TO: Zack Bastow, Unit Forester
Deming Unit, Baker District
Northwest Region

FROM: John McKenzie
Licensed Engineering Geologist
Forest Resources Division
Northwest Region

SUBJECT: **MEMORANDUM**
Engineering Geologic Reconnaissance
Deep-Seated Landslides
North Zender Timber Sale

DATE: May 15, 2015

This memorandum present a brief discussion of two deep-seated landslides that underlie the two units of the North Zender Timber Sale. This discussion is based on review of various GIS layers (including the Forest Practices Inventory layer) in the DNR database; review of pertinent maps in my office files, review of pertinent stereoscopic aerial photographs on file at Northwest Region offices, reconnaissance traverse (from the head of both landslides in question the area of the toe of each slide, as local accesses permitted), and discussions with you. Field reconnaissance was conducted in March 2015, and an earlier reconnaissance of portions of the landslides in question in November of 2013.

The two landslides are located essentially west to southwest of Kendall on the east-facing slopes of Sumas Mountain in Whatcom County (Figure 1). The northern landslide (NLS) is located in Sections 27, 28, and 29 and Sections 32, 33, and 34 T40N, R5E, and is about 8,300-feet long with a width up to about 2,400 feet. It is estimated that it could be up to several hundred feet thick. The southern landslide (SLS) is located in Sections 32, 33, and 34, T40N, R5E and in Sections 3, 4, and 5, T39N, R5E. The southern landslide (SLS) is more like a complex of several landslides that collectively are about 5,500- to 7,000-feet long, and from 3,000- to 3,500-feet wide. This landslide is estimated to be at least a couple of hundred feet thick. Vertical relief from the head of the landslides to the toe of the landslides varies from 1,850 feet for the NLS landslide to about 1,400 feet for the SLS. Both landslides are best characterized as earth-flow type failures, with some rotational slide component at the heads of the landslides. LiDAR slope models show that, save for a road cut and a couple of very small areas, the toes of the landslides are not characterized by slopes in excess of 65 percent. The subdued topography, well developed drainage systems, and relatively well-defined lateral margins suggests the landslides could be characterized as dormant mature. A well-developed alluvial fan has formed on the valley floor on the north side of the NLS, and a small alluvial fan on the south side of the NLS.

Several well-developed alluvial fans have formed at the toe of the SLS. All of the aforementioned alluvial fans were created by the deposition of sediment carried down slope by the several streams that drain the landslides. South-flowing Kendall Creek is located a short distance east of the toe of the NLS, and about 1,500 feet or more from the toe of the SLS. There are several residential structures on the lower slopes of the two landslides and about 1¼ dozen residential structures on the valley floor near (within about 500 feet) the toe of the landslides. In addition several residential access roads or forest haul-roads traverse the lower portions and mid-portions of both landslides. A domestic water-supply intake was identified near a residence located on the south side of the NLS near the valley floor. The area around this water supply was bounded out of the sale.

Both of the landslides, NLS and SLS, are shown on the Forest Practices Landslide Inventory database. However their size, length, and particularly their width on the middle and upper slopes, is somewhat exaggerated or underestimated. A more accurate depiction of the two landslides is shown on Figure 1.

Reconnaissance of the landslides included a traverse of the slopes behind (to the west) of the crowns of the landslides, the scarp and head of the landslides, the body of the landslides, the lower areas of the landslides, and portions of the road system that traverse the lower and mid-areas of the landslides. Save for a very small area of wet ground and some disturbed trees near the head of the SLS (Figure 1), the traverses of the two landslides did not reveal evidence for historic, recent, or on-going movement of the landslides throughout the areas traversed and vicinity. Ground cracks, jack-strawed trees, fresh angular topography, disturbed stumps from previous entries, displaced roads, etc. suggestive of movement/instability of the entire landslide or portions of it were not observed. The alluvial fans at the toes and margins attest to a long history of stability for the NLS and SLS. The alluvial fans at the toe of the SLS are likely providing some stabilizing influence to that landslide.

The presents of rotted stumps testifies to the past harvest histories of the two landslides. During reconnaissance areas of more recent harvest were also noted. The currently proposed harvest will impact relative small areas on relatively gentle to moderately steep slopes in the central and lower portions of the two landslides (Figure 1). There will be some road construction crossing gentle to moderately steep terrain, to access the units on the both landslides.

The two landslides in question, both the NLS and SLS, are very large, deep-seated earth-flow type failures. Save for the very small area of apparent instability at the head of the SLS, evidence for historic, recent, or on-going movement was not observed. This suggests that the landslides in question are relatively stable. The proposed harvest units are relatively small compared to the size of the landslides. Past harvest activities and road construction does not appear to have had an adverse impact on the stability of the two landslides as a whole or in part. Based on the apparent stability of the two landslides and the lack of apparent response to past harvest and road construction it is my judgment that the currently proposed harvest should not have an adverse impact on the stability of either of the north landslide or the south landslide.

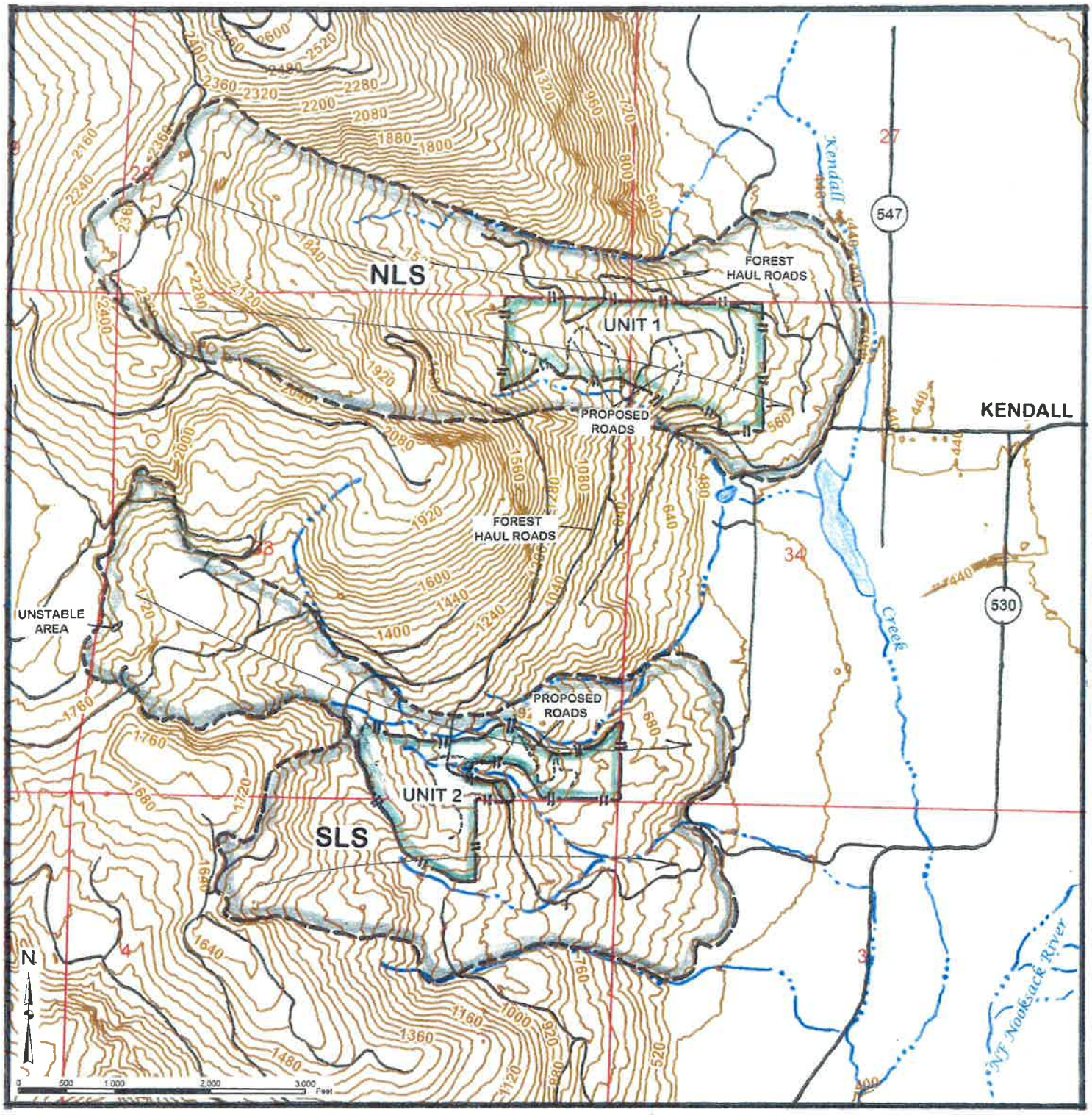

FIGURE 1 ANNOTATED MAP OF NLS AND SLS AND IMEDIATE VICINITY
North Zender Timber Sale