

Water Availability Analysis

APN 022-140-054

Spring Mountain Road

St Helena, CA 94574

Misty Mountain Properties LLC

Prepared by:



O'Connor Environmental, Inc.

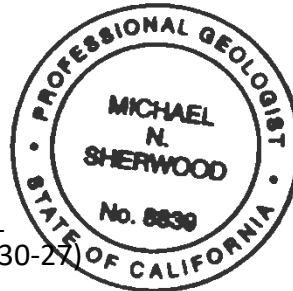
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A handwritten signature in blue ink, appearing to read "Michael Sherwood", is written over a horizontal line.

Michael Sherwood, PG #8839 (Exp. 6-30-27)
Geologist



Cole Daly, BS

Environmental Technician

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Introduction

The applicant, Misty Mountain Properties LLC, is seeking permits from the County of Napa to develop a vacant parcel (Napa County APN 022-140-054-000) containing only an existing well with a new well (Permit No. E25-00193), and up to 4.0 net acres of vineyard on Spring Mountain Rd. (address pending) approximately 3.5 miles northwest of the City of St. Helena (Figure 1). This Water Availability Analysis (WAA) was developed based on the guidance provided in the Napa County Department of Planning, Building, & Environmental Services' Water Availability Analysis Guidance Document formally adopted by the Napa County Board of Supervisors in May 2015. The WAA includes the following elements: estimates of existing and proposed water use within the project recharge area, compilation of drillers' logs from the area and characterization of local hydrogeologic conditions, analyses to estimate groundwater recharge relative to proposed uses (Tier 1), a screening analysis of the potential for well interference at neighboring wells located within 500 feet of the project well or potential effects on springs within 1,500 feet (Tier 2) and an assessment of potential impacts to streamflow in identified Significant Streams within 1,500 feet of the project (Tier 3).

Note: we have been made aware of potential future development on the subject parcel and two neighboring parcels APN 022-070-019 and 022-140-017 located north and northwest of the project parcel (Figure 1). Plans are being developed separately for each parcel with TruNorth and include the construction of one home on each parcel and development of approximately 4.25 acres of vineyards across the two adjacent parcels. Additional water use associated with the houses and vineyard area has been incorporated into the proposed water use conditions.

Limitations

Groundwater systems of Napa County and the Coast Range are typically complex, and available data rarely allows for more than general assessment of groundwater conditions and delineation of aquifers. Hydrogeologic interpretations are based on the drillers' reports made available to us through the California Department of Water Resources, available geologic maps and hydrogeologic studies, and professional judgment. This analysis is based on limited available data and relies significantly on interpretation of data from disparate sources of disparate quality.

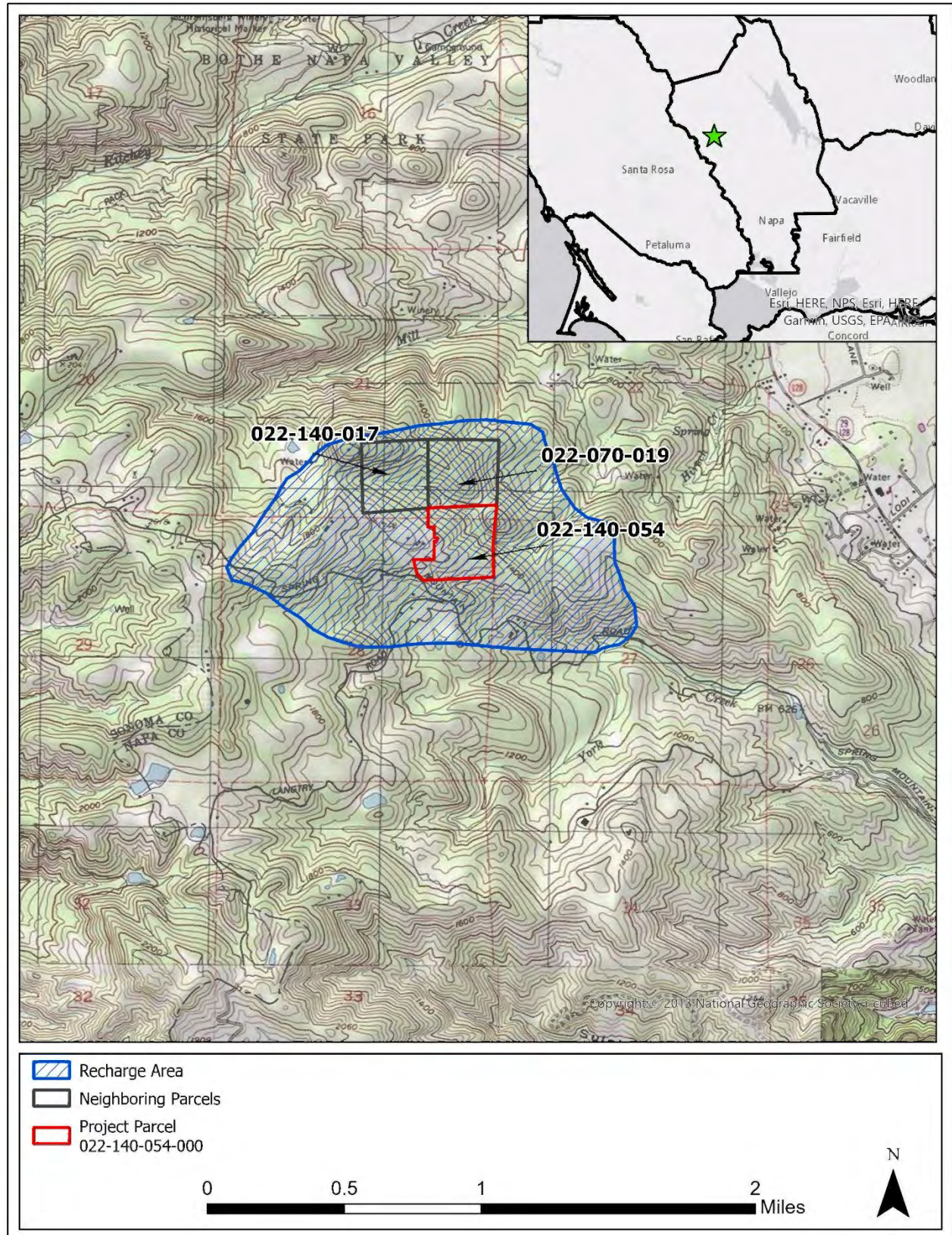


Figure 1: Project location map.

Hydrogeologic Conditions

The project parcel is located in the western foothills of the Napa Valley, in the headwaters of York Creek at the northernmost end of the West Napa Fault Zone and to the east of the Maacama fault zone. The project parcel is located in an area mapped as the Pliocene and late-Miocene-aged pumiceous ash-flow tuff of the Sonoma Volcanics (map unit Tst) (Figure 2). This unit is described as locally welded pumiceous tuff with some Agglomeratic tuff, andesite to basalt flow rocks, tuff breccia, and bedded tuff (Graymer et al., 2007).

In addition to the tuff unit, a block of andesitic to basaltic lava flows of the Sonoma Volcanics is mapped (unit Tsa) to the south of the project parcel. The Sonoma Volcanics are relatively thin in this area and overlie basement rocks of the Franciscan Complex at depths beginning at approximately 200 feet however they appear to thicken moving east. The Franciscan complex mapped in this area (Map unit KJfs) is described as massive to distinctly bedded early Cretaceous and late Jurassic-aged graywacke and *mélange* (Graymer et al., 2007).

In general, the bedrock units of the Sonoma Volcanics have very low primary porosity and groundwater occurs primarily in fractures resulting in highly variable well production. Well yields are low and typically range from less than 16 – 50 gallons per minute (gpm) (LSCE 2013). Unwelded sections of tuff are considered to be good water producers (DWR 1982). Bedrock units such as the Andesite to Basalt Lava Flows (map unit Tsa) typically have low primary porosity and are only water yielding where fractured (DWR 1982).

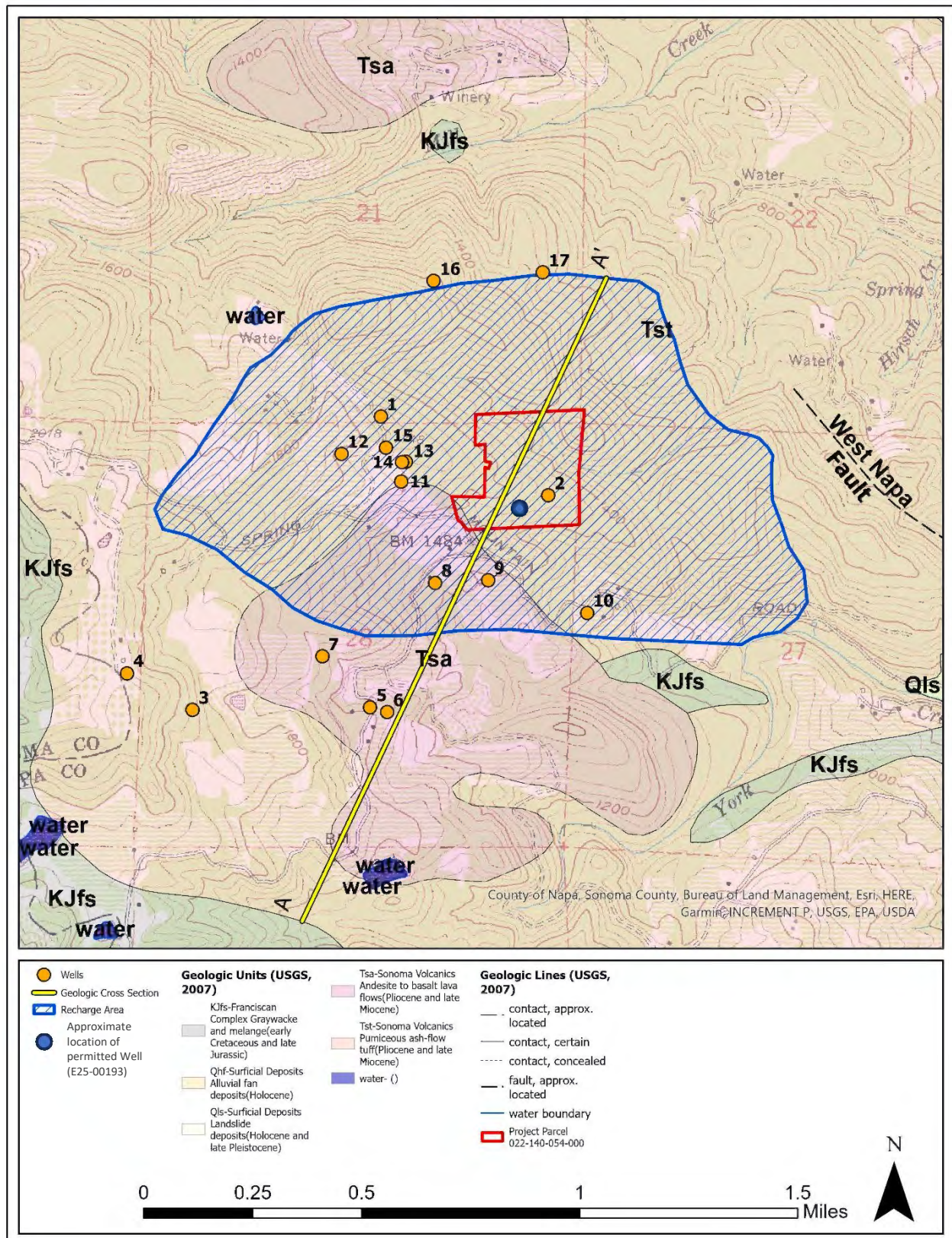


Figure 2: Surficial geology and locations of wells in the vicinity of the project parcel. Surficial geology based on data from the Geologic Map and Map Database of Eastern Sonoma and Western Napa Counties, California (Graymer et al., USGS, 2007)

Well Data

Well Completion Reports for wells within the vicinity of the project parcel were obtained through the California Department of Water Resources (DWR) Well Completion Report Map Application. Additional details about well location were obtained from the County of Napa Planning Building and Environmental Services Division (PBES). A subset of these logs was compiled (Appendix A) and georeferenced based on parcel and location sketch information (Figure 2).

An existing well on the project parcel (Well 2, Figure 2) is located in the southeastern corner of the project parcel at an approximate elevation of 1,583 ft and was completed in 1999 to a depth of 472 feet and a screened interval between 274 and 472 feet. At the time of completion, the well had a static water level of 246 feet below ground surface (bgs) and after a 2-hour air lift test the driller reported an estimated yield of 13 gpm. A more recent pump test from June 2024 by Weeks Drilling and Pump Company (Appendix B) reports a static water level of 246 feet bgs, and a yield of 15 gpm over 5 hours.

The geologic log for Well 2 indicates that the driller encountered mixed volcanic materials throughout the entire boring from 0 to 480 feet bgs. The volcanic material is reported as short intervals of fractured volcanics, volcanic ash, and fractured basalt. These rocks are consistent with the units of the Sonoma Volcanics including the tuffaceous unit (map unit Tst) and the andesitic to basaltic lava flows (map unit Tsa).

Seventeen additional wells were successfully identified and located in the project vicinity, many of which were screened in units of the Sonoma Volcanics (Map units Tst and Tsa). These wells were completed to depths ranging from 30 to 740 feet bgs and have reported yields ranging from 2.7 to 240 gpm. Static water levels at the time of completion range from 4 to 620 feet bgs. Geologic logs for these wells report upper layers of clay, ash, a variety of volcanic rocks including tuff, basalt, and andesite. In some logs drillers also report deeper layers of sandstone, shale, greenstone and mélange below indicative of the surficial units of the Sonoma Volcanics overlying basement layers of the Franciscan Complex. Water surface elevations vary with elevation and occur at or above the top of the screened interval in many of the neighboring wells.

Table 1: Well completion details for wells in the vicinity of the project parcel.

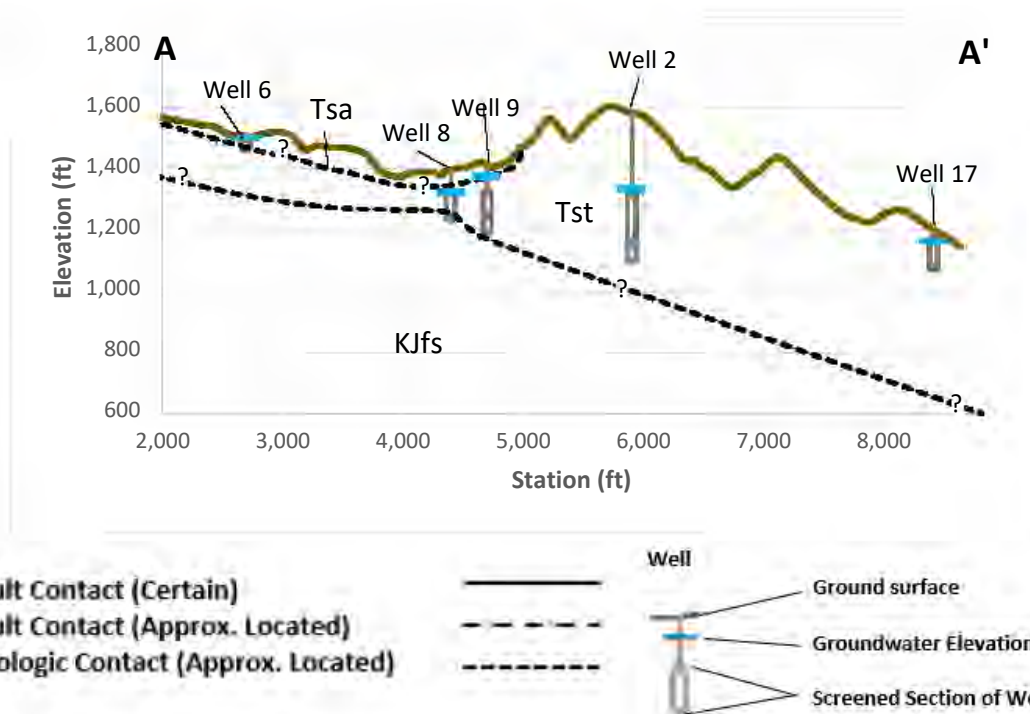
Well No.	1	2	3	4	5	6	7	8	9
DWR WCR No.	319561	777413	812027	496058	407632	407633	407634	e0322915	e0237616
Year Completed	1989	1999	1998	1993	1993	1993	1993	2015	2014
Well Depth (ft)	197	472	270	330	-	30	200	169	238
Static Water Level (ft)	80	246	102	35	-	4	71	73	39
Estimated Yield (gpm)	20	13	240	26	-	-	-	22	50
Top of Screen (ft)	160	274	120	35	-	11	100	79	98
Bottom of Screen (ft)	200	472	270	330	-	30	200	149	158
Geologic Map Unit	Tst	Tst	Tst	Tst/Kjfs	Tsa	Tsa	Tst	Tst	Tst

Table 1 cont.: Well completion details for wells in the vicinity of the project parcel.

Well No.	10	11	12	13	14	15	16	17	18
DWR WCR No.	e015184	E2000648	5084	324601	324603	308413	3284	109630	1098
Year Completed	2004	2021	1978	1989	1989	1989	1976	1978	1974
Well Depth (ft)	397	595	130	400	325	325	230	740	120
Static Water Level (ft)	60	215	70	102	89	60	130	620	36
Estimated Yield (gpm)	4	35	40	4	5	20	2.7	7.5	30
Top of Screen (ft)	97	215	90	100	80	80	120	240	40
Bottom of Screen (ft)	337	575	130	400	325	325	230	740	118
Geologic Map Unit	Tst/Kjfs	Kjfs	Tst	Tst/Kjfs	Tst	Tst/Kjfs	Tst	Tst	Tst

Geologic Cross Section

A geologic cross-section oriented southwest to northeast is shown in Figure 3 cutting across the unnamed tributary to York Creek (see Figure 2 for location). The vertical relief is relatively gentle along this cross-section, with a maximum elevation of 1,700 feet and a minimum of 1,150 feet. The majority of wells are constructed and screened within Sonoma Volcanics with the exception of Well 8 which is screened across the apparent contact between Sonoma Volcanics and Franciscan Complex with the majority in the Sonoma Volcanics. Static water levels are at or above the top of screened interval in most wells located along the cross-section, indicating confined or semi-confined aquifer conditions.



Project Aquifer

The project well (Well 2) and many nearby wells are completed and screened in volcanic rocks of the Sonoma Volcanics, therefore the Tst and Tsa units are understood to be the main project aquifer materials for the project well and proposed future well. A representative groundwater recharge area which also serves as the project impact area has been defined as the blue cross-hatched polygon in Figure 2. The aquifer recharge area has been conceptualized based on geologic boundaries and ridgelines in the vicinity of the project parcel. While some aquifer recharge may be received across these boundaries, they define an area of representative water use intensity centered on the project parcel. As defined, the project recharge area is approximately 590 acres. Because of the depth to groundwater and the hydrogeologic character of volcanic tuff and other bedrock units of the Sonoma Volcanics, the aquifer is likely confined or semi-confined.

Water Demand

Within the project recharge area, water demand was estimated for both the existing and proposed conditions. Uses on the project parcel were determined using site details provided by the applicant. Water uses on other neighboring parcels within the project recharge area were determined using satellite imagery and GIS data available through the Napa County GIS Data Catalog. Water use rates data from the County of Napa's Water Availability Analysis Guidance Document dated May 12, 2015.

Existing Use

The project parcel has no existing water use. Land use on neighboring parcels within the project recharge area includes three wineries, vineyards and domestic residences (Table 2 and 3 and Figure 4). Combined, the domestic parcels appear to have ten main residences, three secondary residences, and four uncovered pools.

Neighboring parcels contain approximately 100.5 acres of vineyard. While portions of a few western vineyard blocks are located outside of the project recharge area, all vineyards appear to be irrigated using water from wells located within the project recharge area. There are also 2.44 acres of orchard planted within the project recharge area which are assumed to be irrigated. The three wineries located within the recharge area are: Robert Keenan, Phillip Vineyard and Eeden Vineyards. Based on the 2024 Napa County Public Winery database combined annually these wineries produce a total of 20,000 gallons of wine, employ 15 full time employees and host up to 13,156 tasting guests and 1,180 event guests (Table 2).

Based on these estimates, all existing water demand within the project recharge area comes from neighboring parcels (Tables 2 and 3). Within the project recharge area, existing water use is estimated to be 69.8 acre-ft/yr. Of this, approximately 1% (0.78 acre-ft/yr) is associated with winery and winery guest and employee use, 13% (8.95 acre-ft/yr) is from residential use and 86% (60.0 acre-ft/yr) is from vineyard and orchard irrigation (Table 2).

Table 2: Estimated existing water use on neighboring parcels within the project parcel recharge area.

	# of Units	Use per Unit	Annual Water Use (AF/yr)
Residential Use			8.95
Residences, Primary	10 Residences	0.75 AF/Residence	7.50
Residences, Secondary	3 Residences	0.35 AF/Residence	1.05
Pools	4 Pools	0.10 AF/Pool	0.40
Agricultural Use			60.0
Vineyard	100.51 Acres	0.50 AF/acre/yr	50.3
Orchard, Irrigated	2.44 Acres	4.00 AF/acre/yr	9.76
Winery Use			0.43
Process Water	20000 Gallons	2.15 AF/100,000 gal.	0.43
Guest & Employee Use			0.35
Tasting Room Visitations	13156 Guests	3 gal./Guest	0.12
Events w/ On-Site Catering	1180 Guests	15 gal./Guest	0.05
Full-Time Employees	15 Employees	15 gal./shift @ 250 shifts/yr	0.17
Total			69.8

Table 3: Existing and proposed water uses within the project recharge area. Note that Residential water use on the project parcel is only potential and would be administered under a separate permit

	Existing Condition (acre-ft/yr)	Proposed Condition (acre-ft/yr)
Project Parcel	0.00	2.81
Residential Use	0.00	0.75
Irrigation Use	0.00	2.06
Neighboring Parcels	69.8	73.4
Residential Use	8.95	10.5
Irrigation Use	60.0	62.1
Winery Use	0.43	0.43
Employee/Guest Use	0.35	0.35
Total	69.8	76.2

Proposed Use

The proposed project is to develop a second well and plant up to 4.0 net acres of vineyard on the project parcel. The proposed well would be used to supplement or possibly replace existing Well 2 and would help provide water for all agricultural uses and potential future residential uses. To avoid impacts to neighboring wells the new well will be located a minimum 500 feet from any existing wells. In addition, this well will be located a minimum of 1,500 feet from the closest significant stream, Mill Creek to avoid impacts to surface water. The applicant also intends to translocate special-status plant *Brodiaea* off of the property, this will be completed under the supervision of a biologist and require a temporary irrigation demand of approximately 19,264 gallons per year while plants and bulbs are relocated. Under these proposed conditions, water use within the project parcel would increase from 0 acre-ft/yr to 2.81 acre-ft/yr (Table 4).

As previously mentioned, we are aware of proposed development on two neighboring parcels 022-070-019 and 022-140-017 as part of separate projects managed by TruNorth (Figure 1). Combined these projects were asked to include two primary residences and net acres of new vineyard. Combining these future uses with proposed use on the project parcel total water use within the project recharge area would increase from 69.8 acre-ft/yr to 76.2 acre-ft/yr, a total increase of 6.37 acre-ft/yr (Table 3).

Table 4: Estimated water use on the project parcel in the proposed condition.

	# of Units	Use per Unit	Annual Water Use (AF/yr)
Residential Use			0.75
Residences, Primary	1 Residence	0.75 AF/Residence	0.75
Agricultural Use			2.06
Vineyard	4 Acres	0.50 AF/acre/yr	2.00
Brodiaea, Irrigated	19,246 Gal/year	325851 gal/AF	0.06
Total			2.81

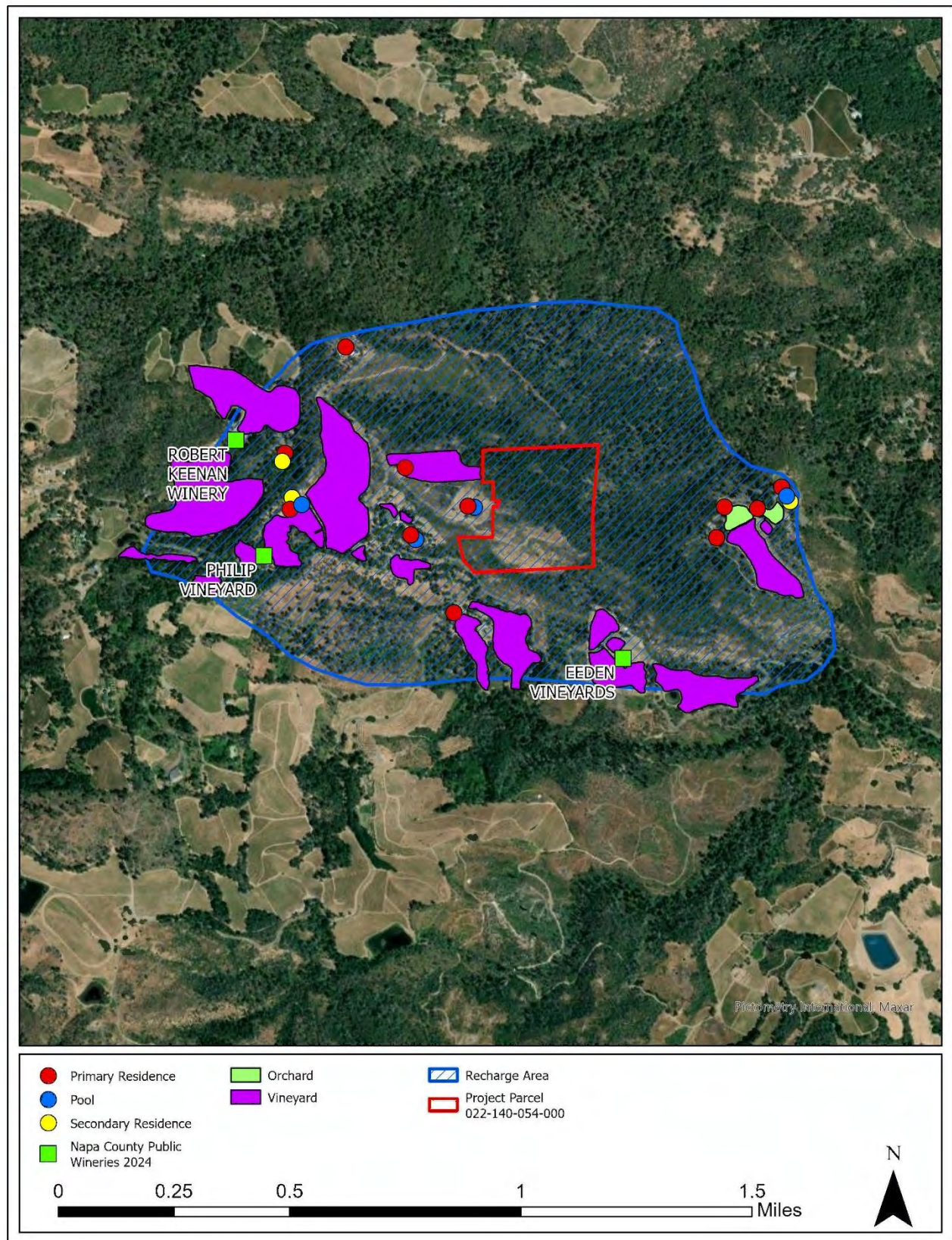


Figure 4: Existing water uses identified in the project recharge area.

Groundwater Recharge Analysis

Groundwater recharge within the project recharge area was estimated using a Soil Water Balance (SWB) of Napa County developed by OEI. This model implements the U.S. Geologic Survey's SWB modeling software and produces a spatially distributed estimate of annual recharge. This model operates on a daily timestep and uses daily values for precipitation and evapotranspiration along with soil hydrologic parameters and vegetation cover. The model calculates runoff based on the Natural Resources Conservation Service (NRCS) curve number approach and Actual Evapotranspiration (AET) and recharge based on a modified Thornthwaite-Mather soil-water-balance approach (Westenbroek et al., 2010). Details of this model are included in Appendix C.

Groundwater recharge for this project area was previously simulated for Water Year 2010 which was selected because annual precipitation in that year was nearest to the 30-year average for the period 1981-2010. OEI's SWB modeling also estimated recharge for Water Year 2014 to represent drought year conditions. In late November 2022, County of Napa instituted a new policy prescribing that for purposes of estimating groundwater recharge, the mean annual precipitation to be used is that mean for Water Years 2012-2021 derived from the newest PRISM data (PRISM, 2010). County of Napa has provided gridded GIS data of the mean precipitation for this period for use by WAA practitioners.

OEI's use of the SWB model is believed to provide more accurate estimates of potential groundwater recharge because it is a physically based spatially distributed model that incorporates information characterizing the water balance in the soil column. Calculation of evapotranspiration using local climate data along with soil moisture storage and precipitation is believed to provide a more accurate representation of local conditions; evapotranspiration is the largest component of the water balance. Unfortunately, the SWB model structure does not allow for a groundwater recharge calculation based on a mathematical average because the model is driven by daily climate data. Consequently, OEI has adapted the SWB model estimates for the prior "average year" (WY 2010) and the "drought year" (WY 2014) to provide an estimate for the average annual rainfall for the period 2012-2021 developed by County of Napa.

OEI has utilized SWB models for WY 2010 and WY 2014 for dozens of project sites in the County of Napa prior to 2022. We have observed that potential recharge for WY 2010 is consistently much greater than for WY 2014 across a wide variety of terrain, vegetation, soils and climate. The SWB model calculates an estimate of water available for recharge for each project site as a spatial average over a hypothetical local aquifer recharge area determined for each project site. Recharge is often characterized as the percentage of annual precipitation that percolates to groundwater.

Our approach for adapting the SWB model outputs to estimate groundwater recharge for the specified annual average precipitation is to assume that the percentage of annual rainfall available for groundwater recharge is a linear function of annual rainfall and interpolating between the recharge percentage for WY 2010 and WY 2014. The linear interpolation procedure is unique for each project site; the application for this project site is graphically displayed in Figure 5. The water balance data from the SWB model years is tabulated in Table 5.

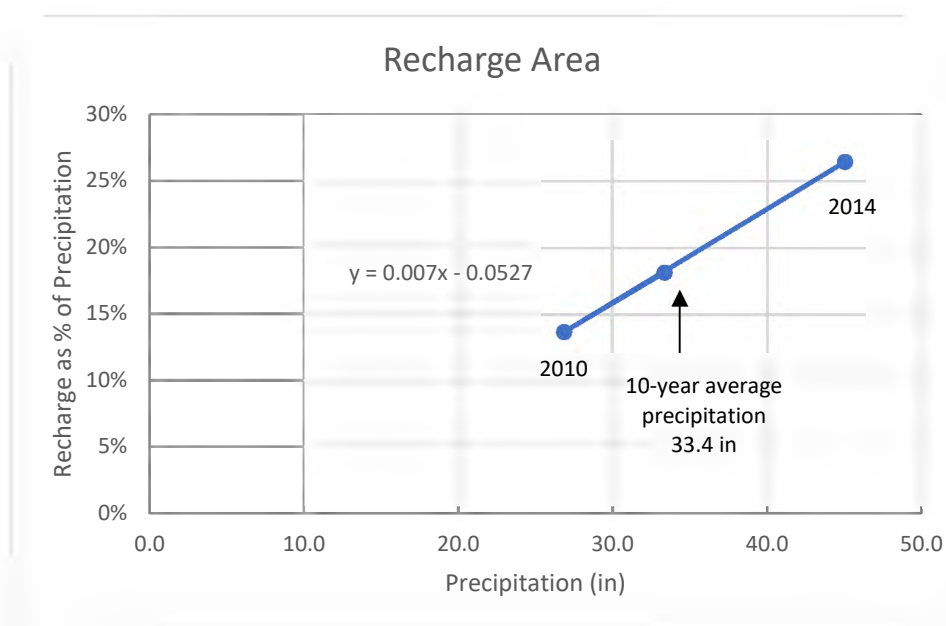


Figure 5: Relationship between precipitation and estimated groundwater recharge as a percent of precipitation.

Water Years 2012 to 2021 average precipitation had a spatial average of 33.4 inches across the project recharge area. During the simulation of Average Water Year 2010, spatially averaged precipitation was 45.0 inches across the project recharge area. Simulated groundwater recharge varied from 5.46 to 19.9 inches across the recharge area, with a spatial average of 11.9 inches (Table 5). During the simulation of dry Water Year 2014, precipitation averaged 26.9 inches across the project recharge. Groundwater recharge varied from near zero to 7.99 inches across the recharge area with a spatial average of 3.7 inches (Table 5). Assuming a linear relationship between the precipitation of the selected average and dry year results of simulated recharge percent (Figures 5), Water Years 2012 to 2021 had an average of 6.1 inches recharge (Table 5).

Table 5: Summary of soil-water balance results estimated by the SWB model for Water Years 2010 and 2014 and calculated average of 2012-2021 WYs.

	2010 Normal Year		2014 Dry Year		2012-2021 10-Year Average	
	inches	% of precip	inches	% of precip	inches	% of precip
Precipitation	45.0	-	26.9	-	33.4	-
AET	24.4	54%	17.3	64%	-	-
Runoff	9.0	20%	9.3	35%	-	-
Δ Soil Moisture	-0.3	-1%	-3.4	-13%	-	-
Recharge	11.9	26%	3.7	14%	6.1	18%

Comparison of Water Demand and Groundwater Recharge

Groundwater recharge estimates can also be expressed as a volume by multiplying the estimated recharge rate by a representative area. For the 590-acre project recharge area, these calculations yield an estimated average annual recharge of 181.5 acre-ft/yr during drought conditions of Water Year 2014 and 585.9 acre-ft/yr for the average Water Year of 2010. Applying these representative rates across the +/- 40.9-acre project parcel, these calculations yield an estimated total recharge of 12.6 acre-ft/yr during Water Year 2014 and 40.6 acre-ft/yr in Water Year 2010. For the impact area for the 10-year average water year, recharge is estimated to be 6.1 inches or 298.2 acre-ft/yr.

For the project parcel the estimated recharge is 20.7 acre-ft/yr (Table 6). The total proposed groundwater use in the project recharge area is estimated to be 76.2 acre-ft/yr; proposed use for the project parcel is 2.81 acre-ft/yr of the total for the recharge area. Groundwater use in the project recharge area is equivalent to 25.5% of the 298.2 acre-ft/year recharge estimated for the average annual precipitation during the 2012-2021 climate period. A similar comparison can be drawn for the project parcel where the estimated use of 2.81 acre-ft is equivalent to 13.6% of the 20.7 acre-ft/yr of average annual recharge (Table 6). Based on estimated annual use of groundwater relative to estimated annual groundwater recharge in the project recharge area, the groundwater use for the proposed project is unlikely to significantly lower groundwater elevation or deplete existing groundwater resources in the project recharge area.

Table 6: Comparison of proposed water use to 10-year average groundwater recharge in the project recharge area.

	Total Proposed Demand (ac-ft/yr)	Average 2012-2021 Water Years		
		Recharge (ac-ft/yr)	Recharge Surplus (ac-ft/yr)	Demand as % of Recharge
Project Recharge Area	76.2	298.2	222.0	25.5%
Project Parcel	2.81	20.7	17.9	13.6%

Well Interference Analysis (Tier 2)

There are no neighboring wells within 500 feet of Well 2, the existing well on the project parcel (Figure 6). The permitted new well will also be constructed more than 500 feet from any wells on neighboring properties. The nearest well to the project well is Well 9, located 1,250 feet to the southwest. Distances between Well 2 and Well 9 were calculated based on aerial imagery interpretation. Based on the WAA guidance document, a Tier 2 well interference analysis is not required for Well 2. The location of the proposed project well has not been determined, however, to avoid impacts to neighboring wells the proposed project well will be located at least 500 feet from any neighboring wells such that a Tier 2 analysis will not be required.

The presence of springs within 1,500 feet of project Well 2 was investigated with assistance from Daniel Byrne of Tru North. The investigation included field reconnaissance and a search of databases according to the same methods and standard of care used by OEI to locate springs. Mr. Byrne traversed the project parcel as well as neighboring parcels APN 022-070-019 and 022-140-017 located north and northwest of the project parcel (Figure 1) and no springs were found. TruNorth also reviewed County of Napa PBES on-line files for the 17 parcels within 1,500 feet of Well 2 (see search summary, Appendix D). This file search located a spring that was noted as a domestic water source on APN 022-260-005 in a permit from 1974; in 2023 the residence was converted to a guest cottage served by three wells on APN 022-260-004 which is winery parcel in common ownership with -005. Mr. Byrne also reviewed the USGS 7.5 Minute Calistoga quadrangle topographic map for the presence of springs in the search area and found none. Finally, OEI conducted a search of the CA State Water Resources Control board map¹ of registered water rights (including springs as water sources) and found none within 1,500 ft of Well 2. Based on the foregoing evidence, we conclude that there are no springs currently in use within 1,500 feet of Well 2, one spring that had been identified as a water source > 1,400 feet from Well 2 in 1974 that was replaced by well sources in 2023, and no other springs observed by field reconnaissance where property was accessible for search.

¹ <https://cw-gis-waterboards.hub.arcgis.com/>

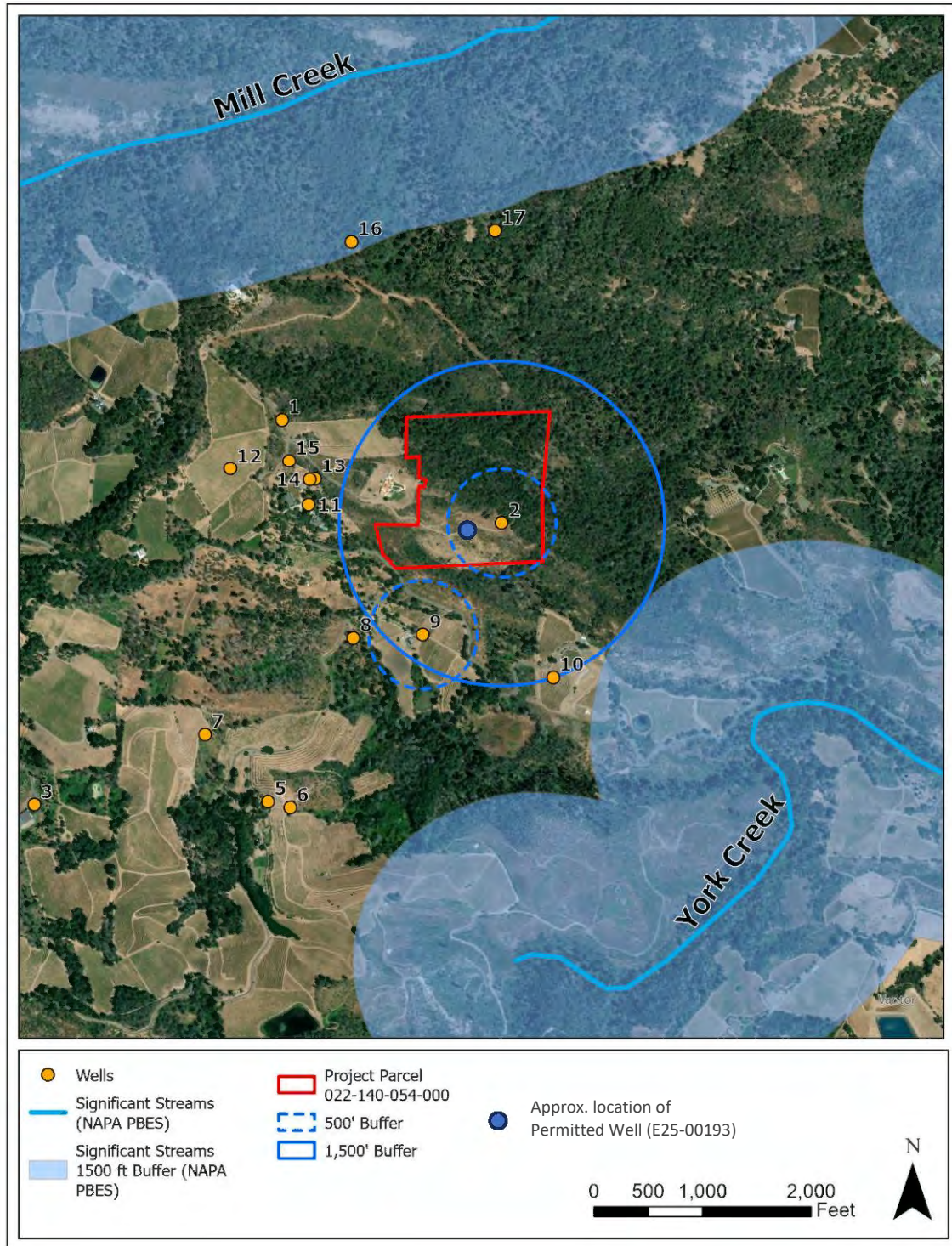


Figure 6: Map showing distances from the project well (Well 2) to other wells in the area (Tier 2 WAA) and to significant streams (Tier 3 WAA). The project well and entire project parcel are located outside of the significant streams 1,500 foot buffer for Tier 3.

Groundwater-Surface Water Interactions (Tier 3)

The nearest significant stream as defined by the County of Napa to the project parcel is York Creek which lies approximately 2,440 feet to the northwest of the project parcel at its closest point (Figure 6). Given this horizontal separation pumping of either the existing Well 2 or any proposed project well is not expected to impact flows in York Creek. Based on County WAA guidance, a Tier 3 analysis of potential for streamflow depletion due to well pumping is not required given that the project well (and entire parcel) is located more than 1,500 feet from a significant stream.

Summary

The proposed project is to develop the vacant parcel with a potential primary residence, existing on-site well and up to 4.0 net acres of vineyard. Application of the Soil Water Balance model (SWB) to the project recharge area revealed that 10-year (WY 2012-2021) average water year recharge was approximately 6.1 inches/yr or 298.2 acre-ft/yr across the project recharge area. Under the proposed conditions water use on the project parcel will be 2.81 acre-ft/yr; there are no existing water uses on the project parcel. The total existing plus proposed water demand (including for a potential future residence) for the project aquifer recharge area is estimated to be 76.1 acre-ft/yr. This represents about 25.5% of the mean annual recharge indicating that the project is unlikely to result in declines in groundwater elevations or depletion of groundwater resources over time.

The existing project well (Well 2) is located more than 500-ft from the nearest neighboring well (Well 9) therefore a Tier 2 well interference analysis is not required so long as the proposed new well also is located 500 feet or more from any neighboring well. Additionally, there were no active springs within 1,500 feet of Well 2. The closest surface waters to the project well is York Creek which is located 2,440 ft to the north. Given this distance and the distance between the closest part of the project parcel is greater than 1,500 ft a Tier 3 analysis of potential for streamflow depletion due to well pumping is not required.

References

Graymer et al., 2007. Geologic Map and Map Database of Eastern Sonoma and Western Sonoma Counties, California. U.S. Geologic Survey Scientific Investigations Map 2956.

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APPENDIX A
WELL COMPLETION REPORTS

QUADRUPLICATE
Use to comply with
local requirements

Well 1

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
WATER WELL DRILLERS REPORT

No. **319561**

Do not fill in

Notice of Intent No. _____
Local Permit No. or Date **6-12-89**

State Well No. _____
Other Well No. _____

(1) OWNER: Name **Jim Henry**
Address **Spring Mountain Road**
City **St Helena** ZIP **94574**

(2) LOCATION OF WELL (See instructions):
County **Napa** Owner's Well Number _____
Well address if different from above _____
Township **8 N.** Range **6 W.** Section **28**
Distance from cities, roads, railroads, fences, etc. _____

(12) WELL LOG: Total depth **200** ft. Completed depth **200** ft.
from ft. to ft. Formation (Describe by color, character, size or material)

0- 20 brown clay & boulders
20- 40 brown clay & gravels
40- 55 volcanic mix
55- 110 cemented sands
110- 120 volcanic rock mix
120- 140 clay & rock
140- 190 volcanic mix
190- 200 black sand

AP. # 22-140-17

(3) TYPE OF WORK:
New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)
(4) PROPOSED USE:
Domestic ☒
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☐
Other ☐ (Describe)

WELL LOCATION SKETCH

(5) EQUIPMENT:
Rotary ☒ Reverse ☐
Cable ☐ Air ☒
Other ☐ Bucket ☐

(6) GRAVEL PACK:
Yes ☒ No ☐ Size **3/8"** peg
Diameter of bore **9"**
Packed from **20** to **200** ft.

(7) CASING INSTALLED:
Steel ☐ Plastic ☒ Concrete ☐
From ft. To ft. Dia. in. Gage or Wall
+2 **200** **5"** **F480**
CLS.
200

(8) PERFORATIONS:
Type of perforation or size of screen
From ft. To ft. Slot size
160 **200** **1/8"**

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth **20** ft.
Were strata sealed against pollution? Yes ☐ No ☒ Interval _____ ft.
Method of sealing **concrete**

(10) WATER LEVELS:
Depth of first water, if known **75** ft.
Standing level after well completion **100** ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom? **driller**
Type of test Pump ☐ Bailer ☐ Air lift ☒
Depth to water at start of test **100** ft. At end of test **170** ft.
Discharge **50** gal/min after **2** hours Water temperature _____
Chemical analysis made? Yes ☒ No ☒ If yes, by whom? **CAL TEST**
Was electric log made Yes ☐ No ☒ If yes, attach copy to this report

Work started **6-9** 19 **89** Completed **6-15** 19 **89**

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed **Donald Huckfeldt** (Well Driller)
NAME **HUCKFELDT WELL DRILLING**
(Person, firm, or corporation) (Typed or printed)
Address **2110 Penny Lane**
City **Napa** ZIP **94559**
License No. **439-746** Date of this report **6-27-89**

DWR USE ONLY DO NOT FILL IN

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

WELL OWNER

[illegible]

Name _____

Mailing Address _____

CITY _____ STATE _____ ZIP _____

WELL LOCATION

Address _____

City _____

County _____

APN Book 22 Page 140 Parcel 43

Township _____ Range _____ Section _____

Latitude _____ NORTH _____ Longitude _____ WEST _____

DEG. MIN. SEC. DEG. MIN. SEC.

LOCATION SKETCH

NORTH _____

WEST _____ EAST _____

400'

500'

WELL

MONITORING _____

TWELVE WELL _____

CATHODIC PROTECTION _____

HEAT EXCHANGE _____

DIRECT PUSH _____

INJECTION _____

VAPOR EXTRACTION _____

SPARGING _____

REMEDICATION _____

OTHER (SPECIFY) _____

ACTIVITY (X) _____

NEW WELL _____

MODIFICATION/REPAIR _____

Deepen _____

Other (Specify) _____

DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG") _____

PLANNED USES (X) _____

WATER SUPPLY _____

Domestic _____ Public _____

Irrigation _____ Industrial _____

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 350 (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 202 (Ft.) & DATE MEASURED 10-12-99

ESTIMATED YIELD * 15 (GPM) & TEST TYPE air lift

TEST LENGTH 2 (Hrs.) TOTAL DRAWDOWN N/A (Ft.)

* May not be representative of a well's long-term yield.

DEPTH FROM SURFACE			BORE-HOLE DIA. (Inches)	CASING (S)						
				TYPE ()				MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS
Ft.	to	Ft.	BLANK	SCREEN	CON- DUCTOR	FILL PIPE				
0	25	12								
25	480	9								
0	274		X				PVC-F480	6	SDR-21	
274	414			X			PVC-F480	6	SDR-21	.032
414	434		X				PVC-F480	6	SDR-21	
434	474			X			PVC-F480	6	SDR-21	.032

DEPTH FROM SURFACE			ANNULAR MATERIAL			
			TYPE			
Ft.	to	Ft.	CE- MENT ($\leq$)	BEN- TONITE ($\leq$)	FILL ($\leq$)	FILTER PACK (TYPE/SIZE)
0		21	X			concrete
21		474			X	pea gravel

ATTACHMENTS ($\leq$)

___ Geologic Log

___ Well Construction Diagram

___ Geophysical Log(s)

___ Soil/Water Chemical Analyses

___ Other _____

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT			
I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.			
NAME HUCKFELDT WELL DRILLING			
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)			
2110 Penny Lane		Napa	CA 94559
ADDRESS	CITY	STATE	ZIP
<i>[Signature]</i>	10-20-99		439-746
Signed	DATE SIGNED	C-57 LICENSE NUMBER	
WELL DRILLER/AUTHORIZED REPRESENTATIVE			

QUADRUPLICATE

For Local Requirements

Page 1 of 1

Owner's Well No.

Date Work Began 12-10-98, Ended 12-18-98

Local Permit Agency Napa County Environmental Mgmt.

Permit No. 96-10772 Permit Date 12-7-98

Well 3 WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No.

812027

DWR USE ONLY		DO NOT FILL IN	
STATE WELL NO. / STATION NO.			
LATITUDE		LONGITUDE	
APN/TRS/OTHER			

GEOLOGIC LOG

ORIENTATION () ☒ VERTICAL ☐ HORIZONTAL ☐ ANGLE (SPECIFY)

DRILLING METHOD **Rotary Air** FLUID

DEPTH FROM SURFACE

Ft. to Ft.

DESCRIPTION

Describe material, grain size, color, etc.

0	12	brown clay with boulders
12	30	brown clay with embedded rock
30	40	volcanic rock
40	50	chert with volcanic rock
50	200	chert
200	240	volcanic rock
240	245	brown clay
245	300	sandstone

WELL OWNER

Name **C. J. Gaspari**

Mailing Address **3787 Spring Mountain Road**

CITY **St. Helena** STATE **CA** ZIP **94559**

WELL LOCATION

Address **3787 Spring Mountain Road**

City **St. Helena**

County **Napa**

APN Book **22** Page **140** Parcel **33**

Township Range Section

Latitude Longitude

LOCATION SKETCH

WEST EAST

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. **PLEASE BE ACCURATE & COMPLETE.**

ACTIVITY ()

☒ NEW WELL

MODIFICATION/REPAIR

Deepen

Other (Specify)

DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES ()

WATER SUPPLY

☒ Domestic ☐ Public

☐ Irrigation ☐ Industrial

MONITORING

TEST WELL

CATHODIC PROTECTION

HEAT EXCHANGE

DIRECT PUSH

INJECTION

VAPOR EXTRACTION

SPARGING

REMEDIATION

OTHER (SPECIFY)

TOTAL DEPTH OF BORING **300** (Feet)

TOTAL DEPTH OF COMPLETED WELL **270** (Feet)

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER **180** (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL **102** (Ft.) & DATE MEASURED **12-18-98**

ESTIMATED YIELD **240** (GPM) & TEST TYPE **air lift**

TEST LENGTH **2** (Hrs.) TOTAL DRAWDOWN **N/A** (Ft.)

* May not be representative of a well's long-term yield.

DEPTH FROM SURFACE	BORE-HOLE DIA. (Inches)	CASING (S)					
		TYPE ()				MATERIAL / GRADE	INTERNAL DIAMETER (Inches)
Ft. to Ft.		BLANK	SCREEN	CON- DUCTOR	FILL PIPE		
0 to 25	15						
25 to 280	12 1/2						
0 to 120		X				PVC F480	8
120 to 240			X			PVC F480	8
240 to 250		X				PVC F480	8
250 to 270			X			PVC F480	8
						SDR-21	.032

DEPTH FROM SURFACE	ANNULAR MATERIAL			
	TYPE			
Ft. to Ft.	CE- MENT ()	BEN- TONITE ()	FILL ()	FILTER PACK (TYPE/SIZE)
0 to 52	X			concrete
52 to 270			X	pea gravel

ATTACHMENTS ()

Geologic Log

Well Construction Diagram

Geophysical Log(s)

Soil/Water Chemical Analyses

Other

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

HUCKFELDT WELL DRILLING

NAME (PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

2110 Penny Lane Napa CA 94559

ADDRESS CITY STATE ZIP

Signed **1-5-99** DATE SIGNED **439-746** C-57 LICENSE NUMBER

WELL DRILLER/AUTHORIZED REPRESENTATIVE

QUADRUPLICATE

For Local Requirements

Well 4

WELL COMPLETION REPORT

STATE OF CALIFORNIA
Refer to Instruction Pamphlet

Page 1 of 1

Owner's Well No. 93-3027

No. 496058

Date Work Began Nov 93, Ended Nov 93

Local Permit Agency Napa County

Permit No. 4791

Permit Date 10-5-93

GEOLOGIC LOG

WELL OWNER

ORIENTATION (✓) ☒ VERTICAL ☐ HORIZONTAL ☐ ANGLE (SPECIFY)

DEPTH TO FIRST WATER (Ft.) BELOW SURFACE

DEPTH FROM SURFACE
Ft. to Ft.

DESCRIPTION

Describe material, grain size, color, etc.

0	2	topsoil
2	22	Red clay
22	60	weathered greenstone
60	220	greenstone
220	245	chert
245	295	greenstone
295	360	clay & melage

Name ~~Carroll, William~~Mailing Address ~~2000 Bonanza~~CITY ~~St. Helena, Ca.~~ STATE ~~CA~~ ZIP ~~94554~~

WELL LOCATION

Address 4003 SIXTH AVE. Spring Mt Rd.

City St. Helena Ca.

County Napa Ca.

APN Book 22 Page 140 Parcel 05

Township or Range Section

Latitude or Longitude DEG. MIN. SEC. NORTH WEST

LOCATION SKETCH

ACTIVITY (✓)

☒ NEW WELL
☐ MODIFICATION/REPAIR

Deepen

Other (Specify)

DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USE(S)

(✓) MONITORING

WATER SUPPLY

☒ Domestic

Public

Irrigation

Industrial

"TEST WELL"

CATHODIC PROTECTION

OTHER (Specify)

SOUTH
Illustrate or Describe Distance of Well from Landmarks such as Roads, Buildings, Fences, Rivers, etc.
PLEASE BE ACCURATE & COMPLETE.DRILLING METHOD Rotary Air FLUID
WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH OF STATIC WATER LEVEL 35 (Ft.) & DATE MEASURED

ESTIMATED YIELD 26 (GPM) & TEST TYPE airlift

TEST LENGTH 3 (Hrs.) TOTAL DRAWDOWN 150 (Ft.)

* May not be representative of a well's long-term yield.

TOTAL DEPTH OF BORING 360 (Feet)

TOTAL DEPTH OF COMPLETED WELL 330 (Feet)

DEPTH FROM SURFACE			BORE-HOLE DIA. (Inches)	CASING(S)						DEPTH FROM SURFACE			ANNULAR MATERIAL			
				TYPE (✓)				MATERIAL / GRADE	INTERNAL DIAMETER (Inches)				GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)	TYPE	
Ft.	to	Ft.		BLANK	SCREEN	CON- DUCTOR	FILL PIPE			CE- MENT (✓)	BEN- TONITE (✓)	FILL (✓)			FILTER PACK (TYPE / SIZE)	
0	20	11	X				F480pvc	5	c200			X				
20	35	8	X				"	"	"				X	3/8 pea		
35	330	"	X				"	"	"	.032						

ATTACHMENTS (✓)

- Geologic Log
- Well Construction Diagram
- Geophysical Log(s)
- Soil/Water Chemical Analyses
- Other

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME FISCH BROS. DRILLING INC.
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

5001 GRAVENSTEIN HWY NO. SEBASTOPOL CA. 95472

ADDRESS CITY STATE ZIP

Signed Steven Unterseher by C.J. Usher 11-5-93 300226
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C.S. LICENSE NUMBER

QUADRUPPLICATE

For Local Requirements

Well 6

WELL COMPLETION REPORT

STATE OF CALIFORNIA
Refer to Instruction Pamphlet

Page 1 of 1

Owner's Well No.

No.

407633

Date Work Began 4-8-1993

Ended 4-13-1993

Local Permit Agency Napa County Environmental Mgmt.

Permit No. 32860

Permit Date 4-12-1993

DWR USE ONLY - DO NOT FILL IN									
STATE WELL NO./STATION NO.									
LATITUDE					LONGITUDE				
APN/TRS/OTHER									

GEOLOGIC LOG

ORIENTATION ()			X VERTICAL		HORIZONTAL	ANGLE	(SPECIFY)
DEPTH TO FIRST WATER 9 (Ft.) BELOW SURFACE			DESCRIPTION				
Ft. to Ft.			Describe material, grain size, color, etc.				
0	3		top soil				
3	8		tuff (volcanic ash)				
8	20		volcanic mix				
20	25		sandstone				
25	75		shale				
75	120		sandstone				
120	170		shale				
170	175		sandstone				
175	210		shale				
210	340		50% sandstone/50% shale				
340	350		sandstone				
350	600		50% sand. stringers thought shale				

RECEIVED
JUN 08 1993

DEPT. OF
ENVIRONMENTAL MANAGEMENT

WELL OWNER

Name			
Mailing Address			
CITY	WELL LOCATION	STATE	ZIP
Address	same		
City			
County	Napa		
APN Book	022	Page	140
Parcel	045		
Township	Range	Section	
Latitude	NORTH	Longitude	WEST
DEG.	MIN.	SEC.	DEG.
MIN.	SEC.	MIN.	SEC.

LOCATION SKETCH	ACTIVITY ()
TW #2-1993	X NEW WELL
LANE TR	MODIFICATION/REPAIR
TW #1	Deepen
Other (Specify)	
DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")	
PLANNED USE(S)	
MONITORING	
WATER SUPPLY	
X Domestic	
Public	
Irrigation	
Industrial	
"TEST WELL"	
CATHODIC PROTECTION	
OTHER (Specify)	

Illustrate or Describe Distance of Well from Landmarks such as Roads, Buildings, Fences, Rivers, etc. PLEASE BE ACCURATE & COMPLETE.

DRILLING METHOD	Rotary (air)
FLUID	
WATER LEVEL & YIELD OF COMPLETED WELL	
DEPTH OF STATIC WATER LEVEL	4 (Ft.) & DATE MEASURED 4-21-93
ESTIMATED YIELD	8 (GPM) & TEST TYPE pump
TEST LENGTH	4 (Hrs.) TOTAL DRAWDOWN 4 (Ft.)

* May not be representative of a well's long-term yield.

DEPTH FROM SURFACE			BORE-HOLE DIA. (Inches)	CASING(S)					DEPTH FROM SURFACE			ANNULAR MATERIAL			
				TYPE (✓)				MATERIAL / GRADE				INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)	TYPE
Ft.	to	Ft.		BLANK	SCREEN	CON- DUCTOR	FILL PIPE		CE- MENT (✓)	BEN- TONITE (✓)	FILL (✓)				FILTER PACK (TYPE / SIZE)
0	35	10									0	10	X		concrete
35	600	8									10	40		X	pea gravel
											40	600		X	cuttings
0	11		X				plastic	5	SDR-21						
11	30			X			plastic	5	SDR-21	1/8"					

ATTACHMENTS ()

- Geologic Log
- Well Construction Diagram
- Geophysical Log(s)
- Soil/Water Chemical Analyses
- Other

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

HUCKFELDT WELL DRILLING

NAME (PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

2110 Penny Lane

Napa

CA 94559

ADDRESS

CITY

STATE

ZIP

Signed

WELL DRILLER/AUTHORIZED REPRESENTATIVE

DATE SIGNED 4-26-1993

439-746

C-57 LICENSE NUMBER

Owner's Well No. 1-2016

Date Work Began 9/9/2016, Ended 9/21/2016

Local Permit Agency Napa County Environmental Mgmt

Permit No. E15-00577

Permit Date 7/21/2015

DWR USE ONLY DO NOT FILL IN

STATE WELL NO./STATION NO.

LATITUDE

LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

WELL OWNER

ORIENTATION (✓) ☒ VERTICAL ☐ HORIZONTAL ☐ ANGLE (SPECIFY)DEPTH FROM
SURFACE
Ft. to Ft.DRILLING
METHOD

ROTARY

FLUID BENTONITE

DESCRIPTION

Describe material, grain, size, color, etc.

DEPTH (Ft.)	DESCRIPTION
0 - 35	MIXED VOLCANIC RK W TAN ASH STRINGERS
35 - 130	LARGE FRACTURED VOLCANICS
130 - 134	TAN VOLCANIC ASH
134 - 140	LARGE FRACTURED VOLCANICS
140 - 290	SANDY BLUE GRAY CLAY
290 - 305	60% GRAY CLAY/ 20% SANDSTONE/ 20% SHALE
305 - 320	GRAY CLAY

Name [REDACTED]

Mailing Address [REDACTED]

City [REDACTED]

CA

94574

STATE

ZIP

WELL LOCATION

Address 3549 Langtry Road

City St. Helena CA

County Napa

APN Book 022

Page 140

Parcel 056

Township

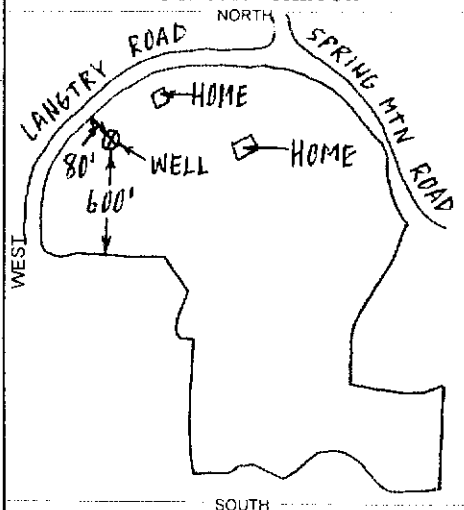
Range

Section

Latitude

DEG MIN SEC

LOCATION SKETCH



Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

DEG MIN SEC

ACTIVITY (✓)

☒ NEW WELL

MODIFICATION/REPAIR

Deepen

Other (Specify)

DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY

☒ Domestic ☐ Public☒ Irrigation ☐ Industrial

MONITORING

TEST WELL

CATHODIC PROTECTION

HEAT EXCHANGE

DIRECT PUSH

INJECTION

VAPOR EXTRACTION

SPARGING

REMEDIATION

OTHER (SPECIFY)

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER N/A (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 73 (Ft.) & DATE MEASURED 9/21/2016

ESTIMATED YIELD 22 (GPM) & TEST TYPE AIR LIFT

TEST LENGTH 3 (Hrs) TOTAL DRAWDOWN N/A (Ft.)

May not be representative of a well's long-term yield.

TOTAL DEPTH OF BORING 320 (Feet)

TOTAL DEPTH OF COMPLETED WELL 169 (Feet)

DEPTH FROM SURFACE			BORE HOLE DIA. (Inches)	CASING (S)				ANNULAR MATERIAL		
Ft	to	Ft		TYPE (✓)	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)	TYPE	FILTER PACK (TYPE/SIZE)
				BLANK						
				SCREEN						
				CONDUIT						
				FILL PIPE						
0	180	12								
180	320	9								
0	79				PVC F480	6	SDR-21			
79	149				PVC F480	6	SDR-21	0.032		
149	169				PVC F480	6	SDR-21			
0	55									10 SK SAND
55	180									#6 SAND
180	320									PEA GRAVEL

ATTACHMENTS (✓)

- Geologic Log
- Well Construction Diagram
- Geophysical Log(s)
- Soil/Water Chemical Analysis
- Other

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME HUCKFELDT WELL DRILLING, INC.

(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

2110 Penny Lane

ADDRESS

Napa

CITY

CA

STATE

94559

ZIP

Signed

WELL DRILLER/AUTHORIZED REPRESENTATIVE

09/30/16

DATE SIGNED

439-746

C-57 LICENSE NUMBER

Owner's Well No. 1-2014

No. **e0237616**

Date Work Began 11/5/2014, Ended 11/17/2014

Local Permit Agency Napa County Environmental Mgmt

Permit No. E14-00180

Permit Date 3/17/2014

DWR USE ONLY -- DO NOT FILL IN

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) ☒ VERTICAL ☐ HORIZONTAL ☐ ANGLE (SPECIFY)

DRILLING METHOD **ROTARY** FLUID **BENTONITE**

DEPTH FROM SURFACE Ft. to Ft.	DESCRIPTION Describe material, grain, size, color, etc.	
0	10	RED, BROWN VOLCANIC ASH
10	15	TAN ASH
15	25	TAN ASH WITH EMBEDDED ROCK
25	40	GRAY SANDY ASH
40	55	TAN ASH WITH EMBEDDED ROCK
55	90	FRACTURED GRAY VOLCANIC ROCK
90	135	TAN VOLCANIC TUFF
135	160	FRACTURED BLACK VOLCANIC ROCK
160	180	GREEN SANDY ASH
180	220	FRACTURED BLACK VOLCANIC ROCK
220	245	GREEN SANDY ASH
245	300	GRAY SHALE AND CLAY
CONTINUED CASING LAYOUT		
178	218	SCREEN PVC 6" .032 SLOT
218	238	BLANK PVC 6"

RECEIVED
NOV 20 2014
Napa County Planning, Building & Environmental Services

TOTAL DEPTH OF BORING 300 (Feet)
TOTAL DEPTH OF COMPLETED WELL 238 (Feet)

WELL OWNER

Name John Gantner

Mailing Address 3549 Langtry Road
St. Helena CA 94574
CITY STATE ZIP

WELL LOCATION

Address 3549 Langtry Road
City St. Helena CA
County Napa
APN Book 022 Page 140 Parcel 056
Township Range Section
Latitude

LOCATION SKETCH

DEG. MIN. SEC. NORTH SOUTH

LANGTRY ROAD SPRING MTN. ROAD

HOME WELL

220' 400'

ACTIVITY (✓)

☒ NEW WELL

MODIFICATION/REPAIR
Deepen
Other (Specify)

DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
☒ Domestic ☐ Public
☒ Irrigation ☐ Industrial

MONITORING
TEST WELL
CATHODIC PROTECTION
HEAT EXCHANGE
DIRECT PUSH
INJECTION
VAPOR EXTRACTION
SPARGING
REMEDIATION
OTHER (SPECIFY)

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 110 (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 39 (Ft.) & DATE MEASURED 11/17/2014

ESTIMATED YIELD 50 (GPM) & TEST TYPE AIR LIFT

TEST LENGTH 2 (Hrs.) TOTAL DRAWDOWN N/A (Ft.)

May not be representative of a well's long-term yield.

DEPTH FROM SURFACE Ft. to Ft.	BORE - HOLE DIA. (Inches)	CASING (S)					
		TYPE (✓)				MATERIAL / GRADE	INTERNAL DIAMETER (Inches)
		BLANK	SCREEN	CON- DUCTOR	FILL PIPE		
0	260						
260	300						
0	98	✓				PVC F480	6
98	158		✓			PVC F480	6
158	178	✓				PVC F480	6

DEPTH FROM SURFACE Ft. to Ft.	ANNULAR MATERIAL			
	TYPE			
	CE- MENT (✓)	BEN- TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	57	✓		10 SK SAND
57	260		✓	#6 SAND
260	300		✓	CUTTINGS

ATTACHMENTS (✓)

Geologic Log
Well Construction Diagram
Geophysical Log(s)
Soil/Water Chemical Analysis
Other

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME HUCKFELDT WELL DRILLING, INC.
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

2110 Penny Lane Napa CA 94559
ADDRESS CITY STATE ZIP

Signed [Signature] DATE SIGNED 11/18/14
WELL DRILLER/AUTHORIZED REPRESENTATIVE C-57 LICENSE NUMBER 439-746

ORIGINAL
File with DWR

Well 10

STATE OF CALIFORNIA
WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. **e015184**

Page 1 of 1

Owner's Well No. Well #1-04

Date Work Began 8/16/2004, Ended 8/25/2004

Local Permit Agency Napa County Environmental Mgmt

Permit No. 96-12625

Permit Date 3/1/2004

DWR USE ONLY		DO NOT FILL IN	
STATE WELL NO./STATION NO.			
LATITUDE		LONGITUDE	
APN/TRS/OTHER			

GEOLOGIC LOG

ORIENTATION (✓) ☒ VERTICAL ☐ HORIZONTAL ☐ ANGLE (SPECIFY)		DRILLING METHOD ROTARY	FLUID BENTONITE
DEPTH FROM SURFACE Ft. to Ft.		DESCRIPTION Describe material, grain, size, color, etc.	
0	5	TAN CLAY	
5	35	GRAY CLAY	
35	100	BLACK VOLCANICS	
100	165	MIXED VOLCANICS	
165	290	GRAY CLAY	
290	294	SANDSTONE	
294	300	GRAY CLAY	
300	302	SANDSTONE	
302	305	GRAY CLAY	
305	330	SANDSTONE & SHALE	
330	335	GRAY CLAY	
335	358	SANDSTONE & SHALE	
358	380	HARD SANDSTONE	
380	400	SHALE & CLAY	
CONTINUED CASING LAYOUT			
337	357	BLANK PVC 6"	
357	397	SCREEN PVC 6" .032 SLOT	

RECEIVED

OCT - 5 2004

DEPT. OF
ENVIRONMENTAL MANAGEMENT

TOTAL DEPTH OF BORING 400 (Feet)

TOTAL DEPTH OF COMPLETED WELL 397 (Feet)

WELL OWNER

Name [Redacted]
Mailing Address [Redacted]
City [Redacted] State CA ZIP 94962

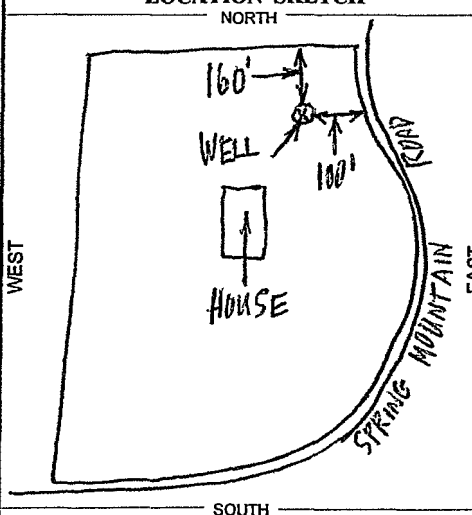
WELL LOCATION

Address 3505 Spring Mountain Road
City St. Helena CA
County Napa
APN Book 22 Page 260 Parcel 04
Township _____ Range _____ Section _____
Latitude _____

DEG. MIN. SEC.

LOCATION SKETCH

NORTH



DEG. MIN. SEC.

ACTIVITY (✓)

☒ NEW WELL
MODIFICATION/REPAIR
— Deepen
— Other (Specify) _____

DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
☒ Domestic ☐ Public
☒ Irrigation ☐ Industrial

MONITORING _____
TEST WELL _____
CATHODIC PROTECTION _____
HEAT EXCHANGE _____
DIRECT PUSH _____
INJECTION _____
VAPOR EXTRACTION _____
SPARGING _____
REMEDICATION _____
OTHER (SPECIFY) _____

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER N/A (FL) BELOW SURFACE **1**

DEPTH OF STATIC WATER LEVEL 60 (FL) & DATE MEASURED 8/25/2004

ESTIMATED YIELD 4 (GPM) & TEST TYPE AIR LIFT

TEST LENGTH 2 (Hrs.) TOTAL DRAWDOWN N/A (FL)

May not be representative of a well's long-term yield.

DEPTH FROM SURFACE			BORE - HOLE DIA. (Inches)	CASING (S)							DEPTH FROM SURFACE		ANNULAR MATERIAL				
				TYPE (✓)				MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS			SLOT SIZE IF ANY (Inches)	TYPE			
FL	to	FT.	BLANK	SCREEN	CON- DUCTOR	FILL PIPE									FL	to	FT.
0	100	12									0	25		✓			CONCRETE
100	400	10									25	56			✓		CHIPS
0	97		✓				PVC F480	6	SDR-21		56	397				✓	#6 SAND
97	177			✓			PVC F480	6	SDR-21	.032							
177	277		✓				PVC F480	6	SDR-21								
277	337			✓			PVC F480	6	SDR-21	.032							

ATTACHMENTS (✓)

— Geologic Log
— Well Construction Diagram
— Geophysical Log(s)
— Soil/Water Chemical Analysis
— Other _____

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.

NAME HUCKFELDT WELL DRILLING

(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

2110 Penny Lane

Napa

CA

94559

ADDRESS

CITY

STATE

ZIP

Signed

WELL DRILLER/AUTHORIZED REPRESENTATIVE

09/23/04
DATE SIGNED

439-746

C-57 LICENSE NUMBER

Well 11 cont.

Casings										
Casing #	Depth from Surface Feet to Feet		Casing Type	Material	Casings Specificatons	Wall Thickness (inches)	Outside Diameter (inches)	Screen Type	Slot Size if any (inches)	Description
1	0	215	Blank	PVC	OD: 5.563 in. SDR: 21 Thickness: 0.265 in.	0.265	5.563			
1	215	275	Screen	PVC	OD: 5.563 in. SDR: 21 Thickness: 0.265 in.	0.265	5.563	Milled Slots	0.032	
1	275	315	Blank	PVC	OD: 5.563 in. SDR: 21 Thickness: 0.265 in.	0.265	5.563			
1	315	435	Screen	PVC	OD: 5.563 in. SDR: 21 Thickness: 0.265 in.	0.265	5.563	Milled Slots	0.032	
1	435	455	Blank	PVC	OD: 5.563 in. SDR: 21 Thickness: 0.265 in.	0.265	5.563			
1	455	535	Screen	PVC	OD: 5.563 in. SDR: 21 Thickness: 0.265 in.	0.265	5.563	Milled Slots	0.032	
1	535	555	Blank	PVC	OD: 5.563 in. SDR: 21 Thickness: 0.265 in.	0.265	5.563			
1	555	575	Screen	PVC	OD: 5.563 in. SDR: 21 Thickness: 0.265 in.	0.265	5.563	Milled Slots	0.032	
1	575	595	Blank	PVC	OD: 5.563 in. SDR: 21 Thickness: 0.265 in.	0.265	5.563			

Annular Material					
Depth from Surface Feet to Feet		Fill	Fill Type Details	Filter Pack Size	Description
0	4	Cement	Other Cement		concrete
4	56	Bentonite	Other Bentonite		grout
56	595	Other Fill	See description.		#6 sand

Other Observations:

Borehole Specifications		
Depth from Surface Feet to Feet		Borehole Diameter (inches)
0	60	12
60	600	9

Certification Statement			
I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief			
Name	HUCKFELDT WELL DRILLING INC		
	Person, Firm or Corporation		
994 KAISER ROAD	NAPA	CA	94558
Address	City	State	Zip
Signed	05/27/2021	439746	
electronic signature received	Date Signed	C-57 License Number	
C-57 Licensed Water Well Contractor			

DWR Use Only									
CSG #	State Well Number	Site Code	Local Well Number						

										N
--	--	--	--	--	--	--	--	--	--	---

Latitude Deg/Min/Sec

										W
--	--	--	--	--	--	--	--	--	--	---

Longitude Deg/Min/Sec

TRS:

APN:

RETURN TO OFFICE
FOR FILING

Well 12

HEALTH DEPT. USE ONLY

FEE 13/31/78

DATE 5094

RECEIPT NO. 177 Heed

BY

NAPA COUNTY HEALTH DEPARTMENT
DIVISION OF ENVIRONMENTAL HEALTH

APPLICATION & PERMIT TO CONSTRUCT
A WATER WELL

A.P. No. 24-150-47

RECEIVED

MAY 8 1978

DIVISION OF
ENVIRONMENTAL HEALTH

NAME Bill P. Pullman (OWNER) ADDRESS 3817 Piedmont Ave. DATE 3-30-78

NAME Bill P. Pullman (WELL DRILLER) ADDRESS 3817 Piedmont Ave.

TYPE OF WORK
NEW WELL ☒ RECONDITIONING ☐ DEEPENING ☐
TEST HOLES ☐ DESTROYING ☐ OTHER ☐
TYPE I PERMIT ☐ TYPE II PERMIT ☐ FEE ☐

PROPOSED USE
DOMESTIC ☒ IRRIGATION ☐ INDUSTRIAL ☐ MUNICIPAL ☐
TEST WELL ☐ OTHER ☐

Sewage disposal on site (existing or proposed) Public ☐ Individual ☒ Private ☐
Distance from well to any part of nearest sewage disposal system 1300 feet
(Sketch of site to accompany application.)

TYPE OF EQUIPMENT TO BE USED
Rotary ☐ Cable ☒ Hand Dug ☐ Other ☐

CONSTRUCTION PROPOSED
Diameter of casing 8" Material 3/4" Annular Space: Size 3/4"
Sealed with: Concrete ☐ Grout ☒ Neat Cement ☐ Puddled Clay ☐ Other ☐
Conductor Casing: Yes ☐ No ☒ Material ☐
Chlorination by: Owner ☒ Pump Co. ☐ Driller ☐

(SIGNATURE OF APPLICANT)

(DATE)

CASING

CONSTRUCTION

Total Depth 130 Ft.
Surface Seal to 30 Ft.
Any stratas sealed: Yes ☐ No ☒
If yes, depth of stratas:
From Ft. to Feet
From Ft. to Feet

Perforations:
From 90 Ft. to 130 Feet
From Ft. to Feet
From Ft. to Feet

WATER LEVELS

First water at 25 Feet
Static level at 70 Feet

WELL TESTS

How performed bailey
Yield 40 GPM with 10 Feet
Drawdown 10 Ft. after 1 1/2 Hrs.

WELL LOG

(Formation; describe by color, size of material, structure)

Ft. to FV

0-60 ft. brown ash small boulders
60-90 ft. grey rock
90-95 ft. broken up rock
95-115 ft. grey rock
115-125 ft. black ash
125-130 ft. blue shell

Signed

License No. 248677

QUADRUPLICATE
Use to comply with
local requirements

Well 13

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
WATER WELL DRILLERS REPORT

No. 324601

Do not fill in

Notice of Intent No. _____

Local Permit No. or Date 9-13-89

State Well No. _____

Other Well No. _____

(1) OWNER: Name Mama Shannon O'Bryan
Address 1055 Spring Street
City St. Helena ZIP 94574

(2) LOCATION OF WELL (See instructions):
County Napa Owner's Well Number _____
Well address if different from above 3620 Spring Mtn. Rd.
Township 8 N. Range 6 W. Section 23
Distance from cities, roads, railroads, fences, etc. _____

A.P. # 22-140-30

(3) TYPE OF WORK:

New Well ☒ Deepening ☐

Reconstruction ☐

Reconditioning ☐

Horizontal Well ☐

Destruction ☐ (Describe
destruction materials and pro-
cedures in Item 12)

(4) PROPOSED USE:

Domestic ☒

Irrigation ☐

Industrial ☐

Test Well ☐

Municipal ☐

Other ☐

(Describe)

WELL LOCATION SKETCH

(5) EQUIPMENT:

Rotary ☒

Reverse ☐

Cable ☐

Air ☐

Other ☐

Bucket ☐

(6) GRAVEL PACK:

Yes ☒ No ☐

Size 3/8"

Diameter of bore 23"

Packed from 23 to 400 ft.

(7) CASING INSTALLED:

Steel ☐

Plastic ☒

Concrete ☐

(8) PERFORATIONS:

Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
+2	400	5"	F480	100	400	1/8"
			CLS.			
			200			

(9) WELL SEAL:

Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 23 ft.

Were strata sealed against pollution? Yes ☐ No ☒ Interval _____ ft.

Method of sealing concrete

(10) WATER LEVELS:

Depth of first water, if known 105 ft.

Standing level after well completion 102 ft.

(11) WELL TESTS:

Was well test made? Yes ☒ No ☐ If yes, by whom? driller

Type of test Pump ☐ Bailer ☐ Air lift ☒

Depth to water at start of test 102 ft. At end of test 365 ft.

Discharge 4 gal/min after 4 hours Water temperature _____

Chemical analysis made? Yes ☐ No ☒ If yes, by whom? _____

Was electric log made? Yes ☐ No ☒ If yes, attach copy to this report

(12) WELL LOG: Total depth 400 ft. Completed depth 400 ft.
from ft. to ft. Formation (Describe by color, character, size or material)

0- 5 top soil
5- 10 brown clay
10- 22 tuff
22- 30 sand
30- 85 clay w/ embedded rock
85-170 fractured volcanic rock
170-235 gray clay
235-300 60% clay/ 40% sandstone
300-330 sandstone 10% clay
330-336 clay & shale
336-400 sandstone/ clay & shale

RECEIVED
SEP 26 1989
DEPT. OF
ENVIRONMENTAL MANAGEMENT

Work started 9-5 19 89 Completed 9-13 19 89

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed [Signature] (Well Driller)

NAME HUCKFELDT WELL DRILLING

(Person, firm, or corporation) (Typed or printed)

Address 2110 Penny Lane

City Napa ZIP 94559

License No. 439-746 Date of this report 9-18-89

QUADRUPLICATE
Use to comply with
local requirements

Well 14

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES
WATER WELL DRILLERS REPORT

11/28/89
#21459
No. 324603

Do not fill in

Notice of Intent No. _____
Local Permit No. or Date 10-13-89

State Well No. _____
Other Well No. _____

(1) OWNER: Name Dennis Shannon & Son
Address 1235 Spring Street
City Bellevue ZIP 94559

(12) WELL LOG: Total depth 306 ft. Completed depth 300 ft.
from ft. to ft. Formation (Describe by color, character, size or material)

(2) LOCATION OF WELL (See instructions):
County Napa Owner's Well Number _____
Well address if different from above 3620 Spring Mtn. Rd.
Township 8N. Range 6W. Section 23
Distance from cities, roads, railroads, fences, etc. 42' from R/W road.

0-40 clay w/ embedded rock
40-90 andesite lava
90-100 brown clay
100-138 lava
138-146 clay
146-200 mixed volcanics/ greenstone
200-260 greenstone & sandstone
260-269 clay
269-283 greenstone & sandstone
283-306 clay

AP. # 22-140-30

(3) TYPE OF WORK:
New Well ☐ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐
Destruction ☐ (Describe destruction materials and procedures in Item 12)
(4) PROPOSED USE:
Domestic ☐
Irrigation ☐
Industrial ☐
Test Well ☐
Municipal ☐
Other ☐ (Describe)

WELL LOCATION SKETCH

(5) EQUIPMENT:
Rotary ☒ Reverse ☐
Cable ☐ Air ☐
Other ☐ Bucket ☐
(6) GRAVEL PACK:
Yes ☒ No ☐ Size 1/8"
Diameter of bore 10.5"
Packed from 21 to 300 ft.

(7) CASING INSTALLED:
Steel ☐ Plastic ☒ Concrete ☐
(8) PERFORATIONS:
Type of perforation or size of screen
From ft. To ft. Dia. in. Gage or Wall From ft. To ft. Slot size
+2 300 5 F480 80 120 1/8"
CLS. 120 180 factory
200 180 300 1/8"

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 21 ft.
Were strata sealed against pollution? Yes ☐ No ☒ Interval _____ ft.
Method of sealing concrete

(10) WATER LEVELS:
Depth of first water, if known 115 approx. ft.
Standing level after well completion 89 ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom? driller
Type of test Pump ☐ Bailer ☐ Air lift ☒
Depth to water at start of test 89 ft. At end of test 275 ft.
Discharge 5 gal/min after 4 hours Water temperature _____
Chemical analysis made? Yes ☐ No ☒ If yes, by whom? _____
Was electric log made? Yes ☐ No ☒ If yes, attach copy to this report.

Work started 10-5 19 89 Completed 10-16 19 89

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed [Signature] (Well Driller)
NAME HUCKFELDT WELL DRILLING
(Person, firm, or corporation) (Typed or printed)
Address 2110 Penny Lane
City Napa ZIP 94559
License No. 439-746 Date of this report 10-24-89

QUADRUPPLICATE
U to comply with
lo requirements

Well 15

WATER WELL DRILLERS REPORT

RECEIVED

JUN 26 1989

Do not fill in

DE No. 308413

ENVIRONMENTAL MANAGEMENT

State Well No.

Other Well No.

Notice Intent No.

Local Permit No. or Date

(1) OWNER: Name Dennis & Bryan Suzanne Placer

Address 1833 Spring St

City Helena Ca.

ZIP 95744

(2) LOCATION OF WELL (See instructions):

County Napa Owner's Well Number

Well address if different from above 3620 Spring Mt. Rd. St Helena

Township Range Section

Distance from cities, roads, railroads, fences, etc.

(12) WELL LOG: Total depth 325 ft. Completed depth 325 ft.

from ft. to ft. Formation (Describe by color, character, size or material)

0 5 topsoil

5 10 clay

10 15 fract rock

15 60 clay

60 160 volcanic ash

160 170 fract rock

170 230 clay

230 320 sandstone

320 325 shale

A.P.#22-140-30

(3) TYPE OF WORK:

New Well ☒ Deepening ☐

Reconstruction ☐

Reconditioning ☐

Horizontal Well ☐

Destruction ☐ (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:

Domestic ☒

Irrigation ☐

Industrial ☐

Test Well ☐

Municipal ☐

Other ☐

(Describe)

WELL LOCATION SKETCH

(5) EQUIPMENT:

Rotary ☒ Reverse ☐

Cable ☐ Air ☒

Other ☐ Bucket ☐

(6) GRAVEL PACK:

Yes ☒ No ☐ Size 3/8 pea

Diameter of bore 10"

Packed from 20 to 325 ft.

(7) CASING INSTALLED:

Steel ☐ Plastic ☒ Concrete ☐

(8) PERFORATIONS:

Type of perforation or size of screen

From ft. To ft. Dia. in. Gage or Wall

0 325 5" c160

From ft. To ft. Slot size

80 325 1/8"

(9) WELL SEAL:

Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 20 ft.

Were strata sealed against pollution? Yes ☐ No ☒ Interval ft.

Method of sealing grout

(10) WATER LEVELS:

Depth of first water, if known ft.

Standing level after well completion 60 ft.

(11) WELL TESTS:

Was well test made? Yes ☒ No ☐ If yes, by whom? driller

Type of test Pump ☐ Bailer ☐ Air lift ☒

Depth to water at start of test 60 ft. At end of test 260 ft.

Discharge 20 gal/min after 3 hours Water temperature

Chemical analysis made? Yes ☐ No ☒ If yes, by whom?

Was electric log made Yes ☐ No ☒ If yes, attach copy to this report

Work started Feb 23 19 89 Completed March 2, 89

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

Signed Dale Theiss by c.j.usher
(Well Driller)

NAME FISCH BROS DRILLING INC.

Address 5001 Gravenstein Hwy. No.
(Person, firm, or corporation) (Typed or printed)

City Sebastopol Ca.

ZIP 95472

License No. 399226

Date of this report 3-2-89

QUADRUPPLICATE
Use to comply with
local requirements

Well 16

STATE OF CALIFORNIA
THE RESOURCES AGENCY

DEPARTMENT OF WATER RESOURCES
WATER WELL DRILLERS REPORT

Do not fill in

No. 109630

Notice of Intent No. 150156
Local Permit No. or Date 5635

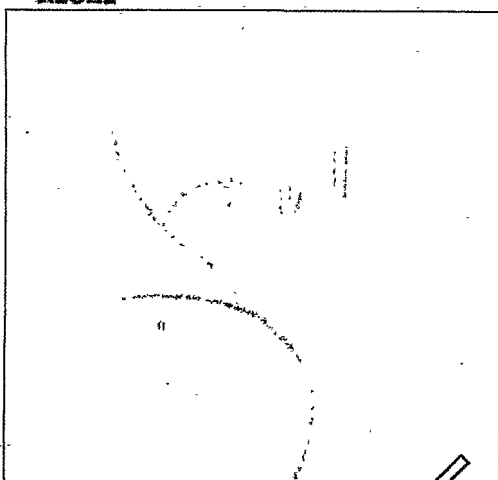
State Well No.
Other Well No.

(1) OWNER: **TELEPHONE**
P.O. BOX 3034
Address **SAN RAFAEL, CALIF**
City **SAN RAFAEL** Zip **94901**

(2) LOCATION OF WELL (See instructions):
County **NAPA** Owner's Well Number **4**

Well address if different from above
Township **ST HELENA** Range **22-150-10** Section **3640-3650**

Distance from cities, roads, railroads, fences, etc.
SPRING MT ROAD, END OF GRAVEL DRIVE, TURN RIGHT
Y IN ROAD, TURN RIGHT DOWN HILL, 1ST PAD ON
RIGHT



WELL LOCATION SKETCH

(3) TYPE OF WORK:

New Well ☒ Deepening ☐
Reconstruction ☐
Reconditioning ☐
Horizontal Well ☐

Destruction ☐ (Describe
destruction materials and
procedures in Item 12)

(4) PROPOSED USE:

Domestic ☒
Irrigation ☐
Industrial ☐
Test Well ☐
Stock ☐
Municipal ☐
Other ☐

(5) EQUIPMENT:

Rotary ☒ Reverse ☐ Yes ☒ No ☐ Size **3/8**
Cable ☐ Air ☒ Diameter of bore **11, 8**
Other ☐ Bucket ☐ Packed from **20** to **740**

(7) CASING INSTALLED:

Steel ☒ Plastic ☒ Concrete ☐
Type of perforation or size of screen

From ft.	To ft.	Dia. in.	Cage or Wall	From ft.	To ft.	Slot size
0	280	5 5/8	120	240	280	1/8
280	140	4	160	700	740	1/8

(9) WELL SEAL:

Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth **20** ft.
Were strata sealed against pollution? Yes ☐ No ☒ Interval **NEAT CEMENT** ft.
Method of sealing

(10) WATER LEVELS:

Depth of first water, if known **730** ft.
Standing level after well completion **620** ft.

(11) WELL TESTS:

Was well test made? Yes ☒ No ☐ If yes, by whom? **DRILLER**
Type of test Pump ☐ Bailer ☒ Air lift ☐
Depth to water at start of test **620** ft. At end of test **7 1/2** ft.
Discharge **7 1/2** gal/min after **4** hours Water temperature
Chemical analysis made? Yes ☐ No ☒ If yes, by whom?
Was electric log made? Yes ☐ No ☐ If yes, attach copy to this report

(12) WELL LOG: Total depth **740** ft. Depth of completed well **740** ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	85	CLAY W/ EMBEDDED BOULDERS
85	190	VOLCANIC ASH
190	350	BLUE VOLCANIC LAVA
350	680	VOLCANIC ASH
680	740	RED VOLCANIC LAVA

RECEIVED

NOV 17 1978

DIVISION OF
ENVIRONMENTAL AFFAIRS

Work started **10-9-78** Completed **10-26-78**

WELL DRILLER'S STATEMENT:

This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

SIGNED

(Well Driller)

NAME **PACIFIC TELEPHONE COAST DRILLING COMPANY**

(Person, firm, or corporation) (Typed or printed)

Address **444 DU BOIS STREET**

City **SAN RAFAEL, CALIF** Zip **94901**

License No. **341694** Date of this report **11-2-78**

HEALTH DEPT. USE ONLY

FEE: 12⁰⁰/₁₀₀DATE: 5/31/74RECEIPT NO: 1098BY: [Signature]NAPA COUNTY HEALTH DEPARTMENT
DIVISION OF ENVIRONMENTAL HEALTH

A.P. #

22-070-22

APPLICATION & PERMIT TO CONSTRUCT

Well 17

A WATER WELL
(ORDINANCE #)NAME [Signature] ADDRESS [Signature] DATE [Signature]

(Owner)

(Job Location)

NAME Valley Drilling ADDRESS P.O. Box 3264

(Well Driller)

TYPE OF
WORKNEW WELL XRECONDITIONING DEEPENING TEST HOLES DESTROYING OTHER TYPE I PERMIT XTYPE II PERMIT FEE PROPOSED
USEDOMESTIC X
TEST WELL IRRIGATION
OTHER INDUSTRIAL MUNICIPAL Sewage Disposal On Site (Existing or Proposed) Public Individual X Private
Distance from well to any part of nearest sewage disposal system 500 feet.
(Sketch of site to accompany application.)TYPE OF
EQUIPMENT TO
BE USEDRotary Cable X Hand Dug Other CONSTRUCTION
PROPOSEDDiameter of casing 2" Material STEEL Annular Space: Size 2"
Sealed with: Concrete X Grout Neat Cement Puddled Clay Other
Conductor Casing: Yes No X Material
Chlorination By: Owner X Pump Co Driller

(SIGNATURE OF APPLICANT)

(DATE)

NOTICE TO DRILLER: COMPLETE THIS PORTION AND PROVIDE OWNER WITH THIS COPY.

CASING

CONSTRUCTION

Total Depth 120 Ft.
Surface Seal to 20 Ft.
Any Stratas sealed: Yes No X
If yes, depth of Stratas
From Ft. to Feet
From Ft. to Feet
Perforations
From 40 Ft. to 118 Feet
From Ft. to Feet
From Ft. to Feet

WATER LEVELS

First water at 38 Feet
Static level at 36 Feet

WELL TESTS

How performed PAVED
Yield 30 GPM with 5 Feet
Drawdown Ft. after 1 1/2 Hrs.

WELL LOG

(Formation; describe by color, size of material, structure)

Ft. to

Ft/

0'-14' Brown Loam Topsoil + Rock
14'-31' Black Volcanic Rock
31'-39' Brown Volcanic Ash
39'-58' Black Volcanic Rock
58'-102' Gray Volcanic Ash + Rock
102'-120' Gray AshSigned: [Signature]License # 28-35-29

APPENDIX B
WELL 2 PUMP TEST

APPENDIX C

NAPA COUNTY GROUNDWATER RECHARGE ANALYSIS

OCONNOR ENVIRONMENTAL INC.

Napa County Groundwater Recharge Analysis

Introduction

Developing accurate estimates of the spatial and temporal distribution of groundwater recharge is a key component of sustainable groundwater management. Efforts to quantify recharge are inherently difficult owing to the wide variability of factors controlling hydrologic processes, the wide range of available tools/methods for estimating recharge, and the difficulty in assessing the accuracy of estimates because direct measurement of recharge rates is, for the most part, infeasible (Healy 2010, Seiler and Gat 2007).

Numerical modeling is a common approach for developing recharge estimates. Soil-water-balance modeling is one category of numerical models particularly well-suited for estimating recharge across large areas with modest data requirements. This study describes an application of the U.S. Geological Survey's (USGS) Soil Water Balance Model (SWB) (Westenbroek et al. 2010) to develop spatial and temporal distributions of groundwater recharge across Napa County. This model operates on a daily timestep and calculates surface runoff based on the Natural Resources Conservation Service (NRCS) curve number method and potential evapotranspiration based on the Hargreaves-Samani methods (Hargreaves and Samani 1985). Actual evapotranspiration (AET) and recharge are calculated using a modified Thornthwaite-Mather soil-water-balance approach (Westenbroek et al. 2010).

It is important to note that the SWB model focuses on surface and soil-zone processes and does not simulate the groundwater system or track groundwater storage over time. The model also does not simulate surface water/groundwater interaction or baseflow; thus, the runoff estimates represent only the surface runoff component of streamflow resulting from rainstorms and the recharge estimates represent only the infiltration recharge component (also referred to as diffuse recharge) of total recharge (stream-channel recharge is not simulated).

This modeling work and summary report has been prepared by O'Connor Environmental, Inc., for its private use in relation to Water Availability Analyses (WAA) prepared on behalf of private clients for projects using groundwater in "hillside" areas of Napa County as required by Napa Planning, Building & Environmental Services. The modeling to-date is complete in its current form but remains subject to revision; it is considered a working draft with information suitable for use to support WAA projects. Parties interested in obtaining more information regarding the modeling or who may wish to offer comments should contact O'Connor Environmental, Inc.



Model Development

The model was developed using a 30-meter (98.4 ft) resolution rectangular grid. Water budget calculations were made on a daily time step. Key spatial inputs included a flow direction map developed from the USGS 1 arc-second resolution Digital Elevation Model (DEM), a land cover map derived from the U.S. Forest Service (USFS) CALVEG dataset that was supplemented by a database of agricultural areas maintained by the County of Napa (Figure 1), a distribution of Hydrologic Soil Groups (A through D classification from lowest to highest runoff potential; Figure 2), and a distribution of Available Water Capacity (AWC) developed from the NRCS Soil Survey Geographic Database (SSURGO) (Figure 3).

A series of model parameters were assigned for each land cover type/soil group combination including an infiltration rate, a curve number, dormant and growing season interception storage values, and a rooting depth (Table 1).

Infiltration rates for hydrologic soil groups A through D were applied based on Cronshey et al. (1986) (Table 2) along with default soil-moisture-retention relationships based on Thornthwaite and Mather (1957) (Figure 4). Curve numbers were assigned based on standard NRCS methods. Interception storage values and rooting depths were assigned based on literature values and from previous modeling experience including a SWB model covering Sonoma County and calibrated using runoff volumes from several stream gages (OEI 2017).

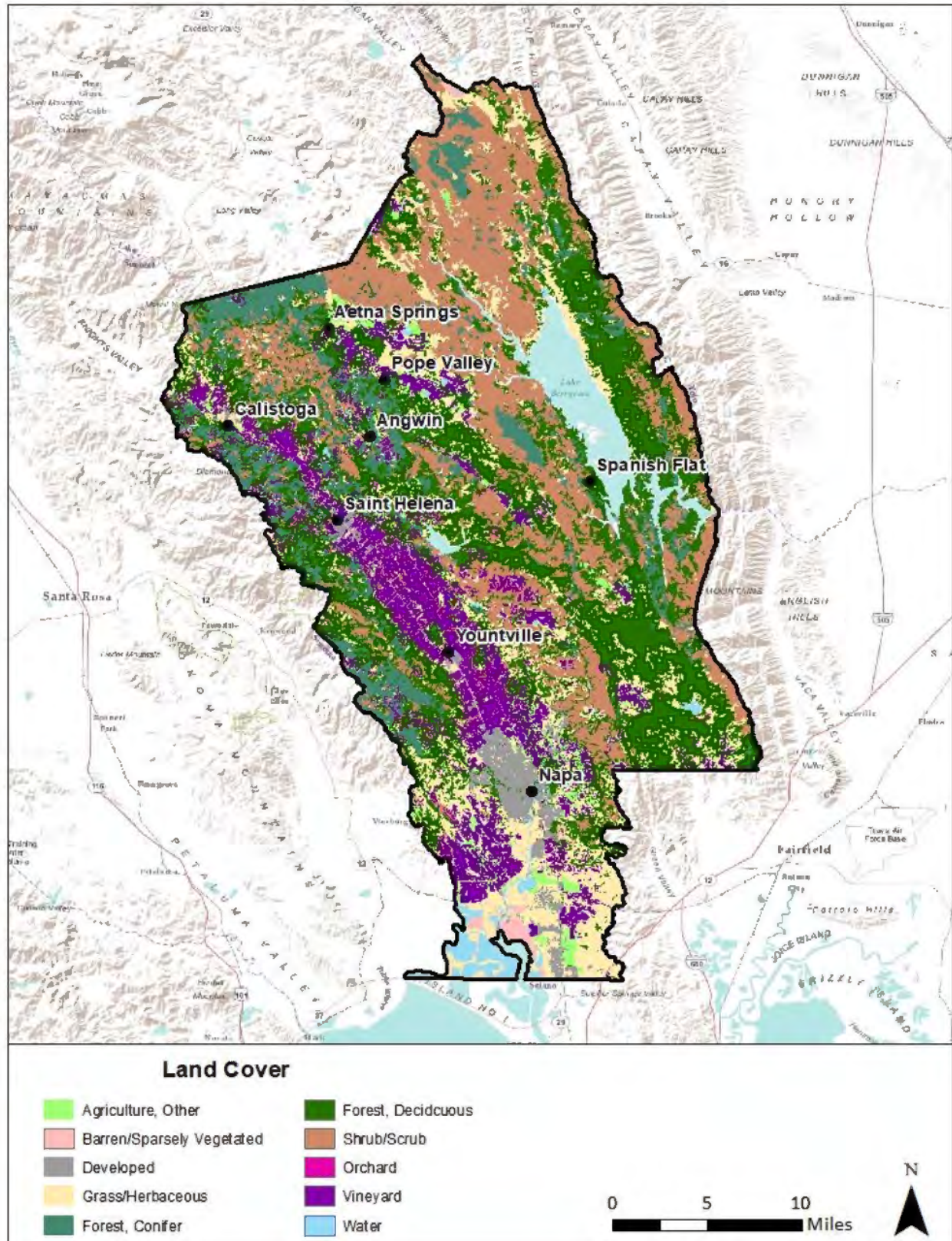


Figure 1: Land cover distribution used in the Napa County SWB model.

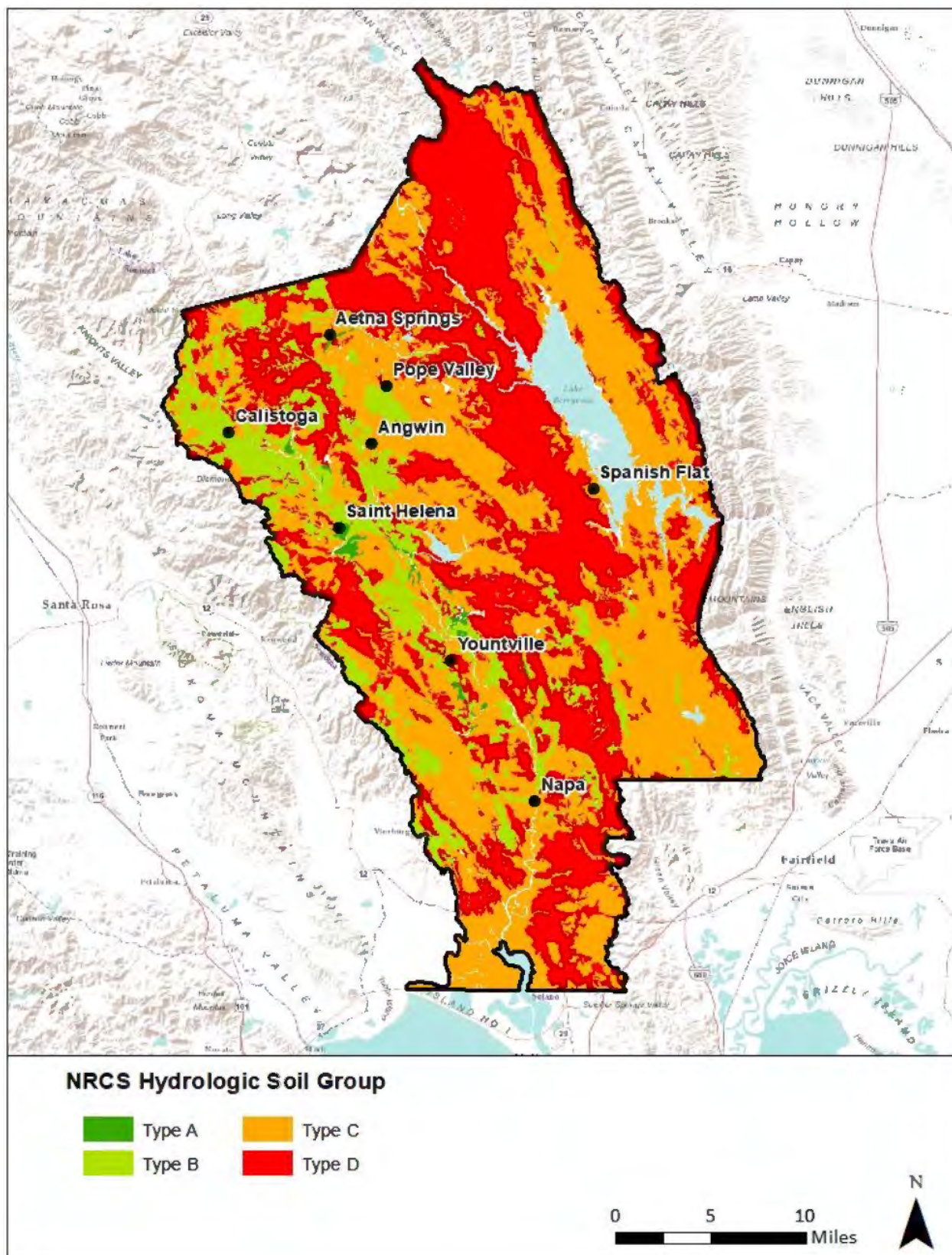


Figure 2: Hydrologic soil group distribution used in the Napa County SWB model.

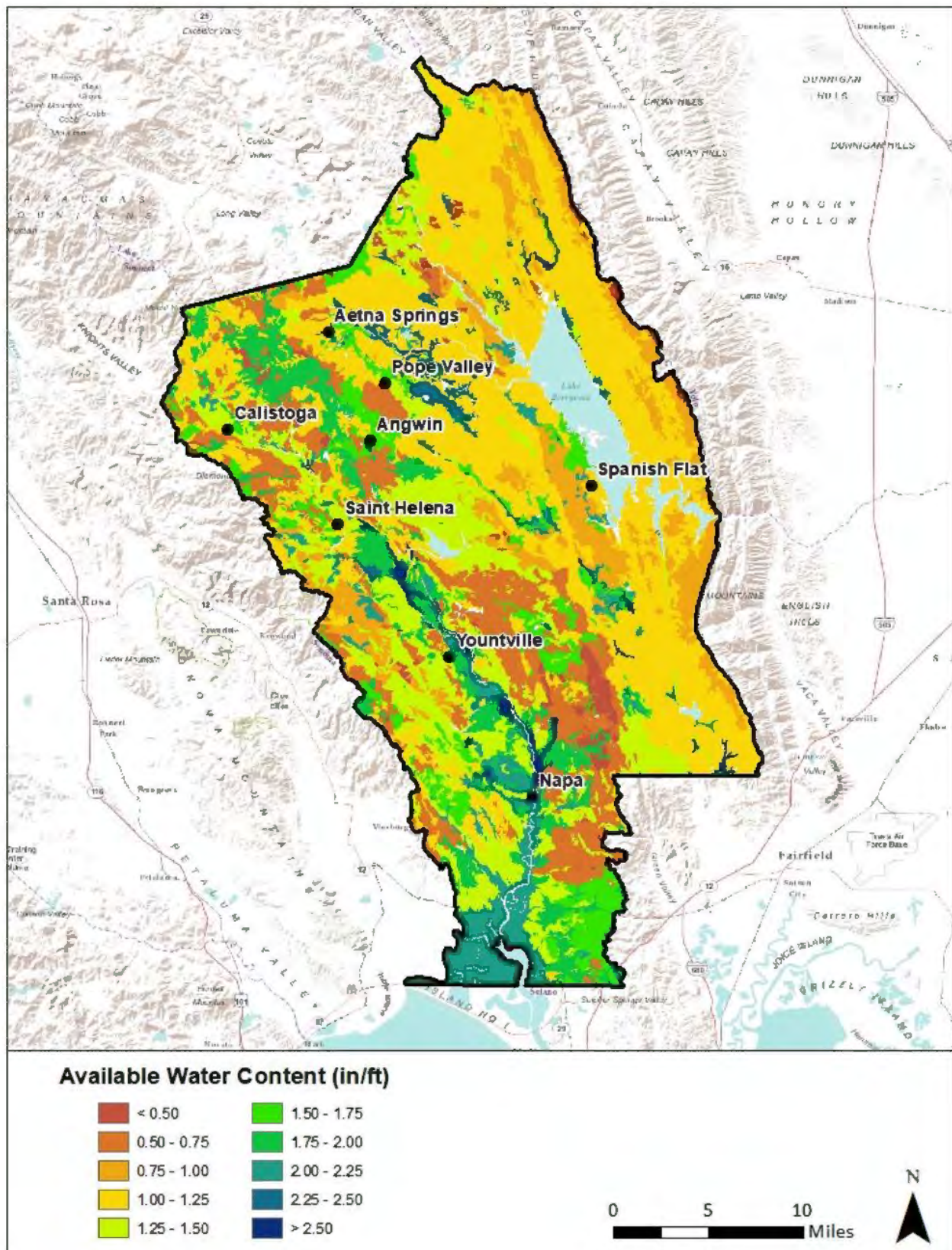


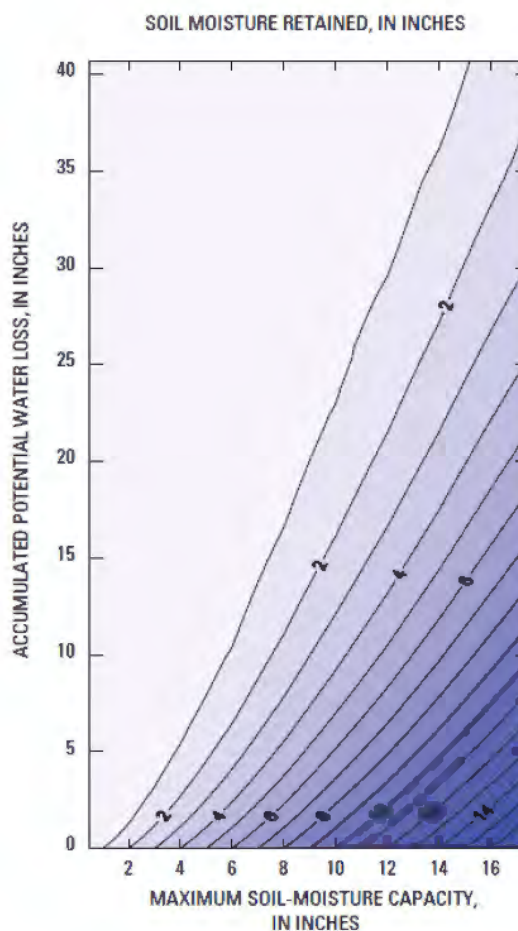
Figure 3: Available water capacity distribution used in the Napa County SWB model.

Table 1: Soil and land cover properties used in the Napa County SWB model.

Land Cover	Interception Storage Values (")		Curve Number by NRCS Soil Type (")				Rooting Depth by NRCS Soil Type (ft)			
	Growing Season	Dormant Season	Type A	Type B	Type C	Type D	Type A	Type B	Type C	Type D
Agriculture, Other	0.080	0.040	38	61	75	81	2.0	1.9	1.8	1.7
Barren	0.000	0.000	77	86	91	94	0.0	0.0	0.0	0.0
Developed	0.005	0.002	61	75	83	87	2.3	2.1	2.0	1.8
Grassland/Herbaceous	0.005	0.004	30	58	71	78	1.3	1.1	1.0	1.0
Forest, Coniferous	0.050	0.050	30	55	70	77	5.9	5.1	4.9	4.7
Forest, Deciduous	0.050	0.020	30	55	70	77	5.9	5.1	4.9	4.7
Shrub/Scrub	0.080	0.015	30	48	65	73	3.2	2.8	2.7	2.6
Orchard	0.050	0.015	38	61	75	81	3.2	2.8	2.7	2.6
Vineyard	0.080	0.015	38	61	75	81	2.2	2.1	2.0	1.9
Water	0.000	0.000	100	100	100	100	0.0	0.0	0.0	0.0

Table 2: Infiltration rates for NRCS hydrologic soil groups (Cronshey et al. 1986).

Soil Group	Infiltration Rate (in/hr)
A	> 0.3
B	0.15 - 0.3
C	0.05 - 0.15
D	<0.05

**Figure 4: Soil-moisture-retention table (Thorntwaite and Mather 1957).**

The SWB model utilizes daily precipitation and mean daily temperature data derived from climate stations. To account for the spatial variability of these parameters, daily precipitation and mean daily temperature were input as gridded (spatially-distributed) time-series. The gridded precipitation time-series was created using data from 15 weather stations in Napa County, and the gridded mean temperature time-series was created using data from 8 stations (Table 3). These stations were selected based on completeness of the records and to provide station data representative of the range of climates experienced in the county. Data was obtained from the California Data Exchange Center (CDEC), the National Climatic Data Center (NCDC), and from Napa One Rain.

To create the gridded time-series, the model domain was divided into discrete areas represented by individual weather stations (Figures 5 and 6). This delineation was based on climate variations described by existing gridded mean annual (1981-2010) precipitation and temperature data (PRISM 2010) and local knowledge of climatic variations across the county.

For the precipitation time-series, each area representing a weather station was subdivided into four to twenty-three zones based on 1-inch average annual precipitation contours. Within each zone the raw station data was multiplied by a unique scaling factor. This scaling factor was calculated as the ratio of average annual precipitation within a zone to average annual precipitation at the representative rain gage. In certain locations, typically near the boundary of areas represented by gages located on the valley bottom and at higher elevations, this scaling was unable to smoothly resolve differences in annual and event precipitation totals. To more accurately estimate precipitation near these boundaries, precipitation records from the two gages in question were averaged using weights calculated proportionally to the difference between PRISM mean annual precipitation at a rain gage and within a selected zone. The resulting gridded time-series is comprised of 220 individual time-series based on the scaled station data from 15 stations.

The assignment of temperature stations was based on the understanding that the spatial variability of temperatures across Napa County is relatively homogenous, with elevation being the primary variable. Temperature records were classified either as Mountain, Valley Bottom, or East County and applied within areas the PRISM datasets described as being similar. To smooth the transition from Mountain zones to Valley Bottom and East County zones, Hillside zones were created where the temperature records of the two nearest gages were averaged.

Missing and suspect data was encountered in the raw precipitation and temperature data from the weather stations used by the model. Values that were significantly outside the typical range, and where similar observations were not found at nearby stations, were removed from the datasets. These and missing values were filled using scaled data from other nearby stations. Precipitation data used for gap filling was scaled using the ratio of the 1981 to 2010 mean annual precipitation (PRISM 2010) between the two stations. Temperature data was scaled using the ratio of the 1981 to 2010 mean monthly minimum and maximum temperatures (PRISM 2010) between the two stations.

The current analysis focuses on Water Year 2010 (October 1, 2009 – September 30, 2010) and Water Year 2014 (October 1, 2013 – September 30, 2014). These years were selected because they represent periods with data available from most weather stations in the county and where most stations reported annual precipitation totals close to the long-term average (WY 2010) and significantly below the long term average (WY 2014). Based on a comparison between station data and PRISM average precipitation depths during Water Year 2010, rainfall averaged 101% of long-term average conditions and ranged from 78% at Lake Hennessey to 111% at the Napa County Airport. In Water Year 2014, rainfall averaged 55% of long-term average conditions and ranged from 41% at Lake Hennessey to 73% at the Napa State Hospital (Table 3).

Table 3: Weather stations used in the Napa County SWB model. See Figures 7- 9 for associated timeseries.

Station	Data Used	1981 - 2010 Mean	WY 2010		WY 2014	
		Annual Precip (in)	Precip (in)	% Avg	Precip (in)	% Avg
Angwin ¹	Precip & Temp	42.54	44.64	105%	25.04	59%
Atlas Peak ¹	Precip & Temp	41.76	39.04	93%	20.08	48%
Berryessa ¹	Precip & Temp	28.97	28.16	97%	13.97	48%
Calistoga ²	Precip	39.41	41.75	106%	18.18	46%
Knoxville Creek ¹	Temp Only	-	-	-	-	-
Lake Hennessey ³	Precip Only	34.09	26.52	78%	13.92	41%
Mt. George ³	Precip Only	31.15	29.64	95%	18.24	59%
Mt. Veeder ³	Precip Only	44.81	46.44	104%	28.6	64%
Napa County Airport ²	Precip & Temp	21.14	23.56	111%	9.87	47%
Napa River at Yountville Cross Rd ³	Precip Only	31.86	32.72	103%	14.93	47%
Napa State Hospital ²	Precip & Temp	26.81	28.85	108%	19.66	73%
Petrified Forest ³	Precip Only	42.39	46.6	110%	22.84	54%
Redwood Creek At Mt. Veeder Road ³	Precip Only	34.71	37.36	108%	23.48	68%
Saint Helena ²	Precip & Temp	37.43	39.11	104%	19.11	51%
Saint Helena 4WSW ¹	Precip & Temp	45.44	47.88	105%	28.88	64%
Sugarloaf Peak ³	Precip Only	32.20	26.16	81%	17.12	53%

1 – Data accessed from California Data Exchange Center (CDEC)

2 – Data accessed from National Climate Data Center (NCDC)

3 – Data access from Napa One Rain

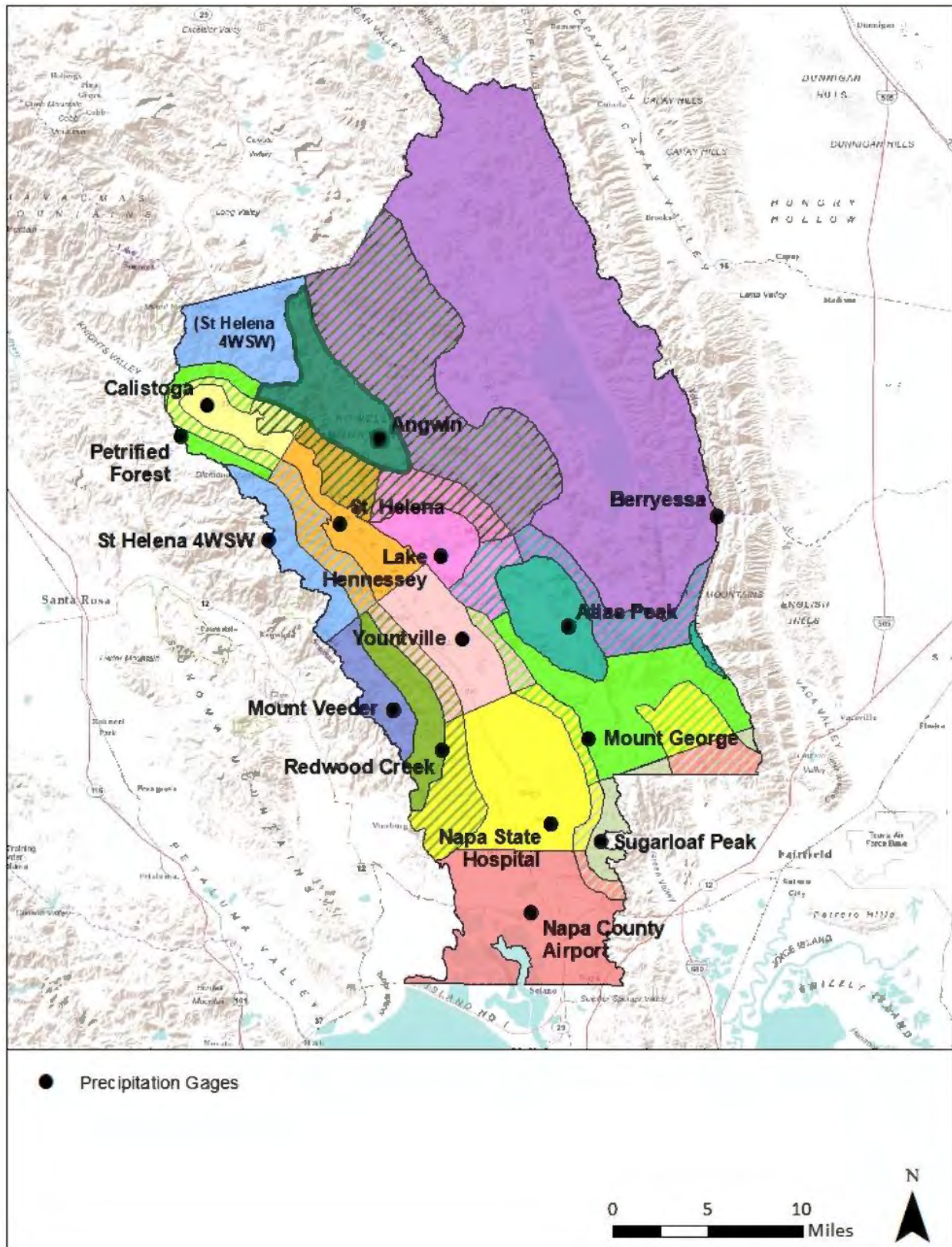


Figure 5: Precipitation zones used in the Napa County SWB model. Hatching indicates areas where two precipitation records were averaged across a zone.

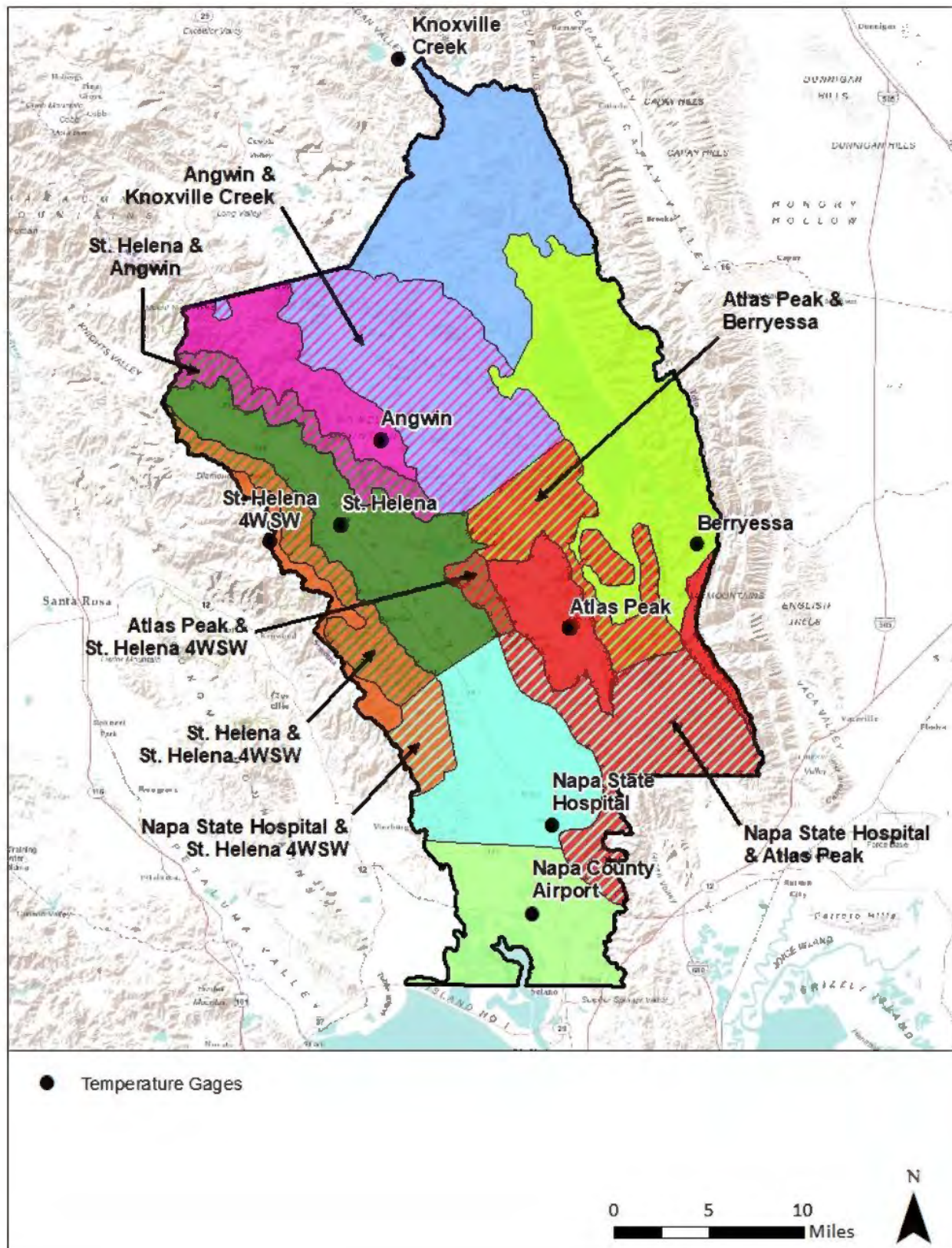


Figure 6: Temperature zones used in the Napa County SWB model. Hatching indicates areas where two temperature records were averaged across a zone.

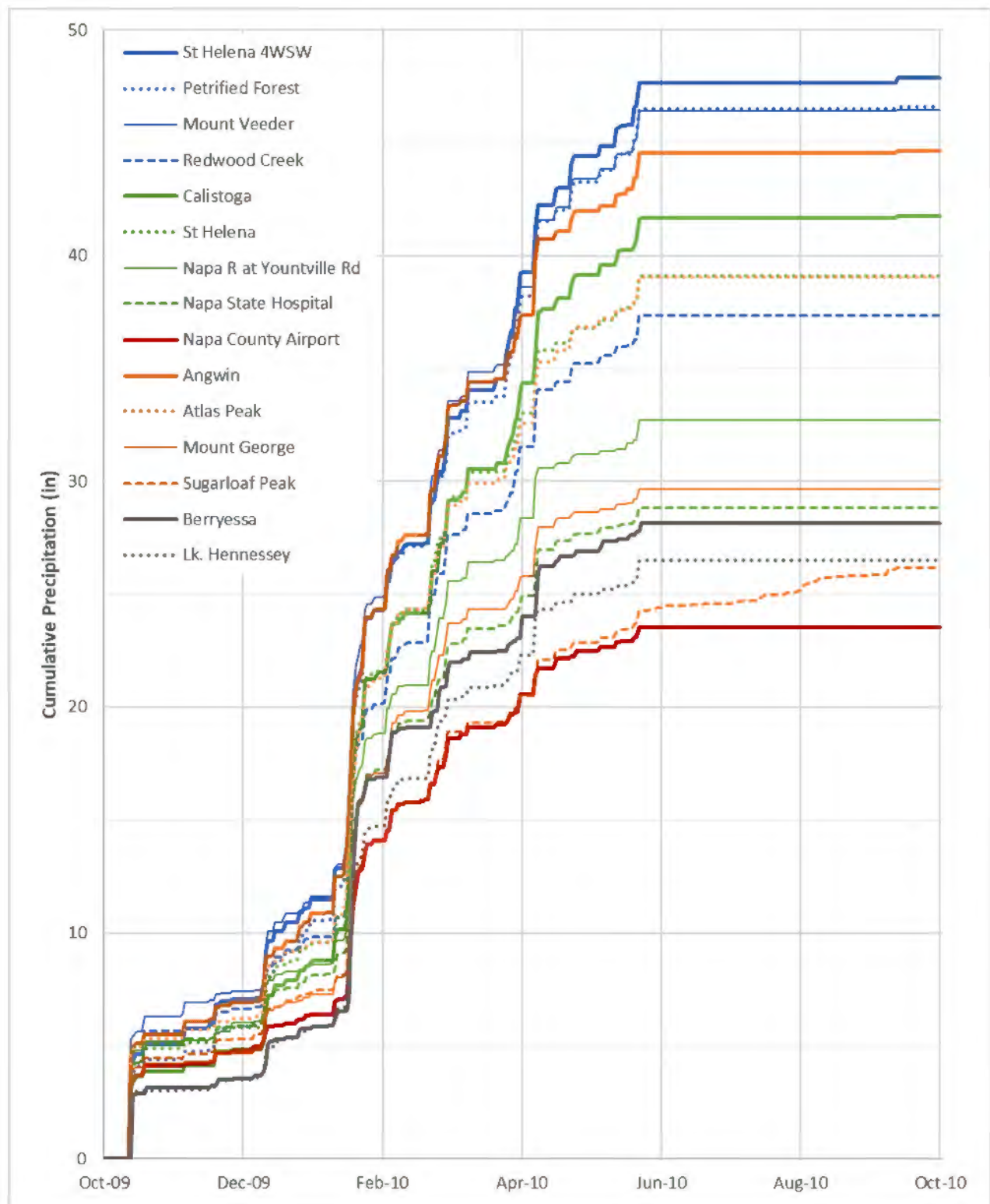


Figure 7a: Daily precipitation data used in the Napa County SWB model for WY 2010.

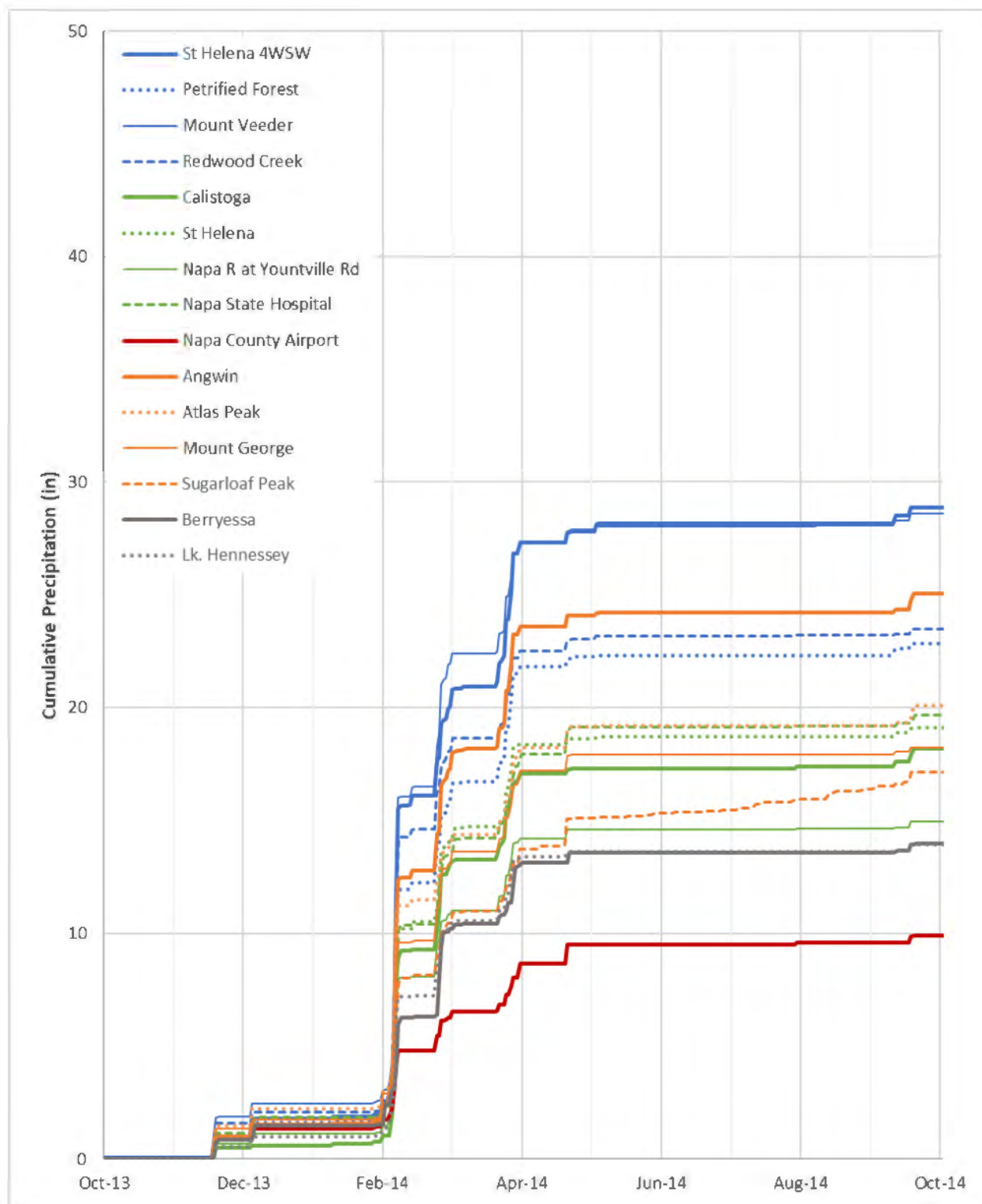


Figure 7b: Daily precipitation data used in the Napa County SWB model for WY 2014.

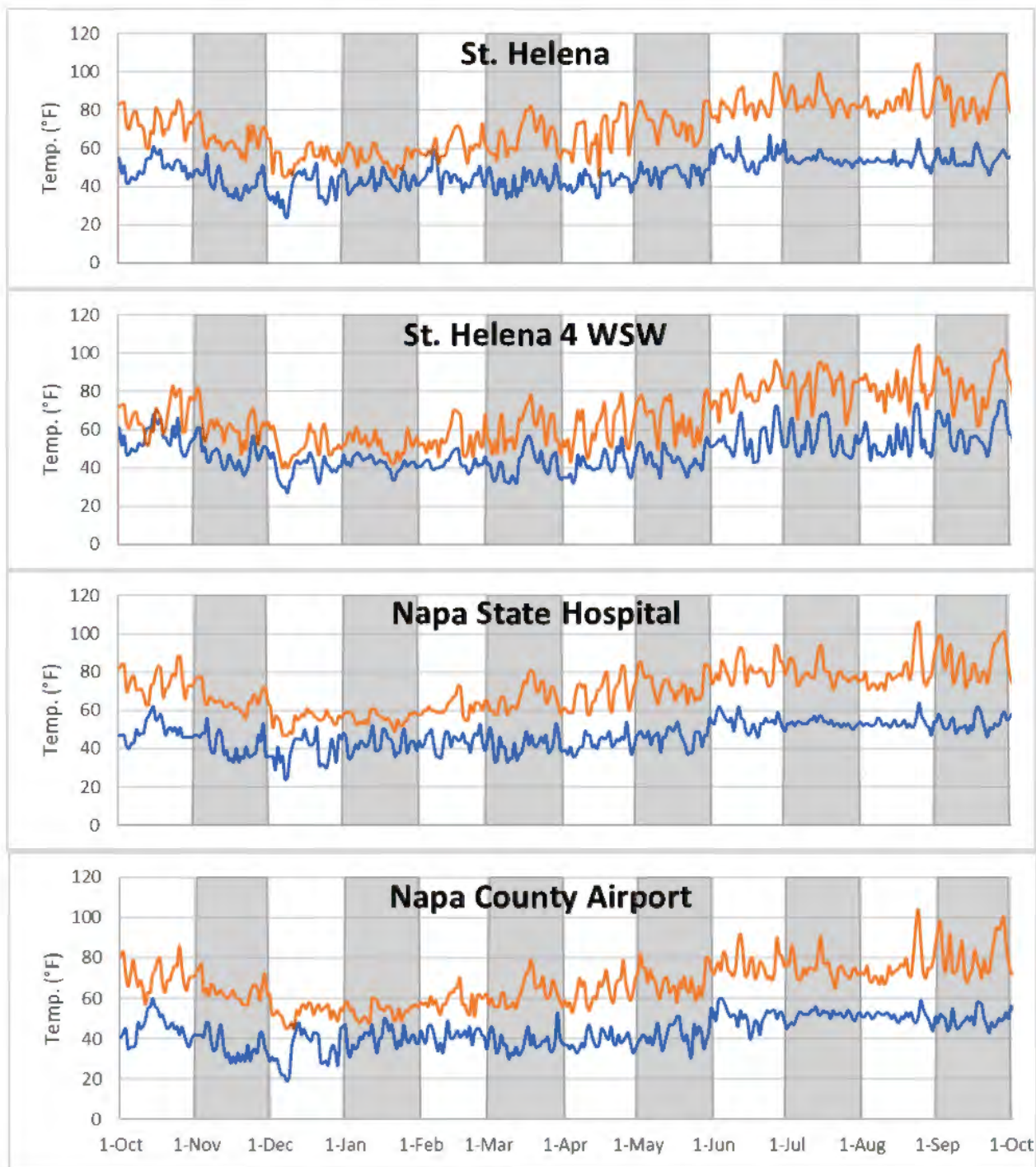


Figure 8: Daily minimum and maximum temperature data used in the Sonoma County SWB model for WY 2010.

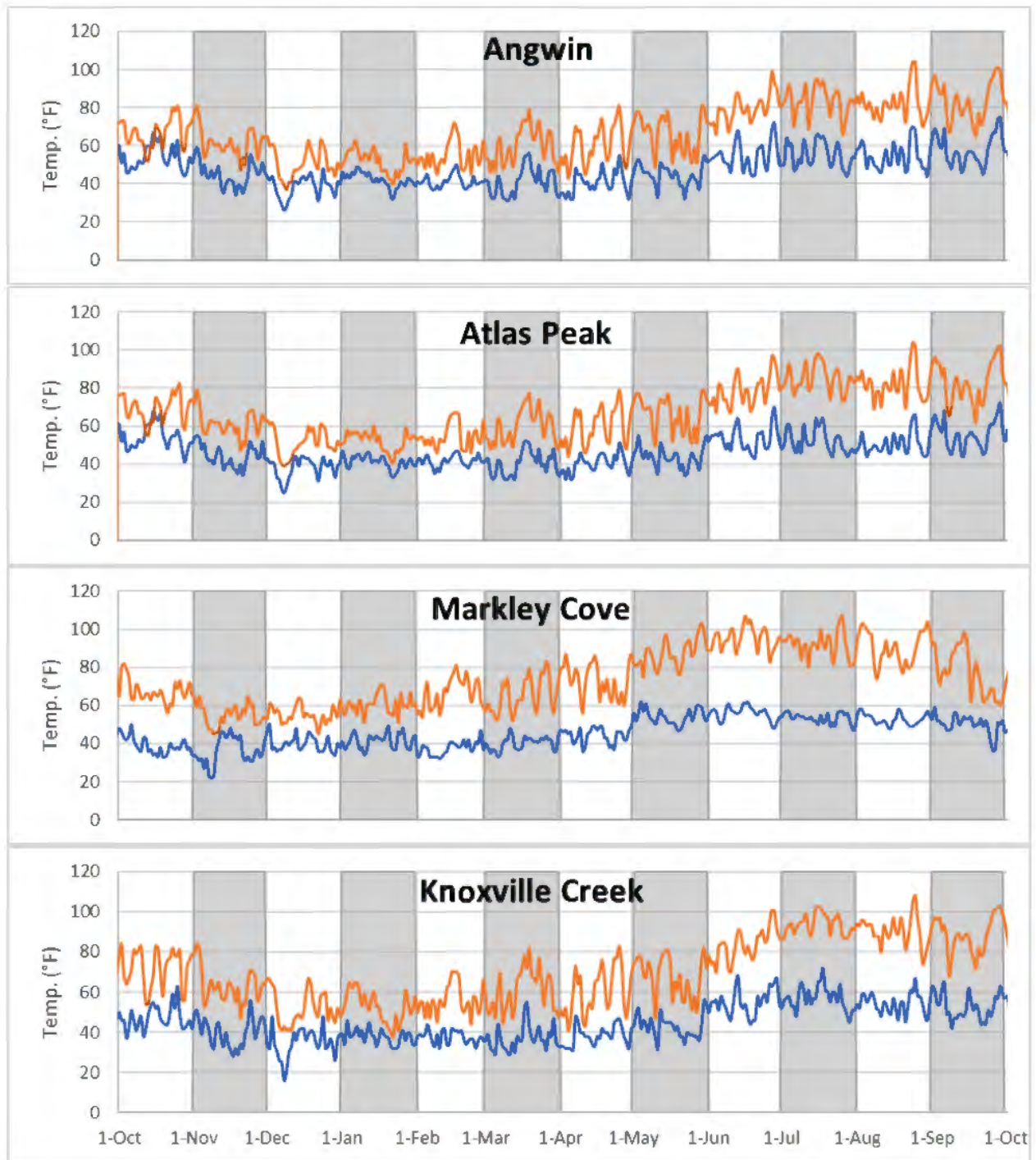


Figure 8 – cont.

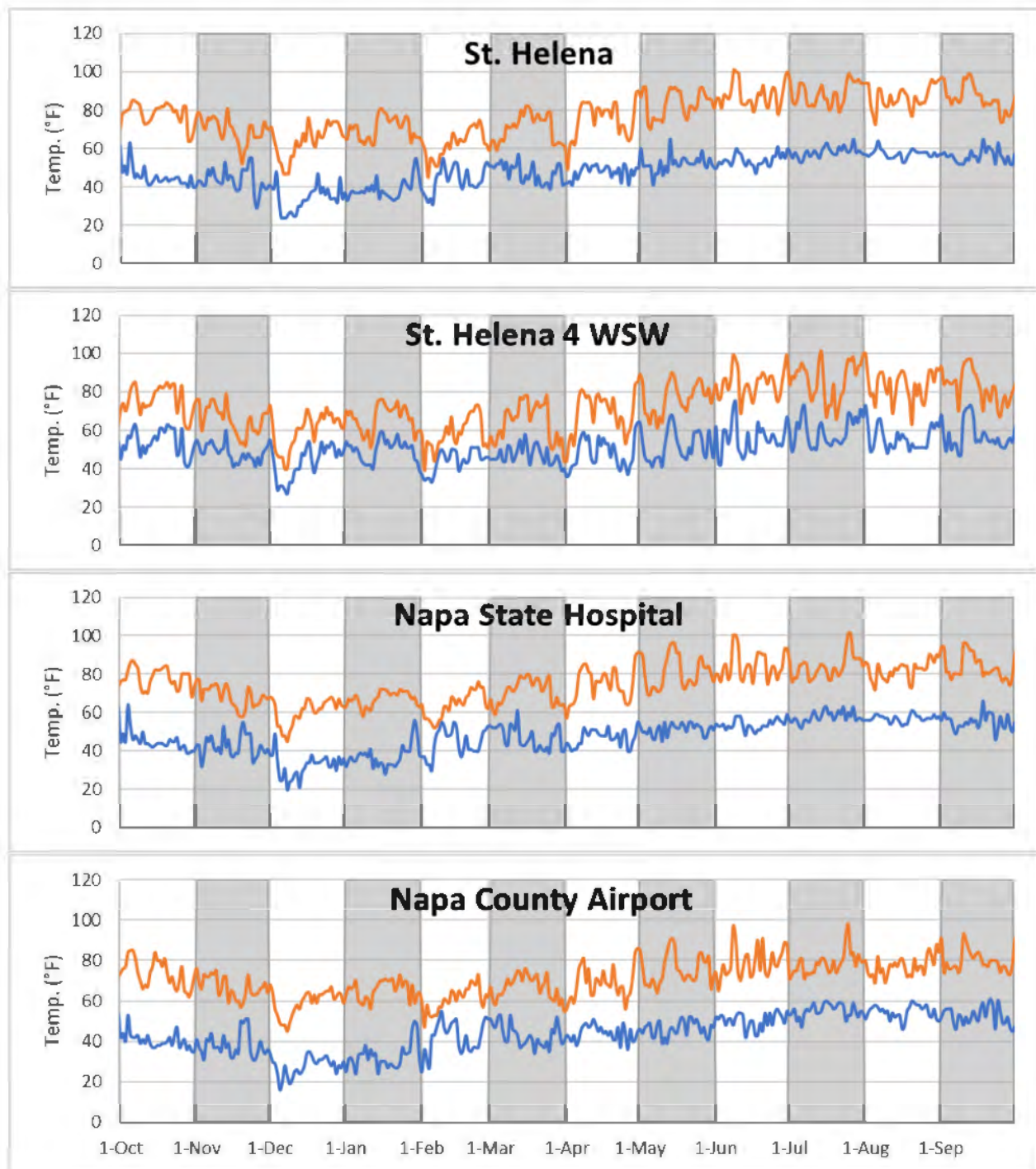


Figure 9: Daily minimum and maximum temperature data used in the Sonoma County SWB model for WY 2010.

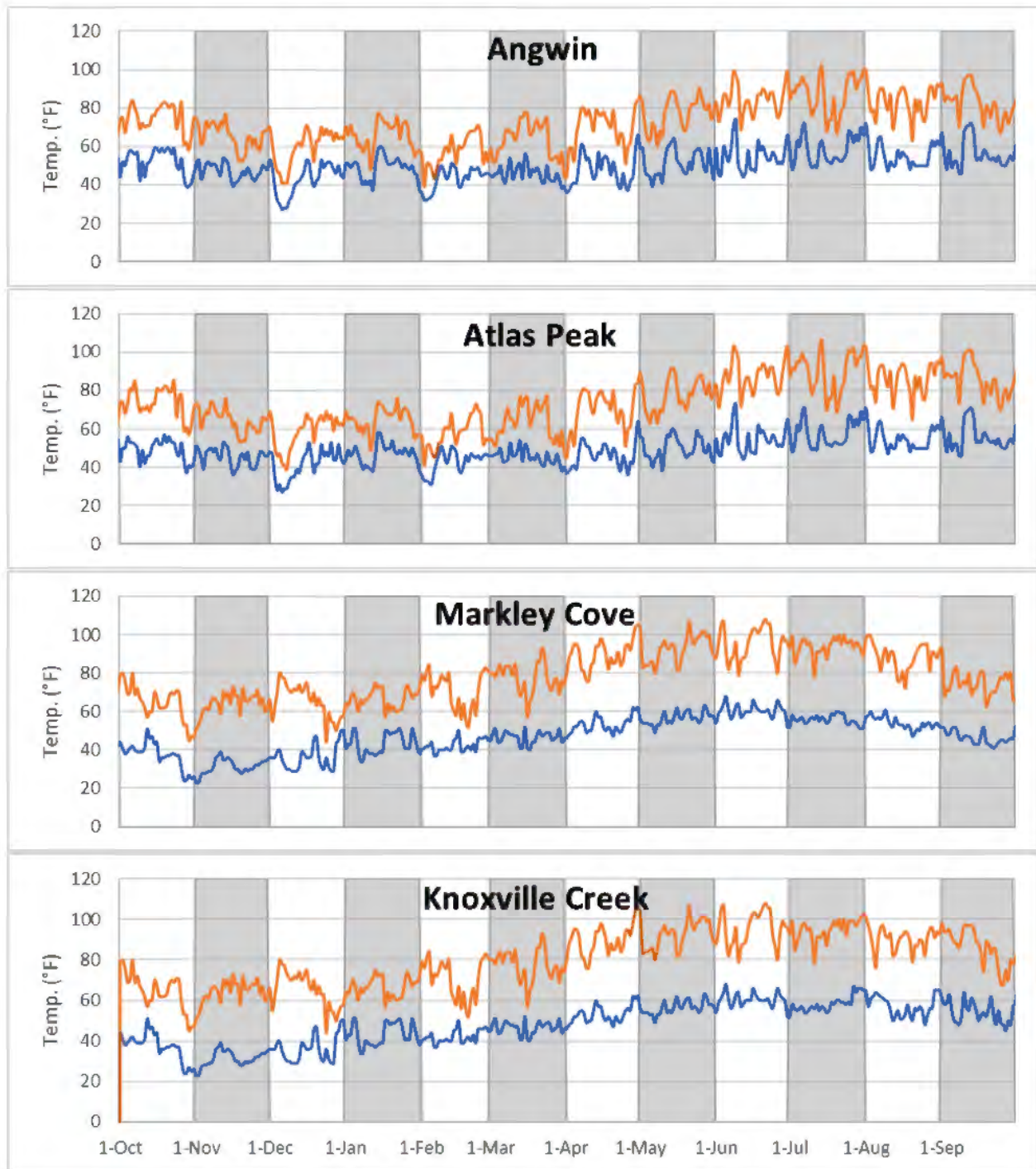


Figure 9 – cont.

Model Calibration

Available data are insufficient to calibrate the Water Year 2010 and 2014 SWB simulations; however, the land cover and soil properties used in the model were obtained from a previously prepared and calibrated SWB model of Sonoma County (OEI 2017). The Sonoma County model was calibrated against total monthly runoff volumes derived using baseflow separation of streamflow data for five watersheds within Sonoma County. Gages were selected because they represented relatively small watersheds (1.2 – 14.3 mi²) without significant urbanization, diversions, groundwater abstraction, reservoir impoundments, or large alluvial bodies where significant exchanges between surface water and groundwater may be expected. These attributes are desirable because the hydrographs can more readily be separated into surface runoff and baseflow components and the surface runoff pattern is more directly comparable to the SWB simulated surface runoff which does not account for water use, reservoir operations, or surface water/groundwater exchange.

SWB utilizes a simplified routing scheme whereby surface runoff is routed to downslope cells or out of the model domain on the same day in which it originates as rainfall, thus it is not capable of accurately estimating streamflow over short time periods. The use of the total monthly surface runoff volumes provided a means of calibrating the Sonoma County SWB model to measured surface runoff data within the limitations of the model's approach to simulating surface runoff.

The SWB model of Sonoma County reproduced seasonal variations in surface runoff in all five calibration watersheds. Monthly Mean Errors (ME) ranged from -0.2 to 0.4 inches with a mean value of 0.1 inches. Annual surface runoff totals ranged from an under-prediction of approximately 10% at Franchini Creek to an over-prediction of approximately 19% at Buckeye Creek, with a mean over-prediction of approximately 6% across the five watersheds. These results indicate that the SWB model was able to reproduce monthly surface runoff volumes with a reasonable degree of accuracy and that the model tends to over-predict surface runoff somewhat, suggesting that the model may generate a low-range estimate of recharge.

Although the climate in Napa County is slightly drier than in Sonoma County, the vegetation, soils, and geology are similar and parameters calibrated using data from Sonoma County should be applicable to Napa County. Calibration of the Napa County SWB model was not performed due to a lack of publicly-available contemporary discharge records in suitable watersheds. Contemporary discharge records exist for USGS gaging stations located along the Napa River near St. Helena and Napa, but the watersheds above these gages are large and contain significant groundwater abstraction, reservoir impoundments, and alluvial bodies. USGS gages on smaller watersheds in Napa County have been inactive since 1983 or earlier. Discharge records exist through Napa One Rain for several streams gaged by the Napa County Resource Conservation District (RCD) but the RCD has cautioned against use of these discharge records for calibration purposes due to incomplete rating curve development.

Estimates of groundwater recharge are also available from an earlier model prepared by Luhdorff and Scalmanini Engineers and MBK Engineers (LSCE 2013). This report provided estimates of average annual recharge as a percentage of average annual precipitation for nine watersheds in Napa County. Averaged across the same nine watersheds, the SWB model predicts significantly higher rates of recharge than the model prepared by LSCE, which predicts slightly lower AET but significantly more runoff (Table 4). Differences in methodology between these two models complicate direct comparisons. The LSCE model calculated infiltration into the soil as the difference between monthly precipitation and discharge volumes within each watershed. Discharge volumes were calculated from USGS stream gages and included both direct runoff and baseflow from groundwater. Inclusion of baseflow with direct runoff in these calculations may inappropriately reduce the estimated volume of water infiltrated into the soil and available for recharge.

Table 4: Comparison of results from SWB model and Luhdorff and Scalmanini model.

USGS Gage	HUC	Mean Precip, 2010 (in)	Mean AET, 2010 (% Precip)		Mean Runoff, 2010 (% Precip)		Mean Recharge, 2010 (% Precip)	
			SWB	LSCE	SWB	LSCE	SWB	LSCE
Conn Ck nr Oakville	11456500	34.8	59%	53%	21%	25%	21%	21%
Dry Ck nr Napa	11457000	41.5	56%	50%	18%	43%	25%	6%
Milliken Ck nr Napa	11458100	32.3	52%	41%	20%	51%	28%	8%
Napa Ck at Napa	11458300	36.6	61%	43%	16%	46%	23%	11%
Napa R nr Napa	11458000	39.5	56%	48%	20%	35%	24%	17%
Napa R nr St Helena	11456000	47.9	46%	45%	23%	42%	30%	14%
Redwood Ck nr Napa	11458200	39.6	53%	49%	26%	40%	22%	10%
Tulucay Ck nr Napa	11458300	27.0	64%	49%	16%	47%	20%	5%

Model Results

The principal elements of the annual water budget simulated with the Napa County SWB model for Water Years 2010 and 2014 are presented in map form in Figures 10 - 19 and in tabular form for 27 major watershed areas in Napa County (Tables 5 - 8). The watersheds are based on USGS HUC-12 watersheds and are named for the stream which comprises the largest proportion of the area; in many cases the areas consist of multiple tributary streams (Figure 20).

In Water Year 2010 (representing “average” hydrologic conditions) precipitation varied from 21.8 inches in the Ledgewood Creek watershed to 53.3 inches in the Saint Helena Creek watershed (Figure 10, Table 5). Actual evapotranspiration (AET) ranged from 13.4 inches in the Jackson Creek watershed to 25.2 inches in the Saint Helena Creek watershed (Figure 11). Surface runoff ranged from 3.4 inches in the Ledgewood Creek watershed to 13.5 inches in the Saint Helena Creek watershed (Figure 12). Recharge ranged from 3.3 inches in the Ledgewood Creek watershed to 14.4 inches in the Saint Helena watershed. (Figure 13). Small decreases in soil moisture storage (up to 1.8 inches) occurred in most watersheds, with changes in most

watersheds being less than an inch (Figure 14). Note that the San Pablo Bay estuaries have been excluded from these comparisons.

Expressed as a percentage of the annual precipitation, AET ranged from 77% in the Ledgewood Creek watershed to 45% in the Jackson Creek watershed (Table 6). Surface runoff ranged from 15% of precipitation in the Ledgewood Creek watershed to 42% in the Jackson Creek watershed. Recharge ranged from 10% of the precipitation in the Jackson Creek watershed to 27% in the Saint Helena watershed.

In Water Year 2014 (representing “dry” hydrologic conditions during the second year of an extreme three-year drought) precipitation varied from 10.1 inches in the American Canyon Creek watershed to 32.2 inches in the Saint Helena Creek watershed (Figure 15, Table 7). Actual evapotranspiration (AET) ranged from 10.3 inches in the Jackson Creek watershed to 17.8 inches in the Saint Helena Creek watershed (Figure 16). Surface runoff ranged from 0.7 inches in the American Canyon Creek watershed to 13.2 inches in the Saint Helena Creek watershed (Figure 17). Recharge ranged from 0.6 inches in the Wragg Canyon watershed to 4.1 inches in the Saint Helena watershed. (Figure 18). Large decreases in soil moisture storage of between 2.3 and 4.3 inches were also simulated (Figure 19).

Expressed as a percentage of the annual precipitation, AET ranged from 55% in the Saint Helena Creek watershed to 121% in the Jackson Creek watershed (Table 8). These very large AET rates caused significant decreases in soil moisture. Decreases in soil moisture ranged from 9% of precipitation in the Saint Helena watershed to 36% in the American Canyon Creek watershed. Surface runoff ranged from 7% of precipitation in the American Canyon Creek watershed to 41% in the Saint Helena Watershed. Recharge ranged from 18% in the Milliken Creek Watershed to 5% in the Jackson Creek and Wragg Canyon watersheds.

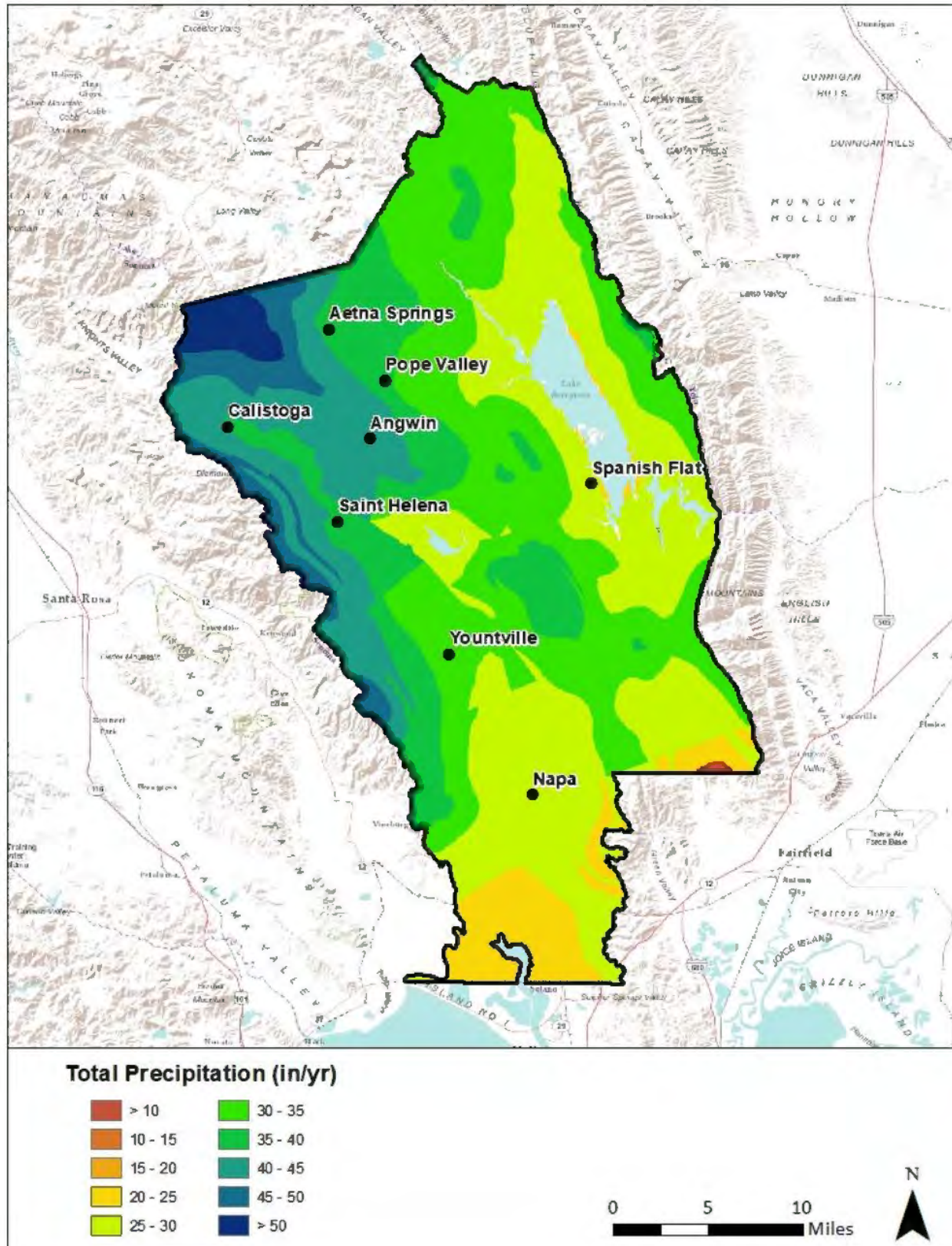


Figure 10: Water Year 2010 precipitation simulated with the Napa County SWB model.

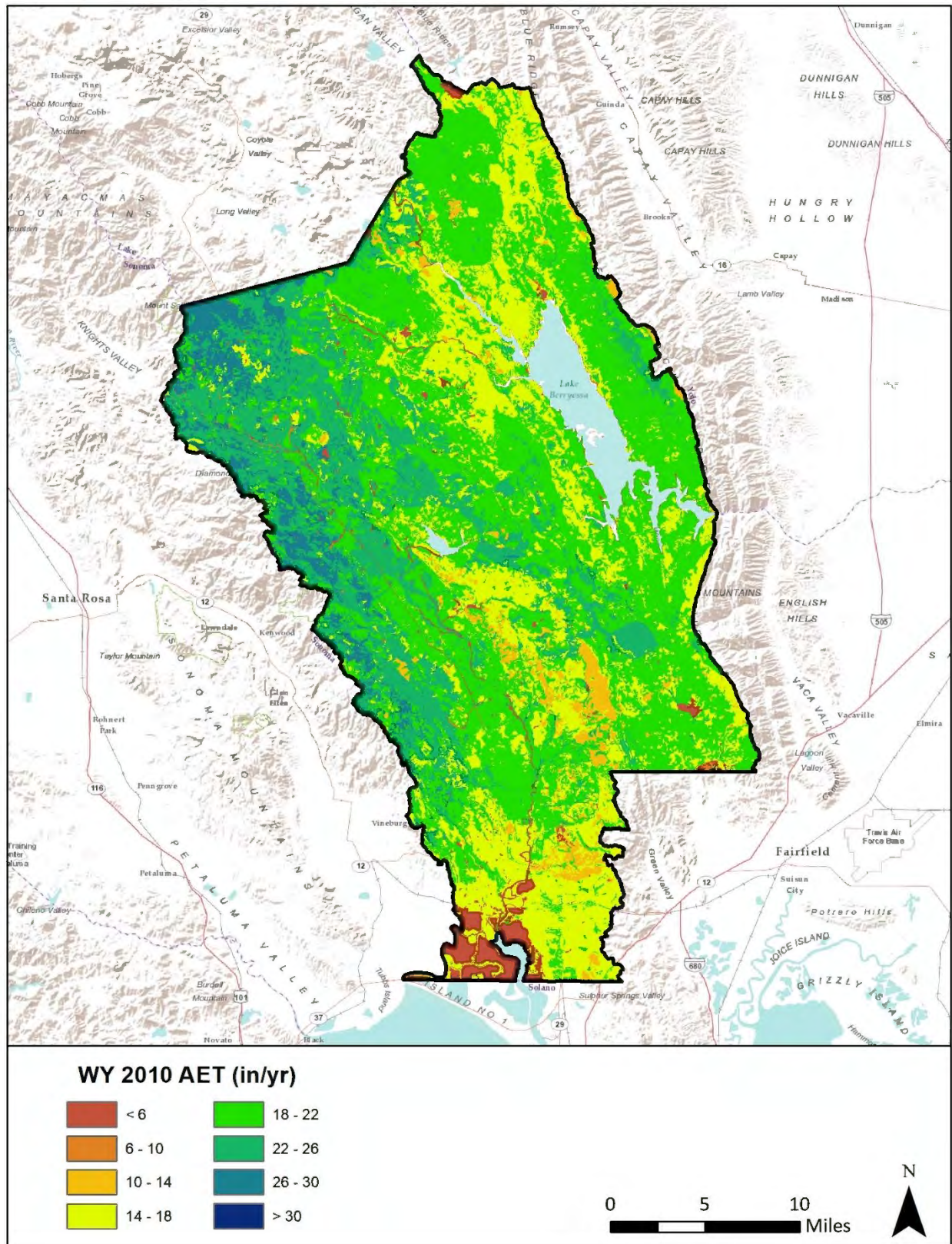


Figure 11: Water Year 2010 AET simulated with the Napa County SWB model.

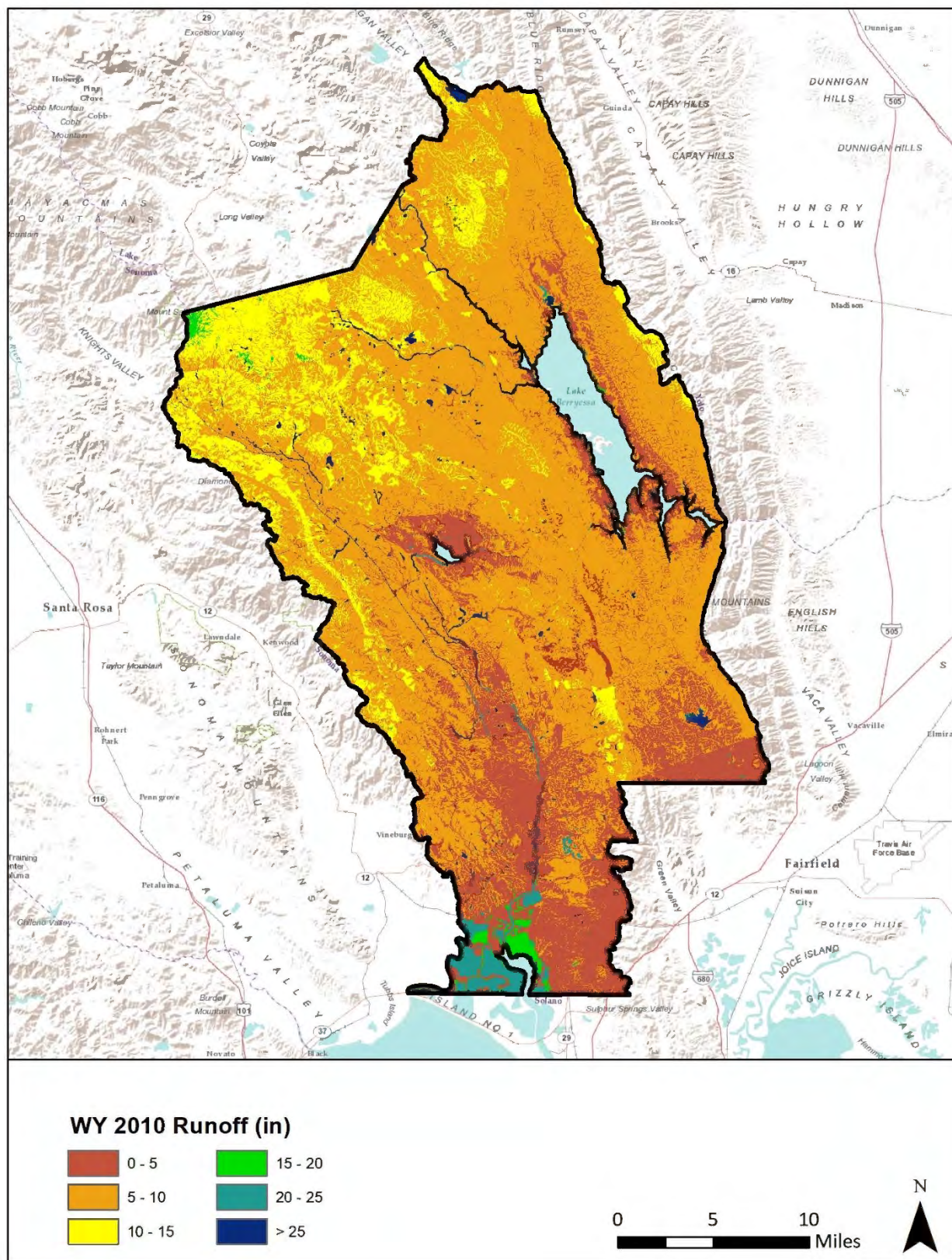


Figure 12: Water Year 2010 runoff simulated with the Napa County SWB model.

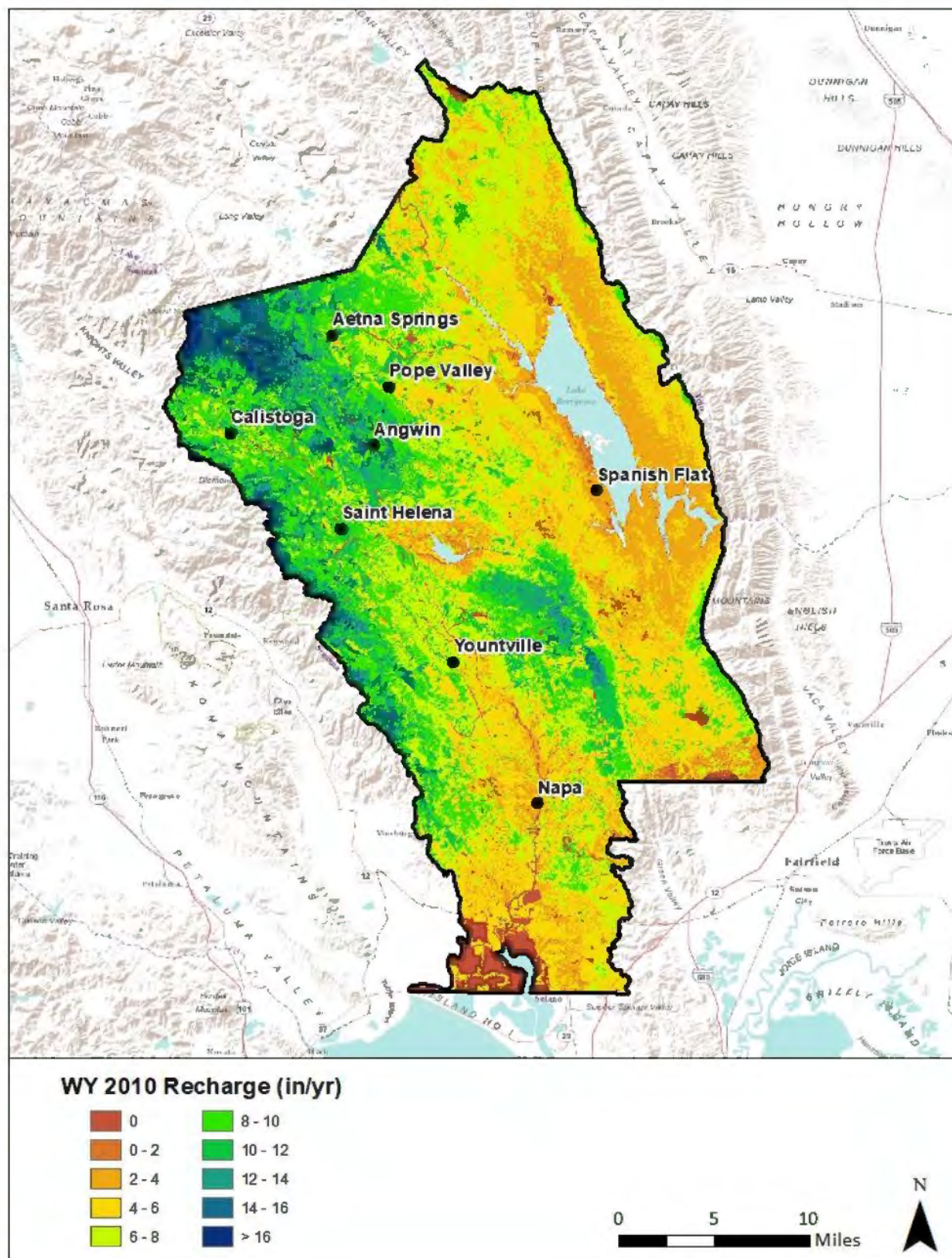


Figure 13: Water Year 2010 recharge simulated with the Napa County SWB model.

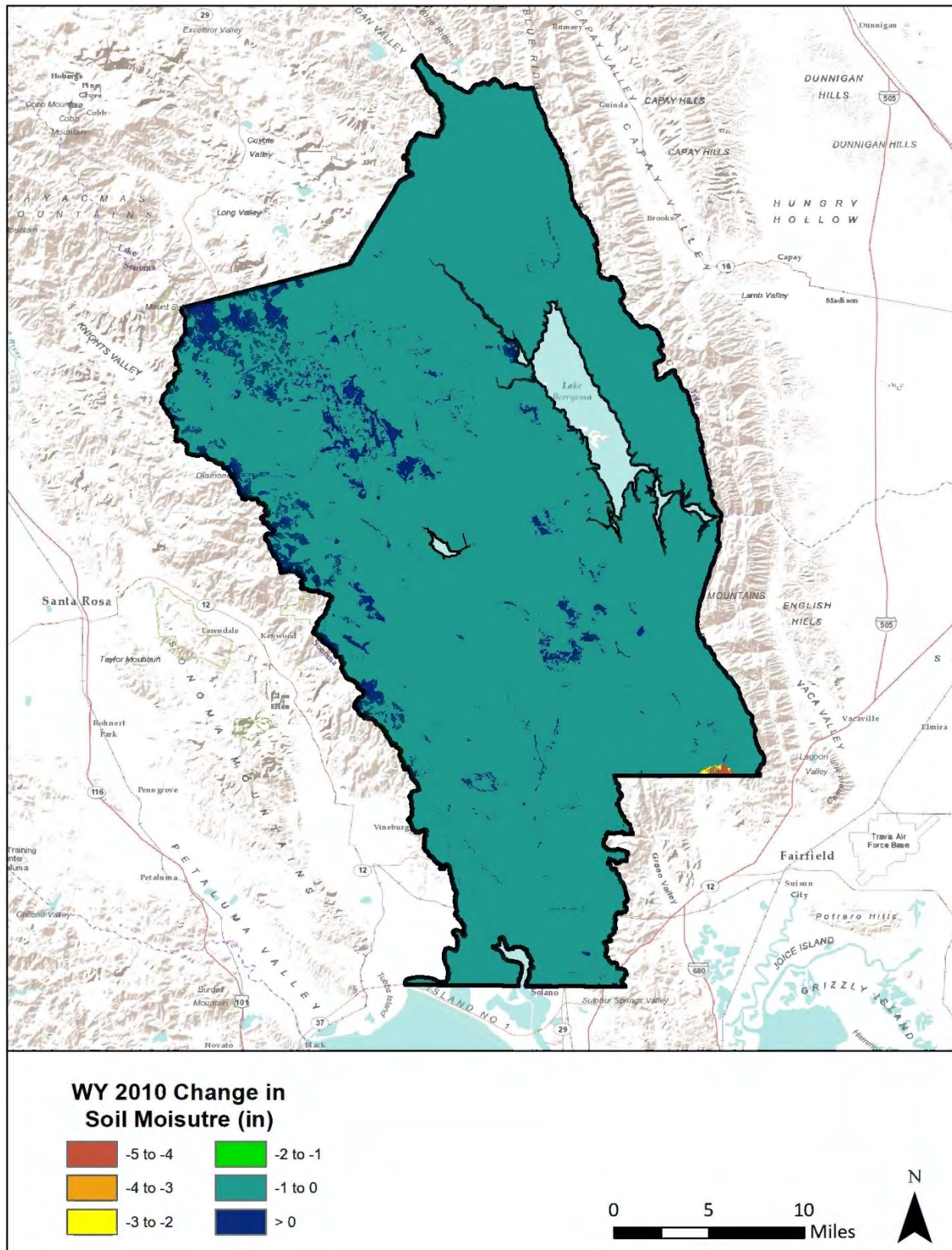


Figure 14: Water Year 2010 change in soil moisture content simulated with the Napa County SWB model.

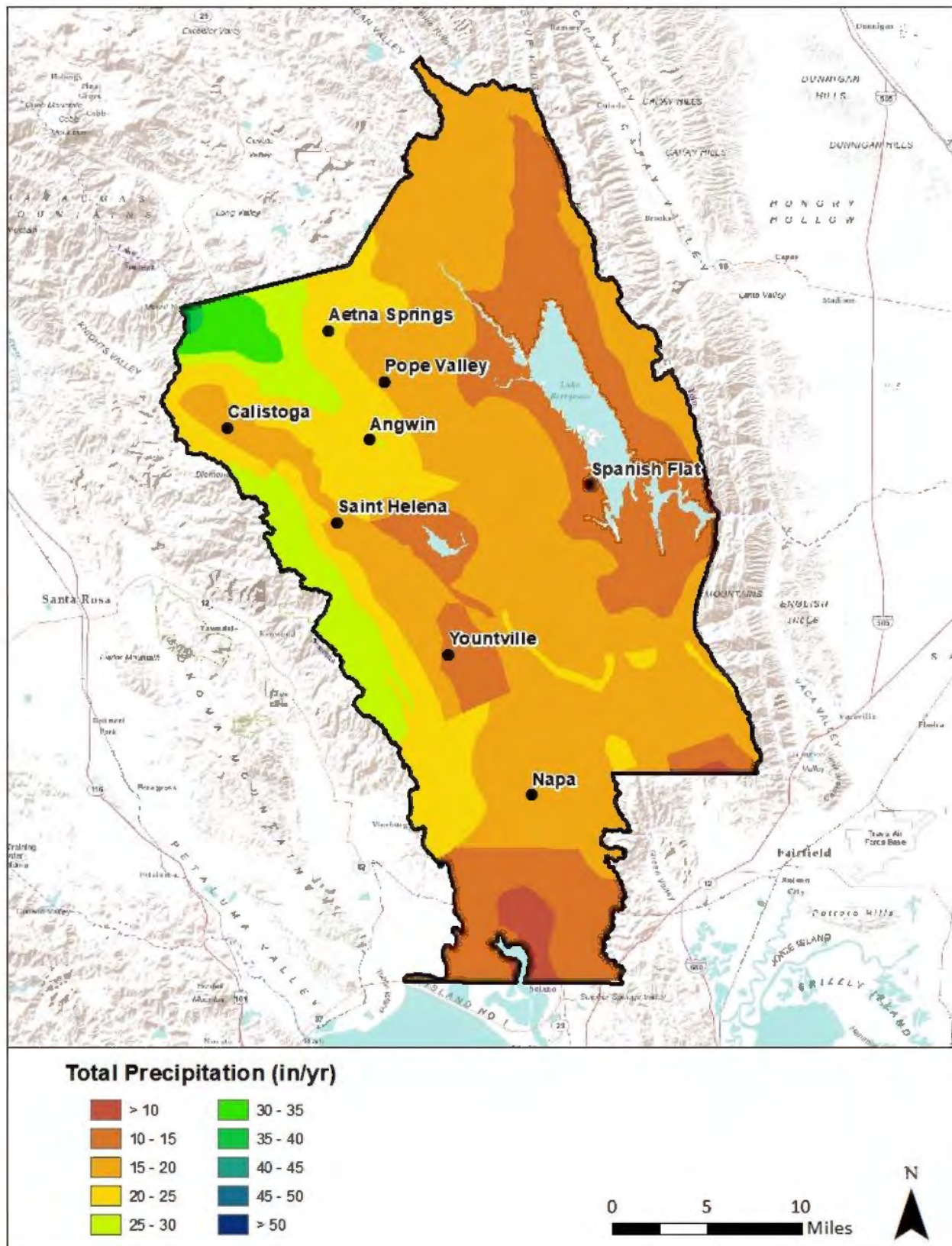


Figure 15: Water Year 2014 precipitation simulated with the Napa County SWB model.

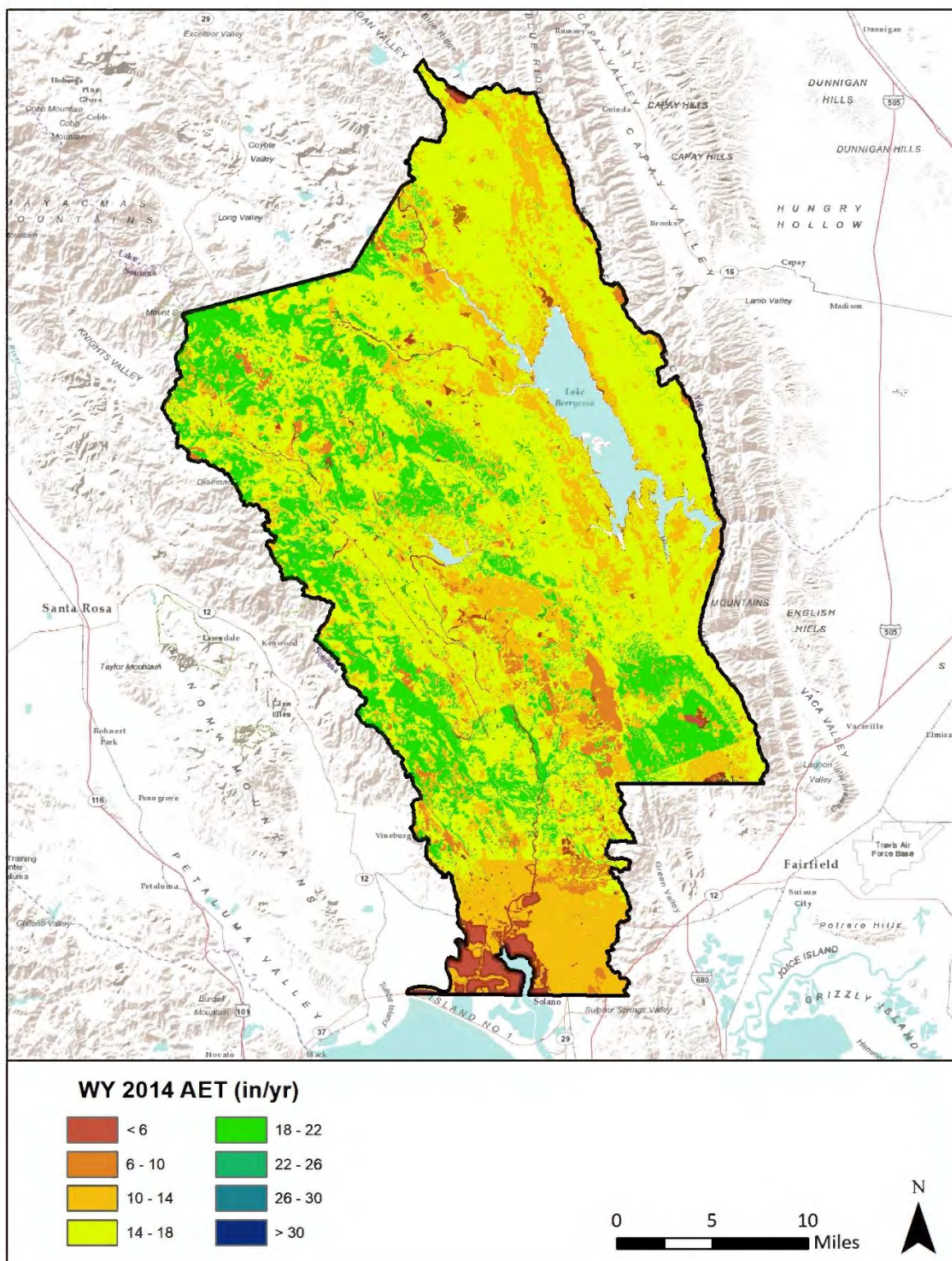


Figure 16: Water Year 2014 AET simulated with the Napa County SWB model.

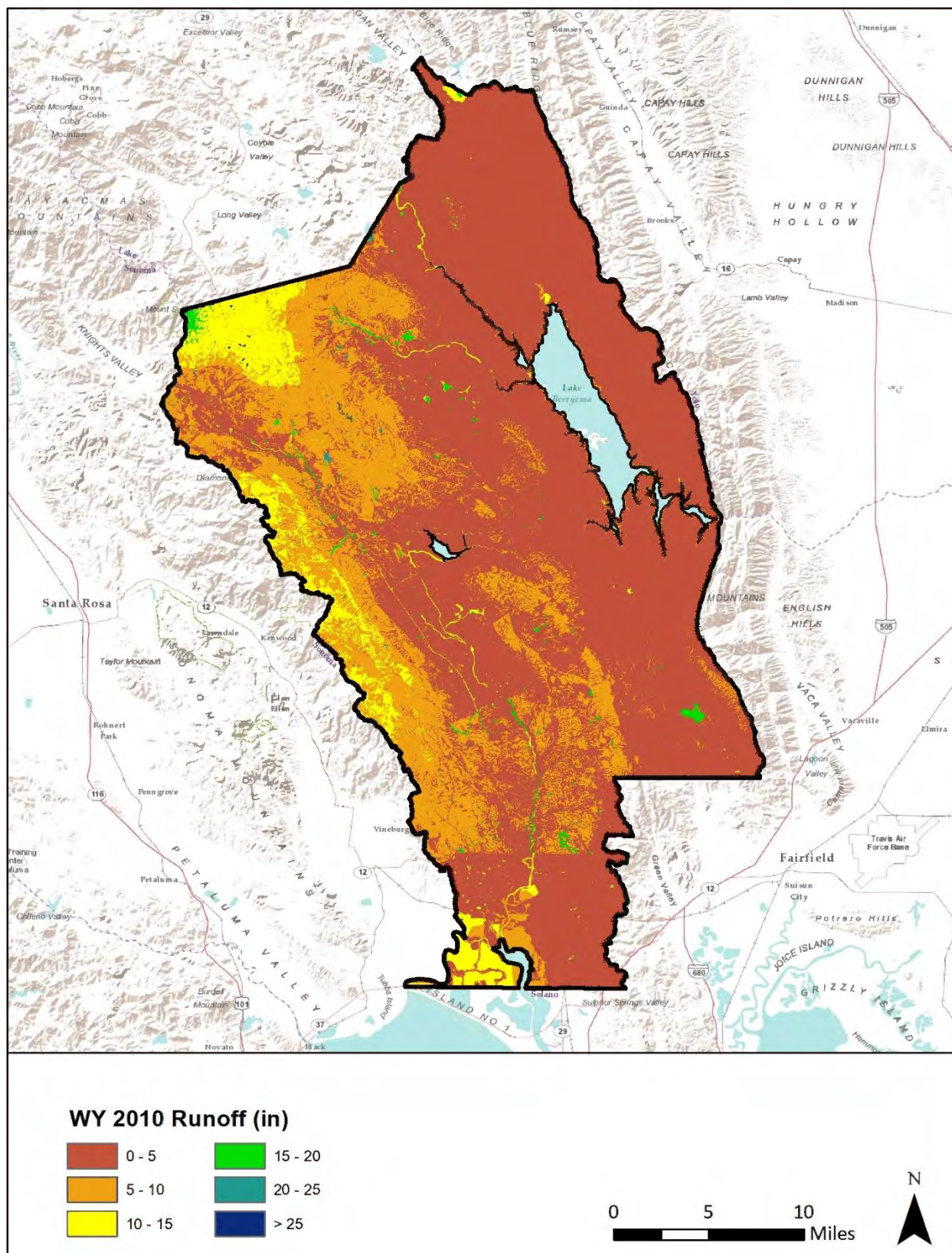


Figure 17: Water Year 2014 recharge simulated with the Napa County SWB model.

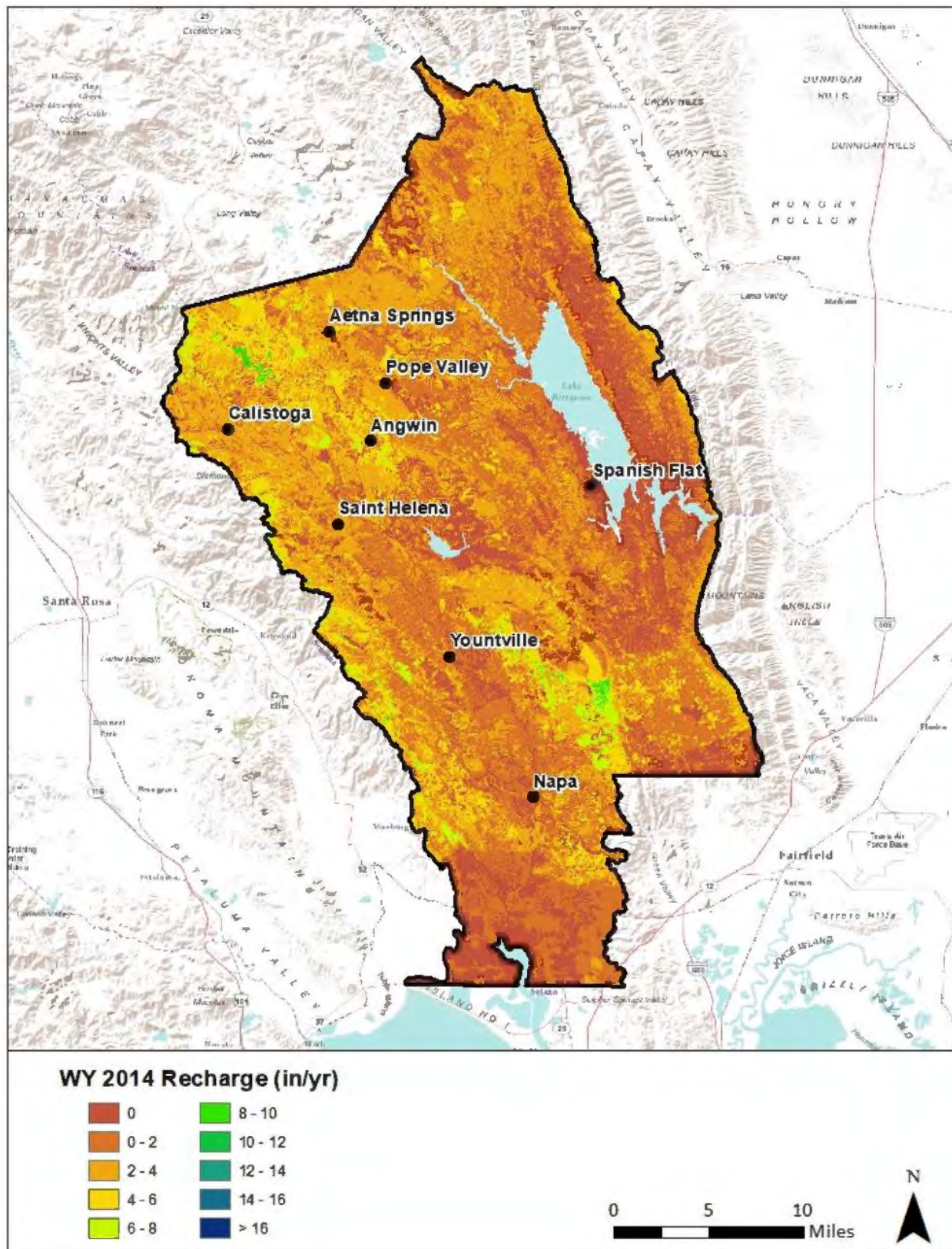


Figure 18: Water Year 2014 recharge simulated with the Napa County SWB model.

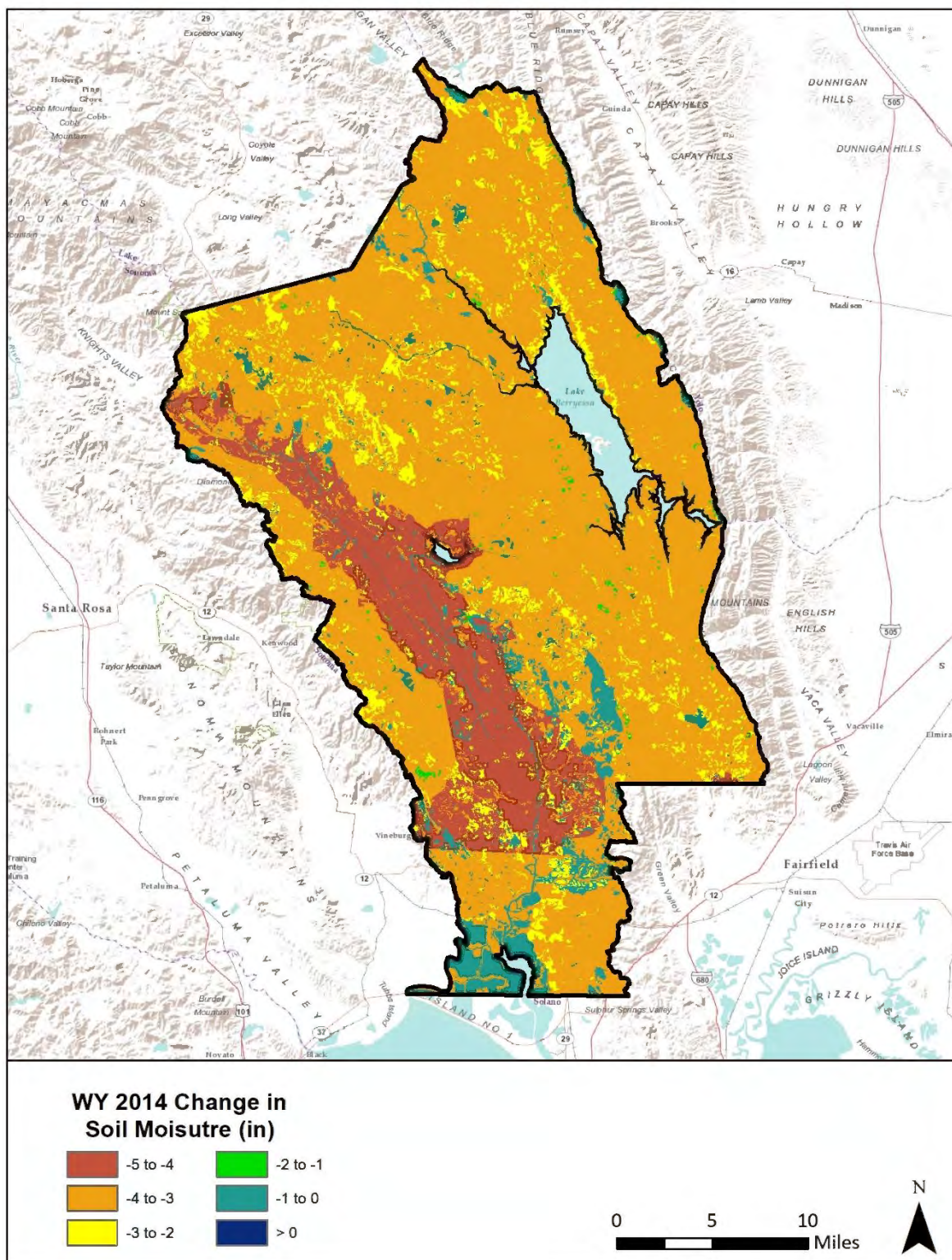


Figure 19: Water Year 2014 change in soil moisture content simulated with the Napa County SWB model.

Table 5: Simulated precipitation and recharge values averaged across HUC-12 watersheds in Napa County for Water Year 2010 expressed as depths. See Figure 20 for watershed locations.

Name	Drainage Area (mi ²)	Precipitation (in)	AET (in)	Surface Runoff (in)	Recharge (in)	Soil Moisture Change (in)
American Canyon Creek	10.8	24.1	16.3	3.7	4.7	-0.6
Bucksnot Creek	1.9	47.9	24.5	12.1	11.1	0.1
Butts Creek-Putah Creek	49.9	33.0	17.4	9.7	6.2	-0.7
Capell Creek	43.0	31.1	19.1	7.4	5.0	-0.6
Carneros Creek	29.7	28.0	18.6	5.2	5.5	-0.6
Chiles Creek	32.0	34.6	21.1	7.1	6.8	-0.5
Dry Creek	28.8	37.0	22.2	7.2	8.4	-0.5
Hunting Creek	12.0	33.7	19.0	9.7	5.7	-0.8
Jackson Creek-Putah Creek	54.5	29.9	13.4	12.6	3.0	-0.5
Lake Curry-Suisun Creek	16.4	30.7	18.9	6.5	5.9	-0.6
Lake Hennessey-Conn Creek	20.0	35.1	19.6	8.5	7.3	-0.4
Ledgewood Creek	6.4	21.8	16.9	3.4	3.3	-1.8
Lower Etcuera Creek	44.0	30.0	17.7	8.1	4.7	-0.7
Lower Napa River	45.0	31.7	19.9	5.6	6.7	-0.6
Lower Pope Creek	31.8	33.9	18.0	9.7	6.5	-0.6
Maxwell Creek	35.1	34.7	19.6	8.7	6.9	-0.6
Middle Napa River	60.3	39.9	22.8	8.5	9.2	-0.5
Milliken Creek	29.7	30.9	16.9	6.6	7.9	-0.6
Rector Creek-Conn Creek	22.3	32.8	18.0	7.1	8.2	-0.7
Saint Helena Creek	7.7	53.3	25.2	13.5	14.4	0.1
San Pablo Bay Estuaries	19.5	23.9	8.1	13.8	2.3	-0.3
Tulucay Creek	34.2	26.1	16.7	4.6	5.4	-0.7
Upper Etcuera Creek	25.6	31.2	17.2	8.6	6.1	-0.8
Upper Napa River	44.6	44.7	23.6	10.6	10.8	-0.4
Upper Pope Creek	21.7	44.5	22.7	10.5	11.5	-0.3
Wooden Valley & Suisun Creeks	23.3	29.0	19.0	5.1	5.5	-0.6
Wragg Canyon-Putah Creek	34.2	28.3	16.3	8.6	3.3	-0.6

Table 6: Simulated precipitation and recharge values averaged across HUC-12 watersheds in Napa County for Water Year 2010 expressed as a percentage of precipitation. See Figure 20 for watershed locations.

Name	Drainage Area (mi ²)	Precipitation (in)	AET (%)	Surface Runoff (%)	Recharge (%)	Soil Moisture Change (%)
American Canyon Creek	10.8	24.1	67%	15%	19%	-3%
Bucksnot Creek	1.9	47.9	51%	25%	23%	0%
Butts Creek-Putah Creek	49.9	33.0	53%	29%	19%	-2%
Capell Creek	43.0	31.2	61%	24%	16%	-2%
Carneros Creek	29.7	29.7	66%	19%	20%	-2%
Chiles Creek	32.0	34.6	61%	21%	20%	-1%
Dry Creek	28.8	37.8	60%	20%	23%	-1%
Hunting Creek	12.0	33.7	56%	29%	17%	-2%
Jackson Creek-Putah Creek	54.5	29.7	45%	42%	10%	-2%
Lake Curry-Suisun Creek	16.4	30.7	61%	21%	19%	-2%
Lake Hennessey-Conn Creek	20.0	36.0	56%	24%	21%	-1%
Ledgewood Creek	6.4	21.8	77%	15%	15%	-8%
Lower Etcuera Creek	44.0	30.0	59%	27%	16%	-2%
Lower Napa River	45.0	31.7	63%	18%	21%	-2%
Lower Pope Creek	31.8	33.9	53%	29%	19%	-2%
Maxwell Creek	35.1	34.7	56%	25%	20%	-2%
Middle Napa River	60.3	40.4	57%	21%	23%	-1%
Milliken Creek	29.7	30.9	55%	21%	26%	-2%
Rector Creek-Conn Creek	22.3	32.8	55%	22%	25%	-2%
Saint Helena Creek	7.7	53.3	47%	25%	27%	0%
San Pablo Bay Estuaries	19.5	23.9	34%	58%	10%	-1%
Tulucay Creek	34.2	26.1	64%	18%	21%	-3%
Upper Etcuera Creek	25.6	31.2	55%	28%	19%	-3%
Upper Napa River	44.6	44.7	53%	24%	24%	-1%
Upper Pope Creek	21.7	44.5	51%	23%	26%	-1%
Wooden Valley & Suisun Creeks	23.3	29.0	65%	18%	19%	-2%
Wragg Canyon-Putah Creek	34.2	28.3	58%	31%	12%	-2%

Table 7: Simulated precipitation and recharge values averaged across HUC-12 watersheds in Napa County for Water Year 2014 expressed as depths. See Figure 20 for watershed locations.

Name	Drainage Area (mi ²)	Precipitation (in)	AET (in)	Surface Runoff (in)	Recharge (in)	Soil Moisture Change (in)
American Canyon Creek	10.8	10.1	12.3	0.7	0.7	-3.6
Bucksnot Creek	1.9	28.8	17.6	11.5	2.6	-3.0
Butts Creek-Putah Creek	49.9	16.9	14.2	3.9	1.9	-3.2
Capell Creek	43.0	15.8	14.8	3.1	1.1	-3.1
Carneros Creek	29.7	15.0	14.7	4.6	2.0	-3.7
Chiles Creek	32.0	18.3	16.5	3.7	1.5	-3.3
Dry Creek	28.8	21.5	16.5	6.8	2.5	-3.7
Hunting Creek	12.0	16.7	15.4	3.1	1.6	-3.4
Jackson Creek-Putah Creek	54.5	14.9	10.3	6.1	0.7	-2.3
Lake Curry-Suisun Creek	16.4	18.4	16.1	3.7	1.9	-3.4
Lake Hennessey-Conn Creek	20.0	19.1	14.8	5.7	2.2	-3.2
Ledgewood Creek	6.4	12.2	13.9	1.7	0.8	-4.3
Lower Elicuera Creek	44.0	14.9	14.0	2.6	1.3	-3.1
Lower Napa River	45.0	19.4	15.9	5.0	2.2	-3.6
Lower Pope Creek	31.8	17.8	14.5	4.5	2.0	-3.2
Maxwell Creek	35.1	18.3	15.9	3.8	2.0	-3.3
Middle Napa River	60.3	21.3	16.5	6.6	2.5	-3.7
Milliken Creek	29.7	18.7	13.7	4.5	3.4	-2.9
Rector Creek-Conn Creek	22.3	16.5	13.6	4.0	2.3	-3.4
Saint Helena Creek	7.7	32.2	17.8	13.2	4.1	-3.0
San Pablo Bay Estuaries	19.5	10.4	6.0	5.6	0.5	-1.6
Tuluca Creek	34.2	14.6	13.5	2.6	1.7	-3.3
Upper Elicuera Creek	25.6	15.5	14.1	2.5	2.1	-3.2
Upper Napa River	44.6	22.9	16.2	6.9	3.3	-3.5
Upper Pope Creek	21.7	25.6	16.8	8.5	3.5	-3.2
Wooden Valley & Suisun Creeks	23.3	17.9	16.4	3.1	2.0	-3.5
Wragg Canyon-Putah Creek	34.2	14.1	12.6	3.6	0.6	-2.8

Table 8: Simulated precipitation and recharge values averaged across HUC-12 watersheds in Napa County for Water Year 2014 expressed as a percentage of precipitation. See Figure 20 for watershed locations.

Name	Drainage Area (mi ²)	Precipitation (in)	AET (%)	Surface Runoff (%)	Recharge (%)	Soil Moisture Change (%)
American Canyon Creek	10.8	10.1	121%	7%	7%	-36%
Bucksnot Creek	1.9	28.8	61%	40%	9%	-10%
Butts Creek-Putah Creek	49.9	16.8	84%	23%	11%	-19%
Capell Creek	43.0	15.8	94%	20%	7%	-20%
Carneros Creek	29.7	17.6	98%	30%	13%	-25%
Chiles Creek	32.0	18.4	90%	20%	8%	-18%
Dry Creek	28.8	22.1	77%	32%	12%	-17%
Hunting Creek	12.0	16.7	92%	18%	10%	-20%
Jackson Creek-Putah Creek	54.5	14.7	69%	41%	5%	-16%
Lake Curry-Suisun Creek	16.4	18.4	88%	20%	10%	-19%
Lake Hennessey-Conn Creek	20.0	19.6	78%	30%	12%	-17%
Ledgewood Creek	6.4	12.2	114%	14%	7%	-35%
Lower Eiticuera Creek	44.0	14.9	94%	18%	9%	-21%
Lower Napa River	45.0	19.4	82%	26%	11%	-19%
Lower Pope Creek	31.8	17.8	81%	25%	11%	-18%
Maxwell Creek	35.1	18.3	87%	21%	11%	-18%
Middle Napa River	60.3	21.8	77%	31%	12%	-18%
Milliken Creek	29.7	18.7	74%	24%	18%	-16%
Rector Creek-Conn Creek	22.3	16.5	83%	24%	14%	-21%
Saint Helena Creek	7.7	32.2	55%	41%	13%	-9%
San Pablo Bay Estuaries	19.5	10.4	58%	53%	4%	-16%
Tulucay Creek	34.2	14.6	93%	18%	12%	-23%
Upper Eiticuera Creek	25.6	15.5	91%	16%	14%	-21%
Upper Napa River	44.6	22.9	71%	30%	14%	-15%
Upper Pope Creek	21.7	25.6	66%	33%	14%	-12%
Wooden Valley & Suisun Creeks	23.3	17.9	91%	17%	11%	-20%
Wragg Canyon-Putah Creek	34.2	14.1	90%	26%	5%	-20%

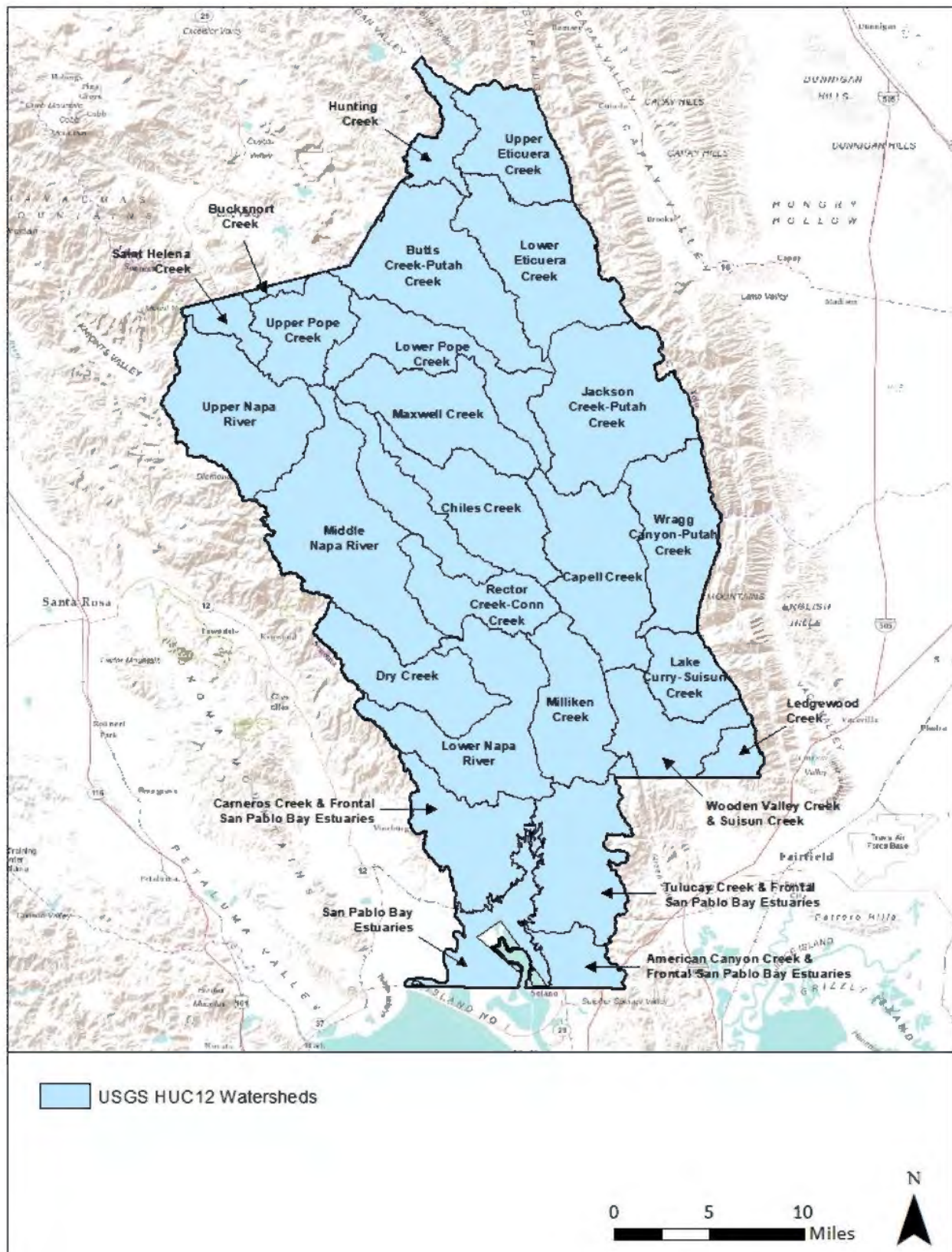


Figure 20: Major watersheds areas used to summarize water budget information in Tables 5 - 8.

Discussion and Conclusion

Numerous previous modeling studies have estimated water budget components in several larger watershed areas in Sonoma and Napa Counties including the Santa Rosa Plain, the Green Valley and Dutch Bill Creek watersheds, and the Sonoma Valley (Farrar et. al., 2006; Kobor and O'Connor, 2016; Woolfenden and Hevesi, 2014). Comparisons to these water budgets are useful for evaluating the SWB results, but one would not expect precise agreement owing to significant variations in climate, land cover, soil types, underlying hydrogeologic conditions, and different spatial scales of modeling studies. These regional analyses estimate that average annual recharge varies from 7% to 19% of the annual precipitation. The equivalent county-wide value from this study is slightly higher at 20%.

Water budgets for the Napa River and selected sub-basins were also estimated in a previous study by Luhdorff and Scalmanini Engineers and MBK Engineers (LSCE 2013). The LSCE study estimated that, as a percentage of annual precipitation, AET comprised slightly less, runoff significantly more, and recharge substantially less of the typical annual water budget. LSCE (2013) calculated infiltration of precipitation based on the difference between total monthly streamflow at selected gaging stations and total monthly precipitation for the gages' drainage area. Streamflow volumes include both direct runoff (overland flow and interflow) and baseflow from groundwater. Inclusion of baseflow with direct runoff in these calculations may inappropriately reduce the estimated volume of water infiltrated into the soil and available for recharge; the LSCE approach therefore tends to underestimate groundwater recharge. Additionally, many of the gauging stations used for the analysis are located in reaches that may be significantly influenced by upstream reservoir releases, surface water diversions, groundwater abstraction, and/or surface water groundwater exchanges, further complicating the interpretation of the LSCE (2013) runoff rates and the interrelated calculations of AET and recharge rates. In contrast, the SWB model presented here is based on calibrated parameter values developed for a similar model in Sonoma County which was calibrated to gauges specifically selected to minimize the effects of reservoir releases, water use, or significant surface water/groundwater interaction, and after separating and removing the baseflow component of streamflow.

The recharge estimates presented here arguably represent the best available county-wide estimates produced at a fine spatial resolution using a consistent and objective data-driven approach. This analysis focused on two Water Years, 2010 and 2014, which represent average and drought conditions respectively. Input parameters were determined based on literature values and values calibrated through prior modeling experience in Sonoma County.

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APPENDIX D

SUMMARY OF SEARCH OF NAPA PBES FILES-

SPRINGS WITHIN 1,500 FEET OF WELL 2

DANIEL BYRNE, TRUNORTH

