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Water Availability Analysis

Schlatter Family Estate Micro-Winery Use Permit
P24-00217-UP
Zoning Administrator Hearing – August 27, 2025

WATER AVAILABILITY ANALYSIS

SCHLATTER FAMILY ESTATE MICRO-WINERY
1111 CONN VALLEY ROAD
ST HELENA, CA 94574

APNs 025-180-082 & -083

Prepared for:
Schlatter Family Estate, LLC

Attn:
Rene Schlatter
1000 Main Street
St. Helena, CA 94574

August 14, 2024
Project #4122083.0

1515 Fourth Street, Napa, CA 94559 www.rsacivil.com 707.252.3301.v 707.252.4966.f

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1. Significant Stream and Well Setback Exhibits
2. Irrigation Water Balance
3. Annual Groundwater Recharge Rate

I. Executive Summary

Schlatter Family Estate (APNs 025-180-082 & -083) is applying for a Use Permit to construct a micro winery. Specifically, as follows:

(1) Production of 5,000 gallons per year;

(2) A maximum of 18 visitors per day;

(3) No marketing events;

(4) Staffing will be comprised of 2 full-time employees;

(5) Construct a new micro winery and a covered crushpad;

(6) To improve safety, the driveway will be upgraded. The project also proposes one (1) ADA parking stall and two (2) standard stalls;

(7) To construct and utilize state-of-the-art environmental process for the process wastewater treatment;

(8) To construct a separate domestic wastewater system for the winery;

(9) To construct a Fire Water Storage Tank within the cave and install a new hydrant at the cave portal.

This report demonstrates that the existing water system is clearly capable of providing the require water per year and complies with Napa County Guidelines. On the next page is a summary of the existing and proposed water use with detailed calculations.

Usage Type	Existing Usage [af/yr]	Standard Usage [af/yr]	Proposed Usage [af/yr]
Irrigation			
Vineyard – Well	12.370	12.255	12.255
Vineyard – Recycled Process Wastewater Credit	0.000	-0.107	-0.092
Landscaping	0.000	0.025	0.025
Winery			
Process Water	0.000	0.107	0.092
Domestic Water	0.000	0.084	0.084
Totals (Acre-ft per Year)	**12.370**	**12.374**	**12.374**
Estimated Water Recharge Rate (Acre-ft per Year)	**37.26**	**37.26**	**37.26**

The proposed modifications for the SFE Micro Winery project will result in a very slight increase of 0.004 af/yr of groundwater use. The total usage will be 12.374 af/yr, which is significantly less than the estimated groundwater recharge rate for the parcel of 37.26 af/yr.

Tier II analysis

An exhibit prepared by RSA+ is contained in Attachment 1 that demonstrates the project well is more than 500 feet from neighboring wells.

Tier III analysis

An exhibit prepared by RSA+ is contained in Attachment 1 that demonstrates the project well is more than 1,500 feet from the nearest significant stream and therefore a Tier III analysis is not required.

II. Groundwater Use Calculation

Existing Vineyard Irrigation and Landscaping Water Demand						
Vineyard – Irrigation from well – (0.5 af/ac-yr x	24.74	acres vineyard) =	12.370	af/yr		
Landscape – (0.5 af / 100,000 gallon wine x	0	gal wine/year) =	0.000	af/yr		
Total Existing Water Demand		**Total =**	**12.370**	**af/yr**		

			Proposed Standard		**Proposed Reduced**	
Proposed Vineyard Irrigation and Landscaping Water Demand						
Vineyard – Irrigation from well – (0.5 af/ac-yr x	24.51	acres vineyard) =	12.255	af/yr	12.255	af/yr
Vineyard – Irrigation from PWW Credit		=	-0.107	af/yr	-0.092	af/yr
Landscape – (0.5 af / 100,000 gallon wine x	5,000	gal wine/year) =	0.025	af/yr	0.025	af/yr
Proposed Winery Process Water Demand						
[1] [2] Process Water – (2.15 af / 100,000 gallon wine x	5,000	gal wine/year) =	0.107	af/yr	0.092	af/yr
Proposed Winery Domestic Water Demand						
[4] FT Employees – (15 gal/person/day x 365 days/yr x	2	employees/day) =	0.034	af/yr	0.034	af/yr
[3] Average Visitors – (3 gal/person/day x	6,570	visitors/year) =	0.060	af/yr	0.060	af/yr
Total Proposed Water Demand		**Total =**	**12.374**	**af/yr**	**12.374**	**af/yr**

Estimates per Napa County Water Availability Analysis – Guidance Document, May 12, 2015 unless noted:

[1] 2.15 ac-ft per 100,000 gallons wine per Napa County WAA – Guidance Document

[2] Reduced water use to 6 gallons per gallon of wine or 1.84 ac-ft per 100,000 gallons wine (14% reduction)

[3] 3 gallons of water per guest per Napa County WAA – Guidance Document

[4] 15 gallons of water per guest per Napa County WAA – Guidance Document

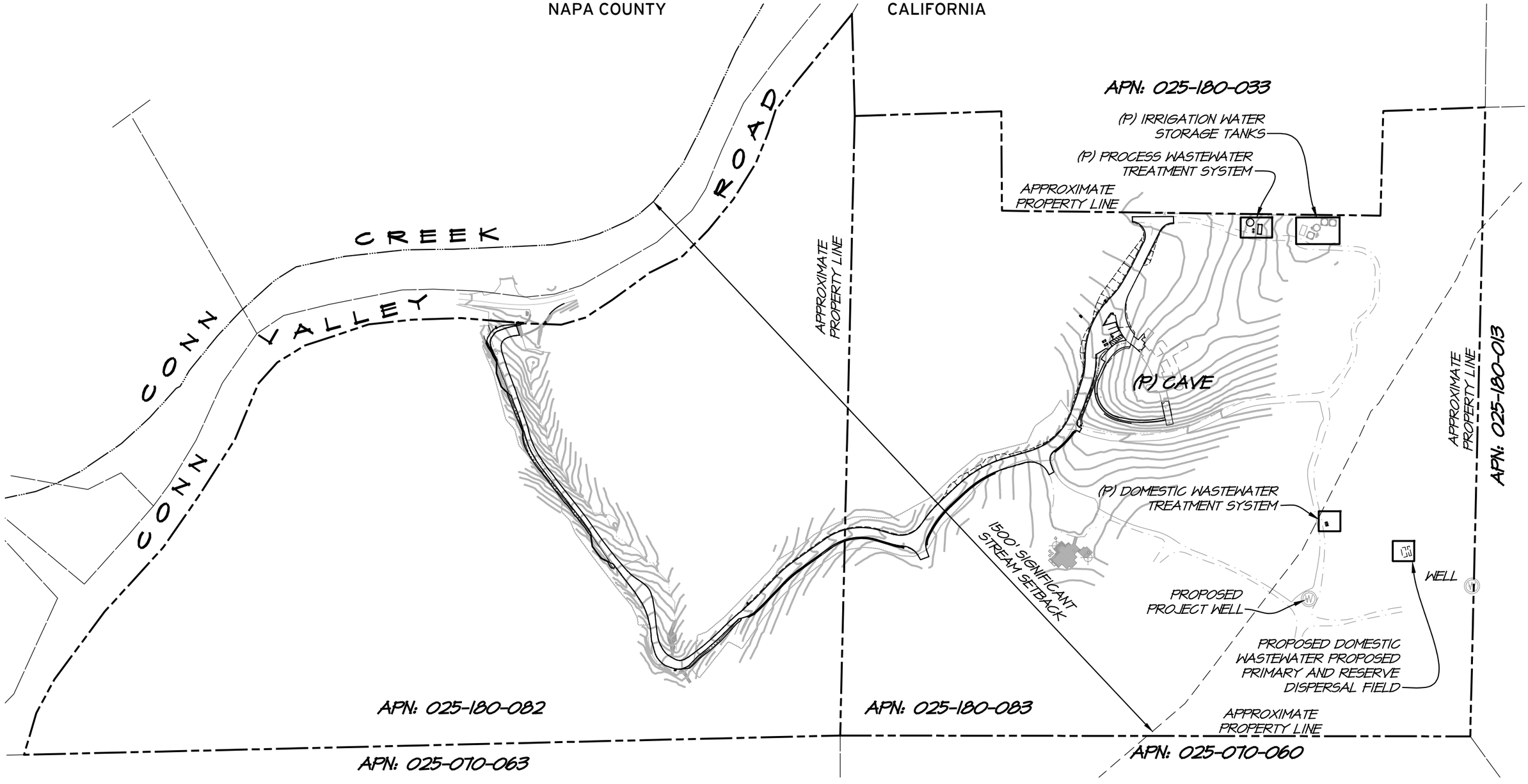
Attachment 1

Significant Stream and Well Setback Exhibits

SIGNIFICANT STREAM SETBACK EXHIBIT

SCHLATTER FAMILY ESTATES, LLC

NAPA COUNTY CALIFORNIA



GRAPHIC SCALE

200' 0 200'

(IN FEET)

1 INCH = 200 FT

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August 7, 2024 2022083.0

PROJECT WELL SETBACK (500') EXHIBIT

SCHLATTER FAMILY ESTATES, LLC

NAPA COUNTY CALIFORNIA

CONN CREEK

CONN VALLEY ROAD

(P) IRRIGATION WATER STORAGE TANKS

(P) PROCESS WASTEWATER TREATMENT SYSTEM

APPROXIMATE PROPERTY LINE

APPROXIMATE PROPERTY LINE

APPROXIMATE PROPERTY LINE

(P) CAVE

GRAPHIC SCALE

200' 0 200'

(IN FEET)

1 INCH = 200 FT

APN: 025-180-013

(P) DOMESTIC WASTEWATER TREATMENT SYSTEM

500' WELL SETBACK

WELL

PROPOSED PROJECT WELL

PROPOSED DOMESTIC WASTEWATER PROPOSED PRIMARY AND RESERVE DISPERSAL FIELD

APPROXIMATE PROPERTY LINE

APPROXIMATE LOCATION OF NEIGHBORING WELL

APN: 025-180-082

APN: 025-180-083

APN: 025-070-063

APN: 025-070-060

NO WELLS ON PARCEL PER NAPA COUNTY RECORD

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AUGUST 13, 2024 2022083.0

R:\2022\41222083.0_SFE_Micro_Winery_Conn_Valley_Rd\DESIGN\EXHIBITS\Exh-Well 500 ft.dwg 08/13/2024

Attachment 2

Irrigation Water Balance

Reclaimed Process Wastewater
Water Balance for Irrigation and Storage

Project Description		Annual Process Waste Flow Volume		
Project Number:	4119046.0	Wine Production:	5,000	gal/year
Project Name:	Schlatter Family Estate Micro-Winery			
Prepared By:	DRL	Annual Process Waste per Gallon Wine:	6	gal/year
Date:	August 2, 2024	Total Annual Process Waste Generated:	30,000	gal/year

Vineyard Irrigation Parameters		Landscape Irrigation Parameters		
Acres of irrigated vineyard:	0.10 acres	Crop type / name:	Cover Crop	
Row spacing:	6.0 feet	Total irrigated acres of crop:	0.00 acres	
Vine spacing:	3.3 feet			
Total number of vines:	220 vines			
Water use per vine per month (peak):	26 gal			
Total peak monthly irrigation demand:	5,720 gal			

Monthly Process Wastewater Generation

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Monthly process wastewater generated as % of annual total:	4%	6%	6%	5%	6%	7%	9%	10%	15%	13%	11%	8%
Monthly process wastewater generated [gallons]:	1,200	1,800	1,800	1,500	1,800	2,100	2,700	3,000	4,500	3,900	3,300	2,400

Monthly Vineyard Irrigation Water Use

(Based on per-vine water use)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Beginning of month reclaimed water in storage [gallons] (This number brought forward from end of previous month)	2,400	3,600	5,400	7,200	2,980	0	0	0	0	0	0	0
Vineyard irrigation as % of peak month irrigation demand:	0%	0%	0%	100%	100%	100%	100%	100%	100%	100%	100%	0%
Irrigation per month per vine (gallons):	0.0	0.0	0.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	26.0	0.0
Total vineyard irrigation demand [gallons]:	0	0	0	5,720	5,720	5,720	5,720	5,720	5,720	5,720	5,720	0
Will vineyard be irrigated with reclaimed water this month?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Process wastewater generated this month, reclaimed for vineyard irrigation [gallons]	0	0	0	1,500	1,800	2,100	2,700	3,000	4,500	3,900	3,300	0
Remaining vineyard irrigation demand after using this month's process water [gallons]	0	0	0	4,220	3,920	3,620	3,020	2,720	1,220	1,820	2,420	0
Drawdown from storage for remaining vineyard irrigation [gallons]	0	0	0	4,220	2,980	0	0	0	0	0	0	0
Well water required to satisfy remaining vineyard irrigation demand	0	0	0	0	940	3,620	3,020	2,720	1,220	1,820	2,420	0
Net storage after vineyard irrigation drawdown [gallons]	2,400	3,600	5,400	2,980	0	0	0	0	0	0	0	0
This month's process wastewater, remaining after vineyard irrigation, available for landscape irrigation[gallons]	1,200	1,800	1,800	0	0	0	0	0	0	0	0	2,400

Water balance continues on next page for cover crop irrigation.

Monthly Landscape Irrigation Water Use

(Based on evapotranspiration crop demand and irrigated area)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
This month's process wastewater, remaining after vineyard irrigation, available for landscape irrigation[gallons] *(From sheet 1)*	1,200	1,800	1,800	0	0	0	0	0	0	0	0	2,400
Reference ET (ETo) (in/month) (see note 1)	1.32	1.8	3.32	4.78	6.11	6.84	7.07	6.3	4.9	3.45	1.74	1.29
Crop Coefficient (k_c) (see note 2)	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Crop water demand per acre [inches]	0.79	1.08	1.99	2.87	3.67	4.10	4.24	3.78	2.94	2.07	1.04	0.77
Crop water demand per acre [gallons]	21,505	29,325	54,088	77,873	99,541	111,433	115,180	102,636	79,828	56,205	28,347	21,016
Total crop water demand for irrigated area [gallons]	0	0	0	0	0	0	0	0	0	0	0	0
Will landscape be irrigated with reclaimed water this month?	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Process wastewater remaining after vineyard irrigation, reclaimed for landscape irrigation [gallons]	0	0	0	0	0	0	0	0	0	0	0	0
Landscape irrigation water required from storage or other source [gallons]	0	0	0	0	0	0	0	0	0	0	0	0
Drawdown from storage for landscape irrigation [gallons]	0	0	0	0	0	0	0	0	0	0	0	0
Process wastewater generated this month, unused for irrigation, to be reclaimed and stored [gallons]	1,200	1,800	1,800	0	0	0	0	0	0	0	0	2,400
Net end-of-month reclaimed water storage after all irrigation [gallons]	3,600	5,400	7,200	2,980	0	0	0	0	0	0	0	2,400

End of Water Balance

Peak Monthly Storage = 7,200 gallons

Notes:

1. Reference ETo from California Irrigation Management Information System
2. Crop Coefficient from Table 1 of "Estimating Irrigation Water Needs of Landscape Plantings in California", University of California Cooperative Extension, August 2000.

Attachment 3

Annual Groundwater Recharge Rate Report

This report determines the annual groundwater recharge rate for the Schlatter Family Estate Micro-Winery property. The parcels are currently only used as an existing vineyard that is located on APN: 025-180-082 and 025-180-083. This total parcel has an area of ± 68.03 acres. The parcel has slopes ranging from 2-75%.

For the analysis, the parcel has been divided into four (4) areas, impervious, vineyard, grassland, and coastal oak tree areas.

METHODOLOGY

The groundwater recharge rate has been determined by examining the annual rainfall, runoff and species-specific evapotranspiration during winter months. The 10-year average rainfall PRISM data DEM provided by Napa County was used to determine the annual rainfall amount and site runoff volumes. It was determined that the average annual rainfall amounts to 30 inches per year.

The runoff volumes were determined by calculating the site-specific runoff coefficient. The runoff coefficients were calculated using aerial images to view the terrain and the county topography to estimate the slopes in each area.

The evapotranspiration losses were calculated using the Water Use Classifications of Landscape Species (WUCOLS) methodology for the vineyard, grassland, and coastal oak tree areas. Only evapotranspiration from the winter was considered, as it is assumed that evapotranspiration in summer will be from irrigation water.

The groundwater recharge rate was calculated as the difference of the total annual rainfall and losses from the stormwater runoff and evapotranspiration. Refer to attached calculations.

Average Recharge Rate = Average Rainfall – Runoff – Evapotranspiration

CONCLUSION

The Schlatter Family Estate Micro-Winery property has an annual rainfall of 30 inches per year, equating to 170.08 acre-feet per year for the parcel.

Total evapotranspiration volume that occurs through the vineyard, grassland, and oak tree areas is 21.90 acre-feet per year. The stormwater runoff from the parcel totals 110.91 acre-feet per year. The total average evapotranspiration and runoff is 132.81 acre-feet per year. This equates to a groundwater recharge rate of 37.26 acre-feet per year, or 0.55 acre-feet per acre per year.

Schlatter Family Estate Micro Winery

Groundwater Recharge Rate

Parcels 025-180-082 & 025-180-083

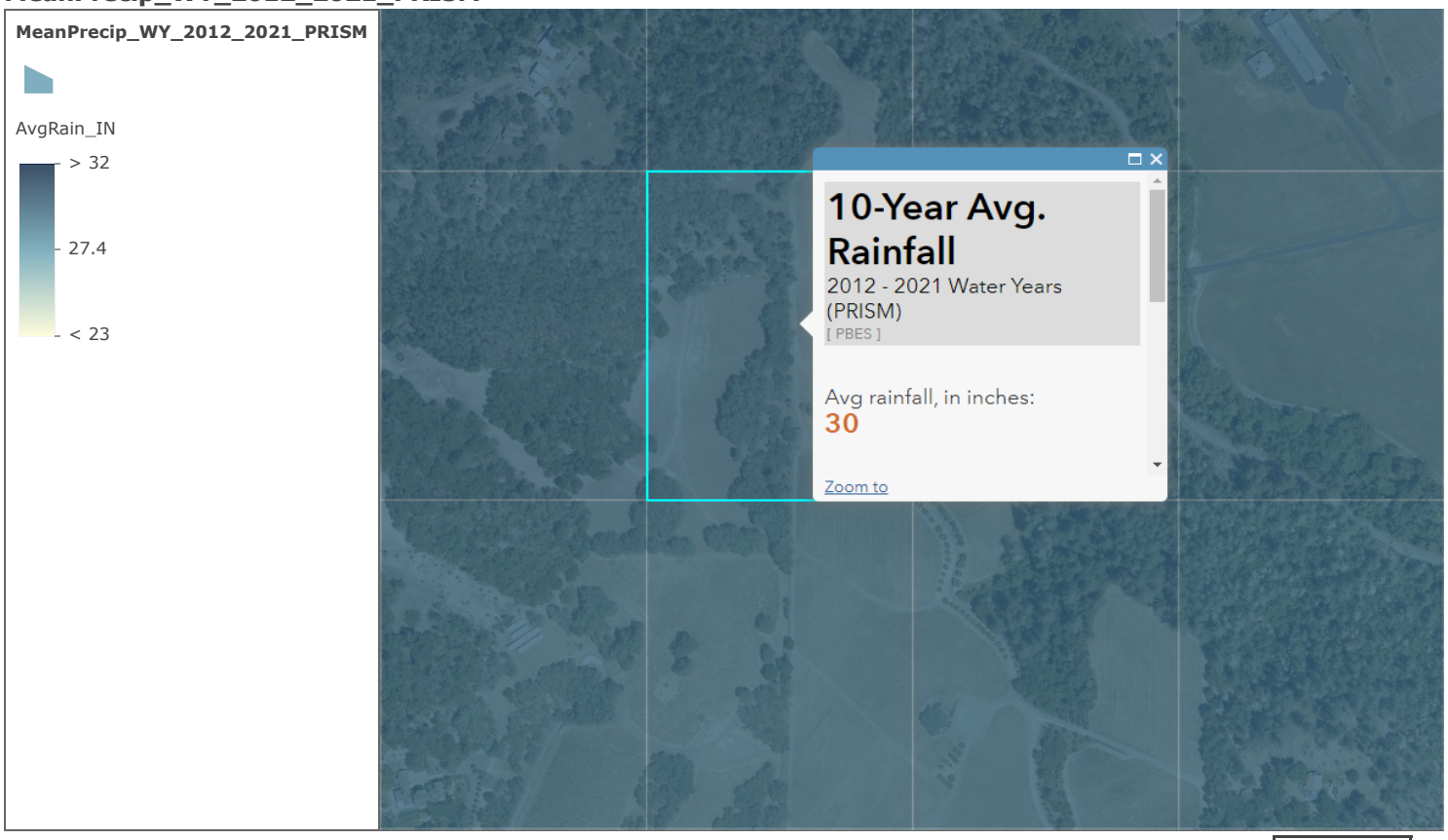
Site Description	Hydrologic Soil Group	Area (ft^2)	Area (ac)	Total Annual Rainfall (in/yr)	Total Rainfall (ft^3/yr)
Impervious Area	C	27,045	0.62	30	67,613
Vineyard Area	C	1,077,670	24.74	30	2,694,175
Grass and Shrubs	C	58,650	1.35	30	146,625
Coastal Oak Trees	D	1,800,020	41.32	30	4,500,050
Total			**68.03**	**30**	**7,408,463**

Evapotranspiration (ET_0)										
Site	January (Et_o) (in)	February (Et_o) (in)	March (Et_o) (in)	October (Et_o) (in)	November (Et_o) (in)	December (Et_o) (in)	Total ET_o (in)	Landscape Coefficient (k_c)	Landscape Evapotrans. (Et_c) (in) = Total Et_o x k_c	Total Landscape Evapotranspiration (ft^3/yr)
Impervious Area	0	0	0	0	0	0	0	0	0.00	0
Vineyard Area	1.24	1.68	3.41	3.41	1.8	0.93	12.47	0.08	1.00	89,590
Grass and Shrubs	1.24	1.68	3.41	3.41	1.8	0.93	12.47	0.68	8.48	41,444
Coastal Oak Trees	1.24	1.68	3.41	3.41	1.8	0.93	12.47	0.44	5.49	823,029
Total										**954,063**

Runoff		
Site	Run-Off Coefficient (C)	Total Runoff (ft^3/yr)
Impervious Area	0.90	60,851
Vineyard Area	0.60	1,616,505
Grass and Shrubs	0.64	93,840
Coastal Oak Trees	0.68	3,060,034
Total		**4,831,230**

Groundwater Recharge Rate						
Site	Total Rainfall (ft^3/yr)	Total Crop Evapotranspiration (ft^3/yr)	Total Runoff (ft^3/yr)	Total Stormwater loss on site (ft^3/yr)	Groundwater Recharge Rate (ft^3/yr)	Groundwater Recharge Rate (ac-ft/ac/yr)
Impervious Area	67,613	0	60,851	60,851	6,761	0.25
Vineyard Area	2,694,175	89,590	1,616,505	1,706,095	988,080	0.92
Grass and Shrubs	146,625	41,444	93,840	135,284	11,341	0.19
Coastal Oak Trees	4,500,050	823,029	3,060,034	3,883,063	616,987	0.34
Total	**7,408,463**	**954,063**	**4,831,230**	**5,785,294**	**1,623,169**	**0.55**

MeanPrecip_WY_2012_2021_PRISM



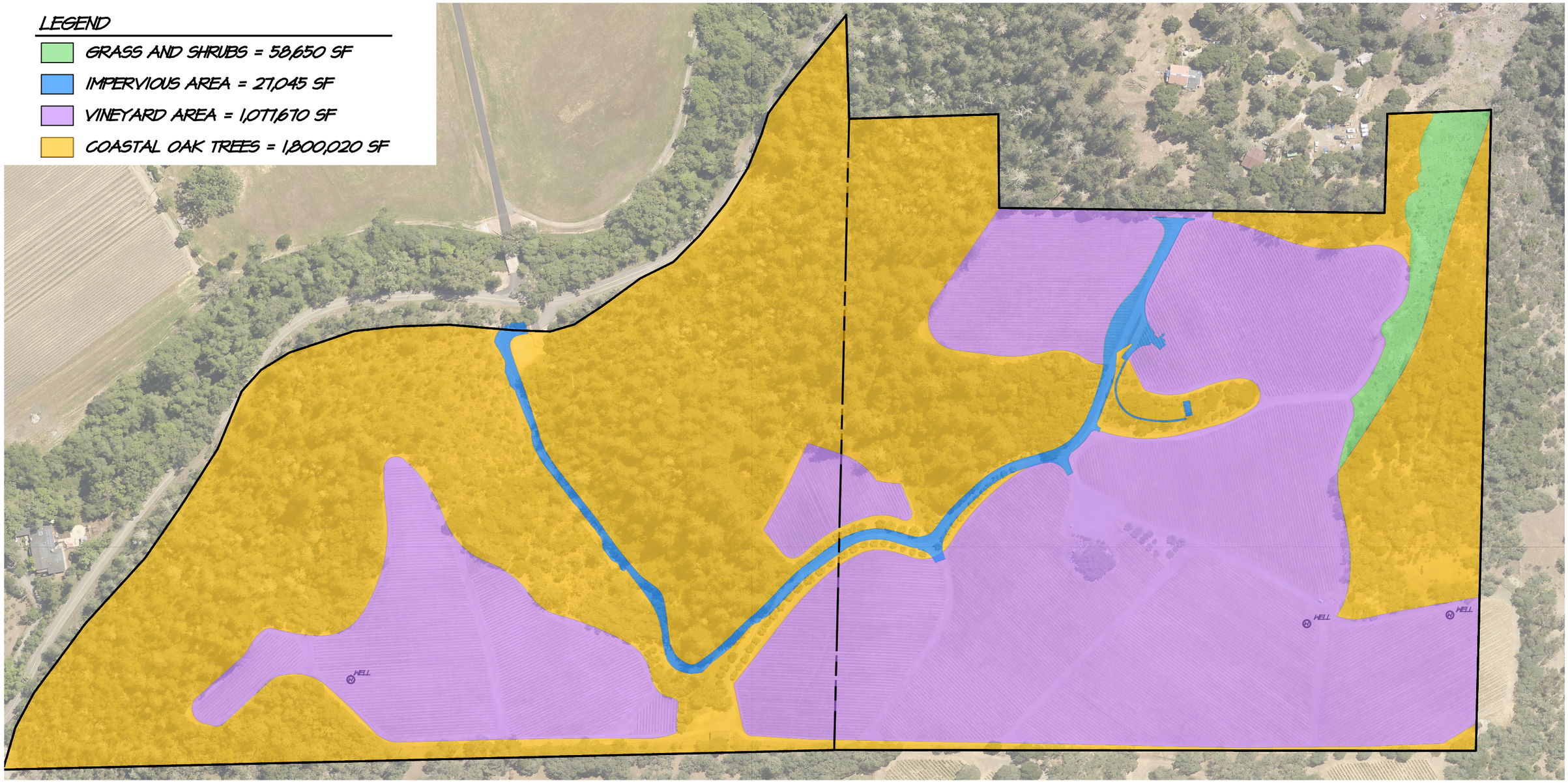
This layer represents the average rainfall across Napa County from water year (WY) 2012 through WY 2021. The 10-year average for precipitation in Napa County was determined with monthly precipitation data from PRISM Climate Group. Annual totals were calculated on a water year basis (October through September). Precipitation values are in inches/year. (from Portal)

https://prism.oregonstate.edu/recent/ (data modified by LSCE and Napa Co. PBES) | Pictometry International, The County of Napa, Yolo County, Maxar

GROUNDWATER RECHARGE EXHIBIT

SFE - MICRO WINERY CONN VALLEY RD

NAPA CALIFORNIA



SITE PLAN

SCALE: 1" = 100'

GRAPHIC SCALE

200' 0 200'

(IN FEET)

1 INCH = 200 FT

RSA+

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JULY 19, 2024 4122083.0

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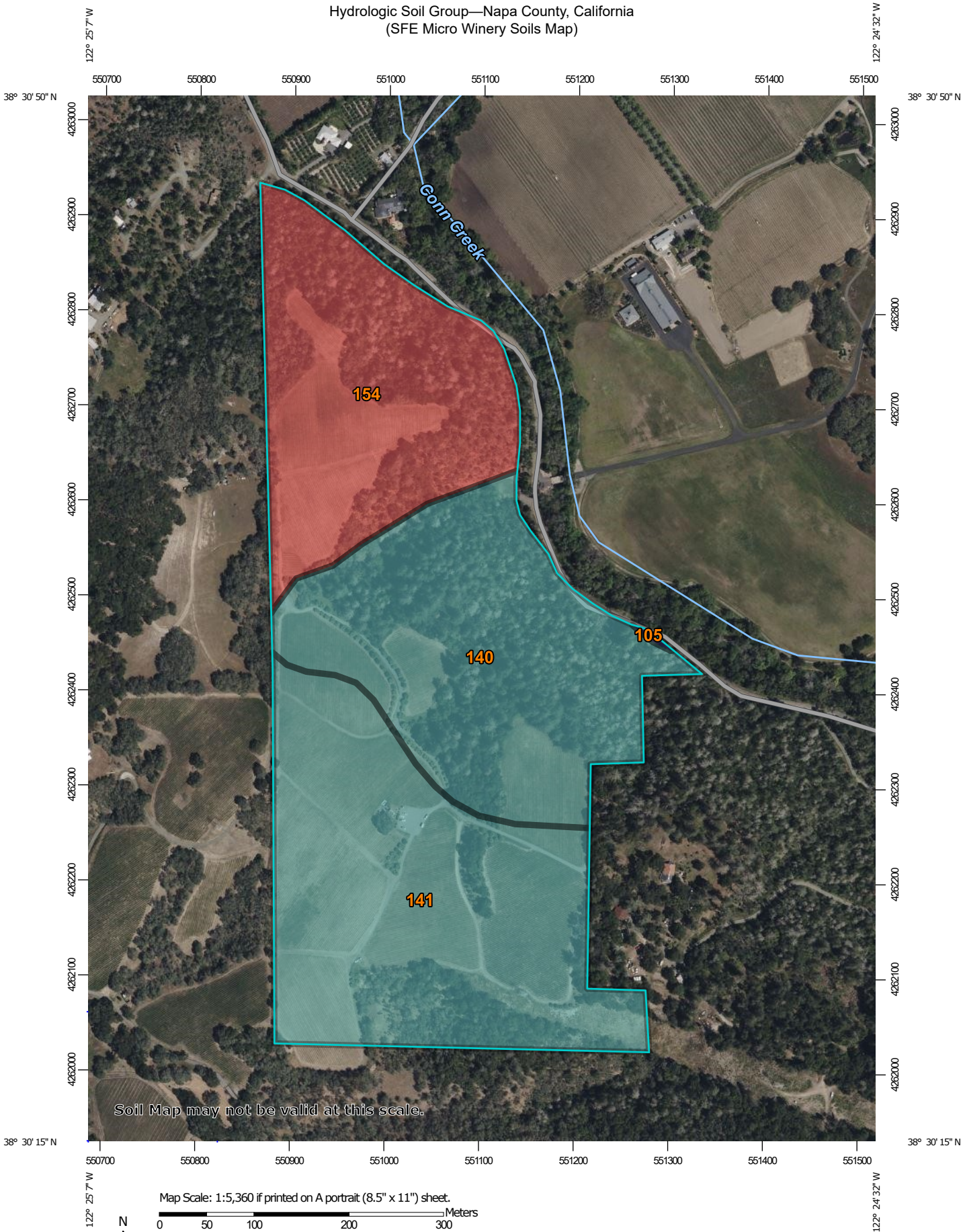
Hydrologic Soil Group—Napa County, California
(SFE Micro Winery Soils Map)



Map Scale: 1:5,360 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Napa County, California
Survey Area Data: Version 16, Sep 11, 2023

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 26, 2022—Apr 25, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
105	Bale clay loam, 2 to 5 percent slopes	B	0.1	0.1%
140	Forward silt loam, 12 to 57 percent slopes, MLRA 15	C	22.0	33.0%
141	Forward-Kidd complex, 11 to 60 percent slopes, MLRA 15	C	26.1	39.2%
154	Henneke gravelly loam, 30 to 75 percent slopes	D	18.4	27.6%
Totals for Area of Interest			**66.5**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

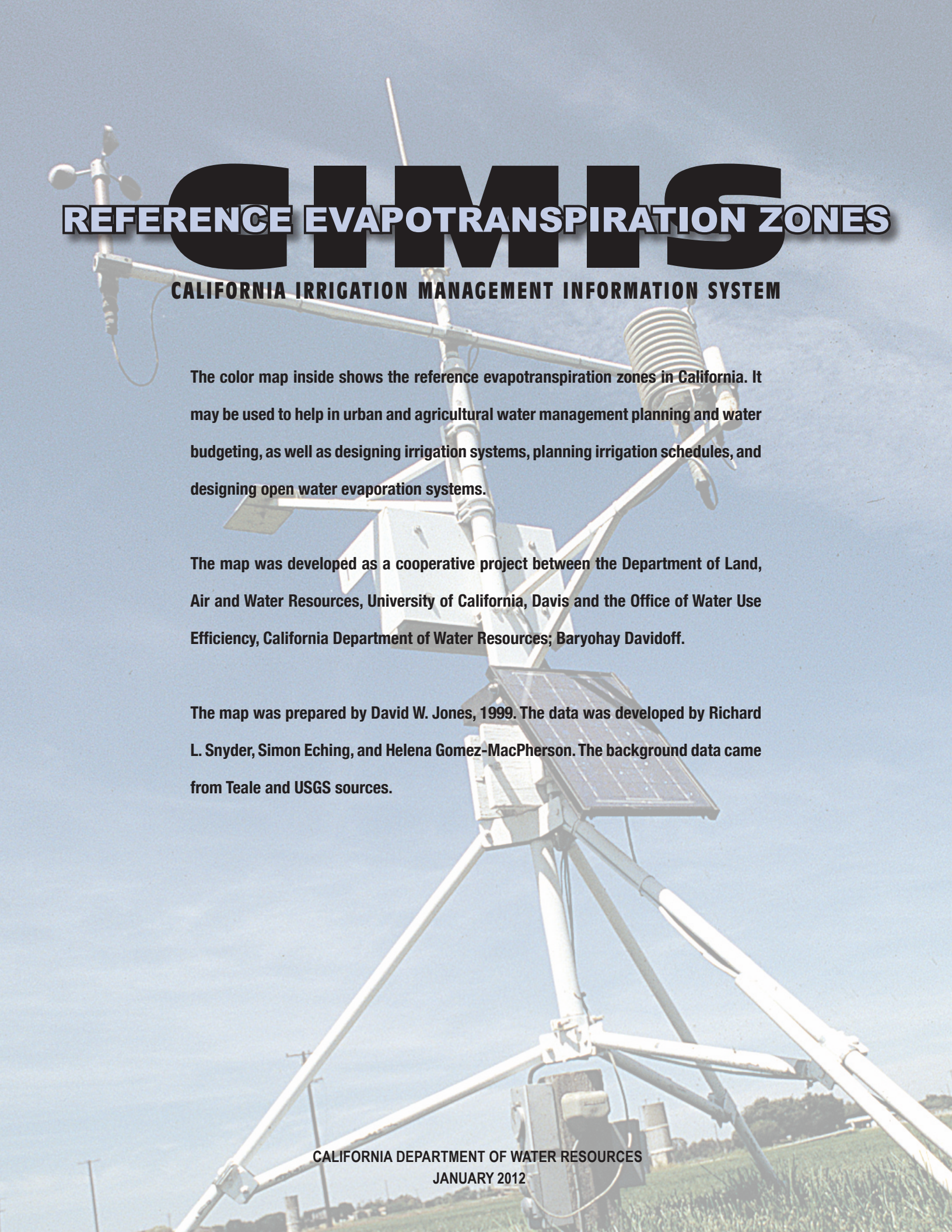
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



CIMIS

REFERENCE EVAPOTRANSPIRATION ZONES

CALIFORNIA IRRIGATION MANAGEMENT INFORMATION SYSTEM

The color map inside shows the reference evapotranspiration zones in California. It may be used to help in urban and agricultural water management planning and water budgeting, as well as designing irrigation systems, planning irrigation schedules, and designing open water evaporation systems.

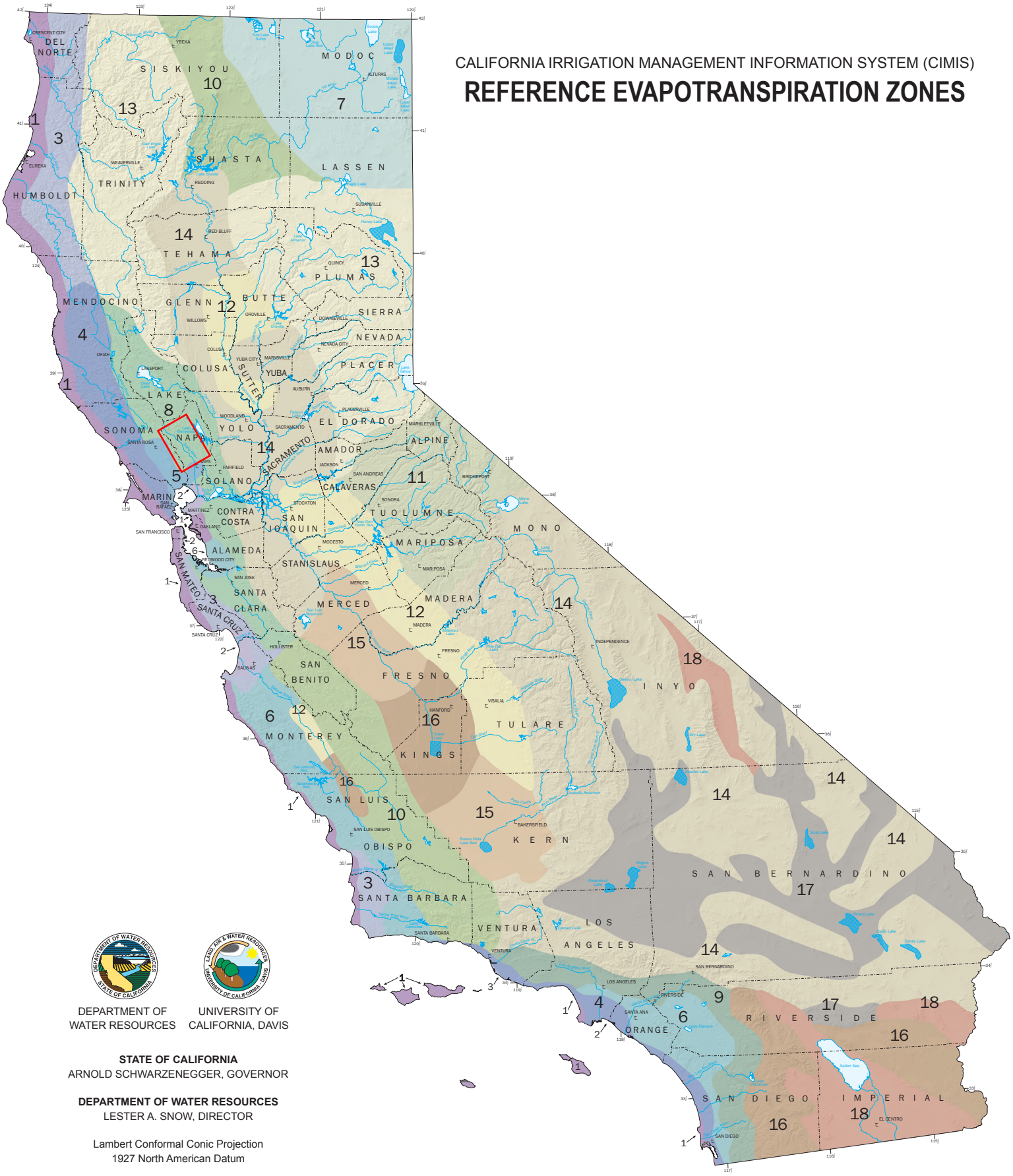
The map was developed as a cooperative project between the Department of Land, Air and Water Resources, University of California, Davis and the Office of Water Use Efficiency, California Department of Water Resources; Baryohay Davidoff.

The map was prepared by David W. Jones, 1999. The data was developed by Richard L. Snyder, Simon Eching, and Helena Gomez-MacPherson. The background data came from Teale and USGS sources.

CALIFORNIA DEPARTMENT OF WATER RESOURCES
JANUARY 2012

CALIFORNIA IRRIGATION MANAGEMENT INFORMATION SYSTEM (CIMIS)

REFERENCE EVAPOTRANSPIRATION ZONES



DEPARTMENT OF WATER RESOURCES

UNIVERSITY OF CALIFORNIA, DAVIS

STATE OF CALIFORNIA
ARNOLD SCHWARZENEGGER, GOVERNOR

DEPARTMENT OF WATER RESOURCES
LESTER A. SNOW, DIRECTOR

Lambert Conformal Conic Projection
1927 North American Datum

Reference EvapoTranspiration (ETo) Zones

1 **COASTAL PLAINS HEAVY FOG BELT** lowest ETo in California, characterized by dense fog

2 **COASTAL MIXED FOG AREA** less fog and higher ETo than zone 1

3 **COASTAL VALLEYS & PLAINS & NORTH COAST MOUNTAINS** more sunlight than zone 2

4 **SOUTH COAST INLAND PLAINS & MOUNTAINS NORTH OF SAN FRANCISCO** more sunlight and higher summer ETo than zone 3

5 **NORTHERN INLAND VALLEYS** valleys north of San Franciaco

6 **UPLAND CENTRAL COAST & LOS ANGELES BASIN** higher elevation coastal areas

7 **NORTHEASTERN PLAINS**

8 **INLAND SAN FRANCISCO BAY AREA** inland area near San Francisco with some marine influence

9 **SOUTH COAST MARINE TO DESERT TRANSITION** inland area between marine & desert climates

10 **NORTH CENTRAL PLATEAU & CENTRAL COAST RANGE** cool, high elevation areas with strong summer sunlight; zone has limited climate data & the zones selection is somewhat subjective

11 **CENTRAL SIERRA NEVADA** mountain valleys east of Sacramento with some influence from delta breeze in summer

12 **EAST SIDE SACRAMENTO-SAN JOAQUIN VALLEY** low winter & high summer ETo with slightly lower ETo than zone 14

13 **NORTHERN SIERRA NEVADA** northern Sierra Nevada mountain valleys with less marine influence than zone 11

14 **MID-CENTRAL VALLEY, SOUTHERN SIERRA NEVADA, TEHACHAPI & HIGH DESERT MOUNTAINS** high summer sunshine and wind in some locations

15 **NORTHERN & SOUTHERN SAN JOAQUIN VALLEY** slightly lower winter ETo due to fog and slightly higher summer ETo than zones 12 & 14

16 **WESTSIDE SAN JOAQUIN VALLEY & MOUNTAINS EAST & WEST OF IMPERIAL VALLEY**

17 **HIGH DESERT VALLEYS** valleys in the high desert near Nevada and Arizona

18 **IMPERIAL VALLEY, DEATH VALLEY & PALO VERDE** low desert areas with high sunlight & considerable heat advection

Monthly Average Reference Evapotranspiration by ETo Zone (inches/month)

Zone	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1	0.93	1.40	2.48	3.30	4.03	4.50	4.65	4.03	3.30	2.48	1.20	0.62	32.9
2	1.24	1.68	3.10	3.90	4.65	5.10	4.96	4.65	3.90	2.79	1.80	1.24	39.0
3	1.86	2.24	3.72	4.80	5.27	5.70	5.58	5.27	4.20	3.41	2.40	1.86	46.3
4	1.86	2.24	3.41	4.50	5.27	5.70	5.89	5.58	4.50	3.41	2.40	1.86	46.6
5	0.93	1.68	2.79	4.20	5.58	6.30	6.51	5.89	4.50	3.10	1.50	0.93	43.9
6	1.86	2.24	3.41	4.80	5.58	6.30	6.51	6.20	4.80	3.72	2.40	1.86	49.7
7	0.62	1.40	2.48	3.90	5.27	6.30	7.44	6.51	4.80	2.79	1.20	0.62	43.3
8	1.24	1.68	3.41	4.80	6.20	6.90	7.44	6.51	5.10	3.41	1.80	0.93	49.4
9	2.17	2.80	4.03	5.10	5.89	6.60	7.44	6.82	5.70	4.03	2.70	1.86	55.1
10	0.93	1.68	3.10	4.50	5.89	7.20	8.06	7.13	5.10	3.10	1.50	0.93	49.1
11	1.55	2.24	3.10	4.50	5.89	7.20	8.06	7.44	5.70	3.72	2.10	1.55	53.1
12	1.24	1.96	3.41	5.10	6.82	7.80	8.06	7.13	5.40	3.72	1.80	0.93	53.4
13	1.24	1.96	3.10	4.80	6.51	7.80	8.99	7.75	5.70	3.72	1.80	0.93	54.3
14	1.55	2.24	3.72	5.10	6.82	7.80	8.68	7.75	5.70	4.03	2.10	1.55	57.0
15	1.24	2.24	3.72	5.70	7.44	8.10	8.68	7.75	5.70	4.03	2.10	1.24	57.9
16	1.55	2.52	4.03	5.70	7.75	8.70	9.30	8.37	6.30	4.34	2.40	1.55	62.5
17	1.86	2.80	4.65	6.00	8.06	9.00	9.92	8.68	6.60	4.34	2.70	1.86	66.5
18	2.48	3.36	5.27	6.90	8.68	9.60	9.61	8.68	6.90	4.96	3.00	2.17	71.6

Variability between stations within single zones is as high as 0.02 inches per day for zone 1 and during winter months in zone 13. The average standard deviation of the ETo between estimation sites wihtin a zone for all months is about 0.01 inches per day for the 200 sites used to develop the map.

STATE OF CALIFORNIA
THE NATURAL RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

CIMIS Information
wwwcimis.water.ca.gov

TABLE 1. Crop coefficients used in daily modeling of soil water processes in vineyards, oak trees and grasslands

Vineyards		Oak trees		Grasslands	
Period	K_c	Period	K_c	Period	K_c
3/1–4/15	0.10	3/1–3/31	0.5	3/1–3/15	0.90
4/16–4/30	0.20	4/1–10/1	0.6	3/16–4/30	0.95
5/1–5/15	0.25	10/2–11/25	0.5	5/1–5/15	0.25
5/16–5/31	0.30	11/26–2/28	0.4	5/16–6/15*	0.10
6/1–6/15	0.35			6/16*–10/13	0.00
6/16–6/30	0.40			10/14–10/31	0.25
7/1–9/30	0.50			11/1–2/28	0.75
10/1–10/15	0.30				
10/16–10/31	0.20				
11/1–11/15	0.15				
11/16–11/30	0.05				
12/1–2/28	0.01				

Sources: Allen et al. 1998 (grasses and trees); Caprile 2007 (vineyards).

* Variable date depending on available soil moisture.

Oak Trees - weighted average for October to March

Time Period	# of Days	K_C	Days * K^C	
3/1-3/31	31	0.5	15.5	
10/01	1	0.6	0.6	Weighted Kc=
10/2-11/25	55	0.5	27	80.7/182 = 0.44
11/26-2/28	95	0.4	37.6	
Totals=	182		80.7	

Vineyard - weighted average for October to March

Time Period	# of Days	K_C	Days * K^C	
3/1-4/15	31	0.1	3.1	
10/1-10/15	15	0.3	4.5	
10/16-10/31	16	0.2	3.2	
11/1-11/15	15	0.15	2.25	Weighted Kc=
11/16-11/30	15	0.05	0.75	14.7/182 = 0.08
12/1-2/28	90	0.01	0.9	
Total=	182		14.7	

Grasslands - weighted average for October to March

Time Period	# of Days	K_C	Days * K^C	
3/1-3/15	15	0.9	13.5	
3/16-3/31	16	0.95	15.2	Weighted Kc=
10/1-10/13	13	0.00	0.00	123.2/182 = 0.68
10/14-10/31	18	0.25	4.5	
11/1-2/28	120	0.75	90	
Totals=	182		123.2	

Grass & Shrubs

WATERSHED TYPES AND FACTORS

RUN-OFF PRODUCING CHARACTERISTICS OF WATERSHEDS SHOWING FACTORS FOR EACH CHARACTERISTIC FOR VARIOUS WATERSHED TYPES				
WATERSHED TYPES AND FACTORS				
Run-off Producing Features	**Extreme**	**High**	**Normal**	**Low**
Relief	0.38 **0.28 – 0.38** Steep, rugged terrain, with average slopes above 30%	**0.20 – 0.28** Rolling, with average slopes of 10 to 30%	**0.14 – 0.20** Rolling, with average slopes of 5 to 10%	**0.08 – 0.14** Relatively flat land, with average slopes of 0 to 5%
Soil Infiltration	**0.12 – 0.16** No effective soil cover either rock or thin soil mantle of negligible infiltration capacity.	0.12 **0.08 – 0.12** Slow to take up water; clay or shallow loam soils of low infiltration capacity imperfectly or poorly drained.	**0.06 – 0.08** Normal; well drained light and medium textured soils sandy loams, silt, and silt loams.	**0.04 – 0.06** Slow to take up water; clay or shallow loam soils of low infiltration capacity imperfectly or poorly drained.
Vegetation Cover	**0.12 – 0.16** No effective plant cover; bare or very sparse cover.	**0.08 – 0.12** Poor to fair; clean cultivation crops or poor natural cover; less than 20% of drainage area under good cover.	**0.06 – 0.08** Fair to good; about 50% of area in good grassland or woodland; not more than 50% of area in cultivated crops.	0.06 **0.04 – 0.06** Good to excellent; about 90% of drainage area in good grassland, woodland, or equivalent crop.
Surface	**0.10 – 0.12** Negligible; surface depressions, few and shallow; drainage ways steep and small; no marshes.	0.08 **0.08 – 0.10** Low well-defined system of small drainage ways; no ponds or marsh.	**0.06 – 0.08** Normal; considerable surface depression storage; lakes, ponds, and marshes.	**0.04 – 0.06** High; surface storage high; drainage system not sharply defined; large floodplain storage or large number of ponds or marshes.

THE RUNOFF FACTOR IS DETERMINED BY THE SUM OF THE FACTORS FOR RELIEF INFILTRATION, COVER, AND SURFACE. NOT APPLICABLE TO BUILT UP AREAS.

FIGURE 3

Sum = 0.38 + 0.12 + 0.06 + 0.08 = 0.64

Coastal Oak Trees

WATERSHED TYPES AND FACTORS

RUN-OFF PRODUCING CHARACTERISTICS OF WATERSHEDS SHOWING FACTORS FOR EACH CHARACTERISTIC FOR VARIOUS WATERSHED TYPES				
WATERSHED TYPES AND FACTORS				
Run-off Producing Features	**Extreme**	**High**	**Normal**	**Low**
Relief	0.38 **0.28 – 0.38** Steep, rugged terrain, with average slopes above 30%	**0.20 – 0.28** Rolling, with average slopes of 10 to 30%	**0.14 – 0.20** Rolling, with average slopes of 5 to 10%	**0.08 – 0.14** Relatively flat land, with average slopes of 0 to 5%
Soil Infiltration	0.16 **0.12 – 0.16** No effective soil cover either rock or thin soil mantle of negligible infiltration capacity.	**0.08 – 0.12** Slow to take up water; clay or shallow loam soils of low infiltration capacity imperfectly or poorly drained.	**0.06 – 0.08** Normal; well drained light and medium textured soils sandy loams, silt, and silt loams.	**0.04 – 0.06** Slow to take up water; clay or shallow loam soils of low infiltration capacity imperfectly or poorly drained.
Vegetation Cover	**0.12 – 0.16** No effective plant cover; bare or very sparse cover.	**0.08 – 0.12** Poor to fair; clean cultivation crops or poor natural cover; less than 20% of drainage area under good cover.	**0.06 – 0.08** Fair to good; about 50% of area in good grassland or woodland; not more than 50% of area in cultivated crops.	0.06 **0.04 – 0.06** Good to excellent; about 90% of drainage area in good grassland, woodland, or equivalent crop.
Surface	**0.10 – 0.12** Negligible; surface depressions, few and shallow; drainage ways steep and small; no marshes.	0.08 **0.08 – 0.10** Low well-defined system of small drainage ways; no ponds or marsh.	**0.06 – 0.08** Normal; considerable surface depression storage; lakes, ponds, and marshes.	**0.04 – 0.06** High; surface storage high; drainage system not sharply defined; large floodplain storage or large number of ponds or marshes.

THE RUNOFF FACTOR IS DETERMINED BY THE SUM OF THE FACTORS FOR RELIEF INFILTRATION, COVER, AND SURFACE. NOT APPLICABLE TO BUILT UP AREAS.

FIGURE 3

Sum = 0.38 + 0.16 + 0.06 + 0.08 = 0.68

Vineyard Area

WATERSHED TYPES AND FACTORS

RUN-OFF PRODUCING CHARACTERISTICS OF WATERSHEDS SHOWING FACTORS FOR EACH CHARACTERISTIC FOR VARIOUS WATERSHED TYPES				
WATERSHED TYPES AND FACTORS				
Run-off Producing Features	**Extreme**	**High**	**Normal**	**Low**
Relief	**0.28 – 0.38** Steep, rugged terrain, with average slopes above 30%	0.28 **0.20 – 0.28** Rolling, with average slopes of 10 to 30%	**0.14 – 0.20** Rolling, with average slopes of 5 to 10%	**0.08 – 0.14** Relatively flat land, with average slopes of 0 to 5%
Soil Infiltration	**0.12 – 0.16** No effective soil cover either rock or thin soil mantle of negligible infiltration capacity.	0.12 **0.08 – 0.12** Slow to take up water; clay or shallow loam soils of low infiltration capacity imperfectly or poorly drained.	**0.06 – 0.08** Normal; well drained light and medium textured soils sandy loams, silt, and silt loams.	**0.04 – 0.06** Slow to take up water; clay or shallow loam soils of low infiltration capacity imperfectly or poorly drained.
Vegetation Cover	**0.12 – 0.16** No effective plant cover; bare or very sparse cover.	0.12 **0.08 – 0.12** Poor to fair; clean cultivation crops or poor natural cover; less than 20% of drainage area under good cover.	**0.06 – 0.08** Fair to good; about 50% of area in good grassland or woodland; not more than 50% of area in cultivated crops.	**0.04 – 0.06** Good to excellent; about 90% of drainage area in good grassland, woodland, or equivalent crop.
Surface	**0.10 – 0.12** Negligible; surface depressions, few and shallow; drainage ways steep and small; no marshes.	0.08 **0.08 – 0.10** Low well-defined system of small drainage ways; no ponds or marsh.	**0.06 – 0.08** Normal; considerable surface depression storage; lakes, ponds, and marshes.	**0.04 – 0.06** High; surface storage high; drainage system not sharply defined; large floodplain storage or large number of ponds or marshes.

THE RUNOFF FACTOR IS DETERMINED BY THE SUM OF THE FACTORS FOR RELIEF INFILTRATION, COVER, AND SURFACE. NOT APPLICABLE TO BUILT UP AREAS.

FIGURE 3

Sum = 0.28 + 0.12 + 0.12 + 0.08 = 0.60