STRATUM GROUP
1451 Grant Street, Bellingham, WA 98225
Phone (360) 714-9409

April 14, 2007

Katharine Alt
310 Disney Road
Norland, WA 98358

Re: **Geology Evaluation, Shoreline Bluff**
310 Disney Road
Norland, Washington

Dear Ms Alt:

Stratum Group is pleased to present the results of our geology evaluation of the above referenced property on a shoreline bluff. The purpose of this geology evaluation was to evaluate the risk of slope failures impacting the property and provide general site maintenance recommendations for the property adjacent to a potentially unstable bluff. This evaluation included a visual inspection of the property and vicinity, a visual inspection of the bluff face, review of available geologic mapping in the area, inspection of the shoreline at the base of the bluff, review of plans and designs for the existing erosion control structures and an inspection of conditions of the erosion control structures.

It is my opinion that the home on the property will not be at risk from slope failures over at least the next 100 years as long as erosion control structures are maintained. At the time of my site inspection in March 2007 the erosion control structures were in good condition and no damage was taking place at bluff. Conditions were essentially the same as the last time I had inspected the bluff slope in November 2002 with the exception that vegetation on the steep bluff slope was in better condition.

SCOPE OF SERVICES

The scope of our services included the following:

1) Conducted a site visit to visually inspect the subject property including the bluff face slope conditions, shoreline conditions, and relevant conditions in the vicinity of the property.

2) Observed surface soil conditions on the bluff face and on the uplands above the bluff by excavating shallow hand dug test pits.

3) Prepared this report summarizing our findings, including an evaluation of the feasibility of building a residence on the subject property, a qualitative evaluation of the shoreline bluff stability, recommendations for site development, and recommendations for further investigation, if necessary.

GENERAL GEOLOGY

Northwestern Washington has been occupied by continental glaciers at least four times during the Pleistocene Epoch (1.6 million to 10,000 years ago). During these glacial and accompanying interglacial periods, the underlying bedrock was eroded and a relatively thick layer of glacial related and interglacial fluvial sediments were deposited over the underlying bedrock in the vicinity of the subject property.

The Surficial Geologic Map of the Port Townsend 30 by 60 Quadrangle, Puget Sound Region, Washington (Pessl, Dethier, Booth and Minard, 1989) indicates the steep shoreline bluff exposed on the subject property is underlain glacial till and advance glacial deposits.

Observations on the bluff face on the subject property and on the bluff face in the vicinity of the property are consistent with the mapping described above. The upper approximate 10 feet of the bluff face and the entire upland area on the property are underlain by very compact glacial till. The lower approximate 60 feet of the bluff consists of compact advance glacial outwash sand and silt. Very hard compact clay is located along the very base of the bluff at the subject property and to the southwest of the property. I interpret this unit to be a preglacial period alluvial deposit. Northeast of the property there is no hard clay along the base of the bluff. Approximately 300 feet northeast of the property the base of the bluff and shoreline is underlain by bedrock. The bedrock consists of sedimentary silt and sandstone with concretions.

SPECIFIC SITE OBSERVATIONS

The property consists of a level to very gently sloping upland area bounded on the southeast by a steep southeast facing shoreline bluff. The upland portion slopes gently towards the west and then levels off at the top of the bluff. The upper 25 feet of the bluff is very steep with slopes that are greater than 70 degrees with portions of the top of the bluff being vertical. The overall slope of the bluff from the top of the slope to the beach is approximately 50 degrees. The lower slope is between 35 and 40 degrees.

The home is located on the upland area of the property. The foundation of the home is set back from the top edge of the steep bluff slope 29 feet. The home is cantilevered such that the outer wall is 22 feet from the top edge of the bluff. The roof of the home is sloped away from the bluff such that roof run off is directed towards the west away from the bluff.

The area between the home and the top of steep shoreline bluff is covered by a wood deck. The deck is supported by 8-inch beams. All the support beams are vertical and no indication of shifting or undermining is evident under any of the support beams. A geofabric covers the soil

under the deck. Water on the fabric is routed to a low point and drains via a pump system to a pipe that routes all storm water to the base of the bluff. At the time of my site visit in March 2007, the system was functioning and water from under the deck was being pumped down to the beach.

The upper approximately 20 feet of the bluff is very nearly vertical and is underlain by very compact glacial till at the top most part of the bluff and compact sand below that. The till consists of silty sand with gravel and a few cobbles. Below the very steep upper section of the bluff, the slope is less steep with an overall slope angle of approximately 40 degrees. The lower 40 feet of the slope is underlain primarily with layers of very compact sand with occasional layers of silt. These layers of sand and silt are covered with loose sand and silt from material that has raveled off of the upper steep slopes in the past.

The uppermost steep section of the bluff is protected by wood slats and the geofabric. The slats minimize the moisture and wind from eroding the slope. The lower portion of the bluff has been tiered in a series of wood crib terraces and has been planted with grasses, tress and brush. The wood crib walls were in good condition and no indications of bulging or failures was evident at the time of my March 2007 site visit.

The base of the bluff has been lined with large 6-foot boulder rip rap. The beach in front of the rip rap consists of a sand beach with gravel. The shoreline sediment transport is not being impacted by the rip rap and there is no evidence that the rip rap is causing the beach to be lowered in front of or on the sides of the rip rap. There is no evidence that the outer portion of the rip rap has settled or been undermined. Trees are growing all along the top of the rip rap area.

Routine slope failures are apparent all along the bluff to the northeast and southwest of the property. The bluff is generally very steep all along this section of shoreline. Very little landslide debris is present at the base of the bluff as waves are large enough that landslide debris is reworked.

The bluff is eroded primarily by wave action that undermines the base of the bluff. The shoreline at the site is exposed to relatively open waters of the Puget Sound. Wave action during high tide from south winds will erode the base of the bluff. The cohesiveless sand unit at the base of the bluff is readily erodable. The slope northeast of the subject property is more susceptible to erosion because the base of the bluff is underlain by readily eroded sand. The bluff to the southwest of the subject property is somewhat more resistant to erosion because the base of the bluff is underlain by compact silts and clays.

Because of the very compact nature of the bluff soils, the slope failures appear to consist of relatively narrow slab type failures. Ravelling of material off the exposed soils on the

unvegetated portions of the bluff, and periodic shallow topsoil failures also play a minor role. The material eroded from the bluff face is removed from the base of the bluff and transported along the shore towards the northeast by wave action.

I did not observe any evidence indicating an incipient global-type or deep-seated failure on the subject property or elsewhere in the vicinity. The layered nature of the bluff face likely would preclude deep-seated rotational type failures. No seeps or seasonal wet areas were observed on the bluff face at the subject property. Very minor seeps were present along the top of the silt/clay unit along the lower part of the bluff to the southwest of the property. However, these seeps do not appear to have resulted in any past slope movement.

CONCLUSIONS AND RECOMMENDATIONS

Based on my visual inspection of the subject property and vicinity, I conclude that the existing residence is not at risk of being impacted by slope failures over at least the next 100 years as long as the erosion controls in place are properly maintained.

The soils underlying the bluff are very dense and are stable. Failures along this shoreline bluff are primarily driven by toe of bluff erosion by wave action. The rock rip rap at the toe of the bluff is effectively preventing erosion at the toe of the slope and therefore this risk of erosion has been adequately addressed.

Another risk at this bluff site is the potential for surface water flow from storm water run off eroding the bluff face as much of the sand on the bluff face is subject to erosion from surface water flow or where in a loose condition such as on the lower 50 feet of the slope is subject to raveling or sliding on the steep slope. The lower 50 feet of the bluff has been terraced and planted with vegetation such that no slope movement should be expected as long as the trees and brush on the slope remains well established.

Storm water controls at the house and with the geofabric under the deck have been successfully preventing any surface water flow onto the bluff face. As long as these controls are maintained, erosion should be minimal. The wood slats in front of the steep vertical sections of the slope are doing a very good job preventing surface erosion of the vertical sections of the bluff from wind erosion.

No further erosion control measures are needed at this time. I recommend that all existing controls be maintained. Inspections of the storm water system should be done routinely to ensure that no surface water flow is impacting the bluff. Vegetation on the lower slopes should continue to be maintained. Overtime wood supports and beams may require replacement. Inspection of all structures and replacement before beams fail will prevent damage to the existing erosion

controls.

Due to the very steep nature of the upper most portion of the bluff, it is possible that a small scale slab of soil could calf off the upper bluff. Based on the till soils on the bluff slope and evidence from other failures along the top of the bluff, I anticipate that the size of a slab that might break off to be no greater than 5 feet thick. A failure on this scale will not threaten the home and will be an unlikely event as long as the upper bluff is protected as it currently is.

Please note that there are inherent risks associated with building on lots near or adjacent to steep slopes. These are risks that the building owner should recognize and be willing to accept. If conditions appear different than those described in this report, or other concerns arise, we request that we be notified so we can review those areas and modify our recommendations as required.

Stratum Group appreciates the opportunity to be of service to you. Should you have any questions please contact our office at (360) 714-9409.

Sincerely yours,

Stratum Group

Dan McShane, M.Sc., L.E.G.
Licensed Engineering Geologist

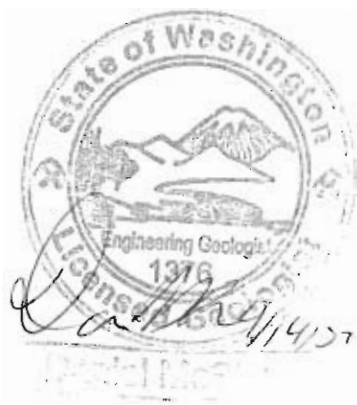
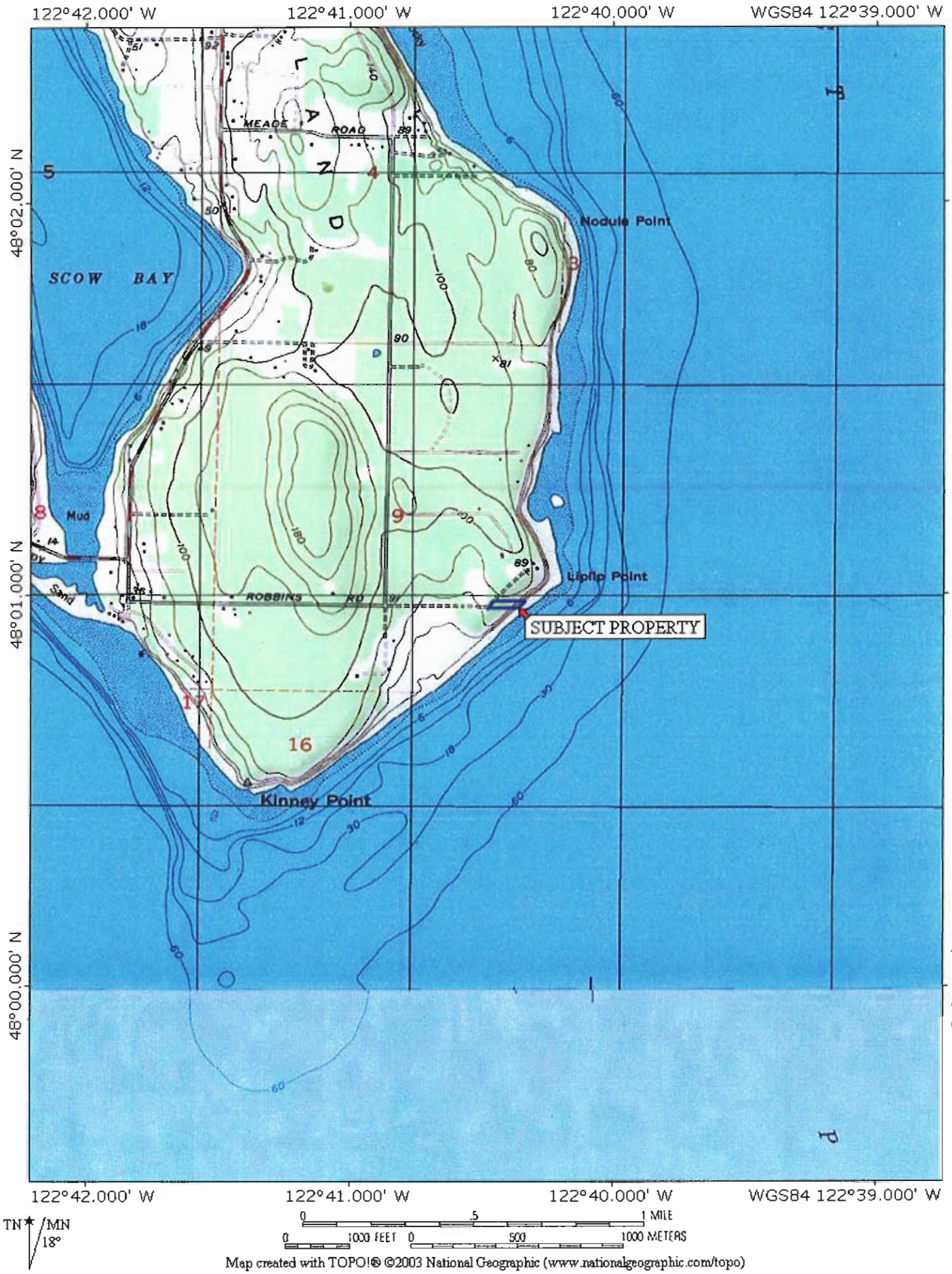


Figure 1. Site Location 48°00.972' N, 122°40.480' W WGS84



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