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Water Availability Analysis
Pickett Road Wine Company Major Modification
P19-00172-MOD

Water Availability Analysis

Kelly Fleming Wines
2339 Pickett Road
Calistoga, CA 94515
APN 018-050-067
P05-0441-UP & P19-00172-MOD

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Kelly Fleming

Prepared by:

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NAPA PBES REVIEW DRAFT

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Contents

Introduction

Kelly Fleming Winery located at 2339 Pickett Road (APN 018-050-067) is proposing a modification to existing Use Permit P05-0441-UP. The project parcel is part of a block of four parcels owned by Kelly Fleming located within the Simmons Canyon Creek watershed approximately one and one-half miles east of Calistoga (Figure 1) within the County of Napa's Hillside Groundwater Zone. Four groundwater wells serve the project parcel and adjacent parcels (Figure 2). Well 4 is the main well serving nearly all the winery water demand while the remaining wells (Wells 1, 2 and 3) provide water for the remaining demands on the project parcels. The existing use permit issued by Napa County allows 12,000 gallons of wine production (including crushing, fermenting, aging, and bottling) three full-time and two part-time employees, 1,040 tasting visitors and 1,392 catered event guests. The proposed use modification would increase the employee count to six full-time and four part-time employees and increase daily tasting visitors to 8,184 annually while reducing catered event visitors to 1,115 annually. All increases in groundwater use associated with the proposed permit modification will be supplied by Well 4.

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 uses 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), and an of the potential for well interference at neighboring wells located within 500 ft of project wells or springs within 1500 ft (Tier 2).

This revision, completed on March 19, 2021, includes updates to visitation numbers, updates to well numbering to be consistent with the project site plan and a supplementary discussion of water use associated with non-project wells located on the project parcels (Wells 2, 3 and 5 in this revision of the report).

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. Existing and proposed future water use on and near the project site is estimated based on information received from the applicant and on regionally appropriate water duties for the observed and expected uses. The recharge estimates presented below are based on established soil water balance modeling techniques for calculating infiltration recharge and they do not explicitly simulate surface water/groundwater interaction in perennial streams or bedrock geology in controlling percolation of infiltrating water to aquifers.

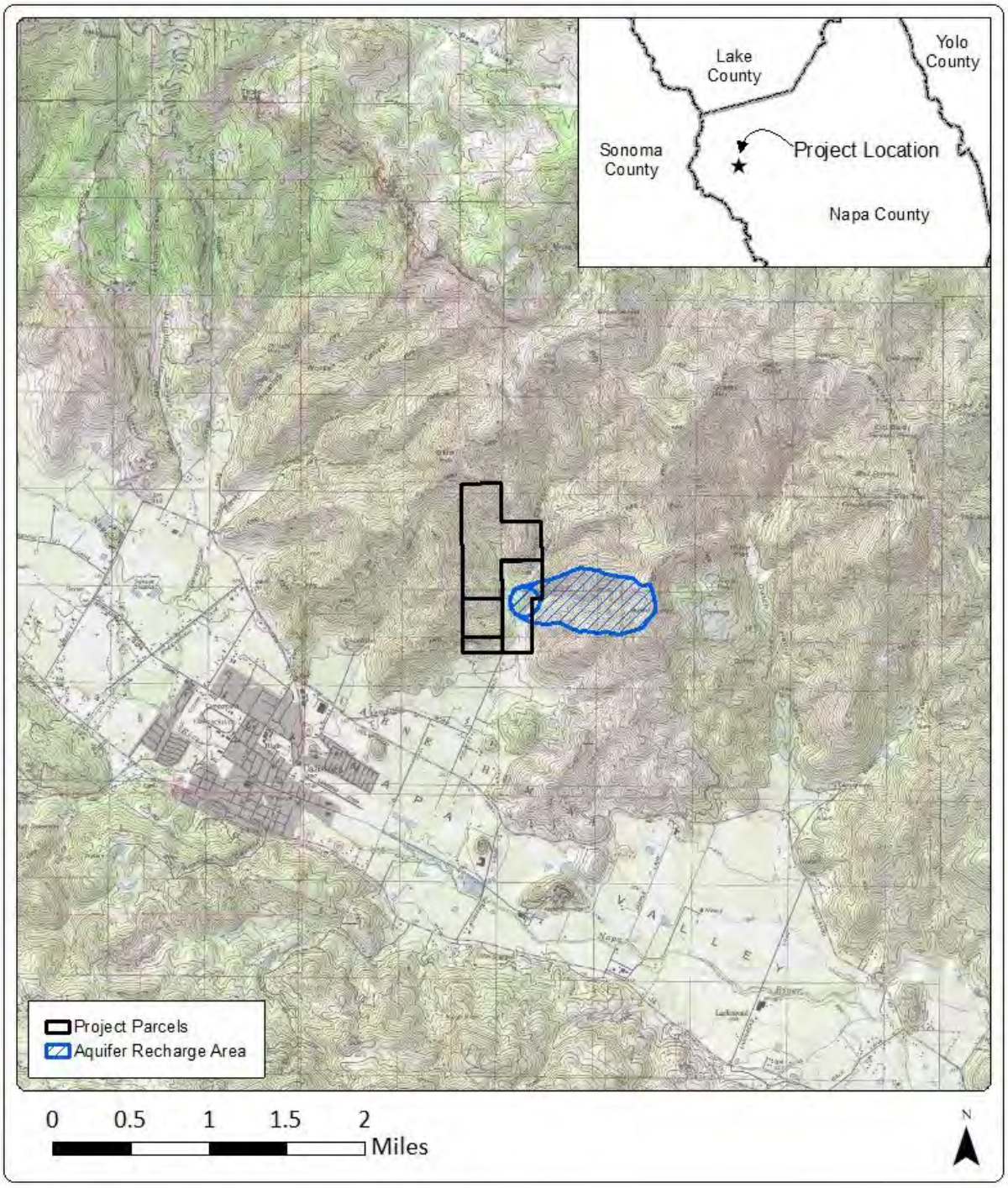


Figure 1: Project location map.

Hydrogeologic Conditions

The project parcel is located along the eastern edge of the northern Napa Valley and, aside from quaternary alluvial fan deposits (unit Qhf) in the valley bottom of Simmons Canyon Creek, is underlain by a sequence of the Sonoma Volcanics associated with the Mount St. Helena Caldera. Geologic maps prepared by the California Geologic Survey (CGS) for the Calistoga 7.5' Quadrangle (Delattre and Gutierrez, 2013) identify the project parcel as being underlain by a large unit of rhyolite flows known as the Pliocene-aged Rhyolite of Calistoga (map unit Tsrc, Figure 2). All four active wells (Wells 1-4) on the project parcels are mapped within this unit. The Rhyolite of Calistoga is described by the CGS as "rhyolitic to rhyodacitic domes and flows… composed of highly variable assemblages of massive or flow banded rhyolite, intercalated crystal and lithic tuff, lithoidal welded tuff, and agglomerate". Hydrothermal alteration is believed to be widespread, increasing clay content throughout and leading to localized mineralization along faults. Regionally the Rhyolite of Calistoga is believed to be underlain by the Tuff of Petrified Forest (Fox et al., 1985) but may locally be underlain by the Andesite of Jericho Canyon (Delattre and Gutierrez, 2013).

The northern portion of the project parcel block (outside of the project recharge and project impact area as shown in Figure 2) includes other units of the Sonoma Volcanics. Mafic plugs and dikes (Tsal) are mapped at the top of a ridge on the northern parcel boundary overlying agglomerate (Tsag) which in turn overlies the Tsrc unit. No wells were located within these two more northerly units in Simmons Canyon.

The Sonoma Volcanics (which includes the Rhyolite of Calistoga) is considered a low-yielding aquifer with reported well yields typically ranging between 16 and 50 gpm. However, yields over 100 gpm have been reported (LSCE and MBK, 2013). Some units, such as unwelded tuff and volcanic sediments, are somewhat more productive but overall are still considered low yielding. Bedrock units such as the andesite and rhyolite lava flows have very low primary porosity and groundwater occurs primarily in fractures, resulting in highly variable well production. Where these fracture networks are extensive, aquifers can have relatively high transmissivities (Nishikawa, 2013).

Two quaternary-aged landslides (Qls) are also mapped on or near parcels in the ownership but are not affected by the project and were not investigated.

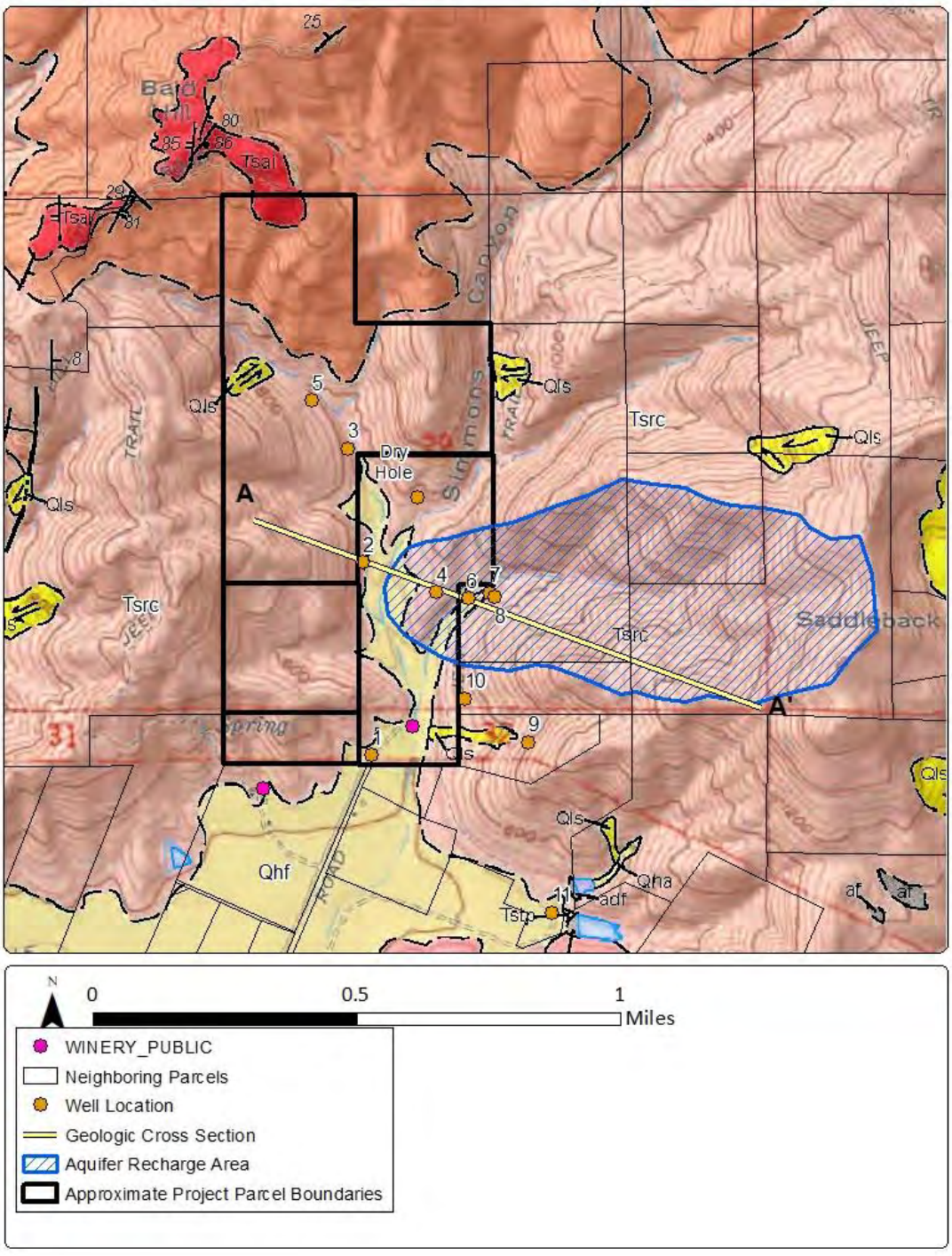


Figure 2: Surficial geology and locations of wells in the vicinity of the project parcel. Surficial geology based on data from the California Geologic Survey Map Preliminary Geologic Map of the Calistoga 7.5' Quadrangle, Napa and Sonoma Counties, California: A Digital Database (Delattre and Guitierrez, 2013); relevant geologic legend on following page.

Qhf **Alluvial fan deposits (Holocene)** – Sediment emanating from canyons to produce relatively undissected, fan-shaped deposits on alluvial valley floors. Sediments are typically moderately to poorly sorted and composed of sand, gravel, silt, and occasionally clay.

Qls **Landslide deposits (historical to Pleistocene)** – Arrows indicate direction of movement; queried where landslide existence is questionable.

Tsag **Agglomerate** – Interlayered agglomerate, laharic tuff breccia, and welded or partially welded tuff. Includes a coarse breccia with abundant blocks of porphyritic vitrophyrenear the base of the unit where exposed along Oat Hill Road. The unit is relatively resistant and lightly vegetated, forming craggy outcrops including the prominent cliffs of the Palisades.

Tsai **Mafic plugs and dikes** – Fine-grained basaltic andesite and andesite intrusions. Mapped at several locations on the south side of the Napa Valley where they appear to represent the source vents for flows that cap the volcanic section in the area. On the north side of the Napa Valley, includes areas of agglomerate and rhyolite intruded by abundant small plugs and dikes not separately mapped.

Tsrc **Rhyolite of Calistoga** – Rhyolitic to rhyodacitic domes and flows found on both sides of the upper Napa Valley and forming domical hills protruding from the valley alluvium in and around Calistoga. Composed of highly variable assemblages of massive or flow banded rhyolite; intercalated crystal and lithic tuff, and lithoidal welded tuff grading to vitrophyre, locally perlitic; and agglomerate with glassy bombs. The unit has experienced widespread hydrothermal alteration to kaolinite and other clay minerals with finely disseminated pyrite, and more pronounced mineralization locally and along faults. Fission-track dating of zircons from this unit yielded ages of 2.6 Ma from near the east end of Franz Valley, and 3.7 Ma from lower Kortum Canyon Rd., although the latter age appears marginally too old based on contact relations with other dated units (Fox et. Al, 1985). More recent radiometric dating of this unit from near Glass Mountain to the east and Pepperwood Ranch to the west yielded ages of 2.78 Ma and 3.19 Ma, respectively (McLaughlin and others, 2005).

SYMBOL EXPLANATION

Contact between map units - Solid where accurately located, dashed where approximately located; short dash where inferred; dotted where concealed; queried where uncertain.

Fault - Solid where accurately located, dashed where approximately located; short dash where inferred; dotted where concealed, queried where uncertain. Ball and bar on downthrown block. Arrow and number indicate direction and angle of dip of fault plane.

Thrust Fault - Solid where accurately located; dashed where approximately located; dotted where concealed; queried where uncertain. Barbs located on upper plate.

25 Strike and dip of inclined beds.

25 Strike and dip of volcanic flow.

Well Data

Well Completion Reports for wells on and near the project parcel were obtained from the project applicant along with the California Department of Water Resources' Well Completion Report Map Application. The subset of the logs which could be accurately georeferenced based on specific information provided by the applicant, parcel numbers and location sketch information are discussed below (Figure 2); these logs are compiled in Appendix A. Of the eleven well logs identified, five wells are located on the project parcels. Well 4 ("Winery Well") is the main project well providing all water used for winery needs including process water and guest use. The well completion report for Well 4 indicates that this well has a 52 ft cement sanitary seal. Wells 2,3 and 5 supply water to the winery landscaping and small fountain at the wineryalong with additional uses across the project parcels including the main residence and all vineyard, orchard and garden irrigation. Well 1 is unproductive and is not in use. Additionally, a dry hole was identified approximately 960 ft north of Well 4 in a previous geologic assessment of the project parcels (Slade and Associates, 2005).

Well 4 is the main project well and is located on the winery parcel (APN 018-050-067) within an existing vineyard block. This well is registered as a public water supply (Napa Co. #10662, CA #2800113) and supplies all winery process water and provides water used by the public during tasting and catered events. In April of 2005 Well 4 was completed to a depth of 599 feet and had an estimated yield of 25 gpm after 2 hours airlift testing. Depth to first water is reported to be 250 feet and post development the depth to static water was 183 feet on April 26, 2005. Throughout the log of geologic materials, the driller reported a sequence of unspecified volcanics with varying color including white, light tan, tan, gray, dark gray, green, and dark gray green. This description is consistent with typical colors of volcanic rocks found within the Sonoma Volcanics and likely represent various layers of tuffs and rhyolitic flows associated with the Tsrc unit. Well 4 is screened from 179 to 399 feet and from 419 to 579 feet below ground surface indicating that the main project aquifer is comprised of Sonoma Volcanics.

On February 3, 2015 Rays Well Testing Services Inc. performed an 8 hour pump test (Appendix B); the initial depth to static water at that time was 343.7 feet (Table2). This potentially represents a drop in water level in the well over the 10 years since development; however, it is unknown if pumping prior to the 8 hour test impacted the initial static water level. Moreover, 2015 was the third consecutive drought year and a drop in groundwater elevation might be expected. After an initial period of pumping at 12 gallons per minute (gpm), the pumping rate was adjusted down to 2.6 gpm and a stable water surface elevation was maintained for 5.5 hours (Table 2). The water level recovered 99% of the total drawdown of 223.3 ft within 7.5 hours after the cessation of pumping.

Well 2, also known as the Garden well is located about 700 ft west of Well 4 on the winery parcel (Figure 2). The Garden Well was drilled in 1993 and completed to a depth of 320 ft with a reported yield estimate of 7 gpm after 4 hours of airlift testing. Static water level after development is reported to be 45 feet. After 18 feet of "soil and creek cobbles" consistent with

the mapped Qhf unit, the driller reported encountering "[rhyolite], very hard" for the remaining 302 feet. A 7 hour pump test performed by Rays Well Testing Services Inc. in February 2015 reported an initial water level of 152 feet indicating a drop in static water level since initial development; this drop in water elevation is at least partially attributable to drought conditions 2013-2015. After two hours of pumping a stable water surface elevation was reached; however, the pumping rate was being reduced until the conclusion of the test. For the final hour of pumping the pumping rate was 0.81 gpm (Table 2).

Well 3, known as the Road Well, is located northwest of Wells 4 and 2 on an adjacent parcel (APN 018-050-042) owned by the project applicant (Figure 2). Well 3 was drilled to a depth of 260 feet and cased to a depth of 120 feet in September 1993. Materials encountered include green, gray, blue and white rhyolite and tuff consistent with other wells drilled in the Tsrc unit. Static water after development was reported to be 35 feet and after a four hour air lift test the driller estimated a yield of 18 gpm. In February 2015 Rays Well Testing Services Inc. performed a 5 hour pump test, an initial depth static water level of 8 feet, potentially indicating an increase in the local groundwater surface since development in 1993. After 45 minutes of pumping a stable water surface elevation and pumping rate of 20 gpm were maintained for the remainder of the test (Table 2).

Well 5 is also called the Big Tanks well and is located further up the hill northwest of Well 2 on the same parcel adjacent to the winery parcel (Figure 2). The Big Tanks well was drilled to a depth of 530 feet and cased to a depth of 220 feet in 1999. The driller reports "brown clay, gray rock" for the first 25 feet followed by "gray ash with white ash" for the remaining 505 feet in the geologic log. The first water was encountered at a depth of 40 feet and after development of the well the static water level remained at 40 ft. A four-hour airlift yield test conducted at the time of development (September 1999) produced an estimated yield of 25 gpm. In February 2015 Rays Well Testing Services Inc. performed a 5 hour pump test; at that time the initial depth static water level was 26.5 feet and representing a potential increase in the local groundwater surface since development in 1999. Water elevation in this well appears unaffected by the drought of 2013-2015. After a stable water surface elevation was maintained for last 2.5 hours of the test, while pumping at a rate of 12.6 gpm (Table 2).

Well yield estimates reported on most WCR's are based on relatively short (2-4 hours) airlift tests associated with well development and are typically overestimates of the actual production of the well. To properly estimate well yield a constant rate pumping test should be performed over a longer period (typically 8 hours or more) and achieve a stabilized pumping water surface elevation. Wells 2, 3 and 5 on the project parcels were all subjected to 7- to 8-hour constant rate pumping tests in February 2005 and each achieved a stabilized water surface elevation. Yields reported for Wells 2, 4 and 5 are less than yields reported at time of development while Well 3 was reported to have a slightly higher yield than what was estimated initially in 1993 (Tables 1 and 2).

Water surface elevations (wsel) were also measured at the time of the four 2015 pumping tests of the project parcel wells. Compared to levels reported at the time of development, Wells 2 and 4 show a decline in static water surface elevation while Wells 3 and 5 show increases. These changes could represent a change in the water table over the years since development and/or be attributed to the time of year when the observations were made and/or the effects of the severe drought years 2013-2015. The initial wsel measurements were made in the driest month of the year (September) at Wells 2, 3 and 5 when depth to water is typically greatest whereas the observations from 2015 were in February when depth to water is typically near an annual minimum. Hence, some of the decline in wsel in Well 2 observed in 2015 could be attributed to normal seasonal variation whereas at Well 4, both the initial and 2015 wsel observations were taken in the same season, so the change in Well 4 is not likely due to normal seasonal variation. The static wsel in Wells 2 & 4 declined significantly (107 ft and 161 ft, respectively) it appears these changes are more likely in response to drought effects of reduced recharge in relation to groundwater withdrawals. Increases in static water levels in Wells 3 and 5 may be a result of original dry month measurements versus more recent wet month (February) measurements however this trend is very different from Wells 2 and 4 located to southeast (Figure 2). This suggests that Wells 3 and 5, are intersecting a portion of the regional aquifer connected to a more productive fracture system located to the north.

Well completion reports could be accurately georeferenced for six other nearby wells (Figure 2). One dry hole was also located on the neighboring parcel east of the project well where Wells 6, 7, and 8 are located. Nearby wells report volcanic rocks of similar color and specifically report encountering ash and rhyolitic rocks. Characteristics of these wells vary, with depths ranging from 180 to 500 feet and estimated yields ranging from 0.5 to 20 gpm. Although highly variable, these are consistent with properties of wells completed elsewhere in the Sonoma Volcanics.

Along with variable well yields reported at the time of development, declines in production have been reported for wells in the area. Well 1, located on the winery parcel (Figure 2) had a reported yield of 4 gpm at the time of development in 1993 but has since been put out of use due to insufficient yield. Also, it has been reported that neighboring wells located in the vicinity of the project well have declined in production since their initial development. Although initial yield estimates for Wells 6, 7 and 8 (located just east of the project well)(Figure 2, Table 1, Appendix A) appear to be sufficient for normal residential and agricultural use, neighbors on this parcel recently reported to the project applicant (Kelly Flemming) that they have supplementary water delivered to meet demands, suggesting that well yields are insufficient.

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

Well ID	1	2	3	4	5	6
CA WCR ID	462607	462606	462608	e023056	814587	324028
Year Completed	1993	1993	1993	2005	1999	1998
Depth (ft)	240	320	120	599	220	250
Static Water Level at time of completion (ft)	15	45	35	183	40	60
Estimated Yield at time of completion (gpm)	4	7	18	25	25	20
Top of Screen (ft)	60	60	40	179	75	130
Bottom of Screen (ft)	140	320	120	399	220	250
Geologic Map Unit	Tsrc	Qa	Tsrc	Tsrc	Tsrc	Qhf

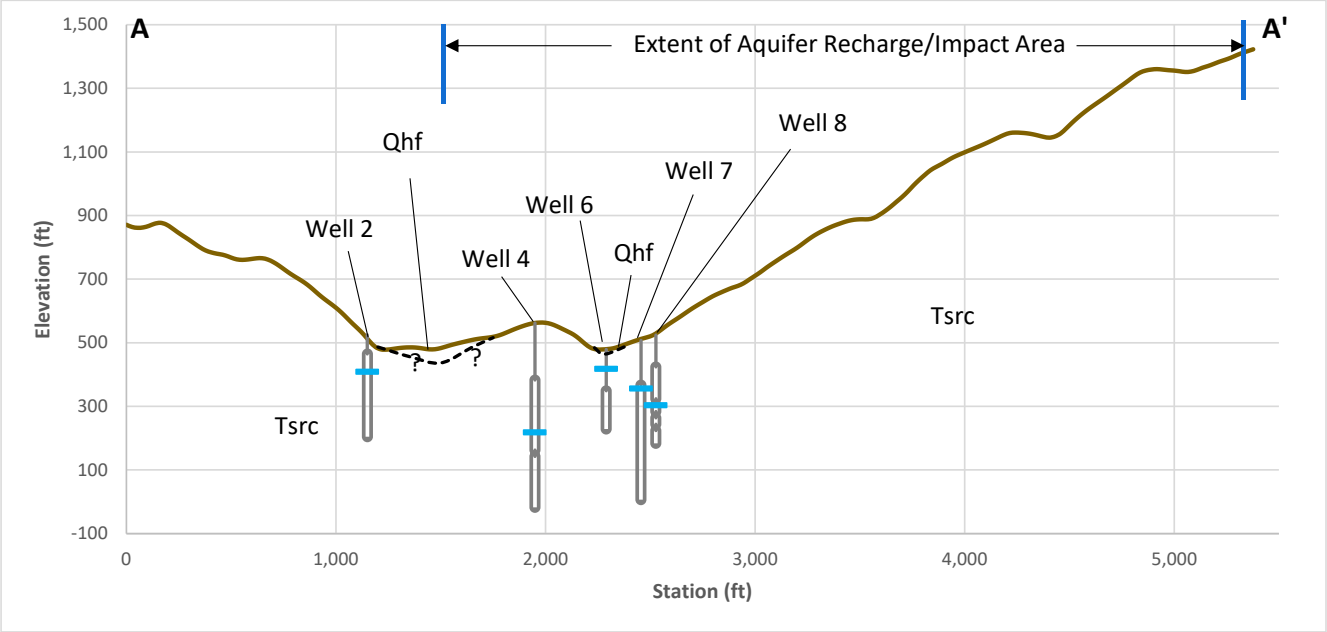
Well ID	7	8	9	10	11
CA WCR ID	939889	939890	95190	324030	e067538
Year Completed	2013	2008	1983	1998	2008
Depth (ft)	500	340	180	450	218
Static Water Level at time of completion (ft)	150	200	60	80	119
Estimated Yield at time of completion (gpm)	15	5	20	0.5	4
Top of Screen (ft)	140	100	60	65	98
Bottom of Screen (ft)	500	340	160	445	198
Geologic Map Unit	Tsrc	Tsrc	Tsrc	Tsrc	Qhf

Table 2. Summary of 2015 pump test details for wells on project parcels.

Well ID	2	3	4	5
CA WCR ID	462606	462608	e023056	814587
Date of Test	2/3/2015	2/2/2015	2/3/2015	2/2/2015
Static Water Level at time of completion (ft)	320	120	599	220
Estimated Yield at time of completion (gpm)	152	8.2	343.7	26.5

Geologic Cross Section

A geologic cross-section oriented west-northwest to east-southeast is shown in Figure 3 (see Figure 2 for location). Elevations along this cross-section range from close to 500 ft where the section crosses the main stem and tributary channels of Simmons Canyon Creek to over 1,400 feet at the east end. Static water elevations shown are from various years, Wells 2 and 4 were most recently recorded in 2015 during pump tests (Table 2). Well 7 was measured at the time of development in 2013 while Well 8 was observed in 2008 and Well 6 was developed in 1998. As mentioned previously, water levels in Wells 2 and 4 have declined since their development and these data reflect the impact of the drought years 2013-2015. Water levels shown for Wells 6, 7 and 8 are from observations at the time of their development and these levels may have declined as their production has reportedly declined.



Geologic contact (queried where uncertain)

Well

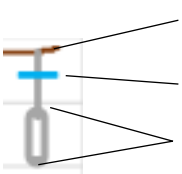


Figure 3: Hydrogeologic cross section A -A' through the project parcel and extending to upper edge of aquifer recharge/impact area (see Figure 2 for location and geologic map units). Note water surface elevations shown reflect most recent observations, Wells 2 and 4 were most recently recorded in 2015 during pump tests. Well 7 was measured at the time of development in 2013 while Well 8 was observed in 2008 and Well 6 was recorded in 1998 .

Project Recharge Area

The project aquifer is located within a significant portion of a large block of the Rhyolite of Calistoga underlying the project parcels and the hills encompassing the Simmons Canyon Creek watershed surrounding and to the east of Well 4. As mentioned earlier, groundwater is stored and transmitted throughout the rocks of the Sonoma Volcanics aquifer almost exclusively via fractures. Although the project aquifer intersected by Well 4 is understood to be connected in varying degrees across the larger extent of the Tsrc block owing to the highly variable nature of fracturing within the aquifer, we conceptualize a project recharge/ impact area as a smaller portion of the larger aquifer. Scaling the impact area down from the full extent of the regional aquifer allows us to conservatively assess the impacts of the proposed change in water use at a project scale. The northern, southern and eastern boundaries of this recharge/impact area are largely defined by the drainage divides of an eastern tributary to Simmons Creek (Figure 2) while the western edge of the area is defined by the main channel of Simmons Creek. It is acknowledged that aquifer recharge affecting the project well may occur over a larger area, and that the use of the surface drainage boundary is an approximation.

Wells 2, 3, and 5 provide water for landscaping of the winery, demands associated with the main residence and all vineyard, orchard and garden irrigation. Although these wells are completed within the same block of the Rhyolite of Calistoga as Well 4 they have not been included in the project impact/recharge area and are not considered in the subsequent water balance calculations. As noted above Wells 3 and 5 appear to be located in a distinct portion of the Tsrc block as they have shown increases in static water elevations since development in contrast to Wells 2 and 4. This portion of the Tsrc is located at somewhat higher elevation at the foot of Mt. St Helena where it is may be connected to a larger network of fractures with a greater area for recharge. Although Well 2 is located relatively close to the project well (Well 4) and has displayed a similar decline in water surface elevation over time and is likely cased within aquifer materials that may be connected hydrogeologically, the horizontal distance (900 ft) and intervening creek between the two wells make it unlikely that the two wells would significantly interact or share a significant recharge area.

Water Demand

Within the project recharge/impact area, water demand was estimated for both the existing and proposed conditions. Uses on the project parcel were determined using site details provided in the Applied Civil Engineering (ACE) Onsite Wastewater Disposal Feasibility Study dated September 2019 and Statement of Request prepared by Albion Surveys Inc. in January 2020. Uses on other neighboring parcels within the project recharge area were determined using satellite imagery and publicly available parcel information. All water use rates were estimated using data from the County of Napa's Water Availability Analysis Guidance Document dated May 12, 2015.

Existing Use

Under existing conditions ACE reports that Kelly Fleming Winery produces 12,000 gallons of wine (including crushing, fermenting, aging, and bottling), maintains three full-time and two part-time employees, and serves 3,128 tasting visitors and 490 catered event guests. Table 3 summarizes all water usage associated with the winery applying use rates listed in the County of Napa's WAA Guidance. Although the winery landscaping is not irrigated using water from the project well Well 4, Napa County guidance includes an estimate that lumps landscaping and general domestic use so for the purpose of our estimates we are assuming existing landscaping is included.

Neighboring parcels within the project recharge area contain one oversized residence, one swimming pool and 0.25 acres of vineyard (Table 4). In total, estimated existing groundwater water use within the project recharge area is estimated to be 1.65 acre-ft/yr (Table 5). Of this, 0.42 acre-ft/yr is used on the project parcel.

As noted earlier, additional uses on the project parcels include landscaping of the winery, one main residence with a pool and approximately 12 acres of vineyard, 0.5 acres of olive trees and about 0.1 acres of garden irrigation. Based on the applicant's records, for the one-year period between May 2019 and May 2020 6.13 acre-ft was used for these additional uses. Compared to an estimate using County Guidance rates, which would roughly total to 9.32 acre-ft annual use, this is slightly lower but well within a normal range of use. These uses are supplied by Wells 2, 3 and 5 which are located outside of the project recharge area and therefore are not included in the use calculations associated with the Winery project well (Well 4).

Proposed Use

The proposed use modification would increase the employee count to six full-time and four part-time employees. Daily tasting visitors would increase by 3,129to 6,257 annually and the number of event visitors would increase by 625 to 1,115 annually. No changes in winery landscape irrigation (supplied by Wells 1-3) is proposed and wine production would remain the same at 12,000 gallons annually (Figure 4). Wastewater estimates (assumed to be equivalent to water demand) provided in ACE's Onsite Wastewater Disposal Feasibility Study state that events with up to 24 people will have on-site catering with a water usage of 15 gallons /guest. The remainder of proposed winery events will serve food prepared off-site and include portable toilets which reduces estimated water use to 5 gallons/guest. Per Napa County guidance daily tasting visitors are estimated to use 3 gallons/guest while employee use is set at 15 gallons/shift. Considering these use updates, the project is estimated to increase groundwater use on the parcel by approximately 22,800 gallons or 0.07 acre-ft/yr (Table 6). Total water use within the project recharge area is estimated to increase to 1.72 acre-ft/yr (Table 5).

Table 3: Estimated groundwater uses on the project parcel in the existing condition.

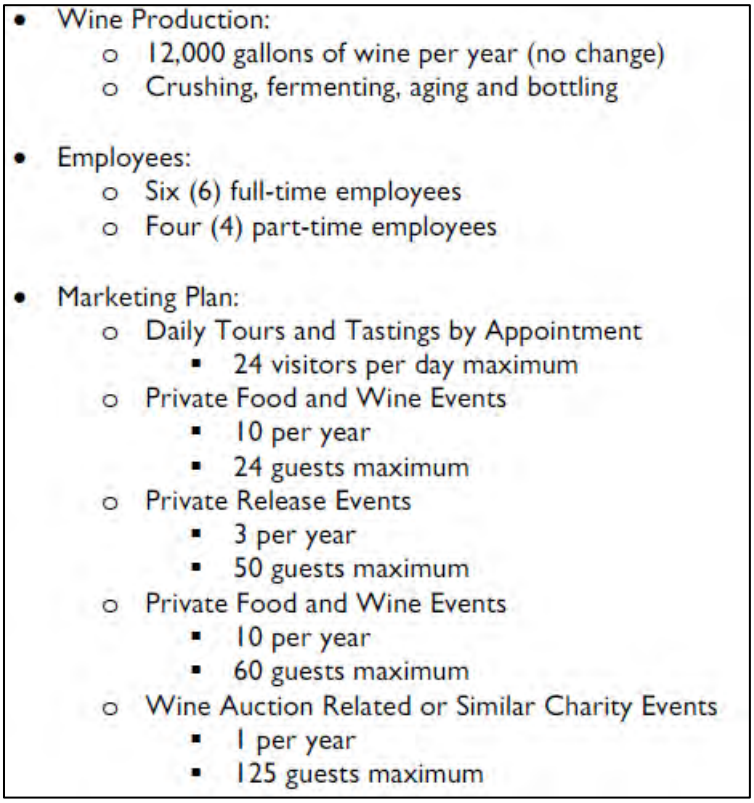
	# of Units	Use per Unit	Annual Water Use (AF/yr)
Winery Use			**0.32**
Process Water	12000 Gallons	2.15 AF/100,000 gal.	0.26
Domestic & Landscaping	12000 Gallons	0.50 AF/100,000 gal.	0.06
Guest & Employee Use			**0.10**
Tasting Room Visitations	3128 Guests	3 gal./Guest	0.03
Events w/ On-Site Catering	490 Guests	15 gal./Guest	0.02
Full-Time Employees	3 Employees	15 gal./shift @ 250 shifts/yr	0.03
Part-Time Employees	2 Employees	15 gal./shift @ 125 shifts/yr	0.01
Total			**0.42**

Table 4: Estimated groundwater uses on neighboring parcels within the project recharge area in the existing and proposed conditions

	# of Units	Use per Unit	Annual Water Use (AF/yr)
Residential Use			**1.10**
Residences, Oversized	1 Residence	1.00 AF/Residence	1.00
Pools	1 Pool	0.10 AF/Pool	0.10
Agricultural Use			**0.13**
Vineyard	0.25 Acres	0.50 AF/acre/yr	0.13
Total			**1.23**

Table 5: Estimated groundwater use within the project recharge area in the existing and proposed conditions.

	Existing Condition (acre-ft/yr)	Proposed Condition (acre-ft/yr)
Project Parcel	**0.42**	**0.49**
Winery Use	0.32	0.32
Employee/Guest Use	0.10	0.17
Neighboring Parcels	**1.23**	**1.23**
Residential Use	1.10	1.10
Irrigation Use	0.13	0.13
Total	**1.65**	**1.72**



- Wine Production:
  - 12,000 gallons of wine per year (no change)
  - Crushing, fermenting, aging and bottling
- Employees:
  - Six (6) full-time employees
  - Four (4) part-time employees
- Marketing Plan:
  - Daily Tours and Tastings by Appointment
    - 24 visitors per day maximum
  - Private Food and Wine Events
    - 10 per year
    - 24 guests maximum
  - Private Release Events
    - 3 per year
    - 50 guests maximum
  - Private Food and Wine Events
    - 10 per year
    - 60 guests maximum
  - Wine Auction Related or Similar Charity Events
    - 1 per year
    - 125 guests maximum

Figure 4: Summary of proposed winery operations from ACE's Onsite Wastewater Disposal Feasibility Study.

Table 6: Estimated proposed water demand from the project parcel.

	# of Units	Use per Unit	Annual Water Use (AF/yr)
Winery Use			**0.32**
Process Water	12000 Gallons	2.15 AF/100,000 gal.	0.26
Domestic & Landscaping	12000 Gallons	0.50 AF/100,000 gal.	0.06
Guest & Employee Use			**0.17**
Tasting Room Visitations	6257 Guests	3 gal./Guest	0.06
Events w/ On-Site Catering	240 Guests	15 gal./Guest	0.011
Events w/ Off-Site Catering	875 Guests	5 gal./Guest	0.013
Full-Time Employees	6 Employees	15 gal./shift @ 250 shifts/yr	0.07
Part-Time Employees	4 Employees	15 gal./shift @ 125 shifts/yr	0.02
Total			**0.49**

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 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 was simulated for Water Year 2010 which was chosen to represent average annual conditions. During Water Year 2010 annual precipitation totals across most of Napa County were close to their long-term 30-year averages. Simulated precipitation averaged 43.6 inches across the project recharge area and simulated actual evapotranspiration (AET) averaged 22.6 inches. Simulated groundwater recharge varied from 7.4 to 18.6 inches across the recharge area, with a spatial average of 11.4 inches. Components of the water balance were also calculated for the project parcel and are very similar to those calculated for the project recharge area (Table 7).

Groundwater recharge estimates can also be expressed as a total volume by multiplying the estimated recharge rate by a representative area. For the 181.5-acre project recharge area, these calculations yield an estimated average annual recharge of 172.1 acre-ft/yr (Table 8). Typically, an estimate of recharge across the project parcel is also made to provide additional perspective however this analysis ignores all uses other than those associated with Well 4. To provide perspective at the project parcel scale while focusing on uses only relate to the winery an alternative area that could be considered is the portion of the project parcel intersecting the recharge area. This area is approximately 20.7 acres and would yield an estimated average recharge of 19.7 ac-ft/yr (Table 8).

Table 7: Summary of water balance results estimated by the SWB model for Water Year 2010.

	2010 Average Year	
	inches	% of precip
Precipitation	43.6	-
AET	22.6	52%
Runoff	10.2	23%
Δ Soil Moisture	-0.6	-1%
Recharge	11.4	26%

Water balance estimates are available for several nearby watersheds that are predominately underlain by the Sonoma Volcanics including Conn, Redwood, Milliken, and Tulucay Creeks. Average annual recharge for these watersheds is estimated to range from 5% in Tulucay Creek to

21% in Conn Creek (LSCE, 2013). Regional estimates are also available for the Napa River watershed, the Santa Rosa Plain, Sonoma Valley, and the Green Valley Creek watershed. These regional analyses estimated that mean annual recharge was equivalent to between 7% and 28% of mean annual precipitation (Farrar et. al., 2006; Flint and Flint 2014, Kobor and O'Connor, 2016; Wolfenden and Hevesi, 2014).

Comparisons to these water balances are useful for determining the overall reasonableness of the results; precise agreement among these estimates is not expected owing to significant variations in climate, land cover, soil types, and underlying hydrogeologic conditions and owing to differences in spatial scale and methods for water balances. A local factor that is highly influential in our local-scale water balance is the high annual precipitation on Mount St. Helena, believed to be the greatest in Napa County (PRISM, 2010). Due largely to these higher precipitation rates, SWB modeling shows that more water was available for groundwater recharge, both in terms of annual depth and as a percentage of the annual water balance, than anywhere else in Napa County (Appendix C). The watersheds referenced above, particularly Milliken and Tulucay Creeks, receive significantly less precipitation than the project parcel and recharge rates in these watersheds may be significantly less than in the project recharge area.

Comparison of Water Demand and Groundwater Recharge

The total proposed groundwater use for the project recharge area is estimated to be 1.7 acre-ft/yr. This use is equivalent to 1% of the estimated 172.1 acre-ft of recharge the project recharge area is estimated to receive during an average water year. A similar comparison can be drawn for the portion of the project parcel intersecting the recharge area, the estimated winery use of 1.7 acre-ft/yr is equivalent to 9% of 19.7 acre-ft/yr of recharge estimated to occur on this portion of the project parcel during an average year (Table 8). Given the estimated large surplus of groundwater recharge available, water use associated with the proposed project is highly unlikely to result in reductions in groundwater levels or depletion of groundwater resources over time. This conclusion does not account for spatial variability of groundwater availability in the fractured bedrock aquifer; access to groundwater may be highly variable from well to well.

Table 8: Comparison of proposed water use to average annual groundwater recharge for the project recharge area and for the project parcel.

Domain	Total Proposed Demand (ac-ft/yr)	Average Water Year (2010)		
		Recharge (ac-ft/yr)	Recharge Surplus (ac-ft/yr)	Demand as % of Recharge
Project Recharge Area	1.7	172.1	170.4	1%
Portion of Project Parcel within Recharge Area	1.7	19.7	17.9	9%

Well Interference Analysis

The County of Napa's WAA Guidance Document indicates that a well interference analysis (Tier 2 Analysis) is required if neighboring wells are located within 500 feet of a project well or if a spring is located within 1,500 ft of a project well. No springs were identified within 1,500 ft of the project well however, based on the locations of wells on neighboring parcels provided by the project applicant, one well (Well 6) is located in the valley bottom 328 feet east of Well 4, requiring that an interference analysis be performed (Figure 5). As shown in Figure 3, the screened interval of Well 4, overlaps with the entire screened interval in Well 6 and review of well logs for each well indicate that these wells are completed within the same aquifer (Rhyolite of Calistoga).

The magnitude of potential drawdown caused by pumping from Well 4 was estimated at Well 6 using the Theis equation (Eq. 1). This approach is recommended by the County of Napa's WAA Guidance Document. The Theis equation (from Driscoll, 1986) is as follows:

$$s' = (Q/4\pi T)\, W(u)$$

with W(u) being the well function where

$$u = (r^2 S/4Tt)$$

and the well function integral expanded as a series as:

$$W(u)= -0.5772 - \ln(u) + u - (u^2/2\cdot 2!) + (u^3/3\cdot 3!) - (u^4/4\cdot 4!)\ldots$$

where:

s' = drawdown (units in ft)	T = transmissivity (units in ft^2/day)
r = radial distance (units in ft)	Q = pumping rate (gpm)
S = storativity (dimensionless)	t = time (days)

Several assumptions are made when using the Theis equation:

1. The aquifer is homogeneous, isotropic, uniformly thick and of infinite areal extent.
2. Prior to pumping, the piezometric surface is horizontal
3. The fully penetrating well is pumped at a constant rate.
4. Flow is horizontal within the aquifer.
5. Storage within the well can be neglected.
6. Water removed from storage responds instantaneously with a declining head.

The County of Napa's WAA Guidance document pertaining to WAA's allows for 10 to 15 feet of water level drawdown attributable to well interference. For wells with a casing diameter of six inches or less, such as Well 4, drawdown of 10 feet is recommended as a threshold of concern.

To estimate potential drawdown at Well 6, the Theis equation requires estimates of aquifer transmissivity and storativity, as well as pumping rate and duration.

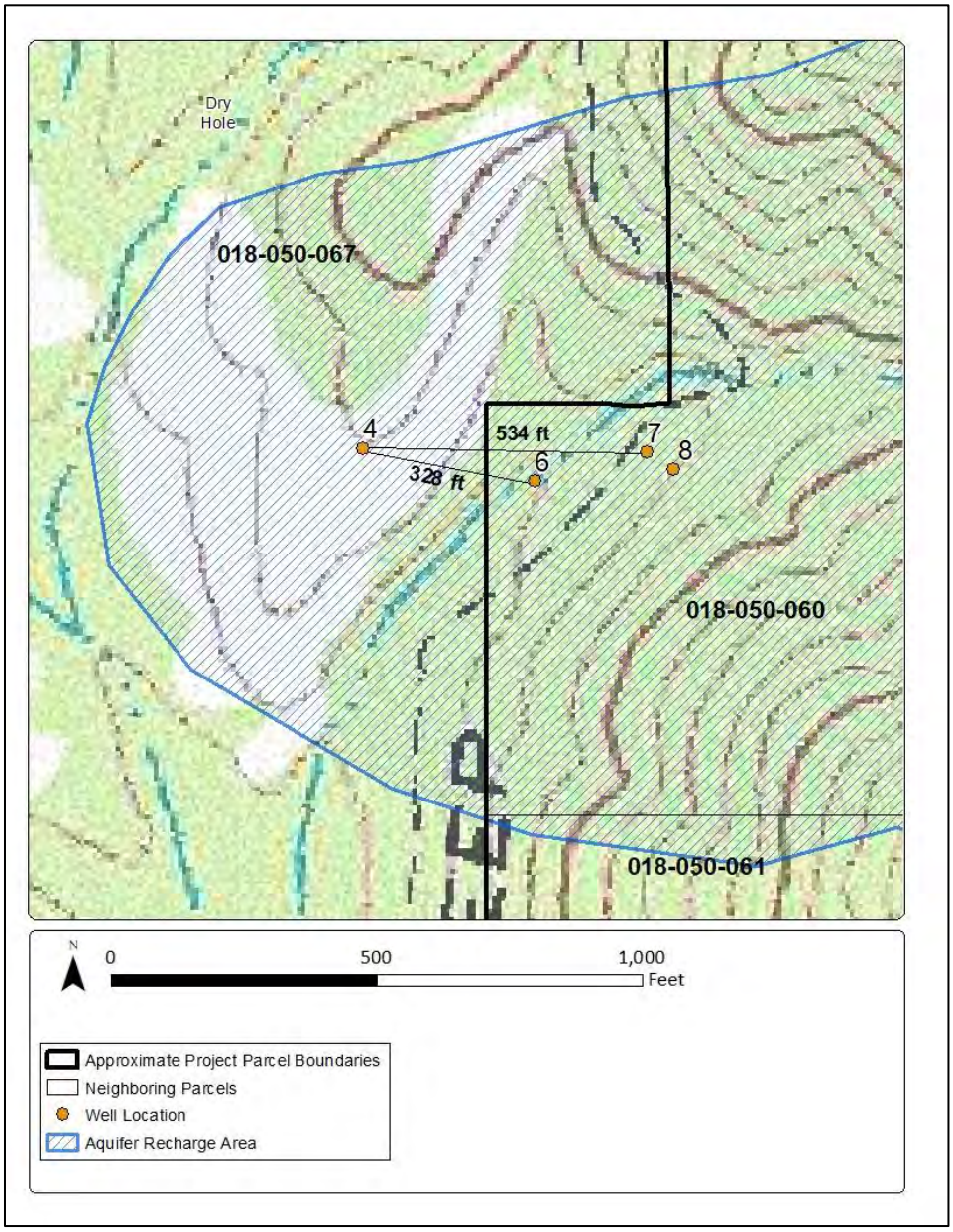


Figure 5: Locations of nearby wells

Hydrogeologic Properties

The storativity of a confined aquifer may be calculated as the product of specific storage (S_s) and saturated aquifer thickness (b). The Napa County WAA Guidance Document reports the specific storage of fissured rocks similar to the project aquifer as $1x10^{-6}$ to $2.1x10^{-5}$ $feet^{-1}$. The screened

interval of Well 4 extends to 579 feet, while the static water level most recently measured at 343.7 feet in 2015. From these measurements, aquifer thickness is estimated as the difference between the observed static water level and the bottom of the screened interval. This gives an estimated aquifer thickness of 235.3 ft. Although pressure heads likely exist in confined or semi-confined aquifers such as the one Well 4 is completed in, Well Completion Reports from other nearby wells do not report significant pressure heads (interpreted as the difference between static water levels and the depth to first water) and using the static water level is appropriate for this application. Using these estimates, the storativity of the project aquifer is believed to between $2.4x10^{-4}$ and $4.9x10^{-3}$.

The transmissivity of the project aquifer was estimated using observed drawdown data from a single-well pump test performed on Well 4 on February 3, 2015. In this test Well 4 was pumped at a rate of 2.6 to 12 gpm for 8 hours. Drawdown stabilized at 567 feet with a steady rate of 2.6 gpm and was stable for approximately 6 hours. From these data transmissivity was estimated using a standard type-curve fitting approach performed using AQTESOLV software. Several type curves were considered, including the Theis equation for confined aquifer conditions and the Gringarten-Witherspoon and Gringarten-Ramey equations for confined aquifers with fracture systems. Because the pump test did not include an observation well, meaningful estimates of storativity cannot be developed from this data. The AQTESOLV analysis assumed the range of possible storativity estimated above and estimated transmissivities assuming low- and high-end storativity values. For all combinations of type curve and storativity evaluated, estimated transmissivities fell within a relatively narrow range (1.2 - 16 $feet^2$/day). Converting transmissivity to hydraulic conductivity (K) by dividing transmissivity (T) by aquifer thickness (b), aquifer hydraulic conductivities ranges from 0.003 to 0.04 ft/d (Table 9). These estimated conductivities are in the center of the range of values estimated for fractured volcanic rocks (0.002 to 85 feet/day; Domenico and Schwartz, 1990).

Table 9: Range of estimated storativity (S), transmissivity (T), hydraulic conductivity (K) and characteristic fracture length (L_f) for the project aquifer.

Type Curve	S ()	T (ft^2/day)	K (ft/day)	L_f (ft)
Theis	2.4E-04	1.7	0.01	-
Theis	4.9E-03	1.2	0.003	-
Gringarten-Witherspoon	2.4E-04	1.2	0.003	10
Gringarten-Witherspoon	4.9E-03	1.5	0.005	1
Gringarten-Ramey	2.4E-04	16	0.04	10
Gringarten-Ramey	4.9E-03	15	0.04	10

Pumping Regime

Pumping rate and maximum daily pumping duration are dependent on peak winery demands. Annually, peak usage would occur on a day with an event held during crush the Applied Civil Engineering (ACE) Onsite Wastewater Disposal Feasibility Study reports peak daily demand of 600 gallons/day for processing and 582 gallons/day for domestic use which includes employee and guest use during an event with on-site catering. This Tier 2 analysis assumes a peak daily demand of 1,182 gallons to estimate the maximum potential effects of drawdown from Well 4 at neighboring Well 6 located 328 feet to the east.

Assuming Well 4 pumps at a rate of 12 gpm the max rate used during the 2015 pumping test (Appendix B), this will require Well 4 to be pumped for 1.6 hours to meet the peak daily demand of 1,182 gallons.

Estimated Drawdown

The Theis equation was evaluated to estimate drawdown induced by Well 4 at the nearby well (Well 6). Given the range of estimated storativity and transmissivity, the Theis equation was evaluated for several combinations of these parameters. Drawdown at Well 6 is estimated to range from less than 0.001 to 0.01 ft (Table 10). Given that estimated drawdown at both wells is less than screening criteria of 10 feet, this drawdown is not considered significant and no site-specific analysis is required.

Table 10: Estimated drawdown at nearby wells.

Combination	1	2	3	4
Storativity ()	2.4E-04	2.4E-04	7.9E-03	7.9E-03
Transmissivity (ft^2/day)	1.2	16	1.2	16
Drawdown, Well 6 (ft)	<0.001	0.01	<0.001	<0.001

Summary

Application of the Soil Water Balance model (SWB) to the project recharge area revealed that average water year recharge was approximately 11.4 inches/yr or 172.1 acre-ft/yr. The total proposed water use for the project aquifer recharge area is estimated to be 1.7 acre-ft/yr. This represents about 1% 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 nearest neighboring well to project Well 4 is Well 6 which is located 328 feet to the east. An evaluation of potential well interference revealed that the proposed increase in pumping required at Well 4 is unlikely to result in significant drawdown at Well 6.

References

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Farrrar, C.D., Metzger, L.F., Nishikawa, T., Koczot, K.M., and Reichard, E.G., 2006. Geohydrological Characterization, Water-Chemistry, and Ground-water Flow Simulation Model of the Sonoma Valley Area, Sonoma County, California, U.S. Geological Survey Scientific Investigations Report 2006-5092.

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Woolfenden, L.R., and Hevesi, J.A., 2014. Santa Rosa Plain Hydrologic Model Results, Chapter E in Simulation of Groundwater and Surface-Water Resources of the Santa Rosa Plain Watershed, Sonoma County, California, U.S. Geological Survey Scientific Investigations Report 2014-5052.

APPENDIX A

WELL COMPLETION REPORTS

#4 WELL 1

ORIGINAL
File with DWR

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet

DWR USE ONLY — 09N 06W [illegible] Well 27
STATE WELL NO./STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

Page ___ of ___
Owner's Well No. 9-16-93
Date Work Began 9-16-93, Ended 9-22-93
No. 462607
Local Permit Agency Napa
Permit No. 3323 Permit Date 9-16-93

GEOLOGIC LOG

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	20	tuff, brown, soft
20	240	hard to soft

[redacted]

WELL LOCATION

Address End Pickett Lane
City Calistoga
County Napa
APN Book ___ Page ___ Parcel 18-050-40
or
Township ___ Range ___ Section ___
or
Latitude ___ DEG. ___ MIN. ___ SEC. NORTH Longitude ___ DEG. ___ MIN. ___ SEC. WEST

LOCATION SKETCH

NORTH
Silverado Trail
WEST
EAST
Pickett
End
100 Ft.
SOUTH

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

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)

TOTAL DEPTH OF BORING 240 (Feet)
TOTAL DEPTH OF COMPLETED WELL 140 (Feet)

DRILLING METHOD air rotary FLUID ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH OF STATIC WATER LEVEL 15 (Ft.) & DATE MEASURED 9-22-93
ESTIMATED YIELD* 4 (GPM) & TEST TYPE air lift
TEST LENGTH 4 (Hrs.) TOTAL DRAWDOWN 60 (Ft.)
* *May not be representative of a well's long-term yield.*

CASING(S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CONDUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	25	9 7/8	✓				plastic	5	200	
25	60	8 3/4	✓				"	"	"	3/32
60	140	8 3/4		✓			"	"	"	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	TYPE CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	24	✓			
24	240				peagravel

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 Fullam Well Drilling (PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
ADDRESS 2877 Piedmont CITY Napa STATE Ca. ZIP 94558
Signed Tom Fullam (WELL DRILLER/AUTHORIZED REPRESENTATIVE) DATE SIGNED 10-5-93 C-57 LICENSE NUMBER 248677

DWR 188 REV. 7-90 IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

3/69

QUADRUPLICATE #2 WELL 2 (GARDEN) 18-050-067

For Local Requirements

Page ____ of ____

Owner's Well No. ________

Date Work Began 9-4-93 Ended 9-8-93

Local Permit Agency Napa County

Permit No. 36837 Permit Date 9-8-93

STATE OF CALIFORNIA

WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. **462606**

DWR USE ONLY — DO NOT FILL IN

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

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	18	Soil & Hen Creek pebbles
18	320	ryholite very hard

TOTAL DEPTH OF BORING 320 (Feet)

TOTAL DEPTH OF COMPLETED WELL 320 (Feet)

WELL OWNER

Name Ken Rand & Leonard Biase

Mailing Address 666 Craig [illegible]

Berkeley Ca 94708

CITY STATE ZIP

WELL LOCATION

Address End Pickett Road Cal St

City Calistoga

County Napa

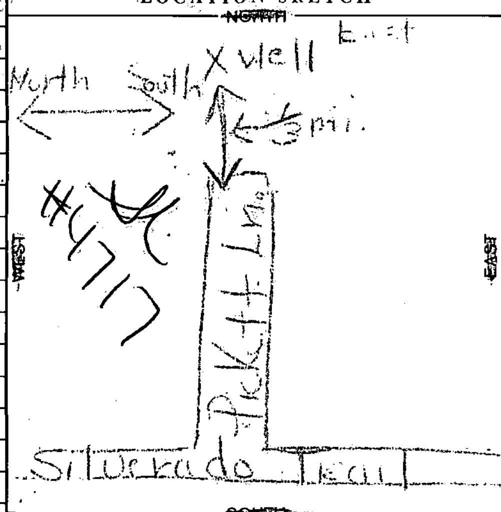
APN Book ____ Page ____ Parcel 18-050-67

or Township ____ Range ____ Section ____

or Latitude ____ NORTH Longitude ____ WEST

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

LOCATION SKETCH



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

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)

DRILLING METHOD air rotary FLUID ____

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH OF STATIC WATER LEVEL 45 (Ft.) & DATE MEASURED 9-8-93

ESTIMATED YIELD* 7 (GPM) & TEST TYPE air lift

TEST LENGTH 4 (Hrs.) TOTAL DRAWDOWN 280 (Ft.)

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

CASING(S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CONDUCTOR	FILL PIPE	MATERIAL/GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	25	16	✓				plastic	5"	200	
25	60	8 3/4	✓				"			
60	320	8 3/4		✓			"	"		3/32

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	25	✓			
25	320				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.

NAME Pulliam Well Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

2877 Piedmont Napa Ca 94558
ADDRESS CITY STATE ZIP

Signed [signature] 10-5-93 348677
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 7-90 IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

QUADRUPLICATE #3 WELL 3 (ROAD)
For Local Requirements

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet

No. 462608

DWR USE ONLY — DO NOT FILL IN: 018-050-042
STATE WELL NO./STATION NO.
LATITUDE | LONGITUDE
APN/TRS/OTHER

Page ___ of ___
Owner's Well No. ___
Date Work Began 9-8-93, Ended 9-12-93
Local Permit Agency Napa
Permit No. 33811 Permit Date 9-8-93

GEOLOGIC LOG

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	34	rhyolite gray green very hard
34	35	clay white
35	100	rhyolite gray green
100	140	tuff green soft to hard
140	160	tuff rhyolite mixed hard
160	240	rhyolite gray green hard blue white green
240	260	blue white green, hard

RECEIVED JAN 31 1994 DEPT. OF ENVIRONMENTAL MANAGEMENT

TOTAL DEPTH OF BORING 260 (Feet)
TOTAL DEPTH OF COMPLETED WELL 120 (Feet)

WELL OWNER

Name Kane & Kaywood Brase
Mailing Address 666 Crystal ...
Brooklyn Ca. 94708
CITY STATE ZIP

WELL LOCATION

Address End Pickett Road Calist.
City Calistoga
County Napa
APN Book ___ Page ___ Parcel 18-060-42
Township ___ Range ___ Section ___
Latitude ___ NORTH Longitude ___ WEST
DEG. MIN. SEC. DEG. MIN. SEC.

LOCATION SKETCH

NORTH / SOUTH / EAST / WEST

Silverado Trail — Pickett Ln. 1 mi. — #4738

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

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)

DRILLING METHOD air rotary FLUID ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH OF STATIC WATER LEVEL 35 (Ft.) & DATE MEASURED 9-16-93
ESTIMATED YIELD* 18 (GPM) & TEST TYPE air lift
TEST LENGTH 4 (Hrs.) TOTAL DRAWDOWN 70 (Ft.)
* *May not be representative of a well's long-term yield.*

CASING(S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	25	9 7/8	✓				plastic	5	200	
25	40	9 7/8	✓				"	"	"	
40	120	8 3/4		✓			"	"	"	3/32

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	21	✓			
21	160				peagravel

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 Pulliam Well Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

2877 Piedmont Ave. Napa Ca. 94558
ADDRESS CITY STATE ZIP

Signed Tom Pulliam 10-5-93 242677
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 7-90 IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

WELL 4 (BLOCK 4, WINERY PROJECT WELL)

ORIGINAL
File with DWR

Page 1 of 1

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet
No. e023056

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

Owner's Well No. Well #5-'05
Date Work Began 4/13/2005, Ended 4/27/2005
Local Permit Agency Napa County Environmental Mgmt
Permit No. E05-0183 Permit Date 3/23/2005

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD HAMMER FLUID AIR

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain, size, color, etc.*
0	30	LIGHT TAN VOLCANICS
30	60	GRAY & TAN VOLCANICS
60	160	GRAY & GREEN VOLCANICS
160	200	BLACK & GREEN VOLCANICS
200	280	DARK GREEN VOLCANICS
280	400	GRAY, GREEN & WHITE VOLCANICS
400	480	DARK GRAY GREEN VOLCANICS
480	580	LIGHT GRAY VOLCANICS
580	600	DARK GRAY GREEN VOLCANICS
		CONTINUED CASING LAYOUT
419	579	SCREEN PVC 6" .032 SLOT
579	599	BLANK PVC 6"

TOTAL DEPTH OF BORING 600 (Feet)
TOTAL DEPTH OF COMPLETED WELL 599 (Feet)

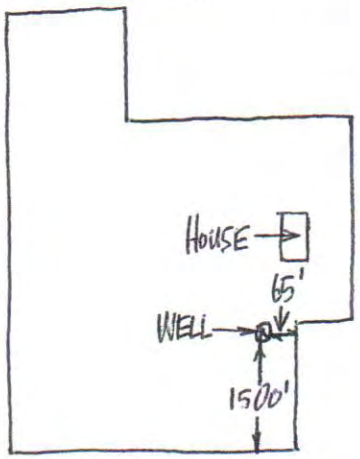
WELL OWNER

Name Kelly Fleming
Mailing Address 2343 Pickett Road
Calistoga CA 94515
CITY STATE ZIP

WELL LOCATION

Address 2343 Pickett Road
City Calistoga CA
County Napa
APN Book 018 Page 050 Parcel 067
Township ___ Range ___ Section ___
Latitude ___ DEG. ___ MIN. ___ SEC. ___ 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.**

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 230 (Ft.) BELOW SURFACE 1
DEPTH OF STATIC WATER LEVEL 183 (Ft.) & DATE MEASURED 4/26/2005
ESTIMATED YIELD 25 (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.

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CONDUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	60	12								
60	600	9								
0	179		✓				PVC F480	6	SDR-21	
179	399			✓			PVC F480	6	SDR-21	.032
399	419		✓				PVC F480	6	SDR-21	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	TYPE CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	52	✓			CONCRETE
52	599			✓	#6 SAND

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 [signature] WELL DRILLER/AUTHORIZED REPRESENTATIVE
04/27/05 DATE SIGNED
439-746 C-57 LICENSE NUMBER

DWR 188 REV. 11-97.
IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

WELL 5 (BIG TANKS)

QUADRUPLICATE
For Local Requirements

Page ___ of ___

Owner's Well No.

Date Work Began 9-14-99, Ended 9-20-99

Local Permit Agency Napa County

Permit No. 96-11294 Permit Date 8-30-99

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet

No. 814587

DWR USE ONLY — DO NOT FILL IN 18-050-042

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD rotary FLUID AIR

DEPTH FROM SURFACE Ft. to Ft.	DESCRIPTION Describe material, grain size, color, etc.
0 25	brown clay, gray rock
25 530	gray ash with white ash

RECEIVED JAN 3 2000 DEPT OF ENVIRONMENTAL MANAGEMENT

TOTAL DEPTH OF BORING 530 (Feet)

TOTAL DEPTH OF COMPLETED WELL 220 (Feet)

WELL OWNER

Name Fleming

Mailing Address Box 373

Oakville Ca.

CITY STATE ZIP

WELL LOCATION

Address end of Pickett rd

City Calistoga

County Napa

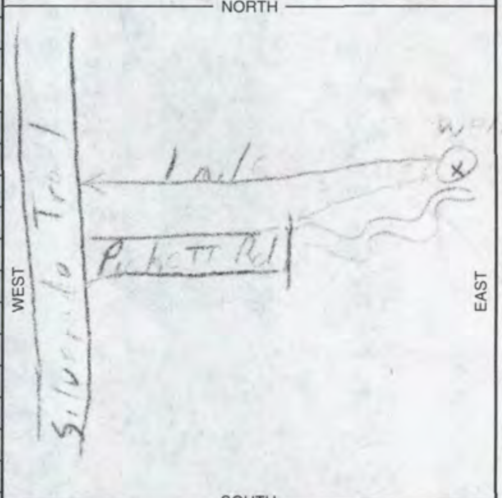
APN Book ___ Page ___ Parcel 018-050-042

Township ___ Range ___ Section ___

Latitude ___ NORTH Longitude ___ WEST

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.***

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 40 (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 40 (Ft.) & DATE MEASURED 9-20-99

ESTIMATED YIELD * 25 (GPM) & TEST TYPE Air Lift

TEST LENGTH 4 (Hrs.) TOTAL DRAWDOWN 180 (Ft.)

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

CASING (S)

DEPTH FROM SURFACE Ft. to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0 75	9	✓				Plastic	5	200	
75 220	9		✓			"			Factory 1/32

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft. to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0 25	✓			
25 220				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.

NAME Pulliam Well Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

3877 Piedmont Ave Napa Ca. 94558
ADDRESS CITY STATE ZIP

Signed [signature] 9-28-99 248677
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97 IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

WELL 6

ORIGINAL
File with DWR

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

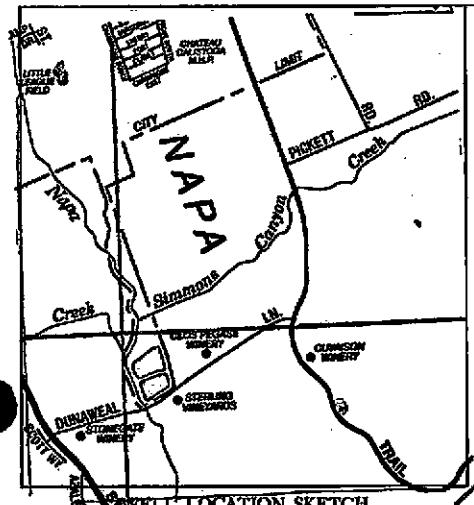
Do not fill in

No. 324028

Notice of Intent No. _____
Local Permit No. or Date _____

State Well No. 09N 06W 29
Other Well No. _____

(2) LOCATION OF WELL (See instructions): AP#018-050-060
County Napa Owner's Well Number _____
Well address if different from above End of Pickett Road, Calistoga
Township _____ Range _____ Section _____
Distance from cities, roads, railroads, fences, etc. _____



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 ☐
Municipal ☐
Other ☐
(Describe)

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

(6) GRAVEL PACK:
Yes ☒ No ☐ Size No. rea
Diameter of bore 8 3/4"
Packed from 20 ft. to 250 ft.

(7) CASING INSTALLED:
Steel ☐ Plastic ☒ Concrete ☐

From ft.	To ft.	Dia. in.	Gage or Wall
0	250	6	F480

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Slot size
130	250	factory

(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 _____ 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 200 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

(12) WELL LOG; Total depth 250 ft. Completed depth 250 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	12	brown soil
12	20	brown clay
20	30	lt gray rock soft
30	130	lt gray rock soft
130	150	lt & dk gray rock stringers red & brown
		fract rock
150	190	lt gray rock
190	210	lt gray rock stringers lite green&brown
		rock fract
210	250	lt gray & green & dk gray rock soft

Work started 10-27 19 98 Completed 10-29 19 98

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 McLean & Williams, Inc. (Person, firm, or corporation) (Typed or printed)
Address 878 El Centro Ave.
City Napa ZIP 94558
License No. 396352 Date of this report 11/27/98

CONFIDENTIAL NOT FOR PUBLIC USE WATER CODE SEC. 13752

DWR 188 (REV. 12-86) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM 86 96355

361

WELL 7

ORIGINAL
File with DWR

Page ___ of ___
Owner's Well No. ___
Date Work Began 5-29-13 Ended 6-6-13
Local Permit Agency Napa County
Permit No. E12-00536 Permit Date 9-10-12

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet
No. 0955793

DWR USE ONLY — DO NOT FILL IN
09N06W29
STATE WELL NO./STATION NO.
3835556 LATITUDE 1223247 LONGITUDE
APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD rotary FLUID air

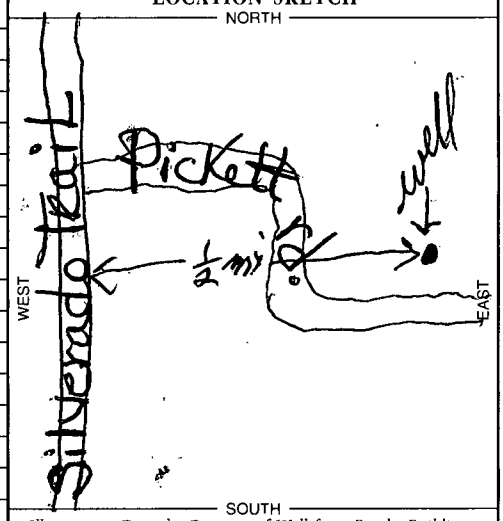
DEPTH FROM SURFACE Ft. to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0 160	brown ash, boulders
160 370	gray sandstone, hard gray ash
370 480	green ash, hard gray sandstone
480 500	hard gray clay

TOTAL DEPTH OF BORING 500 (Feet)
TOTAL DEPTH OF COMPLETED WELL 500 (Feet)

WELL LOCATION

Address 2359 Pickett rd. CITY Calistoga STATE ZIP
City Calistoga
County Napa
APN Book ___ Page ___ Parcel 018-050-060
Township ___ Range ___ Section ___
Lat ___ N DEG. MIN. SEC. Long ___ W 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.***

ACTIVITY (✓)
✓ NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY *(Describe Procedures and Materials Under "GEOLOGIC LOG")*

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 150 (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL 150 (Ft.) & DATE MEASURED 6-6-13
ESTIMATED YIELD * 15 (GPM) & TEST TYPE AIR LIFT
TEST LENGTH 3 (Hrs.) TOTAL DRAWDOWN 480 (Ft.)
** May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft. to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0 50	11"	X				PLASTIC	5"	200	
50 140	9"	X				"	"	"	
140 500	9"	FACT			PERF	"	"	"	3/32

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft. to Ft.	TYPE CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0 50	X			
50 500				WELL PACK #6

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 Pulliam Well Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
ADDRESS 1377 Piedmont CITY Napa, STATE Ca. ZIP 94558
Signed Bill Pulliam
C-57 LICENSED WATER WELL CONTRACTOR
DATE SIGNED 6-16-13 C-57 LICENSE NUMBER 748677

DWR 188 REV. 05-03 IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM OSP 03 78836

ORIGINAL
File with DWR

STATE OF CALIFORNIA

WELL 8 WELL COMPLETION REPORT

Refer to Instruction Pamphlet

No. 0939890

Page ___ of ___

Owner's Well No. ___

Date Work Began 7/29/08, Ended 8/5/08

Local Permit Agency Napa County

Permit No. E08-00330 Permit Date 6/26/08

DWR USE ONLY — DO NOT FILL IN

09N 06W 29

STATE WELL NO./STATION NO.

38 35 41 / 122 32 57

LATITUDE / LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

ORIENTATION (✓) X VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)

DRILLING METHOD air FLUID foam

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0	20	topsoil brown clay
20	60	brown clay
60	80	white ash
80	100	lt gray rock white ash
100	120	white ash
120	160	lt gray black green rock
160	180	black green gray yellow
180	200	black green gray red
200	220	red gray black green
220	240	gray black rock
240	260	gray red black rock
260	280	gray white rock
280	300	white & gray rock
300	320	gray & white rock
320	340	gray rock
340	360	lt & dk gray rock

TOTAL DEPTH OF BORING 360 (Feet)

TOTAL DEPTH OF COMPLETED WELL 340 (Feet)

WELL LOCATION

Address 2395 Pickett Road

City Calistoga

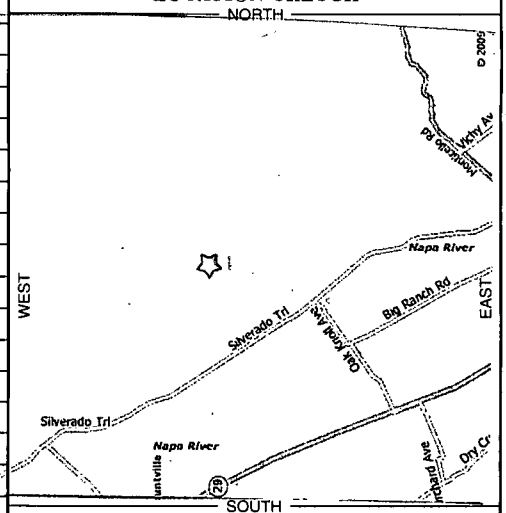
County Napa

APN Book 018 Page 050 Parcel 060

Township ___ Range ___ Section ___

Lat ___ N DEG. MIN. SEC. Long ___ W 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.***

ACTIVITY (✓)

X NEW WELL

MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)

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

USES (✓)

WATER SUPPLY
X
___ 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 ___ (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 220 (Ft.) & DATE MEASURED 8/5/08

ESTIMATED YIELD * 5. (GPM) & TEST TYPE ___

TEST LENGTH ___ (Hrs.) TOTAL DRAWDOWN ___ (Ft.)

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

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	55	14	X				F480	5"	200	
55	100	9 7/8	X				F480	5"	200	
100	200	9 7/8		X			F480	5"	200	factory
200	220	9 7/8	X				F480	5"	200	
220	240	9 7/8		X			F480	5"	200	factory
240	260	9 7/8	X				F480	5"	200	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	TYPE CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	55	X			
55	340				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.

NAME McLean & Williams, Inc. (PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

ADDRESS 878 El Centro Ave., Napa, CA 94558 CITY STATE ZIP

Signed ___ C-57 LICENSED WATER WELL CONTRACTOR

8/15/08 DATE SIGNED

396352 C-57 LICENSE NUMBER

DWR 188 REV. 05-03

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

OSP 03 78836

WELL COMPLETION REPORT NO. 0939890 Mark Ambruster 2395 Pickett Road, Calistoga

Casing list continued

0939890

260 – 280	9 7/8	Perf	F480	5"	200	factory
280 – 300	9 7/8	Blank	F480	5"	200	
300 – 340	9 7/8	Perf	F480	5"	200	blank

ORIGINAL

File with DWR

WELL 9

018 050 031

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

Well 4

Do not fill in

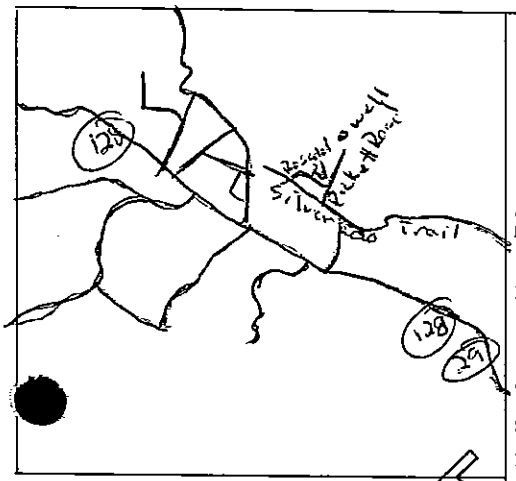
No. 095190

[redacted] of Intent No.
[redacted] Permit No. or Date

State Well No.
Other Well No. 09N06W32B

[redacted]

(2) LOCATION OF WELL (See instructions): A.P.#18-050-31
County Napa Owner's Well Number
Well address if different from above 2375 Pickett Road
Township Range Section
Distance from cities, roads, railroads, fences, etc.



WELL LOCATION SKETCH

(3) TYPE OF WORK:
New Well [X] Deepening [ ]
Reconstruction [ ]
Reconditioning [ ]
Horizontal Well [ ]
Destruction [ ] (Describe destruction materials and procedures in Item 12)

(4) PROPOSED USE:
Domestic [X]
Irrigation [ ]
Industrial [ ]
Test Well [ ]
Stock [ ]
Municipal [ ]
Other [ ]

(5) EQUIPMENT:
Rotary [X] Reverse [ ]
Cable [ ] Air [ ]
Other [ ] Bucket [ ]

(6) GRAVEL PACK:
Yes [X] No [ ] Size Pea
Diameter of bore 8 3/4"
Packed from 180 to 21 ft.

(7) CASING INSTALLED:
Steel [ ] Plastic [X] Concrete [ ]

From ft.	To ft.	Dia. in.	Gage or Wall
0	180	6	160

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Slot size
60	160	STD

(9) WELL SEAL:
Was surface sanitary seal provided? Yes [X] No [ ] If yes, to depth 21 ft.
Were strata sealed against pollution? Yes [ ] No [X] Interval ft.
Method of sealing Concrete

(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 [X] No [ ] If yes, by whom? Driller
Type of test Pump [ ] Bailer [ ] Air lift [X]
Depth to water at start of test 60 ft. At end of test 95 ft
Discharge 20 gal/min after 2¼ hours Water temperature
[redacted]ical analysis made? Yes [ ] No [X] If yes, by whom?
Was electric log made? Yes [ ] No [X] If yes, attach copy to this report

(12) WELL LOG: Total depth 180 ft. Depth of completed well 180 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	10	Top soil.
10	15	Brown clay with bolders.
15	25	Brown sandstone.
25	50	Gray sandstone.
50	80	Gray blue sandstone and gravels.
80	119	Fractured brown rock.
119	185	Gray blue rock.

Work started 7-25- 19 83 Completed 8-2- 19 83

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 McLean & Williams, Inc.
(Person, firm, or corporation) (Typed or printed)
Address 878 El Centro Ave.
City Napa, CA Zip 94558
License No. 396352 Date of this report 8-10-83

DWR 188 (REV. 7-76) IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

WELL 10

STATE OF CALIFORNIA
THE RESOURCES AGENCY
DEPARTMENT OF WATER RESOURCES

WATER WELL DRILLERS REPORT

ORIGINAL
File with DWR

Do not fill in

No. 324030

State Well No. 09N 06W 29

Other Well No.

Notice of Intent No.

Local Permit No. or Date

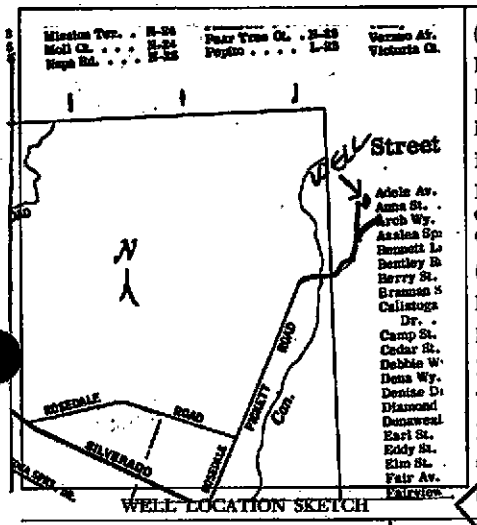
(2) LOCATION OF WELL (See instructions): A.P.#18-050-061

County Napa Owner's Well Number

Well address if different from above End of Pickett Road

Township Range Section

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



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 ☐
Municipal ☐
Other ☐
(Describe)

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

(6) GRAVEL PACK:
Yes ☒ No ☐ Size pea
Diameter of bore 8 3/4"
Packed from 21' to 445' ft.

(7) CASING INSTALLED:
Steel ☐ Plastic ☒ Concrete ☐

From ft.	To ft.	Dia. in.	Gage or Wall
0	445	6"	F480

(8) PERFORATIONS:
Type of perforation or size of screen

From ft.	To ft.	Slot size
65	445	factory

(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 ft.
Standing level after well completion 80 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 80 ft. At end of test 400 ft.
Discharge 5 gal/min after 2 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 450 ft. Completed depth 445 ft.

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	2	topsoil
2	20	brown soil & brown rock & clay
20	30	red & brown rock med
30	50	red brown & gray rock med
50	70	lt gray & reddish brown rock
70	130	lt gray & white rock
130	150	dk & lt gray white & black rock fract
150	270	dk & lt gray white rock stringers brown
270	310	lt gray rock hard
310	330	lt gray & dk gray rock fract hard
330	450	lt green & lt gray rock fract hard

Work started 11/02 19 98 Completed 11/7 19 98

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 McLean & Williams, Inc. (Person, firm, or corporation) (Typed or printed)

Address 878 El Centro Ave.

City Napa ZIP 94558

License No. 396352 Date of this report 01/14/99

DWR 188 (REV. 12-86)

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

86 96335

ORIGINAL
File with DWR

WELL 11

Page 1 of 1

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet

No. e067538

DWR USE ONLY — DO NOT FILL IN
09N06W32
STATE WELL NO./ STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

Owner's Well No. 3-'08
Date Work Began 4/30/2008, Ended 5/14/2008
Local Permit Agency Napa County Environmental Mgmt
Permit No. E08-00135 Permit Date 4/15/2008

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL — HORIZONTAL — ANGLE — (SPECIFY)
DRILLING METHOD ROTARY FLUID AIR

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain, size, color, etc.*
0	30	BROWN VOLCANIC TUFF WITH COBBLE
30	45	BROWN VOLCANIC TUFF
45	110	LIGHT GRAY VOLCANIC ASH
110	340	LIGHT GRAY VOLCANIC ROCK WITH ASH
340	390	LIGHT GREEN, GRAY VOLCANIC ROCK
390	730	LIGHT GRAY VOLCANICS W/ ASH STRINGERS
730	1000	HARD LIGHT GRAY VOLCANIC ROCK

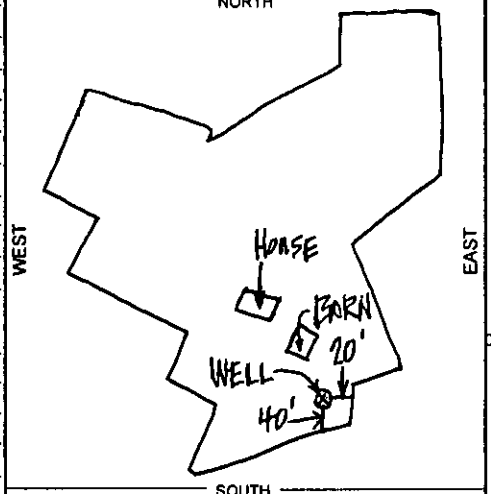
TOTAL DEPTH OF BORING 1000 (Feet)
TOTAL DEPTH OF COMPLETED WELL 218 (Feet)

CITY STATE ZIP

WELL LOCATION

Address 2355 Pickett Road
City Calistoga CA
County Napa
APN Book 018 Page 050 Parcel 064
Township — Range — Section —
Latitude DEG. MIN. SEC. 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.

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 110 (Ft.) BELOW SURFACE 1
DEPTH OF STATIC WATER LEVEL 119 (Ft.) & DATE MEASURED 5/14/2008
ESTIMATED YIELD 4 (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.

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CONDUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	60	12								
60	1000	9								
0	98		✓				STEEL	6	.188	
98	198			✓			STEEL	6	.188	.060
198	218		✓				STEEL	6	.188	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	TYPE CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	55	✓			CONCRETE
55	1000			✓	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 Napa CA 94559
ADDRESS CITY STATE ZIP

Signed [signature] 05/21/08 439-746
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

APPENDIX B

PUMPING TEST RECORDS

Ray's Well Testing Service Inc.
4031 Shadowhill Dr, Santa Rosa Ca 95404
Phone 707 823 3191 **Fax** 707 317 0057 **Lic#** 903708

WELL 2 (GARDEN) PUMP TEST

CUSTOMER INFORMATION

REPORT #: 7008-2 By: Matt Owens	DATE OF TEST: 2/3/2015
CUSTOMER NAME: Kelly Fleming Winery	CONTACT: 707 942 6849
AGENT NAME:	CONTACT:
PROPERTY ADDRESS: 2339 Pickett Rd, Calistoga CA 94515	SENT TO: kelly@kellyflemingwines.com

WELL DATA

LOCATION OF WELL:	Well #2
TYPE OF WELL:	Drilled
DEPTH OF COMPLETED WELL:	313 Feet per pump installer records. 320 Feet per well log.
DIAMETER OF WELL CASING:	5" PVC
SANITARY WELL SEAL (PLATE SEAL AT OPENING OF WELL CASING):	Yes
ANNULAR SEAL (IN-GROUND SEAL OF BOREHOLE):	25 Feet - Per well log
PUMP HP AND TYPE:	2 Hp 230V 1Ph. Submersible 10GS20
DEPTH OF PUMP SUCTION:	296 Feet. 1.25" Tee at well head. #10-4 Sub cable

WATER PRODUCTION RESULTS

WATER LEVEL AT START (STATIC LEVEL):	152 Feet	FLOW RATE AT START:	16.4 GPM
FINAL PUMPING LEVEL:	296 Feet	FINAL FLOW RATE:	**0.81 GPM**
WATER LEVEL DRAWDOWN:	144 Feet	TOTAL LENGTH OF TEST:	see pumping log

CONSTANT PUMPING LEVEL INFORMATION

STABILIZED PUMPING LEVEL:	296 Feet	STABILIZED FLOW RATE (YIELD):	**0.81 GPM**
DURATION OF CONSTANT PUMPING LEVEL:	see pumping log	TOTAL YIELD:	see pumping log

WATER SYSTEM INSPECTION

WELL PUMP	Functional	TECHNICAL INFO: 8.6 GPM @ 100 PSI @ 161', 10.5 amps, installed 2010
ELECTRICAL	Functional	TECHNICAL INFO: 15 amp breaker in sub panel at well
PRESSURE TANK	Not observed	TECHNICAL INFO:
STORAGE TANK	Not observed	TECHNICAL INFO:
BOOSTER PUMP	Not observed	TECHNICAL INFO:

WATER QUALITY TESTING

THE FOLLOWING SAMPLES ARE BEING ANALYZED. PLEASE REFER TO FOLLOW-UP REPORT FOR RESULTS.		
Basic Irrigation Package	DATED: 2/3/2015	TURNAROUND: Due 2/18/2015
Bacteria, Arsenic, Basic Minerals - Not Tested	DATED: Not Tested	TURNAROUND: Not Tested
	DATED:	TURNAROUND:
	DATED:	TURNAROUND:

SEE NEXT PAGE FOR FURTHER INFORMATION...

DATE: 2/3/2015

ADDRESS: 2339 Pickett Rd, Calistoga CA 94515

COMMENTS:

1. The recharge rate at the end of the test was 0.81 gallons per minute. This may not represent the long term or seasonal yield.

PUMPING LOG (2/3/15):

TIME	WATER LEVEL	COLOR	ODOR	SEDIMENT	GPM
10:30 AM	152'	CLEAR	NO	NO	16.4
10:45 AM	176'	CLEAR	NO	NO	15
11:00 AM	184.8'	CLEAR	NO	NO	14.6
11:15 AM	195.8'	CLEAR	NO	NO	14.4
11:30 AM	211.3'	CLEAR	NO	NO	14.1
12:00 PM	251.6'	CLEAR	NO	NO	13.6
12:30 PM	296'	CLEAR	NO	NO	4.1
1:00 PM	296'	CLEAR	NO	NO	2.8
1:30 PM	296'	CLEAR	NO	NO	2.3
2:00 PM	296'	CLEAR	NO	NO	1.4
2:30 PM	296'	CLEAR	NO	NO	1.1
3:30 PM	296'	CLEAR	NO	NO	1
4:30 PM	296'	CLEAR	NO	NO	0.9
5:30 PM	296'	CLEAR	NO	NO	0.81

RECOVERY (2/4/15):

TIME	WATER LEVEL	PERCENT OF TOTAL DRAWDOWN
8:10 AM	181.1'	79.79%

Thank you for allowing us to do your well inspection!

APPROVED BY: NICK BRASESCO

Water levels and well depth are measured as feet below top of well casing unless otherwise noted.

All wells and springs are subject to seasonal and yearly changes in regards to water yield, production and quality. Wells may be influenced by creeks or other water sources and are likely to yield less water during dry months of the year; typically August, September, & October. We make no predictions of future water production or water quality.

Well #2 Garden Well

QUADRUPLICATE #2
For Local Requirements

Page ____ of ____

Owner's Well No. ____

Date Work Began 9-4-93 Ended 9-8-93

Local Permit Agency Napa County

Permit No. 36837 Permit Date 9-8-93

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet

No. 462606

18-050-067

DWR USE ONLY — DO NOT FILL IN

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

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	18	Soil + ten creek pebbles
18	320	ryholite very hard

TOTAL DEPTH OF BORING 320 (Feet)

TOTAL DEPTH OF COMPLETED WELL 320 (Feet)

WELL OWNER

Name Ron Rand & Leonard Biase

Mailing Address 666 Cragmont

Berkeley — Ca. 94708
CITY STATE ZIP

WELL LOCATION

Address End Pickett Road Cal St

City Calistoga

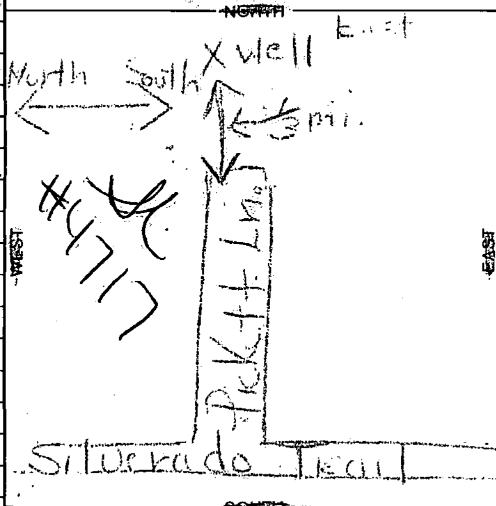
County Napa

APN Book ____ Page ____ Parcel 18-050-67

or Township ____ Range ____ Section ____

or Latitude ____ NORTH Longitude ____ WEST
DEG. MIN. SEC. DEG. MIN. SEC.

LOCATION SKETCH



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

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)

DRILLING METHOD air rotary FLUID ____

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH OF STATIC WATER LEVEL 45 (Ft.) & DATE MEASURED 9-8-93

ESTIMATED YIELD* 7 (GPM) & TEST TYPE air lift

TEST LENGTH 4 (Hrs.) TOTAL DRAWDOWN 280 (Ft.)

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

CASING(S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	25	16	✓				plastic	5"	200	
25	60	8 3/4	✓							
60	320	8 3/4		✓						3/32

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	25	✓			
25	320				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.

NAME Pulliam Well Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

2877 Piedmont Napa Ca 94558
ADDRESS CITY STATE ZIP

Signed Tom Pulliam 10-5-93 548477
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

CONFIDENTIAL WATER CODE SEC. 13752

RECEIVED JAN 31 1994 DEPT. OF ENVIRONMENTAL MANAGEMENT

DWR 188 REV. 7-90

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

Well #3 Road Well

Ray's Well Testing Service Inc.
4031 Shadowhill Dr, Santa Rosa Ca 95404
Phone 707 823 3191 **Fax** 707 317 0057 **Lic#** 903708

WELL 3 (ROAD) PUMP TEST

CUSTOMER INFORMATION

REPORT #: 7008-3 By: Matt Owens	DATE OF TEST: 2/2/2015
CUSTOMER NAME: Kelly Fleming Winery	CONTACT: 707 942 6849
AGENT NAME:	CONTACT:
PROPERTY ADDRESS: 2339 Pickett Rd, Calistoga CA 94515	SENT TO: kelly@kellyflemingwines.com

WELL DATA

LOCATION OF WELL:	Well #3
TYPE OF WELL:	Drilled
DEPTH OF COMPLETED WELL:	117 Feet per pump installer records. 120 Feet per well log.
DIAMETER OF WELL CASING:	5" PVC
SANITARY WELL SEAL (PLATE SEAL AT OPENING OF WELL CASING):	Yes
ANNULAR SEAL (IN-GROUND SEAL OF BOREHOLE):	21 Feet - Per well log
PUMP HP AND TYPE:	3 Hp 230V 1Ph. Submersible 18GS30
DEPTH OF PUMP SUCTION:	112 Feet. 1.25" Tee at well head. #10-4 sub cable.

WATER PRODUCTION RESULTS

WATER LEVEL AT START (STATIC LEVEL):	8.2 Feet	FLOW RATE AT START:	27 GPM
FINAL PUMPING LEVEL:	112 Feet	FINAL FLOW RATE:	**20 GPM**
WATER LEVEL DRAWDOWN:	103.8 Feet	TOTAL LENGTH OF TEST:	5 Hours

CONSTANT PUMPING LEVEL INFORMATION

STABILIZED PUMPING LEVEL:	112 Feet	STABILIZED FLOW RATE (YIELD):	**20 GPM**
DURATION OF CONSTANT PUMPING LEVEL:	4 Hours 30 Minutes	TOTAL YIELD:	see pumping log

WATER SYSTEM INSPECTION

WELL PUMP	Functional	TECHNICAL INFO: 27 GPM @ 100 PSI @ 10', 14.2 amps, control box dated 2006
ELECTRICAL	Functional	TECHNICAL INFO: 30 amp breaker at well head
PRESSURE TANK	Not observed	TECHNICAL INFO:
STORAGE TANK	Not observed	TECHNICAL INFO:
BOOSTER PUMP	Not observed	TECHNICAL INFO:

WATER QUALITY TESTING

THE FOLLOWING SAMPLES ARE BEING ANALYZED. PLEASE REFER TO FOLLOW-UP REPORT FOR RESULTS.

Basic Irrigation Package	DATED: 2/2/2015	TURNAROUND: Due 2/18/2015
Bacteria, Arsenic, Basic Minerals - Not Tested	DATED: Not Tested	TURNAROUND: Not Tested
	DATED:	TURNAROUND:
	DATED:	TURNAROUND:

SEE NEXT PAGE FOR FURTHER INFORMATION...

DATE: 2/2/2015

ADDRESS: 2339 Pickett Rd, Calistoga CA 94515

COMMENTS:

1. The recharge rate at the end of the test was 20 gallons per minute. This may not represent the long term or seasonal yield.

PUMPING LOG (2/2/15):

TIME	WATER LEVEL	COLOR	ODOR	SEDIMENT	GPM
12:15 PM	8.2'	ORANGE	SLIGHT METALLIC	PINCH FINE BLACK	27
12:30 PM	73.5'	ORANGE	SLIGHT METALLIC	PINCH FINE BLACK	34.4
12:45 PM	112'	ORANGE HAZE	NO	PINCH IRON PARTICULATE	26
1:00 PM	112'	CLOUDY YELLOW HAZE	NO	TRACE FINE BLACK	25.1
1:15 PM	112'	CLOUDY YELLOW HAZE	NO	TRACE FINE BLACK	24.3
1:45 PM	112'	CLOUDY YELLOW HAZE	NO	TRACE FINE BLACK	23.1
2:15 PM	112'	SLIGHT YELLOW HAZE	NO	TRACE FINE BLACK	22.5
2:45 PM	112'	SLIGHT YELLOW HAZE	NO	TRACE FINE BLACK	21.5
3:15 PM	112'	SLIGHT YELLOW HAZE	NO	TRACE FINE BLACK	21.1
3:45 PM	112'	SLIGHT YELLOW HAZE	NO	TRACE FINE BLACK	21
4:15 PM	112'	SLIGHT YELLOW HAZE	NO	TRACE FINE BLACK	20.3
4:45 PM	112'	SLIGHT YELLOW HAZE	NO	TRACE FINE BLACK	20.1
5:15 PM	112'	SLIGHT YELLOW HAZE	NO	TRACE FINE BLACK	20

RECOVERY (2/3/15):

TIME	WATER LEVEL	PERCENT OF TOTAL DRAWDOWN
5:00 PM	8.6'	99.61 %

Thank you for allowing us to do your well inspection!

APPROVED BY: NICK BRASESCO

Water levels and well depth are measured as feet below top of well casing unless otherwise noted.

All wells and springs are subject to seasonal and yearly changes in regards to water yield, production and quality. Wells may be influenced by creeks or other water sources and are likely to yield less water during dry months of the year; typically August, September, & October. We make no predictions of future water production or water quality.

WELL # 3 ROAD WELL

018-050-042

QUADRUPLICATE #3
For Local Requirements

Page ___ of ___

Owner's Well No. ___

Date Work Began 9-8-93, Ended 9-12-93

Local Permit Agency Napa

Permit No. [illegible] Permit Date 9-8-93

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet

No. **462608**

DWR USE ONLY — DO NOT FILL IN

STATE WELL NO./STATION NO.

LATITUDE LONGITUDE

APN/TRS/OTHER

GEOLOGIC LOG

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	34	rhyolite gray green very hard
34	35	clay white
35	100	rhyolite gray green
100	140	tuff + gray green soft [illegible]
140	160	tuff + rhyolite [illegible]
160	240	rhyolite gray green hard blue white green
240	260	blue white green, hard

RECEIVED JAN 31 1994 DEPT. OF ENVIRONMENTAL MANAGEMENT

TOTAL DEPTH OF BORING 260 (Feet)

TOTAL DEPTH OF COMPLETED WELL 120 (Feet)

WELL OWNER

Name [illegible]

Mailing Address [illegible]

[illegible] CITY Ca. 94708 STATE ZIP

WELL LOCATION

Address End Pickett Road Calist.

City Calistoga

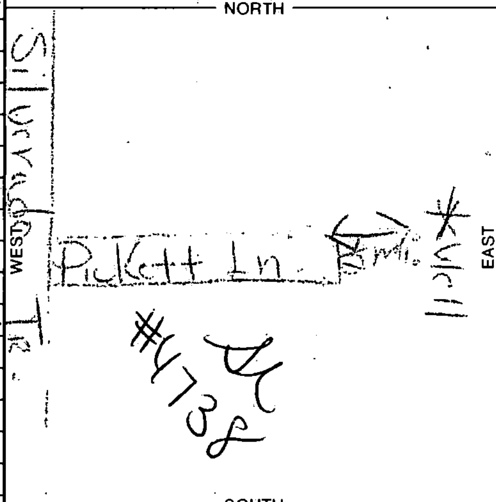
County Napa

APN Book 18 Page ___ Parcel 18-060-42

Township ___ Range ___ Section ___

Latitude ___ NORTH Longitude ___ WEST
DEG. MIN. SEC. DEG. MIN. SEC.

LOCATION SKETCH



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

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)

DRILLING METHOD air rotary FLUID ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH OF STATIC WATER LEVEL 35 (Ft.) & DATE MEASURED 9-16-93

ESTIMATED YIELD* 18 (GPM) & TEST TYPE air lift

TEST LENGTH 4 (Hrs.) TOTAL DRAWDOWN 70 (Ft.)

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

CASING(S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	35	9 7/8	✓				plastic	5	200	
35	40	9 7/8	✓				"	"	"	
40	120	8 3/4		✓			"	"	"	3/32

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	21	✓			
21	160				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.

NAME Pulliam Well Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

3277 Piedmont Ave. Napa Ca. 94558
ADDRESS CITY STATE ZIP

Signed [signature] 10-5-93 248677
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 7/90 IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

Well #4

WELL 4 (BLOCK 4, PROJECT WELL) PUMP TEST

Phone: (707) 823-3191 **Fax:** (707) 317-0057 **Email:** rayswelltesting@gmail.com
Address: 4853 Vine Hill Rd, Sebastopol Ca 95472 **CA Lic. #:** 903708

Well Yield Pump Test for Water Supply Permit

The following test was performed for:

Kelly Fleming Winery
2339 Pickett Rd
Calistoga Ca 94515

Water flow rate measurements were determined by Master Meter multi jet water meters and verified using a container and stopwatch. Water levels were measured with Solinst water level sounding device.

Please contact **Ray's Well Testing Service, Inc**. with any questions: 707 823 3191

Respectfully submitted,
Nick Brasesco

Ray's Well Testing Service Inc.
Phone Number: 707 823 3191
Address: 2339 Pickett Rd., Calistoga, CA 94515
Water System Name: Kelly Fleming Winery
Water System Number:
Well Permit Number:

Page1 **8 -Hour Pump Test Form with Recovery Dat** **Static Water Level:** 343.7

Date	Time	Interval	Water Level	GPM	Water color:	Odor:	Sand:
02/03/15	08:55:00 AM	10 Mins	343.7	12	Clear	No	No
02/03/15	09:05:00 AM	10 Mins	365	12	Clear	No	No
02/03/15	09:15:00 AM	10 Mins	372.8	12	Clear	No	No
02/03/15	09:25:00 AM	10 Mins	378.7	12	Clear	No	No
02/03/15	09:35:00 AM	10 Mins	382.5	12	Clear	No	No
02/03/15	09:45:00 AM	10 Mins	385.3	12	Clear	No	No
02/03/15	09:55:00 AM	10 Mins	386.8	12	Clear	No	No
02/03/15	10:05:00 AM	10 Mins	390.2	12	Clear	No	No
02/03/15	10:15:00 AM	10 Mins	391.4	12	Clear	No	No
02/03/15	10:25:00 AM	10 Mins	392.9	12	Clear	No	No
02/03/15	10:35:00 AM	10 Mins	394	12	Clear	No	No
02/03/15	10:45:00 AM	10 Mins	395.3	12	Clear	No	No
02/03/15	10:55:00 AM	20 Mins	396.8	11.2	Clear	No	No
02/03/15	11:15:00 AM	20 Mins	413.7	10.8	Clear	No	No
02/03/15	11:35:00 AM	20 Mins	439	9.8	Clear	No	No
02/03/15	11:55:00 AM	30 Mins	481	8.7	Clear	No	No
02/03/15	12:25:00 PM	30 Mins	538	7.4	Clear	No	No
02/03/15	12:55:00 PM	30 Mins	567	5.4	Clear	No	No
02/03/15	01:25:00 PM	30 Mins	567	4.3	Clear	No	No
02/03/15	01:55:00 PM	30 Mins	567	3.8	Clear	No	No
02/03/15	02:25:00 PM	30 Mins	567	2.6	Clear	No	No
02/03/15	02:55:00 PM	30 Mins	567	2.6	Clear	No	No
02/03/15	03:25:00 PM	30 Mins	567	2.6	Clear	No	No
02/03/15	03:55:00 PM	30 Mins	567	2.6	Clear	No	No
02/03/15	04:25:00 PM	30 Mins	567	2.6	Clear	No	No
02/03/15	04:55:00 PM	30 Mins	567	2.6	Clear	No	No
02/03/15	05:25:00 PM	30 Mins	567	2.6	Clear	No	No
02/03/15	05:55:00 PM	30 Mins	567	2.6	Clear	No	No
02/03/15	06:25:00 PM	30 Mins	567	2.6	Clear	No	No

Static level:	343.7
Water level drawdown:	223.3
Final Pumping level:	567

Page 2 8 -Hour Pump Test Form with Recovery Data

Date	Time	Interval	Water Level	Recovery %
02/03/15	06:40:00 PM	15 Mins	538.5	12.76%
02/03/15	06:55:00 PM	15 Mins	514.5	23.51%
02/03/15	07:10:00 PM	15 Mins	495	32.24%
02/03/15	07:25:00 PM	15 Mins	477	40.30%
02/03/15	07:40:00 PM	15 Mins	461.2	47.38%
02/03/15	07:55:00 PM	15 Mins	446.1	54.14%
02/03/15	08:10:00 PM	15 Mins	431.1	60.86%
02/03/15	08:25:00 PM	15 Mins	416.3	67.49%
02/04/15	03:55:00 AM	7.5 Hours	345.3	99.28%

-Water level recovered 99.28%
-Water levels recorded as feet below surface.

Well Data:
-Well pump: 3HP 10S30-34 230V 1ph Submersible
-#4-4 sub cable
-Depth as measured by pump installer - 595 Feet
-Pump setting - 567 Feet on 1.25" galvanized

ORIGINAL
File with DWR

Page 1 of 1

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet

No. e023056

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

Owner's Well No. Well #5-'05
Date Work Began 4/13/2005, Ended 4/27/2005
Local Permit Agency Napa County Environmental Mgmt
Permit No. E05-0183 Permit Date 3/23/2005

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD HAMMER FLUID AIR

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain, size, color, etc.*
0	30	LIGHT TAN VOLCANICS
30	60	GRAY & TAN VOLCANICS
60	160	GRAY & GREEN VOLCANICS
160	200	BLACK & GREEN VOLCANICS
200	280	DARK GREEN VOLCANICS
280	400	GRAY, GREEN & WHITE VOLCANICS
400	480	DARK GRAY GREEN VOLCANICS
480	580	LIGHT GRAY VOLCANICS
580	600	DARK GRAY GREEN VOLCANICS
		CONTINUED CASING LAYOUT
419	579	SCREEN PVC 6" .032 SLOT
579	599	BLANK PVC 6"

TOTAL DEPTH OF BORING 600 (Feet)
TOTAL DEPTH OF COMPLETED WELL 599 (Feet)

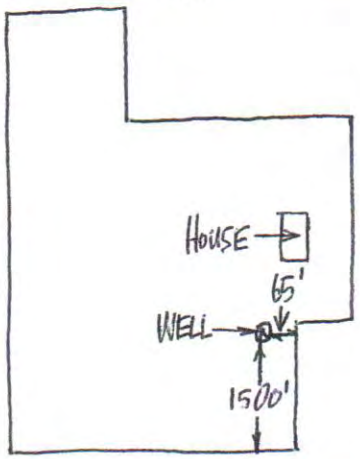
WELL OWNER

Name Kelly Fleming
Mailing Address 2343 Pickett Road
Calistoga CA 94515
CITY STATE ZIP

WELL LOCATION

Address 2343 Pickett Road
City Calistoga CA
County Napa
APN Book 018 Page 050 Parcel 067
Township ___ Range ___ Section ___
Latitude ___ DEG. ___ MIN. ___ SEC. ___ 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.**

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 230 (Ft.) BELOW SURFACE 1
DEPTH OF STATIC WATER LEVEL 183 (Ft.) & DATE MEASURED 4/26/2005
ESTIMATED YIELD 25 (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.

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE (✓) BLANK	SCREEN	CONDUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	60	12								
60	600	9								
0	179		✓				PVC F480	6	SDR-21	
179	399			✓			PVC F480	6	SDR-21	.032
399	419		✓				PVC F480	6	SDR-21	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	TYPE CEMENT (✓)	BENTONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	52	✓			CONCRETE
52	599			✓	#6 SAND

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] 04/27/05 439-746
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97.

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

Well #5 BIG TANKS WELL

Ray's Well Testing Service Inc.
4031 Shadowhill Dr, Santa Rosa Ca 95404
Phone 707 823 3191 **Fax** 707 317 0057 **Lic#** 903708

WELL 5 (BIG TANKS) PUMP TEST

CUSTOMER INFORMATION

REPORT #: 7008-4 By: Matt Owens	DATE OF TEST: 2/2/2015
CUSTOMER NAME: Kelly Fleming Winery	CONTACT: 707 942 6849
AGENT NAME:	CONTACT:
PROPERTY ADDRESS: 2339 Pickett Rd, Calistoga CA 94515	SENT TO: kelly@kellyflemingwines.com

WELL DATA

LOCATION OF WELL:	Well #4
TYPE OF WELL:	Drilled
DEPTH OF COMPLETED WELL:	218 Feet per installer records. 220 Feet per well log.
DIAMETER OF WELL CASING:	5" PVC
SANITARY WELL SEAL (PLATE SEAL AT OPENING OF WELL CASING):	Yes
ANNULAR SEAL (IN-GROUND SEAL OF BOREHOLE):	25 Feet - Per well log
PUMP HP AND TYPE:	1HP 230V 1 Ph. Submersible 10S10
DEPTH OF PUMP SUCTION:	Unknown - Refer to installer (Mclean Williams).

WATER PRODUCTION RESULTS

WATER LEVEL AT START (STATIC LEVEL):	26.5 Feet	FLOW RATE AT START:	16 GPM
FINAL PUMPING LEVEL:	40.5 Feet	FINAL FLOW RATE:	**12.6 GPM**
WATER LEVEL DRAWDOWN:	14 Feet	TOTAL LENGTH OF TEST:	5 Hours

CONSTANT PUMPING LEVEL INFORMATION

STABILIZED PUMPING LEVEL:	40.5 Feet	STABILIZED FLOW RATE (YIELD):	**12.6 GPM**
DURATION OF CONSTANT PUMPING LEVEL:	3 Hours	TOTAL YIELD:	see pumping log

WATER SYSTEM INSPECTION

WELL PUMP	Functional	TECHNICAL INFO: 13.2 GPM @ 70 PSI @ 30', Installed 2/3/2015
ELECTRICAL	Functional	TECHNICAL INFO: 20 amp breaker at well head
PRESSURE TANK	Not observed	TECHNICAL INFO:
STORAGE TANK	Not observed	TECHNICAL INFO:
BOOSTER PUMP	Not observed	TECHNICAL INFO:

WATER QUALITY TESTING

THE FOLLOWING SAMPLES ARE BEING ANALYZED. PLEASE REFER TO FOLLOW-UP REPORT FOR RESULTS.		
Basic Irrigation Package	DATED: 2/4/2015	TURNAROUND: Due 2/19/2015
Bacteria, Arsenic, Basic Minerals - Not Tested	DATED: Not Tested	TURNAROUND: Not Tested
	DATED:	TURNAROUND:
	DATED:	TURNAROUND:

SEE NEXT PAGE FOR FURTHER INFORMATION...

DATE: 2/2/2015

ADDRESS: 2339 Pickett Rd, Calistoga CA 94515

COMMENTS:

1. The recharge rate at the end of the test was 12.6 gallons per minute. This may not represent the long term or seasonal yield.

PUMPING LOG (2/4/15):

TIME	WATER LEVEL	COLOR	ODOR	SEDIMENT	GPM
1:00 PM	26.5'	NO	NO	TRACE IRON PARTICULATE	16
1:15 PM	34'	NO	NO	NO	15.6
1:30 PM	35.5'	NO	NO	NO	15.6
1:45 PM	37'	NO	NO	NO	15.6
2:00 PM	37.8'	NO	NO	NO	15.6
2:15 PM	38.4'	NO	NO	NO	15.6
2:30 PM	39.3'	NO	NO	NO	15.6
2:45 PM	40'	NO	NO	NO	15.6
3:00 PM	40.5'	NO	NO	NO	14.2
3:30 PM	40.5'	NO	NO	NO	13.7
4:00 PM	40.5'	NO	NO	NO	13
4:30 PM	40.5'	NO	NO	NO	12.6
5:00 PM	40.5'	NO	NO	NO	12.6
5:30 PM	40.5'	NO	NO	NO	12.6
6:00 PM	40.5'	NO	NO	NO	12.6

RECOVERY (2/5/2015):

TIME	WATER LEVEL	PERCENT OF TOTAL DRAWDOWN
8:40 AM	26.7'	98.5%

Thank you for allowing us to do your well inspection!

APPROVED BY: NICK BRASESCO

Water levels and well depth are measured as feet below top of well casing unless otherwise noted.

All wells and springs are subject to seasonal and yearly changes in regards to water yield, production and quality. Wells may be influenced by creeks or other water sources and are likely to yield less water during dry months of the year; typically August, September, & October. We make no predictions of future water production or water quality.

WELL # 5 BIG TANKS WELL

18-050-042

QUADRUPLICATE
For Local Requirements

Page ___ of ___
Owner's Well No. ___
Date Work Began 9-14-99, Ended 9-20-99
Local Permit Agency Napa County
Permit No. 96-11294 Permit Date 8-30-99

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet

No. **814587**

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 AIR

DEPTH FROM SURFACE Ft. to Ft.	DESCRIPTION *Describe material, grain size, color, etc.*
0 – 25	brown clay, gray rock
25 – 530	gray ash with white ash

TOTAL DEPTH OF BORING 530 (Feet)
TOTAL DEPTH OF COMPLETED WELL 220 (Feet)

RECEIVED
JAN 3 2000
DEPT. OF ENVIRONMENTAL MANAGEMENT

WELL OWNER

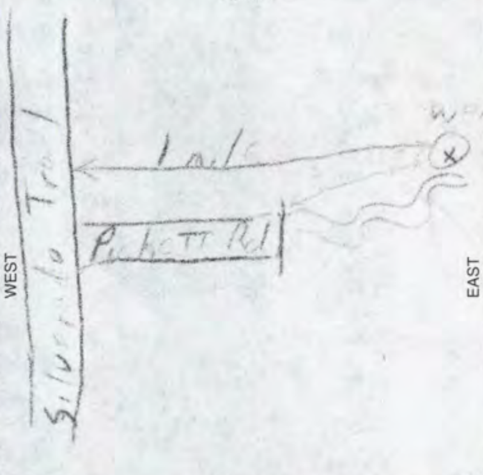
Name Fleming
Mailing Address Box 323
Calistoga Ca.
CITY STATE ZIP

WELL LOCATION

Address end of Pickett rd
City Calistoga
County Napa
APN Book ___ Page ___ Parcel 018-050-042
Township ___ Range ___ Section ___
Latitude ___ NORTH Longitude ___ WEST
DEG. MIN. SEC.

LOCATION SKETCH

NORTH



SOUTH

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) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER 40 (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL 40 (Ft.) & DATE MEASURED 9-20-99
ESTIMATED YIELD * 25 (GPM) & TEST TYPE Air Lift
TEST LENGTH 4 (Hrs.) TOTAL DRAWDOWN 180 (Ft.)
** May not be representative of a well's long-term yield.*

CASING (S)

DEPTH FROM SURFACE Ft. to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0 – 75	9	✓				Plastic	5	200	
75 – 220	9		✓			"			Factory 1/32

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft. to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0 – 25	✓			
25 – 220				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.

NAME Pulliam Well Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
ADDRESS 3877 Piedmont Ave CITY Napa STATE Ca. ZIP 94558
Signed [signature] WELL DRILLER/AUTHORIZED REPRESENTATIVE
DATE SIGNED 9-28-99 C-57 LICENSE NUMBER 248677

DWR 188 REV. 11-97 IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

APPENDIX C

NAPA COUNTY GROUNDWATER RECHARGE ANALYSIS

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 it's 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).

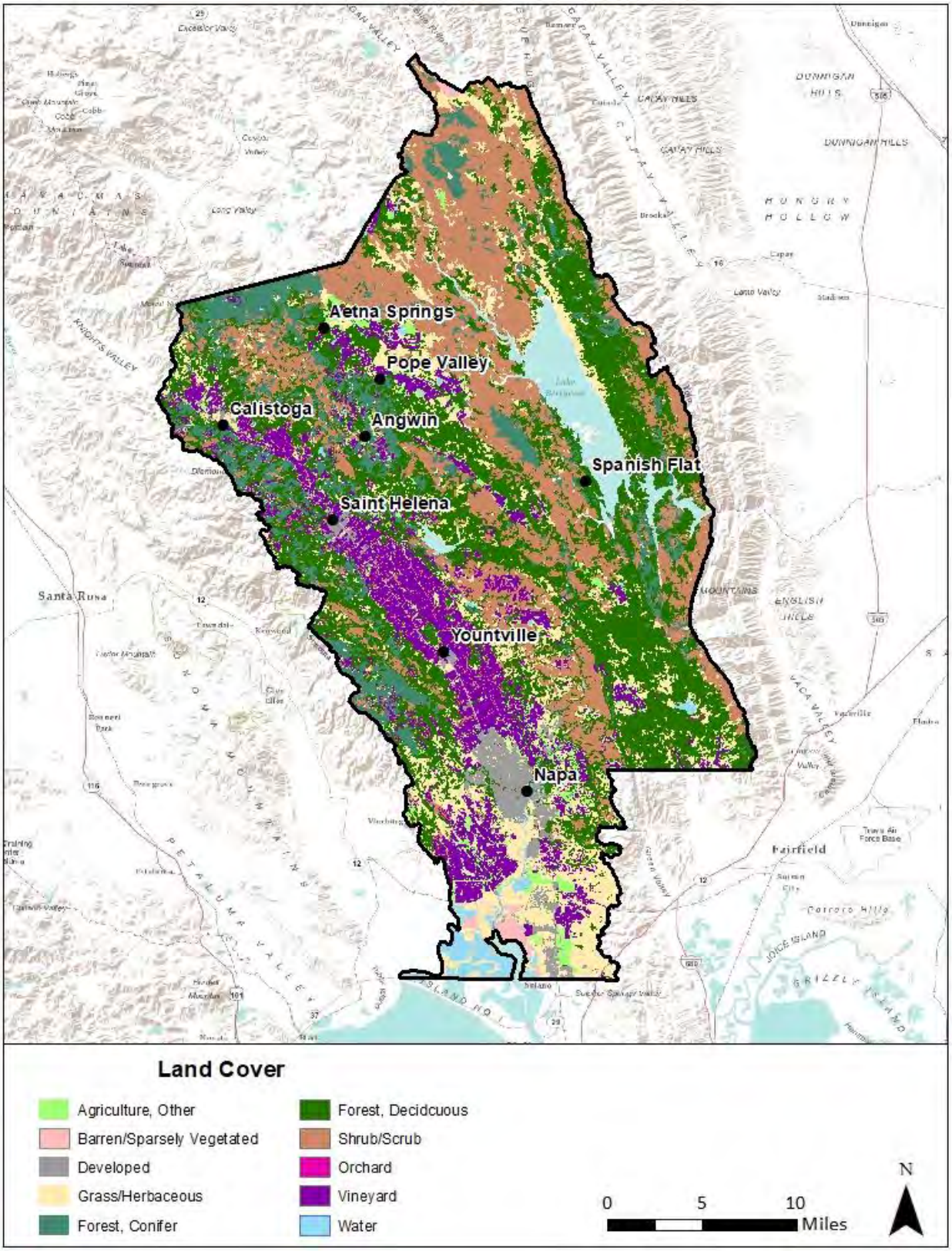


Figure 1: Land cover distribution used in the Napa County SWB model.

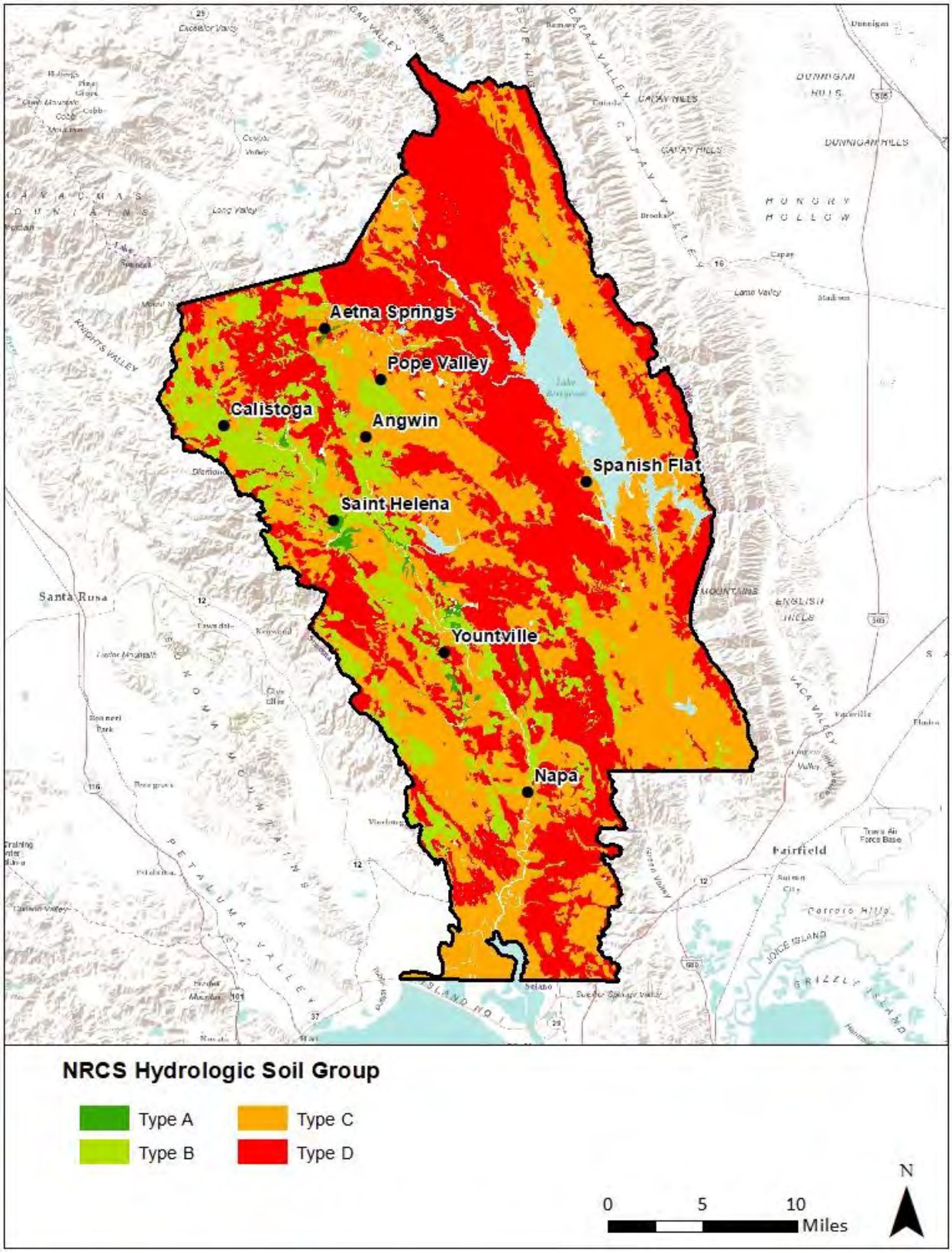


Figure 2: Hydrologic soil group distribution used in the Napa County SWB model.

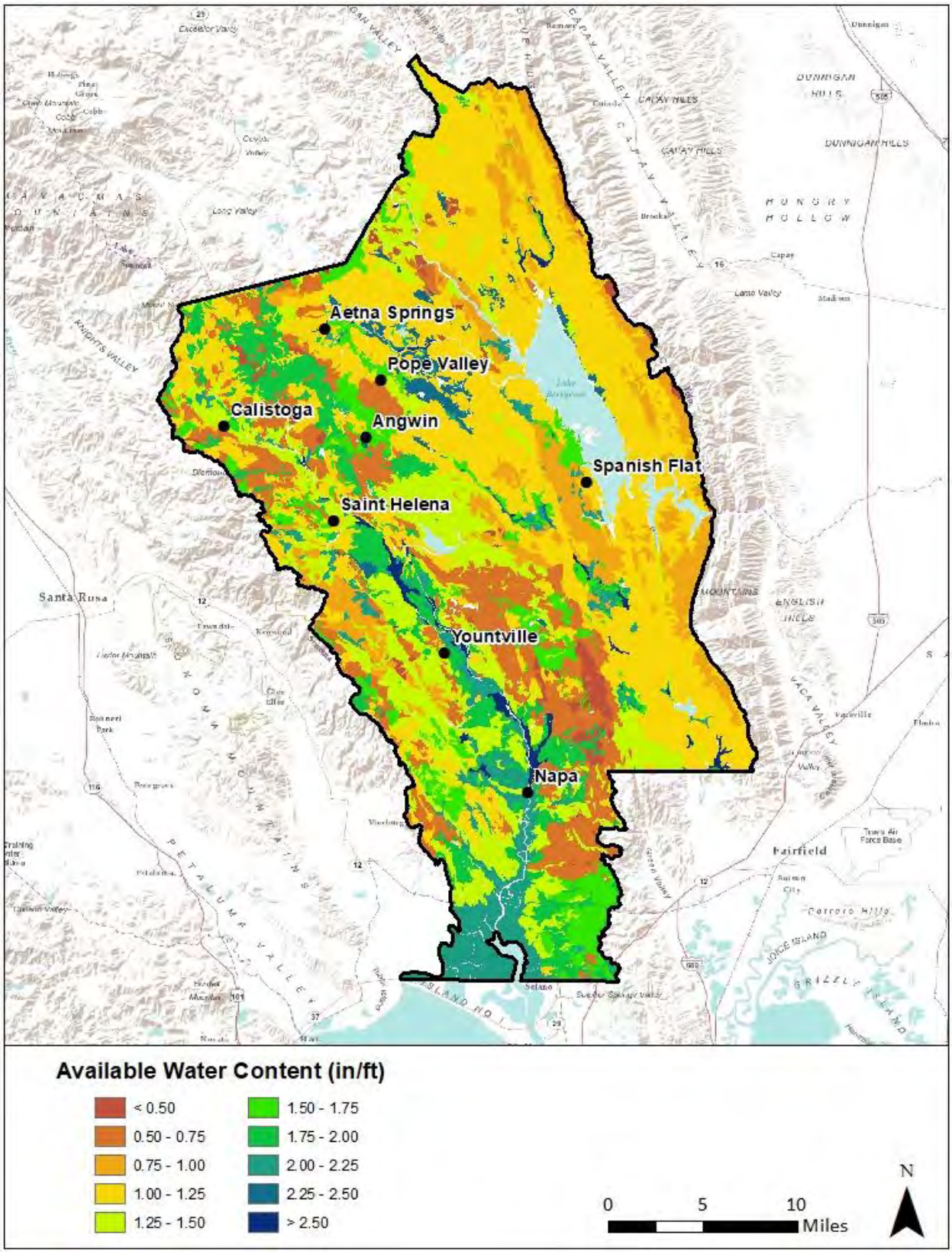


Figure 3: Available water capacity distribution used in the Napa County SWB model.

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

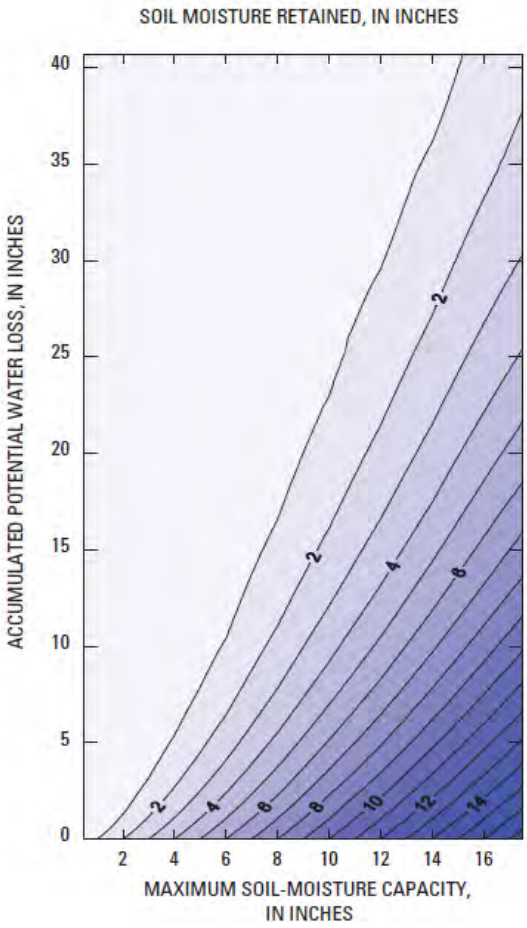


Figure 4: Soil-moisture-retention table (Thornthwaite and Mather 1957).

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 Annual Precip (in)	WY 2010		WY 2014	
			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

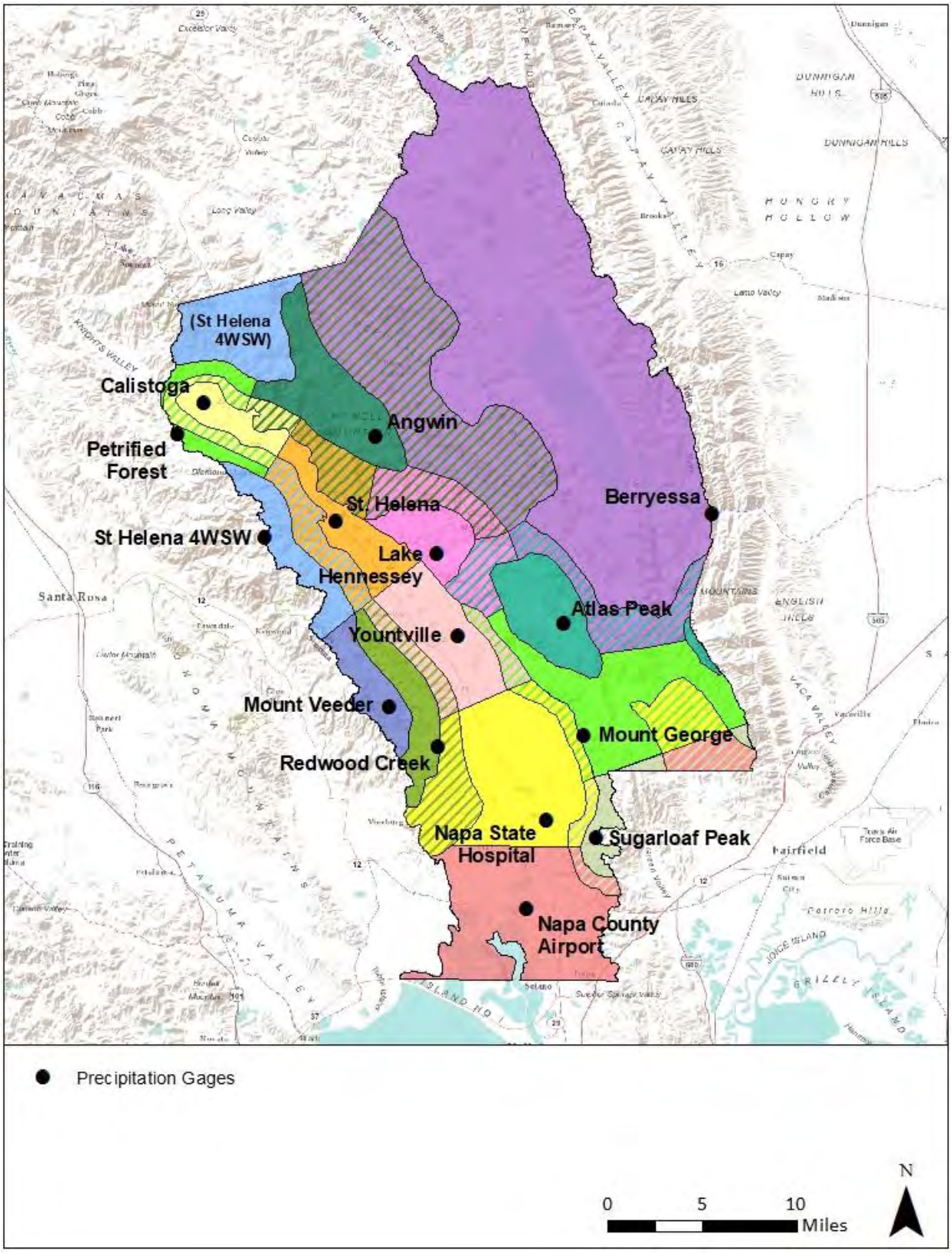


Figure 5: Precipitation zones used in the Napa County SWB model. Hatching indicates areas where two precipitation records were averaged across a zone.

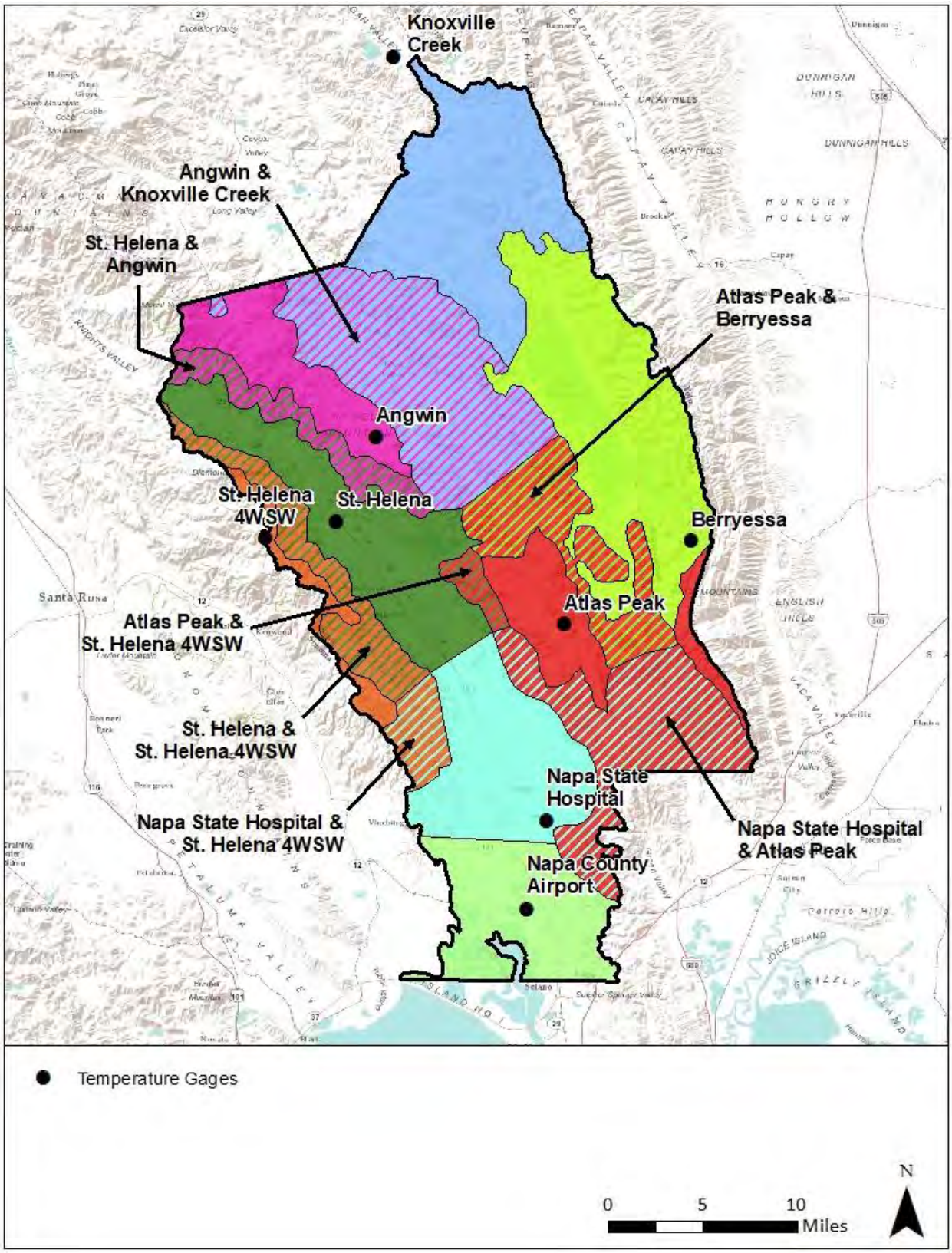


Figure 6: Temperature zones used in the Napa County SWB model. Hatching indicates areas where two temperature records were averaged across a zone.

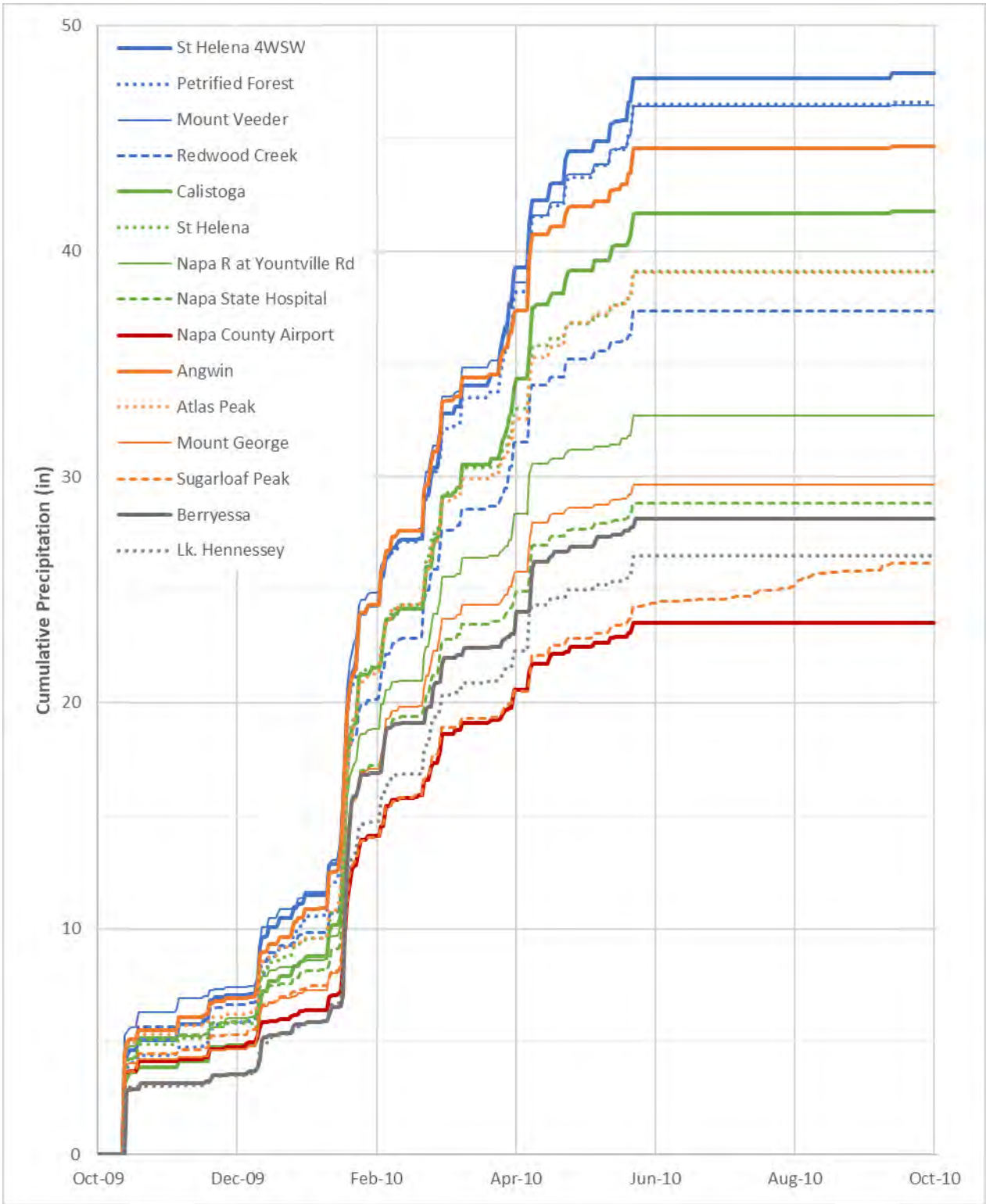


Figure 7a: Daily precipitation data used in the Napa County SWB model for WY 2010.

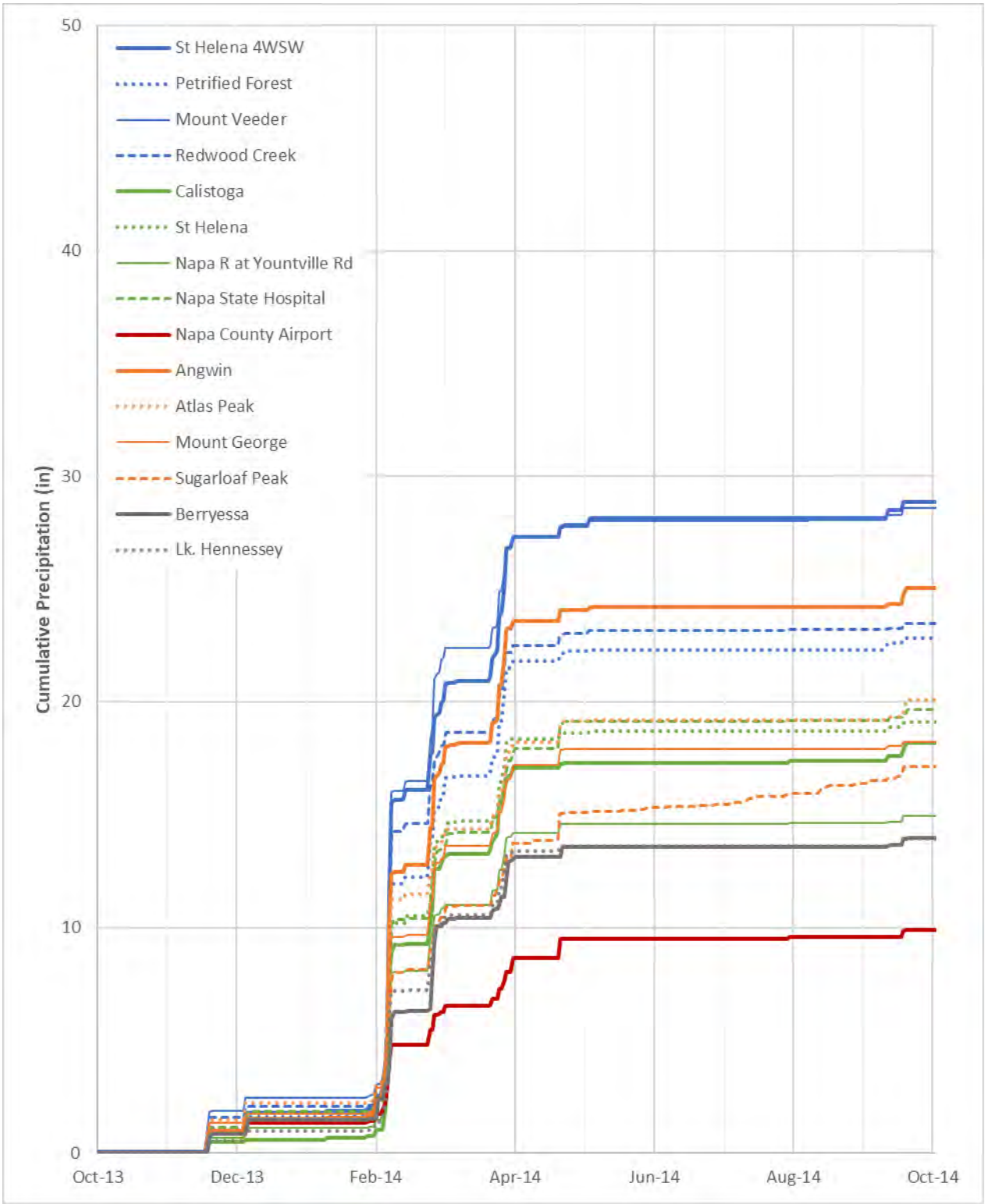


Figure 7b: Daily precipitation data used in the Napa County SWB model for WY 2014.

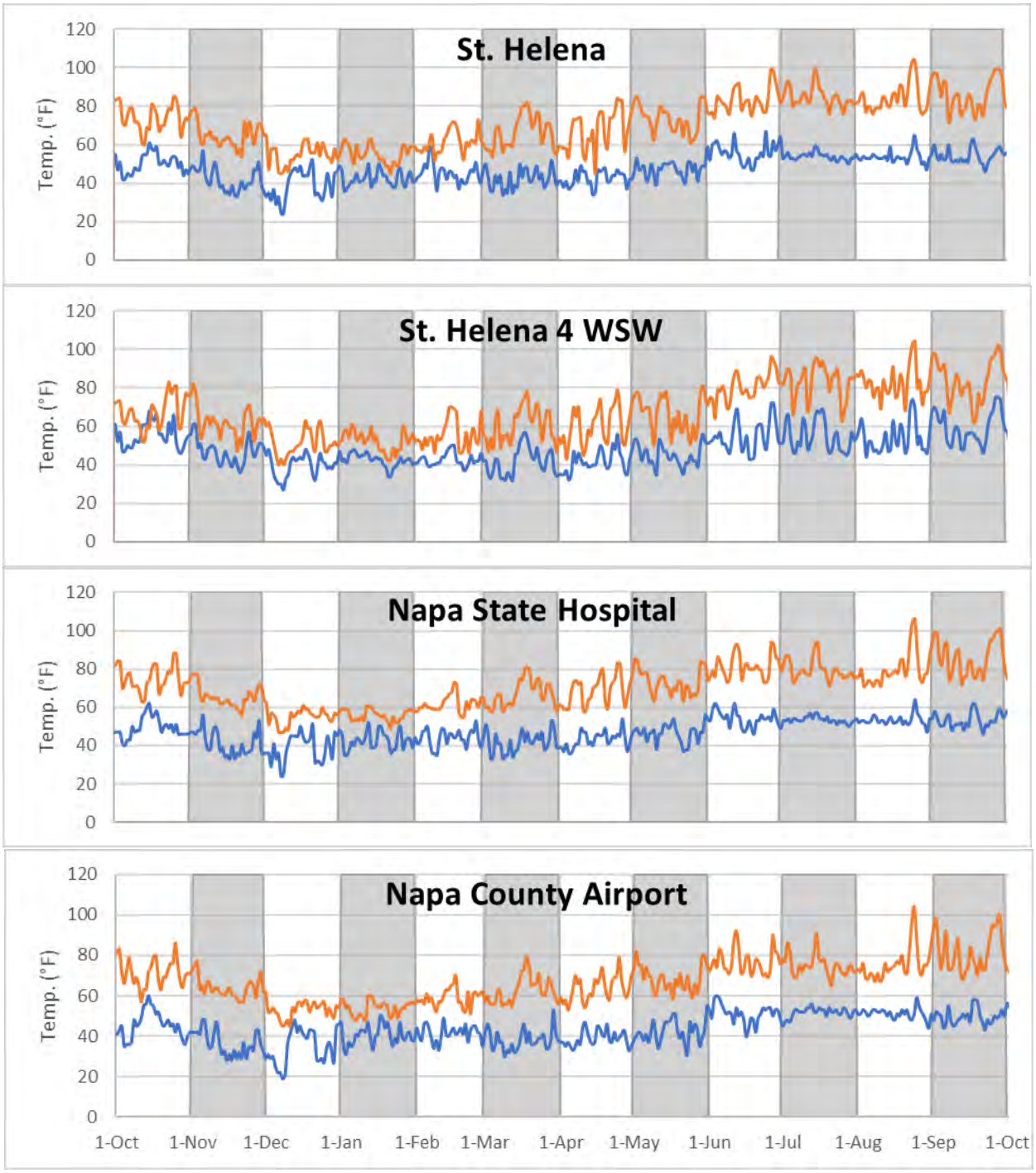


Figure 8: Daily minimum and maximum temperature data used in the Sonoma County SWB model for WY 2010.

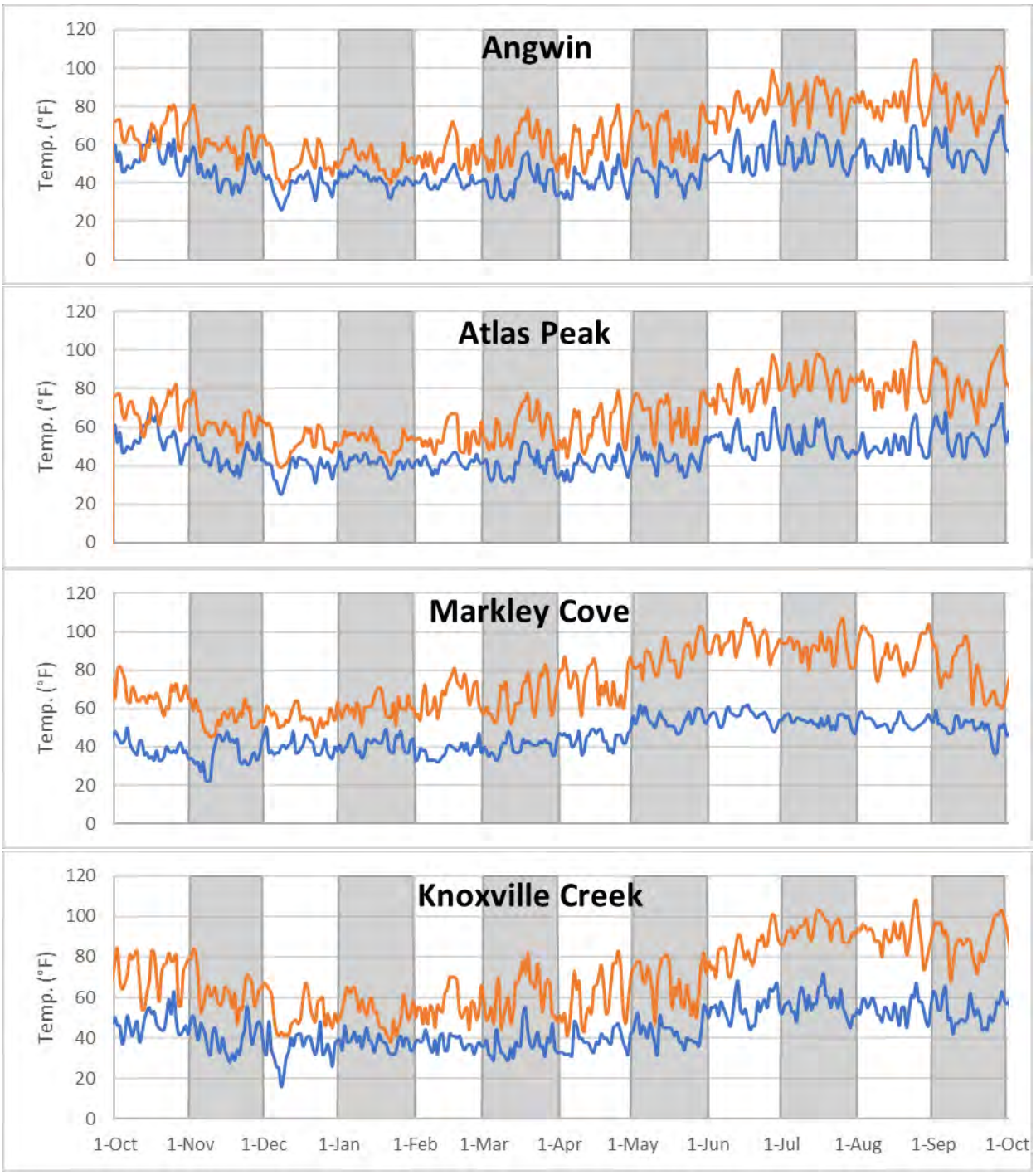


Figure 8 – cont.

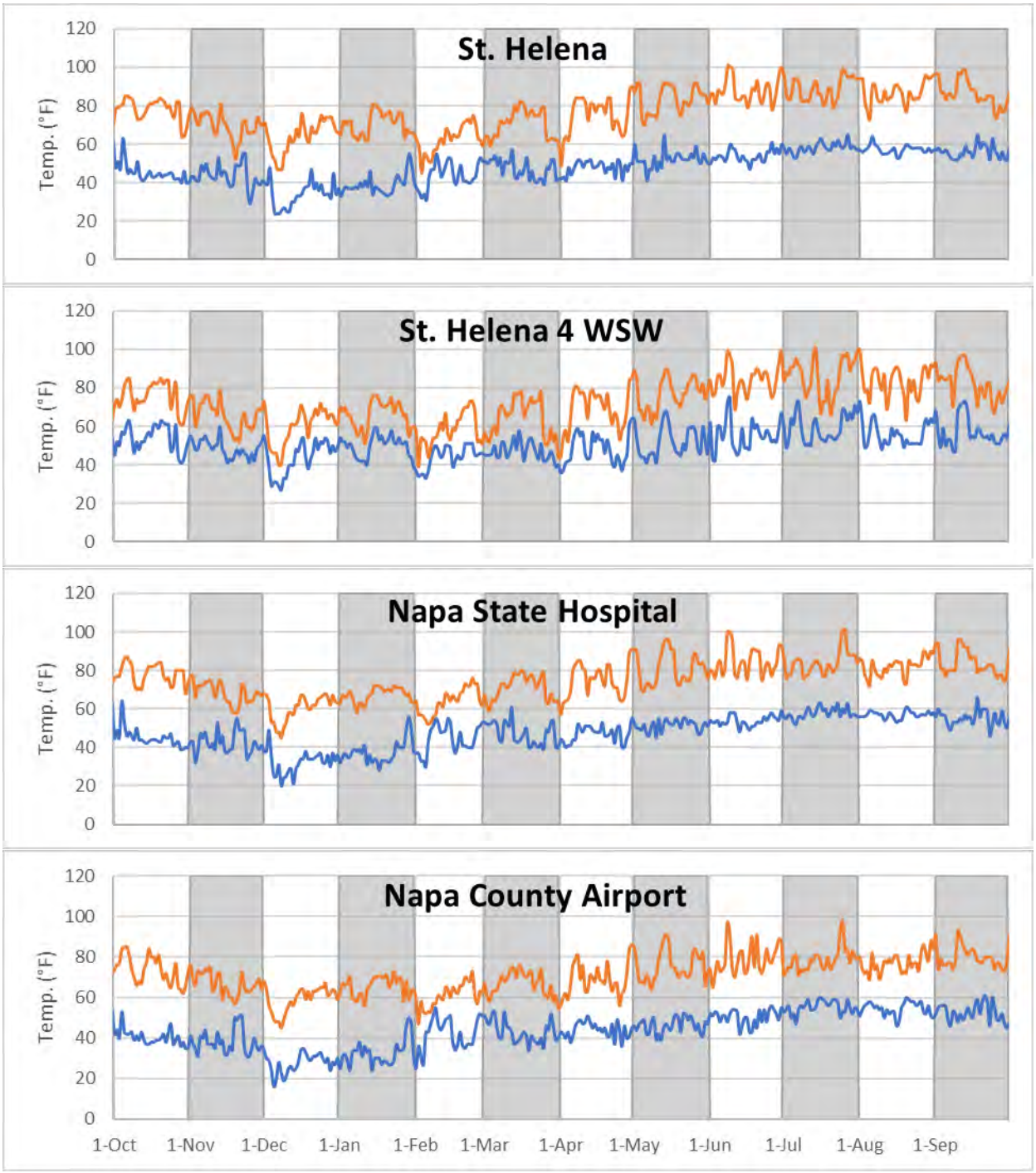


Figure 9: Daily minimum and maximum temperature data used in the Sonoma County SWB model for WY 2010.

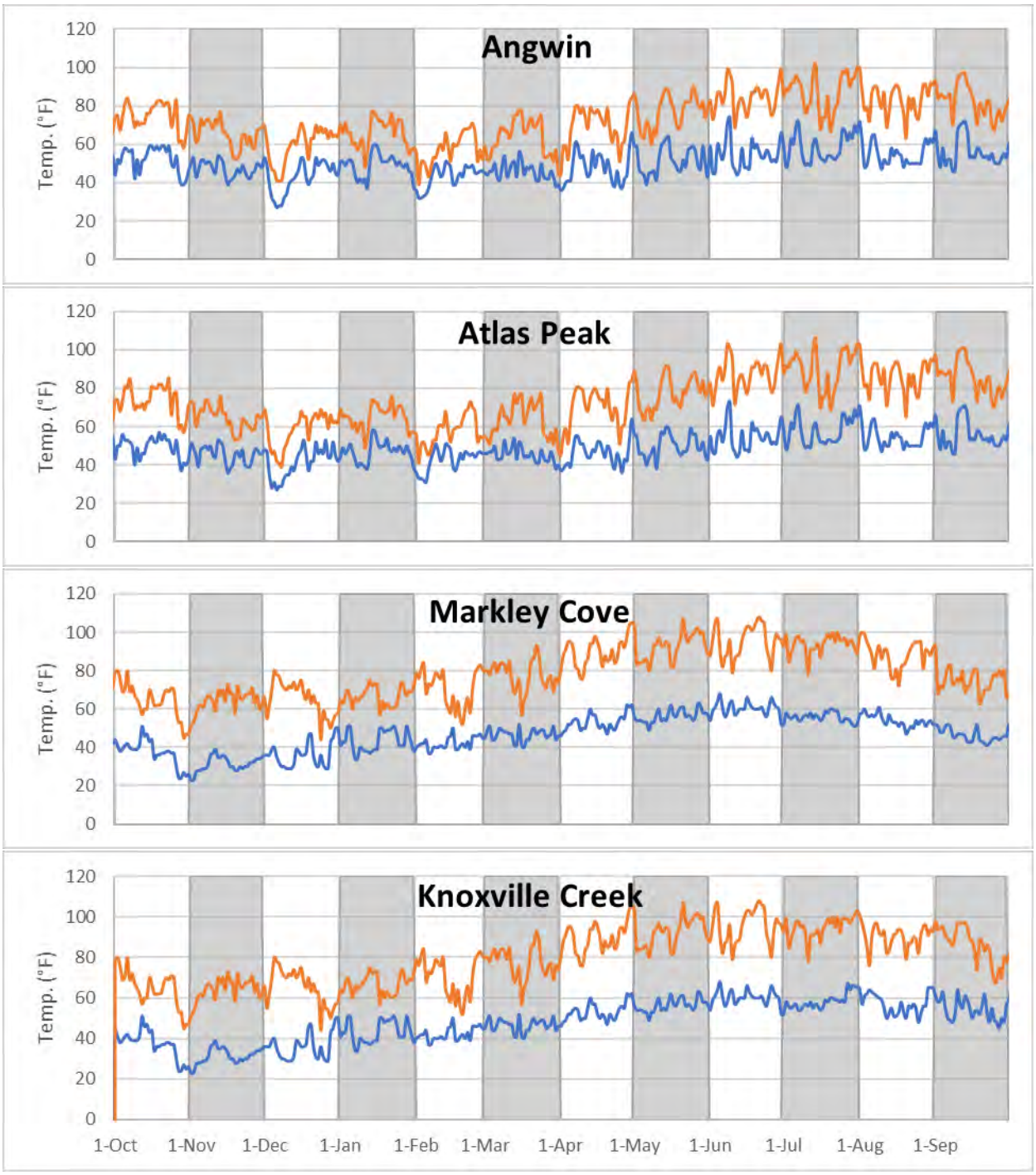


Figure 9 – cont.

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 mi^2) 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.

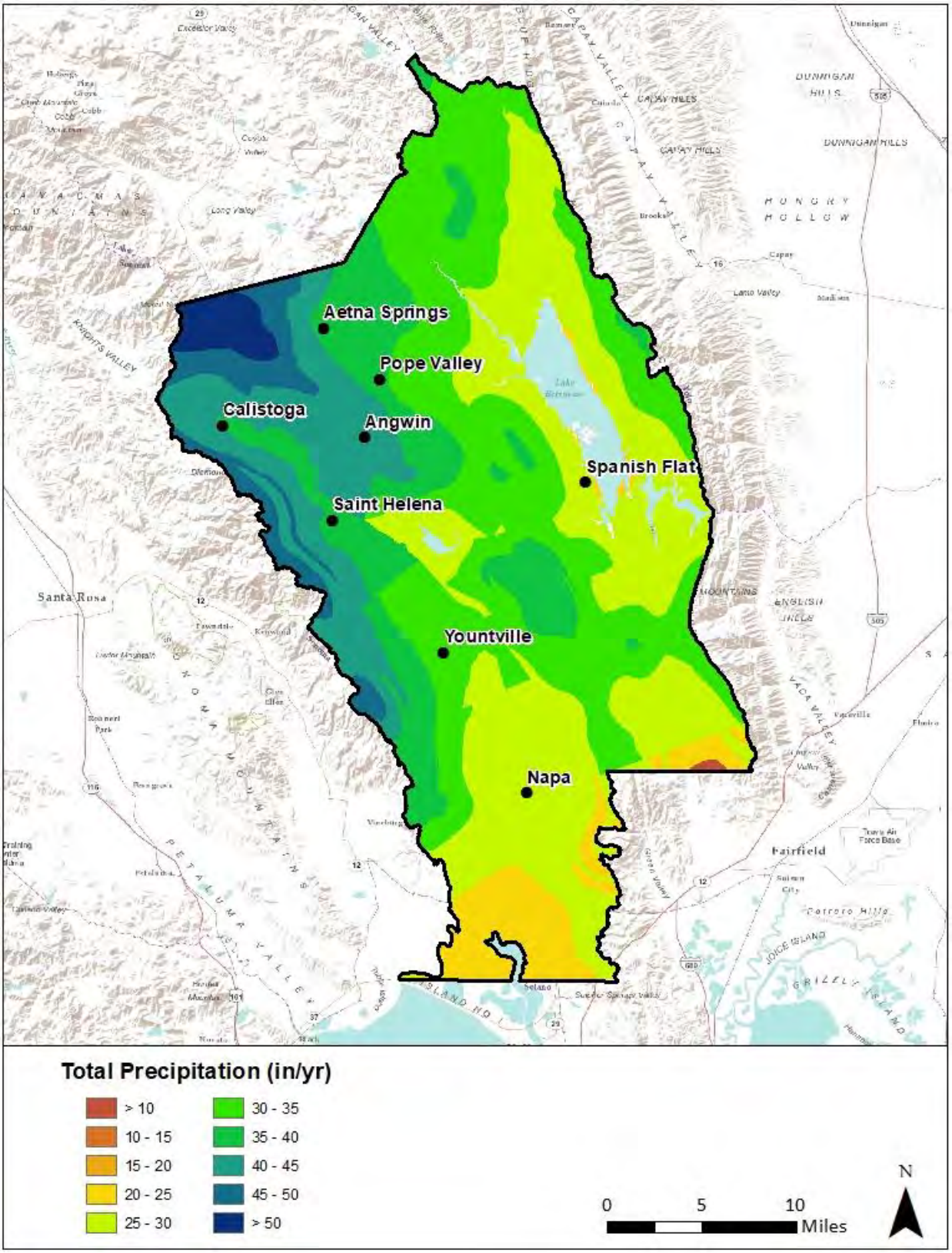


Figure 10: Water Year 2010 precipitation simulated with the Napa County SWB model.

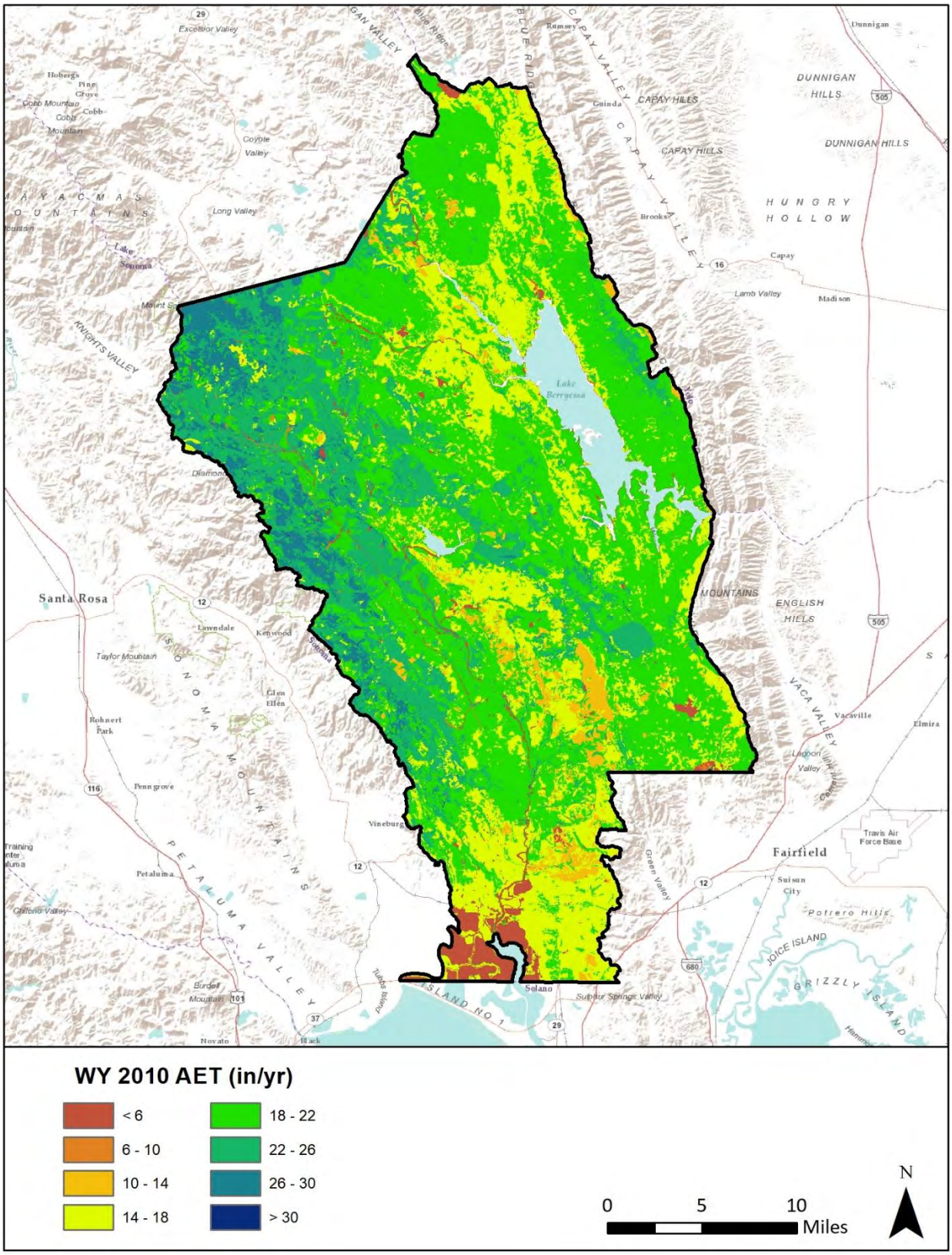


Figure 11: Water Year 2010 AET simulated with the Napa County SWB model.

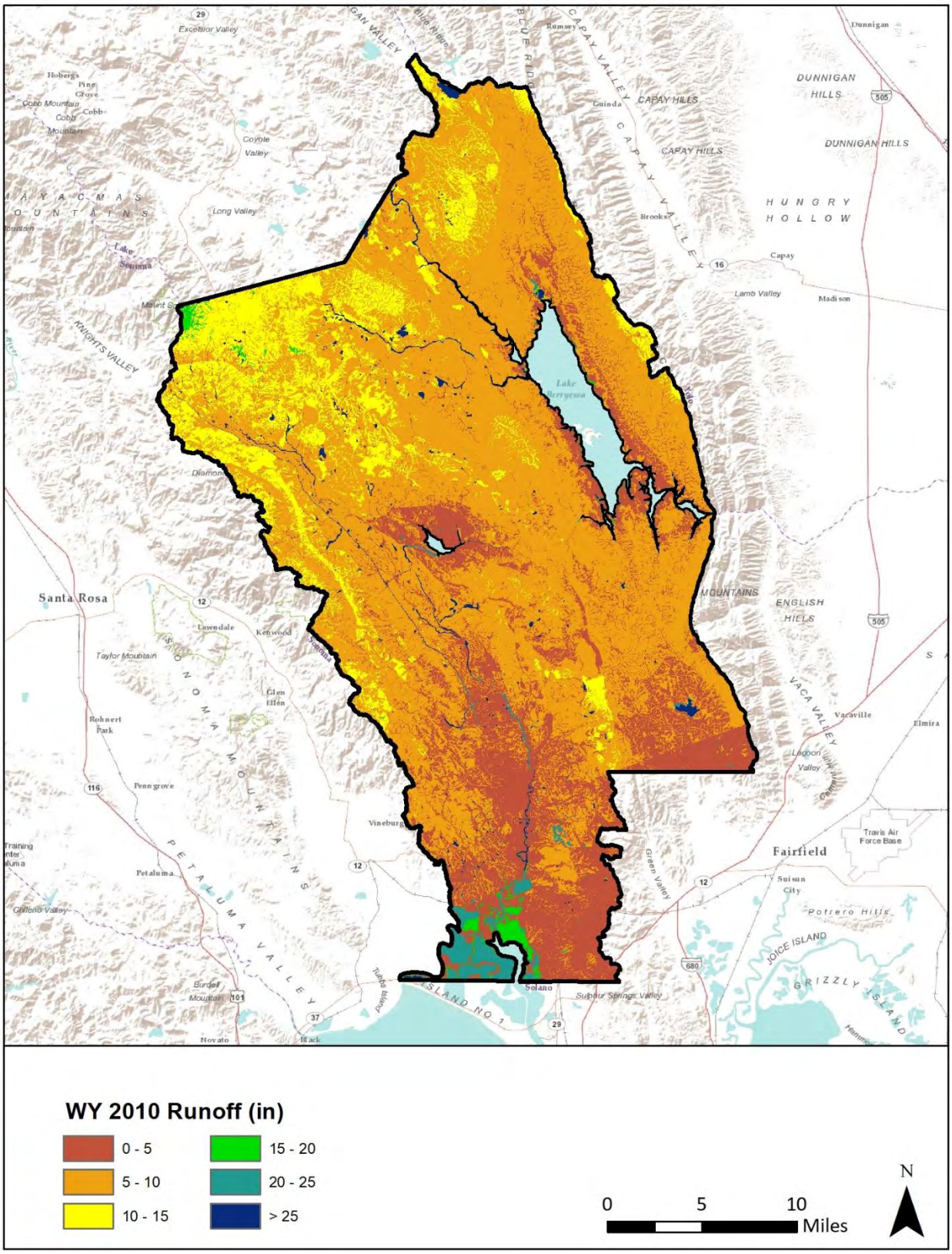


Figure 12: Water Year 2010 runoff simulated with the Napa County SWB model.

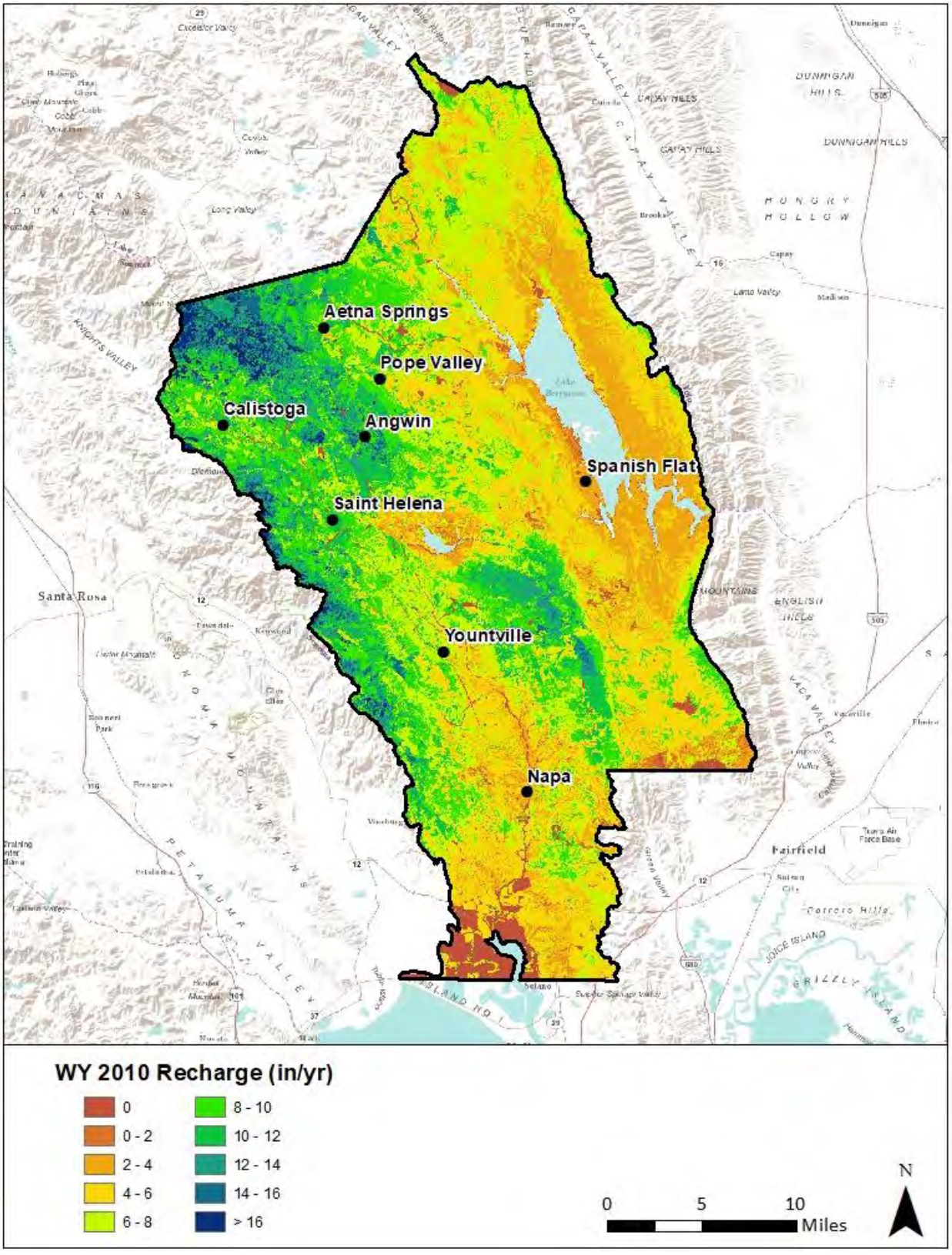


Figure 13: Water Year 2010 recharge simulated with the Napa County SWB model.

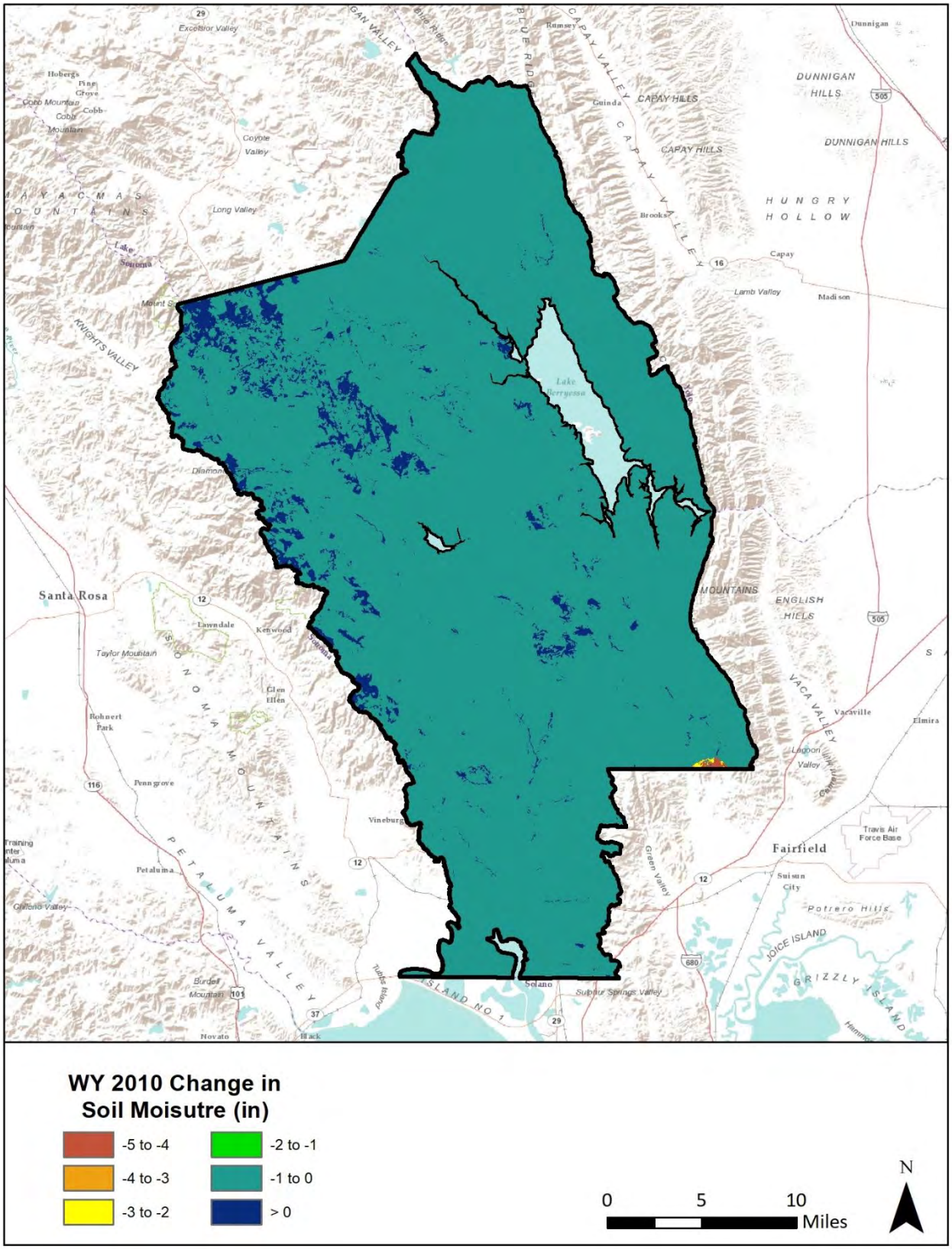


Figure 14: Water Year 2010 change in soil moisture content simulated with the Napa County SWB model.

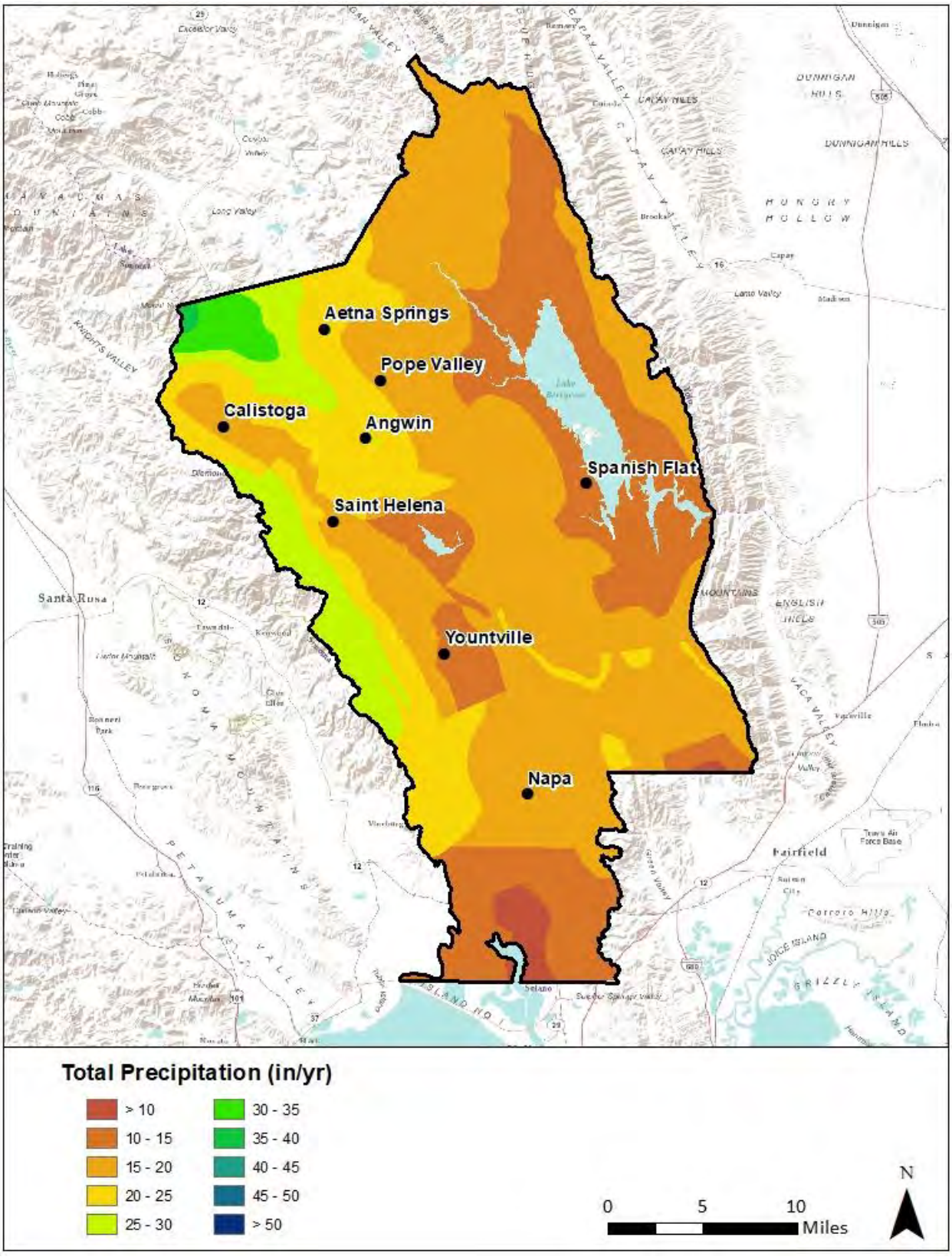


Figure 15: Water Year 2014 precipitation simulated with the Napa County SWB model.

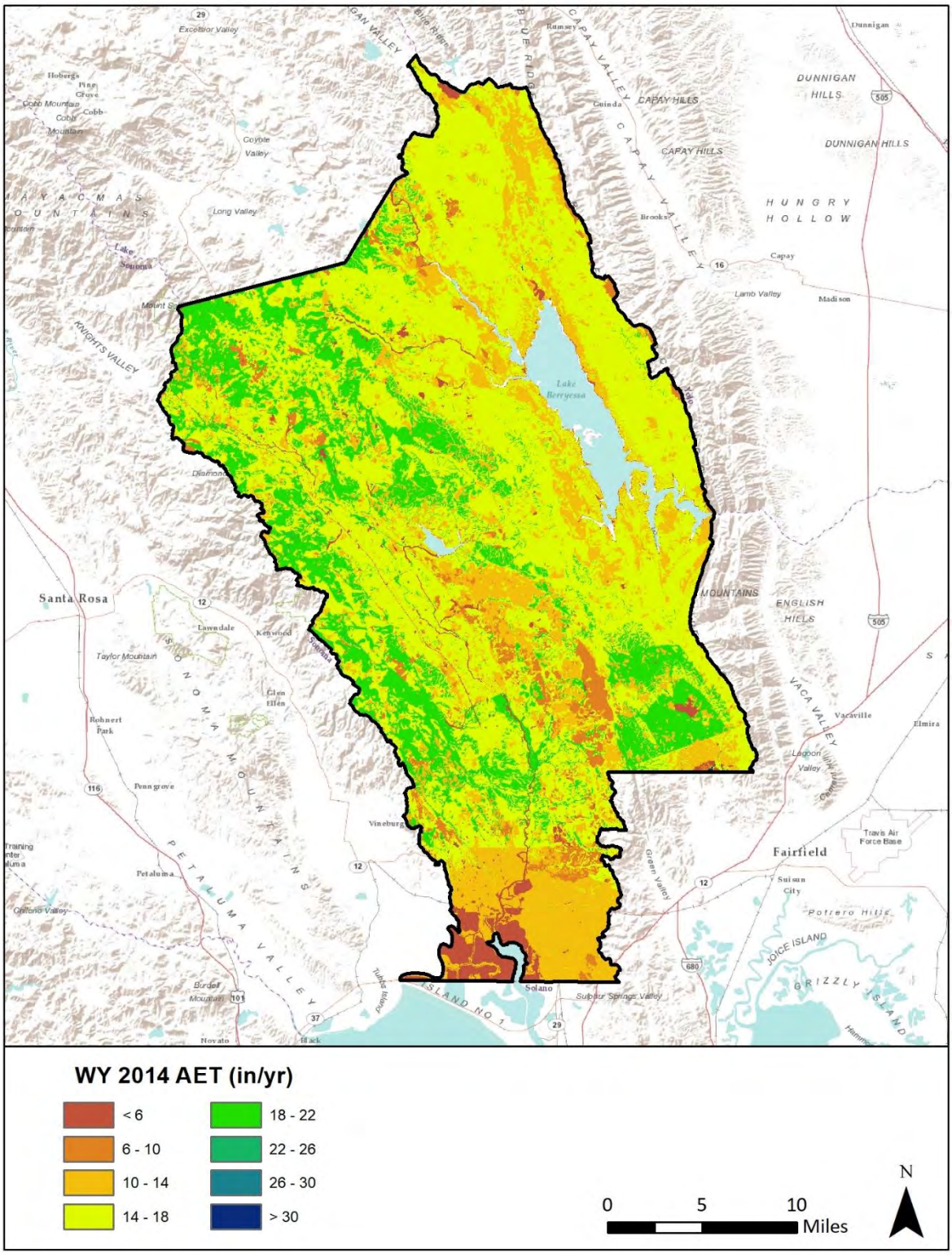


Figure 16: Water Year 2014 AET simulated with the Napa County SWB model.

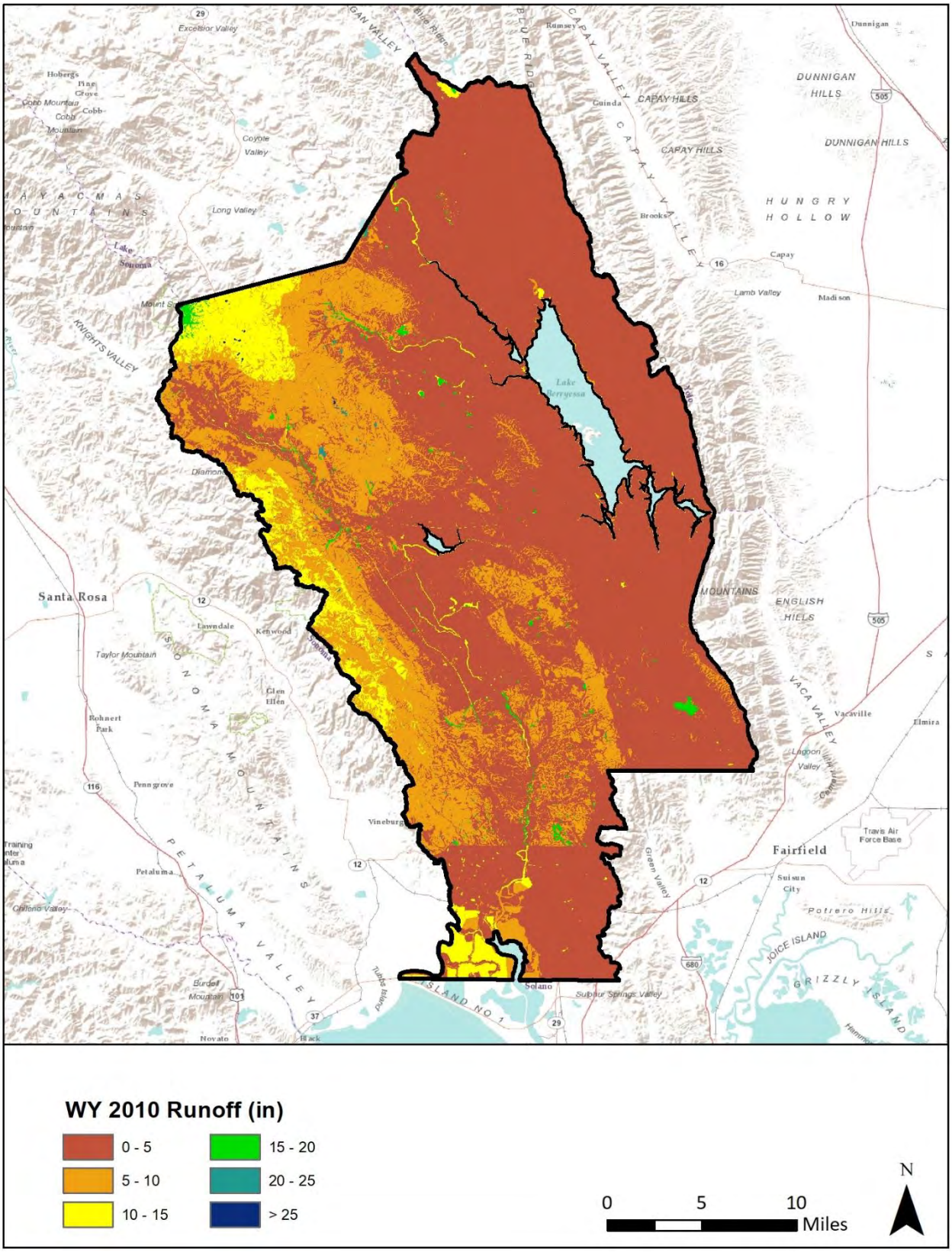


Figure 17: Water Year 2014 recharge simulated with the Napa County SWB model.

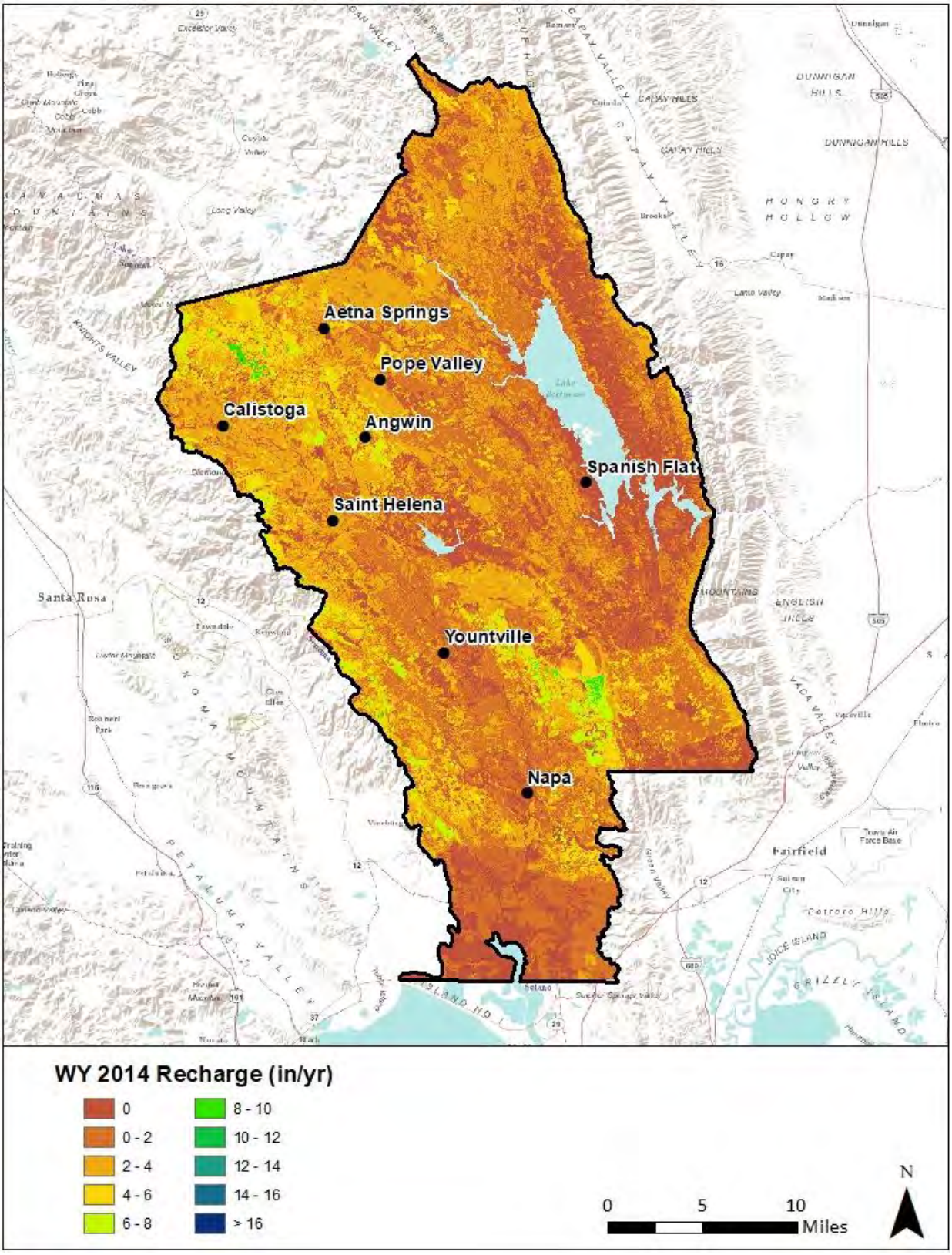


Figure 18: Water Year 2014 recharge simulated with the Napa County SWB model.

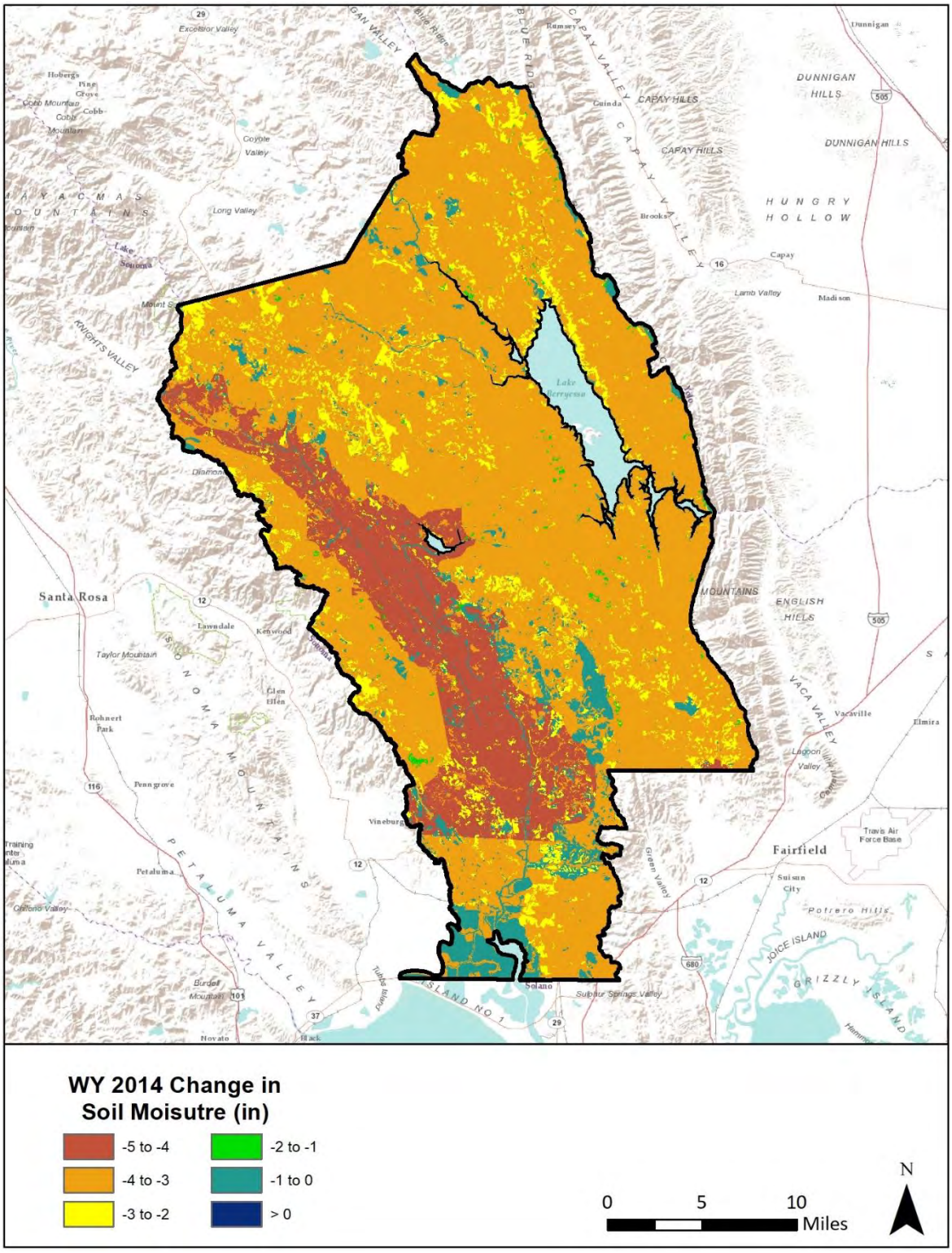


Figure 19: Water Year 2014 change in soil moisture content simulated with the Napa County SWB model.

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
Bucksnort 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 Eticuera 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 Eticuera 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%
Bucksnort 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 Eticuera 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 Eticuera 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
Bucksnort 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 Eticuera 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
Tulucay Creek	34.2	14.6	13.5	2.6	1.7	-3.3
Upper Eticuera 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%
Bucksnort 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 Eticuera 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 Eticuera 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%

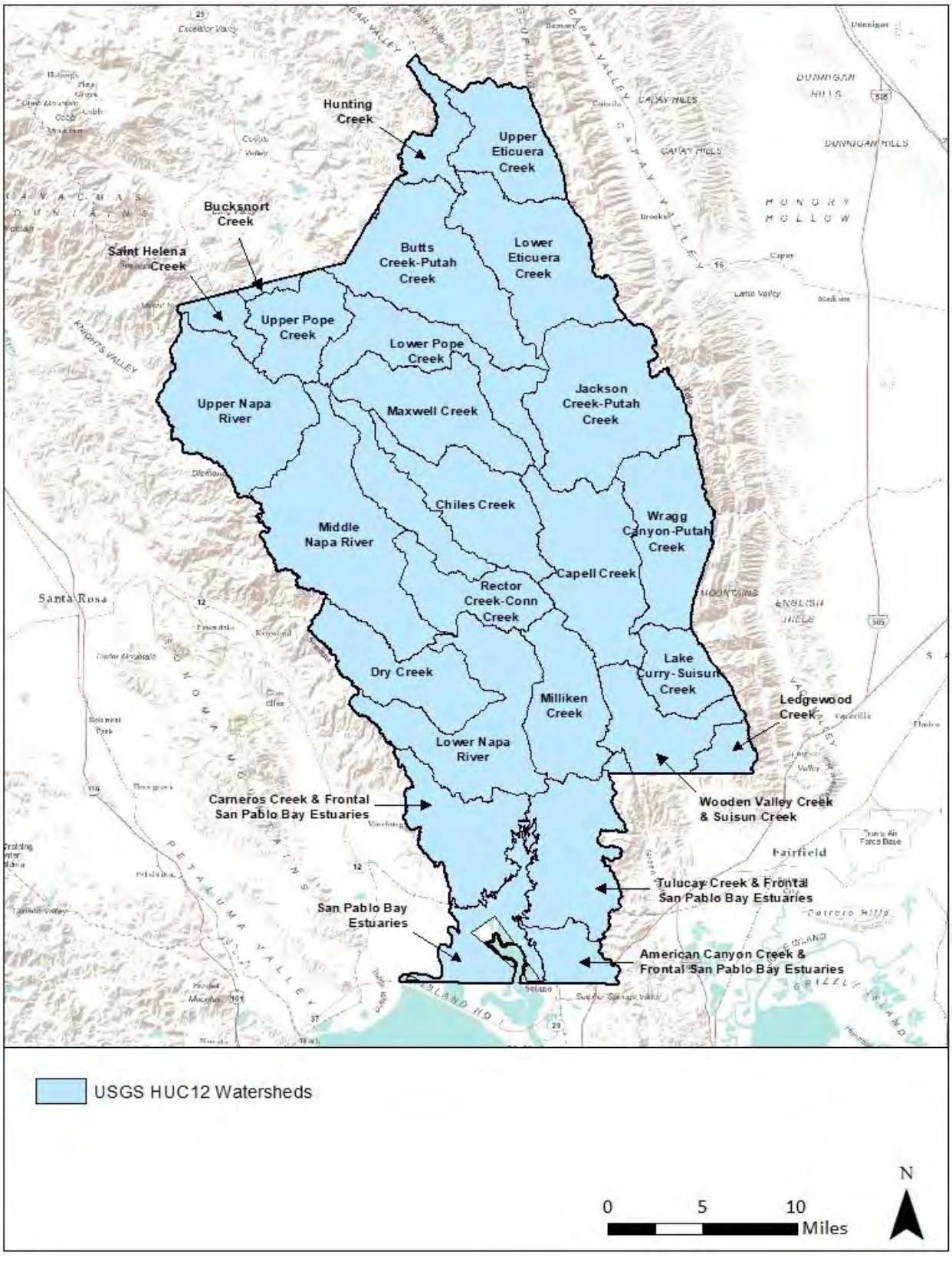


Figure 20: Major watersheds areas used to summarize water budget information in Tables 5 - 8.

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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