

# Horning Geosciences

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July 13, 2016

Angela Lougee  
Executive Director  
Nehalem Valley Care Center  
PO Box 45  
Wheeler, OR 97147

RE: Geological Inspection; Nehalem Valley Care Center; Tax Lot 300, Map 2N 10 3DD; Wheeler, Tillamook County, Oregon

Dear Ms Lougee:

I visited the Nehalem Valley Care Center (NVCC) on June 1, 2016, to examine structural deformation at the west end of the building. Mark Remley toured me through the building and grounds to examine the building, its foundations, and the land for evidence of recent ground movements. We spent about one hour investigating the site and in discussions. I have provided a summary sketch map in Figure 1 that shows the findings of the inspection.

## Background

The NVCC has been built on land that includes many old landslides. The bedrock is relatively weak mudstone. It decomposes to form weak clay-silt soils. The soils are sensitive to water saturation. Both soils and weathered bedrock are prone to landslide movements of several types, some as much as 40 to 60 ft thick. Typical movements of landslides throughout the Wheeler area are concentrated near streams that are incising gullies through old landslides. As the base of support is removed, the walls of the gullies slump down and slides of various sizes are produced. These slides can extend back from the creek axis by up to 200 ft on steeper slopes, but may be limited to 10 to 20 ft on gentler grades.

Movement of the slides is generally triggered by exceptionally heavy rainfall. The heavy rains saturate the soils and weaken the materials until the weight of the saturated soils overwhelms their internal strength, inducing movement. Movements deform buildings and cause cracks to form in concrete and sheet rock. Doors and windows may have problems opening and closing. Floors may sag. Soils may pull away from beneath concrete footings. In lawns, sags and humps may develop. Sometimes the turf may tear open, exposing a gash.

The extensive landslide complex of Wheeler is due additionally to undercutting of the toe of the hill by the Nehalem River, particularly during low-stands of sea level when sea level was more than 350 ft lower than it is now, and also by lateral forces from seismic shaking from periodic subduction zone earthquakes, which strike every 250 to 550 years. The last quake was 316 years ago.

Several landslides have occurred within two blocks to the south-southwest of the NVCC facility over the past 15 years. These were triggered in part by heavy rains, but also by filling the flanks and upper parts of creek drainages improperly. Mr. Remley describes rates of deformation to the building as above average since last fall. It appears that the rate of deformation has dropped off again this spring.

## Observations

The southwest wing of the NVCC facility has been deformed by ground movement. The boundary of the slide damage is illustrated in Figure 1. Lateral extension is greater than vertical displacement, the direction of movement to the west. The edge of the building is near the edge of steep slopes that drop down into the creek gully. It has been built too close to the steep slopes and should have been set back an appropriate distance to avoid the movement. In the building, floors have been cracked, lino-

leum tiles breaking away to reveal cracks up to 2/3 inches across. Window glass in the salon is becoming loose in its frame. Sheet rock in the hallway has rifted open. Examination outside finds that soils have dropped from beneath the concrete footings as the land has dropped.

Examination of pilings, foundation concrete, and lawns farther to the north finds no evidence of slope movement. The pilings stand vertical, although at least on one pile there is spalling off concrete where corrosion of rebar has caused rust to grow and expand, popping the outer skin of concrete off the surface of the pile. There are some subtle hummocks in the lawn, but they cannot be attributed to ground movement. More likely they are coherent blocks of mudstone that are surrounded by fill soils that have settled, leaving the mounds standing with positive relief.

Conclusions

The southwest wing of the NVCC facility has been slowly deforming from incipient landslide movements for many years. The rate of movement is observed to have increased in the winter of 2015-16. This coincides with exceptional rainfall and landslide events during the period that includes December 9, 2015, when the three-day rainfall totals ranged from 9 to 13 inches, causing unparalleled debris flows and flooding. In the past, cumulative rainfall amounts in excess of 6 inches in 3 days have triggered significant slides. It is therefore concluded that the heavy rains increased the rate of slide damage to the southwest wing of the NVCC facility. Assuming that this coming winter is average in storminess, the rate of slide movement will be less than last winter and it will be incremental in nature. If the coming La Nina winter is more like record-setting rainfall of 1998-99, the rate of deformation will be higher, more like that of the winter of 2015-16. It is unlikely that landslide movement will be catastrophic or rapid in either case. Should the rate of slide movement increase due to high rainfall, the movement will be gradual, and perhaps noticeable over a period of a day or so, allowing the wing to be closed temporarily until rates drop once again. Utilities that cross the boundary of slide movement may be stretched and damaged. It is unlikely that movement will be more than one inch of lateral movement in one week to one month.

Recommendations

Open the wing and use it as you have in the past, until movement increases enough to warrant temporarily closing it down. Make sure that drains collect rainwater and pipe it to the base of slope where it can join creek water. Be prepared to shut down any water lines that cross the boundary of the slide, so as to limit accidental saturation.

Outlook

It is most likely that this slide mass will continue to move at incremental rates, punctuated infrequently by higher rates of deformation during periods of exceptionally heavy rainfall. In our opinion, the building is not at risk of catastrophic damage.

Please feel free to call or write if you have questions.

Thomas S. Horning, CEG #1131  
Horning Geosciences



*Expires: 6/30/17*

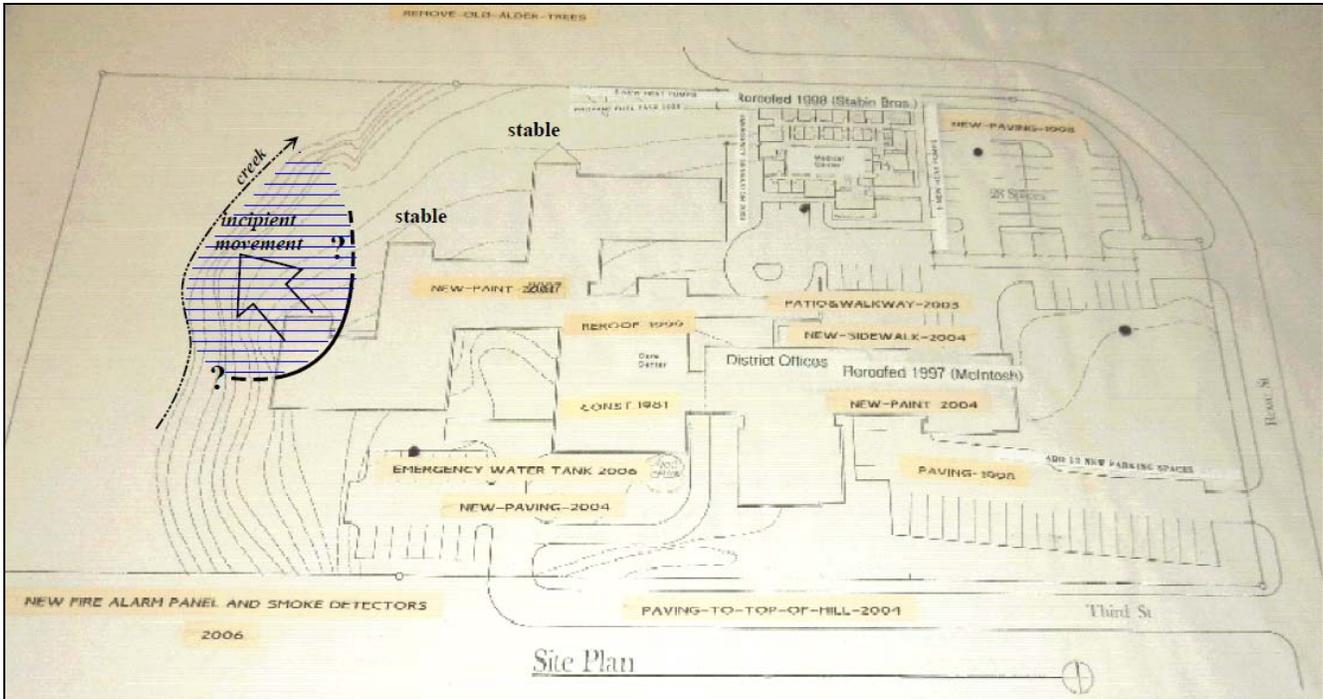


Figure 1: Sketch of original topography and building plan with area of known movement shown by hatching.

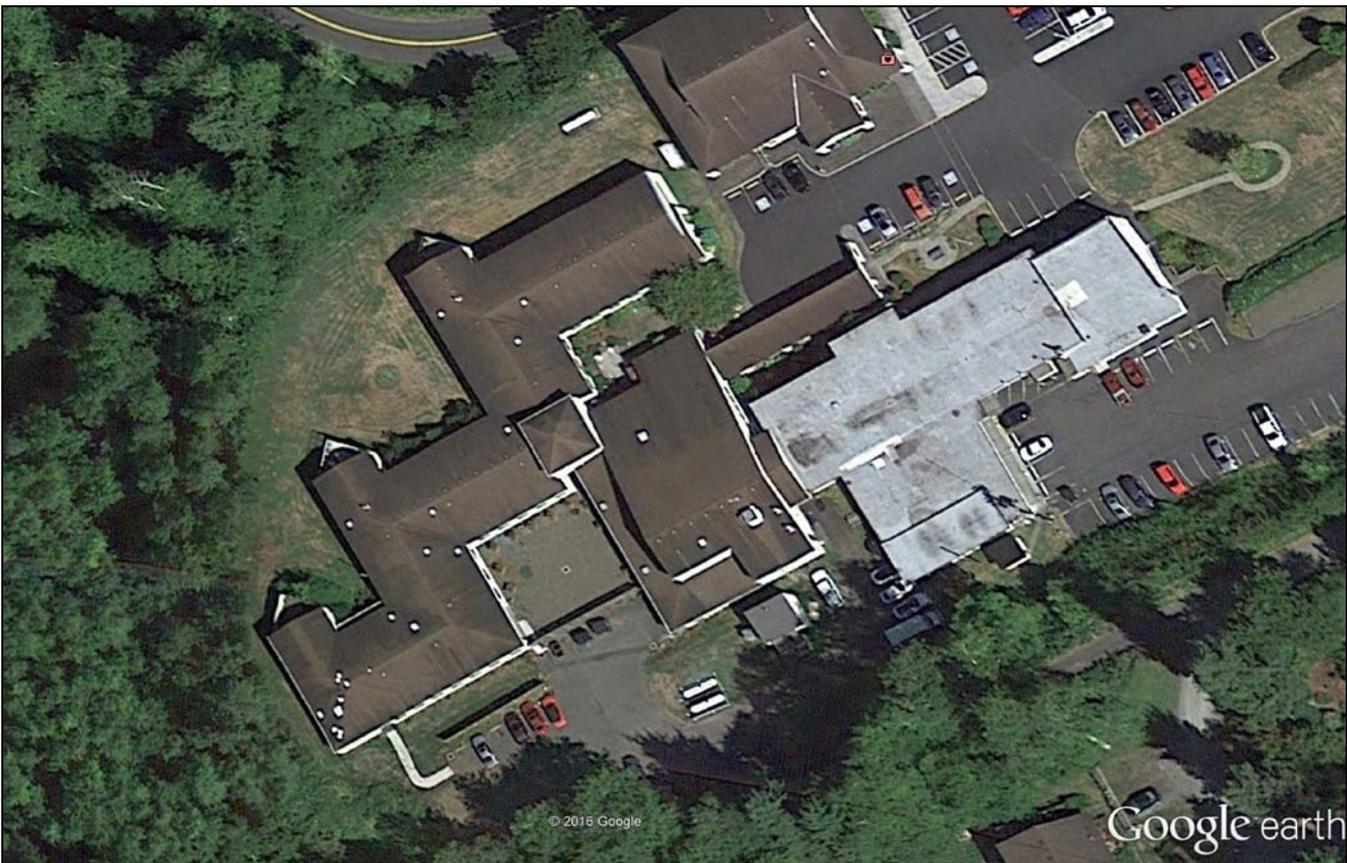


Figure 2: Aerial photo of the Nehalem Valley Care Center.