



## Coastal Solutions, LLC

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City of Bainbridge Island

OCT 17 2017

Planning and  
Community Development

September 6, 2017

Ben Sias  
14462 Sunrise Drive NE  
Bainbridge Island, WA 98110

**Re: Geologic Slope Reconnaissance**

Sias/Johnson Proposed Beach Stair Replacement  
14480 Sunrise Drive NE  
Bainbridge Island, Washington  
Project No. 17080

Dear Mr. Sias:

At your request, we have completed a geologic reconnaissance of the property located at 14480 Sunrise Drive NE to observe and evaluate current soil and slope conditions and topography. The purpose of our study was to observe current conditions with regard to the proposed beach access stair repair/replacement project.

Existing Conditions

The site is located on the eastern shore of Bainbridge Island overlooking the main channel of Puget Sound. The site was developed with the existing Johnson residence, driveway, and surrounding landscaping. Overall topography consisted of a steeply sloping east-facing beach bluff and a relatively flat upland area to the west where the house is located. The existing beach stairs consist of combination path and wood stair structure that allows access to the beach along the south Johnson property line. The upper path portion consists of a notch excavated in the bluff on the order of 20 feet deep and 8 feet wide. The lower stair portion consisted of an existing wood-frame stair structure that traversed the near vertical mid-bluff area and landed near the beach. The stairs are still usable but are in need of replacement.

The eastern beach bluff was vertical for the upper approximately 30 feet. The central lower portion of the bluff was on the order of 1.5H:1V (horizontal:vertical) and the bottom 8 feet was essentially vertical near the beach. Total vertical relief on the bluff was on the order of 80 feet. The upper vertical portion of the bluff consisted of in-place, very dense lodgment till. The lower sloping portion of the bluff consists of colluvium (accumulated erosion and landslide debris) over in-place glacially derived sand and gravel.

Surface and shallow subsurface conditions were observed along the slope at the site and both adjacent properties to the east and west. Site measurements were made by hand and were based on existing developed features at the site.

### Proposed Project

Current plans call for the replacement of the lower stair structure and replacing the current path steps within the notch with wood-framed stairs. The lower exposed portion will consist of an upper landing, lower stair run, and bottom landing constructed landward of the mean higher high water line (MHHW) with a drawbridge style lower stair that will allow access to the beach. We were provided construction plans showing stair and footing locations with proposed embedment depths prepared by Ben Sias in August of 2017.

### Vegetation

Vegetation on the upland portion of the site consisted of grass lawn adjacent to the house with associated landscaping. Vegetation on the lower beach bluff consisted of scattered young alder and maple with a moderately dense understory of low shrubs, berry bushes, and English ivy. The upper vertical portion of the bluff was bare.

### **Geology**

The site is underlain by glacially derived sediments. The following is a discussion of the exposed soils on the beach bluff from the youngest to oldest.

#### Colluvium

The outer 1 to 8 feet of soils on the lower sloping portion of the bluff consists of colluvium. Colluvium is the collection of eroded soils and the products of mass wasting that collects at the toe of steep slopes. While not considered a landslide hazard, the colluvium is loose, bioturbated, and is the growing medium for woody root structured plants on the slope. The colluvium and weathered soils on the slope are subject to soil creep, which is the natural, slow, downward movement of the soils over time. Soil creep can be seen in the form of gently curved tree trunks and other vegetation growing outward instead of straight up. The existing stair foundations showed signs of movement and deflection consistent with creep within the colluvium. The colluvium is NOT suitable for stair structure foundation support.

#### Vashon Lodgment Till

The upper vertical portion of the bluff is comprised of Vashon lodgment till. The till was deposited during the last major glaciation of the Puget lowland approximately 15,000 to 18,000 years ago. As the ice sheet passed over the pre-existing landscape, the till was deposited as a mixture of gravel, sand, silt and clay entrained in the lower portion of the glacier which was then deposited directly onto the pre-existing landscape. The upper 2 to 3 feet of weathered till is less dense and showed signs of bioturbation and reduced gravel content through cycles of freeze-thaw. The unweathered till exhibits high shear-strength and low compressibility characteristics and as observed at the site, can stand vertically for decades. The previously excavated notch was completed within the till. Both sidewalls of the notch were essentially vertical.

### Vashon Advance Outwash

Soil exposures beneath the colluvium were poor, however we noted the presence of sand with interbedded silt and clay near the beach. These lower bluff sediments are Vashon advance outwash sediments. The outwash deposits are primarily sand with variable amounts of silt and gravel. These sediments were deposited during the last major glaciation of the Puget lowland between approximately 15,000 and 18,000 years ago. As the ice-sheet advanced south through the area, sand and gravel were deposited ahead of the advancing ice sheet by pro-glacial streams meandering through a broad outwash plain. These sediments were subsequently overridden and compressed by the weight of thousands of feet of glacial ice. As a result, advance outwash sands exhibit relatively high shear strength and low-compressibility characteristics. The in-place advance outwash sediments below the colluvium are suitable for stair foundation support.

### Drainage

We could not confirm the locations or functionality of the house drain system. However, we saw no indications of erosion or concentrated surface water flow on the bluff or within the notch that could adversely affect the proposed project.

## **Conclusions**

### Stair Structure

From a geotechnical perspective replacement of the proposed stair structure is feasible. Due to the presence of loose, weathered, surficial soils on the slope we recommend a deep, pier-style foundation for all structural elements of the stairs. Stairs properly founded on 6 x 6-inch diameter wood beams encased in concrete and embedded a minimum of 4-feet into the dense glacial soils below the colluvium will have the highest resistance to surficial soil creep with no adverse effect on the slope. The depth of colluvium will vary from less than one foot near the bottom of the notch to over 6 feet near the toe. Minor disturbance of vegetation on the slope where the foundation elements will be located will occur during construction. However, revegetation of the area and care taken to re-establish the pre-existing grade will minimize any impact.

## **Recommendations**

- We recommend the use of 6 x 6-inch treated wood posts with concrete support as shown on the project plans. This type of foundation provides downward vertical capacity only and minimal lateral or uplift capacity. If either lateral or uplift capacity is required, beyond that which is provided by the stair structure itself, an alternative piling design should be considered.
- Once installed, the owner should perform routine, long-term monitoring of the stair structure foundation and slope in the area. Repairs should be made as necessary. While the construction of the stair structure will not decrease slope stability, all steep slopes are subject to natural erosion and landslide activity that could result in damage to the stairs. The piling foundation will support the stair structure but will not buttress or reinforce the slope in any way.

Ben Sias  
September 6, 2017

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- All disturbed areas should be replanted with native, low-growing, woody root structure plants where appropriate.

Provided these recommendations are followed, it is our opinion that the risk of damage by landslide activity that could result in bodily injury is low for the proposed life of the structure.

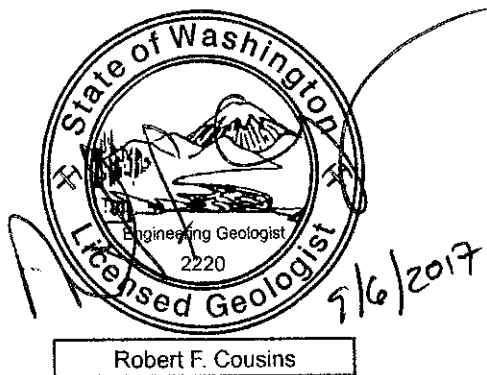
Limitations

This letter was prepared based on a limited field reconnaissance that consisted of identifying onsite soil and topographic conditions that could give rise to the existence of landslide hazard areas at the site. No subsurface explorations were performed by our firm and quantitative slope stability or seismic analyses for the site was beyond the scope of work for this study. The conclusions and/or recommendations in this report cannot provide a guarantee of stable slopes, but are meant to aid the owners in understanding and managing landslide hazard areas on the site. The steep beach slope is a landslide hazard area and should be monitored closely for any signs of instability. The opinions in this letter do not constitute a legal opinion or a warranty, express or implied. This letter was prepared for the exclusive use of Ben Sias and his agents with specific application to the project site.

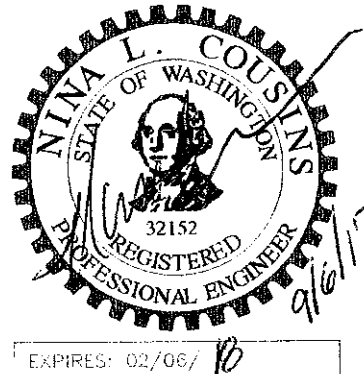
It has been a pleasure to provide these services to you. If you have any questions, please do not hesitate to call.

Sincerely,

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