3.1 EARTH RESOURCES

WAC 463-42-302 Natural environment – Earth. *The applicant shall provide detailed descriptions of the existing environment, project impacts, and mitigation measures for the following:*

(1) Geology *– The applicant shall include the results of a comprehensive geologic survey showing conditions at the site, the nature of foundation materials, and potential seismic activities.*

(2) Soils *– The applicant shall describe all procedures to be utilized to minimize erosion and other adverse consequences during removal of vegetation, excavation of borrow pits, foundations and trenches, disposal of surplus materials, and construction of earth fills. The location of such activities shall be described and quantities of material shall be indicated.*

(3) Topography *– The applicant shall include contour maps showing the original topography and any changes likely to occur as a result of energy facility construction and related activities. Contour maps showing proposed shoreline or channel changes shall also be furnished.*

(4) Unique physical features *– The applicant shall list any unusual or unique geologic or physical features in the project area or areas potentially affected by the project.*

(5) Erosion/Enlargement of the land area (accretion) *– The applicant shall identify any potential for erosion, deposition, or change of any land surface, shoreline, beach, or submarine area due to construction activities, placement of permanent or temporary structures, or changes in drainage resulting from construction or placement of facilities associated with construction or operation of the proposed energy project.*

3.1.1 Geography

3.1.1.1 Regional Geography

The proposed Kittitas Valley Wind Power Project (Project) is located in the Kittitas Valley area of Kittitas County in south central Washington. Comprising a geographic area of 5,978 square kilometers (2,308 square miles), Kittitas County ranks eighth in size among Washington counties. The county is located east of the Cascade Range in the geographical center of the state and is bounded to the north by Chelan County, to the south by Yakima County, and to the east by Grant County. The Pacific Crest Trail, high in the Cascade Range, forms its boundary to the west with King County.

The terrain in the county's northwest corner is in the southern extension of the Wenatchee National Forest and consists of rugged and heavily forested wilderness. At higher elevations, a series of major rivers carries precipitation and snow-melt out of the Cascades and into the Kittitas Valley. The Cooper and Waptus Rivers feed into the Cle Elum River while the North, West, and Middle Forks of the Teanaway River converge and become the main stem of the Teanaway River. Descending out of the mountains, the Cle Elum and Teanaway Rivers then feed into the Yakima River, which flows across the remaining expanse of Kittitas County (including Ellensburg) before winding south into Yakima County.

The Wenatchee Mountains extend from the Cascade Range and run the length of the county's northern border. Surface waters that originate in this area of the Wenatchee Mountains include Naneum and Caribou Creeks, both of which eventually join the Yakima River south of Ellensburg. To the south, the Saddle Mountains and the Manastash and Umtanum ridges are a physical barrier that runs east and west to form the county's southern border with Yakima County.

3.1.2 Geology

3.1.2.1 Regional Geology

The Project area is located on the Columbia Plateau, a broad expanse of land located at the eastern base of the Cascade Range, and at the western edge of the Columbia Intermontane Physiographic Province (Freeman and others, 1945). This lowland province, surrounded on all sides by mountain ranges and highlands, covers a vast area of eastern Washington, and extends south into Oregon. The province is characterized by moderate topography incised by a network of streams and rivers that empty into the centrally located Columbia River.

The Columbia Plateau is underlain by a series of layered basalt flows extruded from vents (located mainly in southeastern Washington and northeastern Oregon) during the Miocene epoch (between 7 and 26 million years before present [B.P.]). Collectively, these basalt flows are known as the Columbia River Basalt Group. Individual basalt flows range in thickness from a few millimeters to as much as 300 feet.

A variety of sedimentary materials (overburden) from Pliocene (2 to 7 million years B.P.) to Holocene (the last 0.01 million years B.P.) are intermixed and overlie the Columbia River Basalt Group. Along the borders of the plateau, the basalts are underlain by Precambrian (more than 570 million years B.P.) to early Tertiary (65 million years B.P.) rock, which is mostly volcanic and metamorphic in origin. Sedimentary rocks are generally thought to underlie the basalts in the Project area (USGS, 2000).

The Columbia Plateau was divided into three informal physiographic subprovinces by Myers and Price (1979) – the Yakima Fold Belt, Blue Mountains, and Palouse subdivisions.

3.1.2.2 Local Geology

The Project site is located in the Yakima Fold Belt subprovince, an area that includes most of the western half of the Columbia Plateau north of the crest of the Blue Mountains. Structurally, the Yakima Fold Belt subprovince is characterized by long, narrow anticlines with intervening narrow to broad synclines that trend in an easterly to southeasterly direction from the western margin of the plateau to its center. The anticlines are generally asymmetrical with the steepest limb to the north. Most major faults are thrust or reverse faults whose strikes are similar to the anticlinal fold axes; the faults are probably contemporaneous with the folding. Northwest- to north-trending shear zones and minor folds commonly transect the major folds (USGS, 2000).

The bedrock underlying the Project site consists of interbedded Miocene basalt flows and weakly lithified volcaniclastic siltstone and sandstone of the Ellensburg Formation. Pliocene to Holocene alluvium, glacial, flood, and mass-wastage deposits constitute the surface materials or overburden that directly overlies the bedrock.

The basaltic bedrock underlying the Project site consists of lava flows of the Grande Ronde Basalt. This basalt is the most abundant and widespread formation of the Columbia River Basalt Group. It consists of about 120 individual flow units and makes up about 90 percent of the total volume of the Columbia River Basalt Group. The thickness of the basalt below the site is not known, but may be as much as 1,000 feet.

A single fault is mapped in the Project area, trending east-west near the intersection of Highway 97 and Bettas Road. This fault is a high-angle fault with its north side downthrown, and crosses Highway 97 approximately 2,493 feet north of Bettas Road. Running east, the fault is inferred in a location that intersects the H, I, and J turbine strings. The fault location underlies the southernmost turbine in turbine string H (H_{23}). It passes beneath turbine I_{19} on the I turbine string, and approximately between turbines J_{10} and J_{11} on the J turbine string. The fault is estimated to have last been active during the Miocene epoch . The total length of the fault is approximately 2.5 miles, and is illustrated in Exhibit 6, 'Geotechnical Data Report'. Prior to final project design, a detailed geotechnical investigation and turbine location field survey will be performed to ensure that no turbine locations lie immediately above a high risk fault line.

While it is possible that there may have been displacement on some of these inferred faults between 700,000 and 140,000 years B.P., the geologic deposits present on the ground surface of the Kittitas Valley do not allow this to be determined. Reidel and others (1994) indicate that the most recent movement on faults in Kittitas Valley may have been during the Pleistocene (between 11,000 and 1.8 million years B.P.). However, they reference the work of Waitt (1979) and do not present any new data to support Landau's inference that displacement could be as recent as 10,000 to 13,000 years ago (Molinari, 1999).

Mineral resources in the immediate vicinity of the Project site includes active and inactive commercial and private rock quarries. In addition, the area is a known resource for a rare type of agate known as the "Ellensburg Blue," which is classified by some gemologists as a precious gem. It is possible that the Ellensburg Blue agate could be found on public lands (Washington Department of Natural Resources [DNR] parcels) where Project facilities would be located. However, most of the areas where the Project would coexist with potential deposits of the Ellensburg Blue agate are on privately owned land, or DNR land which has no public access and therefore is closed to the public except by special permission of the adjacent landowner(s).

3.1.3 Project Area Soils

Soils in the Project area along the ridgetops primarily consist of complexes of shallow to moderately deep mineral soils (known as durixerolls) that formed in alluvium and glacial drift over a duripan (a silica-cemented subsurface horizon). Loess mixed with volcanic ash is typically present at the surface. Ridgetop soils in this portion of the Project area (which includes the turbine areas) include the following series (USDA, 2002*a*):

<u>*Lablue Series*</u>
The Lablue series consists of shallow, well-drained soils that formed in alluvium and glacial drift over a duripan with an influence of loess mixed with volcanic ash in the surface. Lablue soils are on old uplifted fan remnants, old terraces, and old till plains and are 7 to 10 inches to a duripan. Slopes are 3 to 15 percent.

Reelow Series
The Reelow series consists of shallow, well-drained soils that formed in alluvium and glacial drift over a duripan with an influence of loess mixed with volcanic ash in the surface. They are on old uplifted fan remnants, old terraces, and old till plains and are 10 to 20 inches to a duripan.

Sketter Series
The Sketter series consists of moderately deep, well-drained soils formed in alluvium and glacial drift over a duripan with an influence of loess mixed with volcanic ash in the surface. They are on old uplifted fan remnants, old terraces, and old till plains. Slopes are 2 to 15 percent.

Reeser Series
The Reeser series consists of moderately deep, well-drained soils that formed in alluvium and glacial drift over a duripan with an influence of loess mixed with volcanic ash in the surface. They are on old uplifted fan remnants, old terraces, and old till plains. Slopes are 2 to 15 percent.

For information on project area soils and stormwater runoff, see section 3.3.2, 'Runoff/Absorption'. For information on Project area soils as they relate to construction, see Exhibit 6, 'Geotech Data Report'.

3.1.4 Local Geography and Topography

The Kittitas Valley Wind Power Project is located east and north of the Yakima River, to the west of Green Canyon. The Project will be built on the ridges that slope south from Table Mountain, which is part of the Wenatchee Mountains. Although these ridges slope gently southward along their spines, their transverse slopes are steep. The Project site and adjacent lands range in elevation from approximately 2,200 to 3,100 feet above mean sea level.

The Project area extends across a 3.5- by 5 mile portion of land that consists primarily of long north-south trending ridges. Between the ridges are ephemeral and perennial creeks that flow into the Yakima River, which is located just south of the Project area. Slopes within the Project area generally range from 5 degrees to 20 degrees, but can reach 40 degrees or more in some of the stream canyons. Exhibit 1, 'Project Site Layout' presents a topographic map of the Project site.

3.1.5 Project Area Vegetation

As noted above, the Project area and adjacent lands range in elevation from approximately 660 to 1,050 meters (2,165 to 3,445 feet). The lowest elevation is within the shrub-steppe zone. Open range with minimal vegetation comprises the majority of the Project area. The vegetation is dominated by native bunchgrass and low shrubs, such as bitterbrush and stiff sage. Most of the ridgetops proposed for development consist of dry, rocky grassland. Plant life in the Project area is described in further detail in Section 3.4.1, 'Vegetation'.

3.1.6 Unusual Physical Features

There are no unique or unusual features in project or areas affected by the Project.

3.1.7 Erosion Potential and Storm Design

Impacts to the geologic formations during construction would be moderate to low. The Project would alter the landscape with minor cuts-and-fills for roadways and leveling for turbine foundations. These alterations would result in minimal impact to existing topography and surface drainage and not cause any significant change.

Because the construction of roads, turbine foundations and other Project facilities would be engineered, these facilities would be subject to the requirements of a National Pollutant Discharge Elimination System (NPDES) storm water construction permit and other pertinent construction and project operation permits and pollution control regulations as described in Section 7.1, 'National Pollutant Discharge Elimination System Permit Application' and Section 2.10, 'Surface Water Runoff'. These regulations would require the development of an erosion control plan and implementation of erosion control best management practices (BMPs) during Project construction and operation. As a result, it is likely that Project facilities would be constructed with more protections against erosion than existing farm roads in the Project area.

For more information on runoff absorption, see section 3.3.2, 'Runoff/Absorption'.

3.1.8 Disposal of Surplus Materials and Construction of Earth Fills

Most surplus materials generated during Project construction will be earthen materials that originate from road cuts, cable trenching and excavations of pits for turbine foundations. Excavation and foundation construction will be conducted in a manner that will minimize the size and duration of excavated areas required to install foundations. Portions of the work may require over excavation and/or shoring. Foundation work for a given excavation will commence after excavation of the area is complete. Backfill for the foundations will be installed immediately after approval by the engineer's field inspectors. The Applicant plans on using on-site excavated materials for backfill to the extent possible.

Based on preliminary calculations and depending on the type of foundation design used, approximately 125 cubic yards of excavated soil will remain from each turbine foundation excavation. The excess soils not used as backfill for the foundations will be used to level out low spots on the crane pads and roads consistent with the surounding grade. The edges of the disturbed areas will be reseeded with a designated mix of grasses and/or seeds around. Larger cobbles will be used a road edge perimeter boundaries, disposed of off- site, or crushed into smaller rock for use as backfill or road material. All excavation and foundation construction work will be done in accordance to a formal Storm Water Pollution Prevention Plan (SWPPP) for the Project as outlined in Section 2.10, 'Surface Water Runoff'.