Marek Fire

State Emergency Assessment Team (SEAT)
Report

DRAFT

Affected Watersheds in Los Angeles County
California
October 30, 2008

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DISCLAIMER

The scope of the assessment and the information contained in this report should not be construed to be either comprehensive or conclusive, or to address all possible impacts that might be ascribed to the fire effect. Post fire effects in each area are unique and subject to a variety of physical and climatic factors which cannot be accurately predicted. The information in this report was developed from cursory field examination by licensed resource professionals and should be viewed in conjunction with other relevant sources of information. Neither the State of California nor any Agency or Department participating as a member of the State Emergency Assessment Team (SEAT) makes any warranty, express or implied, nor assume any legal liability for the information disclosed herein.

EXECUTIVE SUMMARY

The Marek Fire State Emergency Assessment Team (SEAT) was deployed to Los Angeles County on October 17, 2008. Unlike most previous SEAT assignments, the Marek SEAT worked closely with the USFS BAER Team assembled for this fire. An abbreviated SEAT was convened for this relatively small fire, since specialists with the Forest Service were available to assist in assessment of potential post-fire impacts on non-federal lands. This SEAT report should be read in conjunction with the USDA Forest Service BAER Report (2500-8), and associated federal specialist reports.

The Marek Fire began on October 12, 2008, on the Angeles National Forest, north of San Fernando Valley, in the foothills and lower peaks of the San Gabriel Mountain Range. It burned 4,824 acres by the time it was contained on October 16th. Approximately 40% of the fire burned on the Angeles National Forest and 60% on non-federal lands.

All of the burned area drains into the Tujunga-Pacoima Watershed, the largest sub watershed of the Los Angeles River Watershed. Topography in the fire area is generally steep, with approximately 30% of the burned area having slopes exceeding 60% and about 53% on slopes from 30 to 60%. Elevations within the fire area range from approximately 1,150 feet along Highway 210 to 3,537 feet above mean sea level at Kagel Mountain. Precipitation occurs almost entirely as rain, with infrequent snowfall events occurring above 2,500 feet in the winter. Mean annual precipitation in the burned area is 18 inches at the mouth of the tributary canyons to approximately 34 inches at the upper elevations near Kagel Mountain.

Geology primarily consists of Precambrain to Cretaceous age gneises and granitics. These basement rocks are overlain by the early Pleistocene Saugus Formation, consisting of loosely consolidated sands, gravels, and conglomerates; this formation is highly erodible. Primary plant communities are coastal sage scrub, California sagebrush-black sage, chamise chaparral, mixed chaparral, canyon live oak woodland, big cone Douglas-Fir forest, and sycamore/cottonwood/willow riparian forest. Coastal sage scrub--California sagebrush-black sage scrub is the main vegetation type throughout the burn. Non-native annual grassland is the dominant vegetation at the southern and western perimeters of the fire. Most of the fire area burned in 1975, resulting in vegetation that was approximately 30 years old.

Land uses in areas affected by the fire are residential, recreation, industrial, and watershed. Roads in and adjacent to the fire include Little Tujunga Canyon Road, Lopez Canyon Road, Kagel Canyon Road, and numerous Angeles National Forest roads. Intermittent streams in the burned area drain into Hansen Dam, Pacoima Reservoir, and Lopez Dam, which control flood flows and sediment, as well as releasing water into downstream spreading grounds for groundwater infiltration.

The potential for increased runoff and sediment from the fire area is high due to hydrophobic soil conditions, steep slopes, and erodible soils. First year post-fire peak flows with a two year recurrence interval storm were estimated to increase 2.9 and 2.2 times for Lopez and Kagel Canyons, respectively. Much larger 100 year flood flows were projected to increase 1.8 and 1.6 times for these two basins (without bulking for sediment, which can double flow estimates). First year post-fire sediment estimates varied widely depending on model assumptions and ranged from approximately a 6 fold increase to a 40 times increase. Data collected from the nearby San Dimas Experimental Forest supports the higher estimate, with first year post-fire sediment yields being 35 times higher than in comparable unburned basins.

Values at risk identified on non-federal lands include life, safety, property, transportation systems and access, as well as water quality. In particular, Kagel Canyon had approximately 60% of its watershed burned and has about 300 residences. Lopez Canyon, which was over 90% burned, has numerous businesses located along its lower channel and a large group residence (approximately 150 people) for women and children. Lopez Canyon commonly experienced flooding problems prior to the fire. Wildlife and sensitive plant species issues were identified by the USFS BAER Team (USFS, 2008).

Due to the high potential for flooding, debris flows or torrents from sub watersheds burned in the fire area along with identified values at risk, numerous mitigation measures were proposed by the SEAT. The most significant measures include:

- Installation of a fully functioning Early Warning System that directly warns residents in Kagel and Lopez Canyon when a triggering amount of rainfall has occurred (e.g., reverse 911, etc).
- Installation of sand bags, deflection walls, and temporary rail and timber debris control structures near residences and businesses in Kagel and Lopez Canyon where merited.
- Installation of warning signs on roads in Kagel and Lopez Canyons and in Dexter County Park.
- Improving channel capacity and upgrading watercourse crossings where needed, particularly in lower Lopez Canyon and Kagel Canyon.
- Clearing channel debris, installing debris barriers (trash racks), and establishing evacuation criteria for residences at risk of flooding or debris flows.
- Use of licensed engineers or certified professionals to perform a more in-depth evaluation of the adequacy of storm drainage and flood control features to accommodate the increased runoff from the burned watersheds.
- Use of consistent monitoring and maintenance programs by the appropriate jurisdiction of road crossings before, during and after significant storm events.

ACKNOWLEDGEMENTS

Our heartfelt appreciation goes to the Angeles National Forest (ANF) Burned Area Emergency Response (BAER) team lead, members of the team, the ANF Forest Supervisor, and ANF support staff for granting our State Emergency Assessment Team the privilege of joining forces with them in a common mission to assess post fire threats to lives, property and resources caused by the Marek fire.

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10-30-08

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SETTING AND CONDITIONS

The Marek Fire began on Sunday, October 12, 2008, on the Los Angeles River Ranger District, Angeles National Forest, north of San Fernando Valley in the foothills and lower peaks of the San Gabriel Mountain Range. Driven by strong offshore Santa Ana winds and low relative humidity, the fire spread quickly, burning into both Los Angeles County and later Los Angeles City jurisdictions. The fire began during a "red flag" fire weather warning issued by the National Weather Service. The incident was managed under unified command between the U.S. Forest Service, Los Angeles County Fire Department, and Los Angeles City Fire Department, with the Angeles National Forest taking primary responsibility (Mr. Stanton Florea, USFS BAER Team PAO, written communication).

Evacuations were ordered the morning of October 12th along Little Tujunga Canyon Road and in Kagel and Lopez Canyons. The final fire perimeter was located west of Little Tujunga Canyon, north of Interstate 210, and east of Pacoima Wash (Figure 1). When the fire was contained on October 16th, a total of 4,824 acres were burned, 41 residences destroyed, at least 22 outbuildings destroyed, and 8 residences damaged. Approximately 40% of the fire burned on the Angeles National Forest and 60% on non-federal lands (Figure 2). No tribal lands were identified within the fire perimeter.

Elevations within the fire area range from approximately 1,150 feet along Highway 210 to 3,537 feet above mean sea level at Kagel Mountain. Slopes range from gentle to extremely steep, with approximately 30% of the burned area having slopes exceeding 60%, about 53% on slopes from 30 to 60%, and 17% with slopes less than 30%. The Marek Fire is located in the Transverse Provence and the San Gabriel Mountains consist of Precambrain to Cretaceous age gneises and granitics, which produce toppling rockfall failures. The basement rocks are overlain by early Pleistocene Saugus Formation consisting of loosely consolidated sands, gravels, and conglomerates. This formation is highly erodible (USFS 2008). Soils are generally erodible sandy loams; dominant soil series include Modesto, Trigo, San Andreas, and Chilao. More detailed information about physical site conditions can be found within the SEAT report appendices - Geology and Hydrology specialists' reports, as well as the USFS BAER Soils and Hydrology Reports (USFS, 2008).

All of the burned area drains into the Tujunga-Pacoima Watershed (Figure 3). The majority of the fire area is located in the Little Tujunga Canyon watershed and drains into the Hansen Dam Flood Control Structure. This dam controls flows from both Little Tujunga and Big Tujunga Canyons and was built in 1940 after a destructive flood in 1938. A smaller portion of the fire on the west side drains into Pacoima Canyon. The Tujunga/Pacoima basin is the largest subwatershed of the Los Angeles River Watershed. Several relatively small watersheds within the fire perimeter flow down into Tujunga Canyon and Hansen Dam, including from the west: Lopez Canyon, Indian Canyon, Kagel Canyon, Marek Canyon, and a few small unnamed draws. Limekiln Canyon and several smaller unnamed tributaries flow to the west into the Pacoima Canyon basin.

Precipitation in the burned area occurs almost entirely as rain, with infrequent snowfall events occurring above 2,500 feet in the winter. The mean annual precipitation in the burned area is 18 inches at the mouth of the tributary canyons to approximately 34 inches at the upper elevations near Kagel Mountain, mostly coming in the form of winter rain between November and April (USFS 2008). Rainfall at Pacoima Dam averages 20.8 inches per year. Additional information about runoff is contained in the attached Hydrology specialist's report.

The primary vegetation types within Marek Fire include: coastal sage scrub, California sagebrush-black sage, chamise chaparral, mixed chaparral, canyon live oak woodland, big cone Douglas-Fir forest, and sycamore/cottonwood/willow riparian forest (Figure 4). Coastal sage scrub--California sagebrush-black sage scrub is the main vegetation type throughout the burn. Non-native annual grassland is the dominant vegetation at the southern and western perimeters of the fire. Most of the fire area burned in 1975, resulting in vegetation that was approximately 30 years old. More specific information about vegetation types can be found in the USFS BAER Botany specialist report.

Major land uses in the fire area are residential, recreation, industrial, and watershed. Specific uses include two cemeteries in Kagel Canyon, several gun clubs throughout the fire area, a trailer park in Lopez Canyon, approximately 300 residences in Kagel Canyon, numerous waste management businesses in lower Lopez Canyon, the Hope Garden Family Center (housing 150 individuals) in Lopez Canyon, the USFS Angeles National Forest District Office in Little Tujunga Canyon, polo and equestrian clubs in Little Tujunga Canyon, and Pacoima Reservoir and multiple newer subdivisions in Pacoima Canyon. Intermittent streams in the burned area drain into Hansen Dam, Pacoima Reservoir, and Lopez Dam, which control flood flows and sediment, as well as releasing water into downstream spreading grounds for groundwater infiltration.

Major roads affected by the fire include Little Tujunga Canyon Road, Lopez Canyon Road, Kagel Canyon Road, and numerous Angeles National Forest roads (e.g., Marek Truck Trail (3N40), Sugarloaf Road (3N45.1)). Highway 210 to the south is not expected to be adversely impacted by the fire. Kagel Canyon and Lopez Canyon Roads provide critical access to private homes and businesses property in the south portion of the fire. USFS roads provide access for land management, recreation, fire control, mining claims, and other private property.

A burned area reflectance characterization (BARC) map covering the fire area was provided by the US Forest Service (USFS) to rate differences in soil burn severity (Figure 5). This map was slightly modified by the USFS BAER Team based on observed post-fire vegetation, mainly removing areas on high severity initially mapped near Kagel Mountain. The SEAT field review confirmed the USFS BAER findings, and no further modifications to the revised BARC map are proposed in this report. The resulting, overall, burn severity estimates for the fire area are 42.1 percent low, 42.1 percent moderate, and <1 percent high. In addition, 15.2 percent of the area within the fire boundary was found to be unburned.

SEAT and USFS BAER field reviews found that water repellent soils were present in most burned areas, and that there was little difference in hydrophobic conditions for areas mapped as low and moderate soil burn severity. Field tests revealed high hydrophobicity at the mineral soil surface and at a depth of one half inch in the burned areas, with approximately 80% of the area being affected. At nearly all sites, the soils were not hydrophobic at depth. In the unburned areas, approximately 30% of the sites exhibited hydrophobic conditions near the surface.

First year post-fire peak flows with a two year recurrence interval were estimated to increase 2.9 and 2.2 times for Lopez and Kagel Canyons, respectively. Much larger 100 year flood flows were projected to increase 1.8 and 1.6 times for these two basins (without bulking for sediment, which can double flow estimates). Background sediment yield was determined to be 3,360 cubic yards per year from over 70 years of sediment deposition records in Pacoima Reservoir. First year post-fire sediment estimates varied widely depending on model assumptions and ranged from approximately a 6 fold increase to a 40 times increase. Data collected from the nearby San Dimas Experimental Forest supports the higher estimate, with first year post-fire sediment yields being 35 times higher than in comparable unburned basins. More specific information about hydrologic impacts can be found in the SEAT and BAER Hydrology specialist reports.

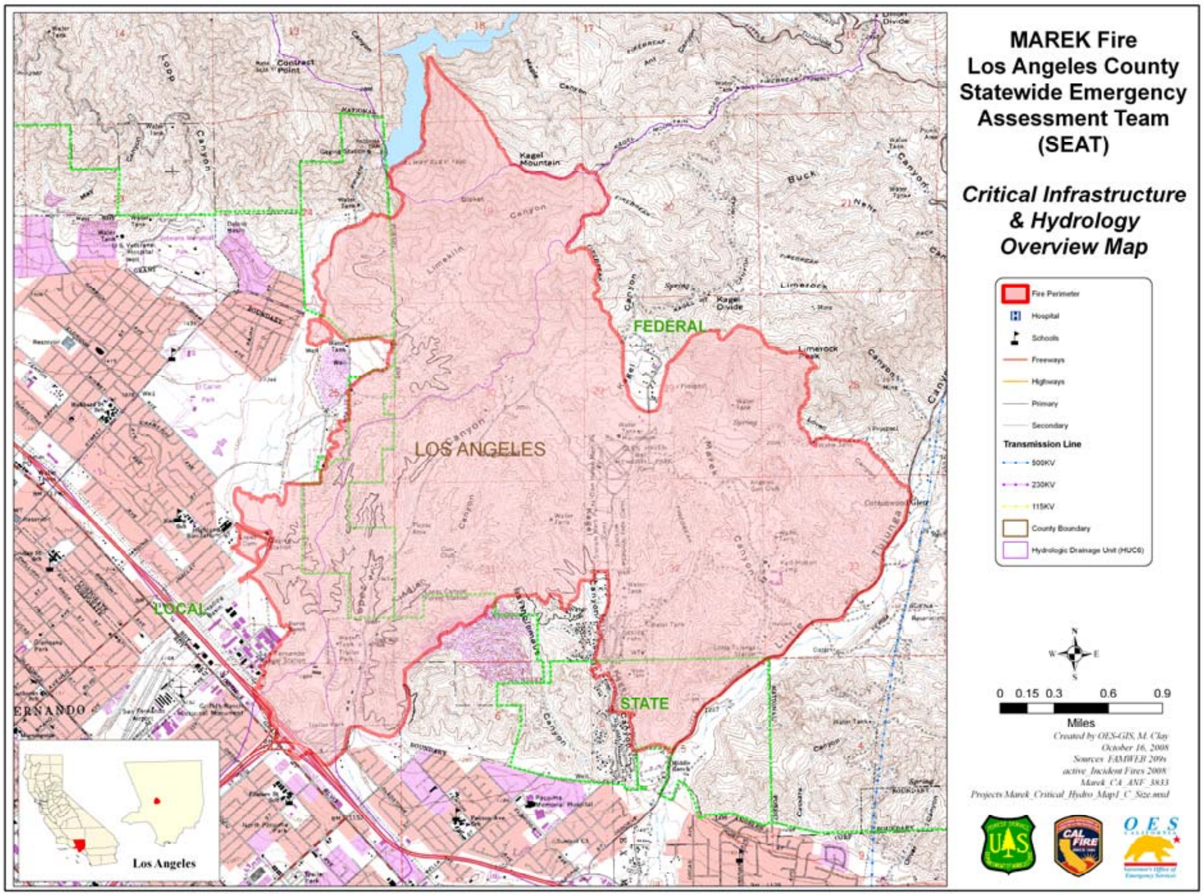

Figure 1: Fire boundary and topography map.

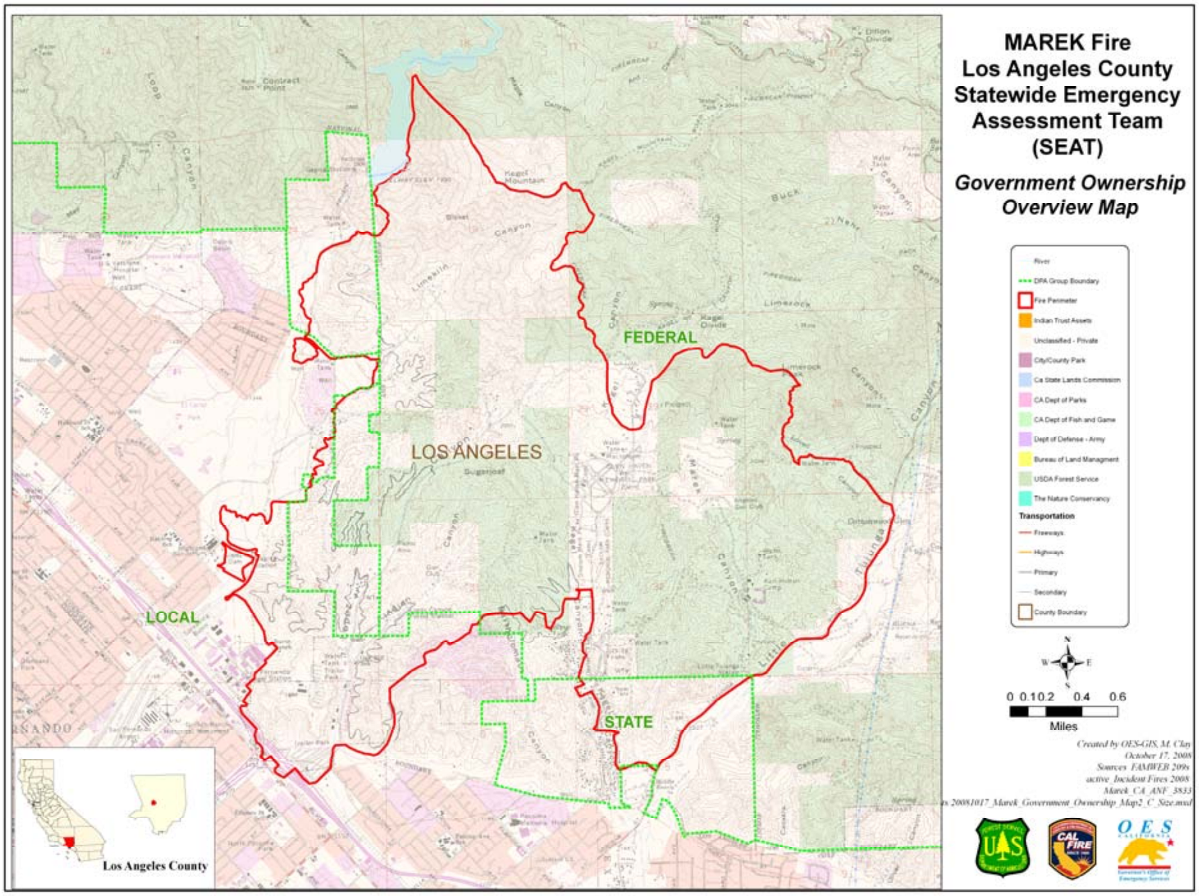

Figure 2: Fire area ownership map.

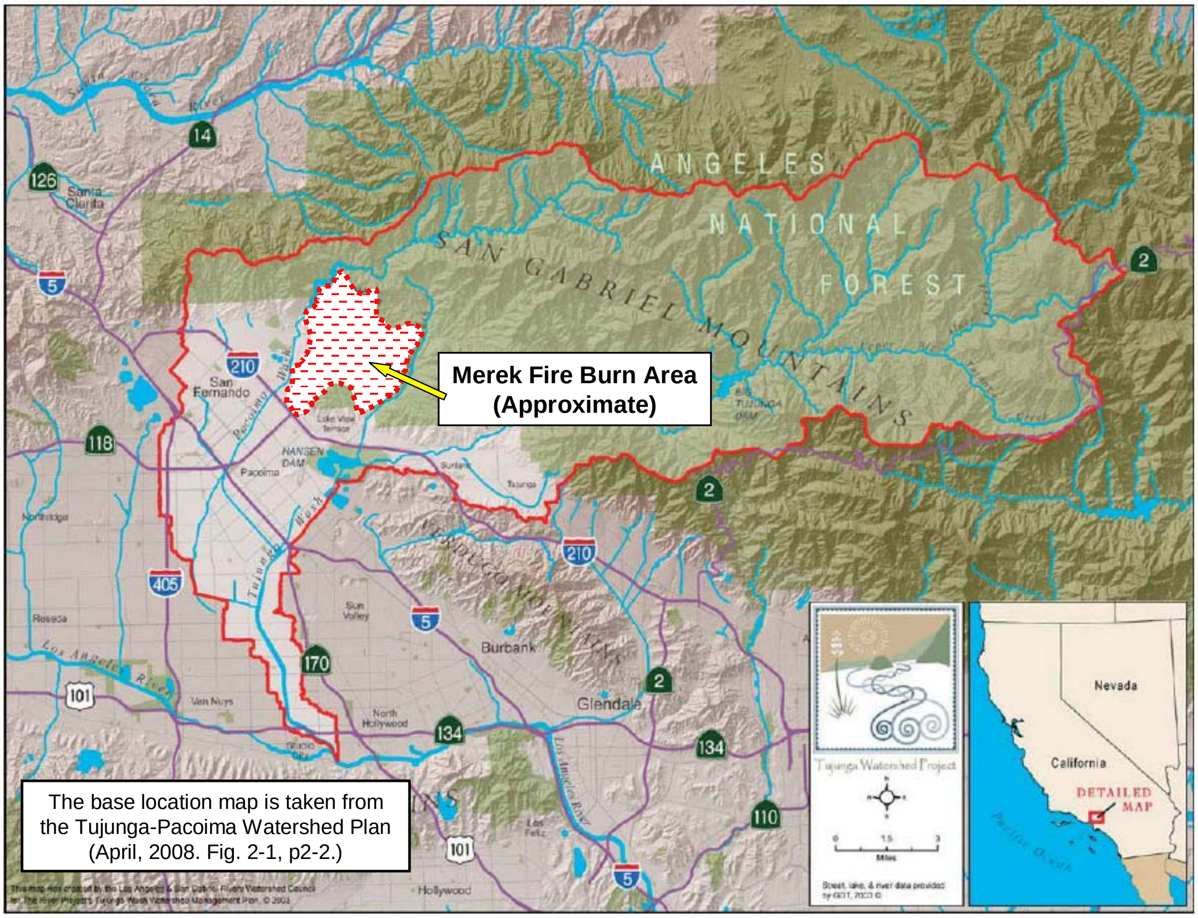

Figure 3: General location of the Marek Fire perimeter in relation to the Tujunga-Pacoima Watershed

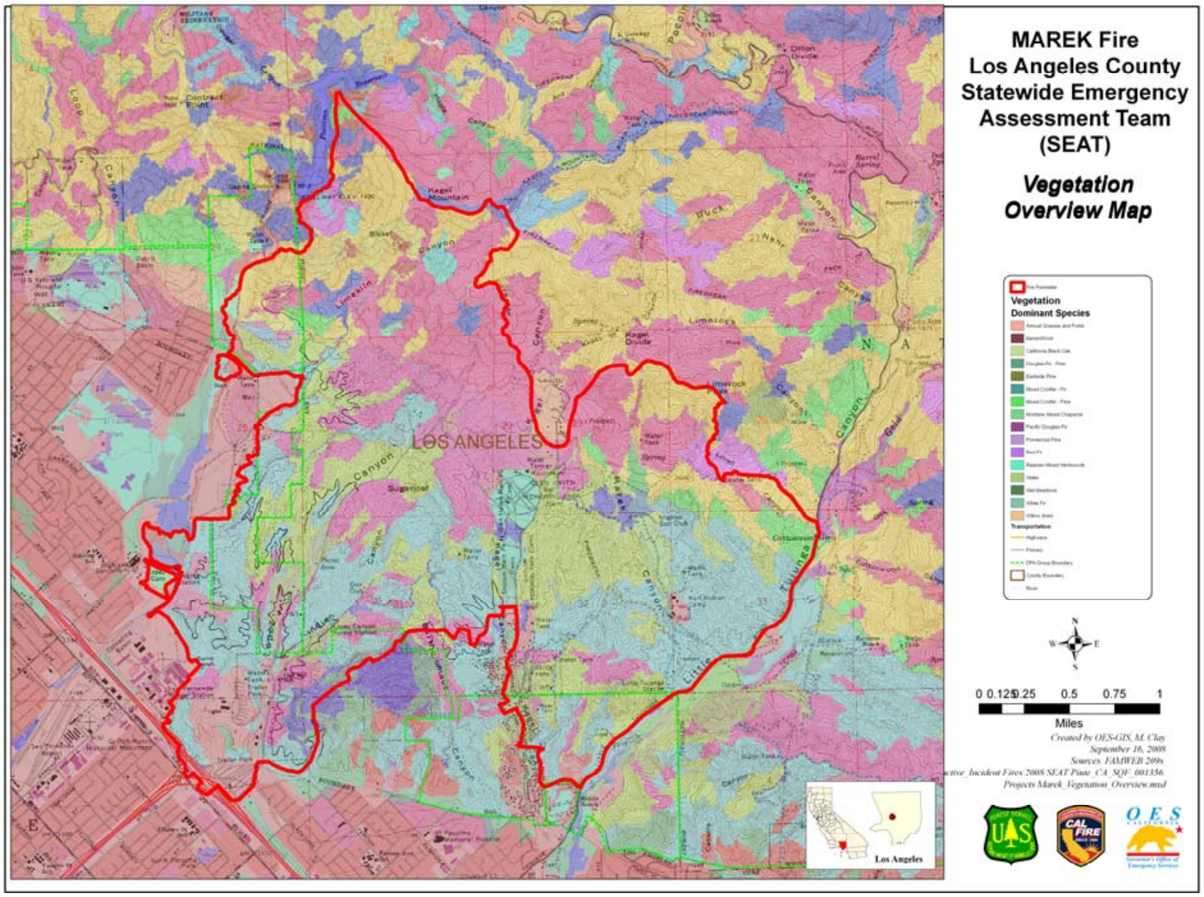

Figure 4: Fire area vegetation types.

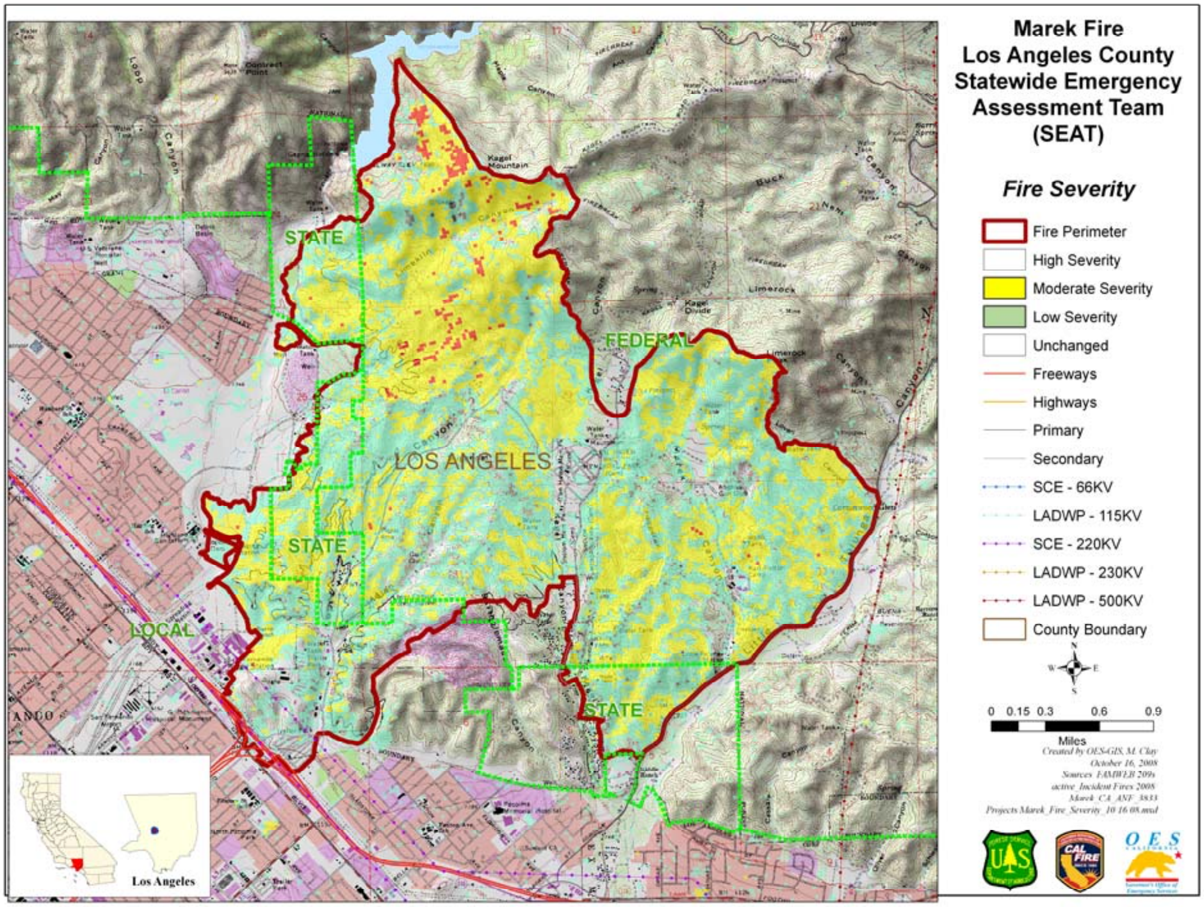

Figure 5: Soil burn severity map (unrevised based on field work).

SPECIALIST REPORTS FINDINGS SUMMARY

Geology

Regional Geology

The Transverse mountain range is a geomorphic province that is approximately 250 miles long. The range is situated in a general west-northwest/east-southeast trend across the State. The province is a major tectonic feature which bounds and separates the Coast Range, Great Valley, Sierra Nevada, and Mojave geomorphic provinces to the north and east from the Coastal basins, Peninsular Ranges and Salton Tough provinces to the south. The San Gabriel Mountains and Tujunga-Pacoima watershed is found on the southern side in the central portion of the Transverse Ranges.

Climate Related to Mass Wasting

The Transverse Ranges form a barrier to the Pacific storm belt and as a result, orographic rainfall (rising of water-laden clouds over the mountains) is common. During wet years, weak rocks and unconsolidated surfacial deposits become saturated and may fail as rock falls, rock avalanches, debris slides, earth slides, and land and debris flows. Debris flows generated during rain storms on recently burned areas have destroyed lives and property throughout the Western U.S. (Cannon, et al., 2007).

Tujunga watershed elevations vary from 562’ to 7128’ above sea level. As such, extreme tectonism and orographic weather conditions combine to produce increased mass wasting of geologic materials. Very old rocks, conveyed along transpressional plate boundaries are brought to the surface and raised through tectonic processes such as compressional thrust and reverse seismic events. Concurrently, erosional processes of gravity, weathering, failure, and mass movement may place relatively young sediments and sedimentary materials directly upon these ancient rocks in unconformable contact.

The San Gabriel Mountains are a mountain range which has been uplifted rapidly in recent geologic time. Resulting erosion and mass wasting has produced a thick series of alluvial fans which spread southerly from the range front. Repeated episodic uplifting resulting from local and regional seismic activity has also raised the alluvial fans. As a result of uplift and weather, rapid erosion and down cutting of drainages produced desiccated hillsides in the multiple fan complexes.

Seismicity

A series of active fault traces, located at the base of the San Gabriel Mountains as well within and near the base of the mid fan hills (near the I-210 freeway), have indicated movement in historic (1971), Holocene (<11,000 yrs bp), and/or repeated movement since Late Quaternary (<700,000 yrs bp) time. The resulting movement combined with orographic weather impacts, have greatly shaped the geomorphic features now seen. Additionally, landform changes due to anthropomorphic impact (i.e., changes brought about by current human activity) are clearly seen on land surfaces revealed in much of the burn area.

Landslides

Given the above information, multiple types of landslide features are determined to exist throughout much of the burn area. Landslide types and features vary depending on many factors including but not limited to: geologic formation, material types, degree of compaction, bed orientation, elevation, aspect of slopes, rainfall occurrence, etc. An in-depth review and discussion of landslide occurrences and types are provided and follow descriptions which are presented by geologic unit as found on the **Geology of the Marek Fire Area** (Please refer to the Technical Specialist's Report; Resource: Geology)

Loss of Human Life and Property

Four principal concerns with the Marek Fire are:

- The loss of human life and property, and infrastructure due to an increase in the potential for debris flow initiation, in-channel flooding, and debris torrents affecting places of population, homes and nearby outbuildings. Infrastructure includes drainage ditches, culverts, County, local and private bridges, water storage tanks, power lines, subsurface cable, water and sewer lines, domestic wells, domestic leach fields, road cuts, road and embankment fill, and other infrastructure, as well as resource areas including hiking and equestrian trails, and open land.

- The loss of life, property, and the closure of Lopez Canyon Road which passes through Lopez Canyon due to an increase in the likelihood of sudden rain-initiated down slope rock falls, rock avalanches, debris flows or torrents, sudden canyon slope failures, and other catastrophic failures. The partial or complete flooding of Hope Garden Family Center, as well as other down stream structures, residences, populated buildings, or open places of habitation or human presence.

- The loss of life, property, and the closure of Kagel Canyon Road and other roads which pass through the Kagel Canyon area due to an increase in the likelihood of sudden rain-initiated down slope flooding, hyperflooding, debris flows or torrents, sudden canyon slope failures, and other catastrophic failures. The partial or complete flooding of Dexter County Park and recreational areas as well as other down stream structures, residences, populated buildings, or open places of habitation or human presence.

- Wildlife, fishery, and botanical impacts to the Tujunga-Pacoima watershed, including burned portions of the Limekiln Canyon, Lopez Canyon, Kagel Canyon, Marek Canyon, and Little Tujunga Wash. Water quantity and quality impacts affecting downstream stakeholders including the Hansen Dam retention area, groundwater stakeholders and users. Reduced reservoir capacity resulting from a large influx of sediment translates to less water downstream for users including municipal, agricultural, domestic, and environmental users. Water quality concerns arise from entrainment of various chemicals which enter the environment during rapid debris flood events. Solvents, dry and liquid chemicals, and household pesticides normally found in domestic outbuildings, become entrained in the debris flow mass leading to potential contamination of both the water flowing as well as the deposited base sediment load.

Hydrology

The Marek Fire burned a small portion of the Tujunga/Pacoima watershed, a major tributary of the Los Angeles River, in the highly erodible San Gabriel Mountains in Los Angeles County. Vegetation mainly consisted of grass as well as chaparral that was approximately 30 years old. Over 80% of the fire perimeter had low or moderate soil burn severity, with an additional 15% being unburned.

Several relatively small sub-watersheds within the fire perimeter flow down into either Little Tujunga Canyon and Hanson Dam, or Pacoima Reservoir/Wash. These structures were built in 1940 and 1929, respectively, to prevent flooding. The major drainages of interest within the fire in terms of threats to lives or property are Kagel and Lopez Canyons.

Pre and post-fire flood flow estimates were compared with three different analytical approaches, with local gaging station data from Little Tujunga Canyon being selected as the best approach for estimating background peak flow rates. First year post-fire peak flows with a two year recurrence interval were estimated to increase 2.9 and 2.2 times for Lopez and Kagel Canyons, respectively. Much larger 100 year flood flows were projected to increase 1.8 and 1.6 times for these two basins (without bulking for sediment, which can double flow estimates).

Peak flow increases from the fire will also be bulked by ash, debris and other floatable and transportable materials. There is a high probability that post-fire flows from the first runoff producing rain events will have a high concentration of ash discharged from the burn area downstream to the lower reaches of streams within the Marek fire burn area and below. The potential for adverse water quality effects is high, but Pacoima Reservoir and Hansen Dan do not supply surface water for domestic uses. There is a possibility for introducing toxic materials into groundwater wells used for domestic use, however, since there are spreading grounds for groundwater infiltration below these structures, this threat may be reduced.

Pre-and post-fire sediment yield projections were made using four different methods. Background sediment yield for all methods was determined to be 3,360 cubic yards per year from over 70 years of sediment deposition records in Pacoima Reservoir. First year post-fire sediment estimates varied widely depending on model assumptions and ranged from approximately a 6 fold increase to a 40 times increase. Data collected from the nearby San Dimas Experimental Forest supports the higher estimate, with first year post-fire sediment yields being 35 times higher than in comparable unburned basins.

The primary values-at-risk to lives and property due to flooding (including limiting emergency access) and debris production associated with landslide processes on non-federal lands were determined to be: (1) Hope Garden Family Center, (2) Kagel Canyon residences, (3) businesses at the base of Lopez Canyon, and (4) Dexter County Park in Kagel Canyon. All four of the values-at-risk listed above were found to constitute an emergency situation for lives and property. Treatments proposed by the SEAT, as well as LACDPW, include using a fully functioning Early Warning System that will directly warn residents to leave their homes when a threshold amount of rainfall has occurred; use of warning signs; use of sand bags, deflection walls, and temporary debris control structures where required; and use of storm patrols to keep road crossing structures functioning during the winter period.

Civil Engineering

The Civil Engineering “Supplemental” SEAT report for the Marek Fire is an abbreviated version of a typical SEAT technical specialist report, limited to inclusion of recommendations in response to emergency declarations made in the US Forest Service BAER technical specialists’ reports, as well as the SEAT Geologist and Hydrologist Specialists’ reports. The SEAT Geologist Specialist report addresses post fire threats to the loss of human life, property, and infrastructure due to an increase in the potential for debris flows, in-channel flooding, and debris torrents affecting residences, businesses, and nearby outbuildings. The SEAT Hydrologist Specialist report provides estimates of post-fire flooding and sediment yields, with implications for the loss of human life and property.

By using the emergency declarations stated in these reports, the SEAT Civil Engineering “Supplemental” report addresses recommendations for reducing adverse impacts from areas where landslides and debris flows are possible with large storm events, and storm flows projected to be excessive. The report recommends mitigation methods for reducing flooding of conveyance features, as well as implementing protection measures for infrastructure. It also addresses general Best Management Practices (BMPs) for erosion control that provide options for protecting ditches, culverts, bridges, residences, businesses, and structures.

There is concurrence with both the SEAT Hydrologist and Geologist that the primary values-at-risk to lives and property due to flooding (including limiting emergency access) and debris production associated with landslide processes on non-federal lands are: (1) Hope Garden Family Center, (2) Kagel Canyon residences, (3) businesses at the base of Lopez Canyon, and (4) Dexter County Park in Kagel Canyon. These four major values at risk warrant immediate emergency actions to protect lives and property from post fire affects. The primary treatment proposed by the SEAT team is to install an Early Warning System that will alert residents to leave their homes when a threshold amount of rainfall has occurred. In addition, recommendations include posting warning signs, improving and installing debris flow structures, implementing reverse 911 procedures, developing evacuation plans, implementing Best Management Practices (BMPs) for general erosion control measures where site specific conditions dictate, and using storm patrols to keep road crossing structures functioning during the winter season.

The US Forest Service BAER report (USFS, 2008) comprehensively addressed potential post-fire impacts to roads and drainage features, as well as potential post fire impacts to water storage tanks, power lines, hazardous material spill sites , water and sewer lines, domestic wells, domestic leach fields, road cuts, road and embankment fill, and other infrastructure, as well as resource areas including hiking and equestrian trails on both federal and non-federal lands. The USFS (per US Forest Service regulations) is allowed to conduct general assessments of post fire assessments down slope and outside of federal lands, but not allowed to implement recommended mitigation measures for post fire impacts on non-federal land. Therefore, the

Civil Engineering SEAT report supplements the BAER assessments reported for non federal land by providing general recommendations for protecting infrastructure. It is noted that more site specific recommendations can be acquired by contacting Los Angeles County Department of Public Works in conjunction with the Los Angeles County Fire Department (see contact information).

The following is a list of recommendations for protection of drainage features, such as culverted road crossings and engineered conveyance channels:

- The local agency/owner is encouraged to employ a licensed engineer or certified professional to perform a more in-depth evaluation of the storm drainage and flood control features than the BAER and SEAT's rapid assessment afforded. The intent is to properly re-analyze the design capacity of structures for culvert sizing and conveyance channel freeboard to accommodate the increased runoff from the burned watersheds.
- Where debris flows pose a threat of flooding, installation of trash racks should be placed upstream of road crossings in a "V" shape configuration with the apex pointing upstream to avoid causing debris buildup while still providing deflection of debris that could cause damage to the road and conveyance structure.
- Maintenance crews from the respective jurisdictional agencies should perform removal of channel vegetation and debris to decrease the chance for flooding and consequent access entrapment.
- The appropriate agency/owner should perform consistent monitoring and maintenance of road crossings before, during and after significant storm events.
- Where necessary, repairing, replacing, and/or installing rock-slope protection along channel banks where erosive soils are prone to undermining adjacent structures is recommended.

For additional recommended Best Management Practices used for curtailing impacts due to flooding and debris damage to property and infrastructure, see the narrative detail within the Civil Engineering Supplemental report. Also, a reference list and hyperlinks to websites are included to provide the reader with a wide variety of tools to protect lives and property caused by post fire threats.

Forestry

A brief assessment was conducted to evaluate and identify both direct and indirect effects of the Marek Fire on the existing vegetation types and trees. The USFS BAER Team's Botany Report provides additional information on the fire's impacts to vegetation.

Marek Fire vegetation types include coastal sage scrub, chamise chaparral, mixed chaparral, big cone Douglas-Fir forest, sycamore/cottonwood/willow riparian forest, and canyon live oak woodland, and annual grass/forb. Chaparral species are well adapted to fire, with many species having the capability to sprout back from root crowns or through adventitious buds. Coast Live Oak (*Quercus agrifolia*) and Scrub Oak (*Quercus berberidifolia*) are common species within the burn area and are expected to recover well from the low to moderate severity burn.

Eucalyptus trees are non-native species widely planted ornamentally, as well as for wind and soil erosion, and are found in certain parts of the Marek Fire. Some scorch morality is expected and trees weakened by fire may create favorable conditions for Eucalyptus Long-Horned Borers to flourish, with an increase in insect mortality. In that occurrence, dead trees may pose a fire hazard as well as a hazard due to limb breakage and wind throw. Additionally, burned oak trees were observed within close vicinity to many of the homes, outbuildings, driveways, frequently traveled roads, and other improvements. As these burned trees continue to weaken, limbs may break off, the bole of the tree may snap off, or the entire tree may uproot. There is a moderate risk that these weakened trees may injure people or cause damage to property. This risk will increase through time as the trees continue to decay, and especially during times of strong winds.

It is recommended that large trees of any species within the fire area be evaluated for existing mortality from the fire, as well as future mortality as trees succumb to the affects of fire. Trees that have not been killed by fire with light to moderate fire damage could also be at an increased risk of mortality in the next one to three years.

VALUES AT RISK AND MITIGATIONS SUMMARY

Hazards resulting from the Marek Fire, consequent values at risk, and proposed mitigations are summarized in Table 1. The following is a more detailed discussion of the information contained in Table 1 to address hazards created by the fire.

Site Map Points K-2 & K-3: Dexter Park, Lower Kagel Canyon Residences:

Approximately 60% of the Kagel Canyon watershed experienced moderate to low burn severity. Multiple tributaries feed both into Dexter County Park as well as down stream. During rain events, the combined tributaries may contribute excess water and sediment in a cumulative amount. In the park, numerous picnic structures, children playground facilities, recreational areas and parking lots exist. Sudden, unannounced flash flooding, hyper flooding, debris flows and/or debris torrents may enter the upper portion of the park and flow through the recreational areas.

Downstream from the park, numerous homes, residences, outbuildings, structures, roads, trails, infrastructure, and other properties exist within, adjacent to, or nearby the drainage channel. Access and escape routes are very limited. Sudden and/or continued heavy storm events may limit movement both in and out of the area. Entrapment may occur.

In this neighborhood of lower Kagel Canyon, a number of residences were identified as being at risk to either flooding from bulked stream flows or debris flows from small drainages draining down to Kagel Canyon. Forty-four residences in Kagel Canyon are currently at risk to flooding or debris slides according to Los Angeles County Department of Public Works engineers' on site assessment. According to LACDPW, of the 44 residences, 12 houses were noted as having very high risk. The majority of the 12 homes at highest risk are located on Spring Trail in Kagel Canyon.

Currently there is no direct way of notifying homeowners when a threshold level of rainfall has occurred. The main treatment recommendation for Kagel Canyon is to install a fully functioning Early Warning System that will directly warn residences when to evacuate Kagel Canyon. At present, there is no reverse 911 system in place or other type of direct warning approach, such as has been used in other high risk canyons following wildfire (e.g., Santiago Canyon in Orange County). LACDPW is not currently responsible for evacuation; this is accomplished through the Los Angeles County Sheriff's Office. In addition to implementing a direct Early Warning System, warning signs should be posted throughout the lower part of the canyon and warnings should be posted on the community's webpage (http://kagelcanyon.com/). Lastly, storm patrols should be conducted before, during, and after significant rain events.

Residences in Kagel Canyon are encouraged to develop a neighborhood watch program to determine when neighbors are at risk during storm events.

<u>Site Map Point LOP-10; Hope Garden Family Center: Upper Watershed Debris Flows & LOP-11 Hope Garden Family Center Residences:</u>

Hope Garden Family Center is a residence with approximately 150 people; there are approximately 75 children, 25 seniors, 50 rotating staff members and 25 women present at the facility run by the Union Rescue Mission. Prior to the Marek Fire, lower Lopez Canyon Road frequently flooded during winter storm, blocking access to the center for several hours (Scott Johnson, Chief Operations Officer, per. communication). A 39 acre burned watershed empties directly into the Hope Garden Valley Center, greatly elevating the risk of flooding and debris inundation. While the facility has a concrete v-shaped road that is designed to divert flow from this drainage into a large concrete channel for Lopez Creek that extends through the entire facility, it is apparent that with a very large storm event, the Center could be overwhelmed with debris from the burned watershed.

The Hope Garden Family Center should review its safety evacuation plan. This plan should include on-site escape routes to higher ground (i.e., 2nd floor safety sites) in case the Center is breached by a massive debris flow.

And finally, observations suggest that during higher flow regimes or debris flow pulses, flooding may spill over onto Lopez Canyon Road, and then flow into the central portion of the Center complex perhaps flooding the lower buildings. Temporary separation between buildings and potential entrapment may occur during severe events.

Identical emergency practices and methods for Kagel Canyon should be implemented for Hope Garden Family Center in terms of installing a fully functioning Early Warning System that will directly warn residences when to evacuate Lopez Canyon. Here also, there is no reverse 911 system in place or other type of direct warning approach, such as has been used in other high risk canyons following wildfire (e.g., Santiago Canyon in Orange County). Warning signs should be posted throughout the lower part of the canyon. Storm patrols should be conducted before, during and after significant rain events.

<u>Site Map Points LOP 7 & 8; County Road Along Lopez Creek Below Hope Garden Family Center and Businesses Below:</u>

Lopez Canyon and its main drainage channel narrows below the Hope Garden Family Center. In addition to narrowing, the channel appears to be choked with sediment from previous rain events. At the junction of Lopez Canyon and Indian Canyons (intersection of Lopez Canyon and Bailey Roads), the Lopez drainage channel appears breached with sand deposits partially covering the roadway. The Indian Canyon channel is blocked by a number of chain-linked fences and in the area of the road intersection, effectively removed without a crossing. This lower area contains numerous businesses which have structures placed adjacent or close to the Lopez Canyon drainage. In this area, numerous businesses have outbuildings, structures, and/or fenced areas where many tanks, bottles, containers, and other storage units are stored. It is not known whether these items contain any hazardous materials, and if so, their types, quantities and qualities of containment. A high potential for disruption, damage, and transport of these containers or their contents may exist during severe post-burn events such as flooding, hyperflooding, debris flows, and/or debris torrents. It is readily apparent that there are several "choke" points along the channel where watercourse crossings are either missing, undersized, or inadequately maintained to handle storm flows. Flood flows the first winter following the Marek Fire in lower Lopez Canyon are estimated to increase 2.9 and 2.2 times for 2 and 10 year events, respectively. LACDPW staff identified three primary businesses that are at risk to flooding associated with the Marek Fire. Additionally, nine other businesses were determined to be at lower risk.

For recommended Best Management Practices used for curtailing impacts due to flooding and debris damage to property and infrastructure, see the narrative detail within the Civil Engineering Supplemental report.

For potential HazMat spills in the area of Lower Lopez Canyon identified above, it is recommended that a Regional Water Quality Control Board HazMat Specialist consult with the US Forest Service HazMat BAER team member to coordinate their assessments and determine what types of toxic clean-up will be required to assure public health and safety.

Resource Values at Risk

The SEAT assessment did not include evaluation for threatened, endangered, and sensitive (TES) plants on the fire. The USFS BAER Report includes specialists that identified OHV use, disturbance from road projects, and invasive weeds as threats to sensitive species (USFS, 2008). For specific mitigation measures as applied to resources affected by the Marek Fire, refer to the US Forest Service BAER Botany, Wildlife Biology, and Archeology Reports.

The SEAT for the Marek Fire interviewed the BAER team resource specialists as to the necessity of mission tasking SEAT resource specialists to assess resource threats to species on non federal lands. Their general opinion favored at minimum a desktop review of resources and a limited field review. This was communicated to the SEAT policy group in Sacramento. Communications are currently pending between the Department of Fish and Game SEAT resource representatives assigned to the Sesnon Fire to follow-up with coordination efforts with the BAER team biologist, archeologist and botanist.

REFERENCES: See individual Specialist Reports

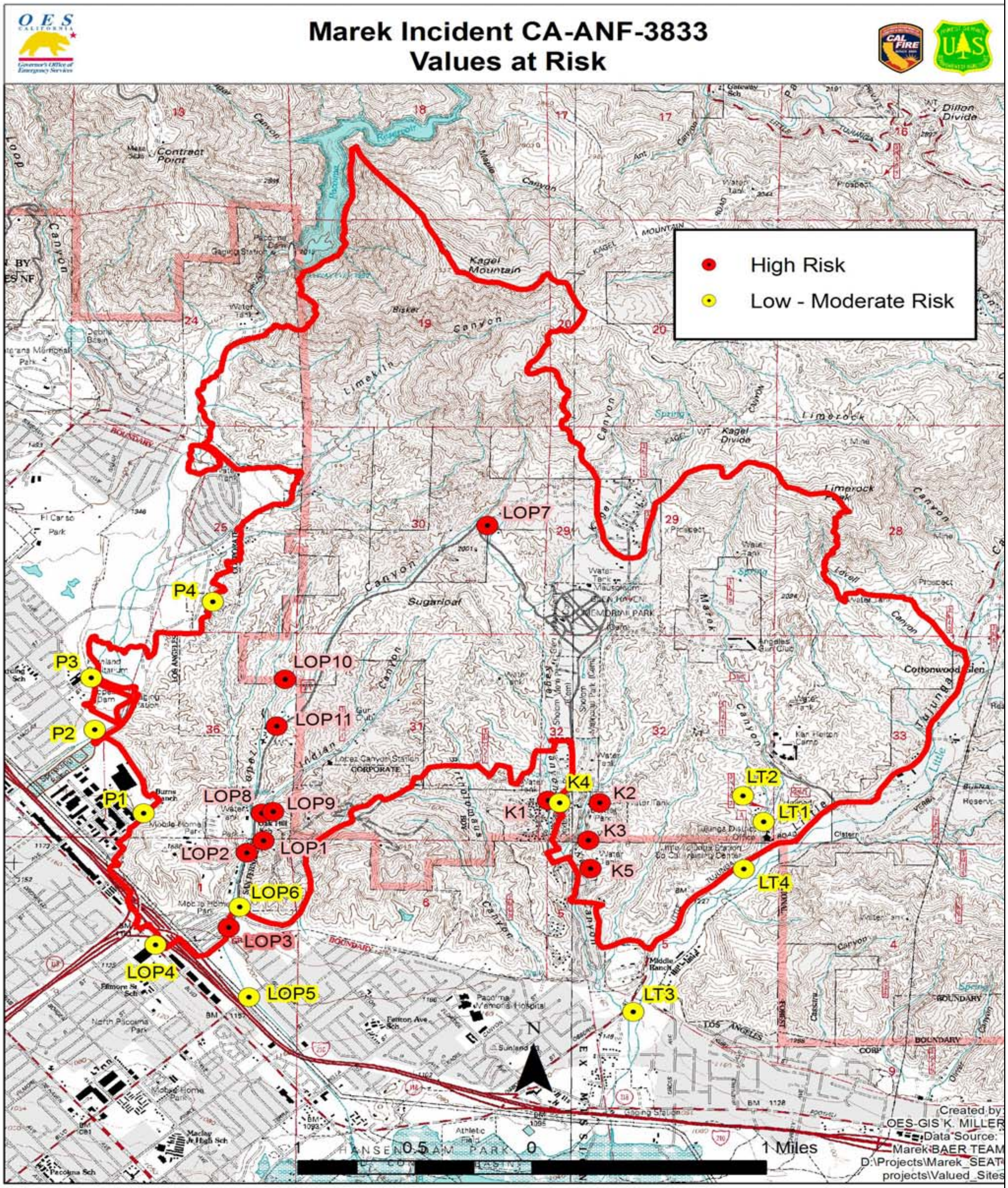

Figure 6. Map point values at risk for the Marek Fire.

Table 1. Values at risk for the Marek Fire.

Site Number		At-Risk Feature	Hazard Location	GPS Location Latitude N	GPS Location Longitude W	Hazard	Likelihood	Risk to Lives Fire	Risk to Lives Pre-Exist	Risk to Property/Habitat Fire	Risk to Property/Habitat Pre-Exist
K	**1**	**Property, pen. animals**	**Blue Sage Road off of Kagel Canyon Rd.**	**34° 17.774'**	**118° 22.665'**	**Flooding, debris flows**	**High**	Mod	Low	**High**	Mod
K	**2**	**Park setting**	**Dexter County Park**	**34° 17.765'**	**118° 22.433'**	**Flooding, debris flows**	**High**	**High**	Low	**High**	Low
K	**3**	**Residences**	**Lower Dexter County Park, Lower Kagel Canyon area**	**34° 17.606'**	**118° 22.484'**	**Flooding, debris flows, entrapment**	**High**	**High**	Low	**High**	Mod
K	4	Wood retaining wall	Kagel Canyon above Blue Sage Road	34° 17.764'	118° 22.614'	Flooding	Low	Low	Low	Low	Low
K	**5**	**Residences**	**Kagel Cyn homes along Spring Trail, Short Trail**	**34° 17.487'**	**118° 22.473'**	**Debris slides, flooding**	**High**	**High**	Low	**High**	Mod
LOP	**1**	**Entrance road**	**Lopez Cyn Rd. @ Lopez Rd. entrance to Sky Terrace**	**34° 17.600'**	**118° 23.939'**	**Flooding, debris flows, entrapment**	**High**	Mod	Low	**High**	Mod
LOP	**2**	**Wellhead, creek, road**	**Lower Lopez Canyon**	**34° 17.548'**	**118° 24.015'**	**Existing landslide, erosive flooding**	**High**	Low to Mod	Low	**High**	Low
LOP	**3**	**Trailer park, Homes**	**Lower Lopez Trailer Park**	**34° 17.232'**	**118° 24.093'**	**Flooding, debris flows**	**High**	**High**	Low	**High**	Low
LOP	4	Homeless encampment	SR 118 and I-210 Interchange (death occurred)	34° 17.157'	118° 24.421'	Slope failure during rains	Low	Low	Low	Low	Low
LOP	5	City street flooding	Van Nuys near Gladstone in San Fernando; L. Lopez Cr.	34° 16.938'	118° 24.002'	Flooding, overtopping of channel onto road	Mod	Low	Low	Low	Low
LOP	6	Business	Lopez canyon mouth on west side of canyon	34° 17.319'	118° 24.045'	Potential rockfall, slope failure onto bldg	Mod	Low to Mod	Low	Low to Mod	Low
LOP	**7**	**County road**	**Lopez Cyn Rd along Lopez Cr @ "big bend" in sec 30**	**34° 18.935'**	**118° 22.942'**	**Rock fall, debris flow, flooding**	**High**	**High**	Mod	**High**	Mod
LOP	**8**	**Business, county road**	**Lower Lopez Canyon**	**34° 17.715'**	**118° 23.948'**	**Flooding**	**High**	Low	Low	Mod	Low

LOP	**9**	**Limited access**	**Lopez Canyon and Bailey Road entrance**	**34° 17.723'**	**118° 23.896'**	**Flooding**	**High**	Low	Low	Mod	Low
LOP	**10**	**Human life**	**39 ac watershed above Hope Garden Valley Center**	**34° 18.283'**	**118° 23.845'**	**Flooding, debris flows**	**High**	**High**	Low	**High**	Low
LOP	**11**	**Human life**	**Cement channel through Hope Garden Valley Center**	**34° 18.084'**	**118° 23.882'**	**Flooding, debris flows**	**High**	**High**	Low	**High**	Low
P	1	Business truck park.	Back of businesses near Arroyo Road	34° 17.714'	118° 24.476'	Slope failure onto property	Mod	Low to Mod	Low	Mod	Low
P	2	Homes	Lower Pacoima Wash adjacent to channel	34° 18.068	118° 24.697'	Channel constriction flooding of 17 homes	Mod - high	Low to Mod	Low	Low to Mod	Low
P	3	Recreation site	Lower Pacoima Wash model plane airfield	34° 18.287'	118° 24.714'	Flooding	Low - mod	Low	Low	Low	Low
P	4	New subdivision	East end of Mountain Glen Terrace No. 2 Subdivision	34° 18.608'	118° 24.172'	Flooding	Low	Low	Low	Low	Low
LT	1	Road	Entrance to USFS training office; overgrown drainage	34° 17.686'	118° 21.699'	Constricted channel, flooding, entrapment	Mod	Low to Mod	Low	Mod	Low
LT	2	Blocked culvert	Top of USFS training office upper parking lot	34° 17.796'	118° 21.793'	Culvert blockage, flooding	Mod	Low to Mod	Low	Mod	Low
LT	3	Bridge	Channel above L. Tujunga Cyn Rd Bridge (Pony Club)	34° 16.880'	118° 22.280'	Flooding	Mod	Low	Low	Mod	Low
LT	4	Culvert	Little Tujunga Canyon Road before USFS Dist. Office	34° 17.487'	118° 21.786'	Plugging at inlet	Mod	Low	Low	Low	Low

Appendices

Appendix A

DRAFT TECHNICAL SPECIALIST'S REPORT
STATE EMERGENCY ASSESSMENT TEAM (SEAT) Emergency Report
Resource: Geology

Fire Name: Marek Fire, Los Angeles County **Month/Year:** October 2008

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Purpose and Background

The intent of this SEAT deployment is to compliment and extend existing assessment efforts concurrently being undertaken by the U.S. Department of Agriculture's U.S. Forest Service (U.S.F.S.). The Burn Area Emergency Response (BAER) team produces information and generates documents which may include 1) an Emergency Stabilization Plan, and 2) a Burned Area Rehabilitation Plan for review and use. Post-fire watershed and assessment and recovery operations are conducted to:

- Identify on-site and downstream threats to public health or safety from various landslide events such as floods, debris flows and torrents, rock fall, rock avalanche, road hazards, or other fire-related problems.
- Identify threats to watershed resources including: Excessive erosion, impaired water quality, threats to wildlife, fisheries, and botanical values, and cultural resources.
- Determine measures needed to prevent or mitigate identified threats.

Additional County and local agencies have also begun hazard identification assessments. **The agencies and personnel involved in their respective jurisdictions should be commended for recognizing and addressing this emergency and urgent need for preparation prior to the upcoming rain season.**

This report is a rapid assessment of the fire area and downstream values at risk which may be impacted by post-fire effects. Impacts may include threats to life or property or may cause unacceptable degradation to natural resources including but not limited to landforms, land uses, surface and groundwater quantity and quality. This report or the overall SEAT report is not meant to imply that all risks and all hazards have been identified and that this analysis and suggested mitigations will eliminate all risk from identified hazards.

Acknowledgements

The SEAT team members worked with and under the Incident Command of Mr. Scott Lauden of the Angeles National Forest as well as Mr. Ken Luckow serving as the BAER team leader. Our gratitude, appreciation and acknowledgements go out to them and to all of the staff technicians, specialists, and fire fighters who provided services and support.

Fire Background

The reader is directed to the BAER report (USFS, 2008) beginning for the Marek Fire particulars (when it started, size, etc.).

Resource Setting

The Marek Fire burn area is located in Los Angeles County. The fire area is located in the northern foothills of the San Fernando Valley and San Gabriel Mountains, which are a portion of the Transverse Ranges geomorphic province. The fire perimeter can be followed on portions of the following U.S. Geological Survey 7.5-Minute Series Topographic Maps:

- San Fernando Quadrangle 1966 (Photo revised 1988)
- Sunland Quadrangle 1966 (Photo revised 1972)

Geological information for the burn area is provided on a map generated by GIS Specialist John Carotta of the California Geological Survey titled Geology of the Marek Fire Area. Data sources include:

- Quaternary Geology of the San Fernando Valley, Los Angeles County California, Map Sheet 50 by C.S. Hitchcock and C.J. Wills, 2000 Scale 1:48,000 (CGS); and
- Fire Perimeter from CAL FIRE/OES, created October 17, 2008.

An additional map, Fault Activity Map of California and Adjacent Areas, 1:750,000 scale, 1994, was also consulted for information.

Area Location

A general area location map is provided in Figure 1. Two outlined areas are depicted. The dashed outline shows the approximate Merek Fire boundary in relation to the overall Tujunga-Pacoima Watershed. The location map was taken from the Tujunga-Pacoima Watershed Plan (April, 2008 p.2-2).

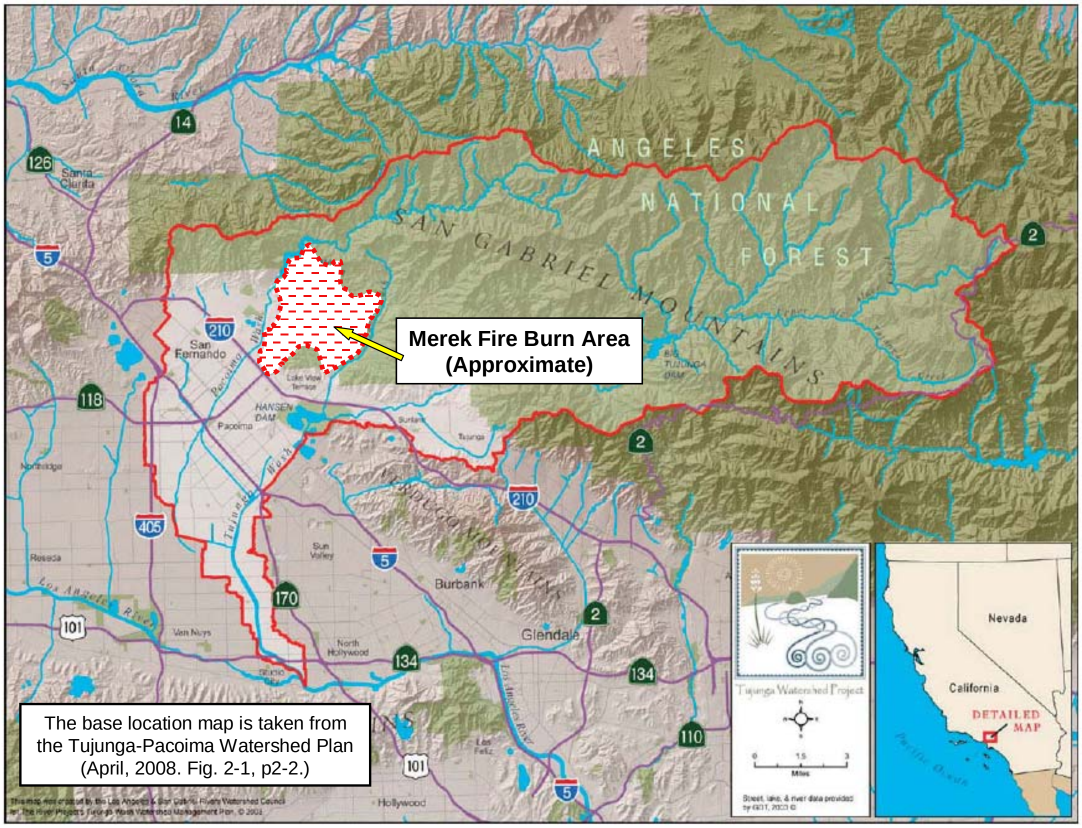


Figure 1: General location of the Marek Fire perimeter in relation to the Tujunga-Pacoima Watershed.

Regional Overview of Geology; *foundations and setting the stage*

The Transverse mountain range is a geomorphic province that is approximately 250 miles long. The range is situated in a general west-northwest/east-southeast trend across the State. The province is a major tectonic feature which bounds and separates the Coast Range, Great Valley, Sierra Nevada, and Mojave geomorphic provinces to the north and east from the Coastal basins, Peninsular Ranges and Salton Tough provinces to the south. The San Gabriel Mountains and the Tujunga-Pacoima watershed are found on the southern side in the central portion of the Transverse Ranges.

The Transverse Ranges form a barrier to the Pacific storm belt and as a result, orographic rainfall (rising of water-laden clouds over the mountains) is common. During wet years, weak rocks and unconsolidated surfacial deposits become saturated and may fail as rock falls, rock avalanches, debris slides, earth slides, and land and debris flows. Debris flows generated during rain storms on recently burned areas have destroyed lives and property throughout the Western U.S. (Cannon et al., 2007).

The following information is taken directly from the “State of the Tujunga Report (2006)” prepared by The River Project with funding from CALFED Bay-Delta Watershed Program:

Geology, geography, and climate shape the topography of the Tujunga Watershed. Elevations range from 171.4 to 2172.8 meters (562 to 7128 feet) above sea level, and major distinctions can be drawn between upper and lower watersheds. In the upper watershed, the western San Gabriel Mountains, part of the Transverse Ranges, are an exceptional geologic assemblage shaped by extreme tectonism. Most rocks are ancient but the mountains are very young and actively rising. California's tectonic history is complex and dynamic because we are on a plate boundary. Relevant local events began about 16 to 12 Ma (millions of years ago), south of the Sierra Nevada, where basins formed and existing mountain ranges, aligned north to south, moved north along faults. By about 5 to 3 Ma, in response to a change in Pacific Plate motion which caused it to compress against the North American Plate, local ranges had broken and rotated to an east-west direction, transverse to other California mountains and to the overall tectonic motion at the plate boundary. Further compression began uplifting the low coastal region to form high mountains. Additional horizontal or transverse motion along the plate boundary is associated with compression, thus forces become more complex and are termed 'transpressional' (Norris & Webb 1990; USGS & CGS 2006).

Geologic Time

Earth is dynamic; earthquakes, volcanic activity, landslides and floods can produce change rapidly. It is much more typical, however, for processes to transform landscapes over extraordinarily long time-spans through a series of imperceptible changes. Annual sea level rise at 5 mm (2 in) is 5m (~16.5 ft) over 1000 years. Fault movement at the same rate over a million years translates to 50 km (~31 mi). In the geologic scheme, one million years is comparatively short. Earth was formed about 4.6 billion years ago. To write this, the convention is 4600 Ma. Earliest fossils are dated at about 3800 Ma. About half the Upper Tujunga Watershed rocks are dated 1200 Ma or older, and are among the oldest in the Western United States. In contrast, consolidated sediments in the lower watershed are at least 3 to 5 orders of magnitude younger. To understand local geology, a grasp of geologic time is helpful (Norris & Webb 1990); a simplified chart is presented below (Table B-1).

Table B-1. Simplified Geologic Time Scale
(Geological Society of America 1999; major revisions made by International Commission on Stratigraphy 2004)

Eon	Era	Period		Epoch	Age [Ma]
Phanerozoic	Cenozoic		Quaternary	Holocene or Recent	< 10 Ka
		Neogene		Pleistocene	10 Ka – 1.8
		Paleogene	Tertiary	[Pliocene-Paleocene]	1.8 – 65
	Mesozoic	Cretaceous			65 – 144
		Jurassic			144 – 206
		Triassic			206 – 250
	Paleozoic			[Permian –Cambrian]	250 – 543
Proterozoic	Precambrian	Proterozoic			543 – 2500
		Archean			2500 – 3800

Additional Attributes: Uplift, Weather, and Erosional Consequences

Extreme tectonism and orographic weather conditions combine to produce increased mass wasting of geologic materials. As indicated above, very old rocks, conveyed along transpressional plate boundaries are brought to the surface and raised through tectonic processes such as compressional thrust and reverse seismic events. Concurrently, erosional processes of gravity, weathering, failure, and mass movement may place relatively young sediments and sedimentary materials directly upon these ancient rocks in unconformable contact. An example of this feature, found in the Angeles National Forest, is presented in Figure 2.

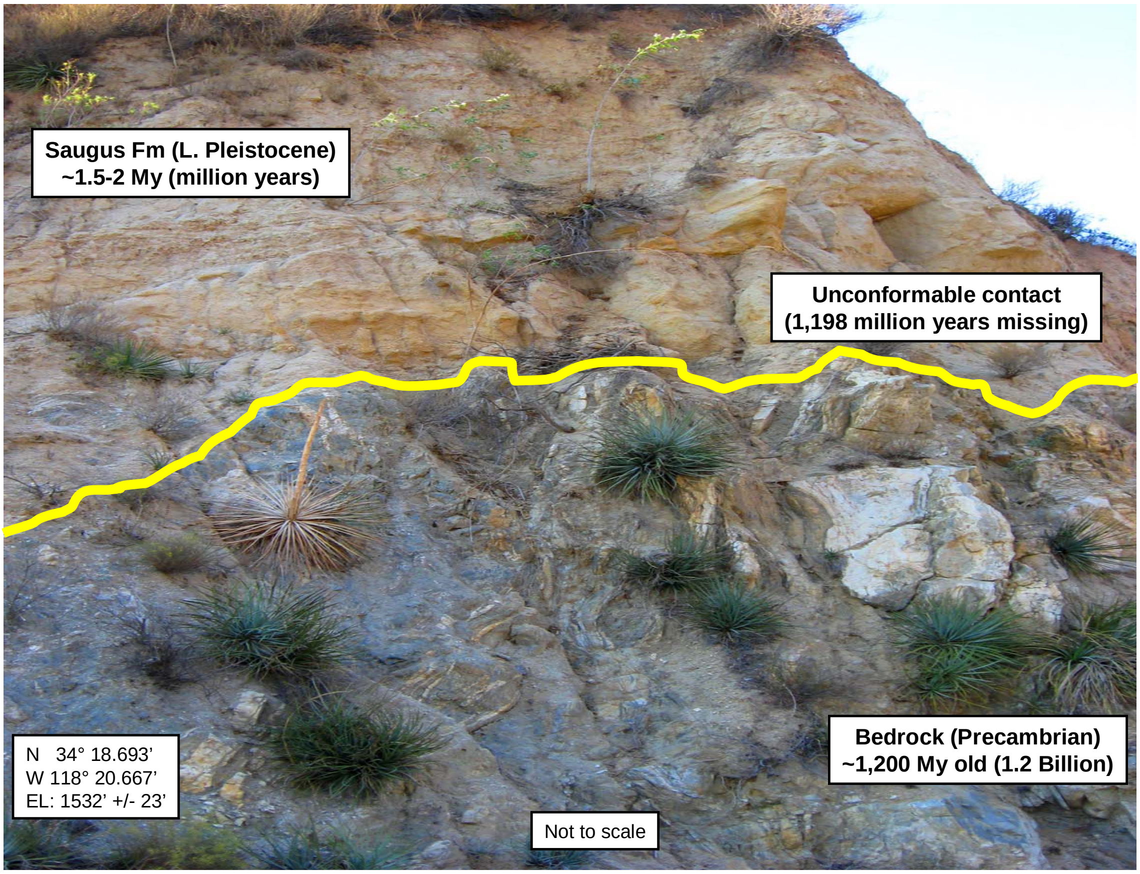
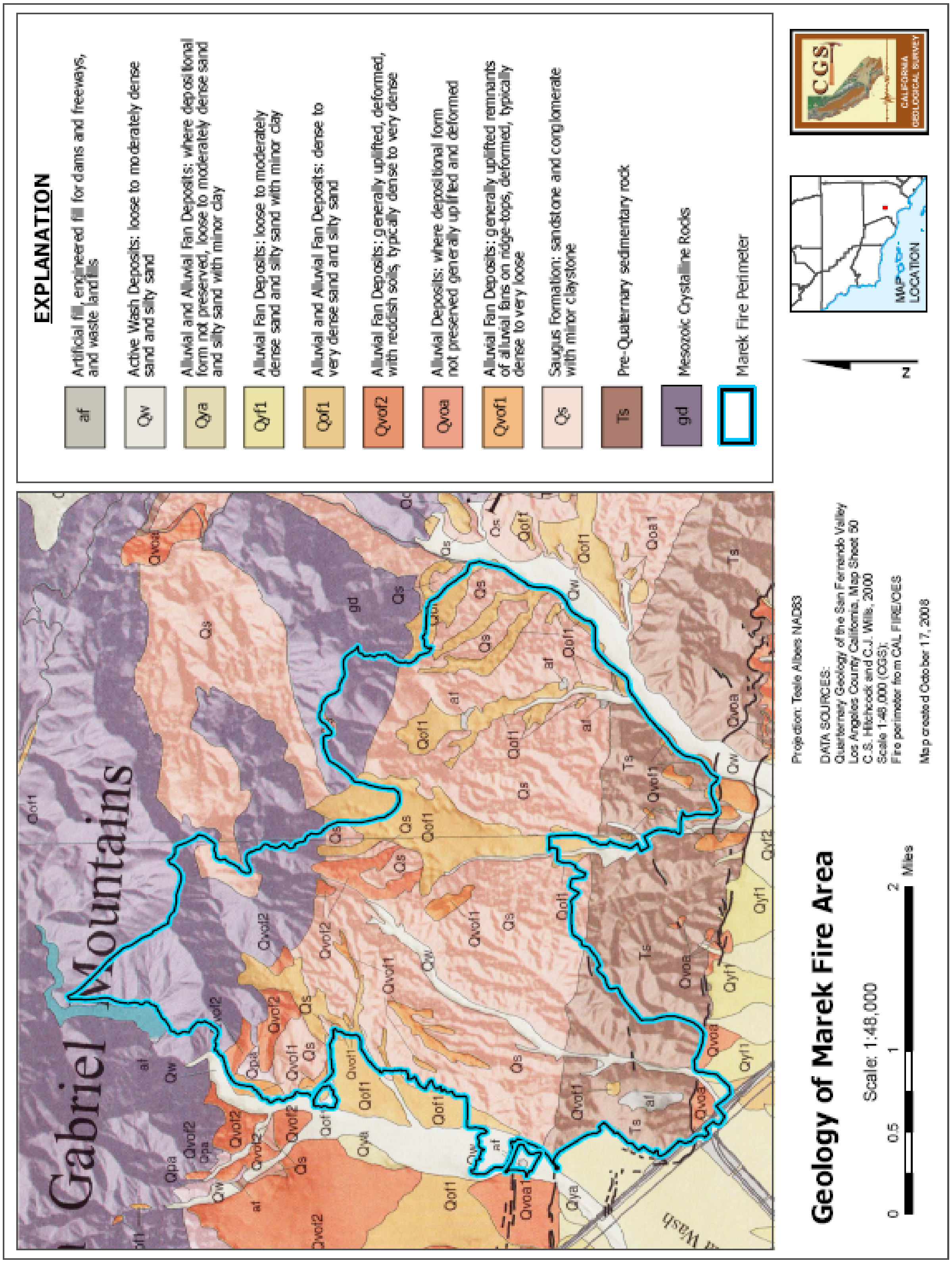


Figure 2: Angeles National Forest geologic resource. Example of extreme tectonism and resulting sediment accumulation.

The San Gabriel Mountains are a mountain range which has been uplifted rapidly in recent geologic time. Resulting erosion and mass wasting has produced a thick series of alluvial fans which spread southerly from the range front. Repeated episodic uplifting resulting from local and regional seismic activity has also raised the alluvial fans. As a result of uplift and weather, rapid erosion and down cutting of drainages produced desiccated hillsides in the multiple fan complexes. A series of active fault traces, located at the base of the San Gabriel Mountains, as well within and near the base of the mid fan hills (near the I-210 freeway), have indicated movement in historic (1971), Holocene (<11,000 yrs bp), and/or repeated movement since Late Quaternary (<700,000 yrs bp) time. The resulting movement combined with orographic weather impacts, have greatly shaped the geomorphic features now seen. Additionally, landform changes due to anthropomorphic impact (i.e., changes brought about by current human activity) are clearly seen on land surfaces revealed in much of the burn area.

Figure 3: Geology of the Marek Fire Area.



Faults and Local Seismicity

The predominate faults located near the Marek burn area are the historic San Fernando thrust fault (1971), additional splays of the San Fernando and/or extensions of the Santa Susana fault, possible Holocene (<11,000 yrs bp) movement on the Sierra Madre Fault system, and Late Quaternary (<700,000 yrs bp) movement on the San Gabriel fault zone (Jennings, 1994). There may be additional new information concerning local seismic activity. The burn area is located in an area of active seismic events. Recurring earthquakes may loosen rock located on steep slopes. Seismic-generated rock fall, rolling, and bouncing can be expected in the mountainous regions. Saturated fine-grained sediments are also subject to liquefaction and slope failure during seismic events.

Landslides and Mass Wasting

The term landslide is used for "The movement of a mass of rock, debris, or earth down a slope" (Cruden, 1991). The criteria used in the classification of landslides follow Varnes (1978). In emphasizing landslide types, various criteria include:

Type of materials:

- Rock, debris, earth

Types of movement:

- Falls, topples, slides, spreads, and flows,

Activity:

- Active, reactivated, suspended, and
- Inactive (dormant, abandoned, stabilized, relict)

Distribution:

- Advancing, retrogressive, widening, enlarging, confined, diminishing, moving

Water content:

- Dry, moist, wet, very wet

And description of first and second movements:

- Extremely rapid, very rapid, rapid, moderate, slow, very slow, and extremely slow

Landslide definitions are then classified in this manner (e.g., Debris flows, Earth spreads, Rock falls, etc.). Activity of landsliding can be extremely slow to extremely rapid. Table 1 depicts a velocity classification related to probable destructive significance.

Table 1: Velocity classification related to Probable Destructive Significance.

Minimum Typical Velocity	Description	Velocity Class	Definition of Probable Destructive Significance of Landslides of Different Velocity Classes (in Turner and Schuster, 1996, Table 3-5, pg. 51).
>10 feet per second	Extremely rapid	7	Catastrophe of major violence; buildings destroyed by impact of displaced material; many deaths; escape unlikely
1 foot per minute	Very rapid	6	Some lives lost; velocity too great to permit all persons to escape
5 feet per day	Rapid	5	Escape evacuation possible; structures, possessions, and equipment destroyed
5 feet per month	Moderate	4	Some temporary and insensitive structures can be temporarily maintained
5 feet per year	Slow	3	Remedial construction can be undertaken during movement; insensitive structures can be maintained with frequent maintenance work if total movement is not large during a particular acceleration phase
1 foot per year	Very slow	2	Some permanent structures undamaged by movement
< 1 foot per year	Extremely slow	1	Imperceptible without instruments; construction possible with precautions

When considering potential rainfall intensity, duration, and location, combined with elevation change and orographic conditions, proximity to populated areas and risk of seismic event, Velocity-Class events up to and including Class 7 can not be ruled out.

Geologic formations and types of mass wasting features (landslide types) found within the Marek Fire area

Given the above information, multiple types of landslide features are determined to exist throughout much of the burn area. The following descriptions are presented by geologic unit as found on the **Geology of the Marek Fire Area** (Figure 3):

Mesozoic Crystalline Rocks (gd) – The San Gabriel Mountains

Much of the bedrock materials up in the headwaters of the Marek fire area appear to be foliated gneisses and granitics. Strong foliation trends, combined with shear zones, multiple joint sets, and steep elevations, set the stage for abundant toppling and planer failures. Loose rock, boulders with sizes between 2-feet to 4-feet in diameter, has accumulated in part on slopes as rock slides. The existing rock slides appeared dormant to very slow in movement but that may substantially increase during rain and/or seismic events. Rock fall and debris chutes are common, indicating an active erosional process. During heavy rain events, loosened rock high up in the mountains may break loose and become entrained within the coursing water. Rock avalanches may occur in the steeper reaches. Rock and debris avalanches rush down incised mountain canyons and reach the apex (top of) of debris fan channels to continue down slope.

Active Wash Deposits – (Qw) – Lopez, Kagel, and Marek Canyons, Little Tujunga and Pacoima Washes

These drainages are mapped as narrow light gray units on the geologic map. They are the active channels and drainages for the mountains above. As such, channel flows have, can, and may vary from a narrow (generally 5-foot to 10-foot width and a few feet deep) thalweg during low flows, to a series of anastamosing and braided streams during moderate runoff events. During high flood events, the channels may become filled across the entire channel width. In moderate and high events, a full range of sized materials may come down the channel. Silts, sands, cobbles and boulders may become entrained within the flood. Additional erosional debris may become entrained as well. The wet mass takes on a bulking capacity, becomes more viscous and may have the potential to impact and move anything which may be in the flood path.

Saugus Formation (Qs) – Much of the Marek Burn Area

"The Saugus formation in the San Fernando Valley is generally restricted to marine and terrestrial deposits of probable lower Pleistocene age usually lying with angular unconformity on formations of all ages from the basement complex to the Pico formation. The Saugus formation crops out in the hills and southern flanks of the mountains along the northern portion of the valley floor and underlies other water-bearing sediments. The maximum thickness is about 6,400 feet as measured on the east side of Lopez Canyon. Two miles east of Little Tujunga Canyon the formation thins rapidly to 2,000'. It is composed of strata that vary greatly in terms of porosity and permeability. The water bearing portion of the Saugus formation consists of light-colored, poorly sorted, loosely consolidated conglomerate and coarse sandstone, commonly crossbedded, which were deposited as fluviatile and alluvial-fan sediments. Throughout the Saugus formation layers and lenses of clayey gravel were formed by in-place weathering of the original materials" (Draft of Report of Referee, Vol. II, Appendixes, {The City of Los Angeles vs. The City of San Fernando} No. 650079, by State Water Rights Board Referee, November 1961).

Being loosely consolidated and structurally tilted through faulting, the Saugus formation easily erodes. Dry raveling of sands appears common. Most of the erosion seen in the burn area appeared to be from general sloughing and incised channeling during rain events. The formation is easily disturbed by mechanical impact such as by tires. Deep-seated rotational earth slides were generally not seen in the burn area. A series of pictures of this formation are provided for review in Figures 4, 5, and 6. Figure 4 (below) of the Saugus formation.

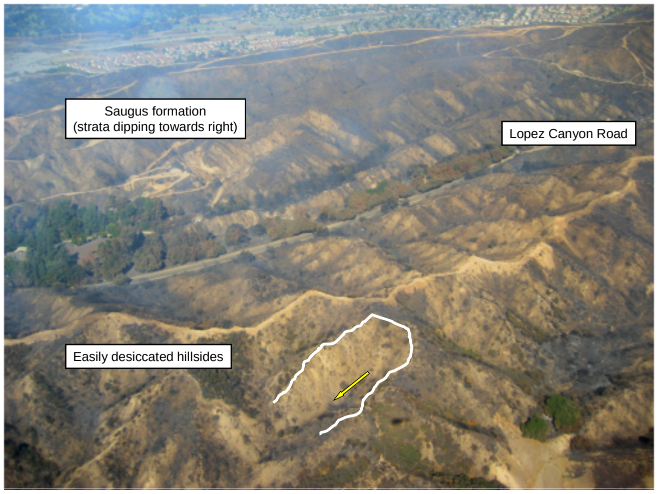


Figure 5: (Below) OHV damage of Saugus formation in the burn area.

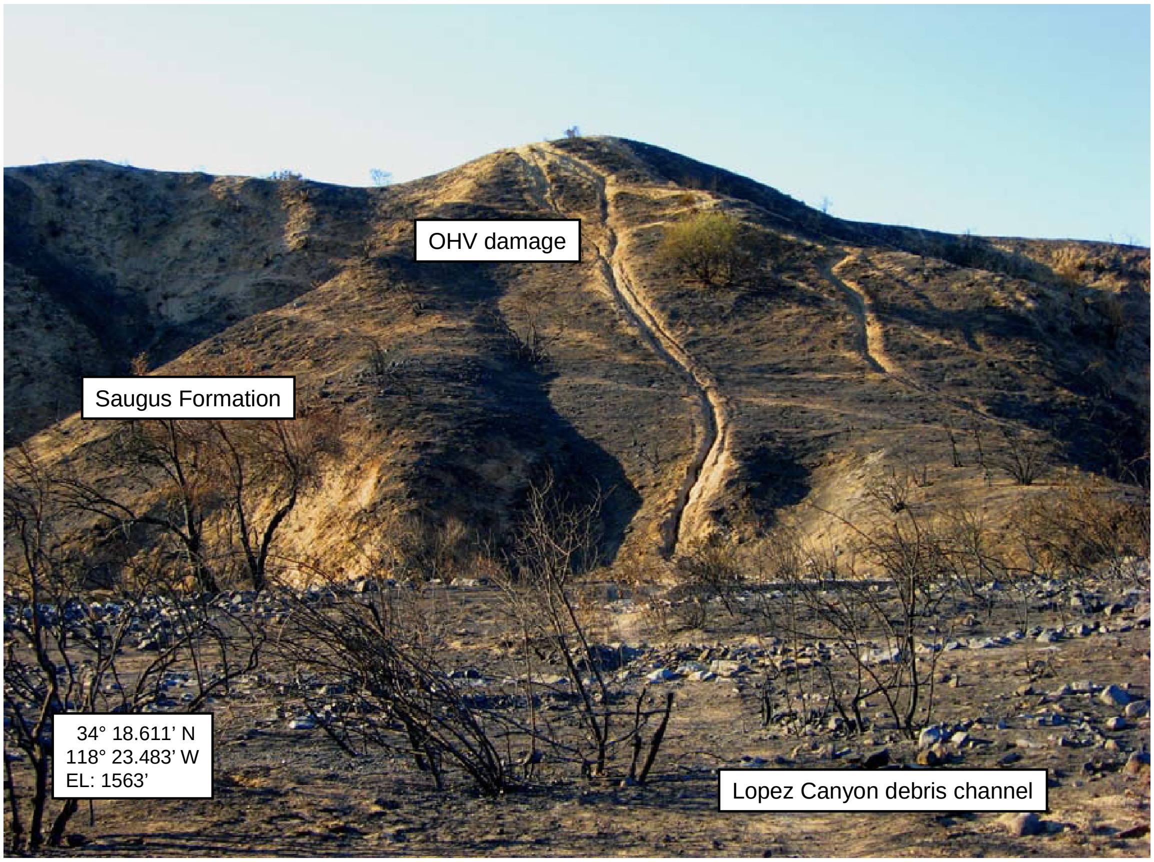
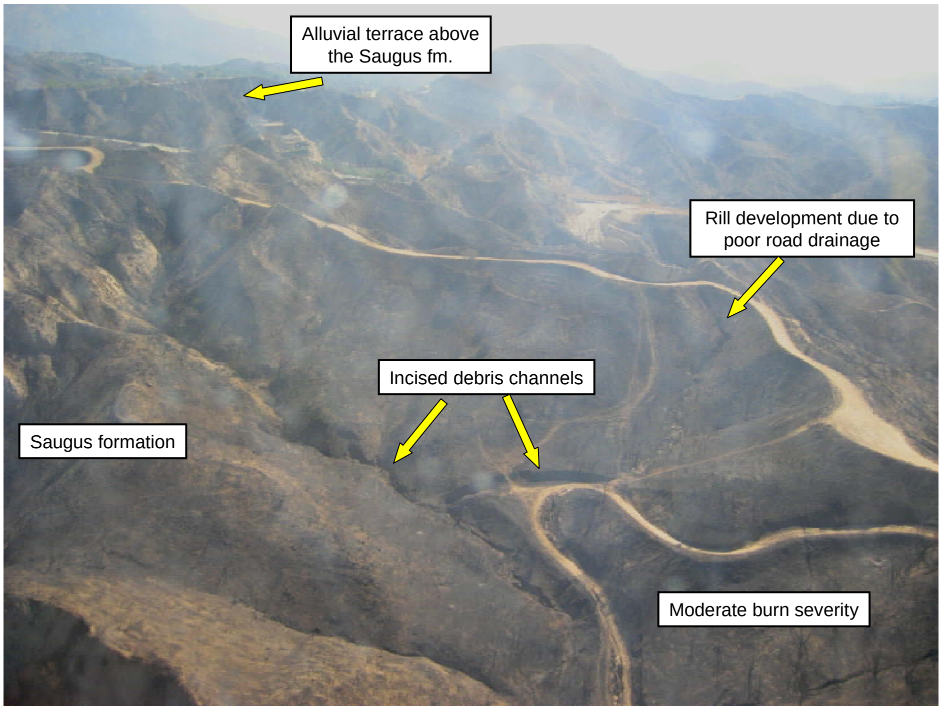


Figure 6: (below) Photograph taken during helicopter flyover.



Pre-Quaternary sedimentary rock (Ts)

This geologic unit is in place or crops out in the lower or southern portion of the Marek burn area. The lower portions of the Lopez, Kagel, and Marek drainages all pass through this formation. Drainages are more constricted and canyon walls steeper. The formation where seen cropping out appears to be a series of alternating shales and sandstones. Locally in canyon road cuts, thin-bedded cherty and siliceous shales appear to be steeply dipping and somewhat folded. Being more coherent and lithified (rock-like), this formation exhibits a different type of mass wasting features. Shallow to moderately deep-seated rotational earth slides were found to exist. These rock outcrops may be part of the Modelo formation of Upper Miocene age. Consolidated channel deposits consisting of cobbles and boulders were seen as overhangs in portions of the canyon walls. The rotational slides may impact infrastructure both above and below the slide mass. Sudden failure of overhanging conglomerate beds may also present risk to both structures and people. Examples of these types of mass wasting are demonstrated in Figures 7 and 8.

Figure 7: Earth slide toe is in Lopez Canyon creek drainage.

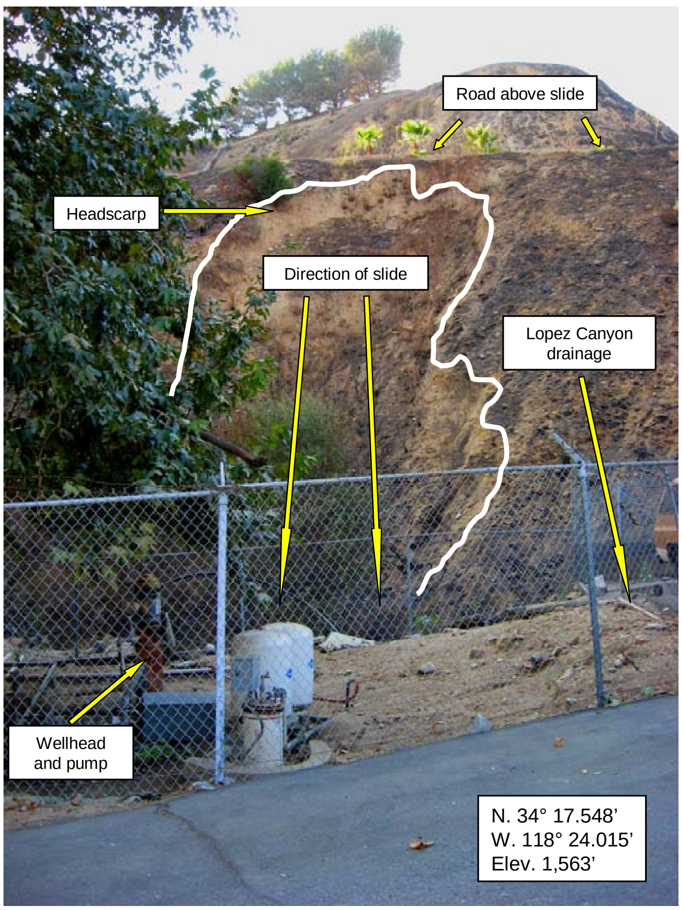
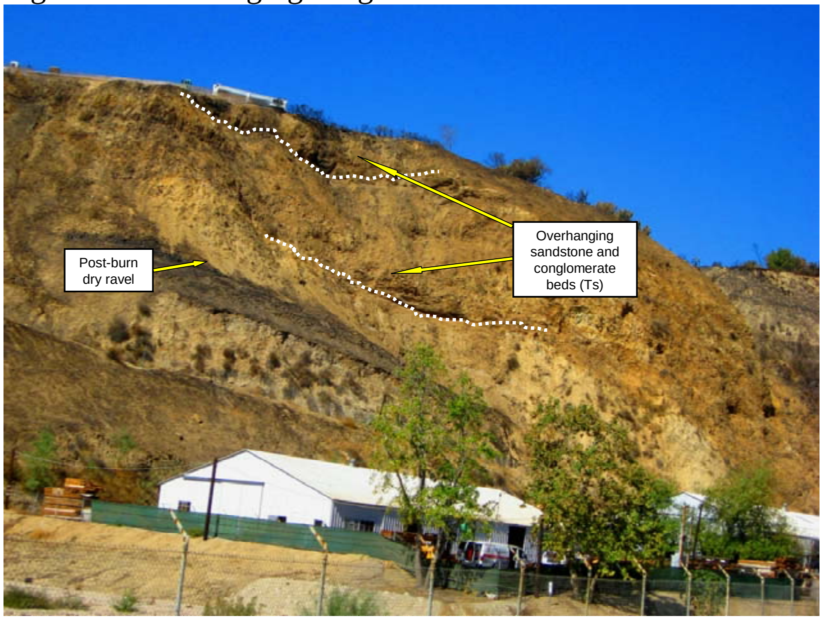


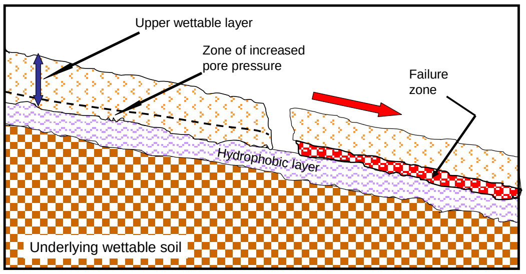
Figure 8: Overhanging conglomerate and sandstone beds above buildings.



Hydrophobicity

Many soils exhibit water-repellent properties after burning. On a typical burned slope, the surficial soil is loosely compacted and easily wettable (Turner and Schuster, 1996). During moderate to high burn intensities, waxy organic molecules generated by the burning of vegetative matter on and in the soil, are driven down into the soil where a hydrophobic barrier forms resisting penetration by water. During a rain event, increased pore pressure above the hydrophobic zone can cause the surface soils to slip. A steep slope is not necessary to start the process of slide movement. As momentum increases with the inclusion of pebbles, cobbles, dead vegetation, and boulders, a rapid pulse of debris flow is formed. The results can be devastating. Figures 9a and 9b provide examples of the effects of Hydrophobicity.

Schematic diagram of post-fire colluvial soil slope, showing effects of hydrophobic soil layer (after Turner and Schuster, 1996)



Figures 9a and 9b: Schematic diagram and photo of hydrophobic conditions.
Much of the materials encountered during the BAER/SEAT field evaluations appeared naturally hydrophobic in the upper 1 to 6 inches of the soil column.

Assessment Methods

A mini State Emergency Assessment Team (SEAT) assembled and met with USFS BAER leader Ken Luckow at the fire site on Saturday morning, October 18, 2008. The team drove into the burn area along USFS roads. Additional BAER team members arrived in the afternoon. On Sunday, a helicopter fly over of the entire burn area was performed to evaluate and determine sites to visit. This assessment method proved cost effective in identifying multiple additional locations for review and ground "truthing". Monday and Tuesday found multiple teams working in various disciplines to acquire additional needed information. Each evening, the combined state and federal teams would hold a group meeting to determine the day's findings.
The magnitude of post-fire damage will ultimately be determined by public response *prior* to the onset, intensity and duration of storms that may impact the burn area, particularly during the winter of 2008-09.

General Observations

1.) County surface roads and USFS roads
Numerous culverts, bridges, and other watercourse crossings are located along county roads including but not limited to Little Tujunga Canyon Road, Lopez Canyon Road, Kagel Canyon Road, and Bailey Road. Many crossings may be impacted by sediment laden floods, debris flows, and debris torrents. Obvious "at risk" locations that were viewed during our assessment are described and included in the BAER Values at Risk spreadsheet.

USFS soils surfaced roads which are located within the burn area are all subject to erosional distress. Depending on orientation, water drainages which leave the road surface may subject the burn areas to increased rill production, deepening and increasing channel downcutting, and potential mass sloughing of fill slopes due to the erosive nature of the Saugus formation.

2) Kagel Canyon, Dexter Park, and downstream residences
Substantial acreage within the Kagel Canyon watershed suffered moderate to low burn severity. Multiple tributaries feed both into Dexter County Park as well as down stream. During rain events, the combined tributaries may contribute excess water and sediment in a cumulative amount. In the park, numerous picnic structures, children playground facilities, recreational areas and parking lots exist. Sudden, unannounced flash flooding, hyper flooding, debris flows and/or debris torrents may enter the upper portion of the park and flow through the recreational areas.

Downstream from the park, numerous homes, residences, outbuildings, structures, roads, trails, infrastructure, and other properties exist within, adjacent to, or nearby the drainage channel. Homes, residences, outbuildings, structures, and other properties also exist within small, narrow, tight, steep, side canyons located adjacent to and upstream from the main drainage. Access and escape routes are very limited. Sudden and/or continued heavy storm events may limit movement both in and out of the area. Entrapment may occur. Figure 10 is an example of a home in extremely close proximity to the Kagel drainage.

Figure 10:

3. Lopez Canyon Drainages

The Lopez Canyon headwaters begin up in the very steep drainages of the San Gabriel Mountains. At the apex of the fan located at the base of the mountains (and at the trace of the San Gabriel Fault), a classic outburst debris field is present. Fire clearance of vegetation has revealed an active upper debris field which includes incised channels containing abundant 2-foot to greater than 4-foot subangular boulders and cobbles. The boulder field continues down slope for an additional ½ mile. A change in slope is indicated by increased deposition of finer-grained sands.

Hope Garden Family Center is located within the main Lopez Canyon drainage as well as at the confluence of an additional tributary flowing in from the north. The Center does have engineered flow conveyances located just above and along the western side of the complex. This suggests that prior engineering considerations for potential flooding have been undertaken. What remains at question is whether prior engineering calculations took into account increased flow and bulking factors resulting from a major watershed burn. Observations suggest that during higher flow regimes or debris flow pulses, flooding may spill over onto Lopez road, and then flow into the central portion of the Center complex, perhaps flooding the lower buildings. Temporary separation between buildings and potential entrapment may occur during severe events.

Lopez Canyon and its main drainage channel narrows below the Hope Garden Family Center. In addition to narrowing, the channel appears filled with sand deposits (from previous rain events). At the junction of Lopez Canyon and Indian Canyons (intersection of Lopez and Bailey Roads), the Lopez drainage channel appears breached with sand deposits partially covering the roadway.

The Indian Canyon channel is blocked by a number of chain-linked fences and in the area of the road intersection, effectively removed. This lower area contains numerous businesses which have structures placed adjacent or close to the Lopez Canyon drainage. It was observed that numerous businesses have outbuildings, structures, and/or fenced areas where many tanks, bottles, containers, and other storage units are stored. It is not known whether these containers contain any hazardous materials; their types, quantities and qualities of containment. A high potential for disruption, damage, and transport of these containers or their contents may exist during severe post-burn events such as flooding, hyperflooding, debris flows, and/or debris torrents.

It should also be noted that the Hansen Dam spreading grounds and groundwater recharge area (to recharge the San Fernando groundwater basin aquifers) is located downstream from Lower Lopez Canyon.

4) Above-ground water storage tanks

Helicopter fly-over provides an opportunity to view potential values at risk. During the one-hour flight with the BAER team, numerous above-ground water storage tanks were observed. The tanks are mostly located at the top of small hills. Many are constructed upon the Saugus and Tertiary geologic formations. The Saugus in particular appears to easily erode, especially where water may be involved. Leaking tanks and/or leaking conveyance piping may lead to washouts of the hill slope. In one instance of what may have been a leaking pipeline, a water tank located near Blue Sage Road has the potential of being impacted by a substantial erosion bowl.

Other storage tank foundations may be impacted by renewed head-scarp advancement during rain events. Leaking tanks, connections, pipelines, or other conveyance structures (i.e., flumes) may contribute to erosion and subject the tank to foundation failure.

5) Other structures or properties of value

Other structures or properties of value may exist within the burn area or may be affected by downstream effects from post-burn flooding, hyperflooding, debris flows, and/or debris torrents. Effects may also include and are not limited to structures placed in side canyons or placed close to hillsides which may fail. Site-specific investigations of such structures – such as power line towers, culverts, bridge abutments, engineered channels, flood abatement structures, debris racks, buried cables, pipes, or other infrastructure may need to be assessed by the private owner, utility company, or local government agency of responsibility. It is not the intent of the SEAT to identify each and every potential site where loss of life or damage to structures of value may occur.

6.) Threats to wildlife, botanical values, and fisheries

As a result of the fire and the impacts from the loss of vegetation and burn severity, evaluation biological and fisheries habitat is at an increased risk to the threat of flooding, debris flows, and sedimentation along all drainages in the burn area and downstream from the burn area. Riparian habitat in the downstream reaches of the drainages located below the burn area may require assessment.

7.) Water quality concerns

Surface water quality concerns are raised in areas of industry where buildings might be impacted by flooding, hyperflooding, debris flows, and/or debris torrents. Industries that, through use, maintain containers, materials, and/or chemicals which may become entrained within a catastrophic flooding event may be located in the debris flood zone. Both surface water quality and groundwater quality downstream at the Hansen retention and spreading basin may become impacted.

Groundwater quantity and quality concerns resulting from post-burn modification of soils may occur. An increase in hydrophobicity over a majority of a watershed's recharge area may reduce infiltration and recharge characteristics. This may result in lower water well levels and reduced well yields. A number of domestic and local water agency water wells, wellheads, and well buildings were observed during the brief field assessment. Often, these wells were located within or adjacent to the main stream drainage. These structures, their power connections, and water conveyances (i.e., above ground or shallow piping) may be in danger of damage during post-burn rain events.

Additionally, any shallow leach fields, animal-droppings dumping grounds, or shallow sewer systems crossing stream channels may be subject to flooding, hyperflooding, debris flows, and/or debris torrents. Entrapment of these materials may impact downstream water and groundwater quality.

8.) Areas Not Assessed
There may be homes, ranches, and cabins in the interior of some of the burn areas that may have been overlooked. It should be noted that it is beyond the scope of this preliminary evaluation to gain access to every business, public, residential structure and/or camp that may be at risk.

Emergency Determination

The values at risk considered in this evaluation include the possible loss of life and property due to landsliding, debris flow, debris torrents, and hyperconcentrated flooding from increased surface water runoff. In general, the risk from landslides, debris flows and floods are possible where roads, residences or other developments are located within and/or adjacent to canyon stream channels or on alluvial fans, colluvial slopes and debris flow deposits.

It should be noted that these hazards are part of the natural processes in this environment, and that these risks were present under pre-fire conditions. Many existing structures in the burn area and downstream of the burn area have been, and will continue to be at risk from these hazards. The potential for these processes to be exacerbated by fire is primarily dependent upon burn severity slope steepness, rain intensity, and storm duration.

General Recommendations:

1.) Public awareness, education, and involvement
The critical importance in saving lives is through making the public aware of the potential risks to life and property that may occur from post-burn flooding and debris flows. Education through

multi-media and bi- or multi-lingual methods is necessary for preserving life during the upcoming rain season. Public involvement through stakeholder meetings, as well as public participation at a variety of levels is critical to the successful exercise and taking of precautionary safety steps to ensure the protection of life and property before, during and after post-burn storm events.

The values at risk such as structures and/or their foundations mentioned in this report should be evaluated by an engineer and/or a certified engineering geologist licensed in the specialty needed to assess the potential for flooding, erosion, foundation scour or other damage resulting from flooding, hyperflooding, debris flows, debris torrents, and/or rock fall or other mass wasting events. County roads not specifically addressed in this report should be evaluated by county engineers for possible implementation of erosion control measures as deemed necessary.

For specific recommendations, the reader is directed to the Civil Engineering Supplemental Report, also found within this SEAT report.

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Appendix B

TECHNICAL SPECIALIST'S REPORT
STATE EMERGENCY ASSESSMENT TEAM (SEAT) Emergency Report
Resource: Hydrology

I.

Fire Name: Marek Incident CA-ANF-003833 October 2008

Author Name: Peter Cafferata, PH, RPF, CPESC, Forest Hydrologist
California Department of Forestry and Fire Protection
1416 9th Street
Sacramento, CA 95814

I. Resource Condition Assessment

A. Resource Setting

The Marek Incident began on October 12, 2008 and was contained on October 16th. This wildfire was located in Los Angeles County west of Little Tujunga Canyon, north of Interstate 210, east of Pacoima Wash, and south of Little Tujunga Road in the San Gabriel Mountains near San Fernando. It burned 4,824 acres of chaparral to six feet in height and grass. Approximately 40% of the fire burned on the Angeles National Forest and 60% on non-federal lands. Unburned areas made up 15.2% of the area, moderate soil burn severity 42.1%, low burn severity 42.1%, and high burn severity <1%. Vegetation types include: coastal sage scrub, chamise chaparral, mixed chaparral, big cone Douglas-Fir forest, sycamore/cottonwood/willow riparian forest, and canyon live oak woodland, and annual grass/forb. Soils are geneally erodible sandy loams; dominant soil series include Modesto, Trigo, San Andreas, and Chilao. Slopes are generally steep and subject to landsliding processes. Approximately 30% of the burned area is on slopes exceeding 60%, about 53% of the fire is on slopes from 30 to 60%, and 17% of the burn is on slopes less than 30% (USFS 2008).

<u>Affected Watersheds</u>

Most of the fire area is located in the Tujunga Canyon watershed and drains into the Hansen Dam Flood Control Structure (Figure 1). This dam controls flows from both Little Tujunga and Big Tujunga Canyons and was built in 1940 after a destructive flood in 1938. A smaller portion of the fire on the west side drains into Pacoima Reservoir, operated by Los Angeles County Department of Public Works—Flood Control District, and Pacoima Wash.

Both Pacoima Wash and outflow from Hansen Dam drain down to the Los Angeles River, and are part of the combined Tujunga/Pacoima watershed. The drainage area for both these watersheds is 225 square miles (144,000 acres). The Tujunga Canyon watershed, including both Little and Big Tujunga basins, drains 153 square miles or 97,920 acres. The Tujunga/Pacoima basin is the largest subwatershed of the Los Angeles River Watershed and consists of three main tributaries—the Big Tujunga (including Little Tujunga) (68% of the basin), Tujunga Wash (5%), and Pacoima Wash (27%) (TRP 2008). Only the Little Tujunga sub-basin of the much larger Big Tujunga Canyon was impacted by the Marek Fire. Hansen Dam, Lopez Dam, and Pacoima Dam are among the 22 reservoirs within the Los Angeles River basin. Each of these three dams have associated spreading grounds for groundwater infiltration (TRP 2008).

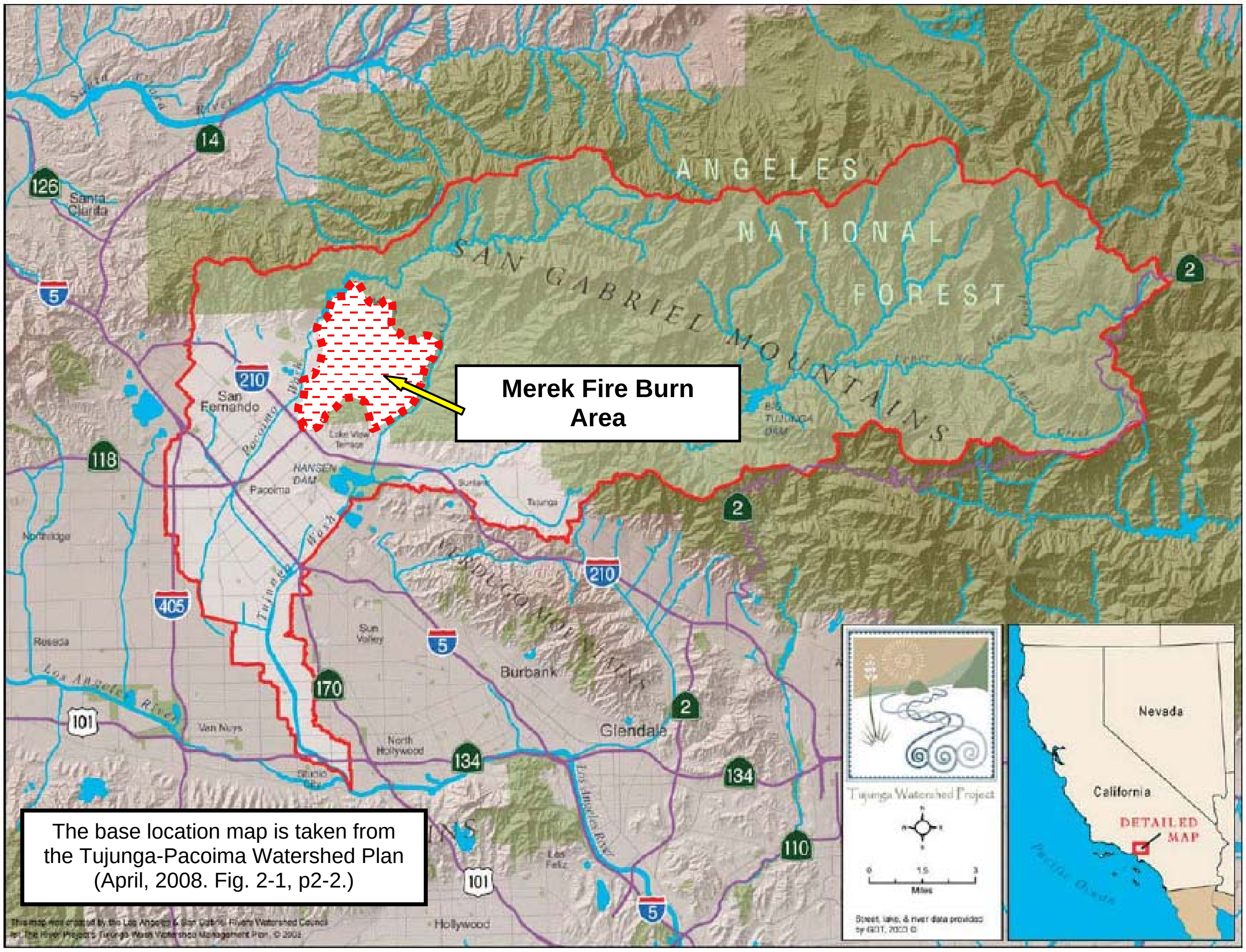

Figure 1: Map of the Tujunga/Pacoima Watershed (TRP 2008), modified by D. Vickery, DWR.

Several relatively small watersheds within the fire perimeter flow down into Tujunga Canyon and Hansen Dam, including from the west: Lopez Canyon,
Indian Canyon, Kagel Canyon, Marek Canyon, and a few small unnamed draws. Limekiln Canyon and several smaller unnamed tributaries flow to the west into the Pacoima Wash basin. The percentages of the smaller watersheds burned in the fire and analyzed for changes in peak flows and sediment yields are displayed in Table 1. Their locations are shown in Figure 2.

Table 1: Percentages of watersheds burned in the Marek Fire.

WS No.	Watershed	Total Area (ac)	Area Burned (ac)	Percent Burned
1	Lopez Canyon and Indian Canyon	1038	978	94
1B	Unnamed Tributary to Lopez Canyon	39	39	100
1C	Indian Canyon Tributary to Lopez Canyon	354	312	88
2	Kagel Canyon	1019	626	61
2A	Kagel Canyon Tributary	252	144	43
3	Unnamed Tributary to Pacoima Dam	217	180	83
4	Unnamed Tributary to Pacoima Wash	191	191	100
5	Limekiln Canyon	349	341	98
6	Unnamed Tributary to Pacoima Wash	706	573	81
7A	Unnamed Tributary to Little Tujunga Canyon	111	111	100
7B	Unnamed Tributary to Little Tujunga Canyon	84	84	100
7C	Marek Canyon Tributary to Little Tujunga Canyon	416	351	84
7D	Unnamed Tributary to Little Tujunga Canyon	290	270	93

Climate Information

The Tujunga/Pacoima watershed has a Mediterranean climate, typical of Southern California, with mild winters and warm summers. Nearly all precipitation occurs during the months of December through April. Precipitation during summer months is infrequent, and rainless periods of several months are common (LACDPW webpage). Elevations within the fire area range from approximately 1,150 feet along Highway 210 to 3,537 feet at Kagel Mountain. Infrequent snowfall events occur above 2,500 feet in the winter. The mean annual rainfall in the Little Tujunga Canyon is 22.9 inches. Rainfall at Pacoima Dam averaged 20.8 inches per year between 1971-2000. Mean annual precipitation ranges from 18 inches at the mouth of the tributary canyons to approximately 34 inches at the upper elevations near Kagel Mountain. Rainfall-depth-duration frequency data for Hansen Dam shows that 6-hr duration for 2, 5, 10, 25, 50, and 100 year events are: 1.34, 2.01, 2.46, 3.02, 3.44, and 3.84 inches, respectively (DWR Climate webpage).

Reservoir Information

Los Angeles County Department of Public Works-Flood Control District operates Pacoima Dam for flood control purposes. The structure is a concrete-arch dam built in 1929 and has a capacity of approximately 4,581 acre feet. The drainage area for the reservoir is 28.1 mi^2 (17,984 ac). Annual inflow has averaged 7,420 acre feet from water year 1930 to 2002 (LACDPW webpage). This reservoir does not provide surface water for domestic use. Sediment has been removed 19 times during the life of the structure.

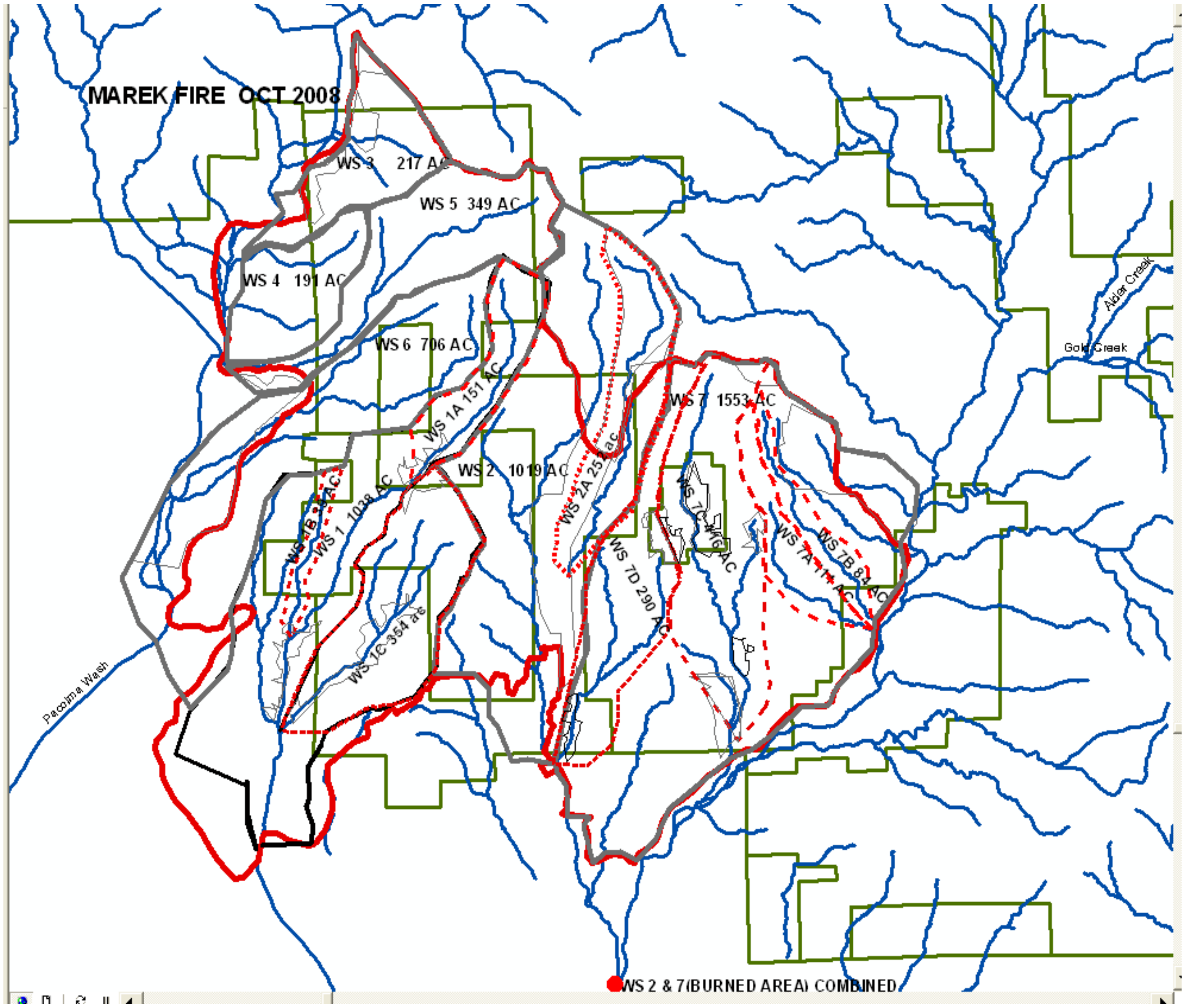

Figure 2: Map of Marek Fire sub watersheds analyzed for changes in peak flows and sediment yields (map prepared by Mr. Paul Gregory, USFS BAER Team Hydrologist, Angeles National Forest).

Hansen Flood Control Reservoir has a compacted impervious earth-filled dam built in 1940 and was the first federal dam constructed in the Tujunga Watershed (TRP 2008). It is operated by the US Army Corps of Engineers (USACE). Including the area above Big Tujunga Dam, the drainage area is 152.6 mi^2 (97,664 ac). Water is not impounded behind Hansen Dam for long term storage, with floods usually being released within 24 hours. There is a temporary storage capacity of 25,450 ac-ft. The 1,450 acres within the reservoir are leased to Los Angeles County for recreational purposes.

Lopez Dam is an earth-filled embankment constructed by USACE in 1954 for flood control purposes.

Flooding History

Major floods in the Tujunga/Pacoima Watershed include January 1862 (greatest storm in Southern California since the 1700's), February and March 1884, January and February 1914, February and March 1938 (one of the most destructive floods in Southern California), and January 1943 (highest 24-hour rainfall in California) (TRP 2008). No large floods occurred in the 1950's. Extremely large floods occurred in the Los Angeles River watershed during the winters of 1968-69 and 1992. The most recent large flood occurred in January 2005.

The flood protection system throughout the entire Tujunga Watershed is considered to be sufficient to contain the 50-year flood event. The channels in several parts of the Tujunga Watershed flood protection system, however, have adequate capacity to convey the 100-yr flood event (TRP 2008).

Fire History

Nearly all of the Marek Fire area burned in the Mill Fire of 1975. Several much smaller fires have also burned in Lopez Canyon (Loper Fire 1983, Lopez Fire 1998), Lovell Canyon (Shooting Fire 1997), and in the southwest corner of the fire area (Bailey Fire 1970).

Water Quality

The Los Angeles Regional Water Quality Control Board (LARWQCB) has the main authority for surface water quality in the Tujunga Watershed. Unfortunately, there are little data on surface water quality in the basin (TRP 2008). For example, the LACDPW does not have any water quality monitoring stations within watershed. Tujunga Wash from the Los Angeles River to Hansen Dam is included on the 303(d) list for ammonia, copper, bacteria (coliform), odors, scum and trash (TRP 2008).

The USFS BAER team identified approximately 20 hazardous material sites within the burn perimeter, some of which may adversely impact water quality (see USFS Hazardous Materials BAER Report for additional information). Additionally, ash from burned structures may present water quality problems. In a recent USGS study of ash from 2007 Southern California wildfires, samples collected from two residential areas indicated that ash contains caustic alkali materials and can contain elevated levels of metals such as arsenic, lead, zinc and copper (Plumlee et al. 2007). The study results indicate that runoff from burned areas may adversely affect ecosystems and the quality of surface drinking water supplies.

The USFS BAER Hydrology Specialist's Report states that peak flow increases from the fire will also be bulked by ash, debris and other floatable and transportable material within the channel areas. This report indicates that there is a high probability that post-fire flows from the first runoff producing rain events will have a high concentration of ash discharged from the burn area downstream to the lower reaches of streams within the Marek fire burn area and below. They state that the potential for adverse water quality effects is high. Pacoima Reservoir is not a surface water source for domestic use. There is the potential for introducing toxic materials into groundwater used for domestic use, however, since there are spreading grounds for groundwater infiltration below Hansen, Lopez and Pacoima Dams, this threat may be reduced.

Predicted Hydrologic Response

Several different approaches are available for estimating pre and post-fire streamflows for the watersheds associated with the Marek Fire (Mai 2003). These include:

- Rational Method (limited to watersheds < 200 ac),
- USGS regional regression equations (Waananen and Crippen 1977),
- Stream gaging station data with flood frequency analysis and flow transference (area adjustment) to nearby hydrologically similar watersheds (Waananen and Crippen 1977),
- Flow estimates provided in Rowe et al. 1949 for Southern California watersheds,
- Los Angeles County Modified Rational Method (LACDPW 2006a)[1], and
- Computer programs using the unit hydrograph approach (programs such as TR-55, HEC-HMS)[2].

Estimates for pre-fire flow assessment, stream gaging data with flow transference, the USGS south coast regression equation, and the Rowe et al. (1949) methods were compared. For this analysis, it was determined that the local stream gaging data would likely provide the best estimate of pre-fire flood flows.

Peak flow calculations were based on the data collected from 1929 to 1973 at USGS stream gaging station No. 11096500 (Little Tujunga Canyon near San Fernando, CA). A flood frequency analysis for this station was produced using the USGS PEAKFQ software program (see Appendix). The Little Tujunga Canyon station was preferred for this analysis over the Pacoima Creek near San Fernando, CA station (No. 11093000) due to the amount of unregulated flow data available.

To determine the impact of the incident on first year post-fire peak flows, increases were based on Rowe et al. (1949) projections for the Lopez Canyon drainage (Table 151; drainage area equals 6.5 square miles). Lopez Canyon is
located within the Marek Fire and was completely burned. For 2, 10, and 100 year return interval events, discharges for the modeled watersheds that were completely burned were

[1] Mr. Mike Miranda, LACDPW, informed the SEAT that his agency would be using the LA County modified rational method for designing structures for high risk areas in the Marek Fire.
[2] The TR-55 program is used for small watersheds in which certain limitations are met with special emphasis on urban watersheds and is computed using the SCS Curve Number method (Mai 2003).

estimated to increase approximately 3.0, 2.3, and 1.9 times over the pre-fire flow rate, respectively.[3]

These estimates are consistent with information included in a review of changes in peak flows following wildfire conducted by Moody and Martin (2001). They state that Rowe et al. (1949) has been used for post-fire flow modification assessments in southern California for decades, and that for the first year after the wildfire, the ratio of post fire flow to pre-fire flow increases from 2 to 3 fold for less frequent, large magnitude storms (100 to 5 year recurrence intervals), from 3 to 30-fold for moderate storms (5 to 0.1 year recurrence interval), and from 30- to 40-fold for the most frequent, small-magnitude storms (<0.1 year recurrence interval).[4]

The Marek Fire estimates were not modified by using "fire intensity factors" that have commonly been used for post-fire assessments in Southern California, producing a weighted average based on soil burn severity. This choice was made since there was extremely little high soil burn severity (<1% of the fire) and the soil scientist on the USFS BAER team, Mr. Eric Nicita, determined that the low and moderate soil burn severity categories had similar hydrophobic conditions. Not lowering the post-fire flow estimates with fire intensity factors (i.e., 1.0 for high, 0.7 for moderate, and 1.15 times the unburned rate for low) produces conservative post-fire flood estimates for this wildfire.

Projected flood flow volumes double due to bulking, or entrainment of sediment from mass wasting processes in Southern California watersheds (J. Frazier, USFS Stanislaus National Forest, personal communication; L. Soriano, LACDPW, per. communication, LACDPW 2006b). No bulking factor correction was included in the post-fire flow estimates provided in Table 2, but bulking by sediment can be extremely important during the first post-winter period.

Estimates for pre and post fire flood flows for 13 sub-watersheds draining the Marek Fire are provided in Table 2. The estimated 100-year post-fire flood flows in the moderately sized Kagel and Lopez Canyons are projected to increase 1.6 and 1.8 times, respectively. For smaller the Limekiln and Marek Canyons, changes in estimated 100-year flood flows are 1.9 and 1.8 times, respectively. For peak discharges that occur on average every two years, flow rates are estimated to increase 2.2 and 2.9 times for the Kagel and Lopez Canyon drainages, and 2.9 and 2.7 times for the Limekiln and Marek watersheds, respectively (Table 2).

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[3] Mr. Paul Gregory and Mr. Casey Shannon, USFS BAER Team Hydrologists, conducted both pre and post-fire peak flow modeling for the Marek Fire using the Rowe et al. (1949) methodology. See their Hydrology Specialists report for additional detailed information.

[4] Sinclair and Hamilton (1955) reported that for a 2.4 mi^2 watershed on the San Dimas Experimental Forest in the San Gabriel Mountains that was one third burned, total storm discharges were 3 to 5 times as great as expected due to the fire. Stormflows were bulked with debris.

Additionally, it is important to note that watershed area affects the size of estimated post-fire flood flows. In general, Neary et al. (2005) state that post-fire changes in peakflows are probably greatest in smaller sized watersheds less than 0.4 mi^2 (~250 ac).

Predicted Sediment Response

Similar to peak flow estimates, several different approaches are available for estimating pre and post-fire sediment yields for the impacted by the Marek Fire. These methods include:

- Bathymetric and sediment removal data from local reservoirs and debris basins,
- Sediment estimates provided in Rowe et al. 1949 for Southern California watersheds,
- Computer programs such as ERMiT (Erosion Risk Management Tool), Disturbed WEPP (Water Erosion Prediction Project, etc. (Robichaud et al. 2006, 2007; Larson et al. 2007), and
- Los Angeles County of Department of Public Works (LACDPW) Sedimentation Manual (LACDPW 2006b).

For post-fire sediment assessment, all four methods were compared, with widely varying estimates due to varying assumptions.

According to data provided by Los Angeles County Department of Public Works, Pacoima Reservoir, located at the northwestern corner of the Marek Fire, has had sediment removed 19 times between 1929 and the present. Average sediment deposition has been approximately 94,410 cubic yards per year, or 3,360 cubic yards per square mile per year.[5] This rate was used as the background value for all four methods compared. As with peak flow predictions, no adjustment was made for differing soil burn severity rates for the incident.

Rowe et al. (1949) lists a background sediment yield for Lopez Canyon and Adjacent Streams of 1,830 cubic yards per square mile per year, and 2,260 cubic yards per square mile per year for Little Tujunga Canyon. First year post-fire sediment estimates for these two watersheds are listed in Rowe et al. (1949) as 57,830 cubic yards per square mile and 75,260 cubic yards per square mile, respectively.[6] The Lopez Canyon first year post-fire value was used for this analysis.

Table 2. Pre and post-fire flood flow estimates for 13 sub-watersheds draining the Marek Fire.

[5] To the east of the Marek Fire in the San Gabriel Mountains, the mean annual sediment yield for the San Gabriel Reservoir was estimated to be 5,870 cubic yards per square mile using bathymetric data from Morris Reservoir on the San Gabriel River (Cafferata 1999).

[6] Sediment production from a major storm in Los Angeles County has amounted to as much as 120,000 cubic yards per square mile of watershed (LACDPW 2006).

Watershed Name	Pre-Fire Flow (cfs)	Pre-Fire Flow (cfs)	Pre-Fire Flow (cfs)	Post-Fire Flow (cfs)	Post-Fire Flow (cfs)	Post-Fire Flow (cfs)	2 Yr Inc	10 Yr Inc	100 Yr Inc
Recurrence Interval	**2 yr**	**10 yr**	**100 yr**	**2 Yr**	**10 Yr**	**100 Yr**			
Lopez Canyon and Indian Canyon	45	344	1324	130	748	2445	2.9	2.2	1.8
Unnamed Tributary to Lopez Canyon	2	13	50	6	29	95	3.0	2.3	1.9
Indian Creek Tributary to Lopez Canyon	18	117	452	49	247	810	2.8	2.1	1.8
Kagel Canyon	51	338	1300	113	597	2019	2.2	1.8	1.6
Kagel Canyon Tributary	12	83	319	23	127	442	1.9	1.5	1.4
Unnamed Tributary to Pacoima Dam	11	72	277	29	146	483	2.6	2.0	1.7
Unnamed Tributary to Pacoima Wash	10	63	244	28	142	463	3.0	2.3	1.9
Limekiln Canyon	17	116	445	51	257	837	2.9	2.2	1.9
Unnamed Tributary to Pacoima Wash	35	234	901	92	471	1559	2.6	2.0	1.7
Unnamed Tributary to L.Tujunga Canyon	6	37	142	17	83	269	3.0	2.3	1.9
Unnamed Tributary to L.Tujunga Canyon	4	28	107	13	63	204	3.0	2.3	1.9
Marek Canyon Tributary to L. Tujunga Canyon.	21	138	531	56	283	934	2.7	2.1	1.8
Unnamed Tributary to L. Tujunga Canyon	14	95	367	41	207	675	2.9	2.2	1.8

In a review of the Rowe et al. (1949) sediment approach, Booker (2000) studied 83 drainage basins in Los Angeles County, including basins in the Tujunga watershed. For each basin, the sediment yield history and drainage area was entered into a spreadsheet with relevant Rowe et al. (1949) watershed information. Booker (2000) concluded that analysis of the Los Angeles County sediment data suggests that the Rowe et al. (1949) data did not perform significantly better than using a regional average value of all measured events. They produced an average sediment yield estimate of 13,617 cubic yards/square mile/year over a 10 year period for a completely burned watershed and an estimate of 1,991 $yd^3/mi^2/yr$ for a background erosion rate (approximately a 6.8 fold increase).[7]

ERMiT is considered to be an improved version of the Disturbed WEPP erosion model that has been in use for several years, since it uses probabilities rather than providing one a single, deterministic value. Use of the ERMiT software program conducted by Mr. Eric Nicita, USFS BAER soil scientist, produced estimates of 3,630 cubic yards per square mile pre-fire and 5,120 cubic yards per square mile post-fire, assuming that there will be a 50% probability that the sediment yield will be exceeded (i.e, assumes only a storm with average intensity will occur). With only a 10% chance that the sediment estimate

[7] Booker's (2004) review of nearly a century of debris basin data from the San Gabriel Mountains showed that: (1) the greater the proportion of the watershed area with slopes greater than 35 degrees, the higher the sediment yields, and (2) sediment yields from the San Gabriel Mountains have not been dominated by fire events, but rather by very large storm events.

will be exceeded (assumes at least a 10-year recurrence interval storm event), post-fire sediment yield elevates to 20,160 cubic yards per square mile per year (see USFS Soil Specialist Report for the Marek Fire; Figure 3 shows an example of estimated sediment yields using ERMiT).

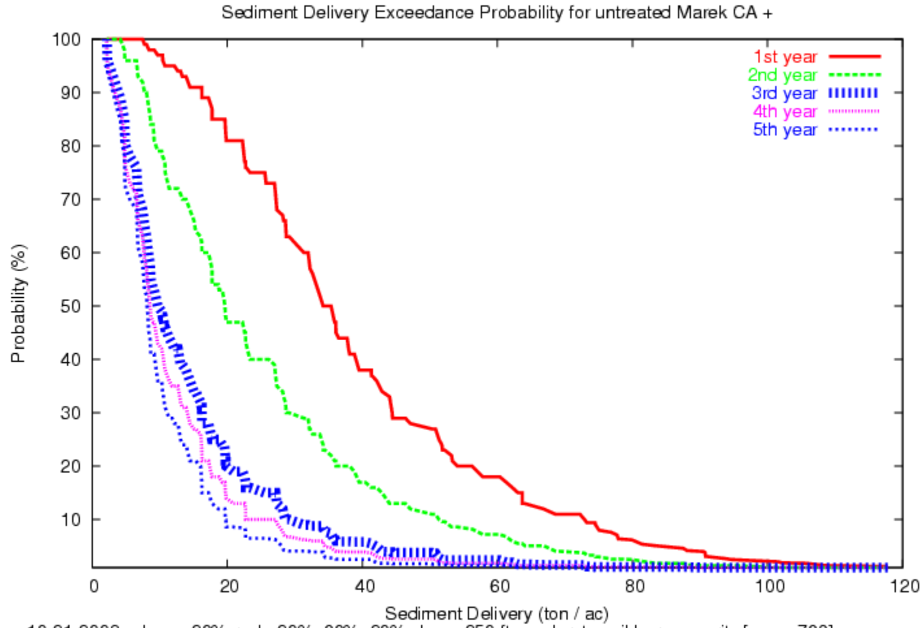

Figure 3: Modeled sediment yield for a burned watershed with the Modesto soil series using the ERMiT software program (provided by Mr. Eric Nicita, USFS BAER soil scientist).

The Los Angles County Department of Public Works produced post-fire debris estimates using curves from the LACDPW Sedimentation Manual (L. Soriano, LACDPW, per. communication; LACDPW 2006b). The manual uses a rate of 120,000 cubic yards/square mile/storm as the design debris event for a one square-mile drainage area in Debris Production Area (DPA)-1 zone, which incorporates the Marek Fire (based on a 50 year storm event). For a 0.1 square mile basin (approximately 60 acres), sediment production of 240,000 cubic yards/square mile/storm is used for DPA-1 (Appendix B, LACDPW 2006). This equates to 375 cubic yards/acre. There is a curvilinear decay for debris yield as watershed area increases.

Estimates for pre and post-fire sediment yields using the four methods for 13 sub-watersheds draining the Marek Fire are provided in Table 3. It is readily apparent that these methods predict widely varying sediment yields due to varying assumptions. The Rowe et al. (1949) method predicts on average approximately a 16 fold increase in sediment following the first post-fire winter (using Pacoima Reservoir sediment deposition data for background, as is done for all four methods). Booker's (2004) approach predicts approximately a 4 fold increase over the first decade following the wildfire. The ERMiT model predicts approximately a 6 fold increase the first year, using the value associated with a 10% chance that the sediment estimate will be exceeded. The LACDPW method predicts by far the largest increase in debris, since a 50 year storm event is assumed to occur on the burned watershed the first winter. For the watersheds located within the Marek Fire, this method predicts roughly a 40 fold increase in debris, a conservative estimate to protect lives and property. Research conducted on the San Dimas Experimental Forest in the San Gabriel Mountains shows that this estimate may be reasonable. Wohlgemuth (2003) reported that on average, first-year post-fire watershed sediment yield is 35 times greater than comparable unburned annual levels.

B. Findings of the On-The-Ground Survey

1. Identify Values-At-Risk

Prior to field evaluation work, the following potential values at risk were identified: Pacoima Reservoir, structures in Limekiln Canyon, structures in Lopez Canyon, structures in Indian Canyon, structures in Marek Canyon, structures in Kagel Canyon, trailer parks below Lopez Canyon, Glen Haven Memorial Park, and new subdivisions to the west of the fire perimeter. A rapid SEAT field investigation of these potential values at risk was undertaken on October 18, 2008 with USFS BAER personnel. Additionally, the SEAT team and a portion of the USFS BAER team evaluated values at risk with a 40 minute helicopter flight on October 19th. More detailed field investigation took place on October 20th and 21st and included field discussions with Los Angeles County Department of Public Works civil engineers at high risk sites.

Hydrophobic soil tests were conducted by the state SEAT team and by Mr. Eric Nicita, USFS BAER soil scientist, at several locations within the Marek Fire and in unburned areas adjacent to the fire. The general procedure utilized was to scrape the upper layer of ash away with a trowel or “sharpshooter” shovel and test soil for hydrophobicity at the bare mineral soil surface in several locations within a three square foot area. Several additional tests were then conducted at depths of one half inch and two to three inches into the soil profile (NRCS 2000). The tests revealed high hydrophobicity at the mineral soil surface and at a depth of one half inch in the burned areas, with approximately 80% of the area being affected. At nearly all sites, the soils were not hydrophobic at depth. In the unburned areas, approximately 30% of the sites exhibited hydrophobic conditions near the surface (see the USFS BAER Soil Science Specialist Report for additional information). These values are similar to those observed by Hubbert el al. (2008) on the San Dimas Experimental Forest in the San Gabriel Mountains. They reported that 38 percent of the pre-fire soil surface exhibited moderate to high repellency, and seven days after a prescribed fire, moderate to high repellency in the surface soil increased to 66 percent. Hydrophobicity is rated as high if water drops remaining on the surface for more than 40 seconds, and moderate if drops remain for 10 to 40 seconds (Frazier 1989).[8]

[8] Hydrophobic soil conditions are commonly produced following wildfire, particularly where coarse textured soils are found. Usually only a thin layer of soil at or below the mineral soil surface becomes hydrophobic after intense heating. The hydrophobic layer is produced when a waxy substance derived from plant material burned during a hot fire penetrates into the soil as a gas and forms a waxy coating around soil particles (NRCS 2000). Hydrophobic soils repel water, reducing the amount infiltration that can occur into the soil profile, resulting in increased winter peak storm flows and significant soil erosion. Depending on the intensity of the fire, hydrophobic layers can persist for about two years, especially if they are relatively thick. The hydrophobic layer is generally ½ inch to 3 inches beneath the soil surface and is commonly as much as 1 inch thick.

After field investigations, evaluation of information provided by the USFS BAER team, and discussion with LACDPW civil engineers and other contacts, the primary values-at-risk to lives and property due to flooding and debris production associated with landslide processes on non-federal lands were determined to be:

1. Hope Garden Valley Center (map point LOP-11)
2. Kagel Canyon residences (map point K-5)
3. Businesses at the base of Lopez Canyon (map points LOP-8,9)
4. Dexter County Park in Kagel Canyon (map point K-2)

Table 3: Estimates for pre and post-fire sediment yields using the four methods for the sub-watersheds draining the Marek Fire.

Watershed Name	Backgrd (cu yds)	Rowe (cu yds)	Booker (cu yds)	ERMiT 10% (cu yds)	LCDPW (cu yds)	RCS inc	Booker inc	ERMiT inc	LCDPW inc
Lopez Canyon and Indian Canyon	5450	88712	21149	31147	168409	16	4	6	31
Unnamed Tributary to Lopez Canyon	205	3524	830	1229	14625	17	4	6	71
Indian Canyon Tributary to Lopez Canyon	1859	28430	6877	10066	68471	15	4	5	37
Kagel Canyon	5350	58794	15548	21948	119438	11	3	4	22
Kagel Canyon Tributary	1323	10606	3120	4228	31230	8	2	3	24
Unnamed Tributary to Pacoima Dam	1139	16475	4040	5880	45194	14	4	5	40
Unnamed Tributary to Pacoima Wash	1003	17259	4064	6017	47750	17	4	6	48
Limekiln Canyon	1832	30858	7301	10787	74636	17	4	6	41
Unnamed Tributary to Pacoima Wash	3707	52530	12946	18804	108136	14	3	5	29
Unnamed Tributary to Little Tujunga Canyon	583	10030	2362	3497	31219	17	4	6	54
Unnamed Tributary to Little Tujunga Canyon	441	7590	1787	2646	23625	17	4	6	54
Marek Canyon Tributary to Little Tujunga Canyon.	2184	32085	7837	11425	77123	15	4	5	35
Unnamed Tributary to Little Tujunga Canyon	1523	24510	5858	8618	61277	16	4	6	40

2. Describe Condition of Values At Risk

1. Hope Garden Family Center is a residence for approximately 150 people; there are approximately 75 children, 25 seniors, and 25 women present at the facility run by the Union Rescue Mission. Additionally, about 50 staff people work at the center at various times during the week. The center covers 78 acres in the lower part of Lopez Canyon. Even prior to the Marek Fire, lower Lopez Canyon Road frequently floods during winter storm, blocking access to the center for several hours (Scott Johnson, Chief Operations Officer, per. communication). Three LACDPW civil engineers, SEAT members, NRCS staff, and others walked a considerable distance on a soil surfaced road that is built up the channel bottom in the lower part of the basin on October 21st. This 39 acre burned watershed empties directly into the Hope Garden Valley Center. While the facility has a concrete v-shaped road that is designed to divert flow from this drainage into a large concrete channel for Lopez Creek that extends through the entire facility, it is apparent that with a very large storm event, the center could be overwhelmed with debris from the burned watershed. Using the LACDPW debris production area curve for DPA-1, an estimate 14,625 cubic yards of debris could enter this facility if a 50 year storm event occurred (Table 3).

2. Several Kagel Canyon residences were identified as being at risk to either flooding from bulked streamflows or debris flows from small drainages draining down to Kagel Canyon. Kagel Canyon is an unincorporated community in Los Angeles County. There are about 300 homes grouped into three sections in the canyon: Upper

Canyon, Middle Canyon and Lower Canyon. As displayed in Table 2, 2 year and 10 year flood flows are expected to approximately double in Kagel Canyon the first winter following the fire. Mr. Mike Miranda, LACDPW, informed the SEAT that his agency had identified 44 residences in Kagel Canyon that are currently at risk to flooding or debris slides. Of these, 12 houses were noted as having very high risk. Home owners at risk were provided with packets of information, including advice on post-burn mudflow protection, FEMA information, sandbagging guidelines, a booklet titled “Homeowner’s Guide for Flood, Debris, and Erosion Control” written by the LACDPW (undated), and a sketch map produced by a staff civil engineer showing how to best protect their homes with sand bags and deflection walls. The majority of the 12 homes at highest risk are located on Spring Trail in Kagel Canyon. LACDPW checks a box on the sketch form noting if the landowner should have an evacuation plan in place, indicating that they should strongly consider leaving if there is more than a ½ inch of rainfall. Currently there is no direct way of notifying homeowners when a threshold level of rainfall has occurred.

3. As described above for the Hope Garden Family Center, lower Lopez Canyon Road is currently subject to frequent flooding associated with winter rainstorms, limiting access during emergencies. Below the center, the lower part of the canyon is occupied by numerous businesses. It is readily apparent that there are several “choke” points along the channel where watercourse crossings are either missing, undersized, or inadequately maintained to handle stormflows. Flood flows the first winter following the Marek Fire in lower Lopez Canyon are estimated to increase 2.9 and 2.2 times for 2 and 10 year events, respectively (Table 2). LACDPW staff identified three primary businesses that are at risk to flooding associated with the Marek Fire. Additionally, nine other businesses were determined to be at lower risk.

4. Dexter County Park in Kagel Canyon was also identified as being at risk to flooding. Dexter Park covers 40 acres, including a gymnasium, two children’s play areas, horseshoe pits, bathrooms, an indoor half-gym for basketball with lights and an outdoor half-court for basketball. Landowners immediately above Dexter Park informed SEAT and BAER team members that the unnamed tributary in Section 32 that enters Kagel Canyon near the entrance of USFS Road 3N45 has inadequate crossings to handle large flood flows. They stated, for example, that the January 2005 flood overtopped the crossings at this location (Mr. Brent Hunsaker, local resident, per. communication). Similar to the flow estimates for the main Kagel Canyon, 2 and 10 year flood flows for the unnamed tributary entering Kagel Canyon near Dexter Park are projected to approximately double in the first winter following the fire (Table 2).

II. Emergency Determination

All four of the values-at-risk listed above were determined to constitute an emergency situation for lives and property and were confirmed by discussions with LACDPW civil engineers, USFS BAER team information, and field observations.

III. Treatments to Mitigate the Emergency[9]

1. Hope Garden Family Center. Treatment types available to lower the risk to lives and property at this facility include using warning signs, Early Warning Systems that directly warn residents, and installation of temporary rail and timber debris control structures for debris that could be produced by the 39 acre drainage entering the center. The treatment objective is lower the risk to lives and property from flooding and debris flows.

   The Hope Garden Family Center should review its safety evacuation plan. This plan should include on-site escape routes to higher ground (i.e., 2nd floor safety sites) in case the Center is breached by a massive debris flow.

2. Kagel Canyon residences. The main treatment recommendation for Kagel Canyon is to develop a fully functioning Early Warning System that will directly warn residences when to evacuate Kagel Canyon. Currently there is real time rainfall data available for Pacoima Dam, part of the LA County Department of Public Works ALERT network. One, 3, 6, 12, 24, 36, 48, 72, 96 hour, season, season normal rainfall data is posted at: http://dpw.lacounty.gov/wrd/Flood/index.cfm. Unfortunately, there is no reverse 911 system in place or other type of direct warning approach, such as has been used in other high risk canyons following wildfire (e.g., Santiago Canyon in Orange County). LACDPW staff informed state SEAT team members that they are not currently responsible for evacuation, and that this is accomplished through the Los Angeles County Sheriff's Office. In addition to implementing a direct Early Warning System, warning signs should be posted throughout the lower part of the canyon and warnings should be posted on the community webpage (http://kagelcanyon.com/).

   Residences in Kagel Canyon are encouraged to develop a neighborhood watch program to determine when neighbors are at risk during storm events.

3. Businesses at the base of Lopez Canyon. Treatments to reduce to risk to lives and property in lower Lopez Canyon include posting warning signs, improving channel capacity and upgrading watercourse crossings, installing a fully functions Early Warning System for businesses operating in this drainage, and conducting storm patrol to ensure that road drainage structures are properly functioning.

[9] Note that neither the state SEAT team or the USFS BAER team (USFS 2008) recommended any land treatments to reduce hillslope erosion and lower sediment yields into areas with values-at-risk. Past monitoring work in Southern California watersheds following wildfires has shown that grass seeding is ineffective (Robichaud et al. 2000, Beyers et al.1998, Wohlgemeuth et al.1998). Helimulching is expensive and can only be used for a very percent of the total fire area. Limited post-fire monitoring in Southern Califonria has shown helimulching is relatively ineffective in areas subject to Santa Ana winds (Hubbert 2005, 2007), and can introduce non-native plants. Wohlgemuth and Robichaud (2007) recently reported that aerial hydromulch application reduced sediment generation in the Cleveland National Forest, but the cost of this treatment is approximately $2000/ac.

4. Dexter County Park. Similar to lower Lopez Canyon, treatments to reduce to risk to lives and property in Dexter County Park include posting warning signs, improving channel capacity and upgrading watercourse crossings, and installing a fully functions Early Warning System for people utilizing the multiple facilities in this 40 acre recreation area. Additionally, installation of additional sandbags will be required, as well as storm patrol to ensure that road drainage structures are properly functioning.

IV. Discussion/Summary/Recommendations

Clearly, there is a considerable risk to lives and property in Kagel and Lopez Canyons following the Marek Fire in Los Angeles County. Numerous state and federal agencies have come together to work to lower these risks and will be implementing measures in the near future. The state SEAT team believes strongly that a fully functioning Early Warning System should be in place prior to the beginning of strong winter storms in these drainages. These types of systems have been installed in other Southern California burned watersheds and should be used here as well. Various types of systems are available, including those using ALERT rain gages and Dopplar radar. We encourage local agencies to immediately begin upgrading their existing system to provide a higher level of protection for residents in Kagel and Lopez Canyons.

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Appendix

Program PeakFq U. S. GEOLOGICAL SURVEY Seq.000.000

Ver. 5.2 Annual peak flow frequency analysis Run Date / Time
11/01/2007 following Bulletin 17-B Guidelines 10/19/2008 13:43

--- PROCESSING OPTIONS ---

Plot option = None
Basin char output = None
Print option = Yes
Debug print = No
Input peaks listing = Long
Input peaks format = WATSTORE peak file

Input files used:
peaks (ascii) - C:\DOCUMENTS AND SETTINGS\PCAFFERA\MY DOCUMENTS\PEAK FLOW MATERIALS\LITTLET.TXT
specifications - PKFQWPSF.TMP
Output file(s):
main - C:\DOCUMENTS AND SETTINGS\PCAFFERA\MY DOCUMENTS\PEAK FLOW MATERIALS\LITTLET.PRT

Program PeakFq U. S. GEOLOGICAL SURVEY Seq.001.001
Ver. 5.2 Annual peak flow frequency analysis Run Date / Time
11/01/2007 following Bulletin 17-B Guidelines 10/19/2008 13:43

Station - 11096500 LITTLE TUJUNGA C NR SAN FERNANDO CA

I N P U T D A T A S U M M A R Y

Number of peaks in record	=	46
Peaks not used in analysis	=	1
Systematic peaks in analysis	=	45
Historic peaks in analysis	=	0
Years of historic record	=	0
Generalized skew	=	-0.162
Standard error	=	0.550
Mean square error	=	0.303
Skew option	=	WEIGHTED
Gage base discharge	=	0.0
User supplied high outlier threshold	=	--
Plotting position parameter	=	--
Plotting position parameter	=	0.00

********* NOTICE -- Preliminary machine computations. *********
********* User responsible for assessment and interpretation. *********

**WCF109W-PEAKS WITH MINUS-FLAGGED DISCHARGES WERE BYPASSED. 1
**WCF113W-NUMBER OF SYSTEMATIC PEAKS HAS BEEN REDUCED TO NSYS = 45

WCF133I-SYSTEMATIC PEAKS BELOW GAGE BASE WERE NOTED. 2 0.0
WCF198I-LOW OUTLIERS BELOW FLOOD BASE WERE DROPPED. 1 1.6
WCF163I-NO HIGH OUTLIERS OR HISTORIC PEAKS EXCEEDED HHBASE. 29316.6
WCF002J-CALCS COMPLETED. RETURN CODE = 2

Program PeakFq U. S. GEOLOGICAL SURVEY Seq.001.002
Ver. 5.2 Annual peak flow frequency analysis Run Date / Time
11/01/2007 following Bulletin 17-B Guidelines 10/19/2008 13:43

Station - 11096500 LITTLE TUJUNGA C NR SAN FERNANDO CA

ANNUAL FREQUENCY CURVE PARAMETERS -- LOG-PEARSON TYPE III

	FLOOD BASE		LOGARITHMIC		
	DISCHARGE	EXCEEDANCE PROBABILITY	MEAN	STANDARD DEVIATION	SKEW
SYSTEMATIC RECORD	0.0	0.9556	2.3698	0.8621	-0.823
BULL.17B ESTIMATE	1.6	0.9333	2.4097	0.7789	-0.364

ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED EXCEEDANCE PROBABILITIES

ANNUAL EXCEEDANCE PROBABILITY	BULL.17B ESTIMATE	SYSTEMATIC RECORD	' EXPECTED PROBABILITY' ESTIMATE	95-PCT CONFIDENCE LIMITS FOR BULL. 17B ESTIMATES LOWER	UPPER
0.9500	--	6.0	--	--	--
0.9000	24.3	16.5	22.7	12.2	41.9
0.8000	59.1	50.1	57.1	33.5	94.9
0.6667	130.2	127.5	128.5	80.2	202.6
0.5000	286.4	306.7	286.4	183.7	449.5
0.4292	392.2	428.3	394.0	252.6	625.5
0.2000	189.0	1281.0	1223.0	737.9	2112.0
0.1000	2359.0	2351.0	2483.0	1388.0	4614.0
0.0400	4688.0	4077.0	5114.0	2579.0	10250.0
0.0200	7138.0	5537.0	8022.0	3749.0	16780.0
0.0100	10260.0	7070.0	11900.0	5167.0	25740.0
0.0050	14120.0	8631.0	16950.0	6843.0	37580.0
0.0020	20480.0	10680.0	25740.0	9475.0	58430.0

Program PeakFq U. S. GEOLOGICAL SURVEY Seq.001.003
Ver. 5.2 Annual peak flow frequency analysis Run Date / Time
11/01/2007 following Bulletin 17-B Guidelines 10/19/2008 13:43
Station - 11096500 LITTLE TUJUNGA C NR SAN FERNANDO CA

INPUT DATA LISTING

WATER YEAR	DISCHARGE	CODES	WATER YEAR	DISCHARGE	CODES
1914	-4100.0	H	1951	13.0	
1929	0.0		1952	2110.0	
1930	0.0		1953	138.0	
1931	30.0		1954	198.0	
1932	660.0		1955	35.0	
1933	450.0		1956	445.0	
1934	1360.0		1957	112.0	
1935	89.0		1958	559.0	
1936	653.0		1959	84.0	
1937	964.0		1960	6.7	
1938	8500.0		1961	266.0	
1939	175.0		1962	1630.0	
1940	2090.0		1963	52.0	
1941	1310.0		1964	256.0	
1942	198.0		1965	223.0	
1943	3700.0		1966	1300.0	
1944	4220.0		1967	901.0	
1945	244.0		1968	112.0	
1946	156.0		1969	1420.0	
1947	200.0		1970	353.0	
1948	16.0		1971	569.0	
1949	0.9		1972	762.0	
1950	9.8		1973	1570.0	

Explanation of peak discharge qualification codes

PeakFQ CODE	NWIS CODE	DEFINITION
D	3	Dam failure, non-recurrent flow anomaly
G	8	Discharge greater than stated value
X	3+8	Both of the above
L	4	Discharge less than stated value
K	6 OR C	Known effect of regulation or urbanization
H	7	Historic peak

- Minus-flagged discharge -- Not used in computation
  -8888.0 -- No discharge value given
- Minus-flagged water year -- Historic peak used in computation

Program PeakFq U. S. GEOLOGICAL SURVEY Seq.001.004
Ver. 5.2 Annual peak flow frequency analysis Run Date / Time
11/01/2007 following Bulletin 17-B Guidelines 10/19/2008 13:43

Station - 11096500 LITTLE TUJUNGA C NR SAN FERNANDO CA

EMPIRICAL FREQUENCY CURVES -- WEIBULL PLOTTING POSITIONS

WATER YEAR	RANKED DISCHARGE	SYSTEMATIC RECORD	BULL.17B ESTIMATE
1938	8500.0	0.0217	0.0217
1944	4220.0	0.0435	0.0435
1943	3700.0	0.0652	0.0652
1952	2110.0	0.0870	0.0870
1940	2090.0	0.1087	0.1087
1962	1630.0	0.1304	0.1304
1973	1570.0	0.1522	0.1522
1969	1420.0	0.1739	0.1739
1934	1360.0	0.1957	0.1957
1941	1310.0	0.2174	0.2174
1966	1300.0	0.2391	0.2391
1937	964.0	0.2609	0.2609
1967	901.0	0.2826	0.2826
1972	762.0	0.3043	0.3043
1932	660.0	0.3261	0.3261
1936	653.0	0.3478	0.3478
1971	569.0	0.3696	0.3696
1958	559.0	0.3913	0.3913
1933	450.0	0.4130	0.4130
1956	445.0	0.4348	0.4348
1970	353.0	0.4565	0.4565
1961	266.0	0.4783	0.4783
1964	256.0	0.5000	0.5000
1945	244.0	0.5217	0.5217
1965	223.0	0.5435	0.5435
1947	200.0	0.5652	0.5652
1942	198.0	0.5870	0.5870
1954	198.0	0.6087	0.6087
1939	175.0	0.6304	0.6304
1946	156.0	0.6522	0.6522
1953	138.0	0.6739	0.6739
1957	112.0	0.6957	0.6957
1968	112.0	0.7174	0.7174
1935	89.0	0.7391	0.7391
1959	84.0	0.7609	0.7609
1963	52.0	0.7826	0.7826
1955	35.0	0.8043	0.8043
1931	30.0	0.8261	0.8261
1948	16.0	0.8478	0.8478
1951	13.0	0.8696	0.8696
1950	9.8	0.8913	0.8913
1960	6.7	0.9130	0.9130
1949	0.9	0.9348	0.9348
1929	0.0	--	--
1930	0.0	--	--
1914	-4100.0	--	--

Appendix C

DRAFT TECHNICAL SUPPLEMENTAL
STATE EMERGENCY ASSESSMENT TEAM (SEAT) Report

Resource: Civil Engineering

Fire Name: 2008 Marek Fire CA-ANF-003833 Month/Year: October 2008

Author Name: Debbie Carlisle, Registered Professional Engineer # C32871
Department of Water Resources
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Sacramento, CA 95814
Office: (916) 651-9624

OVERVIEW

The Civil Engineer's role and responsibility of the SEAT include addressing general impacts to physical infrastructure as it relates to post fire threats to life, property and resources. This assessment typically includes surveying bridges, culverts, roads, hydropower facilities and associated appurtenances, water delivery systems, reservoirs, dams, railroad crossings, residences and businesses.

In the case of the Marek Fire, the SEAT joined forces with the US Forest Service on its seven day post fire containment assessment of the Marek Fire, which began on October 17th and extended to the 23rd. The US Forest Service's (specifically, Angeles National Forest's) mandate was to complete a Burned Area Emergency Response (BAER) report that assessed values at risk to life, property and resources and recommends mitigations to minimize adverse impacts caused by the fire and fire suppression efforts. Thus, this particular SEAT deployment was different than most other SEAT deployments, in that our team worked as an extension of the US Forest Service BAER team to compliment their efforts to comprehensively cover all watersheds affected by the Marek Fire. After departing from the BAER team, the SEAT worked at the Governor's Office of Emergency Services Headquarters in Rancho Cordova to finalize the SEAT draft report following the October 24th submittal of the final BAER 2500-8 report (USFS, 2008a).

The approach of the SEAT report is typically multi-disciplined in nature, and as such, integrates information drawn from other specialists' assessments. Because the SEAT extended the expertise of the BAER team on the Marek Fire, the SEAT recruited a minimal core team of specialists, including myself as a civil engineer, a geologist, a hydrologist, a forester and a public assistance representative. The BAER team's expertise included botany, road engineering, hydrology, soils, hazardous materials, GIS, recreation, forestry, wildlife biology, and archeology. As a result, this Civil Engineering Supplemental Report uses information documented in the BAER Road Engineering and Hydrology reports, as well as the SEAT Hydrologist's Specialist Report, to assess the post-fire runoff effects on the design capacity of culverts and reservoirs per hydrologic models. Similarly, this supplemental report relies on emergency determinations given in the SEAT Geologist's Specialist Report in terms of predicting landslides, debris flows, rock fall, and localized erosion conditions that can pose potential threats to infrastructure.

It should also be noted that the time constraints given for producing the SEAT report prohibits an in-depth analysis of impacts to infrastructure. The consequent recommended mitigation measures should be considered preliminary in nature. Examples of these types of detailed recommendations include precise sizing of culverts and flood conveyance features to meet the demands of increased flood flows; preliminary designs to replace debris damaged foundations; and site specific re-grading needs to realign altered stream courses caused by debris and sediment flow impacts. Furthermore, there are likely to be areas within the burn perimeter and other locations of potential values at risk that were not observed or assessed, as well as other areas where the potential risks are either higher or lower than our initial ranking based on a rapid reconnaissance-level assessment.

For the purposes of identifying values and risk in a correlated and clear manner, the SEAT divided up the major watersheds as Pacoima Canyon, Lopez Canyon, Kagel Canyon, and Little Tujunga Canyon. The four major drainages addressed in this supplemental report refer to the discussions of the SEAT Hydrologist's report for: (1) the post fire physical setting and consequent watershed evaluation of the fire area, and (2) the survey methods in evaluating the post fire impacts to lives and infrastructure. Additionally, the Geologist's report is used for observations related to the local geomorphology and its influence on posing potential risks from landslides, debris flow, rock fall and erosion, which in turn have the potential to threaten life, property and resources. Therefore, this report concurs with both Specialists' reports in reference to their respective list of emergency declarations and recommendations, but adds to their respective lists for reducing potential adverse effects caused by the fire.

AREAS OF PARTICULAR CONCERN

According to the Marek Fire US Forest Service BAER report (USFS, 2008) and the SEAT Hydrology and Geology Reports, specific areas of risk of increased flood and debris flows include Kagel Canyon residences, as well as Lopez Canyon residences, (inclusive of businesses, the Hope Garden Family Center, and Oak Hill School). These areas were predicted to have increased stream flows during the burned area recovery period. The SEAT team drove the County access roads in Kagel, Limekiln, Little Tujunga Canyons, and in so doing, concurred with the US Forest Service BAER Report findings related to the values at risk in terms of lives and property threats.

In light of the fact that additional County and local agencies were in the process of conducting similar field assessments at the time of our surveys, the SEAT took the opportunity to exchange pertinent information with these agencies. A list of contacts within the body of this SEAT report is provided and demonstrates that the SEAT members were able to make numerous contacts, many of which were made during a US Forest Service – Angeles National Forest hosted - BAER interagency coordination meeting held on October 22nd. We also met in the field with Los Angeles County

Department of Public Works' civil engineers, who were conducting on the ground assessment surveys in the Kagel Canyon neighborhood on October 20th. We discussed at length the homes that were at risk from post fire impacts and possible mitigation measures. We also met with several concerned homeowners in Kagel Canyon and imparted our preliminary suggestions for protecting their properties from flood and debris flows.

In addition, on October 21st the SEAT attended a meeting hosted by the Hope Garden Family Center in Lopez Canyon where LACDPW's engineers conducted a preliminary assessment of the property and discussed general mitigation measures to protect the facilities from the high likelihood of flooding and debris flows resulting from the excessive runoff from the denuded 39 acre watershed above the complex and the blockage of road access from flooding below and above the complex.

For the County and private roads in the area affected by the Marek Fire, there were three main arteries that had sites where drainages appeared to be highly susceptible to flooding resulting from: (1) excessive vegetation and debris existing in drainage ditches, and (2) under sizing of culverts and ditches that could become filled with sediment and debris during storm events. These suspect drainage features bordered Little Tujunga, Lopez Canyon, and Kagel Canyon Roads (see Values at Risk Table 1 and Figure 6, as well as the USFS BAER Road Engineering Specialist Report (BAER, 2008b)).

1.0 Recommendations

A. Drainage Features and Appurtenances

Performing hydrologic and hydraulic analyses for the series of drainage culverts that provide drainage along Little Tujunga, Lopez Canyon, and Kagel Canyon Roads was not feasible due to the time constraints for field inspection and the production of this report. However, the local controlling agency/owner is encouraged to employee a licensed engineer or certified professional to perform such analyses to reassess the capacity of the culverts and bridge crossings being mindful of the increased storm water runoff, debris flows, and sedimentation caused by the fire.

The recommendations that follow are generic in nature, and as such, should be customized for site specific cases.

1. Where bridges and culverted road crossings pass over streams in the Lopez Canyon drainage (including Indian Creek where it enters Lopez creek at Bailey Road), as well as the Marek, Kagel, and Little Tuunga Canyon Creeks and tributaries, particularly where debris flows and vegetation persist, it is recommended that trash racks be installed with a series of steel I beams placed upstream of the road crossing inlets in a "V" shape

reconfiguration with the apex pointing upstream so as to avoid causing debris buildup while still providing deflection of debris that could cause damage to the conveyance structures (Weaver and Hagans, 1994).

2. It is highly recommended that maintenance crews regularly perform removal of in channel vegetation and debris during and immediately following winter storms to decrease the chance of flooding and consequent access entrapment. Developing a maintenance schedule based on a ranking of flow can be used to prioritize the treatment of conveyance structures along the tributaries that feed into the Hansen Dam, Pacoima Wash, and Lopez Dam.

3. It is suggested that the appropriate agency/owner should perform consistent monitoring and maintenance of the crossings. For general mitigation activities related to concrete conveyance bridge structures, see reference links to Caltrans' website for this Best Management Practices (BMP), as well as other pertinent references located at the end of this report.

4. Repair, replace, and/or installing rock-slope protection along channel banks where erosive soils are prone to undermining adjacent structures. The intention is to increase the capacity to resist scour and to direct flows and debris away from structures adjacent to streams and drainages.

B. Protection of Infrastructure (businesses, residences, structures):

<u>It is highly recommended that the local jurisdictional agency:</u>

1. Alert residents by installing early warning devices; developing evacuation plans and reverse 911 procedures for neighborhoods identified as having a high risk potential for taking lives and damaging property; and posting warning signs where identification of potential hazards are immanent (See Values at Risk (VAR) Table 1 and VAR Map Points (Figure 6), as well as recommendations in the USFS BAER Report (USFS, 2008).

2. If not already in place, develop road closure plans where potential hazards are identified (see USFS, 2008).

3. Implement Best Management Practices (BMPs) to curtail impacts to structures, such as installation of debris deflectors, sand bags, k-rails, deflector walls, rip-rap, etc. Additionally, it is critical to monitor and maintain intake structures, channels, and water supply lines and appurtenances, where applicable. (See the references and hyperlinks to BMP websites at the end of this supplemental report as they apply to the site specific cases listed in Values at Risk Table 1).

4. Perform routine monitoring by abiding by US Forest Service standard specifications for establishing clearing distances from businesses and

residences to better visually access the presence of any slide activity that could migrate down gradient and compromise infrastructure.

References and Literature Cited

Barkley, Y. 2006. After the Burn: Assessing and Managing Your Forestland after a Wildfire. Idaho Forest, Wildife and Range Experiment Station, Moscow, Idaho.

Butte County Resource Conservation District. Undated. Butte County Watershed Restoration and Erosion Control: A Landowners Post Fire Decision Making Guide. Available at: www.buttecounty.org

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US Forest Service (USFS). 2008b. BAER Report, Road Engineering Specialist Report, Marek Fire, October, 2008.

Weaver, W.E. and D.K. Hagans. 1994. Handbook for Forest and Ranch Roads- A guide for planning, designing, constructing, reconstructing, maintaining and closing wildland roads. Prepared for the Mendicino County Resource Conservation District in cooperation with the California Department of Forestry and Fire Protection and the USDA Soil Conservation Service.
http://www.krisweb.com/biblio/gen_mcrcd_weaveretal_1994_handbook.pdf

Additional Recommended Best Management Practices (BMPs) Web Link References for Civil Features at Prioritized Values at Risk:

General Construction Best Management Practices – Guidelines:
http://www.palomar.edu/ehs/Storm%20Water/BMPS%20Full%20Doc.pdf

Caltrans for all Best Management Practice needs:
http://www.caltrans.ca.gov/hq/construc/stormwater/manuals.htm

NRCS Guidelines for Wildfire Best Management Practices:
http://www.mt.nrcs.usda.gov/technical/fires/ and
http://www.cnr.uidaho.edu/extforest/Publications.htm

Appendix D

TECHNICAL SPECIALIST'S REPORT
STATE EMERGENCY ASSESSMENT TEAM (SEAT) Emergency Report
Resource: Forestry

Fire Name: Marek Incident, CA-ANF-003833 **Month/Year:** October, 2008

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Reviewed by: Registered Professional Forester, License # 2184

I. Resource Condition Assessment

A. Overview

The Marek Fire encompasses an area of 4,824 acres. The origin of the fire was on the Marek Motorway near Little Tujunga Canyon Road, apparently related to a vehicle stuck on the Marek Motorway. The State Emergency Assessment Team (SEAT) evaluated the fire for potential threats to human life, property, and watershed resources.

The purpose of the SEAT post fire watershed assessment and recovery operation was to identify on-site and downstream threats to public health or safety from landslides, debris torrents, flooding, road hazards, and other fire related problems. In addition to these, other goals were to identify threats to watershed resources from excessive erosion and impaired water quality. Lastly, the team was tasked to determine measures needed to prevent or mitigate identified threats during on the ground field inspections.

This assessment was to evaluate and identify both the direct and indirect effects of the fire on the existing vegetation types and trees. The Technical Specialist report for Botany prepared by the Federal BAER Team may be referred to for additional information.

B. Resource Setting

The Marek Fire started on October 12, 2008. The fire was 4,824 acres in size and is located in Los Angeles County in the Lakeview Terrace area, northeasterly of the intersection of the 118 and 210 Freeways.

This fire is located within several drainages that ultimately are part of the Los Angeles River watershed. Approximately 1,850 acres or 40% of this fire burned on federal property included within the Angeles National Forest, 1,179 acres or 26% on State Responsibility Area, and 1,543 acres or 34% on private land.

II. Findings of the On-The-Ground Survey (Observations)

A. Survey Methods

Reconnaissance methods were performed by both vehicle and by travel on foot through portions of the fire. I drove through residential and industrial areas of Kagel Canyon, Lopez Canyon, and on Little Tujunga Canyon Road, and assessed the upper portion of the burn area on Kagel Mountain Road.

B. Observations and Values at Risk

As noted in the USFS BAER Technical Specialist Report for Botany, the fire burned with 42% low soil burn severity and 42% moderate severity, with 15% unburned vegetation or mosaic. Less than 1% had a high severity.

Chaparral species are well adapted to fire, with many species having the capability to sprout back from root crowns or through adventitious buds. As notable tree species, Coast Live Oak (*Quercus agrifolia*) and Scrub Oak (*Quercus berberidifolia*) are expected to recover well from the low to moderate severity burn.

Eucalyptus trees are non-native species widely planted ornamentally, as well as for wind and soil erosion. For many of the eucalyptus trees observed, the litter was consumed with the fast moving wind-driven fire, but the canopies were largely unconsumed and only scorched by the flaming front. Many of the trees showed scorching on the trunk on only one half of the trunk, indicating the wind direction at the time the flaming front passed. No estimate for scorch mortality was made, but it would be reasonable to expect a fair amount of scorch mortality to occur. In addition, trees weakened by fire may create favorable conditions for Eucalyptus Long-Horned Borers *(Phoracantha semipunctata and P. recurva)* to flourish, with an increase in insect mortality. In that occurrence, dead trees may pose a fire hazard as well as a hazard due to limb breakage and wind throw.

Burned oak trees were observed within close vicinity to many of the homes, outbuildings, driveways, frequently traveled roads, and other improvements. As these burned trees continue to weaken, limbs may break off, the bole of the tree may snap off, or the entire tree may uproot. There is a moderate risk that these weakened trees may cause damage to property. This risk will increase through time as the trees continue to decay, and especially during times of strong winds.

There is also a moderate risk to life and safety if people are near the weakened tree when a limb breaks (so-called “widow makers”), or the tree’s bole snaps off, or if the tree uproots. It should be noted that the Los Angeles County Department of Public Works has already assessed and addressed many of the obvious hazard trees in proximity to roadways within the burn area.

III. Emergency Determination

Large trees of any species within the 2008 Marek Fire area should be evaluated for existing mortality from the fire, as well as future mortality as trees succumb to the affects of fire. Trees that have not been killed by fire with light to moderate fire damage could also be at an increased risk of mortality in the next one to three years.

The following are some general guidelines for evaluating the survival of fire-injured trees.

(a) Depending on the species, when no green foliage remains on a fire-damaged tree, the tree is at an increased risk of mortality.

(b) In addition to Coast Live Oak, Canary Island Pine (*Pinus canariensis*) is unique among conifers in its ability to sprout and recover after torching or crown fire.

(c) The amount of cambium killed at the base of the trunk is also an important consideration in tree survival. Cambial kill can be difficult to assess, particularly when the damage is light to moderate. When bark is completely blackened and has been eroded to the point where its structure is no longer discernable, it is reasonable to assume that the cambium beneath is dead.

IV. Recommendations

Evaluate existing stands of trees to determine current mortality as well as future mortality. Trees that have been damaged but have not been killed by the fire should be also evaluated due to the inherent risk of Long-Horned Borers (eucalyptus) attack over the next one to three years.

Areas that have increased mortality should be considered for fire salvage and or biomass where practical (e.g., the eucalyptus grove on the way to the Angeles Gun Club). The limited forested areas that have been affected by the fire should also be evaluated for the next several years for mortality and possible future management.

Landowners and property managers need to be aware and monitor the increased mortality that will continue for the next several years. Areas of most concern are adjacent to homes, outbuildings, driveways, frequently traveled roads, and other improvements. During strong wind events awareness and caution should be elevated when around weakened trees.

References

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Appendix E

MAREK FIRE PHOTOGRAPHS

Including a subset of high

Values at Risk Photos

And

State Emergency Assessment Team (SEAT) Photo

Map Pt. K-2—Dexter County Park. (Note sand bagging that has already begun to reduce potential flooding impacts in Kagel Canyon).

Map Pt. K-3—Residence at risk to flooding and debris below Dexter County Park in Kagel Canyon. (Note the stone lined channel for an unnamed tributary to Kagel Canyon routed immediately next to this residence).

Map Pt. K-5—Residence denoted as high risk to flooding and debris flow damage in Kagel Canyon off of Spring Trail.

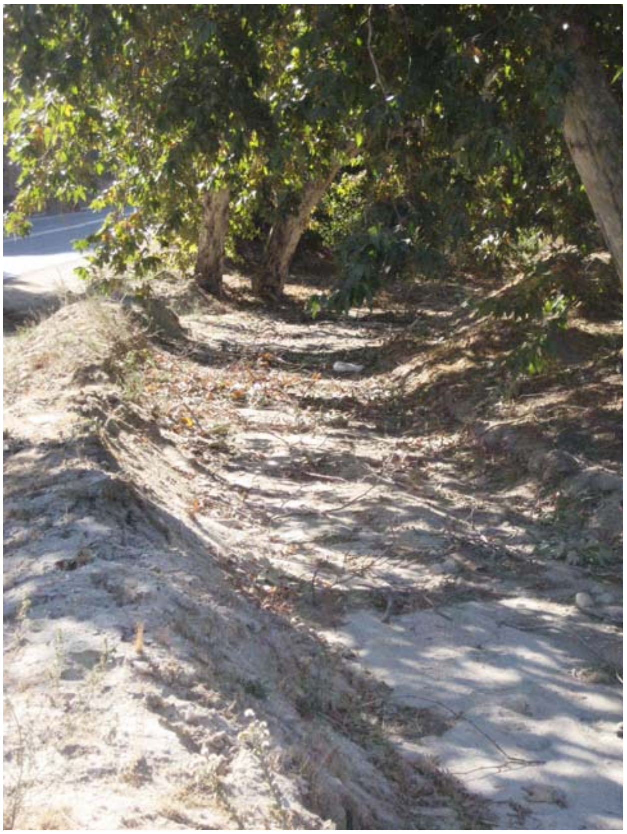
(Note: SEAT team discussing potential mitigation measures with the homeowner).

Map Pt. K-5—Small draw immediately above a residence denoted as high risk to flooding and debris slide damage in Kagel Canyon along Spring Trail.
(SEAT Geologist Darby Vickery, PG, discusses possible impacts with an LACDPW civil engineer).

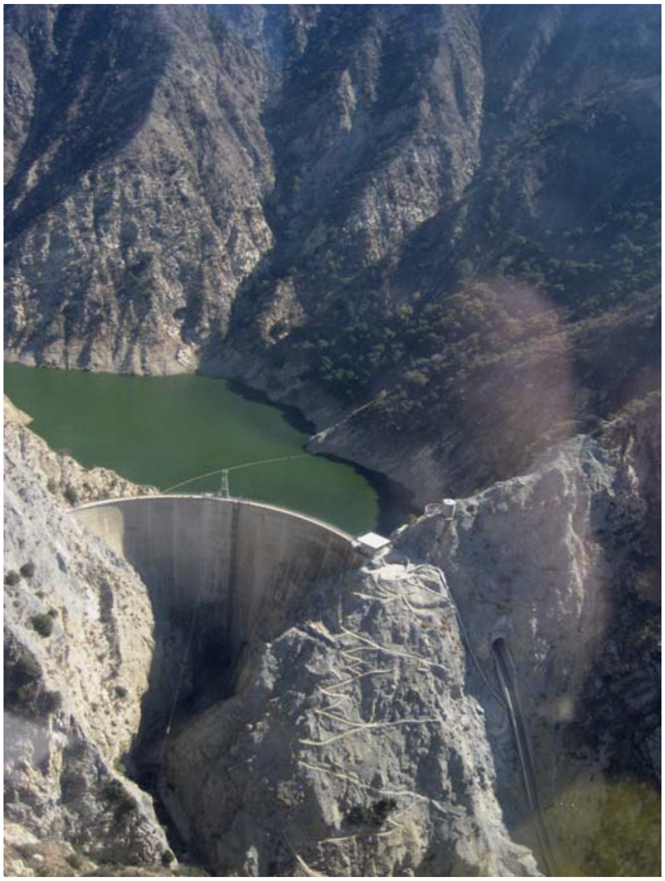
Map Pt. LOP-9. Burned/denuded 39 acre watershed that drains directly into the Hope Garden Family Center in lower Lopez Canyon.

Map pt. LOP-11—Hope Garden Family Center:
cement lined flood channel (Note: Channel drains to Lower Lopez Canyon).

Map pt. LOP-8,9—Lower Lopez Canyon channel filled with sediment and inadequately maintained culverts.



Map pt. LOP-8,9— Lower Lopez Canyon channel filled with sediment and breach in channel berm along Lopez Canyon Road.



Pacoima Reservoir and Concrete Arch Dam
(Note: This site was not designated on Table 1)

Map Pt. P-2--Mountain Glen Terrace #2 Flood Conveyance System at the east end of the subdivision.

Map Pt. LT-3--Little Tujunga Bridge crossing with narrow congested channel above adjacent to Polo Club.

Map Pt.T-4—Representative culvert road crossing on Little Tujunga Canyon Road just below USFS District Office
Note: The trash rack may be too close to the culvert headwall and dam the entrance with debris.

State Emergency Assessment Team (SEAT)- Fall, 2008

From right to left: Tom Bristow, Los Angeles County Fire Dept.; Pete Cafferata, CAL FIRE; Debbie Carlisle, Dept. of Water Resources; Darby Vickery, Dept. of Water Resources; John Schuessler, Governor's Office of Emergency Services