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August 19, 2025

Roots Forestry Consulting, LLC
16102 4th Avenue NW
Arlington, Washington 98223

Attention: Mike Olson

Subject: Geologic Evaluation Services
Spada Lake Thinning
Snohomish County, Washington
File No. 0482-071-00

Introduction

GeoEngineers, Inc. (GeoEngineers) is pleased to present the results of our geological services for review of the Spada Lake Thinning Harvest Forest Practices Application (FPA) on ground owned by Snohomish County Public Utilities District (PUD). The proposed harvest units are in the Spada Lake Watershed Administrative Unit (WAU) in Snohomish County, Washington. The purpose of our services was to evaluate the activity level and limits of the groundwater recharge areas (GWRAs) of glacial deep-seated landslides (GDSLs), and the potential impacts of the proposed forest practices on the features. In addition, this report will supplement the FPA prepared by Roots Forestry Consulting, LLC (Roots Forestry) to the Washington State Department of Natural Resources (DNR). Based on our evaluation, a portion of the proposed harvest will occur within the GWRAs of eleven GDSLs, which may qualify this FPA for Class IV-Special Status.

This evaluation was performed by Brandi Petryk under the supervision of Andrew J. Caneday, a licensed engineering geologist (No. 2555) in the state of Washington and designated by DNR as a "qualified expert" for timberland slope stability evaluation.

Site And Project Description

The proposed harvest units are in Snohomish County, about 10 miles northeast of the Sultan. The proposed harvest units are in Sections 20, 29, 33, 34, 27 and 26 of T29N, R09E, as indicated in Figure 1, Harvest Unit Plan. A portion of the proposed harvest will be within a portion of the GWRAs of eleven GDSLs mapped by the Washington Geological Survey (WGS), identified on a lidar hillshade of the area and confirmed in the field. The approximate limits of the features are presented in Figures 4 through 6, Landslide Activity Maps. During our site visit on April 1 and 2, 2025, glacial soils were observed in the head scarps of GDSLs and throughout the harvest units. A Class-IV Special condition was triggered because the proposed harvest falls

within a portion of the GWRAs of landslides LS-2, LS-4, LS-5, LSI 3418, LSI 3559, LSI 3560, LSI 3421, LSI 3424, LSI 3433 and LSI 3434.

The proposed FPA includes the harvest of 14 units located along Spada Lake. The proposed harvest includes thinning of approximately 30 percent of marketable trees to promote healthy forest growth with the intention of creating old growth forest conditions within the Spada Lake Reservoir. The harvest will be done using cable and ground-based methods.

There are two spurs (Spurs A and D) proposed for construction and reconstruction as shown in Figure 1. Spur A consists of approximately 845 feet of new construction within Unit 12 and crosses mostly planar topography with no proposed stream crossings. Spur D consists of approximately 2,175 feet of road reconstruction along relatively flat, planar ground. There is one stream crossing along Spur D which does not meet the criteria of an inner gorge crossing.

Geologic Conditions

GEOLOGY

The published 1:250,000-scale map for the Spada Lake area indicates Quaternary landslide deposits (Qls), Glacial Till (Qgt), Glaciolacustrine deposits (Qgl) and Marine metasedimentary rocks (KJmm) deposits underlie the proposed harvest units (Dragovich et al. 2002). The glacial till consists of unsorted, unstratified highly compacted mixture of clay, silt, gravel and boulders deposited by the glaciers. The glaciolacustrine deposits consist of sand, silt, and clay deposited in glacial lakes that are laminated and include dropstones. The marine sedimentary rocks consist of metamorphosed sandstone, argillite, mudstone and conglomerate. We observed several outcrops of glacial till and glaciolacustrine clay deposits throughout the harvest units.

LANDSLIDE ACTIVITY

Our assessment of the landslide activity within and adjacent to the proposed harvest unit is based on a review of the Forest Practices Application Mapping Tool (FPAMT) and WGS, a review of lidar-derived hillshade and topography, a review of aerial photography and orthophotos of the project site from 1953 through 2023 (Appendix A), and our site reconnaissance on lidar and field recon.

Our evaluation indicates that there are several mapped WGS SLIP landslides within the proposed FPA. The approximate location and extent of the landslides are shown in the Landslide Activity Maps, Figures 4 through 7. The results of our assessment are summarized below and in Table 1, Summary of Landslide Activity.

- Landslide Inventory: The WGS landslide inventory shows several mapped SLIP landslides and fans throughout the harvest units. The landslides and fans can be seen in Figures 4 through 6. The landslides and fans are described in Table 1 below.
- Lidar Data: We identified 9 additional landslides during our lidar review and confirmed some of the WGS inventory landslides. A lidar hillshade image for the area is presented in Figures 4 through 6.
- Aerial Imagery: Aerial imagery of the project site from 1953 shows the Spada Lake area prior to the construction of the reservoir. The large active headwall (LSIs 3402, 3403, and 3404) is present in the

1953 and 1954 imagery, indicating it was present prior to the reservoir. The area around the active headwall feature was harvested sometime prior to 1974, possibly 1950s and 1960s, based on the bare earth seen in the 1974 imagery. We did not observe any bare ground or other indicators of landslides in the imagery within the proposed harvest unit during our historical aerial review, other than the bare ground visible in the active headwall near Unit 12. The bare ground in the headwall near Unit 12 is visible, to some degree, in every photograph. Select aerial photographs of the project area are included in Appendix A.

TABLE 1. LANDSLIDE ACTIVITY TABLE

LANDSLIDE	TYPE AND ACTIVITY LEVEL	SOURCE	DESCRIPTION	MITIGATION
3402, 3403, 3404	Category A, Active Convergent headwalls	WGS, Lidar, Field recon	LSIs 3402, 3403 and 3404 are part of a large, very active basin of convergent headwalls with slopes over 100 percent and several shallow slides. There are intact glacial clay deposits within the exposed head scarps of these features. The exposed clay consists of layers of laminated horizontal clay beds. There are some seeps throughout the sidewalls. The slopes to the north of the headwalls drain to the west away from the active headwalls. The bottom of the features is a basin full of colluvium consisting of gravel and sand from that eroded from the headwalls (SLIP Fan 2800). The debris fan is populated with scattered alders.	mitigation required. proposed harvest and the harvest boundary was placed 100 feet Note: Flagging moved back to approximately 170ft away from this feature. (Matt Grund 10/31/25)
3400	Glacial deep-seated landslide	WGS, Lidar	Likely a glacial deep-seated landslide. Did not field verify because it is located outside of harvest unit. Mapped a small GWRA which is also outside of the harvest unit.	None required.
3432	Glacial deep-seated landslide, Dormant-indistinct	WGS, Lidar	Likely a glacial deep-seated landslide with a small GWRA. Both the landslide and GWRA are located outside of the proposed harvest unit. Lateral margins are vague and the body is vegetated by mature straight conifer and in-place, old growth stumps.	None required.

LANDSLIDE	TYPE AND ACTIVITY LEVEL	SOURCE	DESCRIPTION	MITIGATION
3433, 2801	Glacial deep-seated landslide, Dormant-indistinct	WGS, Lidar	LSI 3433 is a small glacial deep-seated landslide with vague lateral margins and hummocky topography. There are large (5-7 ft in diameter) in-place, old growth stumps and straight mature conifer throughout the body. The head scarp margins are indistinguishable. SLIP fan 2801 is mapped above the landslide and appears to not exist. The ground above 3433 is planar and smooth, with no discernible fan shape, and is fully forested by straight mature conifer.	Part of the landslide body and GWRA are proposed for harvest. See GDSL assessment below.
3434	Glacial deep-seated landslide, Dormant-indistinct	WGS, Lidar	LSI 3434 is a small, glacial deep-seated landslide that has vague lateral margins and slightly hummocky topography. There is straight mature conifer within the body and within the adjacent terrain. The head scarp is laid back, vegetated and less than 70 percent.	Part of the landslide body and GWRA are proposed for harvest. See GDSL assessment below.
3435, 2802	n/a	WGS	WGS mapped SLIP landslide. Does not appear to exist based on field observations. The area hosts straight conifer and many large, in-place, old growth stumps (6-8 ft in diameter) and planar slopes. There are several streams throughout the area and expose intact, glacial clay. SLIP fan 2802 is mapped above the landslide and appears to not exist. The ground with fan 2802 is planar, smooth and hosts straight mature conifer.	No mitigation needed. Landslide 3435 and fan 2802 likely do not exist.
3416	Bedrock deep-seated landslide, Dormant-indistinct	WGS, Lidar	LSI 3416 is an old, large bedrock deep-seated landslide that has vague lateral margins and smooth topography. The scarp is faintly visible in lidar. At the base of the landslide above the mainline road, there are several exposures of intact bedrock. In our opinion, the landslide does not extend as far downslope as the mapped limits based on the multiple intact bedrock exposures seen along the road cuts.	None required.
3777	Fan	WGS, Lidar	Do not appear to be active within the	Majority of the SLIP fans are outside of the harvest area except for a small portion of 3777.

LANDSLIDE	TYPE AND ACTIVITY LEVEL	SOURCE	DESCRIPTION	MITIGATION
2818	Fan	WGS	WGS SLIP fan at the base of LSI 3416. Did not field verify because it is located outside of harvest unit.	None required.
LS-1 (3507)	Glacial deep-seated landslide, Active	WGS, Lidar, Field Recon	LS-1 loosely aligns with mapped LSI 3507 from the WGS SLIP landslide inventory. 3507 does not exist as mapped within Unit 6. The mapped head scarp area for 3507 is an intact ridge and the lateral margins are indiscernible from the slope. LS-1 is an active deep-seated landslide. The head scarp has exposed glacial soils and laminated clay layers and is unvegetated. There is recent blowdown over the scarp. Outside of the feature there are straight conifer.	No mitigation needed. Landslide and GWRA are outside of the harvest area.
LS-2 (3420)	Glacial deep-seated landslide, Dormant-indistinct	WGS, Lidar, Field Recon	LS-2 aligns with loosely mapped LSI 3420. We adjusted the boundary based on field observations. The mapped right lateral flank of 3420 does not appear to exist; the slope is broad, planar. The head scarp is laid back to 25-35 percent and vegetated by straight mature conifer. The body of LS-2 has several rounded benches and is vegetated by mature straight conifer and in-place, old growth stumps.	Part of the landslide body and GWRA are proposed for harvest. See GDSL assessment below.
3419	Glacial deep-seated landslide, Active	WGS, Lidar, Field Recon	3419 is an active GDSL that has recent movement caused by stream incision at the toe. There are exposed soils at the head scarp and the head scarp is distinct and undercut. The body of the slide has scattered alder and young conifer throughout the hummocky terrain. There are bowed conifer at the top of the head scarp.	Part of the landslide body and GWRA are proposed for harvest. See GDSL assessment below.
LS-3 5276, 5277	Glacial deep-seated landslide, Dormant-distinct	WGS, Lidar, Field Recon	The head scarp is distinct and is approximately 10 to 15 ft in places and has some recently exposed glacial soils. The body is mostly vegetated by straight mature conifer but there are scattered bowed/back tilted conifer and bowed conifer below the head scarp. There are scattered in place old growth stumps. LS-6 has LSI 5276 and 5277 mapped within the feature and are part of LS-3.	Part of the landslide body and GWRA are proposed for harvest. See GDSL assessment below.

LANDSLIDE	TYPE AND ACTIVITY LEVEL	SOURCE	DESCRIPTION	MITIGATION
3418	Glacial deep-seated landslide, Dormant-indistinct	WGS, Lidar, Field Recon	The head scarp is approximately 10-15 feet tall, vegetated by straight mature conifer. The body is hummocky and has in place old growth stumps throughout	3418 is mostly located harvest except for a small portion of the head scarp. A portion proposed for harvest.
3559	Glacial deep-seated landslide, Dormant-indistinct	WGS, Lidar, Field Recon	Head scarp is laid back and less than 4 feet tall and vegetated by straight mature conifer. There are straight mature conifer and scattered old growth stumps throughout the feature.	Part of the landslide body and GWRA are proposed for harvest. See GDSL assessment below.
3560	Glacial deep-seated landslide, Dormant-indistinct	WGS, Lidar, Field Recon	The landslide body is vegetated by straight mature conifer and in-place, old growth stumps. The ground is slightly hummocky and the margins of the feature are very rounded and subdued. The head scarp is vegetated and is 5 to 8 feet tall.	The majority of the landslide body and GWRA are proposed for harvest. See GDSL assessment below.
3421	Glacial deep-seated landslide, Dormant-indistinct	WGS, Lidar, Field Recon	The landslide body is hummocky and supports straight conifer and in-place, old growth stumps throughout. The head scarp is vegetated and is approximately 2-3 feet tall and laid back.	Part of the landslide body and GWRA are proposed for harvest. See GDSL assessment below.
LS-4 (3423)	Glacial deep-seated landslide, Dormant-indistinct	WGS, Lidar, Field Recon	LS-4 generally aligns with mapped LSI 3423. We adjusted the boundary of LSI 3423 based on field observations. There is an active stream running down the head scarp through the body of the feature. Glacial clay is exposed in the stream within the feature. The head scarp is approximately 20 feet tall and is vegetated. The landslide body is vegetated by straight mature conifer similar to the adjacent terrain.	boundary. The majority See Glacial deep-

LANDSLIDE	TYPE AND ACTIVITY LEVEL	SOURCE	DESCRIPTION	MITIGATION
LS-5 (3422)	Glacial deep-seated landslide, Dormant-indistinct	WGS, Lidar, Field Recon	LS-5 generally aligns with mapped LSI 3422. We adjusted the boundary of LSI 3422 based on field observations. The 3422 mapped boundary does not appear to exist along the lake shore or to the north of LS-5. There is a deeply incised stream at the top of the head scarp which shows active stream incision and exposed glacial clay along the landslide margins. This active area is only associated with stream incision. Overall, the landslide is likely dormant-indistinct based on the straight mature conifer, smooth topography, and same vegetation type and age as adjacent terrain.	boundary. The majority See Glacial deep-
LS-6 (3425)	Glacial deep-seated landslide, Active	WGS, Lidar, Field Recon	Active glacial deep-seated landslide below an old road landing, generally aligns with LSI 3425. We adjusted the boundaries based on field observations. The right lateral flank is a distinct lateral ridge that follows the feature. There is a stream flowing within the landslide body and the body is mostly vegetated by alder, young and mature. The landslide debris appears channelized and has distinct lateral boundaries. There are larger back tilted conifer within the slide and the soils are very saturated. The head scarp is approximately 20 to 25 feet tall and backs up to a small ridge, so there is no GWRA. The vegetated head scarp is inclined at 75 percent slopes and appears stable. Active movement of the slide is limited to below the old road landing.	No mitigation required, LS-6 is located outside of harvest unit and the feature does not have a GWRA.
2866	n/a	WGS	WGS mapped SLIP fan, planar area below LS-10. Saturated planar clay soils with no signs of instability or recent activity. Very well vegetated with straight conifer and in-place, old growth stumps throughout.	No mitigation needed. Fan 2866 not active

LANDSLIDE	TYPE AND ACTIVITY LEVEL	SOURCE	DESCRIPTION	MITIGATION
3424	Glacial deep-seated landslide, Dormant-indistinct	WGS, Lidar	LSI 3424 is a small glacial deep-seated landslide located above Type F stream F14. The body hosts in-place, old growth stumps and straight mature conifer. The head scarp is approximately 10 feet tall, laid back, and is vegetated by straight conifer. There are isolated patches of slopes over 70 percent.	majority of the GWRA See Glacial deep-
3478	n/a	WGS	WGS mapped SLIP landslide. Does not appear to exist based on field observations. The feature appears to be a natural swale and the margins of the mapped feature are vague and indiscernible from the hillslope. Above the road there are scattered straight conifer and some alder in a saturated area that leads to a stream which flows through a culvert below the road.	No mitigation needed. Landslide 3478 likely does not exist.

Glacial Deep-Seated Landslide Assessment

Based on our review of aerial photography and lidar, and confirmed during our geologic reconnaissance of the site, portions of the proposed harvest unit are located within the topographically defined GWRAs of GDSLs LS-2, LS-4, LS-5, LSI 3418, LSI 3559, LSI 3560, LSI 3421, LSI 3424, LSI 3433 and LSI 3434. The GWRAs of the landslides were delineated based on topography generated by lidar data. The approximate extents of the GDSLs and associated GWRAs are shown in Figures 4 through 6.

Based on vegetation and slope morphology indicators from Keaton and DeGraff (1996), we classified the overall deep-seated activity level of landslides LS-2, LS-4, LS-5, LSI 3418, LSI 3559, LSI 3560, LSI 3421, LSI 3424, LSI 3433 and LSI 3434 as dormant-indistinct based on the vague lateral margins, smooth vegetated head scarps, and the presence of mature conifer of a similar type and age as present on adjacent terrain.

Based on vegetation and slope morphology indicators from Keaton and DeGraff (1996), we classified the overall deep-seated activity level of landslide LS-3 as dormant-distinct based on a sharp, partially vegetated head scarp, hummocky topography, and the presence of back-tilted trees below the head scarp.

Based on vegetation and slope morphology indicators from Keaton and DeGraff (1996), we classified the overall deep-seated activity level of landslide LSI 3419 as recent to active based on the sharp unvegetated head scarp, hummocky topography, and back-tilted trees below the head scarp.

The effects of timber harvest within the GWRAs of GDSLs LS-2, LS-3, LS-4, LS-5, LSI 3418, LSI 3419, LSI 3559, LSI 3560, LSI 3421, LSI 3424, LSI 3433 and LSI 3434 were evaluated primarily on a qualitative assessment of risk based on current and historical evidence of slope performance after previous forest practice activities. In our opinion, based on our assessment of the groundwater recharge area associated

with the landslides, the proposed forest practices have a low likelihood of resulting in reactivation of the landslide for the following reasons:

- There is no evidence on the aerial photographs or observed during our site visit that previous forest practices within and upslope of LS-2, LS-4, LS-5, LSI 3418, LSI 3559, LSI 3560, LSI 3421, LSI 3424, LSI 3433 and LSI 3434 resulted in reactivation of the features. Previous timber harvest activities within the landslides likely occurred in the 1950s and 1960s based on second-growth timber visible in 1974 aerial imagery. Harvest in 1970s included the complete clearcut of the landslides and the groundwater recharge areas. More recent thinning operations in 2002/2003 also did not result in any movement or reactivation of the dormant-indistinct features.
- The proposed harvest is a thinning of approximately 30 to 40 percent of merchantable trees and the purpose is to promote healthy forest growth with the goal of reestablishing old growth conditions. This amount of harvest is considerably less than the clearcuts in the past, which did not reactivate any of the dormant-indistinct features.
- The total surface area of landslide LS-3 and the associated GWRA is approximately 6 acres. The proposed harvest includes less than 0.2 acres representing approximately 3 percent of the total GWRA. Given the thinning will only include 30 to 40 percent of the trees within the harvest area, the area of ground impacted by harvest within landslide and GWRA will be less than 1 percent. Even under the assumption that all additional water within the GWRA post-harvest reaches LS-3, the change in recharge is likely to be insignificant.
- The total surface area of landslide LSI 3419 and associated GWRA is approximately 1.3 acres. The proposed harvest includes less than 0.1 acres, representing approximately 2 percent of the total GWRA. Given the proposed thinning will only include 30 to 40 percent of the trees within the harvest area, the area of ground impacted by harvest within the landslide and GWRA will be less than 1 percent. Even under the assumption that all additional water within the GWRA post-harvest reaches landslide 3419, the change in recharge is likely to be insignificant.

Conclusions

As required by DNR, the following are responses addressing Washington Administrative Code (WAC) 222-10-030 (1) (a,b,c):

In order to determine whether such forest practices are likely to have a probable significant adverse impact, and therefore require an environmental impact statement, the applicant must submit the following additional information, prepared by a qualified expert. The expert must describe the potentially unstable landforms in and around the application site and analyze:

(a) The likelihood that the proposed forest practices will cause movement on the potentially unstable slopes or landforms, or contribute to further movement of a potentially unstable slope or landform:

The proposed forest practices are unlikely to cause movement on the potentially unstable slopes or landforms, or contribute to further movement of a potentially unstable slope or landform, because the features that were recognized by this evaluation as unstable or potentially unstable have been removed from the proposed harvest, with the exception of the GWRAs of the GDSLs LS-2, LS-3, LS-4, LS-5, LSI 3418, LSI 3419, LSI 3559, LSI 3560, LSI 3421, LSI 3424, LSI 3433 and LSI 3434.

The GWRAs for LS-2, LS-4, LS-5, LSI 3418, LSI 3559, LSI 3560, LSI 3421, LSI 3424, LSI 3433 and LSI 3434 extend areas proposed for thinning. Based on a review of aerial photography, lidar data and observations made in the field, the landslides likely have activity levels of dormant-indistinct. The proposed forest practices could temporarily increase annual recharge to the landslides; however, in our opinion, this increase in annual recharge post-harvest will have a low likelihood of reactivating deep-seated slope movement as evidenced by the lack of response to historic clear-cut harvests which harvested nearly 100 percent of landslides. The proposed harvest under this FPA is a thinning of approximately 30 to 40 percent of marketable trees, which is considerably less impactful than previous clear-cut harvests in the area. A small portion of the GWRAs for LS-3 and 3419 are proposed for thinning. Based on a review of aerial photography, lidar data and observations made in the field, the activity level of LS-3 is dormant-distinct and 3419 activity level is active. The proposed forest practices could temporarily increase annual recharge to the landslides; however, in our opinion, this increase in annual recharge post-harvest will have a low likelihood of reactivating deep-seated slope movement because the increase in WAR is likely to be less than 1 percent.

(b) *The likelihood that sediment or debris would be delivered to any public resources, or in a manner that would threaten public safety:*

The proposed forest practices are unlikely to increase the delivery of sediment or debris to public resources or to threaten public safety because the features that were recognized by this evaluation as unstable or potentially unstable have been removed from the proposed harvest, with the exception of the GWRAs of the GDSLs LS-2, LS-3, LS-4, LS-5, LSI 3418, LSI 3559, LSI 3560, LSI 3419, LSI 3421, LSI 3424, LSI 3433 and LSI 3434 . As mentioned above, harvesting trees within the GWRAs of these landslides may temporarily increase the annual recharge to these features but is unlikely to reactivate slope movement, or increase sediment delivery.

(c) Any possible mitigations for the identified hazards and risks:

The primary mitigation measure for the hazards and risks identified in the proposed harvest unit is avoidance. Features that were recognized as unstable or potentially unstable have been flagged out of the proposed harvest. As mentioned above, harvesting trees within portions of the GWRAs of the dormant-indistinct GDSLs LS-2, LS-3, LS-4, LS-5, LSI 3418, LSI 3559, LSI 3560, LSI 3419, LSI 3421, LSI 3424, LSI 3433 and LSI 3434 is unlikely to reactivate slope movement, or increase sediment delivery.

Limitations

We have prepared this report for use by Roots Forestry for the Spada Lake FPA. We provided our services to evaluate potential impacts of timber harvest and road construction activities on specific sites within the harvest unit. Our recommendations are intended to minimize adverse impacts on slope stability from timber harvest. However, timber harvest on slopes involves risk, only part of which can be mitigated through qualified engineering and harvest practices. Favorable performance of slopes in the near term does not imply a certainty of long-term performance, especially under conditions of adverse weather or seismic activity.

Within the limitations of scope, schedule and budget, our services have been executed in accordance with generally accepted practices in the field of engineering geology in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

Please refer to Appendix B, Report Limitations and Guidelines for Use, for additional information pertaining to the use of this report.

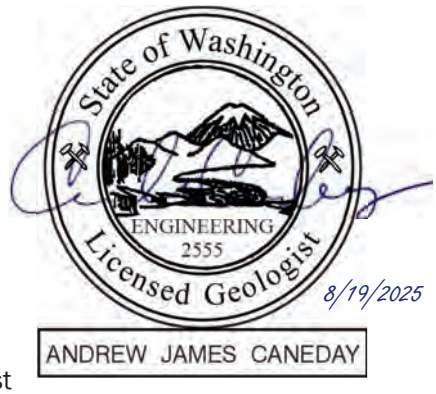
References

Dragovich, J.D., Logan, R.L., Schasse, H.W., Walsh, T.J., Lingley, W.S., Jr., Norman, D.K., Gerstel, W.J., Lapen, T.J., Schuster, J.E., and Meyers, K.D., 2002, Geologic map of Washington--Northwest quadrant, Washington Division of Geology and Earth Resources, Geologic Map GM-50, 1:250,000.

Keaton, J.R. and J.V. DeGraff (1996). Surface observation and geologic mapping. IN: Turner, A.K., Schuster, R.L. (Eds.), Landslides - Investigation and Mitigation. National Academy Press; National Research Council Transportation Research Board Special Report 247, 36-75.

We appreciate the opportunity to provide services to Roots Forestry Consulting, LLC. Please call if you have any questions concerning this report or if we can be of further assistance.

Sincerely,
GeoEngineers, Inc.



Andrew J. Caneday, LEG
Associate Engineering Geologist

BMP:AJC:kjb

Attachments
Figure 1. Harvest Unit Plan Map 1
Figure 2. Harvest Unit Plan Map 2
Figure 3. Harvest Unit Plan Map 3
Figure 4. Landslide Activity Map 1
Figure 5. Landslide Activity Map 2
Figure 6. Landslide Activity Map 3
Appendix A. Historical Aerial Imagery
Appendix B. Report Limitations and Guidelines for Use

One electronic copy submitted

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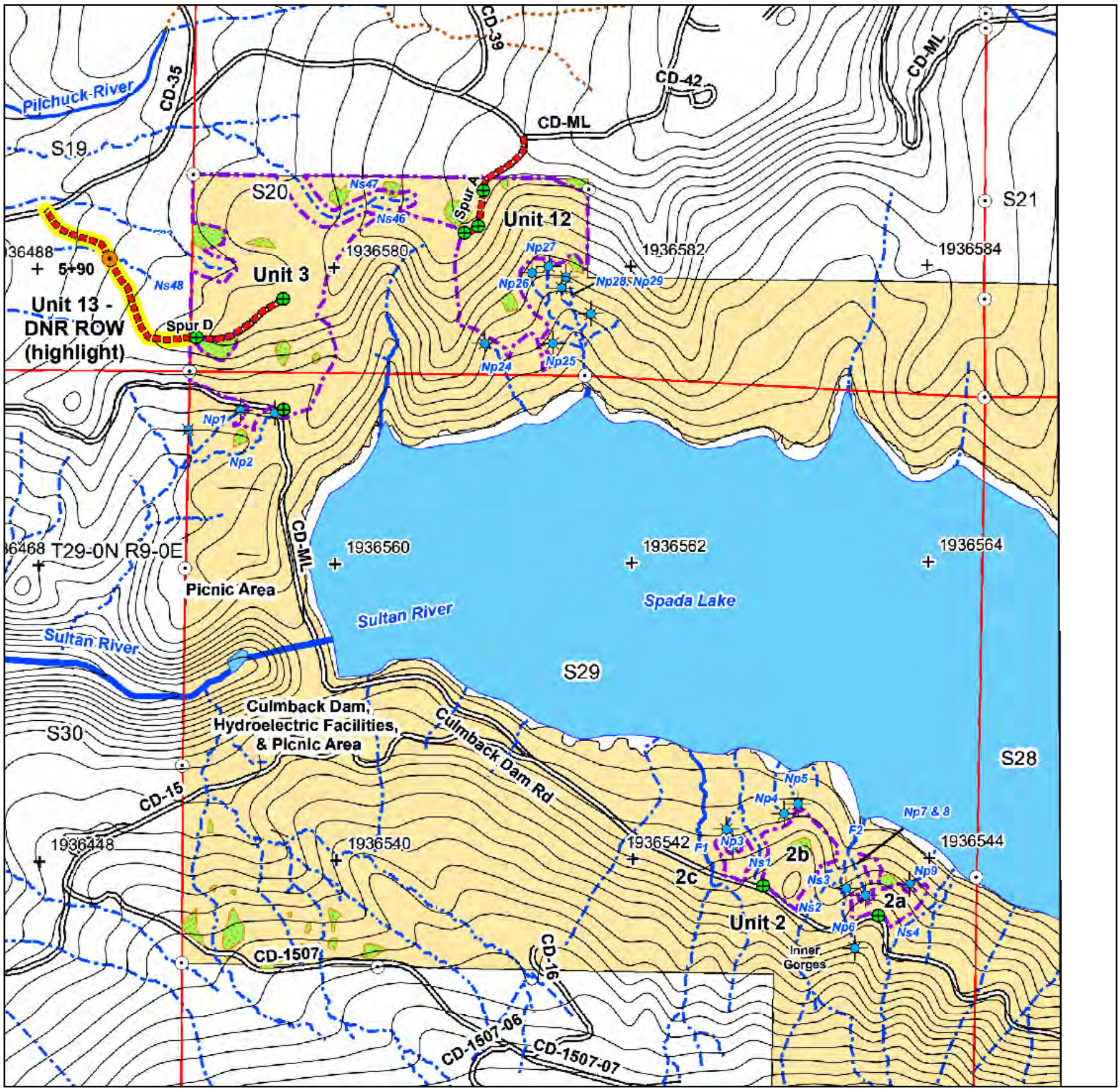

Legend

- PIP
- Potential Landings
- Cadastre Points
- Snag Gaps - Leave Tree Areas
- DNR Registration Points
- F
- Np
- Ns
- Non-typed Water
- 40' Contours
- PUD Ownership
- Road_Construction
- Skid_Trails
- Stream_Crossings

N

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Feet

Harvest Unit Map

Spada Lake Thinning
Snohomish County, Washington

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Figure 1

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet

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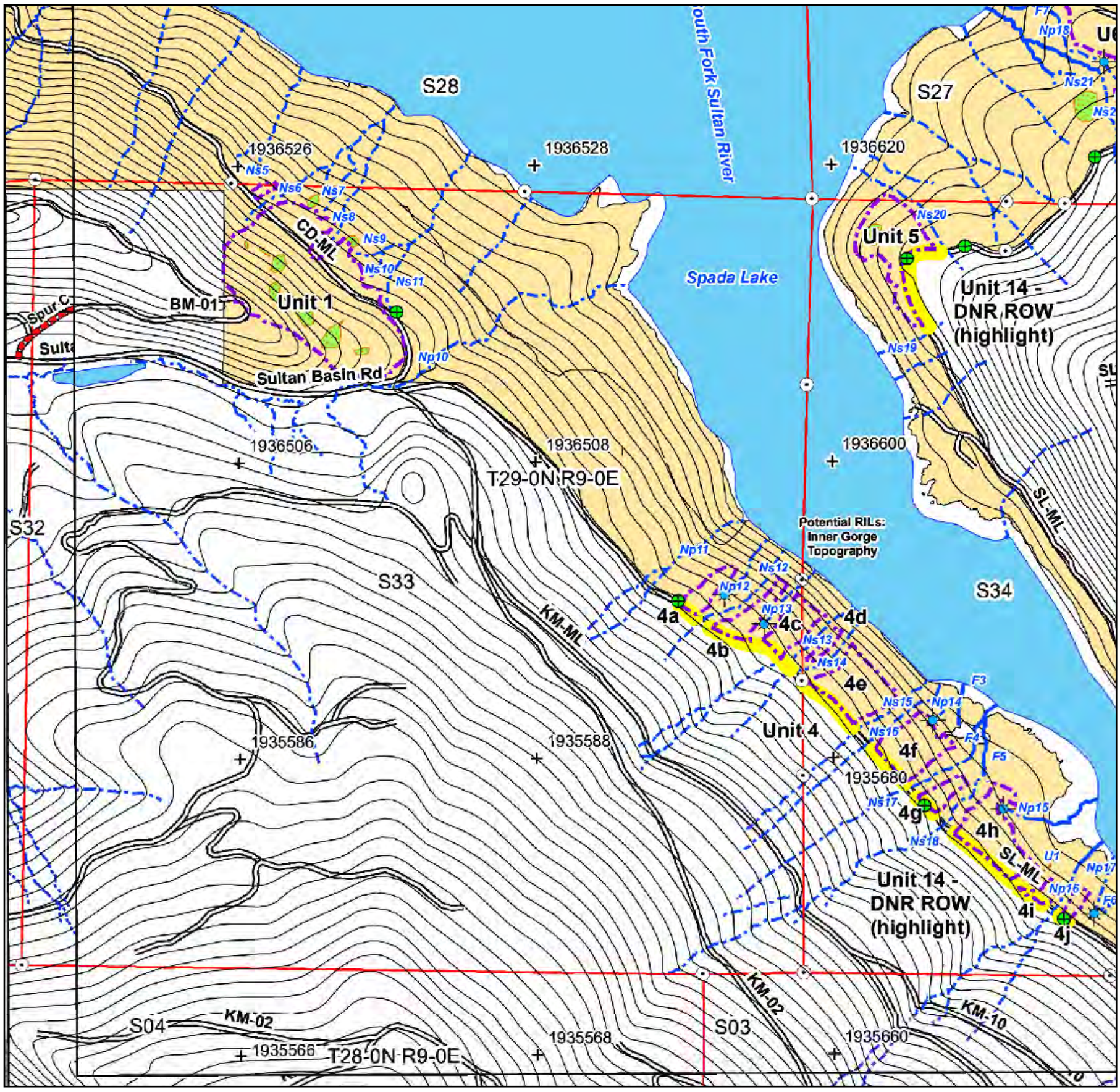

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Harvest Unit Map

Spada Lake Thinning
Snohomish County, Washington

GeoEngineers

Figure 2

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet

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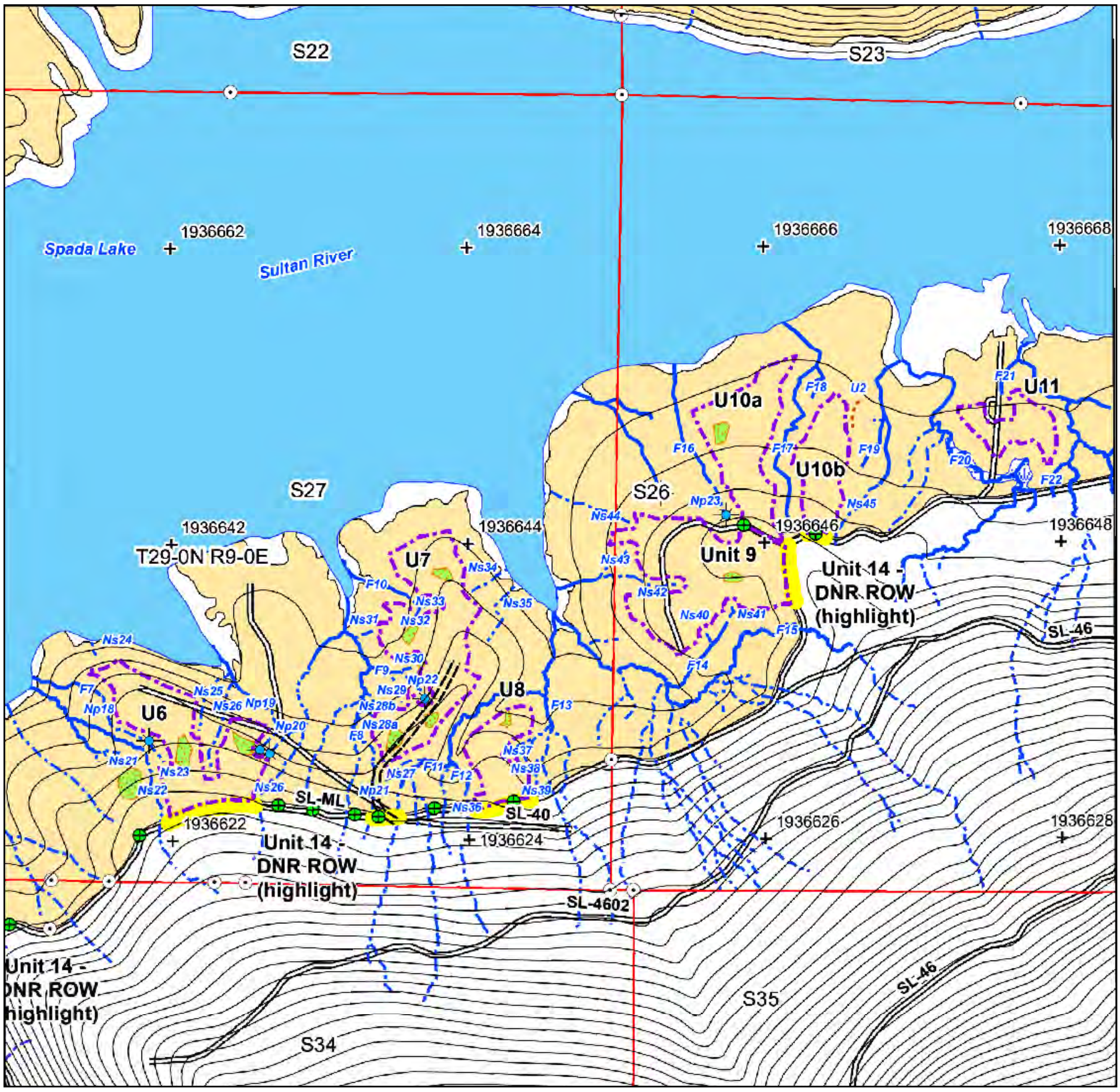

Legend

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Harvest Unit Map

Spada Lake Thinning
Snohomish County, Washington

GeoEngineers

Figure 3

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet

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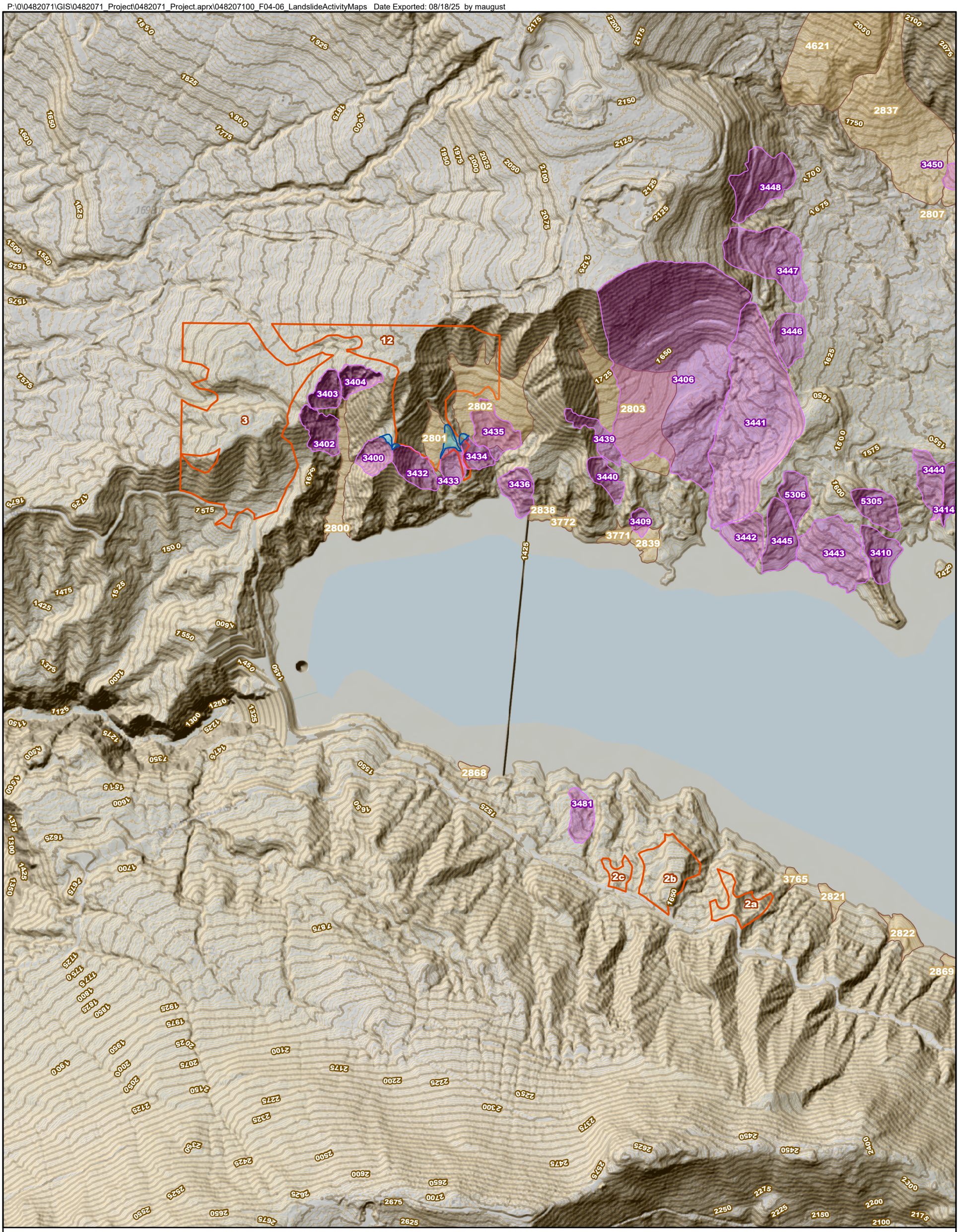

Legend

- Harvest Unit Boundary
- SLIP Landslide
- SLIP Fan
- Mapped Landslide
- Groundwater Recharge Area

N

0 800

Feet

Source(s):
• 2017 LiDAR

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet

Landslide Activity Map 1

Spada Lake Harvest Unit
Snohomish County, Washington

GeoEngineers

Figure 4

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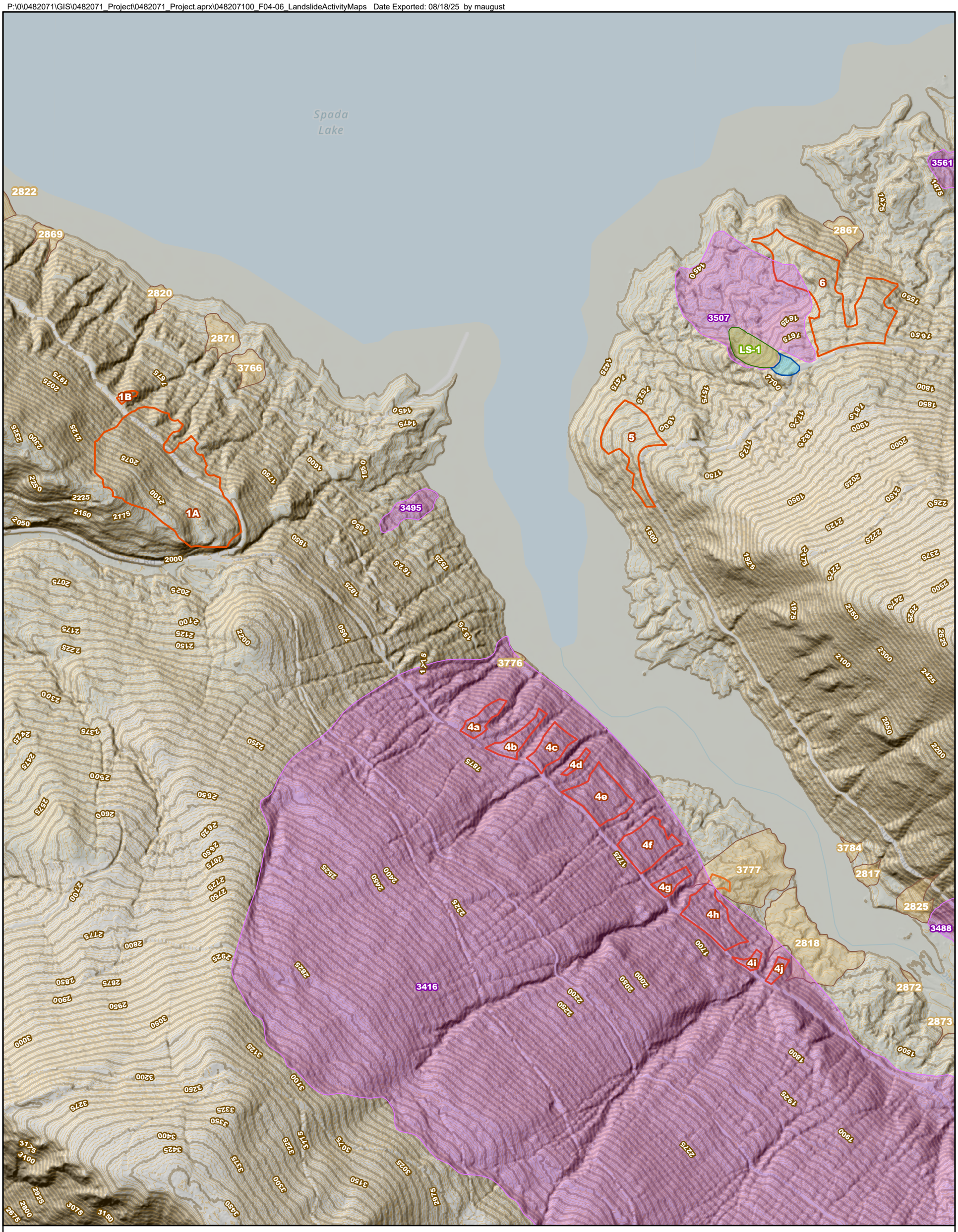

Legend

- Harvest Unit Boundary
- SLIP Landslide
- SLIP Fan
- Mapped Landslide
- Groundwater Recharge Area

N

0 800

Feet

Source(s):
• 2017 LiDAR

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet

Landslide Activity Map 2

Spada Lake Harvest Unit
Snohomish County, Washington

GeoEngineers

Figure 5

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Legend

- Harvest Unit Boundary
- SLIP Landslide
- SLIP Fan
- Mapped Landslide
- Groundwater Recharge Area

N

0 800

Feet

Source(s):
- 2017 LiDAR

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet

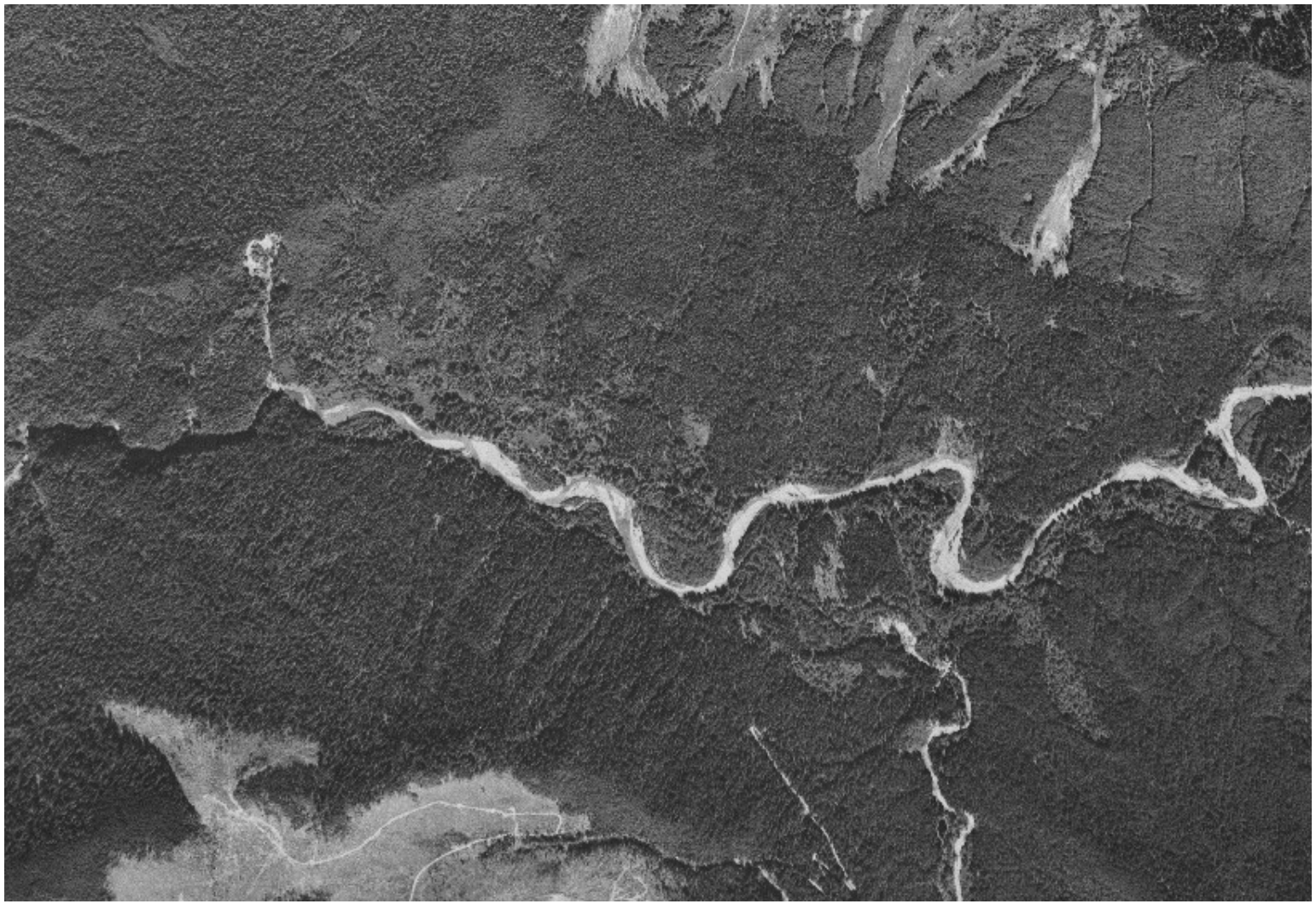
Landslide Activity Map 3

Spada Lake Harvest Unit
Snohomish County, Washington

GeoEngineers

Figure 6

Appendix A
Historical Aerial Imagery



Note(s):

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Source(s): USGS Earth Explorer

Historic Site Photograph – 1953

Spada Thinning
Snohomish County, Washington

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Source(s): USGS Earth Explorer

Historic Site Photograph – 1954

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Source(s): USGS Earth Explorer

Historic Site Photograph – 1974

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Source(s): USGS Earth Explorer

Historic Site Photograph – 1979

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Source(s): USGS Earth Explorer

Historic Site Photograph – 1985

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Snohomish County, Washington

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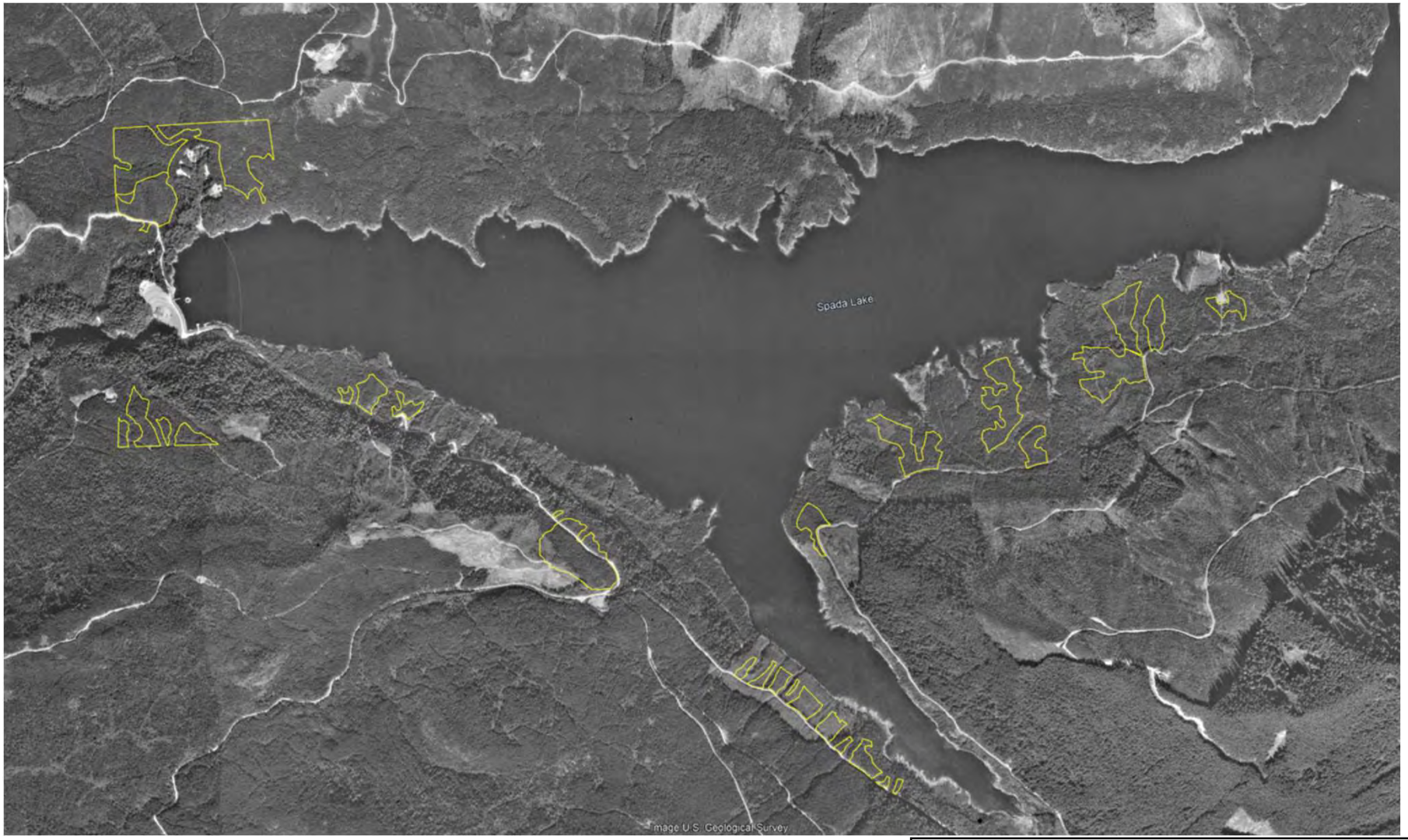

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Source(s): Google Earth

Historic Site Photograph – 1989

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Snohomish County, Washington

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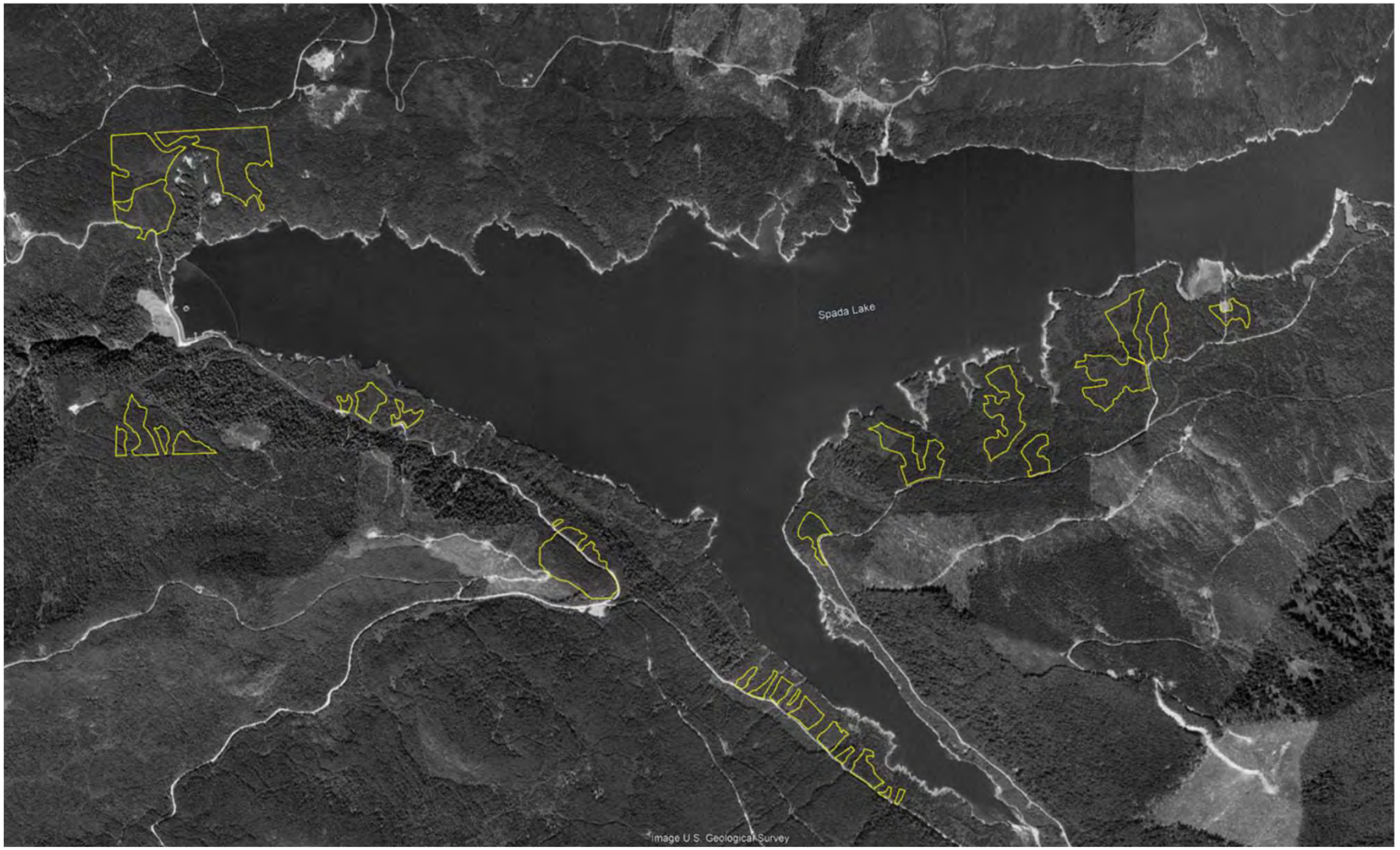

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Source(s): Google Earth

Historic Site Photograph – 1998

Spada Thinning
Snohomish County, Washington

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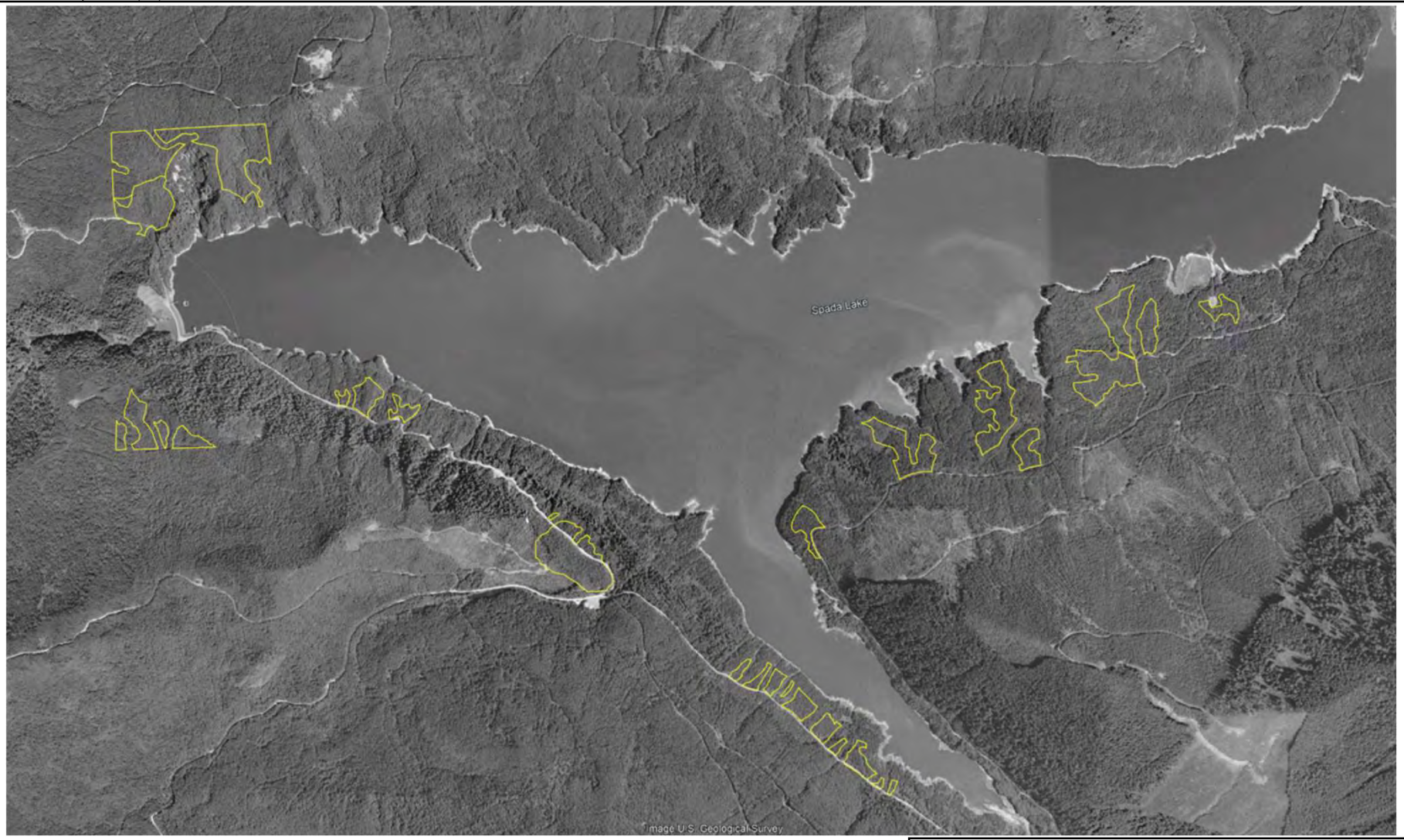

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Source(s): Google Earth

Historic Site Photograph – 2003

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Snohomish County, Washington

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Source(s): Google Earth

Historic Site Photograph – 2007

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Source(s): Google Earth

Historic Site Photograph – 2009

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Snohomish County, Washington

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Source(s): Google Earth

Historic Site Photograph – 2011

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Snohomish County, Washington

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Source(s): Google Earth

Historic Site Photograph – 2013

Spada Thinning
Snohomish County, Washington

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Source(s): Google Earth

Historic Site Photograph – 2014

Spada Thinning
Snohomish County, Washington

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Source(s): Google Earth

Historic Site Photograph – 2015

Spada Thinning
Snohomish County, Washington

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Source(s): Google Earth

Historic Site Photograph – 2017

Spada Thinning
Snohomish County, Washington

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Source(s): Google Earth

Historic Site Photograph – 2018

Spada Thinning
Snohomish County, Washington

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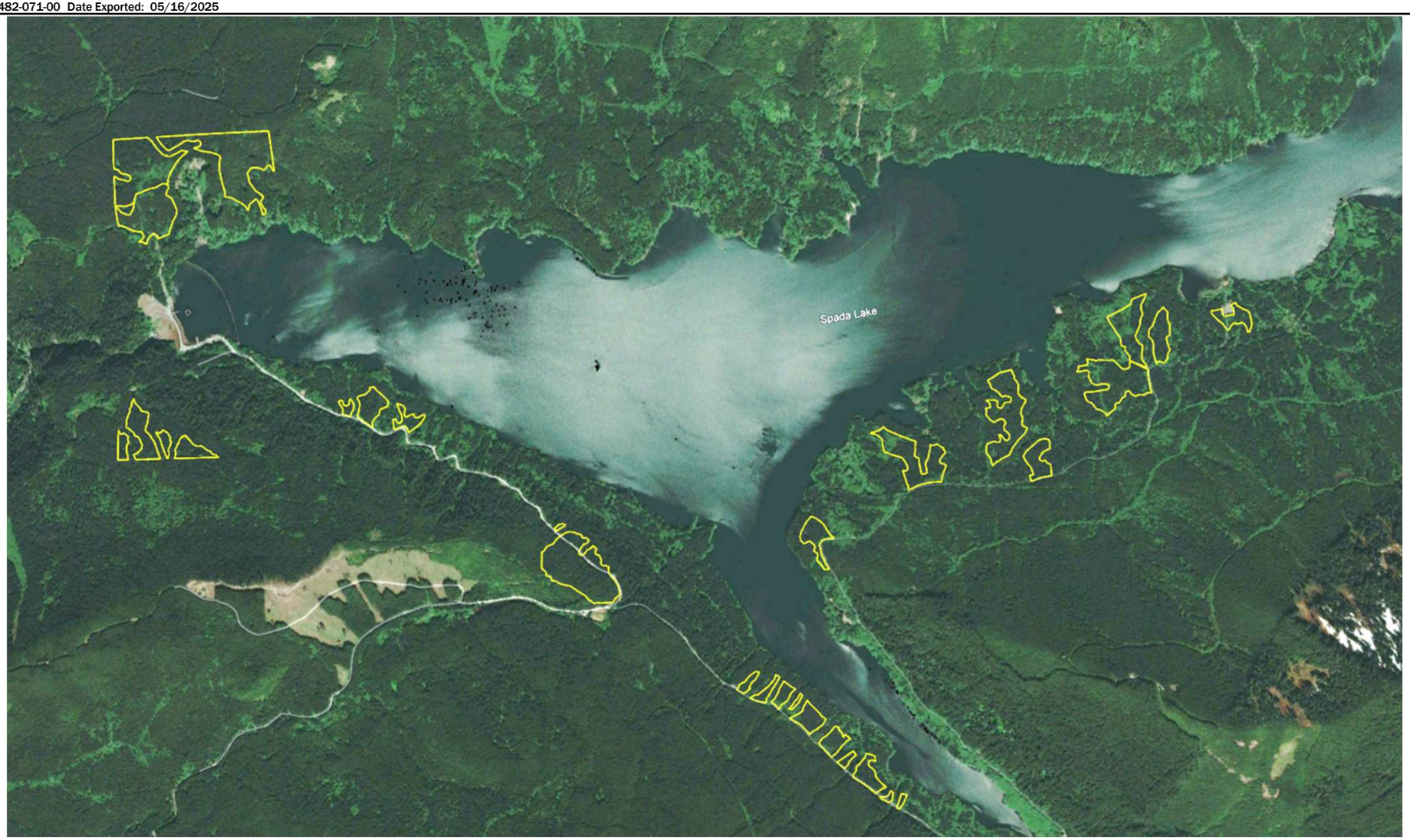

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Source(s): Google Earth

Historic Site Photograph – 2020

Spada Thinning
Snohomish County, Washington

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Source(s): Google Earth

Historic Site Photograph – 2023

Spada Thinning
Snohomish County, Washington

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Appendix B
Report Limitations and Guidelines for Use

Appendix B
Report Limitations and Guidelines For Use[1]

This appendix provides information to help you manage your risks with respect to the use of this report.

READ THESE PROVISIONS CLOSELY

It is important to recognize that the geoscience practices (geotechnical engineering, geology, and environmental science) rely on professional judgment and opinion to a greater extent than other engineering and natural science disciplines, where more precise and/or readily observable data may exist. To help clients better understand how this difference pertains to our services, GeoEngineers includes the following explanatory "limitations" provisions in its reports. Please confer with GeoEngineers if you need to know more how these "Report Limitations and Guidelines for Use" apply to your project or site.

GEOTECHNICAL SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES, PERSONS, AND PROJECTS

This report has been prepared for Roots Forestry and for the Spada Lake Harvest Unit specifically identified in the report. The information contained herein is not applicable to other sites or projects.

GeoEngineers structures our services to meet the specific needs of our clients. For example, a geotechnical or geologic study conducted for a civil engineer or architect may not fulfill the needs of a construction contractor or even another civil engineer or architect that are involved in the same project. Because each geotechnical or geologic study is unique, each geotechnical engineering or geologic report is unique, prepared solely for the specific client and project site. No one except SPI should rely on this report without first conferring with GeoEngineers. This report should not be applied for any purpose or project except the one originally contemplated.

A GEOTECHNICAL ENGINEERING OR GEOLOGIC REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

This report has been prepared for Spada Lake Harvest Unit located in Snohomish County, Washington. GeoEngineers considered a number of unique, project-specific factors when establishing the scope of services for this project and report. Unless GeoEngineers specifically indicates otherwise, it is important not to rely on this report if it was:

- Not prepared for you,
- Not prepared for your project,
- Not prepared for the specific site explored, or
- Completed before important project changes were made.

1 Developed based on material provided by GBA, GeoProfessional Business Association; www.geoprofessional.org.

For example, changes that can affect the applicability of this report include those that affect:

- Elevation, configuration, location, orientation, or weight of the proposed structure;
- Project ownership.

If changes occur after the date of this report, GeoEngineers cannot be responsible for any consequences of such changes in relation to this report unless we have been given the opportunity to review our interpretations and recommendations. Based on that review, we can provide written modifications or confirmation, as appropriate.

SUBSURFACE CONDITIONS CAN CHANGE

This geotechnical or geologic report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by man-made events such as construction on or adjacent to the site, new information or technology that becomes available subsequent to the report date, or by natural events such as floods, earthquakes, slope instability or groundwater fluctuations. If more than a few months have passed since issuance of our report or work product, or if any of the described events may have occurred, please contact GeoEngineers before applying this report for its intended purpose so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

GEOTECHNICAL AND GEOLOGIC FINDINGS ARE PROFESSIONAL OPINIONS

Our interpretations of subsurface conditions are based on field observations from widely spaced sampling locations at the site. Site exploration identifies the specific subsurface conditions only at those points where subsurface tests are conducted or samples are taken. GeoEngineers reviewed field and laboratory data and then applied its professional judgment to render an informed opinion about subsurface conditions at other locations. Actual subsurface conditions may differ, sometimes significantly, from the opinions presented in this report. Our report, conclusions and interpretations are not a warranty of the actual subsurface conditions.

GEOTECHNICAL ENGINEERING REPORT RECOMMENDATIONS ARE NOT FINAL

We have developed the following recommendations based on data gathered from subsurface investigation(s). These investigations sample just a small percentage of a site to create a snapshot of the subsurface conditions elsewhere on the site. Such sampling on its own cannot provide a complete and accurate view of subsurface conditions for the entire site. Therefore, the recommendations included in this report are preliminary and should not be considered final. GeoEngineers' recommendations can be finalized only by observing actual subsurface conditions revealed during construction. GeoEngineers cannot assume responsibility or liability for the recommendations in this report if we do not perform construction observation.

We recommend that you allow sufficient monitoring, testing and consultation during construction by GeoEngineers to confirm that the conditions encountered are consistent with those indicated by the explorations, to provide recommendations for design changes if the conditions revealed during the work differ from those anticipated, and to evaluate whether earthwork activities are completed in accordance with our recommendations. Retaining GeoEngineers for construction observation for this project is the most

effective means of managing the risks associated with unanticipated conditions. If another party performs field observation and confirms our expectations, the other party must take full responsibility for both the observations and recommendations. Please note, however, that another party would lack our project-specific knowledge and resources.

A GEOTECHNICAL ENGINEERING OR GEOLOGIC REPORT COULD BE SUBJECT TO MISINTERPRETATION

Misinterpretation of this report by members of the design team or by contractors can result in costly problems. GeoEngineers can help reduce the risks of misinterpretation by conferring with appropriate members of the design team after submitting the report, reviewing pertinent elements of the design team's plans and specifications, participating in pre-bid and preconstruction conferences, and providing construction observation.