Winter 2012

Galbraith Mountain wind power proposal: environmental impact assessment

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Galbraith Mountain
Wind Power Proposal

Environmental Impact Assessment
Huxley College of the Environment
Western Washington University
Winter 2012
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<td>Steffi Nuerenberg</td>
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<td>Sean Jobes</td>
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<td>Zane Beall</td>
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Dear Citizens Letter

Dear Concerned Citizen:

The following environmental impact assessment (EIA) has been prepared with the intent of assessing the probable and potential environmental impacts associated with the installation of a wind turbine on top of Galbraith Mountain. This EIA has been prepared within the specifications and requirements of Washington State’s Environmental Policy Act (SEPA), and has been compiled in accordance with the relevant legislation, Washington Administrative Code (WAC) 197-11-430. As a student project under the oversight of Dr. Leo Bodensteiner, the following EIA is in fact only an academic exercise, prepared for Environmental Science 436 at Western Washington University.

The implementation of a 2.5-MW Kenersys K100 wind turbine is proposed with the intention of generating inexpensive, clean electricity for up to 1,000 energy efficient homes in Bellingham, Washington. Wind power presents a viable alternative to coal and natural gas, and can help to reduce carbon emissions from local areas where its power is harnessed. The project’s proponents advocate for the reduction of carbon emissions, and promote the wind turbine project as a practical solution for clean power. The following document will outline potential environmental impacts associated with construction and operation of the wind turbine, as well as the implementation of an alternative solar array solution at Lake Padden Park. It should be noted that a “No Action” alternative will have no impacts on the proposal site.

Compiling scientific research from comparable wind turbine usage, county geographical information system (GIS) data, and local wildlife data, this EIA attempts to predict potential impacts, and assess the dangers or benefits associated with each impact. We thank you for taking the time to participate in these civic actions, and hope this document is as encompassing of all necessary data as possible.

Sincerely,

Galbraith Wind Turbine EIA Members:

Zane Beall, Sean Jobes, Anna Herbel, Jaime Liljegren, & Steffi Nuerenberg
Fact Sheet
Title: Mt. Galbraith Wind Power Proposal

Description of Project:
The goal of the project is to construct a single 320-meter tall, 2.5 MW wind turbine on the top of Mt. Galbraith in the Chuckanut Mountains. A wind turbine would provide enough power to fuel 1000 energy-efficient homes and would be an important step towards Bellingham's movement to renewable energy.

Description of Location:
The proposed turbine is to be placed on an area owned by Bertch Timberlands leased to Convivium Wind Energy. The site coordinates are 48°42' 29.85"N, 122° 23' 10.44"W located on Galbraith Mountain. The site is surrounded by Lakes Whatcom, Samish and Padden and is at an elevation of 496 meters or 1627.3 feet.

Proposal Entity: Huxley College of the Environment

Lead Agency: Bodensteiner, LLC

Related Permits and Laws:
Clean Air Act (CAA)
Clean Water Act (CWA)
Endangered Species Act (ESA) of 1973
Migratory Bird Act of 1918
Priority Habitat Species (PHS) List
Bald Eagle Protection Act (Eagle Act) of 1940
National Ambient Air Quality Standards (NAAQS)
Occupational Safety and Health Act of 1970
Washington State Surface Water Quality Criteria
Washington Critical Areas Ordinance (CAO)
Noise Control Act of 1972

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Sean Jobes: Air and Water
Anna Herbel: Wildlife, Vegetation and Land Use
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Bellingham Public Library
210 Central Ave CS 9710
Bellingham, WA 98225
(360) 778-7323
Glossary of Technical Terms, Acronyms and Abbreviations

Absorbents: A substance that is capable of easily soaking up a liquid.

Absorption: In context, absorption is the process of water being soaked up, primarily by the surrounding earth.

Alluvium: A deposit of clay, silt, sand, and gravel left by flowing streams in a river valley or delta, typically producing fertile soil.

Avian: Of or pertaining to birds.

Back Slopes: The component of the hill slope that forms the steepest inclined surface and is frequently the principal element. The surface is dominantly steep and linear in profile and erosional in origin.

Bedrock: Solid unweathered rock beneath the surface, under the deposits of soil layers.

Bellingham Municipal Code: Regulations that govern the City of Bellingham.

Carbon Monoxide: One of the EPA’s six criteria pollutants. A colorless, odorless toxic flammable gas formed by incomplete combustion of carbon.

Cascadia Subduction Zone: The fault along the Pacific Ocean that stretches from Vancouver to Northern California and separates the Juan de Fuca and North American plates.

Colluvium: Material that accumulates at the foot of a steep slope.

Compaction: The packing together of soils as a result of a downward force, resulting in decreased water infiltration.

Conditional Use Permit: Provides flexibility within a zoning ordinance; allows projects that may be beneficial or necessary to the community to be conducted within an area in which they are not zoned for completion.

Conglomerate: A coarse-grained sedimentary rock composed of rounded fragments (> 2 mm) within a matrix of finer grained material.

Corrosion: The wearing away of a substance, caused by external sources such as air or saltwater.

Detritus: Dead plant and animal litter.
**Disturbance:** Any alteration to the natural surface of the ground through the use of construction equipment, tractors, and similar equipment.

**DNR Land:** Public land maintained by the Department of Natural Resources.

**Driven piles:** Structural support made of wood, reinforced concrete or steel to build a deep foundation for large structures.

**Electrical Grid:** An electrical grid is an interconnected network for delivering electricity from suppliers to consumers.

**Erosion Hazard Area:** Regions with soil contents that may undergo severe erosion with construction.

**Erosion:** The process of eroding or being eroded by wind, water, or other natural agents.

**Foundation:** A body or ground on which other parts rest or are overlaid.

**Geology:** The science that deals with the earth's physical structure and substance, its history, and the processes that act on it.

**Grading:** Reducing the slope (or grade) of a road or construction site to a reasonable level plane.

**Ground Water:** Water held underground in the soil or in pores and crevices in rock.

**Haplothods:** From spodosol soil order, minimum horizons. Present in cold moist climates.

**HAZMAT Team:** A trained group of individuals that respond to spills and breaches of hazardous materials. Hazardous materials are solids, liquids, or gases that pose the threat to harm humans, or other living organisms.

**Hemorrhage:** A profuse discharge of blood, as from a ruptured blood vessel; bleeding.

**High Voltage Transmission Lines:** Electrical circuits in which the high voltages used are cause for concern to the safety of individuals at risk of touching them.

**Hill Slopes:** The steeper part of a hill between its summit and the drainage line or valley floor.

**Hydraulic Fluids:** Medium by which power is transferred in hydraulic machinery.
**Hydric**: Soils that formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part.

**Hydrocarbon**: A compound of hydrogen and carbon, such as any of those that are the chief components of petroleum and natural gas. Often found in the exhaust from internal combustion engines.

**Ice Throw**: Meteorologic conditions during winter can result in a build-up of ice on the rotor blades of a wind turbine tower structure when the blades are not moving. Ice throw occurs when these sheets of ice are “thrown” from the spinning rotor blades.

**Impermeable/Impervious Surface**: Mainly artificial structures that are covered by impenetrable materials such as asphalt, concrete, brick, and stone.

**Infiltration**: The process by which water on the surface of the ground enters the soil via absorption.

**Landslide Hazard Area**: Regions that have a high risk of landslides and/or movement of soil, fill, rock or other geologic material.

**Lead**: One of the EPA’s six criteria pollutants. A heavy, bluish-gray, soft, ductile metal. Known to cause neurological damage and other health concerns.

**Loam**: A mix of sand, silt or clay, and organic matter.

**Metamorphic Rock**: The metamorphosis of sedimentary and igneous rocks by conditions underground. The four main agents that metamorphose rocks are heat, pressure, fluids and strain.

**Migratory**: Periodically migrating, or passing periodically from one region or climate to another.

**Mitigation**: The avoidance, minimization, rectification, compensation, reduction, or elimination of adverse impacts to built and natural elements of the environment.

**Negligible**: Small and/or insignificant enough not to be considered.

**Nitrogen Dioxide**: One of the EPA’s six criteria pollutants. An air pollutant, a constituent of untreated automobile exhaust.

**NTU**: A measure of turbidity, or water cloudiness; [*nephel-* Greek for “cloud”].

**Overhead Distribution Lines**: An electrical power transmission line suspended by utility poles.
Ozone: One of the EPA’s six criteria pollutants. A colorless unstable toxic gas with a pungent odor and powerful oxidizing properties, formed from oxygen by electrical discharges or ultraviolet light.

Paralithic: Relatively unaltered materials that have an extremely weakly cemented to moderately cemented rupture-resistance class.

Particulate Matter: One of the EPA’s six criteria pollutants. A complex mixture of extremely small particles and liquid droplets. Particle pollution is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles.

Pitch System: Mechanism to adjust the rotor blades of a wind turbine.

Redd: The spawning area of salmonids.

Retention pond: An artificial lake with vegetation around the perimeter, which includes a permanent pool of water in its design.

Revel Loam: Deep, well-drained soils formed in colluvium and slope alluvium from sandstone, volcanic ash and glacial till. Present on glacially modified mountain slopes, ridges and plateaus.

Revised Code of Washington, (RCW): The compilation of all enforced permanent laws in Washington State as passed by the state legislature.

Rotor: The rotor of a turbine powered by fluid pressure.

Runoff: Water flow that occurs when the soil is infiltrated to full capacity and excess water from rain, meltwater, or other sources flows over the land.

Salmonid: Belonging or pertaining to the family Salmonidae, including the salmons, trouts, chars, and whitefishes.

Saturation: The state or process that occurs when no more of something can be absorbed, combined with, or added.

Sedimentation: The process by which particles in suspension to settle out of fluid and deposit themselves against a barrier. Can result in polluted and clogged waterways.

Seismic Hazard: Of or relating to earthquakes or other vibrations of the earth and its crust.

Settlement: Sinking of part or all of a structure from soil movement or erosion.
**Shadow Flicker**: Condition that occurs when rotating wind turbine blades cast shadows upon stationary objects.

**Shale**: Soft, finely stratified sedimentary rock that formed from consolidated mud or clay and can be split easily into fragile plates.

**Significant impact**: An impact that causes a severe affect on the natural environment from which the species, habitat or ecological systems cannot recover.

**Soil Compaction**: An increase in the density of something.

**Soil Density**: The degree of compactness of a substance.

**Substratum**: An underlying layer or substance, in particular a layer of rock or soil beneath the surface of the ground.

**Sulfur Dioxide**: One of the EPA’s six criteria pollutants. A colorless pungent toxic gas formed by burning sulfur in air.

**Surface Water**: Water that is collected on the ground, in streams, rivers, lakes, wetlands, or other surface bodies.

**Swept Area**: Area in square feet defined by the rotor’s path. Power output of a wind turbine is directly related to the area swept by the blades.

**Toe Slopes**: The outermost inclined surface at the base of a hill.

**Transmission Substations**: A bank of step up transformers near the generating station, increasing the voltage.

**Trenching**: A long narrow ditch embanked with its own soil and used for concealment.

**Turbidity**: Water cloudiness or the amount of suspended solids in water, measured in NTU, or nephelometric turbidity units.

**U.S. Department of the Interior Bureau of Land Management (BLM)**: An agency of the United States Government that oversees America’s public lands.

**Vertical Slope Updrafts**: The movement upward of air along slopes, cliffs, etc.

**Washington Administrative Code (WAC)**: Regulations created by executive agencies and used as a source of primary law in Washington State.
**Washington Department of Natural Resources (WDNR):** Agency within the Washington state government responsible for forest, range, agricultural, commercial lands, and tidelands, including monitoring their cleanup.

**Water Table:** The level below which the ground is saturated with water.

**Watershed:** The region or area drained by a river, stream, etc. into a lake.

**Wildlife:** Undomesticated animals living in the wild, including those hunted for food, sport, or profit.

**Yaw System:** Component responsible for the orientation of the wind turbine rotor towards the wind.
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Chapter 1: Executive Summary of Proposed Project Actions

1.1 Executive Summary

Around the world, wind energy is becoming an increasingly popular renewable alternative to fossil fuels. The U.S alone has installed roughly 35% of the world’s wind capacity over the past four years, a capacity double that of recent coal and nuclear installation combined. Washington State’s total amount of installed wind capacity is among the top five in the country (AWEA, 2011).

Cascade Community Wind has acquired a conditional use permit to construct the first large, 2.5-megawatt wind turbine in Whatcom County on Galbraith Mountain, near Bellingham, Washington. The 2.5 megawatts of wind capacity is expected to provide enough energy to power 1,000 energy-efficient homes. The intended site is located on land owned by Bertch Timblerlands LLC and is zoned for commercial forestry. The timber company is interested in the turbine’s capacity to produce income during the times that harvest is not occurring and has agreed to lease land to Cascade Community Wind (Stark, 2011).

Currently Galbraith Mountain serves as a recreational area for bicyclists and the project is not expected to have any long-term, adverse effects on this activity. The nearest home is over a mile away from the proposed site.

This Environmental Impact Assessment (EIA) will consider potential impacts that this project will inflict on the surrounding environment, including impacts on soil, water, air, wildlife, vegetation, land use, transportation, utilities, public services, environmental health and energy and resources and assess their significance. The site is located on the boundary between the Lake Whatcom and Lake Samish watershed and has the greatest potential impacts on water, soil and wildlife. This assessment will also propose a solar array alternative to the proposed wind turbine installation. The solar array alternative is expected to mitigate all the Proposed Action’s potential impacts.
## 1.2 Decision Matrix

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### Key

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1.4 Site History

The proposed site of the wind turbine is on a ridge of Galbraith Mountain in Bellingham, Washington. The mountain spans over 3,600 acres and is used recreationally by the public and privately for timber harvest by local timber companies. Also known as Lookout Mountain, it is east of Bellingham outside the city limits and encompasses 44 miles of mountain-biking trails.

The proposed site area is owned by Bertch Timberlands and surrounded by lands owned by Washington Department of Natural Resources, Polygon Corporation and Bloedel Timberlands. Bertch Timberlands is a Woodinville-based family firm that has taken ownership of the land for the proposed sight. Logged has taken place at and around the proposed location in the last 15 years. Private timber owners are showing increased interest in cell towers, wind turbines and any other cash-producing enterprise on their lands.

Galbraith Mountain is open only to non-motorized use including hiking, biking, and horseback riding. For years timber companies and recreational users have coexisted on Galbraith. A 3,125-acre area was owned by the Trillium Corporation until April 1, 2010, when the company surrendered the property to Polygon Financial Partners instead of defaulting on the loan held by Polygon (Relyea 2010). In the past 15 years Galbraith Mountain has been frequented by motorized and non-motorized users alike but written or explicit permission by the previous land owner was never granted. The whole area was under a very relaxed land management policy until it was purchased by Trillium.

Galbraith Mountain has two main summits, which are 1,365 ft and 1,785 ft high (Trillium). The Whatcom Independent Mountain Pedalers created and maintained a large trail system under a 2005 contract with Trillium, a contract currently continued with Polygon (WHIMPS 2008). There is active logging on the flanks of the mountain, which has opened clear sight lines from the trails which criss-cross the area.

Chapter 2: Alternatives to the Proposed Action

2.1 Introduction

This section discusses the Alternative Proposal as well as the No Action proposal in detail.
2.2 Alternatives Considered in Detail

2.2.1 Proposed Solar Power Project at Padden Lake

The Alternative Proposal is to construct a solar carport at the upper Lake Padden parking area, the designated parking location for Galbraith Mountain. The carport will use made-in-Washington, Silicon Energy SiE200 modules. Each individual module is rated to output 200 watts. The total array will consist of approximately 5,000 of the SiE200 modules. The carport will require either a metal or wood structure to accommodate the modules in addition to airplane-grade aluminum mounting brackets. The Silicon Energy modules contain only raw Silicon and Aluminum. There are no other chemicals or fluids associated with the array that could be released into the environment and impose adverse impacts. These modules have been UL lab tested to withstand extreme weather conditions and fire hazards.

The construction process will require the use of a van or truck to transport the panels north from Marysville, Washington. Once at the site at Lake Padden, a forklift will be required for the construction of the framing structure as well as lifting the modules. The modules themselves are installed using manual labor. Once in operation the solar array will not require routine maintenance other than occasional cleaning. In the event that a panel should fail, they are warrantied for 25 years, with only a 20% degradation in power production, and will be replaced immediately.

2.2.2 No Action

The No Action alternative would result in no wind turbine on Galbraith Mountain, and maintain the zoning of the land as commercial forestry.

Chapter 3: Affected Environment, Significant Impacts, and Mitigations

3.1 Earth

This section outlines the geology of the site for the proposed wind turbine based on effects from local natural history and activity of humans. This chapter describes the
existing geologic conditions and the risk of building on the proposed site. In addition, the soils section describes existing soil type as well as construction and operational impacts of the wind turbine on the existing soils of Galbraith Mountain.

3.1.1 Geology

Existing Conditions

The existing area formed through the collision and subduction of the Pacific Plate under the North American Plate. Chuckanut Formation, consisting of sandstone, conglomerate, various shale, coal, and volcanic and metamorphic rocks, surrounds the area. Further shaping of the region occurred from the Fraser Glaciation present 20,000 years ago, sending outwash to the ocean. The elevation of the proposed site has an elevation of 1,634 feet. Slopes of the mountain range between 15 and 35% and are underlain by bedrock (Wind Turbine Project Map). Landforms in the region are made of hill, toe and back slopes. Erosion of the folded rocks over millions of years has etched out the upturned less resistant beds leaving the more resistant beds of sandstone and conglomerate as ridges as seen on Galbraith Mountain and the surrounding region (Easterbrook 1971).

Hydrogeological Conditions

Geology of the Bellingham area has been shaped by glacial movement including the Cordilleran Ice Sheet that occurred 12,000-18,000 years ago (New Whatcom Redevelopment Project 2008). Present soil is well drained with a current depth to the water table of 80 inches. The capacity of the most limiting layer to transmit water is moderately high to high with a pace of up to 1.98 inches per hour (USDA Soil Survey). Chuckanut Formation has on average 20-40 inches depth to bedrock.

Seismic Risk

According to the Seismic Hazard Area maps provided by Washington State Department of Natural Resources the site proposed between Mt. Galbraith and Lookout Mountain possesses no significant liquefaction susceptibility, no significant impacts for volcanic hazards, as well as a small potential for enhanced ground shaking (WSDNR 2005).

Proposed Action Impact

Construction Impacts
The construction of the elliptical turbine pad, 200 feet in length, involves cutting and filling the top levels of soil to add a flat region where the rotor and other components can be set down. The rectangular crane pad, measuring 130 feet long by 80 feet wide, will consist of a thick pad of packed coarse gravel added to the area where the crane will sit during the erection of the turbine (HMP Site Map 2012). The potential for moderate to high levels of ground shaking should be considered during the wind turbine's construction to ensure a deep foundation in bedrock. These additions will require a large amount of removal of mineral soils, adding more material susceptible to erosion. The project will also add substantial impervious surfaces to the area, increasing the amount of runoff and lowering the rate of infiltration. Increased amounts of surface construction and water inputs off of the impervious surfaces can add more disturbance to the site and increase the risk of landslides. The proposal states that both pads (about half an acre) will be re-vegetated for a decrease in potential erosion and runoff (HMP Site Map 2012).

The installation of a turbine requires a deep foundation system into the bedrock for stability. The proposed area of the turbine will be connected by means of a foundation ring with an 8 foot radius embedded in reinforced concrete connecting the tower through an L-flange for stability (Kenersis and Kaylani). Construction of a turbine this size may cause settlement as well as the possibility of introducing low levels of landslide potential through the removal of vegetation and root structures as well as the movement of rock. Driven piles, made of wood, reinforced concrete, or steel, are required to build a deep foundation into the bedrock and stabilize the wind turbine, causing the uplift of material and increasing potential landslides.

The expansion of the road by 15 feet in width will require a significant removal of natural slopes in the land and cause less stable material leading to an increased chance of landslides. In regions where bedding or fracture planes intersect the land surface, as in road cuts or natural hill slopes, potential landslide hazards exist (Easterbrook 1971). Conditions that increase external forces acting on slopes include the over-steepening of land slopes by road-cut excavation, and overloading by artificial fill or heavy structures (Easterbrook 1971). The construction involved in the implementation of a wind turbine will therefore create a significant increase in landslide potential to the region.

**Operational Impacts**
There are minimal impacts to the geology and topography of the area after construction is completed. It is necessary to maintain the road up to the site for future crane transport and maintenance purposes.
**Alternative Action Impact**

The addition of solar panels to the Lake Padden parking lot would cause minimal impact to the geology of the area. Panels would be placed on the impervious surfaces of the parking lot previously created, adding no further additions of altered surfaces. There would be no increase in landslide probability due to the site being a pre-developed flat region. No crane pad would be built and no road would need to be created due to the presence of access roads that are already being maintained.

**No Action Impact**

Not implementing the proposal would preclude the transportation of materials, the creation of the crane pad and the attachment of the turbine to a deep foundation. No construction of the turbine would not produce any adverse impacts to the region, but would continue the reliance upon a mix of energy, including CO\(_2\)-emitting plants.

**3.1.2 Soils**

**Existing Conditions**

The soil of the proposed site is almost completely composed of Revel loam, otherwise known as Haplorthods, characterized by 30 to 60% slopes with an of average 20 to 40 inches depth until reaching paralithic bedrock (USDA Web Survey). This soil type is non-hydric, well drained with the capacity of the most limiting layer to transmit water moderately high to high with a pace of up to 1.98 inches per hour. Water capacity of the present soil is low; therefore it is not probable that the site will experience flooding or pooling (USDA Web Survey).

Soils lay on mountain slopes and ridges with a typical profile of surface loam from 0 to 16 inches, substratum as sandy loam from 16 to 35 inches depth and weathered sandstone bedrock of 35-39 inches depth (USDA 1992). Parent materials of Revel loam include volcanic ash, colluvium derived of glacial drift, bedrock of mixed lithology and slope alluvium derived from sandstone and siltstone.

**Proposed Action Impact**

**Construction Impacts**
The proposed site would require a high volume of fill to produce a flat surface for the crane pad area 80 feet in diameter and the oval turbine pad with a length of 200 feet (HMP Site Map). Rocks and gravel would be added to create the base for the crane pad, topped by the addition of concrete. Adding this surface would prevent soil turnover, the infiltration of water and the ability for soil to absorb nutrients to remain healthy and able to support vegetative growth. According to the USDA Soil Survey, the soils located in the site region are rated 'unsuited' for deep mechanical site preparation, indicating the expected performance of soil is unsuitable for the specified site preparation. In addition, the proposed site has a moderate potential for corrosion of concrete, pertaining to potential soil-induced electrochemical or chemical action that corrodes or weakens concrete, and is likely to increase in the development of the crane pad. To the altered basic chemistry of the concrete may react with the weakly acidic soil solution (USDA Web Survey).

Off-road erosion hazard indicates 'severe' rating, meaning that erosion is very likely and that erosion control measures including re-vegetation of bare areas are advised (USDA). The proposed site requires the removal of vegetation within a minimum 75-foot diameter around the crane pad and turbine area. The goal is to re-vegetate the site after construction; however proposed construction will cause immediate loss of vegetation, allowing the decreased uptake of precipitation by plants and increasing probability of the oversaturation of soils. When soils become oversaturated, remaining water inputs flow overland, carrying soil debris along. The removal of vegetation from the area may remove further protect from the wind and cause an increase of wind erosion to the soil.

Present Revel soil has a low rating for soil compaction resistance, indicating site soil has features that are not favorable to resisting compaction (USDA). During construction, there could be increased vibration from pile-driving activities. Depending on the intensity of vibration, pile-driving could also cause increased soil density and compaction, reducing water infiltration, subsequently affecting plant production and composition. Fewer plants result in increase runoff and erosion, as well as adversely affecting living organisms in the soil (USDA).

Whatcom County Ordinance on Wind Energy Systems (Whatcom County Ordinance 20.14) mandates that electrical controls and wiring connecting the turbine to the electric grid must be underground. The Proposed Action will require underground trenches for power lines or any other monitoring cables to connect the wind turbine to the power grid. Power will need to be trenched from the last public utility power pole on the road.
Operational Impacts
Operational impacts of the wind turbine to soil environment on the proposed site are minimal. Performing routine maintenance would require transport up to the site as well as the movement of the crane, both adding to the increased compaction of the soil. Impacts are overall insignificant; however, established road beds would be used which will add to the compaction of soil and the infiltration of water. These roadbeds and crane and turbine pads will therefore create significant impacts to the soil environment.

Alternative Action Impact
Installing solar panels to the existing north parking lot at Lake Padden would require only minimum construction. The panels would be placed over already existing impervious surfaces, having minor additional impacts to the soils. The implementation of panels would increase the runoff to surrounding soils, producing more potential erosion to the area as well as increasing the leaching of nutrients from the soil profile, resulting in a decrease of overall soil fertility.

No Action Impact
Not implementing the proposal would prevent the flattening of the site, constructing the deep foundation of the turbine, and the addition of the impervious surface. Transport of material and maintenance would not be necessary, removing the possibility of increased erosion, compaction and reduction of overall soil, and leaving present soil conditions.

3.2 Air
The following section will discuss potential air-related impacts of the Proposed Action, the existing conditions at the proposed site, and potential impacts related to the Alternative Proposal.

3.2.1 Air Quality
Clean Air Act (CAA) of 1970: Air quality and issues pertaining to air pollution fall under the jurisdiction of the Clean Air Act, legislation signed in 1970 with the intent to “protect and enhance the quality of the Nation’s air resources so as to promote the public health and welfare and the productive capacity of its population” (42 USC § 7401).
Consequently, in 1971 the Environmental Protection Agency established National Ambient Air Quality Standards (NAAQS). These NAAQS set maximum levels for six specific pollutants: ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide, lead and particulate matter. These standards are designed to promote the health of the population and preserve breathable air. The authority to enforce these standards is delegated by the EPA to the individual states (EPA).

**Existing Conditions**

Following the described requirements for air quality, the site of the Proposed Action meets all NAAQ Standards. For reference, the only site in Washington State designated as not meeting NAAQ standards is the Tacoma-Pierce County Nonattainment Area. The site of the Proposed Action on top of Galbraith Mountain resides in an air shed that meets all necessary quality mandates (Washington State Dept. of Ecology). At present, the majority of criteria pollutants released near the site of the Proposed Action come from logging trucks and other logging operations. The combustion of diesel and gasoline by logging trucks results in the release of hydrocarbons, particulate matter, and carbon dioxide.

**Proposed Action Impact**

**Construction**

During the construction period, the potential impacts to air quality would come from exhaust expelled by trucks bringing the turbine components to the site. However, it is unlikely these releases would be significant within the context of the logging trucks that already operate regularly around the site of the Proposed Action. Site preparation will involve the creation of an access road to bring components to the site, and the creation of a crane pad and foundation for the turbine. These activities may require clearing of local flora, which may require bulldozing, grading, and filling techniques to be employed. In this instance, a temporary increase of dust and debris is likely, but not to the extent that would pose a threat to air quality standards. The potential for fugitive dust and other non-point source pollution exists. These activities are temporary. The scheduled maintenance will also require for trucks to access the site, creating a temporary increase in truck emissions on six-month intervals.

**Operational Impacts**

Operational wind turbines produce no CO$_2$, sulfur dioxide, particulate matter, or other criteria pollutants. Unlike coal plants, or other fossil fuel sources of power, wind
turbines produce no impacts on air quality. Their operation and creation of air-pollutant-free power in fact reduces the local carbon footprint and decreases anthropogenic impacts on global warming.

**Alternative Action Impacts**

The Alternative Action involves the installation of a solar array over the parking structure at Lake Padden Park’s upper entrance. Much like the installation of a wind turbine, the only potential air impacts would stem from construction. However, the exhaust and particulate matter expelled during the shipping of components to the construction site are insignificant in the context of the current trips taken on Samish Way, as well as the level of vehicle activity in the surrounding area. Approximately 3300 vehicle trips are logged on a daily basis on Samish Way near Lake Padden (Whatcom Council of Governments). Operational impacts of the Alternative Action mimic those of the proposed, in that solar arrays produce no criteria pollutants, and their generation of power reduces local need for fossil fuel consumption.

**No Action Impact**

Taking No Action towards completing the Proposed Action will preserve the current conditions and maintain the status quo of air quality in the immediate area.

**3.3 Water**

The following section will discuss the current existing conditions at the proposed site, potential water-related impacts of the Proposed Action, and potential impacts related to the Alternative Proposal.

**3.3.1 Surface Water Movement**

**Existing Conditions**

Bellingham and the surrounding area, including the site of the Proposed Action, receive an average of 35 inches of rain per year (Library of Congress). Per month precipitation varies from 1.3 inches in July to 5.0 inches in December. Various seasonal streams develop near the site of the Proposed Action during the rainy season, and the water-heads of several fish-bearing streams that drain into Lake Whatcom and Lake Samish
flow down-slope from the site as well (Lake Whatcom Reservoir, City of Bellingham).

**Proposed Action Impacts**

**Construction**
Clearing areas for the access road, installation site, and crane pad will involve excavation and localized clearing of vegetation. The construction of the turbine pad 200 feet in length will require cutting and filling the top section of the site, and adding a flat region for placement of the rotor and other components. The crane pad measuring ~80 feet in diameter will consist of adding a thick pad of packed coarse gravel to the area where the crane will set during the erection of the turbine. These additions will require a large amount of removal of material, adding more material that can be susceptible to erosion. Additionally, adding large amounts of impervious surfaces to the area increases the amount of runoff and lowers the infiltration. These actions will likely contribute to pulses of sedimentation, and increase runoff of debris into local streams. However, the impacts will be temporary, pending completion of construction.

**Operational Impacts**
During operation, the wind turbine will not affect surface water movement. The only potential impacts to surface water would stem from the crane pad. The 80-foot diameter structure could increase runoff during a major precipitation event. Given the permeability and drainage rates of the soil, an on site retention pond will mitigate against increased over-land runoff by increasing on-site water infiltration.

**Other Considerations**
Near the site of the Proposed Action are streams that normally terminate before reaching any major waterways. If subjected to a significant level of precipitation, the flooding of these streams could create an uninterrupted waterway from the proposed site to downstream bodies of water (i.e. Lake Whatcom, Lake Samish). This fact could pose a threat to aquatic life, in the instance of a catastrophic failure of the wind turbine that caused hydraulic fluid, oil, or any other toxic chemicals to be released into local waterways.

**Alternative Action Impacts**
The adoption of the Alternative Action has the potential to increase sedimentation in Lake Padden. But due to the relatively low-impact process involved in installation, any increase in particulate matter introduced to the lake would be insignificant. The
operational impacts to surface water of the solar array would mimic that of the current use. The current parking lot and the solar array are both impervious surfaces, and consequently the Alternative Action would not change the existing surface water interactions.

**No Action Impact**

Taking No Action will preserve the current conditions and maintain the status quo of surface water movement in the immediate area.

### 3.3.2 Runoff and Absorption

**Existing Conditions**

At the site, soil is well drained, non-hydric, and the most restricting layer of the water table drains at a rate of 1.98 inches per hour. Water runoff at the Proposed Action site moves down-slope (USDA Soil Survey). From there, it is either absorbed into the bedrock at a depth of 20-40 inches, and 80 inches to the water table, or distributed into streams that drain into Lake Whatcom or Lake Samish (Habitat Management Plan Map). Depending on soil saturation and in the event of high levels of precipitation, runoff may exceed absorption and runoff may enter local waterways. This would result in overland flow, which has the potential to erode soils and increase runoff and sedimentation of local waterways.

**Proposed Action Impacts**

**Construction**

There is a potential risk for leaking fuel or oil from diesel-burning trucks to be absorbed into the soil, or to runoff into nearby streams. Additionally, the construction of the road and crane pad will contribute to runoff. As both structures will cause soil compaction, a retention pond is recommended to increase infiltration.

**Operational Impacts**

Excluding the soil compaction and runoff impacts of the access road and crane pad, the operation of the turbine is not likely to cause any environmental impacts with respect to runoff or absorption. In the event of a spillage or release from the turbine’s inner components would there be a risk of hydraulic fluid, lubricating oil, and other toxic chemicals entering the surrounding watersheds.
**Alternative Action Impacts**

As the Alternative Action mirrors the same water-interactions as the parking lot already in place, it is unlikely that the installation of a solar array will have any significant impact beyond the current conditions. In fact, the solar array has no toxic chemicals that could leach, and its prevention of surface runoff from the parking lot will reduce leaching of chemicals from the asphalt, as well as oil slicks produced by parked cars.

**No Action Impact**

Taking No Action towards implementing the Proposed Action will preserve the current conditions and maintain the status quo of runoff and absorption in the immediate area.

**3.3.3 Floods**

**Existing Conditions**

As the site of the Proposed Action is at a higher elevation, in a hilly area, flooding at the site is unlikely. On downslopes adjacent to the site, slope grade varies between 15% and 35% (Whacom County CAO Maps).

**Proposed Action Impacts**

**Construction**

The risks of soil compaction and the introduction of impervious surfaces during construction could increase runoff and cause overland flow of water to flood local streams in the event of major precipitation. The risk of sedimentation also increases with any increase of overland flow due to impervious surfaces and compaction associated with construction.

**Operational Impacts**

The operation of the wind turbine will not cause flooding. A retention pond on site will mitigate the runoff produced by impervious surfaces.

**Alternative Action Impact**
The Alternative Action will not alter the current aspects of the surrounding area. As the alternative will not create or be affected by flooding, impacts are negligible.

**No Action Impact**

Taking No Action towards the implementation of the proposed project would have no impact on flooding.

### 3.3.4 Groundwater Movement

**Existing Conditions**

Present soil is well drained with a current depth to the water table of 80 inches. This soil type is non-hydric, with the capacity of the most limiting layer to transmit water with a pace of up to 1.98 inches per hour. Bedrock depth varies between 20 and 40 inches (USDA Soil Survey). Present soils are not very resistant to compaction. For more details, refer to the soil impacts portion of this document, Section 3.1.2.

**Impacts of Proposed Action**

**Construction**
The surrounding soils are not resistant to compaction, thus the process of creating an access road as well as the creation of a crane pad and turbine foundation pose the risk of causing soil compaction. These processes can limit water infiltration, slowing movement of water into the water table. The impervious surfaces will limit infiltration, increasing runoff over those surfaces. A retention pond will aid in increasing infiltration lost as a result of construction.

**Operational Impacts**
After completion of construction, soil compaction and impervious surfaces created by the crane pad and turbine foundation still pose a risk to localized water infiltration. However, besides the local compaction, the turbine does not affect groundwater movement, and a retention pond on-site can allow for increased water infiltration. Only in the event of an accidental spill or release of hydraulic fluid or mechanical oils does the operation of the turbine pose a threat to groundwater.

**Alternative Action Impacts**
The Alternative Action will not affect the surrounding area more than the existing parking lot already has, and will thus not have any impact on groundwater movement.

**No Action Alternative**

Taking No Action towards implementing the project will preserve the status quo of groundwater movement around the Proposed Action site.

### 3.3.5 Public Water Supplies

**Existing Conditions**

Residents in and around Bellingham rely on water supplied from Lake Whatcom and Lake Samish, which receive water from several different streams. Lake Whatcom is north of the Proposed Action site, and Lake Samish to the south, but the two lakes are linked to the proposed site via stream systems.

**Impacts of Proposed Action**

**Construction**

Clearing, grading, and other processes associated with the construction of the turbine may create a significant amount of particulate debris. There is a chance that those actions could result in increased sedimentation downstream from the site, potentially as far as Lake Whatcom and Lake Samish.

**Operational Impacts**

The operation of the wind turbine could affect public water supplies if an accidental spill of hydraulic fluid, oil, or other toxic chemical were to occur. That spill could make its way into local waterways and into the lakes. Additionally, the gravel access road will be an ongoing source of particulate matter that could contribute to sedimentation of local streams, potentially as far as Lakes Whatcom and Samish.

**Alternative Action**

The location of the Alternative Action proposal precludes it from having any impact on the municipal water supplies of the City of Bellingham. Historically, Lake Padden was the water supply for Bellingham, but is no longer used for such purposes (Lake Whatcom Reservoir).
No Action Alternative

Taking No Action would have no impact on the public water supplies.

3.4 Wildlife and Vegetation
This section outlines the impacts of the Proposed, Alternative and No Action plans on wildlife on Galbraith Mountain.

3.4.1 Wildlife
Existing Regulations

Migratory Bird Act (1918)
This act prohibits the “taking” of migratory bird species. “Taking” includes, but is not limited to, the selling, hunting, capturing, and killing of birds or their eggs.

Endangered Species Act (1973)
This act protects endangered and threatened species listed under state and federal protection, as well as the species’ habitat. It also provides the authority to set aside land for the conservation of species listed under this act.

Bald and Golden Eagle Protection Act (Eagle Act) (1940)
This act prohibits the killing or molestation of the American Bald Eagle, including injury to the eagle, decrease in its productivity, or nest abandonment. It also restricts the removal of Bald Eagle nests without the proper authorization.

Priority Habitat Species (PHS) List (Washington Department of Fish and Wildlife)
This act protects Priority Species, which include Endangered, Threatened, Sensitive, and Candidate species (those listed as possible candidates for endangered or threatened status). All of the species on this list require protection due to their population size, habitat sensitivity, or recreational, commercial or tribal value.

Washington State Surface Water Quality Criteria (WAC 172-201A-200)
This section of the Washington State Code outlines basic water quality parameter limits, such as temperature, pH, and turbidity, for fresh and marine waters.
**Existing Conditions**

The proposed site is located on Galbraith Mountain within a Priority Habitat Species area. Populations of Federally protected species that exist on Galbraith Mountain and within its watershed include the Bald Eagle, Marbled Murrelet, Common Loon, and the Townsend’s Big-Eared Bat (PHS, 2012). Many species of migratory songbirds also inhabit the Bellingham area. The proposed site is located on the boundary between two watersheds that drain into Lake Whatcom and Lake Samish (Figure 1). The fish species present in these water bodies include Cutthroat Trout, Steelhead (or Rainbow Trout), Kokanee Salmon, Smallmouth Bass, and various other fishes (Lake Whatcom, 2009) and (Lake Samish, 2010).

The effects of wind turbines on birds and bats vary significantly across regions and are often some of the most significant impacts of this renewable energy source. Studies suggest that wind turbines pose more of a threat to raptors, such as eagles, than most other avian groups (Orloff and Flannery, 1992). Since the proposal site is located in Bald Eagle habitat, a species protected under the Eagle Act of 1940, the potential for wind turbines to cause raptor mortality must be taken into account. One study suggests that raptors are more prone to wind turbine collisions because of their soaring flight patterns. These birds use vertical slope updrafts, commonly found at large elevation changes such as at the proposed site, to gain altitude and thereby may be exposed to the turbine more often (Barrios and Rodríguez, 2004).

Studies of bats have shown that the number of bat deaths at turbines far exceeds those of birds due to bat’s susceptibility to barotrauma, in which the change in pressure near the top of the turbine causes the sensitive lungs of the bat to hemorrhage (Baerwald et al, 2008).

The Washington State Surface Water Quality Criteria mandates that turbidity caused by construction or surface compaction near fish-bearing streams should not exceed 5 NTU over a background level of 50 NTU or less, and shall not exceed a 10% increase when the background levels are greater than 50 NTU (WAC 172-201A-200). Higher turbidity levels can cause sedimentation, which can inhibit water and oxygen flow through salmon redds. The dissolved solids in streams can also impair juvenile salmons’ ability to find food.

**Mitigation**
McIsaac et al (2001) suggests that adjustments to turbine blades such as black and white banding help to make wind turbines more visible to birds. There is debate regarding a raptor’s ability to learn to avoid sites a few years after a turbine is installed (Garvin et al, 2010), or whether scavenging opportunities near wind turbines attract raptors.

One study has shown that bat deaths increase proportionally as tower height increases (Barclay et al, 2007). Lowering turbine height, or installing smaller turbines could decrease bat death. However, installing many smaller turbines to achieve a similar energy capacity would pose increased negative impacts in other areas such as land use, geology and water quality.

The site proposal plan includes the construction of an access road (15 ft x 365 ft), an elliptical turbine pad (~ 0.2 acres) and a rectangular crane pad for the turbine installation and routine maintenance (~0.2 acres) (Figure 2). To limit the impacts of these impermeable surfaces, the installation of a retention pond is recommended to prevent impacts on water quality or stream and lake habitat in the Lake Whatcom and Lake Samish watersheds.

**Proposed Action Impact**

The Proposed Action has the potential to have a significant negative impact upon the wildlife on Galbraith Mountain. Populations of native and Federally protected species such as the Townsend’s Big-Eared Bat, the American Bald Eagle, and Marbled Murrelet are all present within 3 miles of the proposed site (PHS, 2012). Further studies of the flight patterns and behaviors of the species at this site must be conducted to determine whether the turbine will pose a significant threat to birds and bats at this specific location.

The runoff and erosion from the project’s surface compaction pose a potential threat to the fish species in Lake Whatcom and Lake Samish. Due to the site’s location, it may influence both the Lake Whatcom and Lake Samish watersheds. Increased runoff may have deleterious impacts upon native salmonid species such as Cutthroat Trout, Steelhead (or Rainbow Trout), and Kokanee Salmon, as well as Smallmouth Bass and various fish species. If the proposed retention pond is constructed and maintained, runoff and erosion are not expected to pose a significant impact to the water clarity or fish habitat in nearby stream or lakes.
Since the effects of wind turbines vary significantly between locations, further studies of site-specific habitat and wildlife behavioral patterns are recommended to determine the extent or existence of a significant wildlife impact on Galbraith Mountain. Additionally, the site is located at an elevation of 1627 ft., and additional studies on the behaviors and flight patterns of sea birds in the area should be conducted to see if the turbine poses threats to coastal bird species.

**Alternative Action Impact**

The Alternative Action will have no significant impact on birds or bats in the area. The solar array may even provide sheltered nesting and perching habitat for small avian species. The alternative will also not affect fish populations in the area. The installation of the solar panels will not result in further soil compaction, since it will be installed over a pre-existing parking lot, and will even reduce the runoff of contaminants from cars by shielding the parking area from precipitation.

**No Action Impact**

If No Action is taken, there will be no impact to this site.

**3.4.2 Vegetation**

This section outlines the impacts of the Proposed, Alternative and No Action plans on vegetation on Galbraith Mountain.

**Existing Conditions**

The overstory of Galbraith Mountain is largely dominated by conifers, such as Douglas Fir and Western Red Cedar, and early successional hardwoods, such as Red Alder and Big Leaf Maple. The forest surrounding the Proposed site occurs in a large range of age classes from new to old growth due to the logging activities in the area (Figure 1).

**Proposed Action Impact**

The installation of the access road, turbine pad, and crane pad will require the clearing of approximately 1/2 of an acre, or about 200 trees. The surface compaction, as well as
the removal of vegetation in the area, has the potential to cause increased runoff and erosion, which may adversely affect the surrounding vegetation by decreasing the soil stability. Additional studies of the soil and hydraulic conditions of the site will be required to determine the extent of this project’s impact on vegetation. If the retention pond is installed as proposed, it will mitigate most of these potential impacts.

Alternative Action Impact

The Alternative Action will not require the removal of vegetation on Galbraith Mountain. There is a potential for the solar array to shade out small vegetation growing around the Lake Padden parking lot, but the panel will also decrease the runoff of harmful contaminants from the parking lot.

No Action Impact

If there is No Action taken, there will be no impact to this site.

3.5 Energy and Natural Resources

This section outlines the energy specifications for the proposed turbine, including predicted energy production and the resulting environmental impacts. Nonrenewable energy use and scenic resources alterations will also be discussed.

3.5.1 Energy

Existing Conditions

Currently there is no existing renewable energy infrastructure for Galbraith Mountain. Residences in the area receive their energy requirements from Puget Sound Energy (PSE). According to the Revised Code of Washington (RCW) 19.285.040 qualifying utilities are required to acquire enough renewable energy resources to generate 3% of their power load from renewables by 2012 and 15% by 2020.

Proposed Action Impact

The Kenersys K100 wind turbine proposed for the Galbraith Mountain site will output 2.5 MW of power, enough energy to power 1,000 energy efficient homes in the Bellingham, Washington area. The K100 has a hub height of 100 meters (328 feet) and 3 blades, each measuring 48.7 meters (159 feet) in length. Wind power that is available
for harvesting depends on wind speed and swept area; the proposed turbine has a swept area of 7854 m².

Wind turbines require constant wind flow of at least 15 mph. According to the National Renewable Energy Laboratory, the Bellingham area averages constant wind speeds at a height of 80 meters, ranging from 4.0 m/s to 5.5 m/s (8.95-12.3 mph) (Figure 3.5.1). However, due to required wind availability for energy generation, the majority of 2-MW wind turbines will be generating 30% of their rated output capacity (Wind Turbines, 2008).

![Figure 3.5.1 Washington Average Wind Speed at 80 meters](image)

**Figure 3.5.1 Washington Average Wind Speed at 80 meters**
*(National Renewable Energy Laboratory and AWS True Power 2010)*

**Alternative Action Impact**

The Alternative Proposal to construct a solar carport in the north parking lot of Lake Padden would generate comparable grid-tied electricity, allowing the same amount of energy efficient homes in the area to receive their power from a renewable source. Each individual Silicon Energy Cascade Series (SiE200) module has electrical capacity of 200 watts (see table 3.5.1).
The solar potential for Whatcom County averages 3.5 kwh per square meter per day (Climate Change - Solar and Wind Maps for Washington State. 2012). The Silicon Energy (SiE200) modules have an energy efficiency rating of 16-17%. Solar availability for the Pacific Northwest is at its highest during the summer months (May-September) and the panels will be producing at full capacity over this timeframe. The solar availability and the high efficiency rating of the panels would allow the alternative carport proposal to produce at or near capacity during the summer months, storing enough energy credits on the PSE electric grid to continue to power the 1,000 energy efficient homes on cloudier days.

**No Action Impact**

The No Action alternative to not place the K100 wind turbine on the Galbraith Mountain site, requires approximately 1,000 homes to continue to satisfy their energy requirements from PSE, including using nonrenewable energy sources such as coal and natural gas.

### 3.5.2 Nonrenewable Resources

**Existing Conditions**

Puget Sound Energy, which is the source of electrical generation for the surrounding Galbraith Mountain area, generated 29% of its power from natural gas and 36% from coal in 2010 (PSE Energy Supply Data. 2012).

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Table 3.5.1 *data is based on UL lab testing standards
**Proposed Action Impact**

**Construction Impacts**
The Kenersys K100 wind turbine will be constructed in Munster, Germany. From there it will be transported via plane or boat to the Bellingham area. Once in Bellingham, the turbine will be hauled by diesel semi-truck to the site on Galbraith Mountain where a crane will be used to erect the tower and install the blades and rotor. The construction of the K100, from its point of origin to its point of use will result in increased emissions of CO2 particulate matter from jet fuel, bunker fuel and diesel trucks.

**Operational Impacts**
During operation, the turbine itself will not consume any nonrenewable energy. The K100 will be producing up to 2.5 MW of electrical power, increasing the renewable energy resources for Puget Sound Energy’s power load. Wind generation from the K100 will satisfy electricity demands that would otherwise be provided by nonrenewable sources. Occasionally, the turbine will require maintenance, which involves the use of the crane. During maintenance, diesel emissions will increase slightly at the site location.

**Alternative Action Impact**

**Construction Impacts**
The construction of a solar carport using Silicon Energy, Cascade Series 200 watt modules (SiE200) would require the use of a truck to transport the modules from the Silicon Energy manufacturing plant located in Marysville, Washington, approximately 60 miles north to the site at the Upper Padden Park parking lot. The gasoline/diesel
emissions from the point of origin to the site are minimal. Once at the site location, the solar modules will be installed using manual labor. The framework for the carport will also require manual labor and the possible use of scaffolding and a forklift. The use of the forklift would increase fuel emissions at the site while the framework is being constructed.

**Operational Impacts**

Silicon Energy (SiE200) modules do not contain any heavy metals and contain only raw silicon, the most abundant electropositive element in Earth’s crust. Once in operation, the solar array will not consume nonrenewable resources. Maintenance on a solar array is rare as there are no moving parts and the modules have been lab tested for extreme weather conditions, but when necessary maintenance is required (such as cleaning), it will be done using manual labor.

**No Action Impact**

The No Action alternative will eliminate the amount of gasoline and diesel emissions from the transportation of the K100 wind turbine or the SiE200 solar photovoltaic modules. However, residences in the area whose energy needs would be off-set by the electricity generated by the wind turbine will continue to consume, in part, from nonrenewable sources such as coal and natural gas.

### 3.5.3 Conservation and Renewables

**Existing Conditions**

The Galbraith Mountain site and surrounding area are predominantly forested by Douglas Firs, Big Leaf Maples and Red Alders. The predominant activities are recreational trail use and logging operations. None of these activities can be seen from the surrounding Lake Padden and Lake Whatcom residences.

**Proposed Action Impact**

The hub height of the K100 turbine is at 320 feet and the rotor and the 150 foot blades are visible to surrounding areas, potentially degrading the scenic resources of surrounding areas. Another common scenic concern regarding wind turbines is shadow flicker. Shadow flicker caused by wind turbines is defined as alternating changes in light intensity caused by the moving blade casting shadows on the ground and stationary
Symptoms associated with shadow flicker are disorientation and dizziness. The effects of shadow flicker are short-lived (typically about 30 minutes) and can be mitigated through proper placement of the turbine to prevent shadow flicker from occurring (The Real Truth About Wind Energy. 2011).

**Alternative Action Impact**

The alternative solar carport will be built in an already existing parking area. The structure will have a very low vertical profile, standing only about 10-15 feet tall. Due to tree density surrounding the parking structure, the solar array will not be able to be viewed from surrounding residences or other buildings and should not degrade the aesthetic value of the near-by Lake Padden and wooded areas.

**No Action Impact**

The Proposed Action would have to remove approximately 200 trees from the surrounding area, while the No Action alternative would leave the Galbraith Mountain site in its current state of scenic value at least for the present time. Because the site is owned by Bertch Timerlands logging company, there is the potential that logging operations can result in the removal of trees at the site, which could impact the scenic resources of the residences in the area.

### 3.6 Environmental Health

This section discusses the impacts to both environmental and public health from noise, risk of explosion and toxic releases. In addition potential concerns regarding specific risks associated with wind turbines will be covered.

#### 3.6.1 Noise

**Existing Regulations**

*Noise Control Act of 1972 (42 U.S.C. 4901-4918)*

The Act is designed to provide an environment that does not jeopardize health and welfare for American citizens through establishing noise controls. The act also provides information to the public regarding noise emission and noise reduction characteristics of products.
WA173-60
Pursuant to the Noise Control Act, WAC-173-60 establishes maximum noise levels permissible in identified environments, thereby to provide use standards relating to reception of noise within such environments.

EPA Guidelines 40 CFR 201-211
The EPA recommends a day/night noise level (Ldn) of 55 decibels to protect from broadband noise in typically quite outdoor and residential areas.

Whatcom Zoning Ordinance 20.14
This title facilitates the installation and construction of wind energy systems in Whatcom County. It is required that audible sound generated from wind energy systems are not to exceed 55 decibels for any period of time (20.14.060).

Existing Conditions
Currently there is no wind turbine or any other form of infrastructure at the proposed site on Galbraith Mountain. In the surrounding area of the site there are numerous cellular and communication towers (see figure 3.6.1), which produce a constant low frequency humming from automatic heating and cooling mechanisms (What Are the Dangers of Living near Cell Phone Towers? 2012).
Proposed Action

Wind turbines produce two different kinds of noise; mechanical from the motor and gearbox when functioning correctly and aerodynamic noise produced by wind passing over the blades of the turbine (Minnesota Department of Health. 2009). The nature of the sound that wind turbines produce depends on the design of the specific turbine as well as distance from the turbine, surrounding terrain and atmospheric conditions. The audible “whooshing” sound increases in intensity at night time and becomes more of a “thumping” due to typically larger wind gradients, and ambient noise of the surrounding area is quieter (Wind Turbine Health Impact Study. 2012). The proposed K100 turbine is rated to output 106 decibels.
The perceived sound decreases rapidly with the distance from the turbine. Typically, at distances longer than 400 meters (1312 feet), sound pressure levels for modern wind turbines are less than 40 decibels, which is below the level associated with annoyance according to epidemiological studies. The greatest health hazard resulting from wind turbine noise that has been proved through epidemiological studies is annoyance, and at times sleep-disruption (Wind Turbine Health Impact Study 2012).

The Galbraith Mountain site is zoned as “commercial forestry” and there are no residences within a mile radius of the proposed turbine. Therefore, there is little risk that the surrounding residences will experience annoyance and sleep disruption from the K100 turbine.

**Alternative Action Impact**

A solar carport on the Upper Lake Padden parking area will not produce any noise during operation. The construction of the carport will involve minimal noise from the truck or van used to bring the solar modules to the site. There is the possibility of a forklift being used for some of the construction, which could incur minimal noise disruption during the daytime.

**3.6.2 Risk of Explosion and Toxic Release**

**Existing Conditions**

Currently, at the site for the proposed wind turbine, there are no existing structures that would pose a potential fire hazard. In general, Whatcom County is at low to moderate risk for forest fire (Hazard Risk, Whatcom County Washington. 2012). Typically high moisture levels mitigate fire hazards in this area. However, due to the large amount of forested lands, fire is a concern. Although there are logging operations near the site on Galbraith Mountain, they pose minimal fire hazards. Whatcom County’s geography makes the area more susceptible to heavy storm activity including heavy rains, strong winds, periodic blizzards and partially frozen precipitation (Whatcom County Hazard Identification and Vulnerability Analysis, 2010).

Potential toxic releases near the site are a result of the logging operations on Galbraith Mountain, which typically release forest fertilizers that contain nitrogen and phosphorous into the surrounding environment (Timber Industry Effect on Water Pollution. 2010).
**Proposed Action Impact**

Like all electrical systems, fire and explosions are a concern. Wind turbines are at the greatest risk of fire and explosion when struck by lightning or from machinery breakdowns and defaults.

Additional risks applicable to the Kenersys K100 2.5-MW turbine in Whatcom County include wind damage and ice throw/ice shedding caused by the accumulation of ice on the blades of the turbine, which is shed due to forces of gravity and the mechanical forces of the turbine. The distance that a piece of ice may travel from the turbine depends on wind speeds, operating conditions and the shape of the ice. Ice throws can be dangerous and cause injuries to people in proximity to the turbine. To mitigate potential injuries during ice events, warnings should be posted and activities near the vicinity of the turbine should be restricted until the ice has been shed (Wind Turbine Health Impact Study. 2012).

The motor of most wind turbines, including the proposed K100 2.5, contain hydraulic oils and lubricating fluids. The K100 2.5 turbine includes a lubrication system that will automatically release synthetic lubricant to the gearbox, pitch system and yaw system of the turbine. If an event should occur that damages the wind turbine (e.g. fire, wind damage) there is the potential for these fluids to be released into the surrounding environment. Specific environmental impacts related to these releases are discussed in detail in Section 3.3 of this document.

**Alternative Action Impact**

The Silicon Energy SiE200 modules have the highest industry fire rating (class A); most solar modules are only rated to class C. To prevent any wire damage from weathering or rodents that could cause the panels to ignite, the wires are enclosed in aircraft-grade aluminum casings. The Silicon Energy modules have a double-glass design to give the SiE200 the highest strength and durability of any solar module and are tested to withstand 120 mph wind speeds, 40 lb. snow loads and hail storms (Cascade PV Module and Installation System).

Due to the lack of moving parts in the solar array, there is no need for any hydraulic fluids or lubricating oils. Therefore in the event of damage to the array, no toxic substances will be released into the surrounding environment. The SiE200 modules
contain only raw silicon and aluminum. Silicon is naturally abundant in the environment and all forms of silicon are non-toxic to humans. There are minimal health effects associated with silicon such as skin and lung irritation. At this time there have been no reports of adverse environmental impacts (Silicon-Si.2012).

**No Action Impact**

The present state of the site on Galbraith Mountain is at low to moderate risk for wildland fire. Current logging operations will continue to impose adverse impacts through the removal of trees, fertilizer releases and diesel emissions.

### 3.7 Land Use

This section outlines the impacts of the Proposed, Alternative and No Action plans on land use on Galbraith Mountain.

**Existing Conditions**

The proposed site on Galbraith Mountain is zoned as commercial forestry. The land is owned by Bertch Timberlands Co. and is adjacent to lands owned by Polygon Co. and Bloedel Timberlands Co., and Washington State DNR land (Figure 3). Galbraith Mountain also serves a recreational purpose as a trail system for mountain bikers, hikers and horseback riders. Bertch Timberlands has agreed to a lease and the turbine will be constructed after obtaining a conditional use permit from Whatcom County (Stark, 2011). The installation of the turbine will require the removal of about 200 trees for the crane pad, the turbine pad, and the access road between the site and the existing logging road (Figure 2).

**Proposed Action Impact**

The Proposed Action will have a negligible impact upon the land use of this site. Tree removal will be minimal and forestry and recreational practices will be able to continue with no significant impact on harvest or equipment maneuverability.

Recreational access may be temporarily impacted during installation and maintenance visits, but should not be affected by the turbine operation.

**Alternative Action Impact**
The Alternative Action proposed in this document will have no impact upon land use. Since the solar array will be installed in an area that is not currently logged, it will allow forestry practices to continue unhampered with no effect on the size of the harvest. Additionally, the installation of the panels may temporarily block the access to the Lake Padden parking lot and the Galbraith Mountain trailhead, but after installation, the array will provide a sheltered area for recreational customers to park their cars.

**No Action Impact**

If No Action is taken, there will be no impact to this site.

### 3.9 Transportation

**Existing Conditions**

The proposed site is currently owned by Bertch Timberlands and already has an access road as well as electrical easement to the area (Vicinity Map 2011). The easement is granted by the property owner Bertch Timberlands to extend power lines to the region for production. There are no other vehicles that use the road other than those owned by the timber company.

**Proposed Action Impacts**

**Construction Impacts**

To transport the turbine and materials such as the crane and equipment to build the crane pad to the proposed site, it is necessary to enlarge the current access road. The proposed access road would be constructed from packed gravel and measure 15 feet wide and will span 365 feet long up to the site (HMP Site Map 2012). The turbine must be unloaded by crane and placed onto a truck to be driven up to the site. Fossil fuel use would increase through the transport of the turbine from the manufacturing plant in Germany to the site, as well as for the crane during construction. Although fossil fuels are used, impacts are minimal to the area once the turbine is implemented. The proposed road is not shared by any other users, allowing minimal impacts to the environment only when maintenance vehicles are needed.

**Operational Impacts**

The access road must be maintained for future necessary maintenance to the turbine.
Maintenance vehicles may be required to repair any disturbance to the road, adding minimal motor vehicle exhaust.

**Alternative Action Impacts**

The main road to Lake Padden is already constructed and well maintained, so the Alternative Action will cause minimal impact to the area’s transportation. The impervious surfaces that will accommodate equipment are already created for the parking lot when the panels are transported.

**No Action Impacts**

Transport of the wind turbine or any other construction equipment would not be necessary if the implementation of the turbine did not happen, allowing conditions and impacts of the use of the current access road to continue.

### 3.10 Public Services and Utilities

#### 3.10.1 Public Services

This section outlines the impacts of the Proposed, Alternative and No Action plans on public services on Galbraith Mountain.

**Existing Conditions**

Galbraith Mountain is located outside of the urban service area of Bellingham. While not inside its jurisdiction, Whatcom Fire District 9 oversees rescue and response for the area, where fires have been contained in the past (Regional Fire and Rescue Department, 2011).

**Proposed Action Impact**

The proposed wind turbine project should not increase the need for public services. The site is in commercially zoned land, and there are no homes within a mile of the proposed site. Conversely, in the event of catastrophic failure of the turbine, public services (HAZMAT team) could be required to help prevent environmental damage caused by the lubricating chemicals used to operate the propellers. This scenario assumes the failure of the retention pond being implemented to capture runoff from
the crane pad and turbine base. However, the addition of a retention pond by the developer is expected to mitigate against such an event. The developer should take all necessary steps to mitigate against the runoff of the lubricants such as keeping an onsite storage of absorbents for chemical leaks.

Wind turbines of this size have been known, on rare occasions, to fail in events of severe wind. This event would require Whatcom Fire District 9 to respond to the failure.

**Alternative Action Impact**

The Alternative Action would have no impact on the public services found at Lake Padden, because no toxic chemicals are present in this form of solar panels.

**No Action Impact**

Existing public services would continue unaltered.

**3.10.2 Utilities**

This section outlines the impacts of the Proposed, Alternative and No Action plans on utilities on Galbraith Mountain.

**Existing Conditions**

Private and public utility operators, namely Puget Sound Energy, Whatcom PUD, and Cascade Natural Gas, provide utility services throughout Whatcom County. These providers also service Galbraith Mountain. However, high voltage transmission lines do not extend to the proposed site and would be required for the Proposed Action (Whatcom Comprehensive Plan).

Puget Sound Energy (PSE) is the largest provider in Whatcom County and services 96,141 customers. Their infrastructure consists of 1,127 miles of overhead distribution lines, 734 miles of underground lines, 213 miles of high voltage transmission lines, and nine transmission substations (PSE Fact Sheet).

**Proposed Action Impact**
The addition of electricity harnessed by the proposed project should result in a positive impact on public utilities. The increase will allow utility companies to more easily address electrical needs for the entire county.

The proposed site has modest availability of wind power, but further research could assist in determining the feasibility of the location. The site encounters very powerful gusts, but sustained wind speeds may be lower than are desired for such a project. This becomes important to determine that the turbine, which will have a 2.5-MW capability, will be efficient enough to sustain operation, even during low-wind periods. Wind turbines require electricity to feather their blades, and to properly feed lubricating oils. In the instance of low-wind events this could lead to the wasting of electricity to feed a turbine that is not producing any electricity itself. While this is a concern, it should not risk the project, because the amount of wasted electricity would have little effect on the service area’s total supply.

The proposed wind project will require the trenching of approximately a quarter-mile of underground high-voltage transmission lines, which will be buried five to 10 feet deep. This will require PSE, or Whatcom PUD, time and labor to expedite the Proposed Action.

**Alternative Action Impact**

The Alternative Action is expected to have a positive impact on utilities as well. However, it could lead to a similar problem with wasted potential electricity. Solar energy would be expected to lag in the winter, when additional electricity is most needed. Further research is needed to determine how much of an effect such a project would have on energy availability.

**No Action Impact**

Existing utilities would continue unaltered.

**Summary of Findings**

After careful analysis and consideration of the various elements of the environment, as prescribed by WAC 197-11, this group has arrived at the following conclusions with regards to the Proposed Action, alternative, No Action alternative.
First, given the environmental benefits provided by clean power, we have determined that the Proposed Action’s ability to reduce fossil fuel dependency and local carbon footprints outweighs its potential impacts. Consequently, we conclude that the Proposed Action should be adopted, and the No Action alternative dismissed.

Second, the most likely impacts of the Proposed Action include:

- Runoff and decreased infiltration as a result of construction at the site.
- Risks to local wildlife in the event of increased sedimentation from overland flow, or chemical spill from the turbine.
- Fire, and risk of explosion in the event of mechanical turbine failure.
- Risks of soil erosion and sedimentation of streams due to construction of the crane and turbine pads.

Third, the design of the Alternative Action attempts to mitigate against the potential environmental risks posed by the Proposed Action. The solar installation releases no chemicals, has no significant geologic impacts, and improves water quality by preventing over-parking lot flow from leaching chemicals spilled by vehicles. With these facts in mind, we recommend the adoption and implementation of the Alternative Action over the Proposed Action.
References


Meyers T. Galbraith Mountain wind turbines: vicinity map. Bellingham: Whatcom County DNR & WDFW. PDF.


Appendices

Figure 1. Galbraith Mountain Habitat Management Plan Map, Cascade Community Wind Co., Terry Meyers, 2012.
Figure 2. Galbraith Mountain Vicinity Map, Cascade Community Wind Co., Terry Meyers, 2012.
Figure 3. Galbraith Mountain Vicinity Map, Cascade Community Wind Co., Terry Meyers, 2012.
Figure 4. Galbraith Mountain Project Map, Cascade Community Wind Co., Terry Meyers, 2012.