Watershed Emergency Response Team (WERT)
2024 Airport Fire

CA-ORC-127883

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California Department of Conservation
California Geological Survey

Contents

WERT REPORT AUTHORSHIP AND PROFESSIONAL REGISTRATION

REPORT TITLE: Watershed Emergency Response Team (WERT) Evaluation – 2024 Airport Fire

LIMITATIONS: This report presents the results of a rapid assessment to help communities prepare after wildfire by documenting and communicating postfire risks to life, property, and infrastructure posed by debris flow, flood, and rockfall hazards. 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 responsible jurisdictions and agencies in the development of more detailed postfire emergency response plans.

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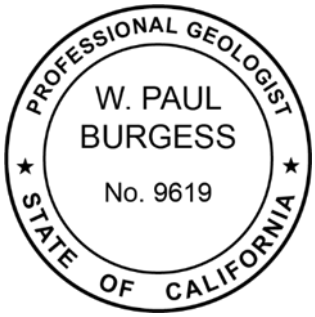

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Airport Fire – WERT REPORT EXECUTIVE SUMMARY

CA-ORC-127883 - WERT Evaluation

Mission Statement: The California Watershed Emergency Response Team (WERT) helps communities prepare after wildfire by rapidly documenting and communicating postfire 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 Orange and Riverside County Offices of Emergency Management, Orange and Riverside County Fire, CAL FIRE, local first responders, Orange and Riverside County Public Works and Flood Control, California Department of Transportation, the California Governor's Office of Emergency Services, the United States Department of Agriculture Natural Resources Conservation Service, the United States Forest Service, utility companies, and other responsible agencies and entities in the development of more detailed postfire 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. 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 Airport Fire started on 9 September 2024, in Trabuco Canyon, in Orange County. By 5 October 2024 the fire was 100% contained after reaching a size of 23,526 acres (37 mi^2). The presence of widespread moderate to high soil burn severity in steep, upland slopes means that parts of the Airport Fire and downstream area will be subject to postfire hazards such as sediment-laden flooding, debris flows, and increased erosion. Postfire watershed response of the Santa Ana Mountains in the vicinity of the Airport Fire burn scar is well-documented, especially during multiple storm events that caused flooding and sediment-laden flows following the 2018 Holy Fire, which burned immediately eastward of the Airport Fire, and also during storm events following the Falls Fire in 2013 and the Santiago Fire in 2007. Following the 2018 Holy Fire, inundation of Trabuco Canyon caused the destruction of the Trabuco Canyon Road bridge crossing, and additional repeat inundation events impacted communities in Riverside County on the east side of the Santa Ana Mountains, in locations situated near watercourses exiting steep eastward-flowing drainages, including Dickey, Leach, McVicker, Rice, and Horsethief Canyons, to name a few. Past inundation events in Modjeska Canyon and Santiago Canyon also have documented property damage. A 2014 storm, following the Falls Fire, led to multiple mudslides and the closure of Ortega Highway (Highway 74).

Due to the potential for increased postfire runoff, sediment-laden flooding, and debris flows, and proximity of the Airport Fire perimeter to residential areas and critical infrastructure, the burn area was assessed by an interagency WERT. The WERT rapidly evaluated postfire watershed conditions, identified potential **Values-at-Risk (VARs)** related to human life-safety and property, and evaluated the potential for increased postfire hazards. The WERT also recommends 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 occurrence of postfire watershed hazards (e.g., debris flows and flooding). Moderate and high soil burn severities typically create the most impacts.
- The Airport Fire produced mostly moderate soil burn severity. Airport Fire area soil burn severity: Unburned to Very Low (3%), Low 17%), Moderate (78%), High (3%).
- The WERT identified 38 VARs within and downslope/downstream of the fire. Twenty-four (24) VARs are shown as polygons which encompass multiple individual sites subject to similar hazard and risk. The remaining 14 VARs are points, which are associated with discrete sites such as homes and road crossing structures.
- Twenty-six (26) are exigent VARs, which present a more urgent threat to life, safety, and/or property.
- Seven (7) of the VARs have a high risk to life, safety, and property, which is the highest potential level of risk assessed by the WERT. Five of the VARs are in Trabuco Canyon (TC-01, TC-02, TC-03, TC-07, and TC-09) and two are in Hot Springs Canyon (HS-01 and HS-02). The these VARs are associated with leased cabins on USFS ground and the Lazy W Camp and Resort in Hot Springs Canyon.
- The road network within and downstream of the Airport Fire perimeter will be subject to increased potential for storm damage for the next two to five years. Specific crossing structures that provide ingress and egress to homes or road crossings of main channels were addressed as VARs.
- Trabuco Canyon, Holy Jim Canyon, El Cariso, Long Canyon, Decker Canyon, Hot Spring Canyon, Bell Canyon, Laguna Canyon, and Modjeska Canyon are areas where several crossing structures may be subject to potential blockage and overtopping.
- Some homes and structures are at risk of flooding or debris flows. These structures primarily exist at Holy Jim Canyon, Trabuco Canyon, Hot Spring Canyon, and in the El Cariso area. Additional locations on the west side of Lake Elsinore, and in the Glen Ivy Canyon area, may be impacted.
- Flooding and debris jams are possible within designated FEMA 100-year flood zones, DWR awareness floodplains, and/or USGS modelled Watchstreams. Trabuco Canyon is a particularly high hazard area for such flooding and debris jams.
- Model results are presented for postfire debris flow hazard and postfire flooding. The debris flow model results show a significant increase in postfire debris flow potential in steep, convergent slopes that are burned at moderate to high severity. High debris flow hazards exist along steep tributary drainages and swales that flank Trabuco, Bell, and Hot Springs Canyons. Runout of debris flows within these canyons is not modelled, but geomorphic evidence observed in the field suggests that debris flows may travel the full distance of these canyons where the mainline channel is laterally constrained. However, as the channels lose confinement where they exit the mountain front, and begin to become braided, the potential for debris flows to persist reduces and flows will likely transition into debris floods. Examples of this would be flows located distally from the fire perimeter within Santiago Canyon and Trabuco Canyon. Hydrologic model results indicate that high flood to debris flood hazards exist in Bell Canyon and Hot Springs Canyon, moderate-high hazards exist in Trabuco Canyon and Long Canyon, and that moderate hazards exist in Santiago Canyon and an unnamed basin that drains towards

Jamieson Street in Lake Elsinore. Low flood hazards exist along drainages that drain eastward into Riverside County, including Coldwater Canyon, Dickey Canyon, and along unnamed drainages that flow towards developed areas west of Lake Elsinore.

- Residents subject to postfire hazards need to have a clear understanding of the hazards and mitigation strategies (e.g., evacuation, deflection structures, culvert improvements) to effectively reduce risk to life, safety, and property.
- **To trigger the National Weather Service early warning system, the WERT suggests two thresholds be applied. For basins that drain to the west, including Santiago, Trabuco, Bell, Hot Springs, Decker, and Long Canyon, including the community of El Cariso, the thresholds are 0.2 inches in 15 minutes, 0.3 inches in 30 minutes, and 0.5 inches in 60 minutes. For basins in Riverside County that drain to the east, including unnamed basins west of Lake Elsinore, the thresholds are 0.25 inches in 15 minutes, 0.35 inches in 30 minutes, and 0.6 inches in 60 minutes.**
- Close coordination between the Orange County Fire Authority (OCFA) and Riverside CAL FIRE Units, Orange and Riverside County Offices of Emergency Management, the National Weather Service, local first responders, and Orange and Riverside County Public Works will be necessary to effectively develop and implement a response plan that will minimize risk. WERT information provides critical intelligence for response planning and implementation.

Introduction

Background

The Airport Fire started on 9 September 2024 near the Trabuco Flyers Club in Trabuco Canyon, Orange County. The fire spread into the Santa Ana Mountains, where it crossed into Riverside County. The fire was 100% contained on October 6, 2024, and had burned 23,526 acres. The Airport Fire destroyed 160 structures and damaged 34 structures. There were 2 civilian injuries, 20 firefighter injuries, and no fatalities.

Given the past postfire runoff response of fires in the area, proximity of the burn scar to developed areas, and forecast of rain showers, CAL FIRE division chief and unified command incident commander, Todd Hopkins, requested a prescreen of the fire, including issuance of emergency rainfall thresholds on 16 September 2024. On 17 September 2024, the California Geological Survey (CGS) submitted the results of the screening that provided emergency rainfall thresholds and recommended a Type-2 Watershed Emergency Response Team (WERT) assessment. Primary concerns for burned watersheds are the increased potential for damaging sediment and debris flood flows, increased potential for debris flow occurrence, rockfall from steep slopes, and hillslope erosion resulting in excessive sedimentation due to storm runoff for several years following the fire. See footnote for definitions of different postfire runoff types[1]. The Airport Fire is unique in that several large watersheds had a high proportion of their drainage areas affected by fire, and these watersheds drain towards populated areas of Orange and Riverside counties. During periods of thunderstorm activity, and as the wet season approaches (typically October through May), it is critical that people who live in hazard areas within and downstream of the Airport Fire implement emergency protection measures (EPMs) where appropriate, check weather conditions and forecasts, stay alert to National Weather Service (NWS) flash flood watches and warnings, and monitor local county resources for guidance on evacuations.

This report presents the results of a rapid evaluation of postfire 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 Airport Fire. Figure 1 shows the acreage and percentage of the burned area by ownership for the fire. Approximately 10% of the burned area is in private ownership, 89% is in federal ownership, and under 0.7% which lies in Orange County is split between county ownership (0.5%), and a special district (0.2%).

The Airport Fire WERT conducted field assessments from 30 September to 2 October 2024. WERT representatives conducted a field reconnaissance with Riverside County Flood Control personnel and interacted with other stakeholders during the WERT assessment (see Appendix

[1] Definitions of different flow types applied in this document are as follows (after Pierson (2005) and Hungr et al. (2001)):
Floods – closely resemble normal streamflow with sediment concentrations less than 20% by volume, bedload transport composed of sands to cobbles, and more predictable Newtonian fluid behavior.
Debris floods – rapid, surging flow that is heavily charged with debris and sediment. Suspended sediment composed of sand-sized particles is common with bedload transport composed of cobbles to boulders. Approximately Newtonian flow behavior with 20% to 60% sediment concentration by volume. Transient debris dams of boulders and woody material are common. Highly erosive.
Debris flows – rapid, surging flow composed of a slurry of sediment and water with suspended gravels and boulders. Less predictable non-Newtonian flow behavior with sediment concentrations of >50% by volume. Can cause catastrophic damage from burial and impact that can infill and divert streams, and destroy automobiles, buildings, and infrastructure.

A for a list of key contacts). Several briefings providing the WERTs preliminary findings and VARs was conducted with Riverside and Orange County emergency response personnel and other responsible agencies on 10 October 2024, 17 October 2024, and 24 October 2024. A preliminary data release composed of a copy of a summary VAR table as a csv file (Appendix B) and a geodatabase of spatial VAR data were released to key stakeholders on 9 October 2024. Copies of the summary VAR table (Appendix B), a VAR Map Book (Appendix C), VAR detail sheets (Appendix D) are provided in this report. A copy of the final VAR geospatial data in the form of a geodatabase was released to key stakeholders on 25 October 2024.

Team members for the Airport Fire WERT are listed in Table 1.

Table 1. Airport Fire WERT members.

Name	Position	Agency	Expertise-Position
Don Lindsay; PG 7489; CEG 2323; CE 76899; GE 3097	Team Leader	CGS	Engineering Geology; Civil Engineering
Kevin Callahan; GE 2989; CE 72202	Team Member	CGS	Engineering Geology
W. Paul Burgess; PG 9619	Team Member	CGS	Engineering Geology
Leah Sabbeth, PhD	Team Member	CGS	Engineering Geology Trainee
Jonathan Woessner; RPF 2571	Team Member	CAL FIRE	Liaison
Adjunct Team			
David Cavagnaro	Adjunct Member	CGS	GIS
Meerea Kang	Adjunct Member	CGS	GIS
Deshawn Brown	Adjunct Member	CGS	GIS

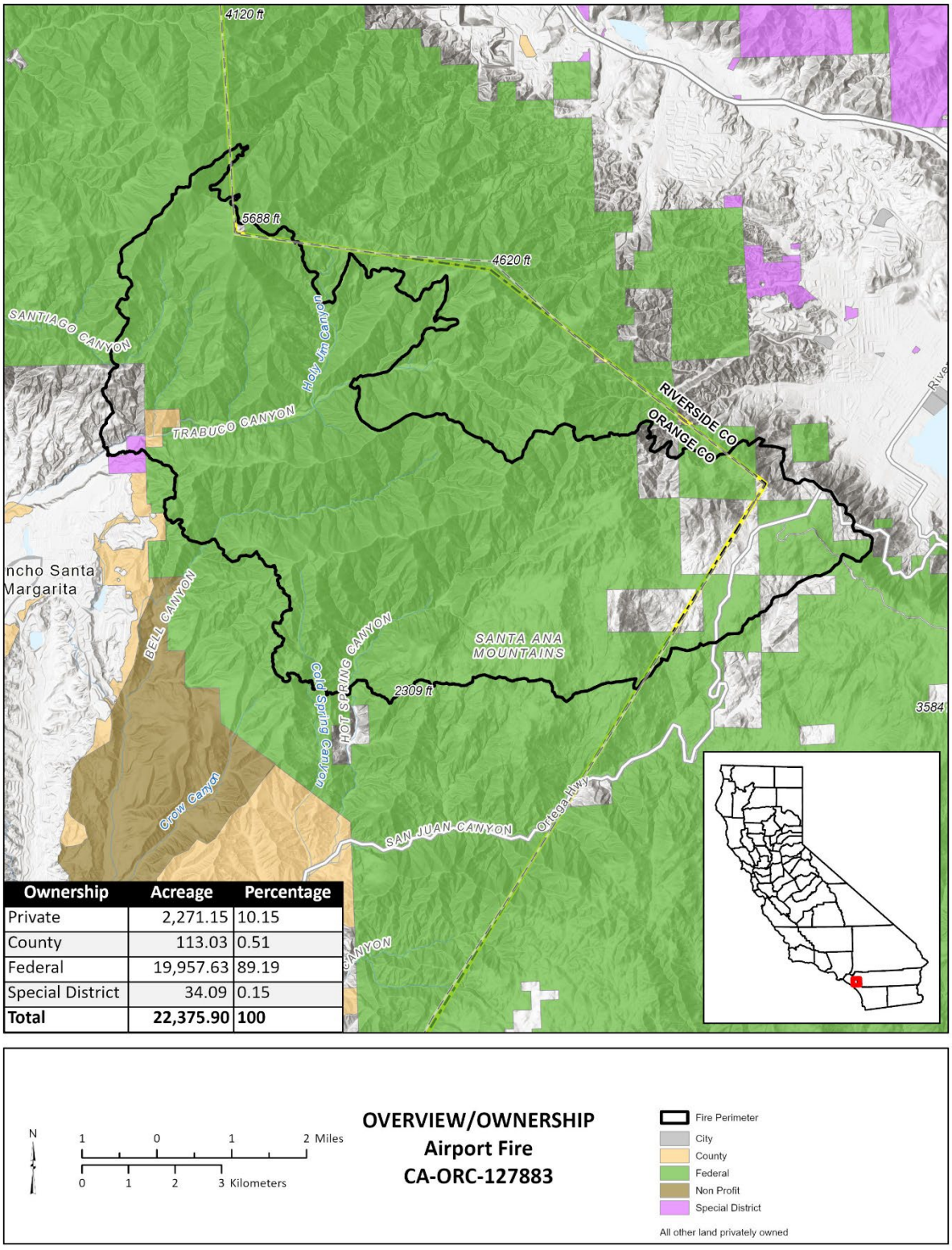


Figure 1. Ownership map of the Airport Fire burned area.

Objectives and Scope

Primary objectives for the WERT are to conduct a rapid preliminary assessment that include the following components.

- 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 postfire flooding, debris flows, rockfall, erosion, and other hazards that are elevated due to postfire conditions.
- Rapidly determine relative postfire risk to these values, using a combination of state-of-the-art analytical tools (e.g., USGS postfire debris-flow likelihood model) and the best professional judgement of licensed geohazard professionals (i.e., Professional Geologists; Certified Engineering Geologists; Professional Civil Engineers).
- Develop preliminary emergency protection measures (EPMs) needed to avoid or minimize threats to life-safety and property.
- Communicate findings to responsible entities and affected parties so that the information and intelligence collected by the WERT can be used in response planning to reduce risk from postfire watershed hazards.
- It is important to emphasize that the WERT performs a rapid evaluation of postfire hazards and risk. A complete characterization of postfire 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 VARs and makes specific and general recommendations to reduce exposure to postfire, life-safety and property hazards on county and private lands. **While the report can provide useful information to emergency planners and first responders, the GIS data, in the form of a geodatabase, produced by the WERT is the most important source of information for postfire 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 Airport Fire burned primarily in the Santa Ana Mountain range east of Rancho Santa Margarita. The topography within and downstream/downslope of the fire is predominately moderately steep to very steep. The burned area partially straddles the crest of the Santa Ana Mountains but tends to favor the western side of the range where it burned large portions of Santiago Canyon, Trabuco Canyon, Bell Canyon, Hot Spring Canyon, and Long Canyon. Areas burned east of the crest occupy a small portion of Coldwater Canyon, Leach Canyon, and Dickey Canyon. Elevations within the burn area range from 5,688 feet at Santiago Peak to 1169 feet in Trabuco Creek wash.

Slope encompassed by the Airport Fire experiences warm to hot, dry summers and cool, wet winters with widely varying amounts of precipitation characteristic of a southern California Mediterranean climate (Beck et al., 2018). Some monsoonal thunderstorms can occur in the summer and fall months which can generate localized heavy rainfall and runoff, although this isn't as common as areas to the east (e.g., Riverside County). Precipitation throughout the burned area occurs almost entirely as rain. Average annual precipitation is variable across the

burn area and ranges from approximately 16 inches in lower elevations to more than 29 inches in higher elevations (PRISM Climate Group, 2024). Higher elevations may occasionally also receive precipitation as a mixture of rain and snow during winter months; approximately 90% of annual precipitation occurs from October through April.

Climatologically, precipitation intensity varies across the burn area. This is primarily due to orographic lift on the west side of the Santa Ana Mountains and rain shadowing on the east side of the mountains during cool season storms. Higher precipitation intensities are observed in the mountainous western portions of the burn area in Orange County, such as upper Trabuco Canyon, while lower precipitation intensities are typically observed in the eastern portion of the burn area in Riverside County, such as Dickey Canyon. One hour rainfall depths at 1, 5, and 10-year recurrence intervals for Trabuco Canyon are approximately 0.5, 0.9, and 1.2 inches, respectively; for Dickey Canyon, the rainfall depths are approximately 0.4, 0.8, and 0.9 inches, respectively (NOAA Atlas 14 Point Precipitation Frequency Estimates for California).

Geology and Landslides

The Airport Fire occurred in the central Santa Ana Mountains. Most of the fire burn area is directly underlain by upper Jurassic marine sedimentary and metasedimentary rocks (Figure 2). These rocks overlie Jurassic/Triassic metavolcanic rocks, which outcrop in large areas of 1 to 2 mi^2 along the north, west, and southwest edges of the fire perimeter. Three small outcrops of the metasedimentary rocks also exist on the eastern part of the burn area. Mesozoic granitic rocks directly underlie the southeastern map area, and three small areas totaling less than 0.25 mi^2 area near Trabuco Peak. Mesozoic basic intrusive rocks intrude into the granite in the southeast of the fire area, and also outcrop on the eastern side of the fire area in four small 0.2 to 0.4 mi^2 areas. Quaternary alluvium underlies Trabuco Creek and the surrounding wash area. Adjacent Quaternary terraces outcrop along Trabuco Creek as well.

Soils are typically shallow (< 50 cm) and rocky with bedrock commonly exposed. Dry ravel loading was abundantly present in the Trabuco Canyon and Holy Jim Canyon areas, including their respective tributary watersheds in the central and western portions of the fire. Areas within the Trabuco Creek drainage exhibit alluvial fan deposits at the outlet of steep, tributary basins that exhibit evidence of prior debris flow activity. Unmapped, ancient landslide deposits, some of which exhibiting nested areas of more recent failure, were observed in the multiple tributary drainages of Trabuco Canyon. Although unlikely, postfire hydrological changes and loss of vegetation may contribute to the reactivation of prior landslides.

Mineral Hazards and Wells

There are three old mine or prospecting sites within the burned area perimeter (Figure 3). The easternmost site was prospected for lead and other metals. The two other sites were prospected for gold. These mining operations may still contain mine tailings and mine waste that may contain potentially harmful concentrations of heavy minerals. The use of mercury was common practice to enhance gold recovery in all the various types of mining operations since 1850. Potential adverse impacts to health and safety from these three features related to postfire conditions is considered negligible given their remote nature. For information on hazardous minerals, please refer to https://www.conservation.ca.gov/cgs/minerals/mineral-

hazards, https://oehha.ca.gov/chemicals/ or https://pubs.usgs.gov/fs/2005/3014/.

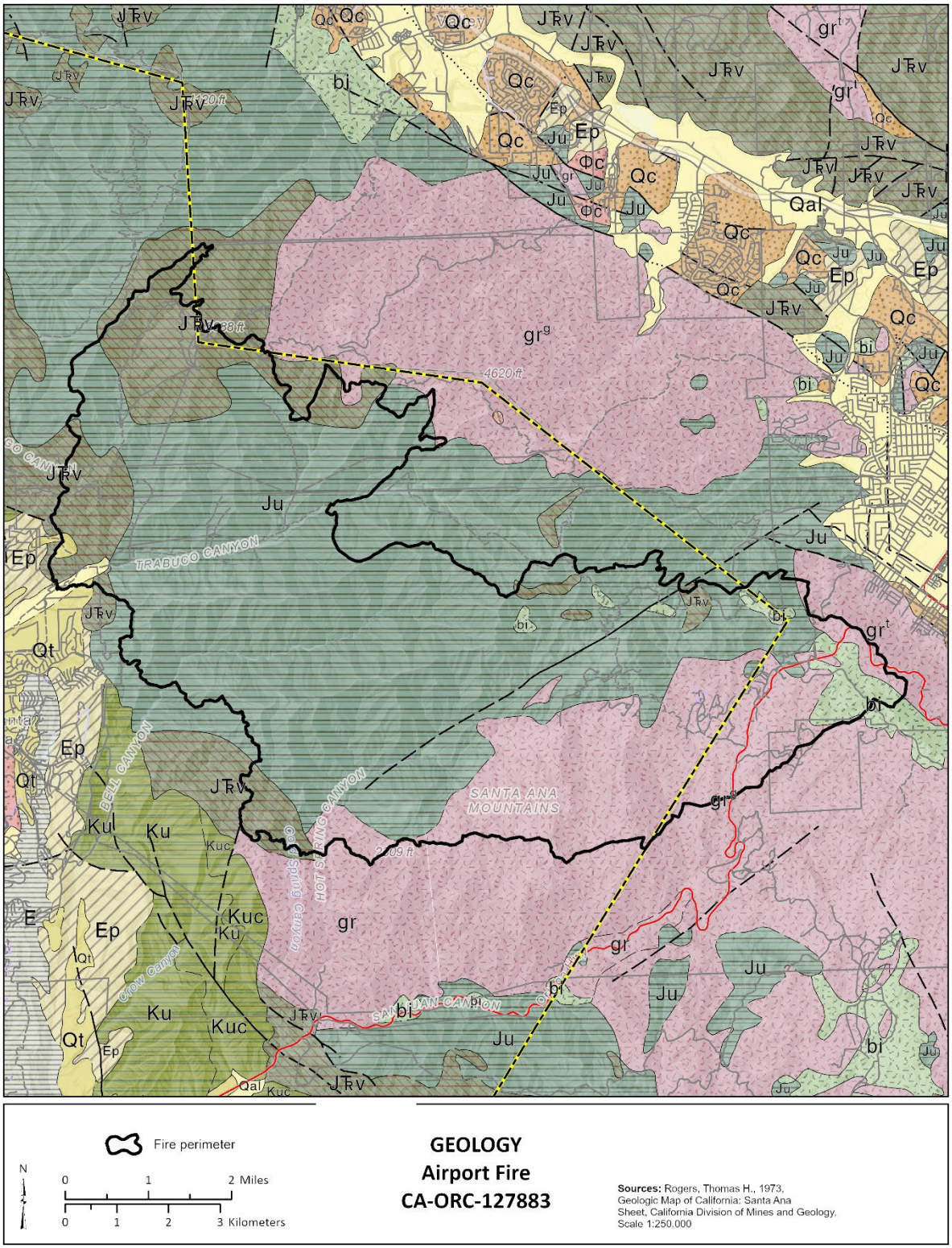


Figure 2a. Geologic map for the Airport Fire.

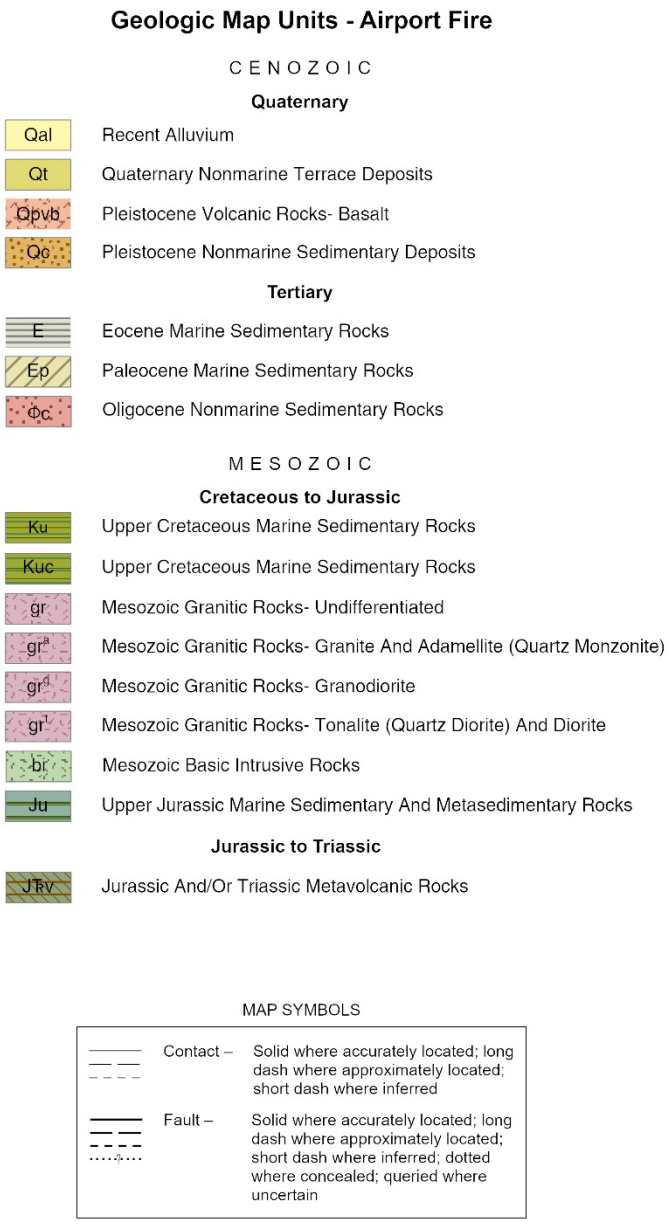


Figure 2b. Legend for geologic map in Figure 2a for the Airport Fire.

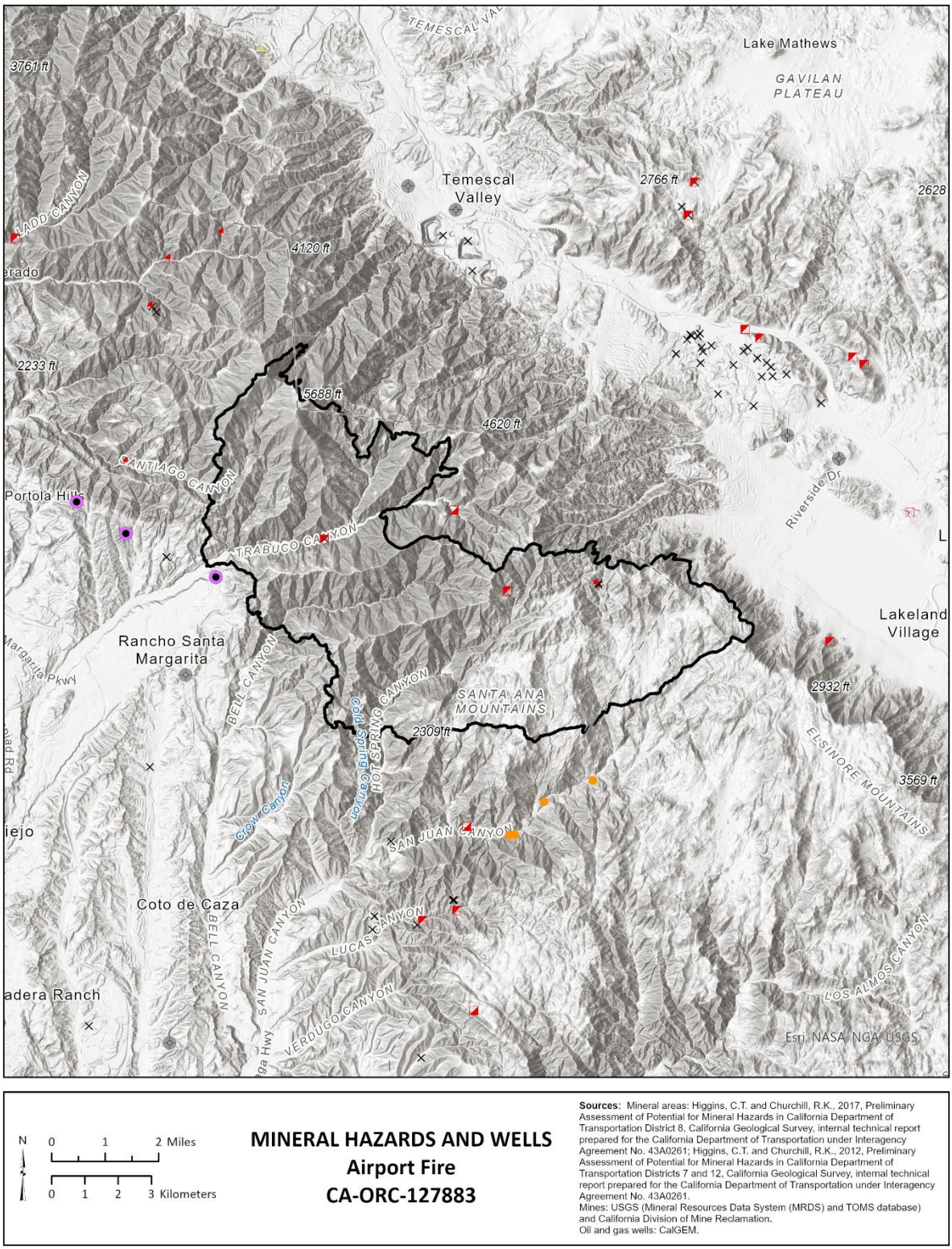


Figure 3a. Mineral Hazards and Wells map for the Airport Fire.

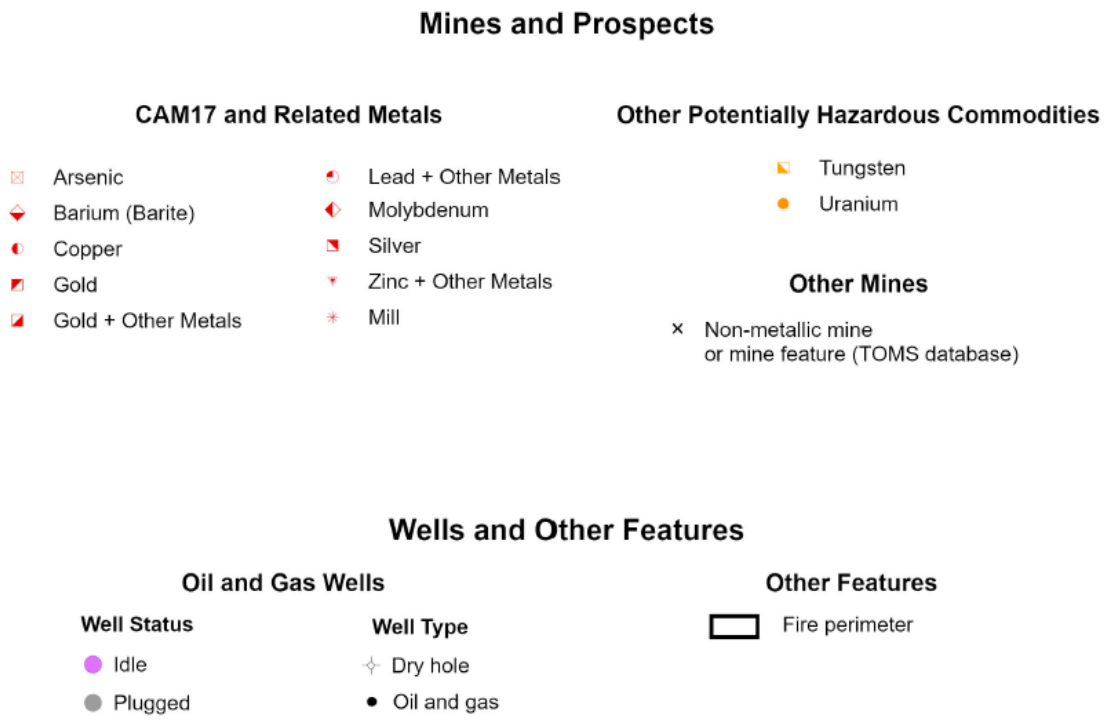


Figure 3b. Legend for Mineral Hazards and Wells map for the Airport Fire, Figure 3a.

Vegetation and Fire History

Vegetation within the burned area is chaparral-dominated. Major plant communities found within the fire burn area include coastal sage scrub, chaparral, oak woodland, riparian mixed hardwood (alder, sycamore, willow, cottonwood), annual grasses and forbs, and perennial grasses and forbs. Scattered large shrubs include toyon and sumac. In general, low elevation slopes are covered by shrublands, mid elevation slopes are covered by mixed shrublands, chaparral, and oak woodlands, and high elevation slopes are covered by a mixture of chaparral, oak woodland, and mixed conifer forests (CAL FIRE 2024).

Prior to Euro-American settlement, mean fire return interval ranged from 11-31 years in the vegetation types represented in the Airport Fire burn area (Van de Water and Safford, 2011). The Airport Fire footprint mostly occupies slopes that have not burned in over 40 years (Figure 4). Two older fires that overlap large areas of the Airport Fire include the 1958 Steward Fire, which burned portions of Bell, Hot Springs, and Long Canyons, and the 1980 Indian Fire, which burned portions of Santiago and Trabuco Canyons. However, more recent fires do overlap small portions of the Airport Fire area including the Holy Fire (2018, 22,838 acres) to the north and east, and the Jim Fire (2022, 563 acres) and the Santiago Fire (2007, 26,795 acres) to the

west. Additional fires in the vicinity of the Airport Fire area, include the Bond Fire (2020, 7,735 acres) and Silverado Fire (2014, 828 acres), which burned in the Silverado Canyon, Williams Canyon, and Santiago Canyon northwest of the Airport Fire. The Bond and Silverado fires burned in areas similar to the Airport Fire in their local vegetation, steep topography, and climate.

Areas with less recent fire activity or no recorded fire history may have a higher potential for postfire response due to their higher fuel loading. In turn, this may lead to more severely damaged soil after a fire and rain event. Since large portions of the Airport Fire have not been subject to recent postfire erosional processes, the burned area may create a more abundant supply of entrained sediment, amplified by postfire runoff.

Hydrology, Flood History, and Observed Postfire Response

High flows and flood events on creeks in the region burned in the Airport Fire are typically associated with winter weather systems featuring long-duration and/or high magnitude atmospheric river conditions. Rapid sequencing of atmospheric river storms may also contribute to flood hazard.

A stream gage located on lower Trabuco Creek, in the city of San Juan Capistrano (Gage Site Number 11047300), is approximately 15 miles downstream of the fire perimeter. This gage has confirmed data from 1972 to present and lists the top four highest flows occurring in 1998, 2011, 2005, and 2019 with estimated discharges of 10,000 ft^3/s, 8,530 ft^3/s, 5,510 ft^3/s, and 5,230 ft^3/s, respectively (Figure 5). Based on the lack of fire history within the Trabuco Canyon watershed prior to 2005, the top three runoff events were all unrelated to postfire effects. However, the 2019 runoff event followed the 2018 Holy Fire, which likely influenced runoff through sediment and debris bulking.

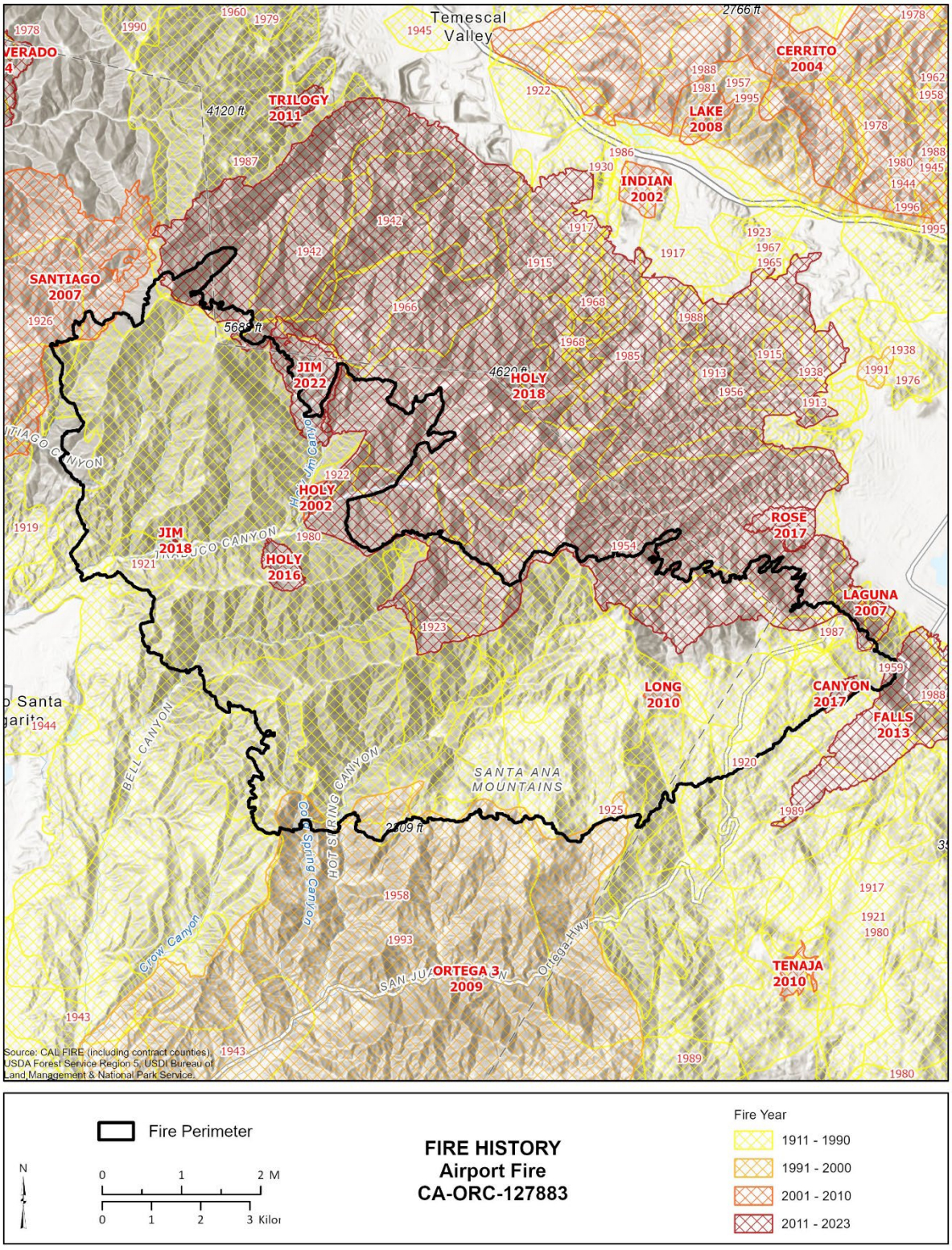


Figure 4. Fire history for the Airport Fire. Note: Areas that haven't burned for many decades have a potentially higher erosional response than areas that have been subject to recent fire.

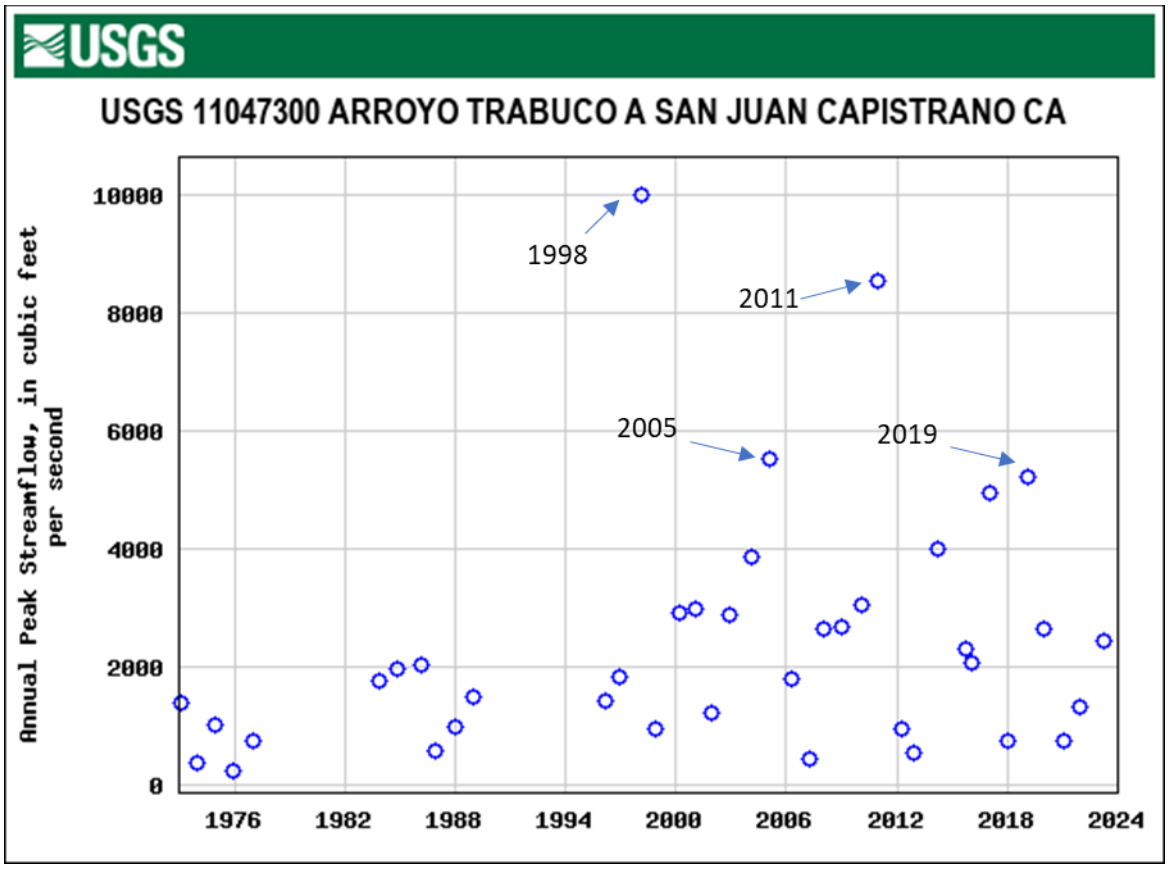


Figure 5. Annual peak streamflow for the USGS Arroyo Trabuco at San Juan Capistrano, CA, gage (11047300) that highlights the top three recorded flow events between 1973 to present (Source: USGS | National Water Dashboard).

Frequent flooding and debris flows have been observed in developed areas downstream of burned areas in the region of the Airport Fire. Heavy rain on 22 May 2008 following the 2007 Santiago Fire led to several debris flows, which damaged several homes and businesses. Following the 2013 Fall Fire, up to 8 inches of rain were recorded in the mountains between February 28 and March 1, 2014. The storm led to damage stemming from the Falls Fire burn scar, including flash flooding with mud and debris flows and mud slides. This resulted in numerous road closures in Anaheim and Lake Elsinore, and included the closure of Ortega Highway (Highway 74) (NWS, 2024).

Following the 2018 Holy Fire, a storm on 6 December 2018 led to mud and debris flows which overtopped the Trabuco Canyon Road bridge crossing Trabuco Creek, taking out the guard rails. Mandatory evacuation orders were issued for residents in burn areas of the Holy Fire in Riverside and Orange counties. A major atmospheric river released heavy rain over California on 14 February 2019, with 8 to 10 inches of rain recorded in many mountain locales, including >10 inches of rain at Palomar Mountain. Flash flooding and debris floods occurred at and below the Holy Fire burn scar damaging roads (Guilinger et al., 2020).

More recently, following the 2020 Bond Fire, winter storms triggered debris floods and debris flows that plugged culverts, overtopped roads, and damaged multiple structures within Silverado Canyon (Oswald, 2022).

Modeling Postfire Response

Soil Burn Severity

The initial field assessment by the WERT was conducted using a Burned Area Reflectance Classification (BARC) map that was field validated and edited in collaboration with soil scientists from the USFS Park Fire BAER team to create a Soil Burn Severity (SBS) map of the burn area (Figure 6).

Within the Airport Fire footprint most slopes were burned at moderate (78%) soil burn severity. However, isolated areas of high (3%) soil burn severity are located within steep headwall slopes and areas of low (17%) burn severity are generally limited to slopes near the fire perimeter, and to discontinuous areas on south-facing slopes in Bell Canyon, Trabuco Canyon, Hot Spring Canyon and in an area of the El Cariso neighborhood.

Postfire Debris Flow: Predicted Thresholds and Hazards

The USGS postfire debris flow hazard model (Staley et al., 2016) was run using the SBS map for the Airport 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 range from low to high. Figure 7 shows the combined debris flow hazard for the 15-minute, 24 mm/hr (0.94 in/hr) intensity storm. Figure 7 indicates that the combined debris flow hazard is mostly high within the steep slopes that flank upper Santiago Canyon, and large portions of Trabuco, Bell, and Hot Springs Canyons, all of which drain to the west. Basins within Long Canyon and along the southeastern portion of the burned area within Riverside County exhibit moderate to low combined debris flow hazards as a result of rounded and more gentle-sloping ground.

Figure 8 illustrates 15-minute rainfall intensities required to generate a 50 percent likelihood of debris flows for each basin across the burned area. The fire wide basin average 15-minute rainfall intensity threshold is about 21.5 mm/hr (0.85 in/hr). Basins on the west side of the mountain range, particularly those underlain by metasedimentary rock and exhibiting steep slopes, have a low triggering threshold of less than 20 mm/hr (0.79 in/hr), while the more gentle slopes in the southeast portion of the burn area underlain by granitic rock have slightly higher triggering thresholds ranging from 20 to 45 mm/hr (0.79 to 1.77 in/hr).

The debris-flow-prone slopes within Trabuco, Bell and Hot Springs canyons are likely to occur since the triggering threshold is less than the 1-year recurrence interval rainfall in the area. Consequently, there may be more than one triggering storm event in the first year following fire. Debris flows that are triggered will likely flow out of steep headwall swales and first order channels to intersect and mix with flows in the main channels that drain the canyons. The travel distance of debris flows within the main channels is uncertain, but it is likely that debris flow

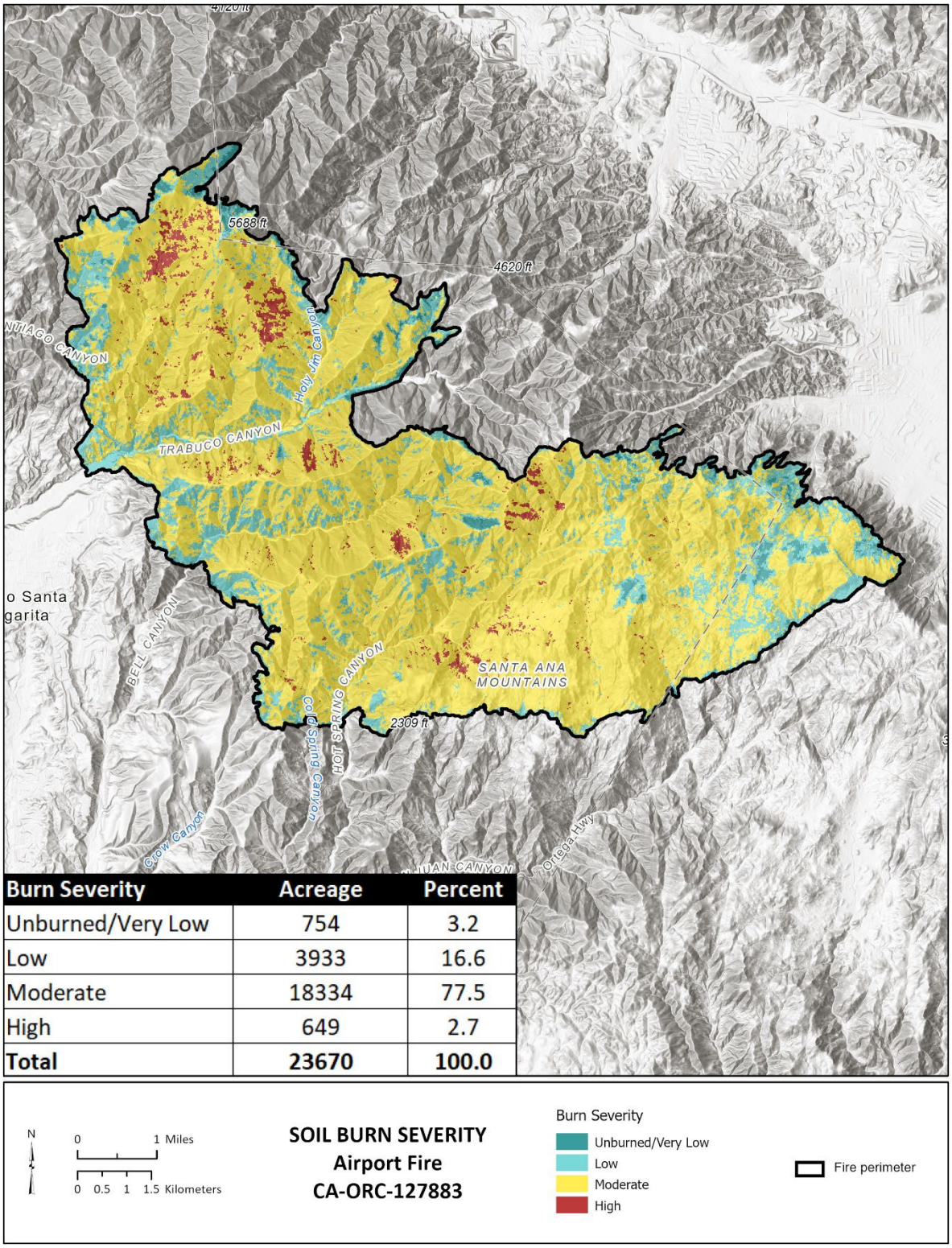
surge fronts will be overrun and mixed by water flow, diluting the mixture as the flows progress. These high-energy debris floods, capable of moving boulders as bedload and large woody material, are likely to persist far downgradient from the burn perimeter. Examples of this were illustrated in Trabuco Canyon following the Holy Fire.

Debris Flow Model Accuracy and Limitations

For basins burned in the Airport Fire, the results of the USGS debris flow model (Staley et al., 2016) give an indication of potential postfire watershed response but may not accurately predict debris-flow likelihood or volume for a given design storm.

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 5 acres in area, and do not specifically identify hazards in areas where one or more tributaries may contribute flood and debris flows (drainage areas approximately greater than 2,000 acres). For areas not shown as having a debris flow hazard along a segment that is 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). Additionally, other hillslope processes such as rockfalls, debris slides, and deep-seated slides are not included in the model results.

It should also be noted that the debris-flow model does not predict runout and inundation areas beyond the modeled source basin and does not consider potential increased hazards from multiple storm events that may load channels with sediment that could be entrained in future debris flows.



Burn Severity	Acreage	Percent
Unburned/Very Low	754	3.2
Low	3933	16.6
Moderate	18334	77.5
High	649	2.7
Total	**23670**	**100.0**

Figure 6. Soil Burn Severity map for the Airport Fire.

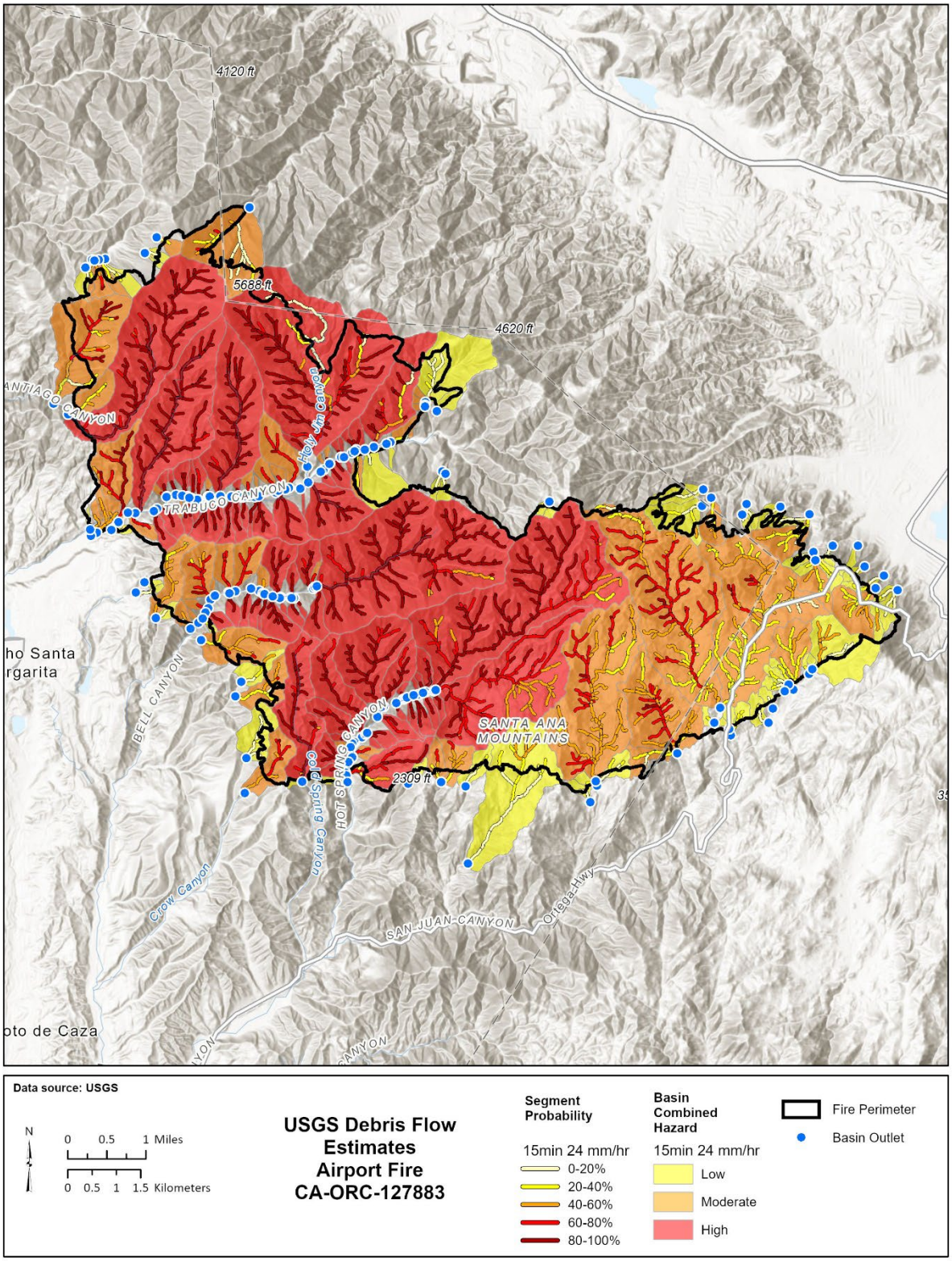


Figure 7. Combined debris flow hazard on the Airport Fire for the 24 mm/hr (0.94 in/hr) 15-minute storm event.

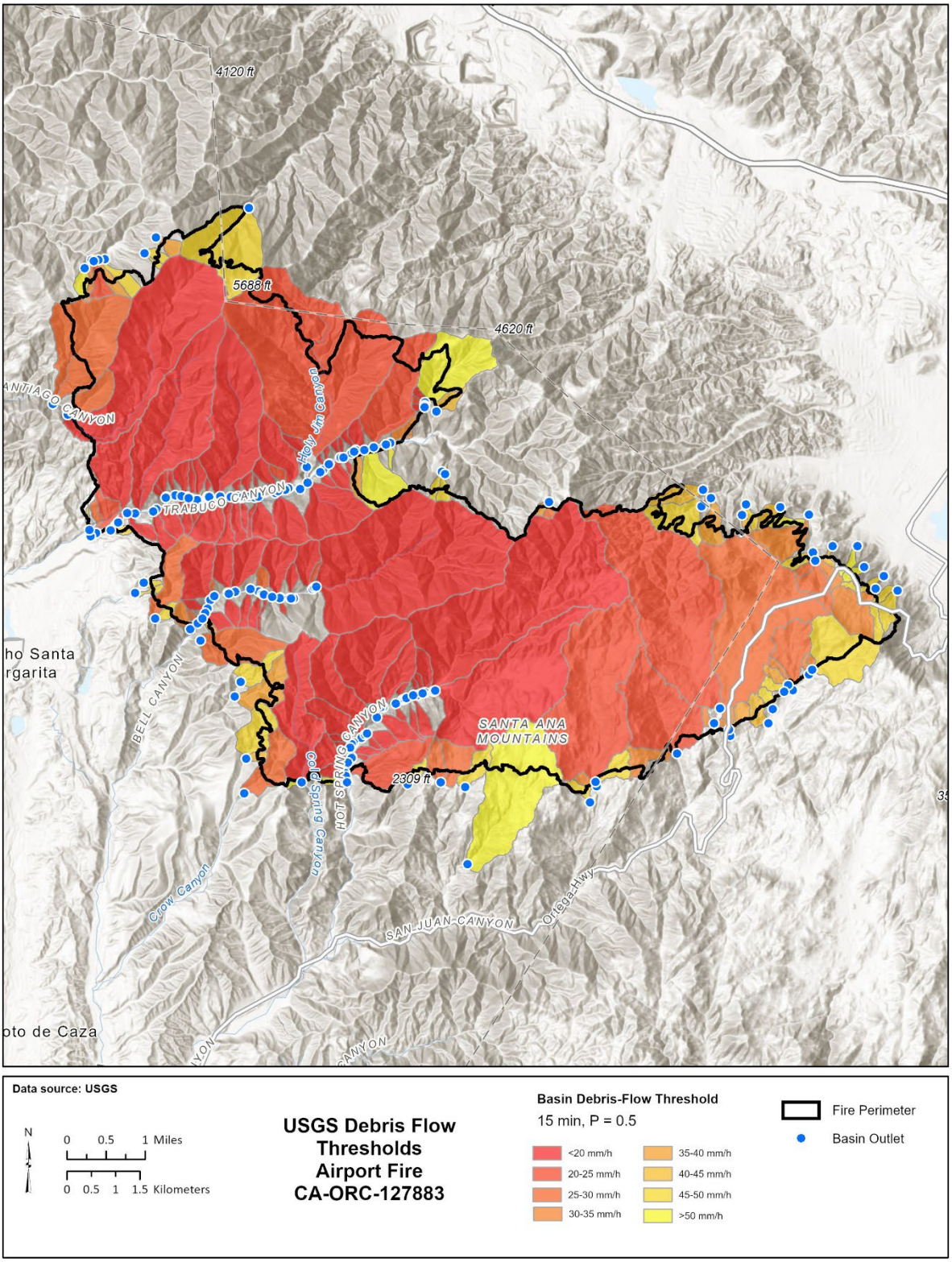


Figure 8. Predicted 15-minute rainfall intensity with a 50 percent likelihood of triggering a debris flow for the Airport Fire.

Postfire Hydrology

Peak flows increase following wildfire due to reduced vegetation, surface cover, infiltration rates, and the formation of water repellent soils. The largest peak flows occur during intense, short duration rainfall events on watersheds with steep slopes (Neary et al., 2005). Research conducted in southern California indicates that postfire peak flows can increase as much as 30-fold for moderate storms (0.1- to 5-year recurrence interval) and approximately 2- to 3-fold for large magnitude storms (5- to 100-year recurrence interval) (Rowe et al., 1949; Moody and Martin, 2001). Kinoshita et al. (2014) reported that commonly used flood flow prediction methods have lower confidence with larger recurrence interval events (25- and 50-year); therefore, we analyzed pre- and postfire flows assuming a 2-year storm event.

The WERT selected fourteen “pour points” (PP) to estimate potential postfire peak flow increases to Values-at-Risk (VAR) from flood to debris flow hazards. Figure 9 shows the fourteen pour point locations, which include all major canyons that drain west, including Santiago, Trabuco, Bell, and Hot Springs Canyons. Three pour points are located below small basins within Holy Jim Canyon that present a high debris flow hazard. Additional pour points are located within small basins that drain to more densely populated areas, such as in the El Cariso area and neighborhood areas west of Lake Elsinore. Lastly, three pour points are at the intersection of drainages that are crossed by major roads including Trabuco Canyon Road and Highway 74. These pour points represent elevated flood and debris flow hazards to private and public roads and residential structures. Pour points located close to or within basins burned at moderate and high soil burn severity (SBS) yield larger postfire flow increases than those far below the fire perimeter or burned at lower severity.

Pre-fire peak flow estimates were first produced for the eleven pour points using the South Coast, Region 5, USGS regional regression equations for a 2-year recurrence interval discharge (USGS StreamStats, 2024; Gotvald et al., 2012).

Changes in postfire peak flows were estimated using two methods based on the basin size and anticipated flow type at each pour point ranging from debris flood to debris flow. Flow type was determined based on existing slope and channel morphology, as well as historic account of postfire runoff events, either reported in public documents reviewed as part of our assessment or through personnel accounts shared by local residences.

To estimate postfire peak discharge for flood and debris floods, we followed procedures outlined by USFS BAER teams (unpublished), referred to here as the BAER method. The BAER method uses the proportions of the watershed that are unburned and burned at low, moderate, and high SBS to account for postfire runoff increases. For this analysis, the postfire 2-year recurrence interval flow is estimated by assuming areas that are unburned or have very low SBS undergo no change in runoff (Q2); runoff from low SBS areas are assumed to respond similarly to a 5-year recurrence interval discharge (Q5); runoff from moderate SBS areas are assumed to respond similarly to a 10-year recurrence interval discharge (Q10); and runoff from high SBS areas are assumed to respond similarly to a 25-year recurrence interval discharge (Q25). Applicable USGS regression equations for the Q2, Q5, Q10, and Q25 flows are applied to each category (USGS StreamStats, 2024; Gotvald et al., 2012). The area-weighted flow estimates by soil burn severity class are then summed to derive the runoff response that would typically generate a 2-year peak flow.

The BAER method is intended to predict peak discharge for postfire floods and debris floods with sediment concentrations less than about 40%, however, it may underpredict peak discharge of debris flows that often form dilated surge fronts composed of segregated boulders and woody debris. Short-lived amplification in stage and instantaneous discharge caused by debris flow surge fronts can be 10 to 100 times larger than normal stream flow (Rickenmann, 2016; Kean et al., 2016) and can lead to flow avulsion, property damage, and sometimes fatalities (Kean et al., 2016; 2019). To demonstrate the potential amplification in postfire peak debris flow resulting from dilated surge fronts, we applied a simple empirical model by Kean et al., 2016, that estimates the mean peak discharge of postfire, runoff-induced debris flows in small (<345 acres) basins burned at over 43% moderate and high SBS:

$$Qp = 5.7 * I30 * Ab$$

Where:

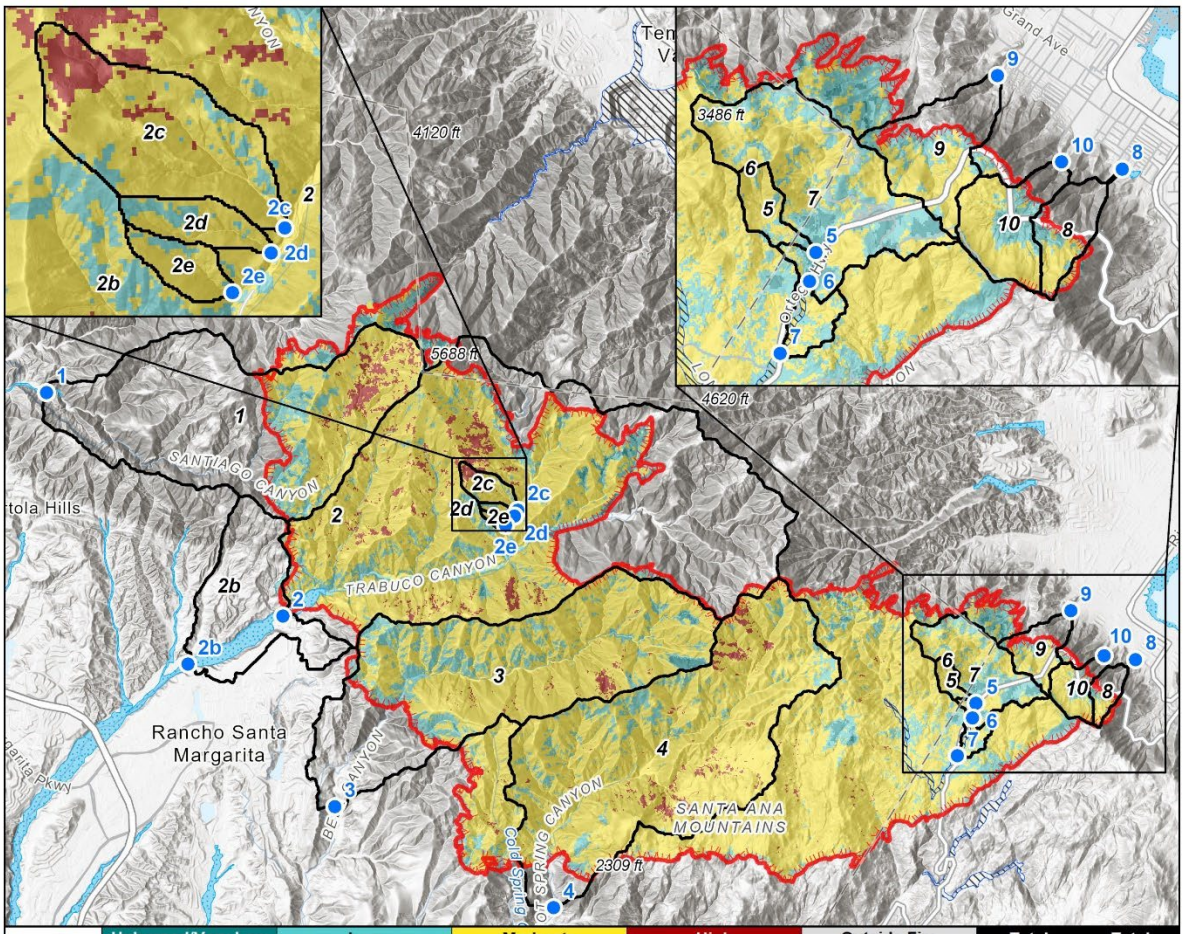
Qp – Peak Discharge

I30 – 30 minute Peak Rainfall Intensity

Ab – Basin area

Three basins that fit the criteria necessary to apply the Kean et al. 2016 model is PP-2c, 2d, and 2e positioned upslope of cabins in Holy Jim Canyon, which is tributary to Trubuco Canyon. These basins, in addition to other basins in the vicinity, have high USGS predicted postfire debris flow probabilities (Figure 7) and exhibit geomorphic evidence indicative of high debris flow potential. Table 2 provides a summary of basin information as well as pre-fire and post-fire flow estimates based on a 2-year recurrence interval flow. Results indicate that postfire runoff events for a 2-year recurrence interval storm can produce floods and debris floods that are about 2 to 6 times larger than normal streamflow. The largest change occurs within Bell and Hot Springs canyons where postfire debris flood hazards are high due to their high percent of slopes burned at moderate soil burn severity. For the small debris-flow-prone basins in Holy Jim Canyon, the postfire flow multiplier ranges from 32 to as high as 57, well inside the expected range for true debris flows (Kean et al. 2016). This large increase in clearwater equivalent peak discharge illustrates the significance of dilated surge fronts for debris debris flows and better frames the potential hazards to life and property in debris-flow-prone basins. Additional basins believed to represent and elevate threat of mobilizing sediment and debris to form dilated surge fronts include pour points, in descending order of perceived threat, Upper and Lower Trabuco Canyon (PP-2 and 2b), El Cariso Rd area and Hwy 74 (PP-6 and PP-7), Jamieson St. (PP-10), and Santiago Canyon (PP-1).

These flow 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 be adjusted to decrease predicted postfire flows and reduce conservatism.



Pour Point	Unburned/Very Low		Low		Moderate		High		Outside Fire		Total	Total
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%	Acres	km²
1	45	1.1	331	7.8	1,190	28.2	157	3.7	2,500	59.2	4,223	17.1
2	188	2.0	854	9.2	4,724	50.9	273	2.9	3,247	35.0	9,286	37.6
2b	195	1.8	877	8.2	4,726	44.2	273	2.5	4,629	43.3	10,700	43.3
2c	0	0.0	11	7.7	112	77.8	21	14.5	0	0.0	144	0.6
2d	0	0.0	7	24.6	22	75.4	0	0.0	0	0.0	30	0.1
2e	0	0.0	3	12.8	21	87.2	0	0.0	0	0.0	23	0.1
3	63	1.4	666	14.8	2,788	62.0	46	1.0	936	20.8	4,498	18.2
4	14	0.3	442	8.9	4,153	83.6	149	3.0	212	4.3	4,970	20.1
5	4	4.7	15	18.9	63	76.4	0	0.0	0	0.0	82	0.3
6	68	9.2	251	34.1	417	56.7	0	0.0	0	0.0	735	3.0
7	70	8.6	277	34.1	465	57.3	0	0.0	0	0.0	812	3.3
8	10	7.3	19	14.2	36	26.3	0	0.0	71	52.2	136	0.5
9	9	3.1	68	23.4	115	39.5	0	0.0	98	33.9	290	1.2
10	13	5.5	55	24.1	125	55.0	0	0.0	35	15.4	227	0.9

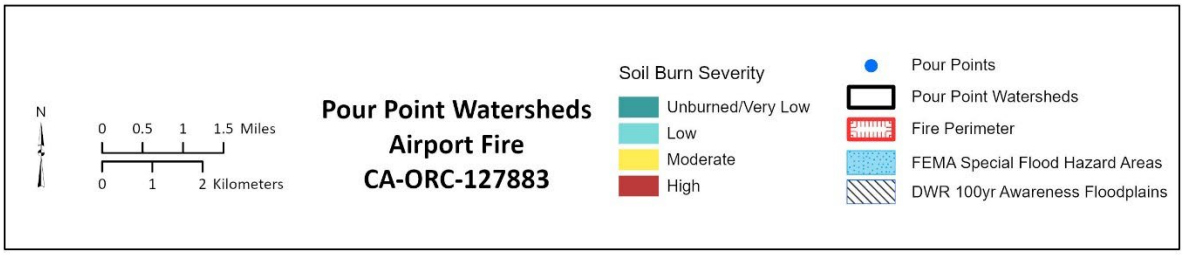


Figure 9. Pour Point locations within and downstream of the Airport Fire.

Table 2. Basin metrics, pre- and postfire Q2 flow estimates, postfire Q2 recurrence intervals, and pre-fire Q2 flow multipliers used to estimate increased relative flood response for watersheds assessed for flood hazard (i.e., “Pour Points”).

Pour Point #	Description	Anticipated flow type based on channel morphology and historic record	Basin Area (mi^2)	Relief (feet)	Mean Basin Elevation (feet)	% Unburned/ very low	% Low SBS	% Moderate SBS	% High SBS
PP-1	Santiago Canyon	Debris Flood	6.6	4278	3150	60	8	28	4
PP-2	Upper Trabuco Canyon	Debris Flood	14.5	4527	3035	37	9	51	3
PP-2b	Lower Trabuco Canyon	Flood	16.7	4691	2835	45	8	44	3
PP-2c	Holy Jim Canyon Upper	Debris Flood/Flow	0.2	1750	2875	0	8	78	14
PP-2d	Holy Jim Canyon Middle	Debris Flood/Flow	0.05	1178	2473	0	25	75	0
PP-2e	Holy Jim Canyon Lower	Debris Flood/Flow	0.04	1063	2369	0	13	87	0
PP-3	Bell Canyon	Debris Flood	7.0	3543	2387	22	15	62	1
PP-4	Hot Springs Canyon	Debris Flood	7.8	3543	2701	5	9	84	3
PP-5	El Cariso Rd	Debris Flood	0.1	852	2870	5	18	77	0
PP-6	El Cariso Rd/HWY 74	Flood	1.1	1022	2835	9	34	57	0
PP-7	HWY 74	Debris Flood	1.3	1096	2801	9	34	57	0
PP-8	Ortega Basin Lateral A[3]	Debris Flood	0.2	1686	2293	32	14	54	0
PP-9	Greenwood Drive (Robinhood)	Debris Flood	0.5	1599	2410	37	23	40	0
PP-10	Jamieson St.	Debris Flood	0.4	1608	2544	21	24	55	0

Pour Point #	Description	Q2 prefire flow (CFS)[1]	Q2 post-fire flow (CFS) following BAER[2]	Q2 post-fire flow (CFS) following Kean[4] for small basins (3.5 - 345 acres) with expected high debris flow potential.	Q2 prefire to postfire flow multiplier (Postfire Q2/Q2) for Flood-Debris Flood/ Debris Flow	Interpreted Postfire Response[5]
PP-1	Santiago Canyon	147	451	--	3	Moderate
PP-2	Upper Trabuco Canyon	236	1055	--	4	Moderate-high
PP-2b	Lower Trabuco Canyon	256	1035	--	4	Moderate-high
PP-2c	Holy Jim Canyon Upper	14	62	809	4/57	High
PP-2d	Holy Jim Canyon Middle	5	16	166	3/34	High
PP-2e	Holy Jim Canyon Lower	4	14	132	3/32	High
PP-3	Bell Canyon	135	613	--	5	High
PP-4	Hot Springs Canyon	141	797	--	6	High
PP-5	El Cariso Rd	8	27	--	3	Moderate
PP-6	El Cariso Rd/HWY 74	35	132	--	4	Moderate-high
PP-7	HWY 74	38	142	--	4	Moderate-high
PP-8	Ortega Basin Lateral A[3]	10	27	--	3	Low
PP-9	Greenwood Drive (Robinhood)	17	45	--	3	Low
PP-10	Jamieson St.	15	44	--	3	Moderate

[1]2-yr Recurrence Interval (Q2) flow estimated using USGS regional regression equations (basins between 0.04 to 850 mi^2) (Gotvald, 2012).

[2]Postfire, 2-yr Recurrence Interval (Q2) flow (clearwater) following BAER protocol based on Soil Burn Severity: non&verylow = Q2; low = Q5; moderate = Q10; High =Q25. See report text for explanation.

[3]Includes an additional 38 acres of moderate burn severity from the July 2024 Macy Fire that impacted the lower elevations of the basin.

[4]Postfire peak debris flow discharge (Kean et al, 2016). See report text for explanation.

[5]Locallized flooding in excess of the postfire reponses presented may occur immidiately downslope of basins burned at a high severity, at tributary confluence, and at crossing structures if high volumes of woody debris and large boulders are transported.

Postfire Hydrologic and Hydraulic Models

The peak flow estimates and flow multipliers summarized in Table 2 are best used to evaluate the relative magnitude of change from pre-fire to postfire runoff. However, because the methods applied only allow for peak flow to be estimated, they do not provide a complete runoff hydrograph needed to conduct unsteady 2D and 1D hydraulic modelling, which would inform flow conveyance and inundation extent within and downslope of burnt areas. Consequently, the WERT recognizes that Orange County and Riverside County public works may wish to conduct detailed hydrologic and hydraulic modelling to better account for increased runoff and potential flow path uncertainty using available models such as the Hydrologic Engineering Center's Hydrologic Modeling System (HEC-HMS) and River Analysis System (HEC-RAS) (HEC, 2024). Upon request, the WERT can provide general guidance to help parameterize basic hydrologic and hydraulic models based on experience from burn scars in similar geoclimatic conditions with known postfire response.

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 are summarized below.

- FEMA, state, and local flood hazard mapping was not complete or non-existent in several areas.
- Not all roadway culverts and bridges in and adjacent to the burn area were evaluated.
- Some potential VARs were not evaluated, or evaluated from a distance, because of the lack of access.
- Hazards on alluvial fans could not be represented as single-points given the potential for avulsion (i.e., rapid channel shifting) and flow-path uncertainty. Alluvial fan VARs are generally presented as polygons or included in FEMA and DWR flood and awareness zones.
- 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 postfire runoff and/or blockage of drainage structures (e.g., culverts and bridges) by postfire debris. As such, local agencies should consider these previously mapped hazard areas in addition to the VARs identified in this report.

Specific Values-at-Risk (VARs) are contained within the geodatabase (VAR point and polygon feature classes) 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. Detailed observations and potential mitigations are provided in the geodatabase (VAR point and polygon feature classes), VAR summary table (Appendix B) and VAR site information sheets (Appendix C and D). A summary of VARs by relative risk to life-safety and property are shown in Table 3.

Table 3. Values-at-Risk (VARs) classified by risk to life-safety and property.

Risk to Property \ Risk to Life-Safety	Low	Moderate	High
Low	DC-01, GI-01, LC-01, LC-02, TC-06	MC-03, MC-04	TC-10
Moderate	EC-05, EC-08, LE-01, TC-12, TC-13	DC-02, EC-01, EC-02, EC-04, EC-06, EC-07, HS-03, LE-02, LE-03, LE-04, MC-02, TC-04, TC-05, TC-08, TC-11	
High		BC-01, EC-03, MC-01	HS-01, HS-02, TC-01, TC-02, TC-03, TC-07, TC-09

Exigent Values-at-Risk

Exigent VARs are those that should receive priority attention for pre-planning and emergency protection measure implementation. The twenty-six (26) exigent VARs on the Airport Fire are VARs with at least moderate risk to both life-safety and property, or high risk to either life-safety or to property (Table 3). These VARs are discussed below, along with associated VARs that include many residential structures that face potential flood risks in areas of known flood hazard and key road crossings that present a moderate hazard to either life-safety or property.

Trabuco Canyon and Holy Jim Canyon (TC-01, TC-02, TC-03, TC-04, TC-05, TC-07, TC-08, TC-09, TC-10, TC-11): The VARs contained within the Trabuco Canyon and Holy Jim Canyon areas (**TC-01**) face a wide spectrum of hazards that will potentially be triggered during stressing rainfall events, with the most pressing hazards being the possibility of debris and flood flows bulked with burned large woody debris. Due to stretches of confinement of Trabuco Creek in Trabuco Canyon downstream of the confluence with Holy Jim Canyon, combined with abundant steep watersheds with moderate burn severity feeding into Trabuco Canyon upstream of the Trabuco Canyon Road crossing (**TC-10**), debris and flood flows in Trabuco Creek may be unpredictable in their extent within the Trabuco Creek floodplain. Debris and flood flows within the active Trabuco Creek channel network are highly likely to impact ingress and egress for all VARs that are in or adjacent to the Trabuco Creek floodplain (**TC-08, TC-09**. In the Holy Jim Canyon area and upper Trabuco Canyon area, the cabins that were not burned by the fire (**TC-02, TC-03, TC-04, TC-05**) are sited adjacent to steep burned hillsides, and have no current

protections (e.g. retaining walls, debris barriers, deflection walls) against local watershed impacts such as bulked surface runoff and debris entrainment into hillside watercourses directed into habitable structures. In lower Trabuco Canyon multiple VARs were identified within O'Neill Regional Park (**TC-11, TC-12, TC-13**), which may be impacted by bulked flood flows that have the potential to exceed the currently defined Trabuco Creek active channel and spill into the adjacent floodplain.

Bell Canyon (BC-01): The Bell Canyon area in the vicinity of the Starr Ranch Sanctuary comprises a VAR with a variety of watershed hazards. Road and drainage crossing infrastructure, in addition to several habitable structures, are located adjacent to the canyon bottom and will potentially be impacted by debris and flood flows from the upstream largely moderately burned watershed. As noted during field reconnaissance, the channel shows signs of high energy flow. Mobilized trees and debris could cause debris jams that force flows out of the channel and contribute to debris impacting the bridge located immediately upstream of the Starr Ranch Sanctuary and its assorted residential structures and outbuildings.

El Cariso Village/El Cariso Springs area (EC-01, EC-02, EC-03, EC-04, EC-06, EC-07): Located within the eastern area of the fire, and partially occupying the boundary between Orange and Riverside Counties, the potential hazards associated with VARs in this area are primarily caused by the presence of multiple watercourses within and adjacent to residential communities that have not been adequately engineered to handle bulked flow during postfire debris and flood flow events. Numerous undersized culverts and watercourse crossing infrastructures were observed to be at risk of blockage and/or overtopping during field reconnaissance, which can cause flooding of watercourse adjacent residential pads. Additional risk of diversion of flood and debris flows onto Highway 74 (**EC-07**) can impact ingress and egress to the affected area. Within the El Cariso Village/El Cariso Springs area of the fire numerous residential structures were significantly burned, and at **EC-01** dozens of vehicles were burned adjacent to a local water course, presenting a potential hazard to water quality as postfire stressing rainfall events will contribute runoff into the local drainage system.

Hot Spring Canyon (HS-01, HS-02, HS-03): The concentration of VARs in Hot Spring Canyon is located less than 1 mile from the perimeter of the burned area of the fire. The upstream watershed burned at an almost entirely moderate soil burn severity, and is one of the larger burned watersheds within the fire perimeter. This means that the Hot Spring Canyon VARs are at high risk of facing a multitude of burned watershed hazards, with debris and flood flows being the most impactful hazards. During field reconnaissance, several watercourse crossing structures were observed to be undersized with respect to anticipated bulked flow that is expected following stressing rainfall events in the burned upstream watershed. Bulked flows in the canyon may cause debris racking and floodplain inundation in stream terraces adjacent to the active stream channel. In VAR **HS-03**, ingress and egress to residential structures will be impacted as the residential structures are connected to Hot Spring Canyon Road by a pedestrian bridge that faces considerable risk from bulked flows.

Lake Elsinore area (LE-02, LE-03, LE-04): The Lake Elsinore area VARs are located at the apices of alluvial fans created by outlets of steep drainages flowing out of the eastern front of the Santa Ana Mountains. These VAR locations are situated below partially burned watersheds which are not expected to generate appreciable flows following stressing rainfall events; however, due to steep topography and historic occurrence of debris and flood flows that

impacted the community following the 2018 Holy Fire, the watersheds may be capable of delivering slightly bulked flows into proximity of the VARs. Therefore, drainage infrastructure may be at risk of partial blockage if it is not maintained and kept clear of debris prior to stressing rainfall events. Above VAR **LE-04**, the 2024 Macy Fire burned the lower portion of a watershed that was burned at a low to moderate soil burn severity in its upper reaches during the Airport Fire. This particular drainage outlets into a debris basin.

Modjeska Canyon (MC-01, MC-02): The Modjeska Canyon community is located more than three miles downstream of the fire perimeter; however, this community is at risk for bulked flood flows that may have the capability to inundate floodplain areas and isolate neighborhoods within the canyon bottom if drainage infrastructure becomes blocked (e.g. **MC-02**). Due to the distance between the burned watershed and the Modjeska Canyon community, watershed impacts may not be immediately observed during stressing rainfall events, but accumulation of debris upstream within confined reaches of upper Santiago Canyon may cause delayed flood flow pulses. The community is advised to keep the canyon bottom clear of debris.

Key Infrastructure

Key infrastructure within and downslope of the Airport Fire perimeter consists mostly of public road and flood-control infrastructure, including engineered drainage structures protecting developed areas along the west side of Lake Elsinore and lower Trabuco Canyon. Monitoring, maintenance, and repair costs to roads and flood-control infrastructure are expected to be high until the Airport Fire burn area revegetates and recovers: a period that typically can take 2 to 5 years, but may occur faster in some areas where the soil burn severity was low.

Public road network potentially affected by the Airport Fire was not completely evaluated during the WERT investigation. All roads, stream crossings, and drainage structures downstream and downslope of hillslopes and drainages burned at moderate to high SBS are at risk of storm damage and may become plugged and overtopped that can lead to crossings being compromised and access restricted. Crossings and drainage along all county roads within and downstream of the burned area should be evaluated and maintained as soon as possible and monitored and cleaned out after significant storm events. In addition, crossings that pose a high risk of failure and sediment delivery may be reconstructed with properly sized structures that can accommodate additional flows and debris loading, replaced by vented low-water crossings meant to be overtopped, or armored to protect the loss of fill. **We recommend receiving regional alerts (for example, the National Weather Service) and watching storm forecasts so problematic roads can be avoided during storms.** Some specific areas of concern are discussed below.

Modjeska Canyon (Santiago Canyon Road, MC-04, and Olive Hill Road MC-02) has two crossings which may become flooded due to debris jams. A bridge on Olive Hill Road (**MC-02**) is the only source of ingress/egress to homes in the neighborhood to the south. The bridge on Santiago Canyon Road (**MC-04**) should also be avoided during stressing rainfall events.

Trabuco Canyon (TC-01, Trabuco Creek Road crossings over or through Trabuco Creek, including TC-08 and TC-09) has many low-water crossings, in addition to some bridges and drainage structures **(TC-10)** which will potentially be impacted during stressing rainfall events.

Trabuco Creek Road, which will potentially endure damage from debris flows and flooding, serves as the sole ingress and egress to all residences and the fire station within Trabuco Canyon and Holy Jim Canyon (**TC-01**). Two access roadways (**TC-08, TC-09**) are within the active Trabuco Creek watercourse, and serve as the sole ingress and egress to structures on the north side of the wash. The Trabuco Canyon Road bridge (**TC-10**) may endure flooding and debris flows as it did following storms after the 2018 Holy Fire. There is also a concern that ingress and egress to the water treatment infrastructure and adjacent roadways (Rose Canyon Road) may be impacted by bulked flows in Trabuco Creek.

Bell Canyon (BC-01)
A bridge crossing along the main access road may be impacted by debris or may jam with debris and force flows out of the channel into a wildlife sanctuary. This bridge should be maintained and monitored to keep it clear of debris.

Hot Spring Canyon (HS-02)
A pedestrian bridge is the only source of ingress and egress to a home (**HS-02**). This bridge may become washed out as debris flows from the upper watershed.

Long Canyon (LC-01, LC-02) has several crossings which serve as ingress and egress, and could become either jammed with material and produce flooding, or may be washed out with debris.

There are burnt structures situated adjacent to watercourses within Long Canyon. The property owner should not relocate temporary housing in potential flow paths.

Decker Canyon (DC-01, DC-02) has two crossings at risk. A crossing at **DC-01** could become overtopped by a flood with mobilized burnt debris and sediment. A culvert at **DC-02**, which is the sole ingress and egress to a residence, could also become plugged, resulting in overtopping and inundation of the road.

El Cariso Rd/ Highway 74 (EC-01, EC-03, EC-05, EC-07, EC-08) is the major highway connecting Riverside County with Orange County through the burned area in Santa Ana Mountains. Several culverted crossings may become clogged and result in flooding (**EC-01, EC-03, EC-05, EC-07, EC-08**).

There are burnt structures situated adjacent to watercourses near El Cariso Road. The property owner should not relocate temporary housing in potential flow paths.

Lake Elsinore (LE-02, LE-04) has several infrastructures at risk in the various smaller drainages between Ortega Highway and Lake Elsinore. First, the Robinhood community, (**LE-02**), a culvert is at risk of being plugged, causing backwater flooding and flows potentially being diverted down local roads. Next, the debris basin and inlet at Ortega Basin Lateral A (**LE-04**) may overtop if the drainage inlet becomes clogged with debris. Last, debris may impact the basin above Jamieson Street and alter the local hydraulics of an engineered trapezoidal drainage ditch that carries water from the basin and directs it towards Lake Elsinore. Hydrologic modeling, however, suggests these concerns present a low to moderate risk.

Rockfall Hazards exist along portions of upper Trabuco Canyon and Holy Jim Canyon (**TC-01**) near the Fire Station (**TC-06**) as well as potentially in slopes adjacent to cabins sited near steep slopes (e.g. **TC-03, TC-05, TC-07**). Increased rock exposure and root damage from the fire will increase the likelihood of rockfall. In high risk rockfall areas during significant storm events we suggest having local agencies patrol these areas for hazards, staging proper heavy equipment for response and provide signage to adequately warn drivers. As a general note, all steep watersheds within which large boulders are observed have the capacity for increased rockfall hazard as slope erosion processes (e.g. dry ravelling) will continue to destabilize slopes and create the potential for rocks to become mobilized in stressing rainfall events.

General Hazards to Water Quality

As a result of the Airport Fire, 160 structures were destroyed, and 34 others damaged. Several populations of destroyed buildings are near Ortega Highway in Long Canyon, Decker Canyon, and in the El Cariso neighborhood, and each has dozens of burned vehicles. Several more destroyed buildings are in Trabuco Canyon and Holy Jim Canyon. Destroyed structures adjacent to watercourses have the potential to transfer contaminated soils, large and small debris, and hazardous materials into waterways which can impact water quality downstream. Based on current understanding of impacts on burned residential homes and structures from wildfires, the resulting ash and debris can contain concentrated and toxic amounts of polycyclic aromatic hydrocarbons and heavy metals such as antimony, arsenic, cadmium, copper, lead, and zinc. The characterization of hazardous materials and their impacts on the environment and water resources is outside the purview of the WERT and is generally under the review of other State and Federal Agencies, such as State Water Quality Control Board, Department of Toxic Substances Control, California Department of Office of Emergency Services (Cal OES), and the Federal Environmental Protections Agency. To protect water quality and human health, local agencies may request assistance from the Cal OES Watershed Mitigation, Coordination, and Outreach unit to deploy emergency protective measures (EPMs) in areas with high potential for hazardous material runoff and increased sedimentation within the watershed. Some more destroyed and damaged buildings exist along Ortega Highway within 1 kilometer of Lookout Roadhouse in Riverside County, and in the northern-most area of the fire near Santiago Peak; these structures were not assessed in this WERT.

General Recommendations

Implement an Early Warning System

An effective early warning system requires the implementation of different components (Figure 10) for hazard risk reduction, as well as linkages between these components so that the goals of protecting life, safety, and property are accomplished. In previous sections, this report characterizes the spatial distribution of hazard and risk within and downstream of the burned area, greatly increasing knowledge about potential risk from postfire hazards. This report also contains a fire-specific rainfall threshold to be used as a trigger point for forecast-based watches and warnings. Each VAR is characterized by the potential postfire hazard, relative risk from the hazard, and the potential emergency protective measures that can be implemented for risk reduction. The granular nature of VAR characterization allows for more targeted communication and response planning by emergency responders, public works/flood control agencies, and other entities tasked with implementing risk reduction activities (e.g., NRCS).

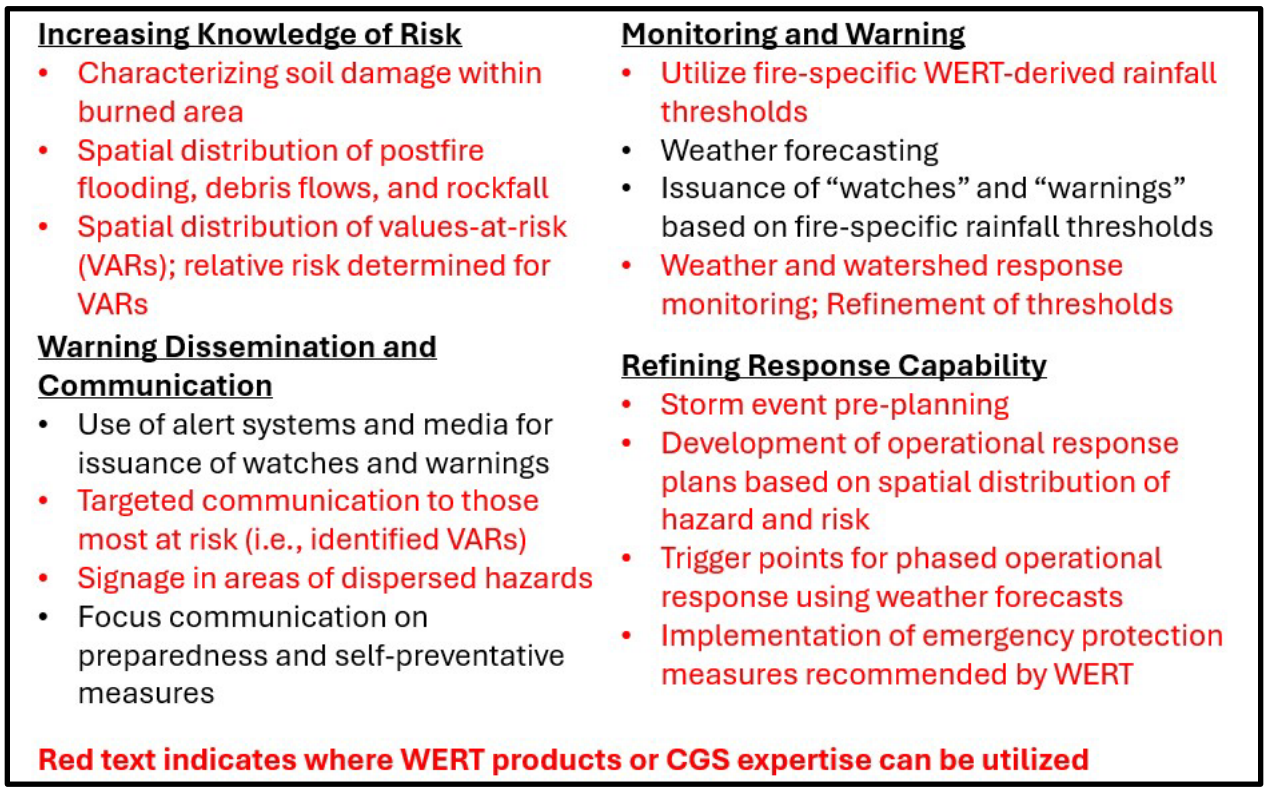


Figure 10. The four components of "people-centered" early warning systems (adapted from Garcia and Fearnley, 2012), along with steps necessary to implement each component specific to minimizing risks from postfire watershed hazards. This WERT report provides knowledge to implement each of these components in a manner specific to the fire.

Prescribed Rainfall Thresholds

The initial year rainfall thresholds are determined by WERT for the Airport Fire by considering data such as the USGS modeled rainfall thresholds, regional debris-flow thresholds, previous flood and rainfall history, geologic/geomorphic conditions of the burned area, and the hazard and relative risk associated with each VAR. The following thresholds have been developed by the WERT and approved by Orange and Riverside Counties and the National Weather Service (NWS).

For basins where the threat of debris flood and debris flow hazards are high and drain to the west, including Santiago, Trabuco, Bell, Hot Springs, Decker, and Long Canyons, plus the community of El Cariso, the thresholds are summarized in Table 4.

Table 4. Year 1 rainfall thresholds for the Airport Fire for basins that drain to the west.

Duration	*Year 1 Threshold Intensity mm/hr (in/hr)*	*Year 1 Threshold Depth mm (in)*	*Recurrence Interval*
15 minutes	20 (0.80)	5 (0.20)	1-years
30 minutes	15 (0.60)	7.6 (0.30)	1-years
60 minutes	13 (0.50)	13 (0.50)	1-years

For basins in Riverside County where debris flood hazards exist and drain to the east, particularly basins immediately west of Lake Elsinore, the thresholds are summarized in Table 5.

Table 5. Year 1 rainfall thresholds for the Airport Fire for basins in Riverside County that drain to the east.

Duration	*Year 1 Threshold Intensity mm/hr (in/hr)*	*Year 1 Threshold Depth mm (in)*	*Recurrence Interval*
15 minutes	25.4 (1.0)	6.4 (0.25)	1-years
30 minutes	17.8 (0.70)	8.9 (0.35)	1-years
60 minutes	15 (0.60)	15 (0.60)	1-years

The WERT strongly recommends that Orange and Riverside County Public Works, Office of Emergency Services, and Sheriff's Offices work with the NWS and the California Geological Survey to monitor forecasts and rainfall intensity during storms, as well as observe postfire response following storm events. If the initial rainfall threshold is too conservative, and little response occurs during storm events, data and observations will be necessary to adjust the threshold upward in a defensible manner. Alternatively, rainfall thresholds can also be lowered based on gage data and observations.

Existing early warning systems should be used and iteratively improved such that residents can be alerted to incoming storms, allowing enough time to safely vacate hazard areas. 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. Early warning systems for the Airport Fire should take advantage of the services described below.

Utilize National Weather Service Forecasting

Flash flood and debris flow 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 postfire debris flow "watch" and "warning" notifications in burn areas.

> **Watches** are issued when the likelihood of hazardous weather or a hydrologic event has increased significantly, but it's occurrence, location, and/or timing is still uncertain. Watches provide lead time for pre-storm planning and response.
>
> **Warnings** are issued when hazardous weather or hydrologic events are occurring, are imminent, or have a very high probability of occurring.

For additional information, see the NWS Los Angeles/Oxnard Forecast Office webpage (https://www.weather.gov/lox/).

Residents Potentially Affected by Postfire Hazards Should Sign Up for Alerts

This report identifies areas in Riverside and Orange counties within and downstream of the Airport Fire burn area with the highest potential for postfire flooding, debris flows, and rockfall. Each county has its own emergency notification system to warn residents of potential hazards. These emergency notification systems enable the counties to provide essential information quickly in a variety of situations, including in the event of fire-induced flooding and debris flows.

Orange County emergency alerts can be received by text, phone call, or email alerts via Everbridge, a community notification system. Anyone can register for these alerts at http://www.alertoc.com/.

Riverside County sends notifications about potential hazardous conditions, evacuations, dangers, and other critical information. Anyone can register for text, phone call, or email alerts at https://rivcoready.org/alert-rivco.

Wireless Emergency Alerts (WEA)

Residents should be aware of what to do when receiving an alert through WEA. WEA is an alert system originated by the NWS that can inform residents, visitors, and businesses of flash flood warnings and other potential hazards. WEA alerts are emergency messages sent by authorized government 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. Since WEA alerts can be disabled by phone users, residents and businesses potentially subject to hazards associated with the Airport Fire are urged not to opt out of WEA. You can find more information at the following link: https://www.weather.gov/crp/wea.

Communicating Hazard and Risk Associated with Airport Fire

Increasing awareness is the key to minimizing risk on the Airport Fire. Primary hazards observed in and downstream of the burn area include debris flows that can exit steep basins burned at moderate and high soil burn severity, such as along Holy Jim Canyon that could impact leased cabins on USFS property, and elevated flood and debris flood hazards that can

impact developed areas, particularly along channels in Santiago, Bell, Hot Springs, Trabuco, and Long Canyons. These hazards constitute a potential threat to life-safety and property. Residents and property owners downstream of burned areas should be aware that flood severity and frequency may increase. Public outreach should focus on communicating this to these affected residents and property owners.

Hazards exist to transportation corridors that allow ingress and egress to Santiago, Trabuco, Bell, Hot Springs, Long, and Decker Canyons, as well as to areas along El Cariso Road and Ortega Highway (Highway 74), to name a few. If these transportation corridors are affected by postfire hazards, they may leave residents stranded after storm events, and prevent the delivery of emergency services to these residents. This constitutes a potential life-safety threat if emergency medical care is needed for residents stranded by storm events. Signage has been used effectively in similar situations on previous fires to inform the public traveling key corridors, such as on the Trabuco Canyon Road Bridge. Signage placed along portions of the county and state road network can help alert drivers of potential debris flow, flooding, and/or rockfall hazards during periods of rainfall. Owners of non-public road networks should be aware of the potential hazards along roadways following fire and should implement signage accordingly.

For those interested, links to additional information about postfire geohazards are listed below.

- CGS Burned Watershed Geohazards website: https://www.conservation.ca.gov/cgs/bwg/program
- CAL FIRE post wildfire safety website: https://readyforwildfire.org/post-wildfire/
- Cal OES postfire geohazards article: https://news.caloes.ca.gov/flood-after-fire-preparing-for-the-post-disaster-danger
- FEMA postfire factsheet: https://www.fema.gov/sites/default/files/documents/fema_flood-after-fire_factsheet_nov20.pdf

Response Planning for the Airport Fire

An objective of the WERT process is to provide operational intelligence to those tasked with implementing risk reduction activities (e.g., emergency planners, fire departments, flood control agencies). WERT information should be used to narrow the decision-space for operational planning, strategy, and tactics. Key information provided by the WERT includes the following:

- VAR location (map and spatial data)
- Whether the VAR is a discrete structure (point) or a grouping of structures (polygon)
- The types of hazards posing risk to the VAR
    - The report discusses whether hazards are debris flows, debris flood/flooding, or rock fall
- What is the relative risk to life-safety and/or property?
    - Relative risk is characterized as low, moderate, and high
    - Response efforts should prioritize VARs with moderate to high life-safety and/or property risk
    - Low risk is associate with a nuisance level of hazard
- Emergency protective measures are recommended to reduce risk
    - WERT does not design direct protection measures (e.g., deflection structures)
    - Some measures need more intensive evaluation and design to reduce risk

Informing and empowering the public is a key step in risk reduction. Riverside and Orange County have resources that can help reduce risk from postfire flooding and debris flows. Riverside County includes tips for storm preparedness guidelines, availability of free sand and sandbags, non-emergency points of contact, information about storm alerts, flood safety, flood insurance, and maintenance requests in English and Spanish (https://rcflood.org/ ; https://rivcoready.org/). Information about emergency management in Orange County in several languages can be found here: https://ocom.ocpublicworks.com/service-areas/oc-operations-maintenance/flood-control, https://ocsheriff.gov/commands-divisions/investigations-special-operations-command/emergency-management/hazard-mitigation.

The WERT recommends that local government conduct public outreach so that residents and property owners can make informed decisions that reduce their risk exposure to postfire hazards.

Transition/Temporary Housing

When there is need for temporary housing or new building construction for residents displaced by the fire, site-specific evaluation of hazards for temporary housing should be conducted by a qualified professional and in accordance with the local lead agency. In addition to assessing the potential for increased flood hazards near watercourses, the following factors should be considered as part of the evaluation. On hillslopes above potential temporary housing and building sites:

- Could runoff from the hillslope concentrate in swales and small drainages and flow onto the site, and flood or otherwise damage the proposed structure, or present a life-safety hazard?
- Is the hillslope behind the structure steep and erodible, where rilling, gullying, or shallow failures could deliver a sufficient volume of sediment and debris to damage the proposed structure or pose a life-safety hazard?
- Are large rocks, boulders, or other material present on the slope that pose a rock or debris fall hazard that could impact the proposed structure, or present a life-safety hazard?
- Is there evidence of recent or impending erosion or mass wasting that could damage the proposed structure or pose a life/safety hazard (e.g., debris torrents/flows, deep-seated slides or slumps)? On hillslopes below potential temporary housing and building sites?
- Is there evidence of recent or impending fill slope landslide-type failures that indicate an elevated risk of building pad failure?
- Is the building pad located above a watercourse where normal or flood flows could potentially erode the toe of the slope and trigger failure?

If any of these conditions are present, then mitigations need to be implemented, or alternative sites need to be identified and evaluated. Technical experts such as licensed engineers or geologists may be needed to support the evaluation.

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

First responders and Emergency Planning personnel should work in conjunction with Orange County and Riverside County Flood Control, Caltrans, and United States Forest Service to

coordinate response planning for increased flood flows and resultant sedimentation in the Airport Fire area. Potential impacts to water quality may stem from burned vehicles, homes, and other debris entrained in flows. Postfire flood inundation mapping should be performed for areas downstream of the burn 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

Potential debris flow hazards were identified that could impact VARs particularly along Trabuco Canyon, Holy Jim Canyon, Bell Canyon, and Hot Springs Canyon. Models used to predict postfire debris-flow runout and methods to parameterize the models are currently under development. Thus, WERT geologists rely partially on geomorphic evidence to estimate the downstream extent of potential debris-flow inundation. Some of the at-risk sites are within built environments where geomorphic evidence may have been altered or destroyed through grading and/or construction. Also, geomorphic evidence may not be sufficient to predict the downstream extent of debris flows under postfire conditions. In areas below larger, severely burned drainages, the areal extent of debris-flow inundation is highly uncertain. It is recommended property owners are made aware of the potential hazards, get connected to receive advanced forecast and information through NWS and County Alert systems, and obey local evacuation notices issued by the County Sheriff or other Government Authority.

Increased Rockfall Hazards

Potential rockfall hazards were identified during field evaluations along portions of Trabuco Canyon and its tributary Holy Jim Canyon, and along cutbanks along portions of Highway 74. 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

The three mine sites were inspected remotely (western two sites) and in the field (eastern site). The western two sites appear to be minor with minimal ground disturbance and minor observed tailings or waste rock piles present. The eastern site was found to include two minor adits recessed into the mountain about 10 to 15 feet with low-volume waste rock piles extending downslope and minor rusty pipes and metal pieces scattered about. Due to their small size, age, and distance to identified VARs, not significant postfire impacts related to mines are anticipated.

Road Drainage Systems, Storm Monitoring, and Storm Maintenance

Due to the presence of areas burned at moderate and high soil burn severities, increased flows on slopes and onto the road and storm drain systems can be expected, particularly on Ortega Highway (Highway 74), Trabuco Creek Road, Modjeska Road, Hot Springs Canyon Road, Long Canyon Road, and roads in the El Cariso neighborhood. Increased erosion 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, debris floods, debris torrents, debris flows, and sedimentation resulting from storm events. Equipment should be staged in areas where risk is high and access is necessary. Spatial data generated by the USGS and the WERT (e.g., USGS debris-flow model and flood flow predictions) can be used to screen potential at-risk areas for increased monitoring and maintenance presence.

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Appendix A – Airport Fire WERT Contact List

Pete DeSimone Audubon California Starr Ranch Sanctuary (Bell canyon) 949.858.0309
Cheyne Maule Division Chief OCFA, cheynemaulesteve@ocfa.org 949-217-9603
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Todd Hopkins CAL FIRE RRU Division Chief, Todd.Hopkins@fire.ca.gov 760-330-7438
Trevor Richardson OC Public Works –Operations & Maintenance 714-448-1929
Kevin McArthur Assistant Emergency Manager Orange County Sheriff's Department 714-612-6710
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Appendix B – Values-at-Risk Summary Table

Airport Fire
Values-at-Risk Table as of 10/25/2024

Site Number	Community / Local Area	Address	Latitude	Longitude	Potential hazard / Field observation	Potential risk	Remarks	Hazard Category	Specific at-risk feature	Feature Category	Potential hazard to life?	Potential hazard to property?	EPM	EPM2	EPM3	EPM4	EPM Text
BC-01	Bell Canyon				Debris flow/flood could overtop channel banks and impact structures and cutoff access.	Likely probability of occurrence with Moderate consequences = High risk.	The upslope basin burned at mostly moderate soil burn severity. The channel shows signs of high energy flow. Mobilized trees and debris could cause debris jams that force flows out of channel. Downstream bridge may be impacted by debris.	debris flow / flood	Residential structures.	multiple	moderate	high	Early Warning	Deflection structure	Monitor and maintain		Deflection structures such as K - rails and HESCO barriers could be effective to mitigate damage to home adjacent to channel. Bridge downstream should be maintained and kept free of debris.
DC-01	Decker Canyon				Burnt residence adjacent to watercourse and access road crossing. Potential hazard is flood that could mobilize burnt debris and sediment, overtopping crossing and impacting temporary housing and/or future structure(s).	Likely probability of occurrence with Minor consequences = Low risk.	The VAR is located in the upper portion of a drainage burned at a mostly moderate soil burn severity.	flood	Home and road crossing.	multiple	low	low	Monitor and maintain				Do not place temporary housing or new structures adjacent to watercourse.
DC-02	Decker Canyon				Access road crossing, residence and outbuildings. Potential hazard is debris flood/flow plugging culvert, resulting in overtopping and inundation of road. Potential avulsion and impacts to residence downstream of crossing adjacent to watercourse.	Possible probability of occurrence with Moderate consequences = Intermediate risk.	Culvert includes a squashed 36" CMP, now 42" x 28", and three ~22" concrete barrels. Barrels up to 60% are plugged with sediment. Upstream channel is choked with brush and vegetation. Block wall adjacent to culvert outlet and downstream made of stacked rock provides some protection to residence. Small pond in residence yard could attenuate potential avulsion away from home. The upstream basin mostly burned at moderate soil burn severity.	debris flow / flood	Home and road crossing.	multiple	moderate	moderate	Early Warning	Clear and maintain culvert	Deflection structure		
EC-01	El Cariso Village	32403 Ortega Highway, Lake Elsinore, CA 92530			Multiple structures and burned out vehicles are located adjacent to watercourse. Avulsions upstream and within VAR can create debris with potential for culvert/drainage infrastructure blockage/damage. Burned materials can contaminate water.	Likely probability of occurrence with Moderate consequences = High risk.	Reconnaissance from driving on highway led us to more closely investigate this site. Water quality is at risk if rain comes before cleanup.	flood	Homes, road infrastructure, culverts.	multiple	moderate	moderate	Early Warning	Clear and maintain culvert	Monitor and maintain	Signage	Clean up burned debris to prevent downstream debris flows and watershed contamination. Do not place temporary housing or new structures adjacent to watercourse.
EC-02	El Cariso Springs				Multiple residences and structures are located adjacent to watercourse. Potential hazard is flood flows overtopping banks and inundating structures and access roads.	Likely probability of occurrence with Moderate consequences = High risk.	Upstream basin burned at mostly moderate soil burn severity with some low.	debris flow / flood	Homes, structures, road network.	multiple	moderate	moderate	Early Warning	Monitor and maintain	Deflection structure		
EC-03	El Cariso Springs	El Cariso Road at Calle de Los Pinos Road.			Multiple residences are located adjacent to watercourse. Potential hazard is flood and debris impacting multiple small crossings, resulting in diversions that can impact residences and associated structures.	Likely probability of occurrence with Moderate consequences = High risk.	Upstream basin burned at moderate soil burn severity. Poor drainage exists along flow paths.	debris flow / flood	Residences and watercourse crossings.	multiple	moderate	high	Early Warning	Monitor and maintain	Deflection structure		
EC-04	El Cariso Springs		33.64675	-117.41788	Business under renovation (Hells Kitchen restaurant) is adjacent to watercourse and gazebo that spans the channel. Flood flows and plugged culvert may cause inundation impacting restaurant, and flooding with mobilized debris impacting gazebo.	Likely probability of occurrence with Moderate consequences = High risk.	Plugged bridge culvert may lead to backwater effects and inundation.	flood	Home, gazebo/bridge.	home	moderate	moderate	Early Warning	Monitor and maintain			
EC-05	El Cariso Springs	Intersection of El Cariso Road and Ortega Highway	33.64587	-117.41836	4' by 6' concrete box culvert crossing at Highway 74. Potential hazard is flood flows mobilizing woody debris plugging culvert, leading to overtopping of road, with some flows directed down the highway to the east.	Likely probability of occurrence with Moderate consequences = High risk.	Culvert has flared wing walls with a 4 foot head wall. Dense riparian vegetation is in the drainage, including a large fallen tree across the upstream side of drainage.	flood	Road crossing.	drainage structure	low	moderate	Early Warning	Clear and maintain culvert	Signage		Remove the large fallen tree across upstream side of drainage.
EC-06	El Cariso Springs, east of Ortega Highway		33.64563	-117.41842	Unmapped residence adjacent to water course, potential for flooding.	Possible probability of occurrence with Moderate consequences = Intermediate risk.	Small round house adjacent to stream, possibly part of 32750 Ortega Highway property. Upstream drainage of 3 square km, with 90% moderate or high soil burn severity on slopes >23 degrees. It could have debris and flooding partly due to clogged culvert upstream and some flows overtopping road.	flood	Home.	home	moderate	moderate	Early Warning	Monitor and maintain			Clear culvert upstream from home.
EC-07	EL Cariso Springs / Highway 74		33.63920	-117.42181	Flood and debris flows may overwhelm crossing composed of box culvert and cause flows to be diverted down Highway 74.	Likely probability of occurrence with Moderate consequences = High risk.	Highway 74 is a high volume road, and water and debris may be a moderate hazard. Basin upslope is burned at mostly moderate soil burn severity.	flood	Box culvert crossing (4' h x 10' w).	drainage structure	moderate	moderate	Early Warning				Clear and maintain culvert.
EC-08	El Cariso Springs	Main Divide Truck Trail at Highway 74	33.63779	-117.42288	Culverted road crossing. Potential hazard is flood flows moving sediment and debris that can block culvert and overtop road. Potential impact to fire hydrant.	Likely probability of occurrence with Moderate consequences = High risk.	Basin above is burned at mostly moderate soil burn severity. Channel has a lot of dead trees along it that can be mobilized by flood flows. Double barrel box culvert, 6' high x 8' wide, may get plugged by debris.	flood	Road crossing and hydrant.	multiple	low	moderate	Early Warning	Clear and maintain culvert			Consider removing hydrant standpipe and/or having hydrant not charged.
GI-01	Glen Ivy Hot Springs / Coldwater Canyon	25000 Glen Ivy Road, Temescal Valley, CA 92883			A steep drainage emanates from the mountain front and directly empties into a resort community and downstream mobile home community. Numerous debris barriers and drainage deflection structures (K -rails) were observed throughout the resort property.	Unlikely probability of occurrence with Low consequences = Very Low risk.	Only a small percentage of the drainage basin burned at a Low soil burn severity. Note that hazards to life and property were identified by the 2018 Holy Fire WERT. The Holy Fire burned most all of the watershed above this VAR, and during field reconnaissance, numerous debris barriers and drainage deflection structures (K -rails) were observed throughout the resort property. The K- rails are adjacent to the active stream channel. Anecdotal evidence suggests that repeat debris and flood flows since the 2018 Holy Fire have impacted the resort property. Roadways appear to become drainage paths during flood flows. The downstream area of the VAR adjacent to the mobile home park could potentially face some degree of inundation. Based on reconnaissance topographic analysis and observed surface roughness in the lidar, the active alluvial fan may extend further to the north/northeast and subsequently inundation may extend the as-drawn boundaries of this VAR.	debris flow / flood	Buildings, roads, infrastructure.	multiple	low	low	Early Warning	Debris barrier	Deflection structure	Signage	The abundance of K - rails found within the resort property suggests repeat inundation events are a definite hazard for many areas of the VAR.
HS-01	Hot Spring Canyon				Multiple structures associated with the Lazy W Camp and Resort are located adjacent to the watercourse. Potential hazard is debris flow/flood that can overtop banks and inundate structures.	Likely probability of occurrence with Moderate consequences = High risk.	The basin upstream burned mostly at moderate soil burn severity with some high. Geomorphic evidence composed of braided channel network, large bedload material featuring large boulders, and steep gradient all suggest a high flow regime capable of flooding and transporting debris. Evidence of past walking bridge failure.	debris flow / flood	Multiple Camp/Resort sructures/cabins.	multiple	high	high	Early Warning	Monitor and maintain			Evacuation is advised before stressing storms. Deflection structures such as K - rails, HESCO barriers, Muscle Walls, and sandbags can be installed to mitigate impacts to local structures.
HS-02	Hot Spring Canyon				Debris flow/ flood hazard to habitable structures adjacent to watercourse, and to pedestrian bridge ingress and egress to residence.	Very Likely probability of occurrence with Major consequences = Very High risk.	Geomorphology of the stream with large boulders in channel indicate potential for high flow power in the stream. The canyon upstream is confined, which will focus flood and debris flows spilling into the local flood terrace. The pedestrian bridge will rack up debris, adding to the flood and debris flow hazard, and block ingress and egress to a house. Some trees upstream may become entrained in flood flows and add to debris clogging the bridge. The presence of constructed rock slope protection adjacent to the watercourse indicate possible prior erosion/flooding issues. Monitor weather and any corresponding stream height changes during stressing rainfall events for situational awareness.	debris flow / flood	Cabin, ingress and egress via bridge.	home	high	high	Early Warning	Monitor and maintain			Keep bridge clear of debris. Structures adjacent to channel may benefit from additional flood-proofing measures, e.g. temporary enclosures at doors, sandbags, and deflection structures.
HS-03	Hot Spring Canyon	Hot Springs Canyon Road at Highway 74			Campground / picnic area located adjacent to watercourse. Potential hazard is debris flood/flow overtopping banks and inundating campground.	Probable probability of occurrence with Moderate consequences = High risk.	The basin upstream is burned mostly at moderate soil burn severity with some high. Geomorphic evidence composed of braided channel network with large bedload material upstream. Shallower gradient and less confined channel at this location may produce flood flows with entrained sediment, woody debris, and some boulders.	debris flow / flood	Campground / picnic area.	recreational	moderate	moderate	Early Warning				Consider evacuation during stressing rainfall events/storms.
LC-01	Long Canyon				Multiple cabins adjacent to water course and road crossings. Potential hazard is flooding with debris impacting cabins, washing out road crossings, and contamination to watershed.	Likely probability of occurrence with Moderate consequences = High risk	Several road crossings and multiple cabins. Swimming pool downstream. Burned structures directly in the water channel. Should clean up burned material before next rain to minimize contaminated water flow.Monitor and maintain the drainage.	flood	Cabins, road crossings.	multiple	low	low	Early Warning	Monitor and maintain			Clean up burned material. Do not place temporary housing or new structures adjacent to watercourse.
LC-02	Long Canyon	40051 Long Canyon			Multiple cabins adjacent to watercourse and road crossings, including one steel bridge. Potential hazard is flooding with mobilized debris impacting cabins and washing out road crossings.	Likely probability of occurrence with Moderate consequences = High risk.	Cabins and property appear to have been abandoned.	flood	Cabins, road crossings.	multiple	low	low	Early Warning	Monitor and maintain			Do not place temporary housing or new structures adjacent to watercourse.
LE-01	Lower Dickey Canyon				Flood hazards may overwhelm drainage structures at Toft Drive and downstream at Brookstone Lane. Less than about 20 percent moderate and high burn severity in the watershed; thus, it would likely require a 10-yr plus RI rainstorm to cause issues.	Unlikely probability of occurrence with Moderate consequences = Low risk	Drainage was near capacity following the 2018 Holy Fire. Flows remained in channel but Brookstone crossing did get plugged. Diversion potential exists down Toft road.	debris flow / flood	Drainage infrastructure, roadway, homes.	drainage structure	low	moderate	Early Warning	Clear and maintain culvert			Consider opening lower chain-link gate at Brookstone Road to allow overtopping flows to pass.
LE-02	Laguna Canyon / Robinhood community				Multiple homes adjacent to watercourse and culverted road crossing at Lancashire Drive. Potential hazard is debris flood / flow overtopping banks and inundating residences. Also, plugging of culvert, resulting in backwater effects and road inundation.	Likely probability of occurrence with Moderate consequences = High risk.	Portion of basin in the burn scar burned mostly at moderate. 0.44 km2 at mod and high. Drainage adjacent to homes narrow and relatively steep with boulders.	debris flow / flood	Homes and road crossing.	multiple	moderate	moderate	Early Warning	Monitor and maintain			

Airport Fire
Values-at-Risk Table as of 10/25/2024

Site Number	Community / Local Area	Address	Latitude	Longitude	Potential hazard / Field observation	Potential risk	Remarks	Hazard Category	Specific at-risk feature	Feature Category	Potential hazard to life?	Potential hazard to property?	EPM	EPM2	EPM3	EPM4	EPM Text
LE-03	Wat Khmer Monastery	15315 Lakeview Avenue, Lake Elsinore, CA 92530			Monastery at base of a steep drainage and within potential flow paths. Potential hazards are flood impacts to several structures, some of which may be habitable.	Possible probability of occurrence with Moderate consequences = Intermediate risk.	40% of basin burned with most of that area above Highway 74.	flood	Monastery and associated structures.	multiple	moderate	moderate	Early Warning				
LE-04	Wilford Place in Lake Elsinore				Possibility for flooding associated with debris basin and inlet.	Possible probability of occurrence with Major consequences = High risk.	Inlet at Ortega Basin Lateral A. Inlet includes 7'x7' box with flared wing walls. Transitions to 60" RCP at 18 feet in. Inlet may clog, making a hazard of flooding and possible debris flowing downstream along Welford Place and toward homes on Lake Ridge Road.	debris flow / flood	Debris basins and homes in water course.	drainage structure	moderate	moderate	Clear and maintain basin	Early Warning			
MC-01	Modjeska Canyon				Possible flood flow inundation from upper watershed burned areas. Much of the community is built along a canyon bottom floodplain adjacent to a highly vegetated reach of Santiago Creek. Drainage maintenance appears to be minimal.	Possible probability of occurrence with Moderate consequences = Intermediate risk.	Many homes and appurtenant structures appear to be built close to the active drainage; it is possible that debris and property items may be entrained into a flood flow and cause potential for multiple avulsion events in a stressing rainfall event. This VAR will require monitoring during and following stressing rainfall events to better understand the sensitivity of the drainage to upstream-originating flood flows. Of note, the bridge on Olive Hill Road that crosses Santiago Creek just south of the Modjeska Community Fire Station (VAR LS - 301) appears to be at risk for potential debris racking during a flood flow. Impacts on the Olive Hill bridge will cause ingress and egress problems for the small community of residents on the south side of Santiago Creek.	debris flow / flood	Homes, road and drainage infrastructure.	multiple	moderate	high	Early Warning	Sandbags	Monitor and maintain	Signage	Given that there is no area aside from the canyon bottom -- which is lined with residential structures -- for upstream flood flows to be diverted/deflected around, early warning for stressing rainfall events is highest priority for community residents.
MC-02	Modjeska Canyon		33.70952	-117.62549	Bridge by fire station	Likely probability of occurrence with Major consequences = Very High risk.	Limited capacity and evidence of high water in the recent past. High diversion potential putting flood water on road and flood terrace. Average height is 6', average width is 35'. Bridge provides ingress and egress to eastern residential community, and Modjeska House historical landmark, as well as additional residential area to south of Santiago Creek.	debris flow / flood	Bridge.	utilities	moderate	moderate	Early Warning	Monitor and maintain	Signage		Clear upstream debris so that bridge does not clog and cause flooding. Early warning for the neighborhood to the south, accessed via Olive Hill Road.
MC-03	Santiago Creek downstream / Lower Modjeska Canyon				This reach of Santiago Creek is unconfined and possible distributed flood flows may impact ingress and egress for residents, structures, and road and drainage infrastructure during stressing rainfall events.	Possible probability of occurrence with Moderate consequences = Intermediate risk.	Hazards within this VAR should be additionally characterized following a stressing rainfall event, which will more fully illuminate the map area/extent of impactful flood flows. Based on field reconnaissance/surveying, there did not appear to be many homes adjacent to or within the VAR. However, several horse pens and horse training facilities were observed adjacent to the active canyon bottom and floodplain.	debris flow / flood	Structures, roads, infrastructure.	multiple	moderate	low	Early Warning	Debris barrier	Sandbags	Signage	Residents should be clearly alerted to inherent dangers present in this transitional area of the Santiago Canyon/Modjeska Canyon watershed. Possible debris barriers/deflection structures, and sandbags could be useful.
MC-04	Santiago Canyon / Lower Modjeska Canyon	17112, 17152, 17211, 17226 County Highway S18, Silverado, CA 92676	33.71293	-117.64523	Ingress and egress for residents living on the south side of Santiago Creek are at risk during flood flows emanating from the burned upstream watershed.	Possible probability of occurrence with Minor consequences = Low risk.	Local residents will be affected by flood flows interrupting access to properties on the south side of Santiago Creek.	flood	Water crossings within floodplain.	home	moderate	low	Early Warning	Monitor and maintain	Traffic control	Signage	Residents should be advised to stay away from any water crossings during stressing rainfall events.
TC-01	Trabuco Canyon and Holy Jim Canyon				The entire floodplain and adjacent slopes contain the full spectrum of post-fire watershed hazards capable of impacting Trabuco Creek Road and residences. Landslides, rockfall, and debris and flood flows are all possible.	Very Likely probability of occurrence with Major consequences = Very High risk.	The hazards within the polygon have the potential to combine and become cascading in nature.	debris flow / flood	Trabuco Creek Road, residences.	multiple	high	high	Early Warning	Traffic control	Signage	Deflection structure	Evacuation is advised prior to stressing rainfall events. Due to complex interplay between a debris-filled canyon bottom and oversteepened adjacent slopes, EPMs should be proposed after a site-specific evaluation.
TC-02	Trabuco Canyon	Cabin 29, Trabuco Creek Road	33.67981	-117.51250	Cabin located within the main canyon drainage and at the base of a steep side canyon drainage. Potential hazard is debris flood/flow from upland swales, potentially simultaneously.	Very Likely probability of occurrence with Major consequences = Very High risk.	This VAR may be impacted by south-facing ascending slope-derived inundation from debris/flood flows onto an active debris fan, as well as by inundation potential delivered by Trabuco Creek. Ingress and egress will be severely impacted from multiple watershed hazards as discussed in VAR TC-01. It is likely that following a stressing rainfall event this location will be cut off entirely by access in any direction.	debris flow / flood	Cabin, adjacent roadway.	home	high	high	Early Warning	Debris barrier	Deflection structure	Monitor and maintain	Evacuation is advised before the arrival of a stressing rainfall event. Following stressing rainfall events, maintenance should be performed to clear freeboard behind installed debris barriers and deflection structures.
TC-03	Holy Jim Canyon	Cabins 27 and 28, Holy Jim Canyon Road			Cabins located at base of steep drainages, oversteepened hillsides. Potential hazard is rockfall and debris flood flows/flow directed directly into back of residences. No retaining walls or debris barrier structures are currently present.	Very Likely probability of occurrence with Major consequences = Very High risk.	HESCO barriers may be implemented to protect cabin 27 (south of the two). The drainage pouring into the rear of Cabin 28 has no outlet other than into the back of the cabin. If HESCO barriers or any other deflection structures can be engineered into the ascending slope behind the cabin, installation is advised.	debris flow / flood	Cabins.	home	high	high	Early Warning	Debris barrier	Deflection structure	Monitor and maintain	Evacuation is advised before arrival of stressing rainfall events. Following stressing rainfall events, maintenance should be performed to clear freeboard behind installed debris barriers and deflections structures.
TC-04	Trabuco Canyon / Holy Jim Canyon	Cabin 23, Holy Jim Canyon Road	33.68305	-117.51607	Potential flood flows may overtop channel banks and impact structure.	Possible occurrence with Moderate consequences = Intermediate risk	Installing deflection structures, such as HESCO barriers, muscle walls, and sandbags, may help mitigate potential hazards.	debris flow / flood	Cabin.	home	moderate	moderate	Early Warning	Deflection structure	Monitor and maintain		HESCO barriers could be installed along upstream side of structure to function as a deflection structure.
TC-05	Holy Jim Canyon	Cabin 5, Holy Jim Canyon Road	33.67927	-117.51676	Cabin is located at base of convex drainage. Debris flood flow path could impact cabin. Oversteepened hillsides also have a potential for shallow landsliding.	Very Likely probability of occurrence with Moderate consequences = Very High risk.	HESCO barrier installation on areas of ascending slopes behind the cabin is advised. Additional deflection structure installation on home pad behind cabin may assist with directing water/flood flow away from rear of cabin.	debris flow / flood	Cabin.	home	moderate	moderate	Early Warning	Debris barrier	Deflection structure	Monitor and maintain	Evacuation is advised before arrival of stressing rainfall events. Following stressing rainfall events, maintenance should be performed to clear freeboard behind installed debris barriers and deflection structures.
TC-06	Holy Jim Canyon and Trabuco Canyon	Holy Jim Volunteer Fire Department	33.67602	-117.51801	The Fire Station building is located below a slope with largely moderate soil burn severity with a risk for slope-derived mud and debris impacting the VAR during a stressing rainfall event.	Possible probability of occurrence with Minor consequences = Low risk.	The Fire Station building is situated on a slightly higher terrace surface, just southwest of the confluence of Holy Jim Canyon and Trabuco Canyon, and appears to be at very low risk of debris flows/flood flows originating in either Holy Jim Canyon or Trabuco Canyon. The primary hazard will be the potential for the rear of the structure to be impacted by slope-derived debris and mud.	rock fall	Fire Station building.	business	low	low	Early Warning	Debris barrier	Deflection structure	Sandbags	The recommended Emergency Protective Measures are generous given the overall location of the VAR with respect to the watershed hazards likely at this site.
TC-07	Trabuco Canyon / Holy Jim Canyon	Cabin 1, Trabuco Creek Road	33.67591	-117.51848	Cabin is at risk of oversteepened ascending slope shedding mud and rocks during stressing rainfall events. Existing trees growing out of the slope to the rear of the cabin are leaning against the cabin.	Likely probability of occurrence with Major consequences = Very High risk.	Though the cabin is adjacent to a slope that decreases in gradient to the north, the entire slope was burned at a moderate soil burn severity. Due to the currently situated trees leaning into the rear of the home, if portions of the ascending slope become destabilized, the combination of bulked mud and debris adding to the force applied against the rear of the cabin may cause the cabin to be inundated and/or crushed during a stressing rainfall event, or after cumulative stressing rainfall events.	rock fall	Cabin.	home	high	high	Early Warning	Debris barrier	Deflection structure	Monitor and maintain	Evacuation is advised prior to stressing storms. If the ascending slope can be armored and debris barriers and/or deflection structures placed adjacent to the rear of the cabin, possible mitigation of unstable slope-derived debris can be implemented.
TC-08	Trabuco Canyon	32195 Trabuco Creek Road, Trabuco Canyon, CA 92679			The access roadway into the VAR is within the active Trabuco Creek watercourse. Ingress and egress will be impacted during and following stressing rainfall events.	Likely probability of occurrence with Moderate consequences = Intermediate risk.	The outbuildings and assorted property (cars, shipping containers) located within the VAR will potentially be impacted due to avulsions caused by flood flows in Trabuco Creek. The property will not be accessible during and after anticipated flood flows in Trabuco Creek and the associated floodplain.	flood	Outbuildings, access driveway.	home	moderate	moderate	Early Warning	Debris barrier	Deflection structure	Monitor and maintain	Evacuation is advised before anticipated stressing rainfall events.
TC-09	Trabuco Canyon / Trabuco Creek Road	31651 Trabuco Creek Road, Trabuco Canyon, CA 92679			Inundation within an active floodplain due to flood/debris flows. Ingress and egress for this site as well as a neighboring property to the northwest, on the bluff above Trabuco Creek, will likely be impacted during a stressing rainfall event.	Likely probability of occurrence with Major consequences = Very High risk.	This VAR was not directly accessed or observed during the WERT field reconnaissance. However, review of Google imagery indicates that the northern portion facing the active channel of Trabuco Creek will be at risk of highly concentrated flow emanating from Trabuco Canyon.	debris flow / flood	Home, mobile homes, property, roadways.	multiple	high	high	Early Warning	Deflection structure	Sandbags	Traffic control	Evacuation is advised before a stressing rainfall events. Access to the north side of Trabuco Creek could be cut off during storms. Residents should consider sheltering in place in the event access is cut off.
TC-10	Trabuco Canyon				The Arizona Bridge crossing structure across Trabuco Creek has the potential to be inundated during high-volume debris-filled flood flows.	Possible probability of occurrence with Moderate consequences = Intermediate risk.	This crossing structure formerly had guard rails which were destroyed by the 12/6/18 debris flow emanating from the uppermost portion of Trabuco Canyon burned in the Holy Fire. While the current crossing structure remains optimized for handling bulked flood flows, given the massive increase of upstream burned area, expected flood flows during stressing rainfall events will cause overtopping and present an extreme life safety hazard. Potential channel avulsions upstream of the crossing structure could cause a wider zone of inundation on roadways adjacent to the crossing structure. Existing signage on both sides of the bridge warns the community ("When Flooded Turn Around Don't Drown" & "Flooded During Rains") about this watershed hazard. This message should be amplified preceding anticipated stressing rainfall events.	debris flow / flood	Arizona Bridge crossing.	drainage structure	high	low	Early Warning	Traffic control	Signage	Monitor and maintain	Traffic control should be considered to avoid use of the crossing during overtopping flows occurring near the crossing structure during and following stressing rainfall events.
TC-11	O'Neill Regional Park / Trabuco Canyon	30892 Trabuco Canyon Rd, Trabuco Canyon, CA 92679			Active floodplain inundation with flood flows and possible distributed hyperconcentrated flow runout across the width of Trabuco Canyon. Historic damaging flood flows have occurred in this reach of the canyon following the 2018 Holy Fire.	Possible probability of occurrence with Moderate consequences = High risk.	This VAR, similar to its upstream counterpart, occupies a sizeable area of the canyon floodplain. Many potentially impacted entities (OCFA, O'Neill Regional Park) will need clear communications regarding the potential hazards and exposure generated by stressing rainfall events to come. Anecdotal evidence provided by the O'Neill Regional Park Supervising Park Ranger indicates that lower areas of the park were impacted with flood flows that eroded the berm adjacent to Trabuco Creek following the 2018 Holy Fire. The park has implemented inflatable door seals to protect the Nature Center, and debris barriers/deflection structures have been placed around the bathroom on the south side of Trabuco Creek in the past as precautionary measures in the event of flooding. There are many access points to the park that will need to be closed in advance of stressing rainfall events.	debris flow / flood	Park infrastructure and outbuildings.	multiple	moderate	moderate	Early Warning	Deflection structure	Traffic control	Signage	Evacuation is advised prior to stressing storm events. Flood flow hazard is historically very well-documented.

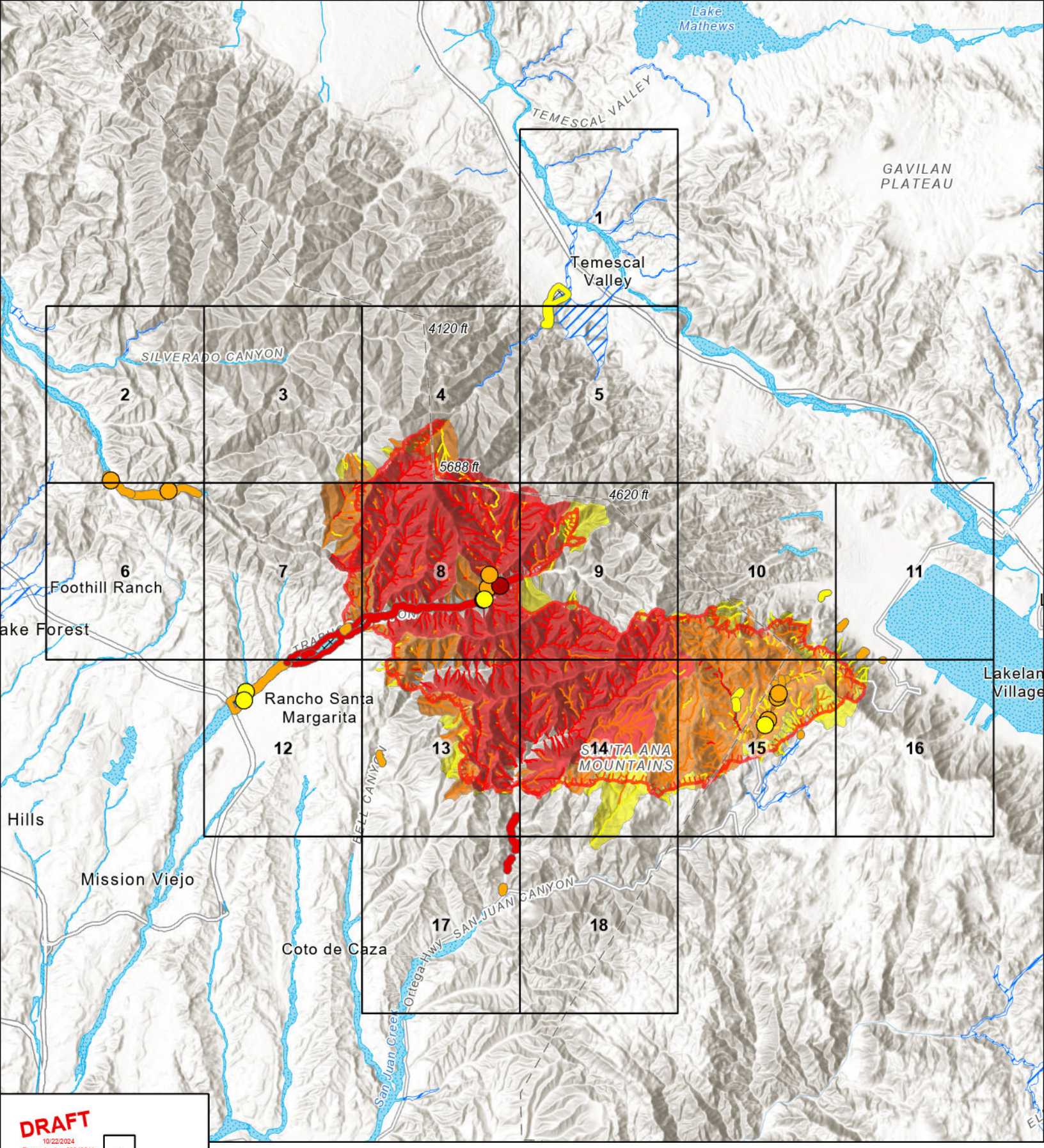
Airport Fire
Values-at-Risk Table as of 10/25/2024

Site Number	Community / Local Area	Address	Latitude	Longitude	Potential hazard / Field observation	Potential risk	Remarks	Hazard Category	Specific at-risk feature	Feature Category	Potential hazard to life?	Potential hazard to property?	EPM	EPM2	EPM3	EPM4	EPM Text
TC-12	O'Neill Regional Park / Trabuco Canyon	30892 Trabuco Canyon Road, Trabuco Canyon, CA 92679	33.65122	-117.60070	Potential for flood flow to impact Nature Center building.	Possible probability of occurrence with Moderate consequences = Intermediate risk.	According to the Supervising Park Ranger, this structure has historically been outfitted with inflatable door seals to add precautionary protection against any potential flood flows originating within the Trabuco Creek/Canyon and/or Live Oak Canyon FEMA-mapped floodplains. Flood flows occurred during stressing rainfall events following the 2018 Holy Fire. There is a berm that extends along the north side of the active channel of Trabuco Creek that aids in confining swollen creek flow to its channel; however, anecdotal evidence indicates that the berm has been occasionally eroded during large flow events. The park staff have worked to repair the berm following every berm erosion incident, and are aware that they will have to remain vigilant during stressing rainfall events to come, originating from a larger burned watershed upstream.	flood	Nature Center building, outbuildings.	recreational	low	moderate	Early Warning	Debris barrier	Deflection structure	Sandbags	Debris barriers and deflection structures should be appropriately placed and augmented to protect any potentially habitable structures. Install sandbags and inflatable door seals on critical buildings.
TC-13	O'Neill Regional Park / Trabuco Canyon	30892 Trabuco Canyon Road, Trabuco Canyon, CA 92679	33.64880	-117.60139	Restroom building is at risk of flood flow inundation. According to the Supervising Park Ranger, this structure has been inundated during past flood flows that overtopped the adjacent berm along the south side of Trabuco Canyon.	Likely probability of occurrence with Moderate consequences = Intermediate risk.	Flood flows following the 2018 Holy Fire reportedly impacted the restroom building; as a result, the park installed debris barriers and deflection structures on the north/northeastern sides of the building in order to divert subsequent flood flows. Based on discussion with the Supervising Park Ranger, the park is aware of the likely increase in flood flow hazards associated with the Trabuco Canyon active floodplain during stressing rainfall events to come.	flood	Restroom building, parking lot.	recreational	low	moderate	Early Warning	Debris barrier	Deflection structure	Sandbags	Debris barriers and deflection structures should be installed between the building and the active floodplain to the north/northeast. Additional sandbags should be placed around doorways.

Summary of General Recommendations and Findings

- Utilize early warning systems available to homeowners, particularly those located in flood-prone areas. The WERT recommends using the National Weather Service early warning system and forecasts.
- Increase the situational awareness of affected residents and the communities regarding the hazards and risks associated with living downstream/downslope of burned areas.
- The WERT strongly recommends that Orange County and Riverside County work with the NWS and the California Geological Survey to monitor forecasts and rainfall intensity during storms, as well as observe postfire response following storm events. The initial rainfall thresholds can be adjusted accordingly after assessing hydrological response to storms.
- Monitor and/or remove accumulated debris from culverts and channels that are upstream of culverts in areas that are subject to postfire flooding where there is an elevated risk to life and/or property.
- Within and downstream of the Airport Fire, there is a potential for flood flows and debris flooding to impact residential areas in Santiago Canyon, Trabuco Canyon, Bell Canyon, Hot Springs Canyon, El Cariso Springs Village/El Cariso, and mountain front communities on the west side of Lake Elsinore. These hazards constitute a potential threat to life-safety and property.
- Debris flood / flow hazards exist throughout the built environment within Holy Jim Canyon, tributaries of upper Trabuco Canyon, and Trabuco Canyon above Trabuco Canyon Road. Additional areas of debris flood / flow hazard, to a lesser extent, include the El Cariso / El Cariso Springs Village area and Long Canyon area.
- The WERT recommends that local government conduct public outreach so that residents and property owners can make informed decisions that reduce their risk exposure to postfire hazards.
- Close coordination between Orange County and Riverside County, the National Weather Service, and local first responders will be necessary to effectively implement a response plan that will minimize risk.

Appendix C – Values-at-Risk Map Book



Incident: Airport Fire (CA-ORC-127883)

Values at Risk (Polygon)
Potential hazard to life
- Low
- Moderate
- High

Value at Risk (Point)
Potential hazard to life
- Low
- Moderate
- High

Basin Combined Hazard
15 min 24 mm/h
- Low
- Moderate
- High

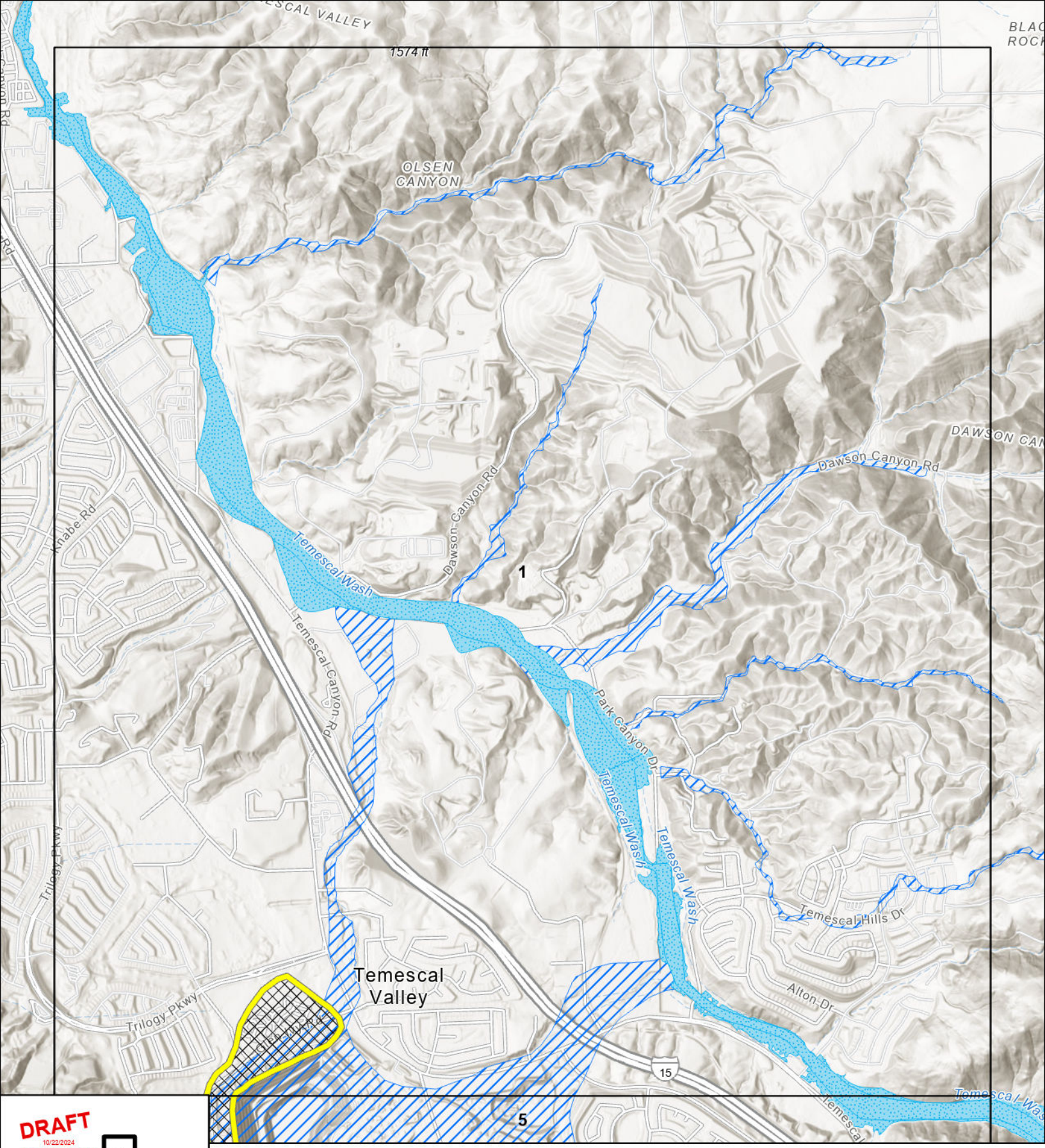
Segment Combined Hazard
15 min 24 mm/h
- Low
- Moderate
- High

N

0 5,000 10,000 ft

0 1,500 3,000 m

- Fire Perimeter
- FEMA Special Flood Hazard Areas
- DWR 100yr Awareness Floodplains



DRAFT
10/22/2024
Fire perimeter: 20240911

Incident: Airport Fire (CA-ORC-127883)

Values at Risk (Polygon)
Potential hazard to life
- Low
- Moderate
- High

Value at Risk (Point)
Potential hazard to life
- Low
- Moderate
- High

Basin Combined Hazard
15 min 24 mm/h
- Low
- Moderate
- High

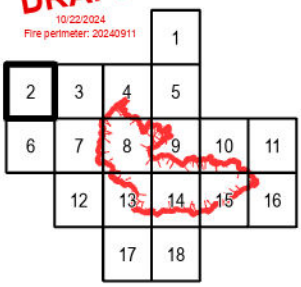
Segment Combined Hazard
15 min 24 mm/h
- Low
- Moderate
- High

N

0 1,000 2,000 ft
0 300 600 m

- Fire Perimeter
- FEMA Special Flood Hazard Areas
- DWR 100yr Awareness Floodplains

DRAFT
10/22/2024
Fire perimeter: 20240911



Incident: Airport Fire (CA-ORC-127883)

Values at Risk (Polygon)
Potential hazard to life
- Low
- Moderate
- High

Value at Risk (Point)
Potential hazard to life
- Low
- Moderate
- High

Basin Combined Hazard
15 min 24 mm/h
- Low
- Moderate
- High

Segment Combined Hazard
15 min 24 mm/h
- Low
- Moderate
- High

N

0 1,000 2,000 ft
0 300 600 m

- Fire Perimeter
- FEMA Special Flood Hazard Areas
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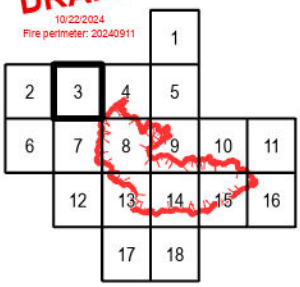
DRAFT
10/22/2024
Fire perimeter: 20240911



Incident: Airport Fire (CA-ORC-127883)

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N

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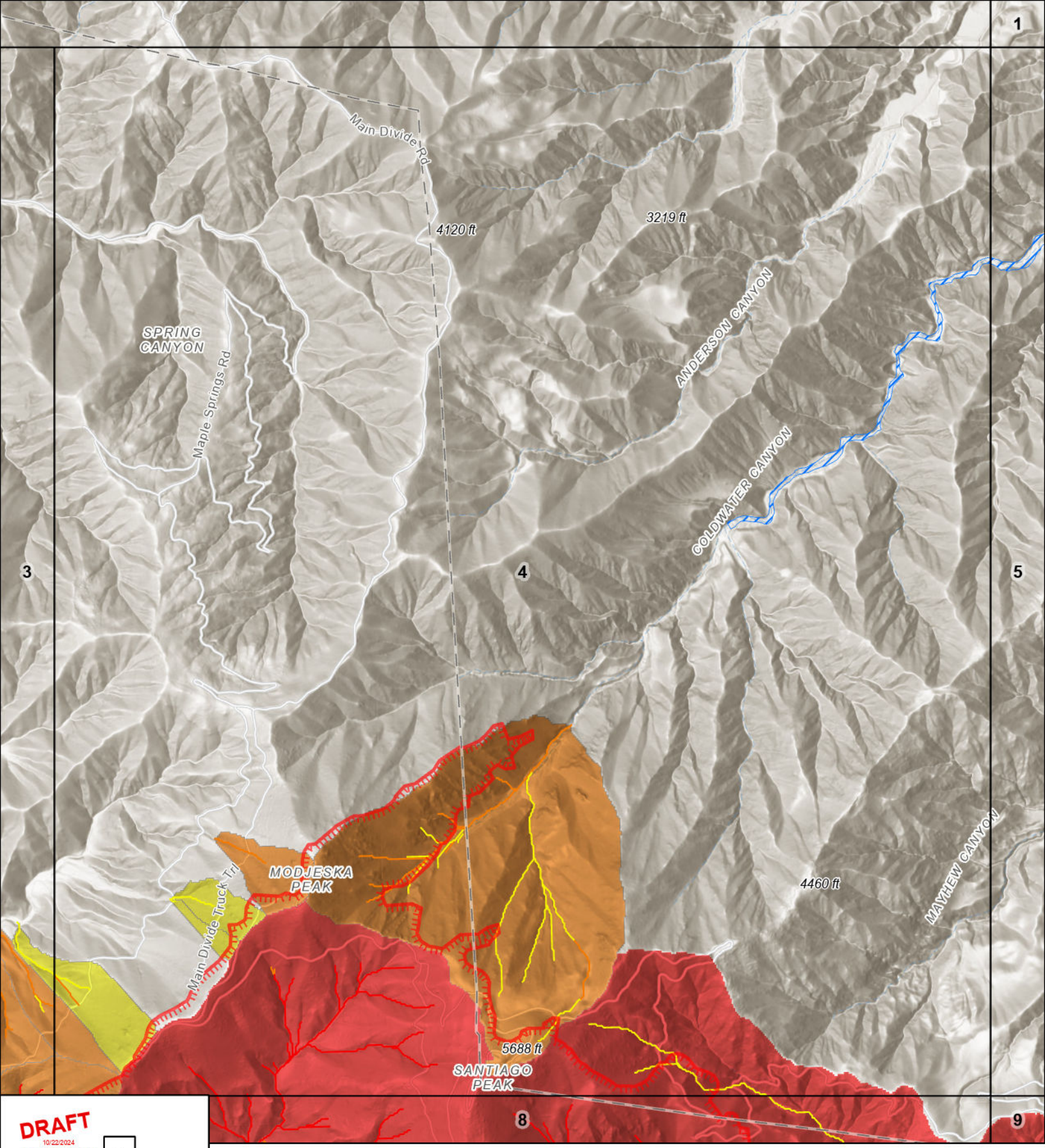

DRAFT
10/22/2024
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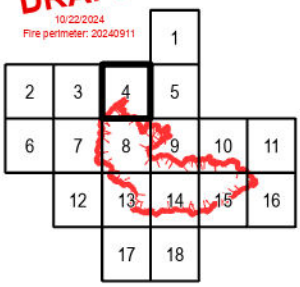

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DRAFT

10/22/2024

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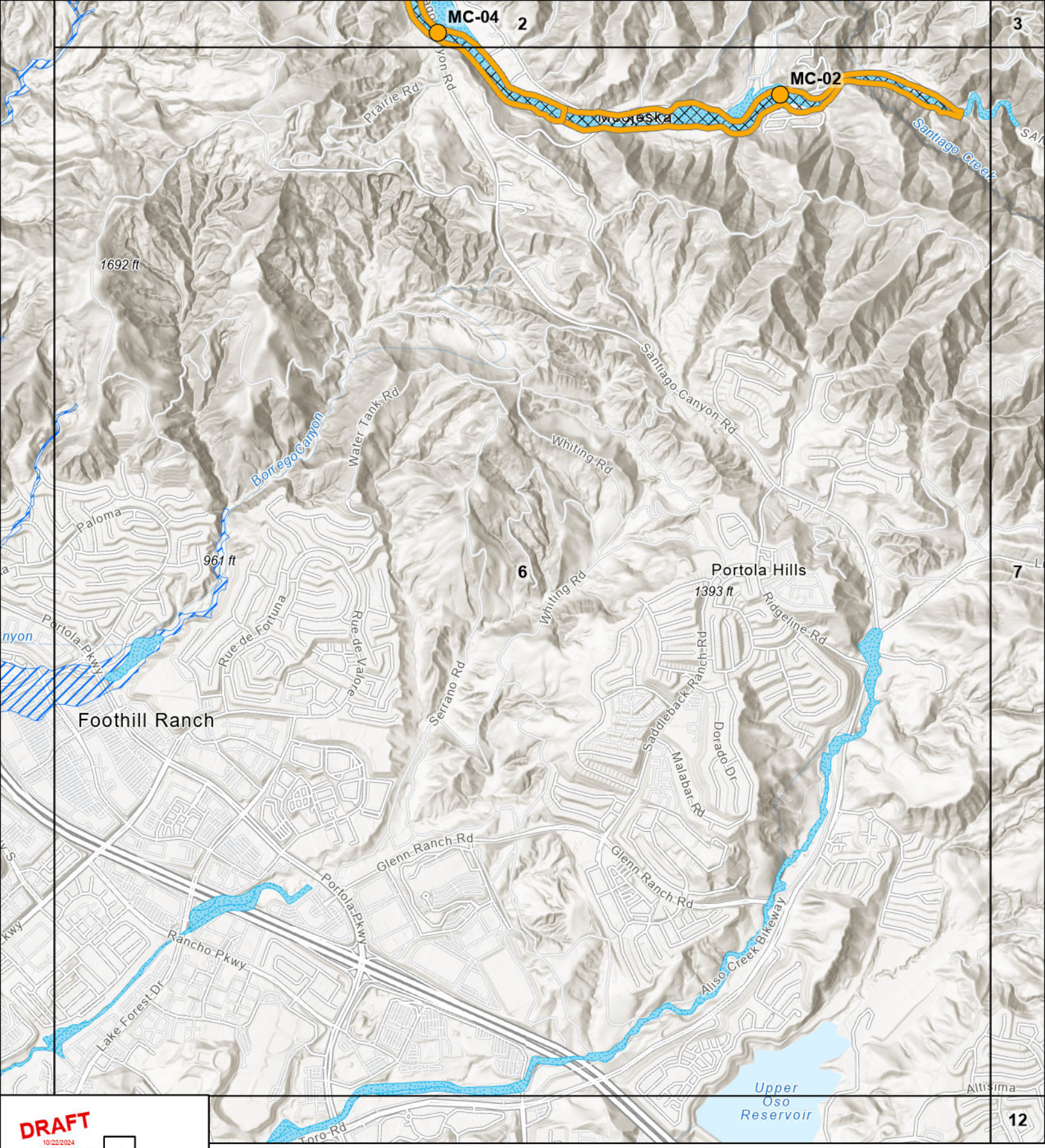

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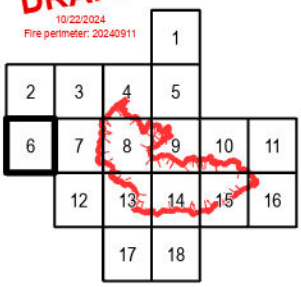

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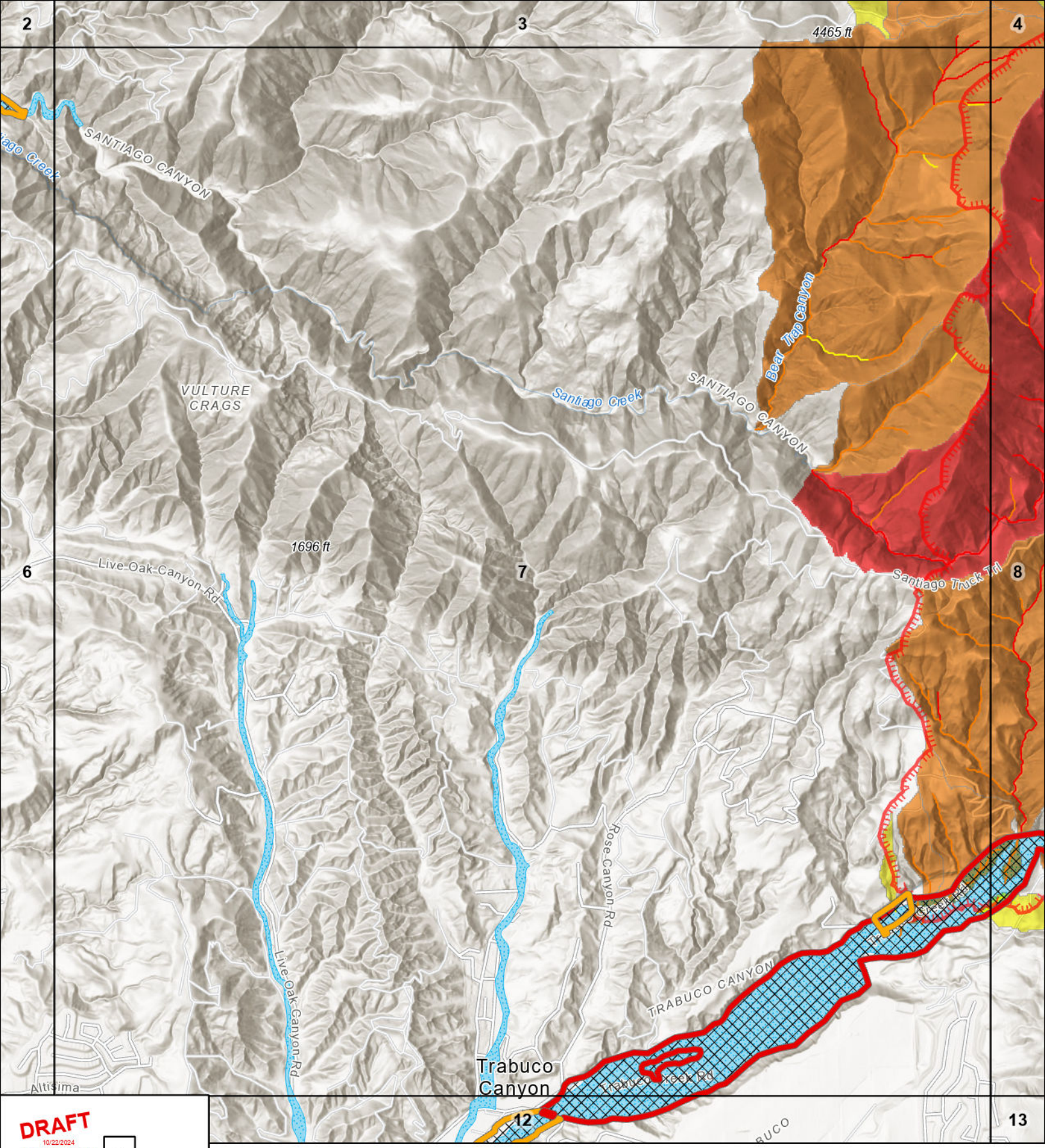

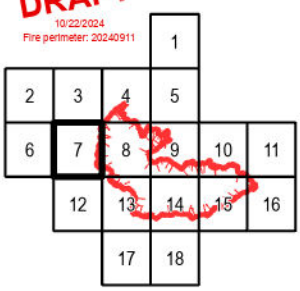

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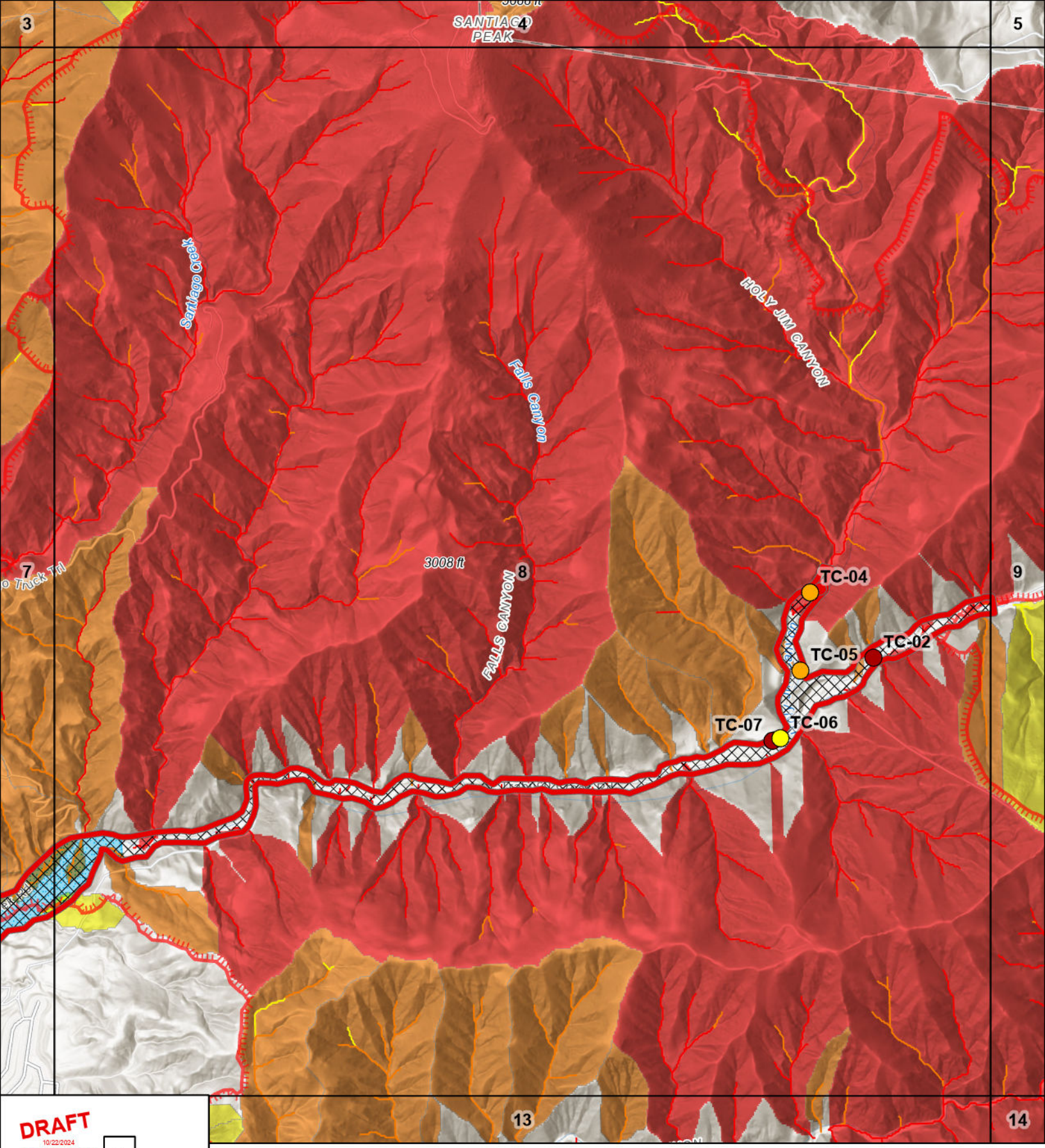

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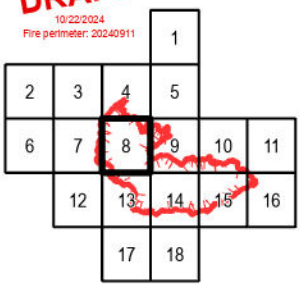

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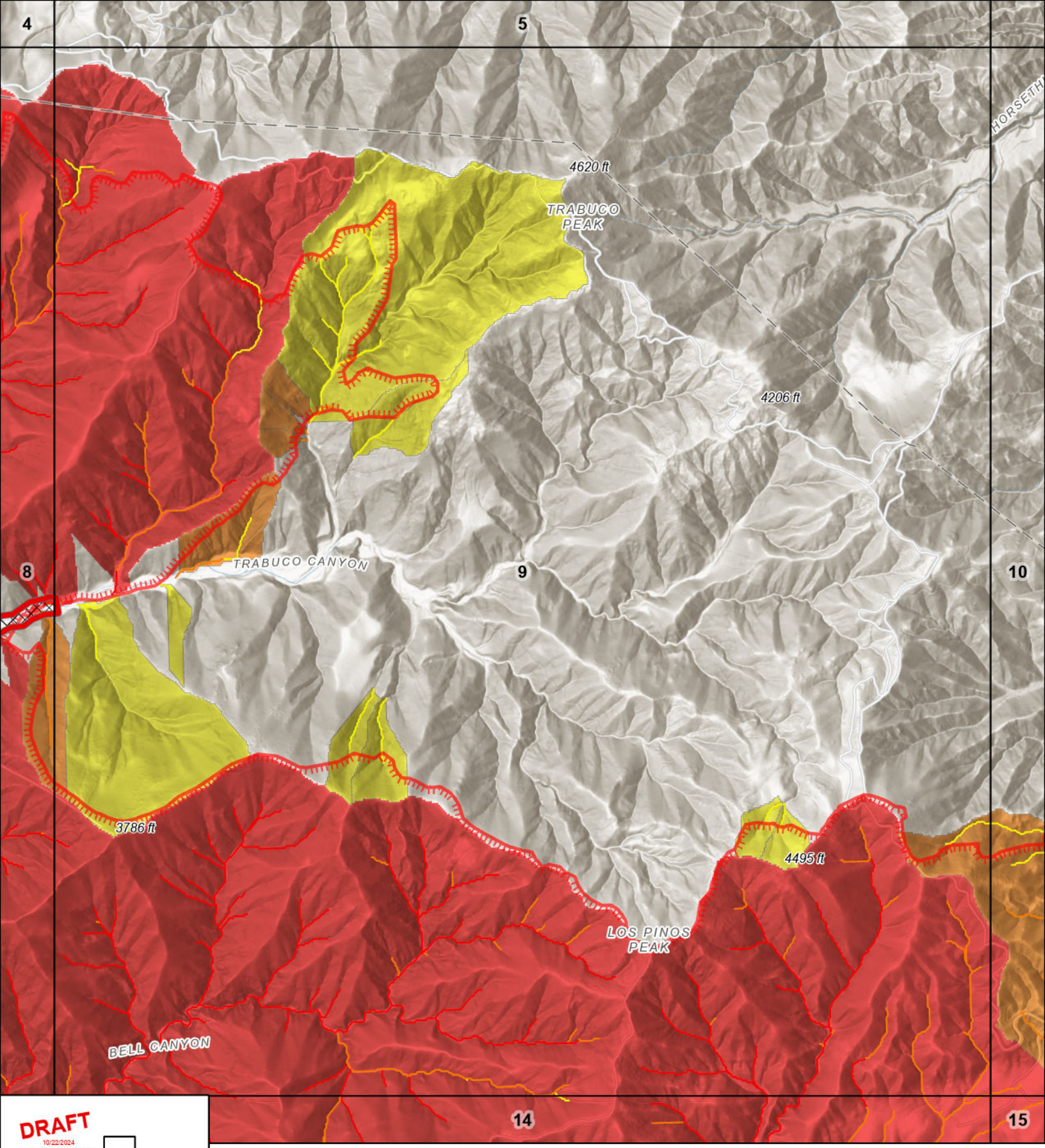

DRAFT
10/22/2024
Fire perimeter: 20240911

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	12	13	14	15	16	
		17	18			

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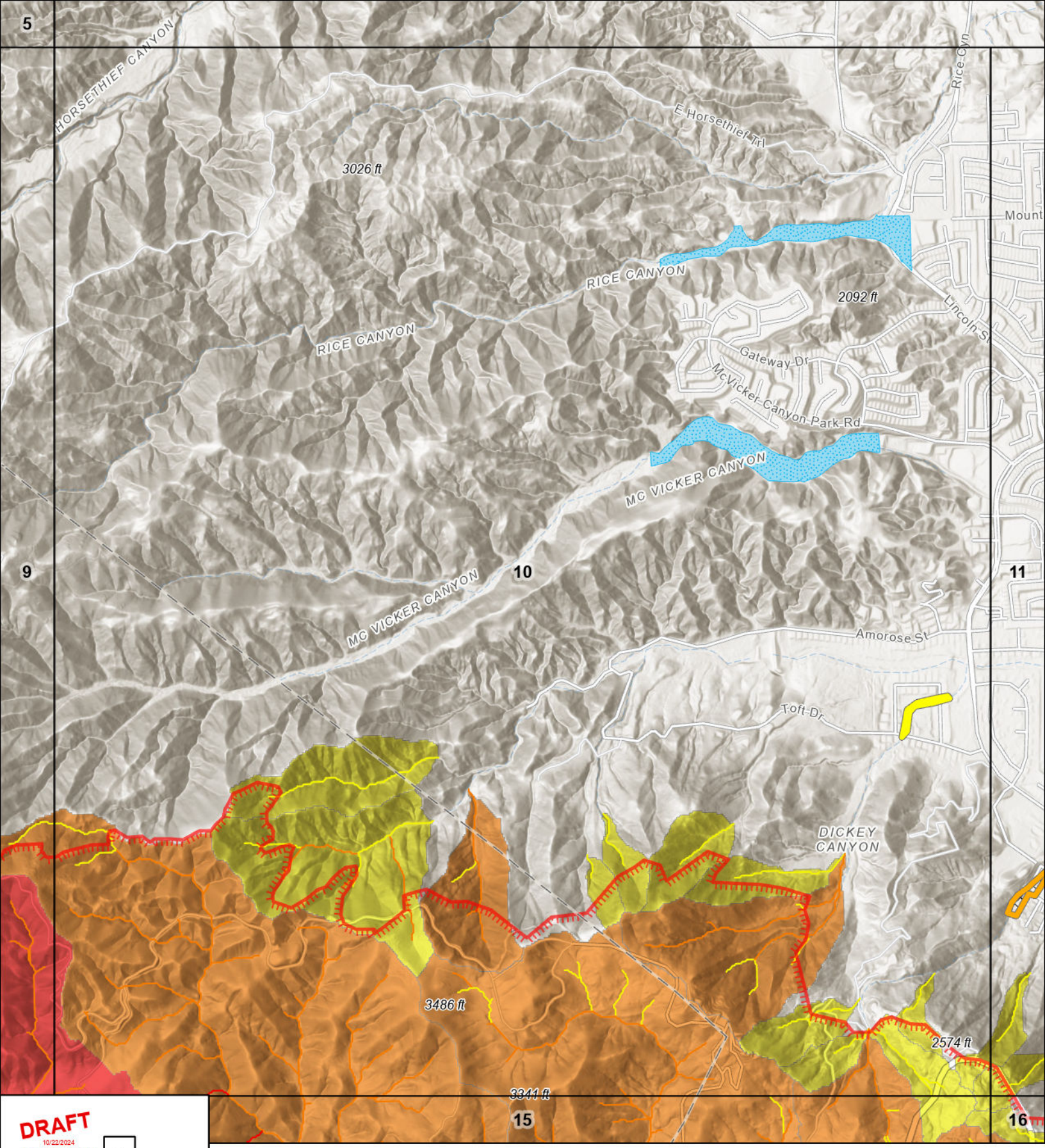

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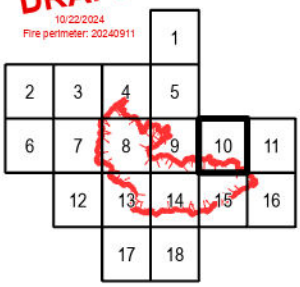

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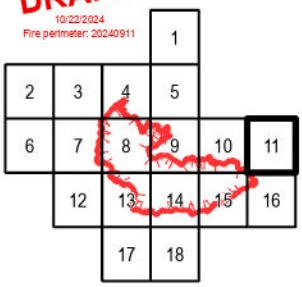

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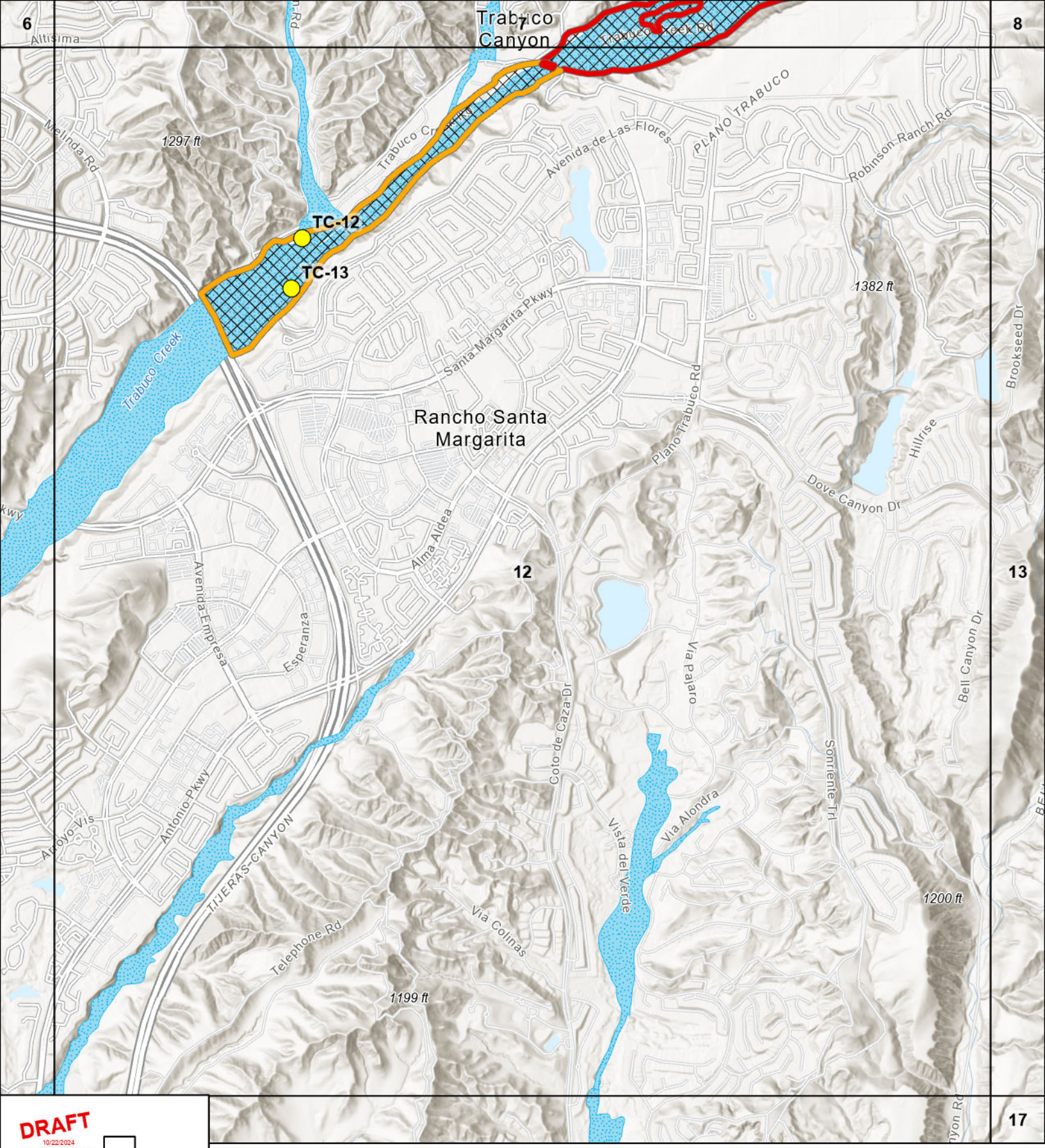

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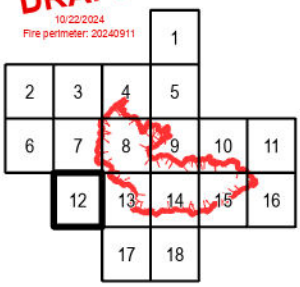

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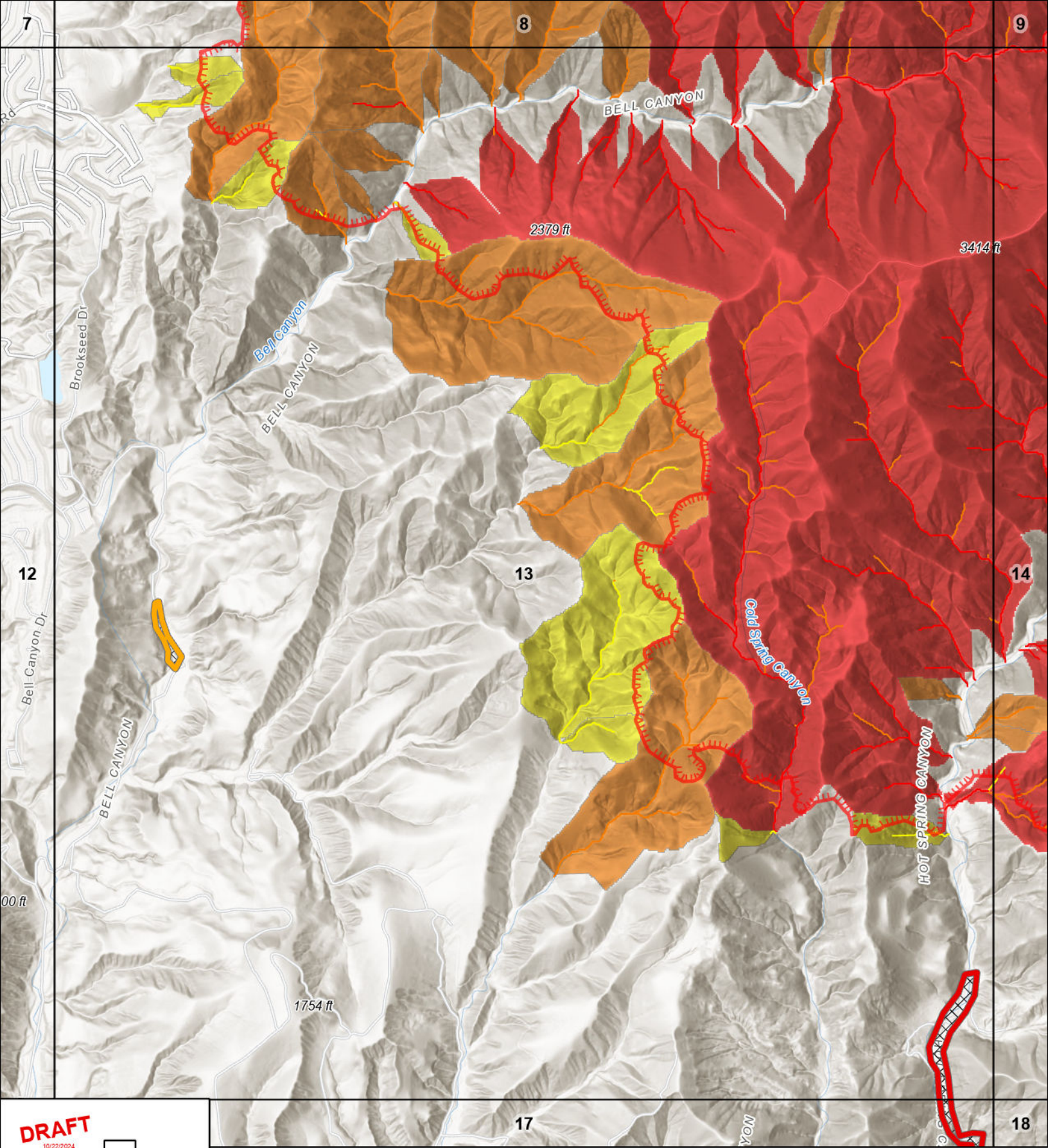

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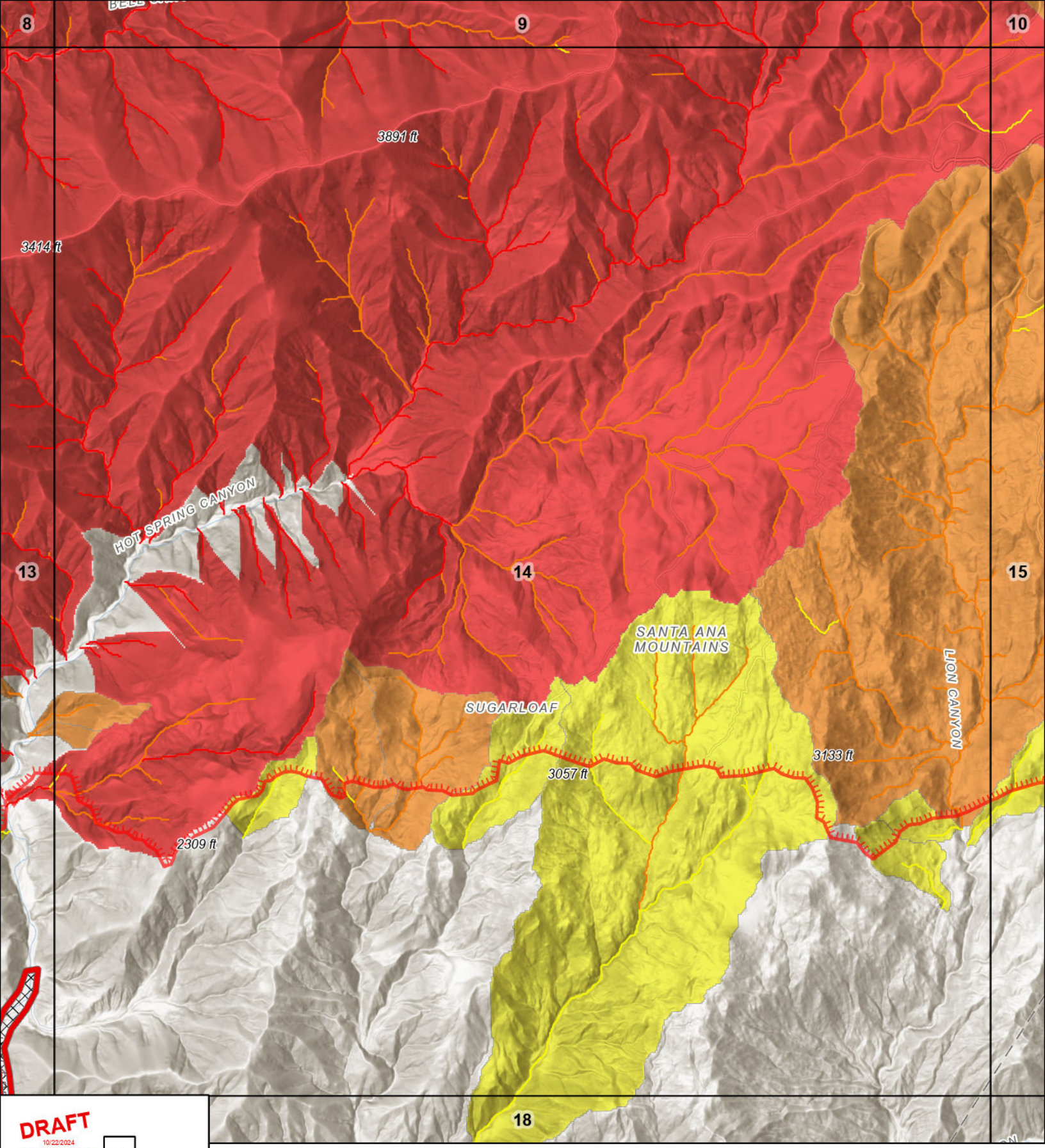

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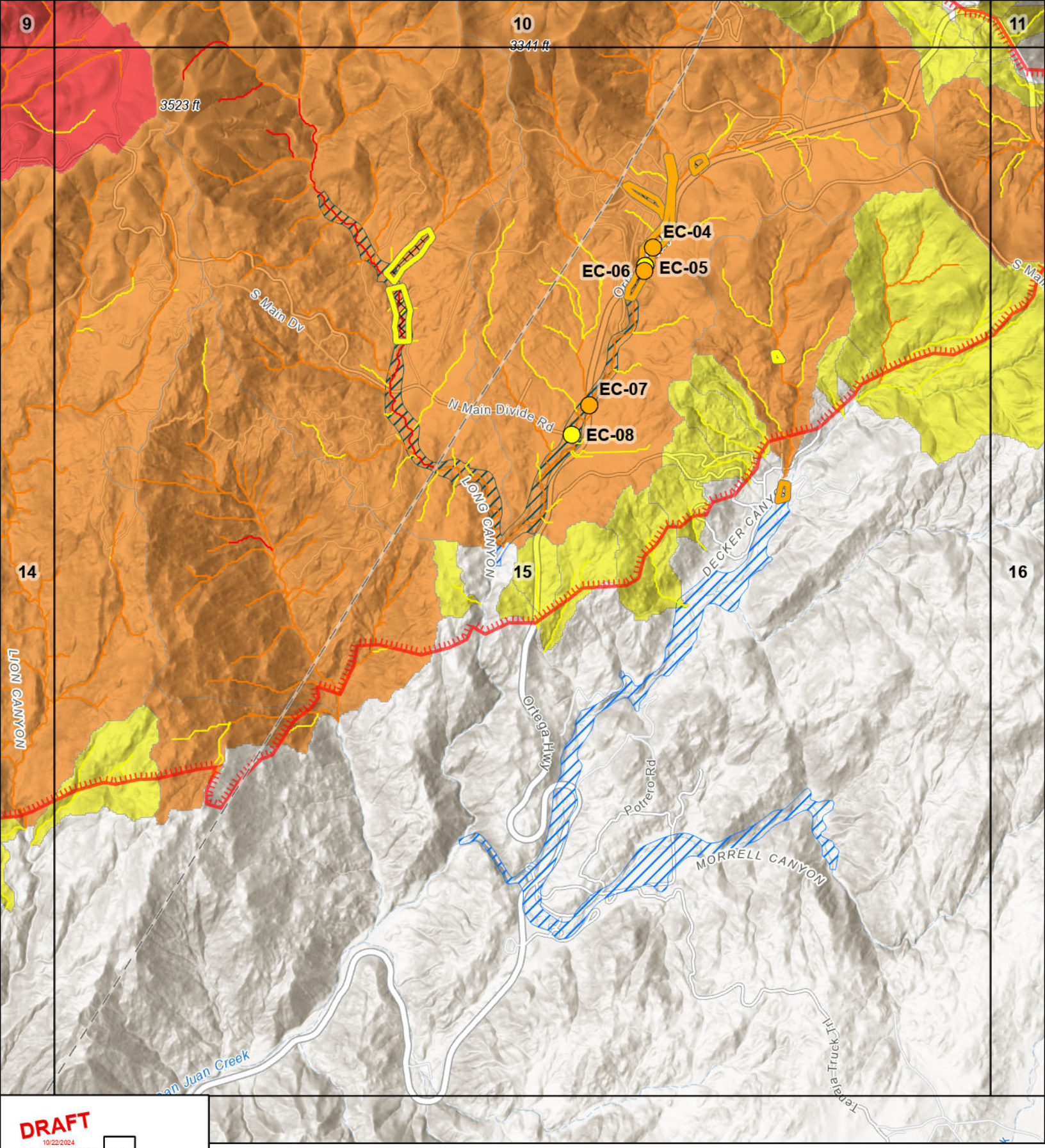

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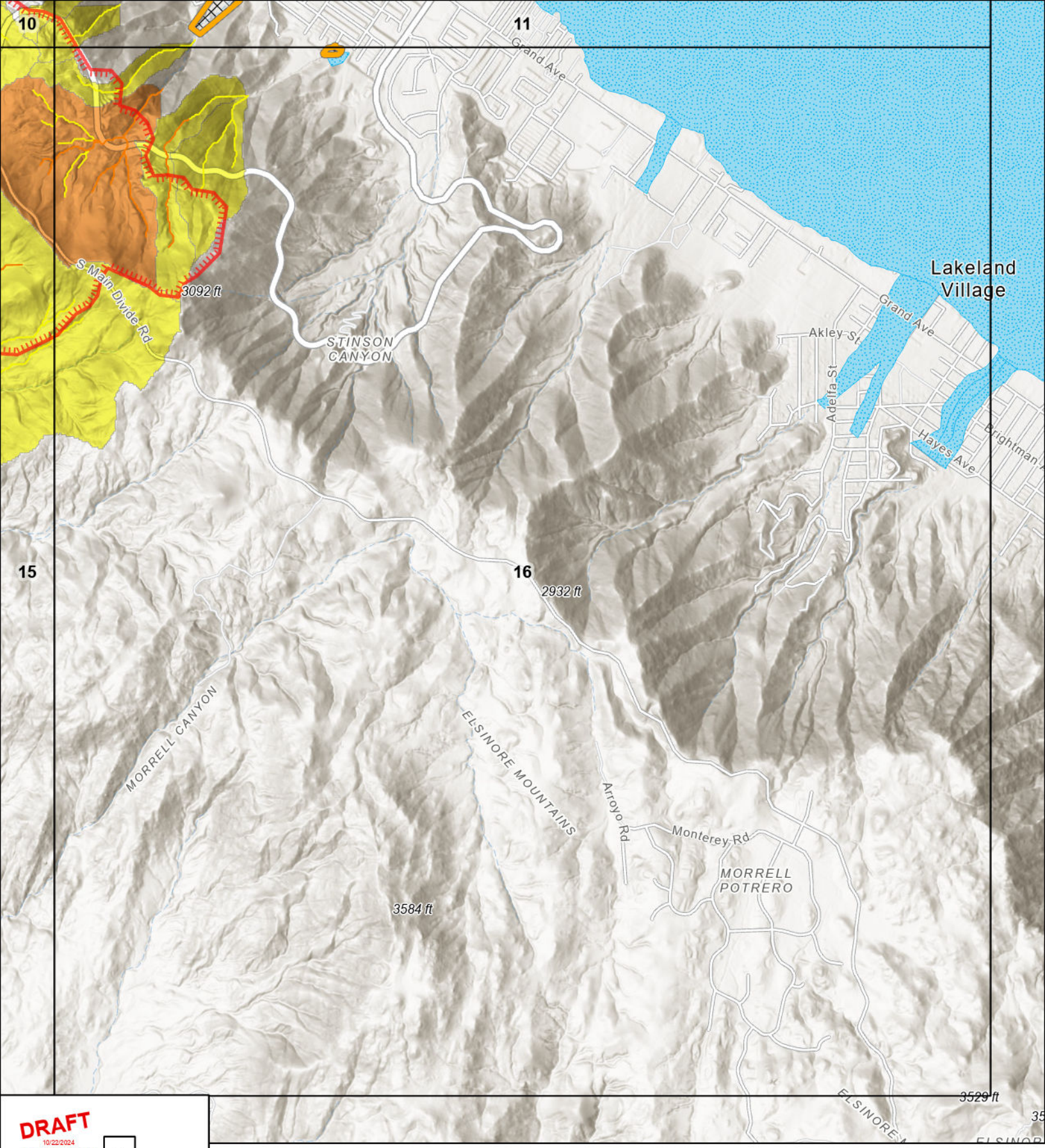

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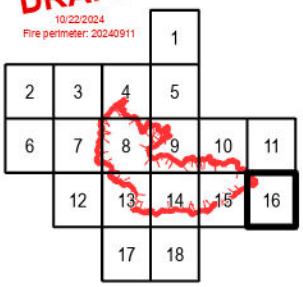

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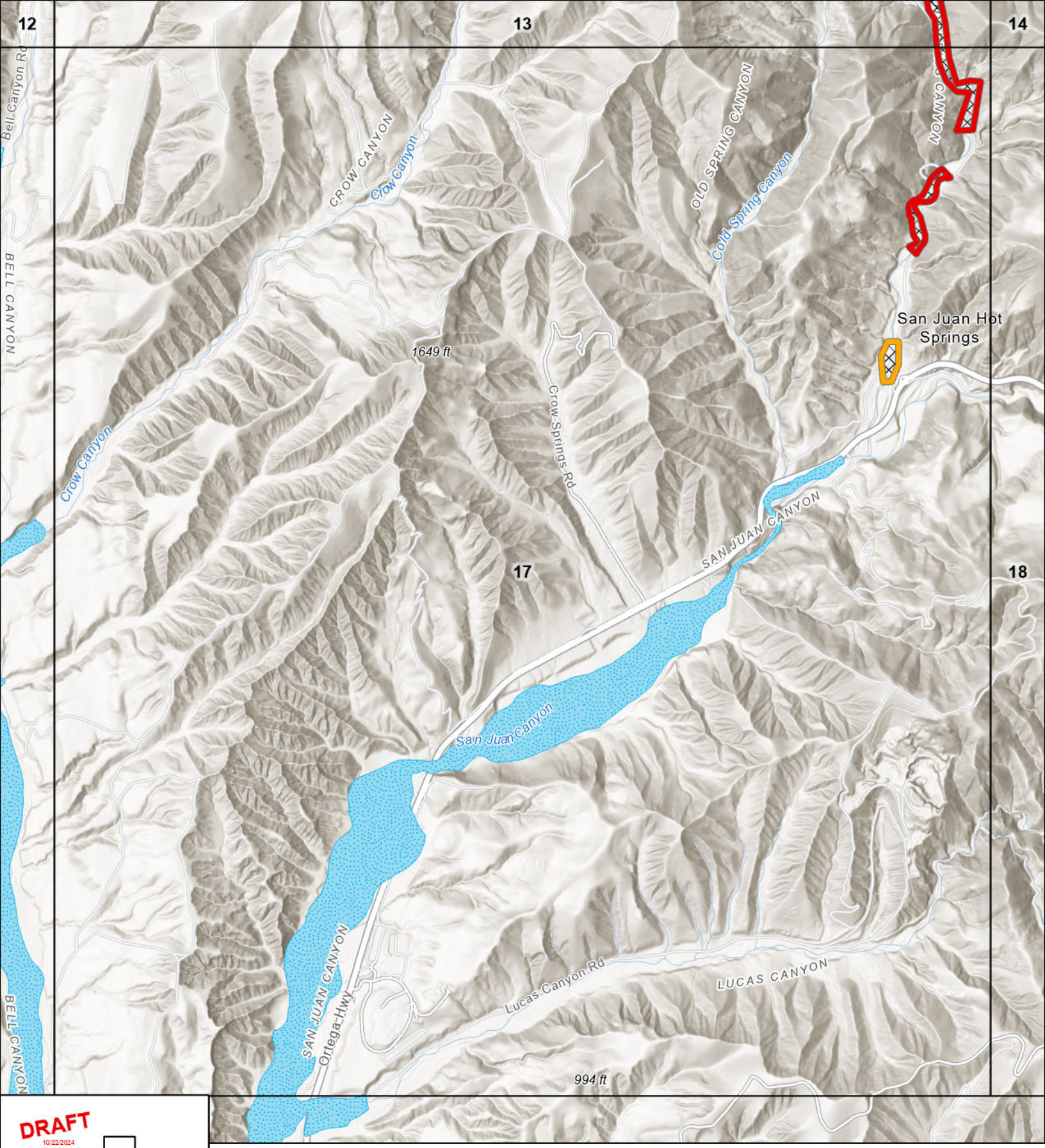

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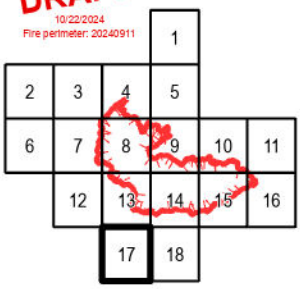

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Appendix D – Values-at-Risk Detail Sheets

VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **El Cariso Springs**

Site Number: **EC-04**

Feature: **Home, gazebo/bridge.**

Feature Category: **home**

Field Observation or Potential Hazard: Business under renovation (Hells Kitchen restaurant) is adjacent to watercourse and gazebo that spans the channel. Flood flows and plugged culvert may cause inundation impacting restaurant, and flooding with mobilized debris impacting gazebo.

Likely probability of occurrence with Moderate consequences = High risk.

Potential Hazard to Life: **moderate**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Monitor and maintain**

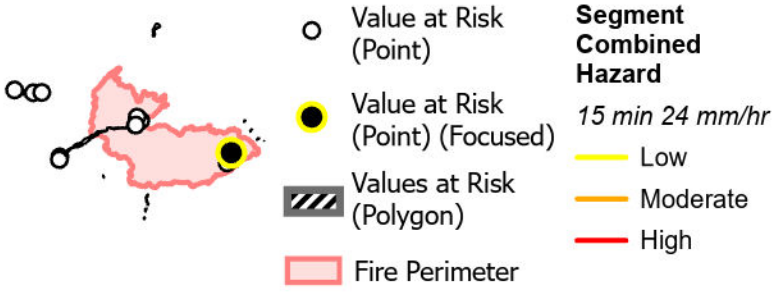
(3) **NA**

(4) **NA**

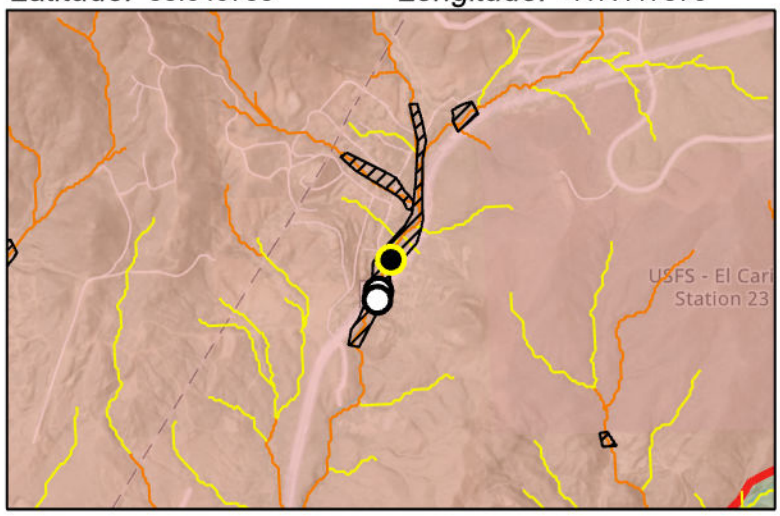
Text: NA

Description: Plugged bridge culvert may lead to backwater effects and inundation.

LOCATION AND PHOTO



Latitude: 33.646753 *Longitude:* -117.417876



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **El Cariso Springs**

Site Number: **EC-05**

Feature: **Road crossing.**

Feature Category: **drainage structure**

Field Observation or Potential Hazard: 4' by 6' concrete box culvert crossing at Highway 74. Potential hazard is flood flows mobilizing woody debris plugging culvert, leading to overtopping of road, with some flows directed down the highway to the east.

Likely probability of occurrence with Moderate consequences = High risk.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Clear and maintain culvert**

(3) **Signage**

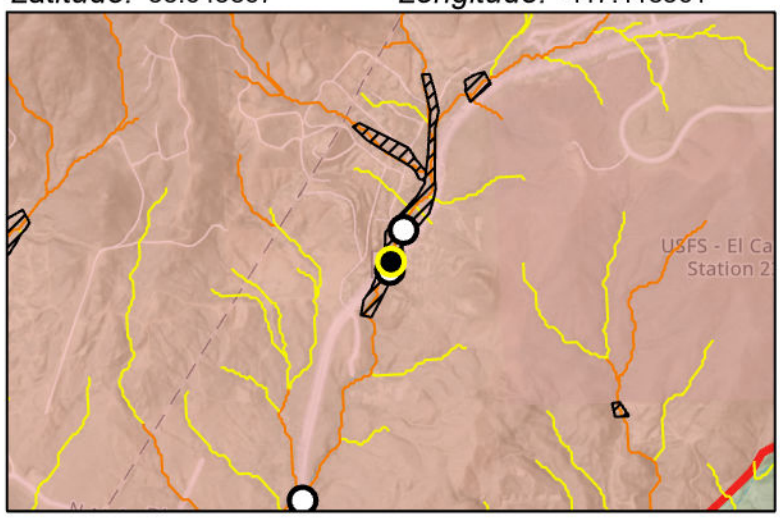
(4) **NA**

Text: Remove the large fallen tree across upstream side of drainage.

Description: Culvert has flared wing walls with a 4 foot head wall. Dense riparian vegetation is in the drainage, including a large fallen tree across the upstream side of drainage.

LOCATION AND PHOTO

Latitude: 33.645867 *Longitude:* -117.418361



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **El Cariso Springs, east of Ortega Highway**

Site Number: **EC-06**

Feature: **Home.**

Feature Category: **home**

Field Observation or Potential Hazard: Unmapped residence adjacent to water course, potential for flooding.

Possible probability of occurrence with Moderate consequences = Intermediate risk.

Potential Hazard to Life: **moderate**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Monitor and maintain**

(3) **NA**

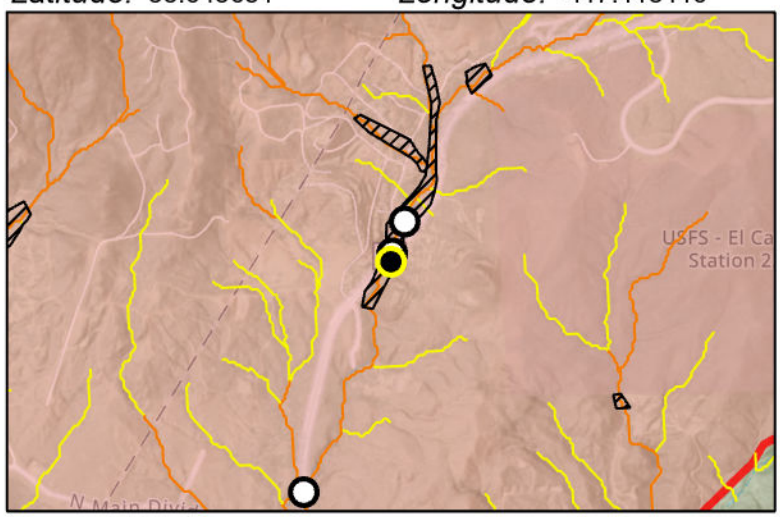
(4) **NA**

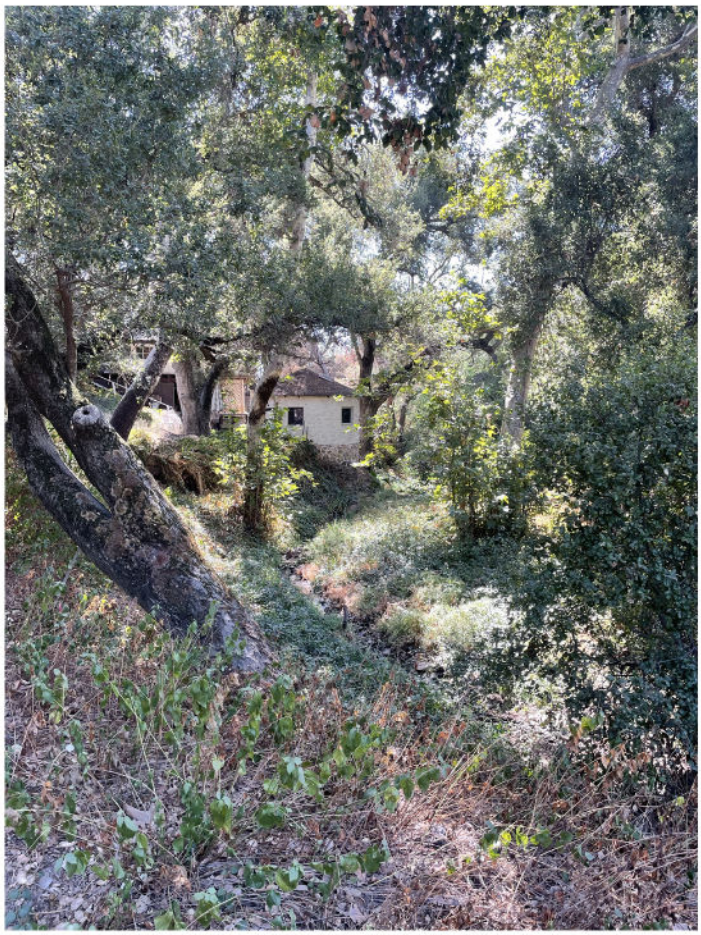
Text: Clear culvert upstream from home.

Description: Small round house adjacent to stream, possibly part of 32750 Ortega Highway property. Upstream drainage of 3 square km, with 90% moderate or high soil burn severity on slopes >23 degrees. It could have debris and flooding partly due to clogged culvert upstream and some flows overtopping road.

LOCATION AND PHOTO

Latitude: 33.645631 *Longitude:* -117.418416





VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **EL Cariso Springs / Highway 74**

Site Number: **EC-07**

Feature: **Box culvert crossing (4' h x 10' w).**

Feature Category: **drainage structure**

Field Observation or Potential Hazard: Flood and debris flows may overwhelm crossing composed of box culvert and cause flows to be diverted down Highway 74.

Likely probability of occurrence with Moderate consequences = High risk.

Potential Hazard to Life: **moderate**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **NA**

(3) **NA**

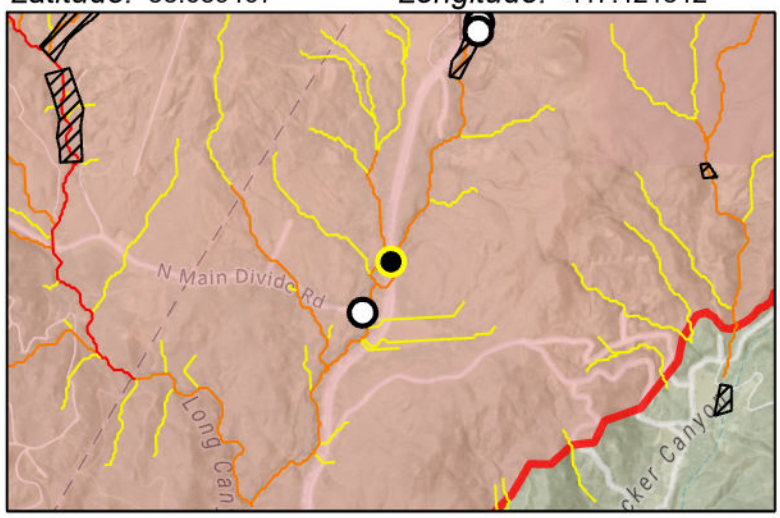
(4) **NA**

Text: Clear and maintain culvert.

Description: Highway 74 is a high volume road, and water and debris may be a moderate hazard. Basin upslope is burned at mostly moderate soil burn severity.

LOCATION AND PHOTO

Latitude: 33.639197 *Longitude:* -117.421812



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **El Cariso Springs**

Site Number: **EC-08**

Feature: **Road crossing and hydrant.**

Feature Category: **multiple**

Field Observation or Potential Hazard: Culverted road crossing. Potential hazard is flood flows moving sediment and debris that can block culvert and overtop road. Potential impact to fire hydrant.

Likely probability of occurrence with Moderate consequences = High risk.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Clear and maintain culvert**

(3) **NA**

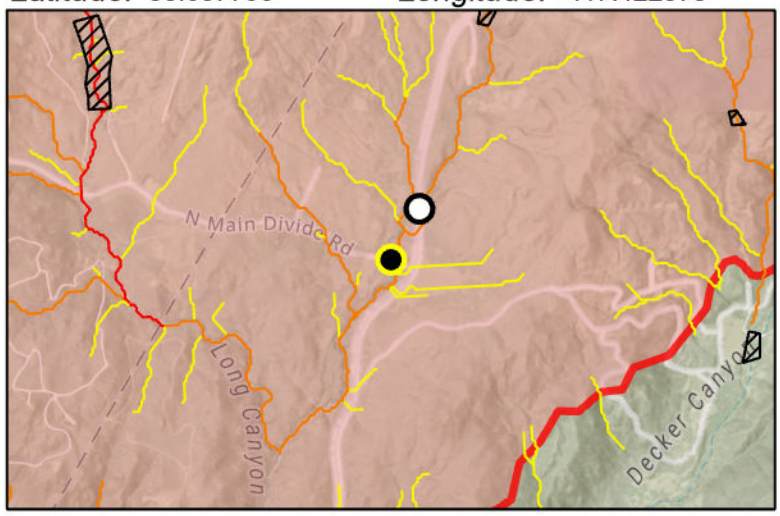
(4) **NA**

Text: Consider removing hydrant standpipe and/or having hydrant not charged.

Description: Basin above is burned at mostly moderate soil burn severity. Channel has a lot of dead trees along it that can be mobilized by flood flows. Double barrel box culvert, 6' high x 8' wide, may get plugged by debris.

LOCATION AND PHOTO

Latitude: 33.637790 *Longitude:* -117.422875



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Modjeska Canyon**

Site Number: **MC-02**

Feature: **Bridge.**

Feature Category: **utilities**

Field Observation or Potential Hazard: Bridge by fire station

Likely probability of occurrence with Major consequences = Very High risk.

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

Preliminary Emergency Protective Measures

(1) **Early Warning** *(2)* **Monitor and maintain**

(3) **Signage** *(4)* **NA**

Text: Clear upstream debris so that bridge does not clog and cause flooding. Early warning for the neighborhood to the south, accessed via Olive Hill Road.

Description: Limited capacity and evidence of high water in the recent past. High diversion potential putting flood water on road and flood terrace. Average height is 6', average width is 35'. Bridge provides ingress and egress to eastern residential community, and Modjeska House historical landmark, as well as additional residential area to south of Santiago Creek.

LOCATION AND PHOTO

Latitude: 33.709521 *Longitude:* -117.625493

VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Santiago Canyon / Lower Modjeska Canyon**

Site Number: **MC-04**

Feature: **Water crossings within floodplain.**

Feature Category: **home**

Field Observation or Potential Hazard: Ingress and egress for residents living on the south side of Santiago Creek are at risk during flood flows emanating from the burned upstream watershed.

Possible probability of occurrence with Minor consequences = Low risk.

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

Preliminary Emergency Protective Measures

(1) **Early Warning** *(2)* **Monitor and maintain**

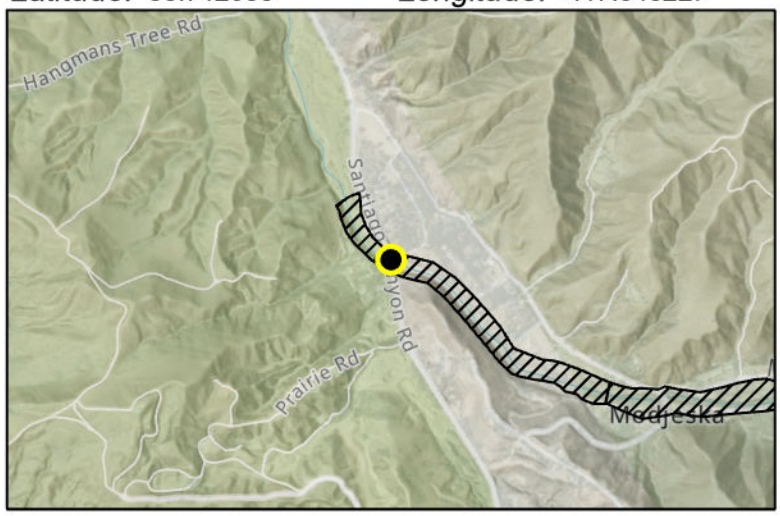
(3) **Traffic control** *(4)* **Signage**

Text: Residents should be advised to stay away from any water crossings during stressing rainfall events.

Description: Local residents will be affected by flood flows interrupting access to properties on the south side of Santiago Creek.

LOCATION AND PHOTO

Latitude: 33.712933 *Longitude:* -117.645227



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Trabuco Canyon**

Site Number: **TC-02**

Feature: **Cabin, adjacent roadway.**

Feature Category: **home**

Field Observation or Potential Hazard: Cabin located within the main canyon drainage and at the base of a steep side canyon drainage. Potential hazard is debris flood/flow from upland swales, potentially simultaneously.

Very Likely probability of occurrence with Major consequences = Very High risk.

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

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Debris barrier**

(3) **Deflection structure**

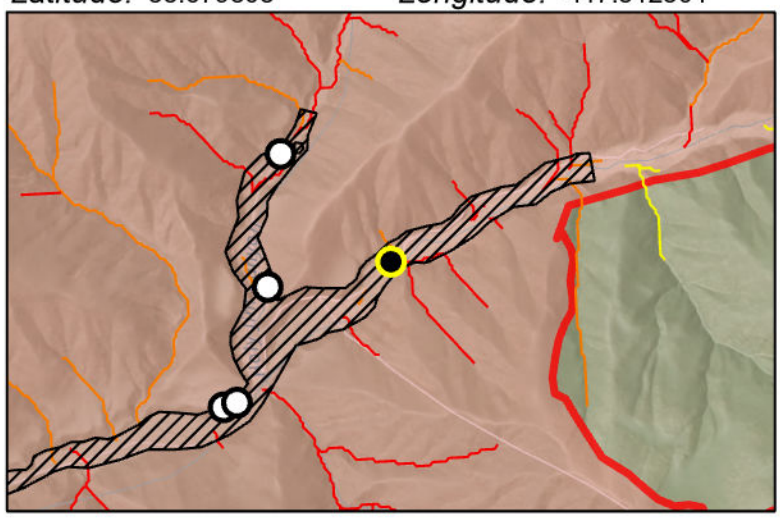
(4) **Monitor and maintain**

Text: Evacuation is advised before the arrival of a stressing rainfall event. Following stressing rainfall events, maintenance should be performed to clear freeboard behind installed debris barriers and deflection structures.

Description: This VAR may be impacted by south-facing ascending slope-derived inundation from debris/flood flows onto an active debris fan, as well as by inundation potential delivered by Trabuco Creek. Ingress and egress will be severely impacted from multiple watershed hazards as discussed in VAR TC-01. It is likely that following a stressing rainfall event this location will be cut off entirely by access in any direction.

LOCATION AND PHOTO

Latitude: 33.679808 *Longitude:* -117.512504



VALUE AT RISK DETAIL

Incident: Airport Fire ***Incident Number: CA-ORC-127883***

Community: **Trabuco Canyon / Holy Jim Canyon**

Site Number: **TC-04**

Feature: **Cabin.**

Feature Category: **home**

Field Observation or Potential Hazard: Potential flood flows may overtop channel banks and impact structure.

Possible occurrence with Moderate consequences = Intermediate risk

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

Preliminary Emergency Protective Measures

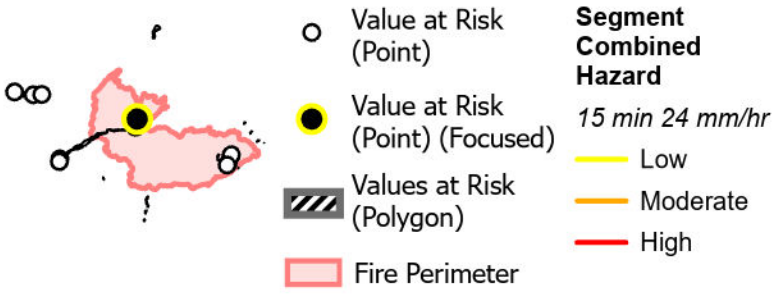
(1) **Early Warning** *(2)* **Deflection structure**

(3) **Monitor and maintain** *(4)* **NA**

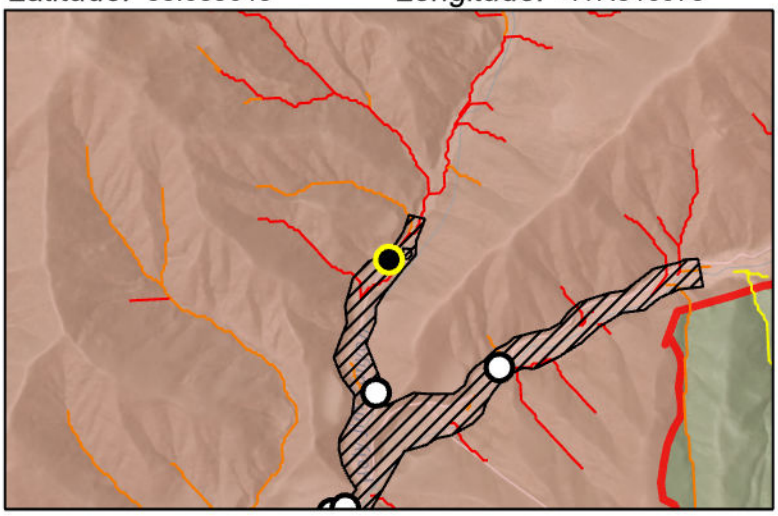
Text: HESCO barriers could be installed along upstream side of structure to function as a deflection structure.

Description: Installing deflection structures, such as HESCO barriers, muscle walls, and sandbags, may help mitigate potential hazards.

LOCATION AND PHOTO



Latitude: 33.683048 *Longitude:* -117.516073



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Holy Jim Canyon**

Site Number: **TC-05**

Feature: **Cabin.**

Feature Category: **home**

Field Observation or Potential Hazard: Cabin is located at base of convex drainage. Debris flood flow path could impact cabin. Oversteepened hillsides also have a potential for shallow landsliding.

Very Likely probability of occurrence with Moderate consequences = Very High risk.

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

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Debris barrier**

(3) **Deflection structure**

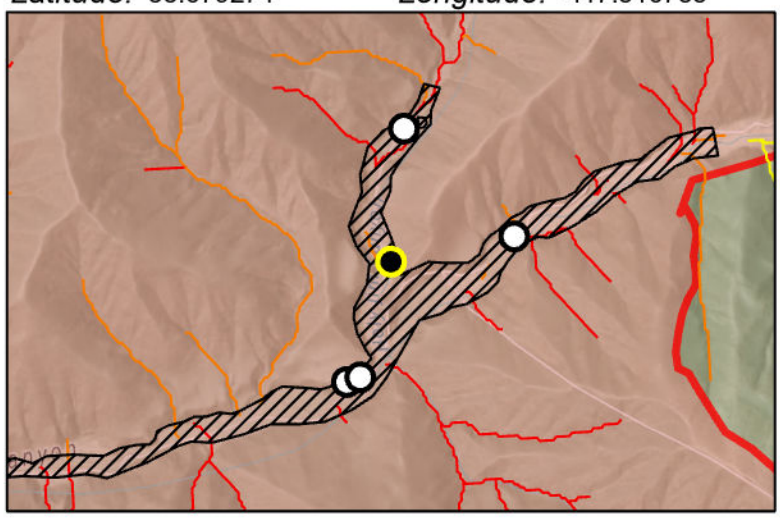
(4) **Monitor and maintain**

Text: Evacuation is advised before arrival of stressing rainfall events. Following stressing rainfall events, maintenance should be performed to clear freeboard behind installed debris barriers and deflection structures.

Description: HESCO barrier installation on areas of ascending slopes behind the cabin is advised. Additional deflection structure installation on home pad behind cabin may assist with directing water/flood flow away from rear of cabin.

LOCATION AND PHOTO

Latitude: 33.679274 *Longitude:* -117.516755



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Holy Jim Canyon and Trabuco Canyon**

Site Number: **TC-06**

Feature: **Fire Station building.**

Feature Category: **business**

Field Observation or Potential Hazard: The Fire Station building is located below a slope with largely moderate soil burn severity with a risk for slope-derived mud and debris impacting the VAR during a stressing rainfall event.

Possible probability of occurrence with Minor consequences = Low risk.

Potential Hazard to Life: **low**

Potential Hazard to Property: **low**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Debris barrier**

(3) **Deflection structure**

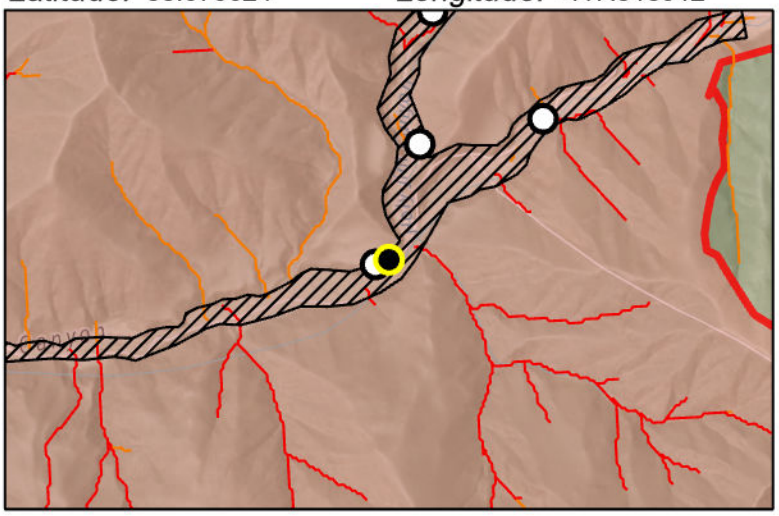
(4) **Sandbags**

Text: The recommended Emergency Protective Measures are generous given the overall location of the VAR with respect to the watershed hazards likely at this site.

Description: The Fire Station building is situated on a slightly higher terrace surface, just southwest of the confluence of Holy Jim Canyon and Trabuco Canyon, and appears to be at very low risk of debris flows/flood flows originating in either Holy Jim Canyon or Trabuco Canyon. The primary hazard will be the potential for the rear of the structure to be impacted by slope-derived debris and mud.

LOCATION AND PHOTO

Latitude: 33.676024 *Longitude:* -117.518012



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Trabuco Canyon / Holy Jim Canyon**

Site Number: **TC-07**

Feature: **Cabin.**

Feature Category: **home**

Field Observation or Potential Hazard: Cabin is at risk of oversteepened ascending slope shedding mud and rocks during stressing rainfall events. Existing trees growing out of the slope to the rear of the cabin are leaning against the cabin.

Likely probability of occurrence with Major consequences = Very High risk.

Potential Hazard to Life: **high**

Potential Hazard to Property: **high**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Debris barrier**

(3) **Deflection structure**

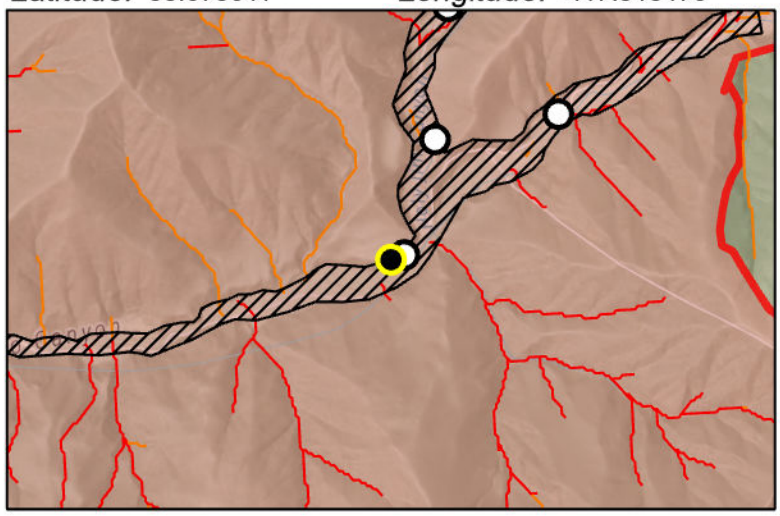
(4) **Monitor and maintain**

Text: Evacuation is advised prior to stressing storms. If the ascending slope can be armored and debris barriers and/or deflection structures placed adjacent to the rear of the cabin, possible mitigation of unstable slope-derived debris can be implemented.

Description: Though the cabin is adjacent to a slope that decreases in gradient to the north, the entire slope was burned at a moderate soil burn severity. Due to the currently situated trees leaning into the rear of the home, if portions of the ascending slope become destabilized, the combination of bulked mud and debris adding to the force applied against the rear of the cabin may cause the cabin to be inundated and/or crushed during a stressing rainfall event, or after cumulative stressing rainfall events.

LOCATION AND PHOTO

Latitude: 33.675911 *Longitude:* -117.518476



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **O'Neill Regional Park / Trabuco Canyon**

Site Number: **TC-12**

Feature: **Nature Center building, outbuildings.**

Feature Category: **recreational**

Field Observation or Potential Hazard: Potential for flood flow to impact Nature Center building.

Possible probability of occurrence with Moderate consequences = Intermediate risk.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Debris barrier**

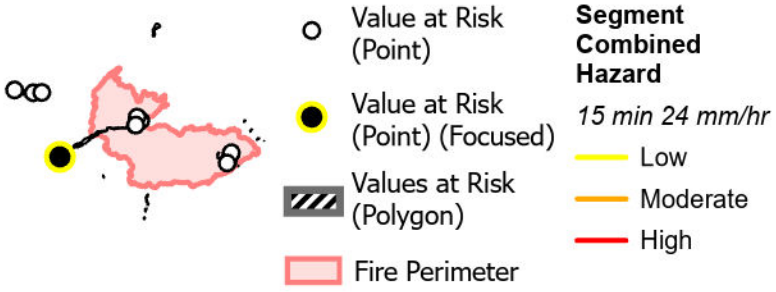
(3) **Deflection structure**

(4) **Sandbags**

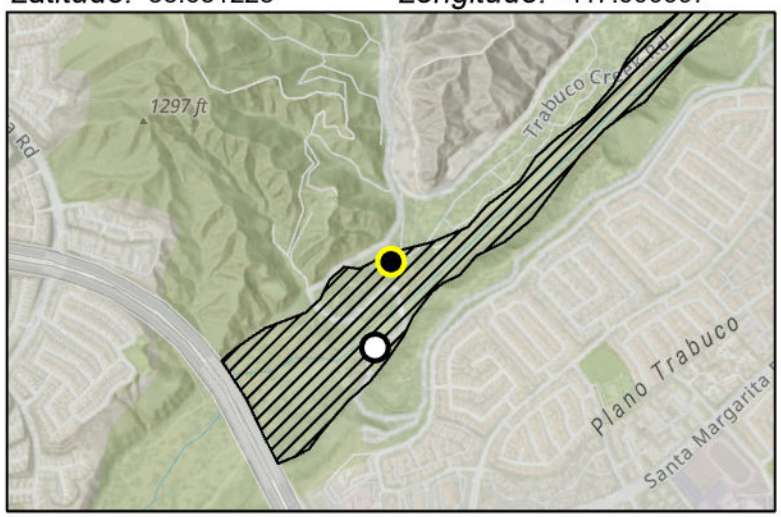
Text: Debris barriers and deflection structures should be appropriately placed and augmented to protect any potentially habitable structures. Install sandbags and inflatable door seals on critical buildings.

Description: According to the Supervising Park Ranger, this structure has historically been outfitted with inflatable door seals to add precautionary protection against any potential flood flows originating within the Trabuco Creek/Canyon and/or Live Oak Canyon FEMA-mapped floodplains. Flood flows occurred during stressing rainfall events following the 2018 Holy Fire. There is a berm that extends along the north side of the active channel of Trabuco Creek that aids in confining swollen creek flow to its channel; however, anecdotal evidence indicates that the berm has been occasionally eroded during large flow events. The park staff have worked to repair the berm following every berm erosion incident, and are aware that they will have to remain vigilant during stressing rainfall events to come, originating from a larger burned watershed upstream.

LOCATION AND PHOTO



Latitude: 33.651223 *Longitude:* -117.600697



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **O'Neill Regional Park / Trabuco Canyon**

Site Number: **TC-13**

Feature: **Restroom building, parking lot.**

Feature Category: **recreational**

Field Observation or Potential Hazard: Restroom building is at risk of flood flow inundation. According to the Supervising Park Ranger, this structure has been inundated during past flood flows that overtopped the adjacent berm along the south side of Trabuco Canyon.

Likely probability of occurrence with Moderate consequences = Intermediate risk.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Debris barrier**

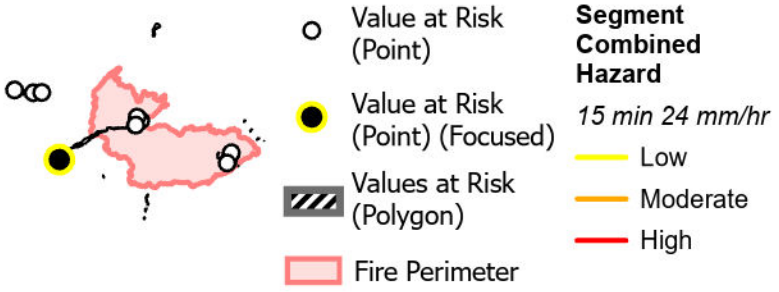
(3) **Deflection structure**

(4) **Sandbags**

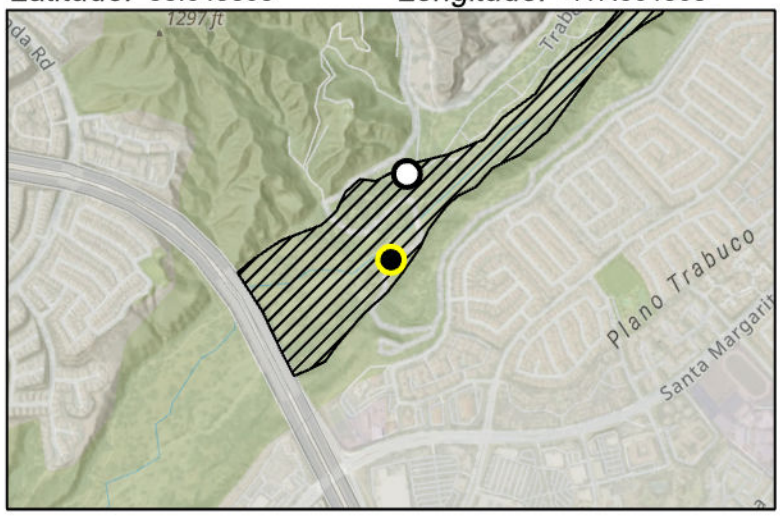
Text: Debris barriers and deflection structures should be installed between the building and the active floodplain to the north/northeast. Additional sandbags should be placed around doorways.

Description: Flood flows following the 2018 Holy Fire reportedly impacted the restroom building; as a result, the park installed debris barriers and deflection structures on the north/northeastern sides of the building in order to divert subsequent flood flows. Based on discussion with the Supervising Park Ranger, the park is aware of the likely increase in flood flow hazards associated with the Trabuco Canyon active floodplain during stressing rainfall events to come.

LOCATION AND PHOTO



Latitude: 33.648803 *Longitude:* -117.601395



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Bell Canyon**

Site Number: **BC-01**

Feature: **Residential structures.**

Feature Category: **multiple**

Field Observation or Potential Hazard: Debris flow/flood could overtop channel banks and impact structures and cutoff access.

Potential Hazard to Life: **moderate**

Potential Hazard to Property: **high**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Deflection structure**

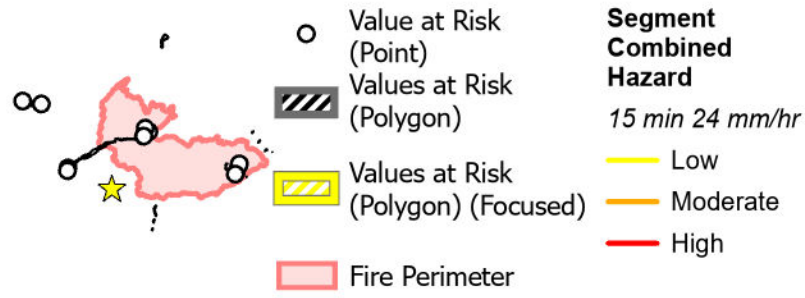
(3) **Monitor and maintain**

(4) **NA**

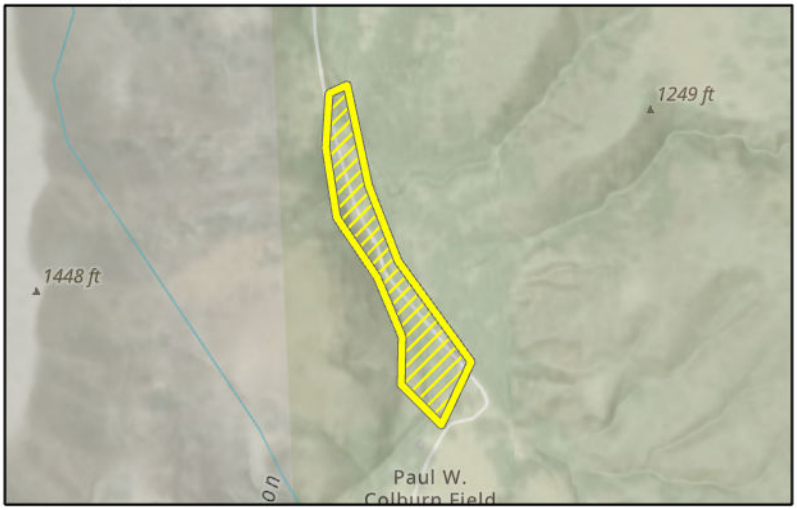
Text: Deflection structures such as K - rails and HESCO barriers could be effective to mitigate damage to home adjacent to channel. Bridge downstream should be maintained and kept free of debris.

Description: The upslope basin burned at mostly moderate soil burn severity. The channel shows signs of high energy flow. Mobilized trees and debris could cause debris jams that force flows out of channel. Downstream bridge may be impacted by debris.

LOCATION AND PHOTO



Scale: 1:8,000



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Decker Canyon**

Site Number: **DC-01**

Feature: **Home and road crossing.**

Feature Category: **multiple**

Field Observation or Potential Hazard: Burnt residence adjacent to watercourse and access road crossing. Potential hazard is flood that could mobilize burnt debris and sediment, overtopping crossing and impacting temporary housing and/or future structure(s).

Potential Hazard to Life: **low**

Potential Hazard to Property: **low**

Preliminary Emergency Protective Measures

(1) **Monitor and maintain**

(2) **NA**

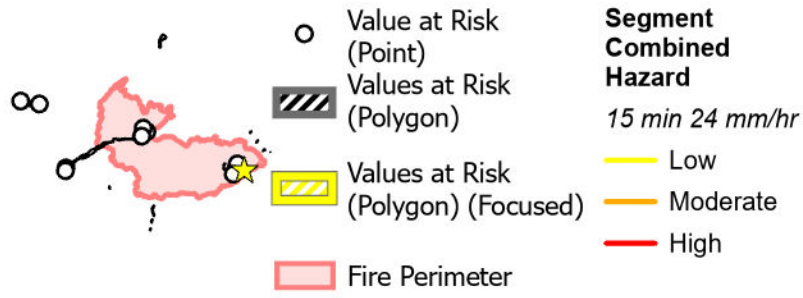
(3) **NA**

(4) **NA**

Text: Do not place temporary housing or new structures adjacent to watercourse.

Description: The VAR is located in the upper portion of a drainage burned at a mostly moderate soil burn severity.

LOCATION AND PHOTO



Scale: 1:1,000

VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Decker Canyon**

Site Number: **DC-02**

Feature: **Home and road crossing.**

Feature Category: **multiple**

Field Observation or Potential Hazard: Access road crossing, residence and outbuildings. Potential hazard is debris flood/flow plugging culvert, resulting in overtopping and inundation of road. Potential avulsion and impacts to residence downstream of crossing adjacent to watercourse.

Potential Hazard to Life: **moderate**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Clear and maintain culvert**

(3) **Deflection structure**

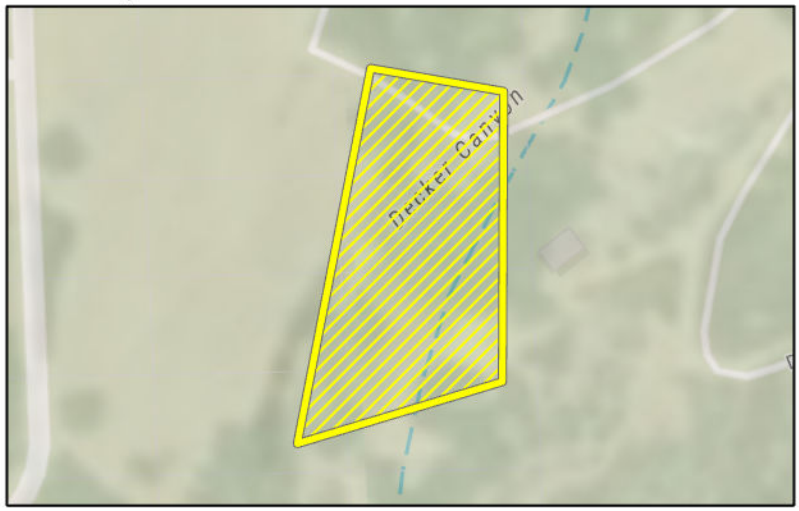
(4) **NA**

Text:

Description: Culvert includes a squashed 36" CMP, now 42" x 28", and three ~22" concrete barrels. Barrels up to 60% are plugged with sediment. Upstream channel is choked with brush and vegetation. Block wall adjacent to culvert outlet and downstream made of stacked rock provides some protection to residence. Small pond in residence yard could attenuate potential avulsion away from home. The upstream basin mostly burned at moderate soil burn severity.

LOCATION AND PHOTO

Scale: 1:2,000



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **El Cariso Village**

Site Number: **EC-01**

Feature: **Homes, road infrastructure, culverts.**

Feature Category: **multiple**

Field Observation or Potential Hazard: Multiple structures and burned out vehicles are located adjacent to watercourse. Avulsions upstream and within VAR can create debris with potential for culvert/drainage infrastructure blockage/damage. Burned materials can contaminate water.

Potential Hazard to Life: **moderate**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Clear and maintain culvert**

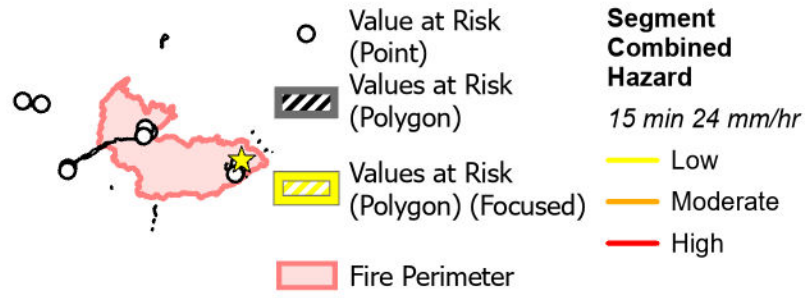
(3) **Monitor and maintain**

(4) **Signage**

Text: Clean up burned debris to prevent downstream debris flows and watershed contamination. Do not place temporary housing or new structures adjacent to watercourse.

Description: Reconnaissance from driving on highway led us to more closely investigate this site. Water quality is at risk if rain comes before cleanup.

LOCATION AND PHOTO



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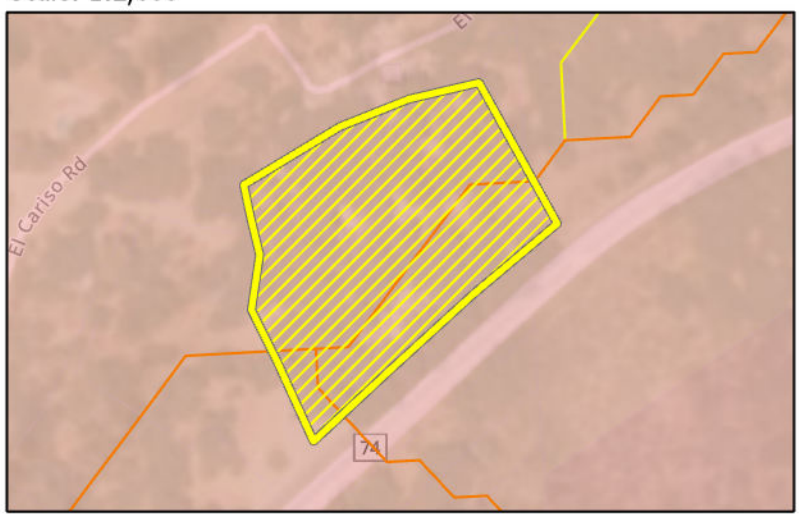


VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **El Cariso Springs**

Site Number: **EC-02**

Feature: **Homes, structures, road network.**

Feature Category: **multiple**

Field Observation or Potential Hazard: Multiple residences and structures are located adjacent to watercourse. Potential hazard is flood flows overtopping banks and inundating structures and access roads.

Potential Hazard to Life: **moderate**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Monitor and maintain**

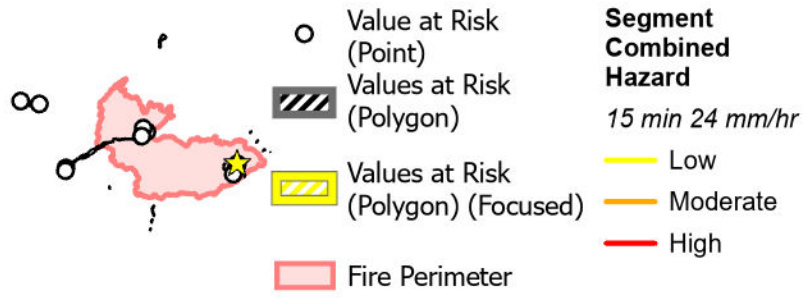
(3) **Deflection structure**

(4) **NA**

Text:

Description: Upstream basin burned at mostly moderate soil burn severity with some low.

LOCATION AND PHOTO



Scale: 1:16,000

VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **El Cariso Springs**

Site Number: **EC-03**

Feature: **Residences and watercourse crossings.**

Feature Category: **multiple**

Field Observation or Potential Hazard: Multiple residences are located adjacent to watercourse. Potential hazard is flood and debris impacting multiple small crossings, resulting in diversions that can impact residences and associated structures.

Potential Hazard to Life: **moderate**

Potential Hazard to Property: **high**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Monitor and maintain**

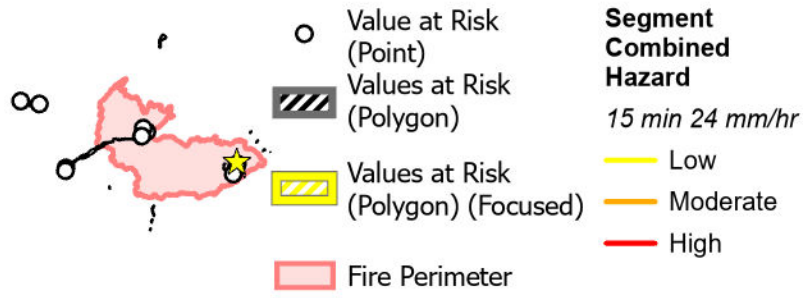
(3) **Deflection structure**

(4) **NA**

Text:

Description: Upstream basin burned at moderate soil burn severity. Poor drainage exists along flow paths.

LOCATION AND PHOTO



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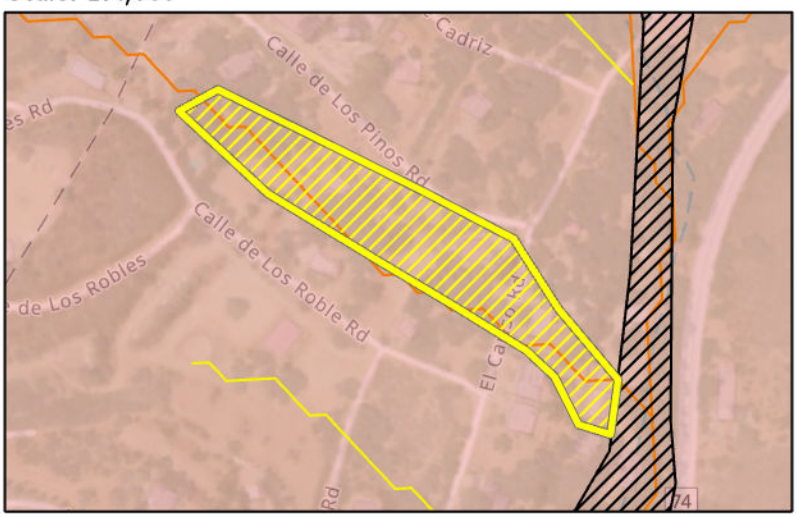


VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Glen Ivy Hot Springs / Coldwater Canyon**

Site Number: **GI-01**

Feature: **Buildings, roads, infrastructure.**

Feature Category: **multiple**

Field Observation or Potential Hazard: A steep drainage emanates from the mountain front and directly empties into a resort community and downstream mobile home community. Numerous debris barriers and drainage deflection structures (K -rails) were observed throughout the resort property.

Potential Hazard to Life: **low**

Potential Hazard to Property: **low**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Debris barrier**

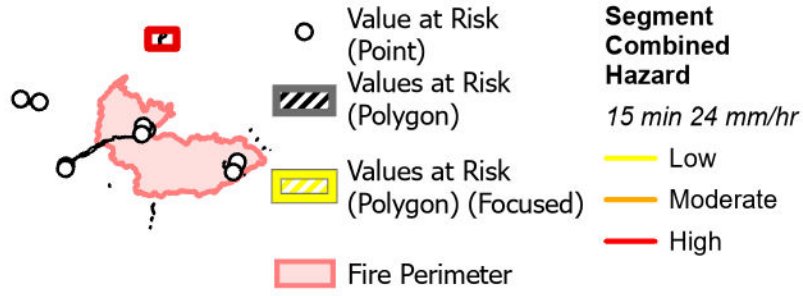
(3) **Deflection structure**

(4) **Signage**

Text: The abundance of K - rails found within the resort property suggests repeat inundation events are a definite hazard for many areas of the VAR.

Description: Only a small percentage of the drainage basin burned at a Low soil burn severity. Note that hazards to life and property were identified by the 2018 Holy Fire WERT. The Holy Fire burned most all of the watershed above this VAR, and during field reconnaissance, numerous debris barriers and drainage deflection structures (K -rails) were observed throughout the resort property. The K- rails are adjacent to the active stream channel. Anecdotal evidence suggests that repeat debris and flood flows since the 2018 Holy Fire have impacted the resort property. Roadways appear to become drainage paths during flood flows. The downstream area of the VAR adjacent to the mobile home park could potentially face some degree of inundation. Based on reconnaissance topographic analysis and observed surface roughness in the lidar, the active alluvial fan may extend further to the north/northeast and subsequently

LOCATION AND PHOTO



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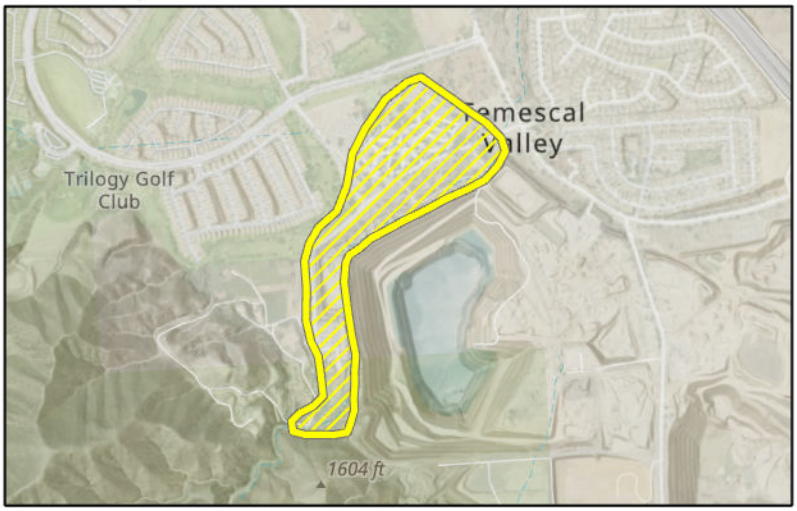


VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Hot Spring Canyon**

Site Number: **HS-01**

Feature: **Multiple Camp/Resort sructures/cabins.**

Feature Category: **multiple**

Field Observation or Potential Hazard: Multiple structures associated with the Lazy W Camp and Resort are located adjacent to the watercourse. Potential hazard is debris flow/flood that can overtop banks and inundate structures.

Potential Hazard to Life: **high**

Potential Hazard to Property: **high**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Monitor and maintain**

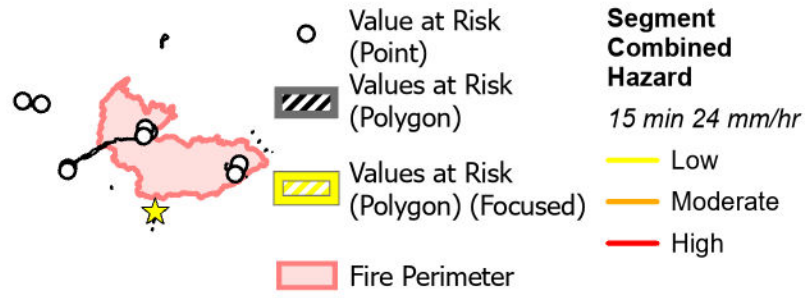
(3) **NA**

(4) **NA**

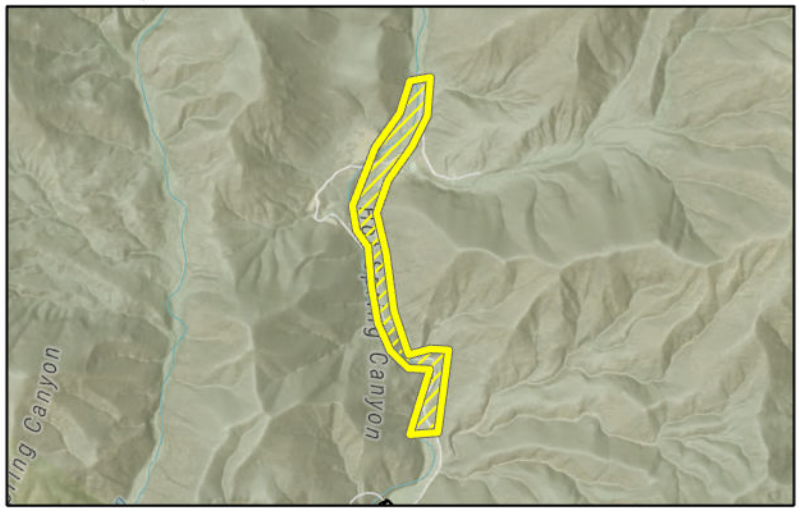
Text: Evacuation is advised before stressing storms. Deflection structures such as K - rails, HESCO barriers, Muscle Walls, and sandbags can be installed to mitigate impacts to local structures.

Description: The basin upstream burned mostly at moderate soil burn severity with some high. Geomorphic evidence composed of braided channel network, large bedload material featuring large boulders, and steep gradient all suggest a high flow regime capable of flooding and transporting debris. Evidence of past walking bridge failure.

LOCATION AND PHOTO



Scale: 1:24,000



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Hot Spring Canyon**

Site Number: **HS-02**

Feature: **Cabin, ingress and egress via bridge.**

Feature Category: **home**

Field Observation or Potential Hazard: Debris flow/ flood hazard to habitable structures adjacent to watercourse, and to pedestrian bridge ingress and egress to residence.

Potential Hazard to Life: **high**

Potential Hazard to Property: **high**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Monitor and maintain**

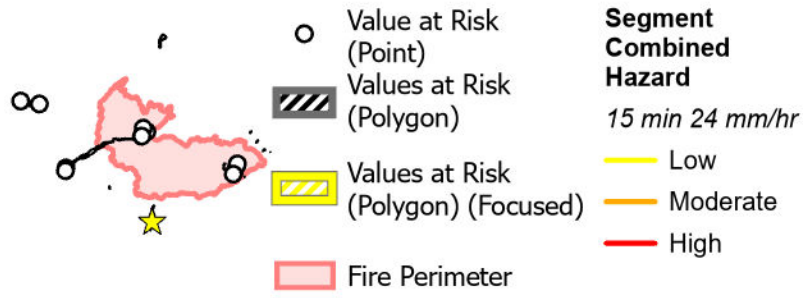
(3) **NA**

(4) **NA**

Text: Keep bridge clear of debris. Structures adjacent to channel may benefit from additional flood-proofing measures, e.g. temporary enclosures at doors, sandbags, and deflection structures.

Description: Geomorphology of the stream with large boulders in channel indicate potential for high flow power in the stream. The canyon upstream is confined, which will focus flood and debris flows spilling into the local flood terrace. The pedestrian bridge will rack up debris, adding to the flood and debris flow hazard, and block ingress and egress to a house. Some trees upstream may become entrained in flood flows and add to debris clogging the bridge. The presence of constructed rock slope protection adjacent to the watercourse indicate possible prior erosion/flooding issues. Monitor weather and any corresponding stream height changes during stressing rainfall events for situational awareness.

LOCATION AND PHOTO



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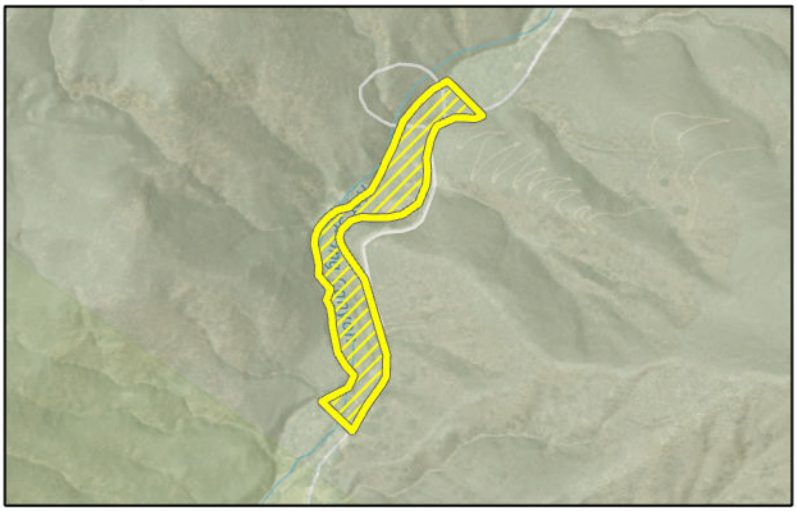


VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Hot Spring Canyon**

Site Number: **HS-03**

Feature: **Campground / picnic area.**

Feature Category: **recreational**

Field Observation or Potential Hazard: Campground / picnic area located adjacent to watercourse. Potential hazard is debris flood/flow overtopping banks and inundating campground.

Potential Hazard to Life: **moderate**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **NA**

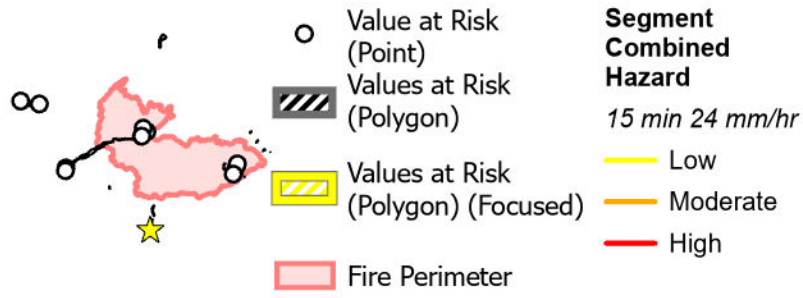
(3) **NA**

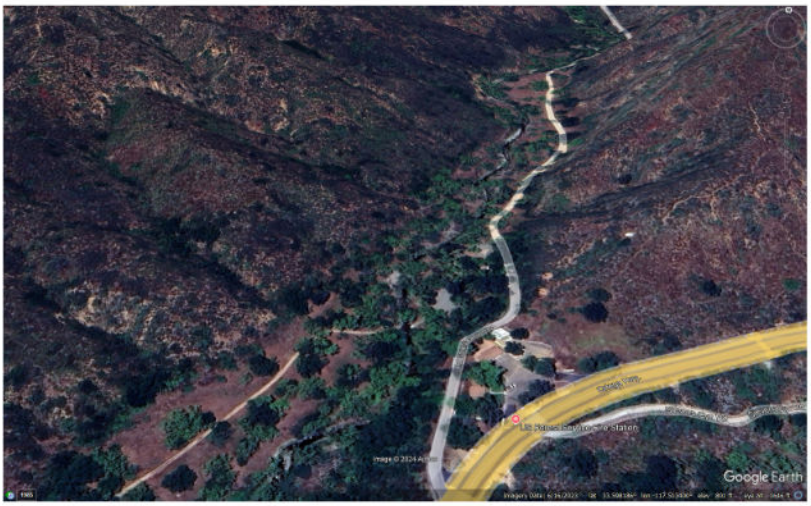
(4) **NA**

Text: Consider evacuation during stressing rainfall events/storms.

Description: The basin upstream is burned mostly at moderate soil burn severity with some high. Geomorphic evidence composed of braided channel network with large bedload material upstream. Shallower gradient and less confined channel at this location may produce flood flows with entrained sediment, woody debris, and some boulders.

LOCATION AND PHOTO





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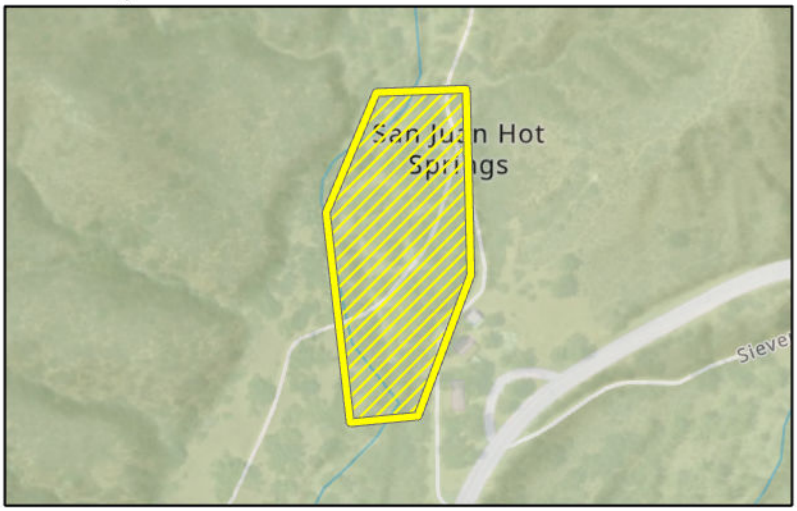


VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Long Canyon**

Site Number: **LC-01**

Feature: **Cabins, road crossings.**

Feature Category: **multiple**

Field Observation or Potential Hazard: Multiple cabins adjacent to water course and road crossings. Potential hazard is flooding with debris impacting cabins, washing out road crossings, and contamination to watershed.

Potential Hazard to Life: **low**

Potential Hazard to Property: **low**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Monitor and maintain**

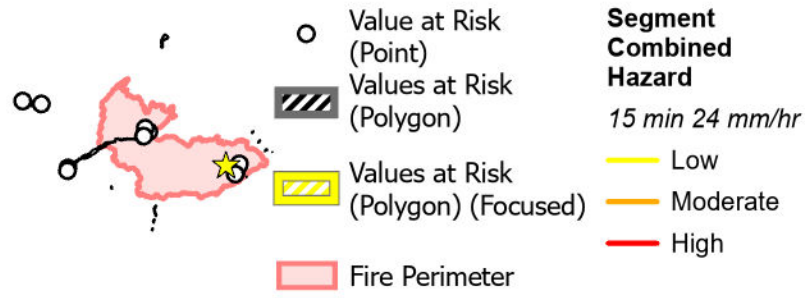
(3) **NA**

(4) **NA**

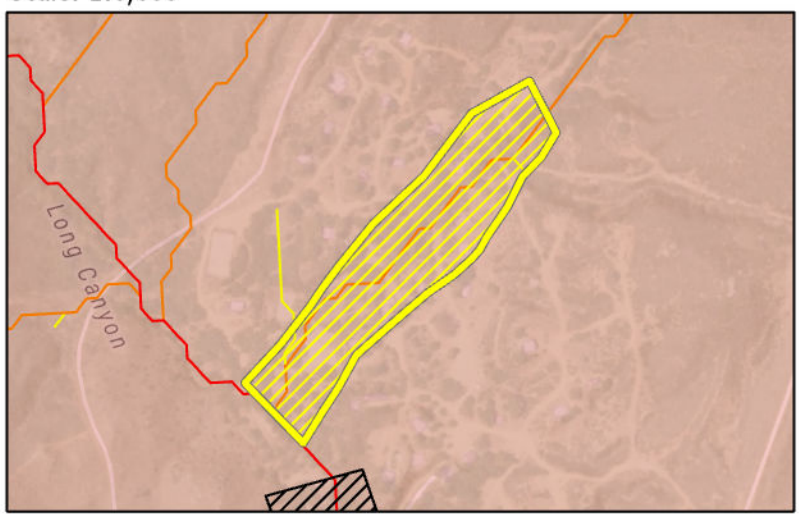
Text: Clean up burned material. Do not place temporary housing or new structures adjacent to watercourse.

Description: Several road crossings and multiple cabins. Swimming pool downstream. Burned structures directly in the water channel. Should clean up burned material before next rain to minimize contaminated water flow.Monitor and maintain the drainage.

LOCATION AND PHOTO



Scale: 1:6,000



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Long Canyon**

Site Number: **LC-02**

Feature: **Cabins, road crossings.**

Feature Category: **multiple**

Field Observation or Potential Hazard: Multiple cabins adjacent to watercourse and road crossings, including one steel bridge. Potential hazard is flooding with mobilized debris impacting cabins and washing out road crossings.

Potential Hazard to Life: **low**

Potential Hazard to Property: **low**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Monitor and maintain**

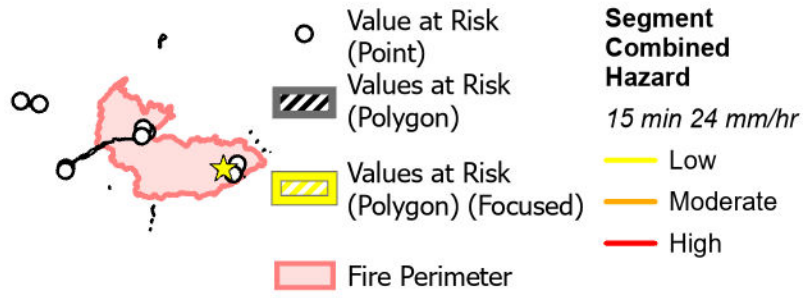
(3) **NA**

(4) **NA**

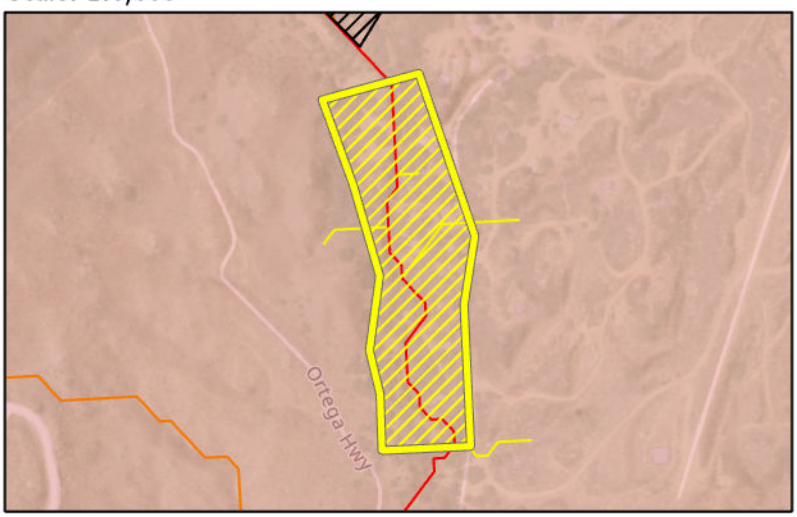
Text: Do not place temporary housing or new structures adjacent to watercourse.

Description: Cabins and property appear to have been abandoned.

LOCATION AND PHOTO



Scale: 1:6,000



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Lower Dickey Canyon**

Site Number: **LE-01**

Feature: **Drainage infrastructure, roadway, homes.**

Feature Category: **drainage structure**

Field Observation or Potential Hazard: Flood hazards may overwhelm drainage structures at Toft Drive and downstream at Brookstone Lane. Less than about 20 percent moderate and high burn severity in the watershed; thus, it would likely require a 10-yr plus RI rainstorm to cause issues.

Potential Hazard to Life: **low**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Clear and maintain culvert**

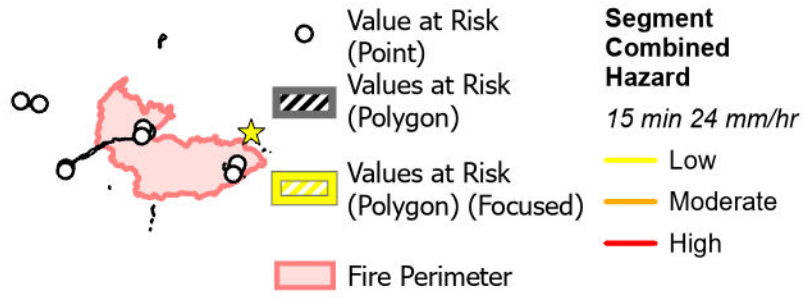
(3) **NA**

(4) **NA**

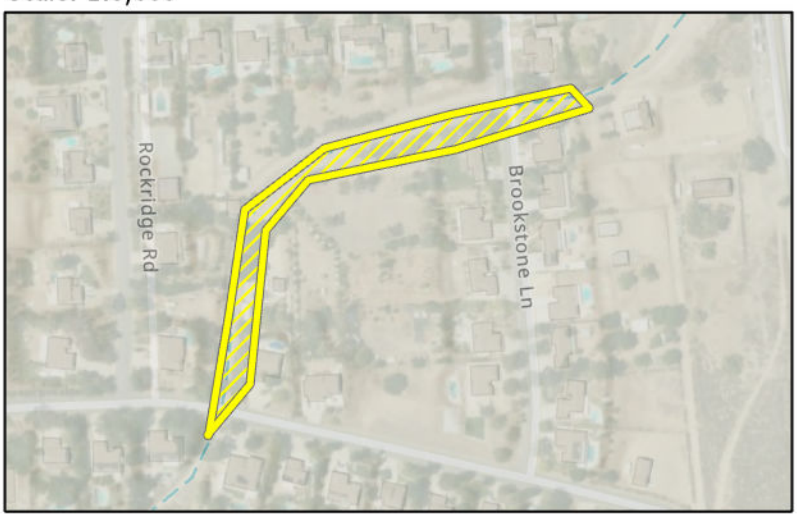
Text: Consider opening lower chain-link gate at Brookstone Road to allow overtopping flows to pass.

Description: Drainage was near capacity following the 2018 Holy Fire. Flows remained in channel but Brookstone crossing did get plugged. Diversion potential exists down Toft road.

LOCATION AND PHOTO



Scale: 1:5,000



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Laguna Canyon / Robinhood community**

Site Number: **LE-02**

Feature: **Homes and road crossing.**

Feature Category: **multiple**

Field Observation or Potential Hazard: Multiple homes adjacent to watercourse and culverted road crossing at Lancashire Drive. Potential hazard is debris flood / flow overtopping banks and inundating residences. Also, plugging of culvert, resulting in backwater effects and road inundation.

Potential Hazard to Life: **moderate**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Monitor and maintain**

(3) **NA**

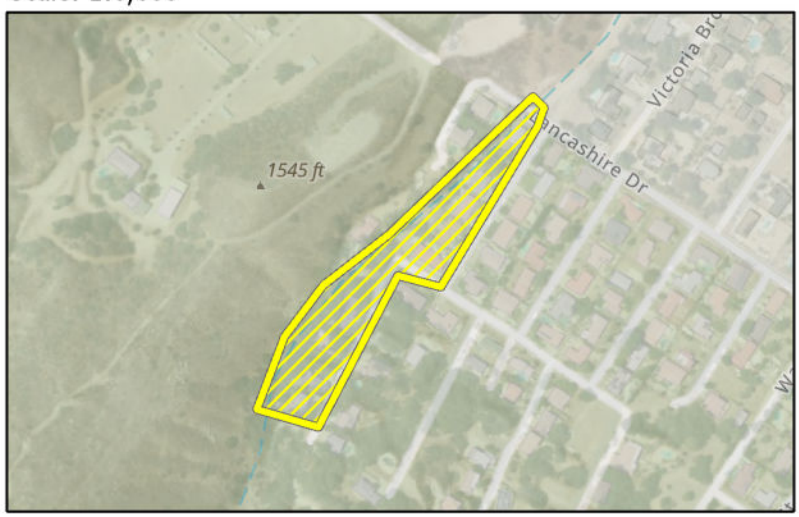
(4) **NA**

Text:

Description: Portion of basin in the burn scar burned mostly at moderate. 0.44 km2 at mod and high. Drainage adjacent to homes narrow and relatively steep with boulders.

LOCATION AND PHOTO

Scale: 1:6,000



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Wat Khmer Monastery**

Site Number: **LE-03**

Feature: **Monastery and associated structures.**

Feature Category: **multiple**

Field Observation or Potential Hazard: Monastery at base of a steep drainage and within potential flow paths. Potential hazards are flood impacts to several structures, some of which may be habitable.

Potential Hazard to Life: **moderate**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **NA**

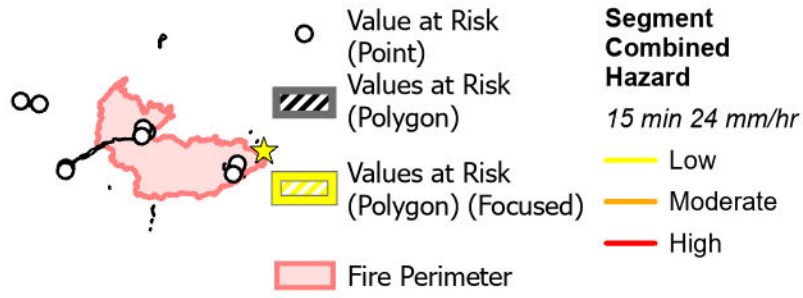
(3) **NA**

(4) **NA**

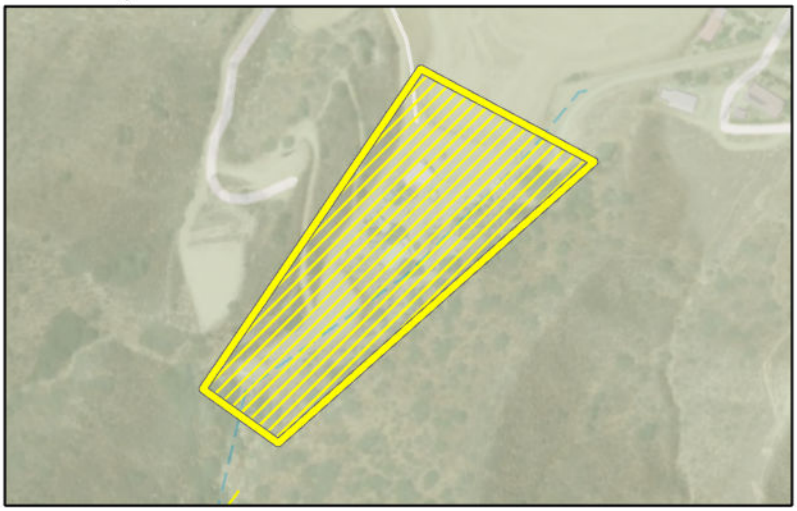
Text:

Description: 40% of basin burned with most of that area above Highway 74.

LOCATION AND PHOTO



Scale: 1:5,000



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Wilford Place in Lake Elsinore**

Site Number: **LE-04**

Feature: **Debris basins and homes in water course.**

Feature Category: **drainage structure**

Field Observation or Potential Hazard: Possibility for flooding associated with debris basin and inlet.

Potential Hazard to Life: **moderate**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures

(1) **Clear and maintain basin**

(2) **Early Warning**

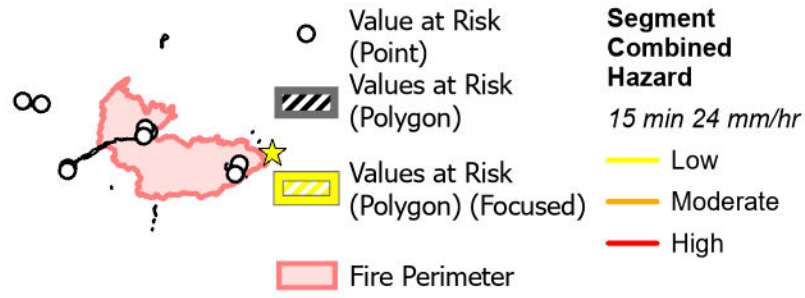
(3) **NA**

(4) **NA**

Text:

Description: Inlet at Ortega Basin Lateral A. Inlet includes 7'x7' box with flared wing walls. Transitions to 60" RCP at 18 feet in. Inlet may clog, making a hazard of flooding and possible debris flowing downstream along Welford Place and toward homes on Lake Ridge Road.

LOCATION AND PHOTO



Scale: 1:1,000

VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Modjeska Canyon**

Site Number: **MC-01**

Feature: **Homes, road and drainage infrastructure.**

Feature Category: **multiple**

Field Observation or Potential Hazard: Possible flood flow inundation from upper watershed burned areas. Much of the community is built along a canyon bottom floodplain adjacent to a highly vegetated reach of Santiago Creek. Drainage maintenance appears to be minimal.

Potential Hazard to Life: **moderate**

Potential Hazard to Property: **high**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Sandbags**

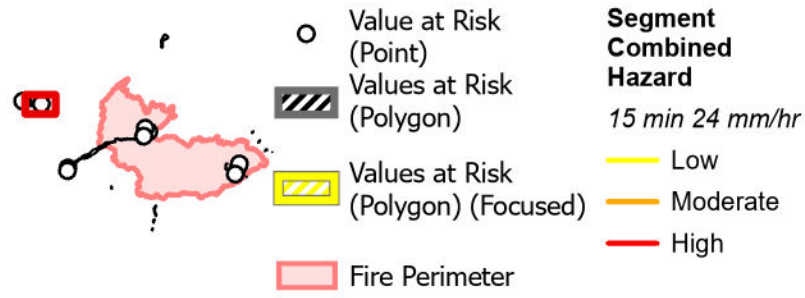
(3) **Monitor and maintain**

(4) **Signage**

Text: Given that there is no area aside from the canyon bottom -- which is lined with residential structures -- for upstream flood flows to be diverted/deflected around, early warning for stressing rainfall events is highest priority for community residents.

Description: Many homes and appurtenant structures appear to be built close to the active drainage; it is possible that debris and property items may be entrained into a flood flow and cause potential for multiple avulsion events in a stressing rainfall event. This VAR will require monitoring during and following stressing rainfall events to better understand the sensitivity of the drainage to upstream-originating flood flows. Of note, the bridge on Olive Hill Road that crosses Santiago Creek just south of the Modjeska Community Fire Station (VAR LS - 301) appears to be at risk for potential debris racking during a flood flow. Impacts on the Olive Hill bridge will cause ingress and egress problems for the small community of residents on the south side of Santiago Creek.

LOCATION AND PHOTO



Scale: 1:29,000

VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Santiago Creek downstream / Lower Modjeska Canyon**

Site Number: **MC-03**

Feature: **Structures, roads, infrastructure.**

Feature Category: **multiple**

Field Observation or Potential Hazard: This reach of Santiago Creek is unconfined and possible distributed flood flows may impact ingress and egress for residents, structures, and road and drainage infrastructure during stressing rainfall events.

Potential Hazard to Life: **moderate**

Potential Hazard to Property: **low**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Debris barrier**

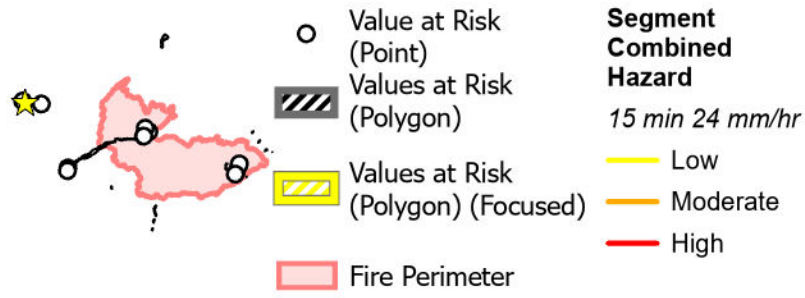
(3) **Sandbags**

(4) **Signage**

Text: Residents should be clearly alerted to inherent dangers present in this transitional area of the Santiago Canyon/Modjeska Canyon watershed. Possible debris barriers/deflection structures, and sandbags could be useful.

Description: Hazards within this VAR should be additionally characterized following a stressing rainfall event, which will more fully illuminate the map area/extent of impactful flood flows. Based on field reconnaissance/surveying, there did not appear to be many homes adjacent to or within the VAR. However, several horse pens and horse training facilities were observed adjacent to the active canyon bottom and floodplain.

LOCATION AND PHOTO



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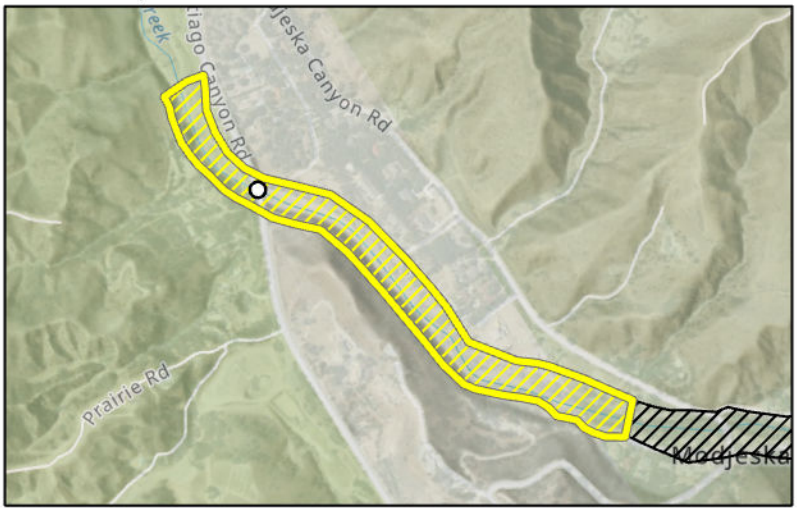


VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Trabuco Canyon and Holy Jim Canyon**

Site Number: **TC-01**

Feature: **Trabuco Creek Road, residences.**

Feature Category: **multiple**

Field Observation or Potential Hazard: The entire floodplain and adjacent slopes contain the full spectrum of post-fire watershed hazards capable of impacting Trabuco Creek Road and residences. Landslides, rockfall, and debris and flood flows are all possible.

Potential Hazard to Life: **high**

Potential Hazard to Property: **high**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Traffic control**

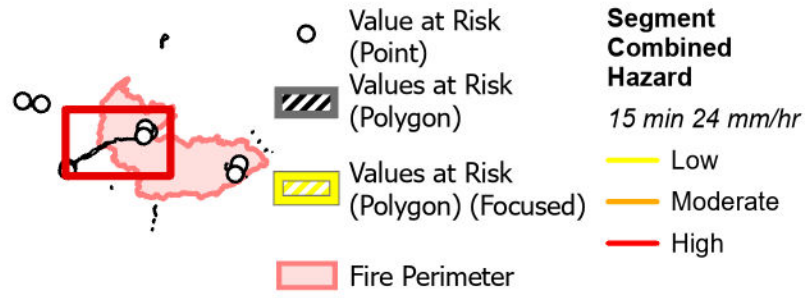
(3) **Signage**

(4) **Deflection structure**

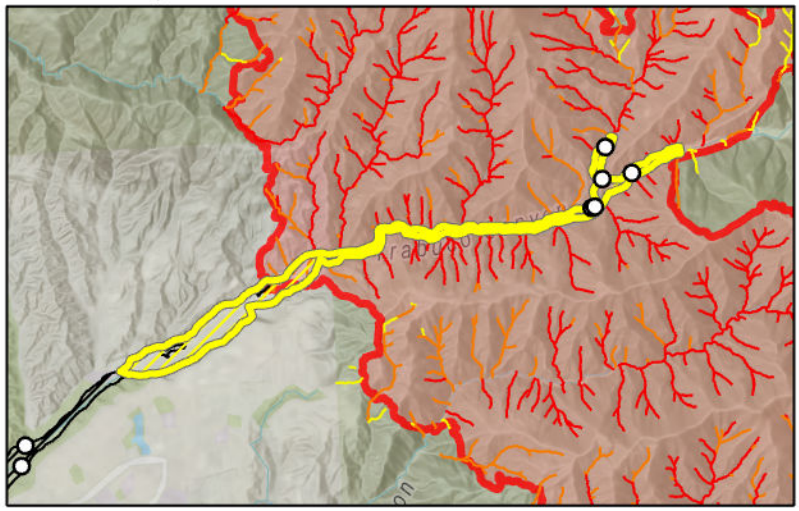
Text: Evacuation is advised prior to stressing rainfall events. Due to complex interplay between a debris-filled canyon bottom and oversteepened adjacent slopes, EPMs should be proposed after a site-specific evaluation.

Description: The hazards within the polygon have the potential to combine and become cascading in nature.

LOCATION AND PHOTO



Scale: 1:100,000



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Holy Jim Canyon**

Site Number: **TC-03**

Feature: **Cabins.**

Feature Category: **home**

Field Observation or Potential Hazard: Cabins located at base of steep drainages, oversteepened hillsides. Potential hazard is rockfall and debris flood flows/flow directed directly into back of residences. No retaining walls or debris barrier structures are currently present.

Potential Hazard to Life: **high**

Potential Hazard to Property: **high**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Debris barrier**

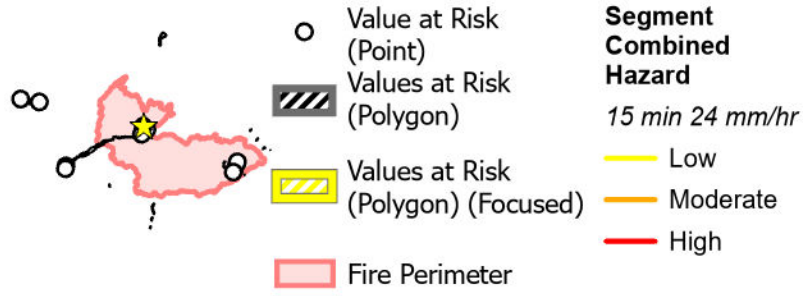
(3) **Deflection structure**

(4) **Monitor and maintain**

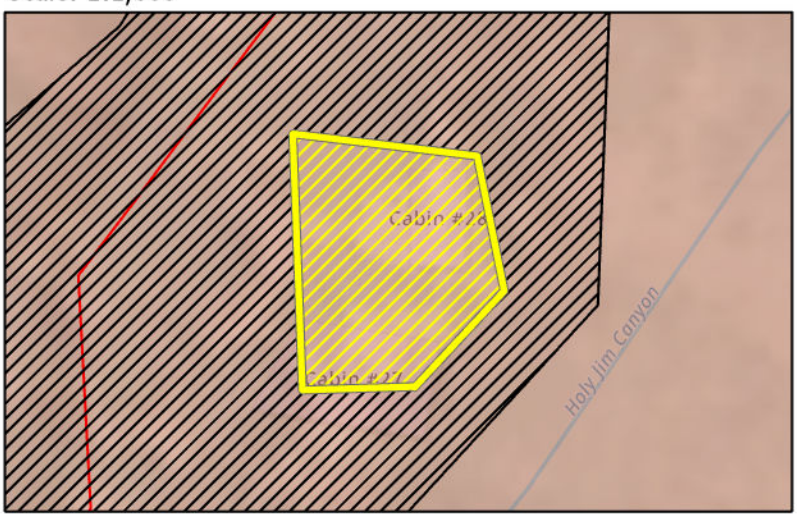
Text: Evacuation is advised before arrival of stressing rainfall events. Following stressing rainfall events, maintenance should be performed to clear freeboard behind installed debris barriers and deflections structures.

Description: HESCO barriers may be implemented to protect cabin 27 (south of the two). The drainage pouring into the rear of Cabin 28 has no outlet other than into the back of the cabin. If HESCO barriers or any other deflection structures can be engineered into the ascending slope behind the cabin, installation is advised.

LOCATION AND PHOTO



Scale: 1:1,000



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Trabuco Canyon**

Site Number: **TC-08**

Feature: **Outbuildings, access driveway.**

Feature Category: **home**

Field Observation or Potential Hazard: The access roadway into the VAR is within the active Trabuco Creek watercourse. Ingress and egress will be impacted during and following stressing rainfall events.

Potential Hazard to Life: **moderate**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Debris barrier**

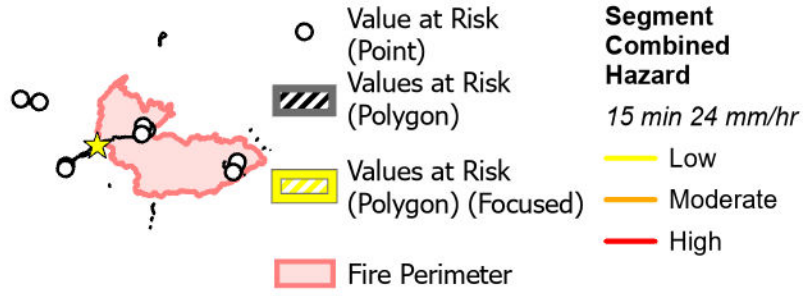
(3) **Deflection structure**

(4) **Monitor and maintain**

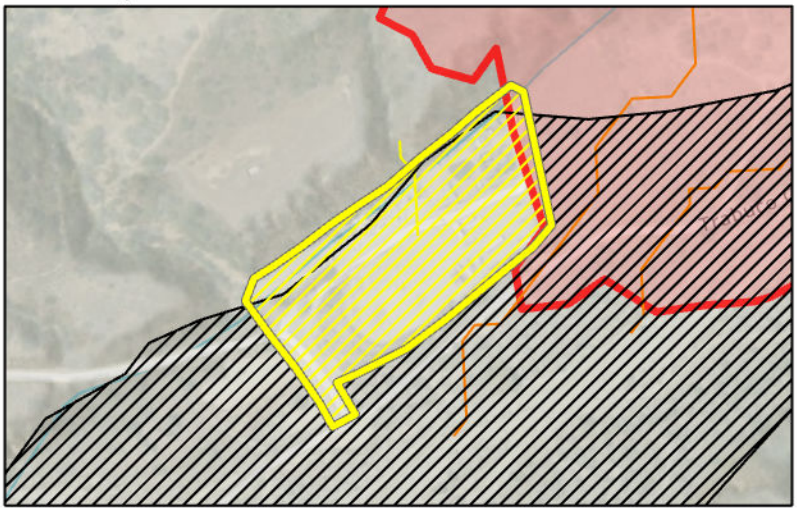
Text: Evacuation is advised before anticipated stressing rainfall events.

Description: The outbuildings and assorted property (cars, shipping containers) located within the VAR will potentially be impacted due to avulsions caused by flood flows in Trabuco Creek. The property will not be accessible during and after anticipated flood flows in Trabuco Creek and the associated floodplain.

LOCATION AND PHOTO



Scale: 1:5,000



VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Trabuco Canyon / Trabuco Creek Road**

Site Number: **TC-09**

Feature: **Home, mobile homes, property, roadways.**

Feature Category: **multiple**

Field Observation or Potential Hazard: Inundation within an active floodplain due to flood/debris flows. Ingress and egress for this site as well as a neighboring property to the northwest, on the bluff above Trabuco Creek, will likely be impacted during a stressing rainfall event.

Potential Hazard to Life: **high**

Potential Hazard to Property: **high**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Deflection structure**

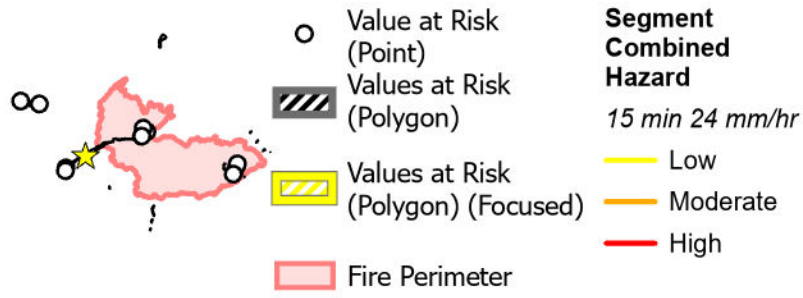
(3) **Sandbags**

(4) **Traffic control**

Text: Evacuation is advised before a stressing rainfall events. Access to the north side of Trabuco Creek could be cut off during storms. Residents should consider sheltering in place in the event access is cut off.

Description: This VAR was not directly accessed or observed during the WERT field reconnaissance. However, review of Google imagery indicates that the northern portion facing the active channel of Trabuco Creek will be at risk of highly concentrated flow emanating from Trabuco Canyon.

LOCATION AND PHOTO



Scale: 1:4,000

VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **Trabuco Canyon**

Site Number: **TC-10**

Feature: **Arizona Bridge crossing.**

Feature Category: **drainage structure**

Field Observation or Potential Hazard: The Arizona Bridge crossing structure across Trabuco Creek has the potential to be inundated during high-volume debris-filled flood flows.

Potential Hazard to Life: **high**

Potential Hazard to Property: **low**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Traffic control**

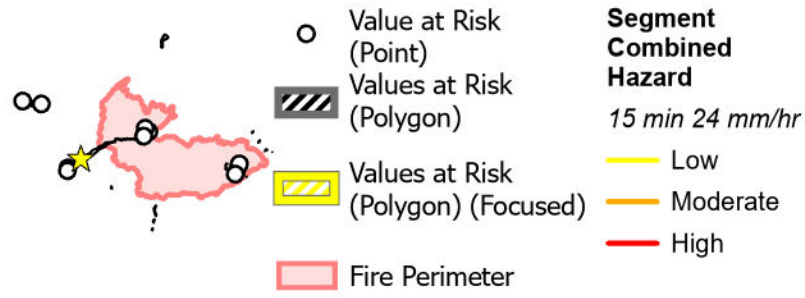
(3) **Signage**

(4) **Monitor and maintain**

Text: Traffic control should be considered to avoid use of the crossing during overtopping flows occurring near the crossing structure during and following stressing rainfall events.

Description: This crossing structure formerly had guard rails which were destroyed by the 12/6/18 debris flow emanating from the uppermost portion of Trabuco Canyon burned in the Holy Fire. While the current crossing structure remains optimized for handling bulked flood flows, given the massive increase of upstream burned area, expected flood flows during stressing rainfall events will cause overtopping and present an extreme life safety hazard. Potential channel avulsions upstream of the crossing structure could cause a wider zone of inundation on roadways adjacent to the crossing structure. Existing signage on both sides of the bridge warns the community ("When Flooded Turn Around Don't Drown" & "Flooded During Rains") about this watershed hazard. This message should be amplified preceding anticipated stressing rainfall events.

LOCATION AND PHOTO



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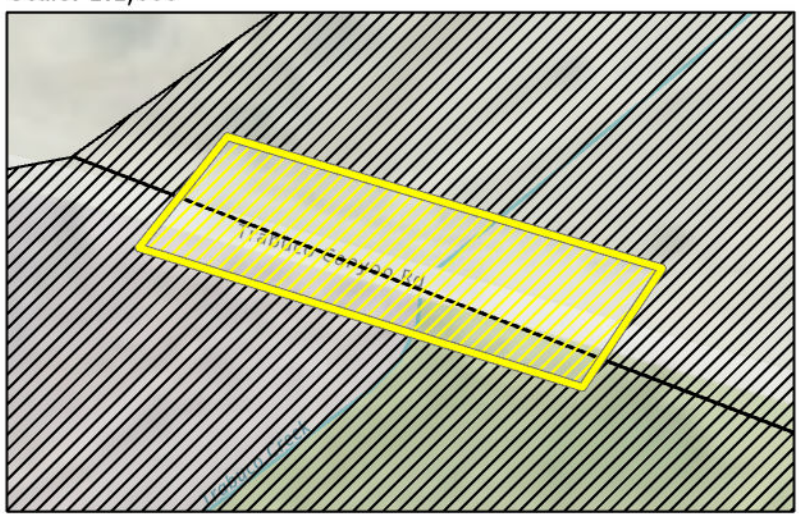


VALUE AT RISK DETAIL

Incident: Airport Fire *Incident Number: CA-ORC-127883*

Community: **O'Neill Regional Park / Trabuco Canyon**

Site Number: **TC-11**

Feature: **Park infrastructure and outbuildings.**

Feature Category: **multiple**

Field Observation or Potential Hazard: Active floodplain inundation with flood flows and possible distributed hyperconcentrated flow runout across the width of Trabuco Canyon. Historic damaging flood flows have occurred in this reach of the canyon following the 2018 Holy Fire.

Potential Hazard to Life: **moderate**

Potential Hazard to Property: **moderate**

Preliminary Emergency Protective Measures

(1) **Early Warning**

(2) **Deflection structure**

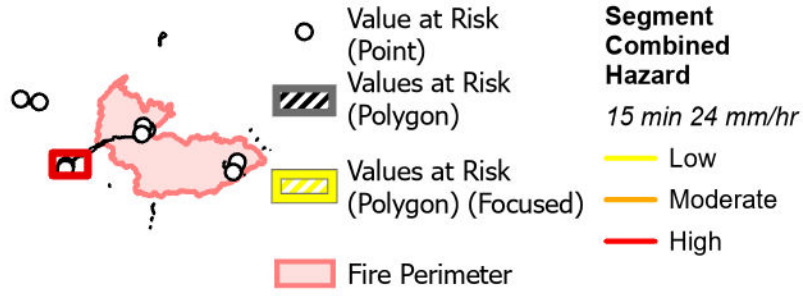
(3) **Traffic control**

(4) **Signage**

Text: Evacuation is advised prior to stressing storm events. Flood flow hazard is historically very well-documented.

Description: This VAR, similar to its upstream counterpart, occupies a sizeable area of the canyon floodplain. Many potentially impacted entities (OCFA, O'Neill Regional Park) will need clear communications regarding the potential hazards and exposure generated by stressing rainfall events to come. Anecdotal evidence provided by the O'Neill Regional Park Supervising Park Ranger indicates that lower areas of the park were impacted with flood flows that eroded the berm adjacent to Trabuco Creek following the 2018 Holy Fire. The park has implemented inflatable door seals to protect the Nature Center, and debris barriers/deflection structures have been placed around the bathroom on the south side of Trabuco Creek in the past as precautionary measures in the event of flooding. There are many access points to the park that will need to be closed in advance of stressing rainfall events.

LOCATION AND PHOTO



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