Revised Targeted Critical Areas Geologic Hazards

Energize East Side Project
Renton, Washington

for
Puget Sound Energy

July 24, 2017

GeoEngineers
Earth Science + Technology

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Geologic Hazards

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File No. 0186-871-06

July 24, 2017

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Table of Contents

INTRODUCTION

GeoEngineers, Inc. (GeoEngineers) is pleased to present this revised report with the results for targeted critical areas evaluation of specific geologic hazards identified by Puget Sound Energy (PSE) for the Energize Eastside Project. Our services have been provided in general accordance with the proposal between GeoEngineers and PSE dated June 21, 2017. These services were authorized by Kelly Purnell with PSE on June 15, 2017, and formal authorization was received on June 26, 2017.

The project area is located along existing PSE rights-of-way and includes areas within the City of Renton. We previously provided a geologic hazard evaluation for various routes under consideration, including the route evaluated within this document, in a separate report submitted to PSE on December 19, 2014 (GeoEngineers 2014). The geologic hazards evaluation included in this report focuses on a desktop review for erosion, steep slope, landslide and coal mine hazard areas, as assigned by PSE, relative to proposed vegetation management activities, including tree-removal required for construction access and pole replacement. PSE has provided specific locations for evaluation and a map developed by others that shows proposed pole replacement activities, including proposed tree removal, vegetation management zones and access roads.

LOCAL REGULATIONS

GeoEngineers assessed local regulations in the City of Renton Critical Areas Regulations, 4-3-050, for the project areas identified by PSE that coincide with regulated geologic hazard areas.

General Geologic Hazard Area Buffers

The criteria for defining geologic hazards and geologic hazard buffers from the Renton Municipal Code Environmental Regulations and Overlay Districts Critical Areas Regulations, 4-3-050, is described below.

- Erosion Hazard Areas:
  - *Low Erosion Hazard (EL): Areas with soils characterized by the Natural Resource Conservation Service (NRCS) as having slight or moderate erosion potential, and a slope less than fifteen percent.*
  - *High Erosion Hazard (EH): Areas with soils characterized by the NRCS as having severe or very severe erosion potential, and a slope more than fifteen percent.*

  There are no buffer requirements for low or high erosion hazards.
- Steep Slopes:
  - *Sensitive Slopes: A hillside, or portion thereof, characterized by: (a) an average slope of twenty five percent (25%) to less than forty percent (40%) as identified in the City of Renton Steep Slope Atlas or in a method approved by the City; or (b) an average slope of forty percent (40%) or greater with a vertical rise of less than fifteen feet (15') as identified in the City of Renton Steep Slope Atlas or in a method approved by the City; (c) abutting an average slope of twenty five percent (25%) to forty percent (40%) as identified in the City of Renton Steep Slope Atlas or in a method approved by the City. This definition excludes engineered retaining walls.*

- *Protected Slopes: A hillside, or portion thereof, characterized by an average slope of forty percent (40%) or greater grade and having a minimum vertical rise of fifteen feet (15') as identified in the City of Renton Steep Slope Atlas or in a method approved by the City.*

The are no established critical area buffers for steep slopes.

- Landslide Hazards:
  - *Low Landslide Hazard (LL): Ares with slopes less than fifteen percent.*
  - *Medium Landslide Hazard (LM): Areas with slopes between fifteen percent and forty percent and underlain by soils that consist largely of sand, gravel or glacial till.*
  - *High Landslide Hazards (LH): Areas with slopes greater than forty percent, and areas with slopes between fifteen percent and underlain by soils consisting largely of silt and clay.*
  - *Very High Landslide Hazards (LV): Areas of known mapped or identified landslide deposits.*

According to City of Renton's Critical Area Regulations, a critical area buffer is not required for low to high landslide hazards. The established critical area minimum buffer for very high landslide hazards is 50 feet from the top, toe and sides of the slope.

- Coal Mine Hazards:
  - *Low Coal Mine Hazard (CL): Areas with no known mine workings and no predicted subsidence. While no mines are known in these areas, undocumented mining is known to have occurred.*
  - *Medium Coal Mine Hazard (CM): Areas where mine workings are deeper than two hundred feet (200') for steeply dipping seams, or deeper than fifteen (15) times the thickness of the seam or workings for gently dipping seams. These areas may be affected by subsidence.*
  - *High Coal Mine Hazard (CH): Areas with abandoned and improperly sealed mine openings and areas underlain by mine workings shallower than two hundred feet (200') in depth for steeply dipping seams, or shallower than fifteen (15) times the thickness of the seam or workings for gently dipping seams. These areas may be affected by collapse or other subsidence.*

The are no established critical area buffers for coal mine hazard areas.

EXISTING CONDITIONS

GeoEngineers reviewed the City of Renton COR Maps, King County iMap and a previous report, titled Geologic Hazards Evaluation and Preliminary Geotechnical Engineering Services report, submitted to PSE in December 2014, to assess existing conditions in the project area within the City of Renton (GeoEngineers 2014). Based on information presented in that report and a review of existing maps, the existing geology mainly consists of glacial drift, recessional outwash, glacially consolidated till and advance outwash deposits, with the exception of localized areas of alluvium, volcanic deposits and rocks, marine sedimentary rocks and artificial fill. Soil types anticipated in the project area include mainly silty gravel, silty sand and silt.

Both steep sensitive slopes and protected slopes were observed locally within the project area. However, outside of the Cedar River corridor and the Honey Dew Creek corridor, the steep sensitive slopes where tree removal is proposed is generally developed and includes rockeries, landscaped residential slopes, and managed right-of-way areas that are unlikely to be adversely impacted based on their current configuration and use. Protected steep slopes that include slopes of 40 percent or greater are observed locally within the project area; however, no access roads or pole replacement activities will occur within the mapped protected slopes. Tree removal for vegetation management purposes that is proposed in the protected slopes occurs in the regional areas of steep slopes, namely within the Honey Dew Creek drainage and the Cedar River drainage.

High erosion hazard areas, sensitive and protected steep slopes, and moderate landslide hazard areas are mapped at the Honey Dew Creek and Cedar River drainages, within the project area (City of Renton, COR Maps). A prehistoric, deep-seated landslide is mapped on the southern side of the Cedar River drainage, within the project area (King County, iMap).

Moderate coal mine hazard areas also are mapped in the Cedar River drainage, within the project area (City of Renton, COR Maps). No high coal mine hazards (CH) are mapped within the project site (City of Renton, COR maps).

No high landslide hazards (LH) or very high landslide hazards (LV) are mapped within the project site (City of Renton, COR Maps).

Field Observations

A field reconnaissance was performed on June 28, 2017, to evaluate the geologic hazard areas identified along the slopes of Honey Dew Creek and the Cedar River. The reconnaissance was divided into three areas: Honey Dew Creek (north and south slopes), north slope of Cedar River, and south slope of Cedar River. Our field observations are summarized as follows.

Honey Dew Creek

The project area is within an existing utility corridor with overhead power lines. Vegetation consists of evergreen trees with bowed or pistol-butted trunks that suggest soil creep or episodic movement, deciduous trees and an understory that includes sword fern, blackberry, salal, Oregon grape and occasional hydrophilic plants (horsetail). Loose recessional deposits of sand and gravel are commonly exposed at the surface within the drainage. The slope on the south side of Honey Dew Creek is inclined between 65 to 100 percent locally. We observed two landslide scarps with 3 to 6 feet of vertical displacement and widths of 15 to 20 feet on the south slope, approximately 40 feet upslope of the Honey Dew Creek channel. The terrain on the slope south of the creek is somewhat hummocky. Localized groundwater seepage and/or hydrophilic plants were observed at an elevation approximately 10 feet upslope of Honey Dew Creek on both the south and north slopes, where a contact with the overlying outwash deposits and an underlying laminated silt was observed. The slope on the north side of Honey Dew Creek is commonly inclined between 60 to 70 percent, and includes a 15-foot-deep tributary drainage swale with sidewalls inclined up to 80 percent.

Cedar River North Slope

The project area within the Cedar River valley wall north slope, located north of SR 169, is within an existing utility corridor that includes overhead power lines. Vegetation consists primarily of deciduous trees with occasional evergreens, and an understory that includes fern, salal, blackberry and Scotch broom. The conifer trees are generally straight and in a vertical growth position. Loose recessional deposits of sand and gravel are commonly exposed at the surface. The slope is inclined between 60 to 85 percent. We observed a small landslide scarp with 8 feet of vertical displacement and a width of 10 feet near the top of the slope. At mid-slope, we observed a larger arcuate landslide scarp with approximately 15 feet of vertical displacement and a width of about 100 feet. Conifer trees near the larger landslide commonly have bowed or pistol-butted trunks. A large hemlock tree (approximately 18 inches, diameter breast height) is growing within the landslide mass, indicating that the landslide is relatively old. The slope also is mapped within a moderate coal mine hazard area (City of Renton, COR MAPs), but we did not observe any evidence of land subsidence, sinkhole formation or deposits associated with coal mining activities.

Cedar River South Slope

The project area within the Cedar River valley wall south slope, located south of the Cedar River Trail Walk, is within an existing utility corridor that includes overhead power lines. Vegetation consists of deciduous and evergreen trees, with a dense understory that includes fern, salal, Oregon grape, blackberry, grass and nettles. The conifer trees are generally straight and upright, with occasional slightly bowed trunks. Loose recessional deposits of sand and gravel are commonly exposed at the surface. A large prehistoric, deep-seated landslide mapped by King County covers the corridor slope south of the Cedar River. The slope is commonly inclined between 30 to 60 percent. The terrain is slightly hummocky, but we did not observe any evidence of landslide reactivation or recent activity at the time of our site reconnaissance. The slope is mapped within a moderate coal mine hazard area (City of Renton, COR MAPs), but we did not observe any evidence of land subsidence or coal mining activities.

IMPACT ASSESSMENT

There are two primary ways in which tree removal activities may impact erosion and slope stability on steep slopes or landslide hazard areas. After tree removal (where the stump is left in place), root decay causes both the numbers of roots and the tensile strength of the remaining individual roots to decrease with time (Burroughs and Thomas 1977). Studies show that the period of minimum root strength is typically from 3 to 5 years after harvest (Ziemer 1981a; 1981b), but can extend up to 10 to 20 years, depending on the tree species. For example, minimum root strength in evergreens is typically 10 years after harvest, alders have a minimum root strength of 5 to 10 years after harvest, and maples typically maintain full root strength after harvest. The reductions in root strength result in a net decrease in the cohesive strength of the near-surface soil mass.

Tree removal also might modify surface and subsurface hydrology. Tree removal may increase soil moisture by reducing canopy interception and evapotranspiration. Ground-based yarding equipment can compact soil, which may alter hydrologic processes in certain soil types.

Elevated groundwater levels decrease the stability of slopes by reducing the shear strength of the soil and by adding additional weight. The probability of erosion and landsliding from elevated groundwater levels

depends on the magnitude of the increase and the existing stability of the slope. The magnitude of potential changes in groundwater levels from tree removal is highly variable and depends on several factors, including the tree size, silviculture, subsurface conditions and topography.

In general, tree removal will increase the potential impact on erosion and slope stability for erosion hazard areas, steep slopes or landslide hazard areas. Fewer impacts are expected in areas where tree removal is isolated to one or two trees, and the erosion, steep slope or landslide hazard area is otherwise stable and well vegetated. Tree removal is not anticipated to impact mapped moderate coal mine hazards. Areas that consist of multiple mapped geologic hazard areas (including moderate coal mine hazards, erosion, steep slope and landslide hazards) are not anticipated to be more sensitive to the proposed vegetation management activities compared to areas where only a single geologic hazard is mapped. Additionally, fewer impacts are expected at the toe of the slope, compared to tree removal within the body or at the top of the slope.

Access Construction

Temporary access routes will generally follow previously established access trails and routes and, in some cases, will cross existing developed landscape. Therefore, little cutting or filling will be required. Small amounts of quarry spalls might be necessary to stabilize portions of existing routes. Many of the existing routes are overgrown with vegetation and, thus, will need to be cleared. Standard erosion control best management practices (BMPs) should be followed during construction (clearing and use of temporary access routes). Following completion of construction activities, restoration BMPs such as mulching and/or placing jute matting should be implemented.

Pole Installation

Where new poles are located in steep slope or landslide hazard areas, a temporary working bench might be necessary to install the pole. These benches may vary from about 10 by 10 feet to 30 by 30 feet in dimension. The same considerations discussed above for access routes also apply to benches needed for pole installation. We recommend that clearing activities be restricted to that necessary to auger the hole for the pole.

Recommendations for the design and construction of poles are presented in our Geotechnical Engineering Services report dated June 8, 2016. In general, most of the site soils along the proposed route consist of recessional deposits or glacially consolidated deposits, and in some limited locations, bedrock. These soils should provide adequate support for the new poles, and it is our opinion that once the pole is installed, the pole will not adversely impact slope stability; the pole should actually provide additional resisting force against slope failure, provided the pole is embedded to a sufficient depth.

New poles are proposed in areas mapped as a medium/moderate coal mine hazard, which is defined in Renton Municipal Code 4-3-050 as areas where the mine workings are deeper than 200 feet for steeply dipping seams or deeper than 15 times the thickness of the seam or workings for gently dipping seams. Based on the results of the subsurface soil investigation conducted in 2014 and our knowledge of the geologic conditions in this area, the installation of new poles in these areas is not anticipated to impact mapped moderate coal mine hazards.

Conclusions

Mapped sensitive and protected steep slopes and moderate or unclassified landslide hazard areas are present within the project area. Outside of the Honey Dew Creek and Cedar River valley areas, most of the remaining areas are developed and include rockeries, landscaped residential or commercial development slopes and cut slopes associated with roadways, and include the following:

- One tree removed in the managed corridor east of North 23rd Court;
- Multiple trees removed east of the residence at 2101 Newport Court NE;
- One tree removed east of the residence at 3118 NE 18th Street;
- One tree removed on the east side of the Goodwill parking lot at 3208 NE Sunset Boulevard;
- Multiple trees removed on the east side of an existing parking lot for 3224 NE 12th Street;
- Multiple trees removed on the east side of existing residences from 1082 to 1074 Lynnwood Avenue NE;
- One tree removed on the campus of the Renton Technical College; and
- One tree removed west of the apartment complex at SE 8th Street and Harrington Place SE.

Localized areas of sensitive and protected steep slopes and moderate or unclassified landslide hazard areas in the project area include the Honey Dew Creek drainage and the Cedar River drainage, which include slopes greater than 40 percent with a 15-foot vertical elevation rise. The project area is within an existing right-of-way that is maintained for vegetation by PSE. The proposed removal of about 35 selected trees in the Honey Dew Creek drainage, four selected trees north of the Cedar River, and about 35 trees south of the Cedar River is consistent with the management activities of the existing power line right-of-way and is not anticipated to impact the mapped geologic hazard areas within these drainage areas, provided that no tracked or rubber-tired equipment is used to remove the trees, in our opinion. The proposed removal of trees in the Honey Dew Creek drainage is located upslope of any identified recently active slope failures and is not anticipated to exacerbate localized slope failures, in our opinion.

Conceptual Impact Mitigation Strategy

Vegetation Management and Tree Removal

For vegetation management and tree removal in the City of Renton within the mapped geohazard areas outlined in the proposed PSE project segment, GeoEngineers suggests the following options for mitigating impacts after tree removal.

In general, to limit impacts on erosion and slope stability from vegetation management and tree removal within steep slope and landslide hazard areas, the sites should be accessed by foot to reduce equipment impacts. Hand cutting with chainsaws should be implemented to trim branches and remove trees. Stumps should remain in place, but can be cut to ground level. Branches, limbs, trunks and other tree debris should be chipped and scattered around the removal site within the right-of-way. Where chipping is not feasible, unchipped tree debris can be scattered.

In areas where tree removal is widely spaced within landslide buffer areas, the trees should be cut, stumps left in place, and trimmed branches and trunks can be scattered within the right-of-way.

We recommend that trees are felled across the fall line and are left perpendicular to slope if they are not chipped.

In areas where tree removal is clustered, erosion control BMPs, such as grass seeding, leaving stumps, scattering straw, and/or replacement planting of native shrubs or small trees, should be implemented to reduce concentrated flows and minimize disturbance.

In areas where houses are located within 25 to 50 feet of vegetation management and tree removal, all tree debris should be removed from the owner's property and communication with the property owner is suggested to identify possible reseeding, replacement tree or shrub, or landscaping options. If agreeable to the property owner, it is possible that the tree trunk can be cut and left below ground surface to maintain root strength (up to 5 to 10 years, depending on tree type), and a replacement tree or shrub may be planted near the trimmed trunk.

Within the Honey Dew Creek and Cedar River drainage areas, where erosion, landslide and steep slope hazard areas are mapped, it is recommended that tree removal be done by hand cutting with chainsaws, stumps left in place, and tree debris scattered. Within the Honey Dew Creek drainage, replacement planting with native shrubs is suggested to increase root strength after tree removal and to reduce impacts within the landslide hazard area.

Reestablish Access Routes

Where vegetation clearing is required to reestablish the access on existing trails and access routes, BMPs should be implemented; these BMPs can include, but are not limited to: outsloping road surfaces, crowning road surfaces (where appropriate, such as at ridge tops and where roads climb gently inclined surfaces) and installing water bars or rolling dips at regularly spaced intervals to avoid concentrating surface water flow along the road surface. The spacing depends on the grade of the route, the soil type present, proximity to streams and the intended use of the road (i.e., temporary or permanent).

Most, if not all, access routes will be temporary and will be abandoned following construction of the transmission line. No temporary access roads will cross any drainages situated in geologic hazard areas.

It is the contractor's responsibility to complete construction work safely and in accordance with applicable local, state and federal laws. After access use is complete, where it is deemed necessary, limited regrading of the access route is recommended to avoid concentrating surface runoff along tracks, ruts or other potential flowpaths. Following completion of construction activities, the construction access routes will be graded to a stable free-draining configuration, treated with appropriate erosion control measures, such as mulching and/or placing jute matting and installation of water bars as needed to control runoff, and seeded. If jute mat is determined a necessary BMP, the jute mat should be anchored at the upslope and downslope ends and secured with staples per the manufacturer's recommendations.

Pole Installation

Where a bench is required to install a pole on a steep slope or landslide hazard area, the recommendations presented above for temporary access roads also apply for pole installation. Appropriate erosion control BMPs should be implemented during construction, and the disturbed area should be restored after pole installation by seeding or revegetating and covering the disturbed area with appropriate BMPs. Soil removed from the new pole excavations should be scattered into vegetation away from the landscaped areas. Any areas of exposed soil must be seeded and mulched (or covered with hog

fuel) to prevent transport of sediment down the steep slopes or into the seepage area during rain events. If the work area is wet or has standing water, driving mats should be used under all equipment and all soils should be removed from the site for off-site disposal.

For poles located in geologic hazard areas, the old poles should be cut off approximately 1 to 2 feet below the ground surface and the remaining portion of each pole left in place. If poles installed on slopes steeper than 2H:1V (horizontal to vertical), they should be embedded at least 3 feet deeper than the typical design embedment.

CODE COMPLIANCE

4-3-050 (G2) – Development Standards – Critical Area Buffers

The critical area buffer width for very high landslide hazard areas is 50 feet. Buffers are not required for steep slopes or high landslide hazards, based on the results of a geotechnical report and/or independent review.

> **Response to Code Requirement:** The site does not include any mapped very high landslide hazard areas (LV) and, as such, there are no required buffers in the project area. The proposed activities include vegetation management and tree removal and access routes (associated with the proposed pole replacement activities) that will be followed by mitigation measures to reduce potential impacts to geologic hazards. These hazards include landslide and steep slope hazards. Possible mitigation measures include a variety of BMPs to reduce potential impacts to geologic hazards in the vicinity of neighboring properties, including plant replacement, scattering trimmed or removed tree debris, and chipping wood to reduce potential impacts to work areas as appropriate. Removal of vegetation by hand and/or using limited access machinery will reduce potential impacts to landslide and steep slope hazard areas. It is our opinion that the proposed project will not require additional buffers.
>
> There are no established critical area buffers for erosion hazard areas or coal mine hazard areas.

4-3-050 (G5f) – Development Standards for Geologically Hazardous Areas – Protected Slopes

Development is prohibited on protected slopes.

> **Response to Code Requirement: No development is planned.** Site activities include vegetation management and limited tree removal (associated with the pole replacement activities) within an existing utility right-of-way. No development or grading activities will be conducted on protected slopes. Replacement of existing utility systems are exempted, provided the work does not increase the footprint by more than 10 percent and that restoration shall be conducted where feasible.

4-3-050 (G5g) – Development Standards for Geologically Hazardous Areas – Sensitive Slopes; Medium, High and Very High Landslide Hazards; High Erosion Hazards

During construction, weekly on-site inspections shall be required at the applicant's expense. Weekly reports documenting erosion control measures shall be required

> **Response to Code Requirement:** Site activities include vegetation management and limited tree removal (associated with the pole replacement activities). Weekly on-site inspections and reports documenting erosion control measures will be completed as required by the applicant.

4-3-050 (G5i(ii)) – Development Standards for Geologically Hazardous Areas – Coal Mine Hazards Found during Construction

Any hazards found during any development activities shall be immediately reported to the Development Services Division. Any coal mine hazards shall be mitigated prior to recommencing construction based upon supplemental recommendations or reports by the applicant's geotechnical professional. During construction, weekly on-site inspections shall be required at the applicant's expense. Weekly reports documenting erosion control measures shall be required

> **Response to Code Requirement:** Any coal mine hazards found during the proposed vegetation management and tree removal activities associated with the pole replacement activities will be immediately reported to the Development Services Division. Any identified coal mine hazards will be mitigated prior to recommencing any activities based upon supplemental recommendations or reports by the applicant's geotechnical professional. Weekly on-site inspections and reports documenting erosion control measures will be completed by the applicant.

LIMITATIONS

We have prepared this report for the exclusive use of PSE and their authorized agents for the Energize Eastside project located in Renton, Washington.

The purpose of our services was to review slope stability impacts in relation to vegetation management and tree removal in erosion, steep slope, landslide and coal mine hazard areas along the transmission line corridor within the City of Renton. Impacts to slope stability for pile installation was evaluated in a separate report. Where appropriate, information from the previous reports have been used in developing our recommendations and comments presented in this report. Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of geotechnical engineering in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

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