



THURSTON COUNTY
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MEMORANDUM

TO: Mark Smuland – Aloha Lumber Corp.

FROM: William E. Halbert, L.E.G., L.H.G.

DATE: May 29, 2012

SUBJECT: Lake Lucinda Estates – Geologic Hazard Classification of Southern Slope

INTRODUCTION AND BACKGROUND

The purpose of our memorandum is to provide our opinion regarding an appropriate geologic hazard classification for a slope in the southern portion of the Lake Lucinda Estates property, per Thurston County Code (TCC). The subject slope trends generally northeast-southwest along the central and southern portions of parcels 13722120100 and 13722210000, respectively, in the southern portion of the larger proposed Lake Lucinda Estates subdivision. A portion of this slope is mapped as Tenino gravelly loam (119), 15 to 30 percent slopes in the Soil Survey of Thurston County, Washington (SSTC) as shown in the site plan, attached. An evaluation of slopes in this area, based on Thurston County contour data, indicates that some slopes may be in excess of 30 percent, which would change the mapped soil classification to Tenino gravelly loam (120), 30 to 60 percent slopes. This soil classification is a listed classification under Table 6 of the TCC Critical Areas Ordinance Title 17, Chapter 17-15 and would change the classification of the slope to a Landslide Hazard Area under the existing ordinance if these soils were in fact present.

SITE EXPLORATION AND REVIEW

We recently completed subsurface explorations and site reconnaissance on the subject slope to evaluate geologic conditions for site development. We also reviewed topographic information developed by Thurston County for the subject slope. Our exploration locations are shown on the attached Site Plan and our exploration logs are attached to this memorandum.

Our findings, based on our subsurface explorations, indicate that the soils on the subject slope consist primarily of deposits of medium dense sand and gravel with variable silt content overlying glacial till. We interpret the materials overlying the glacial till as ablation till deposits. Ablation till typically comprises unstratified sand and gravel with variable silt content that was deposited as glacial ice melted away.

The SSTC describes the Tenino series as glacial till overlying glacial outwash. The SSTC describes the Alderwood series as ablation till overlying basal till. Based on the findings of our subsurface explorations, it is our opinion that the appropriate USDA soil classification for the subject slope is the Alderwood series.

Based on our review of Thurston County's topographic data, the average inclinations across the natural portions of the subject slope are between 30 and 35 percent. Accordingly, it is our opinion that the subject slope should be classified as soil number 4, Alderwood gravelly sandy loam, 30 to 50 percent slopes.

We did not observe frequent interbedding of sand and gravel with silt and clay in our explorations. Springs and/or seeping groundwater were not encountered on the face of the subject slope. As part of our geotechnical study, we also reviewed geologic maps, available landslide hazard maps and LIDAR images for the site. The results of our review and site reconnaissance indicate that the subject slope is not associated with recent or historic landsliding.

Geologic Hazard Opinion Based on Current TCC

The current TCC defines a landslide hazard as follows:

"Landslide hazard areas" means those areas which are potentially subject to risk of mass movement due to a combination of geologic, topographic, and hydrologic factors; and where the vertical height is fifteen feet or more. The following areas are considered to be subject to landslide hazards:

1. Any area with a combination of:
 - a. Slopes of thirty percent or steeper, and
 - b. Impermeable subsurface material (typically silt and clay), frequently interbedded with granular soils (predominantly sand and gravel), and
 - c. Springs or seeping groundwater during the wet season (November to February);
2. Steep slopes of fifty percent or greater;
3. Any areas located on a landslide feature which has shown movement during the past ten thousand years or which is underlain by mass wastage debris from that period of time;
4. Any soil type contained on Table 6 and which does not lie along the shoreline of Puget Sound.

For reasons previously described, it is our opinion that the subject slope does not meet the criteria for items 1 through 3 above. SSTC soil number 4, Alderwood gravelly loam, 30 to 50 percent slopes is not listed on Table 6 of the TCC. Accordingly, it is our opinion that the subject slope does not meet the criteria for item 4.

It is our opinion that the subject slope should not be considered a landslide hazard area based on the current TCC.

Geologic Hazard Opinion Based on Proposed TCC Amendments

Landslide Hazard Area

We understand that the TCC critical areas regulations are likely to change sometime in the near future. Our understanding of the potential changes to the TCC is based on our review of public draft hearing documents, including proposed Amendments to the Critical Areas Regulations dated November 18, 2011. A landslide hazard area might be defined by the amended TCC as follows:

"Landslide hazard areas" means those areas which are potentially subject to risk of landslide due to a combination of geologic, topographic, and/or hydrologic factors; and where the vertical height is fifteen feet or more. The following areas are considered to be subject to landslide hazards:

- A. Any area with a combination of:
 1. Slopes of fifteen percent or steeper, and

2. *Impermeable subsurface material (typically silt and clay), frequently interbedded with granular soils (predominantly sand and gravel), and*
3. *Springs or seeping groundwater during the wet season;*

B. Slopes of forty percent or greater;

C. Any areas located on a landslide feature which has shown movement during the Holocene Epoch (post glacial) or which is underlain by mass wastage debris from that period of time;

D. Known hazard areas, such as areas of historic failures, including areas of unstable, old and recent landslides.

E. Breaks between landslide hazard areas shall be considered part of the landslide hazard area under the following condition: The required buffers from the top of slope of the landslide hazard area located below the break and the toe of slope of the landslide hazard area located above the break overlap or coincide, and the combined height is fifteen feet or more. When this condition is present, the upper and lower landslide hazard areas and the break shall be combined into one landslide hazard area.

For reasons described above, it is our opinion that the slope does not meet the criteria for items A through E above. It is our opinion that the subject slope should not be considered a landslide hazard area based on the proposed amendments to the TCC.

Erosion Hazard Area

The proposed amendments to the TCC introduce the term erosion hazard, defined as follows:

"Erosion hazard areas" means land characterized by soil types that are subject to severe erosion when disturbed. These include, but are not limited to, those identified by the United States Department of Agriculture Soil Conservation Service Soil Classification System, with a water erosion hazard of "severe" or "high" (See Table 24.15-3, Erosion Soils of Thurston County). These areas may not be highly erodible until or unless the soil is disturbed by activities such as clearing or grading.

Based on our review of Table 24.15-3, SSTC soil number 4, Alderwood gravelly loam, 30 to 50 percent slopes is listed as having a "Severe" erosion potential if the soils are disturbed. We understand that this area is to remain as open space within the proposed subdivision, and no development is planned for the slope.

CLOSURE

It is our opinion that the slope in the southern portion of the Lake Lucinda Estates property should not be considered a landslide hazard area based on the current TCC or the proposed amendments to the TCC. It is possible that if development were to occur on the slope, the soils would have severe erosion potential and thus be considered erosion hazard areas based on the proposed amendments to the TCC.

We trust this memorandum meets your current needs. Please contact us if you have questions or seek further clarifications.

FILE INFO: \\g-001\company\insight\545-001-01 Lake Lucinda Estates\Figures\Ceotech Report\Figure 1 - Vicinity Map.dwg PLOTTED: Nov 28, 2011 3:43pm BY: jenned



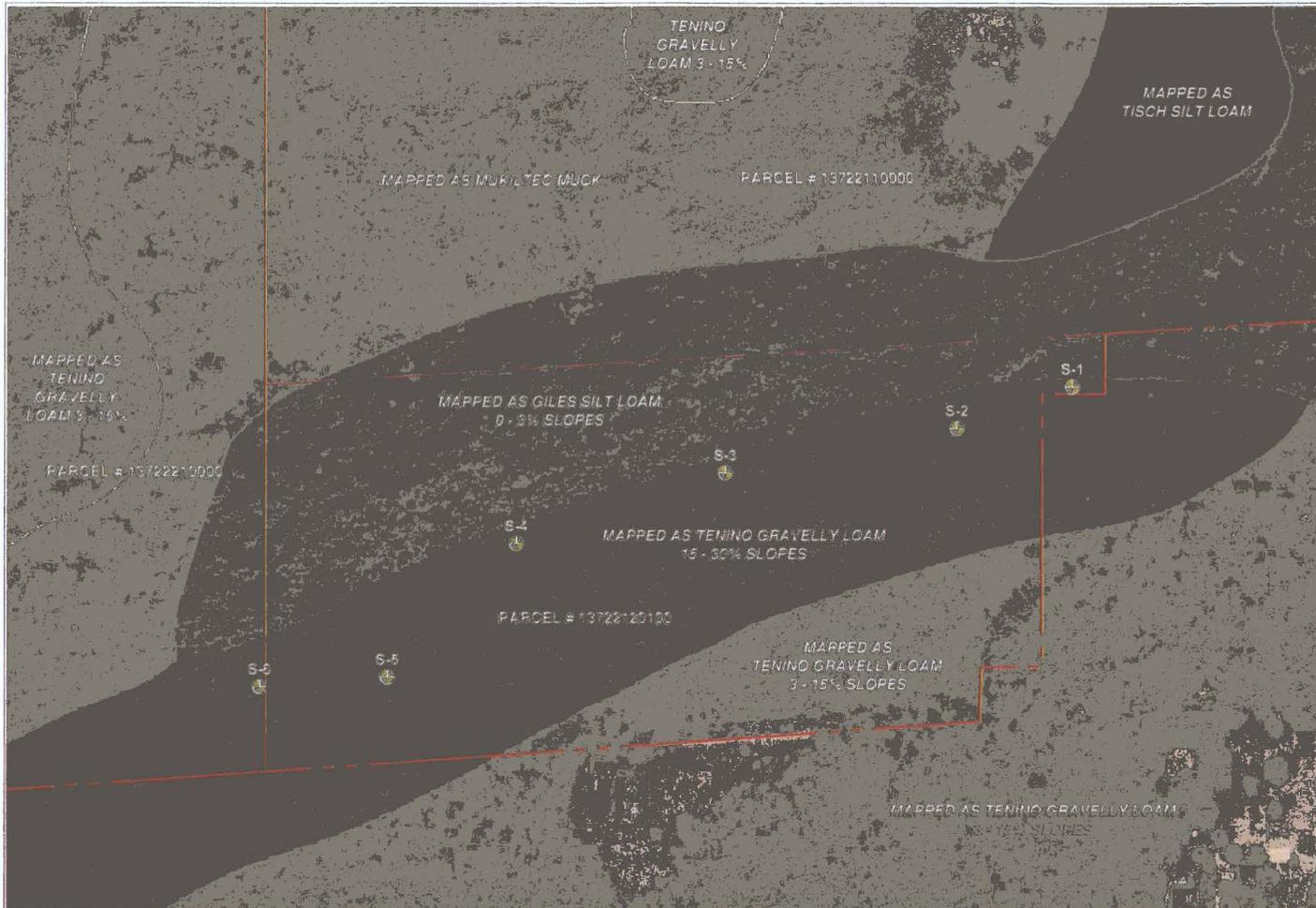
Source: Google (c) 2011

LAKE LUCINDA ESTATES

THURSTON COUNTY, WASHINGTON



Figure 1 Vicinity Map



Source: Thurston County GeoData Center



LEGEND:

- S-1** APPROXIMATE SAMPLE LOCATION
-  APPROXIMATE SAMPLE LOCATION
-  APPROXIMATE PARCEL LINE
-  APPROXIMATE PROJECT BOUNDARY

LAKE LUCINDA ESTATES
 THURSTON COUNTY, WASHINGTON

Figure 2
 Site Plan with Soils Type



ATTACHMENT A
EXPLORATION LOGS

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS		SYMBOLS		GROUP NAME	
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVEL <5% FINES		GW WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL	
		GRAVEL WITH FINES >12% FINES		GP POORLY GRADED GRAVEL	
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SAND <5% FINES		SW WELL-GRADED SAND, FINE TO COARSE SAND	
		SAND WITH FINES >12% FINES		SP POORLY GRADED SAND	
		SANDS AND SANDY SOILS LIQUID LIMIT LESS THAN 50	INORGANIC		ML SILTY SAND
			ORGANIC		CL CLAYEY SAND
FINE GRAINED SOILS MORE THAN 50% PASSING NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50	INORGANIC		OL SILTY SILT, ORGANIC CLAY	
		ORGANIC		MH SILT OF HIGH PLASTICITY, ELASTIC SILT	
	SILTS AND CLAYS LIQUID LIMIT 50 OR MORE	INORGANIC		CH CLAY OF HIGH PLASTICITY, FAT CLAY	
		ORGANIC		OH ORGANIC CLAY, ORGANIC SILT	
HIGHLY ORGANIC SOILS			PT PEAT		

ADDITIONAL MATERIAL SYMBOLS

SYMBOLS	TYPICAL DESCRIPTION
	CC CEMENT CONCRETE
	AC ASPHALT CONCRETE
	CR CRUSHED ROCK / QUARRY SPALLS
	TS TOPSOIL/SOD/DUFF

GROUNDWATER EXPLORATION SYMBOLS

- MEASURED GROUNDWATER LEVEL IN EXPLORATION, WELL, OR PIEZOMETER
- GROUNDWATER OBSERVED AT TIME OF EXPLORATION
- PERCHED WATER OBSERVED AT TIME OF EXPLORATION
- MEASURED FREE PRODUCT IN WELL OR PIEZOMETER

STRATIGRAPHIC CONTACT

- APPROXIMATE CONTACT BETWEEN SOIL STRATA OR GEOLOGIC UNIT
- APPROXIMATE LOCATION OF SOIL STRATA CHANGE WITHIN GEOLOGIC SOIL UNIT
- APPROXIMATE GRADUAL CHANGE BETWEEN SOIL STRATA OR GEOLOGIC SOIL UNIT
- APPROXIMATE GRADUAL CHANGE OF SOIL STRATA WITHIN GEOLOGIC SOIL UNIT

LABORATORY / FIELD TEST CLASSIFICATIONS

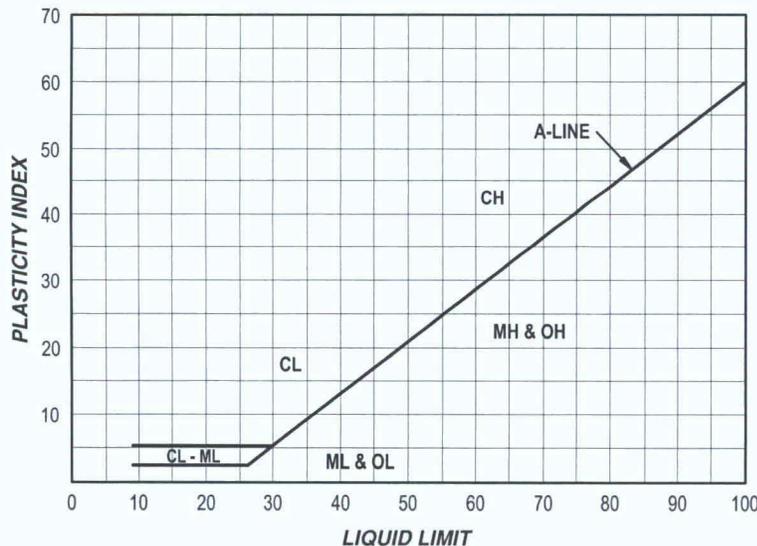
- | | |
|--------------------------------------|--|
| %F PERCENT FINES | MD MOISTURE CONTENT AND DRY DENSITY |
| AL ATTERBERG LIMITS | OC ORGANIC COMPOUND |
| CA CHEMICAL ANALYSIS | PM PERMEABILITY OR HYDRAULIC CONDUCTIVITY |
| CP LABORATORY COMPACTION TEST | PP POCKET PENETROMETER |
| CS CONSOLIDATION TEST | SA SIEVE ANALYSIS |
| DS DIRECT SHEAR | TX TRIAXIAL COMPRESSION |
| HA HYDROMETER ANALYSIS | UC UNCONFINED COMPRESSION |
| MC MOISTURE CONTENT | VS VANE SHEAR |

SAMPLER SYMBOLS

- | | |
|----------------------------|--------------|
| 2.4 INCH I.D. SPLIT BARREL | SHELBY TUBE |
| DIRECT-PUSH | PISTON |
| STANDARD PENETRATION TEST | BULK OR GRAB |

SHEEN CLASSIFICATIONS

- NS** NO VISIBLE SHEEN
- SS** SLIGHT SHEEN
- MS** MODERATE SHEEN
- HS** HEAVY SHEEN
- NT** NOT TESTED

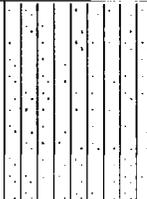
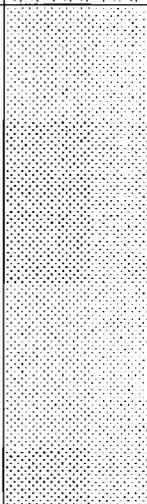
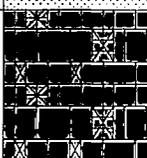


SOIL MOISTURE MODIFIERS:
 DRY - ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH
 MOIST - DAMP, BUT NO VISIBLE WATER
 WET - VISIBLE FREE WATER OR SATURATED, USUALLY SOIL IS OBTAINED BELOW WATER TABLE

DEPTH (FT)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0	SM		Dark brown silty fine to coarse sand with fine to coarse gravel and occasional cobbles, loose, moist	Groundwater not encountered
1	GP		Brown fine to coarse gravel with fine to coarse sand and silt, very dense, moist (till)	
2	BA		Basalt	
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

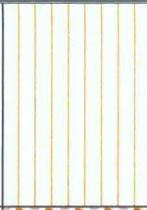


Contractor: Hill Construction
 Equipment: Mini Excavator
 Logged By: Kevin Vandehey

DEPTH (FT)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0	SM		Dark brown silty fine to coarse sand with fine to coarse gravel, loose, moist	Groundwater not encountered
1				
2	SP		Orange-brown fine to coarse sand with fine to coarse gravel and clayey silt, loose, moist	
3				
4				
5				
6				
7	BA		Basalt	
8				
9				
10				
11				
12				
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14				
15				

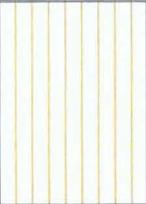


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DEPTH (FT)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0	SM		Dark brown silty fine to coarse sand with fine to coarse gravel, loose, moist	Groundwater not encountered
1				
2	GP		Brown fine to coarse gravel and occasional cobbles with fine to coarse sand and silt, loose, moist	
3				
4				
5				
6				
7				
8	SP		Gray fine to coarse sand with fine to coarse gravel and silt, very dense (till)	
9				
10				
11				
12				
13				
14				
15				

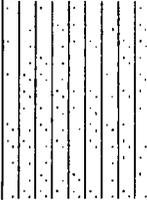
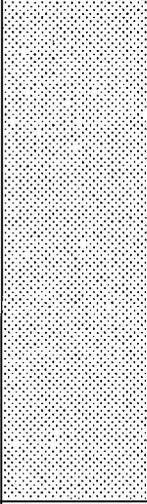
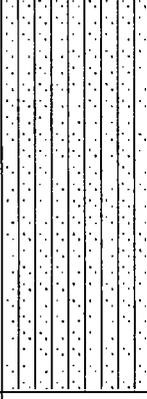


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DEPTH (FT)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0	SM		Dark brown silty fine to coarse sand with fine to coarse gravel, loose, moist	Groundwater not encountered
1				
2	GP		Brown fine to coarse gravel and occasional cobbles with fine to coarse sand and silt, loose, moist	
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

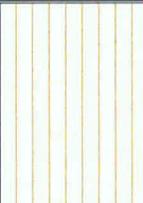
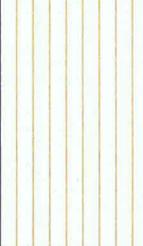
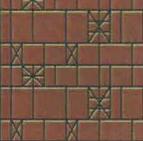


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 Equipment: Mini Excavator
 Logged By: Kevin Vandehey

DEPTH (FT)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0 - 2	SM		Dark brown silty fine to coarse sand with fine to coarse gravel, loose, moist	Groundwater not encountered
2 - 7	SP		Brown fine to coarse sand with fine to coarse gravel and occasional cobbles and silt, loose, moist	
7 - 11	SM		Gray-brown silty fine to coarse sand with fine to coarse gravel and occasional cobbles, medium dense, moist	
11 - 15				



Contractor: Hill Construction
 Equipment: Mini Excavator
 Logged By: Kevin Vandehey

DEPTH (FT)	U.S.C.S.	LITHOLOGY	SOIL DESCRIPTION	REMARKS AND OTHER TESTS
0	SM		Dark brown silty fine to coarse sand with fine to coarse gravel, loose, moist	Groundwater encountered at 10 feet
1				
2	SP		Brown fine to coarse sand with fine to coarse gravel and silt and occasional cobbles, medium dense, moist	
3				
4				
5	SM		Gray-brown silty fine to coarse sand with fine to coarse gravel and occasional cobbles, medium dense, moist	
6				
7	GP		Orange-brown basalt and fine to coarse gravel and cobbles with silty clay, medium dense, moist	
8				
9	BA		Orange-brown basalt and cobbles, dense, wet	
10				
11				
12				
13				
14				
15				



Contractor: Hill Construction
 Equipment: Mini Excavator
 Logged By: Kevin Vandehey