EXHIBIT C-1

Hydrologic Analysis
Proposed Long Ranch Vineyard
Wappo Land Company
Long Ranch Road
St. Helena, CA
030-220-025

Prepared by David A. Steiner
CPESC, CPSWQ
December 11, 2018

The purpose of this investigation is to determine whether or not a proposed 15.9 acre vineyard development project will increase peak flow/runoff on the referenced site, on a ridge separating the Lake Hennessey and Napa River watersheds, east of St. Helena, California. The two subwatersheds are analyzed separately. The investigation was carried out by David Steiner, at the request of Mike Muelrath, principal engineer at Applied Civil Engineering, Inc.

This analysis was performed using WinTR-55, a Windows application based on USDA Technical Release 55, Small Watershed Hydrology. The protocol for this method requires plotting watersheds that encompass the project and drain to applicable "points of interest" or outlets. The analysis includes pre- and post-project examination of Land Use, Hydrologic Condition, soil type and Hydrologic Soil Group (HSG); these factors are combined to determine Runoff Curve Numbers (CN), which are entered, along with acreage, into the application's appropriate data entry fields. Each subwatershed's Time of Concentration (Tc) is calculated from its hydrologically most remote point to its outlet, based on slope, roughness, and a determination as to the type of flow (sheet, shallow concentrated, or channel). 24-hour storm data for the site's 2, 5, 10, 25, 50, and 100-year precipitation depths, as well as distribution curves for CA-1 storm types--per NOAA Atlas 14--are entered into the application's appropriate fields. Results are displayed on the accompanying printouts of the two WinTR-55 runs, pre- and post-project. Descriptions of the various entries are as follows: (Please refer also to the accompanying pre- and post-project watershed maps, which include polygons drawn to delineate the various land uses and hydrologic conditions described.)

Hennessey Watershed Part (46.3 Acres)

Curve Number, Pre-Project Conditions:

- Nearly half of this area is already devoted to vineyard, characterized as equivalent to "**Annual grass**, good condition" in the application's Custom CN field. 15.2 acres HSG C, CN=75; 5.2 acres HSG D, CN=81. The Curve Number for these non-tilled vineyards, with cover levels of at least 75%, was selected from a California-specific table found in the NRCS Engineering Field Handbook.*
- Most of the area above the Hennessey portion of the proposed vineyard is characterized as "**Brush, weeds, grass**, with brush a major component" in fair hydrologic condition. (Limited soil depth and exposed bedrock reduce the surface cover level to below 75%.) 5.7 acres HSG C, CN=70; 4.5 acres HSG D, CN=77.
- Most of the proposed vineyard area in the Hennessey watershed portion of the site is located upwind (northeast) of the owner's residence, and has been subjected to fuel load management activity in the past few years. It is thus characterized as "**Herbaceous**, with brush not a major part" in fair hydrologic condition. (Again, limited soil depth and exposed bedrock reduce the surface cover level to below 75%.) 1.8 acres HSG C, CN=81; 2.0 acres HSG D, CN=89.
- The project is partially surrounded by "**Woods**" in good condition. 3.0 acres HSG C, CN=70; 8.1 acres HSG D, CN=77.
- Existing access roads in the area are characterized as "**Paved, with open ditches.**" .025 acres HSG C, CN=92; .05 acres HSG D, CN=93.
- The area includes one residential homesite, characterized as "**Farmstead.**" .5 acre, HSG D, CN=86.
- The pre-project **Weighted Curve Number** of the Hennessey watershed area is 76.

Curve Number, Post-Project Conditions:

- The proposed non-tilled vineyard development of approximately 6 acres ("**Annual grass**, good condition") in the Hennessey watershed will increase the totals in that category as follows: 16.8 acres HSG C, CN=75; 9.6 acres HSG D, CN=81.
- The "**Brush, weeds, grass**, fair condition" component will be reduced by 2.0 acres. 2.5 acres HSG D, CN=77.
- The entire 3.8 acres of "**Herbaceous**", fair condition will be replaced by vineyard.
- The area of "**Woods**", good condition will be reduced by .2 acres to 7.9 acres, HSG D, CN 77.
- The post-project **Weighted Curve Number** of the Hennessey watershed area remains at 76.

Time of Concentration, Tc will not change under post-project conditions, as no surface drainage improvements, which might accelerate flows, are proposed.

As shown in the accompanying printouts of the pre- and post-project WinTR-55 runs, no increase in peak flows is anticipated as a result of the proposed vineyard development on the Hennessey watershed part of the site.

*Engineering Field Handbook, Part 650, Chapter 2, Supplement 1, USDA/NRCS, Oct 2008.

Napa River Watershed Part (84.7 Acres)

Curve Number, Pre-Project Conditions:

- A significant area of this watershed is managed as non-tilled vineyard with at least 75% cover, characterized as equivalent to "**Annual grass**", good condition. (Data for this area was entered into the application's "Custom CN" field.) Please see footnote in Hennessey watershed analysis. 17.3 acres, HSG D, CN=81.
- Additional existing vineyard acreage appears to be tilled, therefore characterized appropriately as "**Annual grass**", *fair* condition. However, as the "Custom CN" field was already in use, this data was entered as an equivalent land use with the same CN, characterized as "**Open Space, grass cover**", fair condition. 4.8 acres, HSG D, CN=84.
- The majority of this subwatershed is dominated by "**Brush, weeds, grass**", in fair hydrologic condition. 53.4 acres HSG D, CN=77.
- However two small areas are nearly bare, and must be considered to be in "poor" condition. 1.8 acres HSG D, CN=83.
- Scattered oak woodlands are characterized as "**Woods**", good condition. 4.7 acres HSG D, CN=77.
- Two hilltop homesites are entered as "**Farmsteads**." 1.2 acres HSG D, CN=86.
- Several hundred feet of access roads are entered as "**Paved with open ditches**." 1.5 acres HSG D, CN=93.
- The pre-project **Weighted Curve Number** for the Napa River watershed side of the site is 79.

Curve Number, Post-Project Conditions:

- An additional 9.9 acres of non-tilled vineyard is proposed for planting on the Napa River side of the watershed divide. Entered as "**Annual Grass**", good condition in the Custom CN field: 27.2 acres HSG D, CN=81.
- Clearing for the vineyard will remove 8.4 acres of "**Brush, weeds, grass**", fair condition, leaving 45 acres HSG D, CN=77.
- The vineyard clearing will also remove 1.5 acres of "**Woods**", good condition, leaving 3.2 acres HSG D, CN=77.
- All other components of the post-project CN analysis remain unchanged.
- The post-project **Weighted Curve Number** for the Napa River watershed side of the site remains at 79.

Time of Concentration, Tc will not change under post-project conditions, as no surface drainage improvements, which might accelerate flows, are proposed.

As shown in the accompanying printouts of the pre- and post-project WinTR-55 runs, no increase in peak flows is anticipated as a result of the proposed vineyard development on the Napa River watershed part of the site.

Long Ranch

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NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: CA

Data description

Data type: Precipitation depth **Units:** English **Time series type:** Partial duration

Select location

1) Manually:

a) By location (decimal degrees, use "-" for S and W): Latitude: 38.469 Longitude: -122.360 Submit

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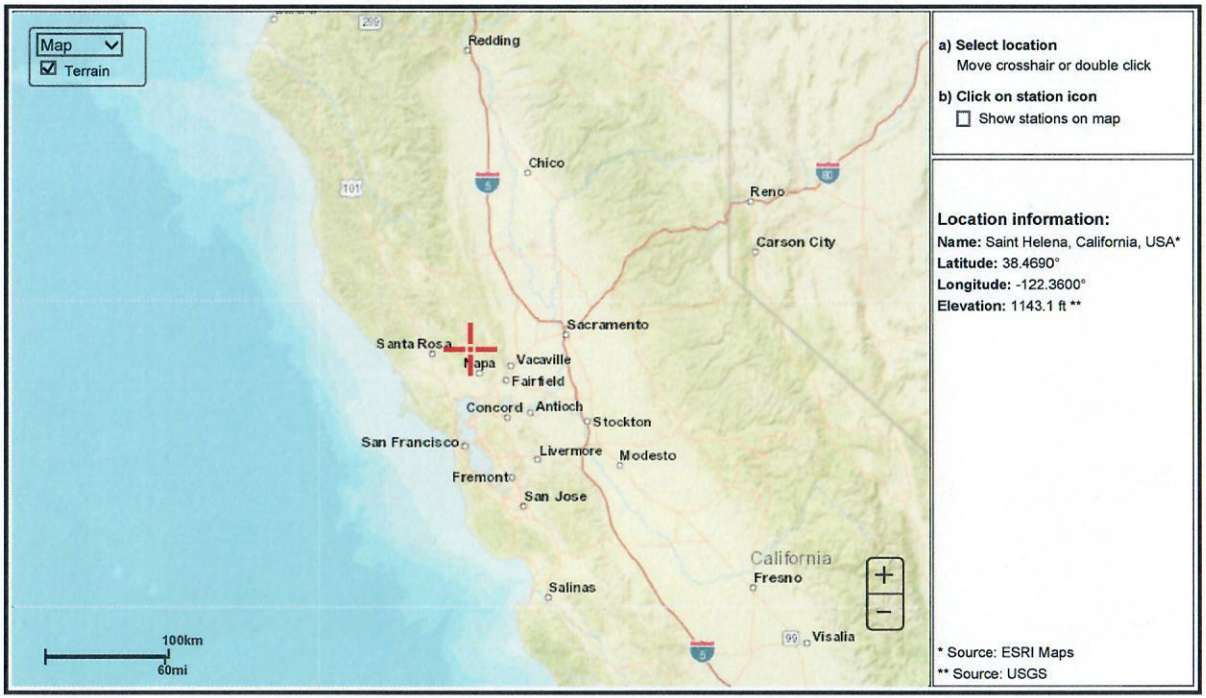
2) Use map (if ESRI interactive map is not loading, try adding the host: **https://js.arcgis.com/** to the firewall, or contact us at hdsc.questions@noaa.gov):



POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 6, Version 2

PF tabular PF graphical Supplementary information

PDS-based precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.139 (0.124-0.158)	0.170 (0.151-0.193)	0.211 (0.187-0.240)	0.245 (0.215-0.282)	0.292 (0.246-0.349)	0.329 (0.271-0.403)	0.368 (0.295-0.463)	0.409 (0.318-0.532)	0.466 (0.346-0.636)	0.513 (0.366-0.727)
10-min	0.200 (0.178-0.227)	0.244 (0.217-0.277)	0.302 (0.268-0.344)	0.351 (0.308-0.404)	0.418 (0.353-0.500)	0.471 (0.389-0.578)	0.527 (0.423-0.664)	0.586 (0.455-0.762)	0.669 (0.495-0.911)	0.735 (0.524-1.04)
15-min	0.242 (0.215-0.274)	0.295 (0.262-0.335)	0.365 (0.324-0.417)	0.424 (0.372-0.488)	0.506 (0.427-0.605)	0.570 (0.470-0.698)	0.637 (0.511-0.803)	0.709 (0.550-0.921)	0.809 (0.599-1.10)	0.889 (0.634-1.26)
30-min	0.350 (0.312-0.397)	0.427 (0.379-0.485)	0.529 (0.469-0.603)	0.614 (0.539-0.707)	0.732 (0.619-0.876)	0.826 (0.681-1.01)	0.923 (0.740-1.16)	1.03 (0.797-1.34)	1.17 (0.868-1.60)	1.29 (0.918-1.83)
60-min	0.512 (0.456-0.581)	0.624 (0.555-0.710)	0.774 (0.686-0.882)	0.898 (0.788-1.03)	1.07 (0.905-1.28)	1.21 (0.996-1.48)	1.35 (1.08-1.70)	1.50 (1.17-1.95)	1.71 (1.27-2.34)	1.88 (1.34-2.67)
2-hr	0.777 (0.692-0.882)	0.949 (0.843-1.08)	1.17 (1.04-1.34)	1.35 (1.19-1.56)	1.60 (1.35-1.92)	1.79 (1.48-2.19)	1.98 (1.59-2.50)	2.18 (1.70-2.84)	2.45 (1.82-3.34)	2.66 (1.90-3.77)
3-hr	0.999 (0.889-1.13)	1.22 (1.08-1.39)	1.51 (1.33-1.72)	1.74 (1.52-2.00)	2.05 (1.73-2.45)	2.28 (1.88-2.79)	2.52 (2.02-3.17)	2.76 (2.14-3.59)	3.08 (2.29-4.20)	3.33 (2.37-4.72)
6-hr	1.51 (1.34-1.71)	1.84 (1.64-2.10)	2.28 (2.02-2.60)	2.62 (2.30-3.02)	3.08 (2.60-3.69)	3.43 (2.83-4.20)	3.77 (3.02-4.75)	4.11 (3.20-5.35)	4.57 (3.39-6.23)	4.91 (3.50-6.96)
12-hr	2.12 (1.89-2.41)	2.64 (2.35-3.00)	3.30 (2.92-3.76)	3.82 (3.35-4.39)	4.51 (3.81-5.39)	5.02 (4.14-6.15)	5.53 (4.43-6.96)	6.04 (4.69-7.85)	6.70 (4.97-9.14)	7.20 (5.13-10.2)
24-hr	2.95 (2.66-3.35)	3.74 (3.36-4.25)	4.74 (4.25-5.40)	5.53 (4.93-6.34)	6.57 (5.70-7.74)	7.35 (6.26-8.81)	8.12 (6.78-9.93)	8.89 (7.25-11.1)	9.90 (7.80-12.8)	10.7 (8.16-14.2)
2-day	3.87 (3.48-4.39)	4.94 (4.44-5.61)	6.31 (5.66-7.18)	7.39 (6.58-8.47)	8.82 (7.64-10.4)	9.89 (8.42-11.9)	10.9 (9.14-13.4)	12.0 (9.79-15.0)	13.4 (10.6-17.4)	14.5 (11.1-19.3)
3-day	4.50 (4.05-5.11)	5.77 (5.18-6.55)	7.39 (6.63-8.41)	8.68 (7.73-9.94)	10.4 (8.99-12.2)	11.6 (9.92-14.0)	12.9 (10.8-15.8)	14.2 (11.6-17.7)	15.9 (12.5-20.5)	17.1 (13.1-22.8)
4-day	5.00 (4.49-5.67)	6.42 (5.77-7.29)	8.23 (7.38-9.37)	9.67 (8.61-11.1)	11.6 (10.0-13.6)	13.0 (11.1-15.5)	14.4 (12.0-17.6)	15.8 (12.9-19.8)	17.6 (13.9-22.9)	19.0 (14.6-25.4)
7-day	6.17 (5.55-7.00)	7.92 (7.11-8.99)	10.1 (9.09-11.5)	11.9 (10.6-13.6)	14.2 (12.3-16.7)	15.9 (13.5-19.0)	17.5 (14.6-21.5)	19.2 (15.7-24.0)	21.4 (16.8-27.7)	23.0 (17.6-30.7)
10-day	6.97 (6.27-7.91)	8.95 (8.04-10.2)	11.4 (10.3-13.0)	13.4 (11.9-15.4)	15.9 (13.8-18.8)	17.8 (15.2-21.3)	19.6 (16.4-24.0)	21.5 (17.5-26.9)	23.8 (18.8-30.9)	25.6 (19.6-34.1)
20-day	9.12 (8.21-10.4)	11.7 (10.5-13.3)	15.0 (13.4-17.0)	17.5 (15.6-20.0)	20.7 (17.9-24.3)	23.0 (19.6-27.5)	25.2 (21.1-30.8)	27.4 (22.4-34.3)	30.2 (23.8-39.1)	32.2 (24.7-43.0)
30-day	11.0 (9.89-12.5)	14.1 (12.7-16.0)	17.9 (16.1-20.4)	20.9 (18.6-23.9)	24.6 (21.3-28.9)	27.2 (23.2-32.6)	29.8 (24.8-36.4)	32.2 (26.3-40.3)	35.3 (27.8-45.8)	37.5 (28.7-50.1)
45-day	13.4 (12.1-15.2)	17.1 (15.4-19.4)	21.6 (19.3-24.6)	25.0 (22.2-28.6)	29.2 (25.3-34.4)	32.3 (27.5-38.7)	35.1 (29.3-43.0)	37.9 (30.9-47.4)	41.3 (32.5-53.5)	43.7 (33.5-58.3)
60-day	16.0 (14.4-18.1)	20.2 (18.2-23.0)	25.3 (22.7-28.8)	29.2 (26.0-33.4)	34.0 (29.4-40.0)	37.3 (31.8-44.7)	40.5 (33.8-49.5)	43.5 (35.5-54.5)	47.2 (37.2-61.2)	49.9 (38.1-66.5)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Estimates from the table in CSV format: Precipitation frequency estimates Submit

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Soil Physical Properties

- Available Water Capacity
- Available Water Storage
- Available Water Supply, 0 to 100 cm
- Available Water Supply, 0 to 150 cm
- Available Water Supply, 0 to 25 cm
- Available Water Supply, 0 to 50 cm
- Bulk Density, 15 Bar
- Bulk Density, One-Tenth Bar
- Bulk Density, One-Third Bar
- Linear Extensibility
- Liquid Limit
- Organic Matter
- Percent Clay
- Percent Sand
- Percent Silt
- Plasticity Index
- Saturated Hydraulic Conductivity (Ksat)
- Saturated Hydraulic Conductivity (Ksat), Standard Classes
- Surface Texture
- Water Content, 15 Bar
- Water Content, One-Third Bar

Soil Qualities and Features

- AASHTO Group Classification (Surface)
- AASHTO Group Index
- Depth to a Selected Soil Restrictive Layer
- Depth to Any Soil Restrictive Layer
- Drainage Class
- Frost Action
- Frost-Free Days
- **Hydrologic Soil Group**

View Description | View Rating

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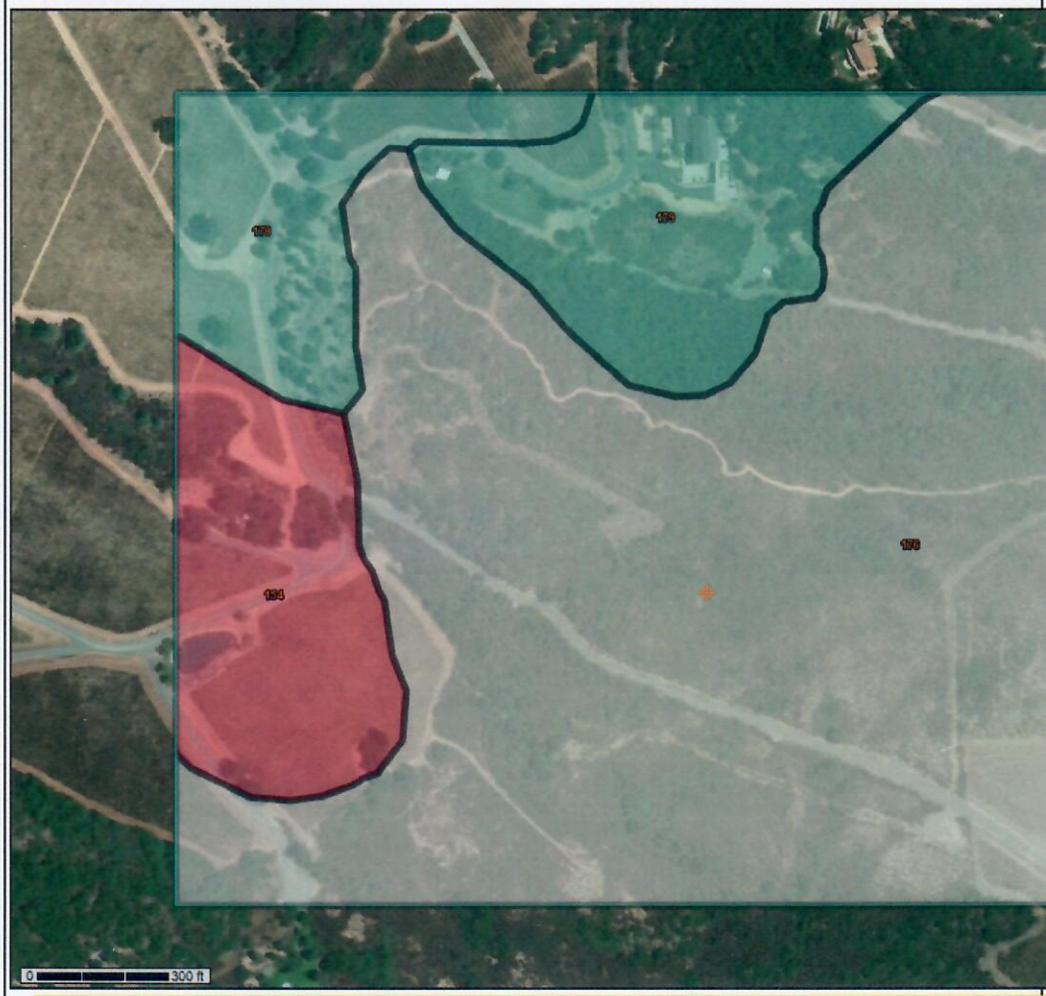
Map ☑
Table ☑
Description of Rating ☑
Rating Options ☑
☐ Detailed Description

Advanced Options

Aggregation Method: Dominant Condition
Component Percent Cutoff:
Tie-break Rule: ○ Lower ◉ Higher

Map — Hydrologic Soil Group

Scale (not to scale)



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

You have zoomed in beyond the scale at which the soil map for this area is intended to be used. Mapping of soils is done at a p mapped at 1:24,000. The design of map units and the level of detail shown in the resulting soil map are dependent on that ma

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil li soils that could have been shown at a more detailed scale.

Tables — Hydrologic Soil Group — Summary By Map Unit

Summary by Map Unit — Napa County, California (CA055)

Summary by Map Unit — Napa County, California (CA055)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
154	Henneke gravelly loam, 30 to 75 percent slopes	D	9.6	7.9%
176	Rock outcrop-Hambright complex, 50 to 75 percent slopes		93.5	76.8%
178	Sobrante loam, 5 to 30 percent slopes	C	7.6	6.3%
179	Sobrante loam, 30 to 50 percent slopes	C	10.9	9.0%
Totals for Area of Interest			**121.7**	**100.0%**

Description — Hydrologic Soil Group

DAS

Long Ranch Vineyard
Napa River Side, post-project
Napa County, California

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs)	(hr)	5-Yr (cfs)	(hr)	10-Yr (cfs)	(hr)	25-Yr (cfs)	(hr)	50-Yr (cfs)	(hr)	100-Yr (cfs)	(hr)
SUBAREAS												
Napa	24.58	12.16	36.29	12.15	45.89	12.16	58.63	12.16	68.33	12.16	77.83	12.15
REACHES												
OUTLET	24.58		36.29		45.89		58.63		68.33		77.83	

DAS

Long Ranch Vineyard
Napa River Side, post-project
Napa County, California

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	-Yr (in)
3.74	4.74	5.53	6.57	7.35	8.12	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type CA-1
Dimensionless Unit Hydrograph: <standard>

DAS

Long Ranch Vineyard
Napa River Side, post-project
Napa County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Napa							
SHEET	100	0.1000	0.170				0.088
SHALLOW	870	0.1440	0.050				0.039
SHALLOW	450	0.3000	0.050				0.014
CHANNEL	480	0.0520	0.040	2.00	3.00	6.349	0.021
CHANNEL	960	0.4190	0.055	3.00	4.00	14.815	0.018
					Time of Concentration		.18

DAS

Long Ranch Vineyard
Napa River Side, post-project
Napa County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Napa	Open space; grass cover 50% to 75%	(fair)	D	4.8	84
	Paved; open ditches (w/right-of-way)		D	1.5	93
	User defined urban (Click button or		D	27.2	81
	Brush - brush, weed, grass mix	(poor)	D	1.8	83
	Brush - brush, weed, grass mix	(fair)	D	45	77
	Woods	(good)	D	3.2	77
	Farmsteads		D	1.2	86
	Total Area / Weighted Curve Number			84.7	79

DAS

Long Ranch Vineyard
Napa River Side, post-project
Napa County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Napa	Tilled vineyard (Open space)	(fair)	D	4.8	84
	Paved; open ditches (w/right-of-way)		D	1.5	93
	Vineyard (Annual grass)	(good)	D	27.2	81
	Brush - brush, weed, grass mix	(poor)	D	1.8	83
	Brush - brush, weed, grass mix	(fair)	D	45	77
	Woods	(good)	D	3.2	77
	Farmsteads		D	1.2	86
	Total Area / Weighted Curve Number			84.7	79

DAS

Long Ranch Vineyard
Napa River Side, pre-project
Napa County, California

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	5-Yr (cfs) (hr)	10-Yr (cfs) (hr)	25-Yr (cfs) (hr)	50-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS						
Napa	24.58 12.16	36.29 12.15	45.89 12.16	58.63 12.16	68.33 12.16	77.83 12.15
REACHES						
OUTLET	24.58	36.29	45.89	58.63	68.33	77.83

DAS

Long Ranch Vineyard
Napa River Side, pre-project
Napa County, California

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	-Yr (in)
3.74	4.74	5.53	6.57	7.35	8.12	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type CA-1
Dimensionless Unit Hydrograph: <standard>

DAS

Long Ranch Vineyard
Napa River Side, pre-project
Napa County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Napa							
SHEET	100	0.1000	0.170				0.088
SHALLOW	870	0.1440	0.050				0.039
SHALLOW	450	0.3000	0.050				0.014
CHANNEL	480	0.0520	0.040	2.00	3.00	6.349	0.021
CHANNEL	960	0.4190	0.055	3.00	4.00	14.815	0.018
					Time of Concentration		.18

DAS

Long Ranch Vineyard
Napa River Side, pre-project
Napa County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Napa	Open space; grass cover 50% to 75%	(fair)	D	4.8	84
	Paved; open ditches (w/right-of-way)		D	1.5	93
	User defined urban (Click button or		D	17.3	81
	Brush - brush, weed, grass mix	(poor)	D	1.8	83
	Brush - brush, weed, grass mix	(fair)	D	53.4	77
	Woods	(good)	D	4.7	77
	Farmsteads		D	1.2	86
	Total Area / Weighted Curve Number			84.7	79

DAS

Long Ranch Vineyard
Napa River Side, pre-project
Napa County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Napa	Tilled vineyard (Open space)	(fair)	D	4.8	84
	Paved; open ditches (w/right-of-way)		D	1.5	93
	Vineyard (annual grass)	(good)	D	17.3	81
	Brush - brush, weed, grass mix	(poor)	D	1.8	83
	Brush - brush, weed, grass mix	(fair)	D	53.4	77
	Woods	(good)	D	4.7	77
	Farmsteads		D	1.2	86
	Total Area / Weighted Curve Number			84.7	79

DAS

Long Ranch Vineyard
Hennessey Side, post-project
Napa County, California

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period 2-Yr (cfs) (hr)	5-Yr (cfs) (hr)	10-Yr (cfs) (hr)	25-Yr (cfs) (hr)	50-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS						
Hennessey	11.00 12.20	16.83 12.20	21.63 12.20	28.15 12.20	33.09 12.19	37.98 12.19
REACHES						
OUTLET	11.00	16.83	21.63	28.15	33.09	37.98

DAS

Long Ranch Vineyard
Hennessey Side, post-project
Napa County, California

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	-Yr (in)
3.74	4.74	5.53	6.57	7.35	8.12	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type CA-1
Dimensionless Unit Hydrograph: <standard>

Long Ranch Vineyard
Hennessey Side, post-project
Napa County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Hennessey							
SHEET	100	0.1200	0.150				0.074
SHALLOW	620	0.1870	0.050				0.025
SHALLOW	2150	0.0580	0.050				0.154
CHANNEL	230	0.4340	0.055	2.50	4.00	12.778	0.005
					Time of Concentration		.258

DAS

Long Ranch Vineyard
Hennessey Side, post-project
Napa County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Hennessey	Paved; open ditches (w/right-of-way)		C	.25	92
	Paved; open ditches (w/right-of-way)		D	.05	93
	User defined urban (Click button or		C	16.8	75
	User defined urban (Click button or		D	9.6	81
	Brush - brush, weed, grass mix	(fair)	C	5.7	70
	Brush - brush, weed, grass mix	(fair)	D	2.5	77
	Woods	(good)	C	3	70
	Woods	(good)	D	7.9	77
	Farmsteads		D	.5	86
	Total Area / Weighted Curve Number			46.3	76

DAS

Long Ranch Vineyard
Hennessey Side, post-project
Napa County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Hennessey	Paved; open ditches (w/right-of-way)		C	.25	92
	Paved; open ditches (w/right-of-way)		D	.05	93
	Vineyard (Annual grass)	(good)	C	16.8	75
	Vineyard (Annual grass)	(good)	D	9.6	81
	Brush - brush, weed, grass mix	(fair)	C	5.7	70
	Brush - brush, weed, grass mix	(fair)	D	2.5	77
	Woods	(good)	C	3	70
	Woods	(good)	D	7.9	77
	Farmsteads		D	.5	86
	Total Area / Weighted Curve Number			46.3	76

DAS

Long Ranch Vineyard
Hennessey Side, pre-project
Napa County, California

Hydrograph Peak/Peak Time Table

Sub-Area or Reach Identifier	Peak Flow and Peak Time (hr) by Rainfall Return Period					
	2-Yr (cfs) (hr)	5-Yr (cfs) (hr)	10-Yr (cfs) (hr)	25-Yr (cfs) (hr)	50-Yr (cfs) (hr)	100-Yr (cfs) (hr)
SUBAREAS						
Hennessey	11.00 12.20	16.83 12.20	21.63 12.20	28.15 12.20	33.09 12.19	37.98 12.19
REACHES						
OUTLET	11.00	16.83	21.63	28.15	33.09	37.98

DAS

Long Ranch Vineyard
Hennessey Side, pre-project
Napa County, California

Storm Data

Rainfall Depth by Rainfall Return Period

2-Yr (in)	5-Yr (in)	10-Yr (in)	25-Yr (in)	50-Yr (in)	100-Yr (in)	-Yr (in)
3.74	4.74	5.53	6.57	7.35	8.12	.0

Storm Data Source: User-provided custom storm data
Rainfall Distribution Type: Type CA-1
Dimensionless Unit Hydrograph: <standard>

DAS

Long Ranch Vineyard
Hennessey Side, pre-project
Napa County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Hennessey							
SHEET	100	0.1200	0.150				0.074
SHALLOW	620	0.1870	0.050				0.025
SHALLOW	2150	0.0580	0.050				0.154
CHANNEL	230	0.4340	0.055	2.50	4.00	12.778	0.005
					Time of Concentration		.258

DAS

Long Ranch Vineyard
Hennessey Side, pre-project
Napa County, California

Sub-Area Time of Concentration Details

Sub-Area Identifier/	Flow Length (ft)	Slope (ft/ft)	Mannings's n	End Area (sq ft)	Wetted Perimeter (ft)	Velocity (ft/sec)	Travel Time (hr)
Hennessey							
SHEET	100	0.1200	0.150				0.074
SHALLOW	620	0.1870	0.050				0.025
SHALLOW	2150	0.0580	0.050				0.154
CHANNEL	230	0.4340	0.055	2.50	4.00	12.778	0.005
					Time of Concentration		.258

DAS

Long Ranch Vineyard
Hennessey Side, pre-project
Napa County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Hennessey	Paved; open ditches (w/right-of-way)		C	.25	92
	Paved; open ditches (w/right-of-way)		D	.05	93
	User defined urban (Click button or		C	15.2	75
	User defined urban (Click button or		D	5.2	81
	Brush - brush, weed, grass mix	(fair)	C	5.7	70
	Brush - brush, weed, grass mix	(fair)	D	4.5	77
	Woods	(good)	C	3	70
	Woods	(good)	D	8.1	77
	Farmsteads		D	.5	86
	Herbaceous	(fair)	C	1.8	81
	Herbaceous	(fair)	D	2	89
	Total Area / Weighted Curve Number			46.3	76

DAS

Long Ranch Vineyard
Hennessey Side, pre-project
Napa County, California

Sub-Area Land Use and Curve Number Details

Sub-Area Identifier	Land Use		Hydrologic Soil Group	Sub-Area Area (ac)	Curve Number
Hennessey	Paved; open ditches (w/right-of-way)		C	.25	92
	Paved; open ditches (w/right of way)		D	.05	93
	Vineyard (Annual grass)	(good)	C	15.2	75
	Vineyard (Annual grass)	(good)	D	5.2	81
	Brush - brush, weed, grass mix	(fair)	C	5.7	70
	Brush - brush, weed, grass mix	(fair)	D	4.5	77
	Woods	(good)	C	3	70
	Woods	(good)	D	8.1	77
	Farmsteads		D	.5	86
	Herbaceous	(fair)	C	1.8	81
	Herbaceous	(fair)	D	2	89
	Total Area / Weighted Curve Number			46.3	76

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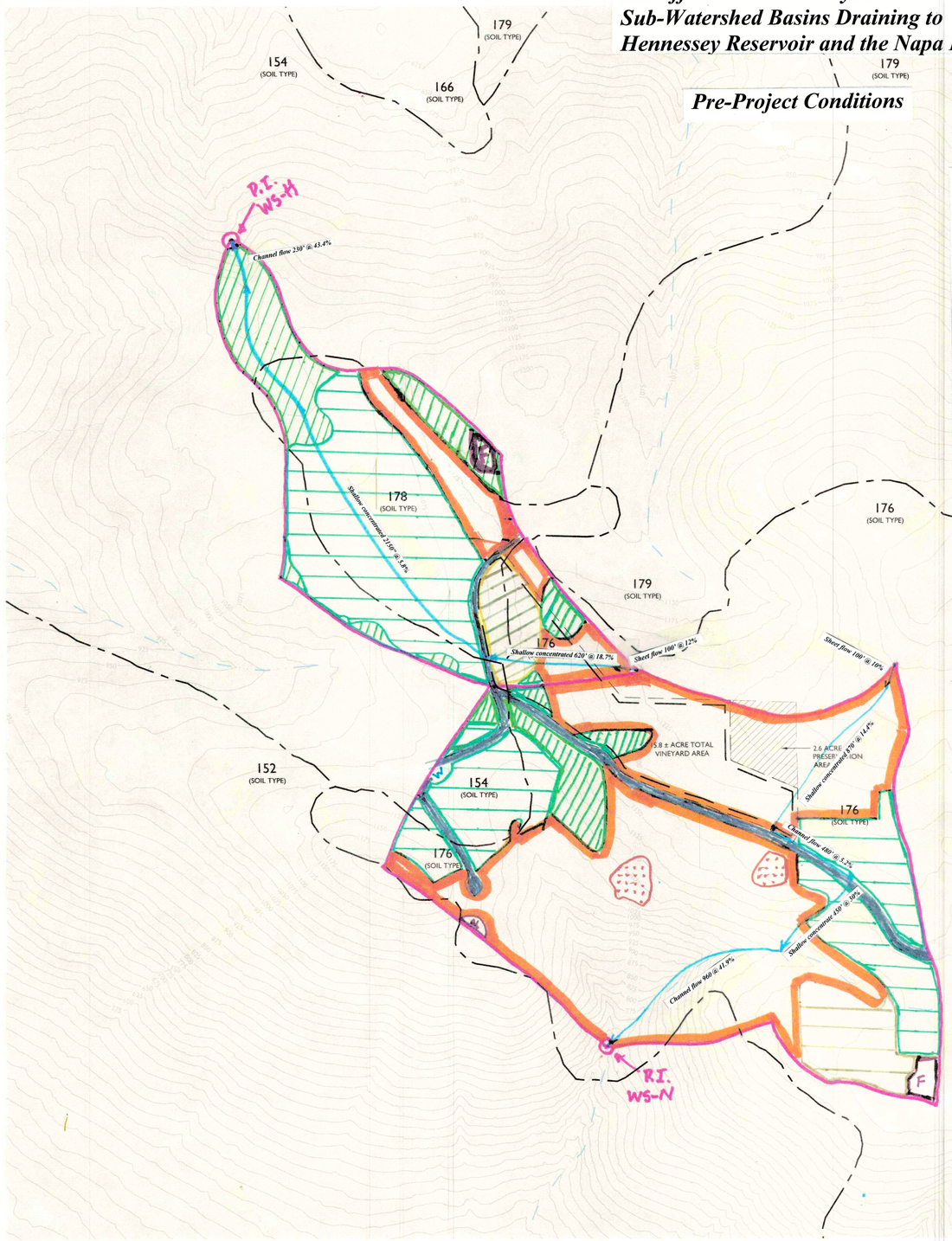
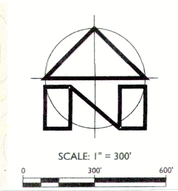
WAPPO LAND COMPANY LLC

Long Ranch Vineyard Proposal
Runoff/Peak Flow Analysis
Sub-Watershed Basins Draining to
Hennessey Reservoir and the Napa River

Pre-Project Conditions



WATERSHED EXHIBIT
SCALE: 1" = 300'



Legend:

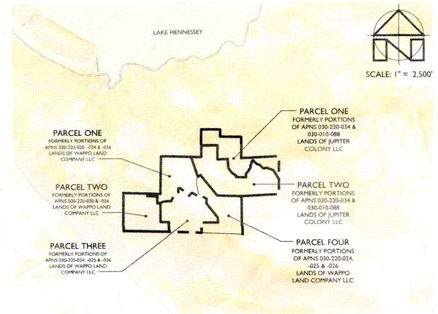
HSG, Land Use, Hydrologic Condition, Curve Number

C	Paved Roads	92
D	Paved Roads	93
D	Farmsteads	86
C	Brush, Weeds, Grass (Brush a major part) Fair Condition	70
D	Brush, Weeds, Grass (Brush a major part) Fair Condition	77
D	Brush, Weeds, Grass (Brush a major part) Poor Condition	83
C	Herbaceous (Brush not a major part) Fair Condition	81
D	Herbaceous (Brush not a major part) Fair Condition	89
C	Woods, Good Condition	70
D	Woods, Good Condition	77
C	Vineyard (Annual Grass) Good Condition	75
D	Vineyard (Annual Grass) Good Condition	81
D	Vineyard (Annual Grass) Fair Condition	84

Watershed Boundaries

Time of Concentration (Tc) Flowpaths

Outlets (Points of Interest) P.I. WS-N



LOCATION MAP
SCALE: 1" = 2,500'

PROJECT INFORMATION:

PROPERTY OWNER & APPLICANT:
WAPPO LAND COMPANY LLC
141 LONG RANCH ROAD
SAINT HELENA, CA 94574
SITE ADDRESS:
LONG RANCH ROAD
SAINT HELENA, CA 94574
ASSESSOR'S PARCEL NUMBER:
030-020-044
PARCEL SIZE:
41.8 ± ACRES
PROJECT SIZE:
16 ± ACRES (12.8 ± ACRES PLANTED)
ZONING:
AGRICULTURAL WATERSHED (AW)

NOTES:

1. FADED BACKGROUND REPRESENTS EXISTING TOPOGRAPHIC FEATURES. TOPOGRAPHIC INFORMATION WAS TAKEN FROM THE NAPA COUNTY GEOGRAPHIC INFORMATION SYSTEM DATABASE. APPLIED CIVIL ENGINEERING INCORPORATED ASSUMES NO LIABILITY REGARDING THE ACCURACY OR COMPLETENESS OF THE TOPOGRAPHIC INFORMATION.
2. AERIAL PHOTOGRAPHS WERE OBTAINED FROM THE SAN FRANCISCO ESTUARY INSTITUTE (SFEI) SAN FRANCISCO BAY AREA ORTHOPHOTOS DATABASE, DATED JUNE 2014 AND MAY NOT REPRESENT CURRENT CONDITIONS.
3. CONTOUR INTERVAL: FIVE (5) FEET, HIGHLIGHTED EVERY TWENTY FIVE (25) FEET.
4. BENCHMARK: NAVD 88
5. THE PROPERTY LINES SHOWN ON THESE PLANS DO NOT REPRESENT A BOUNDARY SURVEY. THEY ARE APPROXIMATE AND ARE PROVIDED FOR INFORMATIONAL PURPOSES ONLY.

SOIL TYPE LEGEND:

152	HAMBRIGHT ROCK-OUTCROP COMPLEX, 30 TO 75 PERCENT SLOPES
154	HENNEKE GRAVELLY LOAM, 30 TO 75 PERCENT SLOPES
166	MONTARA CLAY LOAM, 5 TO 30 PERCENT SLOPES
176	ROCK OUTCROP-HAMBRIGHT COMPLEX, 50 TO 75 PERCENT SLOPES
178	SOBRANTE LOAM, 5 TO 30 PERCENT SLOPES
179	SOBRANTE LOAM, 30 TO 50 PERCENT SLOPES
183	NO DESCRIPTION

SOIL TYPE BOUNDARIES SHOWN ON THIS MAP ARE BASED ON THE NAPA COUNTY GEOGRAPHIC INFORMATION SYSTEM DATA.

LEGEND:

- APPROXIMATE PROPERTY LINE
- WATERSHED BOUNDARY
- SOIL TYPE BOUNDARY
- BLUELINE STREAM
- VINEYARD BLOCK

CALL BEFORE YOU DIG 1-800-227-2600 USA UNDERGROUND SERVICE ALERT

APPLIED CIVIL ENGINEERING INCORPORATED
2074 West Lincoln Avenue
Napa, CA 94558
(707) 320-4968 (707) 320-2395 Fax
www.appliedcivil.com

WAPPO LAND COMPANY LLC
WATERSHED EXHIBIT

PREPARED UNDER THE DIRECTION OF:

REGISTERED PROFESSIONAL ENGINEER MICHAEL R. MUELRATH NO. 67435 Exp. 12/31/2018 CIVIL STATE OF CALIFORNIA
PRELIMINARY NOT FOR CONSTRUCTION

DRAWN BY: PowerCAD
CHECKED BY: MRM
DATE: AUGUST 2018
REVISIONS: BY:

JOB NUMBER: 08-152
FILE: 08-152EXH-WTRSHD.DWG
ORIGINAL SIZE: 24" X 36"
SHEET NUMBER: C1
OF 1

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WAPPO LAND COMPANY LLC

Long Ranch Vineyard Proposal
Runoff/Peak Flow Analysis
Sub-Watershed Basins Draining to
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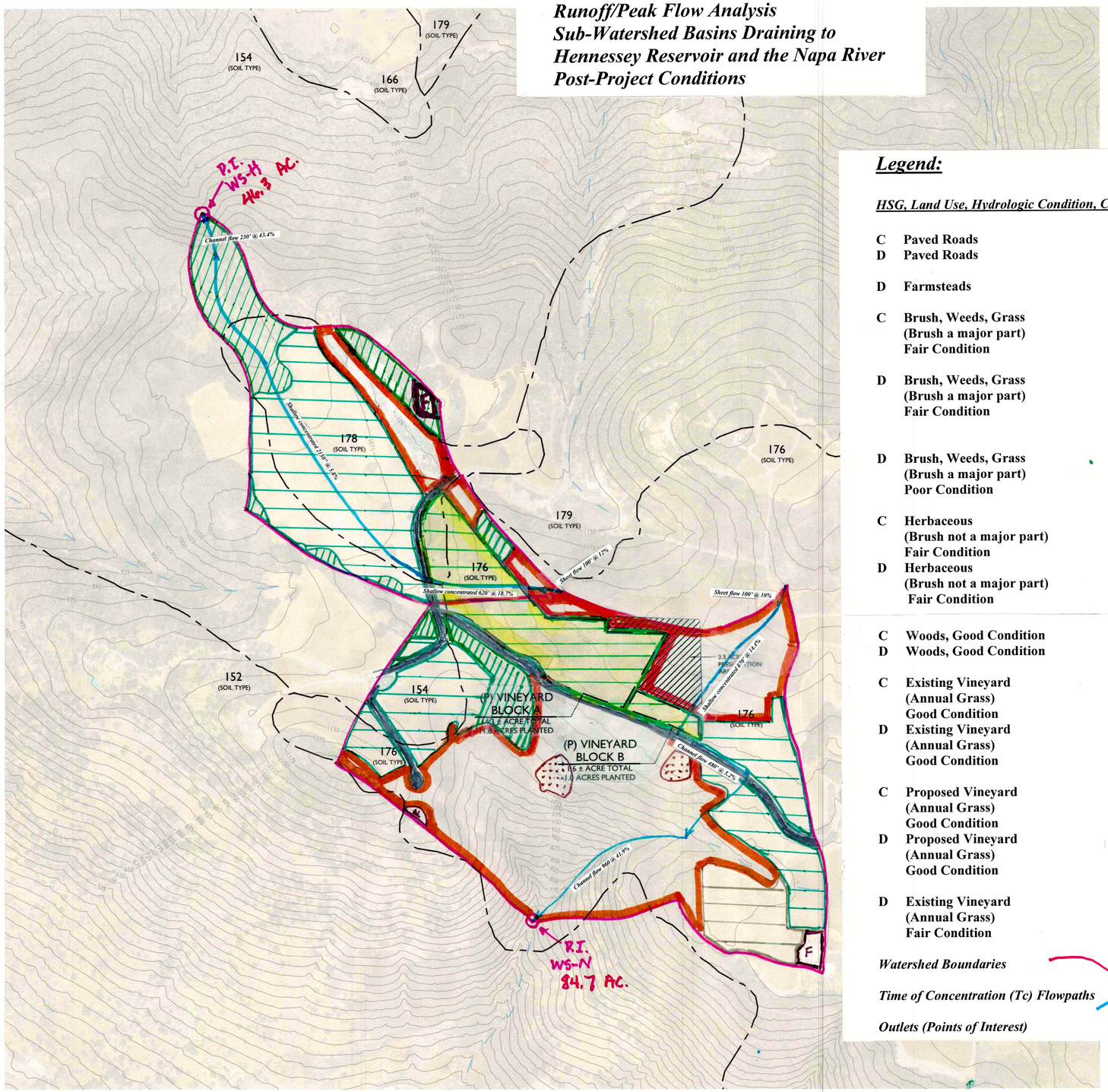

WATERSHED EXHIBIT
SCALE: 1" = 300'

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0 300' 600'

Legend:

HSG, Land Use, Hydrologic Condition, Curve Number

C	Paved Roads	92
D	Paved Roads	93
D	Farmsteads	86
C	Brush, Weeds, Grass (Brush a major part) Fair Condition	70
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C	Woods, Good Condition	70
D	Woods, Good Condition	77
C	Existing Vineyard (Annual Grass) Good Condition	75
D	Existing Vineyard (Annual Grass) Good Condition	81
C	Proposed Vineyard (Annual Grass) Good Condition	75
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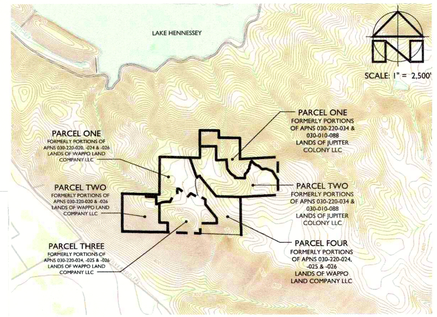
Watershed Boundaries

Time of Concentration (Tc) Flowpaths

Outlets (Points of Interest) P.I. WS-N



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LEGEND:

- APPROXIMATE PROPERTY LINE
- WATERSHED BOUNDARY
- SOIL TYPE BOUNDARY
- BLUELINE STREAM
- VINEYARD BLOCK

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2074 West Lincoln Avenue
Napa, CA 94558
(707) 320-4968 (707) 320-2395 Fax
www.appliedcivil.com

WAPPO LAND COMPANY LLC
WATERSHED EXHIBIT

PREPARED UNDER THE DIRECTION OF:
REGISTERED PROFESSIONAL ENGINEER MICHAEL R. MOELLER NO. 67435 Exp. 12/31/2018 CIVIL STATE OF CALIFORNIA
PRELIMINARY NOT FOR CONSTRUCTION

DRAWN BY: PowerCAD
CHECKED BY: MRM
DATE: AUGUST 2018
REVISIONS: BY:

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FILE: 08-152EXH-WTRSHD.DWG
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OF 1