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SUBJECT: MEMORANDUM
Discussion of Landslides and Slope Stability
Flower Potts Timber Sale

DATE: March 28, 2016

This memorandum briefly discusses several landslides associated with the Flower Potts Timber Sale (Sale). The Sale is located in Section 32, T35N, R06E, about three miles south of the town of Lyman. The discussions herein are based on review of various GIS layers (including the Forest Practices Landslide Inventory) in the DNR database, review of pertinent maps and the publications in my office files, review of pertinent orthophotographs and stereoscopic aerial photos on file at Northwest Region office, field reconnaissance and discussions with Mr. Johnson (Cavanaugh pre-sales forester). Field reconnaissance was conducted on January 7, 2016 and March 7, 2016. In addition a pre-application office meeting with Forest Practices Forester and Geologist was held on February 18, 2016. At that meeting it was determined that based on the office review and field reconnaissance performed in January, the Sale did not appear to be constrained by rule identified landforms that would require additional engineering geologic assessment at that time, and that a memorandum discussing the recognized landslides and slope stability setting of the Sale would be adequate for processing of the Sale to proceed.

PHYSICAL SETTING

The sale is composed of two units that lie on the north-facing slopes of Talc Mountain overlooking the South Skagit highway and the Skagit River (Figure 1). Elevations across the Sale range from 880 feet to 1960 feet. The slopes in the Sale are characterized by generally moderately-steep, north-facing hillside topography (Figure 2). Slopes of 70 percent or greater are confined to inner-gorge topography and the scarps of some large deep-seated landslides around the Sale. Locally, some areas of benched topography and associated steep slopes with short pitches of 70 percent or greater are scattered about the Sale. The Sale area is accessed by the Day Lake mainline, and the DL-10 road system traverses the area slopes. The bedrock geology underlying the area of the Flower Potts Timber Sale was published in 1988 by Whetten and



others (*Bedrock geologic map of the Port Townsend 30- by 60-minute quadrangle, Puget Sound region, Washington: U.S. Geological Survey, Miscellaneous Field Investigations Series Map I-1198-G, 1988; scale 1:100,000*). Surficial geologic mapping was published in 1989 by Pessl and others (*Surficial geologic map of the Port Townsend 30- by 60- minute quadrangle, Puget Sound region, Washington: U.S. Geological Survey, Miscellaneous Field Investigations Series Map I-1198-F, 1989; scale 1:100,000*). Bedrock geologic mapping shows that the area of the sale is underlain by Darrington phyllite. These rocks are complexly folded and locally faulted. Bedrock is overlain by a very patchy veneer of glacial deposits, locally landslide debris, soil and colluvium, and artificial fill related to road and landing construction.

Much of the Sale area is generally confined within one relatively large deep-seated landslide identified as Landslide 16320 in Figure 2. Other portions of the Sale are located on hillside areas not affected by past landslide processes. This landslide is catalogued in the Forest Practices Landslide Inventory database (FPLID), and identified as 16320. Several other landslides are located around the Sale area. Attached Figure 2 shows a large deep-seated landslide (Landslide 16316), a debris slide (Landslide A), and a debris slide source area and debris flow track (Debris Flow Track) flank the Sale to the west. The proposed harvest units are separated from these landslides by a prominent drainage divide, and it is judged that these landslides are not likely to adversely impact the Sale, or the Sale is likely to adversely impact those landslides. Therefore, these landslides are not discussed any further.

One large deep-seated landslide, two smaller deep-seated landslides, and a small shallow landslide flank the Sale to the east and northeast. The large-deep seated landslide (Landslide 16319) is catalogued in the FPLID, and identified as 16319 (Figure 2). Landslide B is a smaller deep-seated landslide and is located on the western margin of Landslide 16319. The proposed harvest units lie adjacent to and above these identified landslides. These landslides are discussed in more detail below. Landslide C is a smaller deep-seated landslide and is located within the body of Landslide 16319. Landslide D is a small, shallow slump landslide and is also located within the body of Landslide 16319. Landslide C and D are separated from the Sale by several smaller drainage divides. Thus they are judged to neither be likely to adversely impact the Sale, or the Sale is likely to adversely impact those landslides. Therefore, these landslides are not discussed any further.

REVIEW OF EARLIER PUBLISHED LANDSLIDE MAPPING

Earlier published landslide mapping catalogued in the FPLID shows three deep seated landslides in or around the Flower Potts Timber Sale. The boundaries of Landslide 16320 were mapped to be smaller than observed in LiDAR topography and during field reconnaissance. The landslide identified as Landslide 16320 was included in the surficial geologic map published by Pessl and others in 1989 (*Surficial geologic map of the Port Townsend 30- by 60- minute quadrangle, Puget Sound region, Washington: U.S. Geological Survey, Miscellaneous Field Investigations*

Series Map I-1198-F; scale 1:100,000). Figure 2 attached shows the configuration of the landslide slide estimated from LiDAR derived topography indicating areas of ground which were displaced by the landslide. The landslide identified as Landslide 16319 was also included in the surficial geologic map published by Pessl and others in 1989 (*Surficial geologic map of the Port Townsend 30- by 60- minute quadrangle, Puget Sound region, Washington: U.S. Geological Survey, Miscellaneous Field Investigations Series Map I-1198-F; scale 1:100,000*). Based on LiDAR derived topography, the extent of Landslide 16319 is exaggerated, and includes portions of the slide scarp and the hill slope, which are underlain by intact bedrock and soil earth materials. Attached Figure 2 shows a map of the landslide interpreted from LiDAR topography. Landslide B was not recognized by FPLID mapping. The area of this landslide was included in the Landslide 16319 polygon. It is interpreted to be a separate event from the large, deep-seated bedrock landslide (16319) as shown on Figure 2. The boundaries of Landslide 16319 and Landslide 16320 in the FPLID were likely compiled from maps published by Pessl and others in 1989. The mappers at that time did not have the benefit of LiDAR generated topographic maps. Such maps might have allowed them to more accurately define the boundaries of Landslides 16319 and 16320. The Landslide 16316 polygon was also apparently adapted from Pessl and others, and its representation in the FPLID database also suffers from the same issues as Landslides 16319 and 16320. Landslides A, C, and D and the debris flow track and source area were not apparently recognized during compilation of the FPLID.

DISCUSSION OF LANDSLIDES IN OR ABOUT THE SALE

As noted earlier several landslides were identified in or about the Flower Potts Timber Sale. Five of these landslides (Landslides 16316, A, Debris Flow Track, C, D) were recognized as being separated from the Sale by topography that would in effect isolate them from the Sale, and they are not discussed any further in this memorandum. However, Landslides 16319, 16320, and B are further discussed because they either underlie units within the Sale or are in close enough proximity that management activities could possibly impact the landslides, or the landslides could possibly impact the Sale. These landslides are discussed below in numerical order followed by Landslide B.

Landslide 16319 - Landslide 16319 is adjacent to the eastern corner of Unit 1 (Figure 2). The topography of Landslide 16319 suggests the landslide can be characterized as rotational/translational, and is a bedrock deep-seated landslide. The landslide is approximately 2,700 feet in length and approximately 2,700 feet in width, and is approximately 149 acres in area. It is estimated to be up to several hundred feet thick, and can be characterized as dormant indistinct (*Forest Practices unstable slopes board manual*) or dormant mature (*Cruden and Varnes, 1996 in Turner, K.A. and Schuster, R.L. eds., Landslides Investigation and Mitigation: Transportation Research Board, National Research Council, Special Report 247; National Academy Press, Washington, D.C.*). The eastern margin of Unit 1 includes portions of the scarp of Landslide 16319, but does not intrude on to the body of the landslide (see Figure 2 below). In

effect no management activities are proposed on the body of Landslide 16319. Portions of the slide were reviewed in the field and reconnaissance did not show evidence of current, recent, or historic movement. Ground cracks suggesting the displacement of road DL-10 that crosses the body of the slide were not observed, and the stumps from earlier entries and the standing conifers do not appear to be disturbed. Review of aerial photographs did not suggest this landslide is active.

Landslide 16320 - Unit 2 is located within the boundaries of Landslide 16320 (Figure 2). The topography of Landslide 16320 suggests the landslide can be characterized as rotational/translational, and is a bedrock deep-seated landslide. This slide is approximately 3,700 feet in length and approximately 1,700 feet in width, and is approximately 103 acres in area. It is estimated to be up to several hundred feet thick and can be characterized as dormant indistinct (*Forest Practices unstable slopes board manual*) or dormant mature (*Cruden and Varnes, 1996 in Turner, K.A. and Schuster, R.L. eds., Landslides Investigation and Mitigation: Transportation Research Board, National Research Council, Special Report 247; National Academy Press, Washington, D.C.*). The landslide was reviewed in the field and did not show evidence of current, recent, or historic movement. Ground cracks suggesting the displacement of road DL-10 that crosses the body of the slide were not observed, and the stumps from earlier entries and the standing conifers do not appear to be disturbed. Review of aerial photographs did not suggest this landslide is active, despite clear-cut entries into the area prior to 1941 and prior to 1970. Recent harvest prior to 2011 has occurred on the lower body of the landslide with no observable impacts.

Landslide B - Landslide B is about 200 feet down slope of the eastern corner of Unit 1 (Figure 2). Attached Figure 2 shows that Landslide B lies on the western margin of Landslide 16319. The landslide is approximately 1,650 feet in length and approximately 300 feet in width, and has an area of approximately 12 acres. Landslide B is estimated to possibly be up to one-hundred feet thick, and can be characterized as dormant indistinct (*Forest Practices unstable slopes board manual*) or dormant mature (*Cruden and Varnes, 1996 in Turner, K.A. and Schuster, R.L. eds., Landslides Investigation and Mitigation: Transportation Research Board, National Research Council, Special Report 247; National Academy Press, Washington, D.C.*). As discussed earlier, this deep-seated landslide was included in the FPLID as part of the 16319 polygon, but is interpreted to be a separate event from that large, deep-seated landslide as shown on Figure 2. Review of aerial photographs did not suggest the landslide is active, despite previous harvest dating back to 1941 on and around the landslide. Portions of the slide were reviewed in the field, and reconnaissance did not show evidence of current, recent, or historic movement. Ground cracks suggesting the displacement of road DL-10 that crosses the body of the slide were not observed, and the stumps from earlier entries and the standing conifers do not appear to be disturbed.

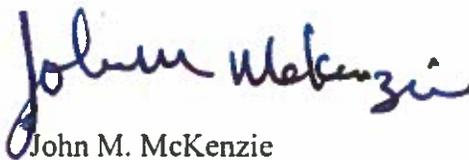
SUMMARY

The potential for the Sale to adversely impact the three deep-seated landslides – Landslide 16320, Landslide 16319, and Landslide B – is judged to be low. No evidence of activity on deep-seated Landslide 16320 was observed. It appears the timber in the vicinity of Units 1 and 2 on this landslide was clear-cut prior to 1941 and again in 1970 without an apparent adverse impact. Currently, timber harvest is proposed on a portion of Landslide 16320. Less than approximately one-third of the landslide body area will be subjected to management activities. Based on the prior harvest history, it is not anticipated that the harvest will have an adverse impact on the stability of the landslide.

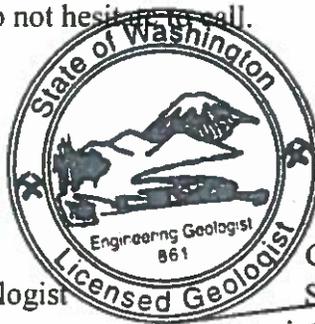
No current or historic evidence of activity on Landslide 16319 was observed. It appears that a majority of the landslide was clear-cut prior to 1941 and again in 1970 without an apparent adverse impact. Proposed management activities extend onto the scarp of the landslide, and do not enter onto the body of the landslide. An unnamed stream divides Landslide 16319 from the proposed harvest area. Less than 10 percent of the Landslide 16319 “watershed” is proposed for harvest. Thus, based on the prior harvest history and proposed harvest unit locations, the impacts of the Sale and associated ground water delivery will likely be very small, especially compared to the size of the landslide and its entire “watershed”.

No current or historic evidence of activity on Landslide B was observed. The proposed Unit 1 harvest area lies within the associated watershed area of Landslide B. It appears that a majority of the watershed area was clear-cut prior to 1970 without an apparent adverse impact on the landslide. Less than approximately one-third of the Landslide B’s “watershed” is proposed for timber harvest. Thus, based on the prior harvest history and the proposed harvest unit locations, the impacts of the Sale and associated ground water delivery will likely be very small, especially compared to the size of the landslide and its entire “watershed”.

If you have any questions, please do not hesitate to call.



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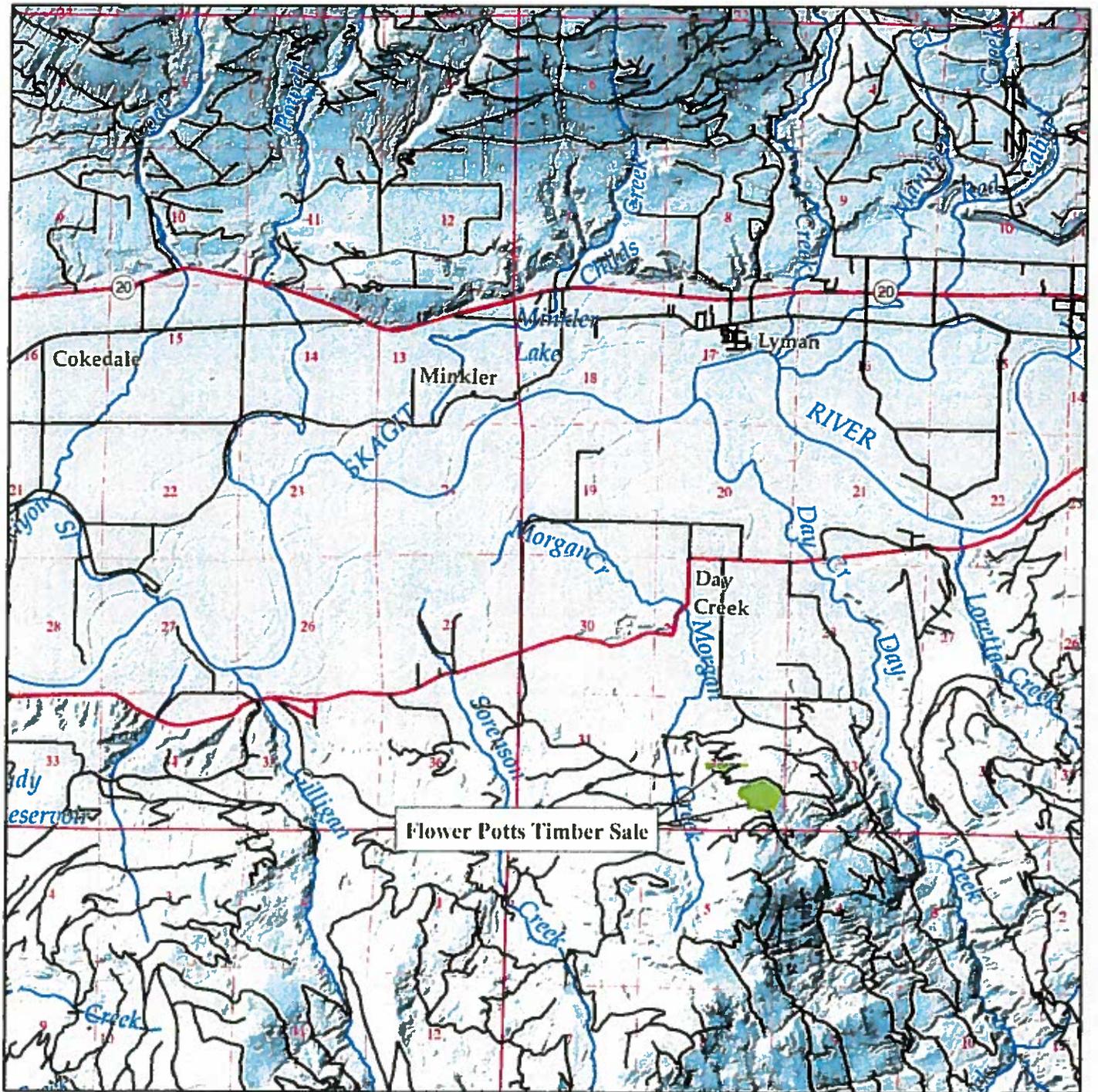



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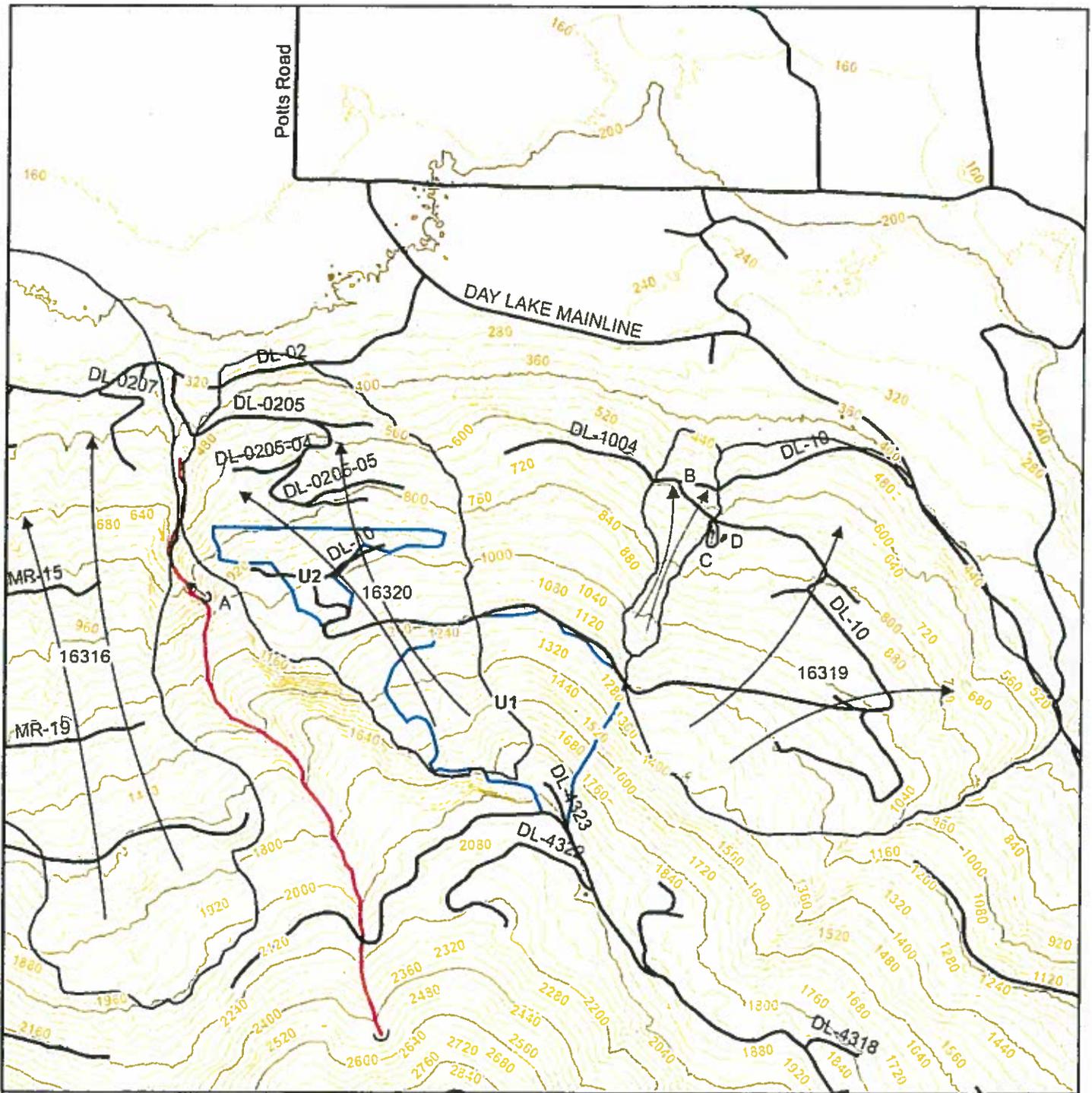
Attachments:

- Figure 1. Location Map
- Figure 2. Landslide Map



Scale 1:63,360

FIGURE 1 LOCATION MAP
Flower Potts Timber Sale
1 inch = approx. 1 mile



EXPLANATION

U2 Flower Potts Timber Sale unit boundaries, U# indicates unit

 Debris flow track with initiation point, approximate location

 Road



Landslide, number or letter label landslide, ? = possible

1 inch = 1 000 feet 1 12 000



FIGURE 2 LANDSLIDE MAP

Flower Potts Timber Sale