Watershed wake up calls from the Wine Country fire zone

North Bay Watershed Association

Lisa Micheli, PhD

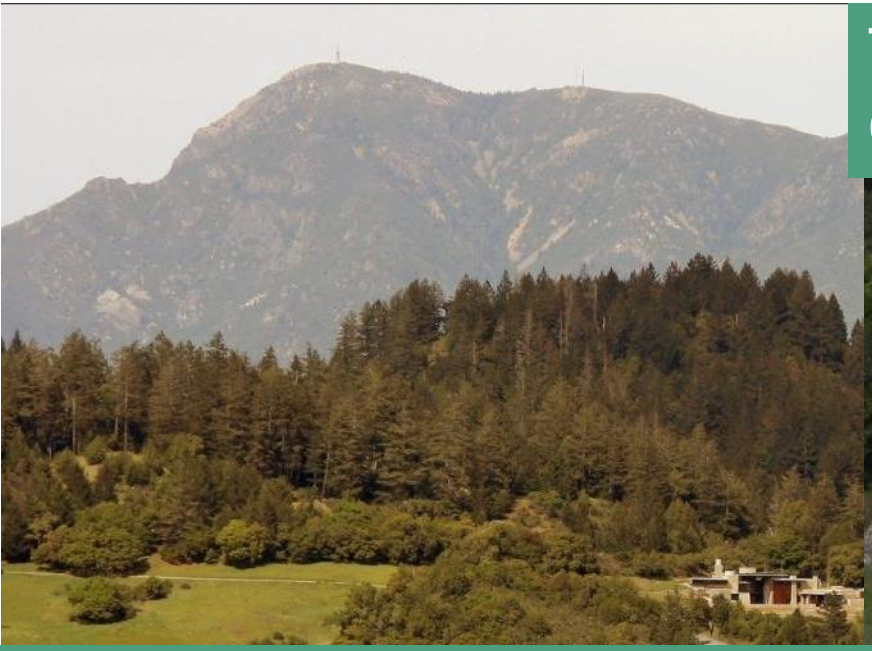
Pepperwood's Dwight Center for Conservation Science

April 6, 2017

Pepperwood PRESERVE
Inspiring conservation through science

TBC3 Terrestrial Biodiversity Climate Change Collaborative

Pepperwood Mission: advance science-based conservation science across our region and beyond



3200-acre reserve in Mayacamas, partnered with CA Academy of Sciences

The new Dwight Center for Conservation Science

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Tubbs Fire unleashed tornadoes

In the late night hours of Oct. 8, the first hours of the Tubbs Fire, a high pressure system over the Central Valley was moving air west in a northeasterly flow to a low pressure system over the coast of California. The change in pressure was so marked that hurricane-force gusts were the result.

Gusting up to 80 mph, the wind funneled into a steep, hilly drainage area along Mark West Springs Road, and was increased in speed by a phenomenon called a Venturi effect.

Pepperwood location

Fire tornado explained

Mini weather system caused by fire.

❹ A thermal column is able to reach wind speeds of well over 100 mph, causing damage similar to hurricanes and tornadoes.

❷ The heated air rises creating a thermal column.

WIND

❸ Cooler air gusts into the space left behind the rising air, bringing in oxygen and combustible material.

❶ Wind moves horizontally over a fire and the turbulence creates vortices.

Super-heated, the roaring wind entered north Santa Rosa and encountered square-edged buildings and homes that trapped the wind in small spaces, creating swirling vortices from the angular momentum.

MARK WEST SPRINGS RD.

MARK WEST SPRINGS RD.

Mark West Creek

OLD REDWOOD HWY.

101

HOPPER RD.

FOUNTAINGROVE PKWY.

MENDOCINO AVE.

Coffey Park

PINER RD.

SANTA ROSA

Sources: Western Regional Climate Center; National Geographic; Howitworksdaily.com

John Blanchard / The Chronicle

201


Tim Carl
TIM CARL PHOTOGRAPHY

What will be the net effect on fuel loads and risk of future fire? Flood risks? Drought resilience?

Can we inform *extreme event*-smart strategies for rebuilding our community?

Outline

Extreme event response =
climate adaptation in real time?

What's happening in terms of impacts on Wine Country fire zone watersheds?
(projections, field evaluations, and response)

What are potential climate-hydrology-vegetation-fire trends that will intersect flooding for Nor Cal watersheds?

Where can you access this kind of data?

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Stornetta Dairy, pre- and post-fire (NY Times)

What's happening in terms of impacts on Wine Country fire zone watersheds? (projections and field evaluations)

This fire has been a tragedy because of costs to human lives and property.
By contrast, our watersheds and biodiversity are showing their resilience.

How are our watersheds projected to respond in terms of runoff and erosion?

NUNS FIRE

Watershed Emergency Response Team

Final Report

CA-LNU-010104

November 15, 2017

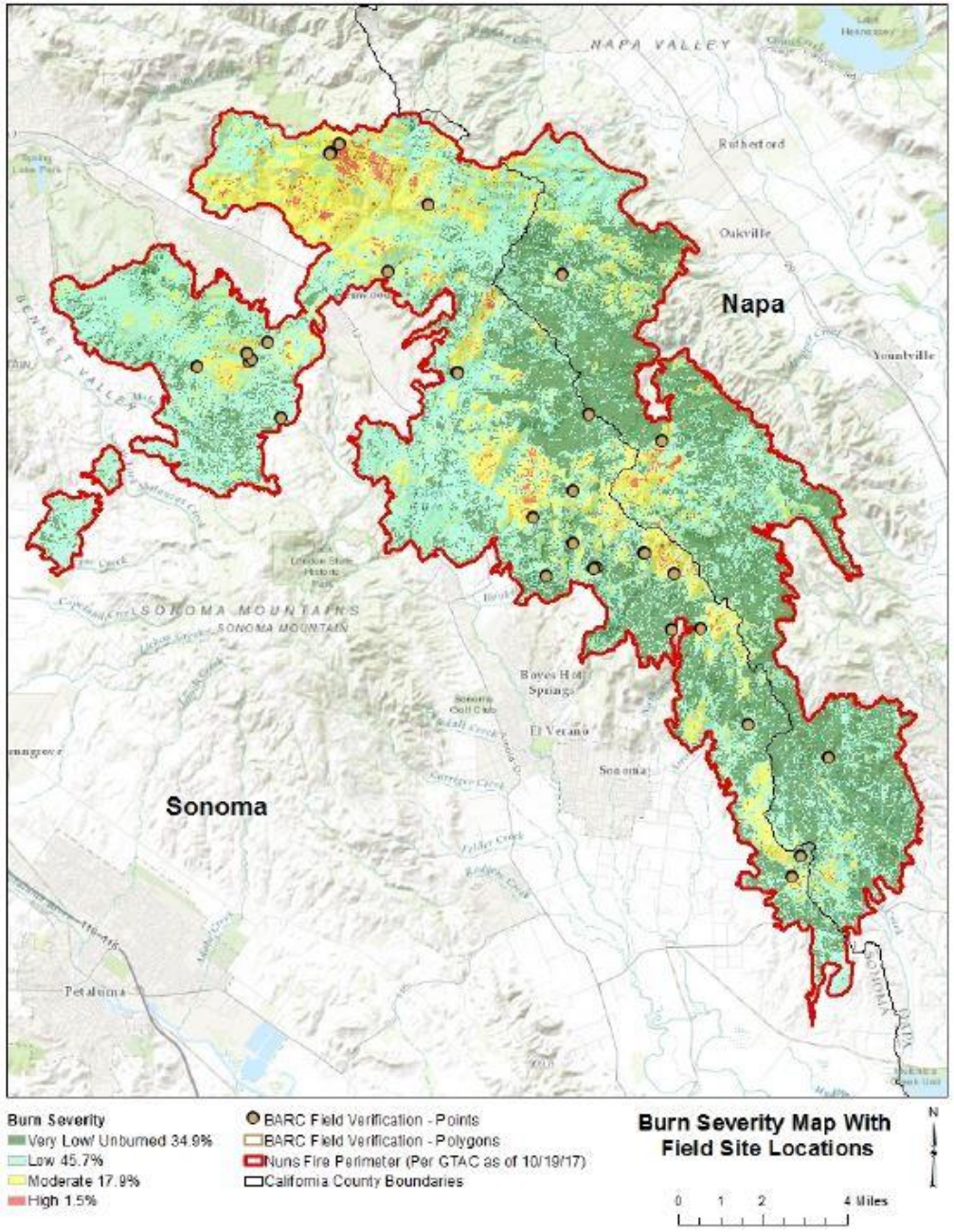


Figure 12. Soil burn severity map.

Nuns fire zone: increase in peak flows

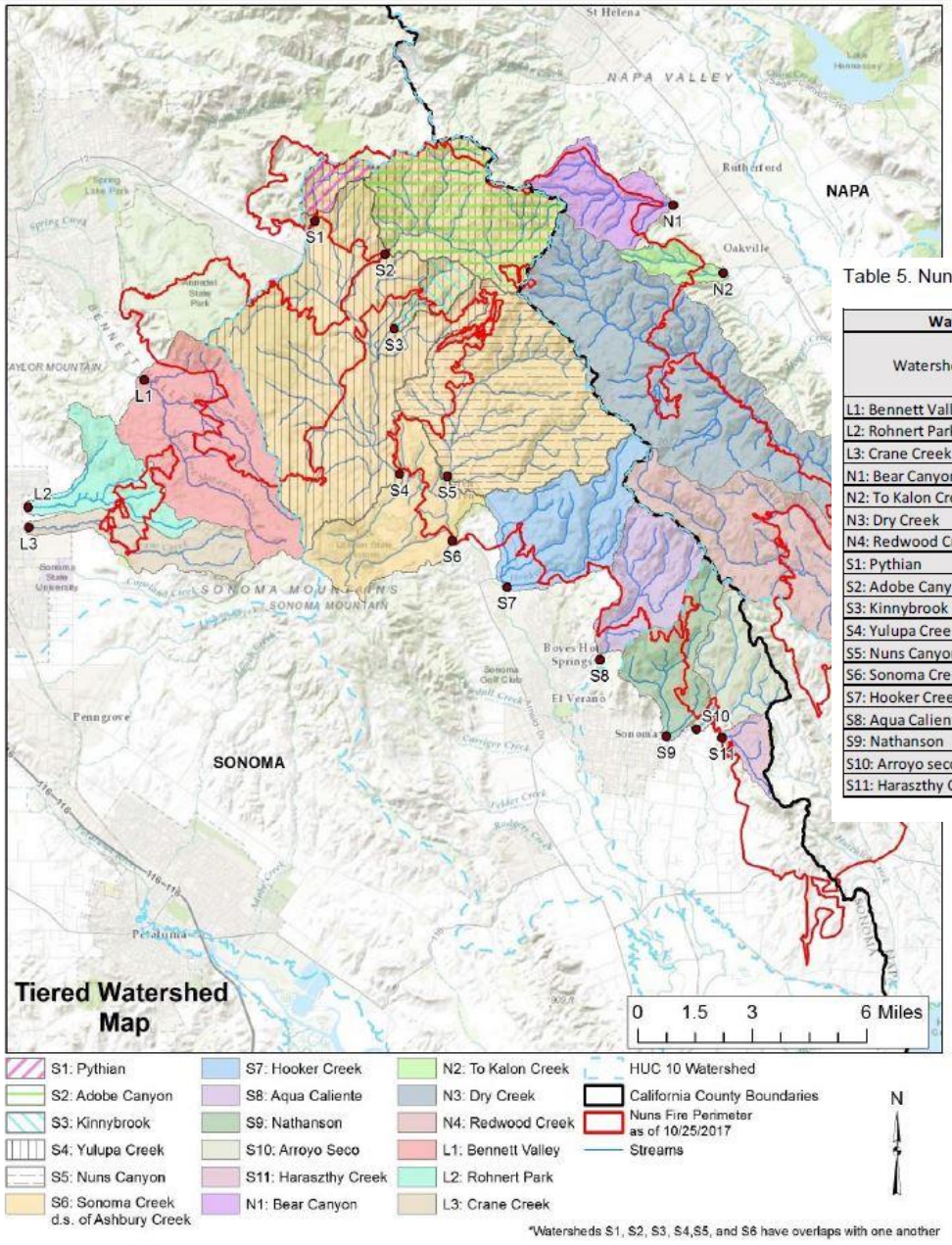


Table 5. Nuns Fire pre- and post-fire non-bulked flow modeling results.

Watershed Data	Modifier	Pre Fire Discharge	Post Fire Discharge	10 Yr Increase
Watershed Drainage Basin	M	Q10 (cfs)	Q10 (cfs)	% Increase
L1: Bennett Valley	1.01	2398	2421	1.0
L2: Rohnert Park	1.00	953	957	0.5
L3: Crane Creek	1.00	924	927	0.3
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	1.73	326	564	73.0
S2: Adobe Canyon	1.47	1985	2909	46.6
S3: Kinnybrook	1.23	362	446	23.0
S4: Yulupa Creek	1.26	6309	7945	25.9
S5: Nuns Canyon	1.16	2992	3486	16.5
S6: Sonoma Creek d.s. of Ashbury Creek	1.21	9680	11670	20.6
S7: Hooker Creek	1.21	1533	1856	21.0
S8: Aqua Caliente	1.19	1103	1316	19.3
S9: Nathanson	1.09	1001	1093	9.2
S10: Arroyo seco	1.14	883	1011	14.5
S11: Haraszthy Creek	1.33	312	416	33.5

Increases in Q10 range from 1-73%

Hot spots: It is estimated that a post-fire 10-year event in the Hood Mountain and Adobe Canyon drainages would produce a 100-year pre-fire peak flow.

Nuns fire zone: increase in erosion

- average pre-fire erosion rate is 0.25 tons/acre for the 2-y RI
- post-fire average is 12 tons/acre (<10 tons/acre to 40 tons/acre)
- roughly an order of magnitude increase over burn zone

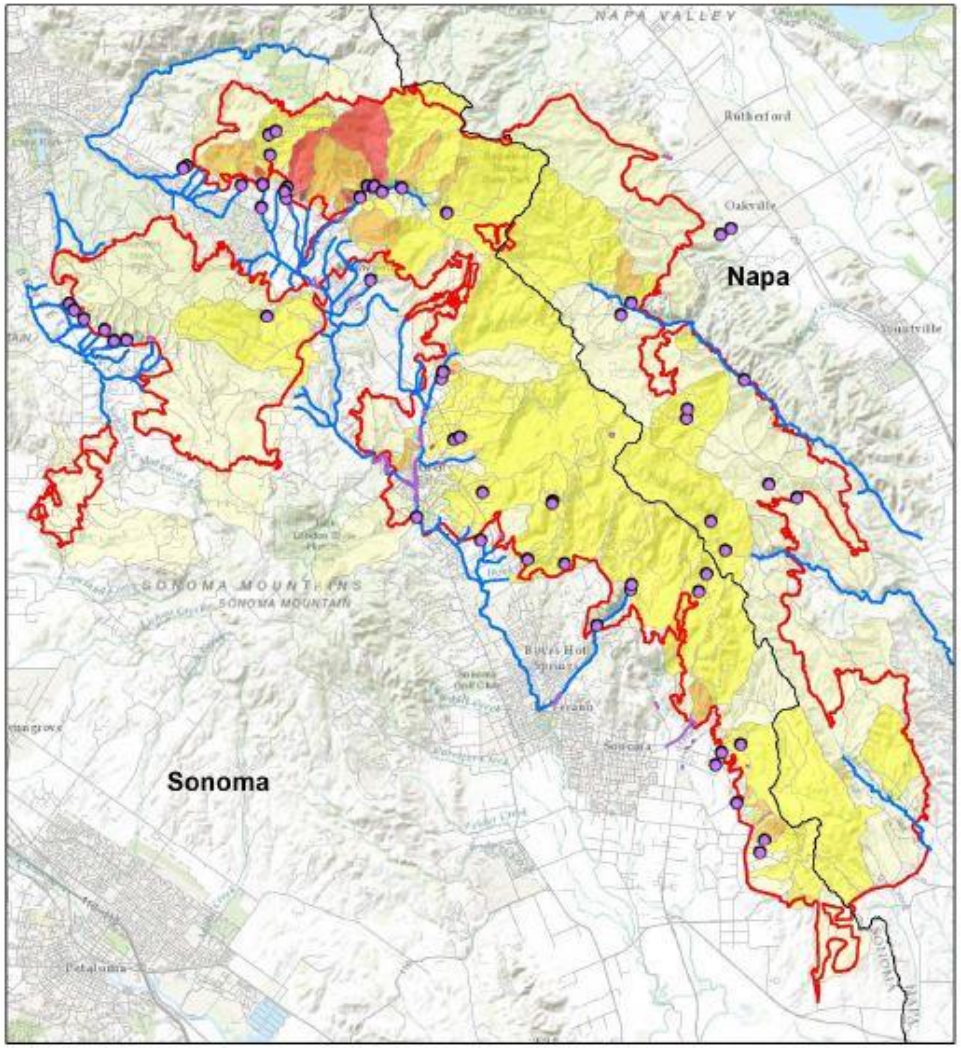


Figure 14. USGS debris flow model results map.

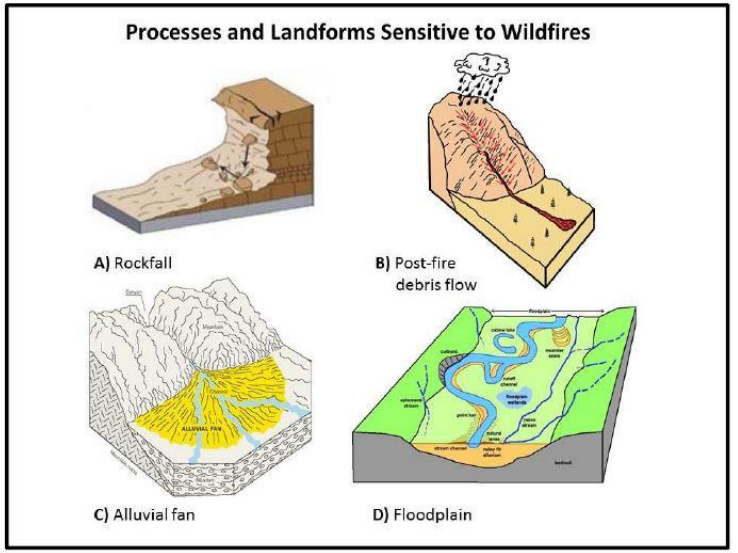
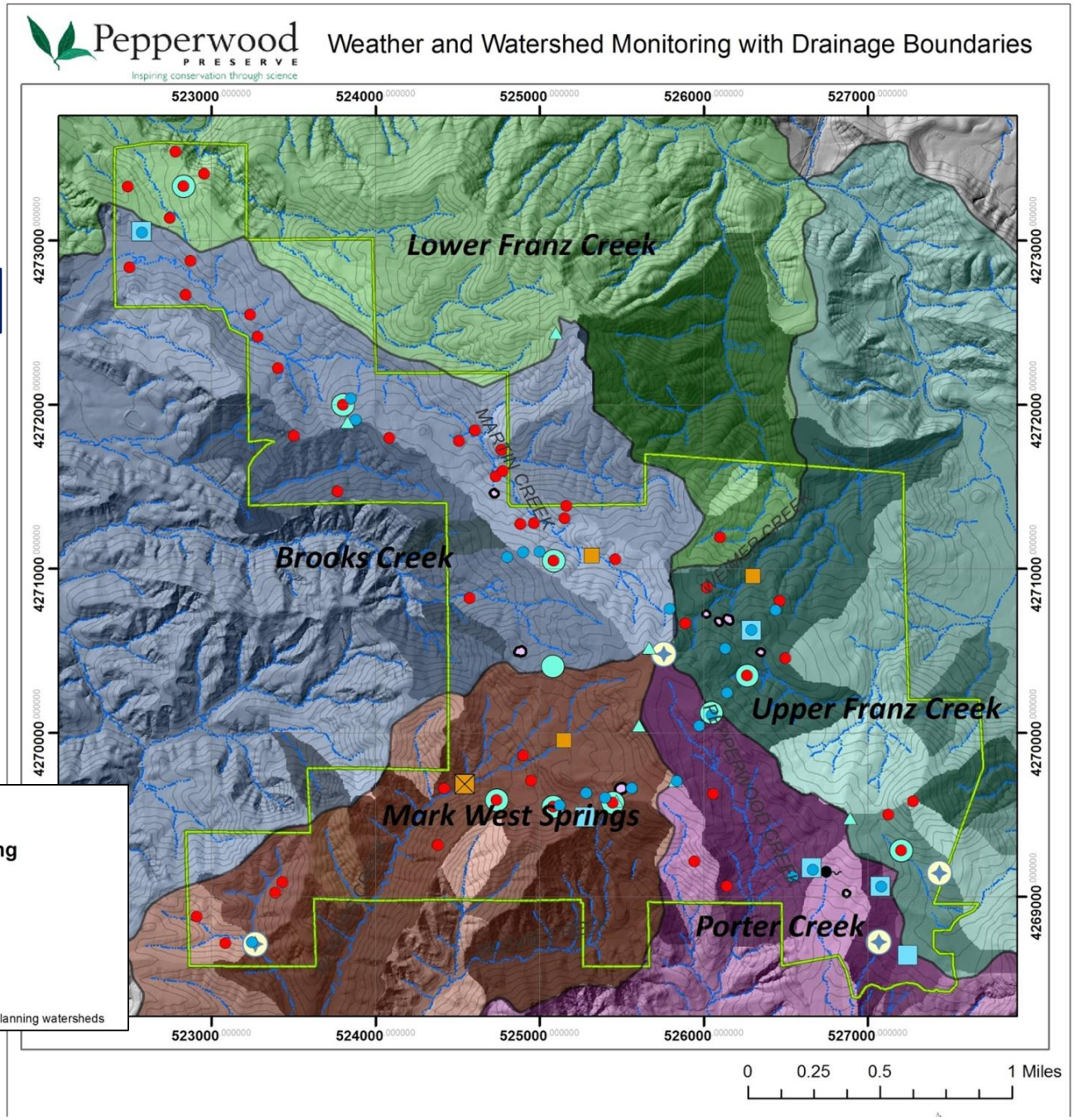


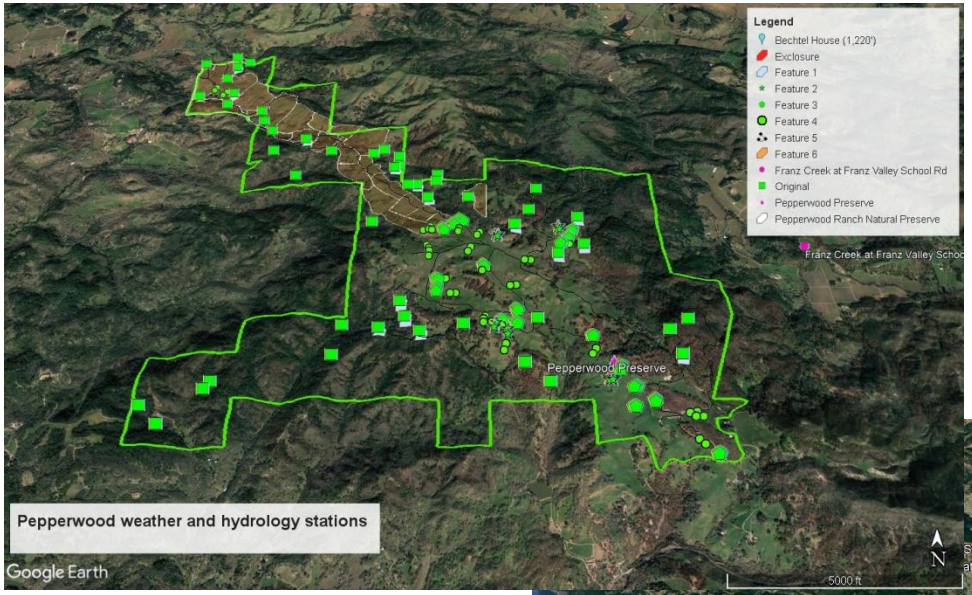
Figure 11. Geomorphic processes and landforms considered by WERT personnel to verify and assess hazards for VARs on the Nuns Fire. VARs potentially subject to these geomorphic processes or located within or adjacent to these landforms were generally assigned a higher risk.

What is meaningful to evaluate in the field to improve our empirical understanding of fire impacts on local watersheds?

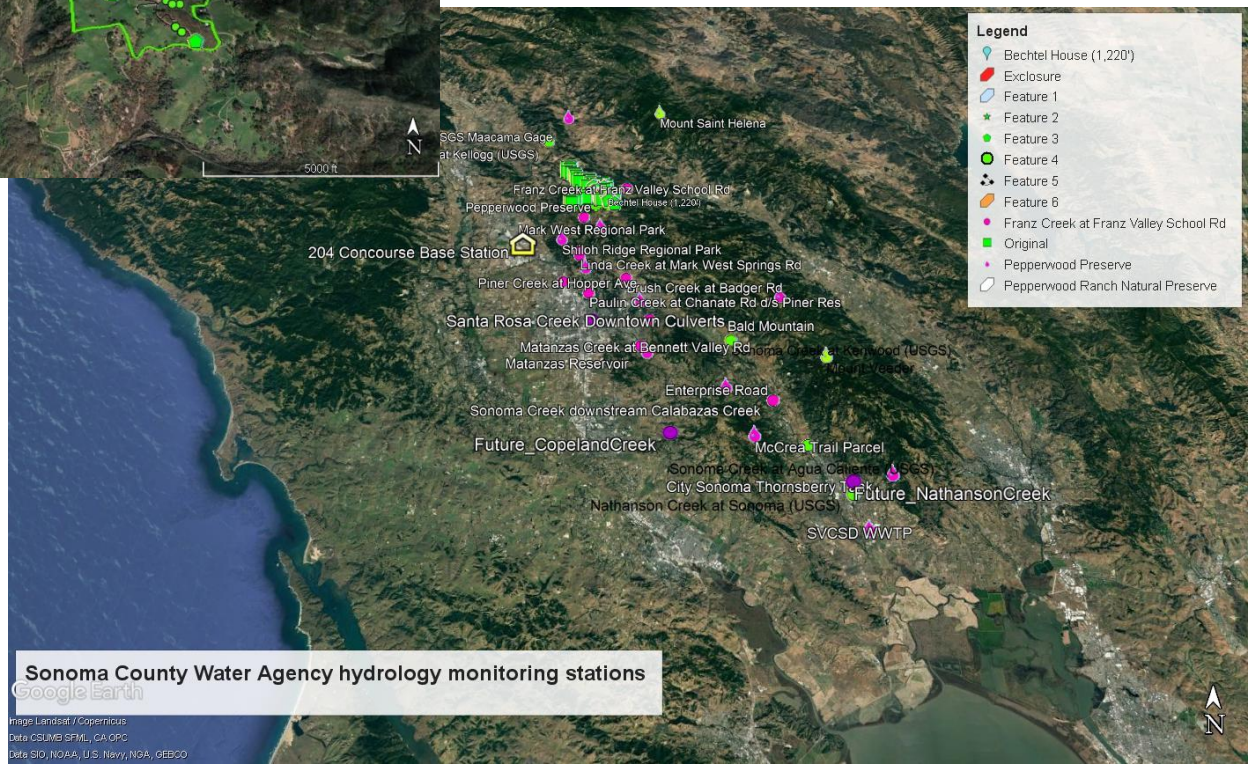
Sentinel site weather and hydrology



Sonoma County Water Agency-USGS-Pepperwood Runoff and Sedimentation project



Rain gages, stream gages, soil moisture probes, sedimentation assessments, complementary flood warning system



SONOMA COUNTY WATER AGENCY

USGS
science for a changing world

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SONOMA ECOLOGY CENTER

About Us Our Work

Community Response

Emergency Watershed Protection Program

Incredible public-private mobilization of materials and volunteer crews to stabilize toxic debris!

SCCA
Sonoma County Conservation Action

News And Views Winter 2017
Environmental Protection, Grassroots Action

Our Water after The Fires: Urgent Protection and Long Term Remedies

By Chris Grabill, SCCA Board Member

More than 100,000 acres burned in the October wildfires, including hundreds of homes along Sonoma County's streams and creeks. This scale of disaster has a sizable and devastating effect on our water sources.

As winter rains pick up, they add the serious danger of hazardous materials entering our waterways, soils, and groundwater.

The burn area includes 617 streams and creeks, each with numerous damaged home sites in water runoff zones. Clean up efforts are moving as quickly as possible, and we are grate-

Leading Community-Powered Disaster Relief

By Neal Fishman, SCCA Board President

SonomaCounty recovers .org

In a matter of a week, over 15,000 family, friends and neighbors lost their homes to the largest wildfires in California history. And now, six weeks later, the second wave of impacts are hitting.

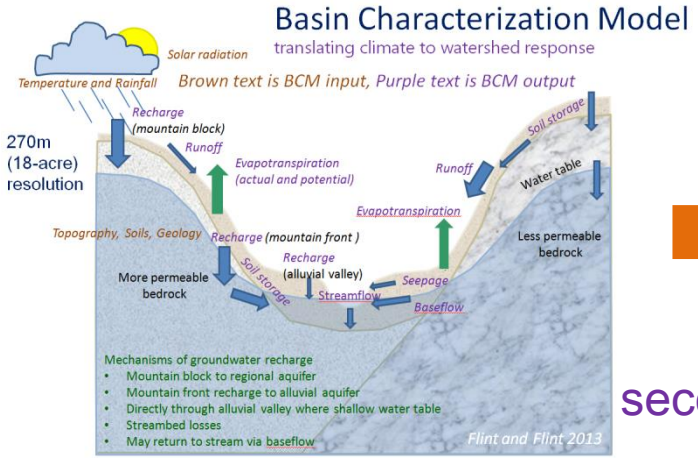
We were very lucky not to get hit with early high intensity storms!
How can we be more prepared next time to do a better job monitoring?

Pepperwood's Turtle Pond-Post-fire recovery

What are potential climate-hydrology-vegetation-fire trends that will intersect flood risks for Nor Cal watersheds?

TBC3 vulnerability assessments

Water balance



inputs to 3 secondary impact models

direct project outputs

- Snow extent
- Water supply (runoff+recharge)
- In-situ recharge per unit area and per basins
- Water deficits and soil storage

Flint and Flint 2015

River discharge

- Cumulative flow at a gage location (annual values) *Flint 2016*

Vegetation exposure

- Exposure rankings based on BCM and vegetation vulnerabilities

Thorne et al 2016

Fire risk

- % Probability of burn over 30 years

Krawchuk and Moritz 2014

USGS science for a changing world

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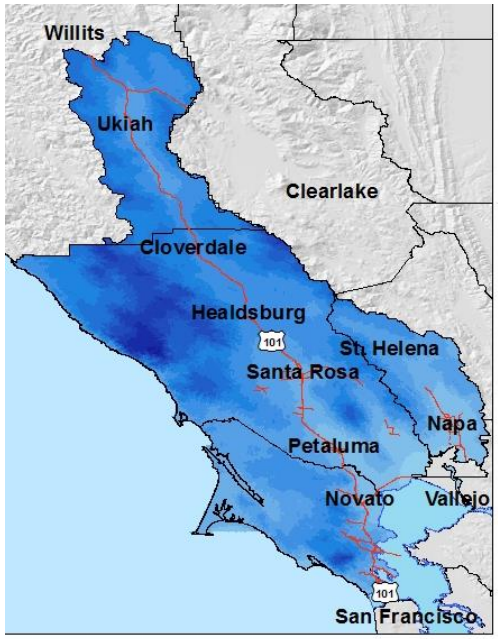
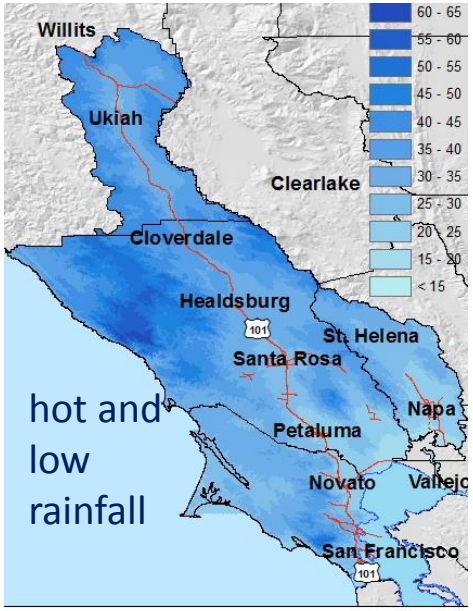
North Bay Precipitation (PPT in/y)

bounding extremes of IPCC range, 30-y average, current to mid-Century



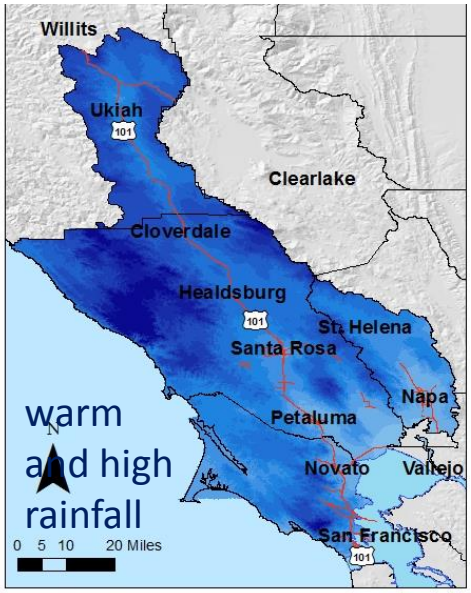
Current 1981-2010
43” average

?



Projected 2040-2069
35” average

projecting 19-21% less
rainfall than 1981-2010



Projected 2040-2069
54” average

projecting 25-35% greater
rainfall than 1981-2010

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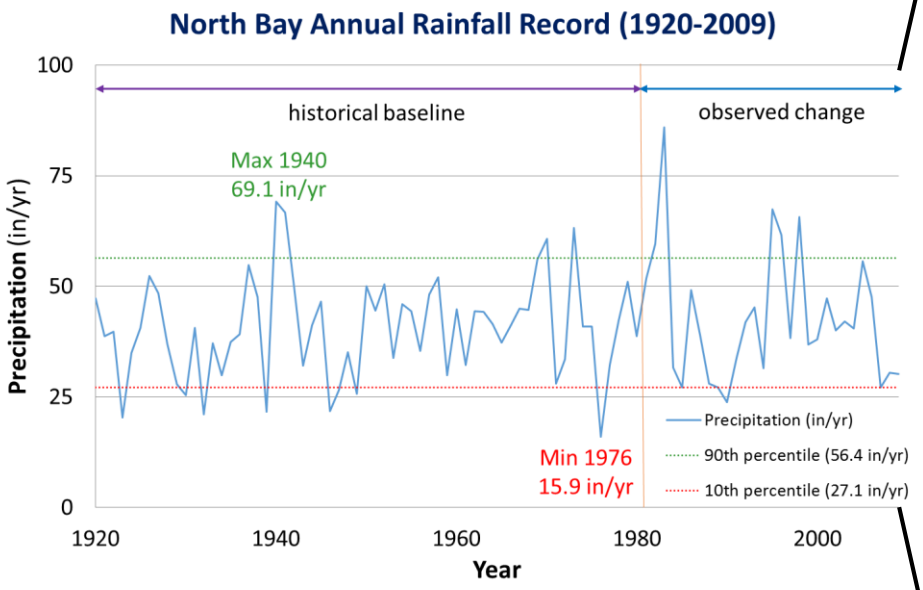
North Bay Climate Ready

Regional Annual Rainfall: Historical and Projected

(comparison of 90-year periods)



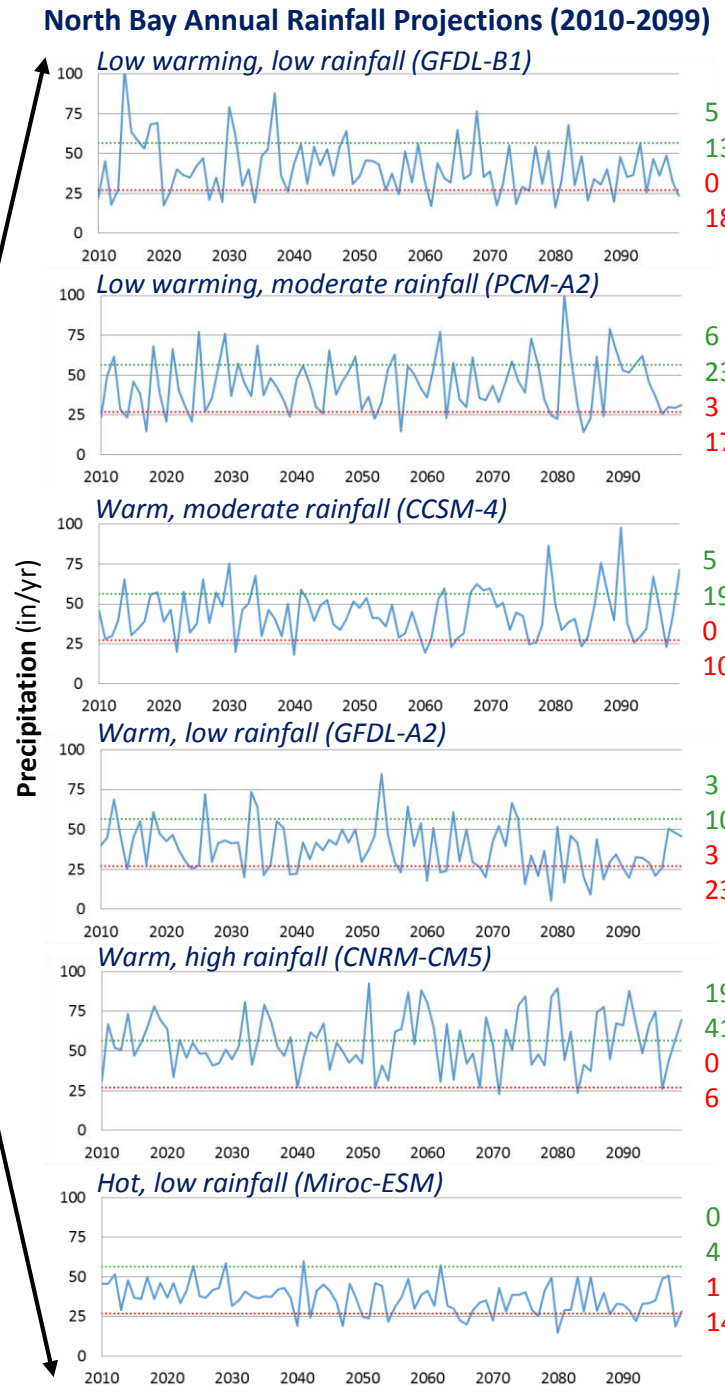
Extremes (1920-2009)

2 events >=1940

9 events >90th % (56.4in/y)*

1 events <=1976

9 events <10th % (27.1 in/y)*



Scenario 1

5 events >=1940

13 events >90th %

0 events <=1976

18 events <10th %

Scenario 2

6 events >=1940

23 events >90th %

3 events <=1976

17 events <10th %

Scenario 3

5 events >=1940

19 events >90th %

0 events <=1976

10 events <10th %

Scenario 4

3 events >=1940

10 events >90th %

3 events <=1976

23 events <10th %

Scenario 5

19 events >=1940

41 events >90th %

0 events <=1976

6 events <10th %

Scenario 6

0 events >=1940

4 events >90th %

1 events <=1976

14 events <10th %

* 10th and 90th percentile benchmarks based on 1920-2009 record

Climate Ready North Bay

Annual Rainfall Extremes per Decade

Factor of increase or decrease (projected relative to 1920-2009):
extreme annual events per decade

Scenario #	Name	Time Period	Annual Peaks (floods)		Annual Lows (droughts)	
			>=1940 (69.1 in/yr)	**>90th %** (56.4 in/yr)	**<10th %** (27.1 in/yr)	**<=1976** (15.9 in/yr)
	Historical through current	1920-2009	1.0	1.0	1.0	1.0
1	*Low warming, Low rainfall*	2010-2099	2.5	1.4	2.0	0.0
2	*Low warming, Mod rainfall*	2010-2099	0.3	2.6	1.9	3.0
3	*Warm, Mod rainfall*	2010-2099	2.5	2.1	1.1	0.0
4	*Warm, Low rainfall*	2010-2099	1.5	1.1	2.6	3.0
5	*Warm, High rainfall*	2010-2099	9.5	4.6	0.7	0.0
6	*Hot, Low rainfall*	2010-2099	0.0	0.4	1.6	1.0
Average			*2.7*	*2.0*	*1.6*	*1.2*

Climatic Water Deficit = drought stress

Potential – Actual Evapotranspiration

BCM methods

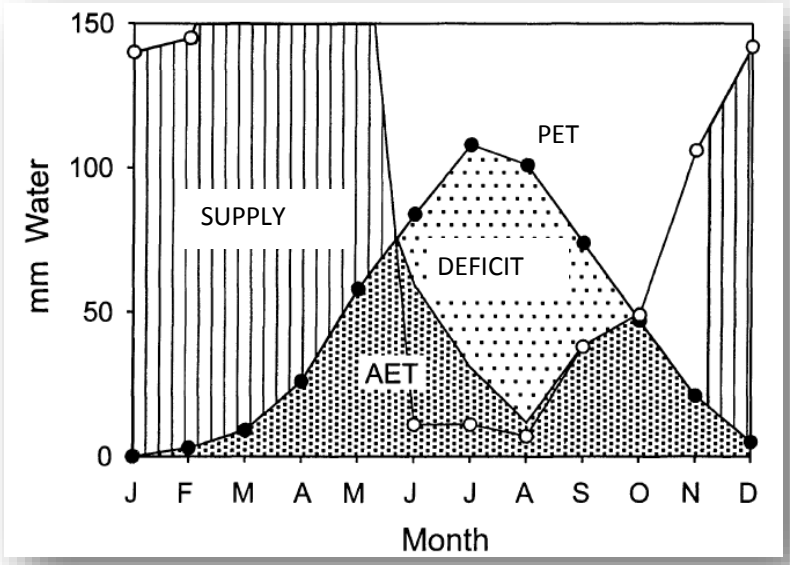
Integrates effects of temperature and rainfall on landscape in context of watershed structure

Surrogate for irrigation demand

Correlates with vegetation and fire risk

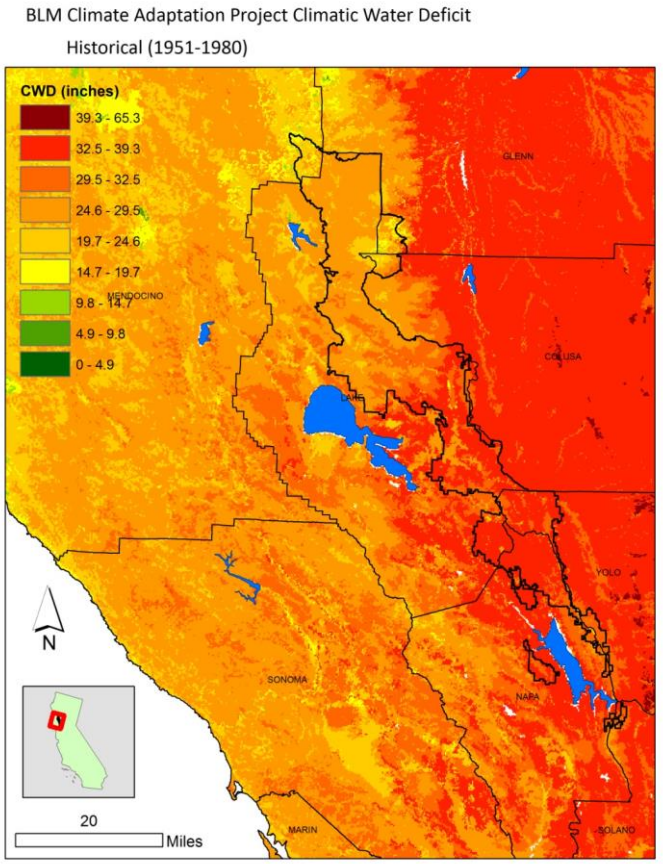
Potential drought-stress indicator

Increases with all future climate scenarios



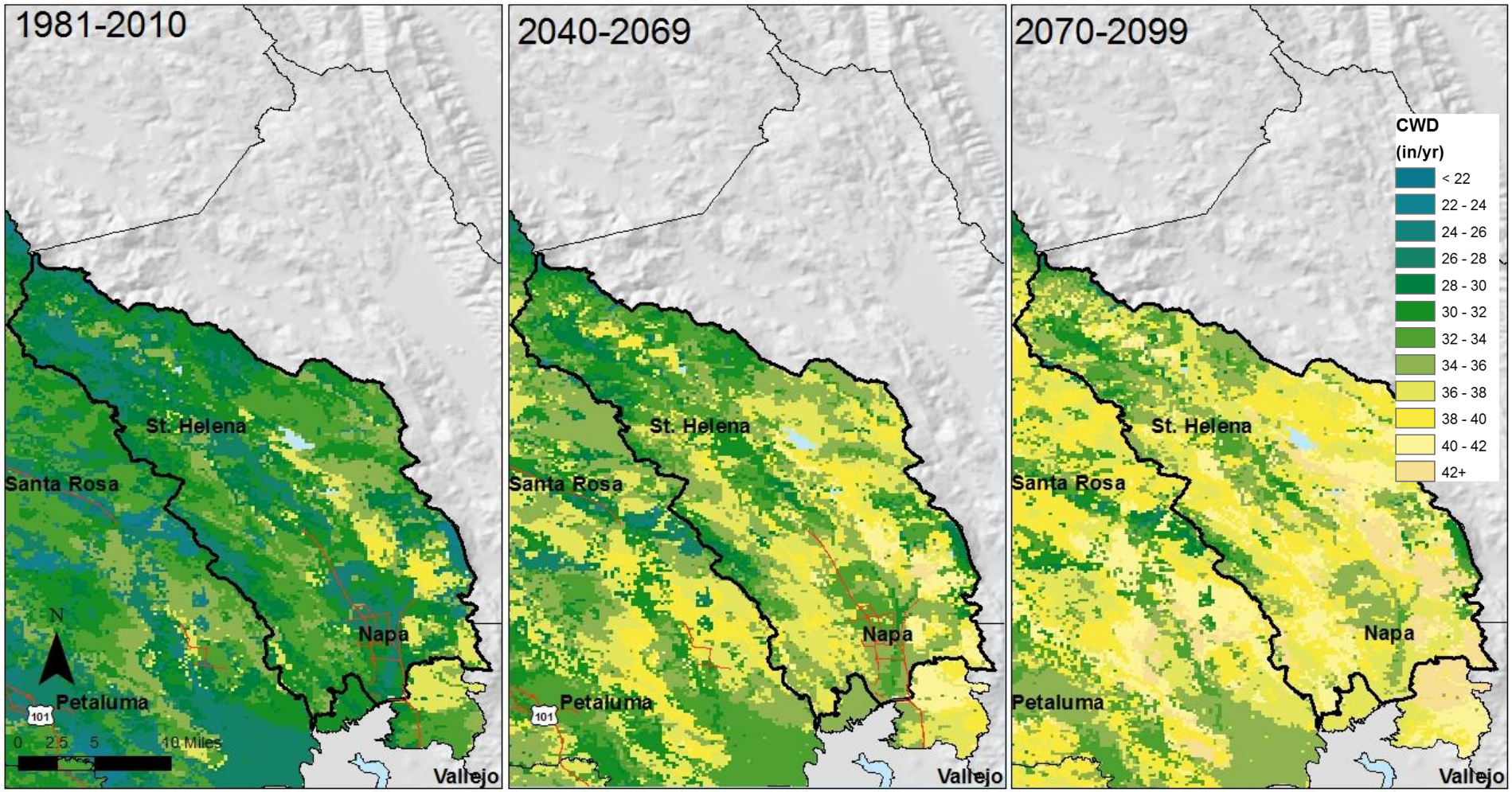
CWD mechanistically links energy loading, drainage, and available soil moisture

Climatic Water Deficit (CWD) of how dry the soils are at the end of the summer



In North Bay on order of 10-20% drier, equivalent to 3-6” rainfall

Climatic Water Deficit, Hot and Low Rainfall



CWD 31 in/y average

CWD 34 in/y average
(-3 in/y)

CWD 37 in/y average
(-6 in/y)

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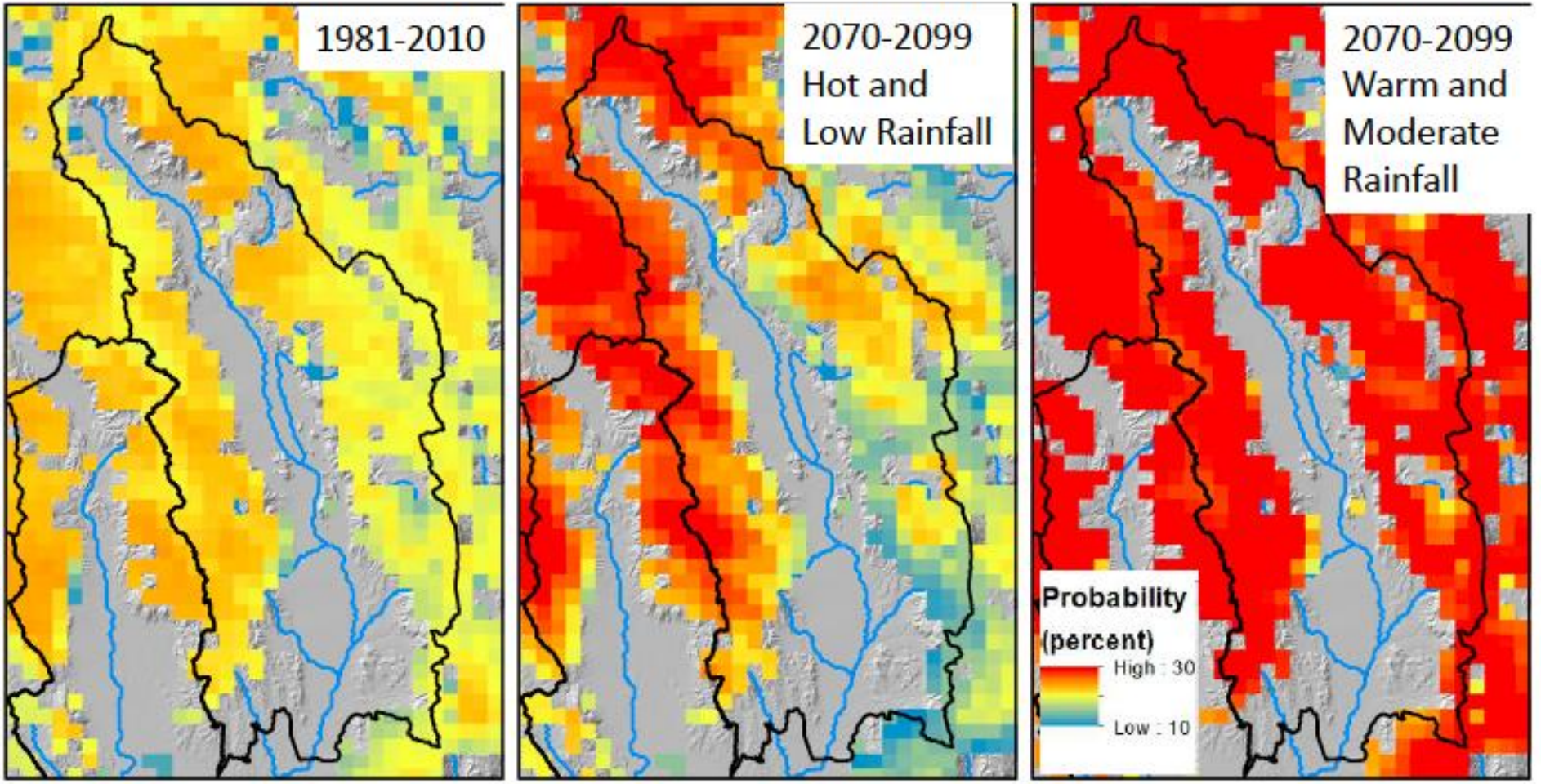
More arid conditions will cause transitions to more fire-prone vegetation

Change in Projected Probability of Burning One or More Times



Probability of fire doubles in some locations

		Current	Hot, Low Rainfall	Moderate Rainfall
Variable	Units	1971-2000	2070-2099	2070-2099
Probability of burning 1	Percent	21%	22%	29%
or more times	SD	2%	5%	3%

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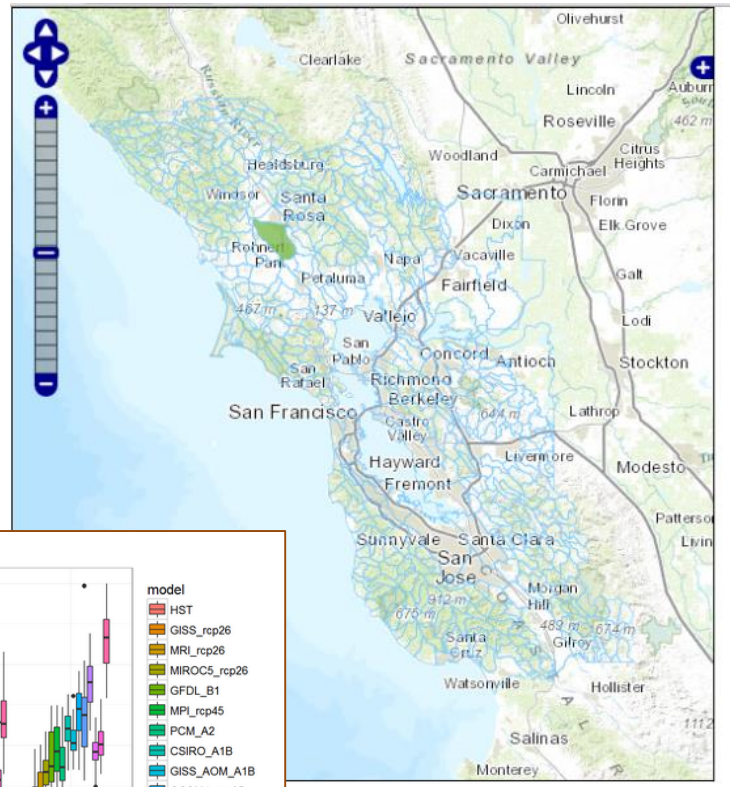
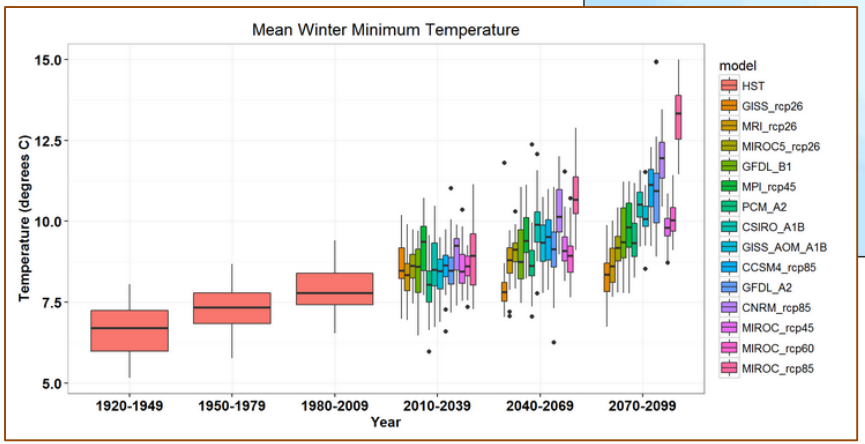
eas masked out

How can I get annual and seasonal time series BCM data for the Napa Valley and beyond?





BETA now available via the Climate Smart Watershed analyst on California Climate Commons!

calcommons.climate.org/tbc3/ sf-bay-wate

TBC3 Terrestrial Biodiversity Climate Change Collaborative

Join us for a world-class conference on fire science and management

May 7-9, 2018

at Sonoma State and in the field!

SONOMA COUNTY FOREST CONSERVATION WORKING GROUP

SONOMA LAND TRUST

SONOMA STATE UNIVERSITY

FOREST SERVICE U S DEPARTMENT OF AGRICULTURE

Berkeley UNIVERSITY OF CALIFORNIA

Go to www.pepperwoodpreserve.org for registration details

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Thank you!

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