9/8/2023

John & Kim Britcher
654 Sandra Lee Ct SE
Olympia, WA 98513

c/o: High Tech Building
Attn: Stefan G. Bull
625 Acorn Ct SE
Olympia, WA 98503

Subject: **Britcher ADU – Critical Area Ordinance (CAO) Report**
654 Sandra Lee Ct SE, Olympia, WA

QG Project No.: QG23-150

Dear Client:

At your request, Quality Geo NW, PLLC (QG) has completed a preliminary critical area review of the above referenced property's existing site conditions, including site visual reconnaissance, subsurface evaluation, slope analysis, and review of existing geologic literature for the site. The project site consists of a developed residential property along a regional slope. It is our understanding that the client intends to construct an additional dwelling unit (ADU) on their property within an area designated by the permitting authority to be a potential critical slope.

QG understands that the permitting authority requires a geotechnical consultation to confirm that currently proposed project is feasible, and to provide any additional and necessary recommendation regarding critical slope considerations including necessary setbacks. The following report presents the findings and conclusions of our review, addresses feasibility of proposed site development, and provides additional geotechnical recommendations for planning and design intended to reduce the inherent risks associated with site development within a potentially geologically hazardous area.

Site region and vicinity maps are provided in Appendix A, and an annotated site map is presented in Appendix B. Typical slope conditions are shown schematically on the attached site slope profile in Appendix C, and exploration logs for a hand auger boring and a Dynamic Cone Penetrometer (DCP) test are provided in Appendix D.

GEOLOGIC LITERATURE REVIEW

QG reviewed available map publications to assess known geologic conditions and hazards present at the site location. The Washington Geologic Information Portal (WGIP), maintained by the Department of Natural Resources Division of Geology and Earth Resources, provides 1:24,000-scale geologic mapping of the region. Geology of the site location and vicinity consists of Vashon Stade recessional outwash (Qgo). The soil on site is described as "Recessional and proglacial stratified, moderately to well-rounded, poorly to moderately sorted outwash sand and gravel of northern or mixed northern and Cascade source, locally containing silt and clay; also contains lacustrine deposits and ice-contact stratified drift."

According to the regional-scale interactive map, there are no recent deep-seated landslide deposits that are mapped within the boundaries of the parcel. Available LiDAR imagery of the site did not reveal prominent landslide features within the site or within the vicinity of the parcel.

The United States Department of Agriculture portal (USDA) provides a soil mapping of the region. The soils in the northwest vicinity are mapped as Everett very gravelly sandy loam (33), while the soils in the southeast vicinity are mapped as Dystric Xerocherpts (30). The Everett very gravelly sandy loam soils are formed as moraines, eskers, and kames derived from sandy and gravelly glacial outwash. They are described as slightly decomposed plant material from 0 to 1 inch, very gravelly sandy loam from 1 to 24 inches, very gravelly loamy sand from 24 to 35 inches, and extremely cobbly coarse sand from 35 to 60 inches. Depth to restrictive feature is more than 80 inches. Capacity of most limiting layer to transmit water (Ksat) is listed as high (1.98 to 5.95 in/hr). Depth to water table is more than 80 inches. Dystric Xerocherpts are formed as escarpments derived from colluvium and glacial till. They are described as very gravelly sandy loam from 0 to 34 inches. Depth to restrictive feature is 20 to 72 inches to densic material. Capacity of most limiting layer to transmit water (Ksat) is listed as very low to moderately low (0.00 to 0.06 in/hr). Depth to water table is more than 80 inches.

SITE INVESTIGATION METHODOLOGY

On 8/8/2023, a QG Staff Geologist visited the site to perform visual reconnaissance of the surface and topographic features of the subject property and its proximal slope. While on site, we conducted site surface explorations for a geologic hazard assessment and site feasibility characterization. Approximate relevant property dimensions and slope topography were documented and mapped at representative intervals as access allowed. Soil conditions were evaluated through local exposures along the slope face. Salient slope features and existing vegetation were documented to assess general site stability as well as observe for signs of local instability of an erosional or subsurface nature currently or in the past.

FIELD WORK

Exploration locations were marked in the field by a QG Staff Geologist with respect to the provided map and cleared for public conductible utilities. Our exploration location was selected by a QG Staff Geologist prior to field work to provide safest access to relevant soil conditions. The geologist directed the advancement of 1 hand auger borehole (HA). The borehole was advanced within the boundaries of the slope failure, to a depth of approximately 2.0 feet below present grade (BPG) in general accordance with the specified contract depth and equipment capabilities.

During explorations QG logged each soil horizon we encountered, and field classified them in accordance with the Unified Soil Classification System (USCS). Representative soil samples were collected from each unit, identified according to boring location and depth, and placed in plastic bags to protect against moisture loss for future reference.

QG advanced 2 Wildcat Dynamic Cone Penetrometer (DCP) tests at a representative location within the vicinity of the proposed development and as slope conditions permitted. The penetrometer test was terminated upon reaching the equipment's maximum practical extent. During penetrometer advancement, blow counts were recorded in 10-centimeter increments as a thirty-five-pound weight was dropped 15 inches. Blow counts were then converted to resistance (kg/cm2), standard penetration blow counts (N-values), and corresponding soil consistency, with complete results shown on the attached logs.

SURFACE OBSERVATION

The parcel is irregularly shaped, with a paved driveway descending from the northern edge leading to a single-family home in the center of the parcel. There is a regional slope descending to the south and east, which is heavily vegetated with shrubs, vines, and mature trees. Some mature trees on the eastern portion of the slope have been recently topped or cut down, and they do not appear to be crooked or bent. The proposed build site is located to the north of the existing house, and is vegetated with landscape grass. This section of the parcel slopes gently to the southeast. No surface water was observed on site.

QG performed reconnaissance within the site to observe for and document indications of surface degradation or large-scale slope instability. Within the proposed building area, no obvious features were observed that would indicate an active or prior deep-seated slope failure within the proposed home area, such as headscarps or significant downslope accumulations. No obvious evidence of rotational or translational failures or major toppling hazards was observed on the slope in the proximity of the potential building footprint.

SUBSURFACE CONDITIONS:

Hand auger borings within the proposed improvements area appear generally consistent throughout the site, comprising a layer of organic-rich topsoil overlying a silty sand with gravel in a generally dense condition with cobbles measuring up to 4 inches. No groundwater was encountered during QG's subsurface investigation. There were no signs of seepage along the sloped where access allowed observations as well as the flat upland area. According to publicly available groundwater well data, there is no shallow groundwater table underlying the site.

DISCUSSION & CRITICAL SLOPE RECOMMENDATIONS

The findings of QG's site reconnaissance at the subject site appear broadly consistent with available geologic literature and do not indicate any excessively prohibitive conditions exist for the site, assuming appropriate site management efforts are maintained. It appears that the designation as a landslide hazard area is based on mapped topography, rather than a known active deep-seated hazard at the subject site. In consideration of the available information, and our direct observations, at this time **QG does not consider the building site to be within an active landslide hazard area.** Based on the information herein, we provide the following development- and site-specific recommendations that will minimize the inherent risks of developing in a sloped area.

Due to the anticipated addition, home-specific foundation setbacks must be maintained to protect the slopes and structures. Additionally, we recommend final design and construction practices limit additional surface excavation to the smallest extent possible. Large excavations are generally discouraged.

Newly Graded Permanent Slopes & Fill Embankments:

QG recommends that new areas of permanently graded slopes in native soil be inclined no greater than 3H:1V, catching natural topography at the top and toe. We recommend that areas expected to receive imported fill be benched, placed, and compacted in accordance with WSDOT Standard Specifications: *Embankment Construction & Hillside Terraces*, sections 2-03.3(14) through 2-03.3(14)D. Fill slopes may be inclined no greater than 2H:1V. All site slopes should be permanently stabilized from erosion.

Setback Recommendations:

Considering the inclination and conditions of the lower slope specific setback requirements must be followed for successful construction at this location. The local critical area ordinance delineates minimum slope toe setbacks for slopes inclined greater than 40% (~22°), which may be further reduced upon review by a licensed geotechnical professional. QG's reviewed existing topographic data and general site observations made during our visit to infer general slope face and slope toe

setbacks based on height and inclination of the typical slopes present on the site in proximity to the proposed structure.

The proposed build site is in proximity to the Nisqually Hillside Overlay District *(TCC 24.15.020)*. Thurston County Code states that *the western two hundred feet of the Nisqually Hillside Overlay District is a buffer measured from the top of McAllister Bluff (TCC 24.15.021 B)*. However, flexibility is granted for *areas of preexisting development along the bluff*, including *lots less than one acre in size... In those locations the buffer from McAllister Bluff shall be at least 50 feet wide (TCC 24.15.021 C)*.

QG recommends that any new foundations be embedded to maintain a minimum horizontal slope crest setback of 50 feet (See Appendix C). Based on this, the proposed new construction location appears suitable. The setback does not prohibit lightweight surface improvements such as septic, uncovered decks, patios, walkways, landscaping, pathways, etc (if approved by the project engineer). QG does not recommend reducing the setback unless further site-specific foundation design efforts are undertaken to ensure building and slope stability is maintained.

Drainage Controls:

QG recommends proper drainage controls for stormwater runoff during and after site development to protect the site. The ground surface adjacent to structures should be sloped to drain away at a 5% minimum to prevent ponding of water adjacent to them. All concrete foundations should incorporate footing drains wrapped in fabric.

Foundations shall incorporate a wraparound footing drain composed of imported clean granular drain rock. There shall be a perforated drainpipe connected around the perimeter of the footing drain (within the rock) graded to gravity drain to an outfall pipe, to allow any accumulated water to be released to an approved drainage feature or location. The outfall point must be lower in elevation than the lowest point of possible water accumulation in the mat fill, so as to allow any captured water within the mat or crawlspace to completely drain away from the building footprint preventing standing water from accumulating.

QG recommends all roof and footing water sources (new or existing) be tightlined (piped) away from the upland site to an existing catch basin, approved dispersion area, established channel, or down the slope to be released beyond the base using appropriate energy-dissipating features at the outfall to minimize point erosion. Roof and footing drains should be tightlined separately or should be gathered in an appropriately sized catch basin structure and redistributed collectively. If storm drains are incorporated for impervious flatworks (driveways, patios, etc.), collected waters should also be discharged according to the above recommendations. All drainage tightlines should be composed of appropriately sturdy material (such as rigid PVC), sized adequately according to

anticipated flow, and anchored sufficiently. QG recommends slope tightlines be inspected by the owner periodically to look for signs of damage or displacement requiring repair.

Erosion Controls:

Erosion is one of the most common driving forces leading to slope instability. In addition to the above commentary, the following general recommendations should be implemented in general to reduce long-term erosion potential of the slope below the project site and maintain slope stability:

- Minimize the volume and velocity of water that travels toward and down the slope face (via proper choice of site development features including stormwater controls discussed above).
- Avoid accelerating slope erosion and mass wasting due to human activity such as:
  - ✓ Adding side-cast such as dumping landscape debris or fallen trees on or above the slopes.
  - ✓ Using heavy construction equipment on or near steep slopes.
  - ✓ Excavating near adjacent steep slopes toe or on slope face.
  - ✓ Placing excavated soil near the steep slope crest.
- Prior to construction, a silt fence and/or a continuous line of straw bales should be placed on the slopeward edge of the construction area. Heavy construction equipment, construction materials, or native and imported soils should not be placed behind the erosion control devices. Suitable temporary erosion and sediment control measures should be implemented at the construction site during and immediately after ground disturbance occurs. Temporary areas bare of vegetation should be protected from erosion via a blanket of straw or rolled erosion control product (RECP) during prolonged breaks in site work and prior to reseeding or revegetation.
- At the end of the project, all bare surfaces and areas of disturbed vegetation should be replanted and maintained until fully reestablished. Concentrated surface water should not be allowed to traverse the slope during or after the construction phase of the project. Roof downspouts and footing drains should be routed into closed separate pipes which outfall into appropriate drainages. Outlets for these pipes should be protected from erosion through the use of rip-rap (quarry spalls) or some other energy dissipating device. Similarly, concentrated drainages should be captured in closed pipe systems and routed down slope to appropriate outfalls.
- Clearing of existing vegetation outside the proposed building area on and adjacent to the existing slopes should be avoided except as approved by a qualified professional. This provides additional stability to the loose topsoil and minimizes the effects of down-slope water

movement. This is excepting removal of problem, dead, or dying, trees if posing a direct hazard to site installations or adjacent roadways.

Grading or excavation of soils during construction should be accompanied by grass reseeding and re-vegetation as the project is completed. Areas of existing moderate vegetation can also benefit from additional deep rooting plants. According to "Vegetation Management: A Guide for Puget Sound Bluff Property Owners" (Manashe, 1993) the following types of vegetation provide good to excellent erosion control:

Common Name	***Botanical Name***	***Deciduous/Evergreen***	***Mature Height (ft)***
Bigleaf Maple	Acer macrophyllum	Deciduous	60
Douglas Fir	Pseudotsuga menziesii	Evergreen	200+
Evergreen	Vaccinium ovatum	Evergreen	To 8
Oceanspray	Holodiscus discolor	Deciduous	10+
Oregon Grape	Mahonia spp.	Evergreen	To 6
Pacific Madrone	Arbutus menziesii	Evergreen	70
Red huckleberry	Vaccinium parvifolium	Deciduous	To 12
Rose	Rose spp.	Deciduous	2-10
Salal	Gaultheria shallon	Evergreen	To 4
Salmonberry	Rubus spectabilis	Deciduous	To 12
Serviceberry	Amelanchier alnifolia	Deciduous	12+
Snowberry	Symphoricarpos albus	Deciduous	3+
Vine Maple	Acer cricinatum	Deciduous	10+
Willow	Salix spp.	Deciduous	10+

CLOSING:

We trust this letter satisfies your project needs currently and thank you for the opportunity to be of service. QG wishes you the best while completing the project.

Respectfully Submitted,

Quality Geo NW, PLLC

Prepared By:

Approved By:

9/8/2023

LUKE PRESTON MCCANN

Audrey White, G.I.T.
Staff Geologist

Luke Preston McCann, L.E.G.
Principal Licensed Engineering Geologist

Attachments: *Limitations*
Appendix A. Site Region and Vicinity Maps
Appendix B. Aerial Site Map
Appendix C. Site Slope Profile
Appendix D. Exploration Logs

LIMITATIONS

Upon acceptance and use of this report, and its interpretations and recommendations, the user shall agree to indemnify and hold harmless QG, including its owners, employees and subcontractors, from any adverse effects resulting from development and occupation of the subject site. Ultimately, it is the owner's choice to develop and live in such an area of possible geohazards (which exist in perpetuity across the earth in one form or another), and therefore the future consequences, both anticipated and unknown, are solely the responsibility of the owner. By using this report for development of the subject property, the owner must accept and understand that it is not possible to fully anticipate all inherent risks of development. The recommendations provided above are intended to reduce (but may not eliminate) such risks.

This report does not represent a construction specification or engineered plan and shall not be used or referenced as such. The information included in this report should be considered supplemental to the requirements contained in the project plans & specifications and should be read in conjunction with the above referenced information. The selected recommendations presented in this report are intended to inform only the specific corresponding subjects. All other requirements of the above-mentioned items remain valid, unless otherwise specified.

Recommendations contained in this report are based on our understanding of the proposed development and construction activities, field observations and explorations, and laboratory test results. It is possible that soil and groundwater conditions could vary and differ between or beyond the points explored. If soil or groundwater conditions are encountered during construction that differ from those described herein, or if the scope of the proposed construction changes from that described in this report, QG should be notified immediately in order to review and provide supplemental recommendations.

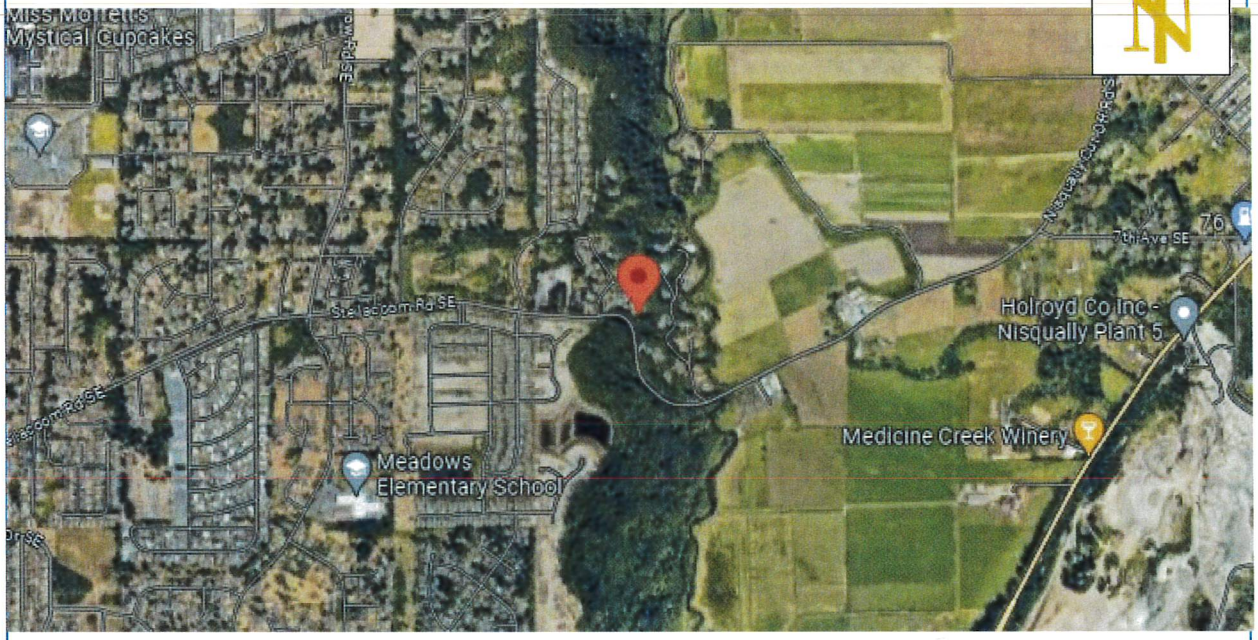
The findings of this study are limited by the level of scope applied. We have prepared this report in substantial accordance with the generally accepted geotechnical engineering practice as it exists in the subject region. No warranty, expressed or implied, is made. The recommendations provided in this report assume that an adequate program of tests and observations will be conducted by a WABO approved special inspection firm during the construction phase in order to evaluate compliance with our recommendations.

This report may be used only by the Client and their design consultants and only for the purposes stated within a reasonable time from its issuance, but in no event later than 18 months from the date of the report. It is the Client's responsibility to ensure that the Designer, Contractor, Subcontractors, etc. are made aware of this report in its entirety. Note that if another firm assumes Geotechnical Engineer of Record responsibilities, they need to review this report and either concur with the findings, conclusions, and recommendations or provide alternate findings, conclusions and recommendation.

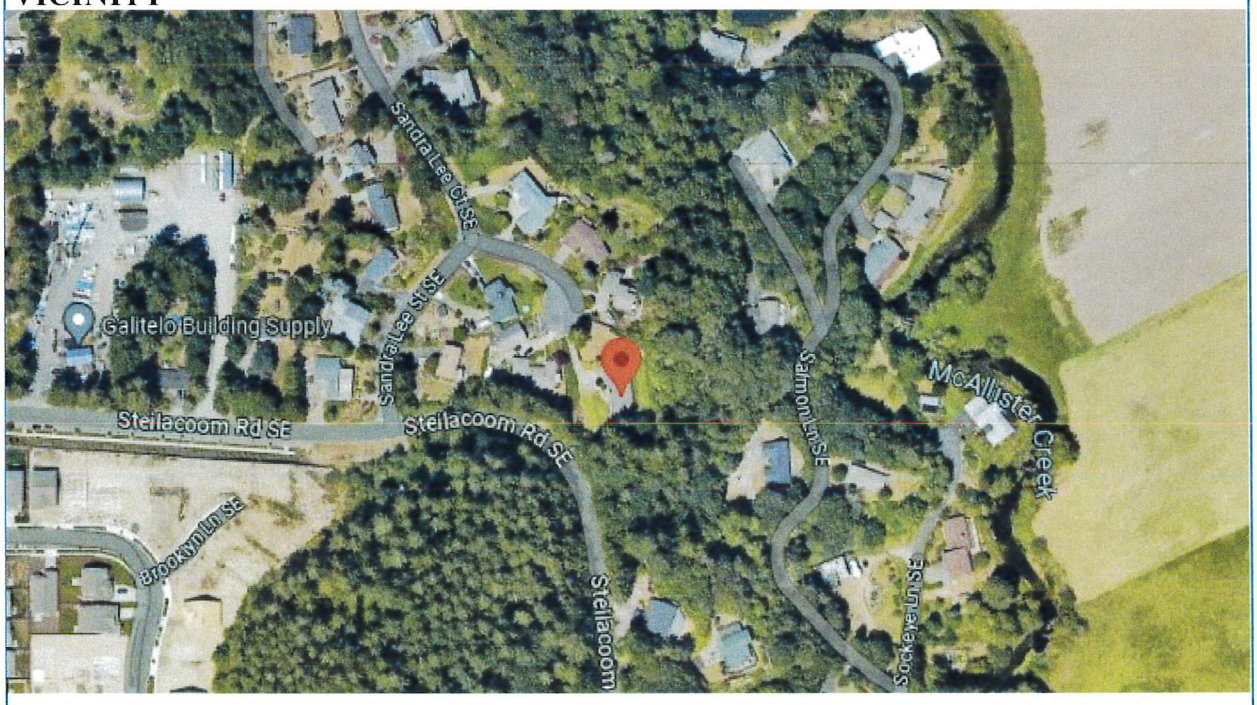
Land or facility use, on- and off-site conditions, regulations, or other factors may change over time, and additional work may be required. Based on the intended use of the report, QG may recommend that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the Client or anyone else will release QG from any liability resulting from the use of this report. The Client, the design consultants, and any unauthorized party, agree to defend, indemnify, and hold harmless QG from any claim or liability associated with such unauthorized use or non-compliance. We recommend that QG be given the opportunity to review the final project plans and specifications to evaluate if our recommendations have been properly interpreted. We assume no responsibility for misinterpretation of our recommendations.

Appendix A. Site Region & Vicinity

REGION

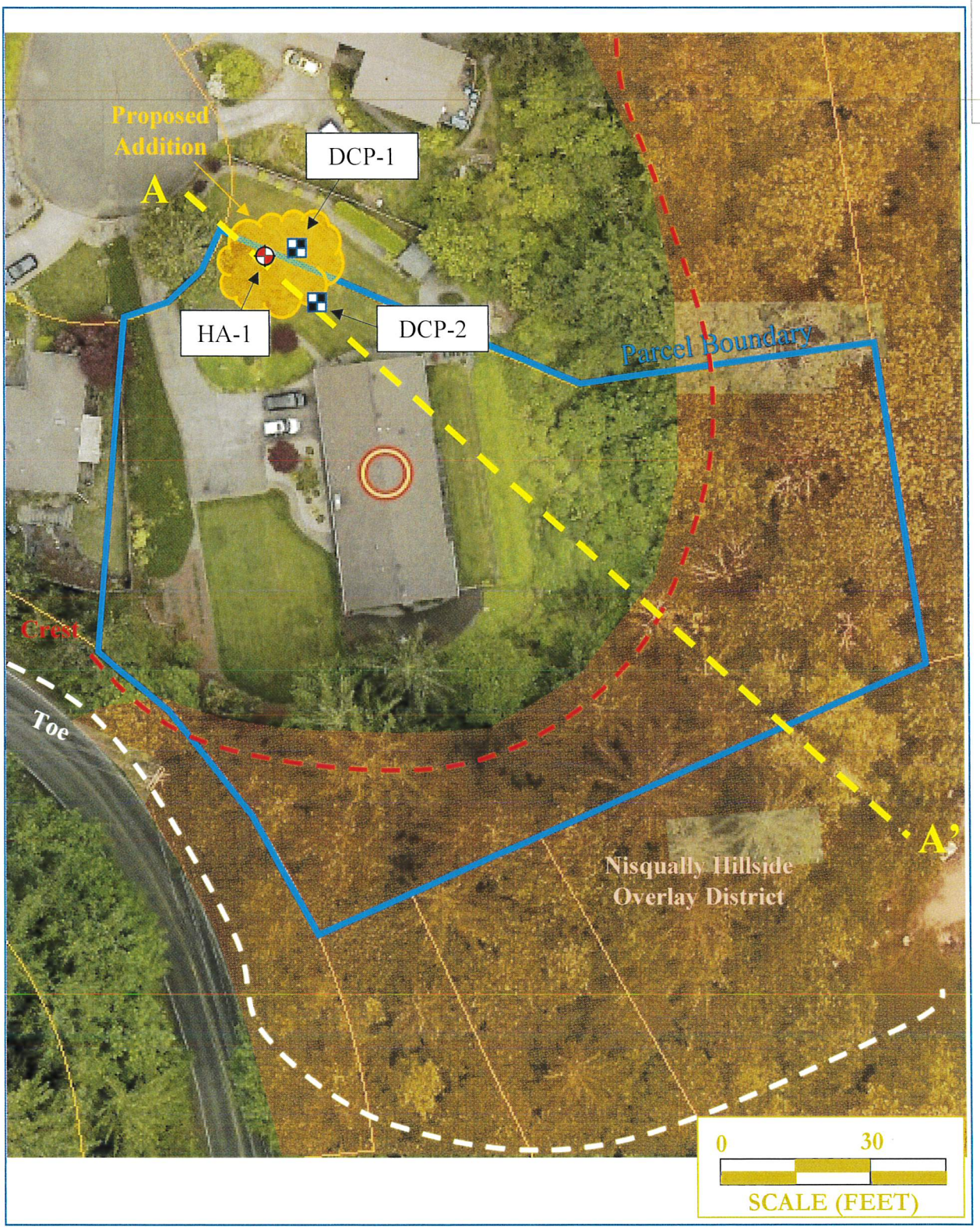


VICINITY



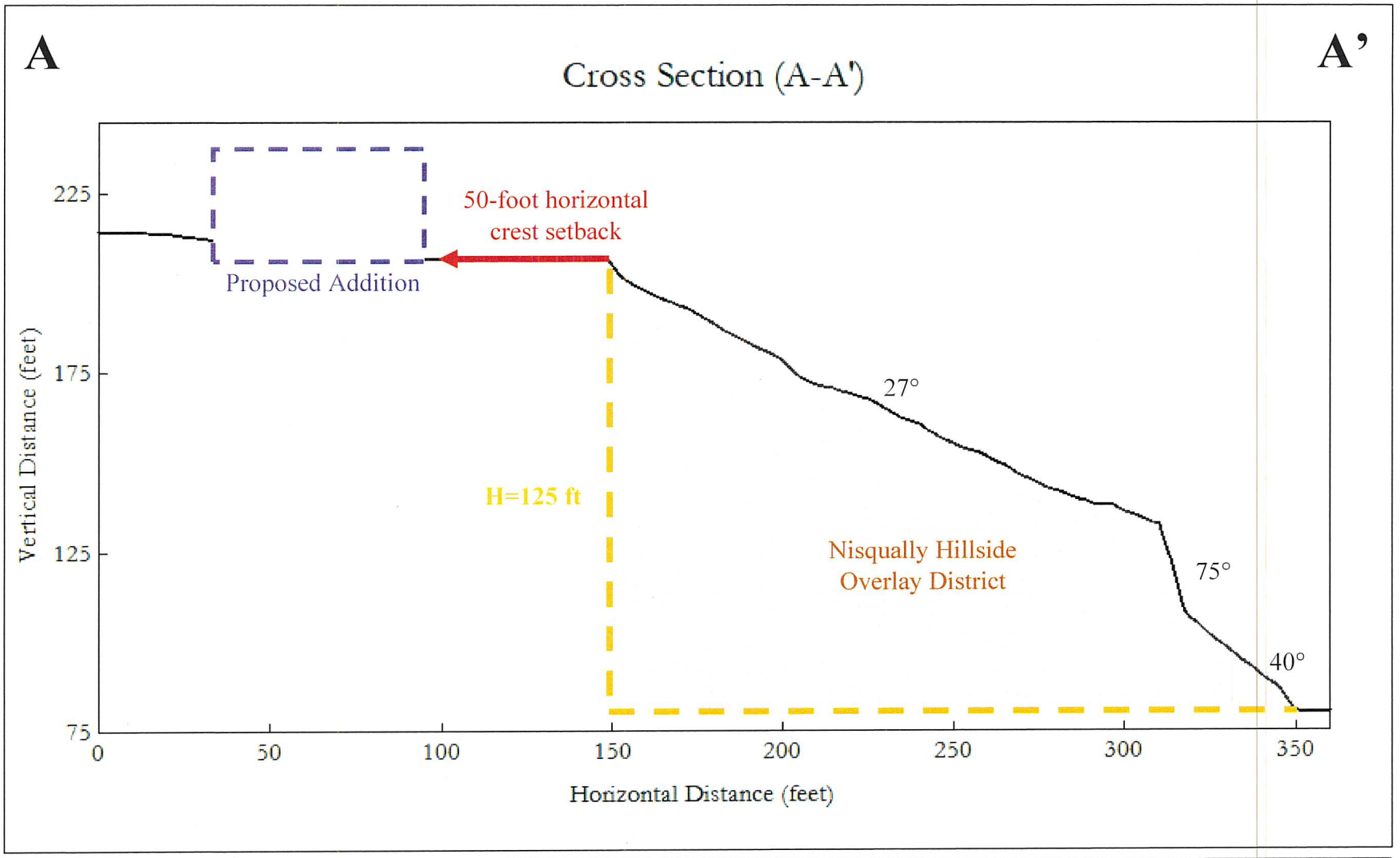
Quality Geo NW, PLLC	Site Region Britcher ADU CAO	Source: Google Imagery, 2023 Scale & Locations are approx. Not for Construction	Figure 1

Appendix B. Aerial Site Map



Quality Geo NW, PLLC	**Site Map** Britcher ADU CAO	Source: Thurston Co. GIS 2023 Scale & Locations are approx. Not for Construction	Figure 2

Appendix C. Slope Profiles



Quality Geo NW, PLLC	**Slope Profile A – A'** Britcher ADU CAO	Source: Mapped Topo & Hand Measurements Scale & Locations are approx. Not for Construction	**Figure 3**

Appendix D. Exploration Logs

Hand Auger Log HA-1

PROJECT NUMBER QG23-150
PROJECT NAME Britcher CAO
PROJECT LOCATION Olympia, WA

FIELD WORK DATE 8/8/2023
DRILLING METHOD Hand Auger

BORING LOCATION Center of Build Site
North Side of Property
SURFACE ELEVATION Existing
LOGGED BY AW

COMMENTS

Depth (ft)	Samples	Is Analysed?	Graphic Log	USCS	Material Description
0				SM	SILTY SAND (TOPSOIL) Brown, loose, dry, high organic content, no cobbles, no mottling Gravel= 5% Sand= 70% Fines= 20%
0.5					
1					SILTY SAND with GRAVEL Grey-brown, medium dense to dense, dry, moderate organic content, cobbles to 4 inches, no mottling Gravel= 30% Sand= 40% Fines= 30%
1.5					
2					Terminated at contracted depth No groundwater encountered

WILDCAT DYNAMIC CONE LOG

Quality Geo NW, PLLC
Geotechnical Consultants
Lacey, WA

PROJECT NUMBER: QG23-150
DATE STARTED: 08-08-2023
DATE COMPLETED: 08-08-2023

HOLE #: DCP-1
CREW: AW
PROJECT: Britcher CAO
ADDRESS: 654 Sandra Lee Ct SE, Olympia, WA
LOCATION: Center of Build Site

SURFACE ELEVATION: Existing
WATER ON COMPLETION: No
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	TESTED CONSISTENCY COHESIVE
-	7	31.1	•••••••••	8	LOOSE	MEDIUM STIFF
-	11	48.8	••••••••••••••	13	MEDIUM DENSE	STIFF
- 1 ft	50	222.0	••	25+	VERY DENSE	HARD
-						
-						
- 2 ft						
-						
-						
- 3 ft						
- 1 m						
-						
- 4 ft						
-						
-						
- 5 ft						
-						
-						
- 6 ft						
-						
- 2 m						
- 7 ft						
-						
-						
- 8 ft						
-						
-						
- 9 ft						
-						
-						
- 3 m 10 ft						
-						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

WILDCAT DYNAMIC CONE LOG

Quality Geo NW, PLLC
Geotechnical Consultants
Lacey, WA

PROJECT NUMBER: QG23-150
DATE STARTED: 08-08-2023
DATE COMPLETED: 08-08-2023

HOLE #: DCP-2
CREW: AW
PROJECT: Britcher CAO
ADDRESS: 654 Sandra Lee Ct SE, Olympia, WA
LOCATION: Southeast Corner of Build Site

SURFACE ELEVATION: Existing
WATER ON COMPLETION: No
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	COHESIVE
-	6	26.6	•••••••	7	LOOSE	MEDIUM STIFF
-	12	53.3	•••••••••••••••	15	MEDIUM DENSE	STIFF
- 1 ft	50	222.0	••	25+	VERY DENSE	HARD
-						
-						
- 2 ft						
-						
-						
- 3 ft						
- 1 m						
-						
- 4 ft						
-						
-						
- 5 ft						
-						
-						
- 6 ft						
-						
- 2 m						
- 7 ft						
-						
-						
- 8 ft						
-						
-						
- 9 ft						
-						
-						
- 3 m 10 ft						
-						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						