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Water Availability Analysis

Kenzo Estates Winery P15-00293
Planning Commission Hearing September 21, 2016

WATER AVAILABLITY ANALYSIS

KENZO ESTATE
3200 MONTICELLO ROAD
NAPA, CALIFORNIA

APN 033-110-075

Property Owner:

Kenzo Estate Inc.
3200 Monticello Road
Napa, California

August 31, 2015
Project #4112041.0

1515 Fourth Street, Napa, CA 94559 www.rsacivil.com 707.252.3301.v 707.252.4966.f

WATER AVAILABILITY ANALYSIS
KENZO ESTATE

TABLE OF CONTENTS

APPENDICIES

SYSTEM DESCRIPTION

The Kenzo Estate Winery is located at 3200 Monticello Road in Napa, California. The APN is 033-110-075 and the parcel has an area of 36.13 +/- acres.

The winery is served by an existing public water system with California System ID Number CA2800021 and Napa County Permit Number 10771.

The Technical Report for the Public Water System was prepared by Summit Engineering in January, 2009. This report states that the winery is served by a well with capacity of 180 gpm. Sections of the Summit report are contained in Appendix B of this report.

PROJECTED WATER DEMAND

The proposed increase in water use will be 0.63 af/yr (210,000 gal/yr) based on the Tier 1 Water Availability Analysis as contained in Appendix A.

WATER SUPPLY CAPACITY

The Summit report states that the existing well has capacity of 180 gpm.

(180 gpm)(1440 min/day) = 260,000 gpd > 7,722 gpd

This demonstrates that the existing well has capacity for supply of process and domestic water.

WATER AVAILABILITY ANALYSIS – TIER 1

Napa County Water Availability Analysis (WAA) Working Draft dated March 2, 2015 is the basis for the Tier 1 and Tier 2 Analysis.

A Water Use Criteria of 0.48 ac-ft/ac/year has been adopted for Kenzo Winery from the RSA Groundwater recharge report attached in Appendix D. This gives an annual estimated recharge (Allowable Water Allotment) of 17.34 ac-ft for the 36.13 acre parcel.

The annual existing and proposed water usage has been calculated and includes details of additional water usage. Calculations were based on WAA - The Guidelines for Estimating Non-Residential Water Usage. Annual water usage is anticipated to increase by approximately 190,000 gallons or 8% of existing usage. This volume is considered conservative as it is based on maximum visitation for the full year as well as maximum attendance at all events.

Demand Type	Existing Demand [ac-ft/yr]	Proposed Demand [ac-ft/yr]
Winery Process Water	1.83	2.19
Landscape Irrigation	0.43	0.43
Employees	0.16	0.30
Visitors	0.04	0.10
Events	0.05	0.12
Vineyard	5.50	5.50
Totals (Acre-ft per Year)	**8.01**	**8.64**
Totals (Gallons per Year)	**2,610,000**	**2,820,000**

The proposed demand of 8.65 ac-ft per year is less than the estimated annual recharge of 17.34 ac-ft per year.

WATER AVAILABILITY ANALYSIS – TIER 2

The nearest adjacent well to the winery parcel is approximately 1,100 feet from the parcel boundary and 1,600 feet from the well that supplies the winery as shown in the Well Exhibit contained in Appendix C. This meets the Napa County Tier 2 requirements as there are no non-project wells located within 500 feet of the project wells.

Appendix A

Tier 1 Water Availability Analysis: Additional Information

Groundwater Recharge

36.13 acres * 0.48 af/acre-yr = 17.34 af/yr

Existing

Vineyard – Irrigation only – (0.5af/ac-yr * 11 acres of vineyard) = 5.50 af/yr

Winery – Process Water – (2.15af/100,000 gal wine * 85,000 gal) = 1.83 af/yr

Winery – Landscape Irrigation Water – = 0.43 af/yr

Winery – FT Employees – (9 @ 15gpd x 365 days/yr)/325,851 gal/af = 0.151 af/yr

PT Seasonal Employees – (2 @ 15 gpd x 60 days/yr)/325,851 gal/af = 0.006 af/yr

Winery – Visitors – (75 visitors/week @ 3gal/visitor x 52 weeks/yr)/325,851 gal/af = 0.036 af/yr

Winery – Food & Wine Pairing Events – (50 @ 15gpd x 12 days/yr)/325,851 gal/af = 0.028 af/yr

Food & Wine Pairing Events – (75 @ 15gpd x 2 days/yr)/325,851 gal/af = 0.007 af/yr

Food & Wine Pairing Events – (150 @ 15gpd x 2 days/yr)/325,851 gal/af = 0.014 af/yr

Existing = (*Vineyard + Process + Landscaping + Employees + Visitors + Events)*

= (5.50 + 1.83 + 0.43 + 0.16 + 0.04 + 0.05) = **8.01 af/yr** (< 17.34 af/yr recharge)

Proposed

Vineyard – Irrigation only – (0.5af/ac-yr * 11 acres of vineyard) = 5.50 af/yr

Winery – Process Water – (2.15af/100,000 gal wine * 102,000 gal) = 2.19 af/yr

Winery – Landscape Irrigation Water – = 0.43 af/yr

Winery – FT Employees – (17 @ 15gpd x 365 days/yr)/325,851 gal/af = 0.286 af/yr

PT Seasonal Employees – (6 @ 15 gpd x 60 days/yr) /325,851 gal/af = 0.017 af/yr

Winery – Visitors – (10,400 visitors/year @ 3gal/visitor)/325,851 gal/af = 0.096 af/yr

Winery – Food & Wine Pairing Events – (50 @ 15gpd x 36 days/yr)/325,851 gal/af = 0.083 af/yr

Food & Wine Pairing Events – (75 @ 15gpd x 2 days/yr)/325,851 gal/af = 0.007 af/yr

Food & Wine Pairing Events – (150 @ 15gpd x 4 days/yr)/325,851 gal/af = 0.028 af/yr

Proposed = (*Vineyard + Process + Landscaping + Employees + Visitors + Events)*

= (5.50 + 2.19 + 0.43 + 0.30 + 0.10 + 0.12) = **8.64 ac-ft/yr** (< 17.34 af/yr recharge)

Appendix B

Technical Water Report (Summit Engineering 2009)

KENZO WINERY

TECHNICAL REPORT

Kenzo Winery is proposing to install and operate a transient non-community public water supply system at 3200 Monticello Road in Napa, California. The winery's water system is classified as transient non-community system based on the projected number of employees and visitors to the facility. The proposed water system will be on the same parcel as the facility it is to serve.

1. General Water System Information

- Type of use or users – The Kenzo Winery water system will provide potable water for winery operations and domestic use by employees, guests, and visitors. The winery is approved for a production capacity of 85,000 gallons of wine per year. Irrigation and fire use are supplied by separate systems that are not connected to this well.

  The domestic water use is based on the winery's current marketing and operation plans that provide projections on the number of visitors and employees at the facility; 9 full-time employees, 2 part-time employees, 25 tasting visitors on average without an event, and 15 tasting visitors with 40 event visitors during a peak event. It is expected that all visitors will not be visiting frequently enough to be classified as present more than 60 days per year. Overall domestic demands are from visiting and restroom use, totaling approximately 225 gallons per day (gpd) and up to 315 gpd with an event.

- Period of use – The winery water system will be used year-round, with peak use during crush. Vineyard irrigation and fire shall be supplied by multiple existing wells not tied to the proposed water system.

- Consolidation evaluation – An existing water system nearby (28-00680) is supplied by two wells approximately 1,000 feet away on different parcels separate from the proposed water system. The first well (located on APN 033-110-008) is capable of supplying 200 gallons per minute (gpm) and the backup well (located on APN 033-190-001) is capable of supplying 30 gpm to 12 residences and permanent employees. The new winery (60 gpm peak demand) use cannot be consolidated with the existing system because the winery demand would limit the primary water source of the residences. Tapping into the existing water system is also unfeasible because of construction costs associated with distributing water to the winery more than 1,000 feet away.

- Map of facilities – See attached map in Enclosure D.

2. Source Water Information

- Description of source – The water source for the Kenzo Winery water system will be the Winery Well shown on the facility site plan (Enclosure D). Based on feedback from the Owner, the winery is not located in a basin that is currently subject to groundwater adjudication procedures. The well pump shall be sized accordingly to supply the four service connections (including a future connection).

- Water rights – The Owner's water rights have been demonstrated by the submission of a copy of the Grant Deed for the specified property (Enclosure E).

- Water quantity – The proposed Kenzo Winery Water System will have three main service connections: one to the winery, one to the hospitality building, and one to the fermentation buildings. A fourth connection may occur with the possible addition of a future building. The peak instantaneous service demand was calculated for 60 gpm at 90 psi. The well water is to be used for

instantaneous service demand was calculated for 60 gpm at 90 psi. The well water is to be used for domestic and processes within the winery and equates to approximately 3,000 gpd estimated usage. Irrigation of landscaping and surrounding vineyards is provided by a separate water supply so is not included in this submittal. According to the well completion report, the winery well is capable of supplying 180 gpm (259,200 gpd). The 8-hour pump test confirmed at least 25 gpm (36,000 gpd) flow capability. In either scenario, the supply of water is more than sufficient to supply the Kenzo Winery facility needs.

There are no firm plans for the next 10 years but additional buildings may be added. The well capacity exceeds what will be needed for an additional building in which 20 gpm may be expected to add to the current peak service demand.

- Assessment of vulnerability to contamination – The water system is absent of coliform in the well supply source based on data collected in 2008 (Enclosure G). A disinfection system is to be provided as a precautionary measure to protect the users from any contamination.

  An assessment of the drinking water source in accordance with California's Source Water Assessment and Protection (SWAP) Program requirements was evaluated. See Enclosure N for the SWAP analysis details.

- Source water quality analysis – The water quality at the well was assessed and is overall good water with no constituents tested above primary or secondary standards. No fecal coliform were detected in the source water. Please see Enclosure G for a detailed breakdown of the testing results and a copy of the well driller's report.

3. Treatment and Design Information

- Description and layout – There currently are no water treatment devices installed at the Kenzo Winery property. Proposed storage and precautionary water treatment elements can be found in Enclosure I.

  The water source is a well without surface water influence. A propeller-style flowmeter will be specified on the discharge side of the well to accurately and continuously measure the quantity of water produced from the Winery well. This style flowmeter does not require power and therefore will still operate during power outages. Regular maintenance will be recommended to check the accuracy of the flow meter. Please see the drawings in Enclosure D for more information.

- Design capacities – Capacity for precautionary disinfection of the source water is designed at a peak rate of 80 gpm. This capacity will be able to accommodate all of the winery needs including future growth.

- Well Construction – The Winery Well has been established since 2006. Please see Enclosure G for the well completion reports and installation diagram.

- Treatment Chemicals – No chemicals are to be utilized in the system for treatment of domestic water. A softener is proposed to meet winery expectations for water quality but is precautionary in nature, not as treatment to correct exceedance of State water quality standards.

- Disinfection facilities – Each UV unit is sized for a flowrate of 40 gpm with a 40,000 uWs/cm^2 dosage capability. Two UV units of this size will be specified to accommodate a peak projected flow rate of

80 gpm (60 gpm for Winery and 20 gpm for additional building). Please see Enclosure I for more information on the UV disinfection equipment proposed.

4. Distribution System Information (CWS only)

N/A

5. Operational Plans

- Water Quality Monitoring Plan – Please see Enclosure See Enclosures J, K, L, & H for information regarding the operations plan, certified/qualified operators, emergency response plan, and bacteriological sample siting plan.
- Water System Operations Plan – Please see Enclosure I for more information on the operations plan.
- Disaster/Emergency Response Plan – Please see Enclosure J for more information on the disaster and emergency response plan.

6. Environmental Documentation

- Kenzo Winery's compliance with California Environmental Quality Act (CEQA) has been obtained by means of negative declaration per Use Permit #03513-UP.

)EPARTMENT OF PUBLIC HEALTH
IVISION OF DRINKING WATER AND ENVIRONMENTAL MANAGEMENT

BACTERIOLOGICAL SAMPLE SITING PLAN

System Information:

Name of Facility: Kenzo Winery System Number: _____

Street Address: 3200 Monticello Rd Napa, CA 94558 Ph. No.: (707) 259 - 1364

Mailing Address: 8999 Wild Horse Valley Rd. Napa, CA 94558 Fax: (707) 259 - 1374

Service Connections: 4 Population Served: 66 Sampling Frequency: Quarterly

Sample Collection:

All water samples will be collected by: Imboden Pump

Name of Laboratory: Cal Test Analytical Lab

Mailing Address: 1885 N. Kelly Road, Napa, CA 94558

State Lab Code: CAD0112 Phone #: (707) 258-4000 Fax #: (707) 226-1001

The Laboratory was sent a copy of this plan on: June 15, 2009

Raw Water Sampling:

Is water continuously disinfected? ☐ YES ☒ NO

Systems which provide any disinfection treatment are required to take samples of water prior to disinfection (raw water samples) on a quarterly basis. Please list below the sources which are continuously treated and the months when raw water samples will be taken:

1. _____ Months sampled: _____

2. _____ Months sampled: _____

Map of System (REQUIRED):

A map of the distribution system showing the source (well, spring, etc.), storage tanks, treatment facilities, distribution piping, routine sample locations, and follow-up (repeat) sample locations is required. Have you enclosed this map? ☒ YES ☐ NO

(OVER)

BACTERIOLOGICAL SAMPLE SITING PLAN (cont.)

Sample Locations:

The following describes each routine sample location, what months the location will be sampled, and where follow-up (repeat) samples will be taken in the event of a "positive" routine sample. A minimum of five sample sites are required. If more than one source is used or if five sites are not adequate to represent the water system, additional sample sites must be added.

Routine Sample Location:

1. Fermentation Building - Lab sink
   (location name or address)

Water samples will be collected from this location during the months of (circle):

1st Qtr:	Jan.	Feb.	(Mar.)
2nd Qtr:	Apr.	May	(Jun.)
3rd Qtr:	July	Aug.	(Sept.)
4th Qtr:	Oct.	Nov.	(Dec.)

Description: Sink faucets, sample valve, hose bib
(hose bib, sink faucet, etc.)

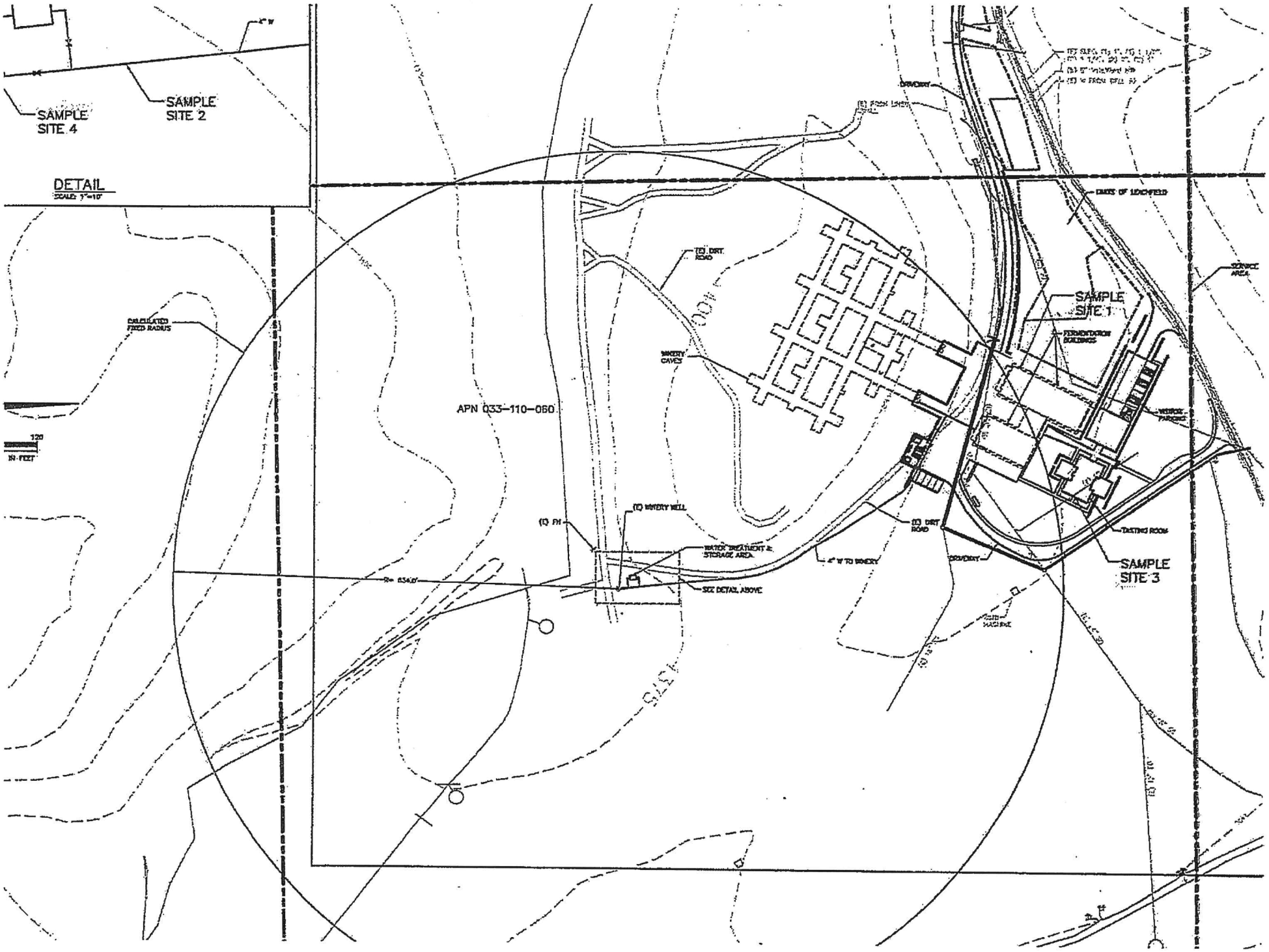
Initial Follow-up (repeat) Sample Location:

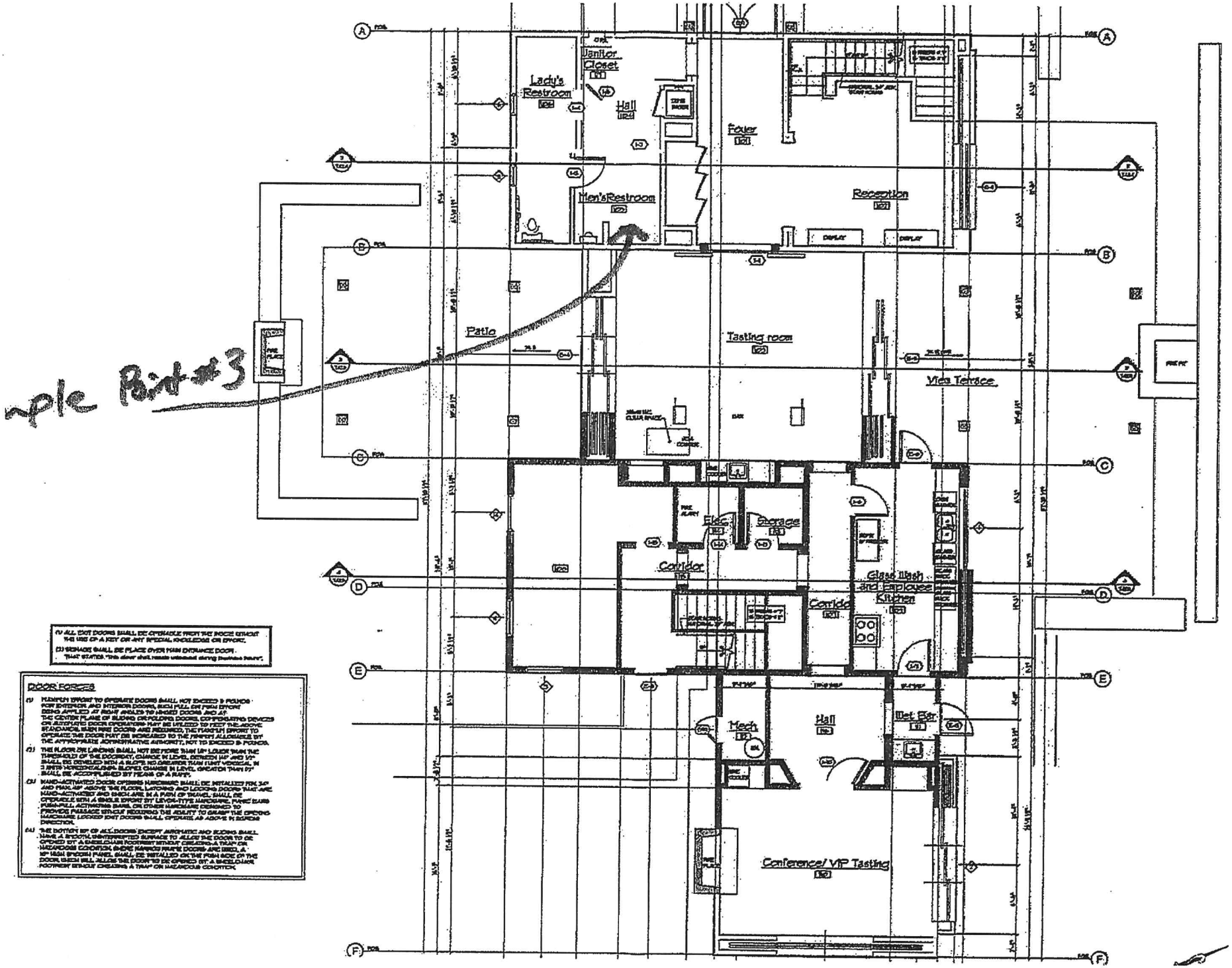
1. Fermentation Building - Lab sink
   (location name or address)
2. Storage Tank - UV Discharge Side
   (location name or address up-stream)
3. Tasting/Admin Building - Men's Restroom Sink
   (location name or address down-stream)
4. Well Supply - Well Head Discharge
   (source)

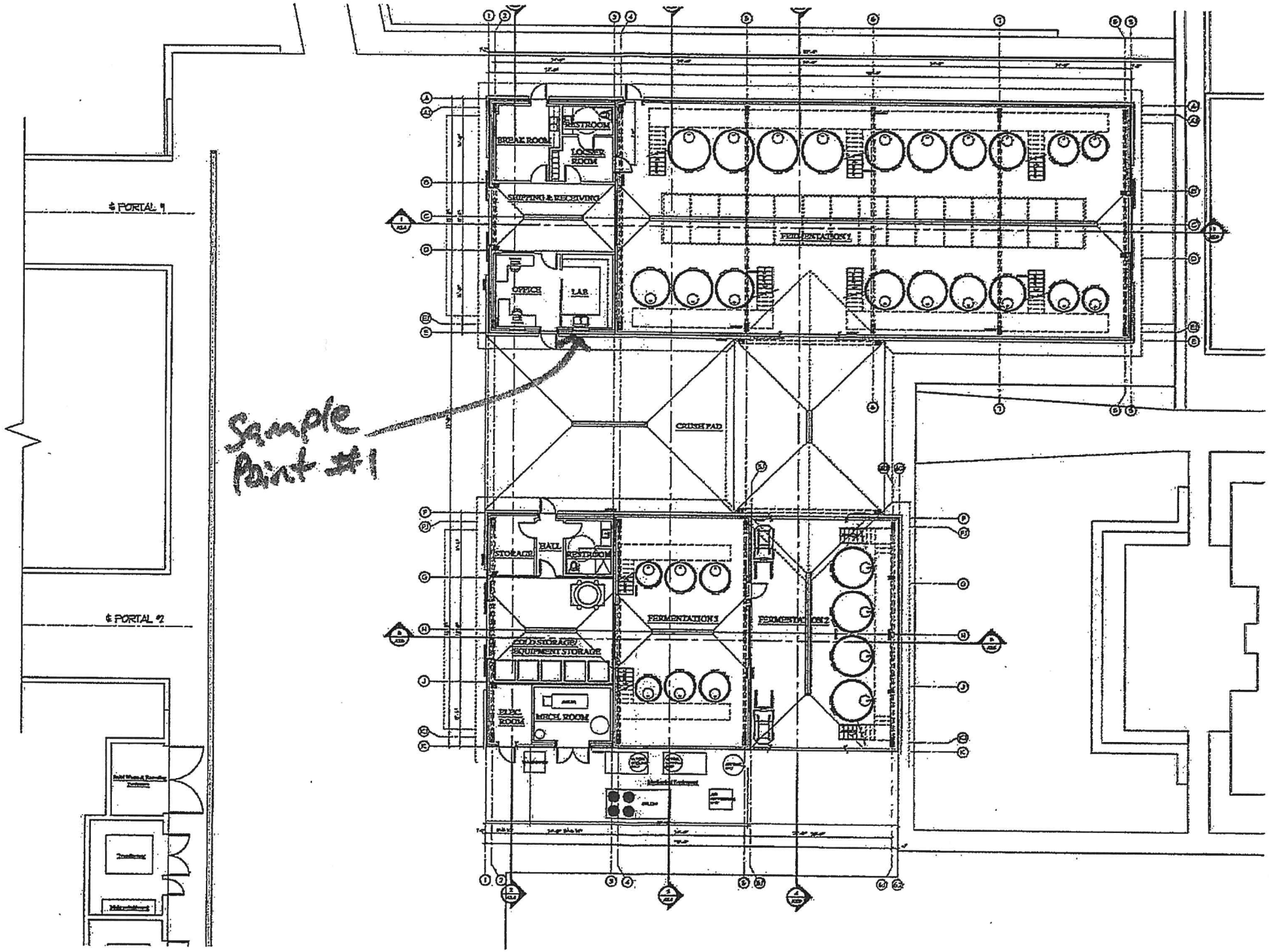
A total of five samples must be collected during the next routine sampling period. If these samples are coliform negative, the system can return to its routine sampling.

Report Prepared by: Richard Ross

Signature and Title: [signature] Date: 4/5/09


SAMPLE SITE 4
SAMPLE SITE 2
DETAIL
SAMPLE SITE 1
SAMPLE SITE 3
APN 033-110-060
(E) DIRT ROAD
DRIVEWAY
CROSS OF LEICHFIELD
SERVICE AREA
CALCULATED FIXED RADIUS
WINERY CAVES
FERMENTATION BUILDINGS
WINERY PARKING
TASTING ROOM
(E) WINERY WELL
(E) PH
WATER TREATMENT & STORAGE AREA
SEE DETAIL ABOVE
4" W TO WINERY
R= 634.0'
1320
IN FEET

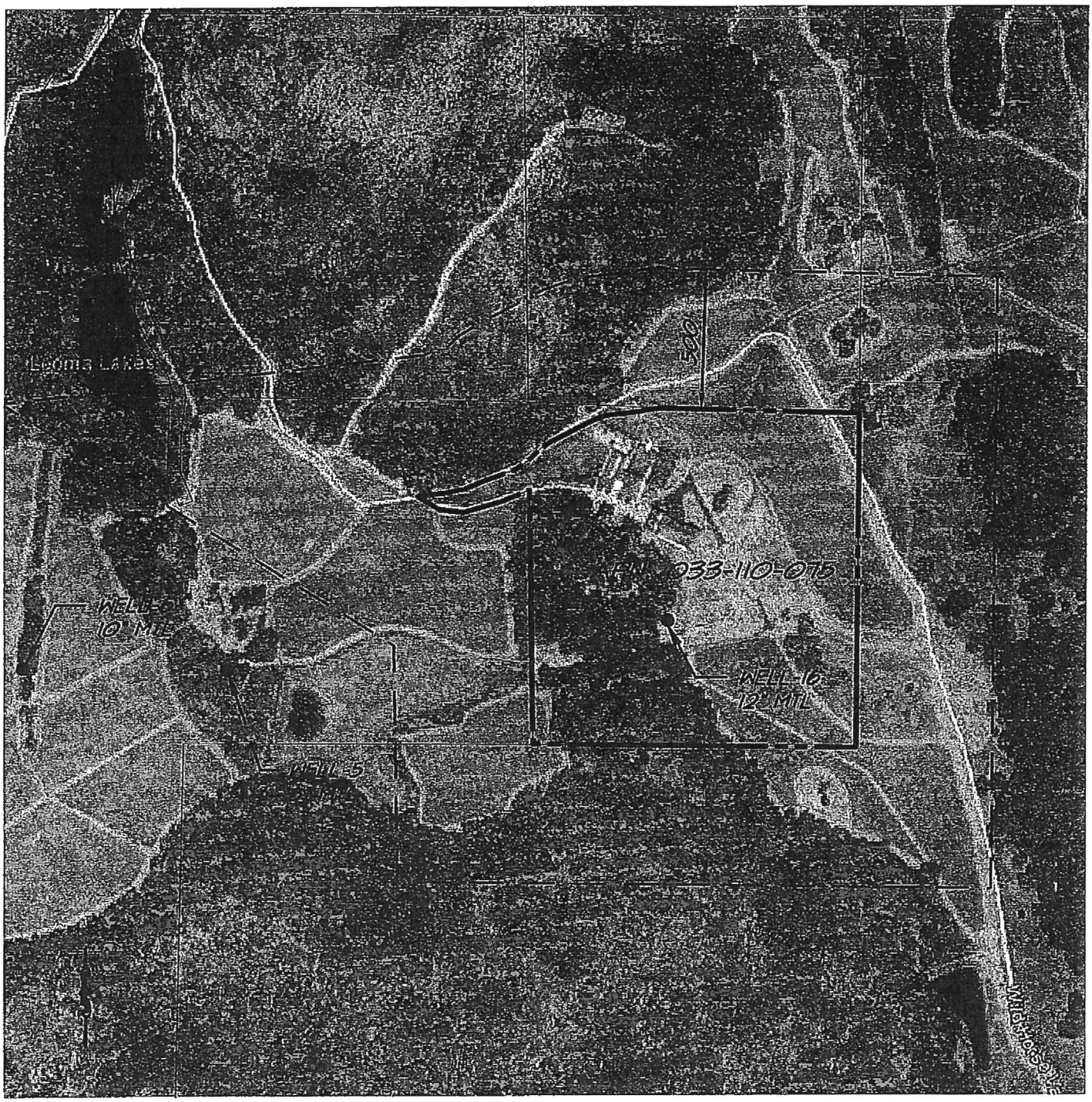

Janitor Closet
Lady's Restroom
Hall
Foyer
Men's Restroom
Reception
Patio
Tasting room
View Terrace
Elec.
Storage
Corridor
Glass Wash and Employee Kitchen
Corrido
Mech.
Hall
Wet Bar
Conference/ VIP Tasting
DOOR FORCES


PORTAL 1
PORTAL 2
BREAK ROOM
RESTROOM
LOCKER ROOM
SHIPPING & RECEIVING
FERMENTATION 1
OFFICE
LAB
CRUSH PAD
STORAGE
HALL
RESTROOM
FERMENTATION 1
FERMENTATION 2
COLD STORAGE/ EQUIPMENT STORAGE
ELEC. ROOM
MECH. ROOM
Sample Point #1

Appendix C

Use Permit Modification Well Exhibit

KENZO WINERY
USE PERMIT MODIFICATION
WELL EXHIBIT



GRAPHIC SCALE

500 0 500 1000

(IN FEET)
1 inch = 500 FT

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DECEMBER 11, 2014 4112041.0 Exh-Wells.dwg

Appendix D

Annual Groundwater Recharge Rate

ANNUAL GROUNDWATER RECHARGE RATE

KENZO ESTATE WINERY
3200 MONTICELLO ROAD
NAPA, CALIFORNIA

APN 033-110-075

PROPERTY OWNER:

Kenzo Estate
3200 Monticello Road
Napa, CA 94558

Project# 4112041.0

August 18, 2015

1515 Fourth Street, Napa, CA 94559 www.rsacivil.com 707.252.3301.v 707.252.4966.f

INTRODUCTION

This report determines the annual groundwater recharge rate for the hillside area on the Kenzo Estate Winery property. The property is located at 3200 Monticello Road in Napa, parcel number 033-110-075. The parcel is 36.13 acres and has slopes ranging from 5-20%. The parcel has been divided into four areas, impervious, vineyard, grass and shrubs, and coastal oak tree areas.

METHODOLOGY

The groundwater recharge rate has been determined by examining the annual rainfall, runoff and species specific evapotranspiration during winter months. The Annual Precipitation Chart and Watershed Types and Factors page in the Napa County Road and Street Standards were used to determine the annual rainfall amount and site runoff volumes. It was determined that the average annual rainfall amounts to 26 inches per year.

The runoff volumes were determined by calculating the site specific runoff coefficient. The runoff coefficients were calculated using aerial images to view the terrain and the county topography to estimate the slopes in each area.

The evapotranspiration losses were calculated using the Water Use Classifications of Landscape Species (WUCOLS) methodology for the vineyard, grass and shrub, and coastal oak tree areas. Only evapotranspiration from the winter was considered, as it is assumed that evapotranspiration in summer will be from irrigation water.

The groundwater recharge rate was calculated as the difference of the total annual rainfall and losses from the stormwater runoff and evapotranspiration. Refer to attached calculations.

Average Recharge Rate = Average Rainfall - Runoff - Evapotranspiration

CONCLUSION

The Kenzo Estate Winery property has an annual rainfall of 26 inches per year, equating to 3.4 million cubic feet per year for the entire site.

Total evapotranspiration volume that occurs through the vineyard, grass and shrub, and oak tree areas on-site is 0.97 million cubic feet per year. The stormwater runoff from the site totals 1.7 million cubic feet per year. The total average evapotranspiration and runoff from the site is 2.65 million cubic feet per year.

The average annual groundwater recharge is 0.76 million cubic feet per year for the 36.13 acre site. This equates an annual groundwater recharge rate of 0.48 acre-feet per acre per year.

RSA+

Kenzo Winery

Groundwater Recharge Rate

Site Description	Hydrologic Soil Group	Area (ac)	Total Annual Rainfall (in/yr)	Total Rainfall (ft^3/yr)
Impervious Area	Sobrante Loam, C	4.21	26	397,340
Vineyard Area	Sobrante Loam, C	10.30	26	972,114
Grass and Shrubs	Sobrante Loam, C	11.00	26	1,038,180
Coastal Oak Trees	Sobrante Loam, C	10.62	26	1,002,316
Total		**36.13**	**26**	**3,409,949**

Evapotranspiration (ET_o)

Site	January (Et_o) (In)	February (Et_o) (In)	March (Et_o) (In)	October (Et_o) (in)	November (Et_o) (in)	December (Et_o) (in)	Total ET_o (in)	Landscape Coefficient (k_c)	Landscape Evapotrans. (Et_c) (in) = Total Et_o x k_c	Total Landscape Evapotranspiration (ft^3/yr)
Impervious Area	0	0	0	0	0	0	0	0	0.00	0
Vineyard Area	1.03	1.53	2.93	3.53	1.64	1.17	11.83	0.8	9.46	353,849
Grass and Shrubs	1.03	1.53	2.93	3.53	1.64	1.17	11.83	0.8	9.46	377,898
Coastal Oak Trees	1.03	1.53	2.93	3.53	1.64	1.17	11.83	0.5	5.92	228,027
Total										**959,774**

Runoff

Site	Run-Off Coefficient (C)	Total Runoff (ft^3/yr)
Impervious Area	0.90	357,606
Vineyard Area	0.46	447,172
Grass and Shrubs	0.41	425,654
Coastal Oak Trees	0.46	461,065
Total		**1,691,497**

Groundwater Recharge Rate

Site	Total Rainfall (ft^3/yr)	Total Crop Evapotranspiration (ft^3/yr)	Total Runoff (ft^3/yr)	Total Stormwater loss on site (ft^3/yr)	Groundwater Recharge Rate (ft^3/yr)	Groundwater Recharge Rate (ac-ft/ac/yr)
Impervious Area	397,340	0	357,606	357,606	39,734	0.22
Vineyard Area	972,114	353,849	447,172	801,022	171,092	0.38
Grass and Shrubs	1,038,180	377,898	425,654	803,551	234,629	0.49
Coastal Oak Trees	1,002,316	228,027	461,065	689,092	313,224	0.68
Total	**3,409,949**	**959,774**	**1,691,497**	**2,651,271**	**758,678**	**0.48**

Hydrologic Soil Group—Napa County, California
(Kenzo Estate Winery)

Map Scale: 1:4,620 if printed on A size (8.5" x 11") sheet.

N

Meters
0 40 80 160 240

Feet
0 150 300 600 900

MAP LEGEND

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

Soils
- Soil Map Units

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

Political Features
- Cities

Water Features
- Streams and Canals

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

MAP INFORMATION

Map Scale: 1:4,620 if printed on A size (8.5" × 11") sheet.

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

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

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

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: UTM Zone 10N NAD83

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

Soil Survey Area: Napa County, California
Survey Area Data: Version 4, Dec 10, 2007

Date(s) aerial images were photographed: 6/30/2005

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

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Napa County, California (CA055)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
151	Hambright-Rock outcrop complex, 2 to 30 percent slopes	D	0.7	1.6%
152	Hambright rock-Outcrop complex, 30 to 75 percent slopes	D	2.1	4.9%
178	Sobrante loam, 5 to 30 percent slopes	C	26.5	60.8%
179	Sobrante loam, 30 to 50 percent slopes	C	14.2	32.6%
Totals for Area of Interest			**43.5**	**100.0%**

Description

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

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

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

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

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

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

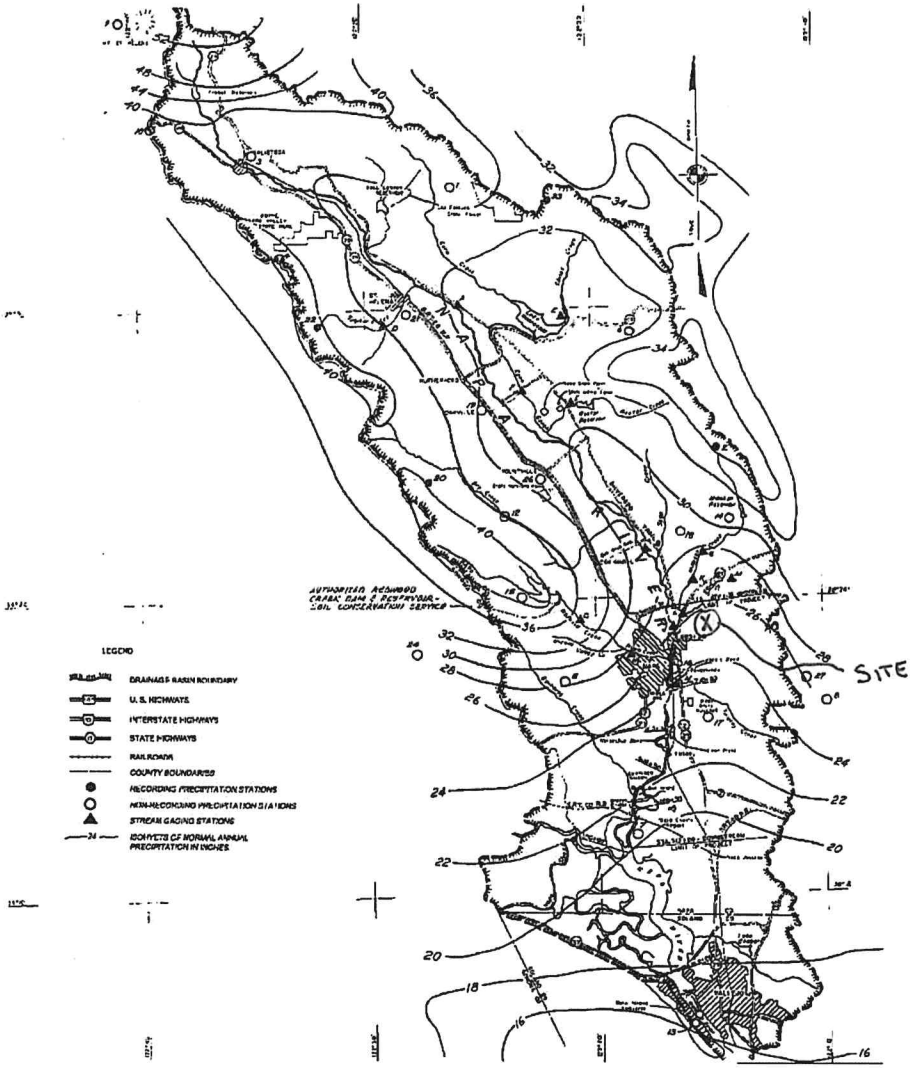
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher



ANNUAL AVERAGE RAINFALL = 26 IN/YR

PRECIPITATION CHART
LOWER COUNTY

FLOOD CONTROL
GENERAL DESIGN MEMORANDUM
NAPA RIVER CHANNEL IMPROVEMENTS
NAPA COUNTY, CALIFORNIA
HYDROLOGY AND HYDRAULIC ANALYSIS
NORMAL ANNUAL PRECIPITATION AND HYDROLOGIC INDEX MAP
U.S. ARMY ENGINEER DISTRICT, SAN FRANSICO, CORPS OF ENGINEERS

TO ACCOMPANY REPORT DATED 12 March 75

FILE NO. 50-47-1

Vineyard Area

WATERSHED TYPES AND FACTORS

RUN-OFF PRODUCING CHARACTERISTICS OF WATERSHEDS SHOWING FACTORS FOR EACH CHARACTERISTIC FOR VARIOUS WATERSHED TYPES				
WATERSHED TYPES AND FACTORS				
Run-off Producing Features	**Extreme**	**High**	**Normal**	**Low**
Relief	**0.28 – 0.38** Steep, rugged terrain, with average slopes above 30%	**0.20 – 0.28** Rolling, with average slopes of 10 to 30%	0.14 **0.14 – 0.20** Rolling, with average slopes of 5 to 10%	**0.08 – 0.14** Relatively flat land, with average slopes of 0 to 5%
Soil Infiltration	**0.12 – 0.16** No effective soil cover either rock or thin soil mantle of negligible infiltration capacity.	0.10 **0.08 – 0.12** Slow to take up water; clay or shallow loam soils of low infiltration capacity imperfectly or poorly drained.	**0.06 – 0.08** Normal; well drained light and medium textured soils sandy loams, silt, and silt loams.	**0.04 – 0.06** Slow to take up water; clay or shallow loam soils of low infiltration capacity imperfectly or poorly drained.
Vegetation Cover	**0.12 – 0.16** No effective plant cover; bare or very sparse cover.	0.12 **0.08 – 0.12** Poor to fair; clean cultivation crops or poor natural cover; less than 20% of drainage area under good cover.	**0.06 – 0.08** Fair to good; about 50% of area in good grassland or woodland; not more than 50% of area in cultivated crops.	**0.04 – 0.06** Good to excellent; about 90% of drainage area in good grassland, woodland, or equivalent crop.
Surface	**0.10 – 0.12** Negligible; surface depressions, few and shallow; drainage ways steep and small; no marshes.	0.10 **0.08 – 0.10** Low well-defined system of small drainage ways; no ponds or marsh.	**0.06 – 0.08** Normal; considerable surface depression storage; lakes, ponds, and marshes.	**0.04 – 0.06** High; surface storage high; drainage system not sharply defined; large floodplain storage or large number of ponds or marshes.

THE RUNOFF FACTOR IS DETERMINED BY THE SUM OF THE FACTORS FOR RELIEF INFILTRATION, COVER, AND SURFACE. NOT APPLICABLE TO BUILT UP AREAS.

FIGURE 3

C = 0.46

Grass and Shrubs Area

WATERSHED TYPES AND FACTORS

RUN-OFF PRODUCING CHARACTERISTICS OF WATERSHEDS SHOWING FACTORS FOR EACH CHARACTERISTIC FOR VARIOUS WATERSHED TYPES				
WATERSHED TYPES AND FACTORS				
Run-off Producing Features	**Extreme**	**High**	**Normal**	**Low**
Relief	**0.28 – 0.38** Steep, rugged terrain, with average slopes above 30%	**0.20 – 0.28** Rolling, with average slopes of 10 to 30%	0.15 **0.14 – 0.20** Rolling, with average slopes of 5 to 10%	**0.08 – 0.14** Relatively flat land, with average slopes of 0 to 5%
Soil Infiltration	**0.12 – 0.16** No effective soil cover either rock or thin soil mantle of negligible infiltration capacity.	0.10 **0.08 – 0.12** Slow to take up water; clay or shallow loam soils of low infiltration capacity imperfectly or poorly drained.	**0.06 – 0.08** Normal; well drained light and medium textured soils sandy loams, silt, and silt loams.	**0.04 – 0.06** Slow to take up water; clay or shallow loam soils of low infiltration capacity imperfectly or poorly drained.
Vegetation Cover	**0.12 – 0.16** No effective plant cover; bare or very sparse cover.	**0.08 – 0.12** Poor to fair; clean cultivation crops or poor natural cover; less than 20% of drainage area under good cover.	**0.06 – 0.08** Fair to good; about 50% of area in good grassland or woodland; not more than 50% of area in cultivated crops.	0.06 **0.04 – 0.06** Good to excellent; about 90% of drainage area in good grassland, woodland, or equivalent crop.
Surface	**0.10 – 0.12** Negligible; surface depressions, few and shallow; drainage ways steep and small; no marshes.	0.10 **0.08 – 0.10** Low well-defined system of small drainage ways; no ponds or marsh.	**0.06 – 0.08** Normal; considerable surface depression storage; lakes, ponds, and marshes.	**0.04 – 0.06** High; surface storage high; drainage system not sharply defined; large floodplain storage or large number of ponds or marshes.

THE RUNOFF FACTOR IS DETERMINED BY THE SUM OF THE FACTORS FOR RELIEF INFILTRATION, COVER, AND SURFACE. NOT APPLICABLE TO BUILT UP AREAS.

FIGURE 3

C = 0.41

Coastal Oak Trees Area

WATERSHED TYPES AND FACTORS

RUN-OFF PRODUCING CHARACTERISTICS OF WATERSHEDS SHOWING FACTORS FOR EACH CHARACTERISTIC FOR VARIOUS WATERSHED TYPES				
WATERSHED TYPES AND FACTORS				
Run-off Producing Features	**Extreme**	**High**	**Normal**	**Low**
Relief	**0.28 – 0.38** Steep, rugged terrain, with average slopes above 30%	0.22 **0.20 – 0.28** Rolling, with average slopes of 10 to 30%	**0.14 – 0.20** Rolling, with average slopes of 5 to 10%	**0.08 – 0.14** Relatively flat land, with average slopes of 0 to 5%
Soil Infiltration	**0.12 – 0.16** No effective soil cover either rock or thin soil mantle of negligible infiltration capacity.	0.10 **0.08 – 0.12** Slow to take up water; clay or shallow loam soils of low infiltration capacity imperfectly or poorly drained.	**0.06 – 0.08** Normal; well drained light and medium textured soils sandy loams, silt, and silt loams.	**0.04 – 0.06** Slow to take up water; clay or shallow loam soils of low infiltration capacity imperfectly or poorly drained.
Vegetation Cover	**0.12 – 0.16** No effective plant cover; bare or very sparse cover.	**0.08 – 0.12** Poor to fair; clean cultivation crops or poor natural cover; less than 20% of drainage area under good cover.	**0.06 – 0.08** Fair to good; about 50% of area in good grassland or woodland; not more than 50% of area in cultivated crops.	0.05 **0.04 – 0.06** Good to excellent; about 90% of drainage area in good grassland, woodland, or equivalent crop.
Surface	**0.10 – 0.12** Negligible; surface depressions, few and shallow; drainage ways steep and small; no marshes.	0.09 **0.08 – 0.10** Low well-defined system of small drainage ways; no ponds or marsh.	**0.06 – 0.08** Normal; considerable surface depression storage; lakes, ponds, and marshes.	**0.04 – 0.06** High; surface storage high; drainage system not sharply defined; large floodplain storage or large number of ponds or marshes.

THE RUNOFF FACTOR IS DETERMINED BY THE SUM OF THE FACTORS FOR RELIEF INFILTRATION, COVER, AND SURFACE. NOT APPLICABLE TO BUILT UP AREAS.

FIGURE 3

C = 0.46

A specialized weather station (CIMIS station) or a Class A evaporation pan (background) can be used to determine reference evapotranspiration (ET_o) for a site. Daily CIMIS data is available online at **www.cimis. water.ca.gov.**

The **crop coefficient (K_c)** is determined from field research. Water loss from a crop is measured over an extended period of time. Water loss and estimated reference evapotranspiration are used to calculate K_c as follows:

$$K_c = \frac{ET_c}{ET_o}$$

As seen in the above equation, the crop coefficient (K_c) is simply the fraction of water lost from the crop relative to reference evapotranspiration. Typically, crop water loss is less than reference evapotranspiration and, therefore, the crop coefficient is less than 1.0. For example, if water loss from corn was measured to be 4 inches in a month, and reference evapotranspiration for the same month was 8 inches, then the crop coefficient would be 0.5. Crop coefficients have been established for many crops and for turfgrasses. A sample of values is given in Table 1.

Table 1—
Crop Coefficients for Various Crops and Turfgrasses

K_c values for agricultural crops typically change during the seasons: low values are for early season (March/April) or late season (September/October) and high values for midseason (May/June/July).

K_c values		
	Low	High
Deciduous orchard*	0.50	0.97
Deciduous orchard with cover crop**	0.98	1.27
Grape	0.06	0.80
Olive	0.58	0.80
Pistachio	0.04	1.12
Citrus	0.65	year-round
Turfgrass		
Cool season species	0.8	year-round
Warm season species	0.6	year-round

Source: UC Leaflet Nos. 21427 and 21428 (see references)
* Deciduous orchard includes apples, cherries, and walnuts
** When an active cover crop is present, K_c may increase by 25 to 80%.

In summary, an estimate of crop evapotranspiration is made from reference evapotranspiration and crop coefficient values. Estimates can be made for any location where reference evapotranspiration data exists and for any crop (or turfgrass) that has a crop coefficient.

Example: A grape grower in Monterey County wants to estimate how much water the vineyard may lose in the month of July. Using the ET_c formula, two numbers are needed: reference evapotranspi-

TABLE 1. Crop coefficients used in daily modeling of soil water processes in vineyards, oak trees and grasslands

Vineyards		Oak trees		Grasslands	
Period	K_c	Period	K_c	Period	K_c
3/1–4/15	0.10	3/1–3/31	0.5	3/1–3/15	0.90
4/16–4/30	0.20	4/1–10/1	0.6	3/16–4/30	0.95
5/1–5/15	0.25	10/2–11/25	0.5	5/1–5/15	0.25
5/16–5/31	0.30	11/26–2/28	0.4	5/16–6/15*	0.10
6/1–6/15	0.35			6/16*–10/13	0.00
6/16–6/30	0.40	$K_c = 0.5$		10/14–10/31	0.25
7/1–9/30	0.50			11/1–2/28	0.75
10/1–10/15	0.30				
10/16–10/31	0.20				
11/1–11/15	0.15				
11/16–11/30	0.05				
12/1–2/28	0.01				

Sources: Allen et al. 1998 (grasses and trees); Caprile 2007 (vineyards).

* Variable date depending on available soil moisture.

KENZO WINERY
GROUNDWATER RECHARGE EXHIBIT

SITE DESCRIPTION	AREA (AC.)
IMPERVIOUS AREA	4.21
VINEYARD AREA	11.00
GRASS AND SHRUBS	10.30
COASTAL OAK TREES	10.62

GRAPHIC SCALE

150 0 150 300

(IN FEET)
1 Inch = 150 FT

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