APPENDIX M: Supplemental Hydrology Report

Objectives

- Additional assessment of risks to private homes and roads in Silverado Canyon.

Initial Concerns

- Threats to human life and property downstream of the burn area from flooding, debris flows, erosion, and sedimentation.

Observation and Findings from On-The-Ground Surveys

The main hydrology report discussed the danger to homes on the north side of the canyon and near tributary channels below the burn area. It is important to note that **ANY** home downslope or near an outlet of a catchment or subwatershed that burned is at risk from flooding, sedimentation, and debris. (For mass wasting and debris flow risks, see geology report.)

The following is a more detailed description of areas at risk. At the time of the second assessment, some of the homes in the area had taken erosion control measures, although the measures may not protect them from all possible risks. Several homes have not taken any measures to date.

Using the BAER risk matrix, almost all sites are considered Very High Risk because they involve major to moderate consequences (loss of life or injury to humans, property damage, and/or safety).

Table 1: Identified Values at Risk: See maps at end of report for locations.

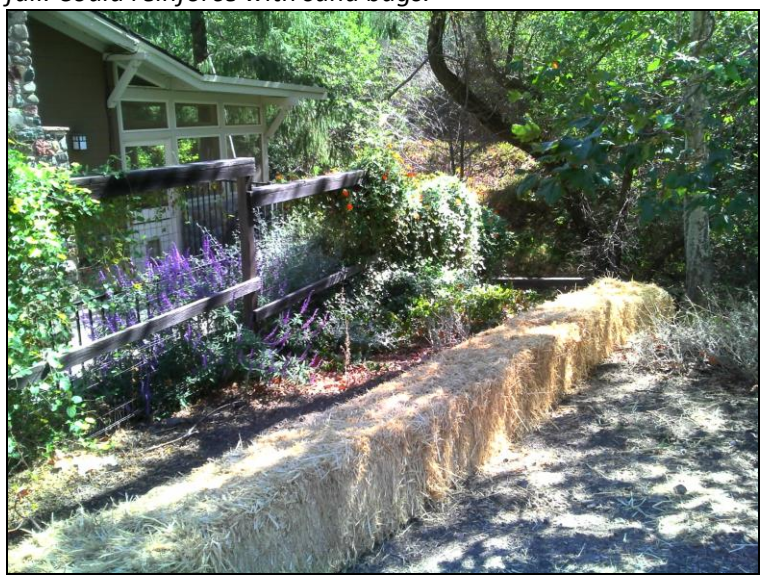
Values at Risk	Findings	Determination /Comments
Life, Public Safety, and Property		
Location 1: Homes of Silverado Cyn near outlet of subwatershed C [GPS location: 33.747394, -117.584318; 33.747012, -117.584114; 33.747169, -117.584010; 33.747294, -117.584138]	Subwatershed C outlets directly into the northern-most neighborhood of Silverado Canyon and crosses Mountain View Trail. There are four homes that are located directly adjacent to the channel, which is confined to a ditch past the stream crossing (Mountain View Trail) as it flows through the neighborhood. The ditch has sections overgrown with vegetation and is restricted by rock and morter rock walls, which are deteriorating and may be breached. A small footbridge crosses the ditch. Modeling in the main report shows Subwatershed C will experience an increase in flows, very likely leading to flooding, increased sedimentation, and increased transport of floatable debris. The proximity of the stream and location of houses at the outlet leaves these homes at a very high risk of flooding and sedimentation. (Geology report discusses debris flows.)	**Very High Risk.** **Emergency exists**

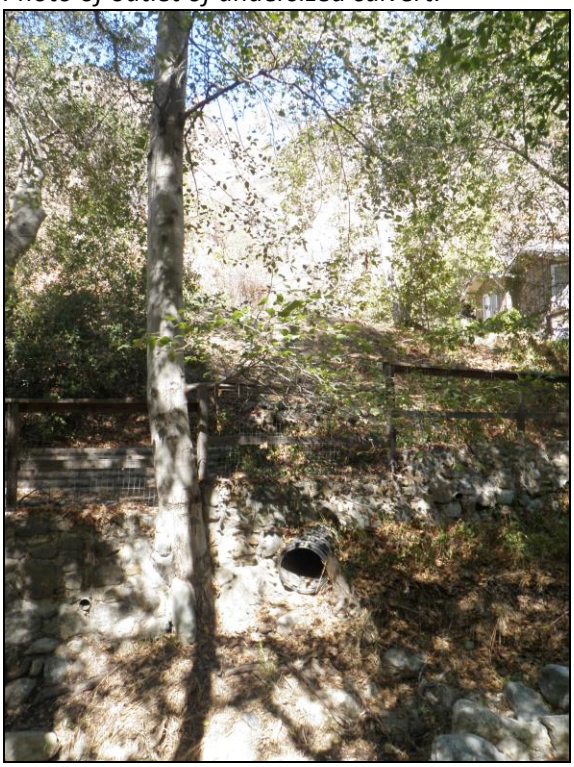
Values at Risk	Findings	Determination /Comments
	The streamcrossing is linked to risks for these homes/residents as failure of the crossing may result in water flowing into the backyard and potentially home of at least two residents. It is also possible for water to be diverted down the road surface into two additional homes. Only one home at this site has erosion control measures in place. Modeling of the stream crossing predicts a flow of 38-52 CFS up to 110 CFS with bulking. It is estimated to pass a 2 year RI peak flow with bulking would require at least a 46-52 inch culvert. The culvert at this location is 36 inches in diameter. See culvert discussion in Roads. **Potential for injury and property damage due to increased water flows, erosion, and mass wasting from burn areas.** *Photo looking downslope. Channel is ditched through neighborhood.* 	

Values at Risk	Findings	Determination /Comments
	Photo looking upslope of crossing. Stream has a small segment of unburned vegetation between burn perimeter and homes. 	
Location 2 Residents of Silverado Cyn near outlet of tributary (horse corral and shed) [GPS location 33.746569, -117.590877]	Smaller tributaries (not designated with a specific name or modeled) are estimated to experience increases in flow and sedimentation as well. Several small tributaries have narrow steep chutes (and may be assoicated with past mass wasting events). One specific home has two nearby chutes that are aligned with a horse corral and storage shed. The home is out of direct alignment with the chute but may still be affected. Deposits near the base of the chutes/slope suggest past slope failures. Ingress and egress to the house could be blocked as runoff crosses their access road. Although no modeling was completed specifically for this site, the results from the modeled sites can be extrapolated. Flows are expected to be at least 4 times higher than usually experienced in a 2 year storm and sedimentation has the potential to increase 29 times. **Potential for injury and property damage due to increased water flows, erosion, and mass wasting from burn areas.**	**Very High to High risk.** **Emergency exists**

Values at Risk	Findings	Determination /Comments
	Photo of horse corral and shed with chutes above. 	
Location 3 Residents of Silverado Cyn, downslope of burned area [GPS location 33.746675, -117.593647]	A house that has already installed some erosion control measures may still be at risk for larger sediment delivery. However, during smaller events the erosion control measures should help to protect their house. **Potential for injury and property damage due to increased water flows, erosion, and mass wasting from burn areas.** *Photo of home with erosion control mitigations that will help protect home from some damage.* 	**Very High to High Risk.** **Emergency exists**

Values at Risk	Findings	Determination /Comments
Location 4 Residents of Silverado Cyn, small slope failure above house [GPS location 33.746940, -117.594266]	A house with a very long driveway and located up on a ridge is not at risk from post-fire flooding in the greater tributary channel; however, there is a small burned catchment directly above their house that has historically failed. Increased runoff and sediment from this catchment is likely. Sandbags were observed on the property, however, they were not in place. **Potential for injury and property damage due to increased water flows, erosion, and debris flows from burn areas.**	**Very High to High Risk. Emergency exists.**
Location 5 Residents of Silverado Cyn, House across from tributary outlet [GPS location 33.746107, -117.595500]	Subwatershed D has the outlet in direct alignment with a house across Silverado Creek. Flooding from the tributary in a 2 year storm should not affect the house; however if enough volume is delivered to the channel in a larger event (mass wasting/debris flow), the house could be affected. (Debris flows may cause a risk, see geo report.) There is a wall the borders the channel, which should provide some protection. **Some potential for injury and property damage due to increased water flows, erosion, and debris flows from burn areas.** *Looking at home from outlet of tributary.* 	**Intermediate Risk. Emergency exists.**
Location 6 Residents of Silverado Cyn, two homes near tributary outlet, [GPS location	Two houses are at risk at the outlet of a small tributary (past subwatershed D) and may be built on an old debris flow deposit. The drainage is burned in the headwaters and a has buffer of unburned. The outlet of the subwatershed drains to a culvert (18”). The culvert is very long (extends the length of the the yard), curves and is partially buried at the inlet. If the	**Very High risk. Emergency exists.**

Values at Risk	Findings	Determination /Comments
33.746625, -117.597158 And 33.746484, -117.597563]	culvert plugs, drainage may just run across the flat surface of the yard (two lines of bales have been lined out on either side of the yard.) Adjacent house may be at risk if flow diverts to that side, despite straw bale. Although no modeling was completed specifically for this site, the results from the modeled sites can be extrapolated. Flows are expected to be at least 4 times higher than usually experienced in a 2 year storm and sedimentation has the potential to increase 29 times. **Potential for injury and property damage due to increased water flows, erosion, and debris flows from burn areas.** *Photo of home adjacent to culvert. At risk if culvert and bale fail. Could reinforce with sand bags.* 	

Values at Risk	Findings	Determination /Comments
	Photo of outlet of undersized culvert. 	
Roads		
Mountain View Trail road, Silverado Cyn	The main stream crossing with drainage from Subwatershed C may be at risk of failing due to increased flows, debris, and sediment. The culvert is a 36" culvert with concrete wingwalls. Existing sediment, debris, and wood are partially decreasing culvert capacity. Sedimentation is expected to increase substantially (Table 5) and estimated bulking of flows will very likely result in crossing and potenitally road failure. There is a small buffer of unburned vegetation between the burn perimeter and the culvert inlet; however, it is unlikely this small buffer with sufficiently trap sediment and floatable debris before it reaches the culvert inlet. The road provides the only ingress/egress for four to five house. See discussion on Location 1 Residents at outlet of Subwatershed C. **Potential for damage to road and adjacent houses and loss of ingress/egress due to increased water flows and erosion from burn areas.**	**Very High Risk.** **Emergency exists**

Values at Risk	Findings	Determination /Comments
	Photo of culvert inlet. 	
County Road, Silverado Cyn	The crossings with drainage from Subwatershed C may be at risk of failing due to increased flows, debris, and sediment. Existing sediment, debris, and wood are decreasing existing drainage capacity. The inlet is partially buried and sediment has accumulated within the box culvert. The channel is confined to a ditch as it flows through the neighborhood but the ditch becomes shallower and flattens out as it approaches the crossing with the County Road (increasing the likelihood of flooding). There is also a substantial amount of vegetation within the ditch. Sedimentation is expected to increase substantially (Table 5) and estimated bulking of flows will very likely result in crossing and potenitally road failure. (Rough estimates of ditch capacity compared to estimated increases in flow indicate this crossing is very likely to flood.)The road provides the main ingress/egress for the northern most part of the neighborhood. **Potential for damage to road and loss of ingress/egress due to increased water flows and erosion from burn areas.**	**Very High Risk.** **Emergency exists**

Values at Risk	Findings	Determination /Comments
	Photo of overgrown ditch between two houses.  *Photo of culvert inlet and crossing with County road.* 	

Values at Risk	Findings	Determination /Comments
	Photo of potential flooding area, if culvert plugs.  *Looking into culvert outlet. Parially plugged.* 	
Private road, Silverado Cyn	The main stream crossing with drainage from tributary subwatershed (adjacent to Subwatershed D) has a large capacity culvert with gabion rock wingwalls and is less likely to fail during a 2 year storm from flooding and sedimentation (See geology report on debris flow risk). The channel leading to the culvert is a long narrow chute with large earthen berms on either side (may be an old debris flow). The culvert is currently clear of debris and vegetation. If the crossing does fail, one house will lose access to and from house. **Some potential for damage to road due to increased flows and erosion from burn areas.**	**Intermediate to Low Risk.** **Emergency exists**

Values at Risk	Findings	Determination /Comments
	Road crossing that may be able to handle increased flows. 	
Ranch access road, Silverado Cyn, 33.746497, -117.600477	The access road to the home upslope is adjacent to the outlet of a tributary in the burn area. The outlet is channelized and if it floods, flow will be diverted down to the access road. May flow across access road, blocking ingress/egress. **Potential for damage to access road due to increased flows and erosion from burn areas.** *Photo from County Road looking up the channel and ditch.* 	**High to Intermediate Risk. Emergency exists.**

Hydrologic Modeling

Hydrologic modeling was completed in the main report. Pertinent results are included below. NOAA precipitation frequency estimates for the burn area are included at the end of the report.

The results of the hydrologic analysis find that Subwatersheds C and D are highly likely to respond to the 2yr storm with greater runoff and sedimentation than typically seen in a 2 year peak flow (Tables 5, 6, 7). Estimated post-fire runoff in a 2 year storm could resemble runoff similar to peak flows with recurrence intervals of 6 to 10 years (vs. 2 year). This increase can be extrapolated to the smaller tributaries that are adjacent to the modeled subwatersheds. The percent increase in runoff is expected to be 2 to 6 times the normal amount observed in a typical 2-year event. Any location found to be at risk in the 2 year storm will be at an even greater risk in larger storms.

Flows are expected to be even greater when considering bulking. Rough estimates of flow capacity of the channel at the outlet below these subwatersheds indicate these tributary channels are at **high risk of flooding**. In a 2 year storm, including bulking, peak flows are estimated to exceed 20 to 30 year peak flows. Because of the increased runoff and bulking, the post-fire flows could lead to plugged culverts, flow over road surfaces, rill and gully erosion of cut and fill slopes, erosion and deposition along road surfaces and relief ditches, loss of long-term soil productivity, and threats to human safety. Flooding below the burned subwatersheds will affect several VARs, Table 1. Any location at risk of flooding in a 2 year event will DEFINITELY be at risk in a larger event.

Flows in Silverado Creek (Subwatersheds E and F) will be less affected than the smaller subwatersheds but are still at risk of increased flows and sedimentation. In response to a 2 year storm, flows in Silverado Creek could be elevated to 3 to 4 year flows or 4 to 6 year peak flows (with bulking). [It is important to note that flooding in Silverado Canyon is an inherent risk. Several homes are within the 100 year floodplain (FEMA mapping of Silverado Canyon).]

Table 2: Acres of burn severity by watershed within the Silverado Fire

Assessment Watersheds	High Burn Severity	Moderate Burn Severity	Low Burn Severity	Very Low to Unburned	Total Watershed Acres	% High & Moderate Burn Severity
Subwatershed C	0	74	106	3	183	40%
Subwatershed D	1	35	78	5	119	30%

Table 3. Pre-Fire discharge by model. The project file includes excel spreadsheets used to calculate the reported values.

	Modeled Pre-fire Discharge Estimates Cubic Feet Per Second								
	RCS, 1949	WC, 1977				USGS PEAKFQ, 2014			
Name	**Q2**	**Q2**	**Q5**	**Q10**	**Q25**	**Q2**	**Q5**	**Q10**	**Q25**
Subwatershed C	9	8	28	52	107	25	39	67	99
Subwatershed D	6	6	20	37	76	18	26	44	62

Table 4. Post-Fire discharge by model.

	Modeled Post-Fire Discharge Estimates for Q2 Cubic Feet Per Second							
	Discharge (without bulking estimates)				Discharge with bulking estimate			
	RCS, 1949	WC, 1977	USGS PEAKFQ, 2014	**Compared to Pre-Fire Flow (Q)**	RCS, 1949	WC, 1977	USGS PEAKFQ, 2014	**Compared To Pre-Fire Flow (Q)**
Name	**Q2**	**Q2**	**Q2**	**Range**	**Q2**	**Q2**	**Q2**	**Range**
Subwatershed C	38	45	52	**Q7-Q8**	81	95	110	**Q20-Q25+**
Subwatershed D	24	31	33	**Q7**	51	65	68	**Q20-Q25+**

Annual erosion rates following fire were also determined using Rowe, Countryman and Storey, 1949. Table 5 displays the estimated increase in erosion following the fire. Based on these estimates, the bulking factor added to the estimated discharge is of particular importance.

Table 5. Estimated Erosion using estimates from Rowe, Countryman, and Storey, 1949.

	Erosion in Cubic Yards		
Name	Pre-fire	Post-fire	Times increase
Subwatershed C	286	8,385	29
Subwatershed D	186	5,341	29

All burned subwatersheds (A, B, C, and D and non-modeled burned hillsides) will see significant increases in discharge and sediment delivery.

Emergency Determination and Treatments

Threats to Values at Risk

Peak flow increases for the 2-year storm in the burned area are estimated to increase 2-6 times depending on subwatershed and model. Including bulking, discharge will increase 3 to 12 times depending on subwatershed and model. Erosion rates are predicted to increase as much as 29 times pre-fire erosion rates (in smaller subwatersheds). Based on these estimates there is an emergency threat to life and property in Silverado Canyon.

Overall, suggested actions primarily include:

- inform adjacent landowners of increased risk and need to contact NRCS/County agencies,
    - NRCS/County agencies can help landowners develop erosion and flooding control plans for their homes
    - Several homes need k-rails/sandbags/other erosion control measure.
- **encourage local agencies and residents to participate in an evacuation plan**,
- close the area (Forest Service land) to use until vegetative recovery occurs and/or during precipitation events,
- sign the area with information about the increased dangers,
- storm patrols (pre and post storm maintenance of drainage structures).

Table 6. Suggested Treatments for VAR. (Maps with locations at end of report.)

Values at Risk	Findings	Determination /Comments
Life, Public Safety, and Property		
Location 1 Homes of Silverado Cyn near outlet of subwatershed C	Contact NRCS/County to determine erosion control needs. Placement of sandbags and k-rails to direct flows back into channel. Reinforcement of channel walls. Maintenance of channel and crossings. Evacuation plan.	**Very High Risk.** **Emergency exists**
Location 2 Residents of Silverado Cyn near outlet of tributary (horse corral and shed)	Contact NRCS/County to determine erosion control needs. Placement of sandbags and k-rails to direct flows away from structures. Maintenance of erosion control structures after each storm. Avoid structures during and following storms. Evacuation plan.	**Very High to High Risk.** **Emergency exists**
Location 3 Residents of Silverado Cyn, downslope of burned area	Contact NRCS/County to determine erosion control needs. Maintenance of erosion control structures after each storm. Evacuation plan.	**Very High to High Risk.** **Emergency exists**
Location 4 Residents of Silverado Cyn, small slope failure above house	Contact NRCS/County to determine erosion control needs. Placement of sandbags to direct flows away from structures. Maintenance of erosion control structures after each storm. Evacuation plan.	**Very High to High Risk.** **Emergency exists**
Location 5 Residents of Silverado Cyn, House across from tributary outlet.	Evacuation plan.	**Intermediate Risk.** **Emergency exists**
Residents of	Contact NRCS/County to determine if additional erosion	**Very High Risk.**

Values at Risk	Findings	Determination /Comments
Silverado Cyn, House with small tributary into long, curved culvert.	control is needed. Maintenance of erosion control structures and culvert after each storm. Evacuation plan.	**Emergency exists**
Roads		
Mountain View Trail road, Silverado Cyn	Crossing is very likely to fail. Private road, contact residents about need for maintenance and clearing on crossing. Upgrade crossing and add wingwalls. Dip road suface to prevent diversion of flow. Evacuation plan for residents.	**Very High Risk.** **Emergency exists**
County Road, Silverado Cyn	Crossing is very likely to fail. Contact County about need for maintenance and clearing on crossing. Potentially add k-rails and/or sandbags to channel edge to prevent flooding onto main road. Post-storm patrol and maintenance. Evacuation plan for residents.	**Very High Risk.** **Emergency exists**
Private road, Silverado Cyn	Contact residents about need for maintenance between storms to prevent failure. Evacuation plan for residents.	**Intermediate to Low Risk.** **Emergency exists**
Ranch access road, Silverado Cyn	Contact NRCS/County to determine erosion control needs. Potentially add k-rails and/or sandbags to channel edge to prevent flooding onto main road. Post-storm patrol and maintenance. Evacuation plan for residents.	**High to Intermediate Risk.** **Emergency exists**

Additional Treatments Considered:

Landscape treatments were re-analyzed to expand potential treatment using newer methods to slopes up to 60% (instead of 50%), and to include areas that burned at Low SBS that may experience a high hydrologic response.

Adjusting the slope map to include areas with slopes up to 60% (using a 10 meter DEM) did not expand the potential treatment area significantly; however, including Low SBS did. Only Subwatershed C has:

1) a substantial amount of acres that could be treated;
2) treatable area that is continuous across the landscape (opposed to small, disjointed treatment areas);
3) VARs directly downstream.

Other tributaries and slopes have VARs (nearby homes) but are still too steep and lack treatable area. Subwatersheds A and B will be effectively treated through administrative closure of the area.

The resulting area that could potentially be treated with mulch is approximately 62-80 acres. Hydrologic modeling of Subwatershed C to evaluate effectiveness of mulching was run using GeoWEPP, Table 7. [Important to note is that the hydrologic modeling was run with a rock content of 30%. Although organic groundcover has been greatly reduced, rock cover remains high and fine roots remain intact, Figure A and B. Many ridges exhibited "armoring" of the soil surface (with rocks greater than a centimeter covering up to 70% of the ground surface). Rock cover can help prevent erosion and provide surface roughness. The model results represent the high end of sediment reduction. Actual sediment reduction may be lower because of the already high rock content.]

Figure A (left). Photo of pre-fire veg type (from unburned area in fire perimeter.)

Figure B. (Below). Photo of post-fire soil conditions in Low SBS.

Models of the area have different estimates of sediment delivery but we can look at the percent change to determine the potential effectiveness a treatment may offer. Based on GeoWEPP modeling for Subwatershed C, flooding risk is not reduced due to mulching; however, reduction in sediment delivery would be approximately 7% during the RI design storm (2 year). (The soils report discusses results using the ERMiT model.)

During higher recurrence interval storms, sediment reduction would be greater, approximately 45% in a 5 year storm and 29-36% in a 10 year storm. The problem with modeling larger/higher intensity storms is that mulch may fail or move and becomes less effective during larger/higher intensity storms (Santiago

monitoring report on hydromulch). Thus the modeled reduction could be inaccurate as mulching starts to fail. Ways to prevent mulching from failing include ensuring that mulch cover is greater than 50% during implementation.

Wood strand mulching is discussed in the attached write-up prepared by the BAER team. Overall, out of agricultural straw, hydromulch and wood shred, wood shred would be the most appropriate as the area is steep and experiences high winds and high intensity storms. Agricultural straw does not hold up in high winds and hydromulch loses effectiveness in high intensity storms.

Table 7 (A and B). Results of treatment polygons using 30% cover on slopes less than 60% with Low SBS. (All values subject to rounding.)

A) No Treatment

Return Period (years)	Runoff Volume (cubic meters)	Sediment Leaving (tons)	Peak Runoff Rate (cubic meters per second)	Daily Precipitation (mm)
2	102	1.4	0.1	57.9
4	1,998	63	1	68.9
5	3,179	103	1.5	72
10	14,201	497	5.8	92.5

B) Treatment of 1-1.5 ton per acre (60%-70% cover)

Return Period (years)	Runoff Volume (cubic meters)	Sediment Leaving (tons)	Percent Reduction	Peak Runoff Rate (cubic meters per second)	Daily Precipitation (mm)
2	104-100	1.3	7%	0.1	57.9
4	1,607-1,603	48-41	23-35%	0.8	68.9
5	2,683-2,677	58-57	44-45%	1.3	72
10	14,195-14,191	354-318	29-36%	5.8	92.5

Overall, there are several factors to consider in potentially treating Subwatershed C.

Table 8: Treatment Analysis: Pros and Cons of treatment

Topic	Pro	Con
VARs	VARs at very high risk locations	Only able to treat in Sub C. Other subs lack treatable area.
Treatable Area	Treatment plot covers 35-44% of the subwatershed	Has powerlines in northern section of treatment area Most of treatable area is Low SBS, which is normally not considered for treatment.
Natural Condition	Very Severe erosion hazard rating 1/3 treatment area is Moderate SBS with less organic material/roots. Sediment laden channels with material that could be mobilized. Unstable slopes exhibiting past failures. Small shrubs did provide some slope stability.	Rocky soils (30-70% surface rock). 2/3 of treatment area has Low SBS: remaining organic material, intact seed bank, intact fine roots. Expected veg recovery in 3 years. Majority of treatment area had sparse pre-fire veg: annual grasses, chemise, buckwheat and other small shrubs. Shallow soils (not a lot of available material to carry away)
Hydrologic Response	May reduce effects of hydrophobic soils. 42% of the soils exhibited strong hydrophobicity. Provides surface roughness and "mini-dams" to break up flow (related to erosion).	No change in flooding potential or runoff volume (modeling). Shallow soils and low water holding capacity of soils. Hydrophobic layer is shallow (in Low SBS),

Topic	Pro	Con
	May change the timing of runoff slightly.	mostly within 1mm of the surface.
Reduction in sediment delivery (modeling)	Will reduce erosion and sediment delivery from treatment areas. In larger storms, may decrease sediment that could initiate debris flows/mass wasting. Effects of treatment increases. 5 year storm reduces erosion about 45%.	Minor reduction in design storm (7% reduction in sediment, 2 year storm) In much larger storms, treatment may start to fail. Even with reduction, modeled amounts of sediment delivery are still large. Estimates using ERMiT modeling show even with treatment, erosion levels are still 3 times higher than background levels in a 2 year event and 26 times higher than background levels in a 10 year event.
Debris Flow Potential	Moderate and High probability of debris flows from fire area near or directly above VARs (human life and safety), especially in 10 year storm. Still a probability of debris flows in design storm (2 year.) Reduction of sediment from treated areas may reduce probability of debris flow initiation. (Based on debris flows initiated by severe erosion events.)	Treatments may be marginally effective. Debris flow potential would only be reduced, not removed. Risk of debris flow and other mass wasting would still exist.

Topic	Pro	Con
Wood Shred	More durable in windy areas May hold up better in high intensity storms than hydromulch (Santiago Monitoring report) and short duration/high intensity storms are expected in the burn area. (See wood shred effectiveness discussion.) Provides protection longer than 1 year. Recovery expected in 3 years. Use available, local wood. Less risk of spreading weeds.	May move around on steeper slopes, although limited research shows it is successful in reducing erosion. Effectiveness is reduced if not applied to provide greater than 50% cover.
Treatment cost	Cost is approximately $250,000 Ability to use local wood, local contractor.	Cost is approximately $250,000 Safety risks related to implementation.
Ability treatment before the first damaging storm	Maybe	Maybe not.

- **Will there still be risks even with treatment? Absolutely.**

Ultimately treatment will not be implemented because BAER policy states that the Forest lacks authority to implement protection measures where the sole beneficiary is non-FS and off forest. Risks on private land can be assessed by the BAER team but are to be funded by other entities. Below is an excerpt from the Forest Service Manual, CHAPTER 2520 - WATERSHED PROTECTION AND MANAGEMENT.

"2523.02 - Objectives

To identify imminent post-wildfire threats to human life and safety, property, and critical natural or cultural resources on National Forest System lands and take immediate actions, as appropriate, to manage unacceptable risks."

“2523.53 - Non-Federal Lands

As appropriate, include consideration of non-Federal intermingled or adjacent, burned lands in burned-area surveys and reports to determine post-fire risks. Coordinate with other affected government agencies to identify shared risk management responsibilities.

When appropriate, inform the non-Federal landowner or manager of the existence of the Emergency Watershed Protection Program administered by the Natural Resource Conservation Service. Funds from this program may be used to help finance watershed protection work on State, Tribal and private lands.

Under the Wyden Watershed Restoration and Enhancement Agreement authority (Pub. L. No. 105-277), Forest Service funding may be used to accomplish work on non-NFS lands if the work is essential to protect NFS lands, NFS roads, or safety of NFS visitors. Use of BAER funding to implement emergency stabilization on non-Federal burned lands is appropriate when there is a clear benefit to safety or critical resources on NFS lands, when actions conducted on NFS lands would otherwise not be effective, and when appropriate Wyden authority agreements with the affected landowners are executed. See applicable provisions in FSM 1580 and FSH 1509.11 for specific guidance on provisions under these agreements.”

References

National Oceanic and Atmospheric Administration (NOAA), 2014. Application listed in NOAA Atlas 2, Volume XI, Precipitation-Frequency Atlas of the United States, Volume XI---California. http://hdsc.nws.noaa.gov/hdsc/pfds/other/nca_pfds.html

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

U.S. Army Corps of Engineers. 2000. Los Angeles District Method for Prediction of Debris Yield. 166 pp. http://www.spl.usace.army.mil/resreg/htdocs/DebrisMethod.pdf

USDA Forest Service, 2006. Burned Area Emergency Response Treatment Catalog. Watershed, Soils, Air Management 0625 1801—SDTDC.

USDA, NRCS Soil Survey, 2014. Web Soil Survey. http://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

USDI, USGS, 2002. Corona South 7.5' Quadrangle, Riverside and Orange Counties, California. OPEN-FILE REPORT 02-21

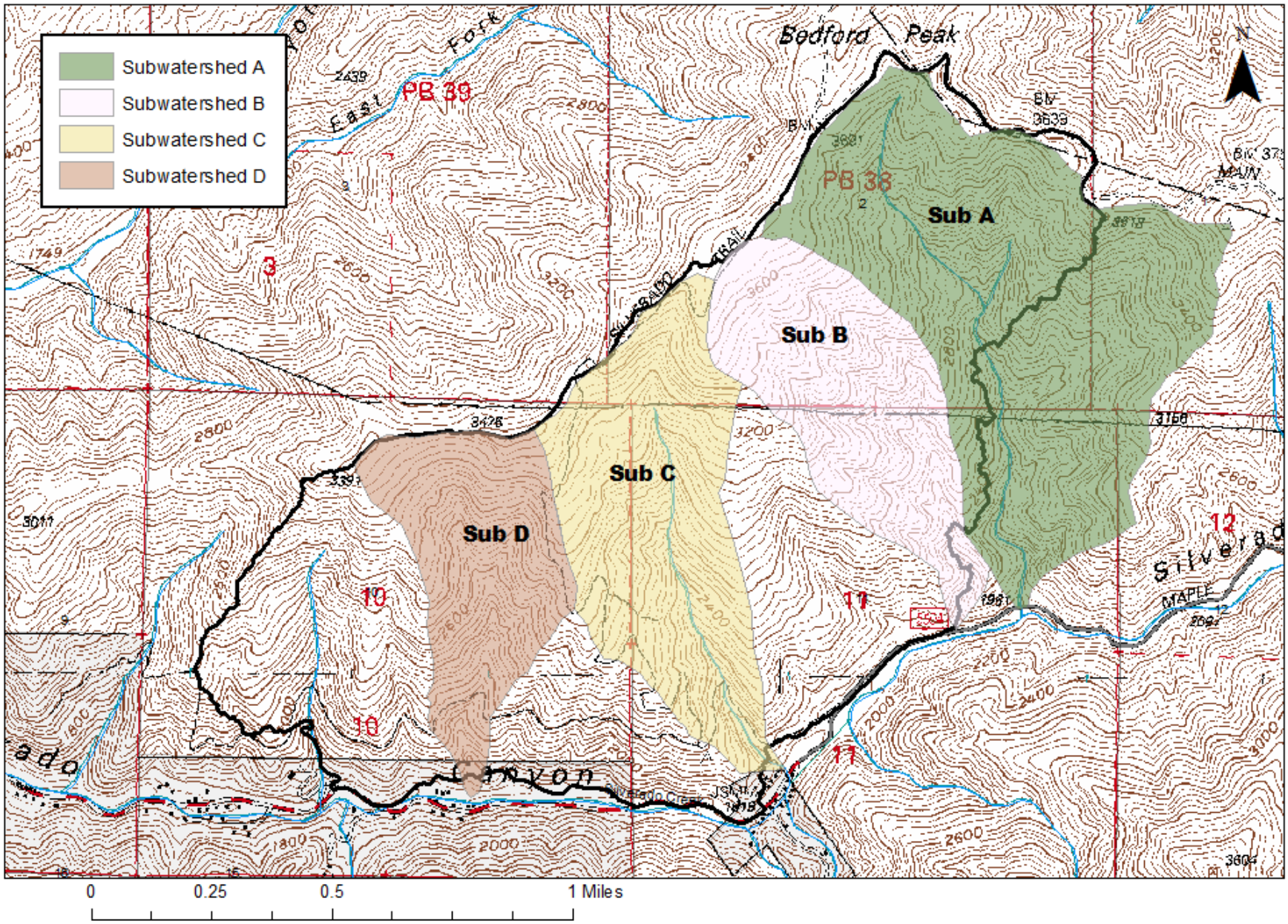
USDI, USGS, 2013. USGS California StreamStats. http://water.usgs.gov/osw/streamstats/

USDI, USGS PeakFQ, 2014. http://water.usgs.gov/software/PeakFQ/

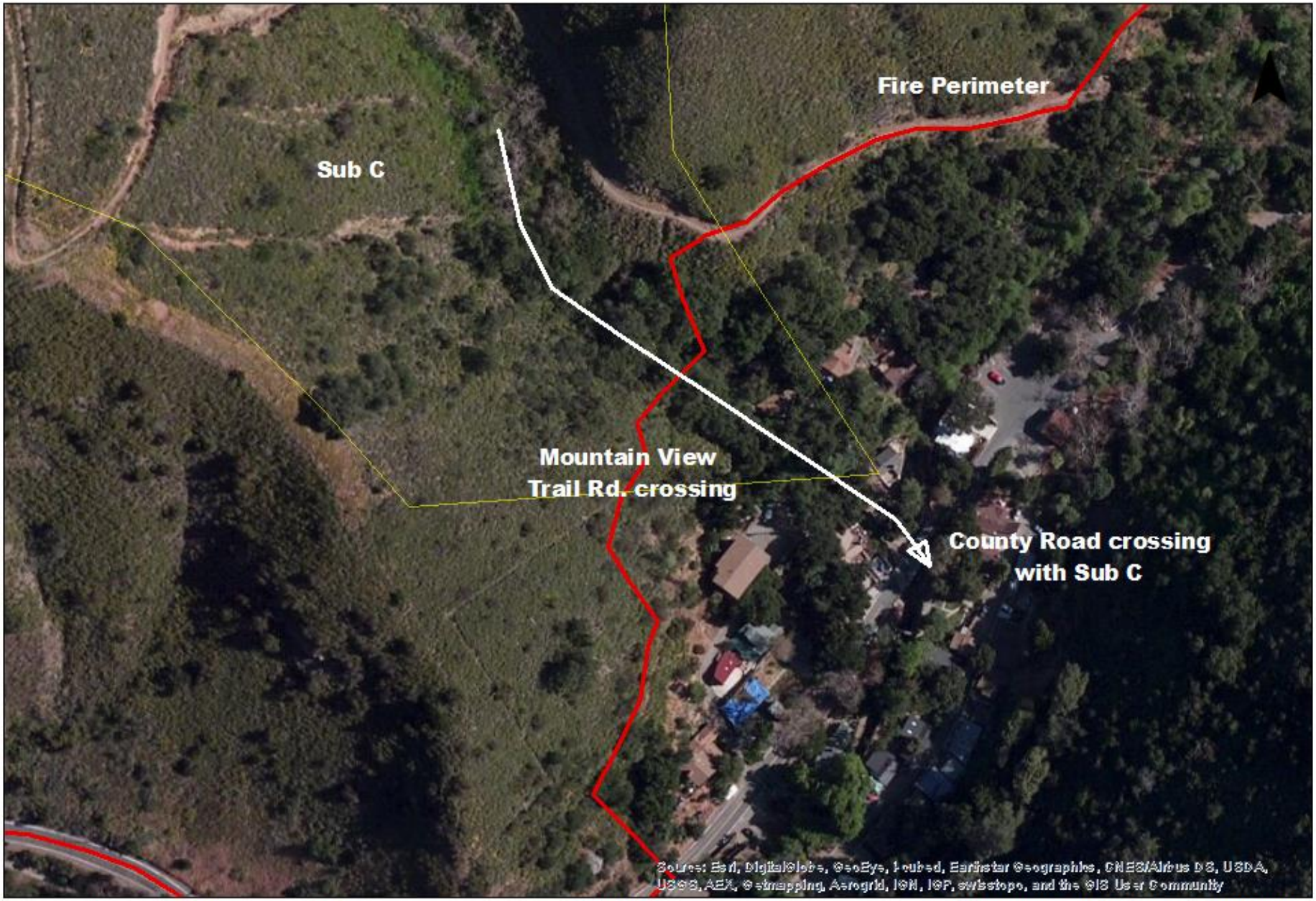
Waananen and Crippen USGS, 1977, USGS Water-Resources Investigations 77-21: Magnitude and Frequency of Flooding in California.

Wohlgemuth, Peter M., Jan L. Beyers, and Peter R. Robichaud, 2011. The effectiveness of Aerial Hydromulch as an Erosion Control Treatment in Burned Chaparral Watersheds, Southern California. The Fourth Interagency Conference on Research in the Watersheds, 26-30 September 2011, Fairbanks, AK.

Silverado FireSubwatershed Map:
Small Subwatersheds within the Fire Perimeter



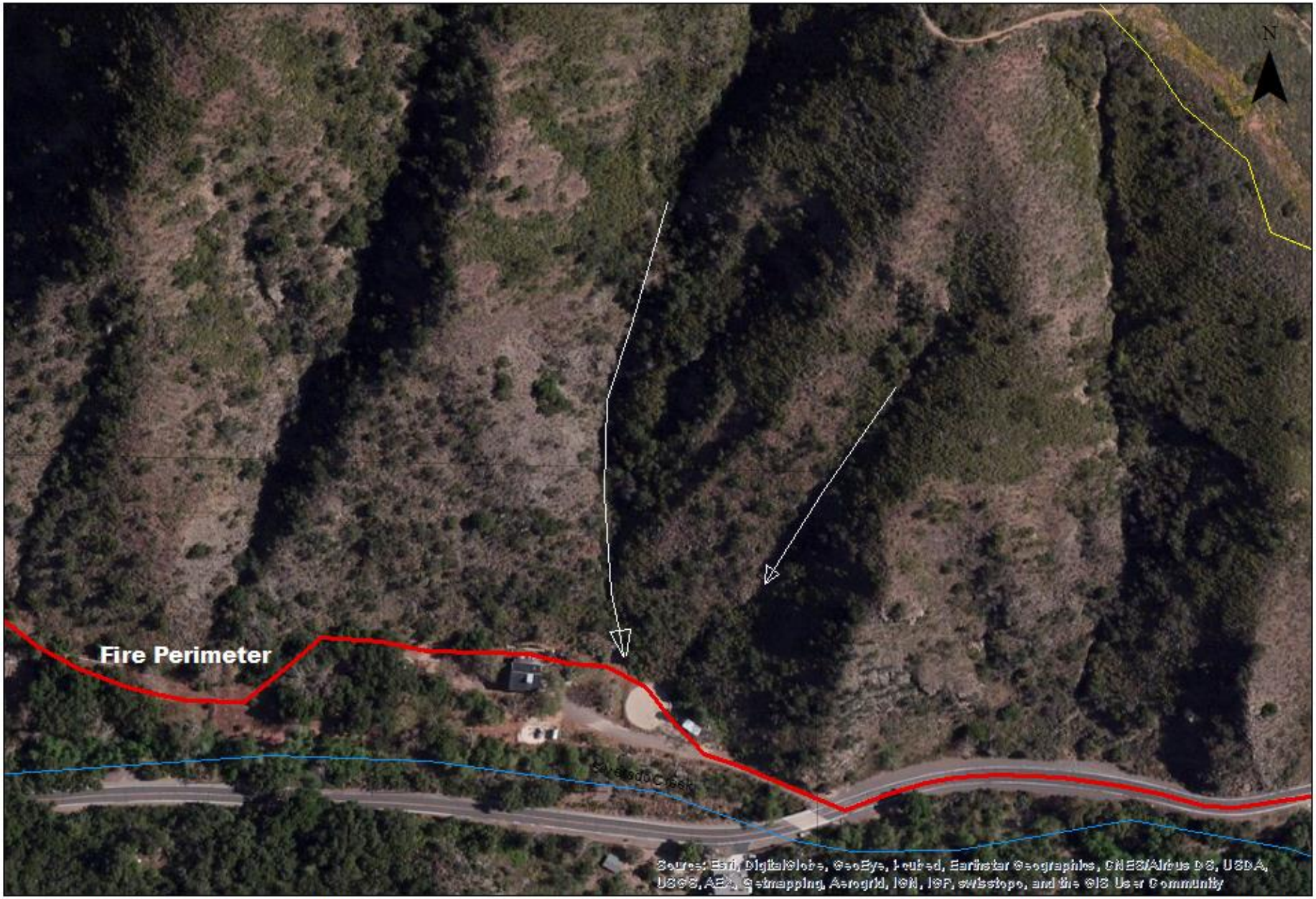
Silverado Fire 2014 Map:
Analysis of VARs--Location 1 (four houses)



0 0.025 0.05 0.1 Miles

All acres, percents, and locations are approximate.

Silverado Fire 2014 Map:
Analysis of VARs--Location 2



All acres, percents, and locations are approximate.

Silverado Fire 2014 Map:
Analysis of VARs--Location 3, 4, and 5

All acres, percents, and locations are approximate.

Silverado Fire 2014 Map:
Analysis of VARs: Location 6

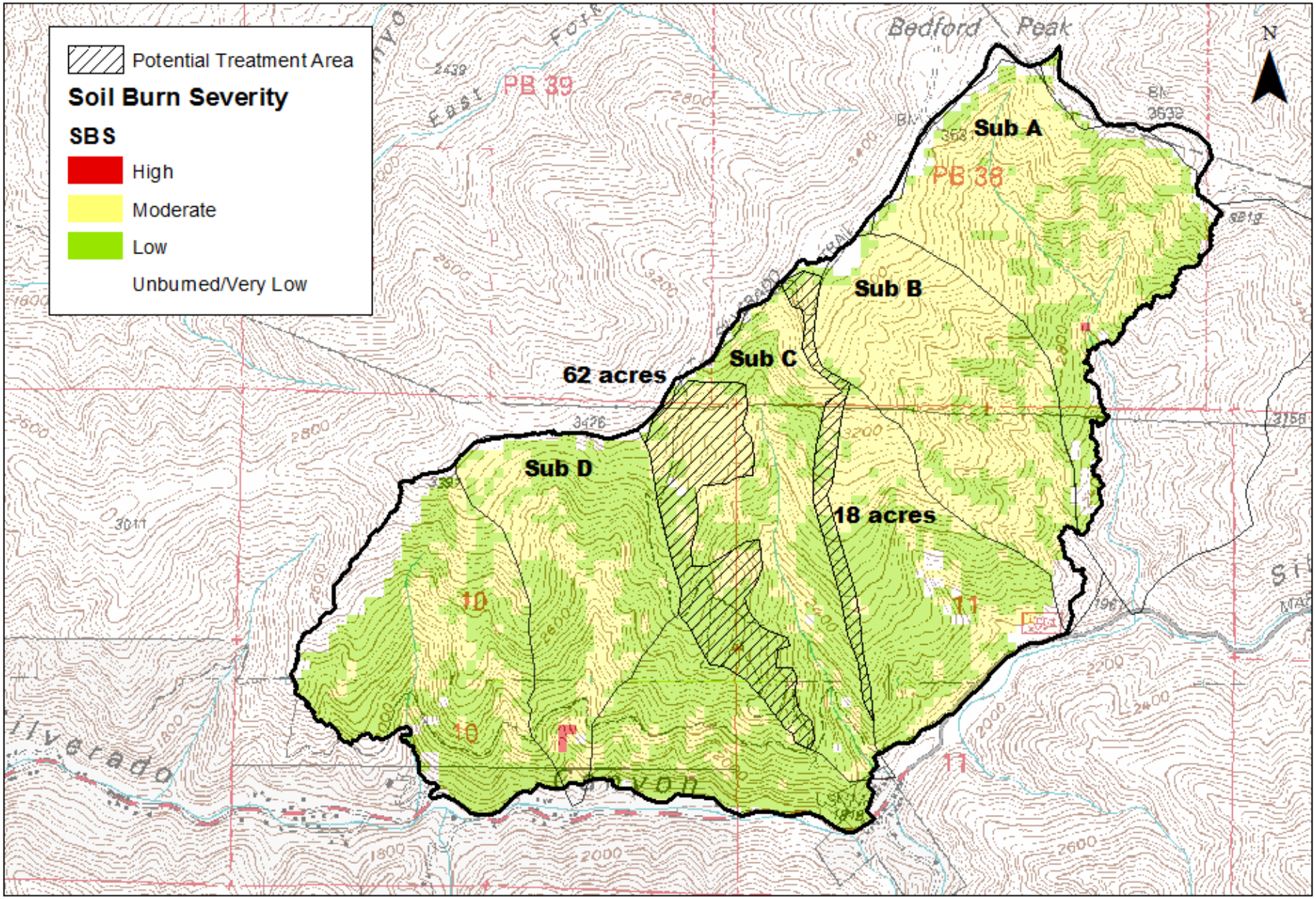
All acres, percents, and locations are approximate.

Silverado Fire 2014 Map:
Analysis of VARs--Ranch Access Road

0 0.0375 0.075 0.15 Miles

All acres, percents, and locations are approximate.

Silverado Fire 2014 Map:
Analysis of Potential Treatment Area by Subwatershed



All acres, percents, and locations are approximate.

Point precipitation frequency estimates (inches)

From: NOAA Atlas 14 Volume 6 Version 2
Data type: Precipitation depth
Time series type: Partial duration
Project area: Southwest
Location name: Corona, California, US*
Station Name: -
Latitude: 33.7510°
Longitude: -117.5897°
Elevation: 2616 ft*
* source: Google Maps

Precipitation Frequency Estimates (in inches)

	Average Recurrence Interval (years)						
Duration	**1**	**2**	**5**	**10**	**25**	**50**	**100**
5-min:	0.15	0.2	0.26	0.31	0.38	0.43	0.49
10-min:	0.21	0.28	0.37	0.44	0.54	0.62	0.7
15-min:	0.26	0.34	0.45	0.53	0.66	0.75	0.85
30-min:	0.37	0.49	0.64	0.77	0.94	1.08	1.22
60-min:	0.56	0.74	0.97	1.17	1.43	1.64	1.85
2-hr:	0.85	1.1	1.44	1.72	2.13	2.45	2.79
3-hr:	1.09	1.4	1.83	2.19	2.71	3.14	3.59
6-hr:	1.58	2.04	2.66	3.19	3.96	4.58	5.24
12-hr:	2.14	2.77	3.64	4.36	5.38	6.19	7.04
24-hr:	2.94	3.88	5.12	6.16	7.59	8.71	9.88
2-day:	3.61	4.82	6.43	7.77	9.66	11.15	12.7
3-day:	3.89	5.22	7.02	8.53	10.67	12.38	14.16
4-day:	4.19	5.66	7.64	9.31	11.68	13.59	15.59
7-day:	4.76	6.45	8.73	10.66	13.4	15.61	17.95
10-day:	5.18	7.04	9.54	11.66	14.68	17.12	19.72
20-day:	6.31	8.6	11.7	14.35	18.1	21.16	24.43
30-day:	7.5	10.23	13.94	17.09	21.61	25.3	29.27
45-day:	9.04	12.24	16.61	20.34	25.69	30.06	34.82
60-day:	10.53	14.14	19.05	23.26	29.32	34.31	39.72