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Water Availability Analysis

Saintsbury Winery Major Modification P18-00027
Planning Commission Hearing August 19, 2020

BARTELT ENGINEERING

WATER AVAILABILITY ANALYSIS FOR THE SAINTSBURY WINERY 1500 LOS CARNEROS AVENUE, NAPA, CA 94559 APN 047-212-002

As required by Napa County Planning, Building and Environmental Services (PBES), this study outlines the availability of groundwater for an existing winery located at 1500 Los Carneros Avenue in Napa County, CA.

PROJECT DESCRIPTION

The project proposes improvements to the existing onsite sanitary wastewater treatment system that serves the existing hospitality building and full crush winery located on an existing 15.83± acre parcel. A new groundwater well will also be drilled on the subject parcel as part of the proposed improvements. The parcel is currently developed with an existing hospitality building and a full crush winery with a permitted production capacity of 135,000 gallons of wine per year. Refer to the attached Use Permit Major Modification Drawings for the existing conditions and proposed improvements.

The existing winery is proposing to employ 13 full time employees, one (1) part-time employee and five (5) seasonal (harvest) employees. The existing winery is proposing to modify the existing marketing plan to include a maximum number of 95 visitors for tour and tastings per day. The winery is proposing to offer food and wine pairings to a maximum of 10 tour and tasting visitors per day. Furthermore, the winery is proposing to host six (6) 50 person Wine Club events and two (2) 100 person Large Events. During Large Events two (2) additional event staff are proposed to be utilized. The Applicant is not proposing to increase the wine production capacity.

EXHIBITS

The attached USGS "Topographic Site Location Map" shows the project site and approximate property line locations. Information regarding the location of existing wells and structures are shown on the Use Permit Major Modification Drawings and attached "Neighboring Well Location Map". All exhibits and drawings mentioned above were prepared by Bartelt Engineering.

WATER USE CRITERIA

TABLE 1: SCREENING CRITERIA	
Parcel Zoning	Agricultural Watershed (AW)
Project Parcel Location	All Other Areas
Parcel Size	15.83± acres
Water Use Criteria	Parcel Specific
Well and Spring Interference	Yes
Groundwater/Surface Water Interaction	No
Screening Tier	Tier 2 – Well Interference

As summarized in Table 1, the subject parcel is located within the Agricultural Watershed (AW) Zoning District. As documented in the attached "Neighboring Well Location Map", the proposed project well appears to be located within 500 feet of an existing well located on a neighboring parcel (APN 047-130-002). Per the PBES Water Availability Analysis (WAA)-Guidance Document dated May 12, 2015 the water use criteria for a parcel located in "All Other Areas" that are not designated as a groundwater deficient area with well or spring interference must follow Tier 2 requirements. The water use criteria for the project is compared to the average annual groundwater recharge for the subject parcel.

WATER DEMAND

The total existing and proposed water demand for the project is calculated and summarized below based on the WAA Guidance Document (2015), Napa County PBES wastewater generation rates and existing water usage data provided by the winery.

TABLE 2A: EXISTING WATER DEMAND	
Description	**Estimated Water Usage (acre-feet/year)**
Winery (135,000 gallons per year)	
Process Water[1]	2.49
Domestic Water	0.16
Landscaping Water	0.11
Vineyard (12.5± acres)[2]	
Irrigation Water	4.01
Heat and Frost Protection	0
Total Existing Water Demand =	6.77

[1] Water usage rates are assumed to be equal to wastewater flowrates; refer to the Onsite Wastewater Dispersal Feasibility Study prepared by Bartelt Engineering for more information.
[2] Irrigation water usage is based on existing irrigation data provided by Saintsbury Winery from the 2015 season.

TABLE 2B: PROPOSED WATER DEMAND	
Description	**Estimated Water Usage (acre-feet/year)**
Winery (135,000 gallons per year)	
Process Water[3]	2.49
Domestic Water[3]	0.50
Landscaping Water	0.11
Vineyard (12.4± acres)[4]	
Irrigation Water	3.98
Heat and Frost Protection	0
Total Proposed Water Demand =	7.08

As shown in Table 2A and Table 2B, the water demand is estimated to increase from 6.77 to 7.08 acre feet per year as part of the proposed improvements under this Use Permit Major Modification as well as those approved under the Use Permit Very Minor Modification (P17-00172) which includes vineyard removal. The vineyard irrigation demand may be offset by beneficially reusing treated winery process wastewater as an additional source for vineyard irrigation. Furthermore, recycled water provided by the Los Carneros Water District (LCWD)[5] may also be utilized as an additional source for vineyard irrigation water.

Refer to the attached Table I and Table II for existing and proposed water demand calculations as well as the Onsite Wastewater Dispersal Feasibility Study prepared by Bartelt Engineering for further information regarding domestic and process water usage rates.

SOURCE WATER INFORMATION

The subject parcel currently sources water from an existing onsite well which is located near the northwest corner of the subject parcel adjacent to Cuttings Wharf Road. The project proposes to destroy the existing well and drill a new well that includes a 50+ foot annular seal.

Prior to use, domestic water is proposed to be stored in two (2) 10,000 gallon storage tanks. Vineyard irrigation water will be stored in one designated (1) 200,000 gallon storage tank[6] and fire protection water is stored in one (1) existing designated 20,000 gallon storage tank.

Water System Classification

Per PBES guidelines, the water system may be regulated as a transient non-community public water system (TNCWS). A TNCWS is identified as a water system that has less than five (5) connections, serves less than 25 yearlong residents and serves 25 people per day at

[3] Water usage rates are assumed to be equal to wastewater flowrates; refer to the Onsite Wastewater Dispersal Feasibility Study prepared by Bartelt Engineering for more information.
[4] Irrigation water usage is based on existing irrigation data provided by Saintsbury Winery from the 2015 season.
[5] Refer to the attached Will Serve Letter for recycled water from the Los Carneros Water District.
[6] Approved under Use Permit Very Minor Modification (P17-00172).

least 60 days per year. Refer to the Technical, Managerial and Financial (TMF) Capacity Worksheet included with the Use Permit Application for further information.

Well Description

A copy of the Well Completion Report for the existing well could not be located and is not included with this report. Following completion of drilling, a well log will be provided for the new project well. The project well is anticipated to consist of 6 to 8 inch diameter PVC F480 casing with a 50+ foot annular seal.

Yield Test

A yield test will be performed at the time of drilling the project well and will be submitted as part of the TNCWS permit application.

Neighboring Water Source(s)

Based on review of neighboring parcel records from the Napa County PBES and through visual observation, there appears to be one (1) neighboring well located on APN 047-130-001 that is located within 500 feet of the proposed project well. Refer to the Estimated Neighboring Well Drawdown section for more information on well interference.

Water Quality

Water quality analysis is anticipated to be completed as part of the TNCWS permit application.

GROUNDWATER OVERVIEW

Per the Napa County Watershed Information & Conservation Council (WICC), the subject parcel is located in the Carneros Groundwater Subarea of Napa County. The Carneros Groundwater Subarea is reported to include the presence of low permeability Huichica Formation with some areas of volcanic rocks and alluvial deposits. Current groundwater data for this subarea is limited and shows varying groundwater levels from 10 feet to 100 feet below the ground surface. Ground water quality is reported to be influenced by the San Pablo Bay which may contribute to elevated concentrations of total dissolved solids (TDS) from saltwater intrusion.

Per the Napa County Baseline Data Report (2005), the Huichica Formation located in the floor of the Carneros Valley underlies much of the Carneros Groundwater Subarea and consist of fluvial deposits of gravel, silt, sand and clay with interbedded tuff. The lower 200 to 300 feet contains Sonoma Volcanics. The Huichica Formation is the primary water-bearing unit in the basin and the underlying Sonoma Volcanics act as a lower confining unit.

GEOLOGICAL FEATURES

The attached “Geological Site Location Map” prepared by Bartelt Engineering shows the parcel boundaries and surrounding geologic materials. The background for the exhibit is sourced from the “Geological Map of Napa County” from the USGS Investigations Map 2918. The subject parcel appears to be underlain with Clear Lake Volcanics – early

Pleistocene and/or Pliocene (map unit QTs) and Surficial Deposits - Quaternary (map unit Qoa).

ROOT ZONE WATER BALANCE FOR ESTIMATING GROUNDWATER RECHARGE

A Root Zone Water Balance was conducted to estimate groundwater recharge for the proposed project. Per the Napa Valley Groundwater Sustainability: A Basin Analysis Report for the Napa Valley Subbasin by Luhdorff & Scalmanini (Luhdorff & Scalmanini 2016), groundwater recharge can be estimated as the net inflow from the total applied water (irrigation + rainfall) minus evaporation and/or transpiration. Furthermore, the Root Zone Water Balance method is based on the following equation:

Groundwater Recharge (or yield) (Y) = Rainfall (R) + Total Water Applied (TWA) – Potential Evapotranspiration (PET) – Change in Soil Moisture (ΔS)

As shown in the above equation, groundwater recharge is site specific and depends on rainfall, type of climate, recharge area(s), soil and crop properties and irrigation method(s). A breakdown of each contributing factor to the water balance is described in the following sections and summarized in the Tables IV – VI.

Rainfall

Rainfall, or precipitation, data used in this analysis is referenced from the PRISM Climate Group at Oregon State University which provides an online interactive tool for analyzing time-series data for a single location. For this analysis, average monthly rainfall data was retrieved from the online database from 1981-2010 (30 year normal) for an 800 meter resolution grid cell that encompasses the project site. The following table summarizes the rainfall data used to estimate groundwater recharge.

Table 3: Monthly Average Rainfall	
Month	**PRISM Rainfall (inches)**
September	0.20
October	1.22
November	3.14
December	4.43
January	4.73
February	4.59
March	3.45
April	1.36
May	0.78
June	0.16
July	0.01
August	0.07
Total	**24.14**

The average rainfall data for the project site is estimated to be 24.14 inches. Refer to the attached Table IV for a summary of the rainfall data.

Recharge Area(s)

The 15.83± acre parcel is divided in to several recharge areas depending on permeable surfaces and type of crop planted. The proposed project site includes 1.46± acres of impermeable surface areas (i.e. existing buildings, driveways, etc.) and other non-infiltrative areas (i.e. existing wastewater ponds and proposed open-top process wastewater pretreatment system). The net permeable area for the parcel is 14.37± acres which consist of the following recharge areas:

- 12.4 acres of vineyards
- 0.06 acres of landscaping
- 1.91 acres of grass (naturally occurring, non-irrigated)

A Root Zone Water Balance was performed on each recharge area. The total estimated groundwater recharge for the proposed project is the summation of groundwater recharge from each recharge area (vineyards, landscaping and grass).

Potential Evapotranspiration (PET)

Potential Evapotranspiration (PET) correlates the ability of crops to uptake and transpire stored water in the soil as well as land surface evaporation. This process takes place simultaneously and evapotranspiration is the sum of evaporation and transpiration.

PET for the subject parcel is based on measured evapotranspiration for Napa County and crop coefficients. The formula for calculating PET is shown below:

Potential Evapotranspiration (PET) = Evapotranspiration (ETo) x Crop Coefficient (K_C , K_L)

Evapotranspiration

Evapotranspiration (ETo) is referenced for this analysis from the California Irrigation Management Information System (CIMIS) for Napa County (Zone 8) and is summarized in the following table.

Table 4: CIMIS Evapotranspiration Values	
Month	**Evapotranspiration, ETo (inches)**
September	5.1
October	3.4
November	1.8
December	0.7
January	1.2
February	1.7
March	3.4
April	4.8
May	6.2
June	6.9
July	7.4
August	6.5
Total	**49.1**

Crop Coefficient

Crop coefficients are based on the amount of water that a plant/crop species requires for survival. The amount of water used by a crop is based on the species type, irrigation method, rainfall and microclimate. The crop coefficients (K_C) used in the Root Zone Water Balance are referenced from various sources.

Vineyard crop coefficients vary by month and are shown on the attached *Table V Vineyard Recharge*. The vineyard crop coefficients are referenced from *Table 6.7 Applied Model Crop Coefficients* from the Napa Valley Groundwater Sustainability: A Basin Analysis Report for the Napa Valley Subbasin (Luhdorff & Scalmanini 2016).

The landscape coefficient (K_L) is referenced from A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California from the California Department of Water Resources (DWR 2000) and is based on the type of species planted (K species, K_S), planting density (K density, K_D) and microclimate (K microclimate, K_{MC}). The following summarizes the various K factors and formula used for calculating K_L:

$$K_L = K_S \times K_D \times K_{MC}$$
$$K_L = 0.4 \times 1 \times 1 = 0.4$$

Where:

K_S = 0.4 *for moderate water usage plants*
K_D = 1 *for low density plantings*
K_{MC} = 1 *for average microclimate*

The calculated K_L for the landscaping recharge area is 0.4.

The turfgrass crop coefficient (K_C) is equal to 0.8 for cool season species which is referenced from *Table 1 Crop Coefficients for Various Crops and Turfgrasses* from A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California (DWR 2000).

Calculated PET

The potential evaporation for each recharge area is equal to the product of the evapotranspiration rates (ETo) and crop coefficients (K_L, K_C). Refer to the attached *Table IV Vineyard Recharge, Table V Landscape Recharge and Table VI Grass Recharge* for a summary of the calculated PET values.

Total Water Applied (TWA)

The Total Water Applied (TWA) includes water that is applied to the land surface primarily as irrigation for use by plants. Sources for irrigation include groundwater, recycled water and treated winery process wastewater. This analysis models all irrigation as sourced by groundwater through pumping of the project well only. However, the project has the ability to use recycled water from the LCWD and treated winery process wastewater as supplemental sources.

TWA Vineyards

Vineyard irrigation is based on historical irrigation data provided by the winery. Refer to the attached *Table IV Vineyard Recharge* for the vineyard irrigation values. The monthly amount of vineyard irrigation does not appear to satisfy the calculated PET values which results in a loss of soil moisture. When this occurs, it is assumed that the initial soil moisture for the following month is zero (0)[7].

TWA Landscaping

Landscape irrigation values are calculated based on the following formula from A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California (DWR 2000):

$$TWA = PET_L \times \text{Irrigation Efficiency (IE)}$$

A 90% (IE = 0.90) is assumed for drip irrigation of the planted landscape. The calculated TWA varies by month and is shown on the attached *Table V Landscape Recharge*.

TWA Grass

The TWA for grass includes rainfall only. The grass areas are not irrigated and depend on rainfall only to satisfy PET demands.

[7] This analysis does not assume capillary movement of groundwater to satisfy PET values.

Change in Soil Moisture (ΔS)

The Root Zone Water Balance is a water balance for the soil root zone. The change in soil moisture in the root zone is modeled as a monthly balance between the initial soil moisture, rainfall, potential evapotranspiration and applied water. The initial soil moisture is equal to the final soil moisture of the previous month. Rainfall and TWA are added to the initial soil moisture while PET values are subtracted out to yield the change in soil moisture over the monthly period.

Available Water Storage (AWS)

The ability of water to be stored in the soil is dependent on soil properties and the root depths of planted crops. Infiltrated water is stored in soil pores within the root zone for plants to use. When infiltrated water[8] exceeds the storage capacity of the soil, it is assumed that the excess water contributes to groundwater storage. The soil properties for the subject parcel, root depths and soil water storage capacity are described in more detail below.

Soil Properties

Soil and drainage properties for the subject parcel are provided by the USDA Web Soil Survey and include the following:

- 100% of the subject parcel includes Haire Loam Soil with 2 to 9% slopes (map unit 146)
- Hydraulic Soil Group (HSG) D properties for very slow infiltrative and high runoff rates when thoroughly wet
- Available Water Capacity (AWC) = 0.11 inch/inch
- Saturated Hydraulic Conductivity (Ksat) = 0.19 in/hr

The AWC refers to the quantity of water soil can store for use by plants (units include inch of water stored per inch of soil layer). Ksat refers to the ease in which saturated soil pores can transmit water. Refer to the attached Custom Soil Resource Report for Napa County, California – Saintsbury Winery for more information on soil properties.

Root Depths

The root zone for each recharge area is dependent on the planted crop/landscape root depths which are referenced from *Table 6-5 Assigned Model Root Depths* from the Napa Valley Groundwater Sustainability: A Basin Analysis Report for the Napa Valley Subbasin (Luhdorff & Scalmanini 2016) and summarized below:

- 3 foot (36 inches) root depth for vineyards
- 0.5 foot (6 inches) root depth for landscaping
- 0.5 foot (6 inches) root depth for grass

[8] This analysis assumes that all rainfall infiltrates into the soil and does not account for runoff which is consistant with the methodology utilized in the Napa Valley Groundwater Sustainability Analysis (Luhdorff & Scalmanini 2016) .

Available Water Storage (AWS)

The capacity of water to be stored in the root depths (or root zone) is referred to as the Available Water Storage (AWS) of the soil. The AWS for each recharge area is calculated using the following formula:

AWS (in) = Available Water Storage (in/in) x Root Depth (in/in)

The resulting AWS for each planted species is summarized below:

- Vineyard AWS = 0.11 in/in x 36 inch root depth = 5.4 inches
- Landscape AWS = 0.11 in/in x 6 inch root depth = 0.90 inches
- Turfgrass AWS = 0.11 in/in x 6 inch root depth = 0.90 inches

Groundwater Recharge

In the Root Zone Water Balance if the monthly change in soil moisture exceeds the AWS of the soil, the resulting yield is assumed to contribute to groundwater storage. Therefore, the change in groundwater storage is calculated using the following formula:

Change in Groundwater Storage (ΔGW) = (Change in Soil Moisture (ΔS) - Available Water Storage (AWS)) x Recharge Area

The change in groundwater storage also needs to account for groundwater being pumped for irrigation. The resulting Groundwater (GW) Recharge using the Root Zone Water Balance is then calculated using the following formula:

GW Recharge (acre-feet/year) = ΔGW (acre-feet/year) – Groundwater pumping (acre-feet/year)

The following summarizes the estimated groundwater recharge for each recharge area:

- Vineyard GW Recharge = 7.50 acre-feet/year
- Landscaping GW Recharge = 0.02 acre-feet/year
- Turfgrass GW Recharge = 1.94 acre-feet/year

The total GW Recharge for the subject parcel is estimated to be 9.5 acre-feet/year.

Refer to the attached *Table IV Vineyard Recharge*, *Table V Landscape Recharge* and *Table VI Grass Recharge* for a summary of the Root Zone Water Balance and monthly change in groundwater storage for the respective recharge areas. The Root Zone Water Balance shows that during winter months when the soil is saturated and PET requirements are low, the change in groundwater storage is high. The opposite is observed during the summer months when the change in groundwater storage is low.

WATERSHED COMPARISON FOR ESTIMATED GROUNDWATER RECHARGE

In 2003, a water balance study was conducted by Bob Zlomke, P.E. of the Napa County Resource Conservation District for the Carneros Creek Watershed. The goal of the water balance study was to provide landowners and residents of the Carneros Creek Watershed with a water budget and estimate how much water is available for various uses in the watershed. The water balance study used estimates of monthly rainfall and potential evaporation to calculate actual evapotranspiration and runoff based on the estimated soil storage capacity of the watershed (Zlomke 2003). Results from the water balance study estimated that 52% of rainfall in an average year is estimated as runoff that contributes to stream replenishment.

Since the subject parcel is partially located within the Carneros Creek Watershed and similar information was not available for the Buhman Creek Watershed, it is assumed that the subject parcel has a runoff coefficient of 0.52. The amount of rainfall that remains onsite is estimated to contribute to groundwater recharge. The estimated groundwater recharge that is calculated using the watershed runoff coefficient method is calculated below:

Groundwater Recharge (acre-feet/year) = Rainfall (feet) x (1 – Runoff Coefficient x Recharge Area (acre-feet))

= (24.56 inches x 1 foot/12 inches) x ((1-0.52) x 14.37 acres)

= 11.78 acre-feet/year

GROUNDWATER MONITORING DATA

The existing well currently serving the subject parcel is part of the California Statewide Groundwater Elevation Monitoring (CASGEM) program. As part of this program, groundwater levels in the existing well (referenced as CASGEM Well #195) were recorded twice per year starting in October 2014. The results of the well monitoring are located online at the CASGEM Program Website. The measured groundwater elevations, sample dates and ground surface of the well are shown on the attached *Groundwater Elevation Summary Graph*.

The measured data and plotted graph show a decrease in groundwater storage over the summer months (when rainfall is low and PET requirements are high) with groundwater replenishment occurring over the winter months (when rainfall is high and PET is low). This is consistent with the findings from the Root Zone Water Balance.

DRY RAINFALL YEARS

Dry rainfall years were not evaluated due to the complexity of the Root Zone Water Balance which provides a general pattern for when groundwater recharge occurs. During dry rainfall years when groundwater recharge may be low, supplemental vineyard irrigation (which comprises a large portion of the project water demand) can be sourced by recycled water from the LCWD and/or treated winery wastewater to reduce the demand from the project well. However, the existing well has been able to meet the demands of the winery for the history of its use without the need for supplemental sources.

Estimated Neighboring Well Drawdown

The location of the proposed project well is approximately 415 feet from a neighboring well located on APN 047-212-002. Based on the Well Completion Report, the neighboring well includes a 6 inch diameter casing constructed to a total depth of 215 feet with a total screened interval of 160 feet. The Well Completion Report shows that during the time of drilling gravel and clay boring material was observed and the well yield was estimated to be 15 gallons per minute. Refer to the attached neighboring Well Completion Report and "Neighboring Well Location Map" for more information.

Information from the neighboring Well Completion Report and soil properties of the subject parcel are used to estimate the well drawdown. Furthermore, the proposed project well is estimated to have a pumping rate of 20 gallons per minute (gpm). This pumping rate is based on the reported flow rate of the existing well from the facility operator. Both wells are assumed to be located within an unconfined aquifer. The following table summarizes the estimated well drawdown using the Theis Equation[9]:

Table 5: Calculated Well Drawdown				
Pumping rate = 20 gpm				
Aquifer thickness[10] = 160 feet				
Time = 1 day				
Specific Storage[11]	Hydraulic Conductivity, K, Class[7]	Hydraulic Conductivity Value[6] (ft/day)	Radial Distance Between Wells (feet)	Calculated Well Drawdown (feet)
0.1	High	80	415	0.02
0.1	Moderate	50	415	0.02
0.1	Low	30	415	0.01
0.1	Very Low	10	415	0.00

Using a very low Hydraulic Conductivity Class which is consistent with the findings from the NRCS soil report (HSG D properties), the estimated drawdown in the neighboring well after one (1) day of continuous pumping of the project well is estimated to be 0.00 feet. Therefore, pumping of the project well is not anticipated to negatively impact the existing neighboring well. Refer the attached *Table VIII Neighboring Well Drawdown Calculation* and *Neighboring Well Drawdown Graph* for more information.

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[9] Drawdown after one (1) day is calculated using the Theis Equation and a series calculation of W(u) to u[6].
[10] Aquifer thickness is assumed to be equal to the screened interval of the neighboring well.
[11] Referenced from *Table F-8: Simulated effect of a project well on water levels at an existing non-project well after one day of pumping at the stated flow rate in an unconfined aquife*r of the WAA-Guidance Document (2015).

Summary & Conclusion

The groundwater demand for the proposed project, which includes vineyard removal approved under the Use Permit Very Minor Modification (P17-00172), is estimated to increase from 6.77 acre-feet per year (see Table 2A) to 7.08 acre-feet per year (see Table 2B). Groundwater recharge is estimated to be between 9.5 acre-feet per year and 11.78 acre-feet per year during average rainfall years. The estimated annual recharge is greater than the proposed project demand of 7.20 acre-feet per year.

Groundwater monitoring from the CASGEM Website shows steady groundwater levels with seasonal variations that appear to be consistent with the Root Zone Water Balance.

A neighboring well on APN 047-212-002 is located within the 500 feet zone of influence for the proposed project well. Based on the neighboring Well Completion Report, PBES criteria for calculating well drawdown and using the Theis Equation, pumping of the new project well is not anticipated to negatively impact the existing neighboring well.

Attachments

Geological Site Location Map

Neighboring Well Location Map

Watershed Site Location Map

Table I – Existing Water Demand

Table II – Proposed Water Demand

Table III – Rainfall

Table IV – Vineyard Recharge

Table V – Landscape Recharge

Table VI – Grass Recharge

Table VII – WAA Summary

Table VIII – Neighboring Well Drawdown and Graph

Groundwater Elevation Summary Graph

Neighboring Well Completion Report

Will Serve Letter from the Los Carneros Water District

NRCS Custom Soils Report

REFERENCES

California Statewide Groundwater Elevation Monitoring (CASGEM) Program. Retrieved from http://water.ca.gove/groundwater/casgem.

California Irrigation Management Systems (CIMIS). Retrieved from http://cimis.water.ca.gov.

DHI Water Environment. Napa County Baseline Data Report. Chapter 16. Groundwater Hydrology. 2005 - Version 1, November 30.

Johnson, A. Specific Yield - Completion of Specific Yields for Various Materials. California Department of Water Resources. Geological Survey Water Supply Paper 1662-D. 1967.

Luhdhorff & Scalmanini. Hudson Vineyards Tier 1 Water Availability Analysis Estimated Average Annual Groundwater Recharge. March 19, 2015.

Luhdhorff & Scalmanini Consulting Engineers and MBK Engineers. Updated Hydrogeological Conceptualization and Characterization of Conditions Prepared for Napa County. January 2013.

Luhdhorff & Scalmanini. Napa Valley Groundwater Sustainability: A Basin Analysis Report for the Napa Valley Subbasin. December 13, 2016.

Napa County. Water Availability (WAA) - Design, Construction and Guidance Document. May 12, 2015.

Napa County Watershed Information & Conservation Council (WICC). (n.d.). Retrieved from www.napawatershed.org

Natural Resource Conservation Service (NRCS). Custom Soil Resource Report for Napa County, California, Saintsbury Winery. November 2, 2016. Retrieved from https://websoilsurvey.sc.egov.usda.gov.

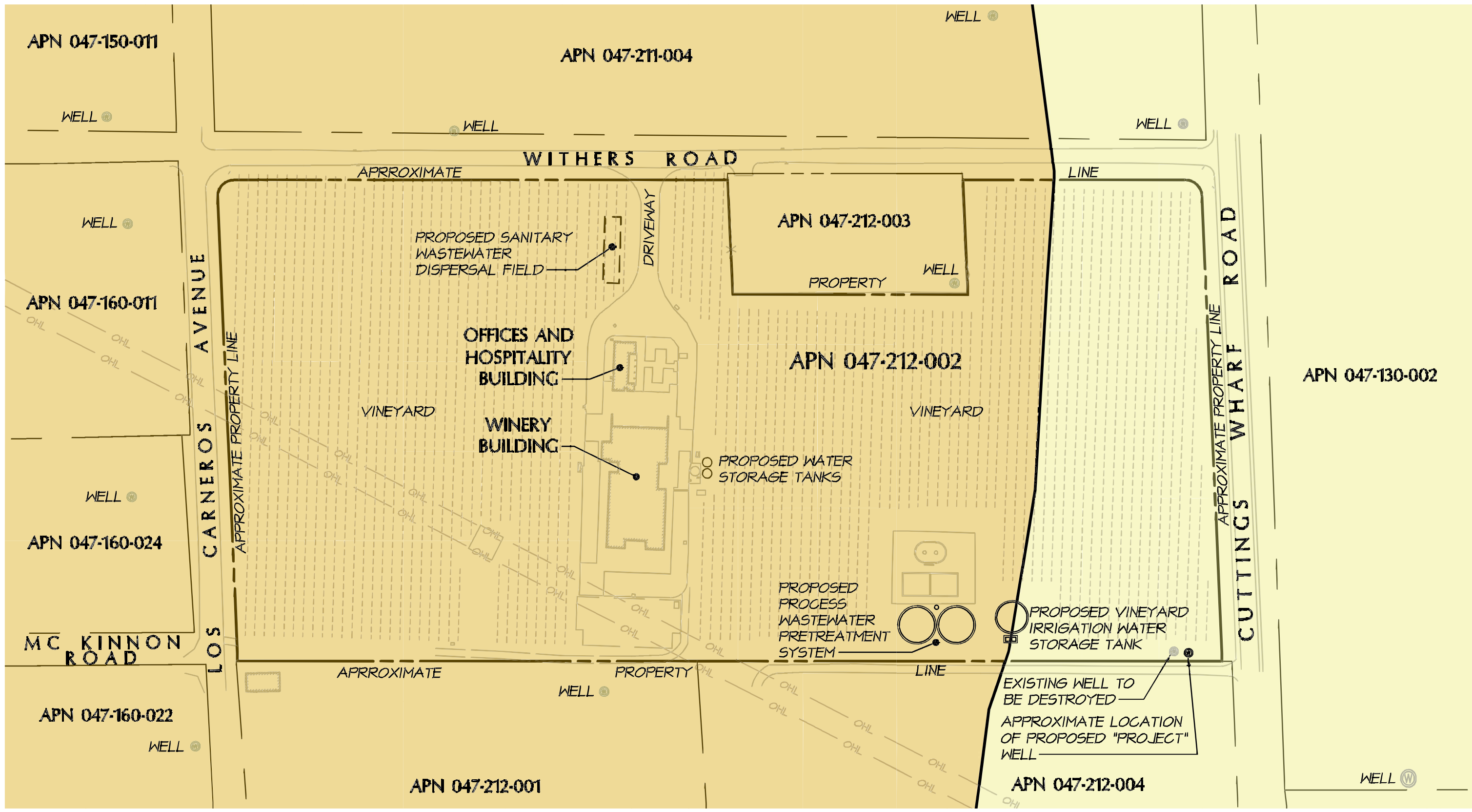
PRISM Climate Group, Oregon State University. 2014. Retrieved from http://prism.oregonstate.edu

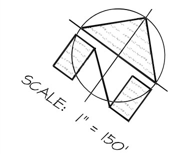
Stamski, R. Geologic map and map database of eastern Sonoma and western Napa Counties, California. U.S. Geological Survey Scientific Investigations Map 2956. 2007

U.S. Geological Survey (USGS). Geology and Ground Water in the Napa and Sonoma Valleys, Napa and Sonoma Counties, California. US Geological Survey Water Supply Paper 1495. 1960.

Utah Division of Water Rights. Theis Equation Calculation for Aquifer Testing and Well Drawdown. May 18, 2010. Retrieved from http://waterrights.utah.gov.

Zlomke, Bob. Napa County Resource Conservation District (RCD). Water Balance Study: A Component of the Watershed Management Plan for the Carneros Creek Watershed, Napa County, CA. 2003.





GEOLOGICAL AREA CALCULATIONS

GEOLOGICAL UNIT: CLEAR LAKE VOLCANICS (PLEISTOCENE - PIOCENE)
GEOLOGICAL DESCRIPTION: HUICHICA AND GLEN ELLEN FORMATIONS
MAP UNIT: Qts

AREA PRESENT ON PARCEL = 560,182± SQUARE FEET = 12.86± ACRES
PARCEL SIZE = 15.83± ACRES
12.86 ACRES / 15.83 ACRES = **81.2%** OF THE SUBJECT PARCEL

GEOLOGICAL UNIT: SURFICIAL DEPOSITS (QUATERNARY)
GEOLOGICAL DESCRIPTION: ALLUVIUM (LATE AND EARLY PLEISTOCENE)
MAP UNIT: Qoa

AREA PRESENT ON PARCEL = 129,334± SQUARE FEET = 2.97± ACRES
PARCEL SIZE = 15.83± ACRES
2.97 ACRES / 15.83 ACRES = **18.8%** OF THE SUBJECT PARCEL

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GEOLOGICAL SITE LOCATION MAP

SCALE: 1" = 150'

NOTES:

1. THE GEOLOGICAL MAP DATA USED AS A BASE FOR THIS EXHIBIT WAS TAKEN FROM THE "GEOLOGICAL MAP OF NAPA COUNTY" USGS INVESTIGATIONS MAP 2918 AND DOWNLOADED FROM WWW.NAPAWATERSHEDS.ORG.

Saintsbury Winery
1500 Los Carneros Avenue
Napa, CA 94559
APN 047-212-002
Job No. 00-87
June 2017
Sheet 1 of 1

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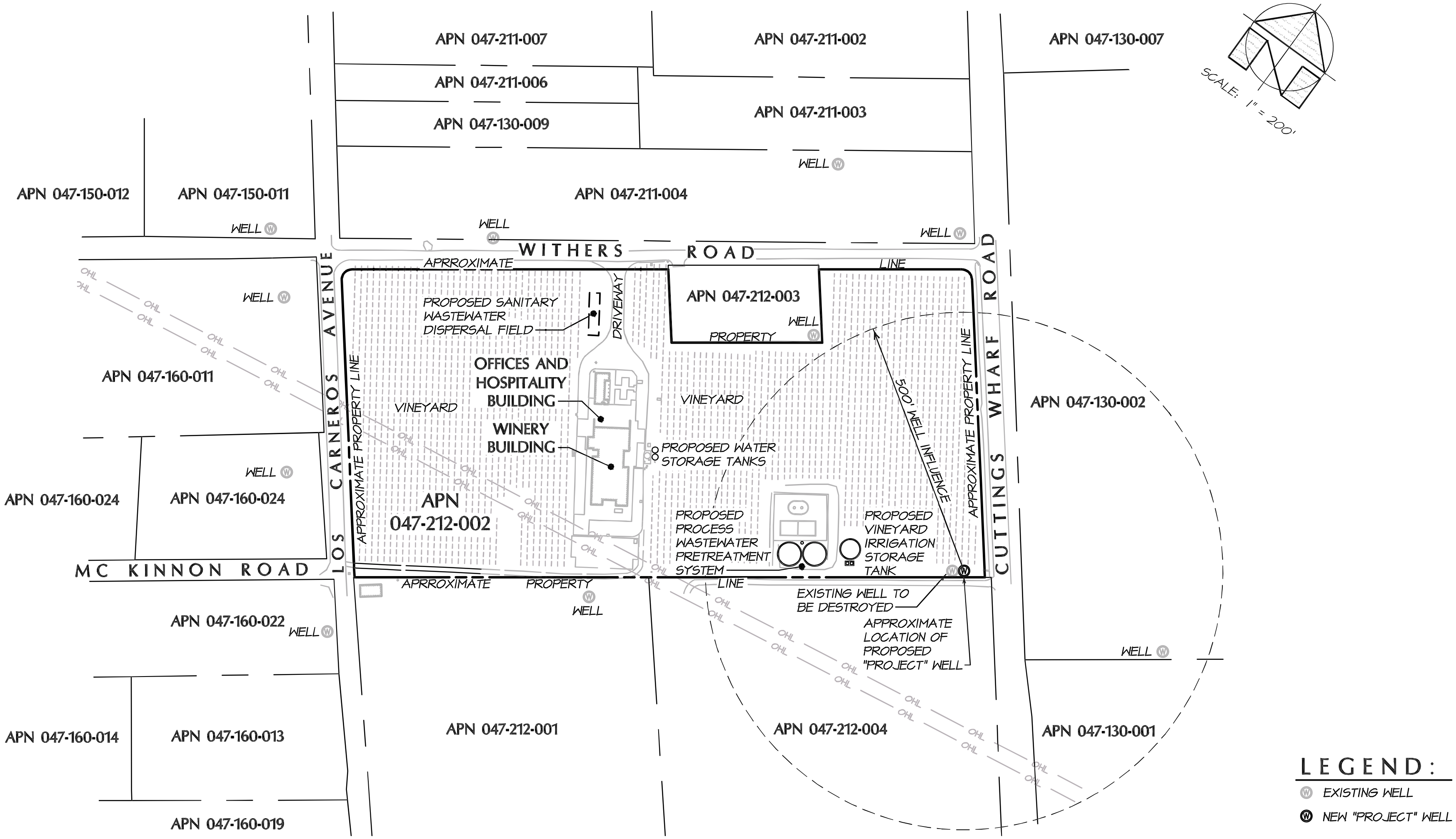

NEIGHBORING WELL LOCATION MAP

SCALE : 1" = 200'

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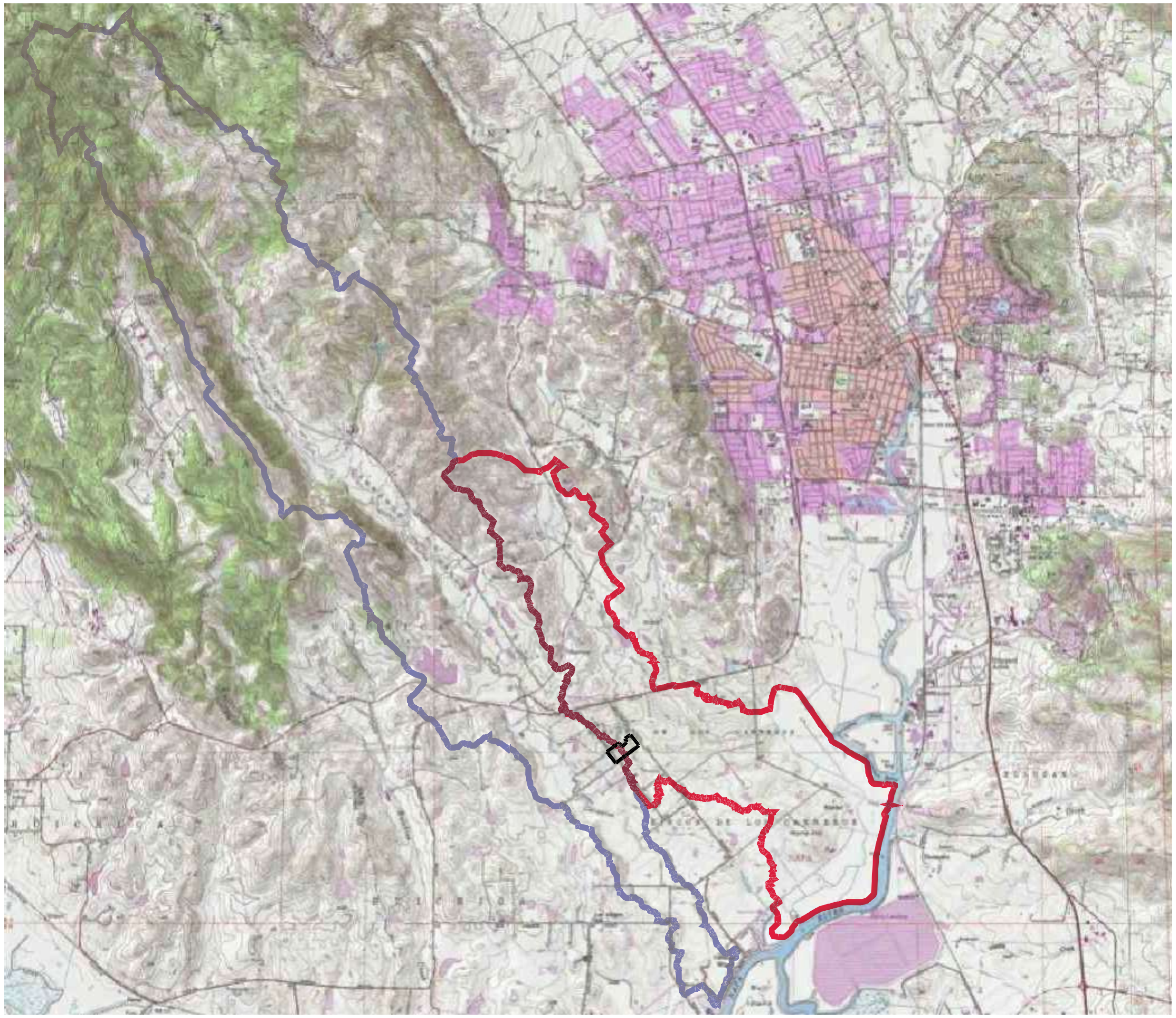
CIVIL ENGINEERING · LAND PLANNING
1303 Jefferson Street, 200 B, Napa, CA 94559
www.barteltengineering.com
· Telephone: 707-258-1301 ·

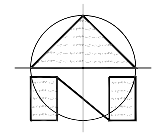
NOTES:

1. WELL LOCATIONS ARE BASED ON TOPOGRAPHIC FEATURES SHOWN ON THE "THE TOPOGRAPHIC MAP OF THE LANDS OF SAINTSBURY LLC" PREPARED BY TERRA FIRMA SURVEYS, INC., DATED MAY 23, 2016 AND DATA OBTAINED FROM THE NAPA COUNTY ENVIRONMENTAL HEALTH RECORDS. WELL LOCATION SHOULD BE FIELD VERIFIED.
2. THE MAP EXTENTS SHOWN REPRESENTS 500 FEET FROM THE SUBJECT PARCEL PROPERTY LINE. NEIGHBORING WELLS THAT ARE LOCATED AT A GREATER DISTANCE THAN 500 FEET FROM THE PROPERTY LINE ARE NOT SHOWN ON THIS MAP.

Saintsbury Winery
1500 Los Carneros Avenue
Napa, CA 94559
APN 047-212-002
Job No. 00-87
June 2017
Sheet 1 of 1

2/14/2018 - 11:08 AM, christinan, S:\LAND PROJECTS\2000-2003\0087\2016 UP MOD_MJR\ACAD\EXHIBITS\0087-WELL NHBR.DWG





SCALE: 1" = 5,000'

LEGEND:

- CARNEROS CREEK WATERSHED (5,718± ACRES)
- BUHMAN CREEK WATERSHED (2,438± ACRES)
- PARCEL BOUNDARY (15.83± ACRES)

NOTES:

1. THE WATERSHED BOUNDARIES SHOWN ARE SOURCED FROM THE COUNTY OF NAPA GEOGRAPHIC INFORMATION SYSTEM DATA CATALOG.

WATERSHED SITE LOCATION MAP

SCALE : 1" = 5,000'

BARTELT
ENGINEERING
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Saintsbury Winery
1500 Los Carneros Avenue
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Sheet 1 of 1

Saintsbury Winery
Existing Water Demand
Table I

BARTELT ENGINEERING

Winery Production Limit: **135,000 gallons/year**
Vineyard Area: **12.5 acres**

EXISTING WATER DEMAND		
Description	**Water Usage Rate[1]**	**Water Demand (acre-feet/year)**
Residential		
Primary Residence	0.75 acre-feet/acre-year	-
Secondary Residence or Farm Labor Dwelling	0.5 acre-feet/acre-year	-
Agricultural		
Vineyards		
Irrigation Only	0.32 acre-feet/acre-year	4.01
Heat Protection	0 acre-feet/acre-year	0.00
Frost Protection	0 acre-feet/acre-year	0.00
Irrigated Pastures	4 acre-feet/acre-year	-
Orchards	4 acre-feet/acre-year	-
Livestock (sheep or cows)	0.01 acre-feet/acre-year	-
Winery		
Process Water[2]	1.84 acre-feet/100,000 gallon of wine	2.49
Domestic Water[2]	0.12 acre-feet/100,000 gallon of wine	0.16
Landscaping Water[3]	0.08 acre-feet/100,000 gallon of wine	0.11
Industrial		
Food Processing	31 acre-feet/employee-year	-
Printing/Publishing	0.06 acre-feet/employee-year	
Commercial		-
Office Space	0.01 acre-feet/employee-year	-
Warehouse	0.05 acre-feet/employee-year	-

Estimated Existing Water Demand (acre-feet/year): 6.77
Estimated Existing Water Demand (gallons/year): 2,206,011

Notes:

[1] Water usage rates referenced from Appendix B: Estimated Water Use of Specified Land Use from Napa County WAA-Guidance Document (2015) unless otherwise noted.

[2] Water usage rates are assumed to be equal to wastewater flowrates; refer to the Wastewater Feasibility Study prepared by Bartelt Engineering (submitted with P17-00172) for more information.

[3] See Table IV for Landscape Irrigation water demand calculation.

Saintsbury Winery
Proposed Water Demand
Table II

Winery Production Limit: **135,000 gallons/year**
Vineyard Area: **12.4 acres**

PROPOSED WATER DEMAND		
Description	**Water Usage Rate[1]**	**Water Demand (acre-feet/year)**
Residential		
Primary Residence	0.75 acre-feet/acre-year	-
Secondary Residence or Farm Labor Dwelling	0.5 acre-feet/acre-year	-
Agricultural		
Vineyards[2]		
Irrigation Only	0.32 acre-feet/acre-year	3.98
Heat Protection	0 acre-feet/acre-year	-
Frost Protection	0 acre-feet/acre-year	-
Irrigated Pastures	4 acre-feet/acre-year	-
Orchards	4 acre-feet/acre-year	-
Livestock (sheep or cows)	0.01 acre-feet/acre-year	-
Winery		
Process Water[3]	2.15 acre-feet/100,000 gallon of wine	2.49
Domestic Water[3]	0.37 acre-feet/100,000 gallon of wine	0.50
Landscaping Water[4]	0.08 acre-feet/100,000 gallon of wine	0.11
Industrial		
Food Processing	31 acre-feet/employee-year	-
Printing/Publishing	0.06 acre-feet/employee-year	
Commercial		-
Office Space	0.01 acre-feet/employee-year	-
Warehouse	0.05 acre-feet/employee-year	-

Estimated Proposed Water Demand (acre-feet/year): 7.08
Estimated Proposed Water Demand (gallons/year): 2,306,783

Notes:

[1] Water usage rates referenced from Appendix B: Estimated Water Use of Specified Land Use from Napa County WAA-Guidance Document (2015) unless otherwise noted.

[2] Vineyard irrigation water is proposed to be sourced from treated winery wastewater and recycled water provided by the Los Carneros Water District.

[3] Water usage rates are assumed to be equal to wastewater flowrates; refer to the Onsite Wastewater Dispersal Feasibility Study prepared by Bartelt Engineering for more information.

[4] See Table V for Landscape Irrigation water demand calculation.

Saintsbury Winery
Rainfall
Table III

BARTELT ENGINEERING

AVERAGE MONTHLY RAINFALL RATES	
Month	**PRISM Rainfall[1] (inches)**
September	0.20
October	1.22
November	3.14
December	4.43
January	4.73
February	4.59
March	3.45
April	1.36
May	0.78
June	0.16
July	0.01
August	0.07
TOTAL	**24.14**

Notes:

[1] PRISM 30-year normal rainfall data from 1981-2010 averaged from one (1) 800 m^2 spatial grid that encompass the total project area; see http://prism.oregonstate.edu/

Saintsbury Winery
Vineyard Recharge
Table IV

Vineyard Area: **12.4 acres**
Root Area: **3 feet**
Available Water Capacity (AWC): **0.15 in/in**

ESTIMATED GROUNDWATER RECHARGE - VINEYARD AREAS												
Month	Initial Soil Moisture[1] (inches)	Rainfall, R[2] (inches)	Evapotranspiration, ETo[3] (inches)	Crop Coefficient, K_C[4] (inches)	Potential Evapotranspiration, PET[5] (inches)	Total Water Applied, TWA[6] (inches)	Change in Soil Moisture, ΔS[7] (inches	Available Water Storage, AWS[8] (inches	Change in Groundwater Storage, ΔGW[9] (inches)	Change in Groundwater Storage, ΔGW[9] (ac-ft/yr)	GW Pumping (irrigation)[10] (ac-ft/yr)	Estimated GW Storage[11] (ac-ft/yr)
September	0.00	0.2	5.1	0.7	3.57	0.55	-2.82	5.40	0.00	0.00	0.57	-0.57
October	0.00	1.22	3.4	0.26	0.89	0.55	0.88	5.40	0.00	0.00	0.57	-0.57
November	0.88	3.14	1.8	0.48	0.86	0.09	3.25	5.40	0.00	0.00	0.09	-0.09
December	3.25	4.43	0.9	0.85	0.79	0.00	6.89	5.40	1.49	1.54	0.00	1.54
January	5.40	4.73	1.2	1.03	1.28	0.00	8.85	5.40	3.45	3.57	0.00	3.57
February	5.40	4.59	1.7	0.4	0.67	0.00	9.32	5.40	3.92	4.05	0.00	4.05
March	5.40	3.45	3.4	0.38	1.30	0.09	7.65	5.40	2.25	2.32	0.09	2.23
April	5.40	1.36	4.8	0.47	2.26	0.18	4.69	5.40	0.00	0.00	0.19	-0.19
May	4.69	0.78	6.2	0.51	3.16	0.37	2.67	5.40	0.00	0.00	0.38	-0.38
June	2.67	0.16	6.9	0.42	2.90	0.55	0.48	5.40	0.00	0.00	0.57	-0.57
July	0.48	0.01	7.4	0.36	2.68	0.73	-1.45	5.40	0.00	0.00	0.76	-0.76
August	0.00	0.07	6.5	0.39	2.54	0.73	-1.74	5.40	0.00	0.00	0.76	-0.76
										TOTAL (acre-feet/year):	**3.98**	**7.50**

Notes:

1 Initial Soil Moisture is either equal to the AWS of the previous month or zero (0) if ΔS is less than zero (0)
2 See *Table III Rainfall* for data; all rainfall is assumed to contribute to infiltration
3 Reference evapotranspiration (ETo) data for Napa County (Zone 8) is referenced from the California Irrigation Management Information System (CIMIS) database
4 K_C values referenced from *Table 6-7. Applied Model Crop Coefficients, K_C* from the Napa Valley Groundwater Sustainability: A Basin Analysis Report for the Napa Valley Subbasin, by Luhdorff & Scalmanini
5 PET = ETo x K_L
6 TWA = Groundwater Pumping for Vineyard irrigation ÷ Vineyard Area x (12 inches/1 foot)
7 ΔS = Initial Soil Moisture + R - PET + TWA
8 AWS = Root Depth x AWC
9 ΔGW = ΔS - AWS; ΔGW is assumed to be zero (0) during months when ΔS is less than zero (0)
10 Vineyard irrigation water is based on data provided by the winery; refer the Onsite Wastewater Dispersal Feasibility Study submitted with the Use Permit Application for more information
11 Estimated GW Storage = ΔGW - GW Pumping for irrigation

References:

> Department of Water Resources California Irrigation Management Information Systems (website: www.cimis.water.ca.gov)
> Napa Valley Groundwater Sustainability: A Basin Analysis Report for the Napa Valley Subbasin, Luhdorff & Scalmanini, December 13, 2016
> Natural Resource Conservation District (NRCS) Soil Survey

Saintsbury Winery
Landscape Recharge
Table V

Existing Landscape Area:	**2,650**	**square feet**	**Irrigation Efficiency:**	**0.9**	*for drip irrigation*
	0.06	**acres**	**K Species (K_L):**	**0.4**	*for moderate water usage*
Root Area:	**0.5**	**feet**	**K Density (K_D):**	**1**	*for low density*
Available Water Capacity (AWC):	**0.15**	**in/in**	**K Microclimate (K_{MC})**	**1**	*for average microclimate*

ESTIMATED GROUNDWATER RECHARGE - LANDSCAPE AREAS

Month	Initial Soil Moisture[1] (inches)	Rainfall, R^2 (inches)	Evapotranspiration, ET_O[3] (inches)	Landscape Coefficient, K_L[4]	Potential Evapotranspiration, PET[5] (inches)	Total Water Applied, TWA[6] (inches)	Change in Soil Moisture, ΔS[7] (inches	Available Water Storage, AWS[8] (inches	Groundwater Storage Change, ΔGW[9] (inches)	Groundwater Storage Change, ΔGW[9] (ac-ft/yr)	GW Pumping (irrigation) (ac-ft/yr)	Estimated GW Storage[9] (ac-ft/yr)
September	0.90	0.2	5.1	0.40	2.04	2.27	1.33	0.90	0.43	0.00	0.01	-0.01
October	0.90	1.22	3.4	0.40	1.36	1.52	2.27	0.90	1.37	0.01	0.01	0.00
November	0.90	3.14	1.8	0.40	0.72	0.80	4.12	0.90	3.22	0.02	0.00	0.01
December	0.90	4.43	0.9	0.40	0.37	0.41	5.37	0.90	4.47	0.02	0.00	0.02
January	0.90	4.73	1.2	0.40	0.50	0.55	5.69	0.90	4.79	0.02	0.00	0.02
February	0.90	4.59	1.7	0.40	0.67	0.75	5.56	0.90	4.66	0.02	0.00	0.02
March	0.90	3.45	3.4	0.40	1.36	1.52	4.50	0.90	3.60	0.02	0.01	0.01
April	0.90	1.36	4.8	0.40	1.92	2.13	2.47	0.90	1.57	0.01	0.01	0.00
May	0.90	0.78	6.2	0.40	2.48	2.76	1.96	0.90	1.06	0.01	0.01	-0.01
June	0.90	0.16	6.9	0.40	2.76	3.07	1.37	0.90	0.47	0.00	0.02	-0.01
July	0.90	0.01	7.4	0.40	2.98	3.31	1.24	0.90	0.34	0.00	0.02	-0.02
August	0.90	0.07	6.5	0.40	2.60	2.89	1.26	0.90	0.36	0.00	0.01	-0.01
										TOTAL (acre-feet/year):	**0.11**	**0.02**

Notes:

1 Initial Soil Moisture is assumed to be equal to the AWS of the previous month
2 See *Table III Rainfall* for data; all rainfall is assumed to contrubte to infiltration
3 Reference evapotranspiration (ETo) data for Napa County (Zone 8) is referenced from the California Irrigation Management Information System (CIMIS) database
4 $K_L = K_S \times K_D \times K_{MC}$
5 $PET = ETo \times K_L$
6 $TWA = ET_L \div IE$
7 ΔS = Initial Soil Moisture + R - PET_L + TWA
8 AWS = Root Depth x AWC
9 $\Delta GW = \Delta S - AWS$
10 GW Pumping (irrigation) = TWA x Recharge Area x (1 foot/12 inches)
11 Estimated GW Storage = ΔGW - GW Pumping for irrigation

References:

> Department of Water Resources California Irrigation Management Information Systems (website: www.cimis.water.ca.gov)
> A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California, University of California Cooperative Extension, California Department of Water Resources, August 2000.
> Napa Valley Groundwater Sustainability: A Basin Analysis Report for the Napa Valley Subbasin, Luhdorff & Scalmanini, December 13, 2016

BARTELT ENGINEERING

Saintsbury Winery
Grass Recharge
Table VI

Native Grass Area (non-irrigated): **1.91 acres**
Root Area: **0.5 feet**
Available Water Capacity (AWC): **0.15 in/in**

ESTIMATED GROUNDWATER RECHARGE - TURGRASS AREAS									
Month	**Initial Soil Moisture[1]** (inches)	**Rainfall, R^2** (inches)	**Evapotranspiration, ETo[3]** (inches)	**Crop Coefficient, K_C[4]**	**Potential Evapotranspiration, PET[5]** (inches)	**Change in Soil Moisture, ΔS[6]** (inches)	**Available Water Storage, AWS[7]** (inches	**Estimated GW Storage[8]** (inches)	(ac-ft/yr)
September	0.00	0.2	5.1	0.8	4.08	-3.88	0.90	0.00	0.00
October	0.00	1.22	3.4	0.8	2.73	-1.51	0.90	0.00	0.00
November	0.00	3.14	1.8	0.8	1.44	1.70	0.90	0.80	0.13
December	0.90	4.43	0.9	0.8	0.74	4.59	0.90	3.69	0.59
January	0.90	4.73	1.2	0.8	0.99	4.64	0.90	3.74	0.59
February	0.90	4.59	1.7	0.8	1.34	4.15	0.90	3.25	0.52
March	0.90	3.45	3.4	0.8	2.73	1.62	0.90	0.72	0.11
April	0.90	1.36	4.8	0.8	3.84	-1.58	0.90	0.00	0.00
May	0.00	0.78	6.2	0.8	4.96	-4.18	0.90	0.00	0.00
June	0.00	0.16	6.9	0.8	5.52	-5.36	0.90	0.00	0.00
July	0.00	0.01	7.4	0.8	5.95	-5.94	0.90	0.00	0.00
August	0.00	0.07	6.5	0.8	5.21	-5.14	0.90	0.00	0.00
								TOTAL (acre-feet/year):	**1.94**

Notes: .

1 Initial Soil Moisture is assumed to be equal to the AWS of the previous month

2 See *Table III Rainfall* for data; all rainfall is assumed to contrubte to infiltration

3 Reference evapotranspiration (ETo) data for Napa County (Zone 8) is referenced from the California Irrigation Management Information System (CIMIS) database

4 K_C is referenced from A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California

5 PET = ETo x K_C

6 ΔS = Initial Soil Moisture + R - PET + TWA

7 AWS = Root Depth x AWC

8 ΔGW = ΔS - AWS

References:

> Department of Water Resources California Irrigation Management Information Systems (website: www.cimis.water.ca.gov)
> A Guide to Estimating Irrigation Water Needs of Landscape Plantings in California, University of California Cooperative Extension, California Department of
> Napa Valley Groundwater Sustainability: A Basin Analysis Report for the Napa Valley Subbasin, Luhdorff & Scalmanini, December 13, 2016
> Natural Resource Conservation District (NRCS) Soil Survey

Saintsbury Winery
WAA Summary
Table VII

Total Parcel Size:	**15.83 acres**
Non-infiltrative Areas (existing + proposed):	**1.46 acres**
Parcel Infiltrative Areas:	**14.37 acres**
Hydraulic Saturation Rate (Ksat):	**0.19 in/hr**
Available Water Capacity:	**0.11 ft/ft**
Watershed Runoff Coefficient:	**52%**

ESTIMATED GW RECHARGE USING THE RUNOFF COEFFIENT

Estimated GW Recharge (acre-feet/year)=

Annual Rainfall (feet) x Parcel Infiltrative Areas (acres) x (1-Watershed Runoff Coefficient)

Estimated GW Recharge = 13.88 acre-feet/year

ESTIMATED GW RECHARGE USING THE ROOT ZONE BALANCE METHOD

Estimated GW Recharge (acre-feet/year)=

Landscape Recharge (acre-feet/year) + Vineyard Recharge (acre-feet/year) + Grass Recharge (acre-feet/year)

Landscape Recharge:	0.02 acre-feet/year
Vineyard Recharge:	7.50 acre-feet/year
Native/grass Recharge:	1.94 acre-feet/year
Estimated Groundwater Recharge =	9.46 acre-feet/year

Saintsbury Winery
Neighboring Well Drawdown
Table VIII

BARTELT ENGINEERING

PROJECT WELL INFORMATION			
Constant pumping rate (assumed)		=	20 gpm
Well diameter (assumed)		=	8 inch
NEIGHBORING WELL INFORMATION			
Constant pumping rate		=	15 gpm
Well diameter		=	6 inch
Total depth of well		=	215 feet
Screened interval		=	160 feet
CALCULATED DRAWDOWN IN NEIGHBORING WELL			
Aquifer thickness[1]	D	=	160 ft
Hydraulic Conductivity[2]	Kh	=	10 ft/day
Aquifer Transmissivity	T	=	1,600 ft^2/day
Project Well Pumping Rate	Q	=	20 gpm
			3,850 ft^3/day
Radial distance between wells	r	=	415 feet
Storage coefficient[3]	S	=	0.1
Time since pumping began	t	=	1 day
Calculated drawdown		**=**	**0.00 ft**

Notes:

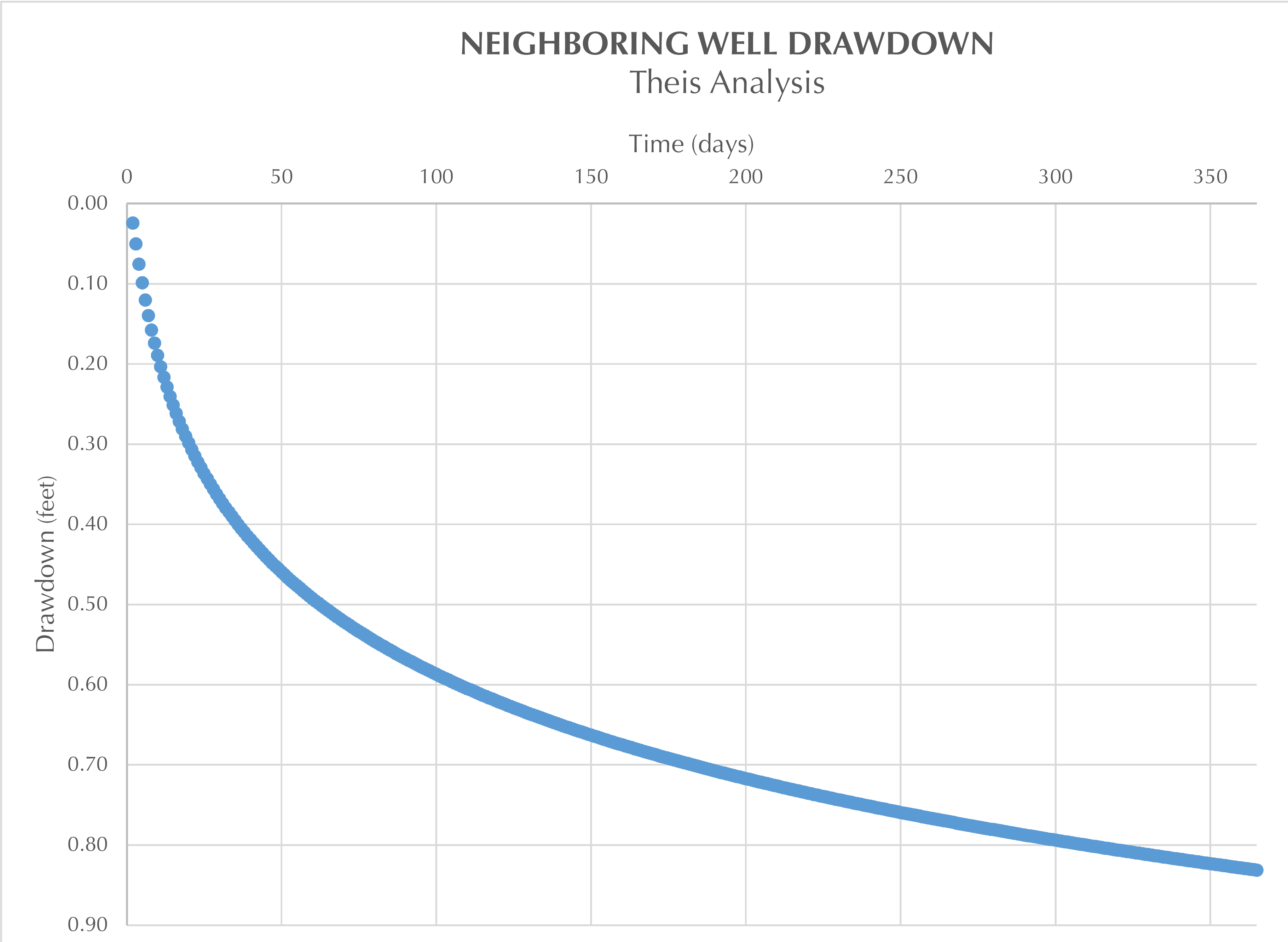
[1] Aquifer thickness is assumed to be equal to the neighboring well screened interval distance.

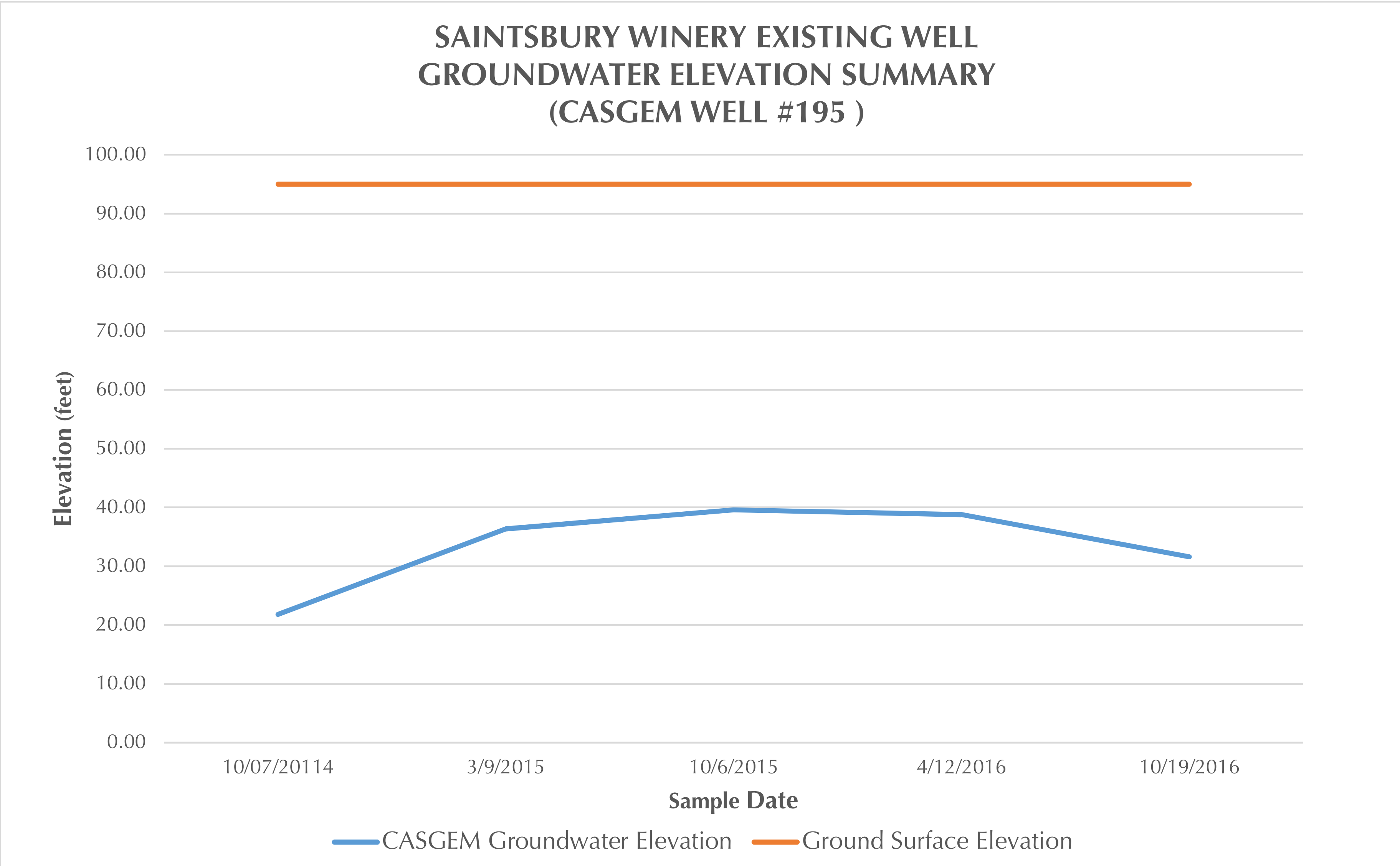
[2] Referenced from Table F-5 for a very low Hydraulic Conductivity, K class from the WAA-Guidance Document (2015).

[3] The soil water storage coefficient is referenced from the NRCS Custom Soil Report for the subject parcel area of interest (AOI); refer to the Custom Soil Report of Saintsbury Winery attached with the Water Availability Analysis.

> Neighboring well data is taken from the Well Completion Report no. 1073662 for the well located on APN 047-130-002

> Since the project well has not been drilled, well information is based on properties from surrounding well logs


NEIGHBORING WELL DRAWDOWN
Theis Analysis
Time (days)
0
50
100
150
200
250
300
350
Drawdown (feet)
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90


SAINTSBURY WINERY EXISTING WELL
GROUNDWATER ELEVATION SUMMARY
(CASGEM WELL #195)
Elevation (feet)
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
10/07/20114
3/9/2015
10/6/2015
4/12/2016
10/19/2016
Sample Date
CASGEM Groundwater Elevation
Ground Surface Elevation

047-130-002

QUADRUPLICATE Well #1
For Local Requirements

Page ___ of ___

Owner's Well No. ___

Date Work Began 4-16-09, Ended 4-27-09

Local Permit Agency Napa County

Permit No. E08-00878 Permit Date 7-15-08

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet

No. 1073662

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 Mud

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION — Describe material, grain size, color, etc.
0	25	Clay
25	30	gravel & boulders
30	50	clay
50	65	gravel & boulders
65	80	clay
80	120	sandy clay & gravel
120	165	clay
165	172	sandy clay & gravel
172	215	hard clay
215	400	blue Clay

TOTAL DEPTH OF BORING 400 (Feet)

TOTAL DEPTH OF COMPLETED WELL 215 (Feet)

WELL OWNER

Name [redacted]

Mailing Address [redacted]

CITY [redacted] STATE ZIP

WELL LOCATION

Address Same

City Same

County Napa

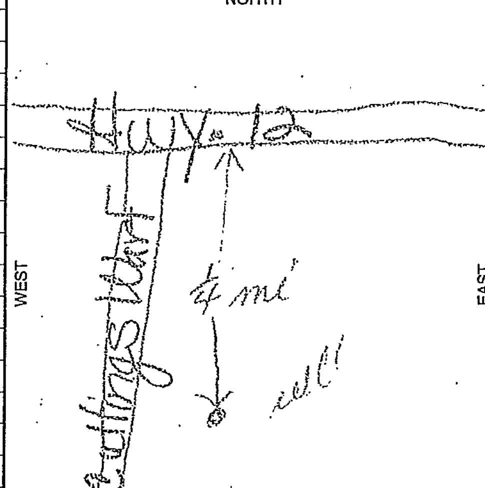
APN Book ___ Page ___ Parcel 047-130-002

Township ___ Range ___ Section ___

Lat ___ N DEG. MIN. SEC. Long ___ W 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 (✓)

X NEW WELL

MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)

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

USES (✓)

WATER SUPPLY
___ Domestic ___ Public
X 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 25 (Ft.) BELOW SURFACE

DEPTH OF STATIC WATER LEVEL 25 (Ft.) & DATE MEASURED ___

ESTIMATED YIELD * 15 (GPM) & TEST TYPE Air Lift

TEST LENGTH 3 (Hrs.) TOTAL DRAWDOWN 150 (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	26	12"	X				PLASTIC	6"	200	
26	55	10"	X				"	6"	"	
55	215	10"	Gap Perf				"	"	5/32	

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	26	X			
26	215				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 Pelliam Well Drilling
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)

1877 Piedmont Av. Napa Ca. 94558
ADDRESS CITY STATE ZIP

Signed [signature] 5-11-09 642175
C-57 LICENSED WATER WELL CONTRACTOR DATE SIGNED C-57 LICENSE NUMBER

RECEIVED SEP 10 2009 DEPT. OF ENVIRONMENTAL MANAGEMENT

DWR 188 REV. 05-03

IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

January 30, 2017

Conservation, Development and Planning Department – County of Napa
1195 Third Street, Room 210
Napa, CA 94559

SUBJECT: APN 047-212-002 – Saintsbury Winery
NSD Will Serve #60 – Recycled Water

To Whom It May Concern:

The Napa Sanitation District (District) has received a request to provide a "Will Serve" letter for proposed winery improvements located on the subject parcel. The District will provide recycled water service to this parcel.

The following items will be required by the owner/developer:

1. Install the recycled water improvements as specified in the District's Conditions of Approval for the project.
2. Pay the appropriate development fees. The facility shall be subject to all applicable rules and regulations of the District.
3. Enter into a Recycled Water User Agreement with the District for purchase and use of recycled water.

This parcel is within the Los Carneros Water District (LCWD). The development will be required to install the necessary facilities to utilize recycled water for irrigation.

The District currently has an irrigation season (May 1 – October 31) supply of recycled water of 3,700 acre-feet. The District's source for recycled water is wastewater generated by sewer customers within the District's sewer service area.

LCWD was issued a will-serve letter for 450 acre-feet of recycled water during the irrigation season which is a portion of the 3,700 acre-feet supply. The subject parcel is allocated 1.73 acre-feet of recycled water during the irrigation season which is a portion of the LCWD allocation. The District will provide recycled water service to this parcel.

This "Will Serve" letter for sanitary sewer and recycled water service is valid for a period of three (3) years from the date of this letter. If the proposed development has not obtained its required Connection Permits from the District at the end of this time, this "Will Serve" letter shall become void. If you have any questions regarding this matter, please contact me at (707) 258-6007 or adamron@napasan.com.

Sincerely,

Andrew Damron, P.E.
Technical Services Director

cc: Christina Nicholson, Bartelt Engineering
David Graves, Saintsbury Winery

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for

Napa County, California

Saintsbury Winery

November 2, 2016

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (http://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

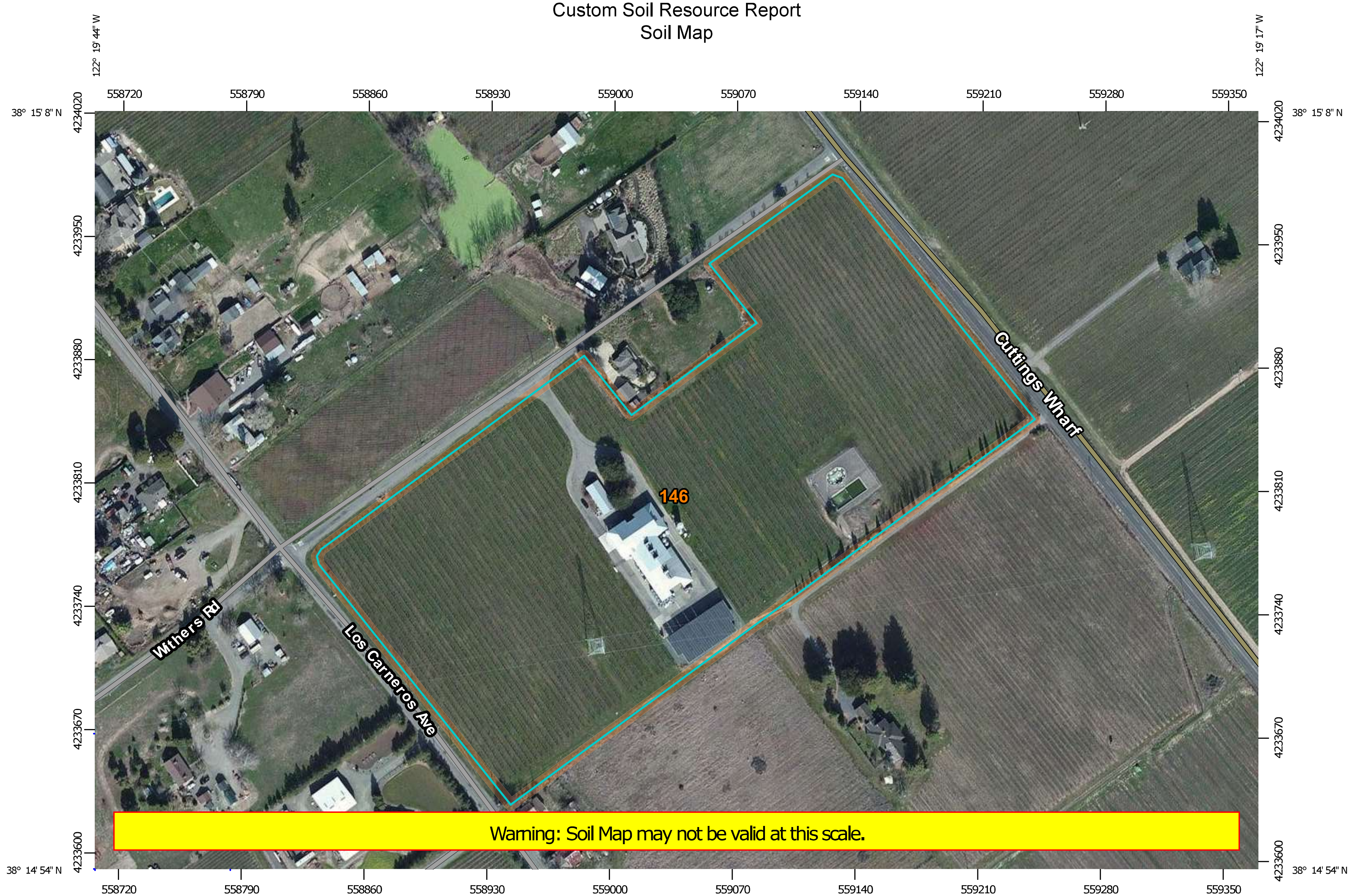
Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

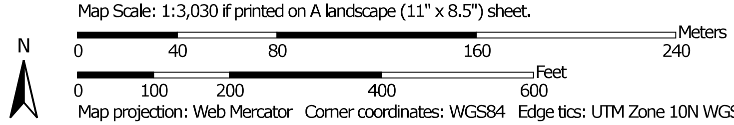
Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Soil Map



Map Scale: 1:3,030 if printed on A landscape (11" x 8.5") sheet.



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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features

- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Napa County, California
Survey Area Data: Version 8, Sep 23, 2015

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

Date(s) aerial images were photographed: Feb 4, 2012—Feb 17, 2012

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

Map Unit Legend

Napa County, California (CA055)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
146	Haire loam, 2 to 9 percent slopes	15.7	100.0%
Totals for Area of Interest		**15.7**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Napa County, California

146—Haire loam, 2 to 9 percent slopes

Map Unit Setting

National map unit symbol: hdlh
Elevation: 20 to 2,400 feet
Mean annual precipitation: 25 to 30 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 220 to 260 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Haire and similar soils: 85 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Haire

Setting

Landform: Alluvial fans, terraces
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope, riser
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock

Typical profile

H1 - 0 to 22 inches: loam
H2 - 22 to 27 inches: sandy clay loam
H3 - 27 to 45 inches: clay
H4 - 45 to 60 inches: sandy clay

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Moderate (about 6.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Ecological site: CLAYPAN (R014XD089CA)
Hydric soil rating: No

Minor Components

Clear lake

Percent of map unit: 5 percent
Landform: Alluvial fans
Hydric soil rating: Yes

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Physical Properties

Soil Physical Properties are measured or inferred from direct observations in the field or laboratory. Examples of soil physical properties include percent clay, organic matter, saturated hydraulic conductivity, available water capacity, and bulk density.

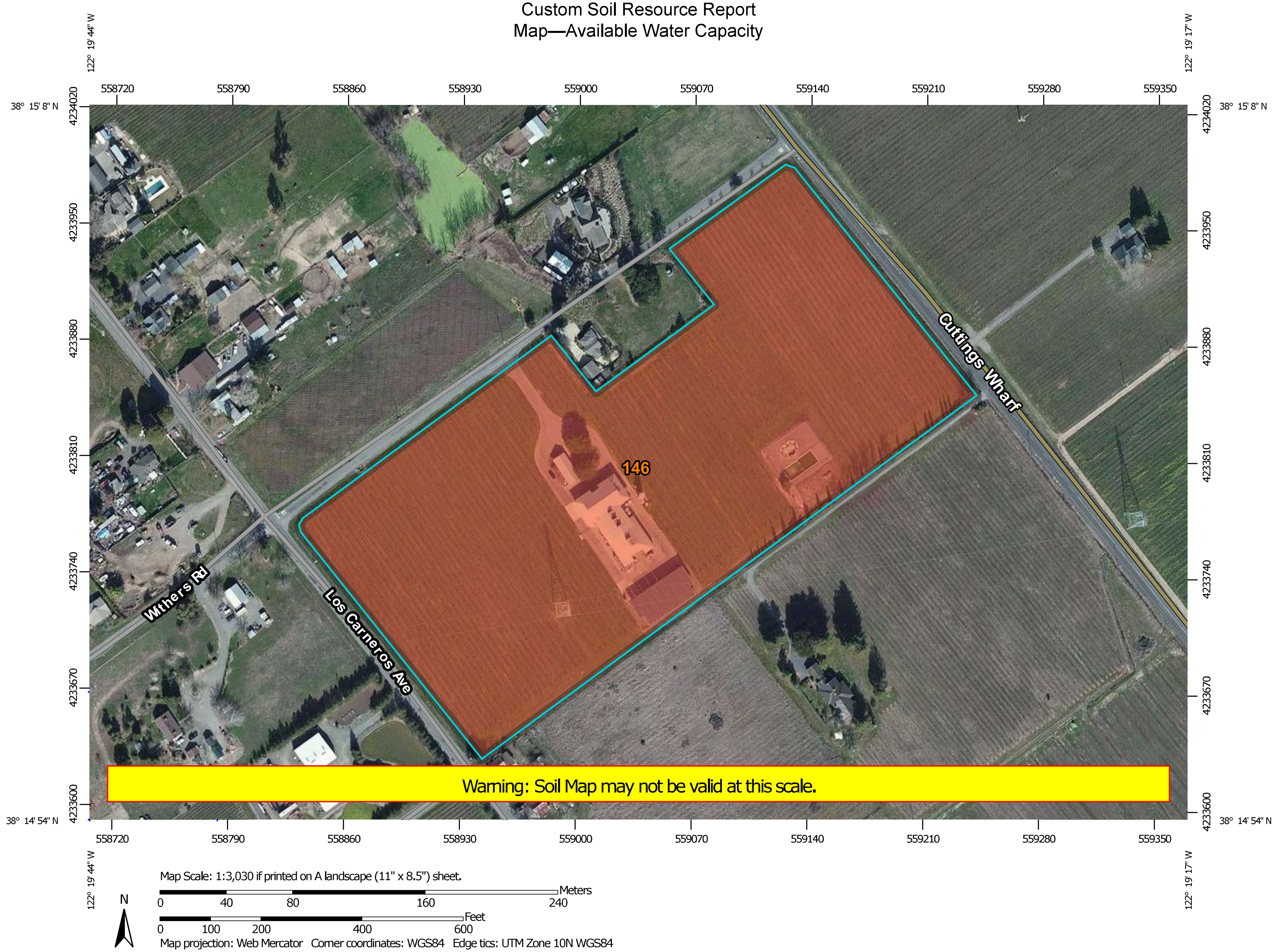
Available Water Capacity

Available water capacity (AWC) refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in centimeters of water per centimeter of soil for each soil layer. The capacity varies, depending on soil properties that affect retention of water. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure, with corrections for salinity and rock fragments. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. It is not an estimate of the quantity of water actually available to plants at any given time.

Available water supply (AWS) is computed as AWC times the thickness of the soil. For example, if AWC is 0.15 cm/cm, the available water supply for 25 centimeters of soil would be 0.15 x 25, or 3.75 centimeters of water.

For each soil layer, AWC is recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

Map—Available Water Capacity



MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

= 0.11

Not rated or not available

Soil Rating Lines

= 0.11

Not rated or not available

Soil Rating Points

= 0.11

Not rated or not available

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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Survey Area Data: Version 8, Sep 23, 2015

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

Date(s) aerial images were photographed: Feb 4, 2012—Feb 17, 2012

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Table—Available Water Capacity

Available Water Capacity— Summary by Map Unit — Napa County, California (CA055)				
Map unit symbol	Map unit name	Rating (centimeters per centimeter)	Acres in AOI	Percent of AOI
146	Haire loam, 2 to 9 percent slopes	0.11	15.7	100.0%
Totals for Area of Interest			**15.7**	**100.0%**

Rating Options—Available Water Capacity

Units of Measure: centimeters per centimeter

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): All Layers (Weighted Average)

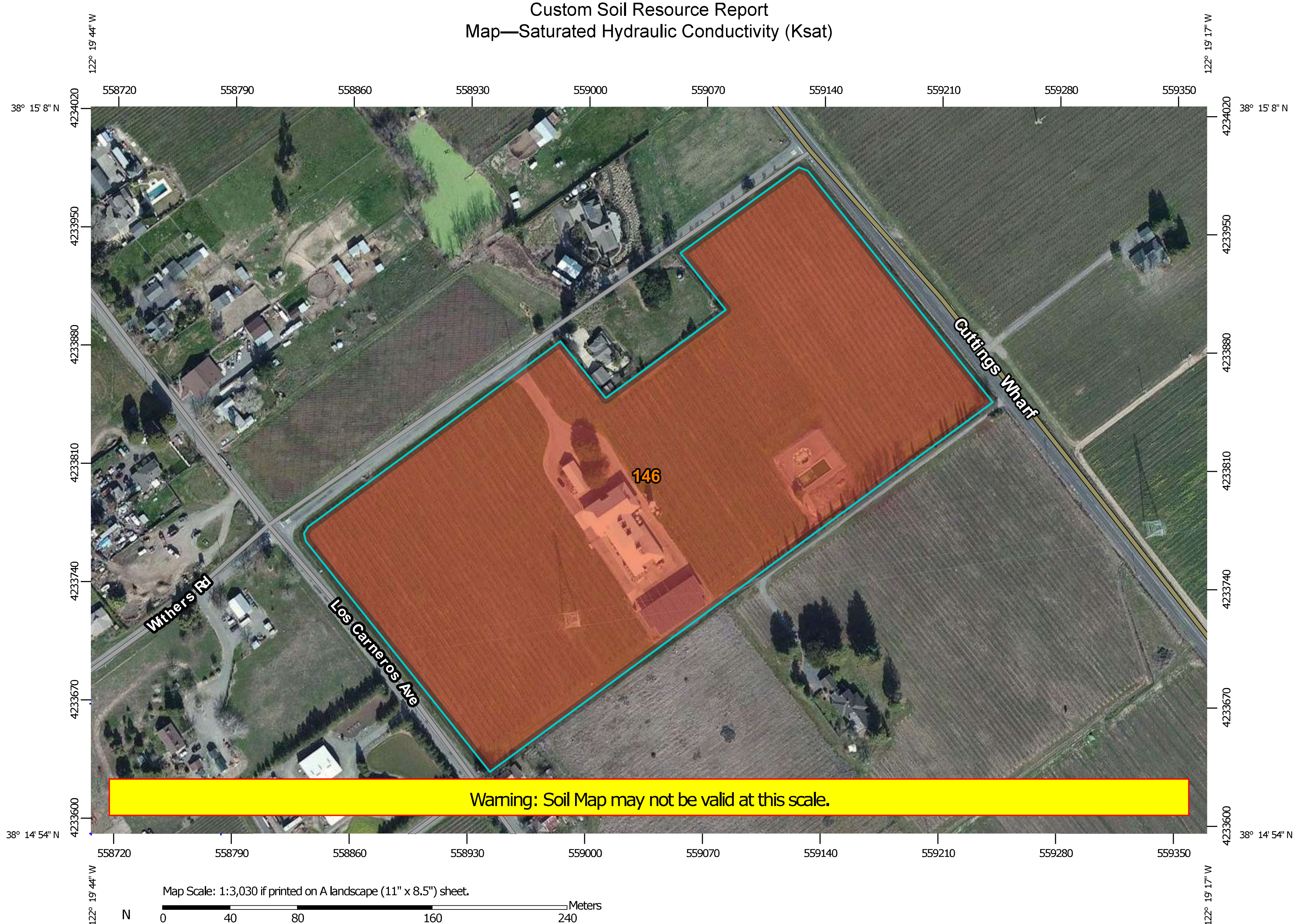
Saturated Hydraulic Conductivity (Ksat)

Saturated hydraulic conductivity (Ksat) refers to the ease with which pores in a saturated soil transmit water. The estimates are expressed in terms of micrometers per second. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Saturated hydraulic conductivity is considered in the design of soil drainage systems and septic tank absorption fields.

For each soil layer, this attribute is actually recorded as three separate values in the database. A low value and a high value indicate the range of this attribute for the soil component. A "representative" value indicates the expected value of this attribute for the component. For this soil property, only the representative value is used.

The numeric Ksat values have been grouped according to standard Ksat class limits.

Map—Saturated Hydraulic Conductivity (Ksat)



Map Scale: 1:3,030 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 40, 80, 160, 240

Feet: 0, 100, 200, 400, 600

N

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

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- = 1.3431
- Not rated or not available

Soil Rating Lines
- = 1.3431
- Not rated or not available

Soil Rating Points
- = 1.3431
- Not rated or not available

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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Table—Saturated Hydraulic Conductivity (Ksat)

Saturated Hydraulic Conductivity (Ksat)— Summary by Map Unit — Napa County, California (CA055)				
Map unit symbol	**Map unit name**	**Rating (micrometers per second)**	**Acres in AOI**	**Percent of AOI**
146	Haire loam, 2 to 9 percent slopes	1.3431	15.7	100.0%
Totals for Area of Interest			**15.7**	**100.0%**

Rating Options—Saturated Hydraulic Conductivity (Ksat)

Units of Measure: micrometers per second

Aggregation Method: Dominant Component

Component Percent Cutoff: None Specified

Tie-break Rule: Fastest

Interpret Nulls as Zero: No

Layer Options (Horizon Aggregation Method): All Layers (Weighted Average)

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group

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

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

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

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

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

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

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

Map—Hydrologic Soil Group

Map Scale: 1:3,030 if printed on A landscape (11" x 8.5") sheet.

Meters: 0, 40, 80, 160, 240

Feet: 0, 100, 200, 400, 600

N

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

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

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

Soil Rating Lines

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

Soil Rating Points

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

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Napa County, California
Survey Area Data: Version 8, Sep 23, 2015

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

Date(s) aerial images were photographed: Feb 4, 2012—Feb 17, 2012

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

Table—Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Napa County, California (CA055)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
146	Haire loam, 2 to 9 percent slopes	D	15.7	100.0%
Totals for Area of Interest			**15.7**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf