



MEMORANDUM

DATE: August 18, 2020

TO: Helge Eng
California Department of Forestry and Fire Protection
135 Ridgeway Avenue
Santa Rosa, CA 95401

FROM: Kevin Doherty
Department of Conservation
California Geological Survey
135 Ridgeway Avenue
Santa Rosa, California 95401

SUBJECT: Engineering Geologic Review of Timber Harvesting Plan 1-20-00084 SON

Inspection Date: July 24, 2020

County: Sonoma

Quadrangles:
Duncans Mills and Camp Meeker 7.5' Quads

Watersheds: Pocket Canyon (1114.110301)
Hulbert Creek (1114.110302), Dutch Bill Creek
(1114.110303)

Silvicultural Method: Selection, Transition,
Group Selection

Logging System:
Ground Based and Cable

Slopes: Moderate and Steep

EHR: Moderate and High

Participants-Affiliation:
RPF – Jaime Pusich, NCRM
Jesse Weaver – Redwood Empire
Kim Sone – Cal Fire
Izaac Russo – NCRWQCB
Julie Coombes – CDFW
Carolyn Buesch – CDFW
Greg Guensch – Russian River Sanitation District
Kevin Doherty – CGS

Legal Description: Sec. 5, T7N, R10W,
Sec. 31, 32, T8N, R10W; MDBL&M

Plan Submitter:
Redwood Empire Sawmills

Timberland Owner:
RMB Revocable Family Trust

Area: 224 acres

Geologic Concerns: Potential effects of operations on slope stability and public safety; reconstruction and use of existing roads and skid trails; potential for sediment delivery to the Russian River and Class I, II, and III tributaries.

References:

Best, T.C., 2020, Focused Engineering Geologic Review of the Silver Estates THP (Revised), Russian River Watershed, Sonoma County, California; dated June 11, 2020.

- Blake, M.C., Graymer, R.W., and Stamski, R.E., 2002, Geologic Map and Map Database of Western Sonoma, Northernmost Marin and Southernmost Mendocino Counties, California: USGS, Miscellaneous Field Studies, Map MF-2402, scale 1:125,000.
- California Geological Survey, 1999 (Revised), Factors Affecting Landslides in Forested Terrain, California Geological Survey (formerly Division of Mines and Geology) Note 50, 5p.
- California Geological Survey (CGS), 1998, Engineering Geologic Review of Timber Harvesting Plan 1-98-253 SON, Memorandum to Ross Johnson, Deputy Director for Resource Management, California Department of Forestry and Fire Protection, P.O. Box 670, Santa Rosa, CA. 95402, prepared by Michael W. Manson, dated September 22, 1998.
- California Geological Survey (CGS), 1999, "Negative Declaration" for the Engineering Geologic Review of Timber Harvesting Plan 1-98-253 SON, Memorandum to Ross Johnson, Deputy Director for Resource Management, California Department of Forestry and Fire Protection, P.O. Box 670, Santa Rosa, CA. 95402, prepared by Michael W. Manson, dated May 10, 1999.
- California Geological Survey (CGS), 2000, Engineering Geologic Review of Timber Harvesting Plan 1-00-092 SON, Memorandum to Ross Johnson, Deputy Director for Resource Management, California Department of Forestry and Fire Protection, 135 Ridgeway Avenue, Santa Rosa, CA. 95401, prepared by Wayne D. Haydon, dated May 22, 2000.
- California Geological Survey (CGS), 2001, Engineering Geologic Review of Timber Harvesting Plan 1-01-012 SON, Memorandum to Ross Johnson, Deputy Director for Resource Management, California Department of Forestry and Fire Protection, 135 Ridgeway Avenue, Santa Rosa, CA. 95401, prepared by John P. Schlosser, dated May 17, 2001.
- California Geological Survey (CGS), 2002, Engineering Geologic Review of Timber Harvesting Plan 1-02-179 SON, Memorandum to Ross Johnson, Deputy Director for Resource Management, California Department of Forestry and Fire Protection, 135 Ridgeway Avenue, Santa Rosa, CA. 95401, prepared by C. Michael Huyette, dated February 19, 2003.
- Huffman, M.E., and Armstrong, C.F., 1980, Geology for Planning in Sonoma County: California Division of Mines and Geology, Special Report 120, Plates 2A and 3A, scale 1:62,500.
- Keaton, J.R., and DeGraff, J.V., 1996, Surface Observation and Geologic Mapping, in Turner, A.K. and Schuster, R.L., *editors*, Landslides, Investigation and Mitigation, Transportation Research Board, National Research Council Special Report 247.
- Aerial Photographs Inspected:
- WAC Inc., 1984 Black and white photographs, Flight WAC-84C, Roll 14, Frames 84, 85, 86; nominal scale 1:31,680.
- WAC Inc., 1992, Black and white photographs, Flight WAC 92CA, Roll 28, Frames 186, 187; nominal scale 1:13,750.
- WAC Inc., 1996, Black and white photographs, Flight WAC 96CA, Roll 19, Frames 73, 74, 75; nominal scale 1:13,750.
- WAC Inc., 1999, Color aerial photographs, Flight WAC-C-99CA, Roll 10, Frames 258, 259; nominal scale 1:24,000.
- Google earth images: 38°29'17.51"N and 123°00'25.28"W. Google Earth., 7/12/1993; 6/25/2006; 4/24/2010; 4/20/2013; 9/9/2014; Accessed July 23, 2020.

LiDAR Data:

38°29'17.51"N and 123°00'25.28"W Sonoma County Vegetation Mapping & LiDAR Program. 2014. A joint program of the Sonoma County Agricultural Preservation and Open Space District and the Sonoma County Water Agency.

Geologic Conditions:

Regional geologic mapping (Blake and others, 2002. Figure 1) identifies Tertiary to Cretaceous-age Coastal or Central Belt Franciscan Formation as underlying Timber Harvest Plan 1-20-00084 SON, consistent with descriptions provided in the plan-attached geologic report (Best, 2020). The Franciscan Formation is described as massive, brown- and orange weathered, green to gray feldspathic-lithic wacke, including thin beds of sandstone, dark-gray shale and slate (Blake and others, 2002). The Franciscan Formation is overlain by Quaternary-age alluvial fan and fluvial deposits along the Russian River floodplain within the southwestern THP boundary (Blake and others, 2002). The fluvial deposits are described as brown or tan, medium dense to dense, gravelly sand or sandy gravel that generally grade upward to sandy or silty clay (Blake and others, 2002). Bedrock observed during the PHI generally consisted of brownish gray sandstone, consistent with mapping and descriptions made by Blake and others (2002) and Best (2020).

Soils complexes identified in the THP are the Hugo very gravelly loam, 50 to 75 percent slopes, Hugo-Atwell complex, 50 to 75 percent slopes, Hugo-Josephine complex, 50 to 75 percent slopes, and Yolo sandy loam, 0 to 2 percent slopes. Soils observed during the PHI generally consist of gray to brown gravelly clay loams that appear well drained. The site inspection concurs with the Moderate and High Erosion Hazard Ratings calculations included with the THP.

Site slopes (ranging from 40 to 70± percent gradients) drain to the southwest, northwest, northeast and east via Class II and Class III watercourses that are tributaries to Mays Canyon and the Russian River, both Class I watercourses. Regional geologic mapping (Huffman and Armstrong, 1980, Figure 2) and plan-attached site-specific mapping (Best, 2020) identify areas of shallow- and deep-seated landsliding as underlying and downslope of the proposed THP boundary. The unstable areas were visited during the PHI and are discussed below under the General Observations portion of this memo.

Agency Question: 1). Please evaluate proposed operations at mapped unstable areas. Are additional mitigations necessary to minimize adverse impacts to slope stability, erosion and public safety?

Response:

The plan-attached geologic report (Best, 2020) identifies areas of shallow- and deep-seated landsliding within and downslope of the proposed THP boundary. The unstable areas were visited during the PHI and are discussed under the General Observations portion of this memo.

General Observations:

1). Harvesting Within Mapped Deep-Seated Landslides: Plan-attached site-specific geologic mapping (Best, 2020) identifies areas of deep-seated landsliding within and downslope of the proposed THP boundary, consistent with available regional geologic mapping (Huffman and Armstrong, 1980). Review of aerial photographs (sets 1984, 1992, 1996, 1999, Google Earth images), lidar (2014) and PHI observations generally concur with Best (2020) that the mapped deep-seated features generally appear as concave slopes tens to hundreds of feet wide and long and appear to correspond to the dormant historic to dormant-young morphological age classification of Keaton and Degraff (1996). The deep-seated landslide areas contain weathered and rounded head and lateral scarps with some evidence of localized historic activity, including hummocky and benched topography along 30 to greater than 70-percent slopes that support generally straight-standing second growth conifers.

Several of the unstable areas mapped by Best (2020) (G1, G2, G3, G6, G10) are located within areas proposed for cable and ground-based selection, group selection and transition harvesting. Mitigation measures proposed in the THP generally appear consistent with recommendations by Best (2020), including increased retention within flagged Special Treatment Zones (STZ), restricting group openings and avoidance of the more sensitive areas. The mapped unstable features appear to toe into the Russian River, Mays Canyon and mapped Class II and Class III tributaries. Class I and Class II WLPZ and Class III ELZ protections, the proposed partial harvesting silviculture (selection, group selection, transition), proposed STZ's and avoidance of the more sensitive areas, appear designed to retain canopy and root function within the unstable features.

2). Harvesting Within Mapped Shallow-Seated Landslides: Best (2020) identifies areas of shallow-seated landsliding within and downslope of the mapped THP boundary. The unstable areas appear to be generally associated with legacy road construction, along steep streamside slopes and the toes of mapped deep-seated landslides. Reuse of existing roads and skid trails are proposed across and upslope of several of the mapped small-scale unstable features. Mitigation measures associated with reconstruction of failed road prisms and cut banks to gain usable road width are described by Best (2020) at five locations (G13, G14, G15, G16, G17). Generally, the remaining proposed road running surfaces appear intact with little to no reduction in usable road width.

The shallow-seated features are located within areas proposed for selection, group selection and transition harvesting and are generally characterized by rounded scarps above 50 to 70-percent benched failure slopes that support straight-standing second growth conifers. Five of the shallow-seated features are located outside of the proposed THP boundary (G5, G7) or proposed for avoidance (G11, G13, G17). Four of the remaining shallow-seated features (G3, G4, G12, G14) are delineated by STZ's limiting harvesting to single-tree selection, three of which (G3, G12, G14) are proposed for increased retention. The remaining two shallow-seated features (G15, G16) are located within areas proposed for single-tree selection with no restrictions. Proposed mark within and

adjacent to the two unstable features, which are located approximately 250 to 400-feet upslope of Mays Canyon, is light, suggesting the potential for adverse impacts to slope stability and sediment delivery is low.

Slides G7 and G12 are identified by Best (2020) as areas of debris slide slope geomorphology. Debris slide slopes are geomorphic features characterized by steep, usually well vegetated slopes that have been sculpted by numerous debris slide events. Areas of mapped debris slides slope geomorphology as mapped by Best (2020) were visited during the PHI. Mitigations proposed in the THP and plan attached geologic report (Best, 2020) include partial (selection) harvesting with increased retention (G12) and avoidance (G7). During the PHI, the RPF stated that, although group openings are allowed within areas proposed for single-tree selection, none are proposed within the STZ for G12. It was discussed that, although not stated expressly in the plan-attached geologic report (Best, 2020), that appears consistent with discussions by Best (2020) and should be included in the description of Slide G12 in Section II of the THP.

3) Public Safety: Best (2020) maps shallow- and deep-seated landslides (Slides G7, G8, G9) along south and west-facing slopes within and downslope of the northwestern THP boundary that drain to Neeley Road, a Sonoma County maintained public road. The Vacation Beach and Edendale residential developments and Russian River Sanitation District structures are located along Neeley Road along the toes of the south and west-facing slopes downslope of the mapped unstable features. In an effort to avoid the mapped unstable features and minimize the potential for adverse impacts to slope stability and public safety, the THP boundary has been located along the ridgeline and no harvesting operations are proposed along the south and west-facing slopes that drain to the Vacation Beach and Edendale residential developments and Russian River Sanitation District structures. During the PHI, the THP boundary was observed flagged along the ridgeline consistent with THP maps.

Best also maps unstable features (Slides G1, G2, G3, G4, G5, G6) along northwest-facing slopes within the northwestern THP boundary that appear to toe into the Russian River. Neeley Road, which provides public access to the Vacation Beach and Edendale residential developments, appears to cross the toe of the mapped unstable features approximately 75 to 100-feet upslope of the Russian River. In an effort to minimize adverse impacts to slope stability and public safety along Neeley Road, the northern THP boundary has been flagged between 50 and 300-feet upslope. Mitigation measures recommended by Best (2020), including partial (selection) harvesting, increased retention, no group openings and avoidance of the more sensitive areas, generally appear designed to retain a large component of the existing canopy and root function. A single residential structure was observed along Neeley Road downslope of the northernmost corner of the THP boundary and Slide G3. The residence and Slide G3 were visited during the PHI and are described under the Specific Observations portion of this memo. Map Point 1 (G18) is just upslope of Neely Road that is controlled by Sonoma County. The potential adverse impacts to

Neely road and associated public safety is discussed below under specific observations.

Specific Observations: (keyed to Figures 3, 4, 5 and 6)

Map Point 3: The THP proposes to install an 18-inch diameter culvert where an existing seasonal road crosses a Class III watercourse at Map Point 3. The seasonal road switches back along the slope and crosses the watercourse at two additional locations (Map Points 2 and 7). Based on review of flow calculations included in Section V of the THP, it appears that the calculated flow at Map Point 7 is larger than the calculated flow at Map Point 3. Map Point 7 is located upstream of Map Point 3. Typically, a watercourse crossing located downstream of another crossing experience a higher flow due to an increase in drainage area and slope runoff, and accumulation of ground water. This suggests that either the flow at Map Point 7 is overestimated or the flow at Map Point 3 is underestimated. During the PHI, the RPF stated that he suspected that the acreages used in the calculations were incorrect. After the PHI, the RPF provided revised calculations using recalculated acreages which appear more representative of the observed watersheds upslope of the crossings. As a result, the RPF proposes to increase the culvert at Map Point 3 from 18-inch diameter to 24-inch diameter.

Special Treatment Zone G10: The plan-attached geologic report (Best, 2020) identifies an approximately 4-acre deep-seated landslide as underlying the southwestern THP boundary. The unstable feature toes into the Russian River floodplain approximately 800 to 900-feet from the active channel and is characterized a rounded scarp above a 40 to 70-percent benched failure slope that supports generally straight-standing second growth conifers. The slide is located within an area proposed for transition and group selection harvesting. The uppermost approximately 0.1 to 0.2-acre of the head scarp of the slide, where group selection harvesting is proposed along 60 to 70-percent slopes, is located within a Russian River Sanitation District effluent spray field. Best (2020) recommends establishing a special treatment zone around the spray area and restricting harvesting operations. During the PHI, it was noted that the silviculture break between transition and group selection harvesting was observed flagged approximately 30 to 50-feet downslope of the STZ. Concern was raised, that a harvesting or the placement of a group opening just downslope of the spray field may result in adverse impacts to slope stability. Extending the no harvest STZ downslope to the silviculture break will minimize the potential for adverse impacts to slope stability by retaining the existing canopy and root function.

Map Point D (Best, G16): The plan-attached geologic report (Best, 2020) describes an approximately 20-foot wide cut bank failure (labeled G16 by Best) along an existing seasonal road proposed for reuse. The road crosses approximately 50 to 70-percent slopes approximately 100 to 150-feet upslope of the head of a mapped Class III tributary to Mays Canyon, a Class I watercourse. Consistent with recommendations by Best (2020), the road was reopened by grading through the deposited material and feathering out the material to either side. During the PHI, unconsolidated earth

materials containing ground cracks was observed sidecast onto the steep slopes. Concern was raised that the unconsolidated material would mobilize during heavy rains and deliver to the Class III watercourse downslope. It was discussed that removing the sidecast material would minimize the potential for adverse impacts to slope stability and sediment delivery.

Map Point 1 (Best, G18): The intersection of an existing seasonal road and a Sonoma County maintained permanent road (Neeley Road) crosses a mapped Class II watercourse along the northwestern THP boundary via an approximately 100-foot long existing culvert. The culvert inlet is located below the upstream edge of the existing seasonal road within the northern THP boundary. According to discussions within the RPF and review of the plan-attached geologic report (Best, 2020), the culvert at the inlet is 24-inches in diameter. This was difficult to confirm, as the culvert was observed to be buried during the PHI. An approximately 6 to 8-foot deep basin was observed at the inlet, which likely allows low flows to pool and seep through to the buried inlet. The outlet of the culvert is located below the downstream edge of Neeley Road approximately 40 to 50-feet upstream of the confluence with the Russian River, a Class I watercourse. The outlet was observed rusted through and shotgunned approximately 4 to 5-feet above the outer road fill prism. An approximately 2-foot wide and deep gully was observed in the outer road fill prism below the outlet. Rock was observed in the gully below the shotgunned outlet that appeared to be minimizing erosion. During the PHI, the culvert at the outlet was observed to be approximately 12-inches in diameter, suggesting that the crossing consists of two culvert segments that are not the same diameter. The watercourse was dry during the PHI, but the observed condition of the culvert and an approximately 2-foot wide and long gully observed in the outer road fill prism below the outlet suggests that water likely pipes through the road fill.

Based on flow calculations included in the plan-attached geologic report (Best, 2020), the 24-inch diameter culvert at the inlet is significantly undersized to accommodate the 100-year flood flow and debris. An approximately 1 to 2-foot wide and deep rill observed along the seasonal road above the inlet suggests that the plugged culvert regularly overtops. The rill extends approximately 40-feet downslope to Neeley Road. An approximately 1-foot wide and deep gully in the outer Neeley Road fill prism across from the rill appears to indicate that the runoff is directed across the road running surface. Accumulated eroded material and rocky bed load observed along both sides of the Neeley Road running surface, suggests that material is deposited on the Neeley Road running surface, likely necessitating cleanup by Sonoma County road crews.

As was stated during the PHI, because Neeley Road is the only access route for residences in the Vacation Beach and Edendale communities, CGS considers the potential for adverse impacts to Neely road a hazard to public safety. Adverse impacts to Neely Road could block emergency access to existing residences and could disrupt utilities located along Neely Road.

The THP proposes to reestablish the capacity of the existing culvert by digging out and rock armoring the culvert inlet. The THP proposes to place a trash rack upstream of the inlet to minimize the amount of rocky material and debris that reaches Neeley Road. The rilled seasonal road running surface will be rocked to minimize continued erosion. During the PHI, it was discussed that maintaining the undersized, mismatched and failing culverts would result in continued overtopping of the watercourse onto Neeley Road during high flows, erosion of the road fill prism resulting from flow piping through the road fill and sediment delivery to the Russian River. The undersized and failing segment of culvert under Neeley Road is located outside of the proposed THP area and according to the RPF outside of the jurisdiction of the THP landowner. Although the THP landowner is amenable to upgrading the segment of culvert under the seasonal road to accommodate the 100-year flood flow and debris, it appears that maintaining the mismatched and failing downstream section of culvert would result in the potential for the culvert to continue to plug, overtop onto Neeley Road and flow to pipe through the Neeley Road fill prism.

The THP states that Sonoma County was contacted and has no immediate plans to replace the culvert. No documentation of the conversation between Sonoma County and Redwood Empire Sawmills is provided in the THP. It was discussed during the PHI, that the RPF and landowner should work with the County to mitigate the failed crossing and public safety hazard. To persuade Sonoma County to work with the landowner and prioritize replacement of the crossing, a copy of this PHI memo describing the existing conditions at Map Point 1 will be forwarded to Sonoma County staff. If not mitigated, future impacts to Neely Road should be anticipated.

Special Treatment Zone G3: The plan-attached geologic report (Best, 2020) maps an approximately 1.5-acre historically-active deep-seated translational landslide within the northern THP boundary. The unstable feature appears to toe into the Russian River and is characterized by 8 to 15-foot high near vertical scarps above a benched failure slope that supports mostly straight-standing and few leaning or pistol-butted second growth conifers. Neeley Road, which is a public access road for the Vacation Beach and Edendale residential communities, crosses the toe of the slide approximately 75 to 100-feet upslope of the Russian River. During the PHI, an existing residential structure was observed along Neeley Road downslope of the northern corner of the THP boundary. Based on mapping by Best (2020) and review of available lidar imagery (2014), it appears that the residential structure is located just above and outside of the northeastern lateral scarp of Slide G3. Best (2020) recommends establishing a special treatment zone (STZ) around Slide G3 from the THP boundary extending upslope of the mapped slide. The THP boundary was observed flagged approximately 75 to 100-feet upslope of Neeley Road. Harvesting within the STZ is to be limited to ground-based single-tree selection with a minimum retention of 100-square feet of total basal area and no group openings. During the PHI, the THP boundary was observed flagged across Slide G3 just downslope of the distinct 8 to 15-foot high head scarp of G3. It appeared that only a few conifers were observed marked for harvest downslope of the scarp. In an effort to

minimize potential adverse impacts to slope stability within the unstable feature and public safety along Neeley Road resulting from the operation of ground-based heavy equipment within the historically-active unstable feature, it was discussed that the marked conifers downslope of the scarp be unmarked and the THP boundary be moved to the top of the head scarp. The RPF agreed and the RPF relocated the THP boundary flagging during the PHI to the top of the head scarp approximately 150 to 200-feet upslope of Neeley Road.

General Recommendations:

1): None

2): Prior to second review, Section II of the THP shall describe no group openings will be placed within the special treatment zone (STZ) for G12. The plan attached geologic report shall be revised to clearly recommend that group openings shall not be located in the STZ for G12.

3): None

Specific Recommendations:

Map Point 3: Prior to second review, Section II of the THP shall be revised to describe that a minimum 24-inch diameter culvert will be installed at Map Point 3. The revised flow calculations shall be included in Section V of the THP.

Special Treatment Zone G10: Prior to second review, Section II of the THP shall be revised to describe that the special treatment zone (STZ) shall extend downslope to the flagged silviculture break. The extended STZ shall be identified on the THP maps.

Map Point D: Prior to second review, Section II of the THP shall be revised to describe that the perched and cracked fill will be pulled back and incorporated into the existing road running surface.

Map Point 1: The public safety concerns regarding failure of the crossing shall be described in Section II of the THP and in the plan attached geologic report (Best, 2020). A copy of this memo shall be cc'd to Sonoma County staff. Without additional mitigation it is unclear how the THP minimizes adverse impacts to slope stability and public safety. As discussed during the PHI, the RPF and landowner shall coordinate with Sonoma County to minimize the existing public safety hazard. If the County refuses or is unable to prioritize replacement of the crossing then it should be clearly understood that a potential for adverse impacts to Neely Road continues. Documentation of Sonoma County refusal shall be included in the THP with an acknowledgement by both Sonoma County and Redwood Empire Sawmills that the public safety hazard continues to exist. CGS assumes no liability in the event that Neely Road is impacted by upslope conditions in the future.

Special Treatment Zone G3: Prior to second review, the THP maps shall be revised to accurately show the revised northern THP boundary.

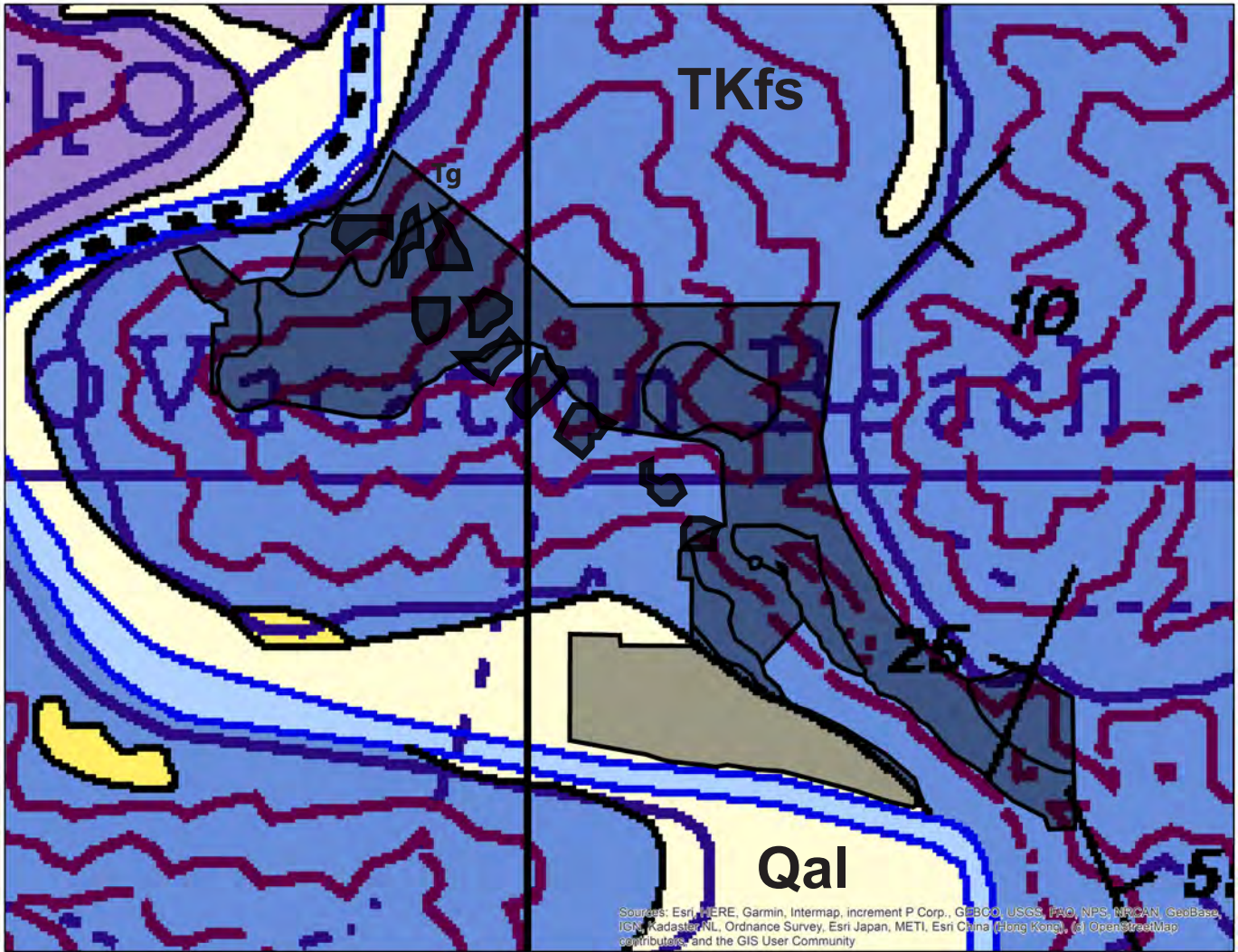
Original signed by
Kevin F. Doherty, CEG # 2666
Engineering Geologist



Concur
8/18/2020 original signed by
Date, David Longstreth, CEG # 2068
Senior Engineering Geologist



Attachments: Figures 1, 2, 3, 4, 5 and 6



Explanation

TKfs Franciscan Formation
 Qal Alluvial fan and fluvial deposits

--- Geologic contact, dashed where approximately located

Inner gorge



0 625' 1250'



Rotational/Translational Landslide

● Active Landslide (too small to show at map scale)



Earthflow

○ Disrupted ground



Debris Slide

▨ Slopes >70 percent



Debris Flow/Torrent Track

75 Strike and dip of bedding



Debris Slide Amphitheater/Slope



Shaded area represents estimated limits of proposed harvest area.

Base Map: Blake, M.C., Graymer, R.W., and Stamski, R.E., 2002, Geologic Map and Map Database of Western Sonoma, Northernmost Marin and Southernmost Mendocino Counties, California: USGS, Miscellaneous Field Studies, Map MF-2402, scale 1:125,000.

Date: Aug. 2020	Regional Geologic Map To Accompany Engineering Geologic Review of THP 1-20-00084 SON	Figure: 1
Scale: 1" = 1250'		
Approved By: CGS		



Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), Swisstopo, OpenStreetMap contributors, and the GIS User Community

Explanation



Rotational/Translational Landslide



Possible Landslide



Shaded area represents estimated limits of proposed harvest area.

Base Map: Huffman, M.E., and Armstrong, C.F., 1980, Geology for Planning in Sonoma County: California Division of Mines and Geology, Special Report 120, Plates 2A and 3A, scale 1:62,500.

Date: Aug. 2020

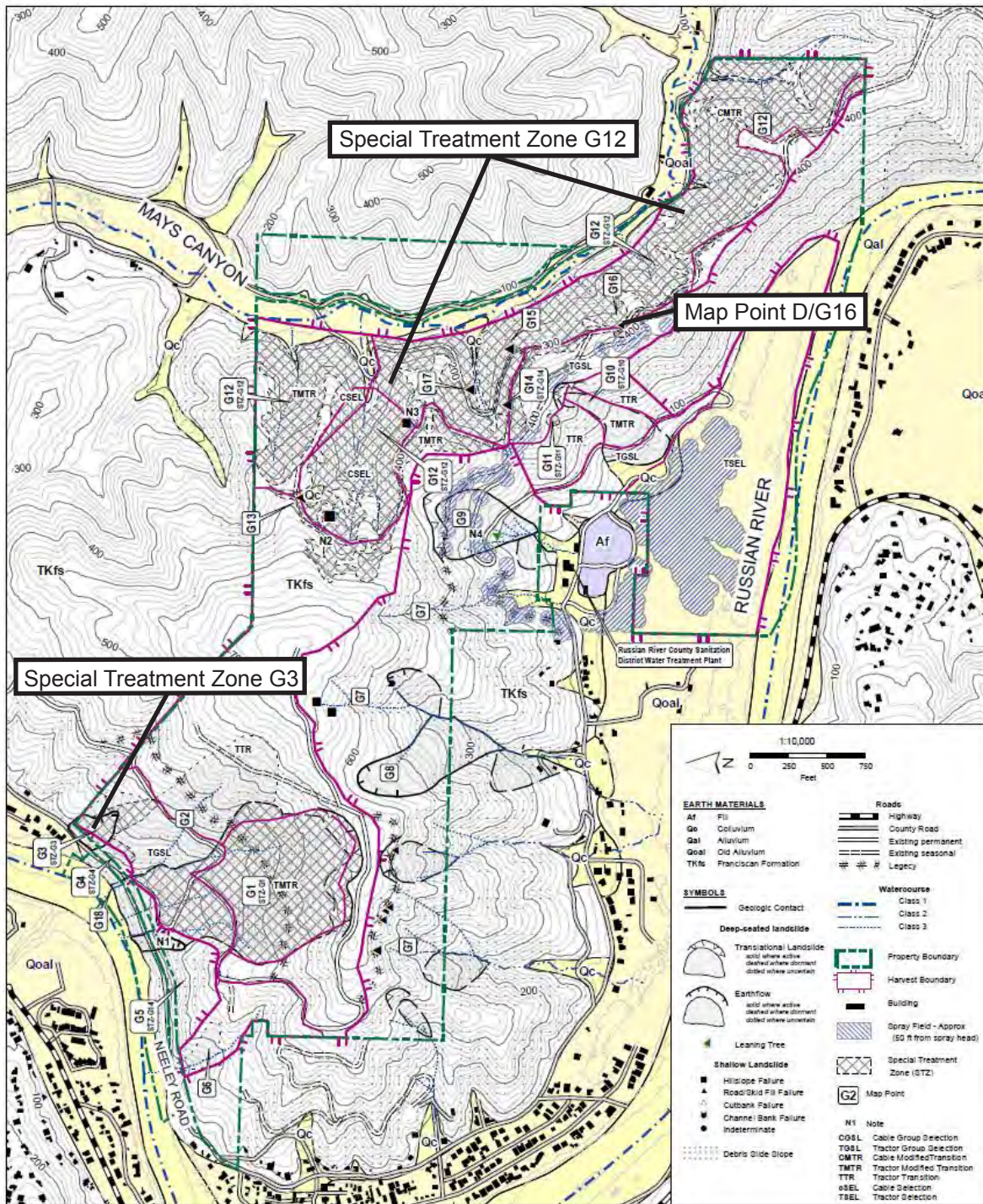
Scale: 1" = 1200'

Approved By:
CGS

Regional Landslide Map
To Accompany
Engineering Geologic Review of
THP 1-20-00084 SON

Figure:

2



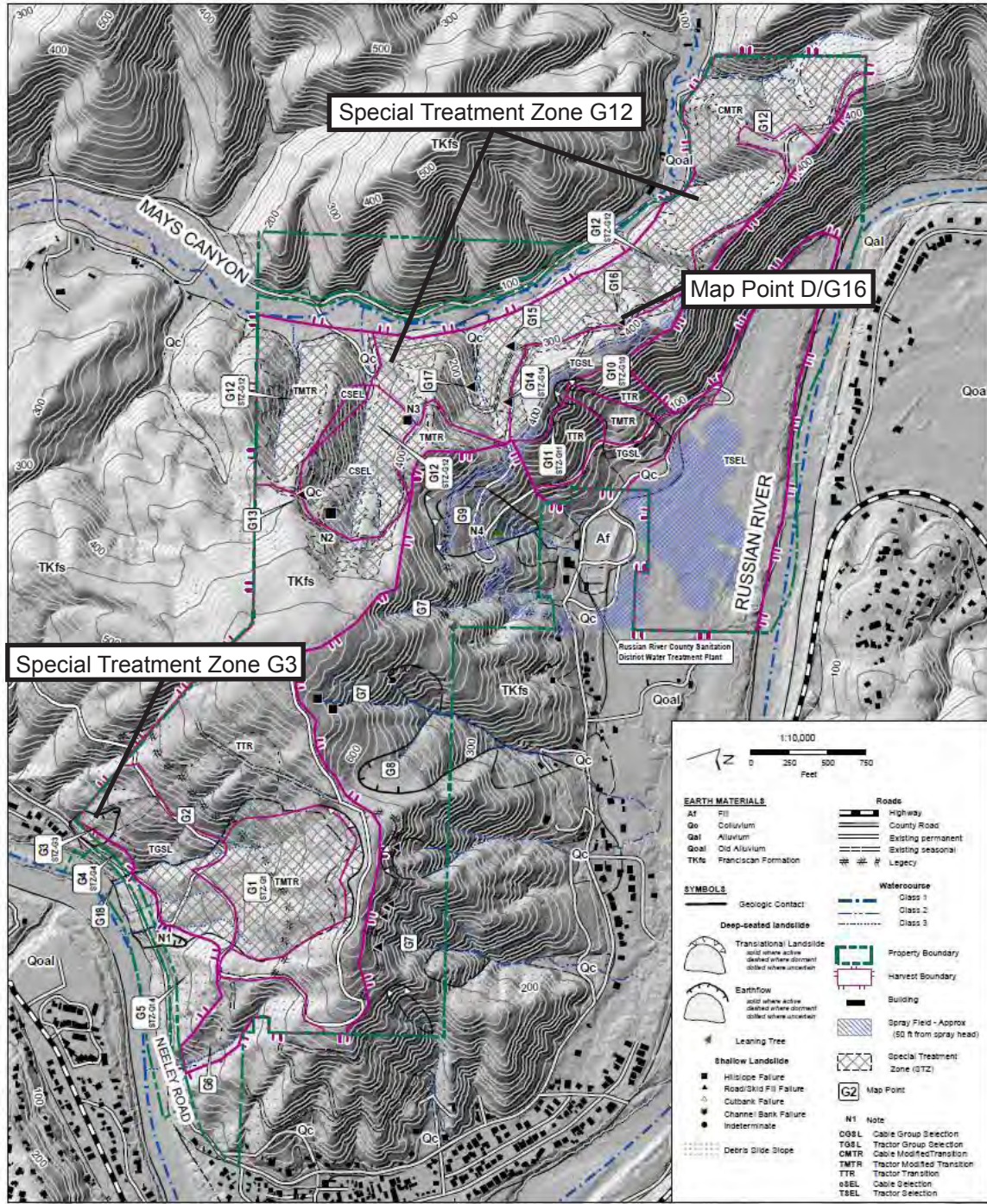
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GEOLOGIC AND LANDSLIDE LIDAR HILLSHADE MAP
SILVER ESTATES THP
 Redwood Empire, Sonoma County

FIGURE: 1
 Job: NCRM-SILVER-857
 Date: 06/11/2020

Base Map: Modified from Best, 2020, THP 1-20-00084, received via email

Date: Aug. 2020	Site-Specific Geologic Map To Accompany Engineering Geologic Review of THP 1-20-00084 SON	Figure: 3
Approved By:		
CGS		



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GEOLOGIC AND LANDSLIDE LIDAR HILLSHADE MAP
SILVER ESTATES THP
 Redwood Empire, Sonoma County

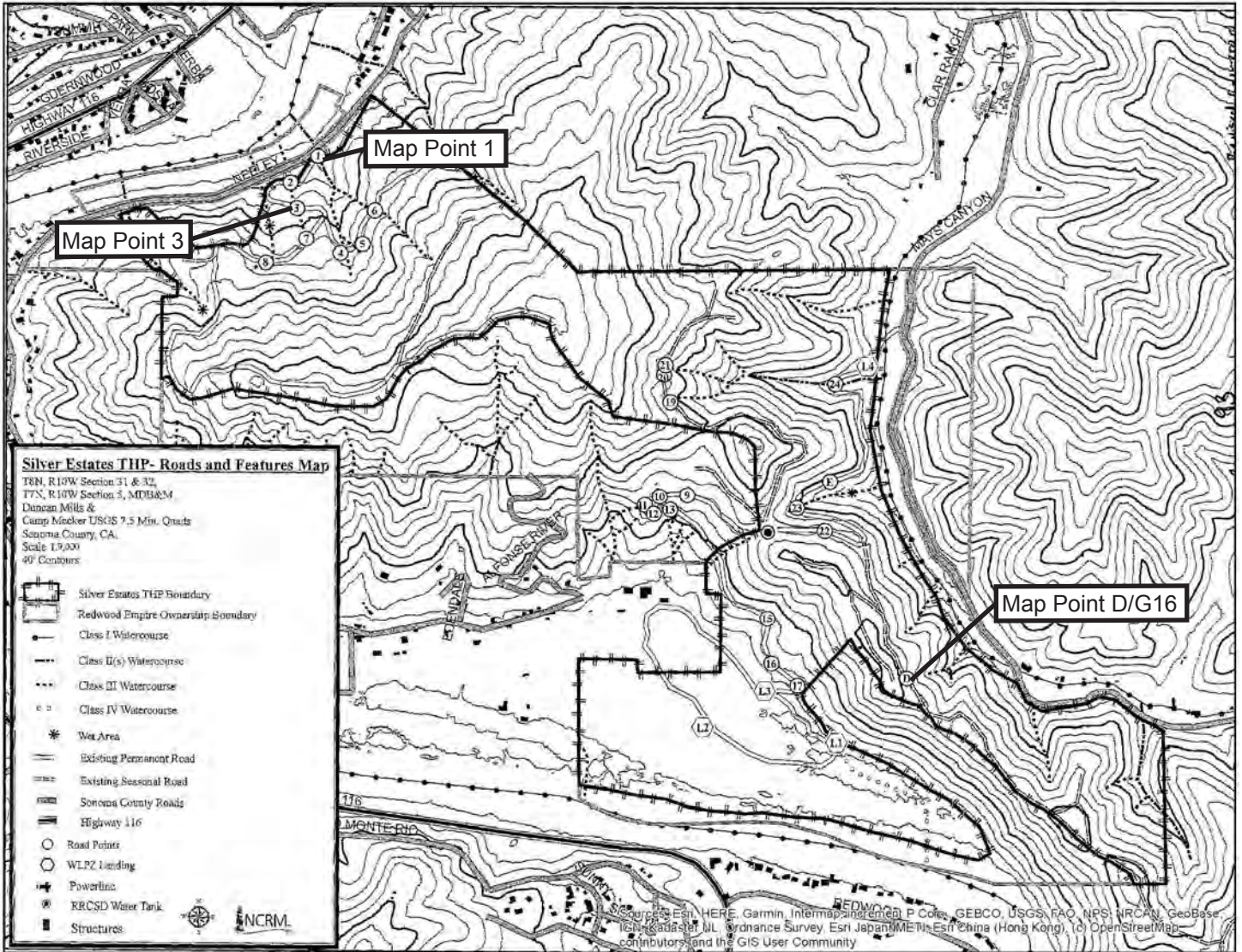
FIGURE: 2
 Job: NCRM-SILVER-857
 Date: 06/11/2020

Base Map: Modified from Best, 2020, THP 1-20-00084, received via email

Date: Aug. 2020
 Approved By:
 CGS

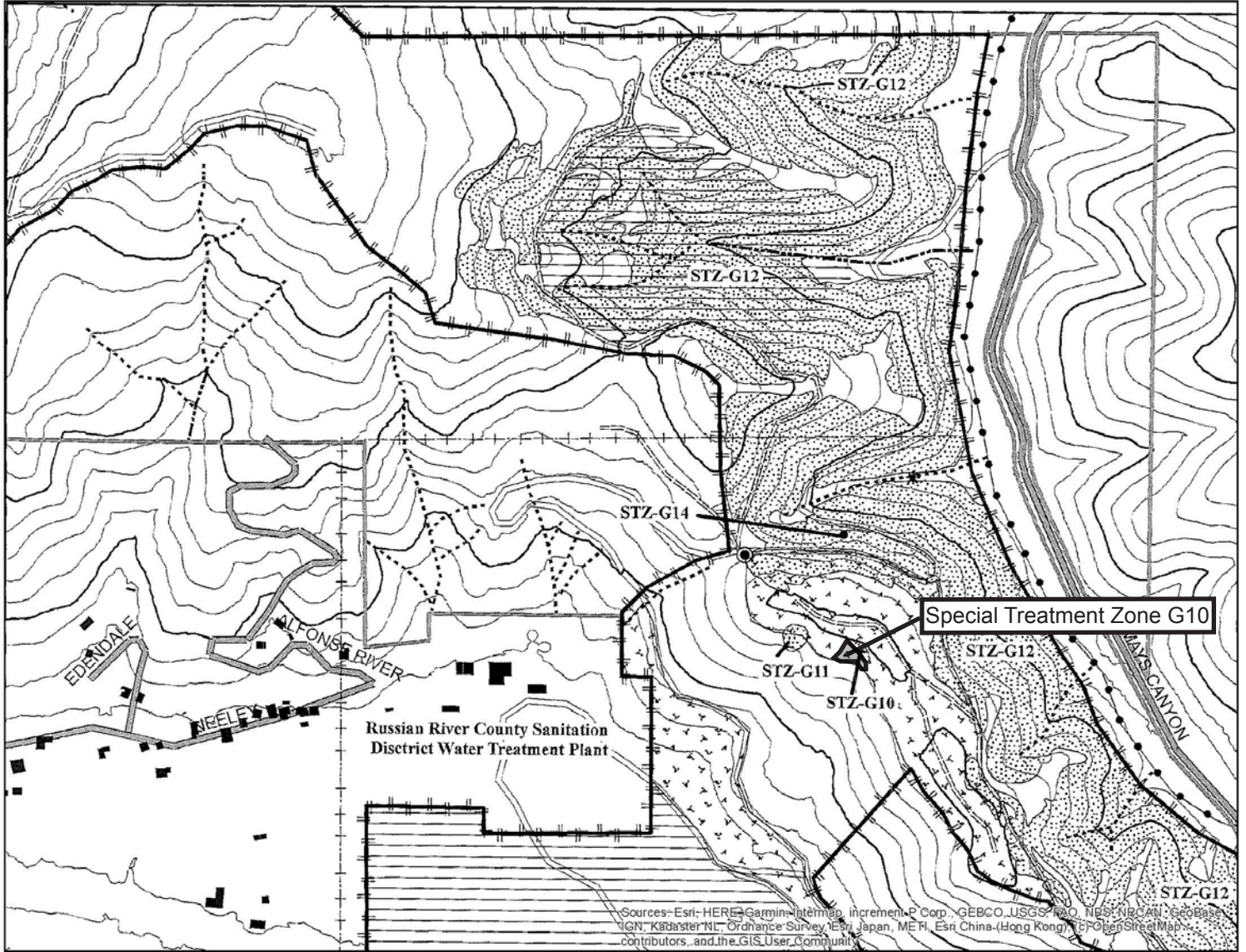
Site-Specific Geologic Lidar Map
 To Accompany
 Engineering Geologic Review of
 THP 1-20-00084 SON

Figure:
 4



Base Map: Modified from THP 1-20-00084, page 93

Date: Aug. 2020	<p>THP Operations Map To Accompany Engineering Geologic Review of THP 1-20-00084 SON</p>	<p>Figure: 5</p>
Approved By:		
CGS		



Base Map: Modified from THP 1-20-00084, page 91.1

Date: Aug. 2020

THP Silviculture Map
 To Accompany
 Engineering Geologic Review of
 THP 1-20-00084 SON

Approved By:
 CGS

Figure:
 6