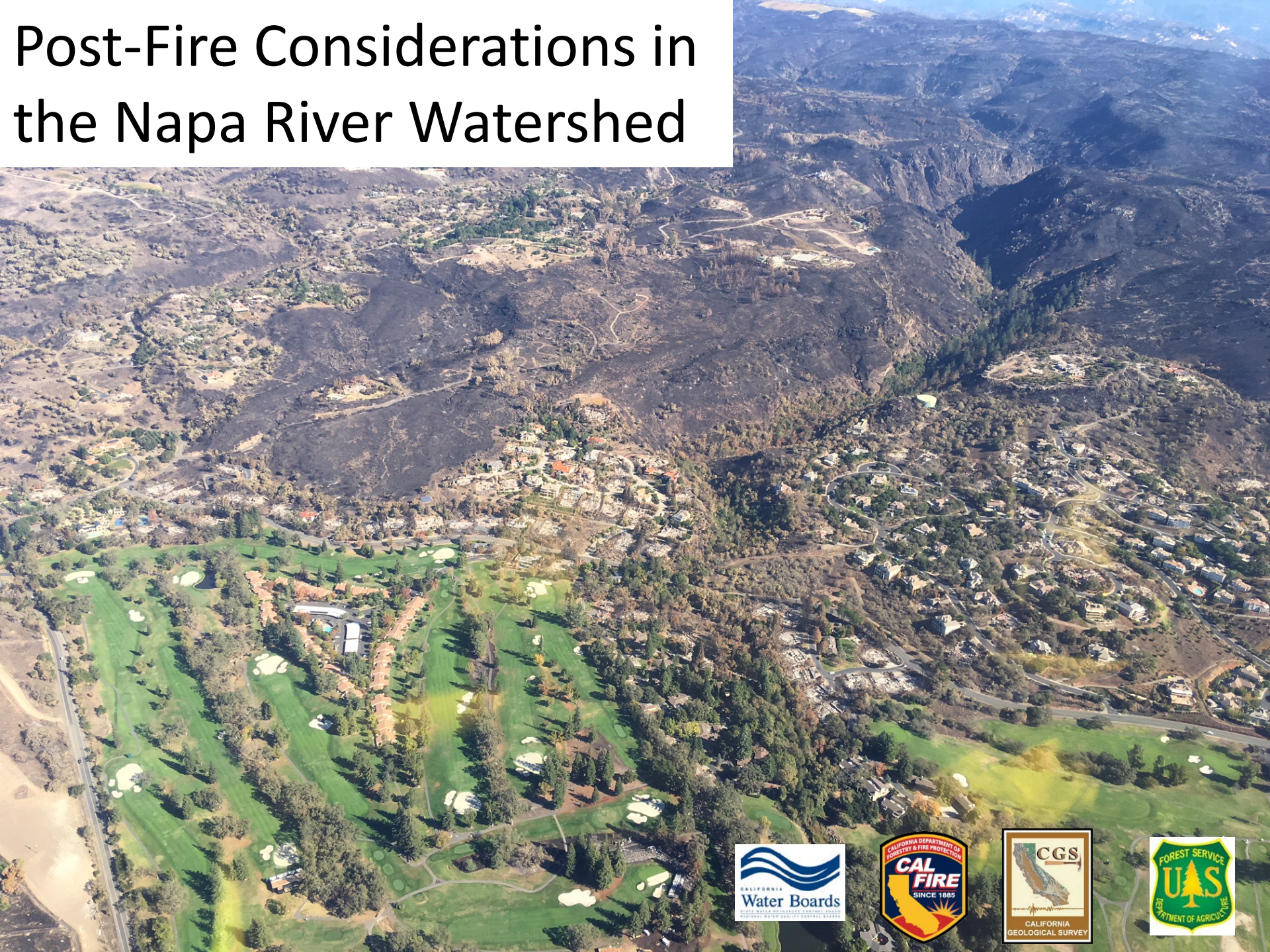
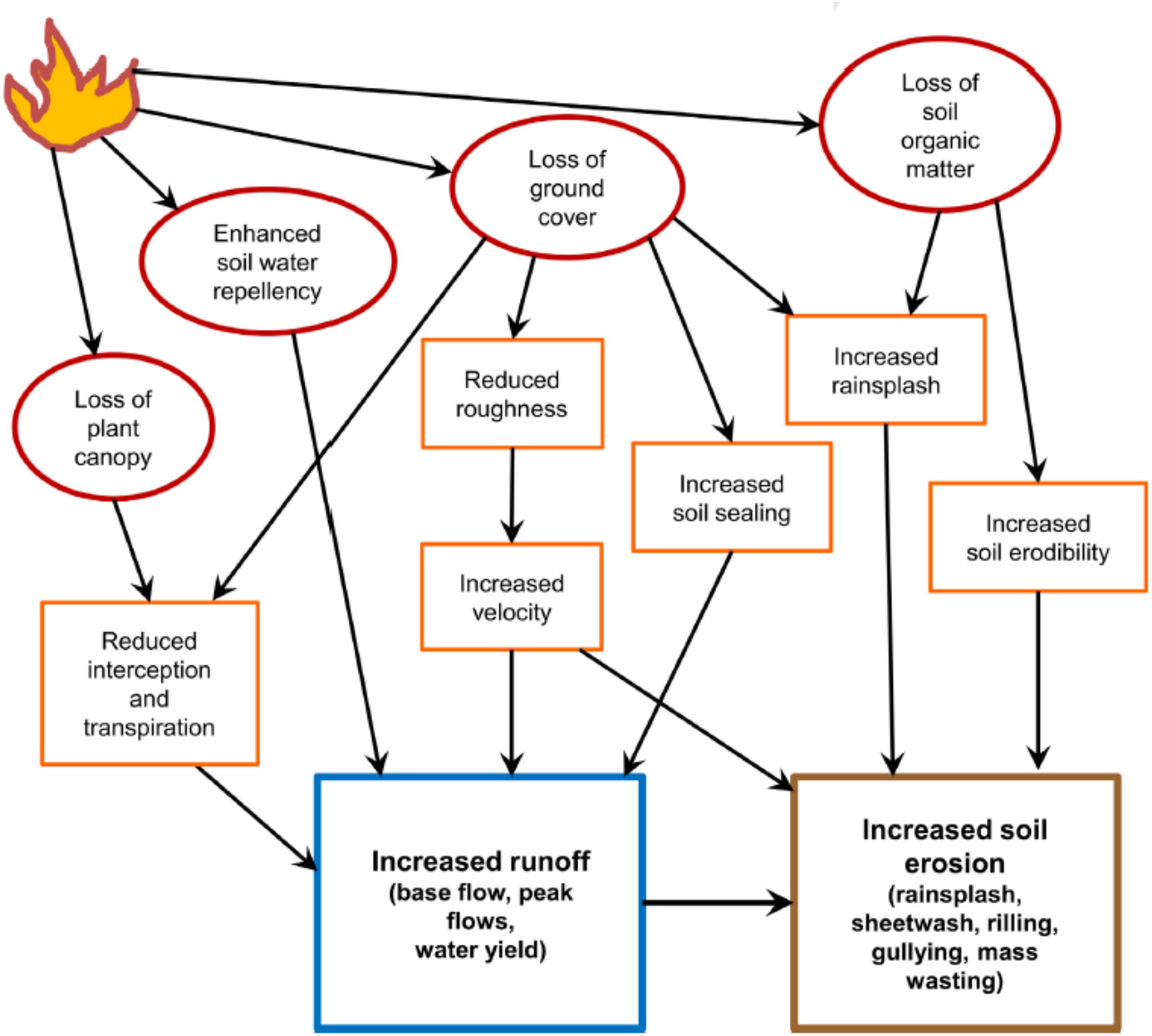
Post-Fire Considerations in the Napa River Watershed

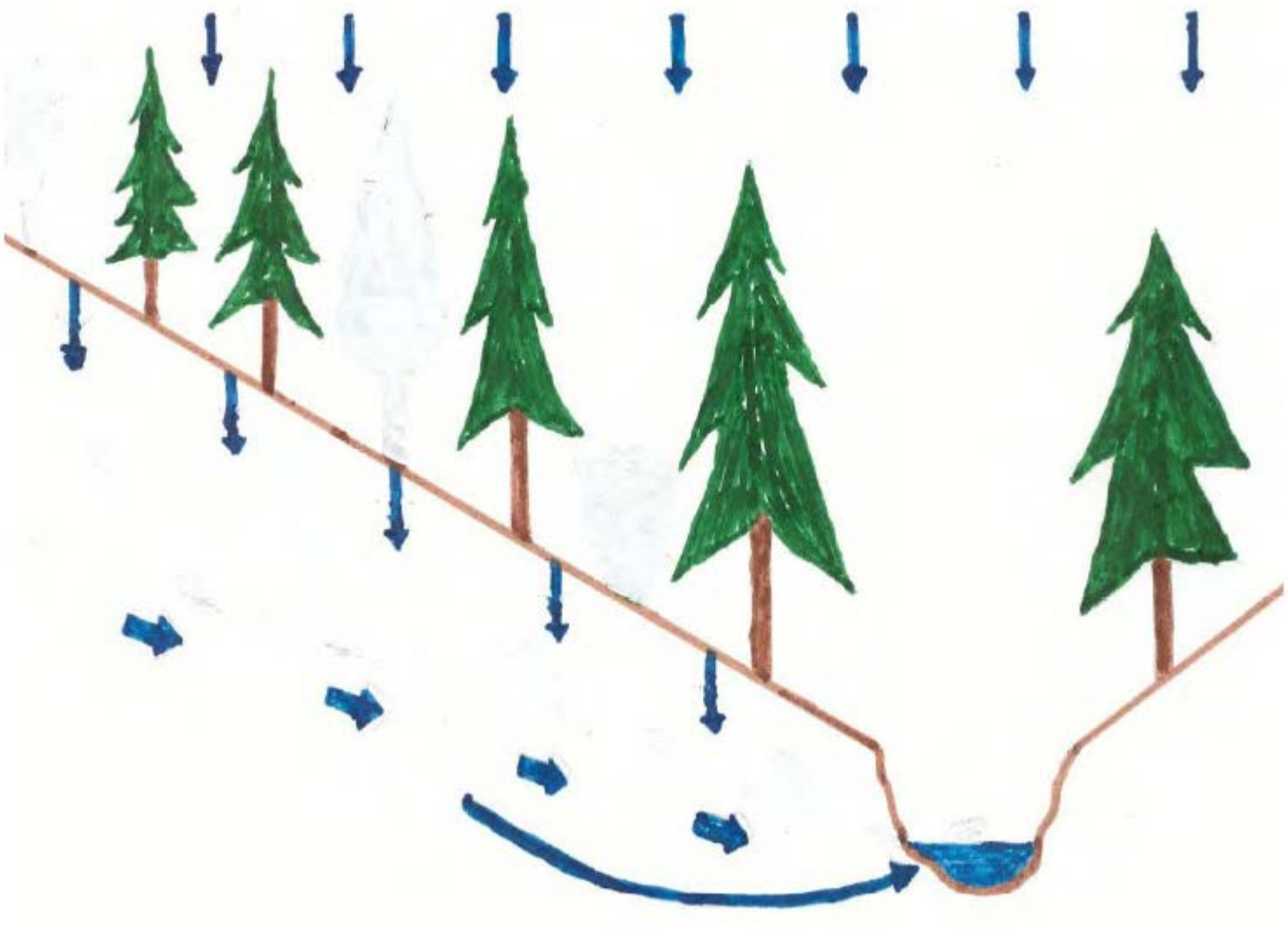


What Happens to Watershed Processes after Wildfire?



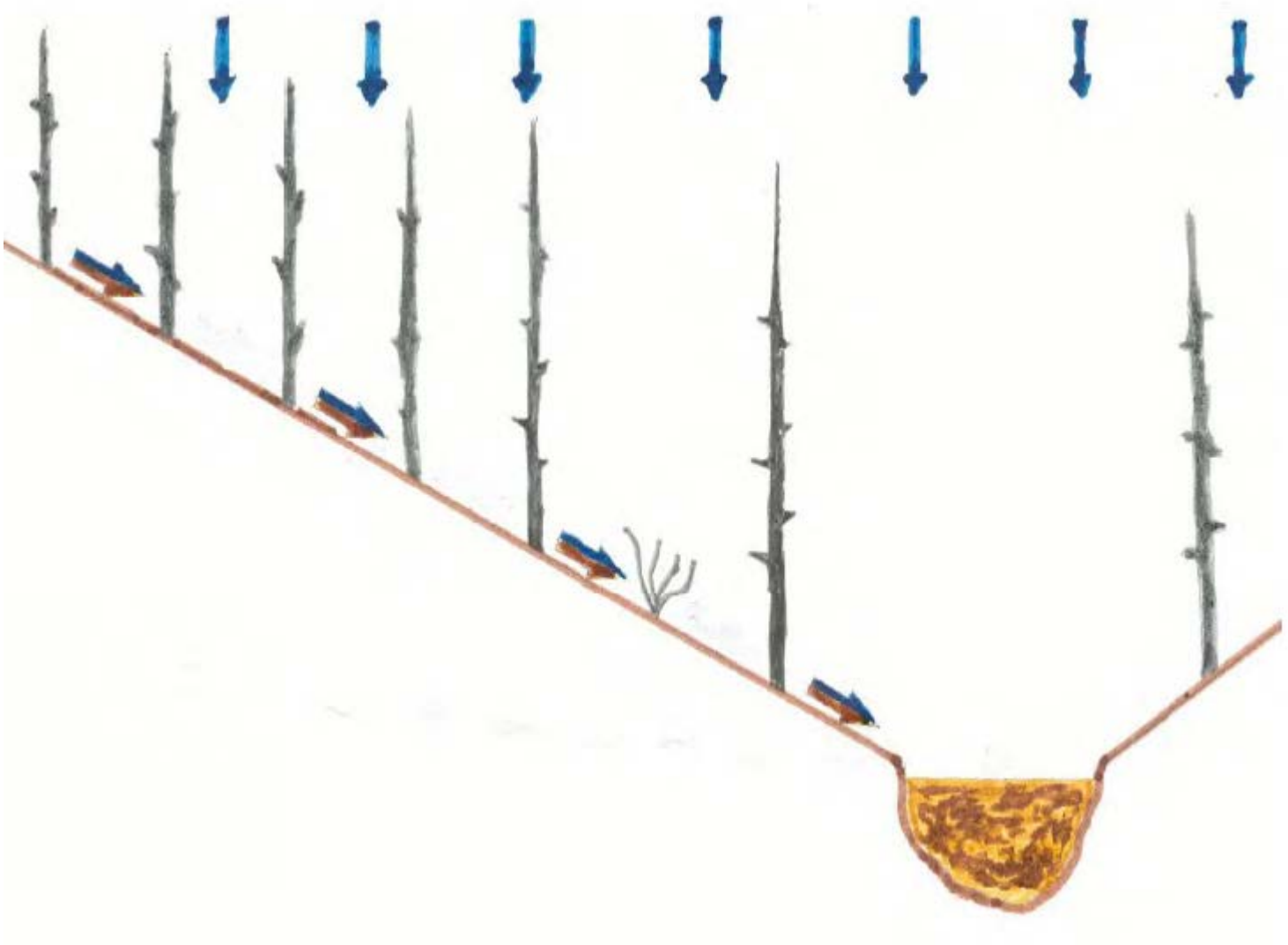
(taken from Wagenbrenner et al., 2015)

Pre-Fire



(used with permission from Dr. Lee Macdonald – Colorado State University)

Post-Fire



(used with permission from Dr. Lee Macdonald – Colorado State University)


Increased Runoff


Increased Surface Erosion

Increased Flooding – Soberanes Fire

Increased Debris Flow Potential

https://blogs.agu.org/geospace/2014/06/12/burns-floods-predicting-post-fire-mudslides-west/

Overview of WERT Process

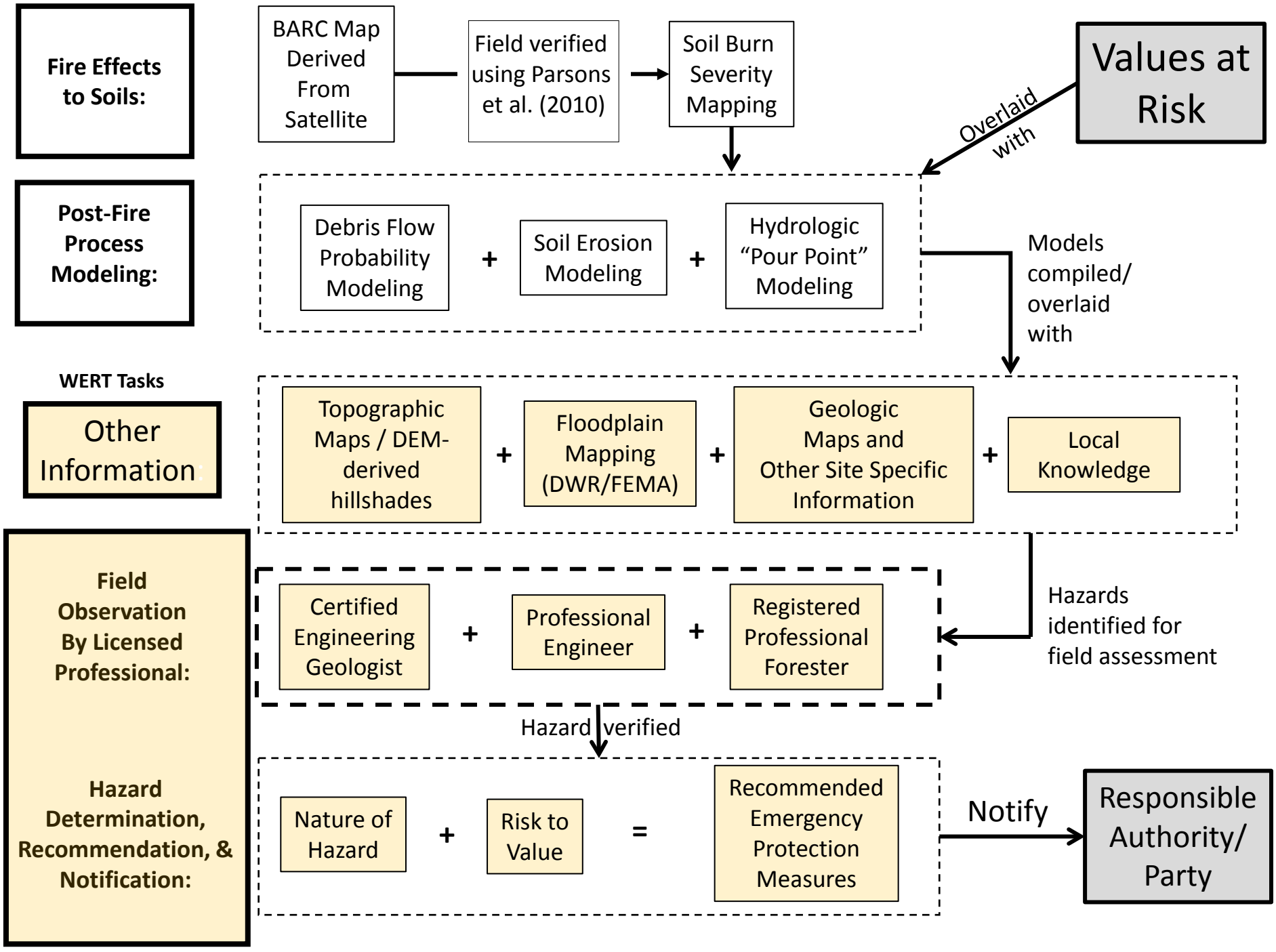
Main goal: Prioritize large fires that pose **significant threats to lives and property** from post-fire debris flows and flooding.

In some ways similar to USFS BAER teams, but rapid emergency protection measures are only recommended (private lands, no direct funding mechanism).

Much less emphasis on natural resources.

Factors:

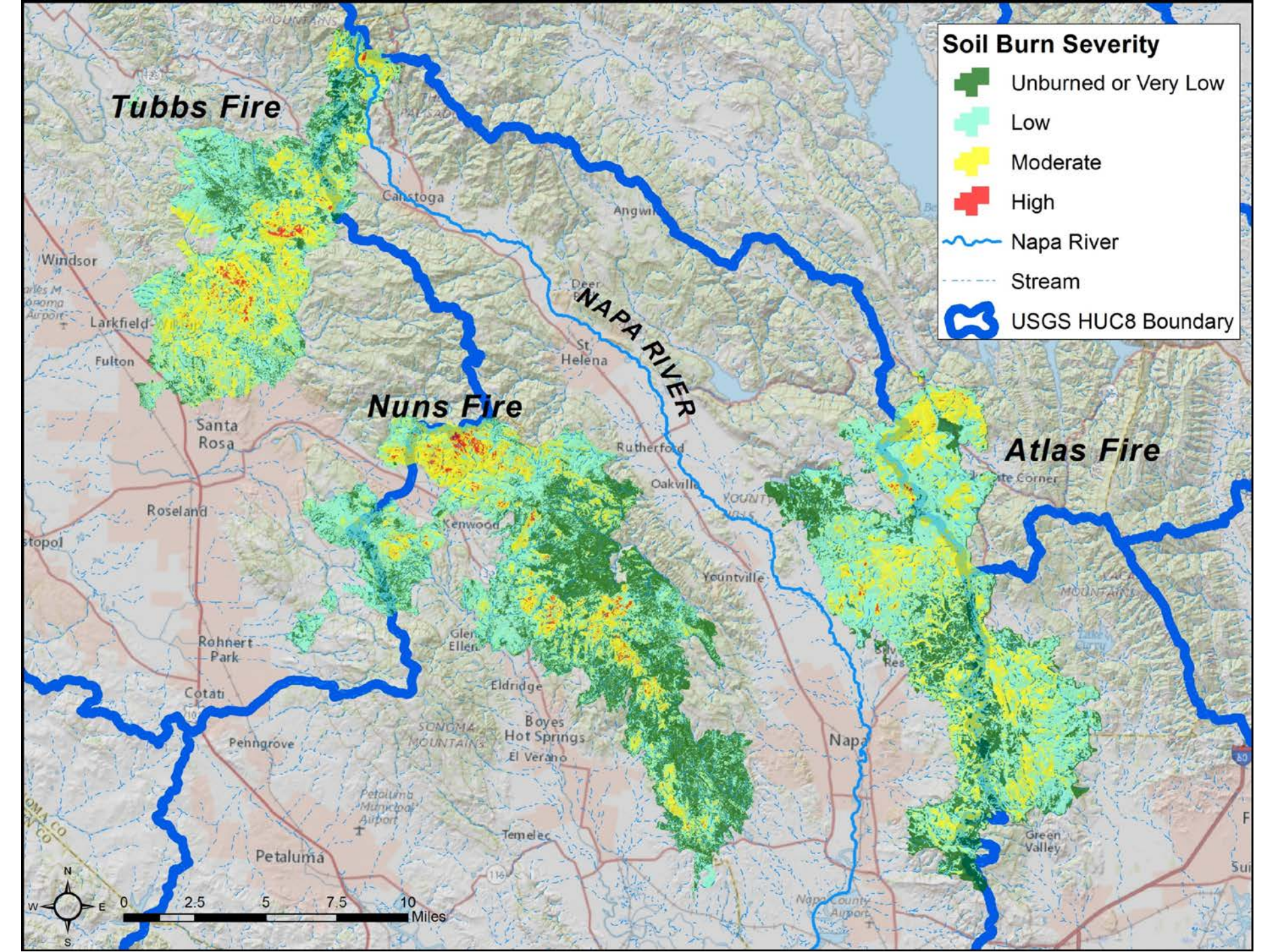
- Fire size, location in relation to values at risk.
- Proximity of intensely burned areas to housing developments.
- Likelihood of debris flows based on topography, geology, climate, etc.
- Proximity to flood prone areas.
- Presence of transportation networks, water supply systems, campgrounds, etc. at potentially high risk.

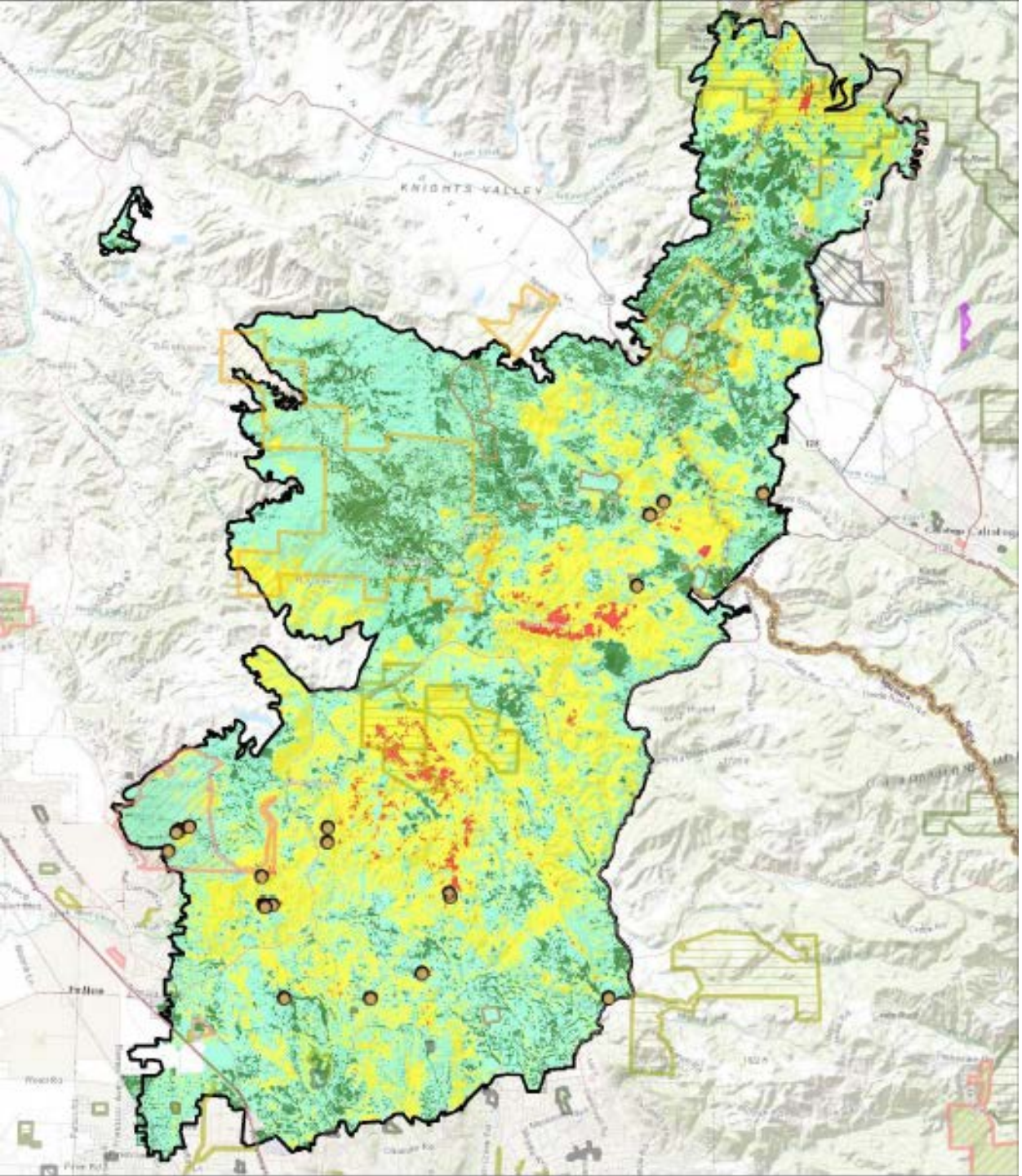

Fire Effects to Soils:
BARC Map Derived From Satellite
Field verified using Parsons et al. (2010)
Soil Burn Severity Mapping
Values at Risk
Overlaid with
Post-Fire Process Modeling:
Debris Flow Probability Modeling
+
Soil Erosion Modeling
+
Hydrologic "Pour Point" Modeling
Models compiled/ overlaid with
WERT Tasks
Other Information:
Topographic Maps / DEM-derived hillshades
+
Floodplain Mapping (DWR/FEMA)
+
Geologic Maps and Other Site Specific Information
+
Local Knowledge
Field Observation By Licensed Professional:
Certified Engineering Geologist
+
Professional Engineer
+
Registered Professional Forester
Hazards identified for field assessment
Hazard verified
Hazard Determination, Recommendation, & Notification:
Nature of Hazard
+
Risk to Value
=
Recommended Emergency Protection Measures
Notify
Responsible Authority/ Party

Soil Burn Severity is a Primary Post-Fire Driver!

- Start with Satellite-Derived Burned Area Reflectance Classification (BARC) Map
- Validate BARC map to create Soil Burn Severity Map
  - Look at soil cover
  - Changes to soil structure
  - Water repellency

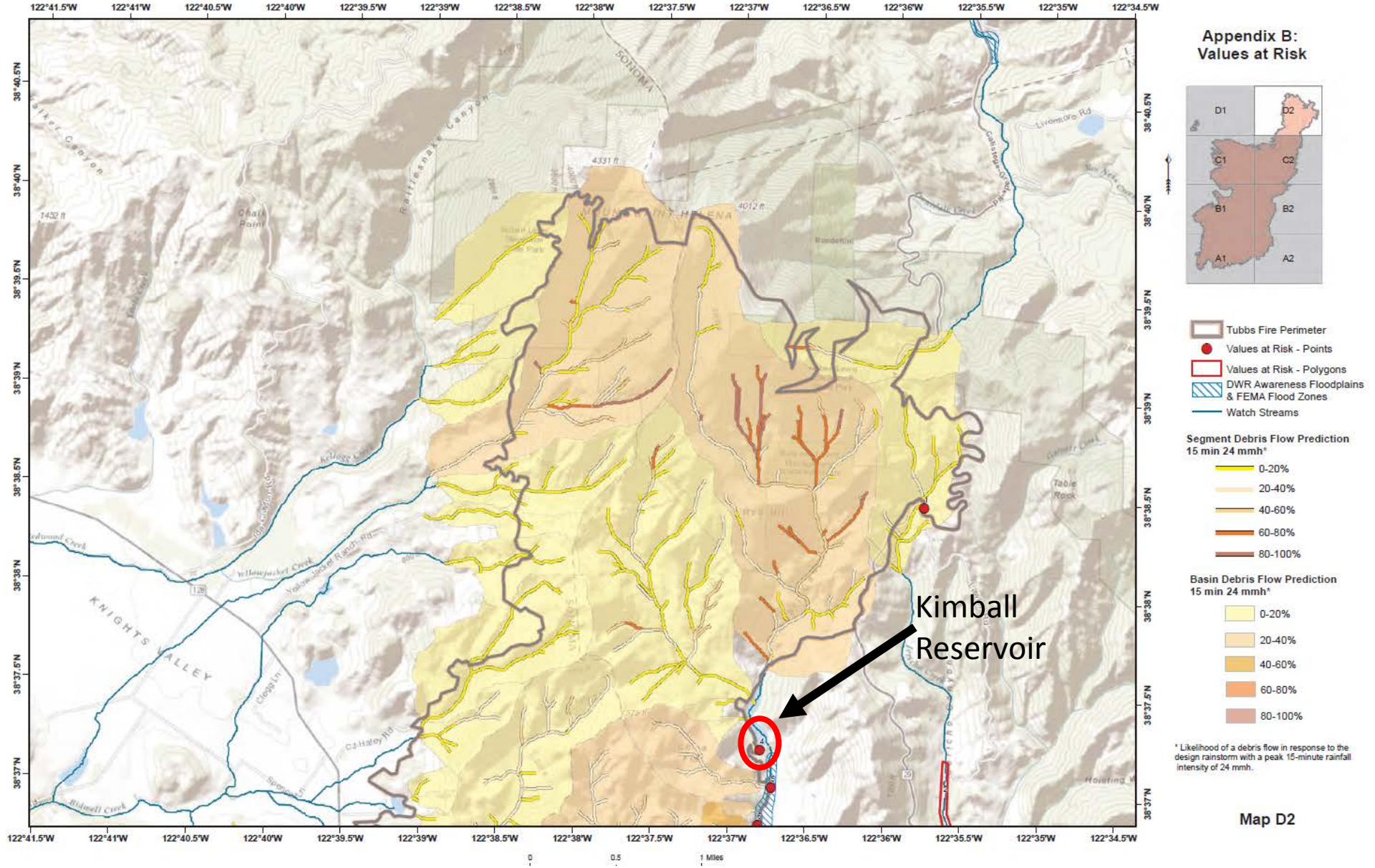

128


Soil Burn Severity
Unburned or Very Low
Low
Moderate
High
Napa River
Stream
USGS HUC8 Boundary
Tubbs Fire
Nuns Fire
Atlas Fire
NAPA RIVER
Windsor
Larkfield
Fulton
Santa Rosa
Roseland
Rohnert Park
Cotati
Penngrove
Petaluma
Petaluma Municipal Airport
Temelec
Boyes Hot Springs
El Verano
Sonoma Mountains
Eldridge
Glen Ellen
Kenwood
Oakville
Rutherford
St Helena
Deer Park
Calistoga
Yountville
Napa
Green Valley
Napa County Airport
N
W
E
S
0
2.5
5
7.5
10
Miles

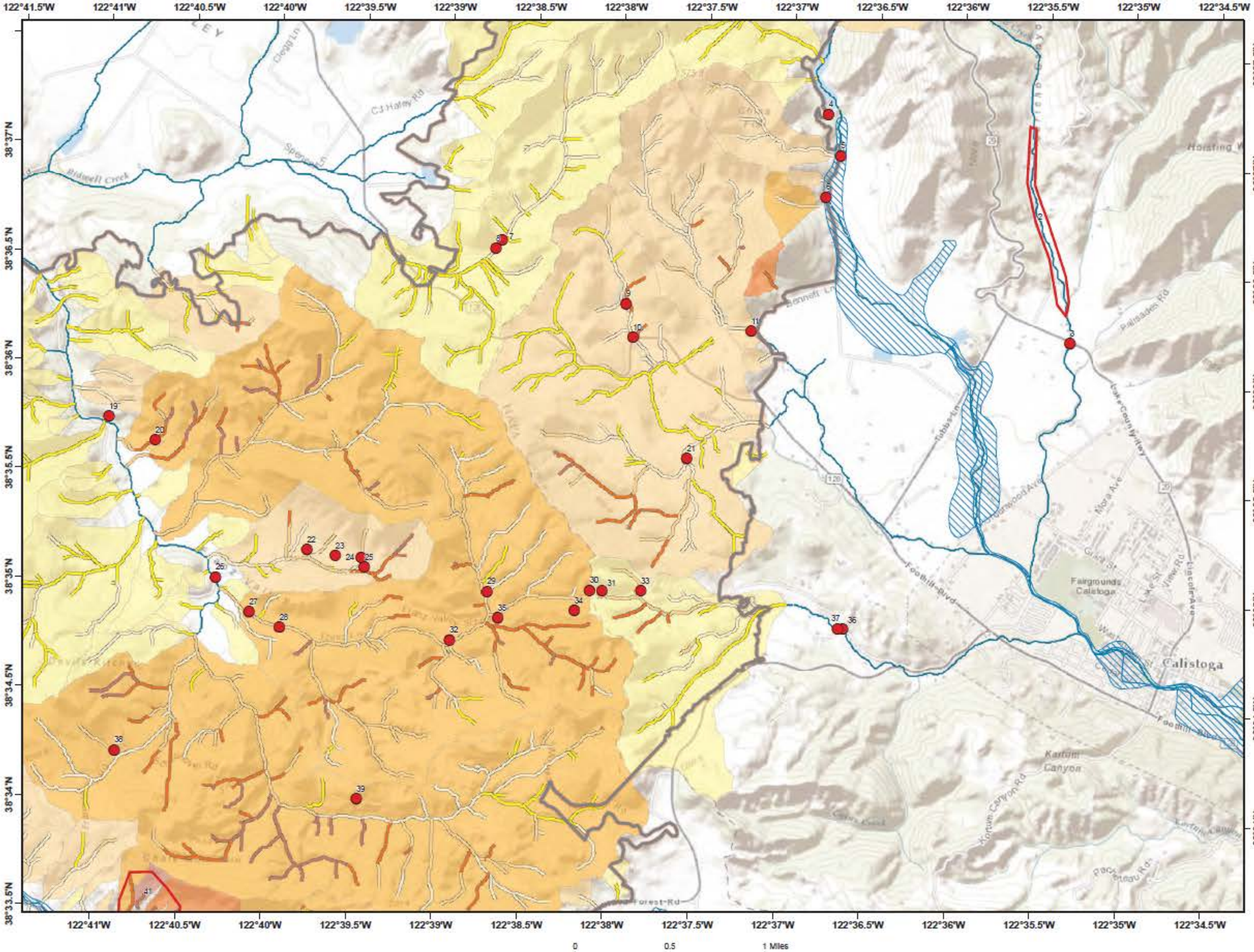


Napa Watershed - Tubbs Fire

- Generally low soil burn severity
- Moderate soil burn severity proximal to Robert Louis Stevenson S.P.


Appendix B:
Values at Risk
D1
D2
C1
C2
B1
B2
A1
A2
Tubbs Fire Perimeter
Values at Risk - Points
Values at Risk - Polygons
DWR Awareness Floodplains & FEMA Flood Zones
Watch Streams
Segment Debris Flow Prediction 15 min 24 mmh*
0-20%
20-40%
40-60%
60-80%
80-100%
Basin Debris Flow Prediction 15 min 24 mmh*
0-20%
20-40%
40-60%
60-80%
80-100%
* Likelihood of a debris flow in response to the design rainstorm with a peak 15-minute rainfall intensity of 24 mmh.
Kimball Reservoir
Map D2
122°41.5'W
122°41'W
122°40.5'W
122°40'W
122°39.5'W
122°39'W
122°38.5'W
122°38'W
122°37.5'W
122°37'W
122°36.5'W
122°36'W
122°35.5'W
122°35'W
122°34.5'W
38°40.5'N
38°40'N
38°39.5'N
38°39'N
38°38.5'N
38°38'N
38°37.5'N
38°37'N
0
0.5
1 Miles

Appendix B: Values at Risk



Tubbs Fire Perimeter

Values at Risk - Points

Values at Risk - Polygons

DWR Awareness Floodplains & FEMA Flood Zones

Watch Streams

Segment Debris Flow Prediction 15 min 24 mmh*

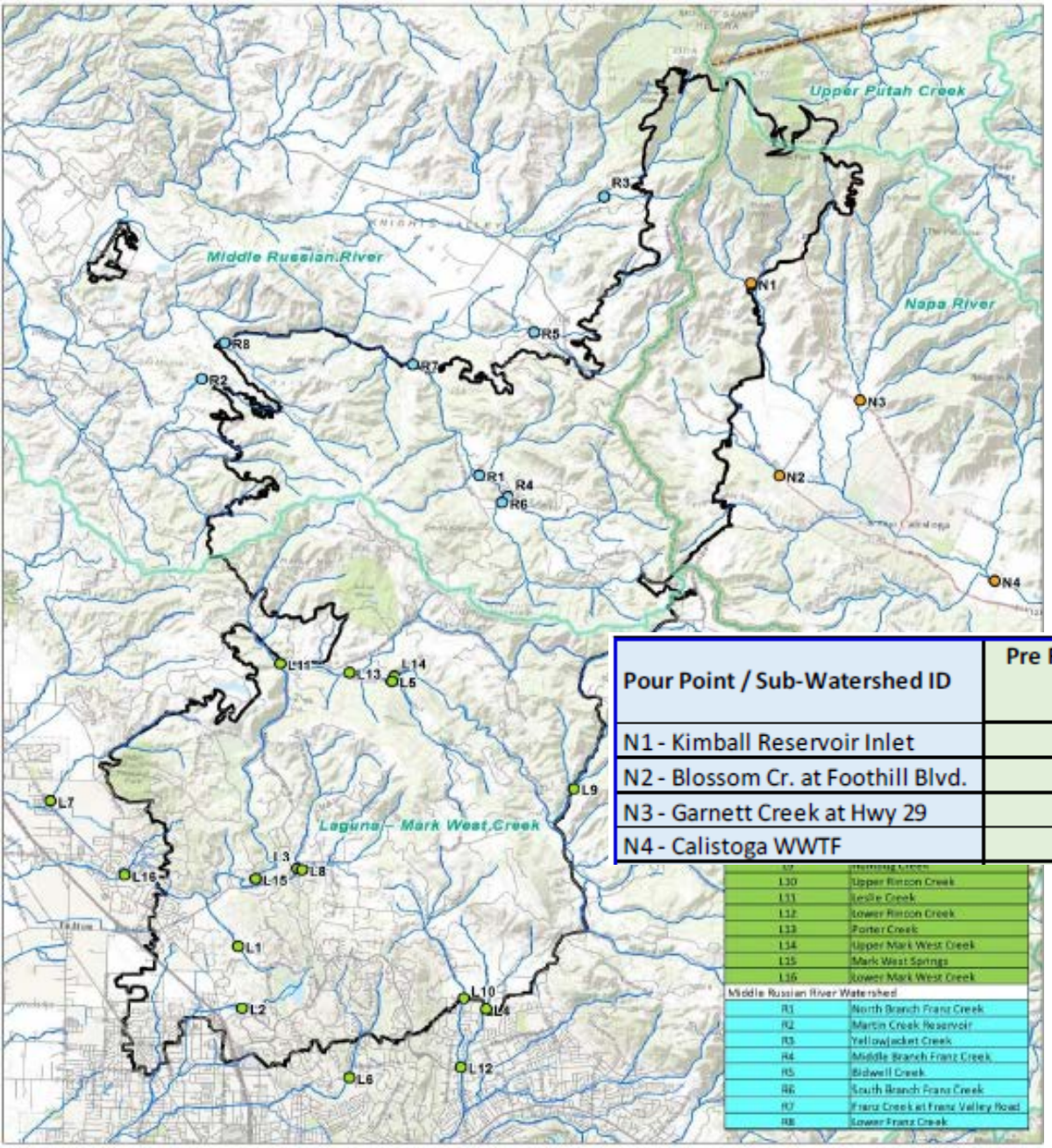
- 0-20%
- 20-40%
- 40-60%
- 60-80%
- 80-100%

Basin Debris Flow Prediction 15 min 24 mmh*

- 0-20%
- 20-40%
- 40-60%
- 60-80%
- 80-100%

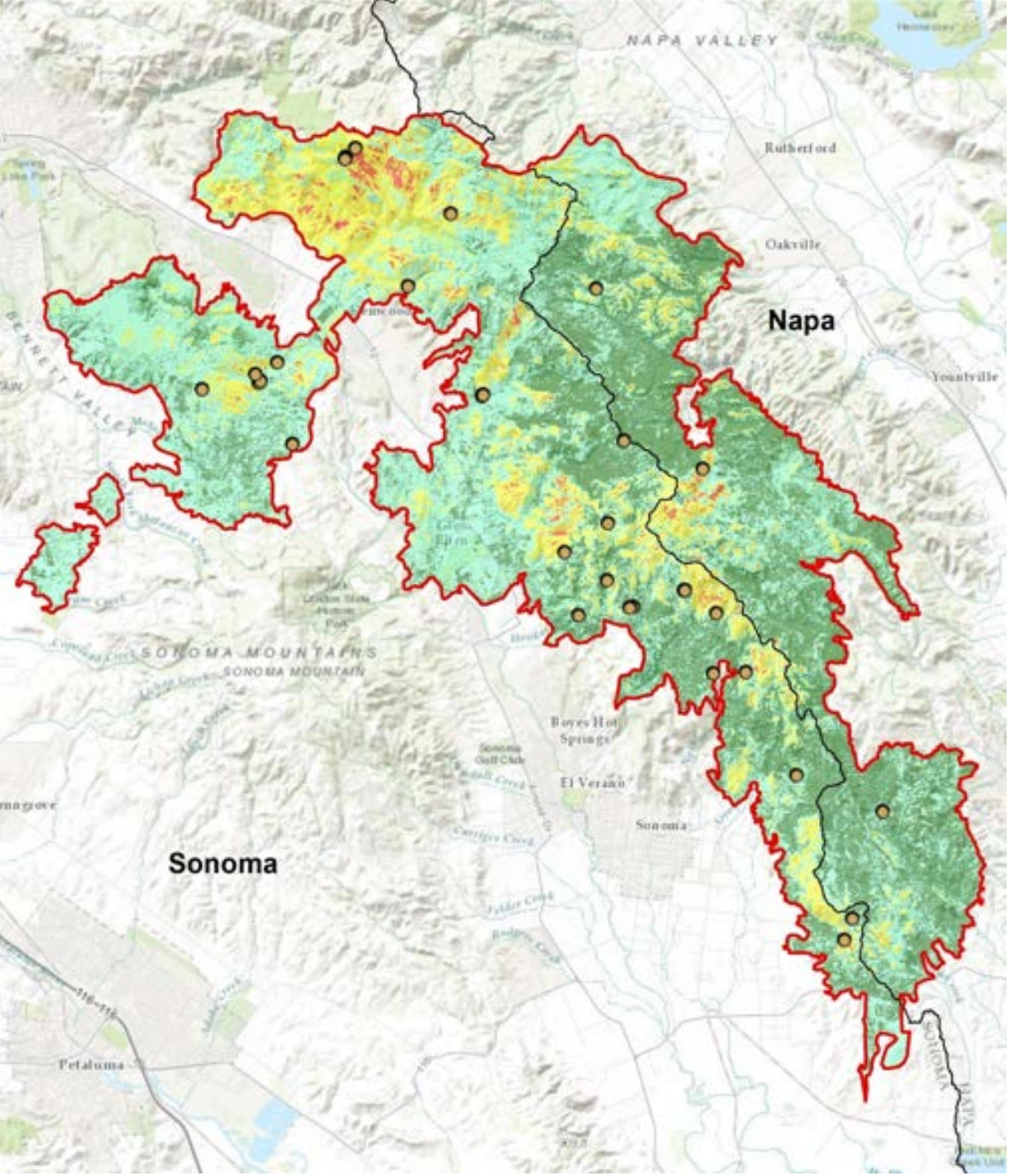
* Likelihood of a debris flow in response to the design rainstorm with a peak 15-minute rainfall intensity of 24 mmh.

Map C2



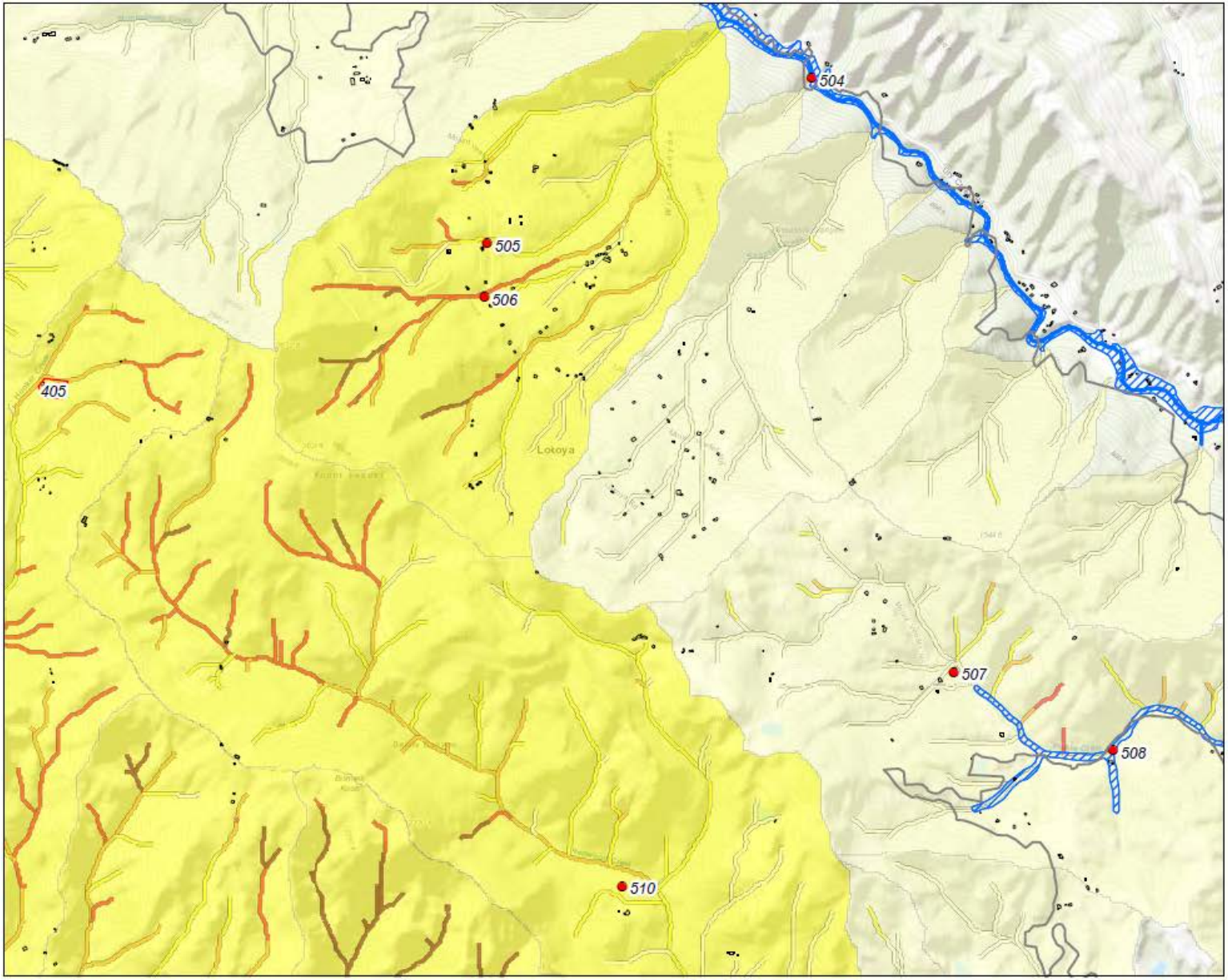
No flow increases predicted over 20 percent over pre-fire conditions

Pour Point / Sub-Watershed ID	Pre Fire Discharge Q10 (cfs)	Post Fire Discharge Q10 (cfs)	10 Yr Increase % Increase
N1 - Kimball Reservoir Inlet	317	356	12
N2 - Blossom Cr. at Foothill Blvd.	770	918	19
N3 - Garnett Creek at Hwy 29	1,188	1211	2
N4 - Calistoga WWTF	5,433	5786	6

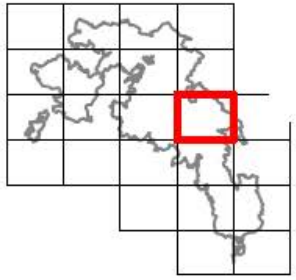


Napa Watershed - Nuns Fire

- Mostly low soil burn severity in the Napa River watershed
- Higher proportions of moderate soil burn severity in Redwood Creek



Appendix C:
Values at Risk Map



- Nuns Fire Perimeter as of 10/25/2017
- Values at Risk - Points
- Values at Risk - Polygons
- USGS Watch Streams
- Building Footprints
- DWR Awareness Floodplains
- FEMA Flood Zone

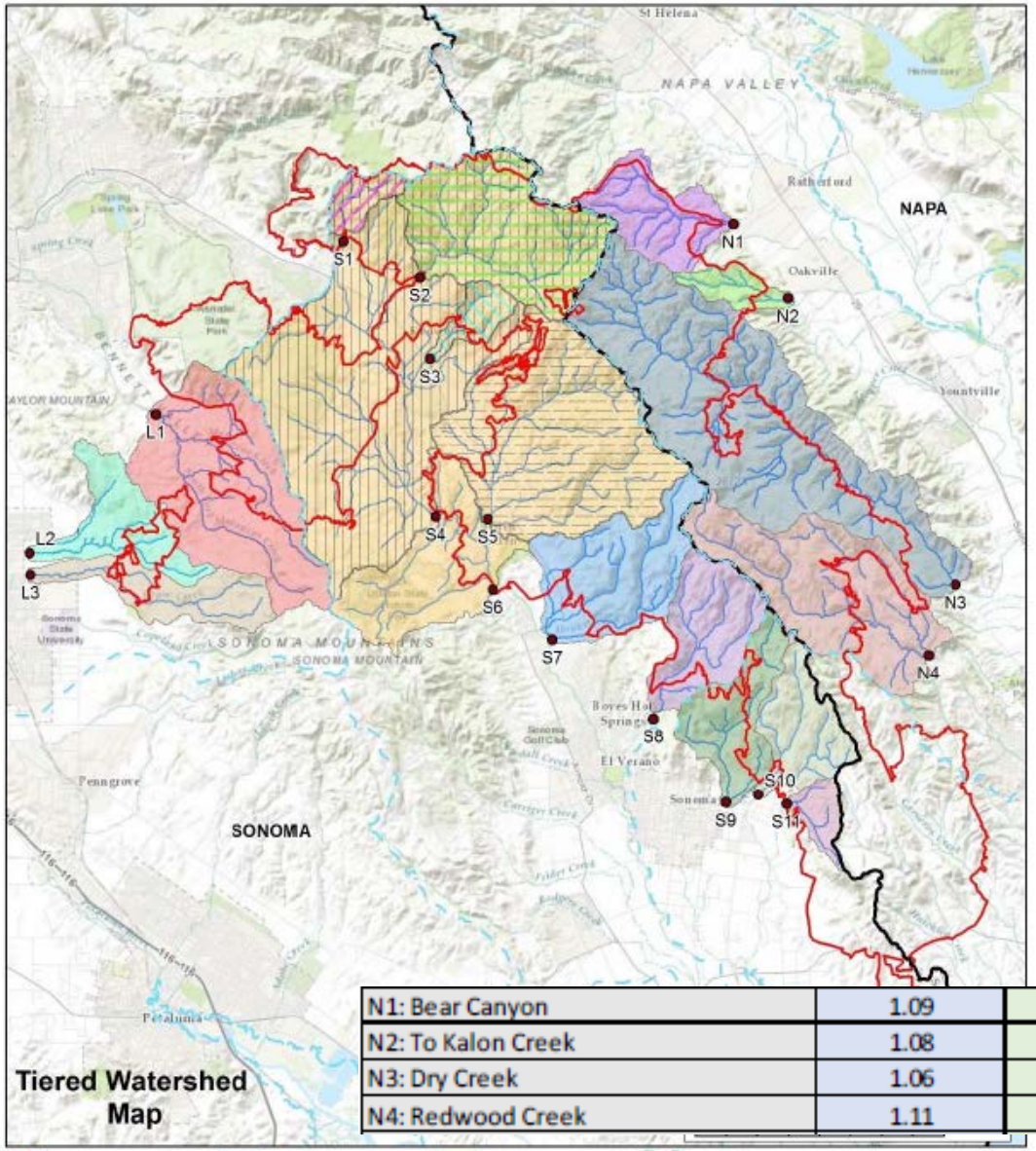
Basin Debris Flow Prediction
15 min 24 mmh*
- 0-20%
- 20-40%
- 40-60%
- 60-80%
- 80-100%

Segment Debris Flow Prediction
15 min 24 mmh*
- 0-20%
- 20-40%
- 40-60%
- 60-80%
- 80-100%

0 0.2 0.4 0.8 Miles

N

* Likelihood of a debris flow in response to the design rainstorm with a peak 15-minute rainfall intensity of 24mmh

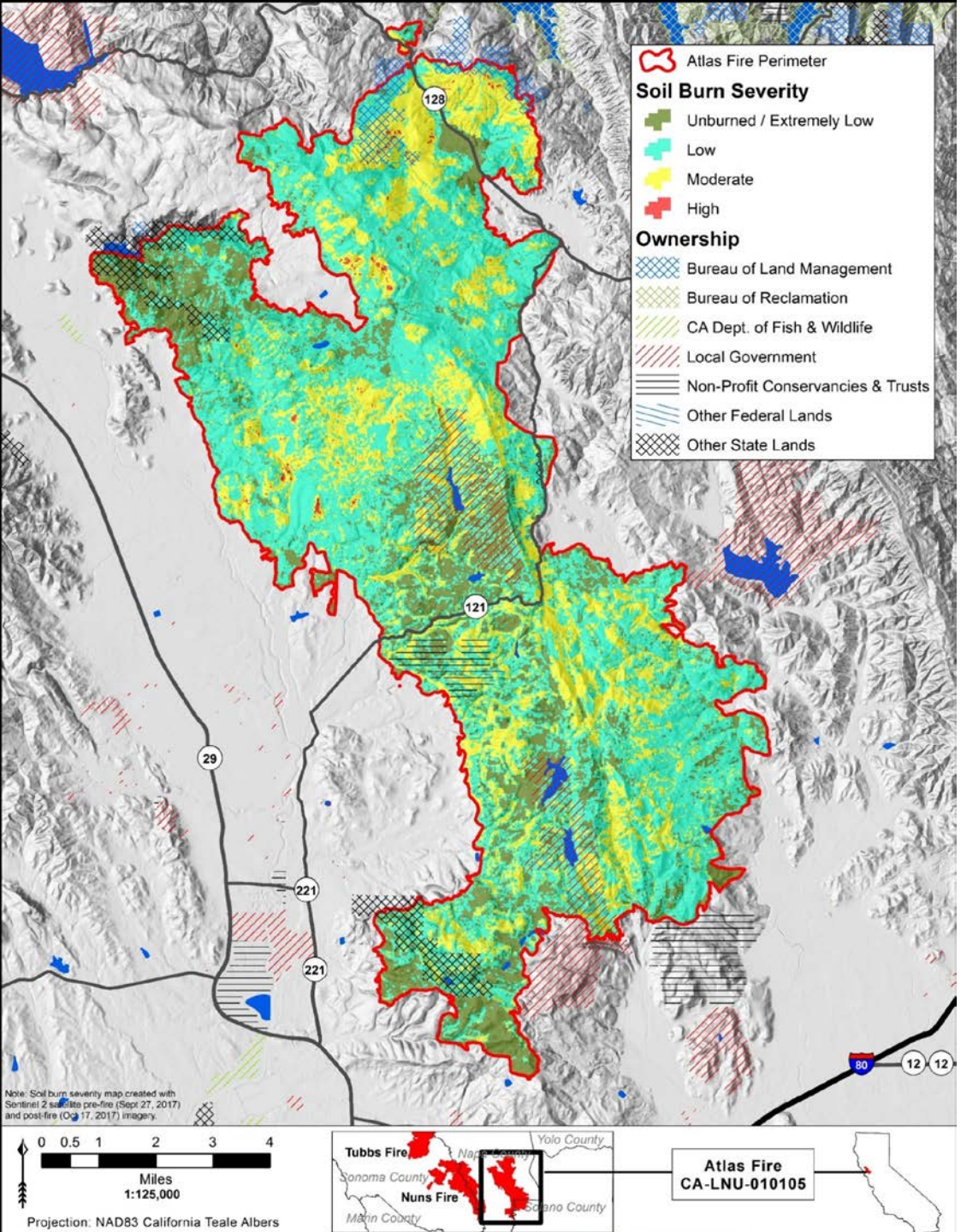


N1: Bear Canyon	1.09	945	1027	8.7
N2: To Kalon Creek	1.08	361	392	8.5
N3: Dry Creek	1.06	4097	4360	6.4
N4: Redwood Creek	1.11	2223	2458	10.6

S1: Pythian
S2: Adobe Canyon
S3: Kinnybrook
S4: Yulupa Creek
S5: Nuns Canyon
S6: Sonoma Creek d.s. of Ashbury Creek
S7: Hooker Creek
S8: Aqua Caliente
S9: Nathanson
S10: Arroyo Seco
S11: Haraszthy Creek
N1: Bear Canyon
N2: To Kalon Creek
N3: Dry Creek
N4: Redwood Creek
L1: Bennett Valley
L2: Rohnert Park
L3: Crane Creek
HUC 10 Watershed
California County Boundaries
Nuns Fire Perimeter as of 10/25/2017
Streams
N

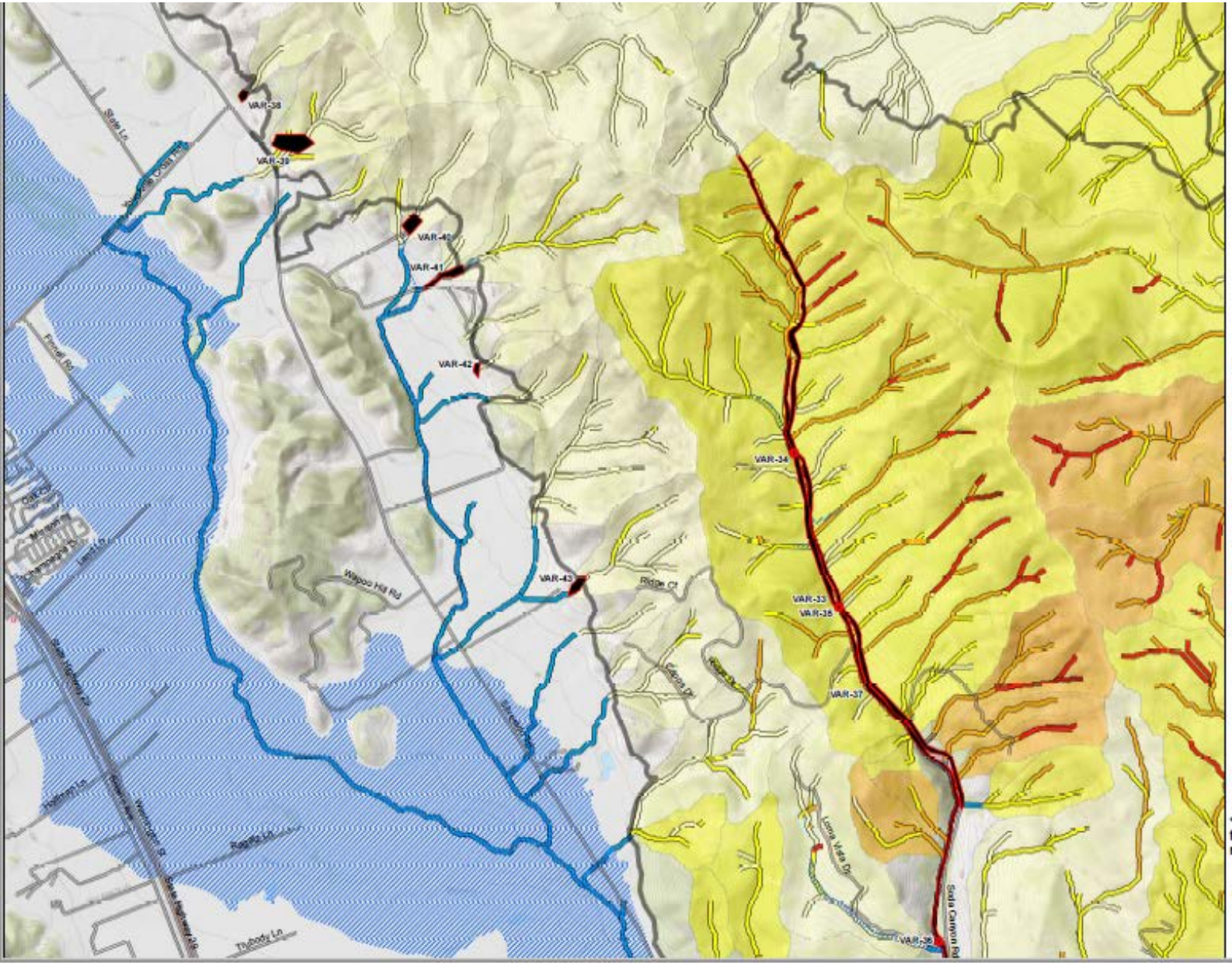
*Watersheds S1, S2, S3, S4,S5, and S6 have overlaps with one another

No predicted flood flows over 11 percent for Napa River tributaries

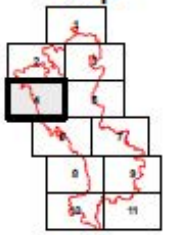


Napa Watershed –Atlas Fire

- Mostly low soil burn severity in the Napa River watershed
- Higher proportions of moderate soil burn severity in Milliken Creek, Sarco, Soda Canyon, and Hagen Creeks



Appendix C Values at Risk Map



Page 4

Atlas Fire Perimeter

Value at Risk (point)

Value at Risk (polygon)

FEMA Flood Zone & DWR Awareness Floodplain

Segment Debris Flow Prediction

15min 24 mm/hr *

0-20%

20-40%

40-60%

60-80%

80-100%

USGS Watchstream

Basin Debris Flow Prediction

15 min 24 mm/hr *

0-20%

20-40%

40-60%

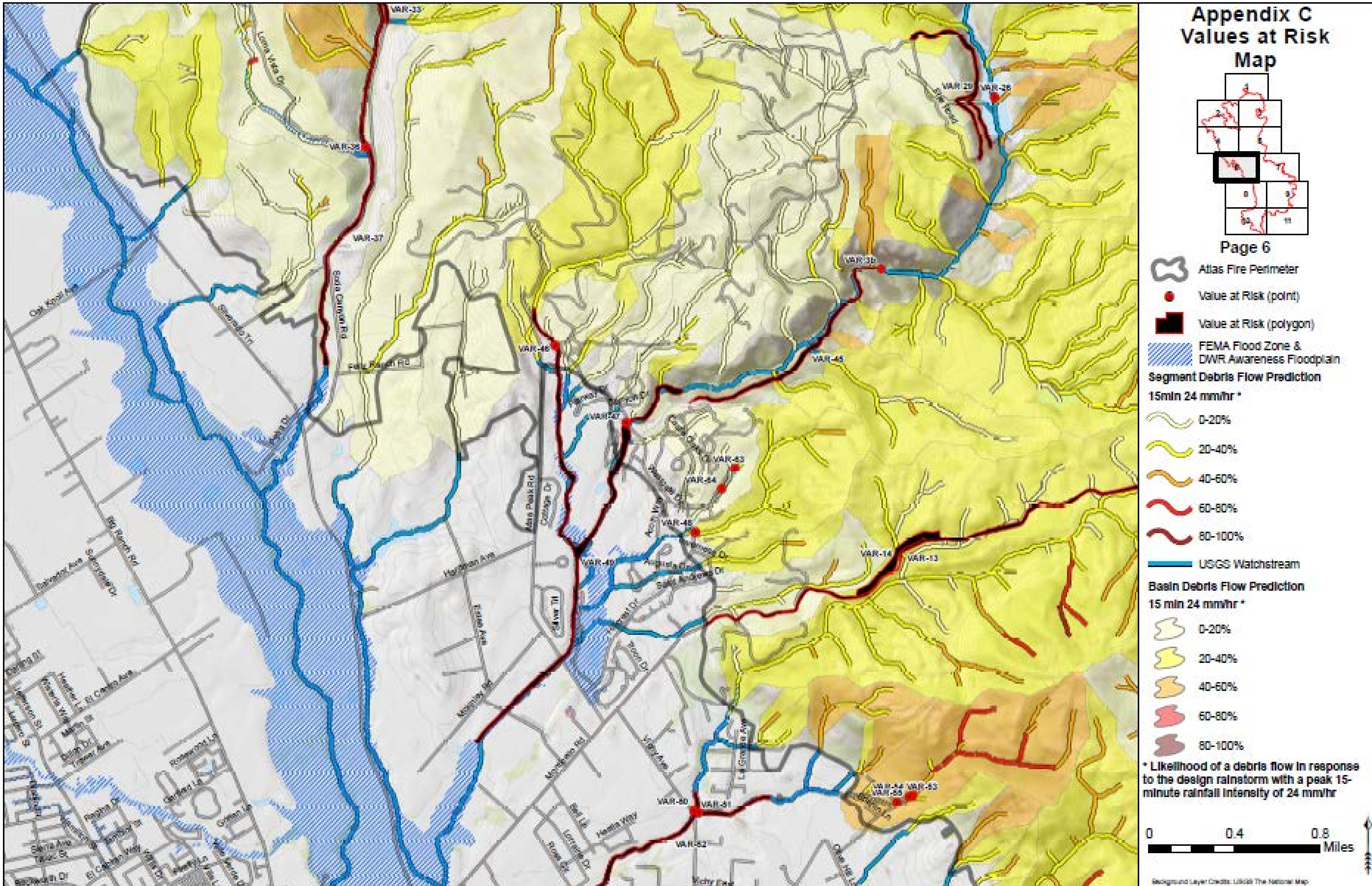
60-80%

80-100%

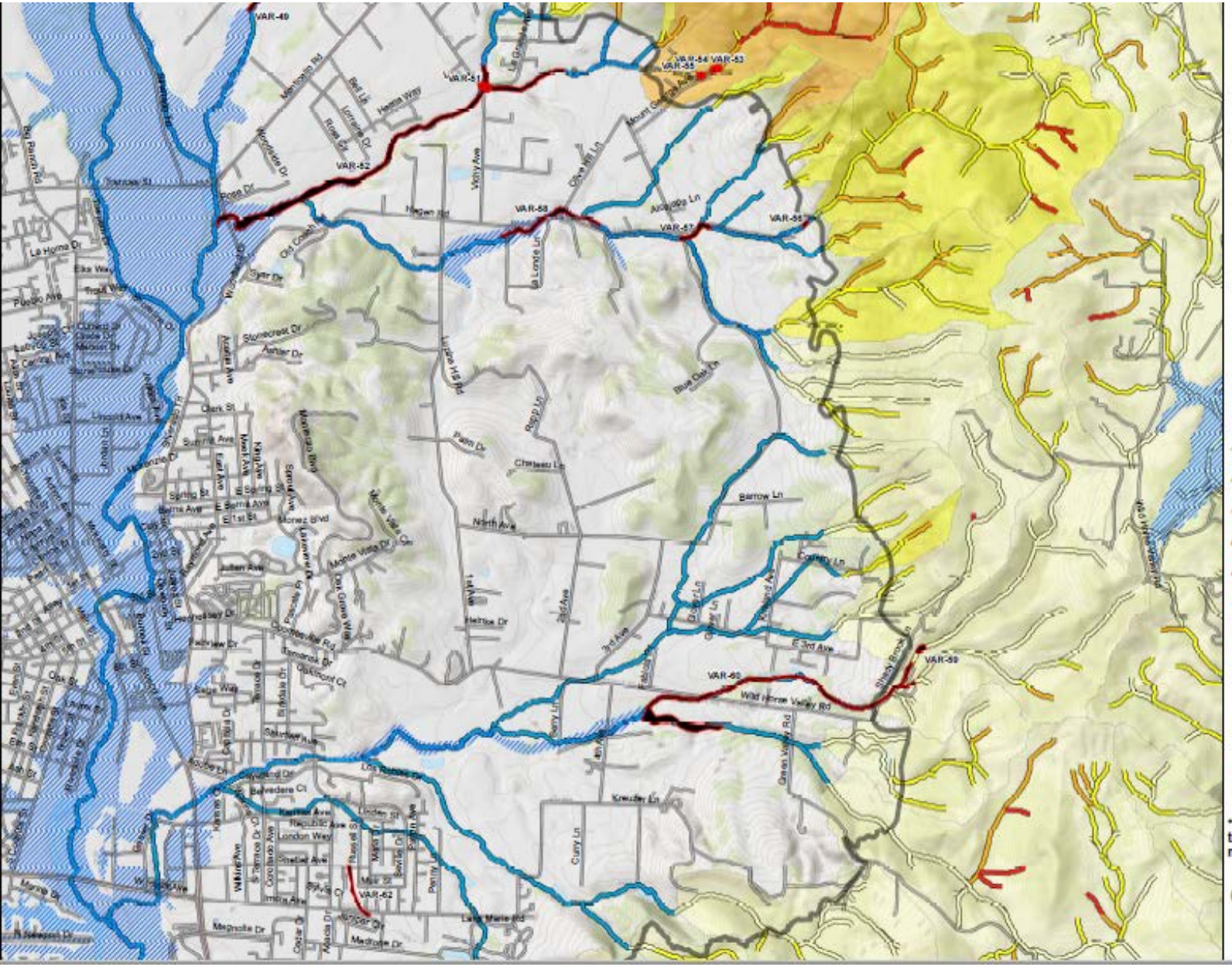
*** Likelihood of a debris flow in response to the design rainstorm with a peak 15-minute rainfall intensity of 24 mm/hr**

0 0.4 0.8 Miles

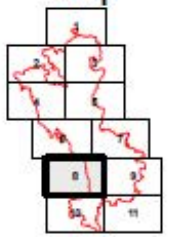
Background Layer Credits: USGS The National Map
Elevation source: Interred 3m DEM



Appendix C
Values at Risk
Map
Page 6
Atlas Fire Perimeter
Value at Risk (point)
Value at Risk (polygon)
FEMA Flood Zone &
DWR Awareness Floodplain
Segment Debris Flow Prediction
15min 24 mm/hr *
0-20%
20-40%
40-60%
60-80%
80-100%
USGS Watchstream
Basin Debris Flow Prediction
15 min 24 mm/hr *
0-20%
20-40%
40-60%
60-80%
80-100%
* Likelihood of a debris flow in response to the design rainstorm with a peak 15-minute rainfall intensity of 24 mm/hr
0
0.4
0.8
Miles
VAR-33
VAR-36
VAR-37
VAR-46
VAR-47
VAR-48
VAR-49
VAR-14
VAR-13
VAR-50
VAR-51
VAR-52
Soda Canyon Rd
Atlas Peak Rd
Hardman Ave
Vichy Ave



Appendix C Values at Risk Map



Page 8

Atlas Fire Perimeter

Value at Risk (point)

Value at Risk (polygon)

FEMA Flood Zone & DWR Awareness Floodplain

Segment Debris Flow Prediction

15min 24 mm/hr *

0-20%

20-40%

40-60%

60-80%

80-100%

USGS Watchstream

Basin Debris Flow Prediction

15 min 24 mm/hr *

0-20%

20-40%

40-60%

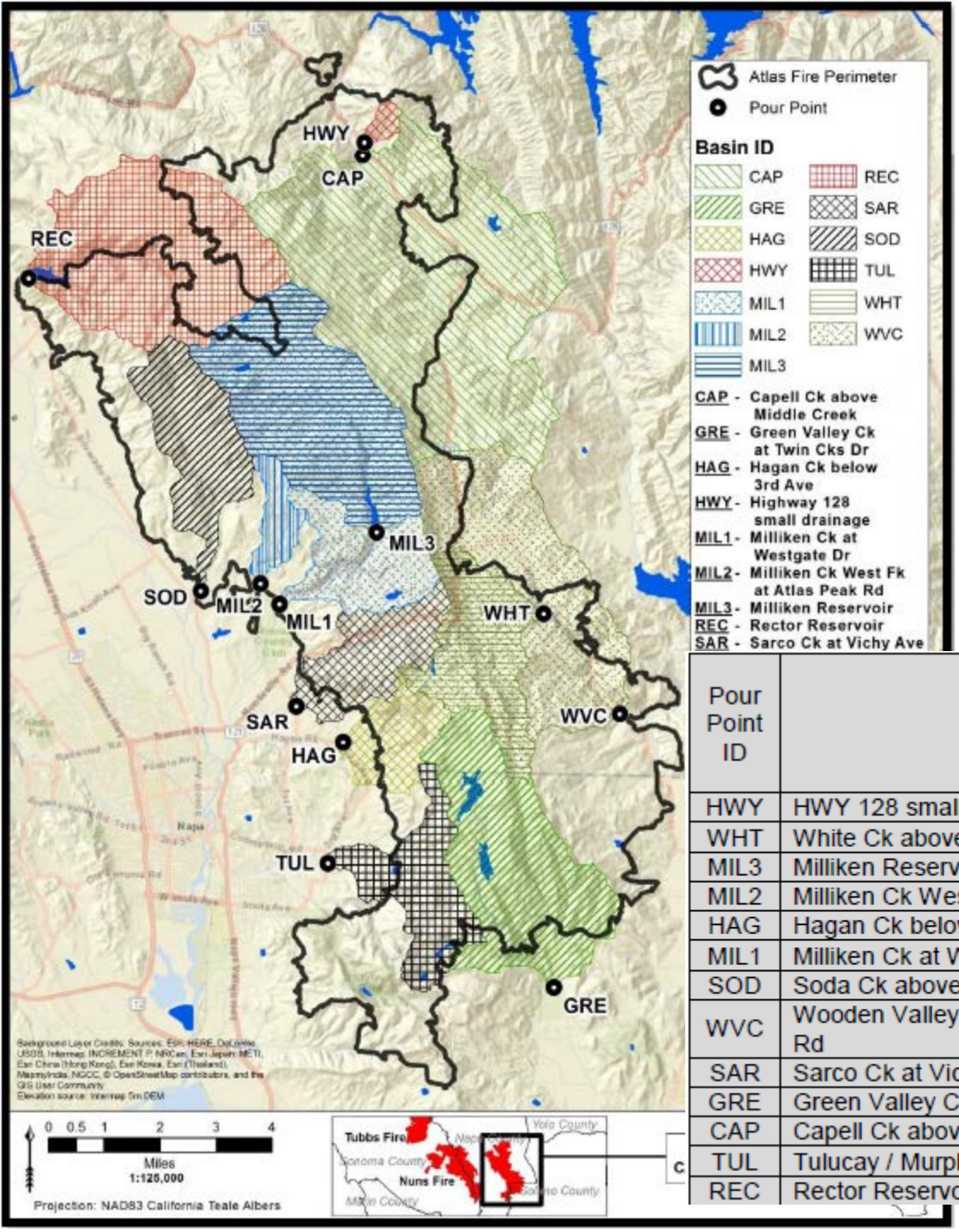
60-80%

80-100%

*** Likelihood of a debris flow in response to the design rainstorm with a peak 15-minute rainfall intensity of 24 mm/hr**

0 0.4 0.8 Miles

Background Layer Credits: USGS The National Map
Elevation source: Interrnac 5m DEM



Eastern tributaries of Napa have predicted increases ranging from 20-30 percent

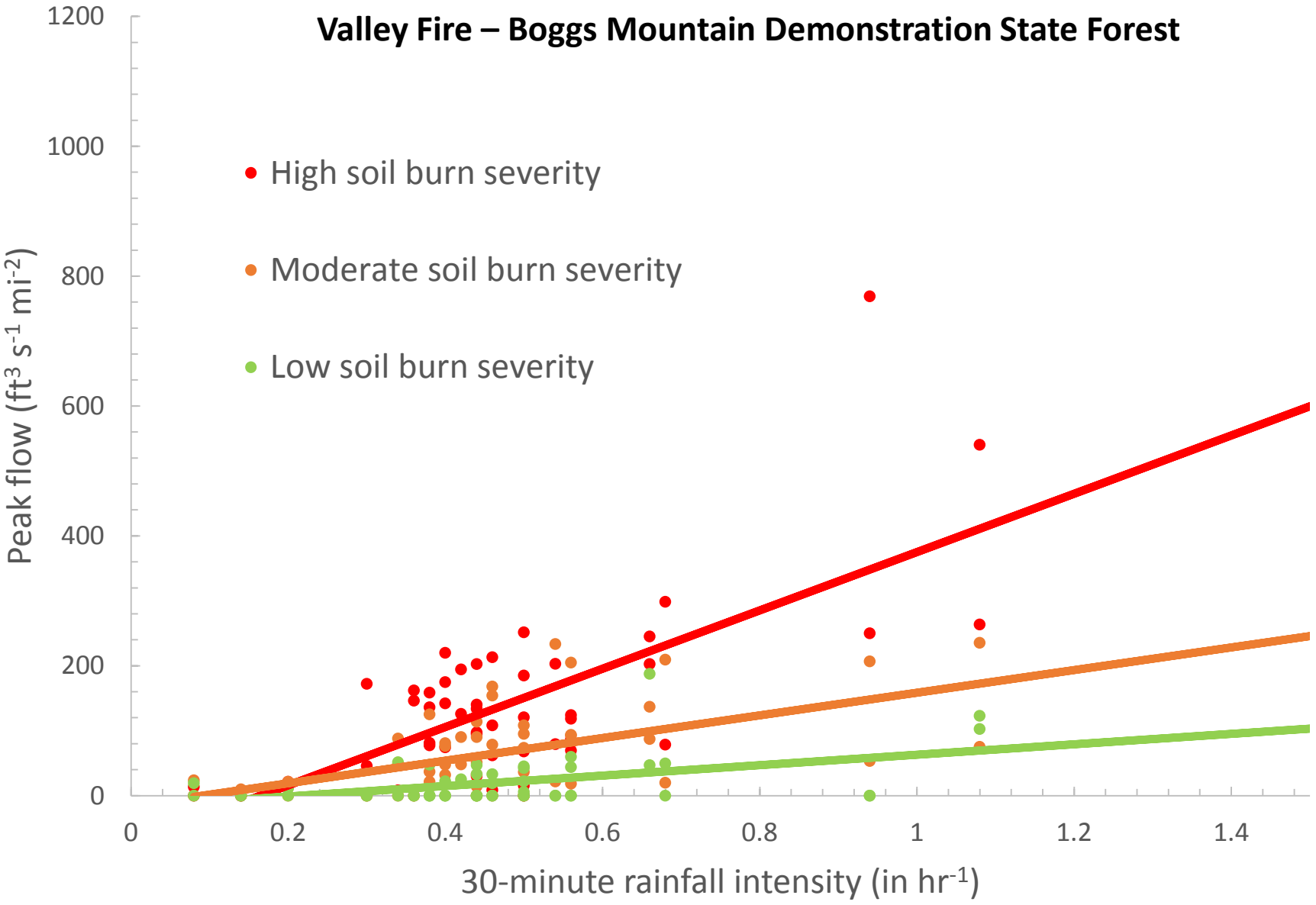
Pour Point ID	Description	Flow Increase from Pre-Fire Conditions*	Post-Fire Adjusted Return Interval*
HWY	HWY 128 small drainage	90%	~150
WHT	White Ck above Wooden Valley Rd	37%	30
MIL3	Milliken Reservoir	32%	25
MIL2	Milliken Ck West Fk at Atlas Peak Rd	30%	25
HAG	Hagan Ck below 3rd Ave	27%	20 - 25
MIL1	Milliken Ck at Westgate Dr	27%	20 - 25
SOD	Soda Ck above Silverado Trail	27%	20 - 25
WVC	Wooden Valley Ck above Wooden Valley Rd	23%	20
SAR	Sarco Ck at Vichy Ave	21%	15 - 20
GRE	Green Valley Ck at Twin Cks Dr	20%	15 - 20
CAP	Capell Ck above Middle Ck	17%	15 - 20
TUL	Tulucay / Murphy Ck at 4th Ave	15%	15
REC	Rector Reservoir	5%	10 - 12

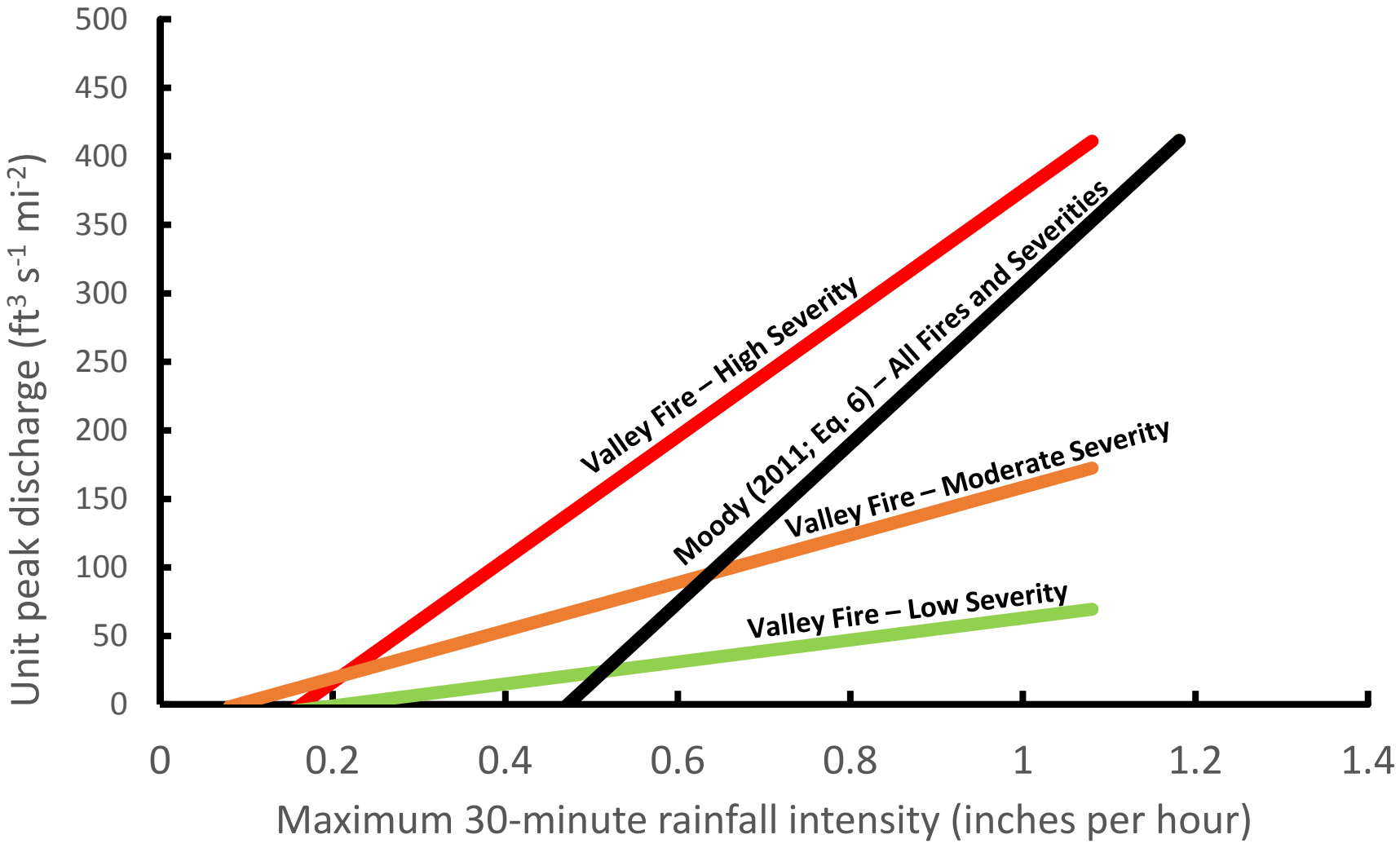
Milliken Creek Watershed

Milliken Creek Intake and Water Line


What Else Needs to be Done?
Cannot Be Successful in Preventing Impacts Unless You Understand Underlying Mechanisms

Soil Burn Severity and Weather are the Primary Drivers!!




Unit peak discharge (ft3 s-1 mi-2)
500
450
400
350
300
250
200
150
100
50
0
0
0.2
0.4
0.6
0.8
1
1.2
1.4
Maximum 30-minute rainfall intensity (inches per hour)
Valley Fire – High Severity
Moody (2011; Eq. 6) – All Fires and Severities
Valley Fire – Moderate Severity
Valley Fire – Low Severity

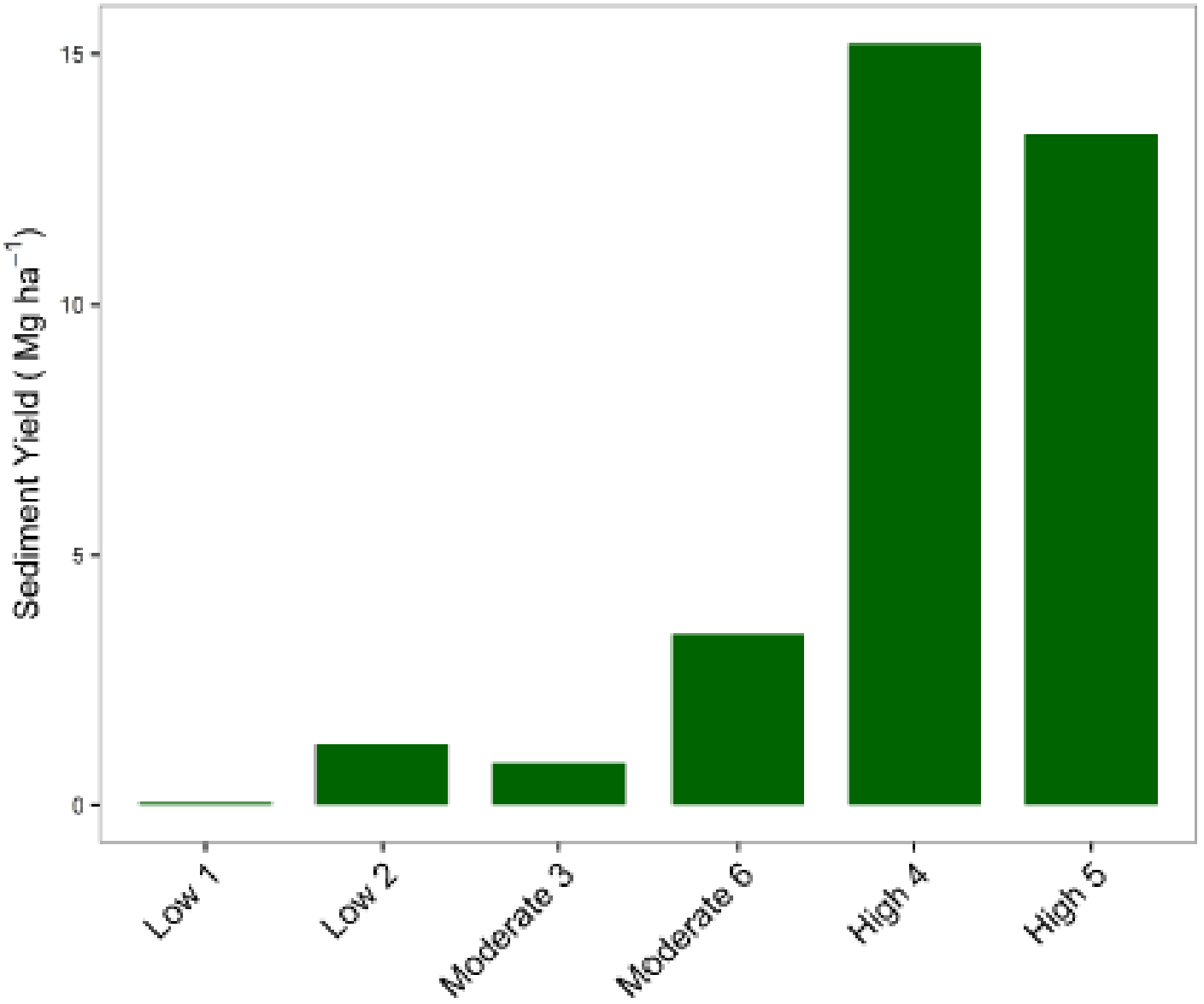
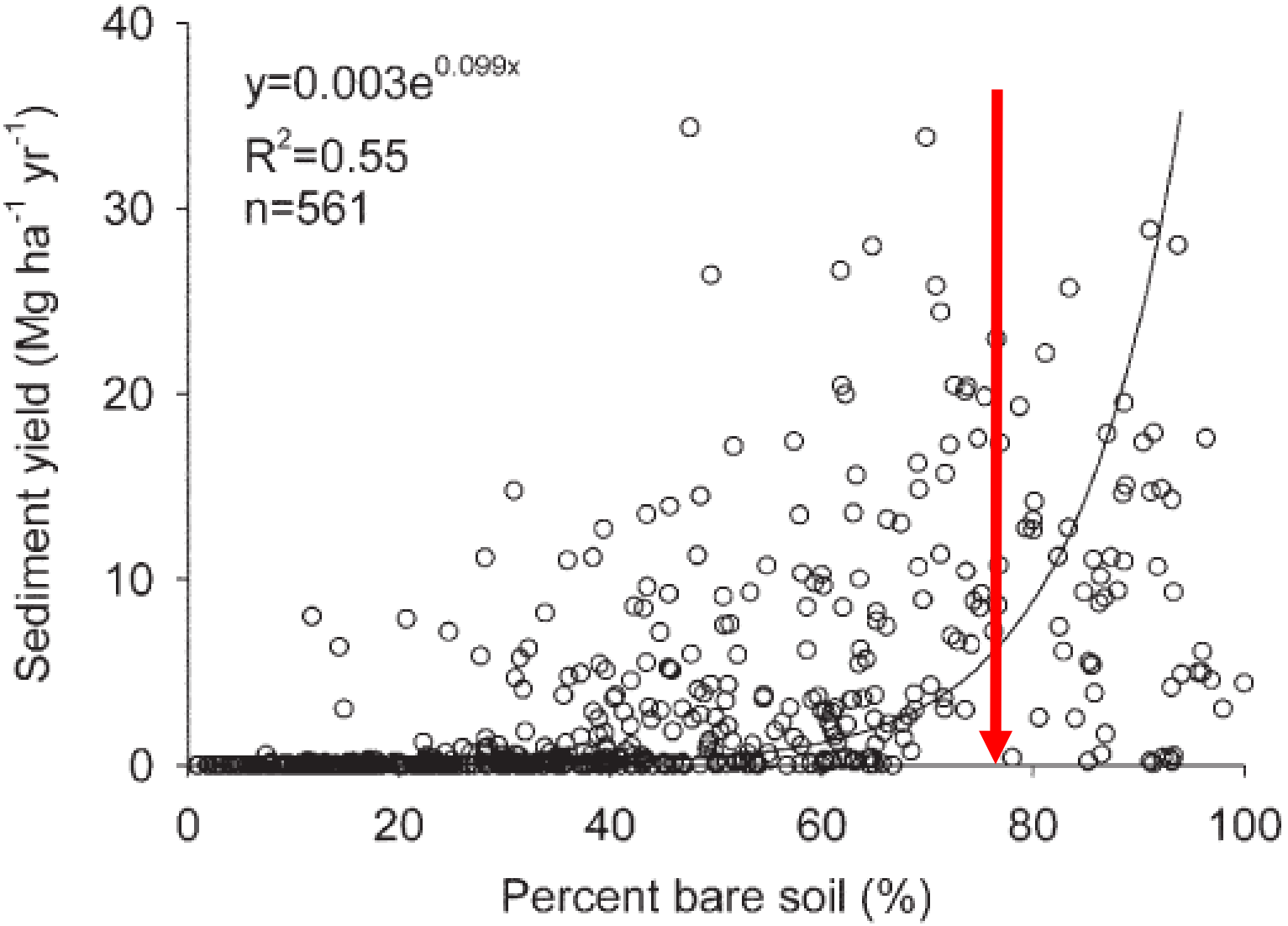


Figure 2.8: Sediment yields by swale and burn severity at BMDSF from October 2015 to June 2016. No additional sediment was produced through September 2016.

(Olsen, 2016)

Boggs Mountain Demonstration State Forest – Frontal Storms/Volcanics

Colorado Front Range – Convective Storms/Granitics



(Larsen et al., 2009)

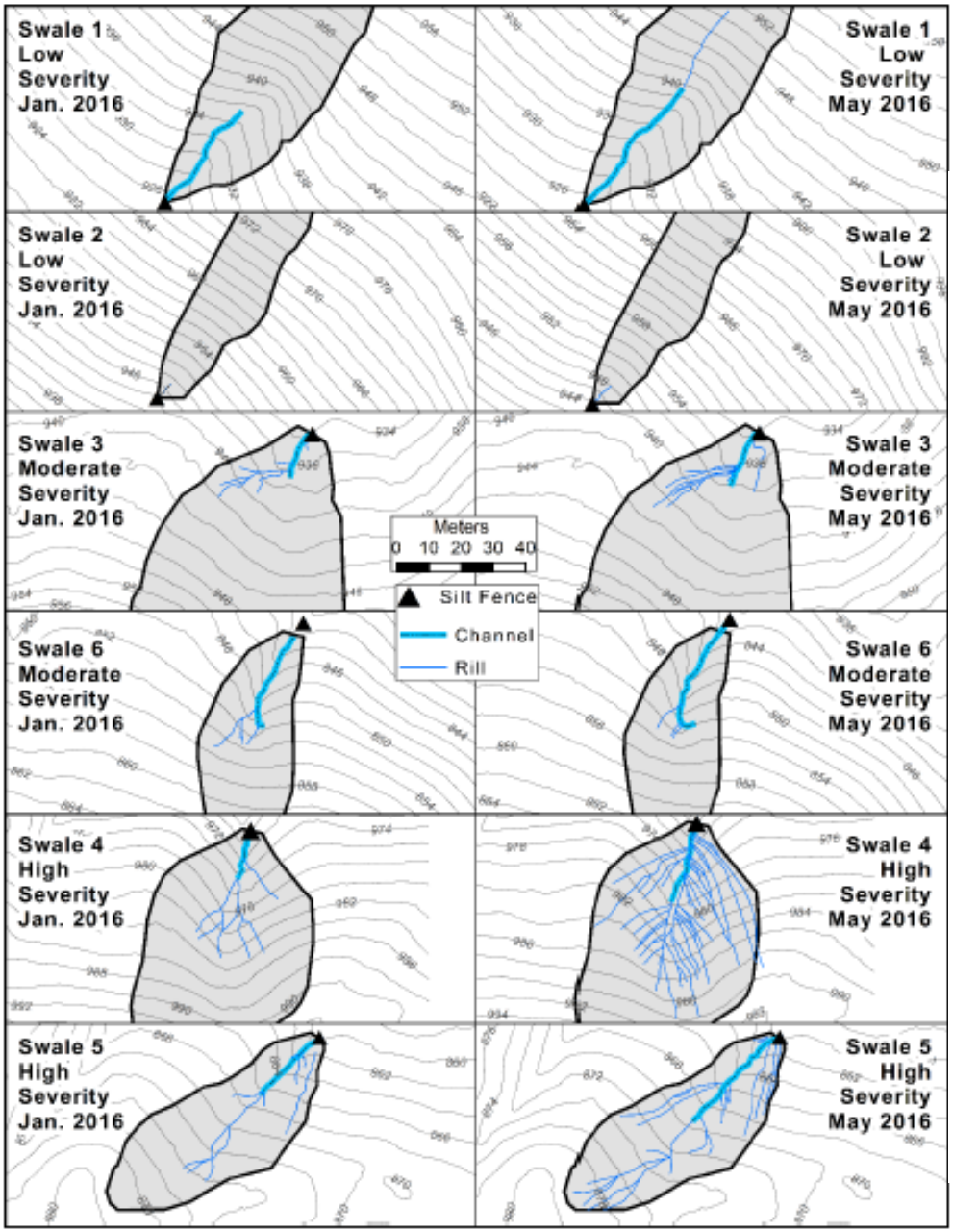


Figure 2.7: Rill networks in BMDSF swales in January 2016 (Left) and May 2016 (Right). Scale in each map is 1:1300.

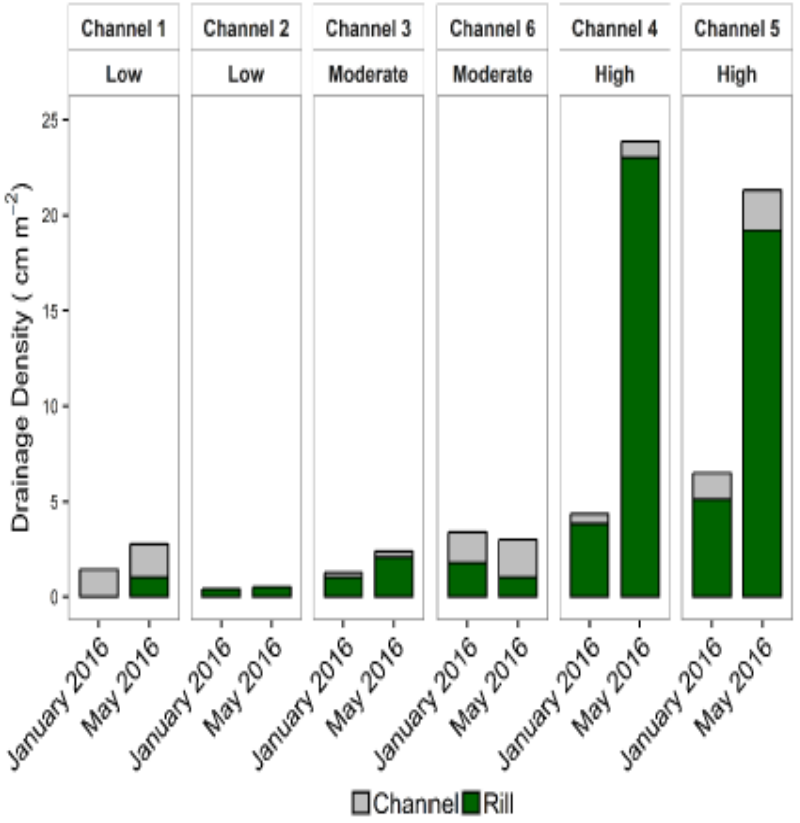
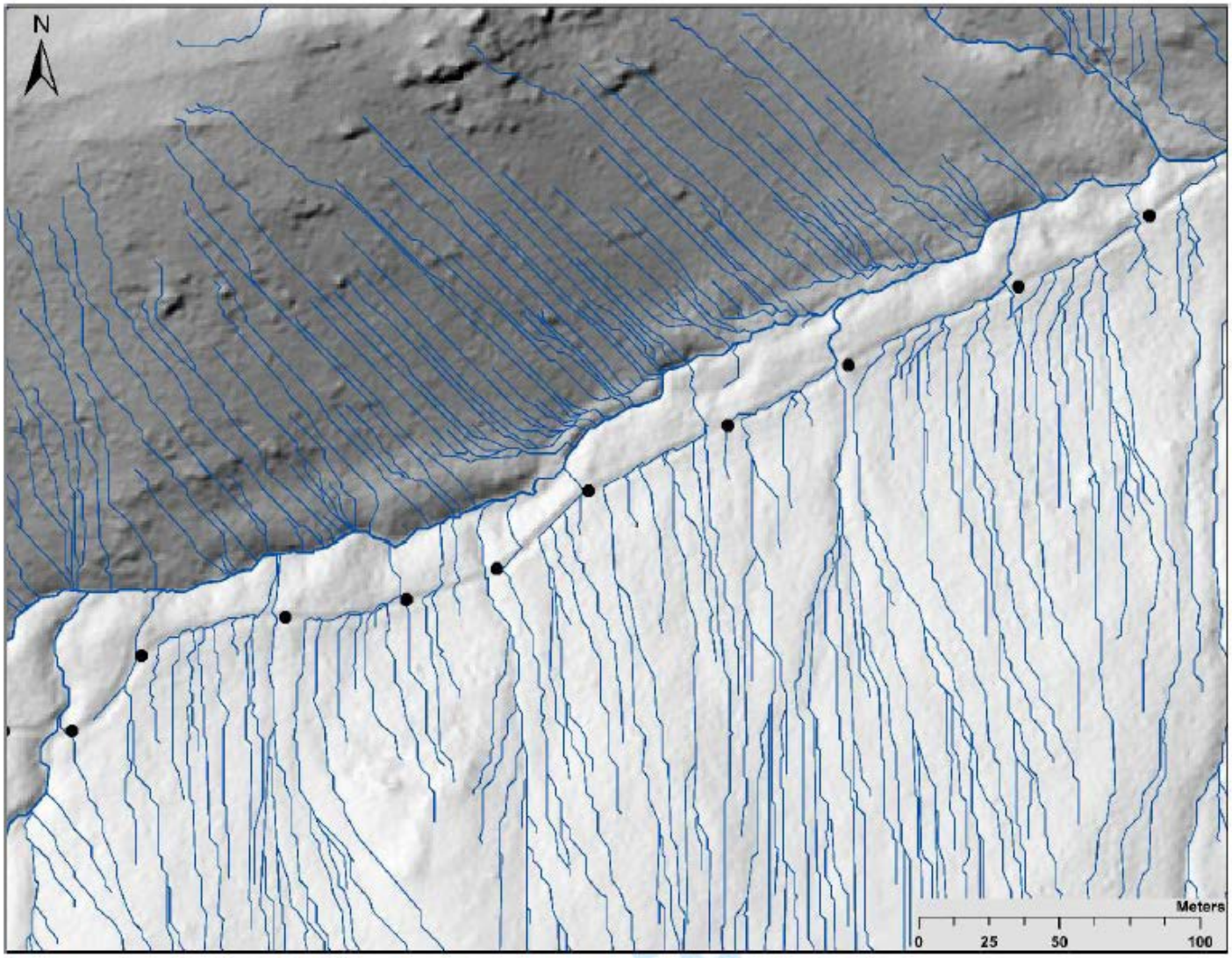


Figure 2.6: Rill and channel densities by swale number and burn severity at BMDSF for each survey date.

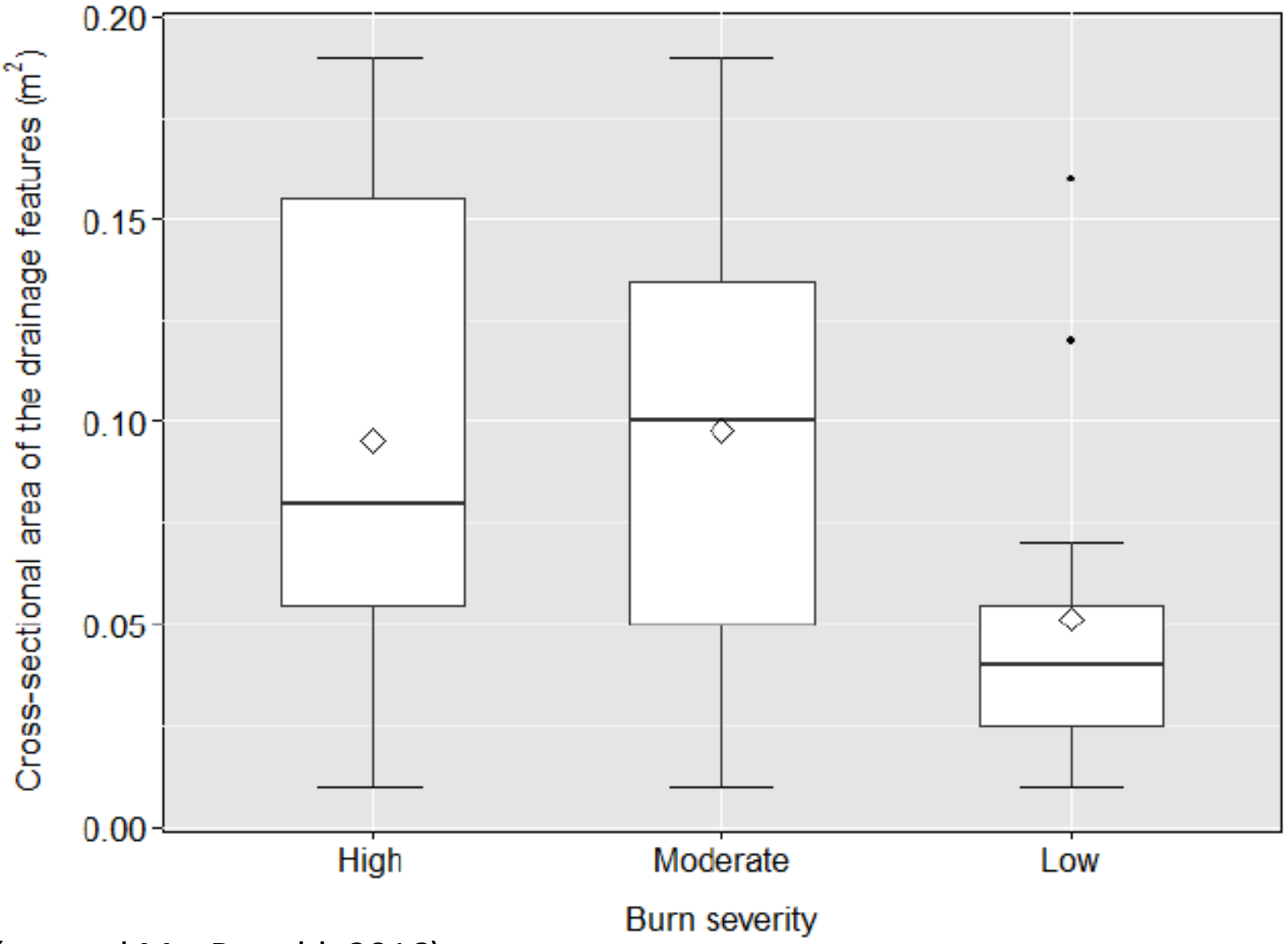
(from Olsen, 2016)

Roads Capture Post-Fire Runoff



(Sosa-Pérez and MacDonald, 2016)

Roads Can Magnify Post-Fire Geomorphic Response

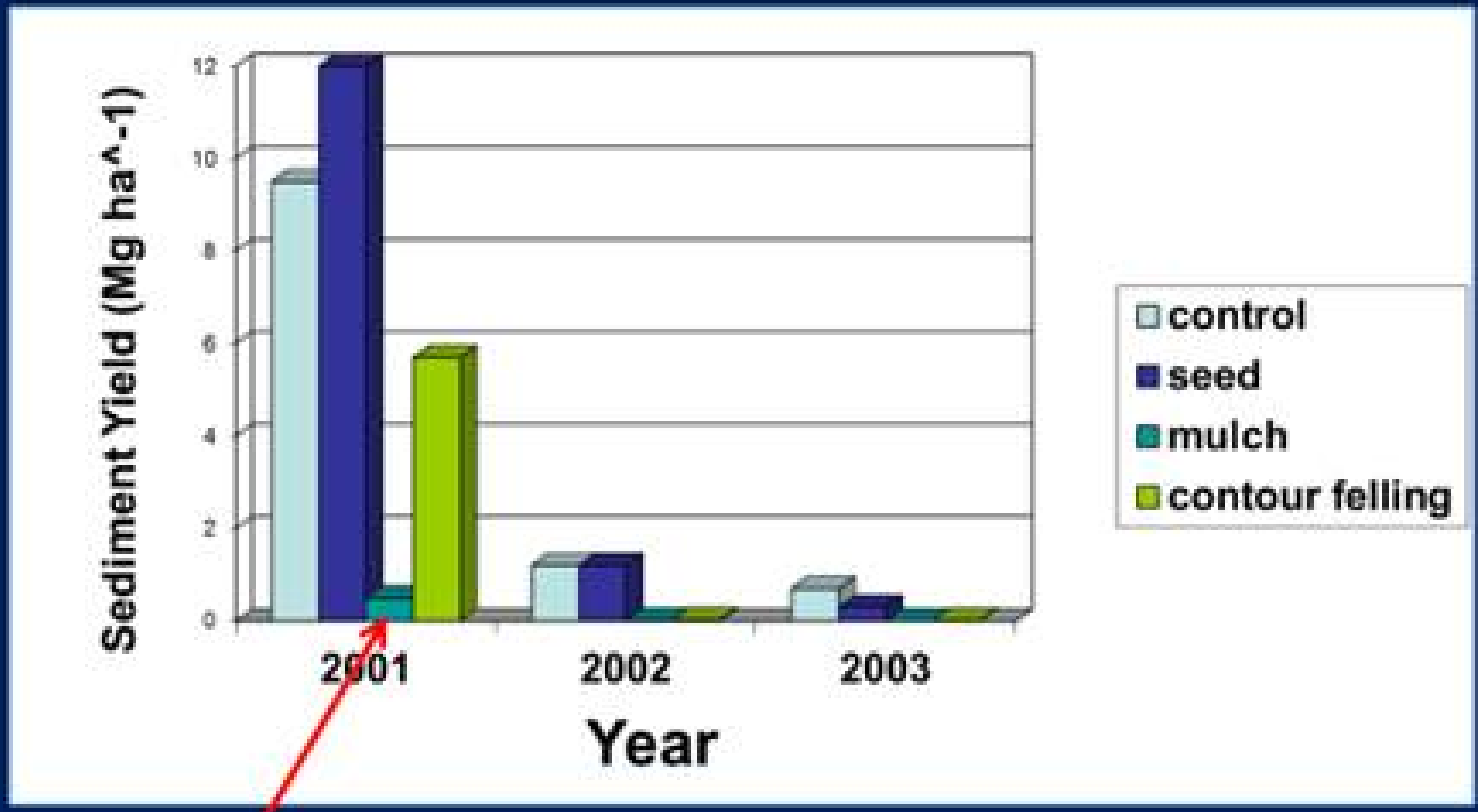


(Sosa-Pérez and MacDonald, 2016)

Hillslope Treatment Considerations

- Treating areas of low soil burn severity is not considered to be cost effective because absolute sediment savings is SMALL and/or NEGLIBLE, while treatment costs remain the same
- Moderate soil burn severity generally produces much less than high soil burn severity, but can produce relatively large amounts of runoff and sediment under intense rainfall
- Makes sense to prioritize high soil burn severity
- Roads are discrete features that can be treated to reduce post-fire impacts

Mean Sediment Yields for Varying Treatments Over Time (Wagenbrenner et al. 2006)



Dr. Lee MacDonald's Presentation-
Pre and Post-Fire Conference February 9-11, 2010

- **Grass seeding** —**NOT** effective.
- **Contour Felling** —**NOT** very cost effective; wide range of effectiveness.
- **Straw mulching*** —**Highly** effective if you achieve 65-70% coverage.
- **Hydro-mulching*** —**Increasingly** being shown as effective.
- **Check Dams** --**NOT** generally effective.

*Typically Treat Between 0 to 2% of Burned Area Due to Values at Risk, Cost, and Expected Effectiveness

Any Questions?