed during the design phase of the project.

The South drainage basin has an area of 723 acres and covers a majority of the proposed site. Rainfall runoff from this drainage basin generally flows south to the base of the ridge, where it then flows east along the north side of Red Bridge Road eventually discharging to the Teanaway River.

The North drainage basin has an area of 259 acres and is located in the northeast corner of the proposed project site with a few small areas along the northern border of the project site. Rainfall runoff from the North drainage basin flows to the north from the site and eventually discharges into the Teanaway River.

3.0 Model Methodology

The selected methodology chosen for this analysis is based on the Natural Resources Conservation Service (NRCS) Technical Release-55 (TR-55), which presents procedures to calculate stormwater runoff volumes and peak rates of discharge. To determine runoff from storm rainfall, this methodology uses a runoff curve number (CN) method. Determination of the CN depends on the watershed's soil and cover conditions, which the model represents as hydrologic soil group, cover type, and hydrologic condition.

The following subsections describe the existing and proposed conditions for the site that were used to create a model of the drainage basins.

3.1 Existing Conditions

3.1.1 Impervious Cover

Currently, no impervious area exists on the project site. The area is undeveloped ponderosa pine forest with dirt roadways.

3.1.2 Soil Infiltration and Drainage Characteristics

Soil types for the project site were determined using the NRCS web soil survey application. There are four types of soil located at the proposed project site: Nard ashy loam, 5 to 25 percent slopes; Nard ashy loam, 25 to 45 percent slopes; Teanaway loam, 3 to 10 percent slopes; and Teanaway loam, 25 to 50 percent slopes. All four soil types are in hydrologic soil group C. Soils in hydrologic soil group C have slow infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water, or soils with moderately fine to fine texture. These soils have a slow rate of water transmission, thus producing a moderate amount of rainfall runoff.

3.1.3 Slopes

Slopes in the South drainage basin were estimated to range between 3 and 26 percent. Slopes in the North drainage basin were estimated to range between 3 and 31 percent. Topographic maps were used to calculate the time of concentration for each basin. Time of concentration calculations are provided in Appendix C.

3.1.4 Vegetated Cover

Per Kittitas County zoning, the site is currently zoned Forest and Range (F&R). Since the early 1900s, this site has been repeatedly selectively logged. Harvests have occurred in the 1920s, 1950s, 1980s, and 2000s. Pre-commercial thinning occurred in the decades between logging. Prior to 1900, the site had a fire frequency of 9 to 12 years, indicating that a healthy understory and small trees did not exist, creating a park-like stand of larger trees that were fire resistant to low-intensity, periodic fires. The site was most recently selectively logged in 2001, and existing site vegetation consists of low grasses, shrubs, and trees. Shrubs and riparian communities are predominantly snowberry and rose bushes. Herbaceous plant communities are predominantly lupine, yarrow, arrowleaf balsamroot, and various grass species. Wetland plant communities are dominated by rushes sedges, wild onion, and various other grass species.

Table 1 is a summary of CNs based on hydrologic soil group and vegetative cover type from *Technical Release 55: Urban Hydrology for Small Watersheds* (NRCS 1986). The woods-grass combination was used to determine the existing curve number for the site. The existing site's CN of 72 was computed for an area with 50 percent woods and 50 percent grass (pasture) cover in good condition.

TABLE 1
Runoff Curve Numbers (TR-55)

Cover Description		Curve Numbers for Hydrologic Soil Group			
Cover Type	**Hydrologic Condition**	**A**	**B**	**C**	**D**
Pasture, grassland, or range-continuous forage for grazing [a]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Woods- grass combination (orchard or tree farm) [b]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods [c]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30[d]	55	70	77

[a] Poor: <50% ground cover
Fair: 50 to 75% ground cover
Good: >75% ground cover

[b] CNs shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

[c] Poor: Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

[d] Actual curve number is less than 30; use CN=30 for runoff computations.

3.2 Proposed Conditions

The purpose of the proposed project is to generate up to 75 direct current megawatts (MWdc) of photovoltaic (PV) solar energy for distribution to utilities and communities seeking to optimize their renewable and sustainable energy sources. The proposed project area consists of 982 acres. Based on site surveys, the project will utilize approximately 477 acres within the proposed project area. Solar arrays will be placed on approximately 399 acres. The remaining acres are currently undeveloped open space, which will be preserved as part of the wildlife mitigation plan for the project. The proposed project will consist of the following key components:

- Solar modules
- Power inverter enclosures
- Power transformers
- Underground electrical conductors
- Electrical substation and switchyard
- Operations and maintenance (O&M) building supervisory control and data acquisition (SCADA) system
- Overhead interconnection transmission line
- Access and maintenance roads

3.2.1 Impervious Cover

A small increase in impervious area on the proposed project site (less than one acre) is expected from the following proposed improvements: solar modules, power inverter enclosures, and the O&M facility. Other project components such as access roads and a 6-acre graveled substation that reduce the infiltration capability of the soil are accounted for in the change in CN. A conceptual site plan and corresponding areas were provided to CH2M HILL by Studio GREENE. These areas were used to determine the impervious area for the site. Impervious surfaces and their corresponding areas are shown in Table 2.

TABLE 2
Project Impervious Surfaces and Areas

Impervious Surface	Area (SF)	Area (ac)
Array Fields		
Solar Modules	12,665	0.291
Field Inverters	6,400	0.147
Field Transformers	3,840	0.088
BPA Substation		
Concrete Pads	7,000	0.161
BPA Control House	1,800	0.041
Tower and Transmission Pole	100	0.002
BPA Switchgear Building	1,080	0.025
BPA Fence (Footings)	3,000	0.069
Operations and Maintenance Building	1,000	0.023
Transmission Structure	800	0.023

Notes:
SF = square feet
ac = acres

An assumption for calculating the impervious area created by solar panels was used for this analysis. The impervious area created by a solar panel was considered to be the area of the foundation of the panels, not the panels themselves. While solar panels do generate concentrated runoff on the panel surfaces, the panels are considered a disconnected impervious surface because the infiltration capability of the soil is only affected by the foundation. Flow spreaders can be used to distribute the concentrated flow from the panels evenly over the ground surface.

Because impervious area from the site is disconnected, the resulting impacts calculated in this analysis are conservative. A more detailed analysis of the small, natural drainage basins on the site that will be completed during the design phase of the project will likely reveal lesser impacts. The detailed analysis completed during design will be used to select the appropriate stormwater Best Management Practices (BMP) that are best suited to protect each drainageway and minimize the impacts of the project to the maximum extent practicable.

3.2.2 Vegetated Cover

The construction of the proposed solar reserve would result in a reduction of the ponderosa pine forest canopy. Project elements that will affect the vegetated cover are shown in Table 3. The CN for the solar array field is based on a CN for grassland in fair condition. Areas were based on a conceptual site plan and corresponding areas that were provided to CH2M HILL by Studio GREENE.

TABLE 3
Project Elements Creating a Change in Vegetated Cover

Project Element	Area (SF)	Area (ac)	Curve Number Used
Roads (Graveled)			
Primary Roads (20 foot width)	549,680	12.6	89
Secondary Roads (16 foot width)	260,160	5.97	89
BPA Substation			
Graveled Area	112,000	2.57	89
Roads	40,000	0.918	89
Array Fields			
Solar Array Field	17,380,440	399	79

4.0 Climate

The NRCS classifies storms in the project vicinity as being Type 1A. Total precipitation amounts in the vicinity of the project were taken from National Oceanic and Atmospheric Administration (NOAA) Atlas 2. Precipitation amounts were modified using guidance provided by the Stormwater Management Manual for Eastern Washington. The 3-hour short-duration storm distribution was run for the 2-, 10-, and 100-year storm events and the regional storm distribution was run for the 10-, 25-, and 100-year storm events. The short-duration event simulates a storm that is 3 hours in length and is representative of a thunderstorm. The regional storm distribution simulates a storm that is longer than 24 hours in duration and represents a general storm. To calculate the precipitation depth for the regional storm, the 24-hour depths were increased by 16 percent per guidance provided by the Stormwater Management Manual for Eastern Washington. The storm depths used in the analysis are shown in Table 4.

TABLE 4
Total Precipitation Storm Events

Storm Event	Precipitation (inches)
2-year, 3-hour	0.64
10-year, 3-hour	0.91
100-year, 3-hour	1.47
10-year, 24-hour	2.90
25-year, 24-hour	3.48
100-year, 24-hour	4.35

Data gathered from the Natural Resources Conservation Service (NRCS) Temperature and Precipitation Summary (TAPS) station WA1504 show the climate in Cle Elum consists of mild summers and cold winters. Temperatures range from an average January minimum of 21.2 degrees Fahrenheit (ºF) to an average August maximum of 80.0ºF. The average annual precipitation is 23.09 inches, with the majority occurring from November through March. Table 5 presents average monthly precipitation and snowfall data for Cle Elum.

TABLE 5
Average Annual Precipitation, Cle Elum, Washington (1971 - 2000)

Month	Average Precipitation (in)	Average Total Snowfall (in)
January	3.80	24.6
February	2.51	14.7
March	1.67	6.2
April	1.16	0.8
May	0.93	0.2
June	0.96	0.0
July	0.46	0.0
August	0.58	0.0
September	0.93	0.0
October	1.76	0.5
November	3.90	12.6
December	4.43	27.0
Annual Average	**23.09**	**86.5**

5.0 Drainage Basin Modeling

The background information described above was used to create basin models using the U.S. Army Corps of Engineers Hydrologic Modeling System HEC-HMS 3.1.0. This software was used to determine the pre- and post- development runoff rates and volumes from the project area for the 2-, 10-, and 100-year, 3-hour storm events to determine the impacts the development will have on hydrology of the two drainage basins on the site and the surrounding area. The 10-, 25-, and 100-year regional storm events were also used to illustrate the effect of longer duration storm events.

The 2-, 10-, and 100-year, 3-hour storm events were used with the NRCS storm distribution Type 1A to calculate the runoff from the drainage basins for the existing and proposed conditions in the North and South drainage basins. The 10-, 25-, and 100-year, regional storms were also used to illustrate the effect of a longer duration storm event. A summary of the areas and curve numbers used in the model are shown in Table 6. The peak rainfall runoff rates and volumes for the existing and proposed conditions are shown in Tables 7 and 8, respectively.

TABLE 6
Areas and Curve Numbers used in the HEC-HMS Model

Conditions	Drainage Basin	Impervious Area (ac)	Impervious Area Curve Number	Pervious Area (ac)	Pervious Area Curve Number [a]
Existing Conditions					
	North	0	98	259	72
	South	0	98	723	72
Proposed Conditions					
	North	0.06	98	258.94	73
	South	0.81	98	722.19	76

[a] Values of proposed conditions are weighted per values shown in Table 3.

TABLE 7
Existing Site Rainfall Runoff and Volume Calculations from HEC-HMS Model

Drainage Basin	Storm	Peak Discharge (cfs)	Total Runoff Volume (cf)
North Drainage Basin	2-year, 3-hour Storm	0.00	0
	10-year, 3-hour Storm	0.72	4,071
	100-year, 3-hour Storm	24.71	98,285
	10-year, Regional Storm	21.77	693,667
	25-year, Regional Storm	39.85	1,027,117
	100-year, Regional Storm	71.54	1,587,806
South Drainage Basin	2-year, 3-hour Storm	0.00	0
	10-year, 3-hour Storm	1.92	11,364
	100-year, 3-hour Storm	58.90	274,364
	10-year, Regional Storm	55.96	1,923,489
	25-year, Regional Storm	102.01	2,849,855
	100-year, Regional Storm	183.89	4,408,120

TABLE 8
Proposed Site Rainfall Runoff and Volume Calculations from HEC-HMS Model

Drainage Basin	Storm	Peak Discharge (cfs)	Total Runoff Volume (cf)
North Drainage Basin	2-year, 3-hour Storm	0.05	141
	10-year, 3-hour Storm	1.01	7,221
	100-year, 3-hour Storm	29.40	113,422
	10-year, Regional Storm	24.78	738,165
	25-year, Regional Storm	43.77	1,082,042
	100-year, Regional Storm	76.53	1,656,542
South Drainage Basin	2-year, 3-hour Storm	0.53	1,942
	10-year, 3-hour Storm	10.36	61,649
	100-year, 3-hour Storm	109.23	465,033
	10-year, Regional Storm	89.52	2,445,290
	25-year, Regional Storm	144.34	3,486,976
	100-year, Regional Storm	237.38	5,196,333

The existing site rainfall runoff and volume calculations were used as a baseline for determining the increase in rainfall runoff and volume expected as a result of the construction of the proposed project.

Rainfall runoff and volume are expected to increase in both the North and South drainage basins. Due to the small amount of construction in the North drainage basin, peak rainfall runoff rates and volumes are expected to increase on a much smaller scale when compared to the increases in the South drainage basin. See Table 9 for a summary of the increase by drainage basin.

TABLE 9
Summary of Peak Discharge and Volume Increases by Basin

Drainage Basin	Storm	Increase in Peak Discharge (cfs)	Increase in Total Runoff Volume (cf)
North Drainage Basin	2-year, 3-hour Storm	0.05	141
	10-year, 3-hour Storm	0.29	3,150
	100-year, 3-hour Storm	4.70	15,137
	10-year, Regional Storm	3.01	44,498
	25-year, Regional Storm	3.92	54,925
	100-year, Regional Storm	4.99	68,736
South Drainage Basin	2-year, 3-hour Storm	0.53	1,942
	10-year, 3-hour Storm	8.44	50,285
	100-year, 3-hour Storm	50.34	190,669
	10-year, Regional Storm	33.55	521,801
	25-year, Regional Storm	42.32	637,121
	100-year, Regional Storm	53.49	788,213

The largest increase in peak discharge for the storm events occurred during the 100-year regional storm in the South drainage basin (53.49 cfs). At the point of discharge to the Teanaway River, the total contributing drainage basin area is 195 square miles. Using a direct proportion of drainage basin area to flow (FEMA data reports recorded the total size of the drainage basin to be 207 square miles and have a 100-year discharge of 7,350 cfs), the flow in the Teanaway River at the discharge point is expected to be approximately 6,924 cfs during a 100-year storm event. An increase of 53.49 cfs results in a 0.77 percent increase in flow during the 100-year short duration storm event. From a flooding standpoint, this increase is determined to be negligible when compared to the contribution of the entire watershed at the point of discharge from the project area.

Increases in rainfall runoff rates and volumes experienced by the onsite natural drainages will be managed using infiltration to the maximum extent practicable and stormwater BMPs will be implemented if necessary.

5.1 Stormwater BMPs

Stormwater BMPs will be chosen based on site-specific conditions during design and on their ability to function with and protect the natural watershed. Specific BMPs will be outlined in the National Pollutant Discharge Elimination System (NPDES) permit and the Stormwater Pollution Prevention Plan (SWPPP) that will be submitted to the Washington State Department of Ecology prior to construction of the project.

There are three basic types of stormwater BMPs: source control, water quality treatment, and flow control. Source control BMPs are measures that are directed toward pollutant-generating activities that will help prevent pollution or other adverse effects of stormwater. Water quality treatment BMPs remove pollutants from stormwater by filtration, biological uptake, adsorption, and gravity settling. The need for water quality BMPs is based on the types of pollutants generated by a project and the vulnerability of the receiving waters to the pollutants of concern. Flow control BMPs control the rate, frequency, and/or flow duration of stormwater runoff through infiltration, evaporation, or detention facilities with infiltration being the preferred method wherever possible. The concept of detention is to collect runoff from a developed area and release it at a slower rate than it would typically run off the site.

Stormwater management involves careful application of source controls, site design principles, and construction techniques in order to protect a watershed. Some potential stormwater BMPs for the site include, but are not limited to, infiltration ponds; infiltration trenches; infiltration swales; large, extended-detention wet ponds; and extended-detention wetlands. Facilities will be designed in accordance with the standards outlined in the Eastern Washington Stormwater Management Manual in order to protect water quality in the receiving waters and reduce the impacts of development on the watershed. Guidance on stormwater BMPs and Low Impact Development (LID) were provided by the Washington Department of Ecology; however, they were not included in the list of facilities above. Stormwater BMPs provided in the Eastern Washington Stormwater Management Manual were more applicable to the rural setting of the project and also account for location and climate in the project area.

6.0 Rain-on-Snow Analysis

A rain-on-snow event occurs when rain falls onto frozen or saturated ground with a pre-existing snow pack. The rain causes the snow to melt, and with the frozen or saturated ground acting like an impervious surface, additional runoff volume is generated. Rain-on-snow events pose a significant flood hazard, such as occurred in 2009. A rain-on-snow analysis was completed for existing and proposed conditions to determine the impacts the development may have on rain-on-snow volumes. The methodology used for the rain-on-snow analysis is outlined in the Eastern Washington Stormwater Management Manual Section 4.2.7. It is a four-step procedure that was originally prepared by the Center for Watershed Protection.

The dataset used for the analysis was downloaded from the Cle Elum National Weather Service Cooperative Station from the NOAA Regional Climate Center's Applied Climate Information System. The dataset contains daily statistics on precipitation, snowfall, and snow depth for Cle Elum, Washington. Detailed information about the station is shown in Table 10. This station provided the most representative data for the project area, both in terms of proximity to the site, elevation, and available data record.

TABLE 10
Rain-on-Snow Dataset Information

Station:	Cle Elum
State:	Washington
ID:	451504
Latitude:	47.19 degrees
Longitude:	-120.91 degrees
Elevation:	1900 feet
Station Period of Record:	Jan. 1899 – Nov. 2009

Two runoff distributions were tabulated: one for months with snow on the ground (winter) and one for months without snow on the ground (summer). In order to determine the months that were included in the winter and summer runoff distributions, historical monthly snowfall averages were reviewed. At the project area, the months November through March typically have snow on the ground, while April through October do not. The criteria for determining the two distributions was any months that have averages of less than 1-inch of snow were grouped into the summer category.

The data were sorted (based on the months for the two distributions) to form separate data sets for winter and summer. Per the rain-on-snow analysis methodology, days that recorded snowfall events and days that had less than 0.1 inches of recorded precipitation were filtered out of the dataset. The remaining summer precipitation events were then modified using the following equation to determine the amount of runoff a summer storm would generate.

$$R = 1.0 * P * (0.05 + 0.9 I)$$

Where R is runoff, P is the precipitation from the runoff distribution for the summer months, and I is the impervious percentage. An impervious percentage of 0 was used to model existing site conditions, while a percentage of 2.34 percent was used to model post-development conditions. Table 11 below lists the project elements and areas that were used to determine the impervious percentage for post-development conditions. The impervious percentage for post-development conditions accounts for 22.95 acres of impervious area over the 982 acres project area. This is a conservative estimate, as some of the project features are graveled areas that will allow for small amounts of infiltration.

TABLE 11
Project Elements and Areas

Project Element	Area (SF)	Area (ac)
Array Fields		
Solar Modules	12,665	0.291
Inverters	6,400	0.147
Transformers	3,840	0.088

TABLE 11
Project Elements and Areas

Project Element	Area (SF)	Area (ac)
Roads (Graveled)		
Primary Roads (20 foot width)	549,680	12.62
Secondary Roads (16 foot width)	260,160	5.972
BPA Substation		
Graveled Area	112,000	2.571
Concrete Pads	7,000	0.161
Roads	40,000	0.918
BPA Control House	1,800	0.041
BPA Switchgear Building	1,080	0.025
Tower and Transmission Pole	100	0.002
Fence	3,000	0.069
Operations and Maintenance Building	1,000	0.023
Transmission Pole	800	0.018

The summer and winter distributions were then combined and ranked. Following the Section 4.2.7 guidance, the 90th percentile value provided a runoff depth that was used to determine the volume of runoff that would result from a rain-on-snow event. This analysis was completed for pre- and post-development. The analysis resulted in the same pre-and post-development runoff depth of 0.5 inch. When applied over the entire site, the expected volume of runoff during a rain-on-snow event is 1,778,700 cubic feet, or 40.83 acre-feet.

As a result of this analysis, the magnitude of runoff from a rain-on-snow event is not expected to significantly increase from construction of the project. Due to limited infiltration capacity during a rain-on-snow event, the site is expected to generate a similar volume of runoff at build-out as would be generated with the current site conditions.

7.0 Construction- and Operation- Related Stormwater Impacts

This section addresses specific concerns related to the stormwater impacts from construction and operation of the Teanaway Solar Reserve facility.

7.1 Teanaway River Total Maximum Daily Loads

Section 303(d) of the federal Clean Water Act requires states to periodically prepare a list of all surface waters in the state whose beneficial uses are impaired by pollutants. Waters placed on the 303(d) list require the preparation of Total Maximum Daily Loads (TMDLs). TMDLs are used to set and implement standards to clean up the polluted waters. TMDLs identify the maximum amount of a pollutant allowed to be released into a waterbody so as not to impair uses of the water, and allocate that amount among various sources.

The Teanaway River has a TMDL for temperature. From July through September stream temperatures in the Teanaway River basin often exceed Washington State water quality standards. Temperature increases in streams can occur for a variety of reasons. Some examples include the loss of vegetation along streams that used to shade the water, impervious area that causes rainfall to increase in temperature before it runs off into a stream, and sediment transport that results in reduced channel width-to-depth ratios.

The Teanaway River is also included in the Upper Yakima Suspended Sediment, Turbidity, and Organochlorine Pesticide TMDL. Suspended sediments and turbidity are caused by erosion of earthen roads and stream banks, and by the discharge of agricultural return flows to the river that are full of sediment. Organochlorine pesticides are also transported by suspended sediment.

In accordance with the standards outlined in the Teanaway Temperature TMDL and Upper Yakima Suspended Sediment, Turbidity, and Organochlorine Pesticide TMDL and the stormwater requirements for Eastern Washington, BMPs will be implemented to prevent soil erosion and any downstream turbidity during construction and operation of the Teanaway Solar Reserve facilities. These BMPs will be outlined in the National Pollutant Discharge Elimination System (NPDES) permit and the Stormwater Pollution Prevention Plan (SWPPP) that will be submitted to the Washington State Department of Ecology prior to construction of the project. The project is highly unlikely to increase temperature in the Teanaway River due to the disconnected nature of impervious area, flow paths on the site, and distance from the project site to its discharge into the Teanaway River.

7.2 Vegetation Management

Routine vegetation management will be required to ensure vegetation growth does not interfere with the operation of any equipment on the Teanaway Solar Reserve project site. Woody vegetation removal and ongoing management will be necessary to prevent interference with solar arrays. Measures will be implemented to protect herbaceous plant cover on site, including under solar arrays. These measures include ongoing vegetation removal that will be limited to woody vegetation that could potentially interfere with safe and effective project operations and preventing non-native plant invasion into the project area.

For a list of BMPs that will be implemented during construction and operation of the Teanaway Solar Reserve, please refer to Attachment G, *Vegetation Management Plan*. The use of herbicides in accordance with the BMPs and requirements of the local, state, and federal jurisdictions is not expected to affect stormwater quality in the project area.

7.3 Improvements to Loping Lane and Wiehl Road

The Teanaway Solar Reserve site will be accessed via Kittitas County and private roads that interconnect with Highway 970. Loping Lane, a private road, and Wiehl Road, a privately maintained public road, will be used to access the site during construction and operation of the project. Currently, Loping Lane and Wiehl Road generally consist of gravel and dirt; the portions of Loping Lane and Wiehl Road that will be used during construction and operation will need to be improved pursuant to County requirements.

With several drainages in close proximity to the roads, stormwater drainage infrastructure will be necessary if Loping Lane and Wiehl Road are improved. All drainage improvements will be designed and constructed in accordance with the Eastern Washington Stormwater Management Manual and the requirements of local, state, and federal jurisdictions. BMPs will also be implemented to prevent soil erosion and any downstream turbidity during construction and operation.

8.0 Summary

Background information was collected on the existing and proposed site conditions for the Teanaway Solar Reserve Project and used to create models of the existing and proposed conditions for the two drainage basins on the project area. The NRCS *Technical Release 55* (*TR-55*) methodology was the selected method for the analysis to determine the increase in rainfall runoff and volume from the project area. To determine runoff from storm rainfall, this methodology uses a runoff CN method. Determination of the CN depends on the watershed's soil and cover conditions, which the model represents as hydrologic soil group, cover type, and hydrologic condition.

Once all of the inputs were determined for the existing and proposed conditions in each drainage basin, models were built using the U.S. Army Corps of Engineers HEC-HMS 3.1.0 software. The models were then used to determine pre- and post-development peak rainfall runoff rates and volumes for 2-, 10-, and 100-year 3-hour and 10-, 25-, and 100-year regional storm events. Peak runoff rates and volumes are expected to increase minimally as a result of the development of the site. The increases are negligible when compared to the contribution of the entire watershed at the point of discharge to the Teanaway River. Moreover, mitigation of the hydrologic impacts, if any, from the increased runoff rates and volumes for local drainages will be mitigated through infiltration to the maximum extent practicable and stormwater BMPs will be implemented if necessary. These measures will be designed and constructed in compliance with the Eastern Washington Stormwater Management Manual.

Rain-on-snow events pose an existing risk of flooding; however, the magnitude of runoff from a rain-on-snow event is not expected to significantly increase as a result of the project. Due to limited infiltration capacity during a rain-on-snow event, the post-development site is expected to generate a similar volume of runoff as would be generated with current site conditions.

Significant stormwater impacts from construction and operation of the Teanaway Solar Reserve facility are not expected. Nevertheless, any impacts will be adequately addressed through the State NPDES permitting program and the implementation of Best Management Practices. Vegetation management through the use of Department of Ecology-approved herbicides is not expected to affect stormwater quality. All stormwater drainage improvements associated with the Teanaway Solar Reserve project will be designed and constructed in accordance with the Eastern Washington Stormwater Management Manual and the requirements of local, state, and federal jurisdictions to reduce the impacts of the project to the maximum extent practicable.

9.0 References

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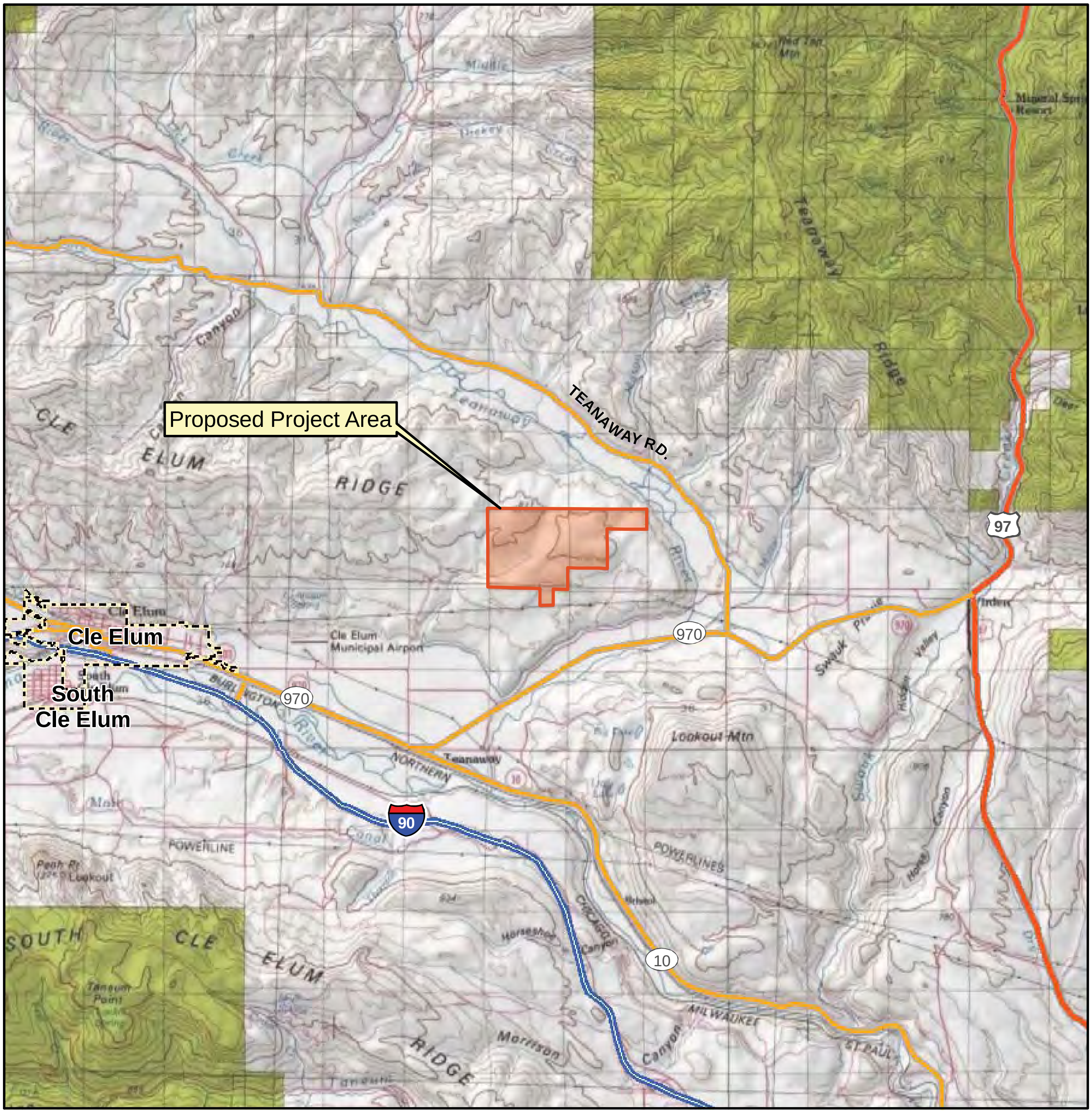
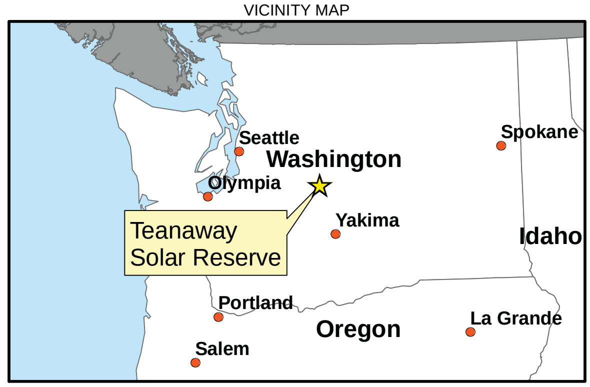
APPENDIX A
Figures



LEGEND
- Proposed Project Area
- City Boundary
- Interstate
- Highway
- Major Road

VICINITY MAP



Note:
1. USGS 100K Quadrangle: Wenatchee.

0 1 2
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N

FIGURE 1
Vicinity Map

Hydrologic Analysis
Teanaway Solar Reserve
Kittitas County, Washington

\\ROSA\PROJ\AFLC\391226\GIS\MAPFILES\DRAFT\SEPA_SUPPLEMENT\HYDROANALYSIS\HA_VICINITYMAP.MXD AROBERT6 1/18/2010 14:19:18

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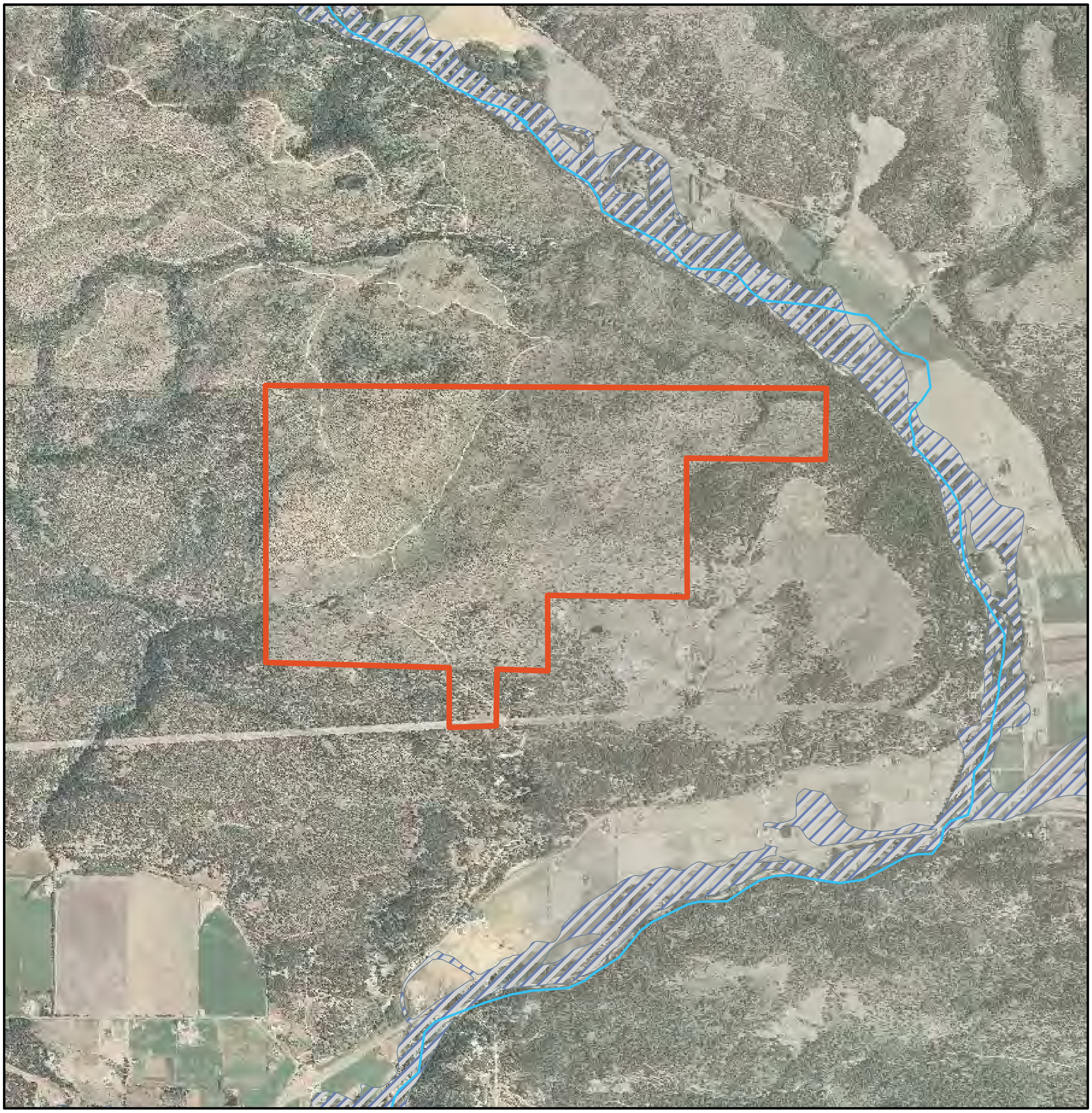
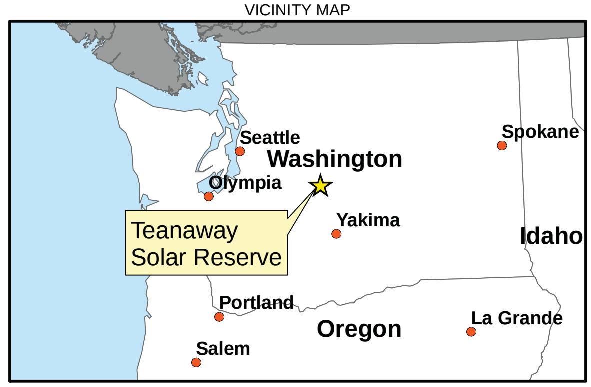


VICINITY MAP



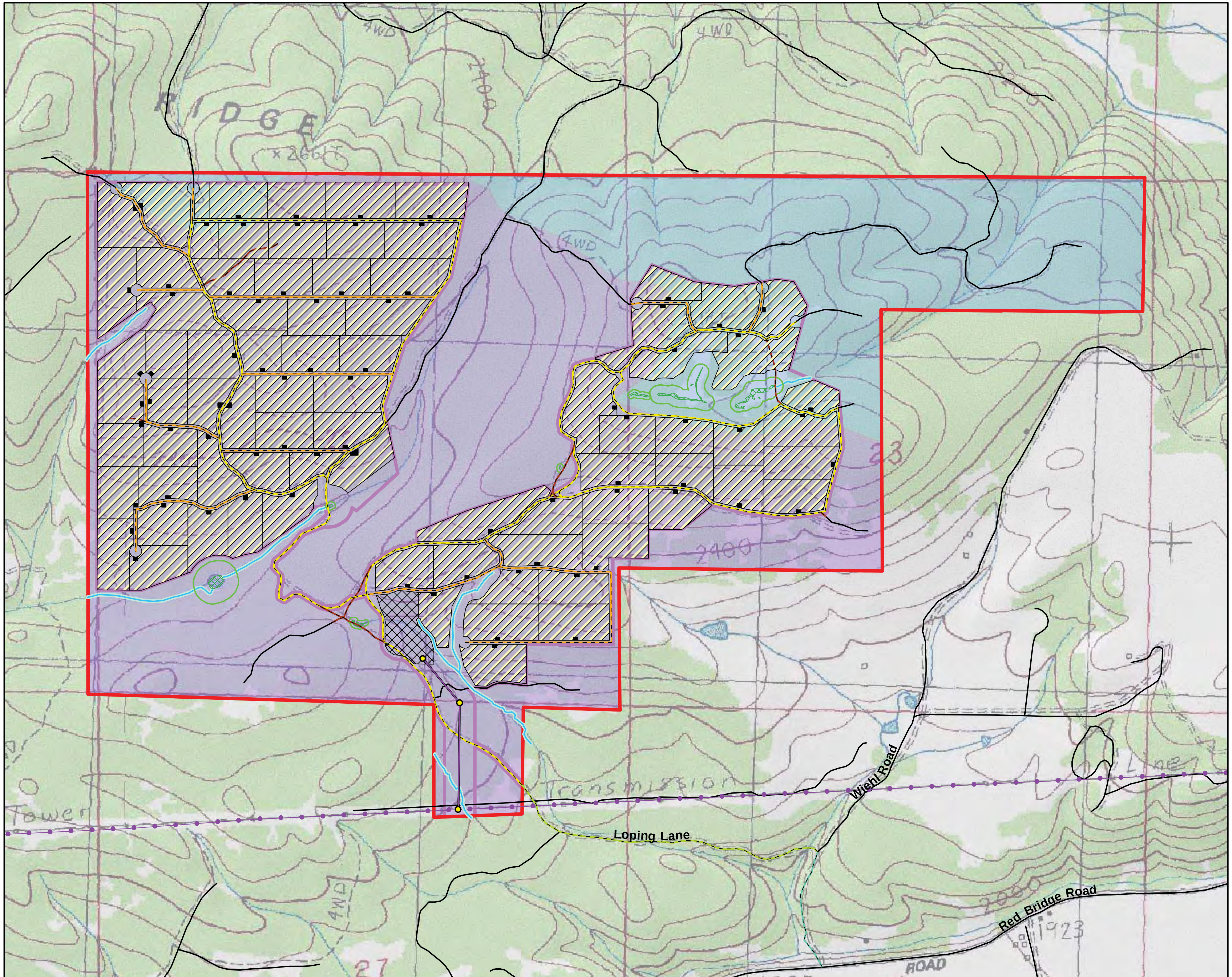
LEGEND

- Shoreline Management Act Stream (450 feet from proposed project area)
- FEMA 100-year Flood Zone
- Proposed Project Area

Notes:
1. Flood Data: Federal Emergency Management Agency Flood Insurance Rate Map.
2. Stream Data: Washington Department of Ecology.
3. Aerial Imagery: 2006 1m NAIP.

0 1,500 3,000
Feet
N

FIGURE 2
100-year Floodplain Map
Hydrologic Analysis
Teanaway Solar Reserve
Kittitas County, Washington



VICINITY MAP

LEGEND

Proposed Project Features

- Proposed Project Area (982 Acres)
- Proposed Project Site (477 acres)
- Proposed PV Array Block
- Proposed Field Inverter and Field Transformer
- Proposed Substation/O&M Facility
- Proposed Transmission Line
- Proposed Transmission Structure
- Primary Access Road
- Secondary Access Road
- Proposed Improved Existing County Access Road
- Proposed Improved Existing Private Access Road
- Existing Maintenance Road (Planned Decommissioning)

Existing Features

- Existing BPA Transmission Line and ROW
- Existing Road
- Stream
- Stream Buffer
- Wetland
- Wetland Buffer
- South Drainage Basin
- North Drainage Basin

N

0 1,000

Feet

1 inch = 1,000 feet

FIGURE 3

Proposed Site Layout with Drainage Basins

Hydrologic Analysis

Teanaway Solar Reserve

Kittitas County, Washington

APPENDIX B

GeoEngineers Letter (October 2009)

October 5, 2009

Teanaway Solar Reserve, LLC
218 E. First Street, Suite B
Cle Elum, WA 98922

Attention: Mr. Howard Trott

Subject: Hydrologic Evaluation
(CU-09-00005)
Hydrologic Services
Teanaway Solar Reserve
Kittitas County
File No. 17700-001-01

INTRODUCTION

Teanaway Solar Reserve, LLC (TSR) proposes to construct and operate the project on approximately 982 acres of private land within the Forest and Range (F&R) zoning district in an unincorporated area of Kittitas County, Washington (see Figure 1). TSR submitted a Conditional Use Permit (CUP) and State Environmental Policy Act (SEPA) Checklist for the proposed project to Kittitas County on August 18, 2009. The application was deemed complete by the County on September 3, 2009. The public comment period on the CUP/SEPA ended on October 5, 2009. Comments were received from various state agencies and interested local parties.

This letter has been prepared on behalf of Teanaway Solar Reserve, LLC (TSR) in response to the September 16, 2009 comment letter prepared by Mark Teske of the Washington Department of Fish and Wildlife (WDFW) regarding the Teanaway Solar Reserve located in Klickitat County, Washington. The letter raised questions regarding the solar reserve's impact, if any, on flooding and erosional hazards in the vicinity of tributary streams to the Teanaway River. To address issues raised in the WDFW letter, a professional hydrologist from GeoEngineers visited the site of the proposed solar reserve, the surrounding watershed, and the drainages that emanate from the project area. The information presented in this letter is based on a review of Solar Reserve design information, a review of area topographic maps, a field reconnaissance and interviews with local residents familiar with the history of flooding issues along Red Bridge Road. This response is organized according to the topics outlined in the September 16th WDFW letter.

PROJECT DESCRIPTION

Teanaway Solar Reserve, LLC (TSR) proposes to construct and operate the project on approximately 982 acres of private land within the Forest and Range (F&R) zoning district in an unincorporated area of Kittitas County, Washington (see Figure 1). The project will generate up to 75 direct current megawatts (MWdc) of photovoltaic (PV) solar energy utilizing approximately 477 acres of land within the proposed project area. The project location was chosen for its south-facing slopes of moderate steepness, which are required for the effectiveness of the solar facilities.

Several module mounting types will be considered to best address the slope of land and soil stability at the project site. For example, large land areas with a slope toward the south are excellent for single-axis tracking systems. Land areas that are sloped to the east, southeast, west, or southwest will not as easily accommodate single-axis tracking systems, and are better suited to a fixed-tilt mounting structure.

The foundations securing the solar modules will be designed to withstand high winds and snow loads. The site may have multiple foundation types to match the ground conditions and type of mounting structures used. The mounting-system support structures could consist of embedded posts, poles, or structural steel angle. The embedment could be completed via a vibratory drill or similar installation method to depths of approximately 8 feet. Pending final design, the solar module foundations will require site work and potential boring.

The posts will not be anchored unless a patch of bedrock is encountered during installation. The embedment could be completed via a vibratory drill or similar installation method to depths of approximately 8 feet. After the posts are installed, they are held in place by friction from the surrounding soil, without the use of concrete. Driven piles develop their strength by utilizing a definable skin friction between the pile and the soil. As the pile is forced into the ground, the displaced material compresses and that, in turn, creates the friction at the pile/soil interface. Piles are typically driven to a depth that prevents seasonal and temporary changes from affecting their strength. A geotechnical engineer will determine the parameters to be used in the structural design. No concrete will be used when installing the foundations for the modules.

METHOLODOLGY

A professional hydrologist from GeoEngineers visited the site of the proposed solar reserve, the surrounding watershed, and the drainages that emanate from the project area. The information presented in this technical memorandum is based on a review of Conceptual Site Layout as presented in the CUP/SEPA application materials, topographic maps, a field reconnaissance, and interviews with local residents familiar with the history of flooding issues along Red Bridge Road.

RESULTS

A summary of the potential impacts related to the development of the solar reserve is presented below. The public comment letter from the Washington Department of Fish and Wildlife (WDFW) outlined the following concerns: impervious surfaces, January 2009 flooding, and the 303(d) listing of the Teanaway River

IMPERVIOUS SURFACES

Concern was raised by the public comments that impervious surfaces from the proposed project will intercept rain and snow.

Permanent impacts resulting from installation of the solar reserve may result from the removal of ponderosa pine trees, road construction, and placement of the panels. In terms of modification of the hydrology of the watershed, the impacts are less than a typical development consisting of structures and supporting facilities. The roads will be maintained as dirt or gravel, and no large-scale clearing or grading beyond tree removal is required for the reserve. After construction, native grasses will be restored to the disturbed areas.

Although the solar reserve panels are impervious, due to their angled orientation above the ground surface, they will not function as an impervious surface such as a roadway or flat surface at ground level. Therefore, rainwater or snow intercepted by the panels will run off the elevated surface and flow to the native soil and grasses, which will continue to serve the same drainage function that approximates the current condition. The primary effect of runoff from the solar panels will be to concentrate the natural rainfall that would naturally have fallen over a 17.5-square-foot area (individual panel dimensions are 3.5 feet by 5 feet) into a linear corridor with a length that may vary from 3.5 feet to 8.5 feet, depending on the orientation and angle of the panel at the time of a storm event. The likely impact that may result from construction of the individual solar panels would be a minor concentration of runoff at the base of each panel that could result in rilling or small-scale gully formation in extreme rainfall cases.

JANUARY 2009 FLOODING

The January 2009 flooding that occurred adjacent to the proposed project area, specifically along Red Bridge and Wiehl Roads was the result of a significant rain-on-snow event and was possibly the flood of record for the small drainages that emanate from the project area. These drainages can be characterized as ephemeral, vegetated swales. A field visit to the project area shows that the drainages that drain the project area (west and east drainage tracts shown in Figure 1) are in stable condition. No excessive erosion, lateral shifting or incision was evident in the drainages around the project site. The vegetation in the drainages acts to reduce velocity and erosional forces of water as it runs off hillslopes into concentrated areas.

The proposed project area is situated within two basins, one of which (east tract) drains to the Red Bridge Road via Wiehl Road. The condition of the channel that drains Wiehl Road shows that the channel was not significantly altered as a result of the extreme flood events in January 2009. Drainage from the west tract is routed through a stock pond, which effectively removes any peak flow from major flood events, and runs southwest into a drainage that is captured for irrigation along Masterson Road. Observations of the channel upstream and downstream of the stock pond show that the extreme flooding in January 2009 did not significantly impact the channel stability.

One of the major sources of flooding and the main source of debris onto Red Bridge Road during the January 2009 event was a small drainage that does not emanate from the project area and will not be affected by the proposed solar reserve. The unnamed drainage (shown in green on the accompanying Figure 1) is not located within the proposed project area and is hydrologically and topographically disconnected from the project area. The drainage receives flow from the hillside above and directs the runoff down a short, steep section that runs into an irrigation ditch parallel to Red Bridge Road.

According to Jesse Geiger, the homeowner across the street from the unnamed drainage, the flooding and debris flow from this drainage were a result of recent disturbance to the stream channel caused by another local valley resident. Mr. Geiger told us that another area resident had used excavating equipment to trench into and disturb the streambed of the unnamed small drainage in an effort to reroute flows into irrigation pipes and ultimately into an existing delivery system. According to Mr. Geiger, the channel was never armored or revegetated after the soil disturbance and channel realignment. As a result, high flows in January 2009 destabilized the unprotected channel and breached the weak soil dam that had been erected adjacent to Red Bridge Road. The condition of the channel upstream of the disturbed area was not subject to erosion or damage; rather, only the disturbed reach was destabilized, causing a debris torrent to spill into the road and the subsequent flooding and damage to the road. Field observations of the drainage correlate with the description of events recounted by area residents, as evidenced by comparing the condition of this drainage to the drainage adjacent to Wiehl Road.

TEANAWAY RIVER

The WDFW letter identifies that the Teanaway River is an impaired waterbody due to temperature and flow limitations as defined by the Washington State Department of Ecology (Ecology) Total Maximum Daily Load (TMDL) detailed implementation plan (DIP). According to the DIP, the sources of temperature and flow impairment in the Teanaway River are:

- Lack of streamside shade
- Increased channel width:depth ratio
- Instability of streambanks
- Lower instream flows during the summer

The proposed solar reserve will have negligible influence on any of the processes listed above. WDFW suggests that the proposed development will result in a flashier hydrograph in the drainage channels that emanate from the planned solar reserve project area and that this conversion will further impair conditions in the Teanaway River. We address issues raised by WDFW below:

TIMING OF RUNOFF

Historically, and in an undisturbed state, the ephemeral drainages emanating from the project area flow are naturally "flashy," typically resulting from short, intense rainfall or rain-on-snow events. These events are likely to occur in autumn and early winter, when flows in the Teanaway River are naturally elevated and temperatures low.

It is also important to note that, the drainages flowing from the project area either are intercepted by irrigation ditches or cross over Red Bridge Road and spread out over the fields between Red Bridge Road and Highway 970. As such, there is no direct surface water connection to the Teanaway River from these drainages.

SEDIMENT TRANSPORT

WDFW suggests that the proposed solar reserve project is expected to increase sediment load and impact salmonid egg incubation in the Teanaway River. Sediment transport from the project area to the Teanaway River is not expected to increase as a result of the detention facilities that will be put in place to offset any predicted increases in post-development sediment load. Additionally, irrigation diversions and the lack of a surface water connection limit any sediment movement to the Teanaway River except during periods of extreme flows and sediment concentrations, when the entire valley is flooding and overtopping Highway 970. Furthermore, field observations indicate that the channels routing water from the project area are in stable condition, while the major source of flooding and debris is from a drainage unaffected by the proposed project.

HYPORHEIC ZONE

Hyporheic exchange between the Teanaway River and its floodplain can be an important source of cool water during periods of low flow. However, the historically ephemeral and flashy flow from the project area stream channels likely supplied little of the total water volume in the hyporheic zone. Most of the water that emanates from the project area and adjacent basins is captured for irrigation and therefore is regulated by the irrigation schedule and ultimately enters the Teanaway River as return flows. Flows that exceed the capacity of the irrigation system or that are routed past irrigation diversions have no open channel to pass water quickly to the Teanaway River; rather, the flows spread across the fields and infiltrate into the floodplain, slowly working their way towards the river as hyporheic flows. The processes that currently supply the hyporheic zone from the project area streams will not be altered, nor will the floodplain processes of the Teanaway River be modified as a result of the proposed project.

PROPOSED MITIGATION MEASURES

While field observations indicate that native grasses are sufficiently dense to attenuate runoff, reduce rilling and gully formation, and moderate the runoff generated from intense storm events mitigation measures will still be implemented to further reduce the potential impacts. To mitigate for the potential rilling that may be associated with the solar panels, level spreaders could be applied beneath each panel to take concentrated flow and distribute it evenly back to the native ground surface beneath each panel.

CONCLUSIONS

During final design of the project, and as part of the building permit application, more detailed hydrologic analyses will be completed to design stormwater management features. The applicant proposes to have no effect on the existing hydrology leaving the project site. Any calculated increase in runoff will be managed through the use of level spreaders, infiltrating basins or detention. Runoff from the project area routes through two drainages, (labeled as the west and east tract drainages on Figure 1), one of which currently has a stock pond that can be easily modified to collect and release runoff in a manner such that the post-development runoff matches the existing hydrology. When additional analyses are completed, the applicant will utilize a continuous hydrologic model such as MGS Flood or the Western Washington Hydrology Model to accurately model the effects of the development on basin hydrology.

There is no field evidence that the landslides/debris torrents referenced in the public comment letter received from the WDFW emanated from the proposed project area. Flooding of the drainages is a natural process that occurs during extreme events such as the rain-on-snow event that occurred in January 2009. The volume and timing of surface water runoff from the project area will not increase beyond the existing condition as a result of careful planning and application of stormwater management measures where necessary. The proposed solar reserve development will not result in hundreds of acres of impervious area, as suggested by the WDFW letter. The primary cause of landslides/debris torrents seen in the January 2009 event that impacted Red Bridge Road resulted from land disturbance in drainage that is neither within, nor affected by, the proposed project.

LIMITATIONS

GeoEngineers has prepared this letter report for the exclusive use of the Teanaway Solar Reserve, LLC and their authorized agents for Hydrologic Services for the Teanaway Solar Reserve located in Klickitat County, Washington.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with the generally accepted hydrologic science practices in this area at the time this report was prepared. The conclusions and opinions presented in this report are based on our professional knowledge, judgment and experience. No warranty or other conditions, expressed or implied, should be understood.

APPENDIX C

Time of Concentration Calculations

Time of Concentration Worksheet					
PROJECT:	Teanaway Solar Reserve Project				
BASIN	North Drainage Basin				
LOCATION:	Kittitas County, Washington				
Parameters		**Units**			**Comments**
Total length of Flow	4895	ft			
Sheet Flow Segment					
Length	100	ft			
Slope of hydraulic Grid Line - S_o	0.11	ft/ft			
n_s - Sheet flow Manning' Effective roughness coeff.	0.4				*[HEC-HMS Technical Reference Manual]*
Travel time (sheet Flow Segment) $T_1 = 0.42 (n_sL)^{0.8}/((1.58^*(S_o)^{0.4})$	12.3	min			*[City of Portland Stormwater Management Manual 2004 page C-2]*
Shallow Concentrated Flow Segment					
Length	300	ft			
S_o	0.050	ft/ft			*[City of Portland Stormwater Management Manual 2004 page C-2]*
Velocity V = 16.1345(S_o)^0.5	3.61	ft/s			*[City of Portland Stormwater Management Manual 2004 page C-2]*
T_2 = L/(60*V)	1.4	min			*[City of Portland Stormwater Management Manual 2004 page C-2]*
Pipe Flow Segment					
Length	4495	ft			Assume sheet flows empty into inlets connected to pipes.
T_3 = L/(60*V)	25.0	min			Assume pipe flow velocity of 3fps
T_c	38.7	min			

Time of Concentration Worksheet

PROJECT: Teanaway Solar Reserve Project
BASIN South Drainage Basin
LOCATION: Kittitas County, Washington

Parameters		**Units**			**Comments**
Total length of Flow	7738	ft			
Sheet Flow Segment					
Length	100	ft			
Slope of hydraulic Grid Line - S_o	0.11	ft/ft			
n_s - Sheet flow Manning' Effective roughness coeff.	0.25				*[City of Portland Stormwater Management Manual 2004 page 2-74]*
Travel time (sheet Flow Segment) $T_1 = 0.42\ (n_sL)^{0.8}/((1.58*(S_o)^{0.4})$	8.4	min			*[City of Portland Stormwater Management Manual 2004 page C-2]*
Shallow Concentrated Flow Segment					
Length	300	ft			
S_o	0.070	ft/ft			*[City of Portland Stormwater Management Manual 2004 page C-2]*
Velocity V = $16.1345(S_o)$^0.5	4.27	ft/s			*[City of Portland Stormwater Management Manual 2004 page C-2]*
T_2 = L/(60*V)	1.2	min			*[City of Portland Stormwater Management Manual 2004 page C-2]*
Pipe Flow Segment					
Length	7338	ft			Assume sheet flows empty into inlets connected to pipes.
T_3 = L/(60*V)	40.8	min			Assume pipe flow velocity of 3fps
T_c	50.4	min			

TSR- Substation Location

TO: Anna Nelson, Gordon-Derr
Dan Valoff, Kittitas County

FROM: Nichole Seidell, CH2M HILL

DATE: June 2, 2010

The proposed BPA transmission line and BPA substation were relocated to minimize the visual impact of the proposed project as well as to incorporate input from BPA standards and electrical engineering consultants. The proposed substation location from August 2009 and the proposed relocation from February 2010 are shown on the attached figures.

The initial application situated the substation adjacent to the southern lease line. From this location the substation would have been visible from multiple neighboring properties. To minimize the visual impacts on adjacent residences, the substation was relocated further north into the project area and away from adjacent property lines.

Detailed input from electrical engineering consultants and BPA design criteria suggested that the proposed BPA interconnection tower be located further to the west. The proposed BPA tower will be constructed mid-way between existing BPA transmission line towers within the existing transmission line corridor. The revised location of the BPA interconnection tower will conform to BPA standards as well as create a transmission line corridor into the project site that maintains forested buffers from neighboring properties.

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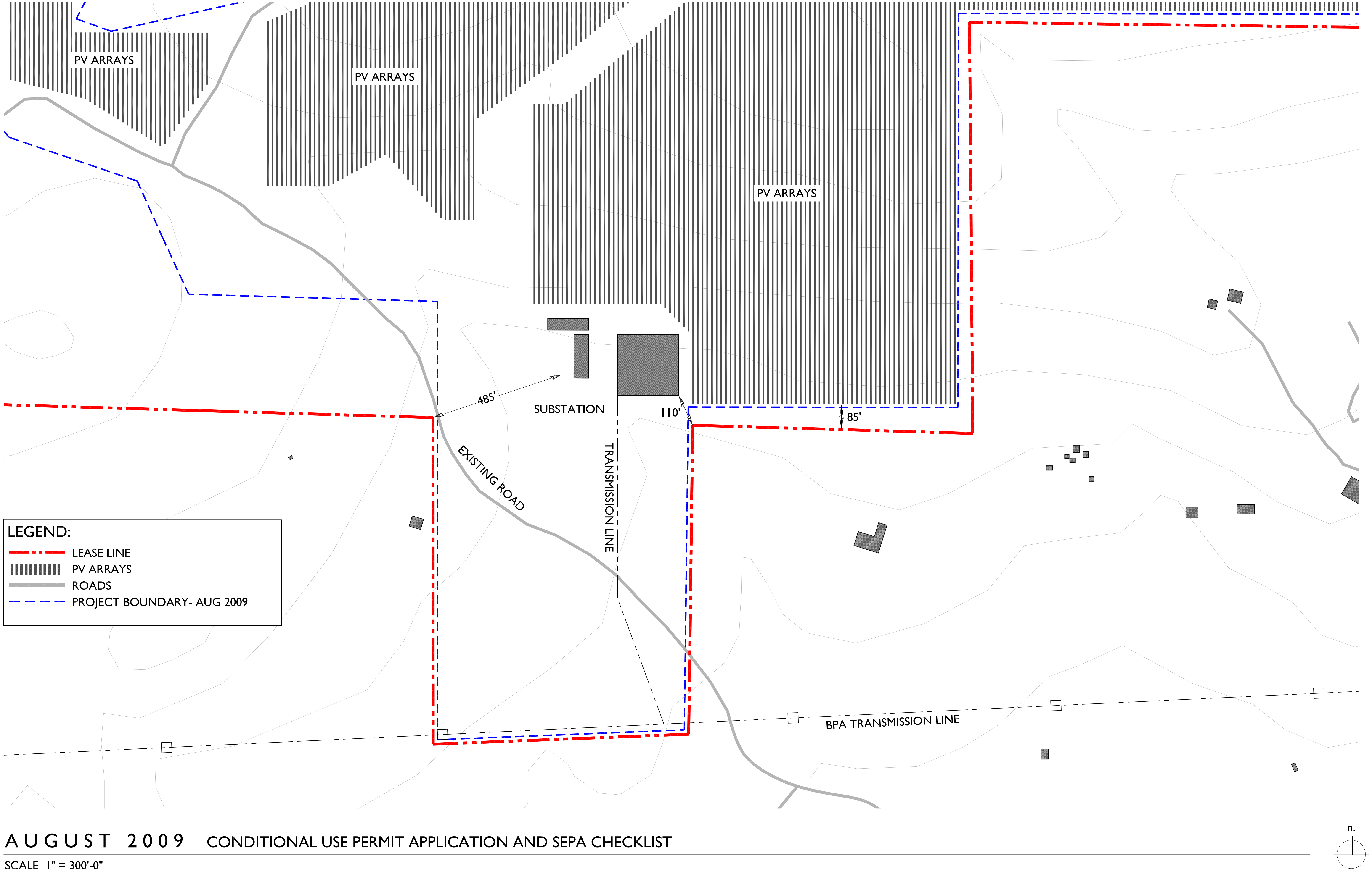
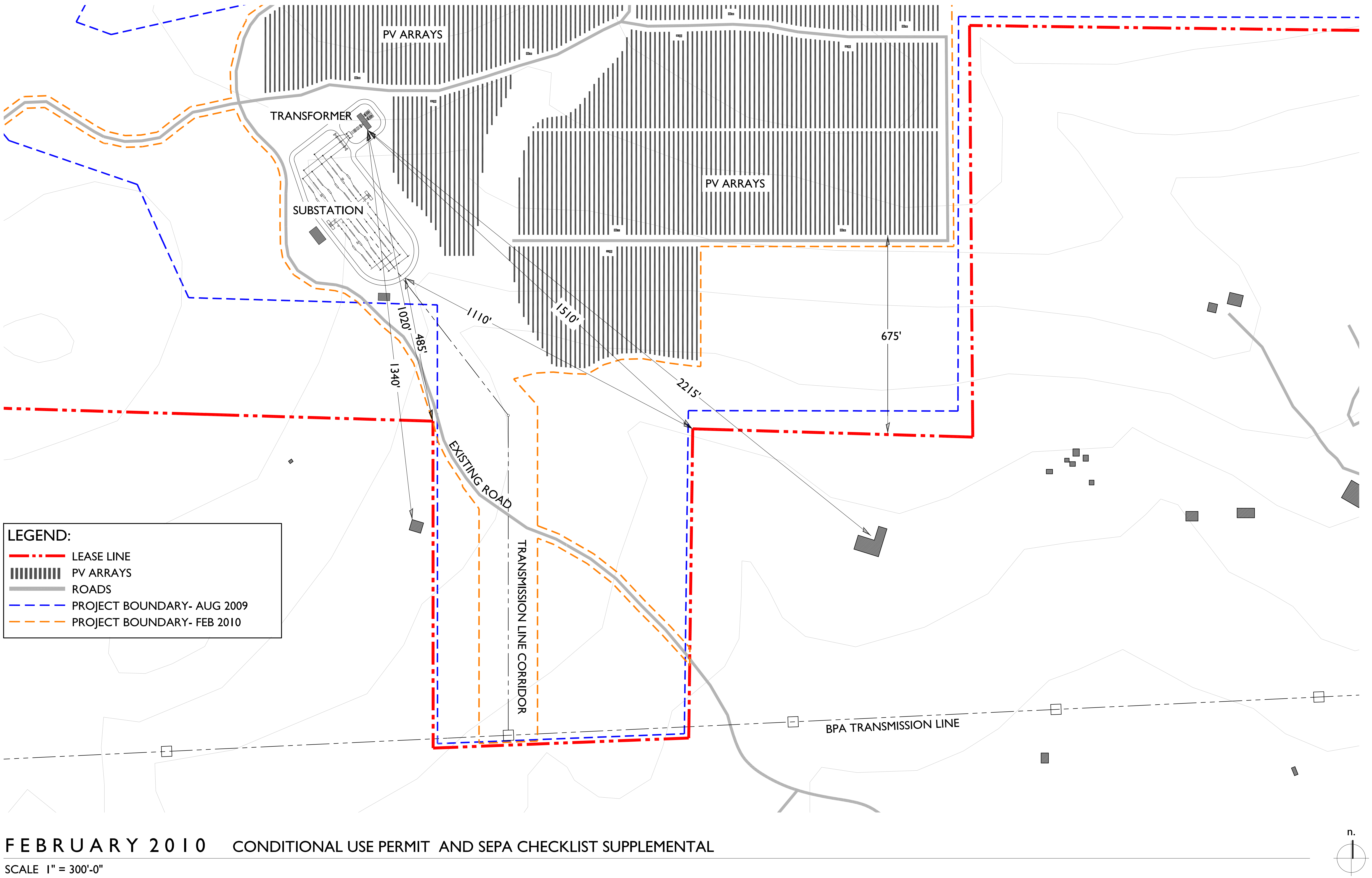


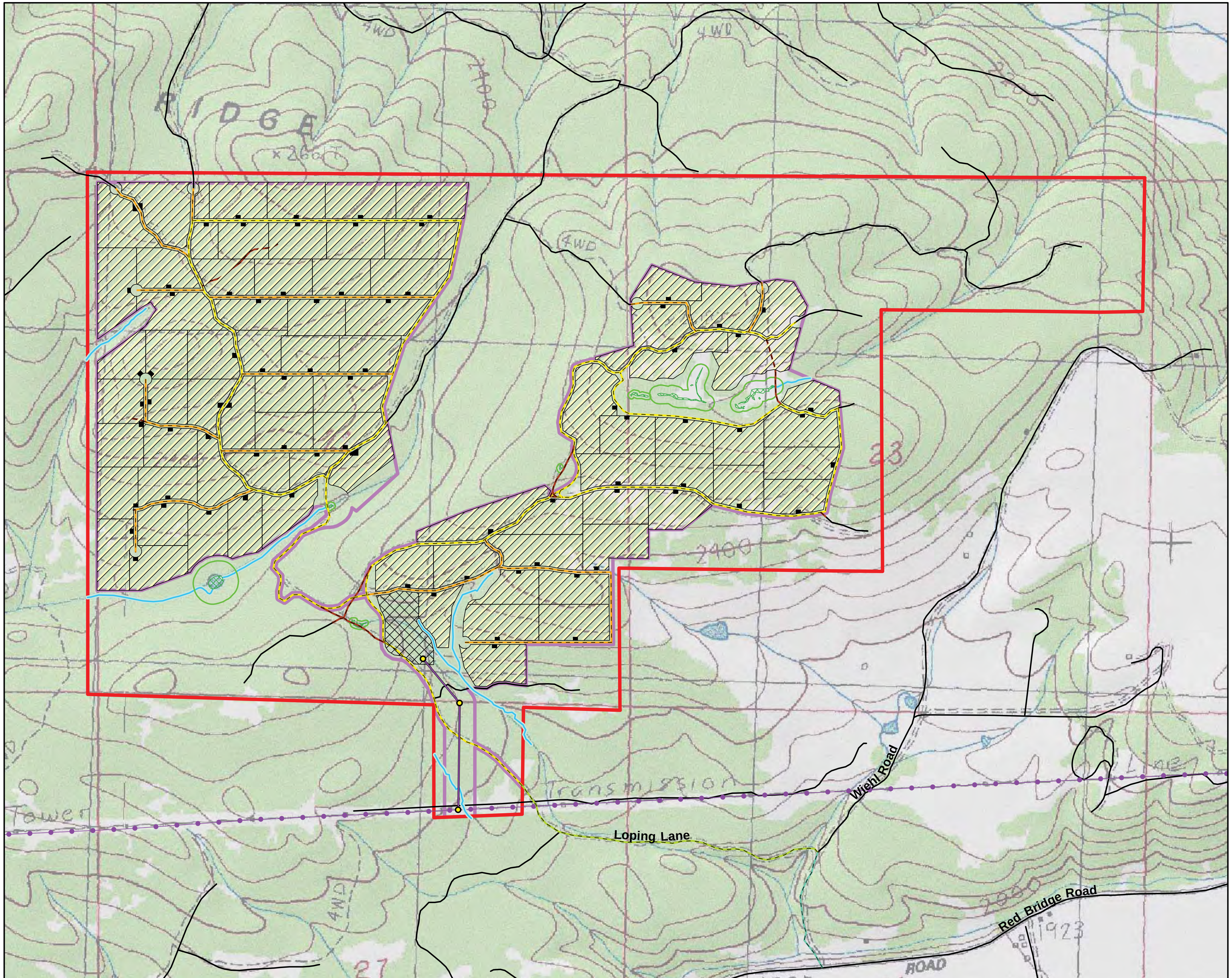
AUGUST 2009 CONDITIONAL USE PERMIT APPLICATION AND SEPA CHECKLIST

SCALE 1" = 300'-0"



FEBRUARY 2010 CONDITIONAL USE PERMIT AND SEPA CHECKLIST SUPPLEMENTAL

SCALE 1" = 300'-0"



VICINITY MAP

LEGEND

Proposed Project Features

- Proposed Project Area (982 Acres)
- Proposed Project Site (477 acres)
- Proposed PV Array Block
- Proposed Field Inverter and Field Transformer
- Proposed Substation/O&M Facility
- Proposed Transmission Line[1]
- Proposed Transmission Structure
- Primary Access Road
- Secondary Access Road
- Proposed Improved Existing County Access Road
- Proposed Improved Existing Private Access Road
- Existing Maintenance Road (Planned Decommissioning)

Existing Features

- Existing BPA Transmission Line and ROW
- Existing Road
- Stream
- Stream Buffer
- Wetland
- Wetland Buffer

Note:
1. TSR has delineated a 300' area within which the BPA transmission line could be sited. Of this 300' area, a maximum of 200' will be cleared for the placement of the BPA transmission line. Final design and placement to be determined by BPA.

N

0 1,000
Feet

1 inch = 1,000 feet

FIGURE 4
Proposed Site Layout
Teanaway Solar Reserve
Kittitas County, Washington

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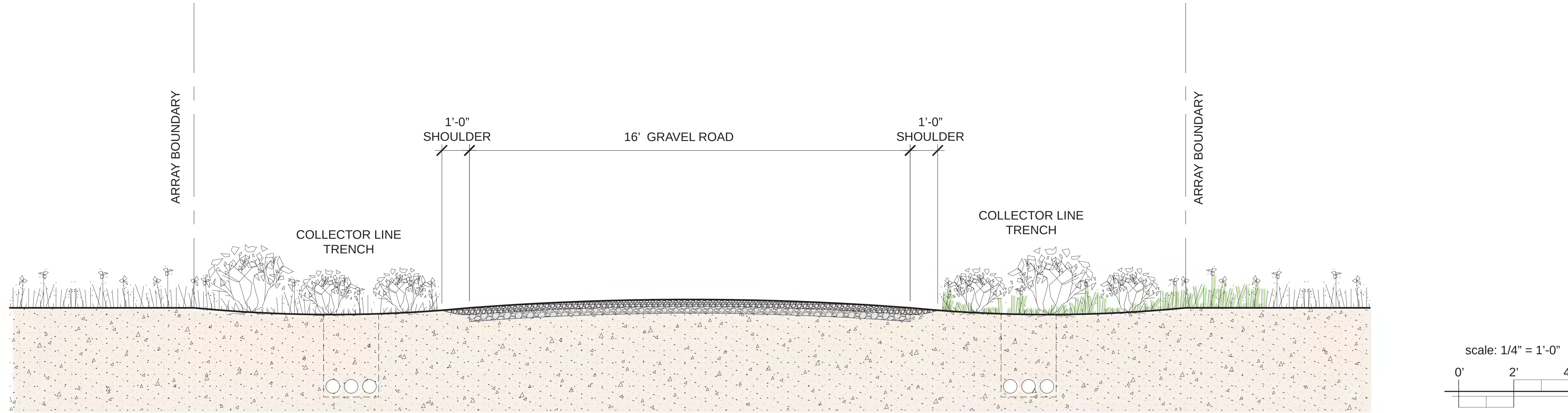
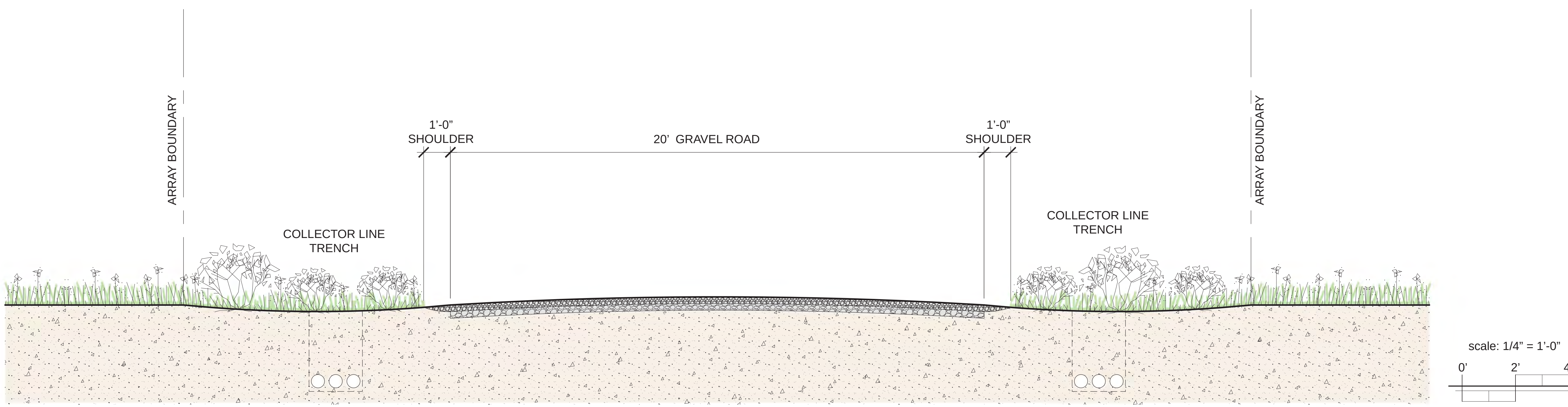
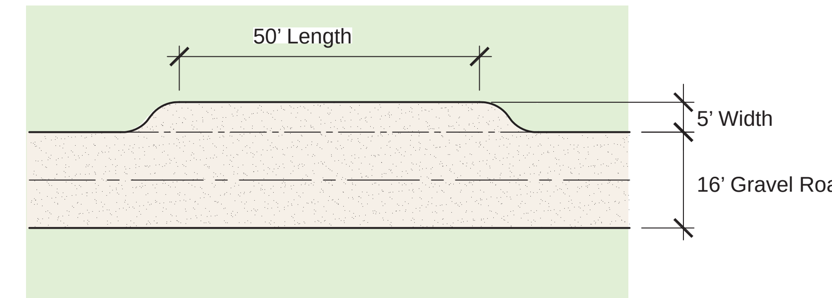


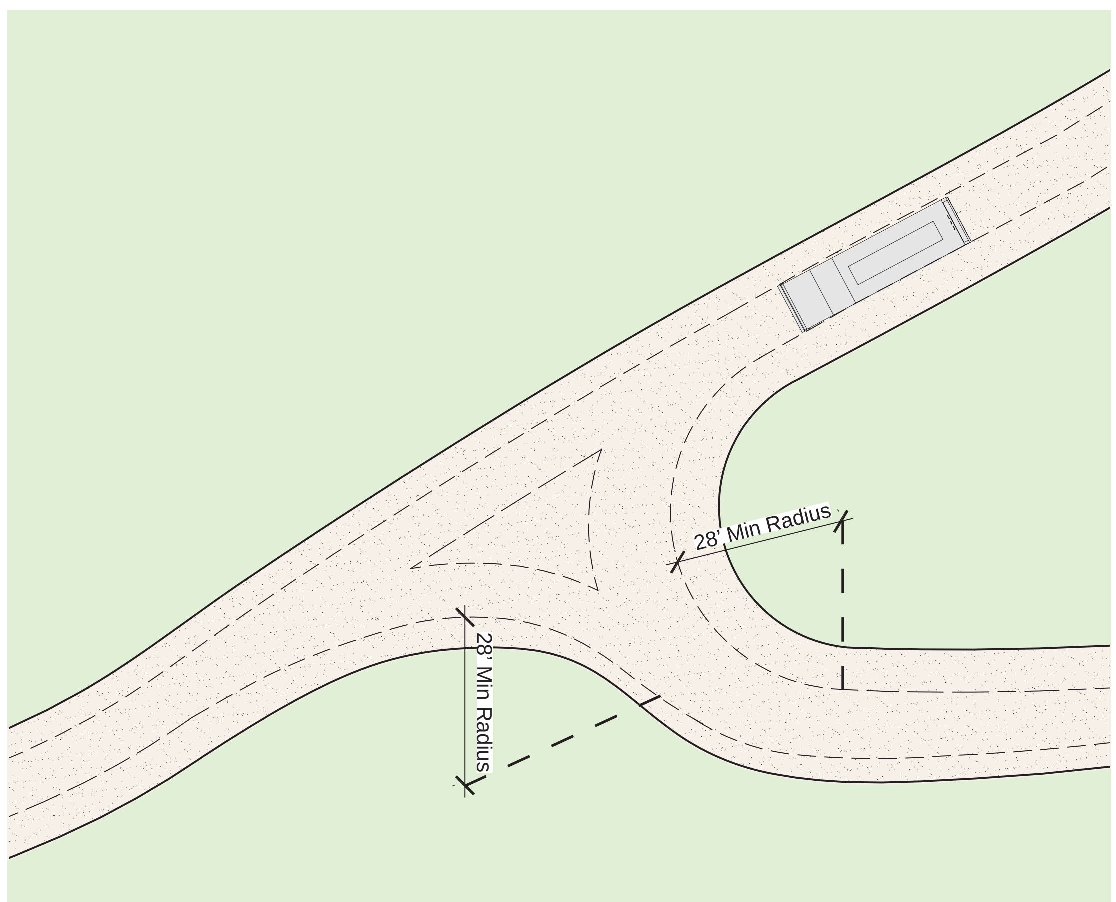
TYPICAL 16' ROAD SECTION



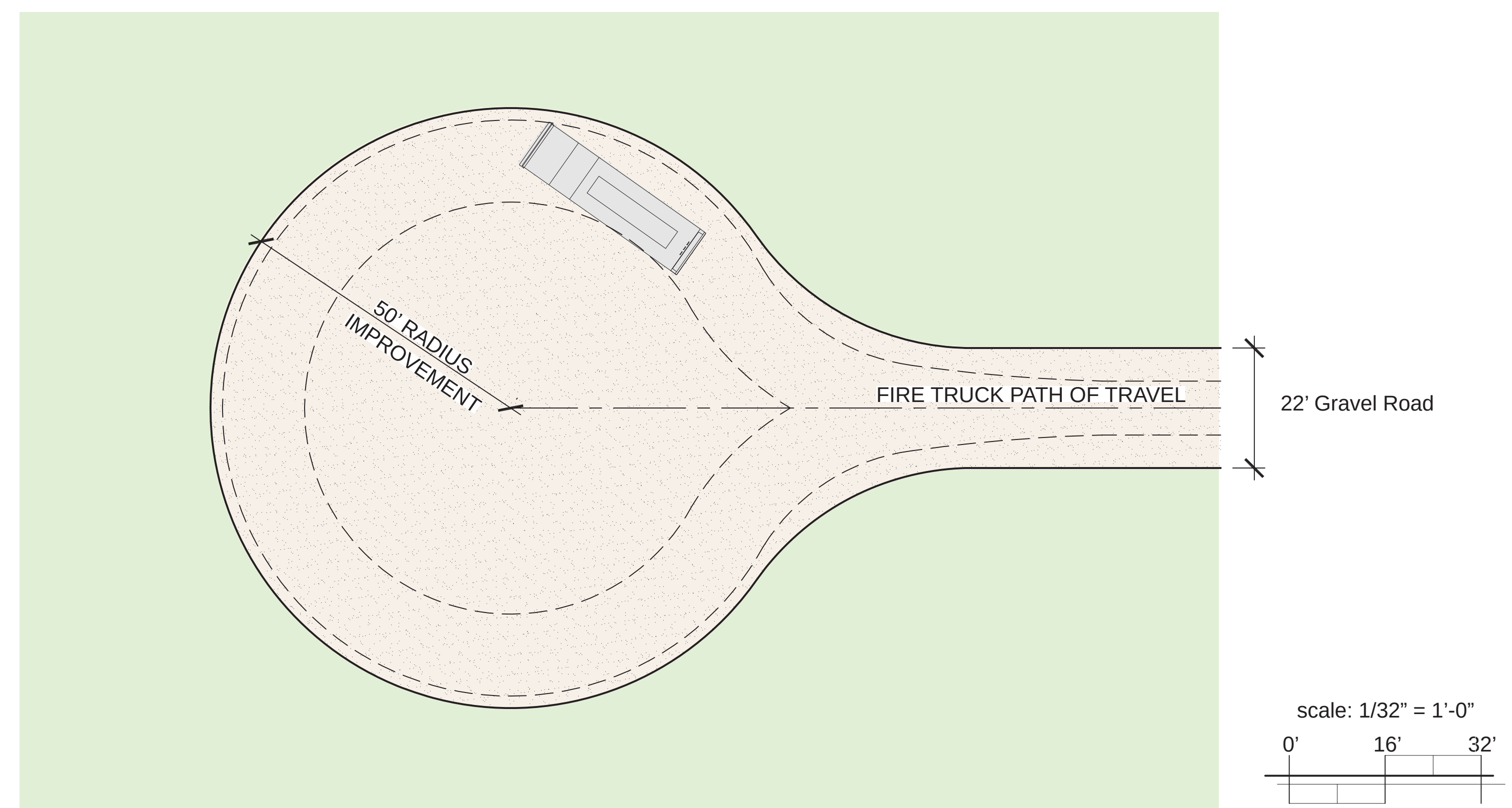
TYPICAL 20' ROAD SECTION



TYPICAL ROAD TURNOUT



TYPICAL ROAD INTERSECTION RADIUS



TYPICAL ROAD TURNAROUND

Road Section and Turnaround
Teanaway Solar Reserve
Kittitas County, Washington