“F”

Water Availability Analysis

Bella Union P19-00139
Planning Commission Hearing Date December 7, 2022

WATER AVAILABILITY ANALYSIS

Bella Union Winery

1695 St. Helena Highway

St. Helena, California

APN 027-470-007

SUMMIT

CIVIL STRUCTURAL ELECTRICAL WATER|WASTEWATER PLANNING

Project No. 2021307
January 7, 2022
Revised: August 3, 2022

TABLE OF CONTENTS

LIST OF ENCLOSURES

PROJECT OVERVIEW

Bella Union Winery (previously Provenance Winery), located at 1695 St. Helena Highway in St. Helena (APN 027-470-007), is applying for a use permit modification to increase the number of employees, tasting visitation, marketing event visitation, and wine production. Wine production is proposed to increase from 180,000 to 300,000 gallons per year. Employees are proposed to increase from the existing 12 full-time to 38 full-time and 7 part-time. Tasting visitation is proposed to increase from 366 visitors per week to 1,375 visitors per week (175 visitors per day for Monday through Thursday and 225 visitors per for Friday to Sunday). Public tasting visitation will remain at 43 visitors per day and is included in the proposed total tasting visitation of 1,375 visitors per week. Marketing events are proposed to change to a schedule of weekly, monthly, and annual events. The site is a 60.65-acre parcel in an agricultural area on St. Helena Highway (Enclosure A). The topography consists of gently sloping vineyards within the Napa Valley Floor (NVF).

There are two existing operational wells on site (Table 1). Well 03 is connected to the public water system and supplies the potable water demand for the entire winery property. The second well ("Ag Well") provides vineyard and landscape irrigation water supply. Well logs are provided in Enclosure B.

Table 1. Summary of existing well information.

Source Name	Primary Use	Year Drilled	Status	Capacity (gpm)	Annular Seal Depth (ft)
Well 03	Domestic/Process	2003	Active	27 [1]	53
Ag Well	Irrigation	1991	Active	100 [1]	22

1. Capacity estimates from both wells are from well tests conducted in 2021 (Enclosure B).

Summit Engineering has prepared the following Water Availability Analysis to demonstrate that there is no net increase in water consumption associated with the proposed increase in wine production, employees, tasting visitation, and marketing events when accounting for changes in irrigation use.

EXISTING WATER DEMAND

Existing water uses on the property are based on the following:

- Winery process water demand for 180,000 gallons per year of wine production
- Winery domestic water demand
- Residential domestic water demand
- Winery landscaping irrigation water demand
- Vineyard irrigation water demand

Water demand estimates are also included in Enclosure C.

EXISTING WINERY PROCESS WATER DEMAND

Water demand for wine production is expected to correlate to the process wastewater (PW) generated at the facility. The existing process water demand is estimated to be 3.31 acre-ft per year (Table 2).

Table 2. Existing winery process water demand.

Parameter	Value	Units
Existing Annual Production	180,000	gallons wine/year
PW Generation Rate	6.0	gallons PW/gal wine
Annual PW Flow	1,080,000	gallons PW/year
Total Annual Winery PW Demand	3.31	ac-ft water/year
Average PW Flow [1]	2,960	gallons PW/day
Peak PW Flow [2]	6,000	gallons PW/day

Notes:
1. Average flow is estimated by dividing the annual PWS flow by 365 days.
2. Peak PW flow is assumed to occur in September and account for 16.4% of the total annual flow (based on similar wineries). This monthly flow is then divided by 30 days.

EXISTING WINERY DOMESTIC WATER DEMAND

The existing domestic water demand from the winery facility is determined based on a maximum of 12 full-time employees, 300 total public tasting visitors per week (assumed to be 43 per day) and hosted, private tastings and tours for up to 65 visitors for marketing events. The facility is currently allowed to have 36 events per year with the number of guests ranging between 50 and 200. Sanitary sewage (SS) generation and domestic water demand are expected to be equivalent, and as such prescribed sewage flows are used to estimate domestic water demand. The existing annual domestic water demand for the winery is estimated to be 0.55 acre-ft per year (Table 3).

Table 3. Existing winery domestic water demand.

Use Type	Number (units/day)	Water Demand (gal/unit)	Daily Demand (gal/day)	Frequency (days/year)	Annual Water Use (gal/year)
Full-Time Employees [1]	12	15	180	365	65,700
Public Tasting Visitors [2]	43	3	129	365	47,085
Hosted Tour and Tasting [3]	65	3	195	52	10,140
Private Promotional Tasting and Meal [4]	50	15	750	24	18,000
Wine Auction Release Event [4]	200	15	3,000	12	36,000
Total Annual Winery Domestic Water Demand (Gallons)					**176,930**
Total Annual Winery Domestic Water Demand (acre-ft/year)					**0.55**
Average Daily Water Use (gpd)					**485**

Notes:
1. Winery operations are assumed to be open 365 days per day. Full-time employees are conservatively assumed for each day.
2. Total visitation of 366 guests per week for an average of 43 people per day, in addition to the 65 visitors per week for hosted/private tours and tastings.
3. Hosted tours and tastings is allowed for up to 65 visitors per week.
4. Event guests listed as peak per event, not to exceed annual total (6,980 visitors per year for hosted tour and tasting, private promotional tasting and meal and wine auction release events).

EXISTING RESIDENTIAL DOMESTIC WATER DEMAND

A 3-bedroom residence on the parcel is also attached to the water system. Sanitary sewage (SS) generation and domestic water demand are expected to be equivalent, and as such prescribed sewage flows are used to estimate domestic water demand. The existing annual residential domestic water demand is estimated to be 0.40 acre-ft per year (Table 4). There are no proposed changes to the residential water demand.

Table 4. Existing residential domestic water demand.

Use Type	Number (units/day)	Water Demand (gal/unit)	Daily Demand (gal/day)	Frequency (days/year)	Annual Water Use (gal/year)
Onsite Residence [1]	3	120	360	365	131,400
Total Annual Domestic Water Demand (Gallons)					**131,400**
Total Annual Domestic Water Demand (acre-ft/year)					**0.40**
Average Daily Water Use (gpd)					**360**

Notes:
1. The 3-bedroom onsite residence is supplied with Well 03 water.

EXISTING WINERY LANDSCAPE IRRIGATION WATER DEMAND

Water from the Ag Well is used for landscaping irrigation on the winery parcel. The existing landscape irrigation water demand is estimated using water efficient landscape ordinance (WELO) calculations and assumptions regarding the total square footage of landscape area that was maintained under previous ownership (Enclosure D). The estimated annual water demand for the existing landscape plan at Bella Union is 187,490 gallons (0.57 acre-ft).

EXISTING VINEYARD IRRIGATION DEMAND

Water from the Ag Well has historically been used to irrigate 34 acres of existing vineyard on the winery parcel. Napa County WAA guidelines for vineyard irrigation are 0.2 to 0.5 acre-ft per acre per year. The high end of this range is typically used for facilities with unknown vineyard irrigation use, and this value was used for irrigation estimates under previous ownership. The existing vineyard irrigation demand is estimated to be 17 acre-ft per year.

$$34\ acres \times \frac{0.5\ acre\text{-}feet}{acre \cdot year} = 17\ \frac{acre\text{-}feet}{year}$$

PROPOSED WATER DEMAND

Proposed water demands are estimated for winery process water, domestic water, landscape irrigation, and vineyard irrigation demand. Water demand estimates are also included in Enclosure C.

PROPOSED WINERY PROCESS WATER DEMAND

Wine production is proposed to increase from 180,000 to 300,000 gallons per year. Water demand for wine production is expected to correlate to the PW generated at the facility. The projected process water demand is estimated to be 5.52 acre-ft per year (Table 5).

Table 5. Proposed winery process water demand.

Parameter	Value	Units
Existing Annual Production	300,000	gallons wine/year
PW Generation Rate	6.0	gallons PW/gal wine
Annual PW Flow	1,800,000	gallons PW/year
Total Annual Winery PW Demand	5.52	ac-ft water/year
Average PW Flow [1]	4,940	gallons PW/day
Peak PW Flow [2]	9,900	gallons PW/day

Notes:

1. Average flow is estimated by dividing the annual PWS flow by 365 days.
2. Peak PW flow is assumed to occur in September and account for 16.4% of the total annual flow (based on similar wineries). This monthly flow is then divided by 30 days.

PROPOSED DOMESTIC WATER DEMAND

The proposed domestic water demand from the winery facility is determined based on the proposed increase in employees, tasting visitors, and marketing events. Full-time employees are proposed to increase from 12 to 38, and part-time employees are proposed to increase from 0 to 7. Weekly tasting visitation is proposed to increase from 366 per week to 1,375 per week (with 175 daily visitors between Monday and Thursday and 225 daily visitors between Friday and Sunday). Public tasting visitation accounts for 43 visitors per day, with the remaining visitation being by appointment only. The marketing event schedule and sizes is also proposed to change to allow for three 50-person events per week, one 100-person event per month, and one 500-person event per year. The proposed annual domestic water demand for the winery is estimated to be 2.50 acre-ft per year (Table 6).

Table 6. Proposed domestic water demand.

Use Type	Number (units/day)	Water Demand (gal/unit)	Daily Demand (gal/day)	Frequency (days/year)	Annual Water Use (gal/year)
Full-Time Employees [1]	38	15	570	365	208,050
Part-Time Employees [2]	7	15	105	92	9,660
Public Tasting Visitors [3]	43	3	129	365	47,085
Weekday Tasting Visitors [4]	36	3	108	209	22,572
Weekend Tasting Visitors [4]	56	3	168	156	26,208
Weekday Tasting Visitors with Pre-Packaged Food [4]	80	8	640	209	133,760
Weekend Tasting Visitors with Pre-Packaged Food [4]	110	8	880	156	137,280
Tasting Visitors with Prepared Food [4]	16	15	240	365	87,600
Weekly Marketing Event [5]	50	15	750	156	117,000
Monthly Marketing Event [5]	100	15	1500	12	18,000
Annual Marketing Event [5]	500	15	7500	1	7,500
Total Annual Domestic Water Demand (Gallons)					**814,720**
Total Annual Domestic Water Demand (ac-ft/year)					**2.50**
Average Daily Water Use (GPD)					**2,230**

Notes:
1. Winery operations are assumed to be open 365 days per day. Full-time employees are conservatively assumed for each day.
2. Part-time employees are assumed to be onsite for three months during harvest.
3. Public visitation is not proposed to change and will remain at 43 visitors per day.
4. 175 total tasting visitors are proposed for Monday through Thursday and 225 total tasting visitors are proposed for Friday through Sunday. Meals are prepared onsite for up to 16 visitors per day. Pre-packaged food is served for up to 50% of the remaining visitors. 43 of the remaining visitors are allocated to public visitation.
5. Weekly marketing events occur up to three times per week for up to 50 guests. Monthly marketing events consist of up to one event per month for up to 100 guests. Annual marketing events consist of up to one event per year for up to 500 guests.

PROPOSED WINERY LANDSCAPE IRRIGATION WATER DEMAND

The proposed landscape irrigation water demand is estimated using WELO calculations and estimates for the proposed landscape plan (Enclosure D). There are currently two landscape demand proposals. The most conservative annual demand estimate is 179,701 gallons (0.55 acre-ft) and is presented in Table 7. This estimate accounts for the use of a medium-water-use lawn. The second estimate replaces this lawn with an artificial turf and is estimated to be 142,789 gallons (0.44 acre-ft). In both scenarios, the estimated landscape water demand is less than the existing condition estimate (0.57 acre-ft).

PROPOSED VINEYARD IRRIGATION DEMAND

Vineyard irrigation demand is anticipated to be lower under the ownership of Far Niente. Far Niente owns two other wineries in the Napa Valley: Nickel & Nickel Winery (N&N) and Far Niente Winery (FNW). Vineyard irrigation demand for these facilities is estimated to be 0.37 acre-ft per year for N&N and 0.34 acre-ft per year for FNW. The average of these two demand estimates (0.35 acre-ft per year) is assumed for Bella Union. The proposed vineyard irrigation demand is estimated to be 11.9 acre-ft per year.

$$34\ acres \times \frac{0.35\ acre\text{-}feet}{acre \cdot year} = 11.9\ \frac{acre\text{-}feet}{year}$$

TOTAL PROPOSED WATER DEMAND

The total water demand for the project with the increase in production, employees, visitation, and marketing events is expected to be 20.9 acre-ft per year (Table 7), compared to an existing water demand of 21.8 acre-ft per year (Table 8).

Table 7. Total projected annual water demand.

Source of Demand	Gallons per day [2]	Gallons per year	Acre-ft per year
Winery Production	4,940	1,800,000	5.52
Winery Domestic Use	2,230	814,720	2.50
Residential Domestic Use	360	131,400	0.40
Landscape Irrigation [1]	490	179,700	0.55
Vineyard Irrigation [1]	10,630	3,877,630	11.9
Total	**18,650**	**6,803,450**	**20.9**

Notes:
1. Based on Napa County WAA Guidelines standard rates.
2. Daily average based on 365 days per year.

Table 8. Existing and proposed water demand comparison.

Source of Demand	Existing (acre-ft)	Proposed (acre-ft)	Difference (acre-ft)
Winery Production	3.31	5.52	2.21
Winery Domestic Use	0.55	2.50	1.96
Residential Domestic Use	0.40	0.40	0.00
Vineyard Irrigation	17.0	11.9	-5.10
Landscape Irrigation	0.57	0.55	-0.02
Total	21.8	20.9	**-0.95**

TIER I ANALYSIS: WATER USE CRITERIA

The Tier I analysis criteria is required for all parcels located within the NVF in the WAA guidelines. The facility parcel is located wholly within the NVF, therefore a Tier I analysis estimating annual recharge during average and dry years is not required.

WATER AVAILABILITY

Parcels within the NVF were previously assumed to have a sustainable water allotment of 1.0 acre-ft per acre per year per the Napa County WAA Guidelines. This results in a water allotment of 60.7 acre-ft per year for the 60.65-acre facility parcel. However, given the Napa County draft related to the Governor's Emergency Executive Order N-7-22, the sustainable water allotment for parcels in the NVF has been reduced to 0.3 acre-ft per acre per year. This represents a significant reduction in allotted water use, resulting in a new water availability estimate of 18.2 acre-ft per year instead of the existing 60.7 acre-ft per year estimate. While the proposed water demand estimate (20.9 acre-ft per year) is greater than this water availability, it represents a net reduction in estimated water use for the facility.

The winery's treated wastewater may also serve as a potential source of groundwater recharge in addition to the 0.3 acre-ft per acre per year allotment. Neither wastewater source is usable for direct reuse, but their application to the land and subsurface may help reintroduce water to the underlying groundwater aquifers. The potential for this recharge is reviewed at a high-level for this report. The numbers presented are for discussion only and should be refined through hydrogeological studies if the site were to be dependent on wastewater recharge.

Process wastewater will be discharged to land where it will have the opportunity to percolate into the underlying groundwater table. A pond water balance was performed to determine the overall process wastewater discharge to land (Enclosure E). This water balance accounts for PW generation, precipitation, evaporation, stormwater contribution, and estimated infiltration capacity of the site soils for a 100-year annual storm year. A total of 6.70 acre-ft of PW is estimated to be discharged to land and infiltrate in the site soils. This total is greater than just the proposed water demand due to the 100-year annual storm year and diverted stormflows to the PW system. The 6.70 acre-ft estimate includes the loss of water that is assumed to be used by potential vineyard uptake. Soil evaporation losses are not considered in this estimate and runoff from the PW land application area is not permitted.

Domestic wastewater is currently discharged to two evaporation, transpiration, and infiltration bed systems. These systems may be replaced with a drip disposal system as part of the facility improvements associated with the use permit. For the subsurface drip system, a portion of the discharged wastewater would be lost to evaporation and transpiration, but the remaining volume would slowly infiltrate to the groundwater aquifer. All domestic wastewater associated with the residence and winery will be disposed into the subsurface drip system except for the wastewater volume associated with monthly (18,000 gallons per year) and annual (7,500 gallons per year) marketing events. This leaves an estimated 789,220 gallons per year, or 2.42 acre-ft per year, of domestic wastewater that will be discharged to the subsurface. It is important to note that the discharged domestic wastewater is not considered to be recycled wastewater or meet the criteria of such as set by the State Water Resources Control Board.

The winery has an estimated 9.12 acre-ft per year of potential recharge when considering both domestic wastewater and process wastewater. This potential recharge is in addition to the 18.2 acre-ft per year allotment set by the Napa County WAA guidelines.

TIER II AND TIER III ANALYSES

Tier II and Tier III analyses are required by the Napa County Planning, Building, and Environmental Services (PBES) planning division if a facility's:

- Proposed water demand represents a net increase from existing conditions, and
- The existing water demand estimate is greater than 0.3 acre-ft per acre per year for the project parcel.

Bella Union is estimated to have a net decrease in total water demand; therefore, a Tier II and Tier III analysis is not required for this project.

CONCLUSION

Bella Union Winery is proposing to alter their water demand through a Use Permit modification. There is an increase in demand associated with an increase in production, number of employees, number of by-appointment tasting visitors, and the number of marketing events. There is also an estimated reduction in water demand from a reduction in landscape and vineyard irrigation demand. The proposed total annual water demand for the facility is estimated to be 20.9 acre-ft per year, representing a net decrease of 0.95 acre-ft per year from the currently permitted water use. The Tier I analysis estimates the sustainable groundwater allotment for the project parcel to be a total of 18.2 acre-ft per year, based on the new sustainable allotment for the Napa Valley Floor. This allotment does not factor in the potential 9.12 acre-ft of recharge from pretreated wastewater that is discharged on site. This water availability analysis establishes that the estimated groundwater demand for the facility represents a net reduction in total water demand from existing conditions. A Tier II and III analysis are not required due to there being no net increase in water demand for the facility.

ENCLOSURE A

VICINITY MAP

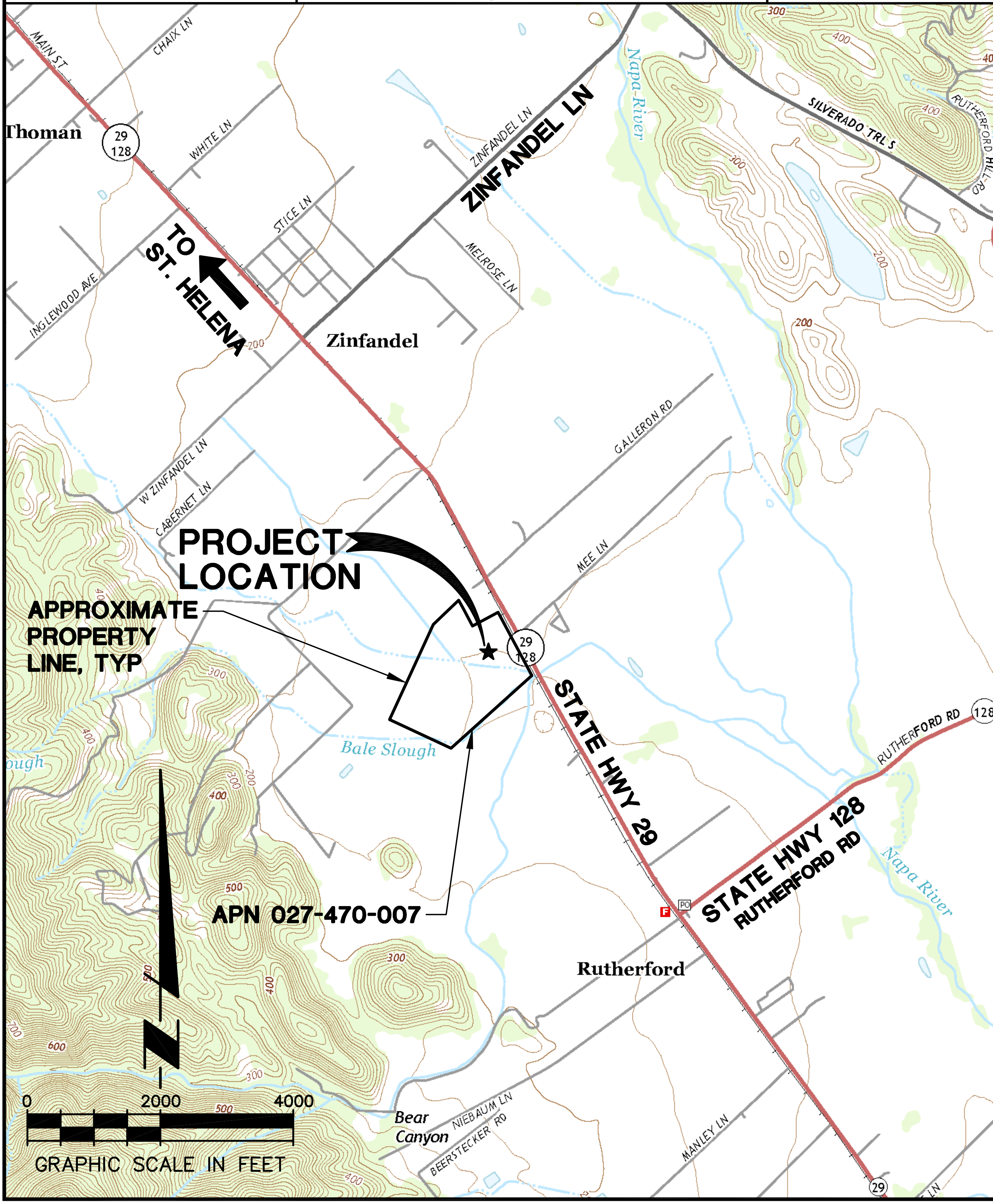
OVERALL SITE PLAN

SUMMIT

BELLA UNION WINERY
1695 ST. HELENA HIGHWAY
ST. HELENA, CA 94574
APN 027-470-007

VICINITY MAP

PROJECT NO.	2021307
DATE	2022-01-10
SHT NO	1 OF 1
BY	JH
CHK	MS

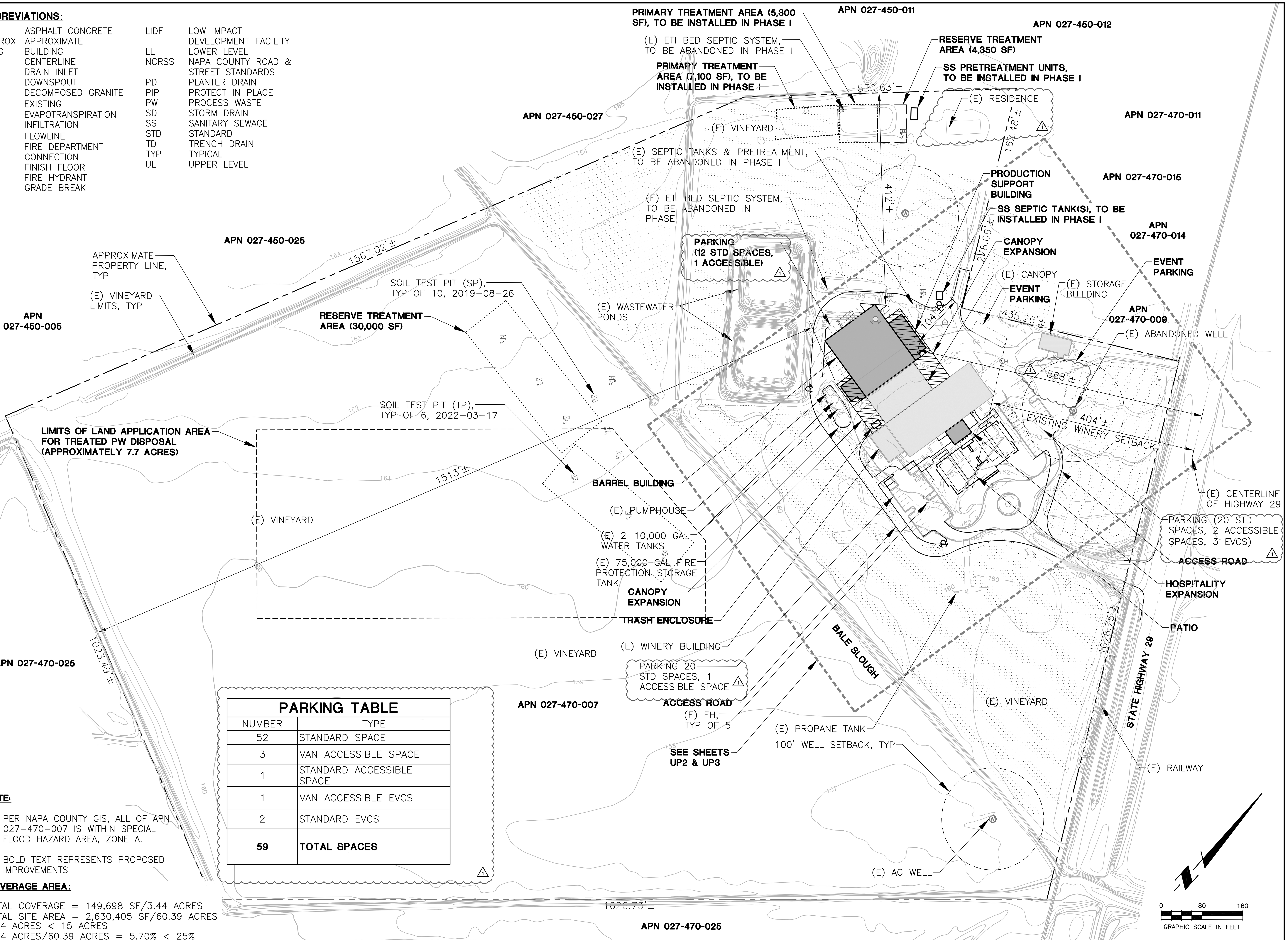


PLOTTED ON: 1/5/2022 3:29 PM
\\SEI1.SUMMITA.LOCAL\P\2021\2021307 BELLA UNION WINERY UP ASSISTANCE\CAD\CIVIL\VICINITY MAP\21307-VICINITY MAP.DWG

Summit Engineering, Inc
463 Aviation Blvd., Suite 200 • Santa Rosa, CA 95403 • 707-527-0775 • www.summit-sr.com

ABBREVIATIONS:

AC	ASPHALT CONCRETE
APPROX	APPROXIMATE
BLDG	BUILDING
℄	CENTERLINE
DI	DRAIN INLET
DS	DOWNSPOUT
DG	DECOMPOSED GRANITE
(E)	EXISTING
ETI	EVAPOTRANSPIRATION INFILTRATION
(F)	FLOWLINE
FDC	FIRE DEPARTMENT CONNECTION
FF	FINISH FLOOR
FH	FIRE HYDRANT
GB	GRADE BREAK
LIDF	LOW IMPACT DEVELOPMENT FACILITY
LL	LOWER LEVEL
NCRSS	NAPA COUNTY ROAD & STREET STANDARDS
PD	PLANTER DRAIN
PIP	PROTECT IN PLACE
PW	PROCESS WASTE
SD	STORM DRAIN
SS	SANITARY SEWAGE
STD	STANDARD
TD	TRENCH DRAIN
TYP	TYPICAL
UL	UPPER LEVEL



PARKING TABLE	
NUMBER	TYPE
52	STANDARD SPACE
3	VAN ACCESSIBLE SPACE
1	STANDARD ACCESSIBLE SPACE
1	VAN ACCESSIBLE EVCS
2	STANDARD EVCS
59	**TOTAL SPACES**

NOTE:

1. PER NAPA COUNTY GIS, ALL OF APN 027-470-007 IS WITHIN SPECIAL FLOOD HAZARD AREA, ZONE A.
2. BOLD TEXT REPRESENTS PROPOSED IMPROVEMENTS

COVERAGE AREA:

TOTAL COVERAGE = 149,698 SF/3.44 ACRES
TOTAL SITE AREA = 2,630,405 SF/60.39 ACRES
3.44 ACRES < 15 ACRES
3.44 ACRES/60.39 ACRES = 5.70% < 25%

SUMMIT
Summit Engineering, Inc
463 Aviation Blvd., Suite 200 • Santa Rosa, CA 95403
707-527-0775 • www.summit-sr.com

BELLA UNION WINERY
1695 ST HELENA HIGHWAY
ST HELENA, CA 94574
APN 027-470-007

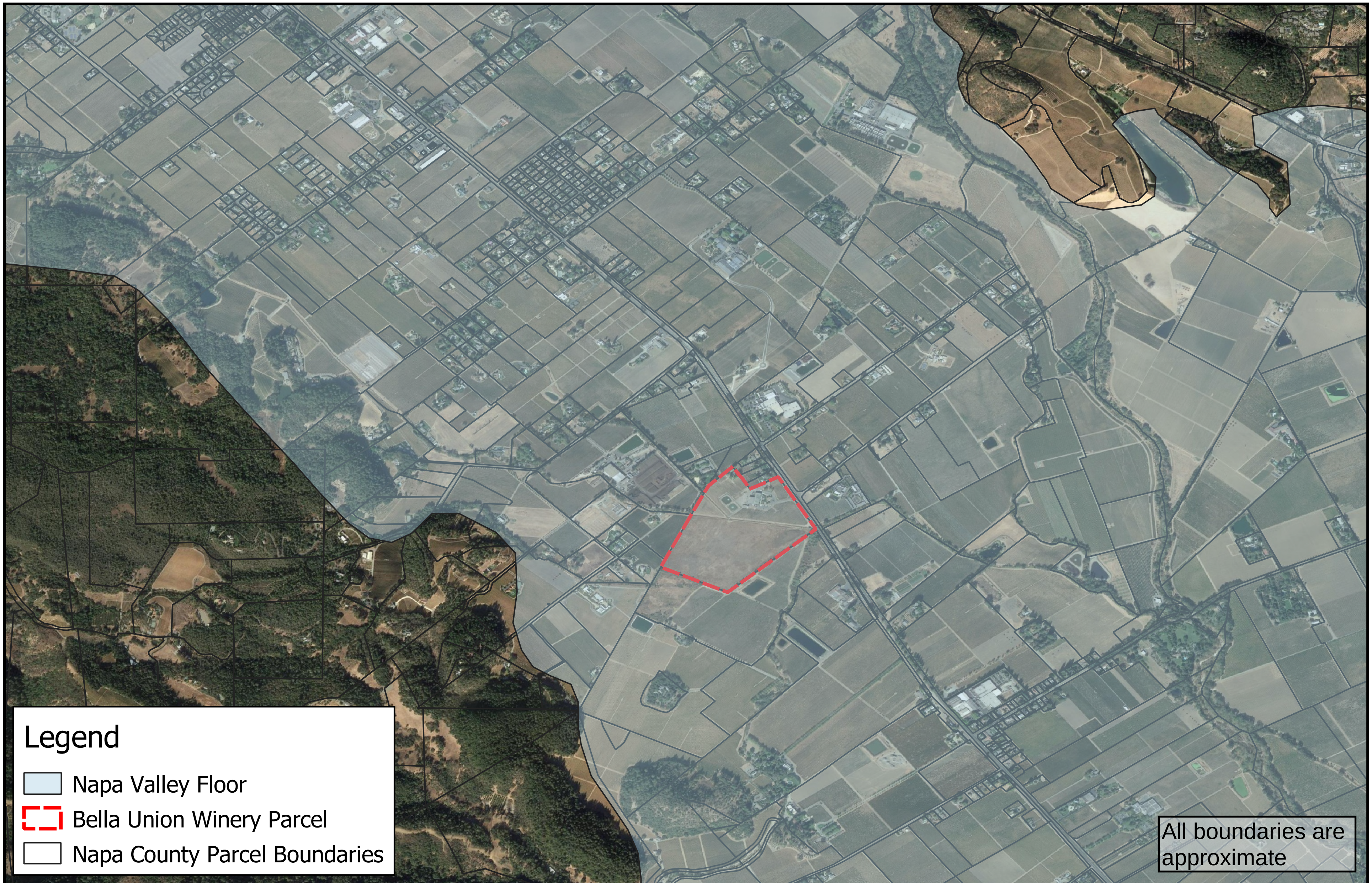
USE PERMIT APPLICATION

OVERALL SITE PLAN

DATE: 2022-04-14
JOB NO: 2021307
SCALE: AS SHOWN
DRAWN: JH
CHECKED: MS
SHEET UP1
1 OF 3

\\SEI1.SUMMITA.LOCAL\P\2021\2021307 BELLA UNION WINERY UP ASSISTANCE\CAD\CIVIL\21307-UP1-UP3_RECOVER.DWG

PLOTTED ON: 4/14/2022 2:19 PM



N

0 1000 2000 3000 ft

PROJECT NO.	2021307
DATE	12/30/2021
BASEMAP	GOOGLE EARTH 2021

LOCATION MAP - NAPA VALLEY FLOOR

BELLA UNION WINERY
1695 ST. HELENA HWY
ST. HELENA, CA
APN 024-470-007

SUMMIT
SUMMIT ENGINEERING, INC.
463 Aviation Blvd., Suite 200
Santa Rosa, CA 95403 707.527.0775

ENCLOSURE B

WELL COMPLETION REPORTS

TRIPLICATE
Owner's Copy
Page ___ of ___
Owner's Well No. well #3
Date Work Began 3-27-03 Ended 4-02-03
Local Permit Agency
Permit No. 27891 Permit Date 03/26/03

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet
No. 796918

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 ROTOry FLUID MUD

DEPTH FROM SURFACE Ft	to Ft	DESCRIPTION Describe material, grain size, color, etc.
0	25	BWN. CLAY with gravel
25	40	BLue clay with gravel
40	90	BWN. CLAY with gravel
90	95	gravel
95	200	BWN. Clay & gravel
200	210	gravel
210	270	Sandy BWN. CLAY
270	310	HARd gravel ash
310	330	sandy BWN. CLAY

TOTAL DEPTH OF BORING 330 (Feet)
TOTAL DEPTH OF COMPLETED WELL 330 (Feet)

WELL OWNER

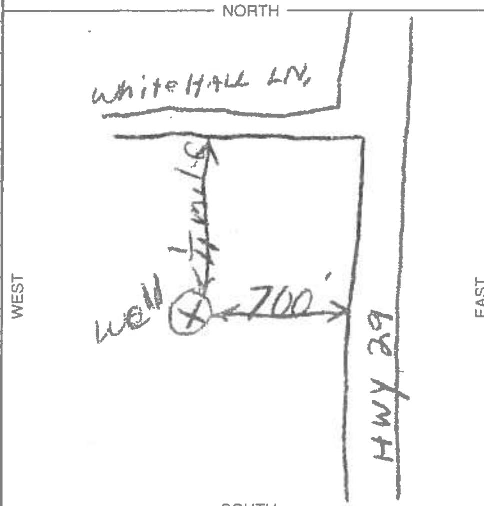
Name Provenance Vineyards
Mailing Address 1695 St. Helena Hwy
Rutherford CITY CA STATE 94574 ZIP

WELL LOCATION

Address 1695 Saint Helena Hwy
City Rutherford
County NapA
APN Book 27 Page 470 Parcel 07
Township ___ Range ___ Section ___
Latitude ___ DEG. MIN. SEC. NORTH Longitude ___ DEG. MIN. SEC. WEST

LOCATION SKETCH

NORTH



WEST | EAST

SOUTH

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

ACTIVITY (✓)

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

PLANNED USES (✓)

WATER SUPPLY
___ Domestic ___ Public
✓ Irrigation ___ Industrial
MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER UK (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL 10 (Ft.) & DATE MEASURED 4-02-03
ESTIMATED YIELD * 60 (GPM) & TEST TYPE Air Lift
TEST LENGTH 6 (Hrs.) TOTAL DRAWDOWN 310 (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	53	11	✓				Plastic	5	200	
53	90	8 3/4	✓				"	"	"	
90	330	8 3/4		✓			"	"	"	Factory 1/32

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	53	✓	✓		
53	330			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 Pulleyn Well Exploration
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
5112 Hwy 121 Napa CA 94558
ADDRESS CITY STATE ZIP
Signed Tom Pulleyn
WELL DRILLER/AUTHORIZED REPRESENTATIVE
4-5-03 DATE SIGNED
C-57 LICENSE NUMBER

Bartley Pump PM LLC Well Test Form

Work Order Number:	64536	Date of Test:	10/5/21 - 10/6/21
Customer Name:	FN Land, LLC	Phone Number:	
Representative Name:		Email Address:	
Property Address:			

Water Well Information

Location of Well:		Pump Model:	
Type of Well :	PVC	Pump Setting:	
Depth of Completed Well		Booster Pump:	
Diameter of Well Casing:	5	Pressure Tank:	2.86's
Sanitary Well Seal:		Storage Tank:	Yes
Annular Well Seal:			

Well Test Data

Date:	Time:	W/L (FEET)	GPM	Comments
10/5/2021	2:00		27	Couldn't get sounder down well
	2:30		27	
	3:00		26.7	37,600 gallons pumped in 24 hours
	3:30		26.5	
	4:15		26.5	
10/6/2021	9:00		26	
	12:00		26	
	12:30		26	
	1:00		26	
	1:30		26	
	2:00		26	

047-470-007

ORIGINAL
File with DWR

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

Do not fill in

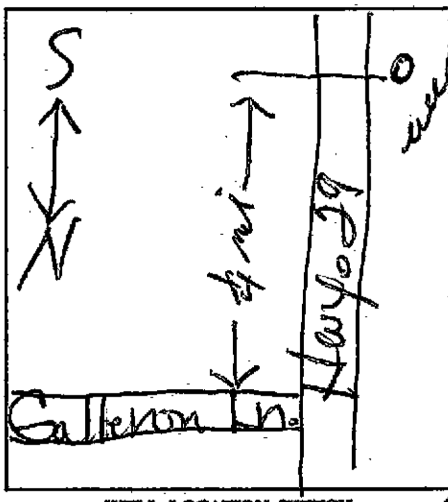
No. 384903

State Well No. 07N 05W 08
Other Well No.

Notice of Intent No.
Local Permit No. or Date 38520

(1)
Addr
City

(2) LOCATION OF WELL (See instructions):
County 28 Owner's Well Number
Well address if different from above Same
Township 027 Range 470 Section 007
Distance from cities, roads, railroads, fences, etc. 4 Mi. So. of Galleron Lane on Hwy. 29



WELL LOCATION SKETCH

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

(4) PROPOSED USE:
Domestic ☐
Irrigation ☒
Industrial ☐
Test Well ☐
Municipal ☐
Other ☒
(Describe)

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

(6) GRAVEL PACK:
Yes ☒ No ☐ Size Pea
Diameter of bore 10 3/4
Packed from 22 to 250 ft.

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

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

From ft.	To ft.	Dia. in.	Gage or Wall	From ft.	To ft.	Slot size
0	250	6	200	80	250	SCREEN

(9) WELL SEAL:
Was surface sanitary seal provided? Yes ☒ No ☐ If yes, to depth 22 ft.
Were strata sealed against pollution? Yes ☒ No ☐ Interval 10-18 ft.
Method of sealing Cement

(10) WATER LEVELS:
Depth of first water, if known ft.
Standing level after well completion 20' ft.

(11) WELL TESTS:
Was well test made? Yes ☒ No ☐ If yes, by whom? Driller
Type of test Pump ☐ Bailer ☐ Air lift ☒
Depth to water at start of test 20 ft. At end of test 200 ft.
Discharge 150 gal/min after 4 hours Water temperature
Chemical analysis made? Yes ☐ No ☒ If yes, by whom?
Was electric log made Yes ☐ No ☒ If yes, attach copy to this report

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

from ft.	to ft.	Formation (Describe by color, character, size or material)
0	10'	Clay
10	18'	Sandy clay & gravel
18	40'	Clay
40	45'	sandy clay & gravel
45	65'	Clay
65	72'	Sandy clay & gravel
72	115'	Clay
115	123'	sandy clay & gravel
123	170'	Clay
170	230'	gravel & boulders, streaks of clay
230	250'	clay

Work started 5-3-1991 Completed 5-10-1991

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.
Signed Bell Driller (Well Driller)
NAME
(Person, firm, or corporation) (Typed or printed)
Address
City ZIP
License No. 248677 Date of this report 5-28-91

CONFIDENTIAL
NOT FOR PUBLIC USE
WATER CODE SEC. 13752

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

Bartley Pump PM LLC Well Test Form

Work Order Number:	64537	Date of Test:	10/5/2021
Customer Name:	FN Land, LLC	Phone Number:	
Representative Name:		Email Address:	
Property Address:			

Water Well Information

Location of Well:		Pump Model:	
Type of Well :	PVC	Pump Setting:	
Depth of Completed Well		Booster Pump:	
Diameter of Well Casing:		Pressure Tank:	2.86's
Sanitary Well Seal:		Storage Tank:	
Annular Well Seal:			

Status is 88 but was running when I got there

Well Test Data

Date:	Time:	W/L (FEET)	GPM	Comments
10/5/2021	9:15	90	100	Pumped about 25k gallons in 4 hours
	12:30	107	100	15 min of pumping
	1:00	120	100	
	1:30	128.5	100	
	1:45	135.4	100	
	2:00	136.7	100	
	2:30	138.3	100	
	2:45	139	100	
	3:30	142	100	
	4:00	144	100	
	4:30	144	100	

ENCLOSURE C

WATER DEMAND CALCULATIONS

SUMMIT ENGINEERING, INC.	Bella Union Winery Wastewater Feasibility Study Existing SS Flows	PROJ NO: 2021307 BY: JM CHK: GG

SANITARY SEWAGE - EXISTING

Average Day w/o Event - Non-harvest							
Employee (full-time)	12	x	15	gpcd	=	180	gal/day
Public Tasting Visitors	43	x	3	gpcd	=	129	gal/day
Private Tasting	65	x	3	gpcd	=	195	gal/day
3-Bedroom Residence	3	x	120	gpd	=	360	gal/day
Total					=	864	gal/day
					=	***870***	***gal/day***

Peak Tasting Day Harvest w/Event							
Employee (full-time)	12	x	15	gpcd	=	180	gal/day
Public Tasting Visitors	43	x	3	gpcd	=	129	gal/day
Private Tasting	65	x	3	gpcd	=	195	gal/day
3-Bedroom Residence	3	x	120	gpd	=	360	gal/day
Private Promo Meal & Tasting	50	x	15	gpcd	=	750	gal/day
Wine Auction Release Event	200	x	15	gpcd	=	3,000	gal/day
Total					=	4,614	gal/day
					=	***4,620***	***gal/day***

Notes:
1) All marketing events are to be catered.

SUMMIT ENGINEERING, INC.	Bella Union Winery Wastewater Feasibility Study Proposed SS Flows	PROJ NO: **2021307** BY: **JM** CHK: **GG**

SANITARY SEWAGE - Proposed

Peak Day w/o Event					
Employee (full-time)	38	x	15 gpcd	=	570 gal/day
Employee (part-time)	7	x	15 gpcd	=	105 gal/day
Public Visitors w/o Food	43	x	3 gpcd	=	129 gal/day
Private Tasting Visitors w/o Food	56	x	3 gpcd	=	168 gal/day
Tasting Visitors w/ Pre-Packaged Food	110	x	8 gpcd	=	880 gal/day
Tasting Visitors w/ Prepared Food	16	x	15 gpcd	=	240 gal/day
3 Bedroom Residence	3	x	120 gpd	=	360 gal/day
Total				=	**2,452 gal/day**
Peak Tasting Day Harvest w/ Annual Event					
Employee (full-time)	38	x	15 gpcd	=	570 gal/day
Employee (part-time)	7	x	15 gpcd	=	105 gal/day
Public Visitors w/o Food	43	x	3 gpcd	=	129 gal/day
Private Tasting Visitors w/o Food	56	x	3 gpcd	=	168 gal/day
Tasting Visitors w/ Pre-Packaged Food	110	x	8 gpcd	=	880 gal/day
Tasting Visitors w/ Prepared Food	16	x	15 gpcd	=	240 gal/day
3 Bedroom Residence	3	x	120 gpd	=	360 gal/day
Weekly Marketing Event	0	x	15 gpcd	=	0 gal/day
Monthly Marketing Event	0	x	15 gpcd	=	0 gal/day
Largest Marketing Event [1]	500	x	0 gpcd	=	0 gal/day
Total				=	**2,452 gal/day**
Peak Tasting Day Harvest w/ Monthly Event					
Employee (full-time)	38	x	15 gpcd	=	570 gal/day
Employee (part-time)	7	x	15 gpcd	=	105 gal/day
Public Visitors w/o Food	43	x	3 gpcd	=	129 gal/day
Private Tasting Visitors w/o Food	56	x	3 gpcd	=	168 gal/day
Tasting Visitors w/ Pre-Packaged Food	110	x	8 gpcd	=	880 gal/day
Tasting Visitors w/ Prepared Food	16	x	15 gpcd	=	240 gal/day
3 Bedroom Residence	3	x	120 gpd	=	360 gal/day
Weekly Marketing Event	0	x	15 gpcd	=	0 gal/day
Monthly Marketing Event [1]	100	x	0 gpcd	=	0 gal/day
Largest Marketing Event	0	x	15 gpcd	=	0 gal/day
Total				=	**2,452 gal/day**
Peak Tasting Day Harvest w/ Weekly Event					
Employee (full-time)	38	x	15 gpcd	=	570 gal/day
Employee (part-time)	7	x	15 gpcd	=	105 gal/day
Public Visitors w/o Food	43	x	3 gpcd	=	129 gal/day
Private Tasting Visitors w/o Food	56	x	3 gpcd	=	168 gal/day
Tasting Visitors w/ Pre-Packaged Food	110	x	8 gpcd	=	880 gal/day
Tasting Visitors w/ Prepared Food	16	x	15 gpcd	=	240 gal/day
3 Bedroom Residence	3	x	120 gpd	=	360 gal/day
Weekly Marketing Event	50	x	15 gpcd	=	750 gal/day
Monthly Marketing Event	0	x	15 gpcd	=	0 gal/day
Largest Marketing Event	0	x	15 gpcd	=	0 gal/day
Total				=	**3,202 gal/day**

1. Portable toilets will be used for annual and monthly marketing events.

SUMMIT ENGINEERING, INC.	Bella Union Winery Wastewater Feasibility Study Existing Process Wastewater Flows	PROJ NO: **2021307** BY: **JM** CHK: **GG**

PROCESS WASTEWATER GENERATION

Annual Volume		Value	Units
Annual Production (projected)	=	75,000	cases wine/year
Gallons of Wine Per Case	=	2.4	gal wine/case of wine
Annual Production	=	180,000	gal wine/year
Generation Rate (assumed)[1]	=	165	gal wine/ton grapes
Tons Crushed	=	1,091	tons grapes/year
Process Wastewater (PW) Generation Rate[2]	=	6.00	gal PW/gal wine
Annual PW Flow	=	*1,080,000*	*gal PW/year*
Average Day Flow	=	***2,959***	***gal PW/day***
		2,960	***gal PW/day***
Napa County Peak Day Flow			
Peaking Factor[3]	=	1.5	
Harvest Length	=	60	days
Peak Harvest Day Flow	=	***4,500***	***gal PW/day***
Average, Day Peak Harvest Month Flow			
Assume 16.4% of annual PW flow is generated in September [4]	=	16.4	%
Monthly PW Generation	=	177,120	*gal PW*
Peak Harvest Day Flow		***5,904***	***gal PW/day***
		6,000	***gal PW/day***

1. Industry standard wine generation rate.
2. Industry standard PW generation rate.
3. Peaking factor from Napa County OWTS (Final Draft 2013). Peaking factor applied to wine production not PW production.
4. Based on distribution of flows from similar sized wineries.

SUMMIT ENGINEERING, INC.	Bella Union Winery Wastewater Feasibility Study Proposed Process Wastewater Flows	PROJ NO: **2021307** BY: **JM** CHK: **GG**

PROCESS WASTEWATER GENERATION

Annual Volume		Value	Units
Annual Production (projected)	=	125,000	cases wine/year
Gallons of Wine Per Case	=	2.4	gal wine/case of wine
Annual Production	=	300,000	gal wine/year
Generation Rate (assumed)[1]	=	165	gal wine/ton grapes
Tons Crushed	=	1,818	tons grapes/year
Process Wastewater (PW) Generation Rate[2]	=	6.00	gal PW/gal wine
Annual PW Flow	=	*1,800,000*	*gal PW/year*
Average Day Flow	=	***4,932***	***gal PW/day***
		4,940	***gal PW/day***
Napa County Peak Day Flow			
Peaking Factor[3]	=	1.5	
Harvest Length	=	60	days
Peak Harvest Day Flow	=	***7,500***	***gal PW/day***
Average, Day Peak Harvest Month Flow			
Assume 16.4% of annual PW flow is generated in September [4]	=	16.4	%
Monthly PW Generation	=	295,200	*gal PW*
Peak Harvest Day Flow		***9,840***	***gal PW/day***
		9,900	***gal PW/day***

1. Industry standard wine generation rate.
2. Industry standard PW generation rate.
3. Peaking factor from Napa County OWTS (Final Draft 2013). Peaking factor applied to wine production not PW production.
4. Based on distribution of flows from similar sized wineries.

SUMMIT ENGINEERING, INC. Consulting Civil Engineers	Bella Union Winery Water Availability Analysis Annual Water Demand	PROJECT NO. 2021307 BY: JM CHK: GG

NAPA COUNTY WAA GUIDELINES

Existing Use

Water Use	Unit Water Use		No. of Units		Total (ac-ft/year)
Vineyard Irrigation	0.5	ac-ft/acre/year	34	acres	17
Winery Domestic/Landscaping	187,490	gallons	0.575	ac-ft	0.58
				Total	**17.58**

Proposed Use

Water Use	Unit Water Use		No. of Units		Total (ac-ft/year)
Vineyard Irrigation	0.35	ac-ft/acre/year	34	acres	11.9
Winery Domestic/Landscaping	179,701	gallons	0.551	ac-ft	0.55
				Total	**12.45**

SUMMIT ENGINEERING, INC.	Bella Union Winery Water Availability Analysis Summary Water & Wastewater Flows	PROJECT NO. 2021307 BY: JM CHK: GG

EXISTING DOMESTIC WATER USE

Use Type	Number (units/day)	Water Demand (gal/unit)	Daily Demand (gal/day)	Frequency (days/year)	Annual Water Use (gal/year)
Onsite Residence [1]	3	120	360	365	131,400
Full-Time Employees [2]	12	15	180	365	65,700
Public Tasting Visitors [3]	43	3	129	365	47,085
Hosted Tour and Tasting [4]	65	3	195	52	10,140
Private Promotional Tasting and Meal [5]	50	15	750	24	18,000
Wine Auction Release Event [5]	200	15	3,000	12	36,000
Total Annual Winery Domestic Water Demand (Gallons)					**308,330**
Total Annual Winery Domestic Water Demand (ac-ft/year)					**0.95**
Average Daily Water Use (GPD)					**850**

Notes:
1. The 3-bedroom onsite residence is supplied with Well 03 water.
2. Winery operations are assumed to be open 365 days per day. Full-time employees are conservatively assumed for each day.
3. Total visitation of 366 guests per week for an average of 43 people per day, in addition to the 65 visitors per week for hosted/private tours and tastings.
4. Hosted tours and tastings is allowed for up to 65 visitors per week
5. Event guests listed as peak per event, not to exceed annual total (6,980 visitors per year for hosted tour and tasting, private promotional tasting and meal and wine auction release events).

PROPOSED DOMESTIC WATER USE

Use Type	Number (units/day)	Water Demand (gal/unit)	Daily Demand (gal/day)	Frequency (days/year)	Annual Water Use (gal/year)
Onsite Residence [1]	3	120	360	365	131,400
Full-Time Employees [2]	38	15	570	365	208,050
Part-Time Employees [3]	7	15	105	92	9,660
Public Tasting Visitors [4]	43	3	129	365	47,085
Weekday Tasting Visitors without Food [5]	36	3	108	209	22,572
Weekend Tasting Visitors without Food [5]	56	3	168	156	26,208
Weekday Tasting Visitors with Pre-Packaged Food [5]	80	8	640	209	133,760
Weekend Tasting Visitors with Pre-Packaged Food [5]	110	8	880	156	137,280
Tasting Visitors with Prepared Food [5]	16	15	240	365	87,600
Weekly Marketing Event [6]	50	15	750	156	117,000
Monthly Marketing Event [7]	100	15	1500	12	18,000
Annual Marketing Event [8]	500	15	7500	1	7,500
Total Annual Winery Domestic Water Demand (Gallons)					**946,120**
Total Annual Winery Domestic Water Demand (ac-ft/year)					**2.90**
Average Daily Water Use (GPD)					**2,600**

Notes:
1. The 3-bedroom onsite residence is supplied with well water.
2. Winery operations are assumed to be open 365 days per day. Full-time employees are conservatively assumed for each day.
3. Part-time employees are assumed to be onsite for three months during harvest.
4. Public visitation is not proposed to change and will remain at 43 visitors per day.
5. 175 total tasting visitors are proposed for Monday through Thursday and 225 total tasting visitors are proposed for Friday through Sunday. Meals are prepared onsite for up to 16 visitors per day. Pre-packaged food is served for up to 50% of the remaining visitors. 43 of the remaining visitors are allocated to public visitation.
6. Weekly marketing events occur up to three times per week for up to 50 guests.
7. Monthly marketing events consist of up to one event per month for up to 100 guests.
8. Annual marketing events consist of up to one event per year for up to 500 guests.

TOTAL PROPOSED WAA

Source of Demand	Gallons per day	Gallons per year	Acre-feet per year
Winery Production	4,940	1,800,000	5.52
Winery Domestic Use	2,600	946,120	2.90
Vineyard Irrigation	10,624	3,877,627	11.9
Landscape Irrigation	492	179,701	0.55
Total	**18,656**	**6,803,448**	**20.9**

Notes:

WATER DEMAND COMPARISON

Source of Demand	Existing (ac-ft)	Proposed (ac-ft)	Difference (ac-ft)
Winery Production	3.31	5.52	2.21
Winery Domestic Use	0.95	2.90	1.96
Vineyard Irrigation	17.0	11.9	-5.10
Landscape Irrigation	0.58	0.55	-0.02
Total	21.8	20.9	-0.96

ENCLOSURE D

WELO ESTIMATES

EXISTING IRRIGATION SYSTEM **WATER EFFICIENT LANDSCAPE WORKSHEET**

This worksheet is filled out by the project applicant and it is a required element of the Landscape Documentation Package.

Reference Evapotranspiration (ETo) **44.1**

Hydrozone # /Planting Description[a]	Plant Factor (PF)	Irrigation Method[b]	Irrigation Efficiency (IE)[c]	ETAF (PF/IE)	Landscape Area (sq. ft.)	ETAF x Area	Estimated Total Water Use (ETWU)[e]
Regular Landscape Areas							
Low Water-Use Plants	**0.30**	**Drip**	**0.81**	**0.37**	**6,500**	**2,405**	**65,758**
Moderate Water- Use Plants	**0.50**	**Drip**	**0.81**	**0.62**	**6,200**	**3,844**	**105,103**
Lawn	**0.80**	**Spray**	**0.75**	**1.07**	**2,510**	**2,686**	**73,432**
Water Features	**0.80**	**n/a**	**1.00**	**0.80**	**26**	**21**	**569**
					(A)	**(B)**	
				Totals	**15,236**	**8,956**	**244,861**
Special Landscape Areas							
	[redacted]						
					(C)	**(D)**	
				Totals	**0**	**0**	**0**
			ETWU Total				**244,861**
			Maximum Allowed Water Allowance (MAWA)e				**187,490**

a ***Hydrozone #/Planting Description***
E.g
1.) front lawn
2.) low water use plantings
3.) medium water use planting

b ***Irrigation Method***
overhead spray
or drip

c ***Irrigation Efficiency***
0.75 for spray head
0.81 for drip

d ***ETWU*** **(Annual Gallons Required) = *Eto x 0.62 x ETAF x Area***
where 0.62 is a conversion factor that converts acre-inches per acre per year to gallons per square foot per year.

e ***MAWA (Annual Gallons Allowed) = (*** *Eto) (0.62) [(ETAF x LA) + ((1-ETAF) x SLA)]*
where 0.62 is a conversion factor that converts acre-inches per acre per year to gallons per square foot per year, LA is the total landscape area in square feet, SLA is the total special landscape area in square feet, and ETAF is .55 for residential areas and 0.45 for non-residential areas.

ETAF Calculations

Average ETAF for Regular Landscape Areas must be 0.55 or below for residential areas, and 0.45 or below for non-residential areas.

Regular Landscape Areas

Total ETAF x Area (B)	8,956
Total Area (A)	15,236
Average ETAF	**0.59**

All Landscape Areas

Total ETAF x Area (B+D)	8,956
Total Area (A+C)	15,236
Sitewide ETAF (B+D) ÷ (A+C)	**0.59**

NEW IRRIGATION SYSTEM

WATER EFFICIENT LANDSCAPE WORKSHEET

This worksheet is filled out by the project applicant and it is a required element of the Landscape Documentation Package.

Reference Evapotranspiration (ETo) **44.1**

Hydrozone # /Planting Description[a]	Plant Factor (PF)	Irrigation Method[b]	Irrigation Efficiency (IE)[c]	ETAF (PF/IE)	Landscape Area (sq. ft.)	ETAF x Area	Estimated Total Water Use (ETWU)[e]
Regular Landscape Areas							
Low Water-Use Plants	**0.30**	**Drip**	**0.81**	**0.37**	**9,063**	**3,353**	**91,686**
Moderate Water- Use Plants	**0.50**	**Drip**	**0.81**	**0.62**	**2,343**	**1,453**	**39,719**
High Water-Use Trees	**0.80**	**Drip**	**0.81**	**0.99**	**64**	**63**	**1,732**
Water Features	**0.80**	**n/a**	**1.00**	**0.80**	**133**	**106**	**2,909**
					(A)	**(B)**	
				Totals	**11,603**	**4,976**	**136,046**
Special Landscape Areas							
	[redacted]						
					(C)	**(D)**	
				Totals	**0**	**0**	**0**
			ETWU Total				**136,046**
			Maximum Allowed Water Allowance (MAWA)[e]				**142,789**

a Hydrozone #/Planting Description
E.g
1.) front lawn
2.) low water use plantings
3.) medium water use planting

b Irrigation Method
overhead spray
or drip

c Irrigation Efficiency
0.75 for spray head
0.81 for drip

d ETWU **(Annual Gallons Required) = *Eto x 0.62 x ETAF x Area***
where 0.62 is a conversion factor that converts acre-inches per acre per year to gallons per square foot per year.

e MAWA (Annual Gallons Allowed) = (*Eto) (0.62) [(ETAF x LA) + ((1-ETAF) x SLA)]*
where 0.62 is a conversion factor that converts acre-inches per acre per year to gallons per square foot per year, LA is the total landscape area in square feet, SLA is the total special landscape area in square feet, and ETAF is .55 for residential areas and 0.45 for non-residential areas.

ETAF Calculations

Average ETAF for Regular Landscape Areas must be 0.55 or below for residential areas, and 0.45 or below for non-residential areas.

Regular Landscape Areas

Total ETAF x Area (B)	4,976
Total Area (A)	11,603
Average ETAF	**0.43**

All Landscape Areas

Total ETAF x Area (B+D)	4,976
Total Area (A+C)	11,603
Sitewide ETAF (B+D) ÷ (A+C)	**0.43**

NEW IRRIGATION SYSTEM

WATER EFFICIENT LANDSCAPE WORKSHEET

This worksheet is filled out by the project applicant and it is a required element of the Landscape Documentation Package.

Reference Evapotranspiration (ETo) 44.1

Hydrozone # /Planting Description[a]	Plant Factor (PF)	Irrigation Method[b]	Irrigation Efficiency (IE)[c]	ETAF (PF/IE)	Landscape Area (sq. ft.)	ETAF x Area	Estimated Total Water Use (ETWU)[e]
Regular Landscape Areas							
Low Water-Use Plants	**0.25**	**Drip**	**0.81**	**0.31**	**9,063**	**2,791**	**76,323**
Moderate Water-Use Plants	**0.45**	**Drip**	**0.81**	**0.56**	**2,343**	**1,300**	**35,555**
Moderate Water-Use Lawn	**0.55**	**Spray**	**0.75**	**0.73**	**3,000**	**2,190**	**59,879**
High Water-Use Trees	**0.80**	**Drip**	**0.81**	**0.99**	**64**	**63**	**1,727**
Water Features	**0.80**	**n/a**	**1.00**	**0.80**	**133**	**106**	**2,909**
					(A)	**(B)**	
				Totals	**14,603**	**6,451**	**176,392**
Special Landscape Areas							
	[redacted]						
					(C)	**(D)**	
				Totals	**0**	**0**	**0**
						ETWU Total	**176,392**
			Maximum Allowed Water Allowance (MAWA)[e]				**179,701**

a Hydrozone #/Planting Description
E.g
1.) front lawn
2.) low water use plantings
3.) medium water use planting

b Irrigation Method
overhead spray
or drip

c Irrigation Efficiency
0.75 for spray head
0.81 for drip

d ETWU* (Annual Gallons Required) = *Eto x 0.62 x ETAF x Area
where 0.62 is a conversion factor that converts acre-inches per acre per year to gallons per square foot per year.

e MAWA (Annual Gallons Allowed) = (*Eto) (0.62) [(ETAF x LA) + ((1-ETAF) x SLA)]*
where 0.62 is a conversion factor that converts acre-inches per acre per year to gallons per square foot per year, LA is the total landscape area in square feet, SLA is the total special landscape area in square feet, and ETAF is .55 for residential areas and 0.45 for non-residential areas.

ETAF Calculations

Average ETAF for Regular Landscape Areas must be 0.55 or below for residential areas, and 0.45 or below for non-residential areas.

Regular Landscape Areas

Total ETAF x Area (B)	6,451
Total Area (A)	14,603
Average ETAF	**0.44**

All Landscape Areas

Total ETAF x Area (B+D)	6,451
Total Area (A+C)	14,603
Sitewide ETAF (B+D) ÷ (A+C)	**0.44**

ENCLOSURE E
POND WATER BALANCE

SUMMIT ENGINEERING, INC. Consulting Civil Engineers	Bella Union Winery Pond Water Balance Pond Water Balance (300k)	PROJECT NO. 2021307 BY: JM CHK: GG

DESIGN CRITERIA

FULL PRODUCTION

Annual Harvest	1,818	ton/year
Wine Generation Rate	165	gal wine/ton
Annual Production	300,000	gal wine/year
PW Generation Rate	6.0	gal PW/gal wine
Annual PW Flow (Crush)	1,800,000	gal PW/year
Bulk Wine Bottled onsite (Cases)	0	
Bulk Wine bottled onsite (gallons)	0	
Generation Rate	0.6	
Annual PW Flow (Bottled)	0	
Total Annual PW Volume	1,800,000	
Annual Average PW Flow	4,940	
Months of Harvest	Aug-Oct	
Average Day Harvest Flow	7,780	gal PW/day
Average Day Peak Harvest Month Flow	9,840	gal PW/day
Maximum daily crush rate		tons/day
Peak day generation rate		gal PW/gal wine
Maximum daily PW flow		gal PW/day
Pond No. 1 Volume	0.558	Mgal
Pond No. 2 Volume	0.580	Mgal
Total Pond Volume	1.138	Mgal
Pond No. 1 HRT	56.7	days
Pond No. 2 HRT	59.0	days
Total HRT	115.7	days

DESIGN PROCESS WASTEWATER FLOWS

Month	Monthly Percentage of Annual Flow[a] (%)	Monthly Flow (Mgal)	Monthly Flow (gal)
August	10.5%	0.188	188,142
September	16.4%	0.295	295,281
October	12.9%	0.232	231,976
November	7.4%	0.133	133,404
December	6.4%	0.115	115,482
January	6.6%	0.118	118,154
February	7.2%	0.130	130,005
March	7.6%	0.137	137,331
April	6.8%	0.122	121,925
May	6.4%	0.116	116,083
June	5.6%	0.101	100,705
July	6.2%	0.112	111,514
Total	**100%**	**1.800**	**1,800,000**

[a] Monthly percentage of annual flow based on average of PW flow data from similar wineries.

SUMMIT ENGINEERING, INC. Consulting Civil Engineers	Bella Union Winery Pond Water Balance Climate Data	PROJECT NO. 2021307 BY: JM CHK: GG

Month	Days	Average Temp[a] (F)	Reference Evapotranspiration[b] (in)	Pan Evaporation[c] (in)	Lake Evaporation[d] (in)	Average Precipitation[e] (in)	10-Year Precipitation[f] (in)	100-Year Precipitation[f] (in)
August	31	72.3	6.5	12.1	9.3	0.0	0.1	0.1
September	30	70.2	5.1	8.7	6.7	0.1	0.1	0.1
October	31	63.7	3.4	5.7	4.4	1.7	2.7	4.0
November	30	54.7	1.8	2.5	1.9	3.2	5.3	7.9
December	31	48.9	0.9	1.7	1.3	7.2	11.6	17.4
January	31	49.5	1.2	1.5	1.2	6.5	10.5	15.7
February	28	52.2	1.7	2.2	1.7	6.7	10.9	16.3
March	31	55.4	3.4	3.8	2.9	5.0	8.1	12.1
April	30	59	4.8	5.8	4.5	2.0	3.2	4.8
May	31	64.3	6.2	8.9	6.9	1.3	2.1	3.2
June	30	69.8	6.9	11.0	8.5	0.4	0.6	0.8
July	31	72.4	7.4	13.2	10.2	0.0	0.0	0.0
Total	**365**		**49.4**	**77.0**	**59.3**	**34.0**	**55.1**	**82.4**

[a] Average monthly temperature observed between 1991-2020 for St. Helena, CA (NOAA 2021)
[b] Average monthly reference evaporation rates for Zone 4, CIMIS, DWR, 1999.
[c] Average monthly pan evaporation rates observed in Lake Berryessa, CA between 1957 and 1970.
[d] Pan evaporation rates adjusted by a factor of 0.77 to determine lake evaporation.
[e] Monthly precipitation normals between 1991-2020 for St. Helena, CA (NOAA 2021)
[f] Average monthly rainfall adjusted by the ratio of 10-yr and 100-yr wet year return storm identified by Pearsons Log III Distribution.

SUMMIT ENGINEERING, INC. Consulting Civil Engineers	Bella Union Winery Pond Water Balance Stormwater	PROJECT NO. 2021307 BY: JM CHK: GG

STORM WATER CONTRIBUTION FROM WINERY

Month	Days in Month	Runoff Coefficient [a]	Surface Area [b] (SF)	10-Year Precipitation [c] (in)	100-Year Precipitation [c] (in)	10-Year Contribution [d] (Mgal)	100-Year Contribution [d] (Mgal)
August	31	0.95	3,800	0.1	0.1	0.000	0.000
September	30	0.95	3,800	0.1	0.1	0.000	0.000
October	31	0.95	3,800	2.7	4.0	0.006	0.009
November	30	0.95	3,800	5.3	7.9	0.012	0.018
December	31	0.95	3,800	11.6	17.4	0.026	0.039
January	31	0.95	3,800	10.5	15.7	0.024	0.035
February	28	0.95	3,800	10.9	16.3	0.024	0.037
March	31	0.95	3,800	8.1	12.1	0.018	0.027
April	30	0.95	3,800	3.2	4.8	0.007	0.011
May	31	0.95	3,800	2.1	3.2	0.005	0.007
June	30	0.95	3,800	0.6	0.8	0.001	0.002
July	31	0.95	3,800	0.0	0.0	0.000	0.000
Total	**365**			**55.1**	**82.4**	**0.124**	**0.185**

[a] Runoff coefficient for concrete
[b] Surface area only includes surfaces that divert stormwater to the ponds. See attached Site Plan.
[c] See Climate Data worksheet for precipitation.
[d] Stormwater contributions are estimated using the Rational Method (Flow = Drainage Area * Rainfall * Runoff Coefficient)

SUMMIT ENGINEERING, INC. Consulting Civil Engineers	Bella Union Winery Pond Water Balance Pond Worksheet	PROJECT NO. 2021307 BY: JM CHK: GG

Pond No. 1

Bottom Width	95.0'	Bottom Radius	-	Start Month	August
Bottom Length	81.0'	Top Radius	-	Min. Depth	3.0'
Interior Side Slope (x:1)	2.0	Total Depth	10.0'	Annual PW	1.80 Mgal
Length:Width	-	Freeboard	2.0'	Initial Depth	8.0'

Depth (ft)	Surface Area (ft^2)	Total Volume (Mgal)
0	6,500	0.000
1	7,100	0.051
2	7,800	0.107
3	8,500	0.168
4	9,200	0.234
5	10,000	0.306
6	11,000	0.384
7	11,500	0.468
8	12,500	0.558
9	13,184	0.654
10	14,127	0.756

Pond No. 2

Bottom Width	96.0'	Bottom Radius	-	Start Month	August
Bottom Length	83.0'	Top Radius	-	Min. Depth	3.0'
Interior Side Slope (x:1)	2.0	Total Depth	10.0'	Divert Volume	2.2 Mgal
Length:Width	-	Freeboard	2.0'	Initial Depth	8.0'

Depth (ft)	Surface Area (ft^2)	Total Volume (Mgal)
0	6,860	0.000
1	7,510	0.054
2	8,190	0.112
3	8,900	0.176
4	9,600	0.246
5	10,390	0.320
6	11,170	0.401
7	11,980	0.488
8	12,810	0.580
9	13,560	0.679
10	14,440	0.784

SUMMIT ENGINEERING, INC. Consulting Civil Engineers	Bella Union Winery Pond Water Balance 100-Year Design Storm	PROJECT NO. 2021307 BY: JM CHK: GG

Pond No. 1

Month	Initial Volume [a] (Mgal)	Pond Evaporation [b] (Mgal)	PW Inflow [c,1] (Mgal)	100-Year Precipitation (Mgal)	Volume Change [d] (Mgal)	Total Volume [e] (Mgal)	Divert Volume [f] (Mgal)	Final Volume [g] (Mgal)	Final Pond Depth [h] (ft)	Volume Check [i] (Mgal)	Surface Area (ft^2)
August	0.558	-0.072	0.188	0.001	0.117	0.675	0.117	0.558	8.0	0.117	12,500
September	0.558	-0.052	0.296	0.001	0.245	0.803	0.245	0.558	8.0	0.245	12,500
October	0.558	-0.034	0.241	0.033	0.240	0.798	0.240	0.558	8.0	0.240	12,500
November	0.558	-0.015	0.151	0.065	0.201	0.759	0.201	0.558	8.0	0.201	12,500
December	0.558	-0.010	0.155	0.143	0.288	0.846	0.288	0.558	8.0	0.288	12,500
January	0.558	-0.009	0.153	0.129	0.273	0.831	0.273	0.558	8.0	0.273	12,500
February	0.558	-0.013	0.167	0.134	0.287	0.846	0.287	0.558	8.0	0.287	12,500
March	0.558	-0.023	0.165	0.099	0.241	0.799	0.241	0.558	8.0	0.241	12,500
April	0.558	-0.035	0.133	0.039	0.137	0.695	0.137	0.558	8.0	0.137	12,500
May	0.558	-0.053	0.123	0.026	0.096	0.654	0.096	0.558	8.0	0.096	12,500
June	0.558	-0.066	0.103	0.007	0.044	0.602	0.044	0.558	8.0	0.044	12,500
July	0.558	-0.079	0.112	0.000	0.032	0.590	0.032	0.558	8.0	0.032	12,500
Total		**-0.462**	**1.985**	**0.677**	**2.201**		**2.201**			**2.201**	

Pond No. 2

Month	Initial Volume [a] (Mgal)	Pond Evaporation [b] (Mgal)	PW Inflow [c,2] (Mgal)	100-Year Precipitation (Mgal)	Volume Change [d] (Mgal)	Total Volume [e] (Mgal)	Divert Volume [f] (Mgal)	Final Volume [g] (Mgal)	Final Pond Depth [h] (ft)	Volume Check [i] (Mgal)	Surface Area (ft^2)
August	0.580	-0.074	0.117	0.001	0.043	0.624	0.043	0.580	8.0	0.043	12,810
September	0.580	-0.053	0.245	0.001	0.193	0.773	0.193	0.580	8.0	0.193	12,810
October	0.580	-0.035	0.240	0.034	0.238	0.819	0.238	0.580	8.0	0.238	12,810
November	0.580	-0.015	0.201	0.066	0.252	0.832	0.252	0.580	8.0	0.252	12,810
December	0.580	-0.010	0.288	0.147	0.425	1.005	0.425	0.580	8.0	0.425	12,810
January	0.580	-0.009	0.273	0.133	0.396	0.977	0.396	0.580	8.0	0.396	12,810
February	0.580	-0.013	0.287	0.138	0.412	0.992	0.412	0.580	8.0	0.412	12,810
March	0.580	-0.023	0.241	0.102	0.320	0.900	0.320	0.580	8.0	0.320	12,810
April	0.580	-0.036	0.137	0.040	0.142	0.722	0.142	0.580	8.0	0.142	12,810
May	0.580	-0.055	0.096	0.027	0.068	0.648	0.068	0.580	8.0	0.068	12,810
June	0.580	-0.068	0.044	0.007	-0.017	0.563	0.022	0.541	7.5	0.000	12,810
July	0.541	-0.079	0.032	0.000	-0.046	0.495	0.022	0.474	6.8	0.000	12,395
Total		**-0.471**	**2.201**	**0.696**	**2.426**		**2.53**			**2.489**	

[a] Volume of each pond at the beginning of each month.
[b] Estimated pond evaporation by month based on starting volume.
[c,1] Process wastewater inflow to Pond 1.
[c,2] Inflow to Pond 2 is set to the Pond 1 divert volume.
[d] Volume change is equal to the sum of pond evaporation, PW inflow, and precipitation.
[e] Total volume is equal to initial volume plus the volume change.
[f] Divert volume is the amount of PW that exceeds a set pond volume (related to maximum pond height; Total de
[g] Final volume is equal to the total volume minus the divert volume.
[h] Pond depth associated with final volume.
[i] Determines difference between total volume and volume associated with the pond height to help determine dive

SUMMIT ENGINEERING, INC. Consulting Civil Engineers	Bella Union Winery Pond Water Balance Irrigation & Effluent Application Rates	PROJECT NO. 2021307 BY: JM CHK: GG

Applied Irrigation Area	Vineyard	7.7	acres
	Pasture	0.0	acres
Total Area Available for Irrigation	Vineyard	7.7	acres
	Pasture	0.0	acres

Month	Reference ET[a]	Pasture Coefficent [b]	Vineyard Crop Coefficient[c]	Pasture ET[d]	Vineyard ET[d]	Precipitation[e]	Irrigation Demand[f]		Operating Days per Month[g]	Percolation Capacity[h]		Assimilative Capacity[i]		Effluent Applied		Excess Capacity	Remaining effluent to "perc"
	(in)			(in)	(in)	(in)	(in)	(Mgal)	(d)	(in)	(Mgal)	(in)	(Mgal)	(Mgal)	(in)	(Mgal)	(Mgal)
August	6.5	0.9	0.5	5.9	2.9	0.1	2.8	0.593	22	5.49	1.149	8.3	1.741	0.043	0.21	1.70	0.00
September	5.1	0.9	0.3	4.6	1.3	0.1	1.2	0.247	17	4.24	0.888	5.4	1.135	0.193	0.92	0.94	0.00
October	3.4	0.9	0.1	3.1	0.2	4.0	0.0	0.000	19	4.74	0.992	4.7	0.992	0.238	1.14	0.75	0.24
November	1.8	0.8	0.0	1.4	0.0	7.9	0.0	0.000	12	3.00	0.627	3.0	0.627	0.252	1.21	0.37	0.25
December	0.9	0.8	0.0	0.7	0.0	17.4	0.0	0.000	9	2.25	0.470	2.2	0.470	0.425	2.03	0.05	0.42
January	1.2	0.8	0.0	1.0	0.0	15.7	0.0	0.000	10	2.50	0.522	2.5	0.522	0.396	1.90	0.13	0.40
February	1.7	0.8	0.0	1.3	0.0	16.3	0.0	0.000	9	2.25	0.470	2.2	0.470	0.412	1.97	0.06	0.41
March	3.4	0.8	0.0	2.7	0.0	12.1	0.0	0.000	10	2.50	0.522	2.5	0.522	0.320	1.53	0.20	0.32
April	4.8	0.9	0.2	4.3	0.8	4.8	0.0	0.000	13	3.24	0.679	3.2	0.679	0.142	0.68	0.54	0.14
May	6.2	0.9	0.6	5.6	3.6	3.2	0.4	0.088	18	4.49	0.940	4.9	1.028	0.068	0.33	0.96	0.00
June	6.9	0.9	0.7	6.2	4.9	0.8	4.1	0.847	21	5.24	1.097	9.3	1.944	0.022	0.11	1.92	0.00
July	7.4	0.9	0.6	6.7	4.8	0.0	4.7	0.991	22	5.49	1.149	10.2	2.140	0.022	0.10	2.12	0.00
Total	**49.4**			**43.6**	**18.5**	**82.4**	**13.2**	**2.8**	**182.0**	**45.4**	**9.5**	**58.6**	**12.3**	**2.53**	**12.1**	**9.74**	**2.184770**

(a) Average monthly reference evapotranspiration rates, see Climate Data Worksheet.

(b) Kc coefficients for pasture from Table 5-1, "Irrigation with Reclaimed Municipal Wastewater-A Guidance Manual"- California State Water Resources Control Board, July 1984 (San Joaquin Valley).

(c) Kc coefficients for vineyards from Table 5-12, "Irrigation with Reclaimed Municipal Wastewater-A Guidance Manual"- California State Water Resources Control Board, July 1984 (San Joaquin Valley).

(d) ET=ETo x Kc. A weighted value is determined on the basis of the available irrigated acreage of vineyard and pasture.

(e) Precipitation, 10-year rainfall event, see Climate Data Worksheet.

(f) Irrigation Demand = ET-Precipitation, inches. A weighted value is determined on the basis of the available irrigated acreage of vineyard and pasture.

(g) Number of operating days per month based on estimated irrigation days available for XX, CA. Precipitation data from NOAA between XXXX-YYYY.

(h) Design percolation rate is a maximum of 0.25 inches per day for the number of operating day per month. Design perc rate based on estimated hydraulic conductivity for soils in the area (USGS Websoil Survey) adjusted by a 0.04 safety factor to account for typical slow rate land application design methodology.

(i) Assimilative capacity is the sum of irrigation demand and percolation applied.

(j) Effluent applied is the monthly divert volume from Pond 2 (Sheet 5 of 6). This volume is also represented as a depth spread over the total irrigation area. The target application rate is to be less than one inch per month.

(k) Excess capacity is the difference between the Assimilative Capacity (note i) and the Effluent Applied (note j). This is the estimated remaining disposal capacity of the soil.

SUMMIT ENGINEERING, INC.
463 Aviation Blvd., Suite 200
Santa Rosa, CA 95403
707 527-0775
sfo@summit-sr.com

Bella Union Winery #P19-00139

Vineyard Water Use

October 20, 2022

This summary provides additional detail to support a stated reduction in total vineyard irrigation demand of 5.1 ac-ft. This represents a reduction of 0.15 ac-ft per acre over a 34-acre total site vineyard area.

The reduction in vineyard irrigation is achieved through the following measures:

<u>Frost protection changed from overhead irrigation to frost fans</u>: Historically, frost protection for the onsite vineyards has been provided by overhead spray irrigation. Currently, only 11 acres of vineyard are frost protected by frost fans. The applicant proposes to install frost fans over the remaining vineyard such that all onsite vineyards will utilize frost fans for frost protection. The projected groundwater demand reduction in an average frost year is projected to be 0.25 ac-ft per acre x 23 acres = 5.75 ac-ft.

<u>Redevelopment of vineyards</u>: Eleven acres of the existing vineyard have a limited remaining useful life. These acres will be redeveloped over the next 10 years at an approximate rate of 10% annually to preserve the grape production needed for the Bella Union wines. The applicant proposes a combination of measures during the replant to reduce the projected irrigation demand. These measures include:

- Use of drought tolerant rootstock
- Double poly irrigation system
- Optimized canopy and vine row orientation

Details regarding the implementation and results of these measures are included as Appendix A. The redeveloped vineyard is expected to reduce irrigation levels by 40%. The resultant reduction in water use is approximately 11 acres x 0.50 ac-ft per acre x 40% = 2.2 ac-ft.

<u>Reuse of treated process wastewater to offset irrigation by groundwater</u>: Currently, treated process wastewater is used to irrigate fallow pasture. Summit Engineering, Inc. has estimated that during an average year, approximately 1.9 ac-ft of water would be available during the months of April through October for irrigation of vineyards. The applicant proposes to modify the irrigation system to utilize treated process wastewater for irrigation of vineyard areas. The irrigation of the pasture would be discontinued.

Taken together, the above measures well exceed the 5.1 ac-ft reduction in vineyard irrigation water use for the site as stated in the Water Availability Analysis submitted with the use permit application.

Bella Union Vineyard Water Reduction

Water reduction measures across the vineyard as a whole include installation of wind machines and the installation of a double poly system across existing blocks and replant blocks; this system allows for water reduction through targeted irrigation. In addition, we are planning to embark upon a sequential replanting of an11-acre vineyard block, at a rate of approximately 10% per year. This replanting will include a number of water conservation measures, as described below.

Drought tolerance of various rootstocks

In general, we have selected for more drought tolerant rootstocks that are better acclimated for this site and help us to improve wine quality. In California viticulture we have over 20 different phyloxera resistant rootstocks to choose from that have a variety of different growing characteristics and water use habits. Rootstocks have been matched for this planting that are deep rooted, highly drought tolerant, well adapted for deficit irrigation viticulture, and have the ability to survive high water stress. *The below chart illustrates a few of the choices that are available, and in particular note that drought resistance differs wildly between some of our most common rootstocks.*

TABLE 1. Rootstock characteristics

Rootstock	Parentage	Vigor*	Drought resistance	Lime tolerance†	Salt resistance	Wet feet‡	Soil preference§
				%			
St. George	*V. rupestris*	H	Var	14	M/H	L/M	Deep, uniform, loam
1616C	*V. solonis* × *V. riparia*	L	L	L/M	M/H	H	Deep/fertile
3309C	*V. riparia* × *V. rupestris*	L/M	L/M	11	L/M	L/M	Deep, well-drained
44-53	*V. riparia* × 144M	M	M/H	10	na	H	Loam/good fertility, high Mg
101-14	*V. riparia* × *V. rupestris*	L/M	L/M	9	L/M	M/H	Heavy, moist clay
420A	*V. berlandieri* × *V. riparia*	L	L/M	20	L	L/M	Fine texture, deep/fertile
5BB	*V. berlandieri* × *V. riparia*	M	L/M	20	L/M	Var	Moist clay
5C	*V. berlandieri* × *V. riparia*	L/M	L	20	M	Var	Moist clay
1103P	*V. berlandieri* × *V. rupestris*	H	H	17	M	H	Adapted to drought, saline soils
110R	*V. berlandieri* × *V. rupestris*	M/H	H	17	M	Var	Hillside soils, acid soils, moderate fertility
Freedom	1613 C × *V. champinii*	H	M/H	M	L/M	L	Sandy to sandy loams
Harmony	1613 C × *V. champinii*	M/H	Var	M	L/M	L	Sandy loams, loamy sands
Ramsey	*V. champinii*	VH	H	M	H	L/M	Light sand, infertile soils
O39-16	*V. vinifera* × *V. rotundifolia*	H	L	L	L	na	Poor on coarse, sandy soils

* L = low; M = medium; H = high; VH = very high; Var = variable; na = not available.
† Tolerance to lime-induced chlorosis (percent by weight of finely divided calcium carbonate in soil that can be tolerated by the rootstock).
‡ Wet feet = tolerance to excessive moisture caused by poor soil drainage.
§ Actual performance characteristics of these rootstocks on specific soils and scions may vary.
Source: Christensen (2003) and Pongracz (1983).

Studies have been done of our soil chemistry and soil physical properties. We know the total water holding capacity, effective rooting depth, percent sand/silt/clay/rock and many other factors that affect vine growth and water relations for the vineyard and future replant areas. Each vineyard block to be planted has been thoroughly investigated, categorized and evaluated for the need for supplemental irrigation. In our soil investigations we have estimated the total soil reserve from winter rainfall and the appropriate rootstock has been preliminarily matched to minimize the need for supplemental summer irrigation.

Solar Radiation Effects

In addition to the drought tolerance of our rootstocks the most important factor of water use in a vineyard operation is the amount of solar radiation intercepted by the canopy of grapevines. This interception of solar radiation causes the plant to take up water from the soil and transpire gaseous water through the stomata on a leaf. This process is commonly referred to as Evapo-Transpiration or ET. Specific crops have different water use efficiencies and this can be expressed by their specific crop coefficient (k_c) which is how much water they use compared to a reference Evapotranspiration (ET_o) measurement. This measurement is estimated on-site from our weather stations. The measurement that we commonly refer to ET_c, is a measure of what each vine would be using at a given time under well watered conditions ($ET_c = ET_o \times k_c$).

Generally speaking, more leaf area/light interception = higher potential water use. Although it is commonly cited within our industry, overall crop yield is largely irrelevant to water use. Leaf area, specifically the Leaf Area Index (LAI) is the main driver of a vine's water use. As a general rule, more canopy exposed to more direct sunlight means more water use, and more light interception usually means higher water demand. We are planning to replant to vertical shoot positioning system which has the lowest Kc compared to other trellis/training styles. For example, a vertical shoot positioned vineyard at the correct row orientation may have a Kc of .45 during the peak of summer, while a California sprawl or Lyre system would have a Kc of .8-.9. When plugged into our equation of total water demand for the crop, these other systems are requiring 40-50% more water for the same vine spacing. We are changing trellis type and optimizing row orientation to minimize leaf light interception during the hottest parts of the day. This serves to greatly reduce our measured Kc in the vineyard.

Winegrapes also have the unique ability to grow under wildly different water use conditions. It is possible to water to 125% of ET_c, 100% of ET_c, 75% of ET_c, and 50% of ET_c, under the same growing conditions and produce no measurable difference in yield. *–see figure below from Dr. Larry Williams work on grapevine water relations at the UC Davis Oakville Field Station.*

Table V — Relative yield as a function of applied irrigation amounts (fraction of estimated full ET) at four locations and two cultivars, Cabernet Sauvignon and Chardonnay. All vineyards used a VSP trellis. Values at each location are the mean of three different rootstocks except at Paso Robles, which had five rootstocks, with data collected for a minimum of three growing seasons.

Location	Cultivar	Irrigation Treatment (fraction of estimated ET_c) 0.25	0.5	0.75	1.0	1.25
		— (percent of maximum weight)* —				
Oakville	Cabernet	77	96	100	99	99
Paso Robles	Cabernet	61	70	81	91	100
Gonzales	Chardonnay	65	81	87	89	100
Edna Valley	Chardonnay	92	90	92	98	100

* The weights of each treatment were divided by the treatment with the greatest weight. The treatment with the greatest weight was set to 100%.

Since vine water use is a function of vine stress level, plant genetics, total vine canopy, and light interception by the canopy, we have designed our future vineyard replants to optimize water use efficiency, which will in turn give us the best wine quality possible.

We employ a wide variety of data gathering tools that we integrate into our strategy of reducing water use in the vineyard. Each one of these tools gives us insight as to the stress level of each block and allows us to safely use the least amount of water in our vineyard.

- ET modeling for irrigation scheduling
- Weather stations located onsite running full evapotranspiration models
- Pressure chamber measurements for Leaf Water Potential
- Vineyard Heat mapping with FLIR (forward looking infra-red) tools
- real-time ET stations
- NVDI imagery
- Monitor root growth and uptake efficiency

General Irrigation Practices

Decisions surrounding when to irrigate and how much can be critical for the cultivation of fine wine grapes. As with many other aspects of viticulture, the answer should always be site specific.   Irrigation protocols and run times should also be tailored to the water holding capacities of different soil types. Each soil change is mapped and characterized as to the specific water holding capacity, the recharge rate, field capacity, permanent wilting point, and many other key soil factors are all known. This knowledge of the site allows us to use precision irrigation techniques to minimize our water use and maximize our wine quality.

Irrigation Timing

The timing of irrigation is critical in every year and it is important to approach the season with a plan. Our plan addresses water availability throughout the growing season while also carefully monitoring canopy size and timing of bud break. We time operations early and begin a water deficit program to acclimate the vines for the continuation of a dry season. Changing row orientation to minimize overall canopy light interception will allow us to deploy the best water saving strategy.

Key irrigation times:

1. Bud break (if needed)
2. Flowering and fruit set
3. Post Hardseed
4. Tail end of veraison
5. 20-22 brix,
6. As needed in advance of extremely low humidity or high temperature events.

We begin our water deficit program and supplemental irrigation between bloom and veraison, which coincides with the natural drying down of our soils. This irrigation trigger point is determined by several of our irrigation tools (usually a combination of Leaf Water Potentials, visual observations, ET modeling, and soil moisture probes). Using these different tools over the years has allowed us to get away from the "weekly" watering schedule and move towards watering 6-8 times per year. Without this type of monitoring, watering schedules may be each week throughout the growing season.

Irrigation Methods

Decisions surrounding irrigation methods in a drought year should be made with careful consideration and planning. We have found that it has been very successful to water less frequently, with slightly larger volumes of water (the "big drink" method) to achieve a significant reduction in our water usage. This method is commonly used in vineyards that are looking to reduce their water usage and it is a very effective tool. We install double poly in our blocks to significantly minimize water use. This type of system is essentially a second drip system that waters only the weakest of the vines in a block which are often less than 15% of the total vine count. By delivering water only to those weak vines we are able to withhold 2-3 (frequent) irrigation events that would have gone out to the entire block. While this system is a great capital cost to us, we are committed to improving irrigation efficiency. Many growers are forced to water to the "lowest common denominator" of plant health if they do not have a "double poly" system, which may lead to excessive water use and decreased wine quality. We also try to force roots to mine additional areas of soil volume for residual winter water by decreasing the frequency of our supplemental irrigations.

In terms of water use and conservation, we are very aware and proactive in performing practices that will promote smaller vines. The critical cultural practices that favor conserving water in our vineyards are:

1. We do not encourage excess canopy growth.
2. We address soil nutrition issues with excessive growth in-mind; we do not want to encourage additional canopy growth.
3. We do all canopy operations early and often to keep actual Evapotranspiration to a minimum.
4. We reduce shoot growth to 18-20 nodes on all vines and remove laterals and young leaves that are not drought tolerant.
5. Foliar fertilizer applications can be applied to minimize the effects of high stress and condition our vines to use less water. This in turn also leads to increased wine quality.

In Summary

- We are using drought tolerant rootstocks to reduce total water use.
- Replanting to a more efficient trellis (reducing overall canopy size vs. historical).
- Optimizing the row orientation to be more water efficient and protect from sun during the hottest times of the day. Water use demand during the hottest parts of the day can be reduced by more than 40% by optimizing row orientation as replanting takes place.
- All blocks are planned to get double poly installed, at great capital cost, allowing for a large reduction in overall water use and improving vineyard uniformity. Watering weak areas independently of strong areas will significantly reduce overall water use, upwards of 20%.
- Blocks undergoing redevelopment will be prepped properly, ripped to proper depths, and more uniformly, to encourage deep roots, more soil mining for residual winter moisture, and increase our water holding capacity per foot of soil in every block.
- Soils are being amended properly, to minimize additional fertility treatments required in the future.
- All blocks are scheduled to install modern drip irrigation with electric shutoff valves, which are all tied into our weather stations, minimizing additional run-time beyond scheduled irrigations.

At the Bella Union Vineyard, we are planning to see significant supplemental irrigation reductions below 50% of ETc, which is below .5 acre ft/acre of supplemental irrigation consistent with the Napa County Water Availability Analysis for vineyard irrigation; we expect to see a water savings of approximately 2.2 acre ft across the 11 acre replant. Replacing historical frost control usage with wind machines will provide for a substantial reduction in overall historical groundwater use (.25 acre ft/acre average) on 20+ acres of the property. Installation of Double Poly infrastructure to water weak vines only should result in an additional significant permanent reduction to historical water usage.

Sincerely,

Garrett Buckland

Partner, Premiere Viticultural Services

P.O. Box 10880 Napa, CA 94581 phone (707) 974-1706