Watershed Emergency Response Team (WERT)
2022 MOSQUITO FIRE

CA-TNF-001371

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California Department of Conservation
California Geological Survey

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Contents

Contents....3
2022 Mosquito Fire – WERT REPORT EXECUTIVE SUMMARY....5
Summary of the Key WERT Findings....6
Introduction....8
Background....8
Objectives and Scope....10
Physical Setting....10
Topography and Climate....10
Hydrology and Flood History....11
Modeling Post-Fire Response....18
Soil Burn Severity....18
Post-Fire Debris Flow: Predicted Thresholds and Hazards....18
Post-Fire Hydrology....22
Post-Fire Erosion....26
Model Accuracy and Limitations....28
VAR Observations and Discussion....29
Key Infrastructure....30
County Roads....30
Public Utility Districts....33
Placer County Water Agency....33
Georgetown Divide Public Utilities District....35
Temporary Housing....37
General Recommendations....38
Rainfall Thresholds....38
Early Warning Systems....38
National Weather Service Forecasting....39
Augmenting Existing Rain Gauge Networks....39
Refinement of Rainfall Thresholds....39
Wireless Emergency Alerts (WEA)....39
Emergency Alert System (EAS)....39
Integrated Public Alert and Warning System (IPAWS)....40
Education for Residents and General Public....40
Burned Structures....40
Increased Flood Flows, Erosion, Sedimentation, and Water Quality Impacts....40

Debris Flow Runout....41
Increased Rockfall....41
General Recommendations for Mine Sites:....41
Road Drainage Systems, Storm Monitoring, and Storm Maintenance....41
References....42
Appendix I – Mineral Hazards and Wells....45
Appendix II – Values at Risk Detailed Data....46

2022 Mosquito Fire – WERT REPORT EXECUTIVE SUMMARY

CA-TNF-001371 - WERT Evaluation

<u>Mission Statement</u>: The California Watershed Emergency Response Team (WERT) helps communities prepare after wildfire by rapidly documenting and communicating post-fire risks to life, property, and infrastructure posed by debris flow, flood, and rockfall hazards.

It should be noted that the findings included in this report are not intended to be fully comprehensive or conclusive, but rather to serve as a preliminary tool to assist Placer County and El Dorado County Offices of Emergency Services, CAL FIRE Nevada-Yuba-Placer Unit, CAL FIRE Amador-El Dorado Unit, local first responders, County Public Works, local Public Utility Districts, the California Governor's Office of Emergency Services, the United States Department of Agriculture Natural Resources Conservation Service, utility companies, and other responsible agencies and entities in the development of more detailed post-fire emergency response plans. It is intended that the agencies identified above will use the information presented in this report as a preliminary guide to complete their own more detailed evaluations, and to develop detailed emergency response plans and mitigations measures. This report should also be made available to local districts, residents, businesses, and property managers so that they may understand their proximity to hazard areas, and to guide their planning for precautionary measures as recommended and detailed in this document.

The Mosquito Fire started on September 6, 2022 near Oxbow Reservoir and Mosquito Ridge Road in Placer County. By the next day, the fire had rapidly grown in Placer County, and moved south into El Dorado County. The relatively large size of the fire (i.e., 120 square miles), the localized predominance of High and Moderate SBS in specific areas of the fire area that burned at a higher intensity, and the extremely steep slopes indicates that the Mosquito Fire area will likely be subject to post-fire hazards such as sediment laden flooding, debris flows, rockfall, and greatly increased erosion and sedimentation. Aerial imagery evidence and on-the-ground reporting from the 2014 King Fire burned area, in the same general location and upstream in the Rubicon River drainage, confirms that the area is subject to post-fire flooding, rock fall hazards and debris flows. Of note, the majority of the steepest locations within the burned area are non-populated, however public roads do traverse some of these slopes.

Due to the fire's proximity to residential areas and critical infrastructure, the burn area was evaluated by an interagency WERT. The WERT rapidly evaluated post-fire watershed conditions, identified potential **Values-at-Risk (VARs)** related to human life-safety, property, and infrastructure, and evaluated the potential for increased post-fire flooding, debris flows, rockfall, and erosion. The team also recommended potential emergency protection measures to help reduce the risks to those values.

Summary of the Key WERT Findings

- The degree of fire-induced damage to soil is called “soil burn severity” and is a primary influence on increased runoff and sediment generation, and the resultant occurrence of post-fire watershed hazards (e.g., debris flows and flooding). High and Moderate SBS typically create conditions conducive to the most impacts.
- The soil burn severity in the Mosquito Fire is nine percent (9%) High, twenty-five percent (25%) Moderate, fifty-nine percent (59%) Low, and seven percent (7%) Very Low/Unburned SBS.
- There are twenty-one (21) VARs identified within and downslope/downstream of the fire. Two (2) of the VARs are shown as polygons which encompass two linear features of concern (Gorman Ranch Road VAR GOR-1 and the Georgetown Divide Public Utilities District (GDPUD) canal VAR GDPUD-1). The remaining nineteen (19) VARs are points, which are associated with discrete VARs.
- The WERT did not locate any VARs that are exigent for life-safety risk, however the WERT cautions that the assessment is a rapid evaluation and the post-fire environment is dynamic and can be unpredictable.
- The county road network will likely be subject to extensive storm damage for the next 2 to 5 years. Specific crossing structures that provide access and egress were identified along road segment VAR GOR-1, as VARs GOR-2, GOR-3, GOR-4, GOR-5, GOR-6, GOR-7, and GOR-8 along Gorman Ranch County Road in Placer County.
- One (1) VAR, RES-2**,** is associated with a burned structure and associated house pads. Further evaluation of these sites is needed before residents erect or occupy temporary housing (e.g. trailers) on these sites.
- One (1) VAR, RES-1, is associated with a non-burned structure. Multiple potential issues were associated with this VAR and it is recommended a licensed resource professional and / or the County evaluate this site. This recommendation is made due to the number of potential issues with the property, even prior to the fire, and the potential of a mine adit draining into a pond that may be used for domestic purposes.
- Georgetown Public Utility District operates a community water supply ditch that serves approximately 10,000 constituents in El Dorado County. A significant portion of the ditch alignment is located in areas impacted by High and Moderate SBS, and was determined to be at an elevated risk of post-fire impact. The ditch alignment within the bounds of the fire was addressed as VAR GDPUD-1, and specific crossing and erosion related risks were addressed as VARs GDPUD-2, GDPUD-3, GDPUD-4, GDPUD-5, GDPUD-6 and GDPUD-7.
- Placer County Water Agency operates water and hydroelectric utility infrastructure within the burned area, specific risks to utility installations were addressed as VARs MOS-1, MOS-2, MOS-3 and MOS-4.
- Modeling results are presented for debris flow hazard, post-fire flooding, and surface erosion, the model results show the fire has significantly increased these hazards.
- The ERMiT post-fire surface erosion model predicts elevated surface erosion across the burned area due to the preponderance of moderate average erosion rates for the 2-year, 5-year and 10-year storm event, ranging from 3 to 20 tons per acre for the fire area, a potential increase of up to approximately 200% over background rates.
- The Placer County Water Agency should prepare for increased sedimentation in Oxbow Reservoir and Interbay Reservoir.

- To trigger the National Weather Service early warning system, WERT recommends a firewide rainfall threshold of 0.3 inches for 15-minutes, 0.5 inches for 30-minutes, and 0.7 inches for 60-minutes.
- Close coordination between Placer and El Dorado Counties Offices of Emergency Services, the National Weather Service, and local first responders will be necessary to effectively implement a response plan that will minimize risk.
- Residents potentially subject to post-fire hazards will need to have a clear understanding of these hazards, and mitigation strategies (e.g. evacuation, etc.), to effectively reduce risk to life and safety.
- General recommendations are contained herein to help further reduce risk from dispersed hazards throughout the burned area (e.g. rockfall hazards, etc.) along public roadways.

Introduction

Background

The Mosquito Fire started on September 6, 2022 near Oxbow Reservoir and Mosquito Ridge Road in Placer County. As of October 1, 2022, it was 76,754 Acres. The relatively large size of the fire (i.e., 120 square miles), the localized predominance of High and Moderate SBS in specific areas of the fire area that burned at a higher intensity, and the extremely steep slopes suggests that the Mosquito Fire area will likely be subject to post-fire hazards such as sediment laden flooding, debris flows, rockfall, and greatly increased erosion. While the majority of the steepest locations within the burned area are non-populated, past experience from the 2014 King Fire in the same general location confirms that the area is subject to post-fire flooding, rock fall, debris flows, erosion, and sedimentation, as evidenced in post-King Fire aerial imagery in the upper reaches of the Rubicon River.

A primary concern for burned watersheds is the increased potential for damaging sediment and debris-laden flood flows, increased potential for debris flow occurrence, rockfall from steep slopes, and hillslope erosion resulting in excessive sedimentation. As winter approaches, it is critical that people who live, and public agencies that control infrastructure, in and downstream from large wildfires implement emergency protection measures (EPMs) where appropriate, remain alert of weather conditions, and be ready to evacuate, if necessary, prior to National Weather Service flash flood watches and warnings. The fire area and upslope watersheds are also subject to atmospheric river and convective storm events (i.e., thunderstorms) which can generate localized heavy rainfall, run off and resultant post-fire hazards.

This report presents the results of a rapid evaluation of post-fire geologic and hydrologic hazards to life-safety and property (i.e., collectively known as “Values-at-Risk” or “VARs”) for private lands affected by the Mosquito Fire (Figure 1). Figure 1 shows the acreage and percentage of the burned area by ownership for the fire. Approximately 28 percent of the burned area is in private ownership. The Mosquito Fire WERT arrived on-site September 26, 2022 and left the field on September 29, 2022, with intermittent field visits afterwards as necessary to meet with local officials and review site specific locations with interested parties. A briefing providing the WERTs preliminary findings and VARs was conducted with local emergency response and county agencies on October 17, 2022. Team members for the Mosquito WERT are listed in Table 1.

Table 1. Mosquito Fire WERT members.

Name	Position	Agency	Expertise-Position
John Ramaley; RPF 2504	Team Lead	CAL FIRE	Forestry
Clay Allison; PG 9760	Co-Team Leader	CGS	Engineering Geology
Adjunct Team			
Deshawn Brown	Adjunct Member	CGS	GIS
Michael Falsetto	Adjunct Member	CGS	GIS
Will Olsen	Adjunct Member	CAL FIRE	Hydrology/GIS
Francesca Rohr	Adjunct Member	CAL FIRE	GIS

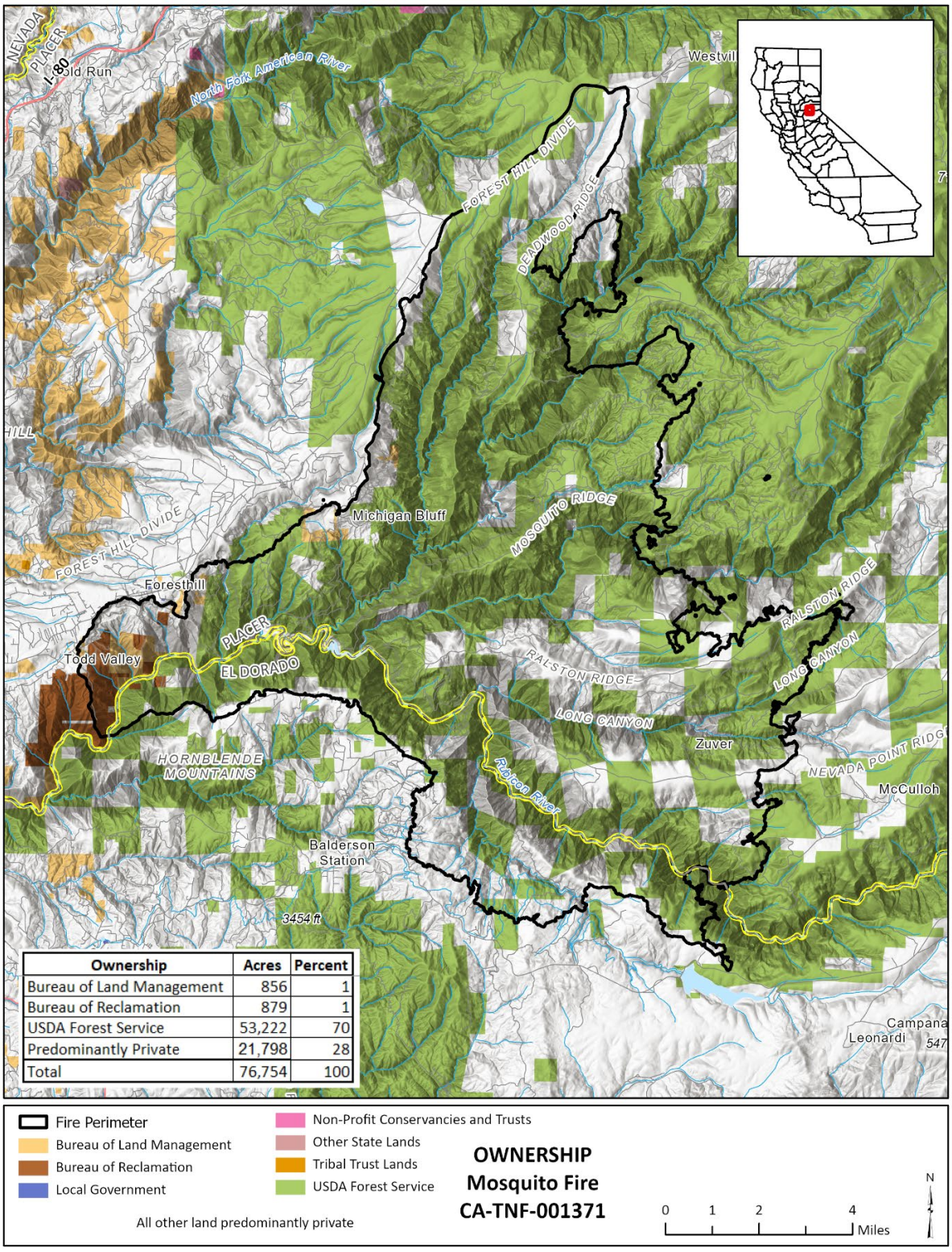


Figure 1. Ownership map of the Mosquito Fire burned area.

Objectives and Scope

Primary objectives for the WERT are to conduct a rapid preliminary assessment to:

- Identify types and locations of on-site and downstream threats to life-safety, property, and critical infrastructure (i.e., Values-at-Risk or VARs) from post-fire flooding, debris flows, rockfall, erosion, and other hazards that are elevated due to post-fire conditions.
- Determine relative risk to these values rapidly, using a combination of state-of-the-art analytical tools (e.g., post-fire debris flow likelihood model) and the best professional judgement of licensed geohazard professionals (i.e., Professional Geologists; Certified Engineering Geologists).
- Develop preliminary emergency protection measures needed to avoid or minimize life-safety and property threats.
- Communicate findings to responsible entities and affected parties, so that the information and intelligence collected by WERT can be used in response planning to reduce risk from post-fire watershed hazards.

It is important to emphasize that the WERT performs a rapid evaluation of post-fire hazards and risk. A complete characterization of post-fire hazards and/or in-depth design of protection measures is beyond the scope of the WERT evaluation. However, findings from the WERT evaluation can potentially be used to leverage emergency funds for emergency treatment implementation and more detailed site investigation and/or treatment design.

This document summarizes downslope/downstream Values-at-Risk (VARs) and makes specific and general recommendations to reduce life-safety and property exposure to post-fire hazards on state, county and private lands. **While the report can provide useful information to emergency planners and first responders, the GIS data, in the form of shapefiles and raster files, produced by the WERT is the most important source of information for post-fire response planning. Clear communication of life-safety and property hazards is an objective of the WERT process, and the use of these spatial data is a critical component for communicating hazards in a planning and operational context. These data have been shared with federal, state, and local responsible agencies.**

Physical Setting

Topography and Climate

The Mosquito Fire is located in the southern-most region of Placer County and the northern-most region of El Dorado County. The fire area is located mostly south and east-northeast of the town of Foresthill, CA and north of the community of Quintette along the Georgetown Divide. The fire area includes portions of the Rubicon River, Middle Fork American River, and the North Fork of the Middle Fork American River. The topography within and downstream/downslope of the fire is predominately very steep. The steepness of the slopes and the preponderance of US Forest Service ownership has limited residential construction to the broad flat ridges that border the fire perimeter. Elevations of the burned area range from approximately 1,000 feet near the Middle Fork American River (below the confluences of the North Fork Middle Fork and the Middle Fork of the American River and the Rubicon River) in the western end of the burned area, to a benchmark elevation of 5,406 feet along the Foresthill Divide near the site of Westville on the northeast of the fire.

Along with the aforementioned rivers, the burned area drains tributaries to the rivers via El Dorado Canyon, Peavine Creek, Brushy Canyon, Long Canyon, Skunk Canyon, Big and Little Grizzly Canyons, Pilot Creek and Volcano Canyon, as well as other smaller named and unnamed tributary streams.

The Mosquito Fire burned area is classified as having a Temperate Mediterranean Climate (Köppen Climate: Csb). Annual precipitation along Mosquito Ridge, approximate mid-point of the fire burned area, over the last 20 years ranges from a low of approximately 15 inches annually in 2013, to a high of 79 inches annually in 2017, with an average precipitation of 57 inches annually. This precipitation is primarily in the form of rain, rain/snow mixed as it is below 5,000 feet elevation. Snow is the primary precipitation in the highest elevations of the fire burned area.

Hydrology and Flood History

The Mosquito Fire burned area is primarily drained by the North Fork Middle Fork and the Middle Fork of the American River and the Rubicon River and tributary streams. These rivers are regulated by several upstream reservoirs, including Stumpy Meadows Reservoir (Mark Edson Dam) along Pilot Creek which drains into the Rubicon River, Hellhole Reservoir (Lower Hell Hole Dam) along the Rubicon River, and French Meadows Reservoir (L.L. Anderson Dam) along the Middle Fork American River. Smaller reservoirs, such as Duncan Creek and Oxbow, are not designed for flood control, as their main function is to provide domestic water and energy to local communities serviced by the Placer County Water Agency. Loon Lake is at the very head of the Rubicon River with only a small watershed above it to control and receives most of its' flow from the Buck-Loon Tunnel.

Two river gauges are located within the fire area. Gauge Site Number 11433300, is located on the Middle Fork American River, approximately 2 miles below Oxbow Reservoir, and 7 miles upstream from the lowest portion of the fire perimeter. This gauge has confirmed data from 1958 to present and lists the 1964 flood as the highest flow (estimated at 310,000 ft3/s). This occurred on December 23, 1964. The caveat to this very large storm flow is that the first Hell Hole Dam, a dam being constructed in the upper watershed at the time of the storm, failed on this same day, adding to the volume of flow. The second largest flow was the 1997 flood that caused substantial damage along the Sierra due to a rain on snow event. This flood flow was measured at 123,000 ft3/s. At this point in time, the flow had been regulated after the construction of the dams described below. The highest flow measured since the 1997 flood, was during the 2016/2017 winter, and on February 8, 2017, a flood flow of 67,200 ft3/s was recorded. This portion of the Middle Fork American River is regulated by the L.L Anderson Dam, which contains the French Meadows Reservoir, the Lower Hell Hole Dam, containing the Hell Hole Reservoir, and Mark Edson Dam, containing Stumpy Meadows Reservoir.

The second river gauge, Site Number 11427760, is located on the upper fire perimeter and is also on the Middle Fork American River, at the Interbay Reservoir near the power generation station for Placer County Water Agency (PCWA). This gauge has confirmed data from 1966 to present and lists the 1997 flood as the highest flow (13,900 ft3/s). The highest flow measured since the 1997 flood, was during the 2016/2017 winter, and on February 8, 2017, a flow of 6,620 ft3/s was recorded. Eleven miles upstream of this gauge, the Middle Fork American River is regulated by the L.L Anderson Dam, which contains the French Meadows Reservoir.

Vegetation and Fire History

The Mosquito Fire burned area primarily consists of coniferous forest in the northern exposure areas, and conifers in lessor amounts in the southern exposed areas, with shrub, hardwood forest and herbaceous vegetation types in the rockiest sites and in the southern exposed sites. The northern slopes provide denser coniferous canopy, and the more exposed southern slopes less overall coniferous canopy, or areas dominated by hardwood and brush species such as oak, manzanita, ceanothus, and annual grasses. Coniferous species range from Ponderosa Pine (located almost throughout the fire burned area, in differing amounts due to sun exposure and rock), Grey Pine in the lower elevations, or mixed with hardwoods in south exposed slopes, and mixed conifer in the upper elevations. Some of the southern slopes have also recovered at a slower rate from the 2007 Ralston Fire, which encompassed both sides of Mosquito Ridge and some north slopes along the Middle Fork American River, above Oxbow Reservoir. These south exposed areas are very rocky with a thinner soil mantle. The southern slopes of the Mosquito Fire that re-burned in the 2007 Ralston Fire, mostly burned at a low intensity, whereas a 700-acre portion of the north slopes along Mosquito Ridge that burned at a low intensity in the 2007 Ralston Fire suffered mostly moderate to high severity burn in the Mosquito Fire.

Fire history and lack thereof has influenced the vegetation types and the soil burn severity within the Mosquito Fire perimeter. Areas without recent fire activity potentially have a higher supply of readily erodible sediment than areas exposed to more frequent fire. This is because areas with more frequent fire have had soil exposed to several erosion events following fire. Areas that haven’t burned in the historic record have the potential to have a higher erosive response than other areas. The 2007 Ralston Fire discussed above is the largest fire within the Mosquito Fire footprint since 1960. Prior to the Ralston Fire, the 1960 Volcano Fire at 44,386 acres and the 1924 Deadwood Fire at 28,880 acres are the other known large fires that were primarily within the Mosquito Fire burned area.

A precipitation event over the Mosquito Fire burned area occurred from September 18 through September 20, 2022, with a recorded accumulation of 2.38 inches (BMT, USFS). The volume of precipitation was significant enough to essentially halt the progress of the fire and allow fire suppression efforts to take advantage of the moisture and bolster and construct containment lines. After September 18, 2022 only small increments in expansion of the fire occurred. As of September 18th, the fire had averaged an expansion of over 6,300 acres a day, and on September 19 and 20, the fire only gained 8 acres. VAR’s GOR-2 and GOR-3 show localized evidence of the rain event in the sediment that had been washed onto Gorman Ranch Road from the September 2022 rain event.

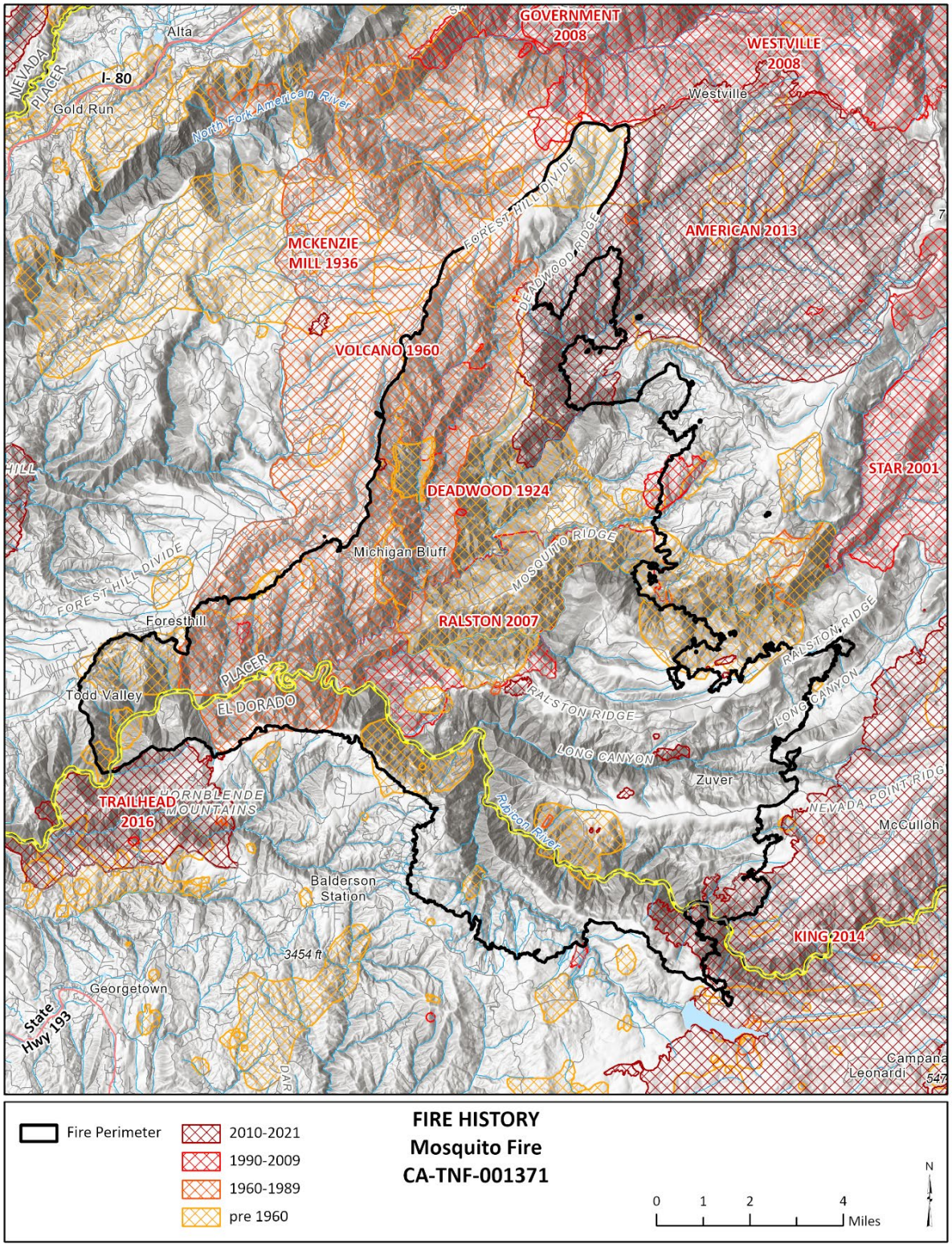


Figure 2. Fire history for the Mosquito Fire. Areas that haven't burned for many decades have a potentially higher erosional response than areas that have been subject to recent fires.

Geology and Landslides

The Mosquito Fire footprint is located within the Sierra Nevada Geomorphic Province (CGS, 2002). The approximate 400-mile-long tilted fault block of the Sierra Nevada is characterized by gentle western slopes, and a high, steep eastern face. Relatively gentle slopes and broad interfluvial ridges along the western flank of the Sierra Nevada are punctuated by steep, deeply incised, westerly trending rivers flanked by steep walled canyons, such as those present in the Middle Fork American River and Rubicon River Basins. Within the burned area the bedrock is generally comprised of; metamorphosed Paleozoic era (250 million to 540 million years) metasedimentary and metavolcanic rocks, Mesozoic era (65 million years to 250 million years) metasedimentary and metavolcanic rocks, Mesozoic era granitic batholiths and plutons, and Tertiary period (2.6 to 66 million years) gravels, tuffs, and volcanic lahar deposits. (Saucedo & Wagner, 1981; Wagner, 1981)

- Paleozoic aged Shoo Fly Complex (Pszfss) rocks composed of metamorphosed sedimentary mélange generally comprised of metasandstone, metasiltstone, and shale. Much of the unit is susceptible to rock fall hazards, where it is exposed in outcrops and road cuts along the steep slopes. Structural discontinuities, within the often-fissile formation, increase the prevalence of rock falls and landslide processes along adverse orientations, and steep slopes.
- Paleozoic aged peridotites (Pzp) of the Melones Fault zone and Calaveras Complex metavolcanic rocks (Pzcv) are present in the lower westerly elevations of the burned area, downstream of the Oxbow Reservoir. These rocks tend to be highly sheared, may be partially to completely serpentinized, and therefore may contain naturally-occurring asbestiform minerals.
- Mesozoic aged granitic rocks (Mzg/Jgr) and dioritic rocks (Mzd/KJdi) are mapped in downstream portions of the Rubicon Basin and Pilot Creek tributary. Mesozoic granitic rocks may be deeply weathered, resulting in granular sandy soil complexes with minimal cohesion. The highly weathered exposures and derivative soils may be prone to failure and potential mobilization in response to mechanical disturbances such as rainfall induced erosion, slope failure, or other types of significant ground surface disturbances.
- Tertiary aged volcanic rocks mantel many of the interfluvial ridge tops in the vicinity of the fire. These rocks are composed of Miocene-Pliocene aged volcanic rocks, consisting of andesitic pyroclastic flows (MPvap/Tm), overlying isolated exposures of Oligocene-Miocene aged tuffaceous volcanic rocks (OMv/Tvs), and Eocene aged Auriferous (gold bearing) Gravel deposits (Tg). These units have the potential to transmit shallow ground water laterally along unit contacts, and formation boundaries are often the locus of slope instabilities. The gold-bearing deposits (Tg) were also the focal point of historic hydraulic mining activities in the vicinity of the burned area, and numerous mining features are present along upper midslope settings within the Middle Fork American River Basin, and its tributaries. These anthropogenic features can be highly erosive, and suspectable to slope failures.

A map showing the regional geologic units is presented in (Figures 3a & 3b).

Review of LiDAR derived hillshade and field observations reveals a high density of landslide features within the steep river valleys in fire impacted basins. Observed slope morphologies indicate the presence of isolated and nested landslides, including shallow translational failures, and deep-seated rotational slide complexes. Furthermore, physical evidence of geomorphic

morphologies indicative of debris flow processes within the steep canyon settings were observed in many locations.

Review of satellite imagery depicts the occurrence of a large number of post-fire slope responses associated with the significant 2016-2017 wet weather season, within the 2014 King Fire burned area. Documented post-fire terrain responses related to intense post-fire run off, within the King Fire impact area along the South Fork Rubicon River Bain, appear to indicate the widespread mobilization of shallow slope failures and surface erosion that impacted many road alignments proximal to the burned area. Post-fire related erosion and shallow slope failures significantly impacted road alignments such as Blacksmith Flat Road and 11 Pines Road. Relatively recent slope remobilization, as of 2018/2019, has significantly blocked a segment of Blacksmith Road approximately 500 feet upstream of the PCWA Ralston Penstock Powerhouse, and was observed by the WERT during the field assessment.

The Mosquito Fire has a high density of mapped mine sites (Appendix I). Mine sites have the potential to contain physical hazards (e.g. shafts, adits, oversteepend slopes) and chemical hazards such as acid mine drainage, mercury from the prospecting and recovery process, and heavy metals from processed ore deposits. Serpentinite/ultramafic and fault shear zone rocks are also mapped within the burned area, these rocks may contain naturally-occurring asbestiform minerals. Asbestos is classified as a known human carcinogen by state, federal and international agencies and is regulated under Title 8 Section 1529 of the California Code of Regulations. State and federal health officials consider all types of asbestos to be hazardous. These areas of potential mineralogical hazards are mapped in Appendix I, but were not explicitly evaluated by the WERT.

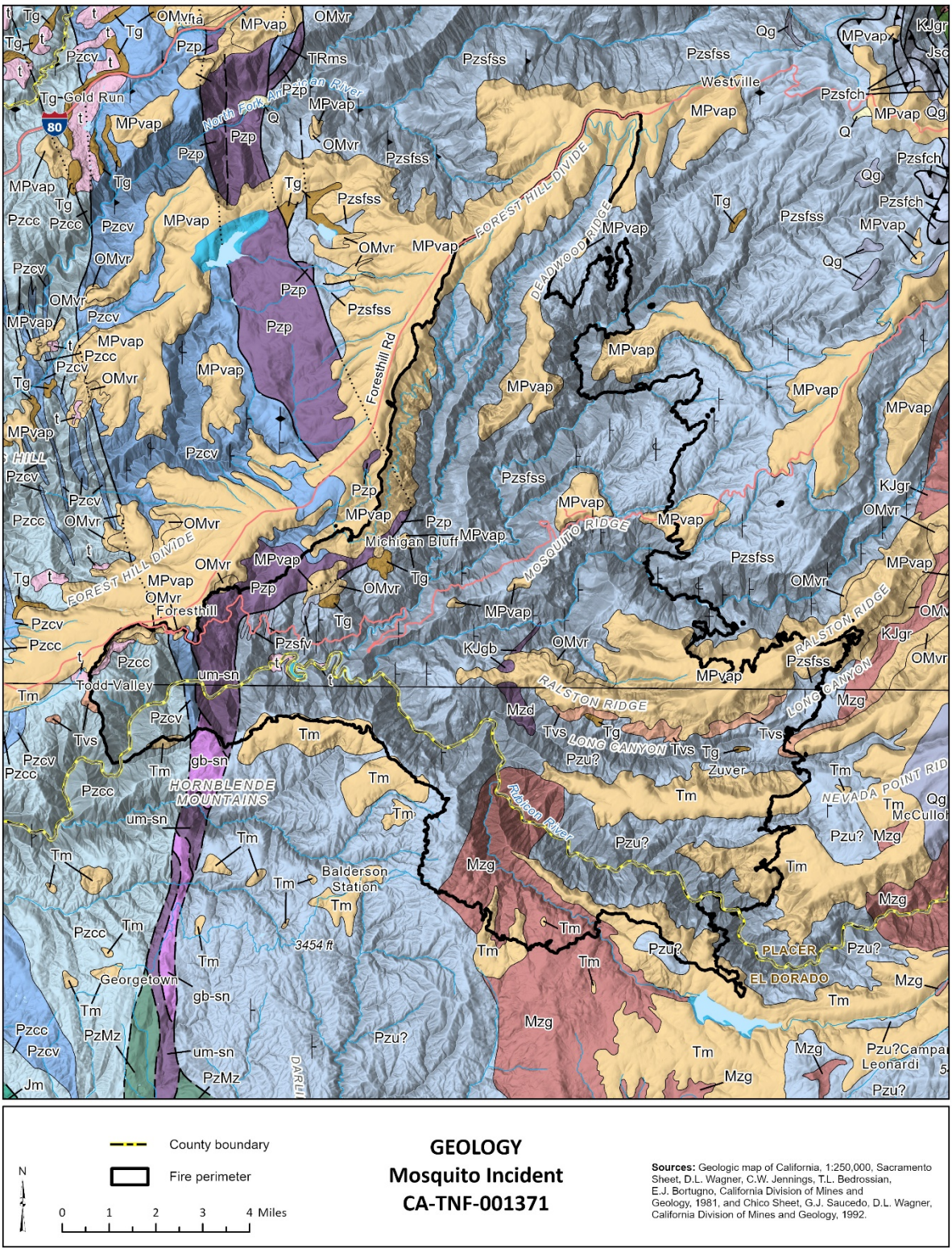


Figure 3a. Geologic map of the Mosquito Fire area.

Figure 3b. Legend for the Geologic Map in Figure 3a.

Modeling Post-Fire Response

Soil Burn Severity

Soil Burn Severity (SBS) was mapped by the USFS Mosquito Fire BAER Team. The Mosquito Fire burned area is characterized by a moderate proportion of High and Moderate SBS (Figure 5). Mapping within the Mosquito Fire footprint shows nine percent (9%) high, twenty-five percent (25%) moderate, fifty-nine percent (59%) low, and seven percent (7%) very low/unburned SBS. Locally concentrated areas impacted by High and Moderate SBS are present in several areas in the north central fire area including the Skunk Canyon Drainage and adjacent tributaries, and along Deadwood Ridge. The southern portions of the burned area contain a preponderance of High and Moderate SBS along generally steep north aspect slopes. This roughly 11,000-acre block contains the highest proportion of High and Moderate SBS within the burned area. These heavily burned areas have a significantly heightened potential for post-fire watershed responses.

Post-Fire Debris Flow: Predicted Thresholds and Hazards

The USGS post-fire debris flow hazard model (Staley et al., 2016) was run for the Mosquito Fire to assist in the WERT's assessment of locations where hazards to life, property, and infrastructure may exist. The 'combined hazard' model results reflect the potential likelihood of a debris flow occurring as well as the volumetric yield of the debris flow. These results are combined into an overall categorical ranking that ranges from Low to High. Figure 5 shows the combined debris flow hazard for the 24 mm/hr (0.94 in/hr) storm). Figure 5 indicates that the combined debris flow hazard is moderate to high for areas containing critical VARs at a rainfall intensity of 24 mm/hr. The highest combined debris flow hazard is for tributaries of Middle Fork American River and Rubicon River adjacent to and upgradient of Horseshoe Bar (Figure 7), portions of the North Fork of the Middle Fork American River and downstream portions of the West Branch El Dorado Canyon. In general, the Middle Fork American River basin has a moderate combined debris flow hazard, within the portion of the burned area upstream of the confluence of the Rubicon River, and downstream Horseshoe Bar.

Figure 6 shows the predicted 15-minute rainfall intensities necessary to have a 50 percent probability of triggering a debris flow. Rainfall rates necessary to trigger a debris flow with 50 percent probability of occurring were predicted as low as 12 to 16 mm/hr (0.47 to 0.63 in/hr) in the steepest and most severely burned basins, and as high as 40 mm/hr (1.57 in/hr) in the northeastern portion of the fire.

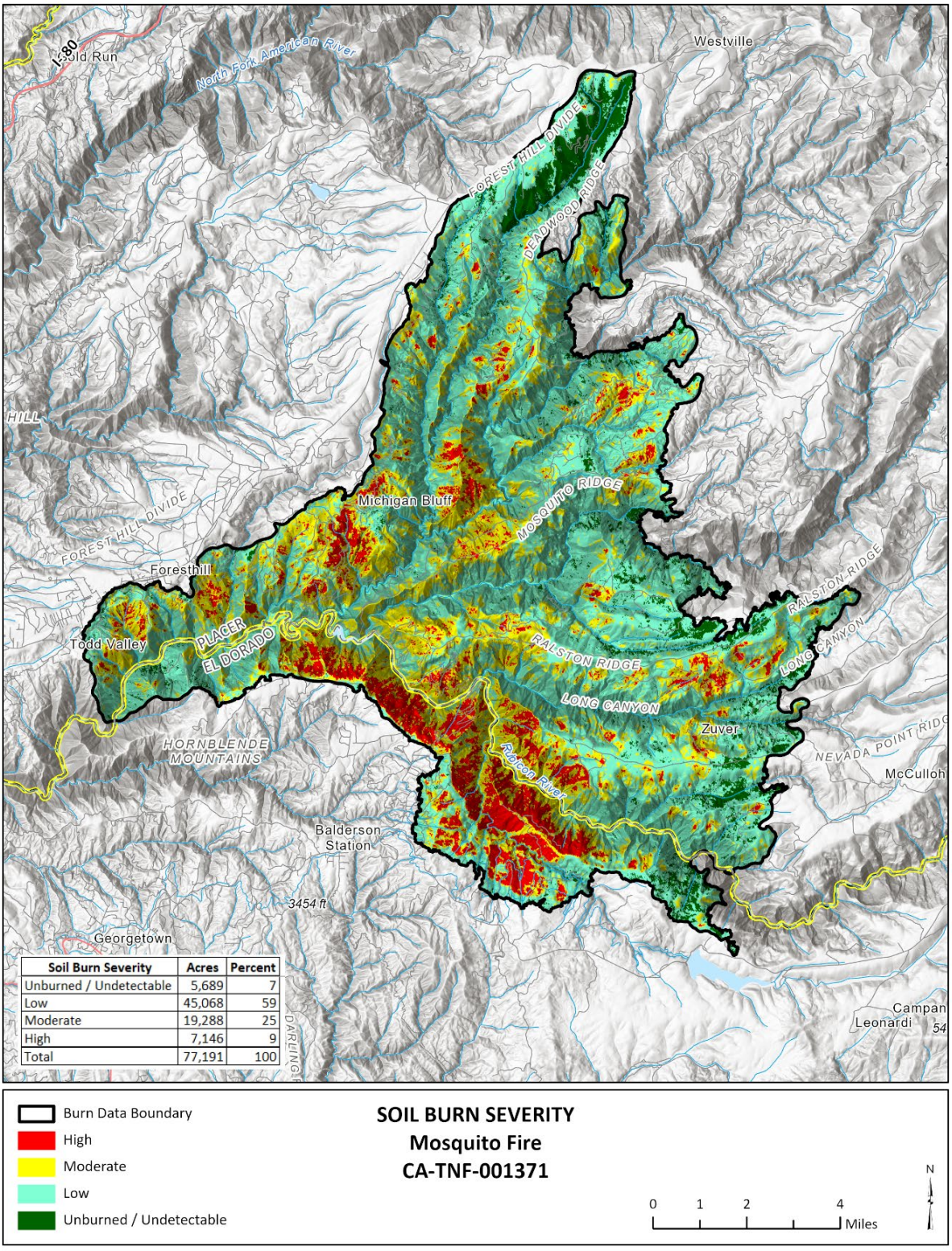


Figure 4. Soil Burn Severity (SBS) map for the Mosquito Fire.

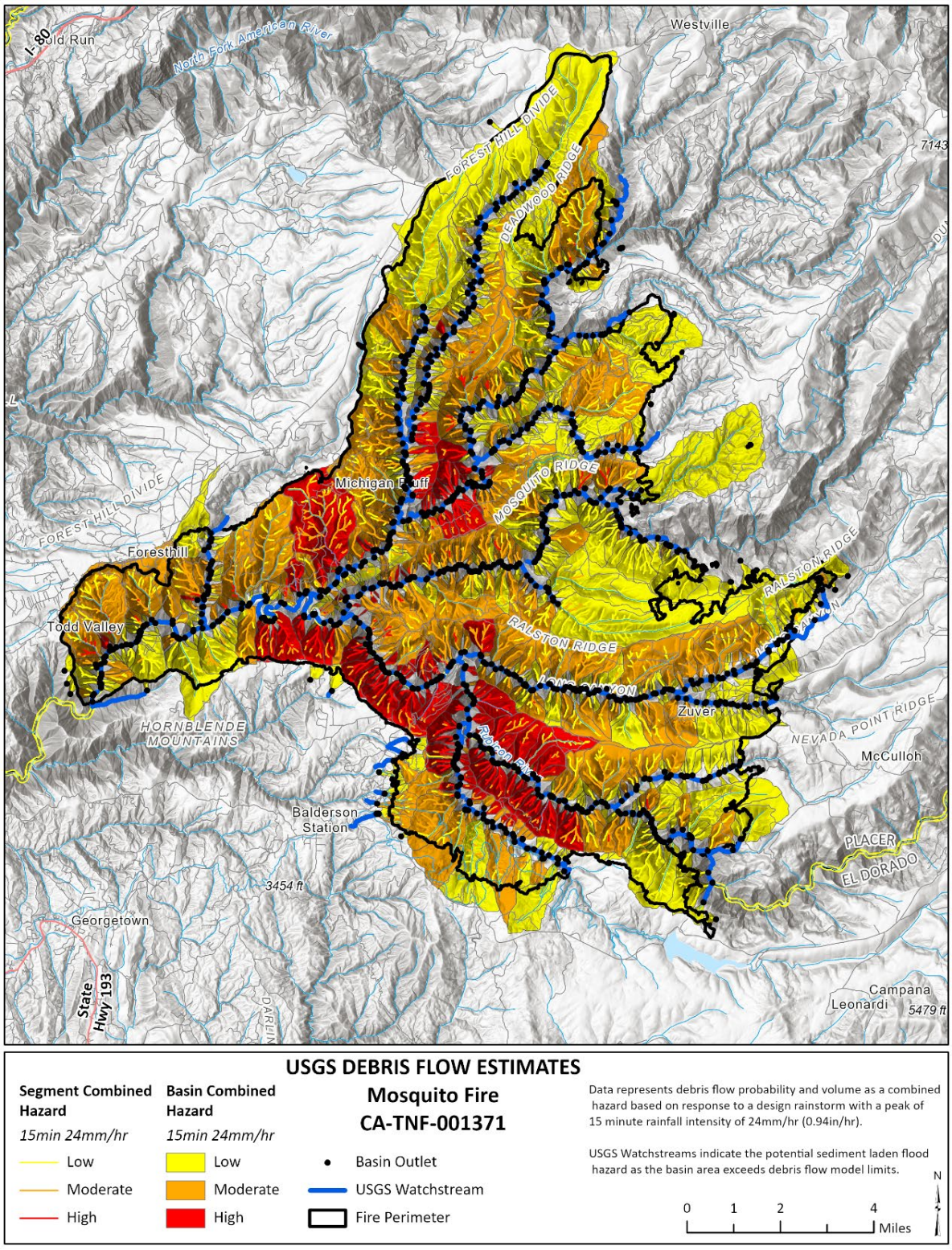


Figure 5. Combined Debris Flow Hazard on the Mosquito Fire for the 24 mm/hr (0.94 in/hr) 15-minute storm event.

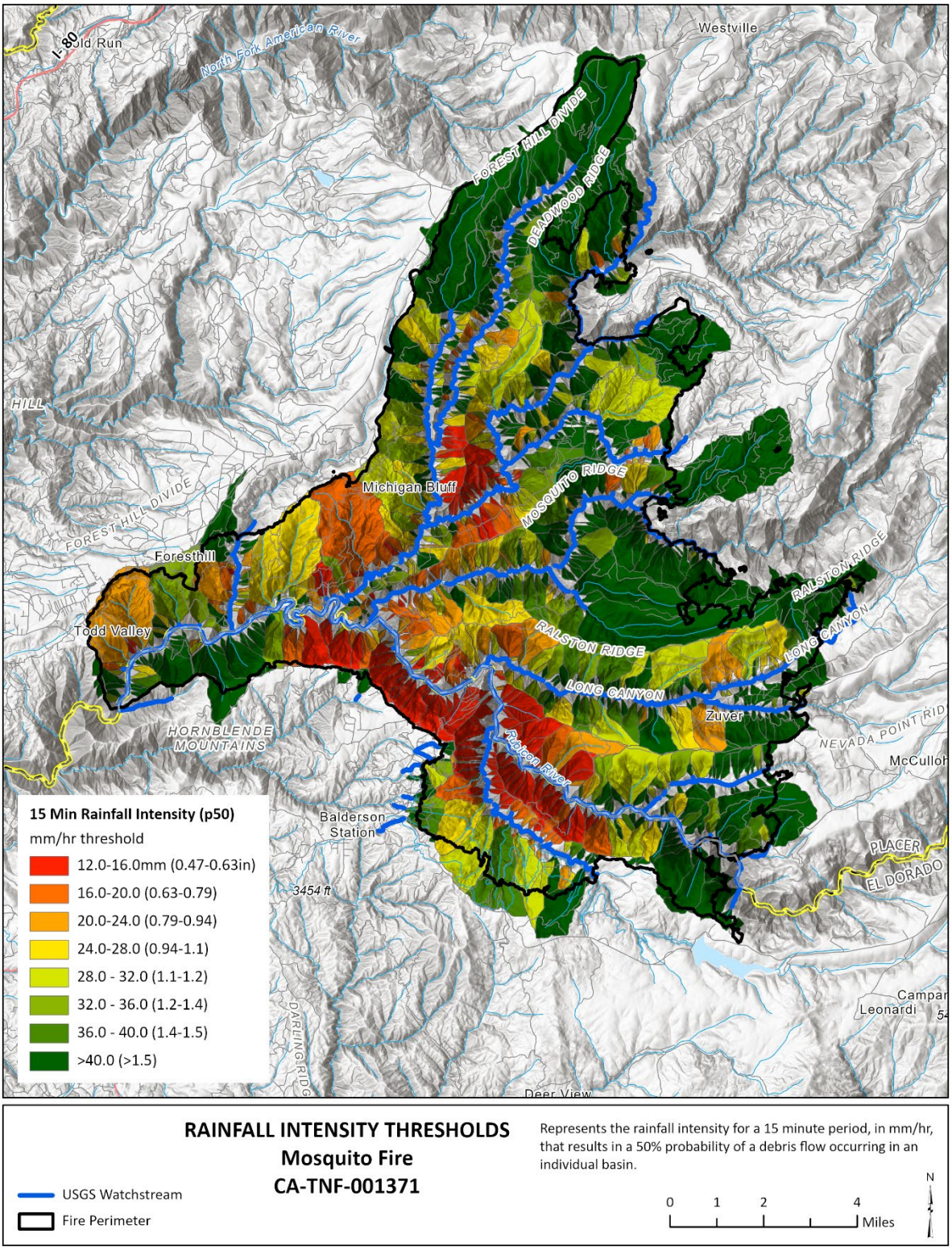


Figure 6. Predicted 15-minute Rainfall Intensity with a 50 percent probability of triggering a debris flow for the Mosquito Fire.

Post-Fire Hydrology

Peak flows increase following wildfire as a result of reduced vegetation, surface cover, reduced infiltration, and the formation of water repellent soils. The largest peaks occur during intense, short duration rainfall events on watersheds with steep slopes (Neary et al., 2005). Research conducted in southern California indicates that post-fire peak flows can increase as much as 10- to 30-fold for low-magnitude storms over small basins and approximately 2- to 3-fold for larger magnitude storms over large basins (Rowe et al., 1949; Moody and Martin, 2001). The WERT selected four (4) watersheds, or "Pour Points", to evaluate potential post-fire peak flow increases to Values-at-Risk (VARs) from flooding and sediment-laden flood hazard. The WERT focused the post-fire run-off analyses that are reflective of the post-fire watershed response at a basin level to interpret potential impacts to VARs located on mainstem drainages and the potential for post-fire runoff impacts to downstream areas. The BAER team performed post-fire peak flow analyses focused on smaller tributary basins within the burned area that pose potential risks to USFS assets. Readers should refer to the BAER team report for pour point data associated with smaller tributary basins throughout the burned area.

The WERT designated four (4) Pour Points, which are placed to determine relative hydrologic changes in the main river systems, one at the mouth of the North Fork of the Middle Fork American River, one on the main-stem of the Middle Fork American River at the furthest downstream extent of the fire area, one on the Middle Fork American River immediately upstream of the Oxbow Reservoir and associated infrastructure, and one on the Rubicon River, (Figures 7 and 8). These pour points represent relative elevated flood hazard and/or debris flow impacts to public safety, property, and infrastructure along the Middle Fork American River and its main tributaries.

Flows within the Middle Fork of the American River and Rubicon River are substantially influenced by an extensive network of infrastructure used to control runoff for power generation. See Figure 12 for a relative view of PCWA infrastructure distribution throughout the Middle Fork American River Watershed. The presence of significantly controlled flows, coupled with the large size of the watersheds above each pour point make it difficult to quantify the fire-induced increases in runoff and sediment and debris loading via traditional hydrologic calculation methods. The existing constraints to modeling are such that bulked flow estimates would not likely account for the existing anthropogenic flow constraints, and outputs would not be reflective of potential impacts to VARs along the mainstem drainages within the burned area. As a result, the WERT performed a qualitative assessment of potential impacts at each pour point utilizing GIS analysis derived post-fire run-off statistical values.

Pour Point 1 – North Fork of the Middle Fork of the American River. This pour point captures the watershed area that drains into the North Fork of the Middle Fork of the American River above Pour Point 1. This watershed is not regulated by any flood control dams. Approximately 13% (7,911 acres) of the catchment (59,039 acres) was burned at High to Moderate SBS. Local impacts, particularly along segments of channels that are immediately downslope of areas burned at High to Moderate SBS will likely be subject to increased runoff, sediment and debris loading, and debris flow potential. These impacts at the geographically localized resolution will attenuate downstream over distance, but could result in low to moderate impacts to the Middle Fork American River.

Pour Point 2 – Middle Fork of the American River. This pour point captures the watershed area that drains into the Middle Fork of the American River above Pour Point 2. This watershed is

regulated by the L.L. Anderson Dam (French Meadows Reservoir) and other PCWA hydroelectric infrastructure. Approximately 4% (2,458 acres) of the catchment (70,959 acres) was burned at High to Moderate SBS. Local impacts, particularly along segments of channels that are immediately downslope of areas burned at High to Moderate SBS will be subject to increased runoff, sediment and debris loading, and debris flow potential. These impacts at the local level will likely attenuate downstream, but could result in increased sediment and woody debris impacting the Oxbow Reservoir and associated PCWA infrastructure. The Lowell P Stephenson Powerplant and the Interbay Reservoir are located on the edge of the fire perimeter. A segment of generally Low SBS, along north aspect slopes, upslope of the utility installation may lead to increased rates of sedimentation within the small reservoir.

Pour Point 3 – Rubicon River. This pour point captures the watershed area that drains into the Rubicon River above Pour Point 3. This watershed is regulated by the Lower Hell Hole Dam (Hell Hole Reservoir) and the Mark Edson Dam (Stumpy Meadows Reservoir). Approximately 6% (11,631 acres) of the catchment (202,215 acres) was burned at High and Moderate SBS. Local impacts, particularly along segments of channels that are immediately downslope of areas burned at High and Moderate SBS will be subject to increased runoff, sediment and debris loading, and debris flow potential. Because numerous steep slopes burned at High and Moderate SBS are perched immediately upslope of the Rubicon River in the vicinity of the Oxbow Reservoir and the Ralston Penstock Powerhouse. The reservoir and associated hydroelectric utility infrastructure is at an elevated risk of adverse impact from post-fire related sediment-laden flood hazards and debris.

Pour Point 4 – Middle Fork of the American River. This pour point captures the entirety of the upstream catchment that drains to an area approximately 4.75 miles below Pour Point 1. This includes the same upper watershed boundaries as discussed in Pour Points 1 – 3 above, plus additional acreage within and outside the fire perimeter, toward the lower end of the fire. Approximately 8% (26,298 acres) of the catchment (347,776 acres) was burned at High and Moderate SBS. This pour point is partly influenced by hydrologic controls present above Pour Points 2 and 3. Impacts immediately downslope of steep slopes burned at High and Moderate SBS are likely to impact segments of the Middle Fork American River. Compounding impacts to downgradient areas in response to locally bulked flows are anticipated to attenuate downstream of the burned area, as the volume of unburned contributing drainages within the Middle Fork American River Basin, and American River Basin systems increase. These impacts will likely disperse and attenuate downstream, but may result in low to moderate increases in sediment and woody debris loading extending downstream of Pour Point 4.

These estimates are intended for emergency response planning purposes only and are not to be used for design. Moreover, they are most appropriately applied to flows within the first year following the fire, or until ground cover within the burned area is well established. As knowledge is obtained through monitoring the runoff response of stressing storms in the first wet season after fire, or as the slopes in the watersheds become revegetated, these flow multipliers may need to be adjusted either up or down.

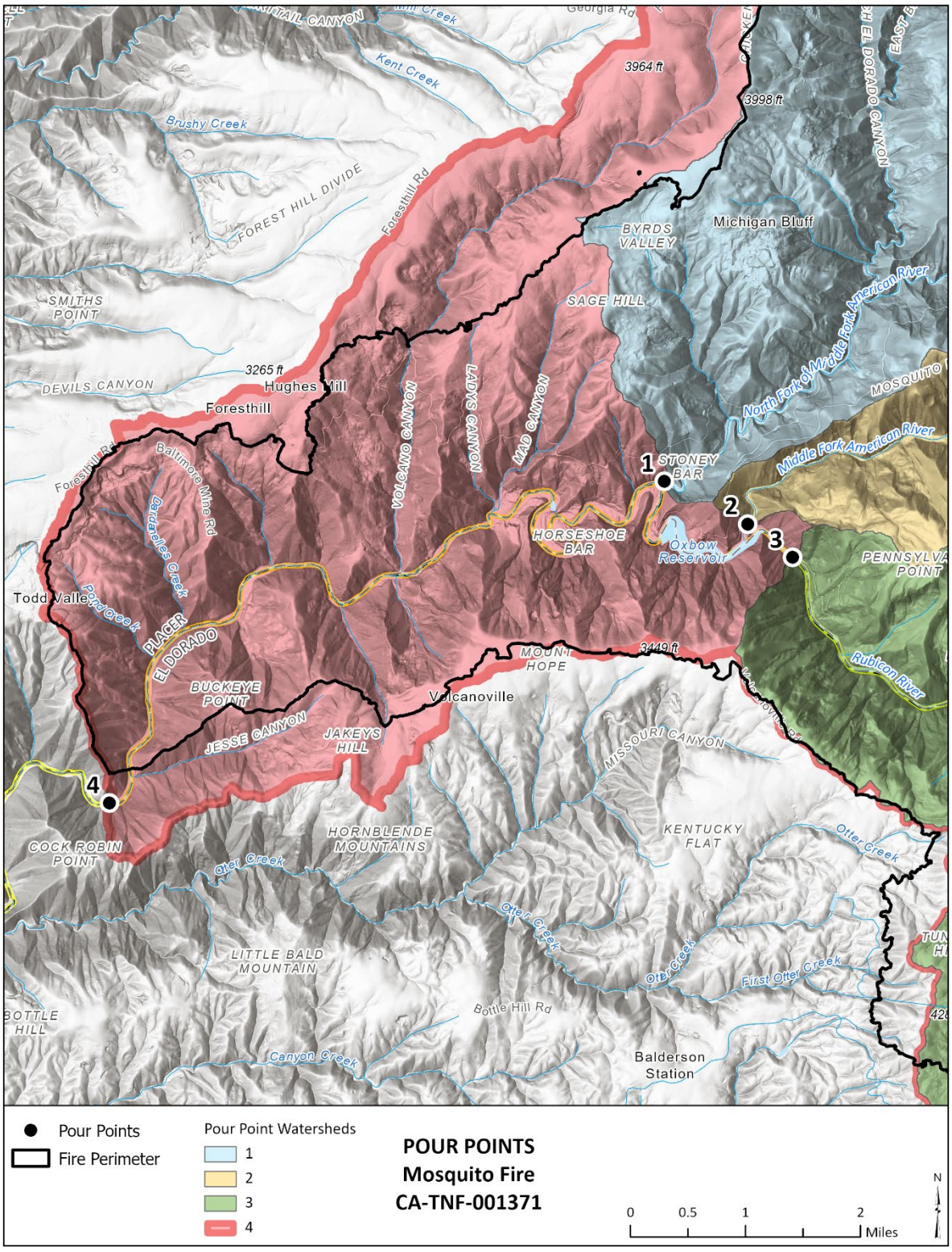


Figure 7. Map of the 4 Pour Point locations.

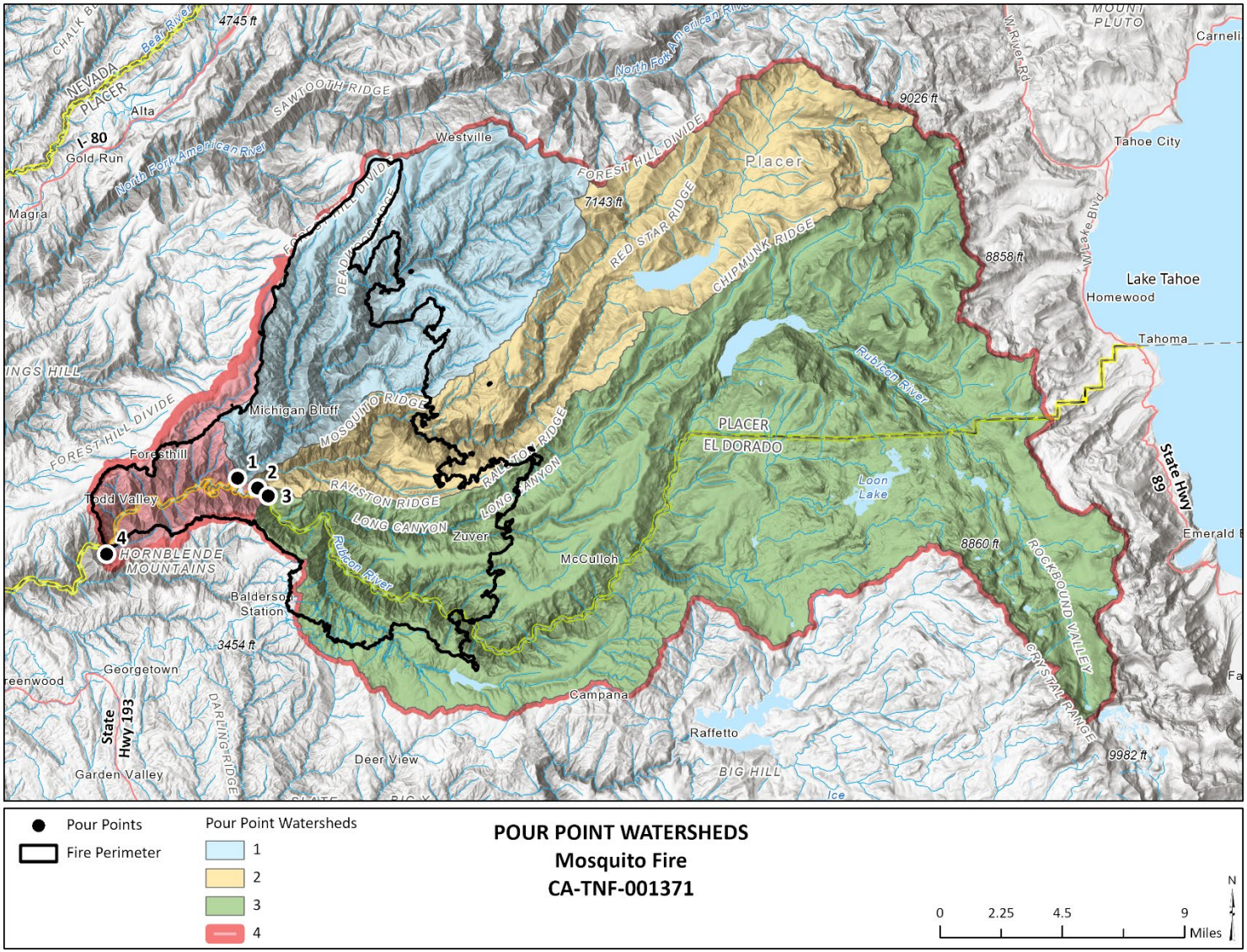


Figure 8. Watershed view of the 4 Pour Point locations within and downstream of the Mosquito Fire burned area.

Post-Fire Erosion

Fire typically increases surface erosion rates by one or more orders of magnitude over unburned erosion rates, and the magnitude of increase is dependent upon fire severity, rainfall depth and intensity, slope, and soil properties. Post-fire surface erosion is predicted for the 2-year, 5-year and 10-year storm using the Erosion Risk Management Tool (ERMiT) generated by the USFS Rocky Mountain Research Station. USFS BAER soil scientists performed the initial model run, predicting soil erosion as a 10-m raster file. WERT spatially averaged these predictions into hillslope and/or sub-catchments to better identify erosional hotspots within the burned area. The literature also indicates that spatially averaged predictions for post-fire erosion more closely reflect field measured erosion rates (Larsen and MacDonald, 2007). Based on a comparison of unburned basins in the vicinity of the fire area, post-fire erosion rates may increase by up to approximately 200% more than background rates. For the 2-year storm, ERMiT generally predicts erosion between 3 and 10 tons per acre (Figure 9), an increase of approximately two to three times background erosion rates. For the 5-year storm, ERMiT generally predicts erosion between 5 and 15 tons per acre for the majority of the burned area (Figure 10). For the 10-year storm, ERMiT generally predicts erosion between 10 and 20 tons per acre for the majority of the burned area (Figure 11), an increase of approximately two to three times background erosion rates.

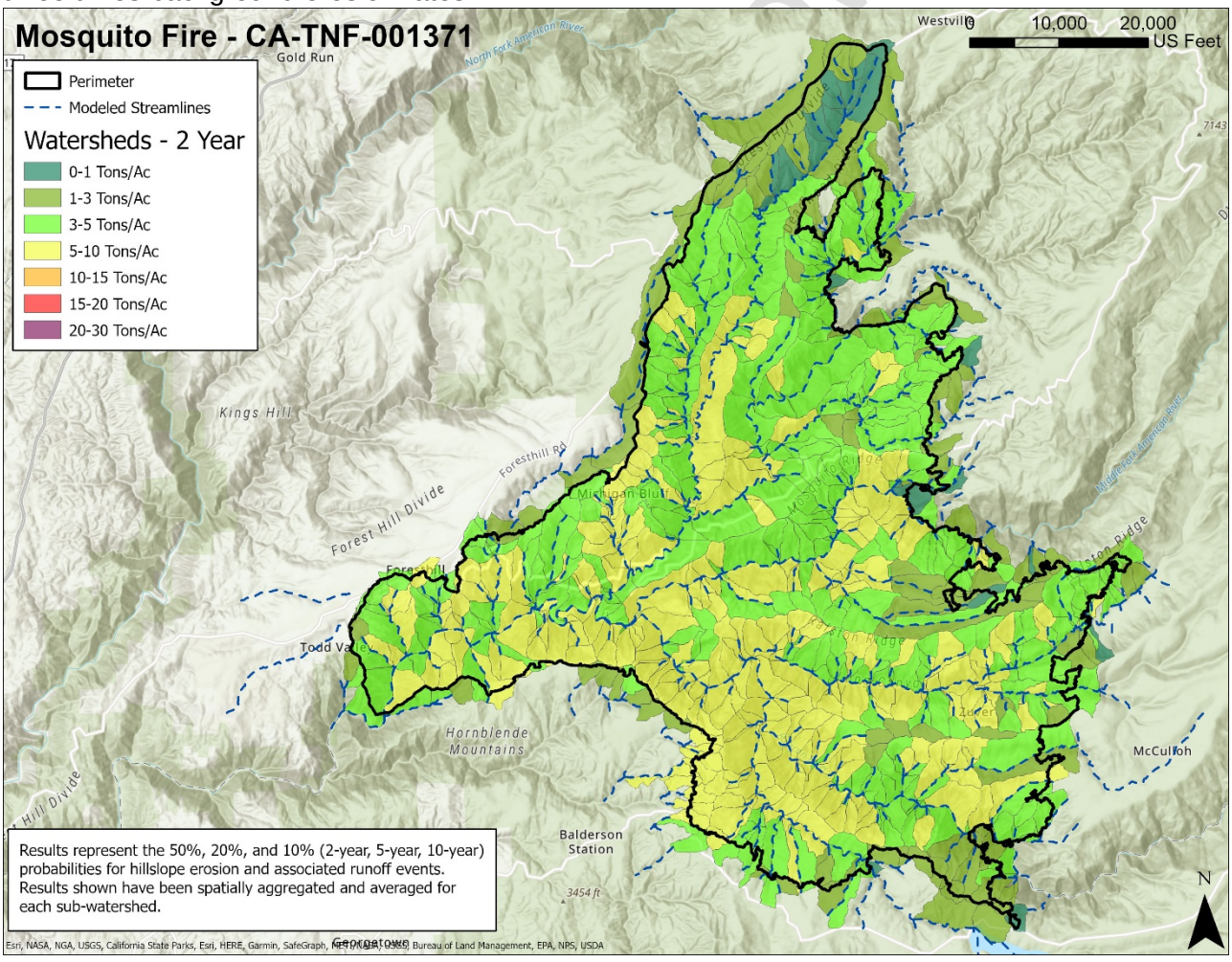


Figure 9. ERMiT predicted surface erosion for the 2-year storm event on the Mosquito Fire.

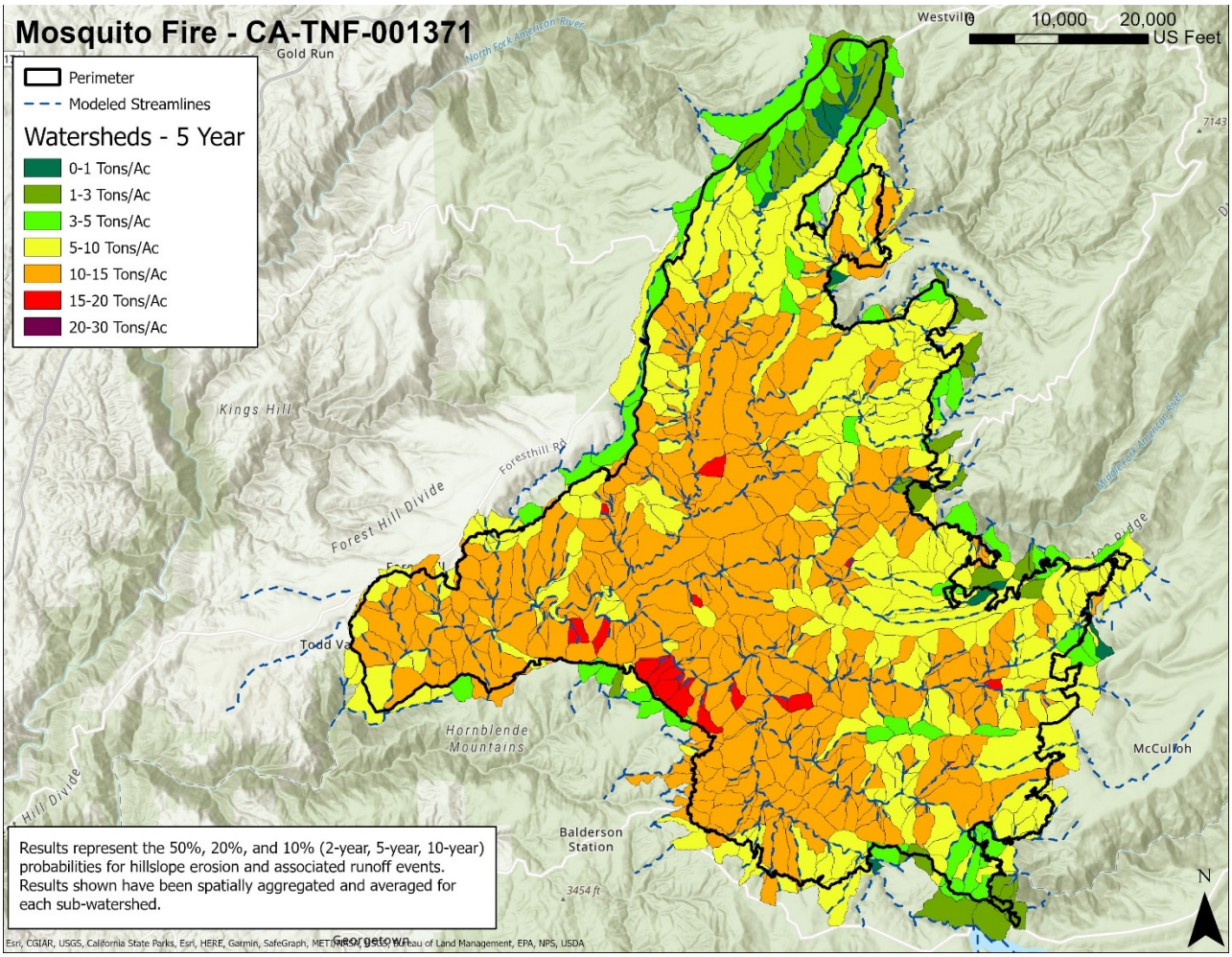


Figure 10. ERMiT predicted surface erosion for the 5-year storm event on the Mosquito Fire.

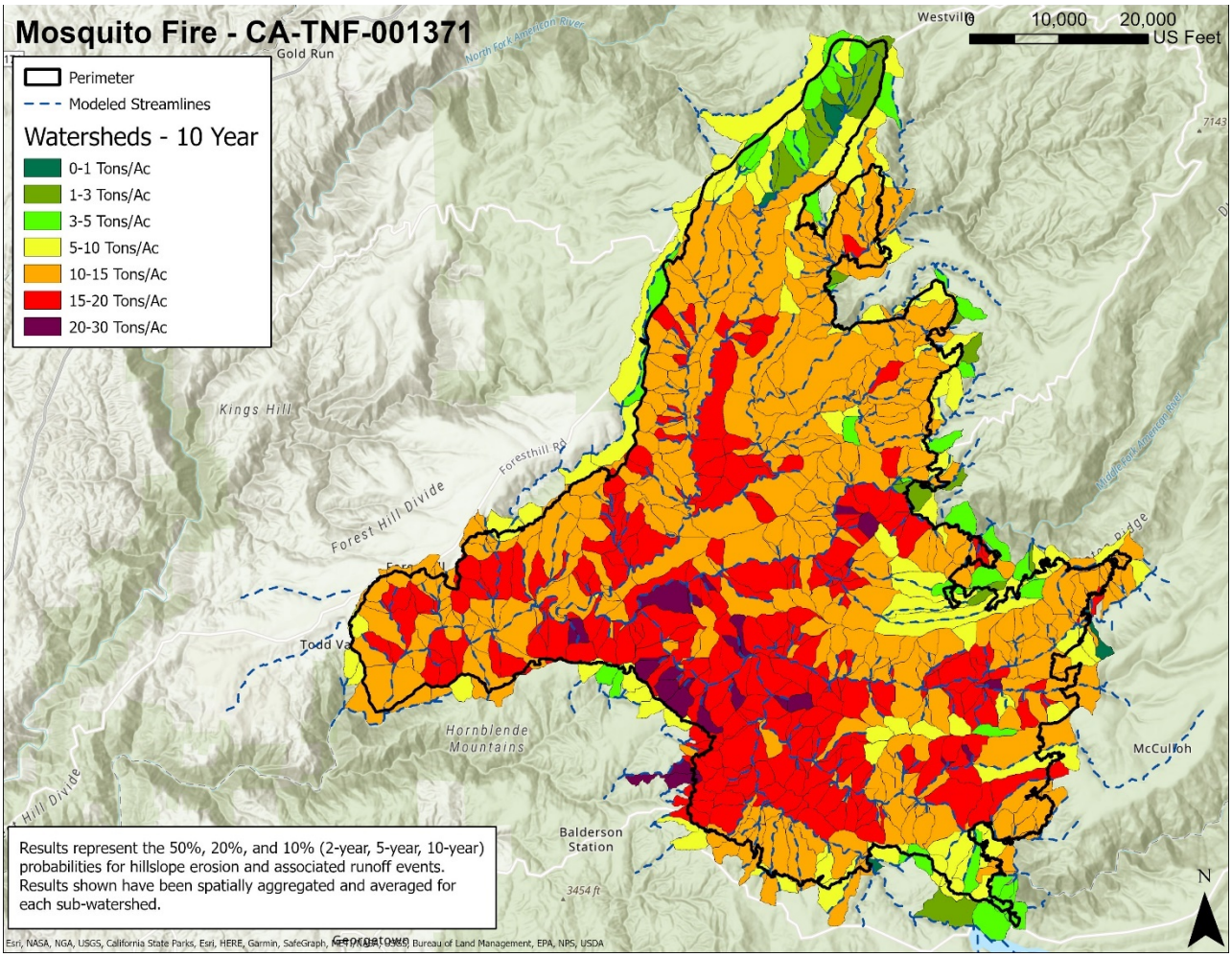


Figure 11. ERMiT predicted surface erosion for the 10-year storm event on the Mosquito Fire.

Model Accuracy and Limitations

For catchments (sub-watersheds) burned in the Mosquito Fire, the results of the USGS debris flow model (Staley et al., 2016) give an indication of potential post-fire watershed response, but may not accurately predict debris flow likelihood or volume for a given design storm. It is important to note that the dataset used to develop the USGS model is from southern California. However, channels modeled with the highest combined debris flow hazard will generally have the highest degree of post-fire response.

The USGS model results do not constitute a site-specific analysis of debris flow hazards. Additional on-the-ground evaluation should be conducted by qualified and licensed professionals where necessary and appropriate, rather than taking the model results at face value. The model results are also limited in that they do not show hazards for basins that are less than approximately five (5) acres in area, and do not specifically identify hazards in areas where one or more tributaries may contribute flood and debris flows (watch segments). Therefore, hazards can exist in burned areas that do not show a modeled result. Similarly, for areas not shown as having a segment debris flow hazard associated with a drainage network, a hazard may still be present yet undefined, because the segment model results are limited based on the resolution of the input digital elevation model (DEM), in this case a 10-meter synthetic DEM. Additionally, other hillslope

processes such as rockfalls, debris slides, and deep-seated landslides are not included in the model results.

Post-fire flood flow prediction is difficult, due to the general lack of measured post-fire flood flows that can be used for model calibration and/or validation, as well as the factors such as the controlled flows from upstream reservoirs. In general, our flood flow prediction tools have been found to underpredict actual post-fire flood flows (Wilder et al. 2020).

Similarly, ERMiT was used by the WERT to evaluate the relative magnitude of increased erosion following wildfire. ERMiT performs best when site-specifically calibrated, only a cursory calibration was performed for this analysis.

VAR Observations and Discussion

This evaluation is not intended to be comprehensive and/or conclusive, and additional VARs may be identified through more detailed evaluation by responsible agencies. This includes more detailed site investigation for the development and design of appropriate mitigation measures. Several limitations include:

- VARs were not evaluated on USFS lands, with the exception of the portions of USFS lands that contained the Georgetown Divide Public Utilities District Ditch and Gorman Ranch Road, which is a public road maintained by Placer County. Other evaluations of VARs on USFS lands were performed by the USFS BAER team. Readers are referred to the BAER team for those results.
- Not all public roadway culverts and bridges in, adjacent, and downstream of the burned area were evaluated.
- VAR evaluation was not conducted within all mapped flood hazard areas that are downstream of the burn perimeter. Risk of flooding in these areas is preexisting and is anticipated to be increased by post-fire runoff and/or blockage of drainage structures (e.g., culverts and bridges) by post-fire debris. As such, local agencies should consider these mapped flood hazard areas in addition to the VARs identified in this report.

Specific Values-at-Risk (VARs) are contained within the VAR shapefiles created by WERT, and these are the best product for use in response planning because they provide spatial location along with attribute data captured in the field. General observations related to key infrastructure, and sites where temporary housing may be located/constructed are included in the narrative below. More detailed observations and potential mitigations are provided in the VAR shapefiles (point and polygon), VAR summary table, and VAR site information (Appendix II) sheets. A summary of VARs by relative risk to life-safety and property are shown in Table 2.

Risk to Life-Safety				
Risk to Property		**Low**	**Moderate**	**High**
	Low	GDPUD-5, MOS-4		
	Moderate	GDPUD-1, GDPUD-2, GDPUD-3, GDPUD-4, GDPUD-6, GOR-1, GOR-2, GOR-3, GOR-5, GOR-6, GOR-7, GOR-8, MOS-2, RES-1, RES-2	MOS-1	
	High	GDPUD-7, GOR-4, MOS-3		

Table 2. Values-at-Risk classified by risk to life-safety and property.

Key Infrastructure

Key infrastructure within the Mosquito Fire burn perimeter includes county roads, public utility infrastructure installations, and private utility infrastructure (e.g. PG&E). Roads allowing access and egress into and throughout the burned area include roads for domestic water and utility management of the Georgetown Divide Public Utilities District (GDPUD), and Placer County Water Agency (PCWA) hydroelectric utilities and water supply infrastructure.

County Roads

County road networks potentially affected by the Mosquito Fire were not completely evaluated by the WERT. All roads and drainage structures downstream and downslope of hillslopes and drainages burned at High and Moderate SBS are at risk to post-fire storm damage. Monitoring, maintenance, and repair costs are expected to be high until the Mosquito Fire burned area revegetates and recovers; a period that typically can take 2 to 5 years. County transportation networks in the vicinity of the fire are primarily located along the northern and southern boundaries burned area near the Foresthill Divide, and communities of Quintette and Volcanoville respectively. Some specific areas of most concern include, but are not limited to:

Gorman Ranch Road is an unpaved Placer County maintained road, located in the west portion of the fire area, and contains potential risks to road infrastructure that provide primary access to PCWA utility installations. The alignment connects upslope Michigan Bluff Road to Mosquito Ridge Road at its base. The road is located within steep tributary drainages of the Middle Fork of the American River, and surface flows deliver to downslope Mosquito Ridge Road. Crossings along the road generally consist of culverts that drain portions of the burned area set on steep to very steep slopes with pervasive High and Moderate SBS (Appendix II, Map Plates 12 &13).

Of specific concern is an approximate 4 mile-long road segment (VAR **GOR-1**), located approximately 2.5 miles downslope of the road intersection with Michigan Bluff Road. The lower portion of the road appears on the El Dorado National Forest Map of 1949, and the 1952 Michigan Bluff USGS Quadrangle, and has experienced significant rain events over the decades on very steep terrain, as evidenced by past road failures. The WERT also identified specific VARs along **GOR-1** that are intended to exemplify the general post-fire risks to drainage infrastructure that may impact Gorman Ranch Road, and subjacent Mosquito Ridge Road (VARs **GOR-2, GOR-3, GOR-4, GOR-5, GOR-6, GOR-7, GOR-8**). VAR designations along Gorman Ranch Road were collected during a rapid field assessment and are not comprehensive and/or conclusive, thus responsible agencies should perform additional detailed evaluation along this road. Below we discuss roads in more detail.

- Crossings and drainage along all county roads within and downstream of the burned area should be evaluated and maintained as soon as possible. County road drainage facilities should be monitored and cleaned out after storm events. In addition, crossings that pose a high risk of failure and sediment delivery should be reconstructed with properly sized culverts, lower fillslope heights and rock armor; VARs **GOR-2, GOR-3, GOR-4, GOR-5, GOR-7** provide examples of types of road hazards present along public roads within and downstream of the burned area.
- **VAR GOR-1** traverses steep midslope settings impacted by pervasive High and Moderate SBS. Observed post-fire settings along VAR **GOR-1** indicate the area is susceptible to increased risks from post-fire dynamics such as; increased overland flow, tree throw, rockfall, debris transport, hyperconcentrated flow, and debris flow hazards. USGS debris flow modeling associated with drainages along VAR **GOR-1** suggest widespread moderate and high probability of debris flow initiation for a design storm of 15-minute duration at a rate of 24 mm/hr (0.94 in/hr).
    - Signage should be utilized along the entire county road corridor to alert vehicles to post-fire rockfall, debris flow, and/or flood hazard. Crossings should be monitored and cleaned out after storm events. The highway corridor should be evaluated following storm events for evidence of rockfall, landslides, and excessive erosion.
    - Traffic control and/or road closure may be advisable along the lower four miles of the road alignment (VAR **GOR-1**) during the initial years following the fire, to minimize potential safety risks to the general public.
        - A portion of the observed stream crossings within the bounds of VAR **GOR-1** were observed to have diversion potential. Discharge of uncontrolled stream flows along the sensitive post-fire slopes above below the road alignment increase the probability of adverse impacts to downslope road infrastructure. Placer County Roads Department should consider reducing diversion potential at stream crossings along the Gorman Ranch Road alignment to prevent discharge of diverted stream flows onto potentially sensitive slopes, via the installation of critical dips or other appropriate critical overflow structures.
- **VARs GOR-2 & GOR 3** are stream crossings on Gorman Ranch Road with no exposed drainage infrastructure. PCRD staff indicated that french drains are present within the crossing areas. Evidence of recent incision in upstream channels associated with recent precipitation was observed. Recently deposited sediment was also observed along the inboard edge of the road, and showed evidence of transport across the road and partial diversion down the right road approach toward Mosquito Ridge Road. These crossings

display potential channel responses to precipitation events in steep relatively small catchments with moderate and high burn severities.

- **VAR GOR-4** is culverted stream crossing with an approximately 30-inch diameter culvert that conveys flow from a steep drainage (~88 acres), impacted at High and Moderate SBS. The culvert was observed to be rusted, torn at inlet, and separated at the outlet. The crossing appears to have a high risk of failure. The WERT observed an approximately 12-15 foot drop at the culvert outlet, and the outboard fillslope is subvertical likely indicating past fill failure. The USGS model predicts a moderate probability of debris flow initiation, with a mean value of 4,607 m^3 of sediment generated from this catchment for a design storm of 15-minute duration at a rate of 24 mm/hr (0.94 in/hr).
    - The impaired stream crossing may fail/overtop and deliver sediment and debris downstream, which may induce additional adverse impacts to road infrastructure on Mosquito Ridge Road. Placer County Roads Department should consider immediately utilizing a qualified professional to evaluate the crossing and determine effective mitigation strategy for existing conditions**.**
- **VAR GOR-5** consists of two adjacent culverted crossings with approximate 30-inch diameter culverts and rocked headwalls. Outboard fillslopes are steep and long, and the drainage outflows combine immediately below the base of the outboard fillslopes. Upslope areas are significantly burned at High and Moderate SBS. The streamside slopes above crossing were observed to have dry ravel and a notable volume of channel stored sediment consisting of fine sediment, angular clasts, and debris. In the event of crossing failure, transported debris and sediment may add to compounding post-fire impacts downstream on Mosquito Ridge Road.
- **VAR GOR-6** consists of two in line stream crossings located on a switchback within a steep confined drainage. The crossings are set on the mainstem drainage of the Skunk Canyon tributary, which conveys flow to a culverted stream crossing on Mosquito Ridge Road. GIS-analysis shows that approximately 94% of the upstream catchment (665 acres) was burned, with High (27%) and Moderate (44%) severities. The USGS model predicted a mean value of 9,163 m^3 of sediment generated from this catchment for a design storm of 15-minute duration at a rate of 24 mm/hr (0.94 in/hr), which is likely to overtop the crossings and may induce failure.
    - Approximately 200 linear feet of the road and associated crossing infrastructure is oriented within the steep channel area. This crossing is at an elevated risk from potential post-fire debris flow and hyperconcentrated flow impacts, and may subsequently elevate the risk of adverse impacts to downstream Mosquito Ridge Road at the crossing on Skunk Canyon. This stream crossings should be monitored and cleaned out after storm events, and should be evaluated following storm events for potential failure.
    - Placer County should consider the utilization of a qualified licensed professional, such as a licensed civil/geotechnical engineer or geologist to perform a detailed evaluation and develop an effective crossing design to address the risk to the road infrastructure and downstream resources.
- **VAR GOR-7** is a stream crossing that conveys flow from two steep streams via an approximately 5-foot diameter pipe arch set at a shallow gradient, high in the fill. Mobile angular clasts and sediment were observed in the upstream channel reaches. The contributing drainage area (~48 acres) was impacted at a High and Moderate SBS. The outboard fill area appears to have been eroded by combined overtopping flows and road drainage. Stream crossing may be prone to increased risk of failure due to existing culvert orientation, and post-fire dynamics such as increased rates of runoff and sediment/debris transport. Crossing failure may increase the potential for downstream impacts.

- Placer County Roads Department should consider utilizing a qualified professional to evaluate the crossing and determine effective mitigation strategy for existing crossing conditions.

- **VAR-GOR-8** is a crossing on a near origin Class III stream. Flow drains through the road via an approximately 18-inch diameter culvert with a rock headwall, and the culvert is set at the base of fill. The contributing drainage area (~10 acres) was impacted at a High and Moderate SBS. Burned debris, trees, and rocks in channel upstream of crossing may increase the plug potential and subsequent potential impacts to downstream road infrastructure.

Public Utility Districts

Two primary Public Utility Districts contain significant infrastructure within the burned area. These districts provide either or both domestic water and energy to local communities. Infrastructure resources, such as intakes, dams and associated reservoirs, ditches, penstocks, power stations and transmission lines can all be impacted by post-fire rockfall hazards, increased erosion and sedimentation, elevated sediment laden flood flows, and debris flows. All road access to this critical infrastructure, and drainage structures on these access roads in and below areas burned at High and Moderate SBS are susceptible to increased risks from post-fire dynamics such as; overland flow, rockfall, debris transport, hyperconcentrated flow, and debris flow hazards. Monitoring, maintenance, and repair costs can be expected to be high until the burned area revegetates and recovers; a period that typically can take 2 to 5 years. Some specific areas of concern include, but are not limited to:

Placer County Water Agency

Placer County Water Agency's (PCWA) Middle Fork Project provides water and power to a significant portion of Placer County, and is the eighth largest power project in California. Figure 11 illustrates the geographic extent and types PCWA infrastructure within the Middle Fork American River Basin. The two main reservoirs of this project include Hell Hole and French Meadows, both located upstream of the burned area. Many of the onstream and near stream utility installations are in areas with potential recreational uses including the Oxbow Reservoir, Middle Fork Interbay, and Indian Bar recreational area. Primary PCWA infrastructure within the burned area includes the Ralston Powerhouse and Ralston Penstock (VAR **MOS-1**), the Ralston Penstock Butterfly Valve Powerhouse (VAR **MOS-2**), Lowell P. Stephenson Powerplant and Interbay Reservoir, Ralston Tunnel and Surge Tank, Oxbow Reservoir/Ralston Afterbay Dam and Powerhouse (VAR **MOS-3**), and the Indian Bar Recreation Area (VAR **MOS-4**). Critical infrastructure access routes within the burned area include the Mosquito Ridge, Blacksmith Flat, French Meadows, Long Canyon, and Interbay Road systems, located within USFS ownerships. Specific post-fire impacts and potential risks to road infrastructure on USFS alignments were not assessed by the WERT, and are addressed by the BAER team. Observations and recommendations related to post-fire conditions within USFS responsibility areas are not specifically addressed in this report. Observed High and Moderate SBS on steep slopes suggest that segments of the PCWA infrastructure may be susceptible to increased flood, erosion and sedimentation, rockfall, hyperconcentrated flow, and debris flow hazards. Some specific areas of concern include, but are not limited to:

- **VARs MOS-1 & MOS-2** are located on steep slopes above the mainstem Rubicon River drainage approximately 1.5 miles upstream of the Ralston Afterbay Dam. The 1,670 foot long Ralston Penstock conveys flow from the Ralston Butterfly Valve Powerhouse (VAR **MOS-2**) downslope to the Ralston Penstock Powerhouse (VAR **MOS-1**), at the base steep rocky

slopes. The very steep slopes were generally burned at a Moderate SBS, and rockfall and ravel accumulations were observed along the adjacent road alignment in the proximity the installations**.** Rockfall netting was observed immediately upslope of both utility installations. The spatial extent and effectiveness of the mitigations were not determined by the WERT. Observed rockfall mitigations may not provide an adequate level of protection to prevent adverse impacts to property and access related to post-fire dynamics. Rockfall hazards present a continuous potential risk to onsite staff operations, and the limited road access to the substation. Observed rockfall hazard may be exacerbated by post-fire conditions in the vicinity of the utility installation and access alignments.

  - Extra caution should be afforded during the initial years following the fire. PCWA should consider utilizing qualified professionals, such as California Licensed Certified Engineering Geologist and/or Geotechnical Engineer, to evaluate the rockfall hazards and determine effective mitigation strategies for existing conditions.

- **VAR MOS-3** consists of the Oxbow Reservoir impounded by the Ralston Afterbay Dam, and Powerhouse. The Ralston Afterbay Dam is an 89-foot-high, 560-foot-long dam that impounds the waters of the upgradient Middle Fork American River. Ralston Afterbay Dam creates the 2,782 acre-foot capacity Ralston Afterbay/Oxbow Reservoir (FERC, 2019). The relatively small capacity of the reservoir, and the tightly confined meandering morphology of the Middle Fork American River valley underlying Oxbow Reservoir, support high rates of sedimentation within and upstream of the Ralston Afterbay Dam. We understand that pre-fire sediment loads have accumulated in the reservoir, requiring periodic dredging to maintain the reliability of Ralston and Oxbow Powerhouses. PCWA management plans reference two sedimentation mitigation techniques including, dredging of upstream reaches and sediment pass through (SPT) (Robertson-Bryan, 2008). Anticipated post-fire increases in the rates of sedimentation elevate the risk of adverse impact to the Ralston Dam and Powerhouse infrastructure.
  - Pervasive High and Moderate SBS are concentrated on densely timbered, steep, north aspect slopes immediately south of the reservoir, generally extending into the Rubicon River Basin. PCWA should monitor the rates of sedimentation and implement remedial measures to minimize the potential for adverse impact to the utility infrastructure from excessive post-fire sedimentation.
  - Accelerated rates of debris transport into the reservoir are anticipated to occur in the first 5 years following the fire. Existing debris barriers within the reservoir should be monitored for potential damage and maintained to minimize potential impacts to the Ralston Afterbay Dam and Powerhouse. PCWA may consider bolstering the existing debris barrier systems to enhance the effectiveness of current debris impact mitigations.

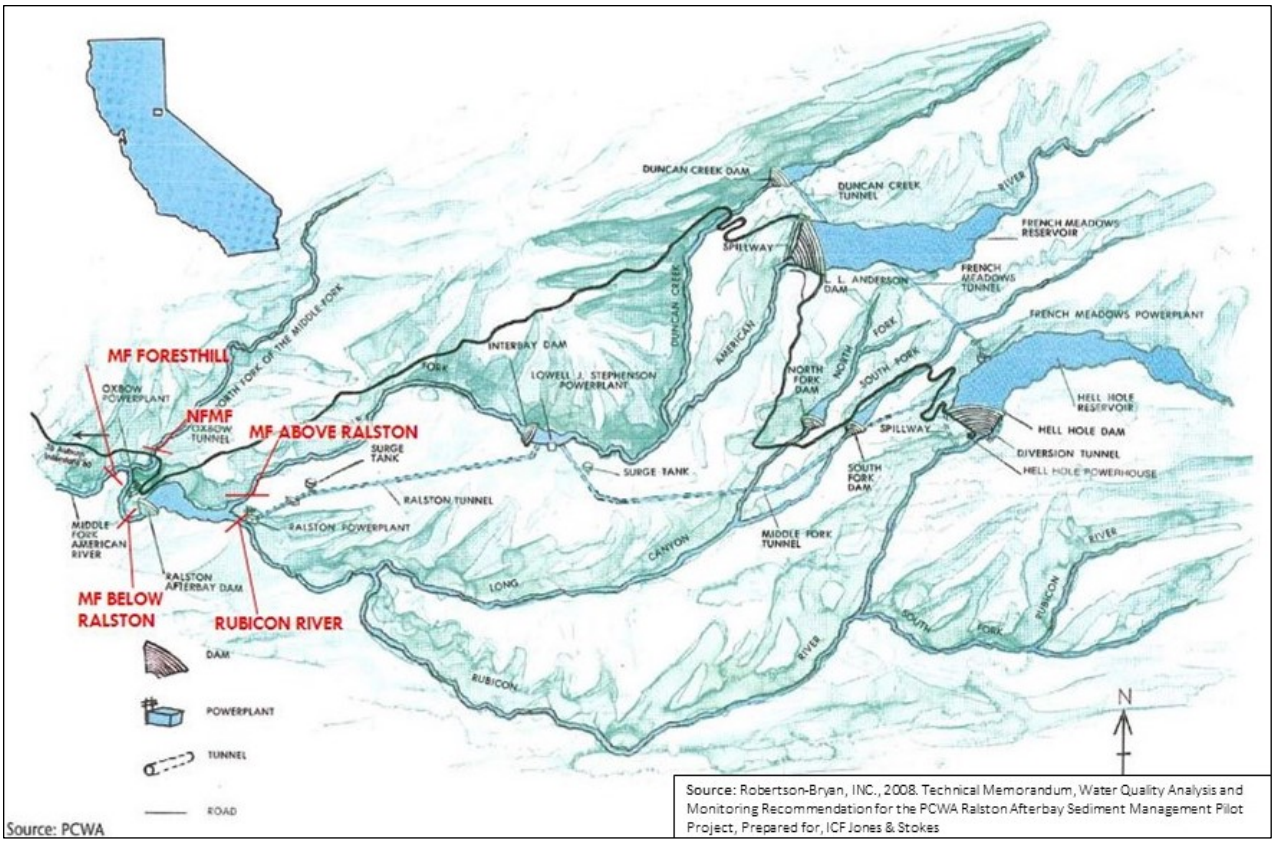


Figure 12. Illustration of PCWA hydroelectric infrastructure in the Middle Fork American River

Georgetown Divide Public Utilities District

Georgetown Divide Public Utilities District (GDPUD) operates the Georgetown Divide Public Utilities Ditch, which is a critical water conveyance that collects flows from Pilot Creek, below Stumpy Meadows Reservoir (20,000 ac-ft). The GDPUD Ditch conveys water, for domestic and irrigation uses, to dispersed rural communities in north and northwestern regions of El Dorado County that spans 112 square miles. Iterations of the conveyance have been utilized for at least 150 years, and are present on maps dating back to 1873 (Bowman, 1873). GDPUD provides domestic and irrigation water service to the communities of Georgetown, Buckeye, Garden Valley, Kelsey, Spanish Dry Diggins, Greenwood, Cool, and Pilot Hill. GDPUD is geographically separated from its neighboring water purveyors by the three forks of the American River, and therefore has no direct inter-ties with any adjoining water systems. Consequently, there is no immediate mechanism for the transfer of water into or out of the District (IRWMP, 2021). The critical water supply infrastructure serves as a primary water source for over 10,000 constituents. Improvements have been implemented along the ditch alignment over the years, such as burying approximately half of the line within culverts.

In cooperation with the GDPUD the WERT observed existing post-fire conditions along segments of the ditch alignment to assess the potential for increased risk of adverse impacts to related to post-fire conditions. The ditch alignment is generally located on densely timbered northern aspect slopes above Pilot Creek, that were burned at High and Moderate SBS. Approximately 3.6 miles of open ditch line, and 3.5 miles of underground conduit exists within the fire perimeter. A narrow,

unpaved, utility access road was observed along the outboard edge of the ditch alignment. Many sections of the road were set atop oversteepened outboard fillslopes on steep gradient sideslopes, and isolated past road failures are present along the roadway. The WERT observed numerous burned trees and buried woody debris within and immediately downslope of the road prism. Burned trees, and in-situ debris within the fill are anticipated to elevate the potential for increased road failures as the organic material decays, and interstitial voids develop within the fill prism.

Primary access to the GDPUD Ditch and associated utility infrastructure within the burned area is gained along several forestland roads including Ditch Camp Road. Ditch Camp Road is unpaved and descends from Wentworth Springs Road, generally traversing unburned to low SBS impacted areas. Various other access roads are utilized by operations staff that lie within High and Moderate SBS impacted terrain. Only a subset of these additional utility access roads within the burned area were observed by the WERT. Conditions along access road alignments indicate an increased risk of adverse impact to drainage infrastructure and passage from post-fire impacts, such as tree fall and accelerated runoff derived erosion.

Observed High and Moderate SBS in the vicinity of the ditch suggest that segments of the GDPUD infrastructure within the burned area are susceptible to increased risk of adverse impact related to post-fire dynamics, such as increased rates of overland flow, erosion, and sedimentation, hyperconcentrated and debris flows, rock fall, tree throw (VAR **GDPUD-1**). Additional specific VARs were designated along portions of the alignment of VAR **GDPUD-1** with elevated risk of adverse impact from post-fire dynamics, with the intent of highlighting risks to the critical community water supply (VARs **GDPUD-2 through GDPUD-7**). Some specific areas of concern include, but are not limited to:

- GDPUD operations management indicated that the water conveyance system has a limited capacity of contingency water supply, an approximate 5-day supply within the winter months, that could be delivered to its constituents in the event of significant utility failure. Thus, significant adverse impacts to the ditch that may render it inoperable, and would need to be sufficiently mitigated within the span of several days, to avoid water service outages within local communities.
    - GDPUD should develop specific contingency water supply measures in cooperation with appropriate local agencies and stakeholders to minimize the potential impacts of critical community water supply interruptions from post-fire impacts.
- It is expected that post-fire runoff from the burned area will contain chemical contaminants in addition to ash and fire-related sediment and debris that may pose adverse environmental impacts to the water supply. Additional study of potential impacts to downstream water supplies should be undertaken to ensure that treatment systems are equipped to address potential fire-derived sediment, ash, and chemical contaminants.
- Formal stream conveyances over the exposed ditch generally consisted of concrete flumes with inlet wing walls (VARs **GDPUD-2, GDPUD-4, GDPUD-5, GDPUD-6**). The concrete flumes are approximately 4 feet wide and 5 feet tall, and the wing walls generally extend to the lateral edges of the confined stream channels. Ditch bypass outflow structures were observed in-line with downstream channel alignments channels. Additionally, the concrete flume ditch crossings deliver to culverted crossings on the utility access road, directly downslope of the ditch alignment. Burned catchments across the alignment range from 45 acres to 240 acres. Moderate and High and Moderate SBS observed within the headwaters

of many drainages that intersect GDPUD infrastructure will likely result in increased rates of overland and stream flow and sediment/debris transport.
    - Observed burned terrain and vegetation in the vicinity of the crossings increase the potential for plugging and crossing failure. Post-fire flow dynamics pose a risk of increased crossing failure via plugging and flow diversion into the ditch. Subsequent delivery of sediment and debris to the conveyance may adversely impact the associated infrastructure.
    - GDPUD should consider readying suitable equipment to address physical impacts to the ditch and access alignments that are likely to occur in the post-fire setting such as, tree fall, cutslope failures, utility access road impediments, and ditch/crossing plugging.
    - GDPUD should anticipate an elevated frequency of maintenance and monitoring needs prior to the onset of the wet weather season, and during the years following the fire to account for the high potential for adverse impacts to GDPUD community water infrastructure within the burned area.
- **GDPUD-3** is a dormant historic aged landslide feature directly upslope of an open portion of the ditch alignment. The toe of the slide is located along the inboard edge of the ditch alignment, and a small stream has incised through the right edge of the feature. Upslope area burned at a high and moderate severity. Subsequent fire impacts to vegetation and post-fire hydrologic dynamics may exacerbate the adverse physical dynamics of the landslide feature, and elevate the potential for adverse impact to the GDPUD ditch alignment.
- **GDPUD-7** is a destroyed wooden stream conveyance over an exposed segment of the ditch alignment, located directly upstream from a tunnel inlet. Burned dimensional lumber was observed immediately downstream of the ditch. The WERT observed deposits of angular cobbles and boulders in a sediment supported matrix immediately upstream of the crossing, indicative of relatively high rates of sediment transport. The relatively steep, confined upstream catchment (~45 acres) descends approximately 400 vertical feet through burned terrain with High and Moderate SBS. The stream adjacent slopes were unvegetated and appear prone to accelerated rates of erosion and direct delivery to the stream and ditch. Accelerated rates of erosion and stream sediment transport are anticipated to adversely impact the water conveyance infrastructure if the burned stream conveyance is not repaired prior to precipitation events.
    - GDPUD should consider the utilization of a qualified licensed professional, such as a licensed civil/geotechnical engineer or geologist to perform a detailed evaluation and develop an effective crossing design to address the risk to the water conveyance system.

Temporary Housing

One VAR is associated with burned residential structures, and presents an elevated risk if temporary housing is located or built before the burned area recovers. Before burned structures are replaced with temporary housing, or rebuilt, they should be specifically evaluated for site-specific post-fire hazards such as rockfall, flooding, debris flow, and excessive sedimentation. These evaluations should be conducted by qualified licensed professionals, such as licensed civil/geotechnical engineers and licensed geologists. The VAR is: **RES-2.**

General Recommendations

Rainfall Thresholds

Rainfall thresholds are prescribed by the WERT, approved by the USGS Landslides Hazard Program, discussed with USFS BAER team, and concurred by the National Weather Service (NWS). Rainfall thresholds trigger the implementation of the early warning system which may include evacuations and road closures, or other heightened levels of response. Rainfall thresholds were determined based on a variety of factors including:

- Observations of geologic hazards within the burned area
- Location of VARs relative to observed hazards
- Spatial distribution of High and Moderate SBS within the burned area
- Empirical data on post-fire rainfall and geomorphic response in northern California
- Depth duration frequency data for rainfall within the burned area
- USGS model predicted rainfall thresholds
- Best professional judgement of licensed professionals

The rainfall thresholds recommended for the Mosquito Fire are:

FIREWIDE YEAR 1 RAINFALL THRESOLDS:

- **15-minute: 0.30 inches**
- **30-minute: 0.50 inches**
- **60-minute: 0.70 inches**

These thresholds are the fire-wide thresholds prescribed by the WERT in cooperation with the NWS, USFS BAER Team, and other stakeholders. The WERT recognizes the uncertainty with these prescribed thresholds, and highly recommends reviewing the need for augmenting the existing rain gage network so that rainfall thresholds can be revised in response to watershed response, or lack thereof, and measured rainfall intensities. The NWS is best positioned to recommend locations for additional telemetered rain gages.

Early Warning Systems

Existing early warning systems should be used and improved such that residents can be alerted to incoming storms, allowing enough time to safely vacate hazard areas, and emergency responders to be mobilized. In areas where cellular reception is poor or non-existent, methods should be developed to effectively contact residents. For example, installation of temporary mobile cellular towers should be considered. Additionally, responsible agencies should conduct an outreach campaign to encourage residents and business to sign up for early warning systems. Early warning systems for the Mosquito Fire should at a minimum take advantage of the following service:

Placer County Code Alert emergency alert system:

https://www.placer.ca.gov/2426/Placer-Alert

The El Dorado Smart911 emergency alert system:

https://ready.edso.org/

National Weather Service Forecasting

Flash flood and debris flow watches and warnings with practical lead times of several hours must come from a combination of weather forecasts, rainfall measurements of approaching storms, and knowledge of triggering thresholds. The following information is from the National Weather Service (NWS); they provide flash flood and post-fire debris flow "watch" and "warning" notifications in burned areas:

The NWS provides 24/7 information on watches, warnings and advisories for California. For additional information, see: NWS – Medford Forecast Office: https://www.weather.gov/mfr/

NWS - Post-wildfire flash flood and debris flow guide:
https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/fseprd889214.pdf

Augmenting Existing Rain Gauge Networks

The WERT suggests that Placer and El Dorado Counties and the NWS evaluate the existing rain gage network to determine where there is a need to augment the existing rain gauge networks to increase the efficacy of early warning systems.

Current RAWS weather sites are located at Bald Mountain, located about 2 miles south of the southern fire perimeter at 4,680 feet of elevation, Foresthill, located along the northern perimeter of the fire burned area at 4,350 feet of elevation, Duncan Peak Lookout, located about 7 miles east of the northeast portion of the fire perimeter at 7,100 feet elevation, and Hell Hole Reservoir, located about 10 miles east of the eastern portion of the fire perimeter at 5,240 feet of elevation.

Refinement of Rainfall Thresholds

The initial rainfall threshold prescribed for the Mosquito Fire burned area may be too conservative if future storm rainfall intensities at or above the prescribed threshold result in little to no watershed response. For this reason, the WERT suggests that Placer and El Dorado Counties implement formalized monitoring programs where watershed and stream response is monitored and related to both rain gauge data and weather radar imagery. Rain gauge data is critical for testing the effectiveness of the initial thresholds in predicting damaging levels of watershed response. Weather radar imagery can be used to look at the relative variability in rainfall intensity, how it relates to specific rain gauge data, and how it relates to observed watershed response.

Wireless Emergency Alerts (WEA)

WEA is an alert system originated by the NWS that can inform residents and businesses of flash flood warnings and other potential hazards. WEA alerts are emergency messages sent by authorized government agencies alerting authorities through mobile carriers. Government partners include local and state public safety agencies, FEMA, the FCC, the Department of Homeland Security, and the National Weather Service. No signup is required, and alerts are automatically sent to WEA-capable phones during an emergency. Residents and businesses interested in this function must turn on the emergency alert setting for their phone. https://www.weather.gov/wrn/wea

Emergency Alert System (EAS)

EAS is a national public warning system that may also be used by state and local authorities to delivery important emergency information, such as weather information, to targeted specific areas. https://www.fema.gov/emergency-managers/practitioners/integrated-public-alert-warning-system/public/emergency-alert-system

Integrated Public Alert and Warning System (IPAWS)

IPAWs is a FEMA-originated system that integrates federal, state, and local emergency warning systems (e.g., WEA, EAS) into a single interface. https://www.fema.gov/integrated-public-alert-warning-system

Education for Residents and General Public

First and foremost, it is critical that residents heed evacuation warnings from local officials. In the absence of an official notice, residents should pay attention to evolving conditions around their homes.

Suzanne Perry, disaster scientist from the USGS, suggests the following:

● Be ready for debris flows for 2-5 years after a wildfire. Don't worry about every storm, as it takes more intense rain (typically about ½ inch per hour – like being in a thunderstorm) on a recently burned slope to trigger a debris flow.

● Follow all evacuation orders. Debris flows can destroy everything in their path.

● Pay attention to official weather forecasts. The National Weather Service will issue a Flash Flood "Watch" or "Warning" for your area when rainfall is anticipated to be intense. Also – and this is important - the rain back in the mountains can be different than where you are. It's the rain in the mountains that will start the debris flow.

● Don't rely on what you've seen in past floods and debris flows. Debris flows and floods can hit new areas or return to previous areas; they might be smaller - or larger - the next time. Whatever happened before, the next time could be different.

● If you must shelter in place, choose your spot in advance and stay alert. Find the highest point nearby (such as a 2nd story or roof) and be ready to get there with a moment's notice. Listen and watch for rushing water, mud, unusual sounds. Survivors describe sounds of cracking, breaking, roaring, or a freight train.

● Never underestimate a debris flow. Unlike other landslides, debris flows can start in places they've never been before. They can leave stream channels and plow through neighborhoods. When a debris flow is small, people can control it with walls, K-rails, and sandbags. When a debris flow is big enough, nothing can stop it.

● Expect other flood dangers. Storms that can cause debris flows can also cause more common flooding dangers.

● Turn Around, Don't Drown!® Never drive, walk, or bicycle through a flooded road or path. Even a few inches of water can hide currents that can sweep you away. Also, the water level can rise before you finish crossing. For an easy to understand summary of what a debris flow is see Geology.com, What is a Debris Flow.

Burned Structures

Before burned structures are replaced with temporary housing or rebuilt, they should be specifically evaluated for site-specific post-fire hazards such as rockfall, flooding, debris flow, and excessive sedimentation. These evaluations should be conducted by qualified licensed professionals, such as licensed civil/geotechnical engineers and licensed geologists.

Increased Flood Flows, Erosion, Sedimentation, and Water Quality Impacts

First responders and Emergency Planning personnel should work in conjunction with Placer and El Dorado Counties respective Public Works to coordinate response planning for increased flood

flows and resultant sedimentation in and around the burned area. Post-fire flood inundation mapping should be performed for areas downstream of the burned area and should be used as the basis for response planning and potential evacuations. All areas downstream/downslope of the burned areas will potentially be subject to nuisance flooding and sedimentation at the minimum.

Debris Flow Runout

No tools are currently available to rapidly predict post-fire debris flow runout extent. WERT geologists rely partially on geomorphic evidence to estimate the downstream extent of debris flow inundation. However, some of the at-risk sites are within built environments where geomorphic evidence has been altered or destroyed through grading, past mining and/or construction. Also, geomorphic evidence may not be sufficient to predict the downstream extent of debris flows under these post-fire conditions. In areas below larger, severely burned drainages, the areal extent of debris flow inundation is uncertain. The WERT strongly recommends more detailed analysis to further refine the identification downstream debris flow inundation areas.

Increased Rockfall

Existing rockfall hazards were identified during field evaluations, particularly along the portion of Gorman Ranch Road (VARs **GOR-1 – GOR–8**), the GDPUD community water supply ditch alignment (VARs **GDPUD1 – GDPUD-7**), PCWA Infrastructure (**MOS-1 & MOS-2**), and Mosquito Ridge Road (refer to BAER report). However, due to the rapid nature of the evaluation, a fully comprehensive evaluation of rockfall hazard was not possible. DeGraff and Gallegos (2012) provide an overview of rockfall hazard following wildfire, along with suggested approaches for identifying these hazards. The WERT strongly recommends more detailed analysis to further refine the identification of rockfall hazard areas.

General Recommendations for Mine Sites:

Although mine sites were not evaluated by the WERT, they are a potential source of post-fire contamination due to the increased runoff and erosion that occurs following the fire:

- Regularly inspect drainage culverts at road crossings for debris blockage before and after a weather event.
- Maintain channels free of debris upstream of structures; improve routing of drainage; consult with qualified professionals to review natural drainage and conveyance structures.
- Manage surficial storm runoff to divert around waste containment ponds, mine tailings and overburden piles, fill caps, and other environmental cleanup infrastructure.
- Consider evacuation of active mine sites prior to a predicted high intensity storm events**.**
- Expect higher erosion and sedimentation rates, as well as increased runoff from these mining sites. Take appropriate actions to reduce the potential for these processes to further impact infrastructure and the environment.
- Regularly monitor environmental cleanup infrastructure before, during, and after forecasted storm events.

Road Drainage Systems, Storm Monitoring, and Storm Maintenance

Increased flows on slopes and onto the road and storm drain systems can be expected, and are predicted to be higher on slopes that received High and Moderate SBS. Increased erosion and sedimentation can inundate roads and plug these drainage systems. Flows could be diverted down roads and cause erosion and possible blockage, and/or loss of portions of the road infrastructure and structures along roads. The WERT did not evaluate the potential for rockfall, sedimentation, flooding, or debris flow hazards at all roads or watercourse crossings along federal, state, county, or municipal road corridors. Existing road drainage systems should be

inspected by the appropriate controlling agency to evaluate potential impacts from floods, hyperconcentrated floods, debris torrents, debris flows, and sedimentation resulting from storm events. Spatial data generated by the USGS and the WERT (e.g., USGS debris flow model, ERMiT model, and flood flow predictions) can be used to screen potential at-risk areas for increased monitoring and maintenance presence.

Reservoirs

Reservoir operators should anticipate large quantities of ash and sediment to be transported downstream of the burned area, producing high turbidity levels and potentially affecting water chemistry due to ash and sediment loading.

Utilities

Companies and public utility districts with linear facilities/structures, such as PCWA, GDPUD, and PG&E, should consider specific studies to address runoff hazards. This is particularly important in the Middle Fork American River and Rubicon River watersheds where GDPUD, and PCWA have numerous community water supply systems and hydroelectric power generation related facilities in the burned area.

Water(domestic)

Many rural properties contain small ponds/reservoirs created by impounding streams behind earthen dams. It is not known if these structures were constructed using engineered methods. Some of these had earthen fills with potentially compromised culverts that may drain onto unstable fills if they fill during the winter. These earthen dams were not a part of the WERT evaluation and should be evaluated by a qualified professional.

Water(municipal),

A portion of the Mosquito Fire burned area drains into tributaries of the Pilot Creek watershed, which drain into the GDPUD Ditch alignment, which is primarily utilized as a domestic water supply. Other portions of the burned area may drain to other domestic water supplies. It is expected that runoff from the burned area will contain chemical contaminants in addition to ash and fire-related sediment and debris that may pose adverse environmental impacts to the water supply. Additional study of potential impacts to downstream water supplies should be undertaken to ensure that treatment systems are equipped to address potential fire-derived sediment, ash, and chemical contaminants. Water supply agencies, GDPUD, and PCWA, should be notified of this potential threat.

Erosion controls should be put in place to limit potential chemical and sediment impacts from burned structures and facilities. Typical erosion control measures include such items as straw waddles, straw cover, geotextiles, and filter fabric around burned structures and facilities, as well as at or near storm-drains.

References

Bowman, A., 1873. *map titled* “Map of Georgetown Divide, El Dorado County Showing Also Portions of the Placerville and Forest Hill Divide, with the Ditches, Mines and Other Properties of the California Water Company”.

FERC, 2019. Placer County Water Agency Middle Fork American River Hydroelectric Project Federal Energy Regulatory Commission Project No. 2079, 1.4 (p. 6). State of California, State Water Resources Control Board.

Gotvald, A.J.; Barth, N.A.; Veilleux, A.G.; Parrett, C. 2012. Methods for determining magnitude and frequency of floods in California, based on data through water year 2006. U.S. Geological Survey Scientific Investigations Report 2012–5113. 38 p., 1 pl. https://pubs.usgs.gov/sir/2012/5113/

Harden, D.R., 2004, California Geology, Second Edition, Chapter 9.

Gusman 2011. Sediment/debris bulking factors and post-fire hydrology for Ventura County. Final Report prepared for the Ventura County Watershed Protection District. Ventura, CA. 184p. http://www.ascesbriv.org/sw_committee/documents/Bulking_Factor_Study%20_Final_Report_6_24_11.pdf

Kinoshita, A.M., Hogue, T.S. and Napper, C., 2014. Evaluating pre-and post-fire peak discharge predictions across western US watersheds. JAWRA Journal of the American Water Resources Association, 50(6), pp.1540-1557.

Larsen, I.J. and MacDonald, L.H., 2007. Predicting postfire sediment yields at the hillslope scale: Testing RUSLE and Disturbed WEPP. Water Resources Research, 43(11).

Lindgren, W., 1911. The Tertiary Gravels of the Sierra Nevada of California (p. 35). US Department of the Interior, US Geological Survey Professional Paper 73.

Moody, J.A. and Martin, D.A., 2001. Post-fire, rainfall intensity–peak discharge relations for three mountainous watersheds in the western USA. Hydrological processes, 15(15), pp.2981-2993.

Neary, D.G., Ryan, K.C. and DeBano, L.F., 2005. Wildland fire in ecosystems: effects of fire on soils and water. Gen. Tech. Rep. RMRS-GTR-42-vol. 4. Ogden, UT: US Department of Agriculture, Forest Service, Rocky Mountain Research Station. 250 p., 42.

Robertson-Bryan, INC., 2008. Technical Memorandum, Water Quality Analysis and Monitoring Recommendation for the PCWA Ralston Afterbay Sediment Management Pilot Project, Prepared for, ICF Jones & Stokes, 630 K St. Sacramento, CA, 95814.

Rowe, P.B., Countryman, C.M. and Storey, H.C., 1949. Probable peak discharges and erosion rates from southern California watersheds as influenced by fire. US Department of Agriculture, Forest Service, California Forest and Range Experiment Station. 107 p.

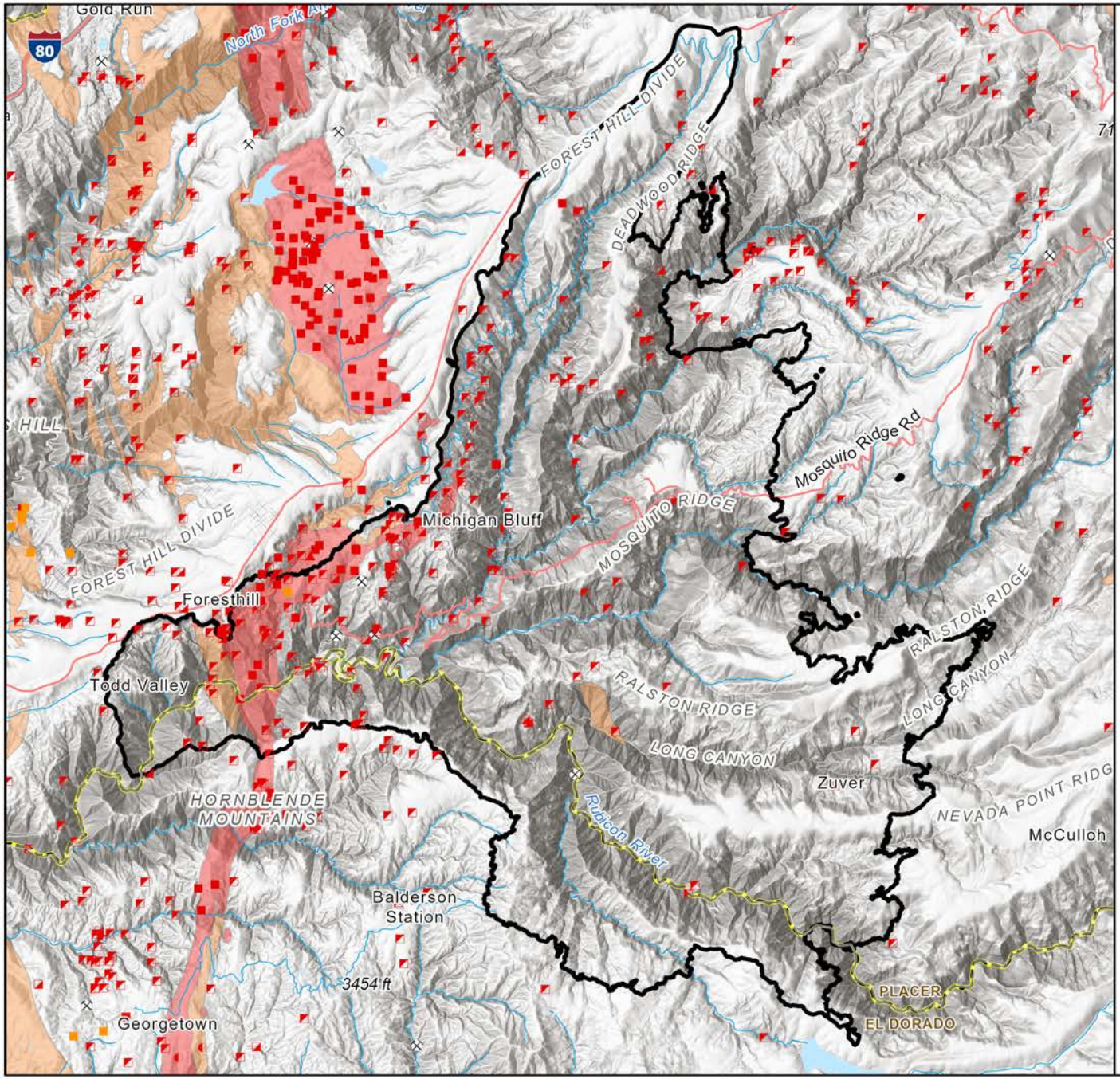
Scott, K.M., Gravlee, G.C., 1968. Flood Surge on the Rubicon River, California Hydrology, Hydraulics, and Boulder Transport, Geological Survey Professional Paper 422-M. US Department of the Interior, US Geological Survey.

Staley, D.M., Negri, J.A., Kean, J.W., Laber, J.L., Tillery, A.C. and Youberg, A.M., 2016. Updated logistic regression equations for the calculation of post-fire debris-flow likelihood in the western United States (p. 13). US Department of the Interior, US Geological Survey.

Wagner, D.L., Jennings, C.W., Bedrosssian, T.L., Bortungo, E.J., 1981. Geologic Map of the Sacramento Quadrangle: California Department of Conservation, Division of Mines and Geology, Regional Geologic Map Series, Map No. 001A (geology), 4 sheets, scale 1:250,000

Wagner, D.L. & Saucedo, G.J., 1992. Geologic Map of the Chico Quadrangle: California Department of Conservation, Division of Mines and Geology, Regional Geologic Map Series,

Appendix I – Mineral Hazards and Wells



Areas of Potential Mineralogical Concern

Areas of serpentinite/ultramafic rock (including rock units with matrix of same). These have potential for locally elevated concentrations of the following:

Asbestos	Copper
Chromium	Mercury
Cobalt	Nickel

Areas of various metamorphic and igneous rocks that include the following units: Gabbro, metavolcanic rock. These have potential for locally elevated concentrations of the following depending on the rock type:

Arsenic	Copper
Asbestos	Lead
Chromium	Nickel
Cobalt	Zinc

Mines and Prospects

Asbestos- and CAM17-Metals-Related Commodities

- Asbestos
- Chromite
- Copper
- Gold
- Gold + Other Metals
- Lead + Other Metals
- Nickel
- Silver + Other Metals

Other Potentially Hazardous Commodities

- Manganese
- Non-metallic commodity (MRDS)
- Non-metallic mining symbol in TOMS database

N

County boundary

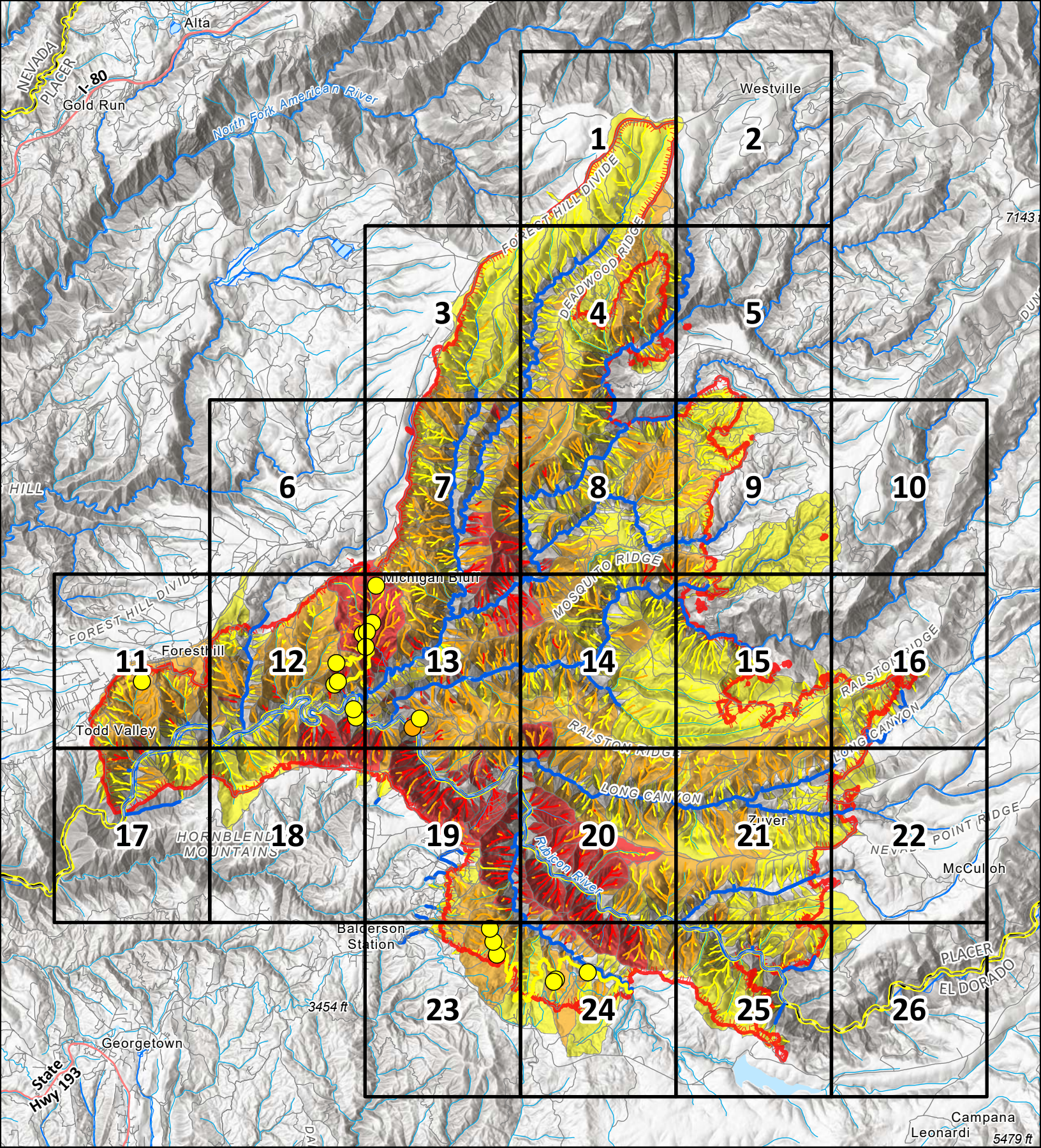
Fire perimeter

0 1 2 3 4 5 Miles

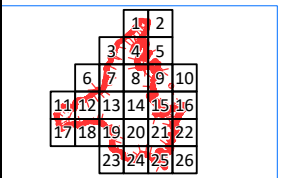
MINERAL HAZARDS AND WELLS
Mosquito Incident
CA-TNF-001371

Sources: Mineral areas and mines: Higgins, C.T. and Churchill, R.K., 2014, Preliminary Assessment of Potential for Mineral Hazards in California Department of Transportation District 3, California Geological Survey, internal technical report prepared for the California Department of Transportation under Interagency Agreement No. 43A0311. Mines: USGS (Mineral Resources Data System (MRDS) and TOMS database) and California Division of Mine Reclamation.

Appendix II – Values at Risk Detailed Data



Incident:
CA-TNF-001371
Mosquito Fire



Value at Risk (Point)

Potential hazard to life

- low
- moderate
- high

Values at Risk (Polygon)

Potential hazard to life

- low
- moderate
- high

Segment Combined Hazard

15min 24mm/hr

- Low
- Moderate
- High

Basin Combined Hazard

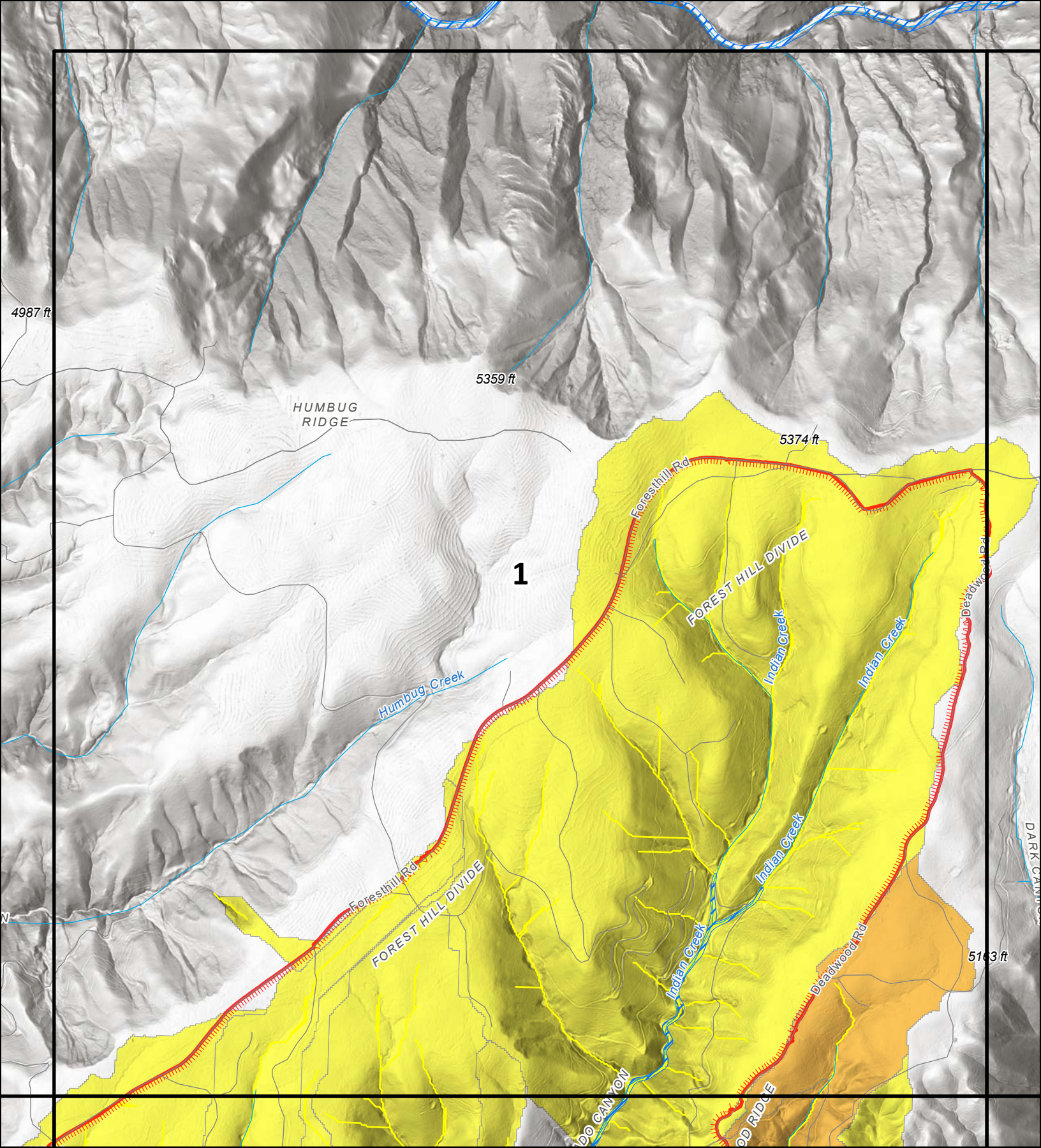
15min 24mm/hr

- Low
- Moderate
- High

- USGS Watchstream
- FEMA/DWR Floodplain
- Fire Perimeter

N

0 0.5 1 2 Miles



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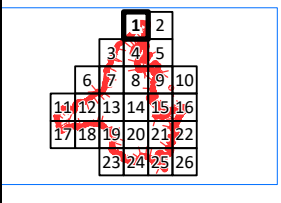
Mosquito Fire



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15min 24mm/hr

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- Moderate
- High

Basin Combined Hazard

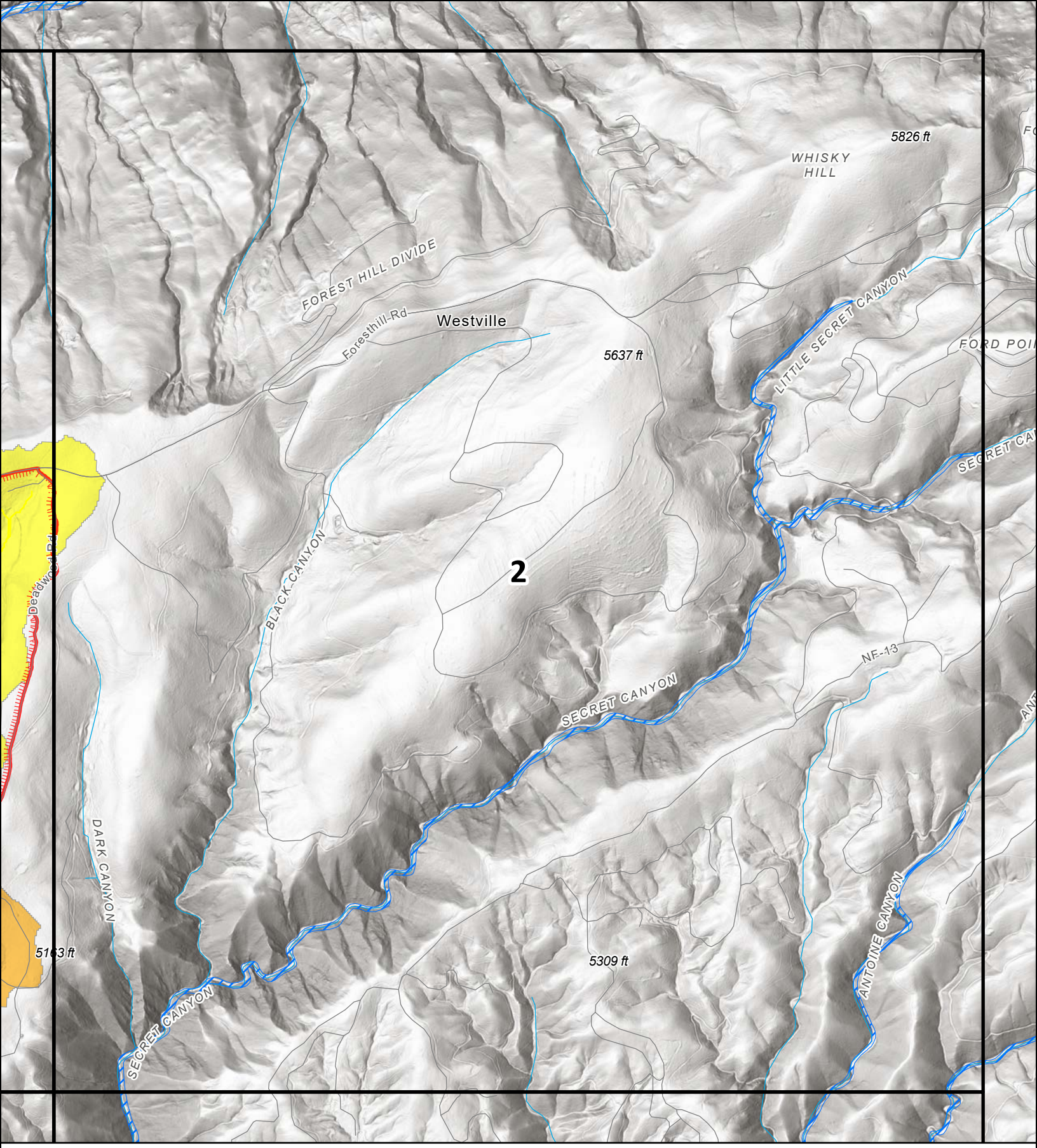
15min 24mm/hr

- Low
- Moderate
- High

- USGS Watchstream
- FEMA/DWR Floodplain
- Fire Perimeter

N

0 0.07 0.15 0.3 Miles



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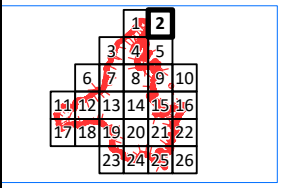
Mosquito Fire



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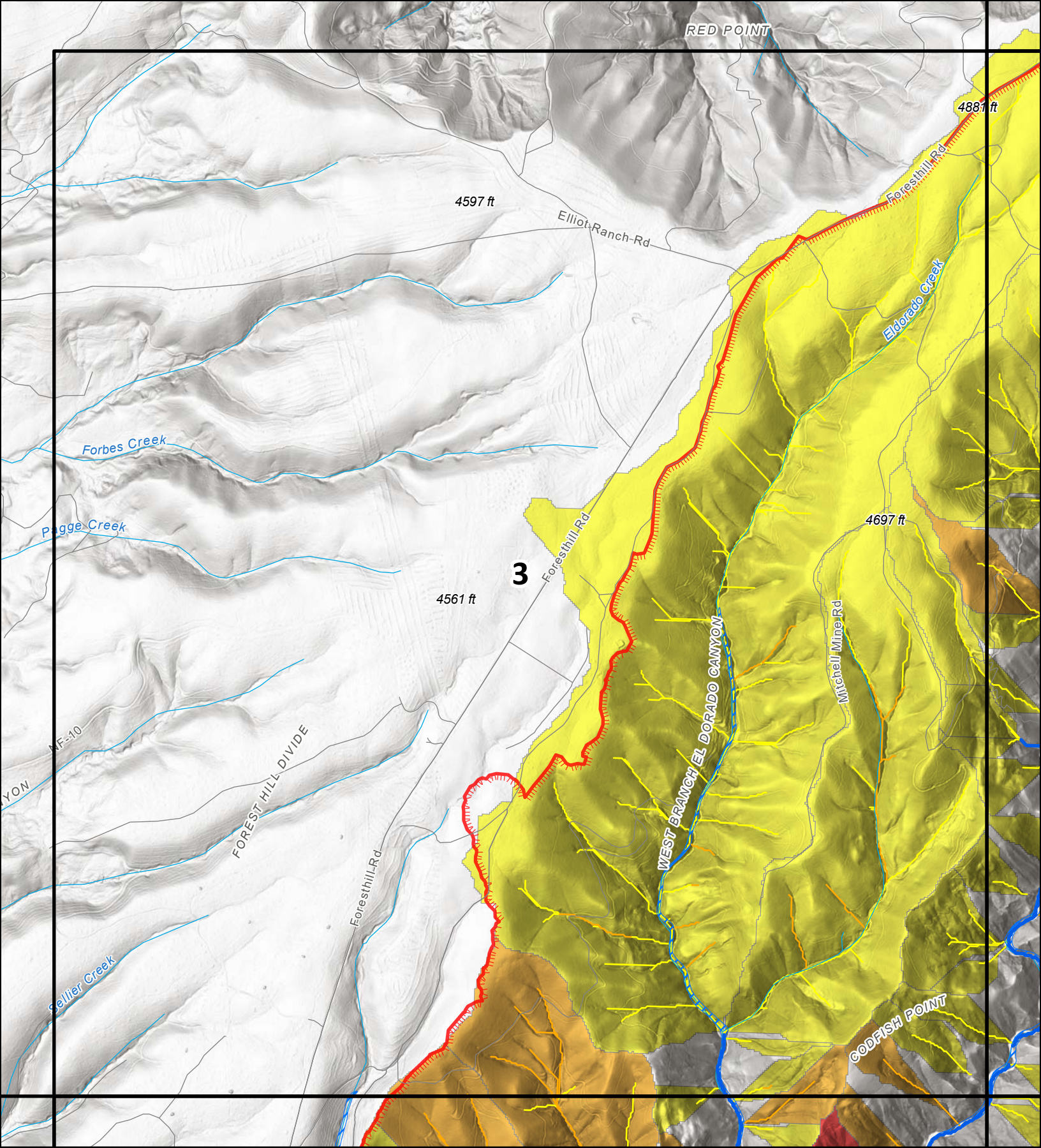

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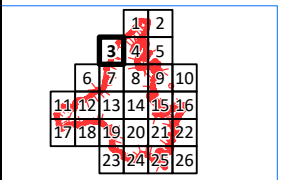

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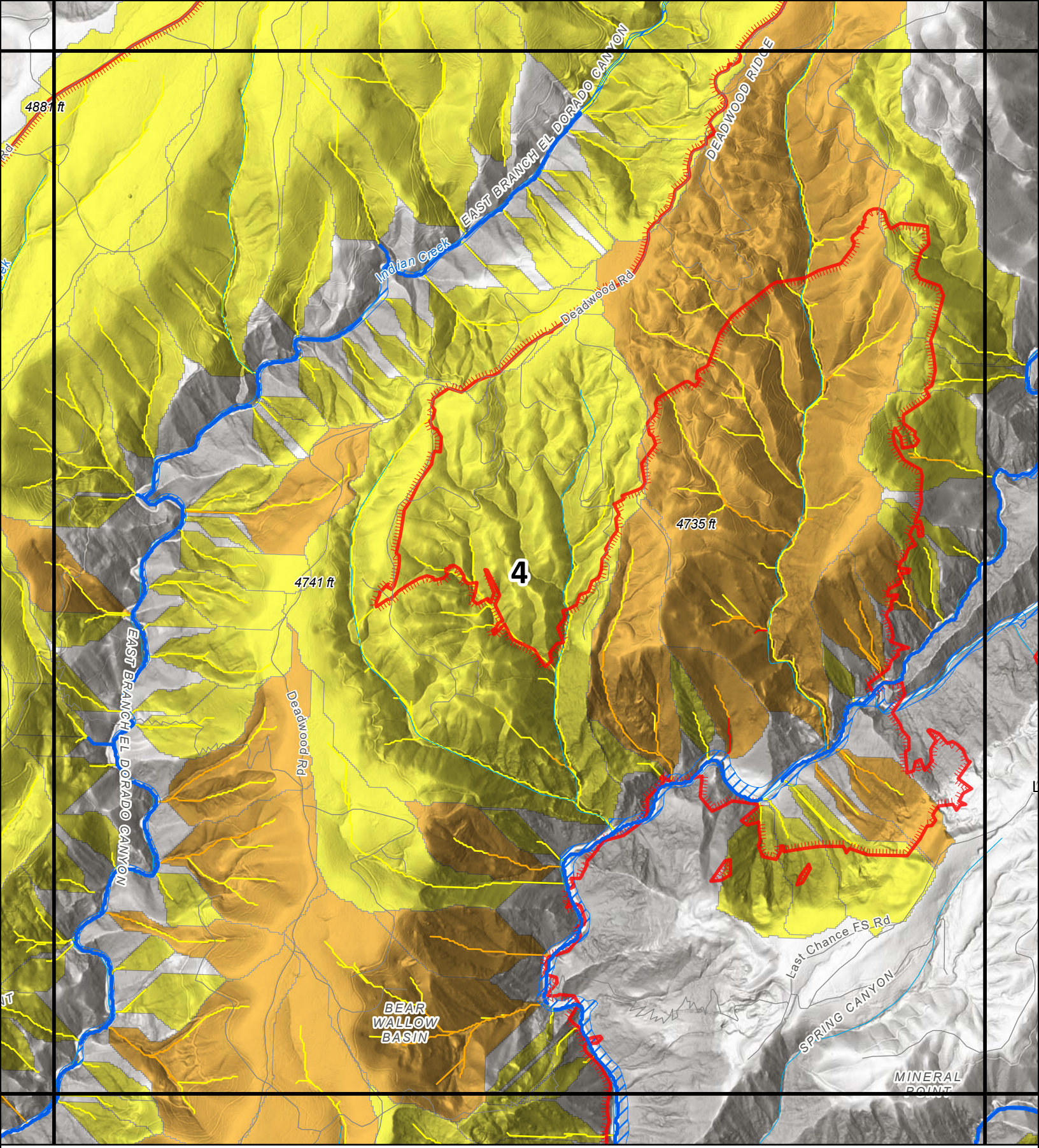

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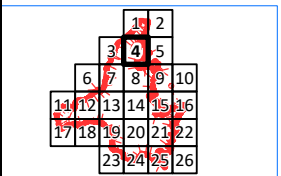

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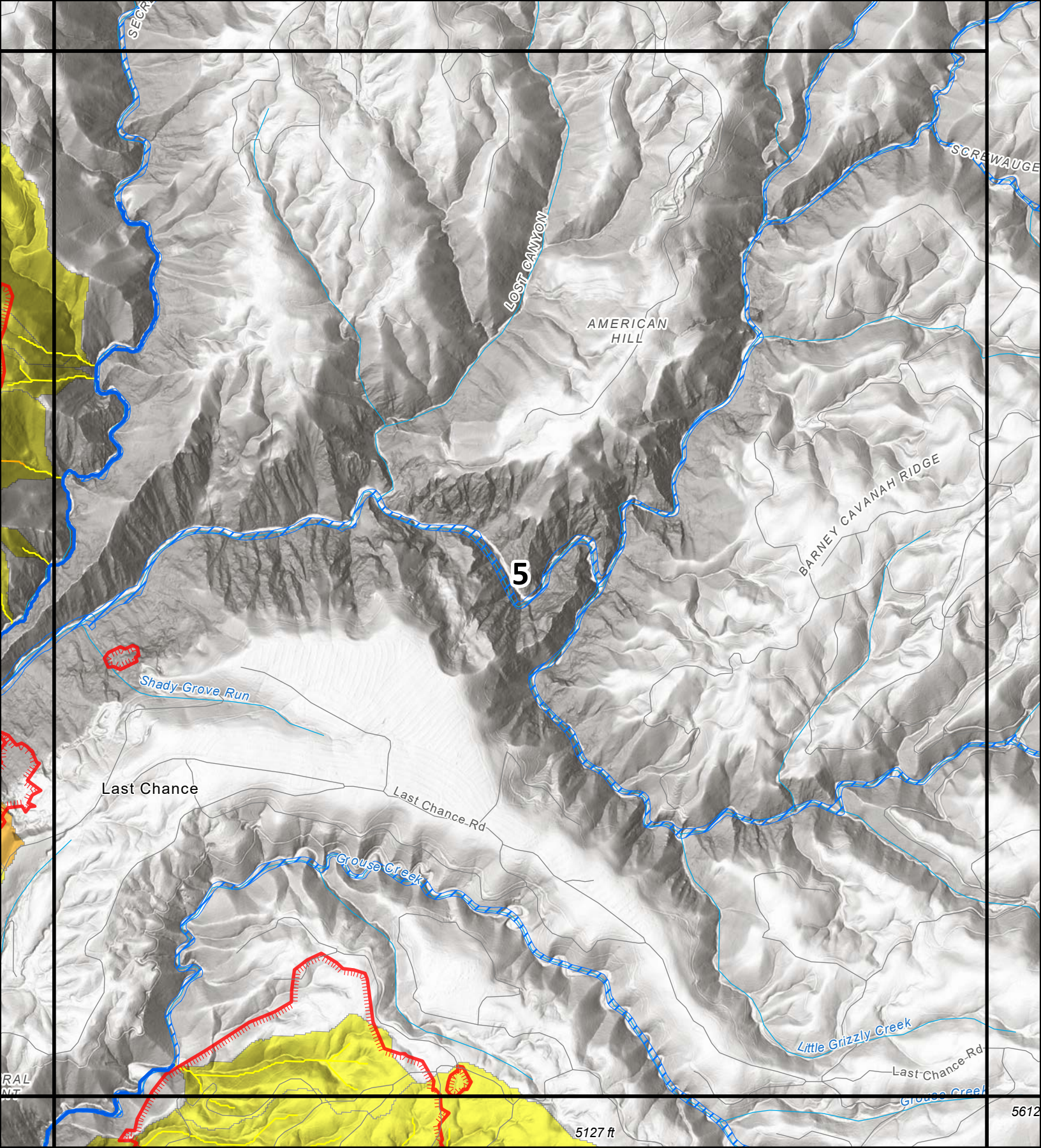

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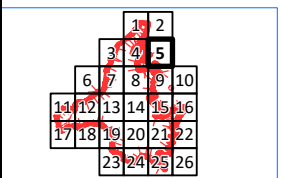

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- high

Values at Risk (Polygon)

Potential hazard to life

- low
- moderate
- high

Segment Combined Hazard

15min 24mm/hr

- Low
- Moderate
- High

Basin Combined Hazard

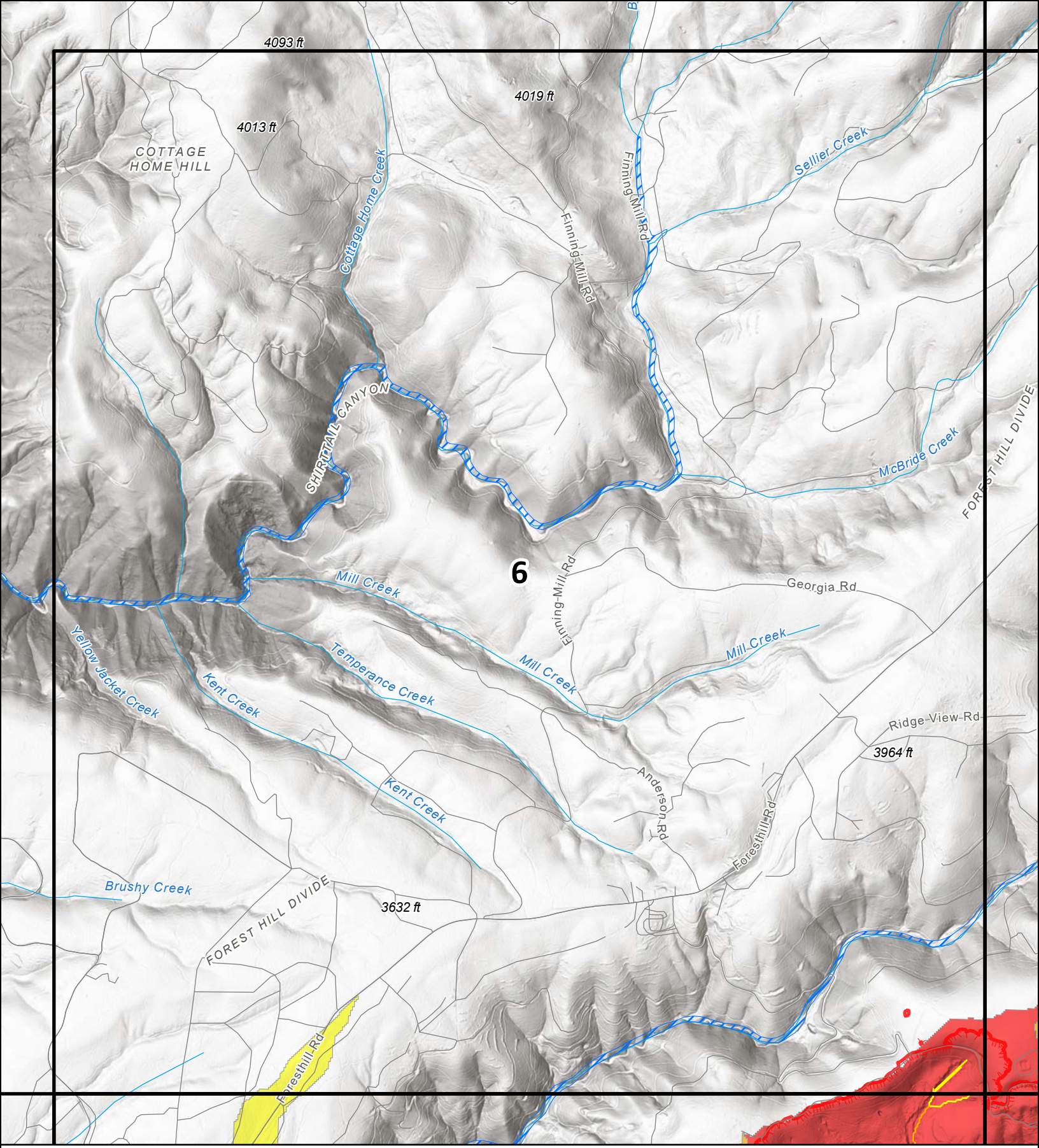
15min 24mm/hr

- Low
- Moderate
- High

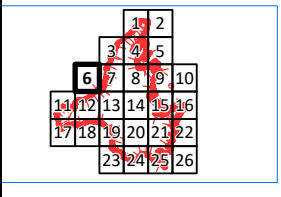
- USGS Watchstream
- FEMA/DWR Floodplain
- Fire Perimeter

N

0 0.07 0.15 0.3 Miles



Incident:
CA-TNF-001371
Mosquito Fire



Value at Risk (Point)

Potential hazard to life

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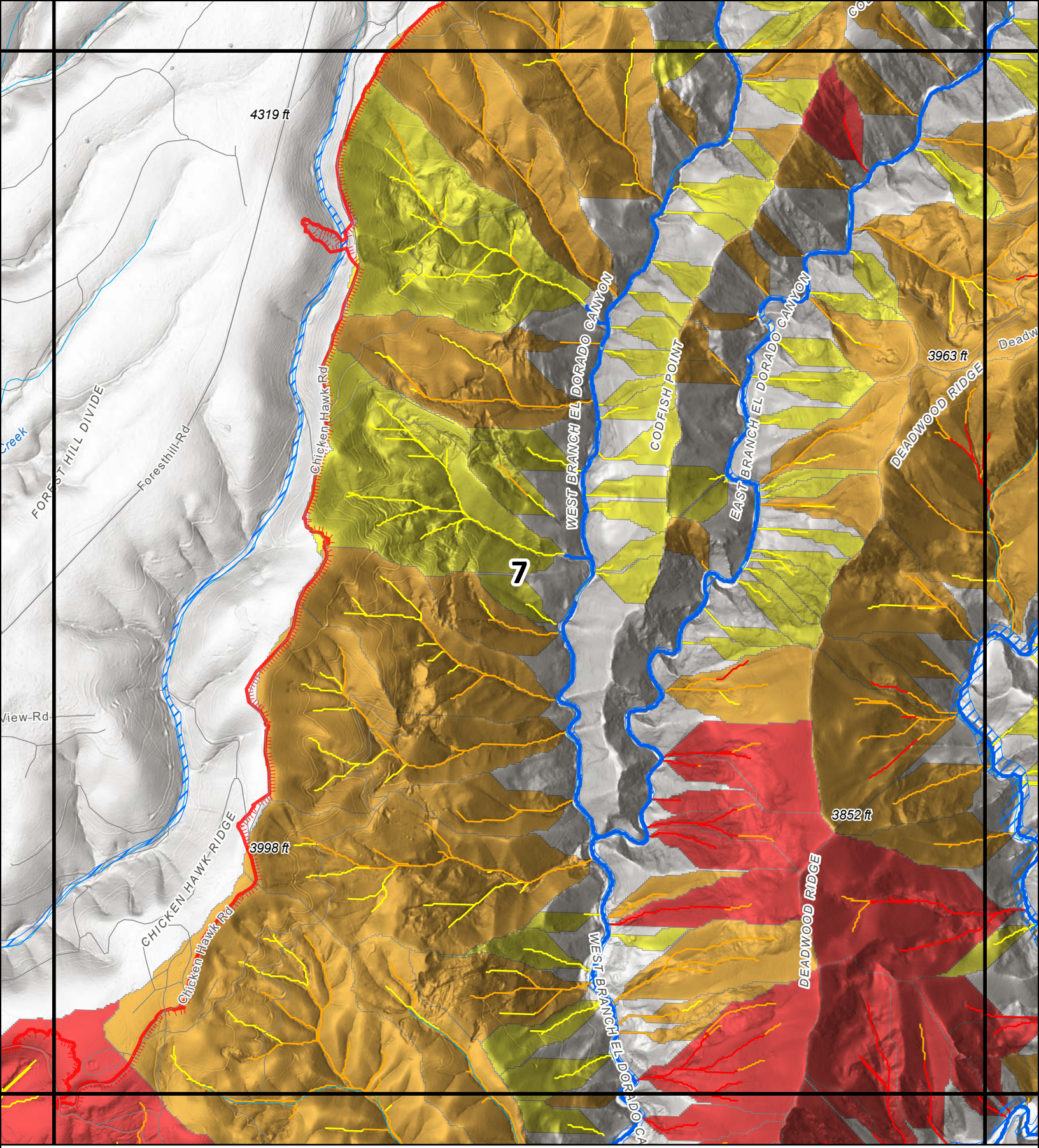

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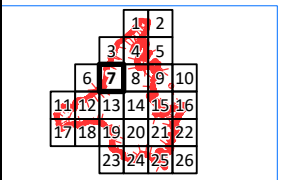

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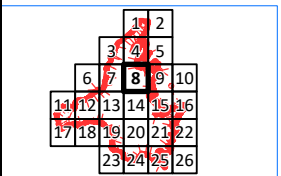

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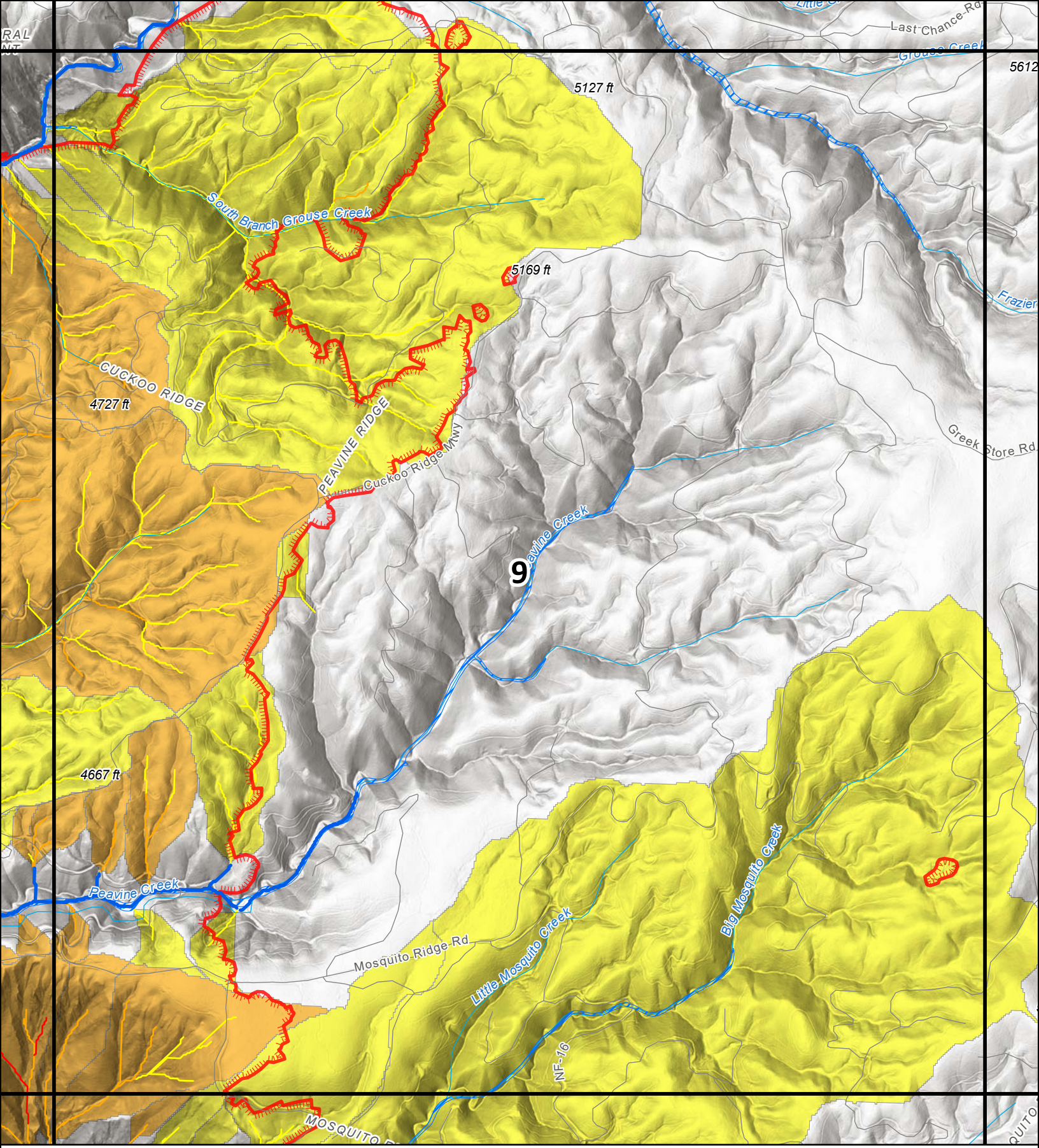

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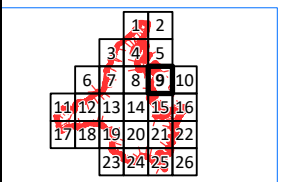

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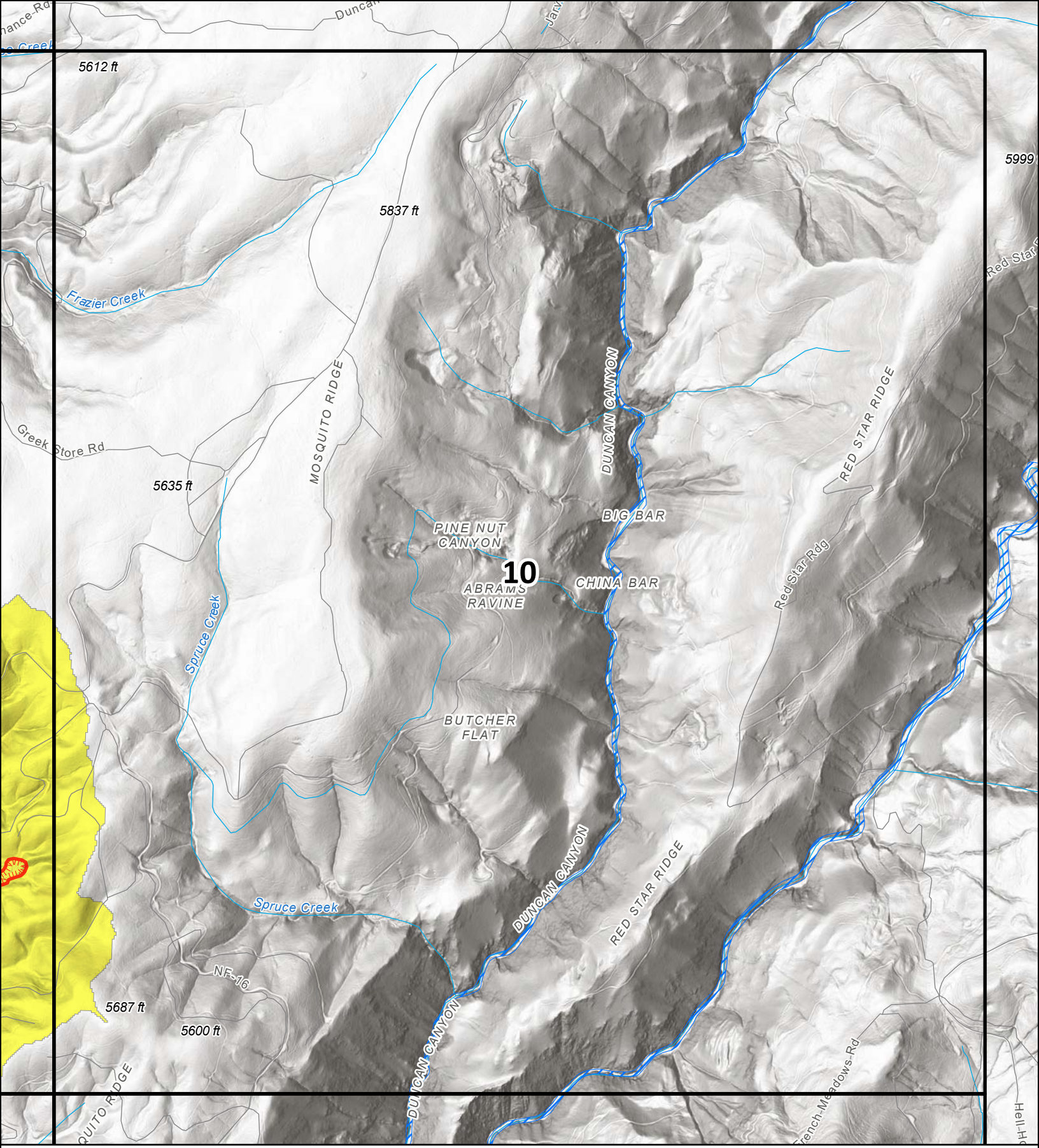

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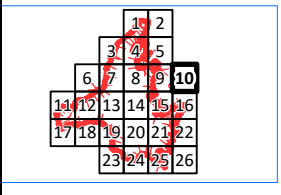

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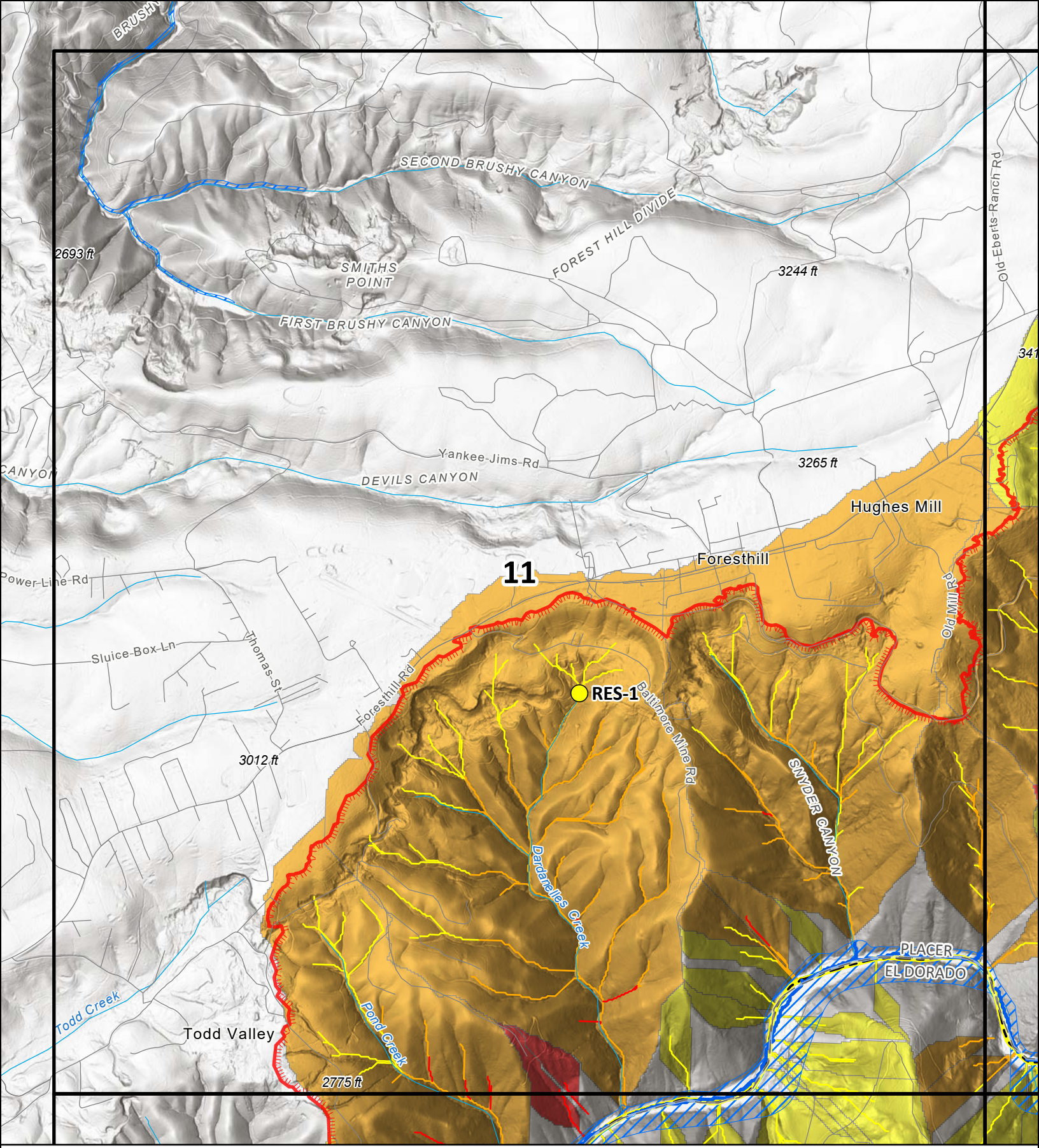

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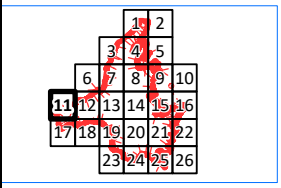

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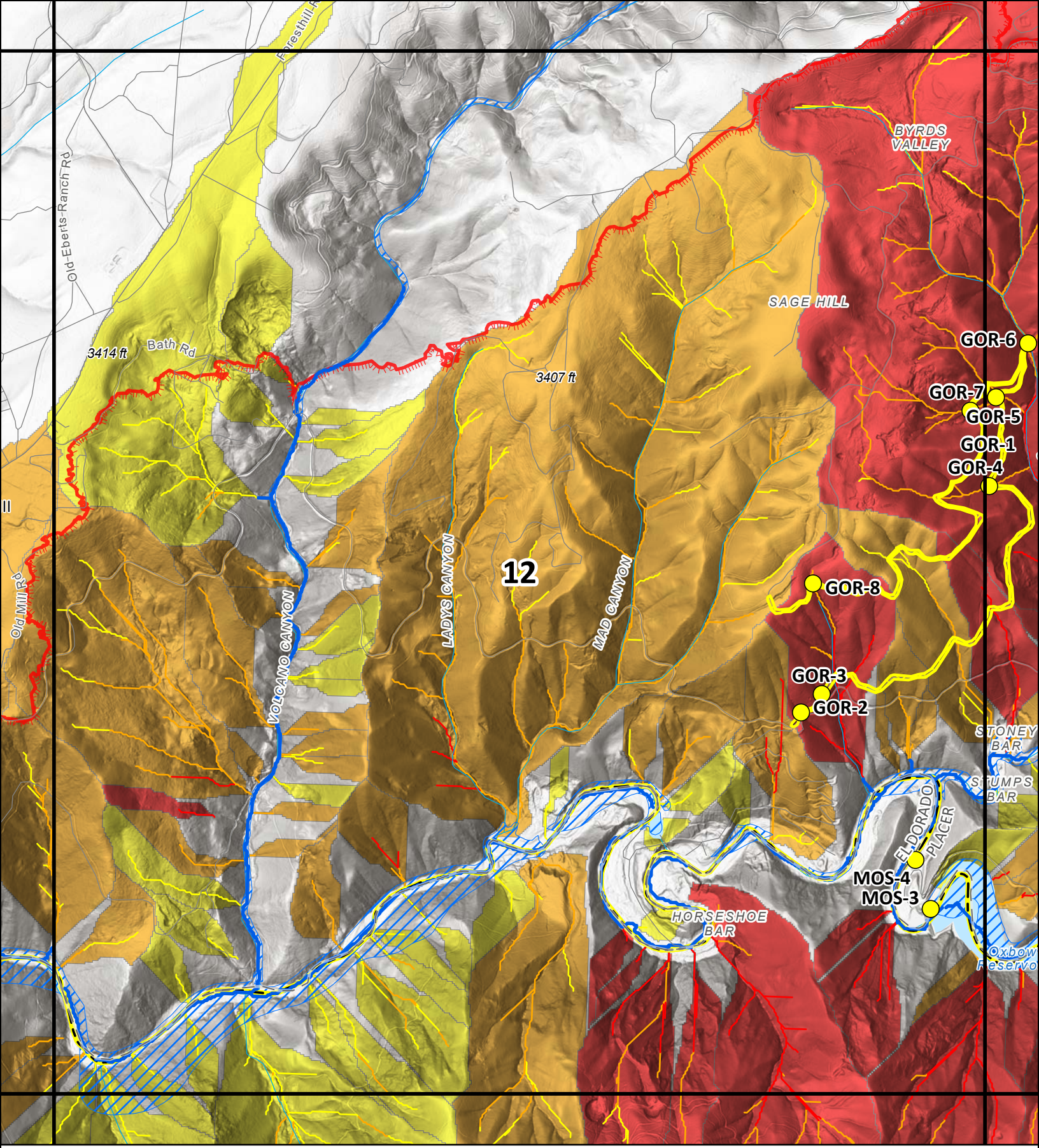

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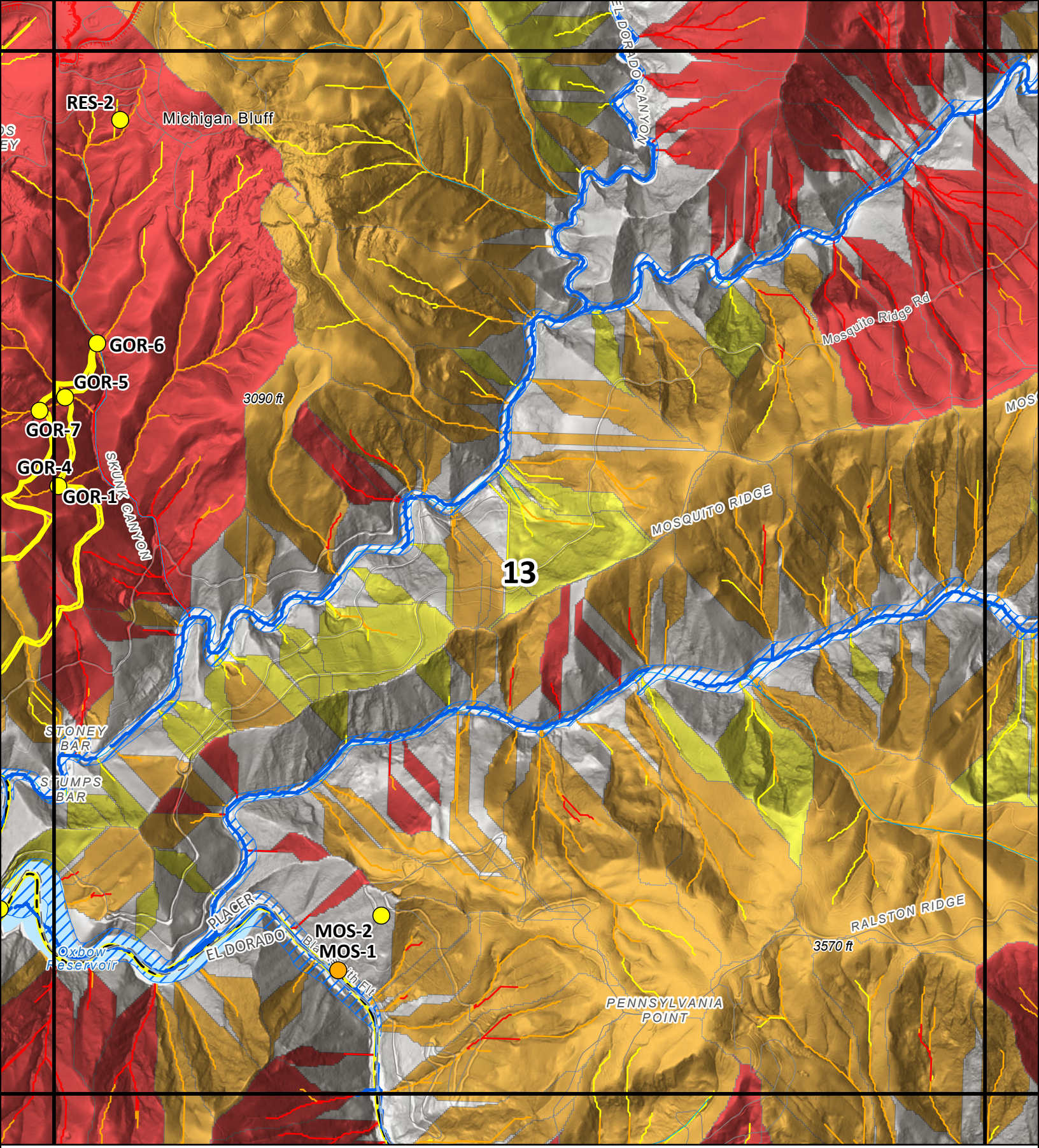

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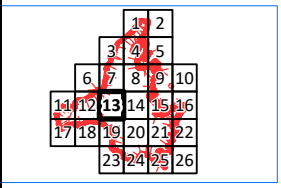

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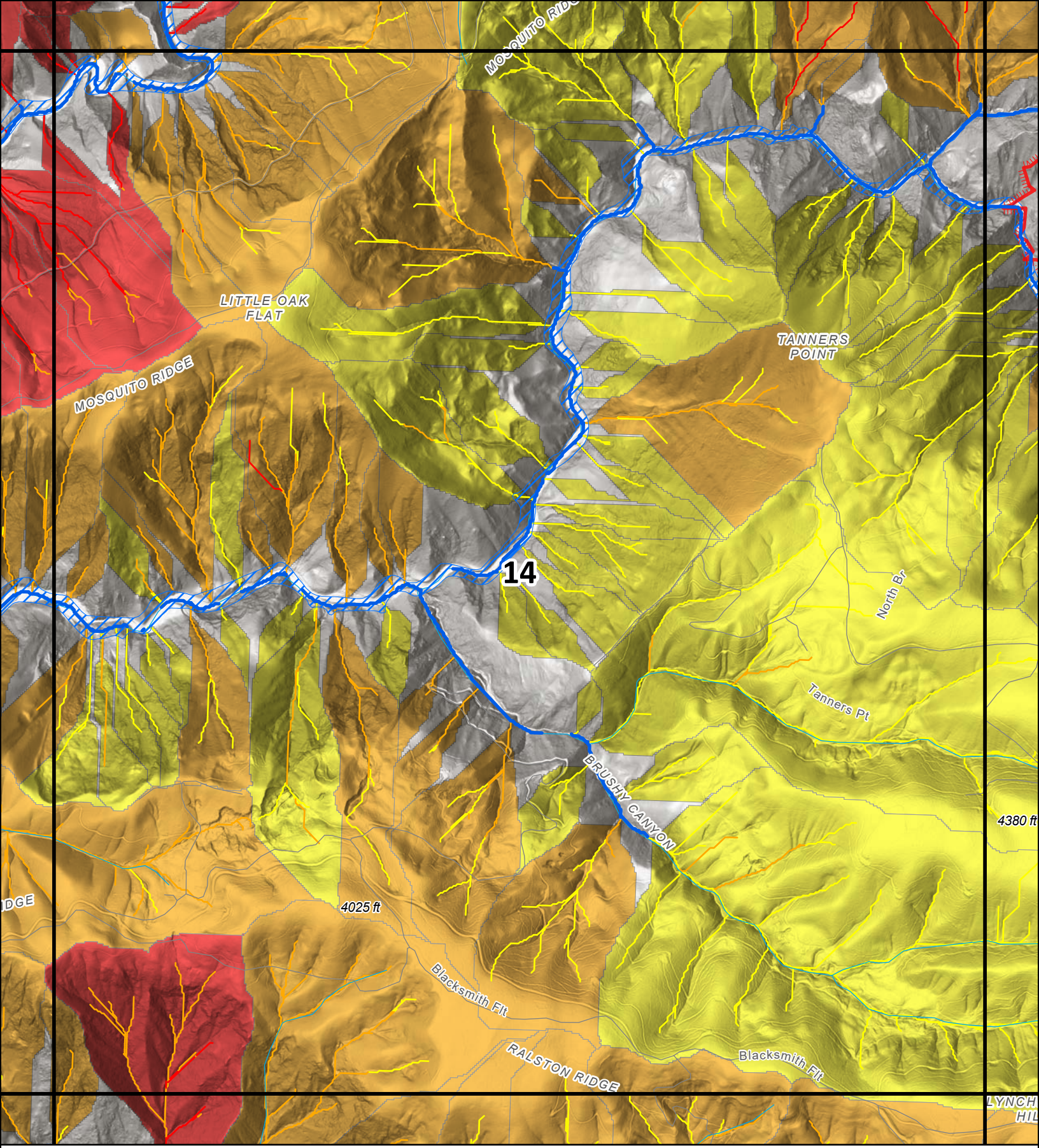

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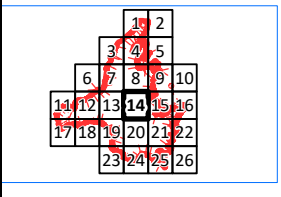

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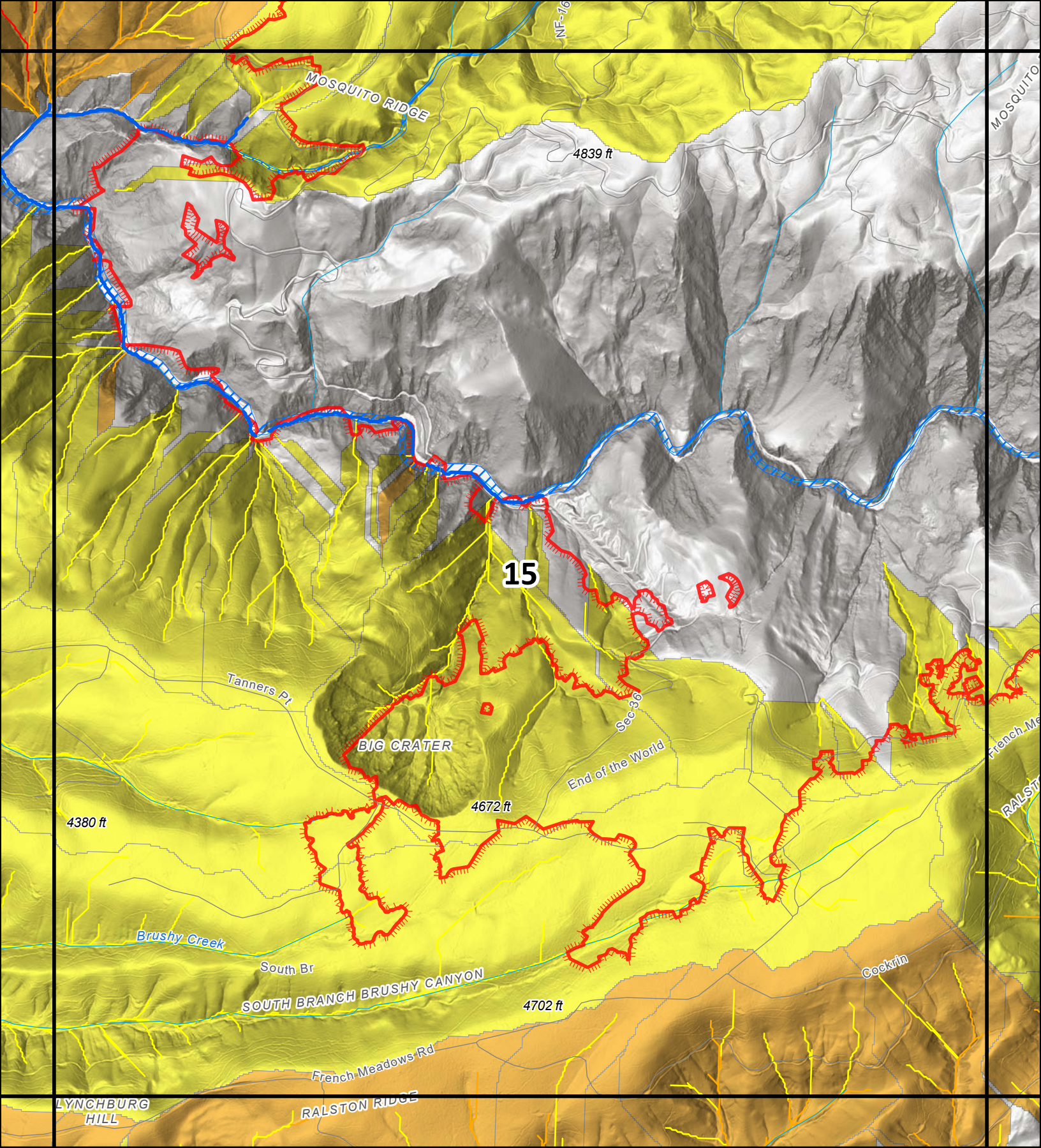

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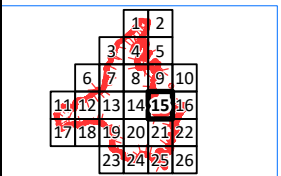

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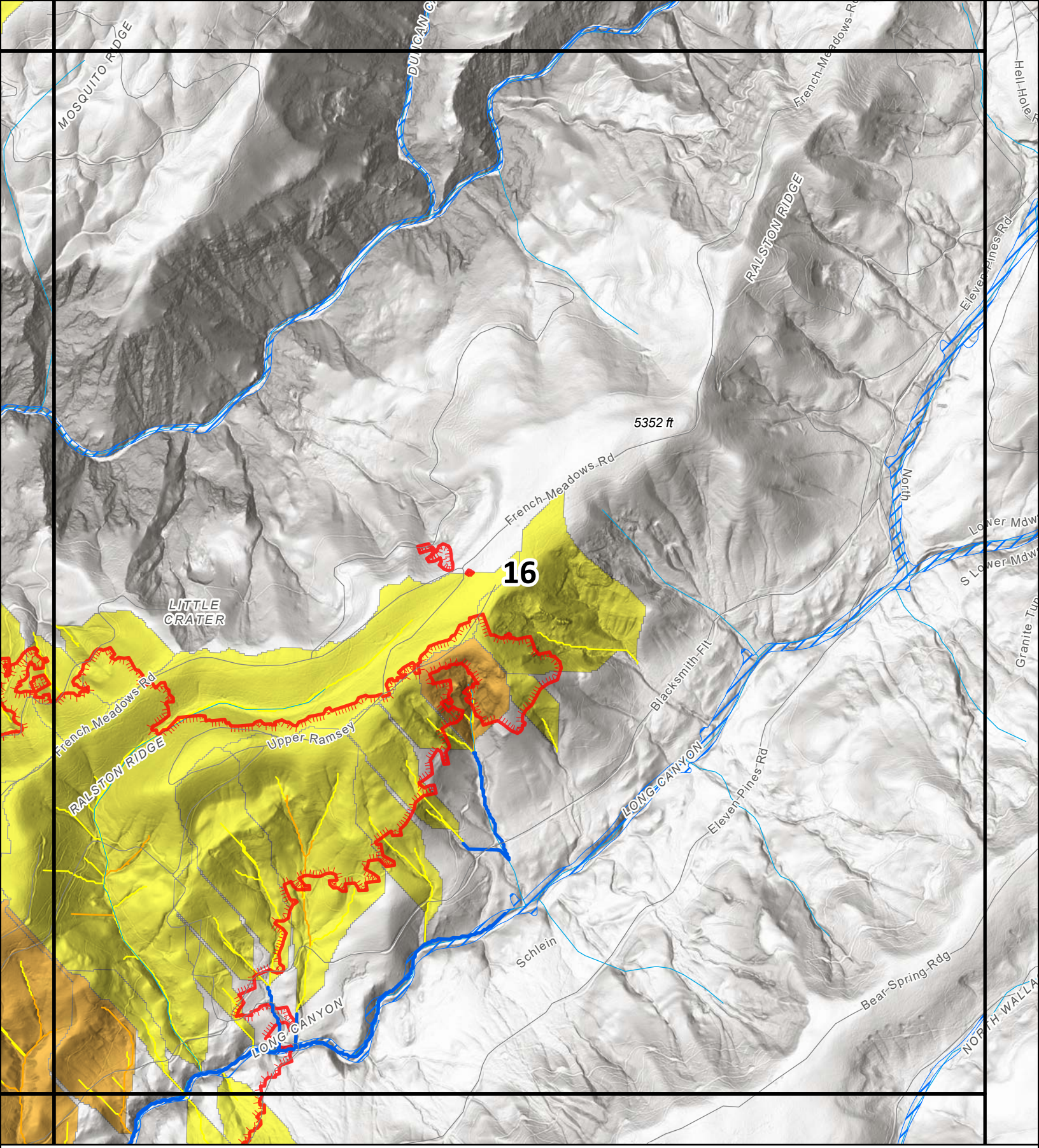

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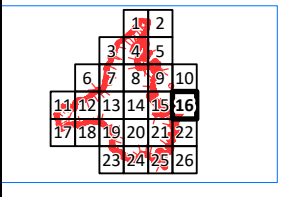
Mosquito Fire



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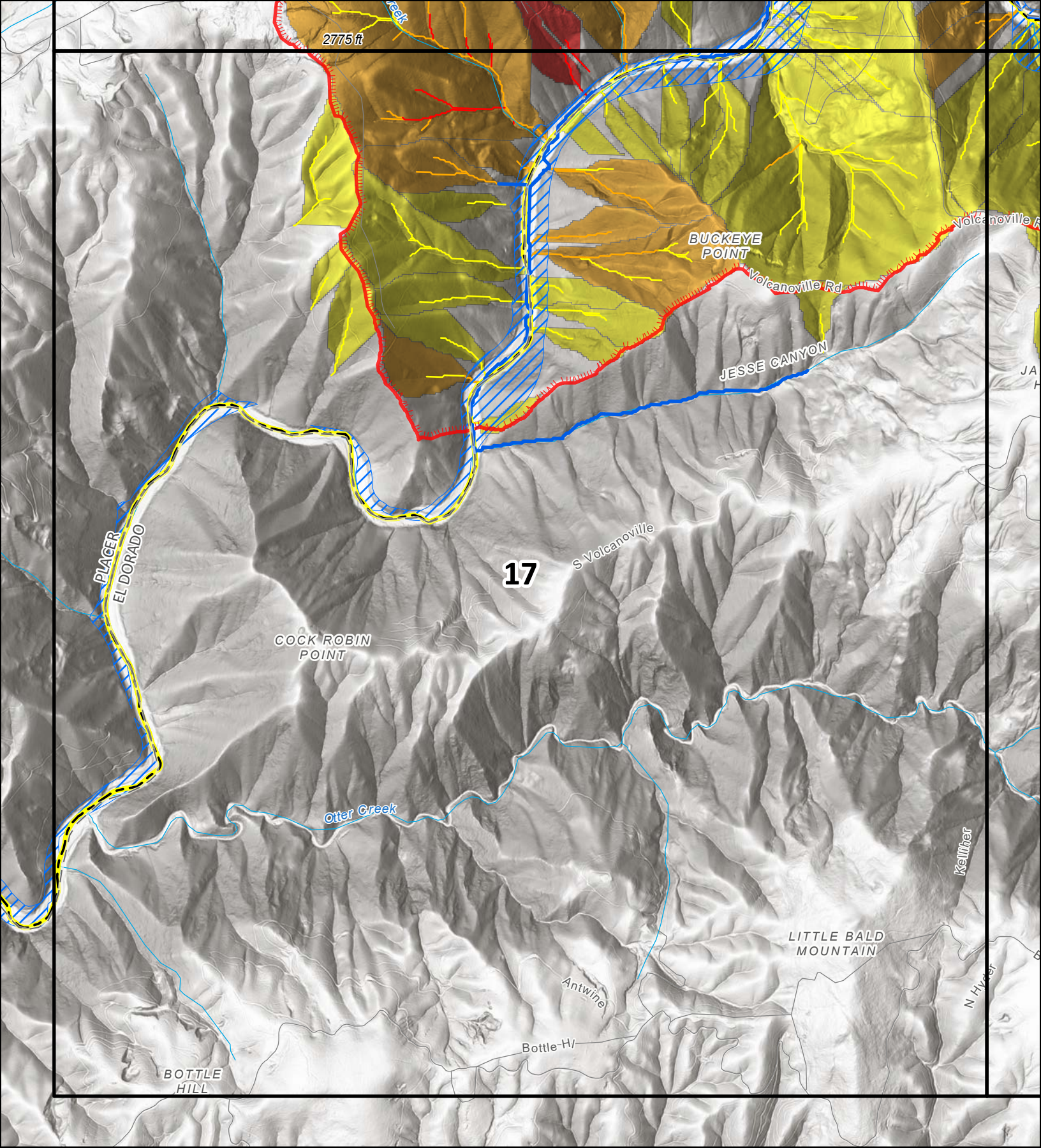

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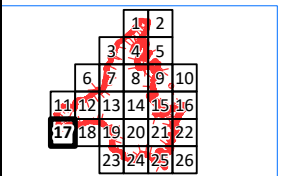

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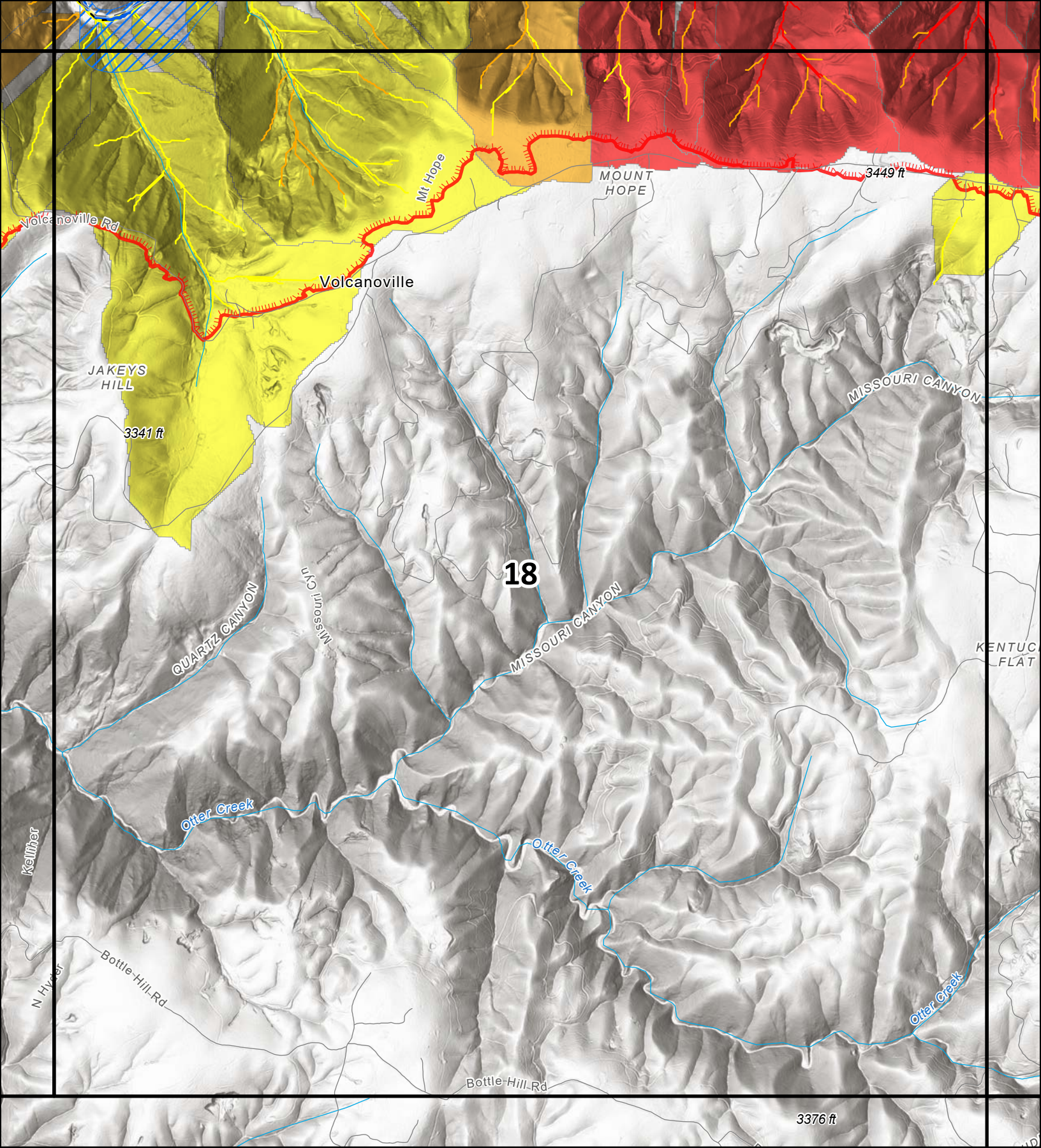

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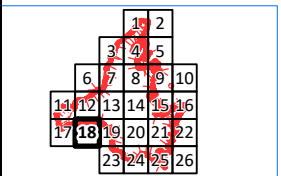

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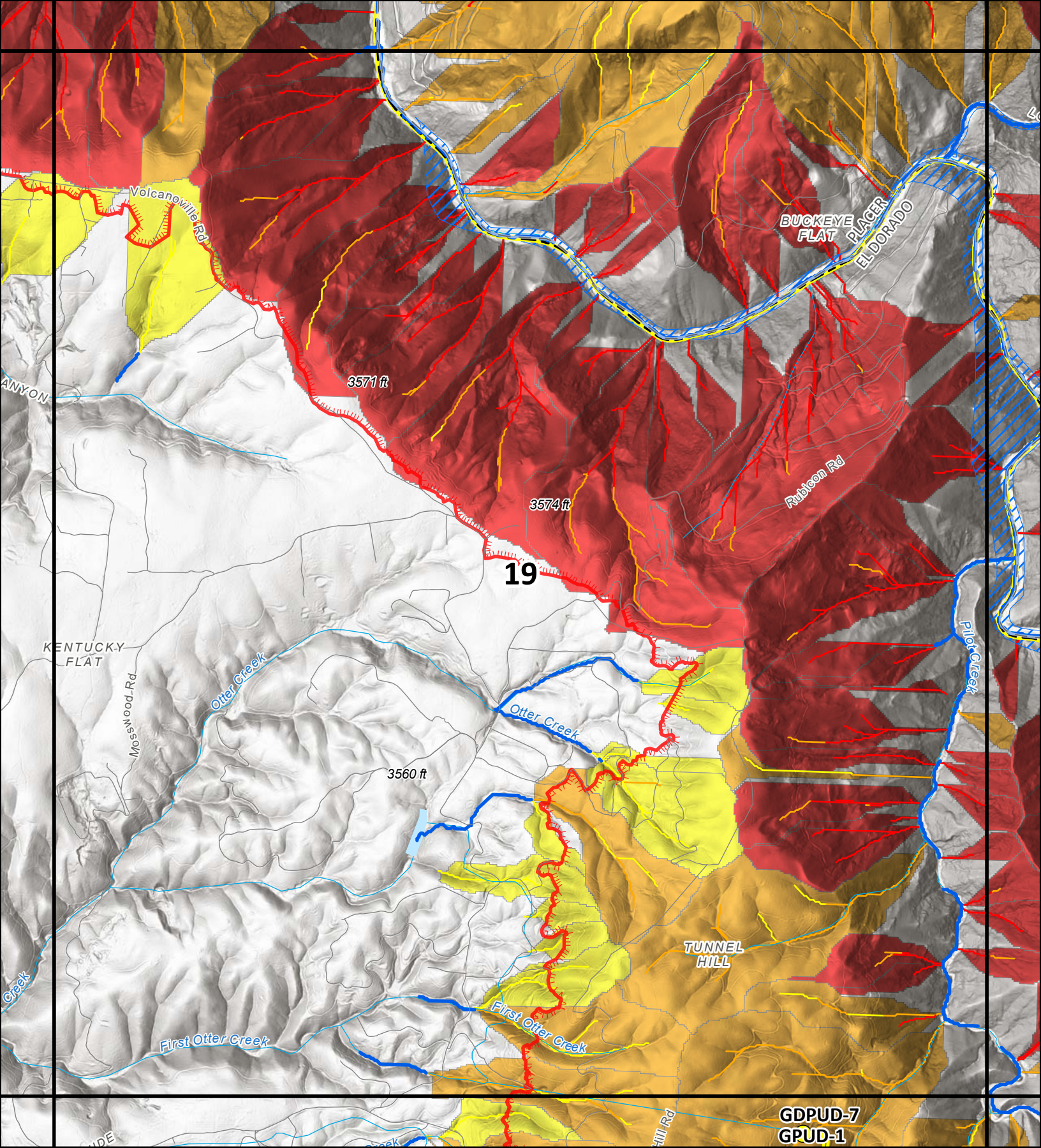

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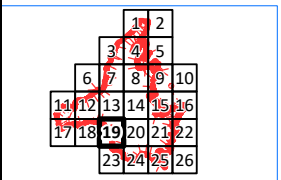

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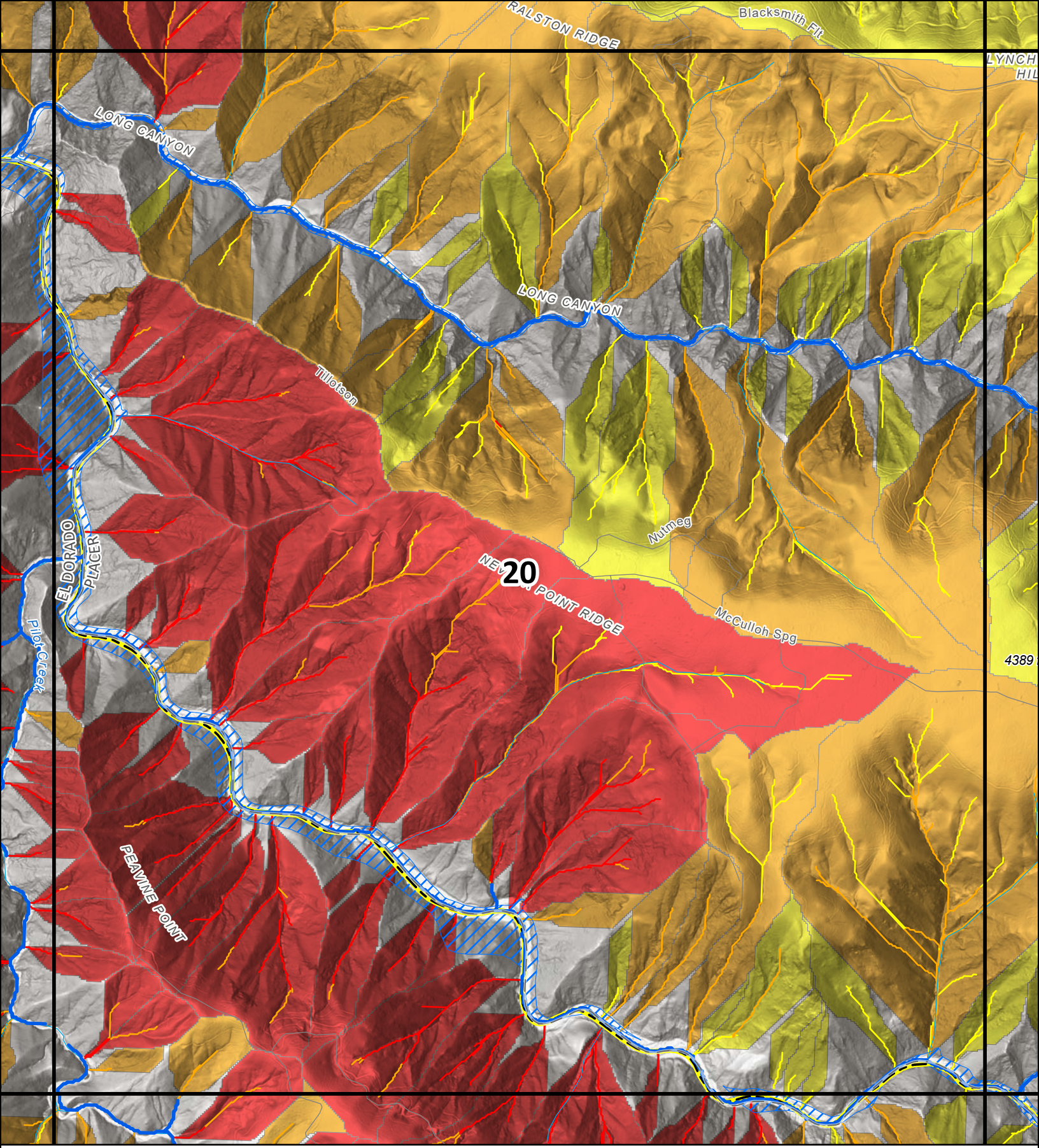

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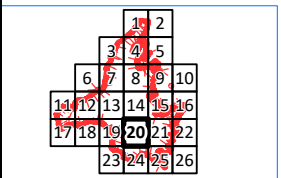

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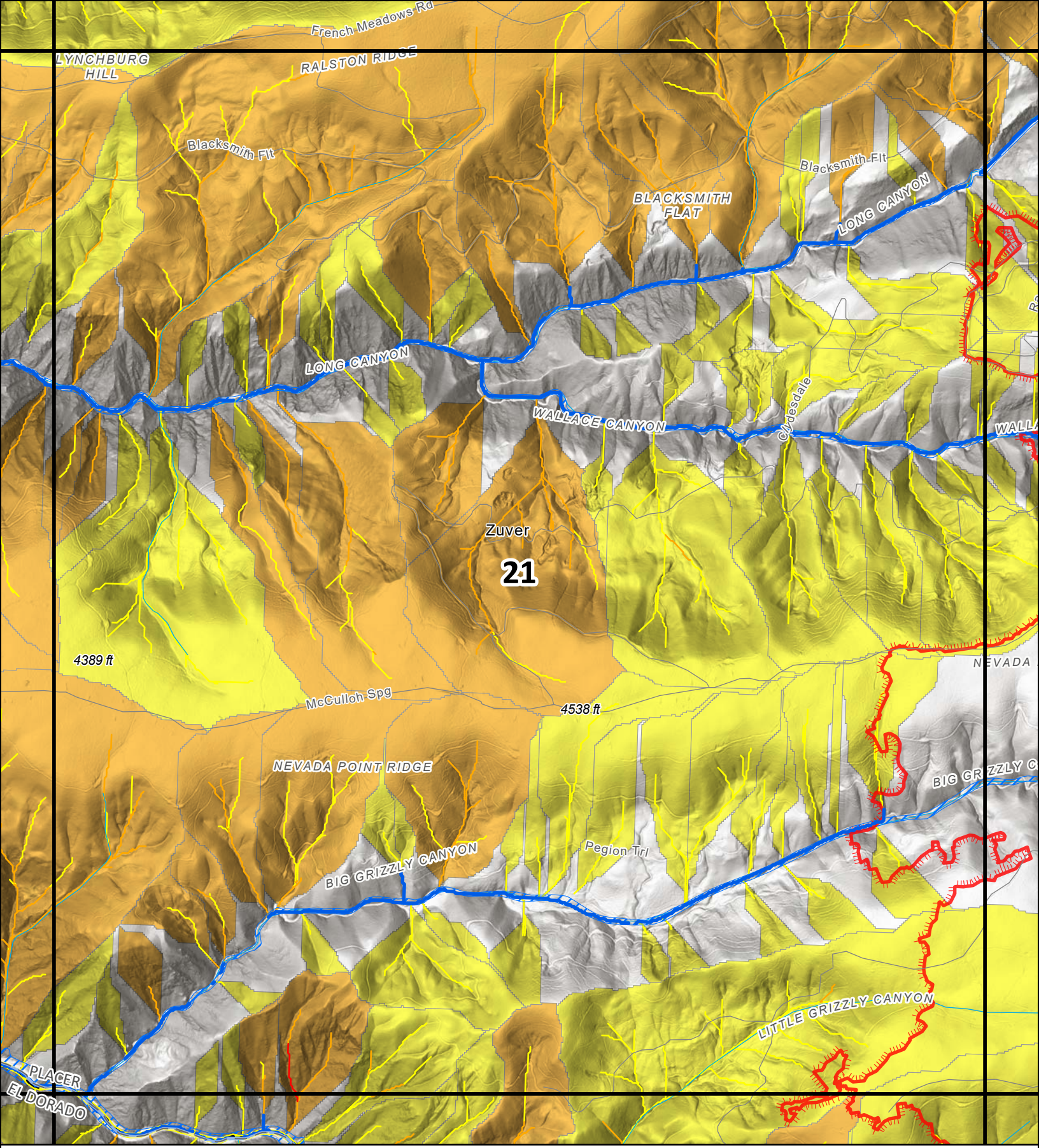

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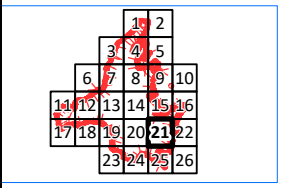

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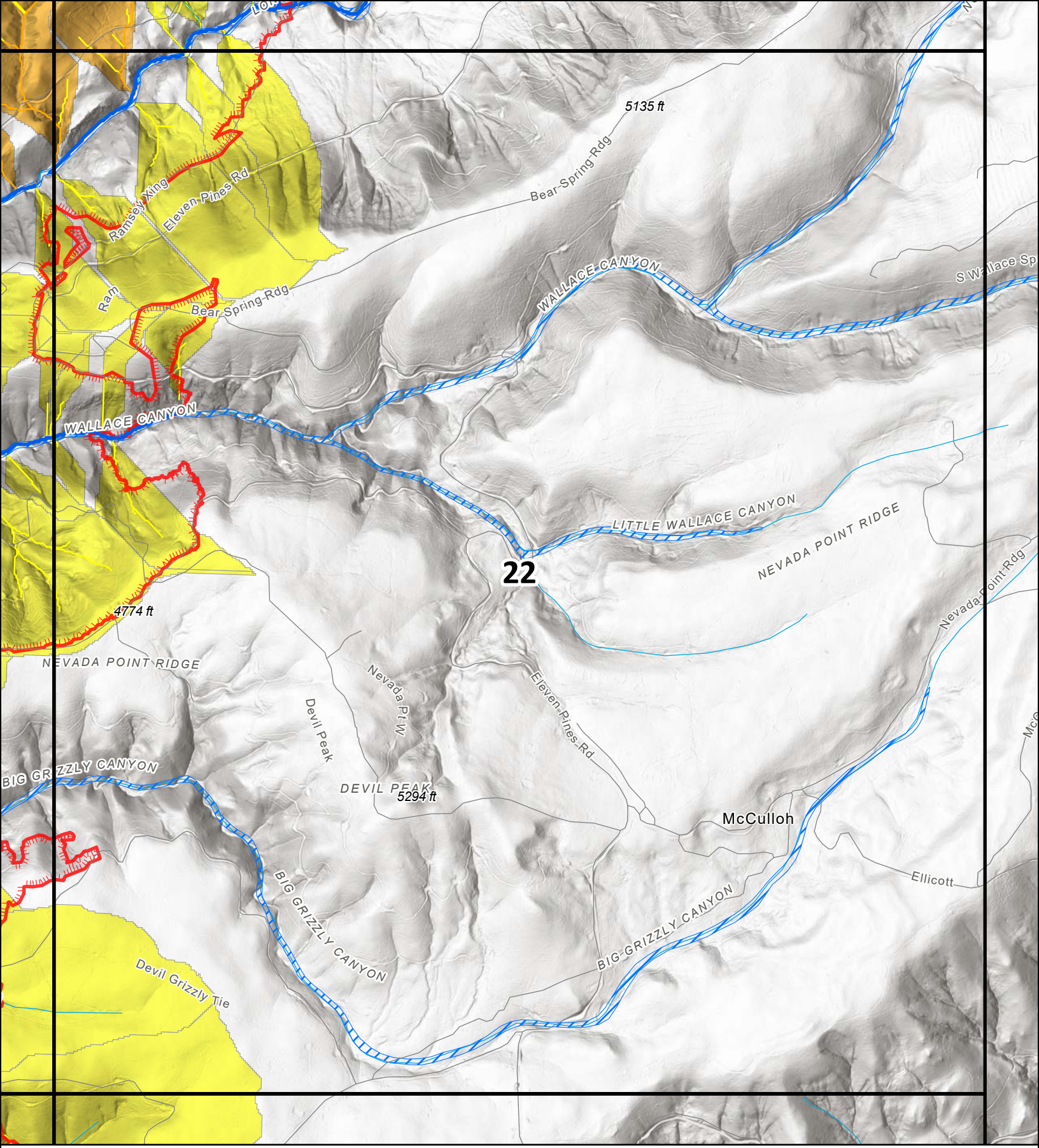

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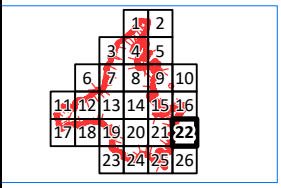

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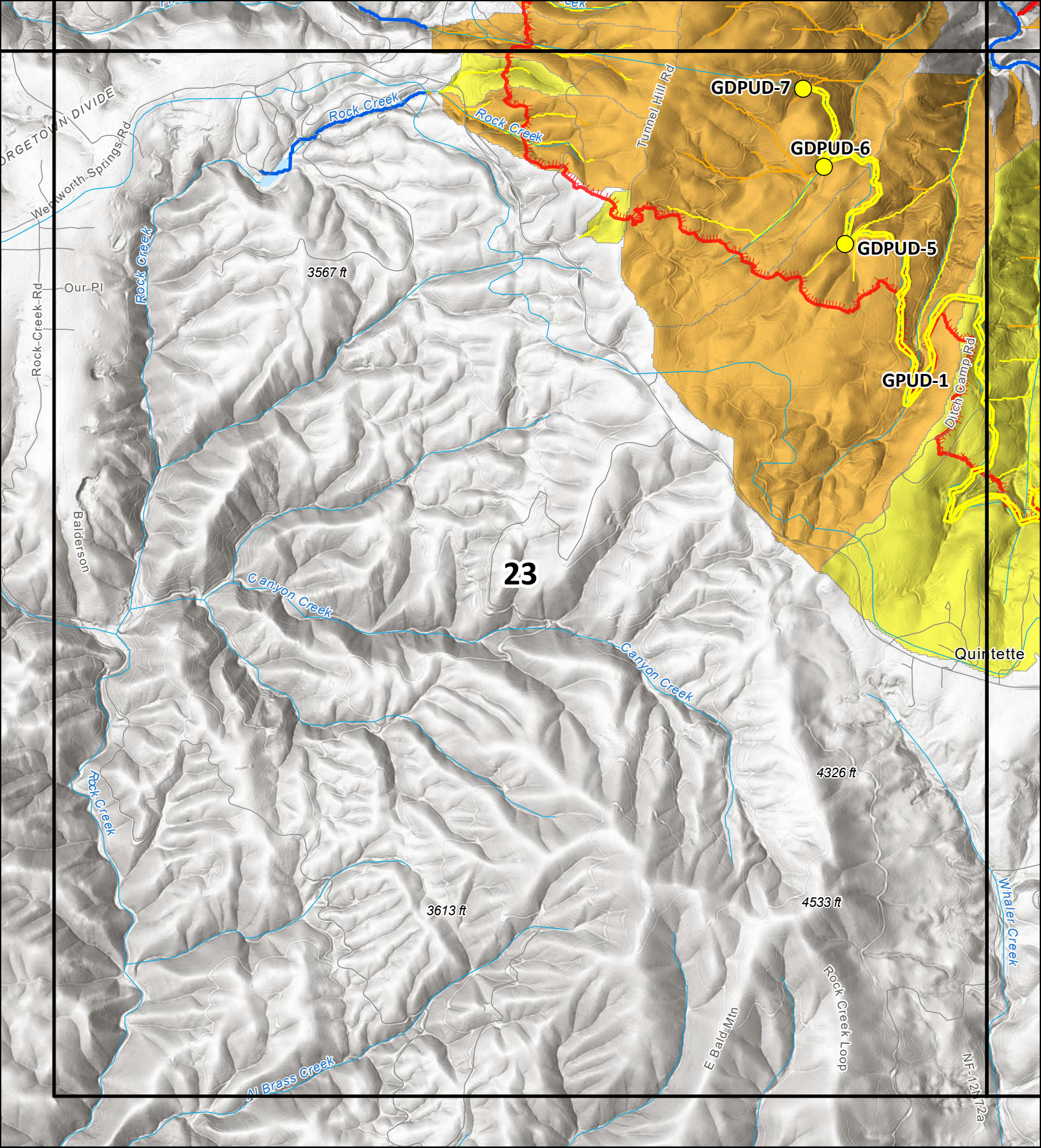

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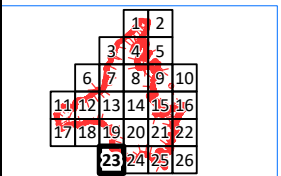

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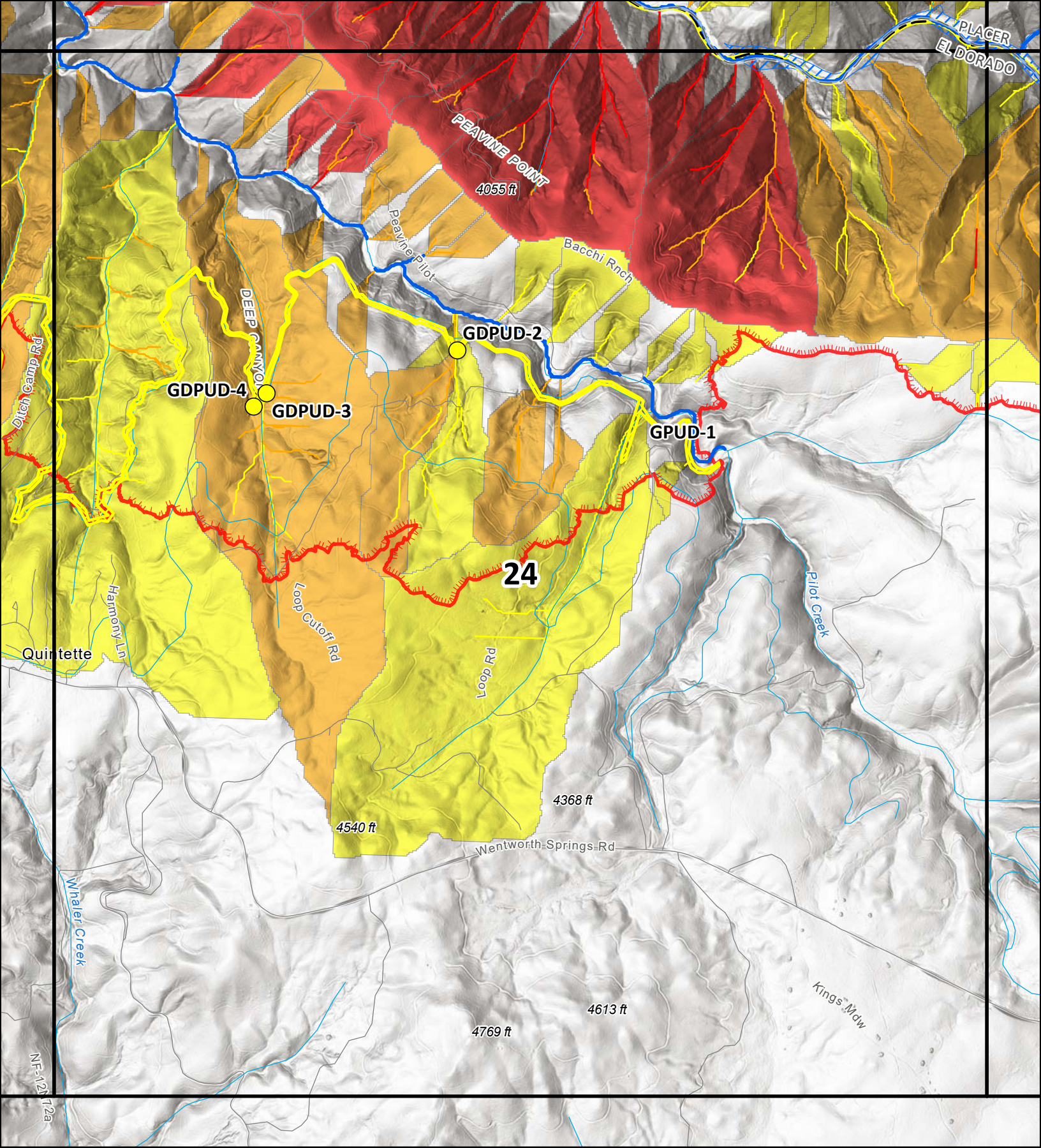

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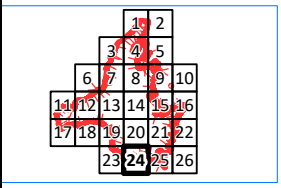

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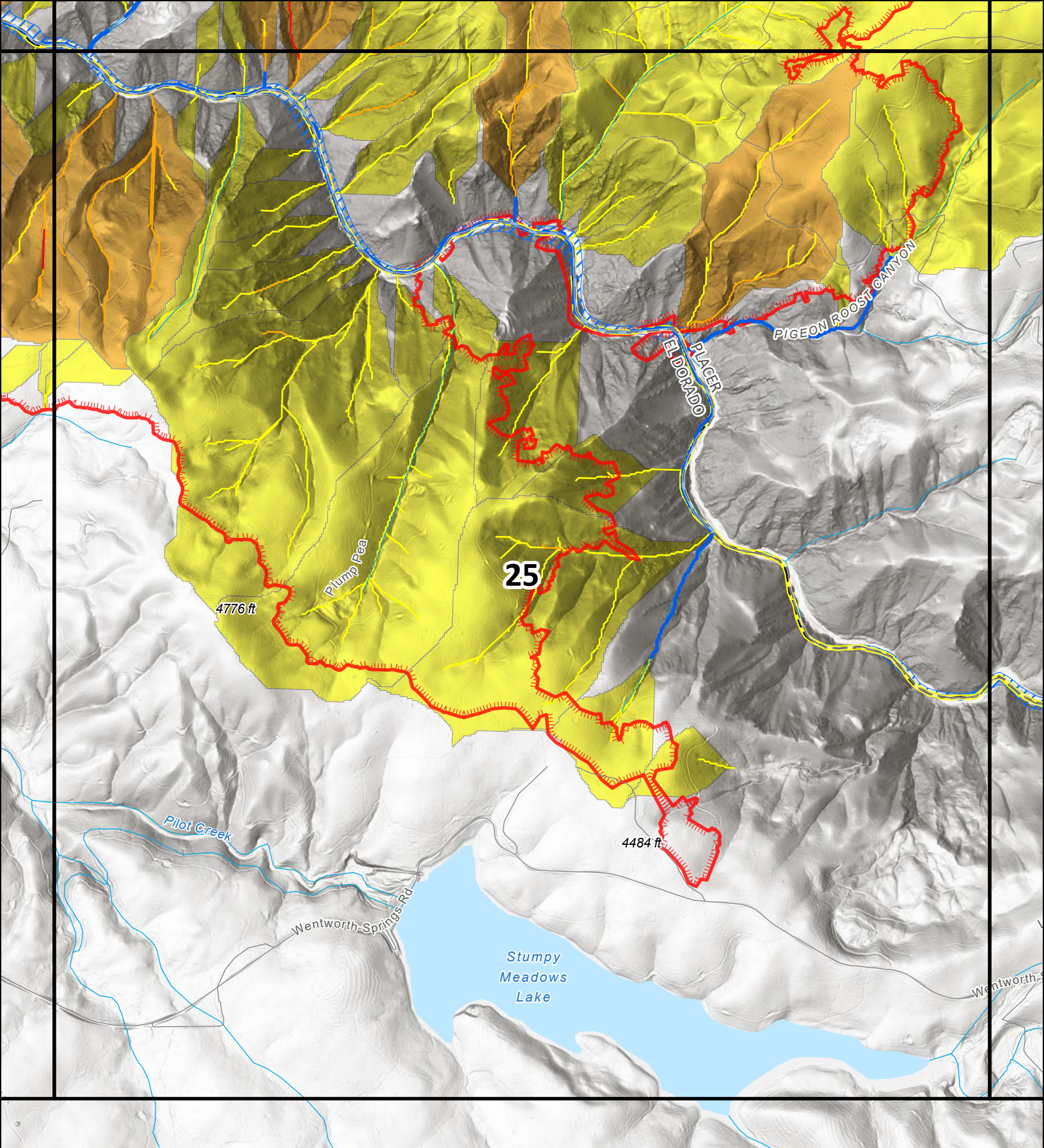

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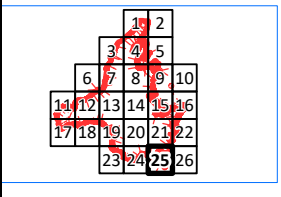
CA-TNF-001371
Mosquito Fire



Value at Risk (Point)

Potential hazard to life

- low
- moderate
- high

Values at Risk (Polygon)

Potential hazard to life

- low
- moderate
- high

Segment Combined Hazard

15min 24mm/hr

- Low
- Moderate
- High

Basin Combined Hazard

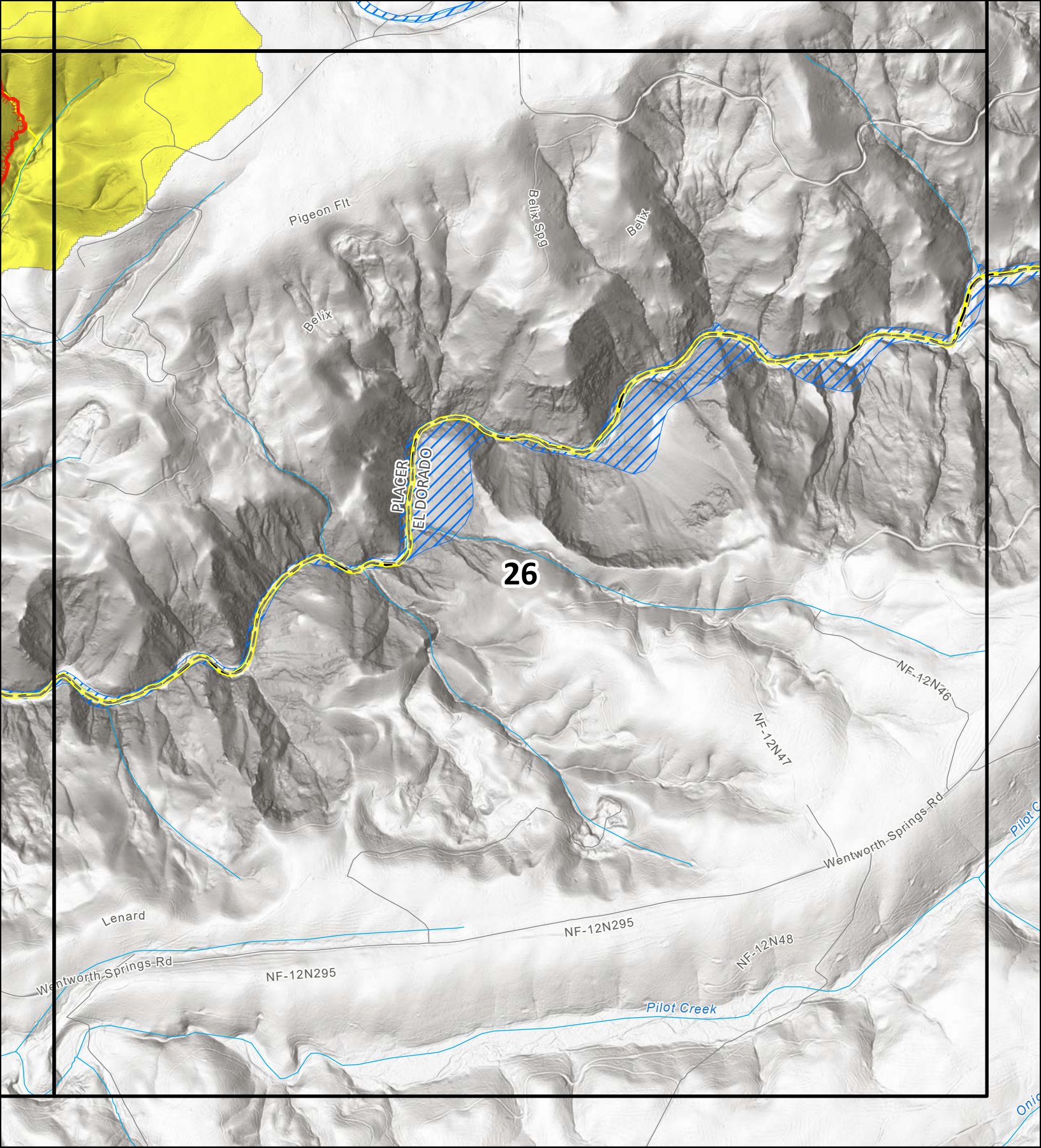
15min 24mm/hr

- Low
- Moderate
- High

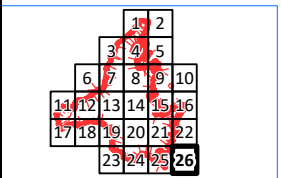
- USGS Watchstream
- FEMA/DWR Floodplain
- Fire Perimeter

0 0.07 0.15 0.3 Miles

N



Incident:
CA-TNF-001371
Mosquito Fire



Value at Risk (Point)

Potential hazard to life

- low
- moderate
- high

Values at Risk (Polygon)

Potential hazard to life

- low
- moderate
- high

Segment Combined Hazard

15min 24mm/hr

- Low
- Moderate
- High

Basin Combined Hazard

15min 24mm/hr

- Low
- Moderate
- High

- USGS Watchstream
- FEMA/DWR Floodplain
- Fire Perimeter

N

0 0.07 0.15 0.3 Miles

VALUE AT RISK DETAIL

Incident: Mosquito Fire *Incident Number: CA-TNF-001371*

Community: **Georgetown Divide Public Utilities District**

Site Number: **GDPUD-1**

Feature: **water supply ditch**

Feature Category: **utilities**

Field Observation or Potential Hazard: Critical water supply infrastructure that serves as primary water source for over 10,000 residents. The majority of the ditch alignment within the burned area lies within high and moderate burn severity.

Potential Hazard to Life: **low**

Potential Hazard to Property: **high**

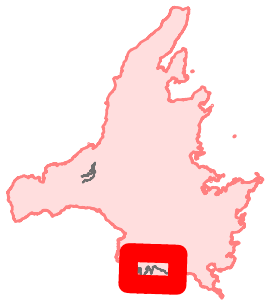
Preliminary Emergency Protective Measures (1): **Monitor and maintain**

Preliminary Emergency Protective Measures (2): **Early Warning**

Preliminary Emergency Protective Measures (3):

Description: GDPUD should consider readying suitable equipment to address physical impacts to the ditch alignment that are likely to occur in the post-fire setting such as, tree fall, cutslope failures, utility access road failures, and ditch plugging.

LOCATION AND PHOTO



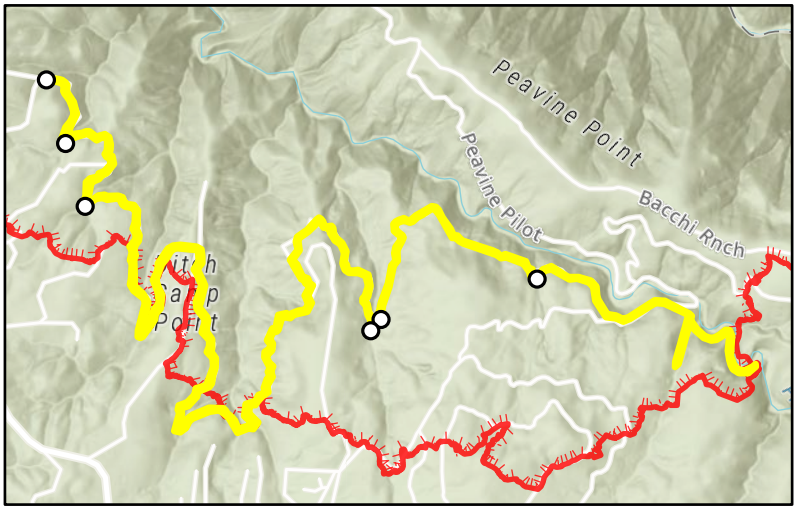
Value at Risk (Point)

Values at Risk (Polygon)

Values at Risk (Polygon) (Focused)

Fire Perimeter

Scale: 1:49,500



VALUE AT RISK DETAIL

Incident: Mosquito Fire *Incident Number: CA-TNF-001371*

Community: **Gorman Ranch Road**

Site Number: **GOR-1**

Feature: **Gorman Ranch Road infrastructure**

Feature Category: **multiple**

Field Observation or Potential Hazard: NA

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

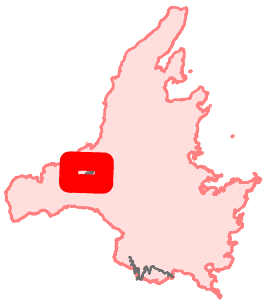
Preliminary Emergency Protective Measures (1): **Monitor and maintain**

Preliminary Emergency Protective Measures (2): **Signage**

Preliminary Emergency Protective Measures (3): **Traffic control**

Description: Placer County Roads Department may consider reducing diversion potential at stream crossings along the Gorman Ranch Road alignment to prevent discharge of diverted stream flows onto potentially sensitive slopes.

LOCATION AND PHOTO



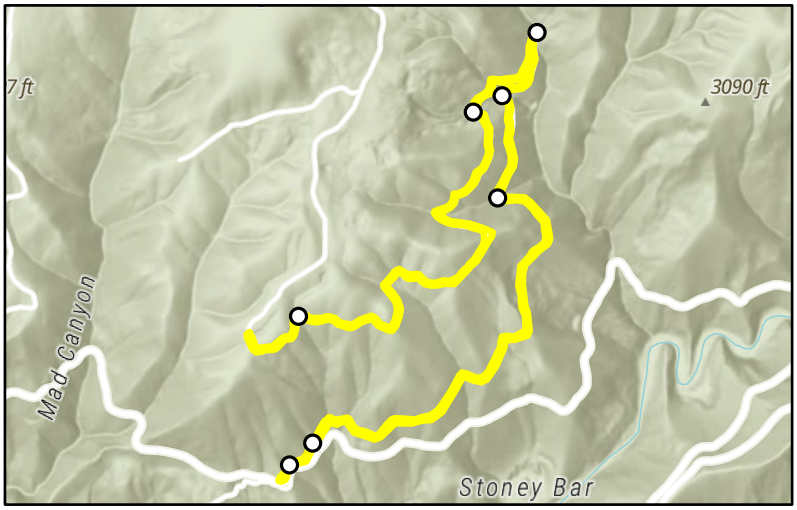
Value at Risk (Point)

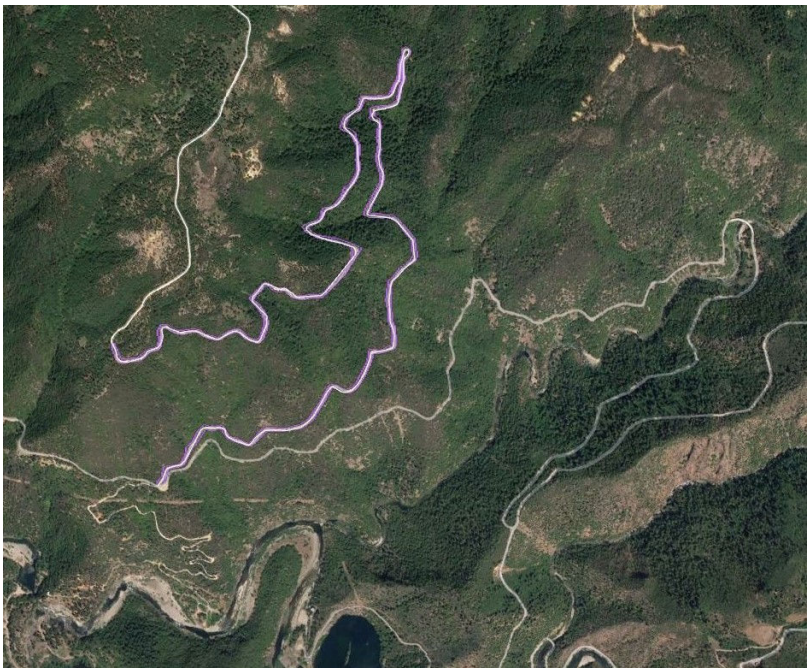
Values at Risk (Polygon)

Values at Risk (Polygon) (Focused)

Fire Perimeter

Scale: 1:35,500





VALUE AT RISK DETAIL

Incident: Mosquito Fire ***Incident Number: CA-TNF-001371***

Community: **Georgetown Divide Public Utilities District**

Site Number: **GDPUD-2**

Feature: **water supply ditch**

Feature Category: **utilities**

Field Observation or Potential Hazard: Crossing is at elevated risk of failure via plugging and flow diversion. Crossing failure may adversely impact the associated infrastructure via potentially significant delivery of sediment and debris to the ditch alignment.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures (1): **Monitor and maintain**

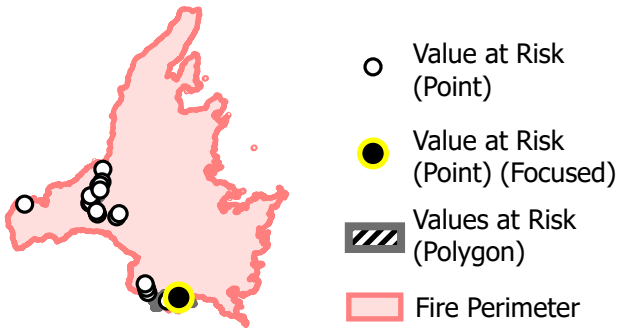
Preliminary Emergency Protective Measures (2):

Preliminary Emergency Protective Measures (3):

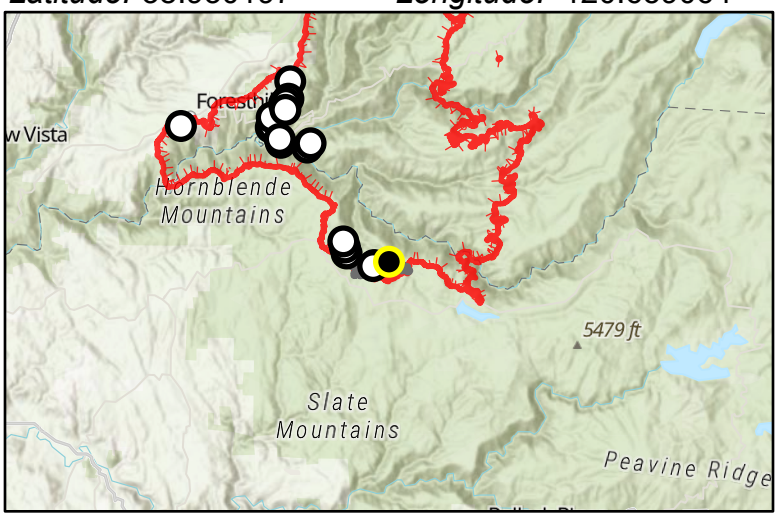
Preliminary Emergency Protective Measures (4):

Description: GDPUD should consider clearing burned debris from the immediate upstream channel reach to reduce the potential for adverse impacts to the ditch infrastructure.

LOCATION AND PHOTO



Latitude: 38.930197 *Longitude:* -120.659064



VALUE AT RISK DETAIL

Incident: Mosquito Fire ***Incident Number: CA-TNF-001371***

Community: **Georgetown Divide Public Utilities District**

Site Number: **GDPUD-3**

Feature: **water supply ditch**

Feature Category: **utilities**

Field Observation or Potential Hazard: Slope failure near the ditch alignment may impact the infrastructure via potentially significant inputs of sediment and debris. Slopes should be monitored for potential slope instability and mitigated as necessary.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Monitor and maintain**

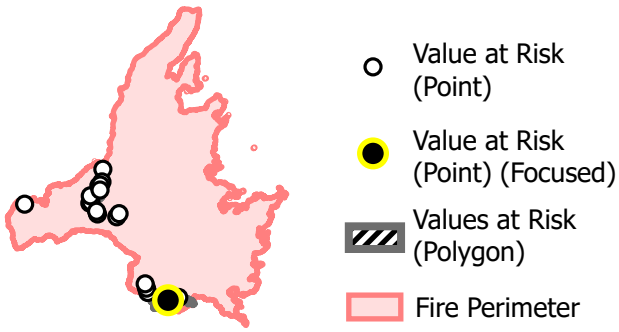
Preliminary Emergency Protective Measures (2):

Preliminary Emergency Protective Measures (3):

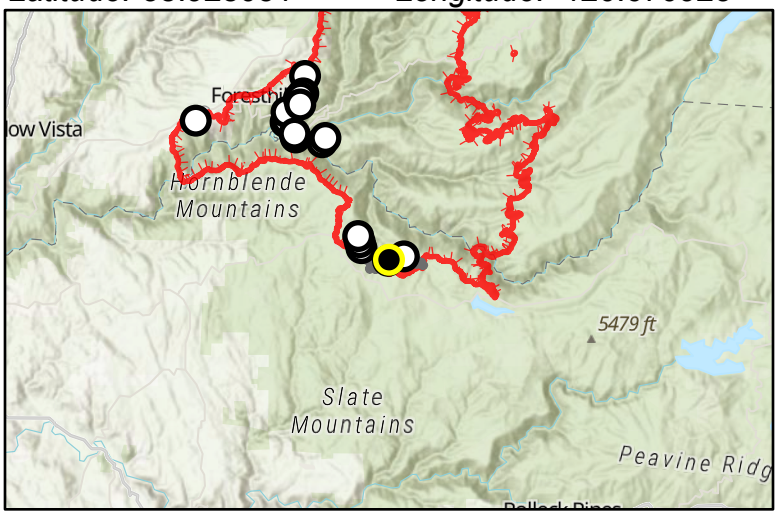
Preliminary Emergency Protective Measures (4):

Description:

LOCATION AND PHOTO



Latitude: 38.928051 *Longitude:* -120.670923



VALUE AT RISK DETAIL

Incident: Mosquito Fire ***Incident Number: CA-TNF-001371***

Community: **Georgetown Divide Public Utilities District**

Site Number: **GDPUD-4**

Feature: **water supply ditch**

Feature Category: **utilities**

Field Observation or Potential Hazard: Crossing is at elevated risk of failure via plugging and flow diversion. Crossing failure may adversely impact the associated infrastructure via potentially significant delivery of sediment and debris to the ditch alignment.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures (1): **Monitor and maintain**

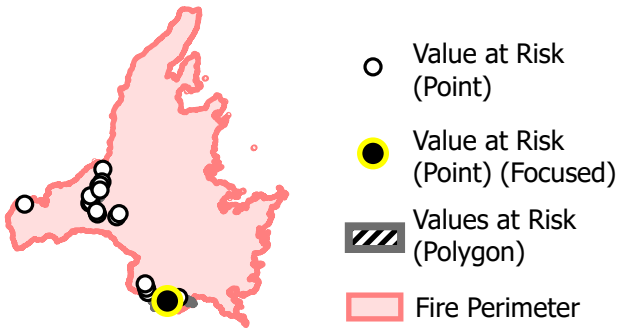
Preliminary Emergency Protective Measures (2): **Clear and maintain basin**

Preliminary Emergency Protective Measures (3):

Preliminary Emergency Protective Measures (4):

Description: GDPUD should consider clearing burned debris from the immediate upstream channel reach to reduce the potential for plugging and associated adverse impacts to the ditch infrastructure.

LOCATION AND PHOTO



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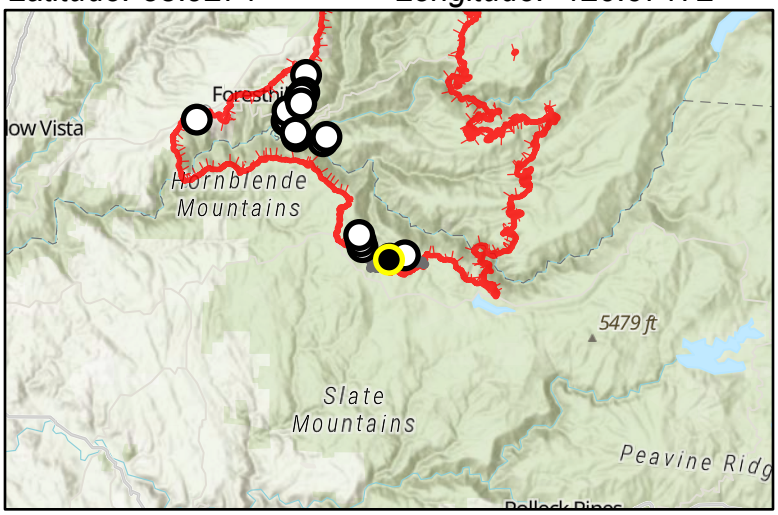


VALUE AT RISK DETAIL

Incident: Mosquito Fire ***Incident Number: CA-TNF-001371***

Community: **Georgetown Divide Public Utilities District**

Site Number: **GDPUD-5**

Feature: **water supply ditch**

Feature Category: **utilities**

Field Observation or Potential Hazard: Crossing is at elevated risk of failure via plugging and flow diversion. Crossing failure may adversely impact the associated infrastructure via potentially significant delivery of sediment and debris to the ditch alignment.

Potential Hazard to Life: **low**

Potential Hazard to Property: **low**

Preliminary Emergency Protective Measures (1): **Monitor and maintain**

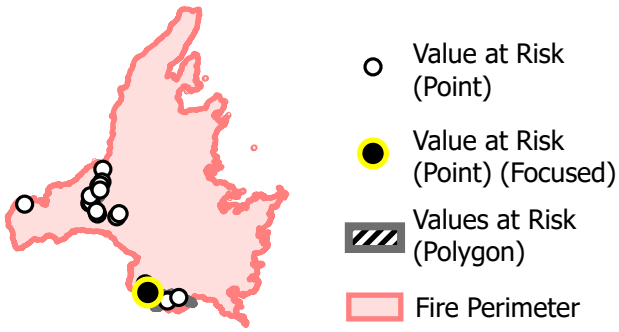
Preliminary Emergency Protective Measures (2): **Clear and maintain basin**

Preliminary Emergency Protective Measures (3):

Preliminary Emergency Protective Measures (4):

Description: GDPUD should consider clearing burned debris from the immediate upstream channel reach to reduce the potential for adverse impacts to the ditch infrastructure.

LOCATION AND PHOTO



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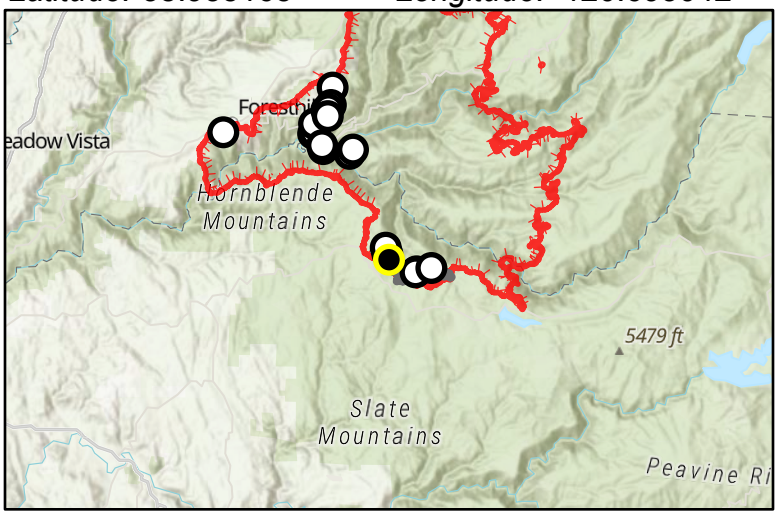


VALUE AT RISK DETAIL

Incident: Mosquito Fire ***Incident Number: CA-TNF-001371***

Community: **Georgetown Divide Public Utilities District**

Site Number: **GDPUD-6**

Feature: **water supply ditch**

Feature Category: **utilities**

Field Observation or Potential Hazard: Crossing is at elevated risk of failure via plugging and flow diversion. Crossing failure may adversely impact the associated infrastructure via potentially significant delivery of sediment and debris to the ditch alignment.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures (1): **Monitor and maintain**

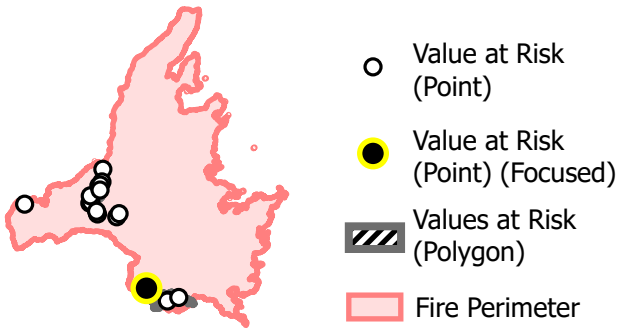
Preliminary Emergency Protective Measures (2):

Preliminary Emergency Protective Measures (3):

Preliminary Emergency Protective Measures (4):

Description: GDPUD should consider clearing burned debris from the immediate upstream channel reach to reduce the potential for adverse impacts to the ditch infrastructure.

LOCATION AND PHOTO



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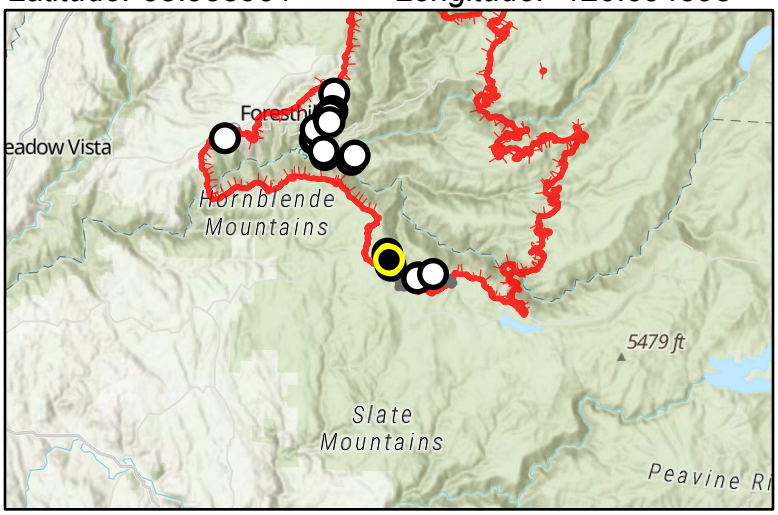


VALUE AT RISK DETAIL

Incident: Mosquito Fire *Incident Number: CA-TNF-001371*

Community: **Georgetown Divide Public Utilities District**

Site Number: **GDPUD-7**

Feature: **water supply ditch**

Feature Category: **utilities**

Field Observation or Potential Hazard: Failed crossing infrastructure over ditch poses a direct risk of delivery of uncontrolled volumes of sediment laden stream flow directly to the ditch immediately upstream of tunnel inlet.

Potential Hazard to Life: **low**

Potential Hazard to Property: **high**

Preliminary Emergency Protective Measures (1): **Monitor and maintain**

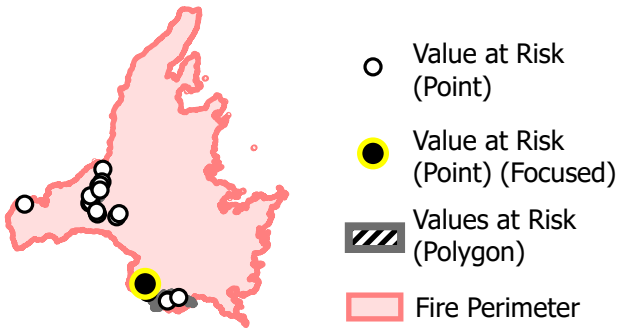
Preliminary Emergency Protective Measures (2): **Debris barrier**

Preliminary Emergency Protective Measures (3):

Preliminary Emergency Protective Measures (4):

Description: GDPUD should consider utilizing qualified licensed professionals (licensed civil/geotechnical engineer and/or licensed geologist) to perform a detailed evaluation and develop a crossing design to address risks to the ditch and tunnel.

LOCATION AND PHOTO



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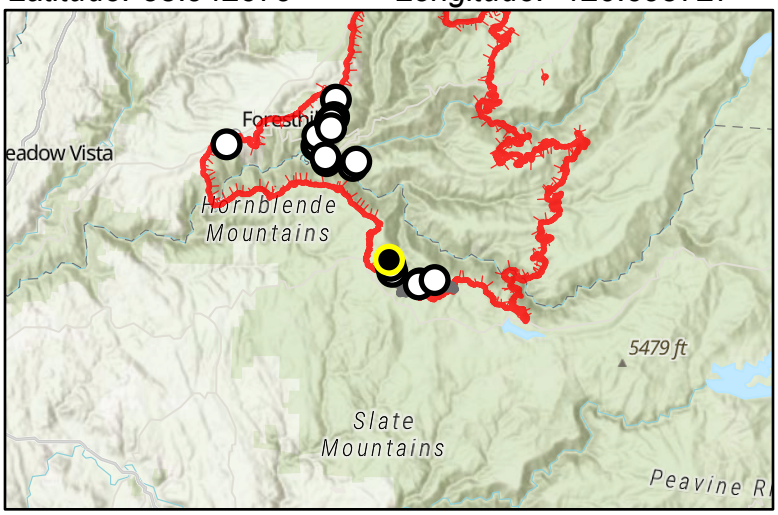


VALUE AT RISK DETAIL

Incident: Mosquito Fire *Incident Number: CA-TNF-001371*

Community: **Gorman Ranch Road**

Site Number: **GOR-2**

Feature: **stream crossing**

Feature Category: **drainage structure**

Field Observation or Potential Hazard: The crossing is receiving increased volumes of flow, sediment, and debris. The subsurface drain does not appear capable of conveying potential post-fire flow. Post-fire flows may continue to adversely impact this crossing and Mosquito Ridge Road.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures (1): **Monitor and maintain**

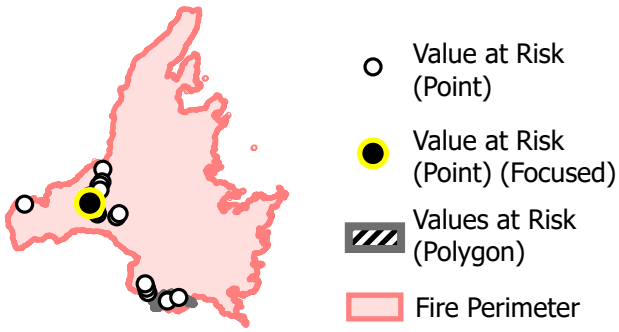
Preliminary Emergency Protective Measures (2): **Signage**

Preliminary Emergency Protective Measures (3): **Traffic control**

Preliminary Emergency Protective Measures (4):

Description: Placer County Roads Department (PCRD) should consider utilizing a qualified professional to evaluate the crossing and determine effective mitigation strategy for existing conditions.

LOCATION AND PHOTO



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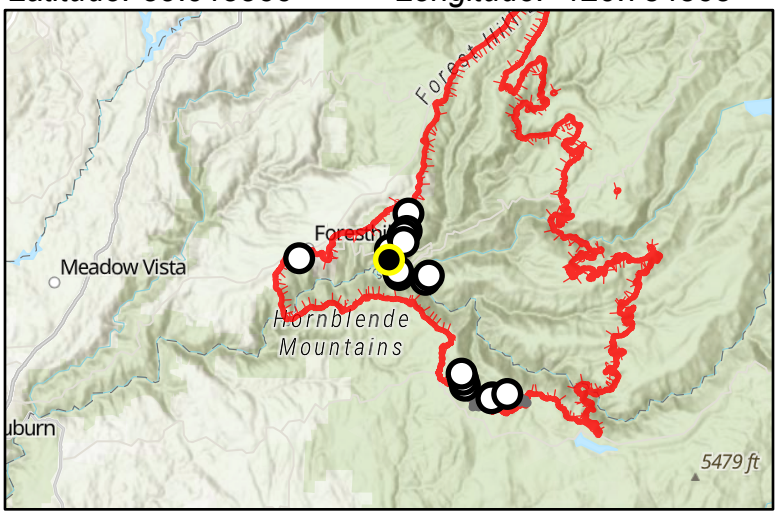


VALUE AT RISK DETAIL

Incident: Mosquito Fire *Incident Number: CA-TNF-001371*

Community: **Gorman Ranch Road**

Site Number: **GOR-3**

Feature: **stream crossing**

Feature Category: **drainage structure**

Field Observation or Potential Hazard: The crossing is receiving increased volumes of flow, sediment, and debris. The subsurface drain does not appear capable of conveying potential post-fire flow. Post-fire flows may continue to adversely impact this crossing and Mosquito Ridge Road.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures (1): **Monitor and maintain**

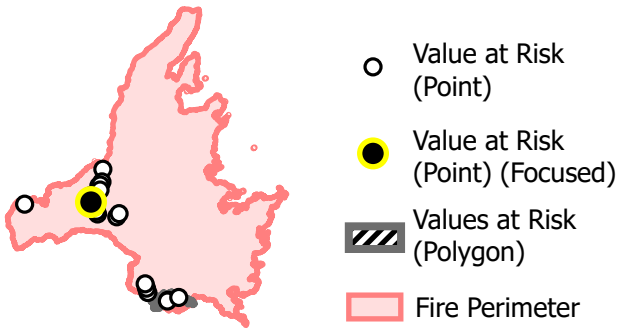
Preliminary Emergency Protective Measures (2): **Signage**

Preliminary Emergency Protective Measures (3): **Traffic control**

Preliminary Emergency Protective Measures (4):

Description: Placer County Roads Department (PCRD) should consider utilizing a qualified professional to evaluate the crossing and determine effective mitigation strategy for existing conditions.

LOCATION AND PHOTO



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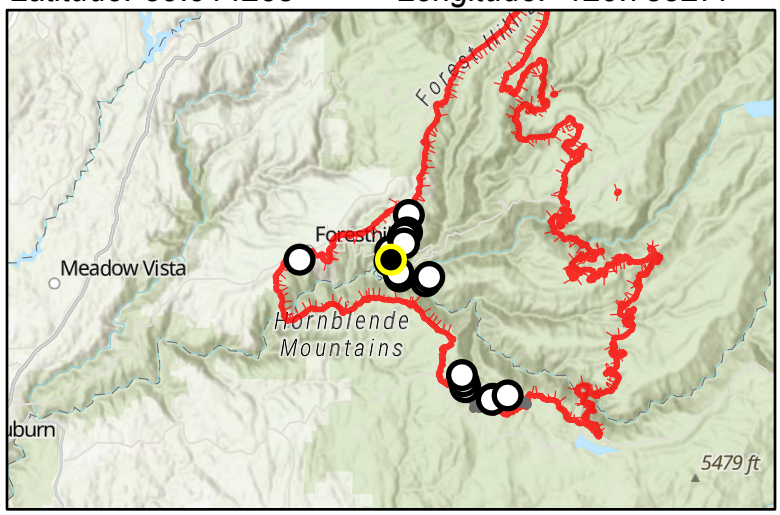


VALUE AT RISK DETAIL

Incident: Mosquito Fire *Incident Number: CA-TNF-001371*

Community: **Gorman Ranch Road**

Site Number: **GOR-4**

Feature: **stream crossing**

Feature Category: **drainage structure**

Field Observation or Potential Hazard: Dysfunctional culvert at stream crossing may fail and deliver sediment and debris downstream, potentially impacting downstream road infrastructure on Mosquito Ridge Road.

Potential Hazard to Life: **low**

Potential Hazard to Property: **high**

Preliminary Emergency Protective Measures (1): **Monitor and maintain**

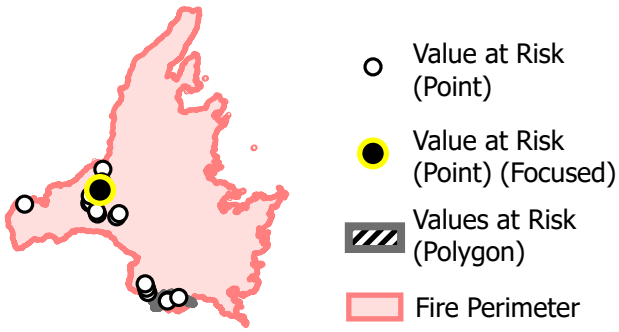
Preliminary Emergency Protective Measures (2):

Preliminary Emergency Protective Measures (3):

Preliminary Emergency Protective Measures (4):

Description: Placer County Roads Department should consider utilizing a qualified professional to evaluate the crossing and determine effective mitigation strategy for existing conditions

LOCATION AND PHOTO



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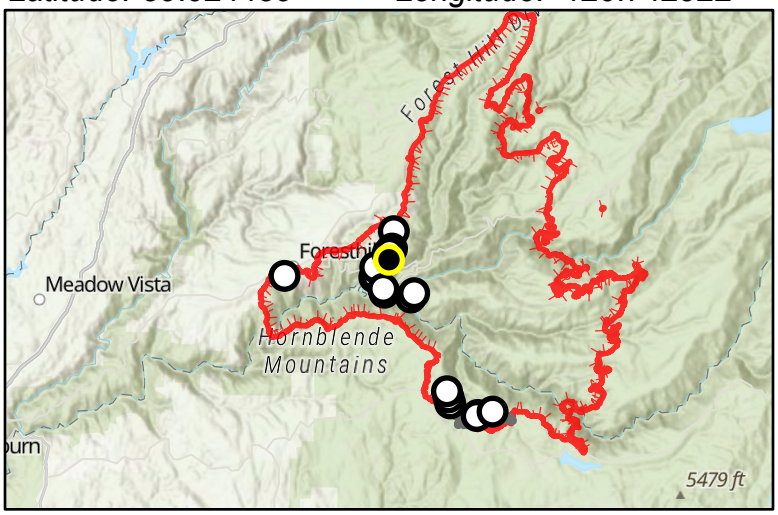


VALUE AT RISK DETAIL

Incident: Mosquito Fire ***Incident Number: CA-TNF-001371***

Community: **Gorman Ranch Road**

Site Number: **GOR-5**

Feature: **stream crossing**

Feature Category: **drainage structure**

Field Observation or Potential Hazard: Potential crossing failures may transport debris and sediment downstream and impact infrastructure on Mosquito Ridge Road.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures (1): **Monitor and maintain**

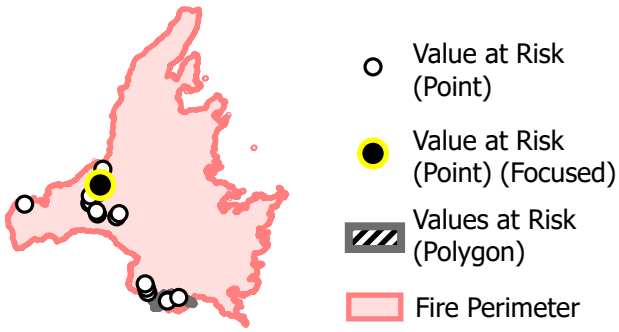
Preliminary Emergency Protective Measures (2):

Preliminary Emergency Protective Measures (3):

Preliminary Emergency Protective Measures (4):

Description:

LOCATION AND PHOTO



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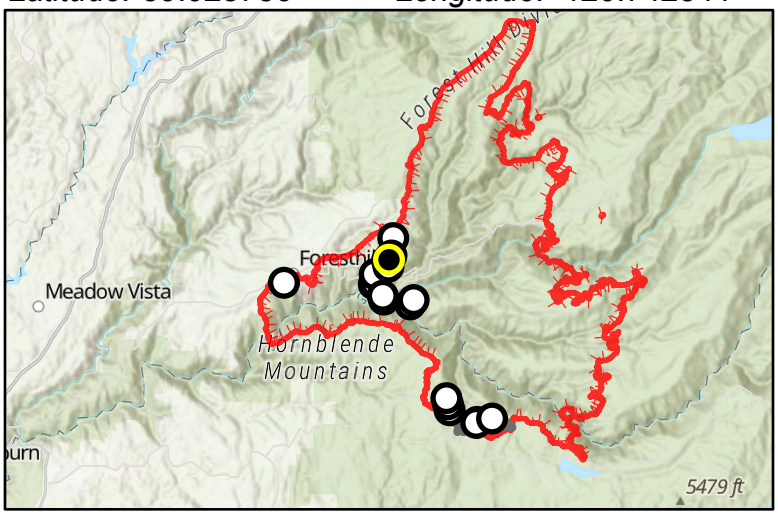


VALUE AT RISK DETAIL

Incident: Mosquito Fire ***Incident Number: CA-TNF-001371***

Community: **Gorman Ranch Road**

Site Number: **GOR-6**

Feature: **stream crossing**

Feature Category: **drainage structure**

Field Observation or Potential Hazard: Potential crossing failure may transport debris and sediment downstream and impact downstream infrastructure on Mosquito Ridge Road.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures (1): **Monitor and maintain**

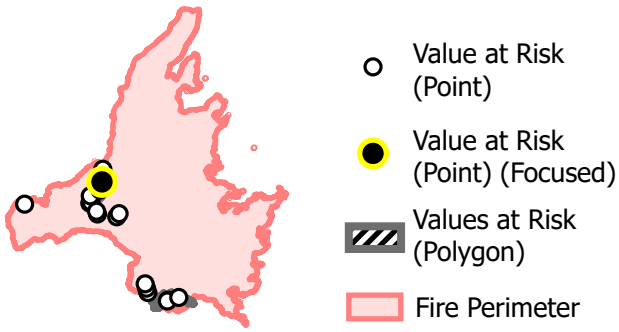
Preliminary Emergency Protective Measures (2):

Preliminary Emergency Protective Measures (3):

Preliminary Emergency Protective Measures (4):

Description:

LOCATION AND PHOTO



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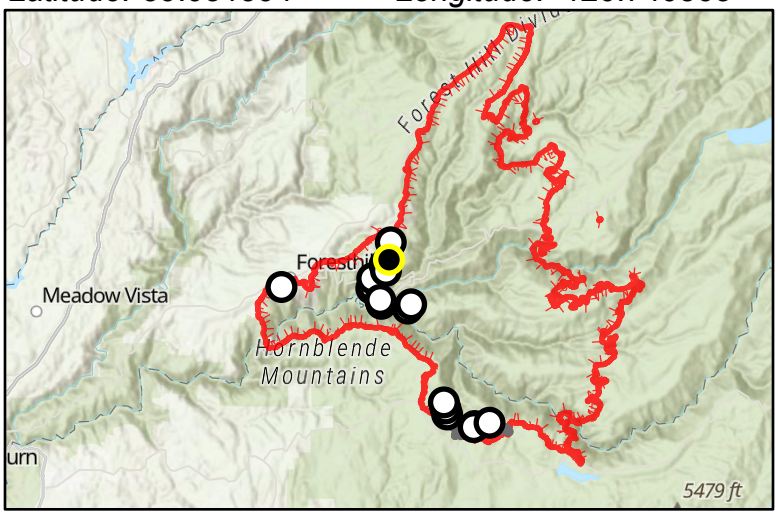


VALUE AT RISK DETAIL

Incident: Mosquito Fire *Incident Number: CA-TNF-001371*

Community: **Gorman Ranch Road**

Site Number: **GOR-7**

Feature: **stream crossing**

Feature Category: **drainage structure**

Field Observation or Potential Hazard: Stream crossing may be prone to increased risk of failure due to existing culvert orientation and post-fire dynamics such as increased rates of runoff and sediment/debris transport. Crossing failure may increase the potential for downstream impacts.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures (1): **Monitor and maintain**

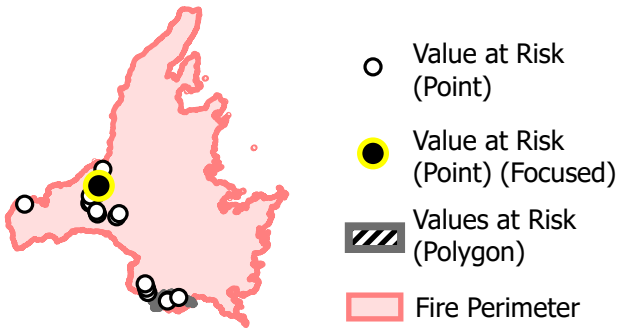
Preliminary Emergency Protective Measures (2):

Preliminary Emergency Protective Measures (3):

Preliminary Emergency Protective Measures (4):

Description: Placer County Roads Department should consider utilizing a qualified professional to evaluate the crossing and determine effective mitigation strategy for existing post-fire conditions.

LOCATION AND PHOTO



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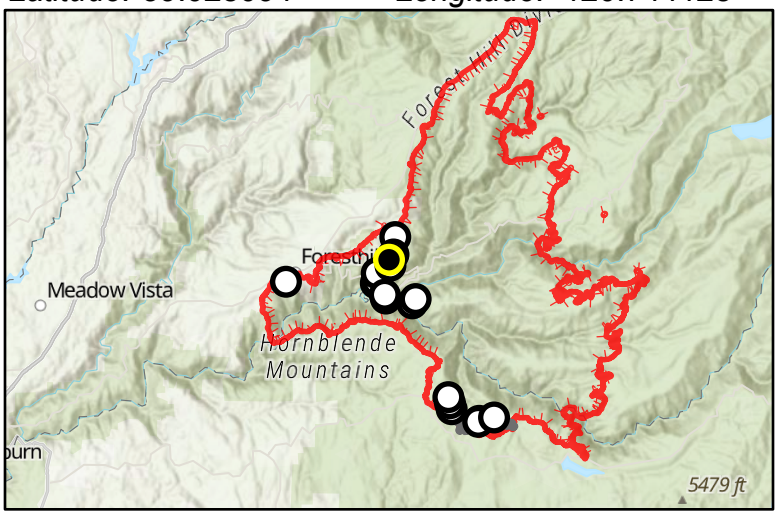


VALUE AT RISK DETAIL

Incident: Mosquito Fire *Incident Number: CA-TNF-001371*

Community: **Gorman Ranch Road**

Site Number: **GOR-8**

Feature: **stream crossing**

Feature Category: **drainage structure**

Field Observation or Potential Hazard: Stream crossing culvert may be prone to plugging and subsequent failure or overtopping in response to post-fire run off. Crossing malfunction may induce subsequent downslope impacts to lower Gorman Ranch Road and Mosquito Ridge Road.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Monitor and maintain**

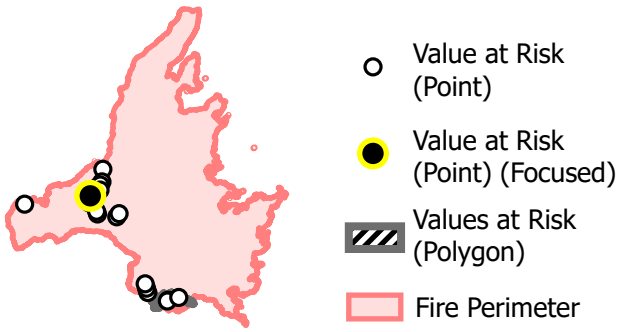
Preliminary Emergency Protective Measures (2):

Preliminary Emergency Protective Measures (3):

Preliminary Emergency Protective Measures (4):

Description:

LOCATION AND PHOTO



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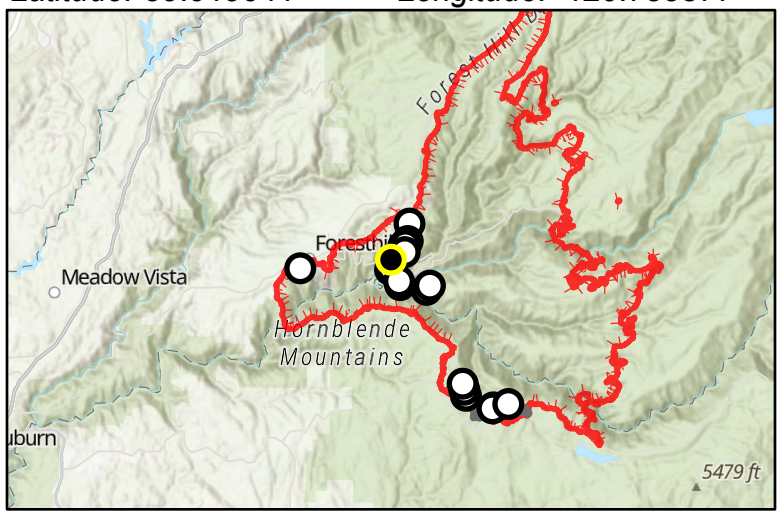


VALUE AT RISK DETAIL

Incident: Mosquito Fire *Incident Number: CA-TNF-001371*

Community: **Rubicon River Gorge**

Site Number: **MOS-1**

Feature: **PCWA Ralston Powerhouse**

Feature Category: **utilities**

Field Observation or Potential Hazard: The steep rocky upslope areas were burned at a moderate severity, and post-fire conditions may exacerbate the existing rock fall hazard in the vicinity of the utility installation.

Potential Hazard to Life: **moderate** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Monitor and maintain**

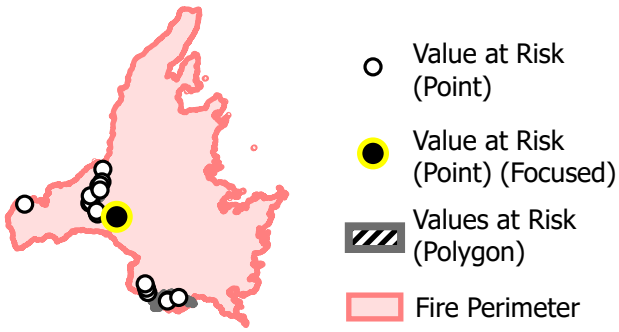
Preliminary Emergency Protective Measures (2):

Preliminary Emergency Protective Measures (3):

Preliminary Emergency Protective Measures (4):

Description: Extra caution should be afforded during the initial years proceeding fire event. PCWA should consider utilizing a qualified professional to evaluate the existing rockfall hazard and determine effective mitigation strategies for existing conditions.

LOCATION AND PHOTO



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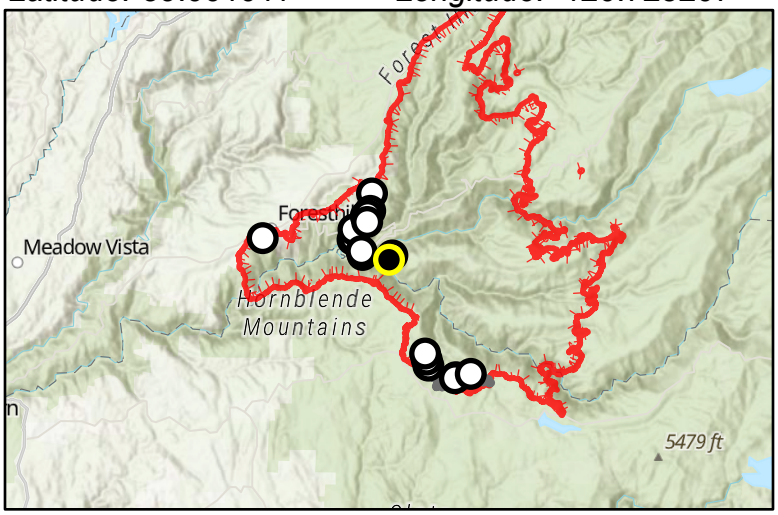


VALUE AT RISK DETAIL

Incident: Mosquito Fire ***Incident Number: CA-TNF-001371***

Community: **Ralston Powerhouse Butterfly Valve House**

Site Number: **MOS-2**

Feature: **PCWA Ralston penstock infrastructure**

Feature Category: **utilities**

Field Observation or Potential Hazard: Steep rocky cutslopes and slope face above utility structure and associated infrastructure may be at increased risk of adverse impact from rockfall hazard.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **moderate**

Preliminary Emergency Protective Measures (1): **Monitor and maintain**

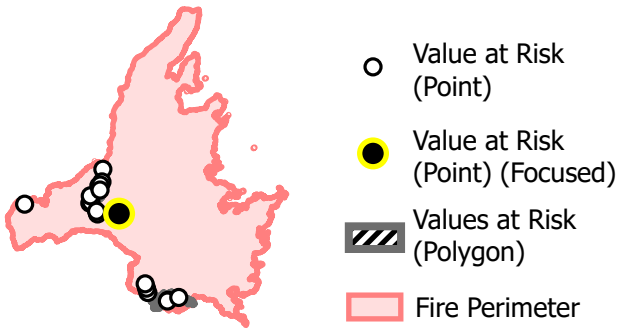
Preliminary Emergency Protective Measures (2):

Preliminary Emergency Protective Measures (3):

Preliminary Emergency Protective Measures (4):

Description: Extra caution should be afforded during the initial years proceeding fire event. PCWA should consider utilizing a qualified professional to evaluate the existing rockfall hazard and determine effective mitigation strategies for existing conditions.

LOCATION AND PHOTO



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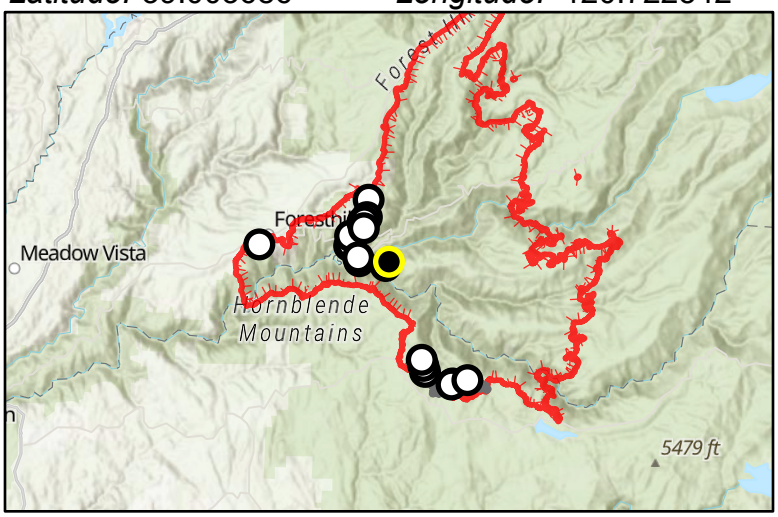


VALUE AT RISK DETAIL

Incident: Mosquito Fire *Incident Number: CA-TNF-001371*

Community: **Oxbow Reservoir**

Site Number: **MOS-3**

Feature: **PCWA utility infrastructure**

Feature Category: **utilities**

Field Observation or Potential Hazard: Post-fire impacts to flow dynamics within the associated tributary basins pose a risk of adverse impact to utility and recreational infrastructure in the vicinity of the PCWA reservoir.

Potential Hazard to Life: **low** *Potential Hazard to Property:* **high**

Preliminary Emergency Protective Measures (1): **Early Warning**

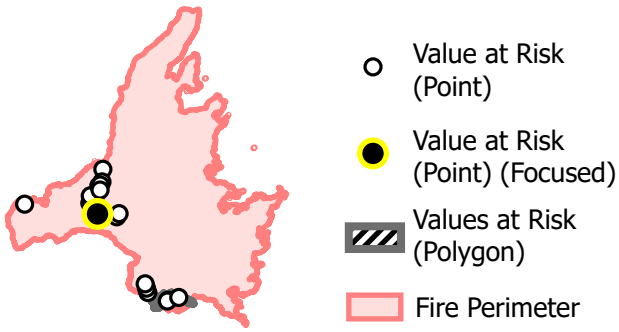
Preliminary Emergency Protective Measures (2): **Debris barrier**

Preliminary Emergency Protective Measures (3): **Monitor and maintain**

Preliminary Emergency Protective Measures (4):

Description:

LOCATION AND PHOTO



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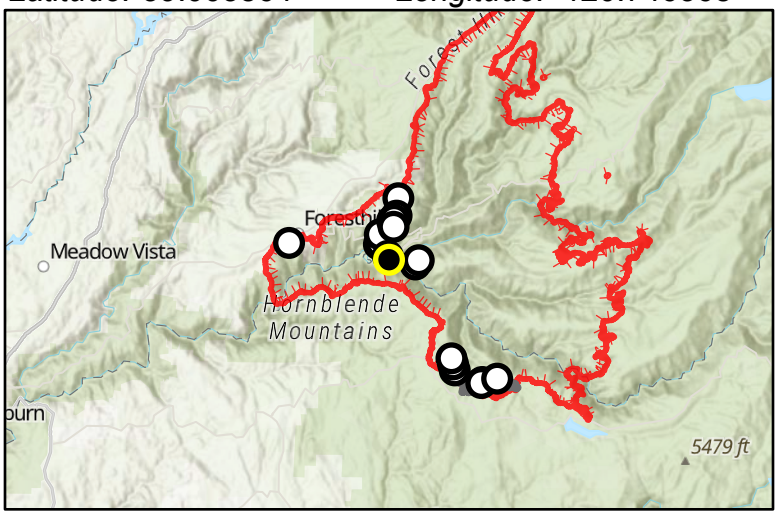


VALUE AT RISK DETAIL

Incident: Mosquito Fire *Incident Number: CA-TNF-001371*

Community: **Indian Bar recreational area**

Site Number: **MOS-4**

Feature: **Recreation area**

Feature Category: **recreational**

Field Observation or Potential Hazard: Post-fire flows within the vicinity of the parking lot and recreational area may increase the risk to the general public at this location.

Potential Hazard to Life: **low**

Potential Hazard to Property: **low**

Preliminary Emergency Protective Measures (1): **Signage**

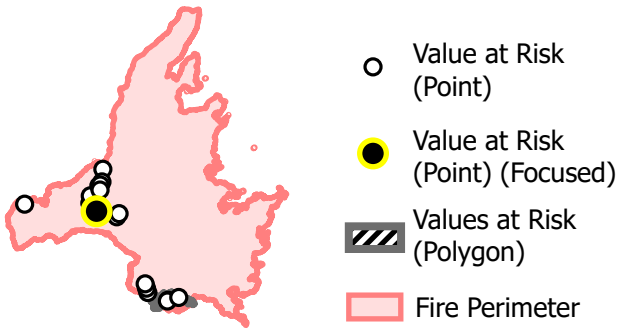
Preliminary Emergency Protective Measures (2): **Early Warning**

Preliminary Emergency Protective Measures (3):

Preliminary Emergency Protective Measures (4):

Description: PCWA may consider closing down the recreational area on a seasonal basis to minimize risk to general public during high flow conditions following the fire.

LOCATION AND PHOTO



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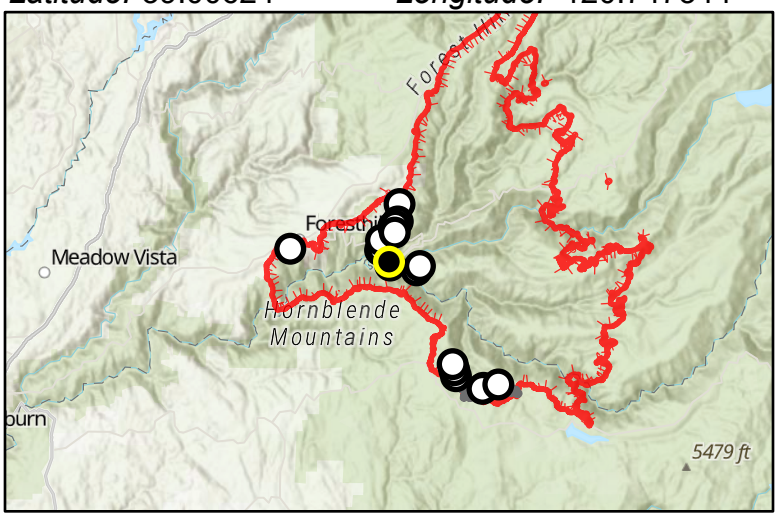
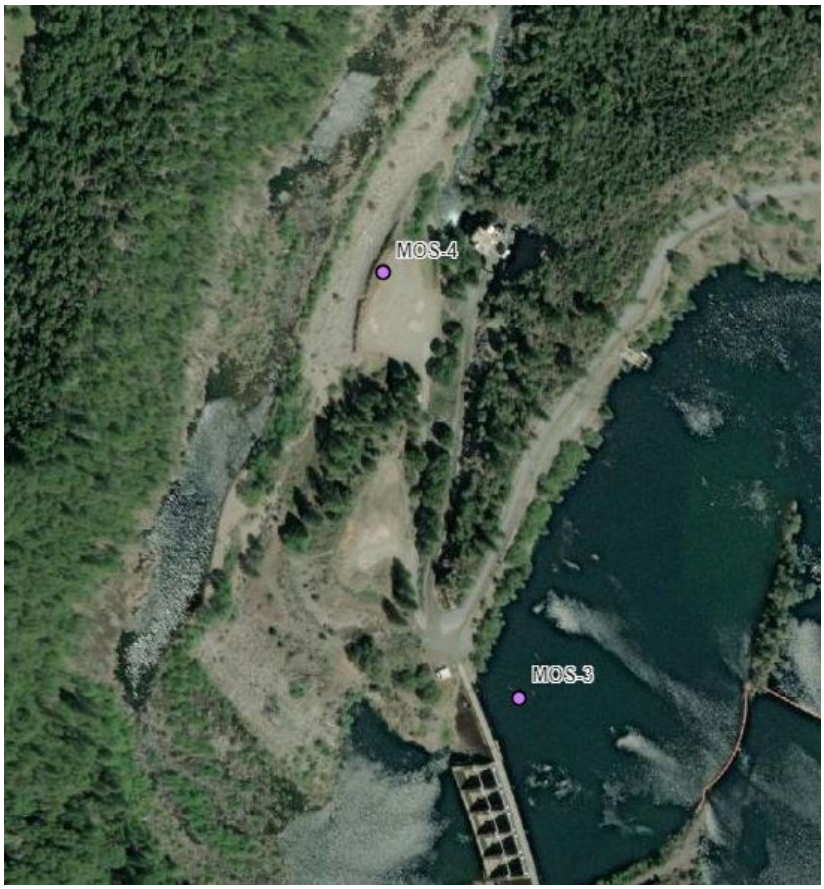




VALUE AT RISK DETAIL

Incident: Mosquito Fire *Incident Number: CA-TNF-001371*

Community: **Foresthill**

Site Number: **RES-1**

Feature: **Residential structure**

Feature Category: **home**

Field Observation or Potential Hazard: Existing residential structure adjacent to drainage paths and over-steep fillslopes. Poor drainage around the structure and down adjacent fillslopes may be exacerbated by increased post-fire surface and subsurface flows that may impact the structure.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

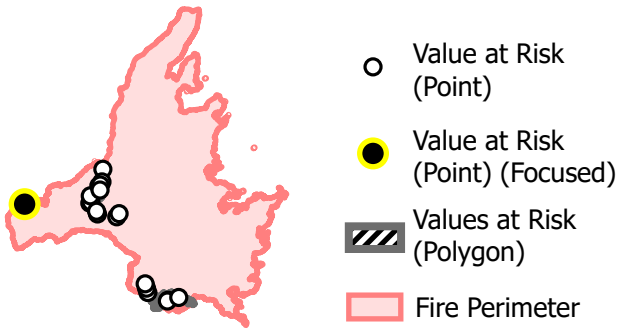
Preliminary Emergency Protective Measures (2): **Monitor and maintain**

Preliminary Emergency Protective Measures (3): **Sandbags**

Preliminary Emergency Protective Measures (4):

Description: Property should be assessed by county and or qualified professional to determine effective mitigation strategy for existing conditions.

LOCATION AND PHOTO



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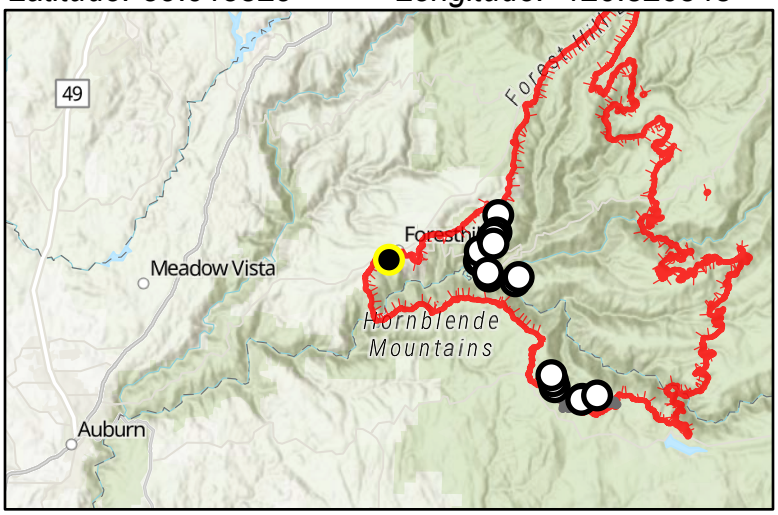


VALUE AT RISK DETAIL

Incident: Mosquito Fire *Incident Number: CA-TNF-001371*

Community: **Michigan Bluff**

Site Number: **RES-2**

Feature: **Residential structure**

Feature Category: **home**

Field Observation or Potential Hazard: Burned residential structures downstream of two inline crossings on Class III stream. Potential crossing failures and observed diversion potential may result in delivery of flow and sediment toward residential structures.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures (1): **Early Warning**

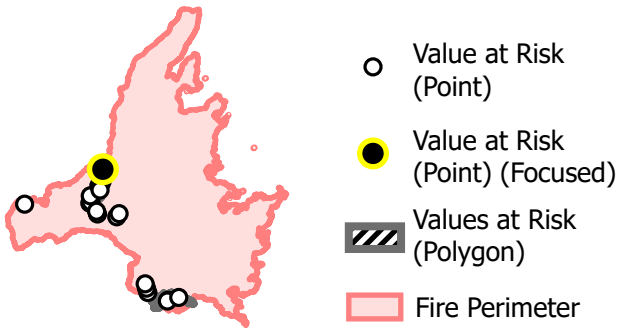
Preliminary Emergency Protective Measures (2): **Monitor and maintain**

Preliminary Emergency Protective Measures (3): **Deflection structure**

Preliminary Emergency Protective Measures (4):

Description: Define dip through driveway crossing to minimize diversion potential toward residence.

LOCATION AND PHOTO



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