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Wastewater Feasibility Study

Ballentine Vineyards Use Permit Major Modification P18-00382 &
Variance P19-00006
Planning Commission Hearing September 2, 2020

WASTEWATER FEASIBILITY REPORT

FOR THE

BALLENTINE VINEYARDS
USE PERMIT MODIFICATION

PROJECT LOCATED AT

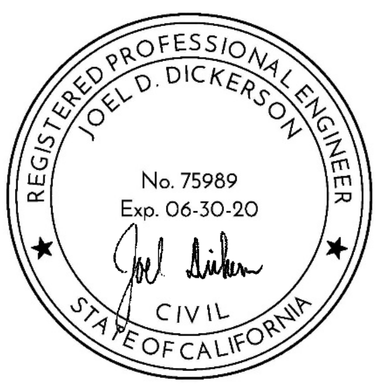
2820 ST. HELENA HIGHWAY NORTH
ST. HELENA, CA 94574

COUNTY: NAPA
APN: 022-200-003

OCTOBER 3, 2018

PREPARED FOR REVIEW BY:

NAPA COUNTY DEPARTMENT OF ENVIRONMENTAL HEALTH
1195 THIRD STREET
NAPA, CA 94559



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I. INTRODUCTION

Ballentine Vineyards is requesting a Use Permit Major Modification to increase production and visitation for an existing winery on a 21.1 acre parcel located at 2820 St. Helena Highway North, St. Helena, by owner and applicant Frank Ballentine. Existing wine production is approved for 50,000 gallons, and is requested to be expanded to 125,000 gallons annually. The property will be improved as follows: the existing tasting room will be renovated and expanded with addition of a small outdoor tasting area, the existing parking area will be reconstructed and improved, new fire hydrants will be added, and a new cover will be constructed over the existing crush pad.

This report has been prepared to evaluate the feasibility of handling the proposed increase of process and domestic wastewater on the parcel and in a manner following the requirements of the County Environmental Health Division.

Based on the proposed marketing plan for the winery, the maximum number of winery staff on-site on any given day is estimated to be fifteen (15) full-time employees.

The existing use permit allows up to 10 visitors per week, 2 events per month with 5 visitors each. The proposed marketing plan allows for up to ninety-five (95) visitors per day (max) in addition to winery special events. The following special events are proposed in the marketing plan:

- *Wine Club/Release Events – 8/Month with up to 25 guests each, 1/Month with up to 50 guests, and 1/Quarter with up to 150 guests*
- *Wine Auction/Charity Events – up to 75 guests*

All events will be catered (no on-site food preparation), and events for more than 50 people shall occur on days when the tasting room is closed to visitors.

This report presents a preliminary plan for treating and dispersing the wastewater generated from the additional wine production and visitation.

All plumbing fixtures in the approved winery shall be low flow, water-saving fixtures per the Uniform Plumbing Code as adopted by the Napa County Building Department.

II. WINERY DOMESTIC WASTEWATER FLOW

A. Wastewater Generation

The domestic wastewater (DW) generated at Ballentine Vineyards is dependent on the daily number of employees and visitors present at the winery. The marketing plan, as presented in the Introduction of this report determines the maximum number of guests the winery is permitted to serve in one day, as well as the maximum number of permanent employees that the winery needs to functionally operate. In terms of wastewater generation, this gives the maximum number of people that will be contributing to the daily peak wastewater flow rate.

B. Estimating Wastewater Quantity

To calculate the daily peak DW flow rates generated at Ballentine Vineyards, the maximum number of people present at the site, as well as the amount of wastewater each person will generate, must be estimated. The marketing plan proposes a total of 15 employees and 95 daily visitors (maximum). Napa County estimates the wastewater generated by visitors is 3 gallons per day per person, and 15 gallons per day per employee[1].

The peak effluent generated in a day will occur when the winery requires all part-time and full-time (fifteen (15)) employees on staff and receives a maximum (95) visitors in a single day as well as holds a marketing event for another 50 visitors. *Based on this combination, the peak daily domestic wastewater flow is 675 gallons per day* (see **Table 1**, below). For design purposes, this shall be taken as the maximum daily flow considered for storage and treatment requirements.

Source	Number	Projected Flow (gpd)	Total Flow No Event Day (gpd)	Total Flow Event Day (gpd)
Full-time employees	15	15	225	225
Part-Time employees (<60 days/year)	0	15	0	0
Visitors (95 day)	95	3	285	0
Private Event*	150	3	0	450
Private Residence (bedrooms)**	4	120	480	480
Grand Total		Total Peak Flow	510	675

*Events for more than 50 people shall occur on days when the tasting room is closed to visitors

**Private Residence flows for 4 bedrooms are included for reserve area sizing only

Table 1: Total Domestic Wastewater Flows

C. Estimating Wastewater Quality

The quality of domestic wastewater generated at a winery is similar to wastewater generated from a residence. The main effluent quality parameters that must be estimated from a winery's wastewater are the 5-day Biochemical Oxygen Demand (BOD5) and the Total Suspended Solids (TSS). The BOD5 concentration is a measurement used to estimate the amount organic matter present in wastewater. The TSS concentration is a measure of solid particles that have not yet settled out of the wastewater. Several additional wastewater constituents must also be estimated, as they have a direct correlation with the treatment processes used to reduce BOD5 and TSS concentrations. Fats, oils, and grease (FOG) will likely be discharged to the sewer system, and can damage the biological processes that take place in wastewater treatment. The total dissolved solids (TDS) present in wastewater can be an indicator for cleaning agents, which can affect the pH balance and destroy the bacteria that reduce organic matter in wastewater. The pH value affects bacteria that consume organic matter in the wastewater. The dissolved oxygen (DO) level can tell wastewater treatment operators that the bacteria need more or less

[1] Napa County Regulations for Design, Construction, and Installation of Alternative Sewage Treatment Systems, Appendix 1, Table 4, 2006.

oxygen in order to consume and reduce organic matter present in the wastewater. In addition to oxygen, bacteria need nitrogen to fuel their consumption of organic matter. The total nitrogen concentration in wastewater will alert wastewater treatment operators to how much nitrogen they need to add to the wastewater in order for bacteria to most efficiently consume organic matter. If a high level of wastewater treatment is required, it is important to know the type and amount of harmful bacteria and pathogens that are present in the effluent so the most appropriate form of disinfection can be applied. In domestic wastewater, fecal coliform is extremely prevalent, and is detrimental to human health. Table 2 provides a description of the expected strength of each wastewater constituent.

Constituent	Unit	Domestic
FOG	Mg/L	31-164
BOD5	Mg/L	110-400
TSS	Mg/L	100-350
TDS	Mg/L	280-850
Nitrogen (total as N)	Mg/L	20-85
Total Coliform	MPN/100 mL	10^7-10^8
Fecal Coliform	MPN/100 mL	10^4-10^5

Table 2: Typical Domestic Wastewater Values

III. WINERY PROCESS WASTEWATER FLOW

A. Production Methods

Winery wastewater outflow and strength varies throughout the winemaking year. A typical winemaking year begins with harvest preparation and harvest. These events occur during the months of August, September, and October. The harvest season typically generates both the largest volume and maximum strength of process wastewater. A breakdown of the different winemaking phases are detailed below.

Harvest and Crush – As previously mentioned, a winery will harvest and crush its fruit during the months of August, September, and October. Once the grapes have reached maturity, the fruit will be separated from the stems, and crushed to collect the juice for fermentation. Floor drains typically collect the juice, stems, seeds, and skins that are washed off of the equipment in the crush process. Grate covers on the drains can prevent larger solids from entering the wastewater system, but seeds and skins can often enter the primary wastewater tank.

Fermentation – Juice from crush is collected and stored in tanks for fermentation. Yeast will be added to the juice in order for sugar to be converted to alcohol. The fermentation process can take anywhere from one to three weeks to complete. Once the fermentation process is complete, the wine will be drained from the tank into barrels for aging. Wine drained from the fermentation tanks will carry excess skins and seeds into the barrel. The remaining solids, known as pomace, will remain at the bottom of the tank. If desired by the winemaker, the pomace can be pressed to produce more wine with different characteristics for the blending process. The remaining solids will be disposed of at a solid waste facility. The empty fermentation tanks and pomace bins will be washed out with a combination of water and sodium hydroxide or potassium hydroxide. These additives can reduce the pH of the wastewater, and contribute to the total dissolved solids (TDS) concentration.

Clarification and Racking – Due to the excess grape skins and seeds carried over from the fermentation tanks, wine can have a high concentration of suspended solids directly after fermentation. These solids are called "lees" and are allowed to settle in the barrel during the aging process. To improve the clarity and quality of the wine, the liquid will be removed from the initial barrel, and placed in a new barrel that is free of settled solids. This process is called "racking" and will often occur several times through the wine aging process, which can last for several years. The first racking will most likely occur between the months of November and January. The lees that are washed out of barrels after the first racking are known as "gross lees." Gross lees represent the largest solid particles collected during the racking process. Responsible wineries will de-water the gross lees, and dispose of the solids off-site. However, lees are often washed out of barrels and allowed to drain to the process wastewater system due to their high water content. Wastewater generated from this process will typically have very high total suspended solids (TSS) content, and a very high biological oxygen demand (BOD). Additionally, tartaric acid can be added to the wine to adjust the acidity. Process wastewater generated by racking after pH treatment can negatively affect the natural biological treatment process in the primary wastewater tanks. As clarification and racking are part of the process used to "age" wine, it is possible for wastewater to be generated by this phase year round.

Filtering and Bottling – Wine that has reached the end of its aging process will be filtered and bottled. This process can occur throughout the year due to wine types aging at different rates and the winery's production schedule. The wine storage barrels will often be washed and reused. Equipment used for bottling will be washed on a daily basis. The wastewater strength at this stage of the wine making process is typically much lower than the previous three stages of winemaking.

B. Estimating Wastewater Quantity

As every individual winery incorporates differing winemaking methods and equipment, the actual annual wastewater produced varies for each winery. The amount of wine produced in one year is the most important part in estimating a specific winery's wastewater generation. Once a winery determines the volume of wine they will produce, various factors can be applied to estimate the wastewater that will be generated from production. Furthermore, it is very important to estimate the peak volume of wastewater that can be generated in one day. Undersized storage tanks and pumps can lead to the costly failure of wastewater treatment systems, and halt the production process. Two methods are currently used by the local wastewater engineering consultants to determine both the annual and daily peak process wastewater flows generated from a winery. The Napa County Method is used to estimate the peak wastewater flow that could occur in one day during harvest. The Industry Method estimates the annual wastewater generation, then distributes a percentage of that flow to each month based on the seasonal behaviors of winemaking. The daily peak flow is then estimated by dividing the volume of wastewater generated during the peak month by the number of days in the month. The Industry Method generally produces a more realistic estimate of wastewater flows. This report will analyze and compare both methods to determine the volume of process wastewater produced, and will size the system based on the more conservative (higher) flow estimate.

Napa County Method

The Napa County Method focuses on determining the maximum daily flow a wastewater system would be required to treat. This method uses two base assumptions: the amount of process wastewater generated annually is only distributed during harvest period, and a multiplication factor of 1.5 is used for process waste generation. The harvest period, shown in **Table 3** below, is divided into days that grapes are crushed based on annual production in order to obtain a flow rate in gallons per day (GPD).

Table 3: Napa Method: Crush Days

Annual Wine Production (gallons)	# of Crush Days
<20,000	30
20,000-50,000	45
>50,000	60

Based on the projected wine production (125,000 gallons), the multiplication factor (1.5), and the number of crush days (60) that wastewater generation is distributed over, the Napa Method estimates a process wastewater (PW) peak harvest flow of **3,125 gallons per day** (see Appendix 1).

Industry Method

The Industry Method uses a ratio of 4-12 gallons of PW generated per gallon of finished wine produced to determine the annual PW volume produced. The ratio depends on the water conservation techniques utilized within each individual winery. In rare cases, if the winery is water conscious, the ratio can be as low as 4. For a typical winery, the ratio is higher. For Ballentine Vineyards, a value of 6 gallons of PW per gallon of wine is analyzed. The next step in estimating wastewater quantity is to determine the peak daily flow. The annual estimated PW is broken down into monthly percentage flows. This method attempts to consider the winery operations, which vary by month depending on the winemaking season. For example, with this method, the percentages increase for the harvest months and the percentages decrease for the non-harvest months.

Based on the proposed annual wine production of 125,000 gallons of wine and 6 gallons of PW generated per gallon of wine, the Industry Method estimates 750,000 gallons of PW produced annually. **Table 4** shows the percentage breakdown for monthly and daily flows. This table is located in the 'Wastewater Flow Generation' page of the Water Balance Spreadsheet, found in **Appendix 1**.

PW Generation Table			
Month	% of Annual	Monthly Flow	Average Daily Flow
January	4.0%	30,000	968
February	6.0%	45,000	1,607
March	6.0%	45,000	1,452
April	4.5%	33,750	1,125
May	6.0%	45,000	1,452
June	7.0%	52,500	1,750
July	8.5%	63,750	2,056
August	10.0%	75,000	2,419
September	16.0%	120,000	**4,000**
October	14.0%	105,000	3,387
November	10.5%	78,750	2,625
December	7.5%	56,250	1,815
Total	**100.0%**	**750,000**	**2,055**

Table 4: Monthly Process Wastewater Flows

Based on Table 4 above, the peak daily process waste flow using the industry method is estimated to be **4,000 gallons per day**, which is more conservative than the County method and will be used as the basis of septic system design in this report.

C. Estimating Wastewater Quality

The effluent strength parameters for all wineries vary throughout the year as different processes take place in each stage of the winemaking process. Furthermore, the strength of effluent at each individual winery can vary due to differences in the winemaker's technique and philosophy. The main effluent quality parameters that must be estimated from a winery's wastewater are the 5-day Biochemical Oxygen Demand (BOD5) and the Total Suspended Solids (TSS), as the concentrations of these constituents are regulated by both the Bay Area Water Quality Control Board and Napa County. The BOD5 concentration is a measurement used to estimate the amount organic matter present in wastewater. The typical BOD5 concentration of raw winery wastewater is 5,000 mg/L. The TSS concentration is a measure of solid particles that have not yet settled out of the wastewater.

Several additional wastewater constituents must also be estimated, as they have a direct correlation with the treatment processes used to reduce BOD5 and TSS concentrations. The total dissolved solids (TDS) present in wastewater can be an indicator for the amount of additives used to clean winery equipment, which can affect the pH balance and destroy the bacteria that reduce organic matter in wastewater. The pH value affects bacteria that consume organic matter in the wastewater. The dissolved oxygen (DO) level can tell wastewater treatment operators that the bacteria need more or less oxygen in order to consume and reduce organic matter present in the wastewater. In addition to oxygen, bacteria need nitrogen to fuel their consumption of organic matter. The nitrogen concentration in wastewater will alert wastewater treatment operators to how much nitrogen they need to add to the wastewater in order for bacteria to most efficiently consume organic matter. Fortunately, the presence of fecal coliform's and other pathogens are not detectable in process waste, and will not be considered a constituent of concern. The following table provides a range of the expected strength of each wastewater constituent throughout the winemaking year.

Table 5: Typical Process Wastewater Values

Constituent	Unit	Peak Season[a]	Off Season[b]
PH		3.8-7.8	3.8-7.8
BOD5	Mg/L	5,000	1,000
TSS	Mg/L	57-3,950	12-400
TDS	Mg/L	315-1,240	214-720
Nitrate	Mg/L	0.63-362	0.23-53
Ammonia	Mg/L	2.25	
D.O.	Mg/L	2.3-6.3	2.3-6.3

[a] Peak season is September through March

[b] Off season runs from April to August

IV. SITE EVALUATION

A site evaluation is required to determine available on-site reserve areas for subsurface dispersal of domestic wastewater generated from the winery. Madrone Engineering completed a site evaluation on July 12, 2018 to locate acceptable soils for a reserve area. Ten (10) test pits were excavated in the vineyard. The site evaluation denoting the test pit locations and soil findings can be found in **Appendix 2** of this report.

Soils on the site are not adequate for a standard leach field, as is typical in this area of the Napa Valley, but Test Pits 1 through 6 contained sufficient soil depth to support a subsurface drip system. The application (infiltration) rate of the soil in this location for this system type is recommended to be no greater than 0.60 gallons per square foot per day.

V. WASTEWATER TREATMENT SYSTEM – OPTION 1

The proposed Option 1 system design proposes to handle the domestic and process wastewater separately. The system would disperse winery domestic waste into the existing winery septic system (standard system) and would send all process waste to the existing process waste treatment system (Lyve System) before dispersing into the existing vineyard via surface drip.

A. Domestic Wastewater

The domestic wastewater from the winery is to be treated via a standard septic tank (primary treatment) with final disposal via gravity to leach lines. The primary treatment system shall be equipped with effluent filters and will treat and remove settleable solids to acceptable concentration levels.

The disposal area for the domestic wastewater is proposed to be the existing leach field that currently serves the existing winery. With historic production levels of 50,000 gallons of wine annually, the system has been successfully dispersing peak wastewater flows of up to 2,500 gallons per day since its installation up until process waste flows were diverted to a recently-installed Lyve System (2016, E15-00961). Under this option, winery process waste would continue to be routed to the existing Lyve System, therefore reducing the load on the existing leach lines from the historic peak of 2,500 gpd to 675 gpd (proposed domestic waste only).

The existing system was inspected in September 2018 by McCollum General Engineering, and is in good condition with ten distribution boxes and twenty leach lines of varying length (total length of 1,670 linear feet).

Using a conservative application rate of 0.33 gal/sf/day, and a sidewall credit of 2 feet/foot, the required leach line length to serve the proposed domestic uses would be ~1,025 linear feet. Approximately 1,670 LF of leach field is currently available to disperse the domestic wastewater.

Following is a schematic of the proposed domestic wastewater treatment system:

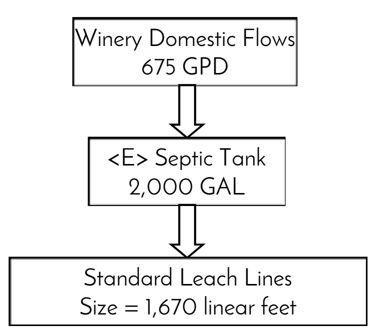

Figure 1: Conventional Domestic Wastewater Treatment System Schematic

B. Process Wastewater – Lyve System

For Option 1, process wastewater would continue to be handled through the existing Lyve System. The treatment system was installed in 2016 under permit E15-00961, and the LS35 unit has the capability of treating up to 7,000 gallons per day. Peak process waste flow under the proposed Use Permit modification would be up to 4,000 gallons per day, well within the treatment capacity of the Lyve LS35.

C. Domestic and Process Wastewater Reserve Areas

Under the current approved production level of 50,000 gallons of wine per year, peak wastewater flow is 1,250 gallons per day, and the current process waste dispersal area for the Lyve System is ~20,000 SF (0.46 acre). For the proposed production level of 125,000 gallons of wine per year (4,000 gallons of wastewater per day), approximately 64,000 SF (1.47 acres) of vineyard would be required as a surface drip disposal area. Outside of existing well setbacks, the existing domestic septic system, proposed domestic reserve area, and the FEMA floodway, approximately 10.6 acres of vineyard is available for surface drip.

In the event a reserve area is required for domestic wastewater, suitable area has been identified in Test Pits 1 through 6. Reserve area shall be sized for ~675 gpd of winery domestic, and shall also be sized to accommodate the existing 4-bedroom residence on the parcel (~480 gpd). Due to the limited depth of suitable soil, the recommended wastewater system type for the reserve area is a sub-surface drip engineered wastewater system. The application (infiltration) rate of the soil in this location for this system type is recommended to be 0.60 gallons per square foot per day. Using this application rate, we can calculate the required reserve area for domestic wastewater as follows:

$$square\ feet\ of\ reserve: \frac{1{,}155\ gpd}{0.60\ gal/ft^2} = 1{,}925\ ft^2\ x\ 200\% = 3{,}850\ ft^2$$

Please see Appendix 2 for a map showing the proposed reserve area for Option 1, and the available drip area for process waste.

VI. CONCLUSION

Based on the analysis performed in this report, the Ballentine Vineyards project is feasible with regard to wastewater disposal. The parcel contains suitable soils and adequate available dispersal area to support the project from a wastewater treatment perspective. Please see the Use Permit Plans for the proposed sizes and location of the primary and reserve areas for all the options described previously.

IX. APPENDIX

1. Water Balance Calculations
2. Site Evaluation Report

madrone
engineering

APPENDIX 1:
WATER BALANCE CALCULATIONS

Project: Ballentine Vineyards
2820 St. Helena Hwy
St. Helena, CA 94515
APN: 022-200-003

Project Description:
The following calculations are intended to estimate the process and domestic wastewater flows for Ballentine Vineyards.

Winery Process Wastewater Generation

	125,000	gallons
Annual Wine Production	2.4	gal/case
	52,083	cases
Wastewater Generation Rate	6	gal water/gal wine
Annual Process Wastewater	750,000	gal
Crush Length	60	days (<20k, 20k-50k, 50k+)
Wastewater Generation Rate (during crush)	1.5	gal water/gal wine
Daily Wine Production (during crush)	2,083	gal wine/day
Peak Daily Process Waste (County Method)	3,125	gal PW/day
Peak Daily Process Waste (Industry Estimation - see table below)	4,000	gal PW/day

PW Generation Table

Month	% of Annual	Monthly Flow	Average Daily Flow
January	4.0%	30,000	968
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Domestic Wastewater Generation

Source	Number	Projected Flow (gpd)	Total Flow No Event Day (gpd)	Total Flow Event Day (gpd)
Full-time employees	15	15	225	225
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Visitors (95/day)	95	3	285	0
Private Event	150	3	0	450
Private Residence (bedrooms)*	4	120	480	480
Grand Total		Total Peak Flow	510	675

**private residence flows for 4 bedrooms are included for reserve area sizing only

APPENDIX 2:
SITE EVALUATION REPORT

Napa County Division of Environmental Health

SITE EVALUATION REPORT

Please attach an 8.5" x 11" plot map showing the locations of all test pits triangulated from permanent landmarks or known property corners. The map must be drawn to scale and include a North arrow, surrounding geographic and topographic features, direction and % slope, distance to drainages, water bodies, potential areas for flooding, unstable landforms, existing or proposed roads, structures, utilities, domestic water supplies, wells, ponds, existing wastewater treatment systems and facilities.

Permit #: E18-00558
APN: 022-200-003
(County Use Only) Reviewed by: Date:

PLEASE PRINT OR TYPE ALL INFORMATION

Property Owner Ballentine William Van & Betty P TR ETAL	☐ New Construction ☐ Addition ☐ Remodel ☐ Relocation ☒ Other: Use Permit Modification
Property Owner Mailing Address 2820 St. Helena Highway	☒ Residential - # of Bedrooms: 4 Design Flow : 480 gpd
City: St. Helena State: CA Zip: 94574	☒ Commercial – Type: Sanitary Waste: 690 gpd Process Waste: gpd
Site Address/Location 2820 St. Helena Highway St. Helena CA 94574	☐ Other: Sanitary Waste: gpd Process Waste: gpd

Evaluation Conducted By:

Company Name	Evaluator's Name	Signature (Civil Engineer, R.E.H.S., Geologist, Soil Scientist)
MADRONE ENGINEERING	Joel Dickerson, P.E.	[signature]
Mailing Address: 1485 Main St., Suite 302		Telephone Number: 707-302-6280
City: St. Helena	State: CA Zip: 94574	Date Evaluation Conducted: 07/12/2018

Primary Area	**Expansion Area**
Acceptable Soil Depth: NA in. Test pit #'s: N/A	Acceptable Soil Depth: 29 in. Test pit #'s: 1-4
Soil Application Rate (gal. /sq. ft. /day):	Soil Application Rate (gal. /sq. ft. /day): 0.60
System Type(s) Recommended:	System Type(s) Recommended: Sub-Surface Drip
Slope: %. Distance to nearest water source: ft.	Slope: <5 %. Distance to nearest water source: >100 ft.
Hydrometer test performed? No ☒ Yes ☐ (attach results)	Hydrometer test performed? No ☒ Yes ☐ (attach results)
Bulk Density test performed? No ☒ Yes ☐ (attach results)	Bulk Density test performed? No ☒ Yes ☐ (attach results)
Percolation test performed? No ☒ Yes ☐ (attach results)	Percolation test performed? No ☒ Yes ☐ (attach results)
Groundwater Monitoring Performed? No ☒ Yes ☐ (attach results)	Groundwater Monitoring Performed? No ☒ Yes ☐ (attach results)

Site constraints/Recommendations:

The site evaluation demonstrates adequate reserve area for all winery domestic wastewater, as well as existing residential wastewater on the parcel. Winery process waste is treated by a Lyve System and dispersed into the vineyard via surface drip.

Test Pit # 1

PLEASE PRINT OR TYPE ALL INFORMATION

Horizon Depth (Inches)	Boundary	%Rock	Texture	Structure	Consistence			Pores	Roots	Mottling
					Side Wall	Ped	Wet			
0-29	G	<10	SCL	S-SB	VH	FRB	S	M-F	F-F	N/A
29-54	G	<10	SCL	S-SB	S	VFRB	S	M-F	F-F	N/A
54-60	Massive Clay									

Test Pit # 2

Horizon Depth (Inches)	Boundary	%Rock	Texture	Structure	Consistence			Pores	Roots	Mottling
					Side Wall	Ped	Wet			
0-38	G	<10	SCL	S-SB	VH	FRB	S	M-F	F-F	N/A
38-59	Massive Clay									

Test Pit # 3

Horizon Depth (Inches)	Boundary	%Rock	Texture	Structure	Consistence			Pores	Roots	Mottling
					Side Wall	Ped	Wet			
0-56	G	<10	SCL	M-SB	SH	FRB	S	M-F	F-F	N/A
56-60	Massive Clay									

Attach additional sheets as needed

Test Pit # 4

PLEASE PRINT OR TYPE ALL INFORMATION

Horizon Depth (Inches)	Boundary	%Rock	Texture	Structure	Consistence			Pores	Roots	Mottling
					Side Wall	Ped	Wet			
0-40	G	<10	SCL	M-SB	H	FRB	S	M-F	F-F	N/A
40-60	Massive Clay									

Test Pit # 5

Horizon Depth (Inches)	Boundary	%Rock	Texture	Structure	Consistence			Pores	Roots	Mottling
					Side Wall	Ped	Wet			
0-28	G	<10	SCL	M-SB	H	FRB	S	M-F	F-F	N/A
28-60	Massive Clay									

Test Pit # 6

Horizon Depth (Inches)	Boundary	%Rock	Texture	Structure	Consistence			Pores	Roots	Mottling
					Side Wall	Ped	Wet			
0-26	G	<10	SCL	M-SB	H	FRB	S	M-F	F-F	N/A
26-60	Massive Clay									

Attach additional sheets as needed

Test Pit # 7

PLEASE PRINT OR TYPE ALL INFORMATION

Horizon Depth (Inches)	Boundary	%Rock	Texture	Structure	Consistence			Pores	Roots	Mottling
					Side Wall	Ped	Wet			
0-20	G	<10	SCL	M-SB	H	FRB	S	M-F	F-F	N/A
20-56	Massive Clay									

Test Pit # 8

Horizon Depth (Inches)	Boundary	%Rock	Texture	Structure	Consistence			Pores	Roots	Mottling
					Side Wall	Ped	Wet			
0-20	G	<10	SCL	M-SB	H	FRB	S	M-F	F-F	N/A
20-60	Massive Clay									

Test Pit # 9

Horizon Depth (Inches)	Boundary	%Rock	Texture	Structure	Consistence			Pores	Roots	Mottling
					Side Wall	Ped	Wet			
0-18	G	<10	SCL	M-SB	H	FRB	S	M-F	F-F	N/A
18-56	Massive Clay									

Attach additional sheets as needed

Test Pit # 10

PLEASE PRINT OR TYPE ALL INFORMATION

Horizon Depth (Inches)	Boundary	%Rock	Texture	Structure	Consistence			Pores	Roots	Mottling
					Side Wall	Ped	Wet			
0-20	G	<10	SCL	M-SB	H	FRB	S	M-F	F-F	N/A
20-62	Massive Clay									

Test Pit #

Horizon Depth (Inches)	Boundary	%Rock	Texture	Structure	Consistence			Pores	Roots	Mottling
					Side Wall	Ped	Wet			

Test Pit #

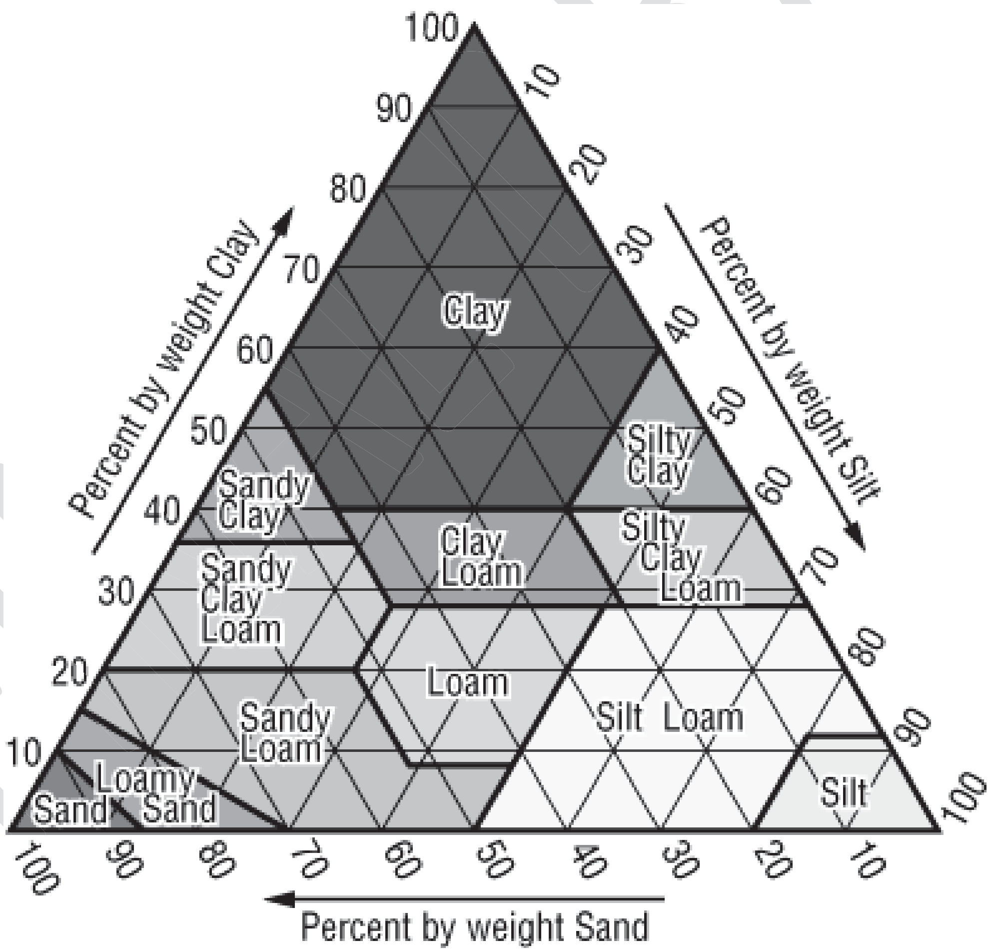
Horizon Depth (Inches)	Boundary	%Rock	Texture	Structure	Consistence			Pores	Roots	Mottling
					Side Wall	Ped	Wet			

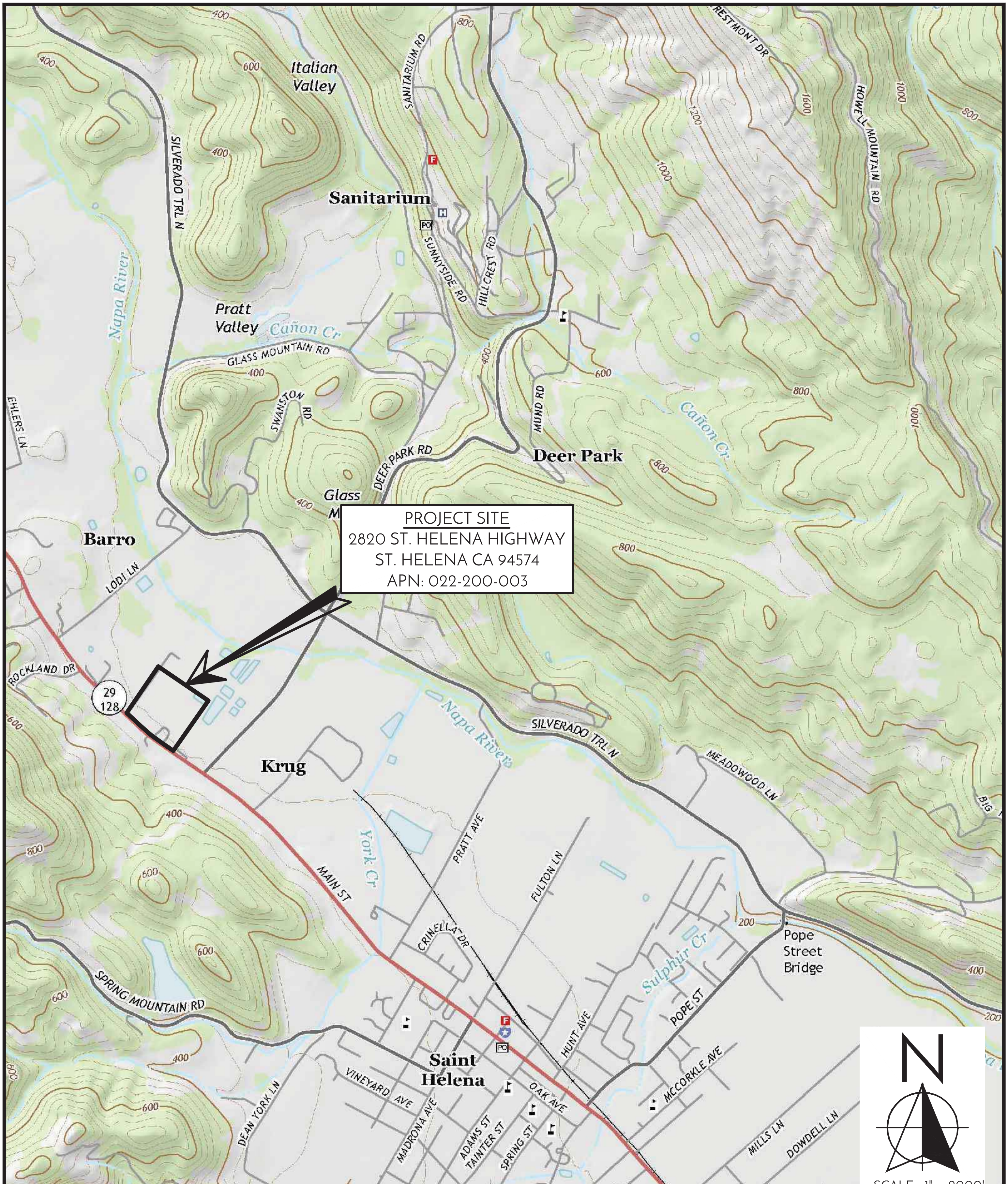
Attach additional sheets as needed

ABBREVIATIONS

Boundary	Texture	Structure	Consistence			Pores	Roots	Mottling
			Side Wall	**Ped**	**Wet**			
A=Abrupt <1" **C**=Clear 1"-2.5" **G**=Gradual 2.5"-5" **D**=Difuse >5"	**S**=Sand **LS**=Loamy Sand **SL**=Sandy Loam **SCL**=Sandy Clay Loam **SC**=Sandy Clay **CL**=Clay Loam **L**=Loam **C**=Clay **SiC**=Silty Clay **SiCL**=Silty Clay Loam **SiL**=Silt Loam **Si**=Silt	**W**=Weak **M**=Moderate **S**=Strong **G**=Granular **Pl**=Platy **Pr**=Prismatic **C**=Columnar **AB**=Angular Blocky **SB**=Subangular Blocky **M**=Massive **SG**=Single Grain **C**=Cemented	**L**=Loose **S**=Soft **SH**=Slightly Hard **H**=Hard **VH**=Very Hard **ExH**=Extremely Hard	**L**=Loose **VFRB**=Very Friable **FRB**=Friable **F**=Firm **VF**=Very Firm **ExF**=Extremely Firm	**NS**=NonSticky **SS**=Slightly Sticky **S**=Sticky **VS**=Very Sticky **NP**=NonPlastic **SP**=Slightly Plastic **P**=Plastic **VP**=Very Plastic	**<u>Quantity:</u>** **F**=Few **C**=Common **M**=Many **<u>Size:</u>** **VF**=Very Fine **F**=Fine **M**=Medium **C**=Coarse **VC**=Very Coarse	**<u>Quantity:</u>** **F**=Few **C**=Common **M**=Many **<u>Size:</u>** **F**=Fine **M**=Medium **C**=Coarse **VC**=Very Coarse **ExC**=Extremely Coarse	**<u>Quantity:</u>** **F**=Few **C**=Common **M**=Many **<u>Size:</u>** **F**=Fine **M**=Medium **C**=Coarse **<u>Contrast:</u>** **Ft**=Faint **D**=Distinct **P**=Prominent

U.S.D.A. SOIL CLASSIFICATION TRIANGLE





BALLENTINE VINEYARDS

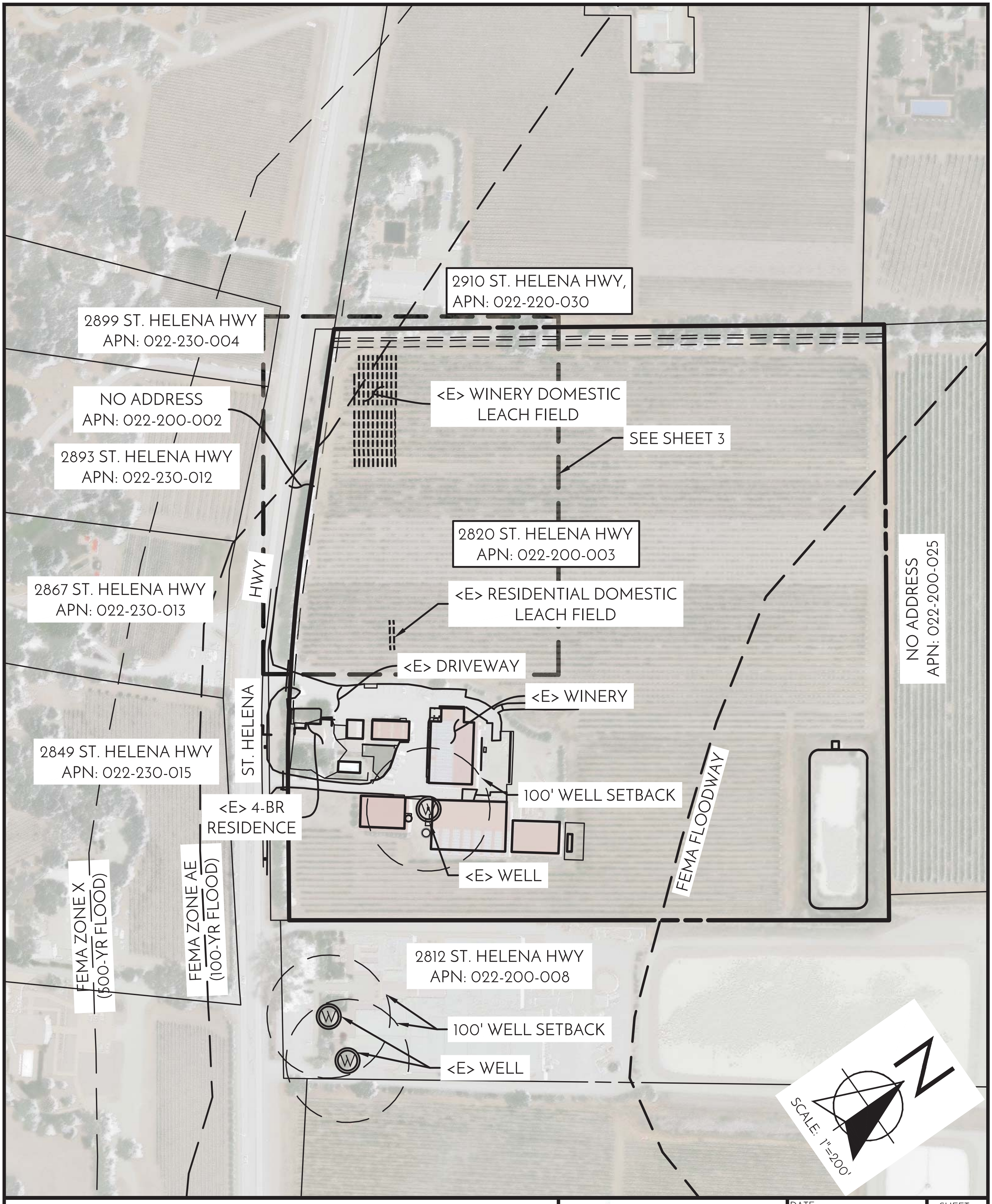
VICINITY MAP

madrone engineering

1485 MAIN ST., SUITE 302
ST. HELENA, CA 94574
(707) 302-6280

DATE:	08/13/2018
SCALE:	1"=2000'
JOB #	17.047
APN:	022-200-003

SHEET 1 OF 3



BALLENTINE VINEYARDS

OVERALL SITE MAP

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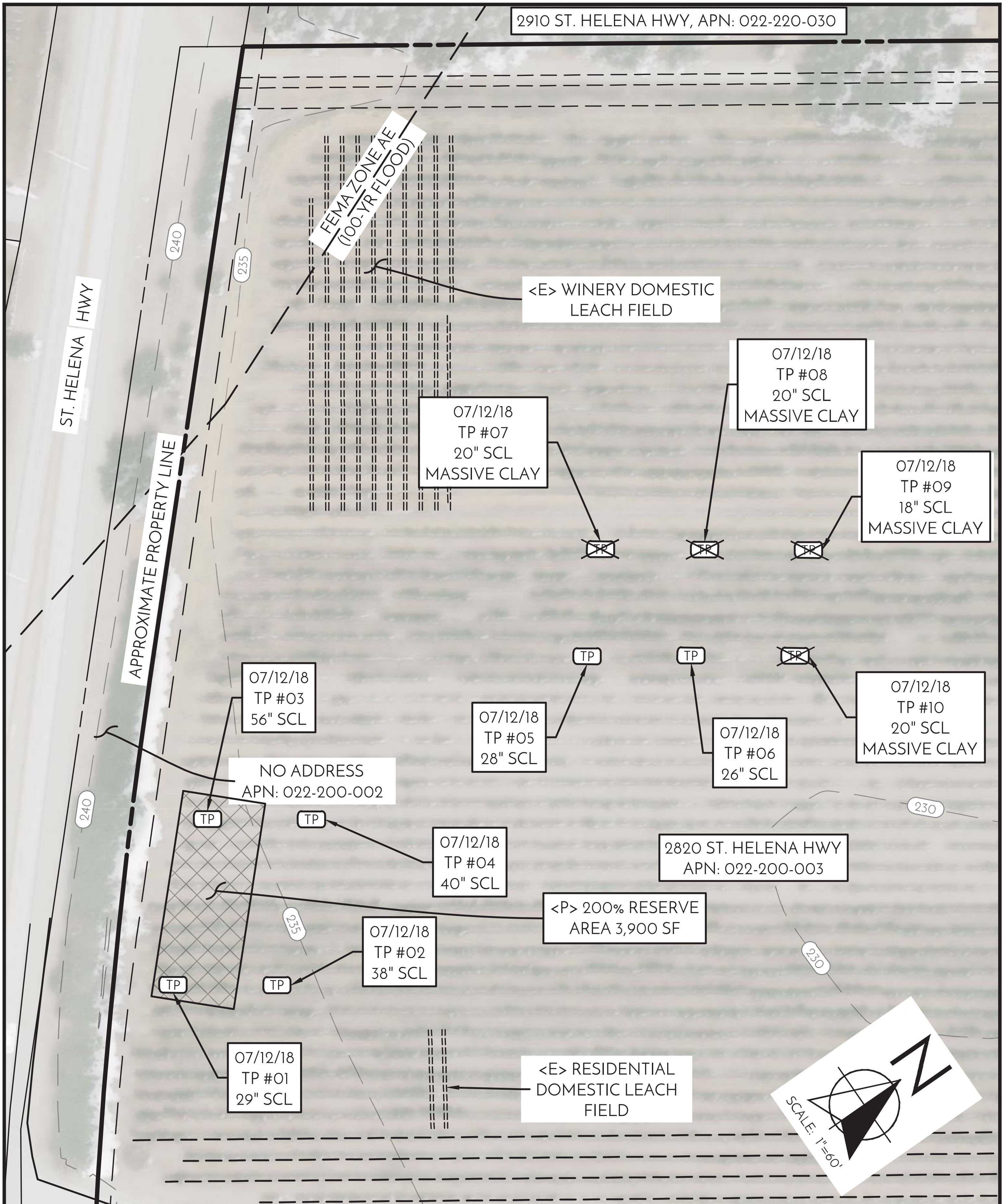
1485 MAIN ST., SUITE 302
ST. HELENA, CA 94574
(707) 302-6280

DATE:	08/13/18
SCALE:	1"=200'
JOB #	17.047
APN:	022-200-003

SHEET 2 OF 3



BALLENTINE VINEYARDS
TEST PIT MAP

madrone engineering

1485 MAIN ST., SUITE 302
ST. HELENA, CA 94574
(707) 302-6280

DATE:	08/13/18
SCALE:	1"=60'
JOB #	17.047
APN:	022-200-003

SHEET 3 OF 3