PPI ENGINEERING
VINEYARD DESIGN
EROSION CONTROL
WATER DEVELOPMENT
DRAINAGE
PERMITTING
GPS/GIS

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Napa, California 94558
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MEMORANDUM

Date: October 13, 2021

To: Patrick Ryan, Napa County Planning, Building, and Environmental Services

From: Matthew S. Bueno, P.E.
Rachel L. Rosasco, E.I.T.

Cc: John McDowell, Napa County Planning, Building, and Environmental Services

Re: Red Boat Vineyard Track I ECP
APN 039-380-037
Hydrologic Analysis

This memo transmits the findings of a hydrologic analysis for the above-referenced Track I Erosion Control Plan (ECP). HydroCAD software was used to estimate pre- and post-project runoff from watersheds containing the proposed development areas. The software uses the Natural Resource Conservation Service (NRCS) TR-20 method to calculate runoff. The analysis uses the Type IA 24-hr storm distribution and includes site-specific National Oceanic and Atmospheric Administration (NOAA) point precipitation data for the ranch.

Two (2) watersheds were delineated for the hydrologic modeling using 2-foot contours from American Aerial, Inc. and 5-foot contours from Napa County LIDAR data. Watershed 1 encompasses approximately 25.3 acres and drains into a swale which eventually flows into a neighboring reservoir. Watershed 2 is located to the east of Watershed 1 and contains approximately 14.9 acres which drain directly into Soda Creek. Please see the attached figures for the location of each watershed.

Soils within the watersheds were obtained from the NRCS Web Soil Survey and are classified as the following:

Cortina Very Gravelly Loam, 0-5% Slopes (Map Unit Symbol 124)
Hambright-Rock Outcrop, 2-30% Slopes (Map Unit Symbol 151)
Hambright Rock-Outcrop, 30-75% Slopes (Map Unit Symbol 152)
Sobrante Loam, 30-50% Slopes (Map Unit Symbol 179)

Cortina Very Gravelly Loam (124) is classified as Hydrologic Soil Group (HSG) A. Sobrante Loam (179) is classified as HSG C. The Hambright-Rock Outcrop (151) and Hambright Rock-Outcrop (152) soils are both classified as HSG D. Please see the attached figures for soil type delineations within the vicinity of each watershed.

Land use areas were initially delineated based on Napa County orthophotos. A site visit was then conducted on June 8, 2021 by Matt Bueno and Rachel Rosasco of PPI Engineering to ground truth the orthophotos and determine the existing land use conditions. The land use hydrologic conditions were classified based on the respective covers as poor (less than 50% cover), fair (50%-75% cover), or good (greater than or equal to 75% cover). The HydroCAD software analyzes the land use data along with the corresponding soil HSGs to determine a weighted Curve Number (CN) for runoff calculations. The grassed areas have been historically managed with grazing. Consequently, the pre-project condition of the grassed areas that are proposed to be converted to vineyard were classified as Annual Grass in Fair condition. The land use classification of Annual Grass is based upon the NRCS Engineering Field Manual Chapter 2, Supplement 1 definition. The post-project condition within the proposed vineyard will be classified as good (based on the proposed cover in the ECP). Please see the attached figures for existing and proposed land use delineations.

The Time of Concentration (Tc) flow path within each watershed was determined using American Aerial, Inc. and Napa County contours. The flow path in each watershed was drafted from the hydrologically most distant point (longest travel time) in the watershed, which still flows through the project area, to the watershed outlet per NRCS standards. For both watersheds the Tc did not change from pre- to post-project conditions. The proposed project will not change any of the existing drainage patterns and does not include any surface water conveyance infrastructure. Please see the attached figures for both the pre- and post-project Tc flow paths by watershed.

Pre- and post-project runoff calculations from the HydroCAD models for each individual watershed are summarized in Table 1 below. Runoff was calculated for the 2-, 10-, 50- and 100-year storms respectively for each watershed and for the modeled outlets.

Table 1. Individual Watershed Summary

	Runoff (cfs)					
	Watershed 1			Watershed 2		
	Pre-Project	Post-Project	Increase/Decrease	Pre-Project	Post-Project	Increase/Decrease
2-Year Storm	7.31	7.31	0.00	5.43	5.09	0.34
10-Year Storm	16.53	16.53	0.00	11.32	10.88	0.44
50-Year Storm	26.77	26.77	0.00	17.63	17.15	0.48
100-Year Storm	31.24	31.24	0.00	20.35	19.85	0.50

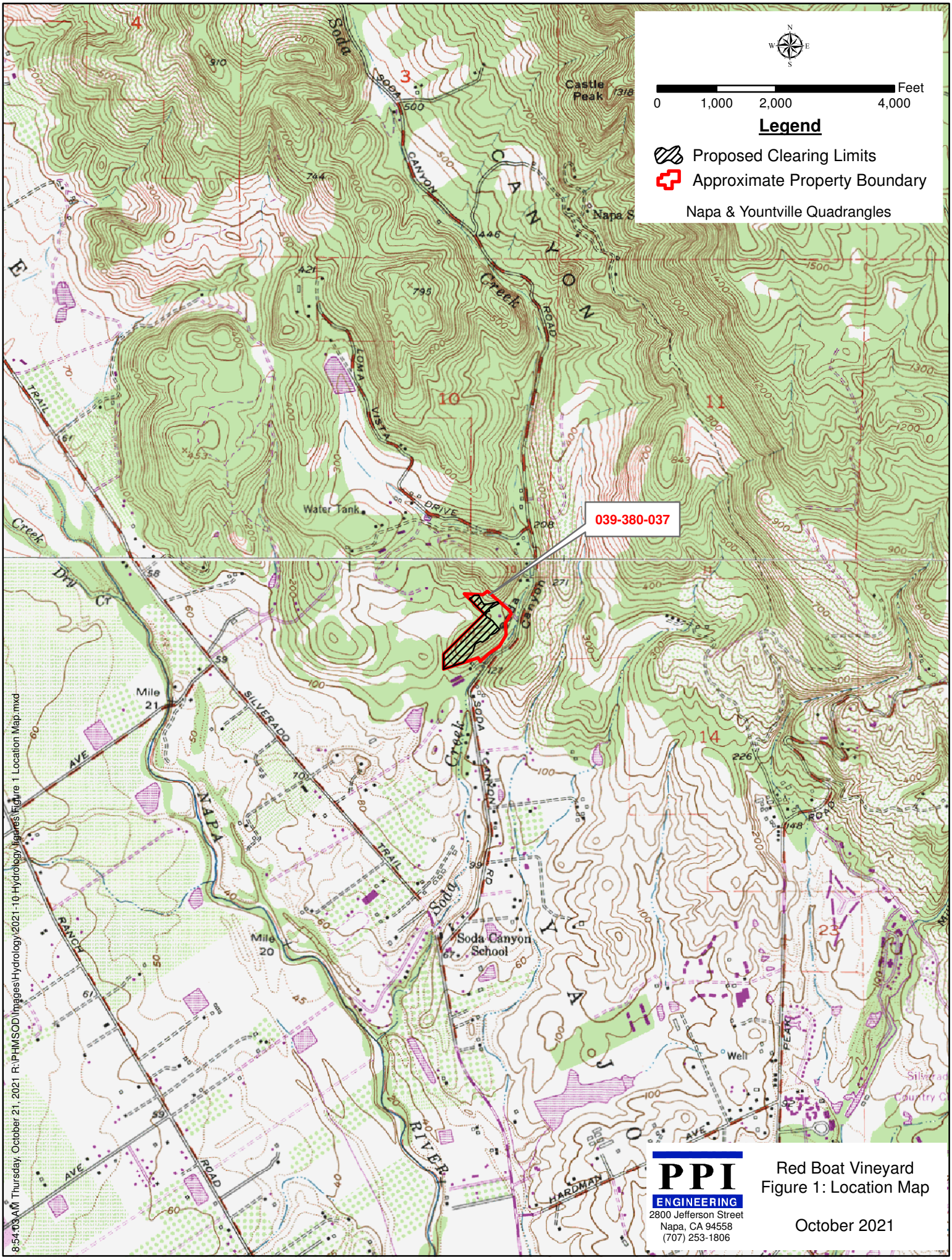
Estimated runoff from Watershed 1 did not change from pre- to post-project and Watershed 2 saw a decrease post-project as a result of the decrease in curve number from pre- to post-project.

Please see the attached HydroCAD analyses for inputs, details, and summaries of the hydrologic modeling. Based on our analysis, there are no predicted net runoff increases, and no negative hydrologic impacts are expected as a result of this project. The project as proposed is in compliance with Napa County's General Plan policy requiring no-net-increase in runoff.



ATTACHMENT A

SUPPORTING FIGURES



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Red Boat Vineyard
Figure 1: Location Map

October 2021

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Red Boat Vineyard
Figure 2: Property Boundary & Waters

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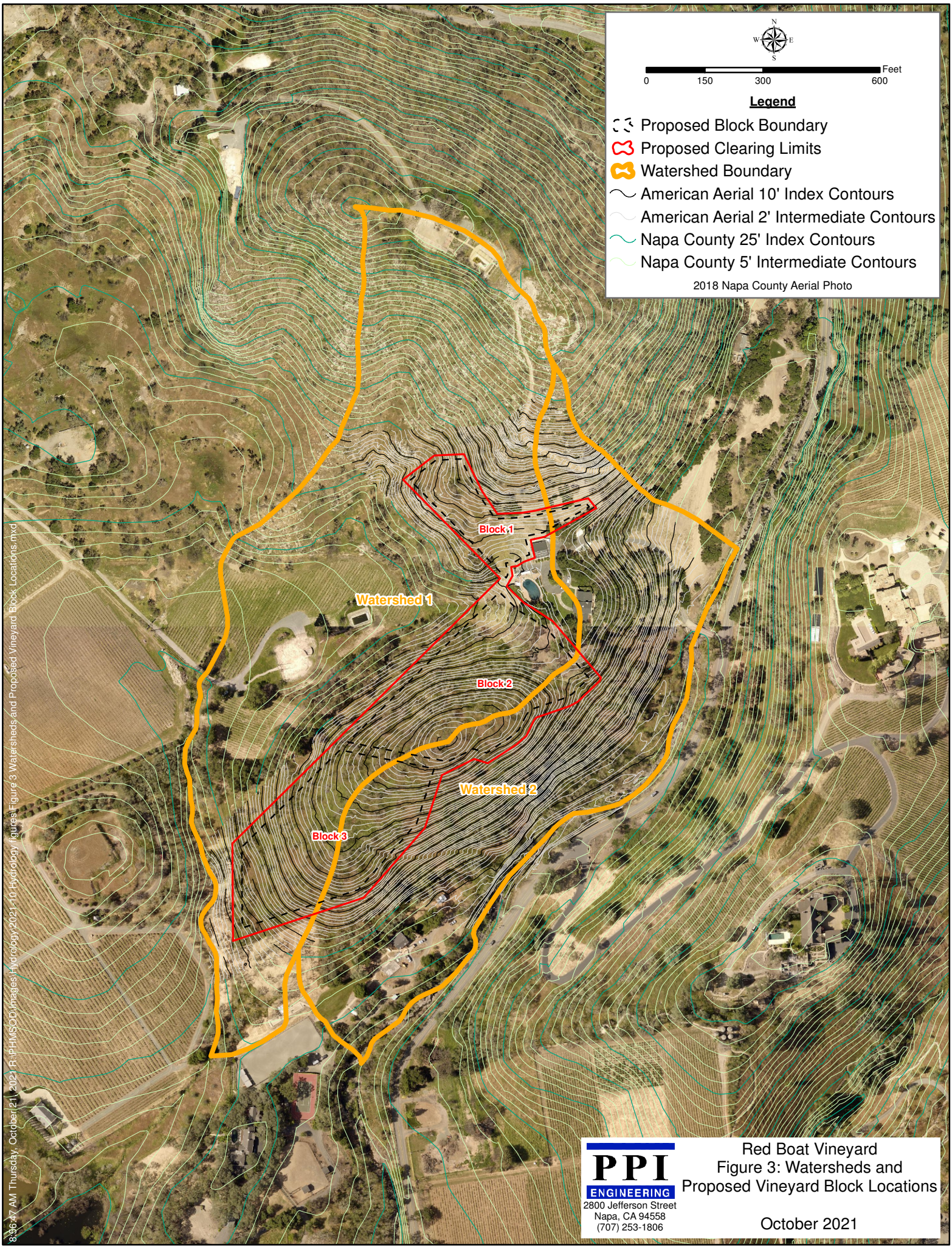
N
W
E
S
0
150
300
600
Feet
Legend
Proposed Block Boundary
Proposed Clearing Limits
Watershed Boundary
American Aerial 10' Index Contours
American Aerial 2' Intermediate Contours
Napa County 25' Index Contours
Napa County 5' Intermediate Contours
2018 Napa County Aerial Photo
Block 1
Block 2
Block 3
Watershed 1
Watershed 2
8:36:47 AM Thursday, October 21, 2021 R:\PHMSOD\Images\Hydrology\2021_10 Hydrology Figures\Figure 3 Watersheds and Proposed Vineyard Block Locations.mxd
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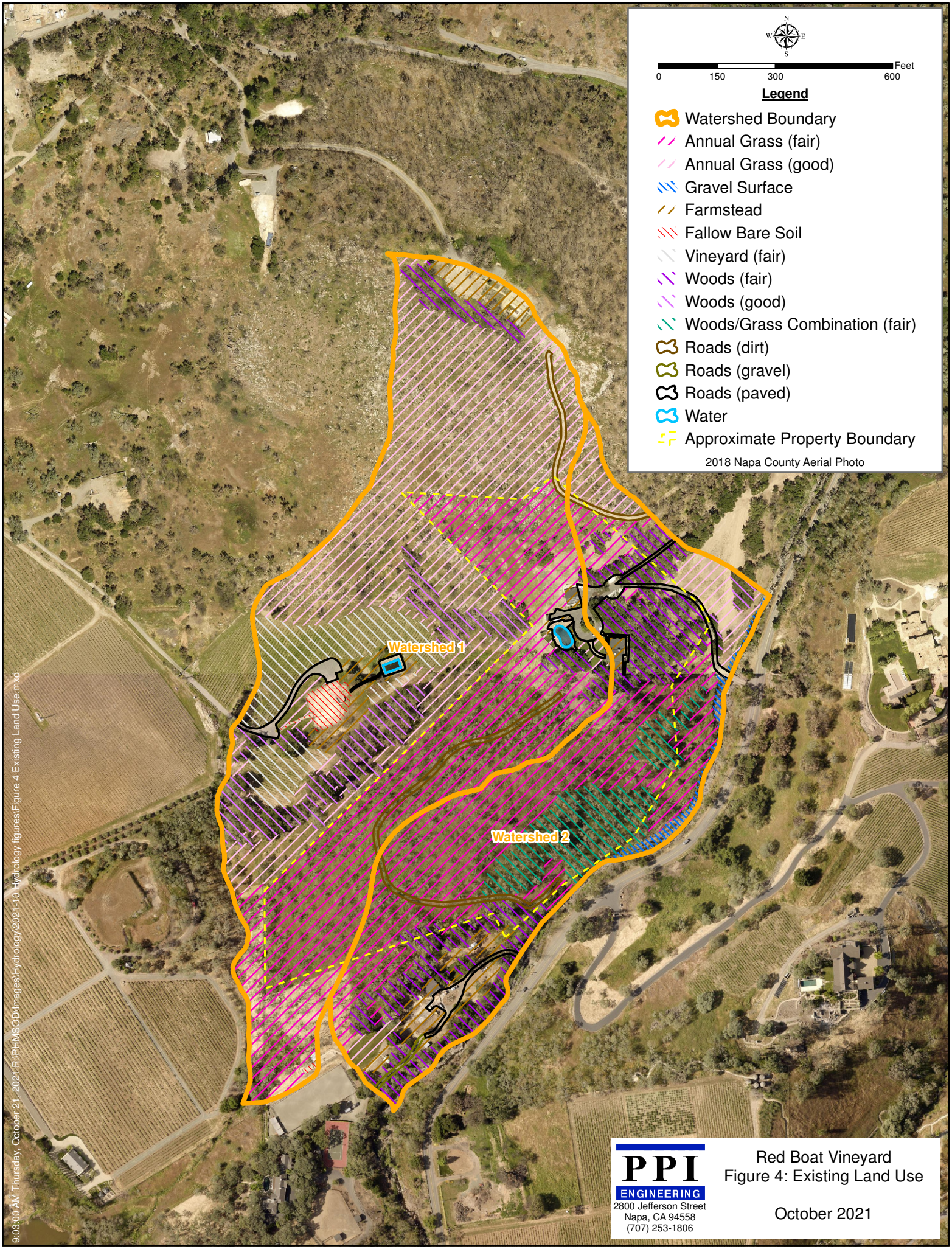
Red Boat Vineyard
Figure 3: Watersheds and
Proposed Vineyard Block Locations
October 2021



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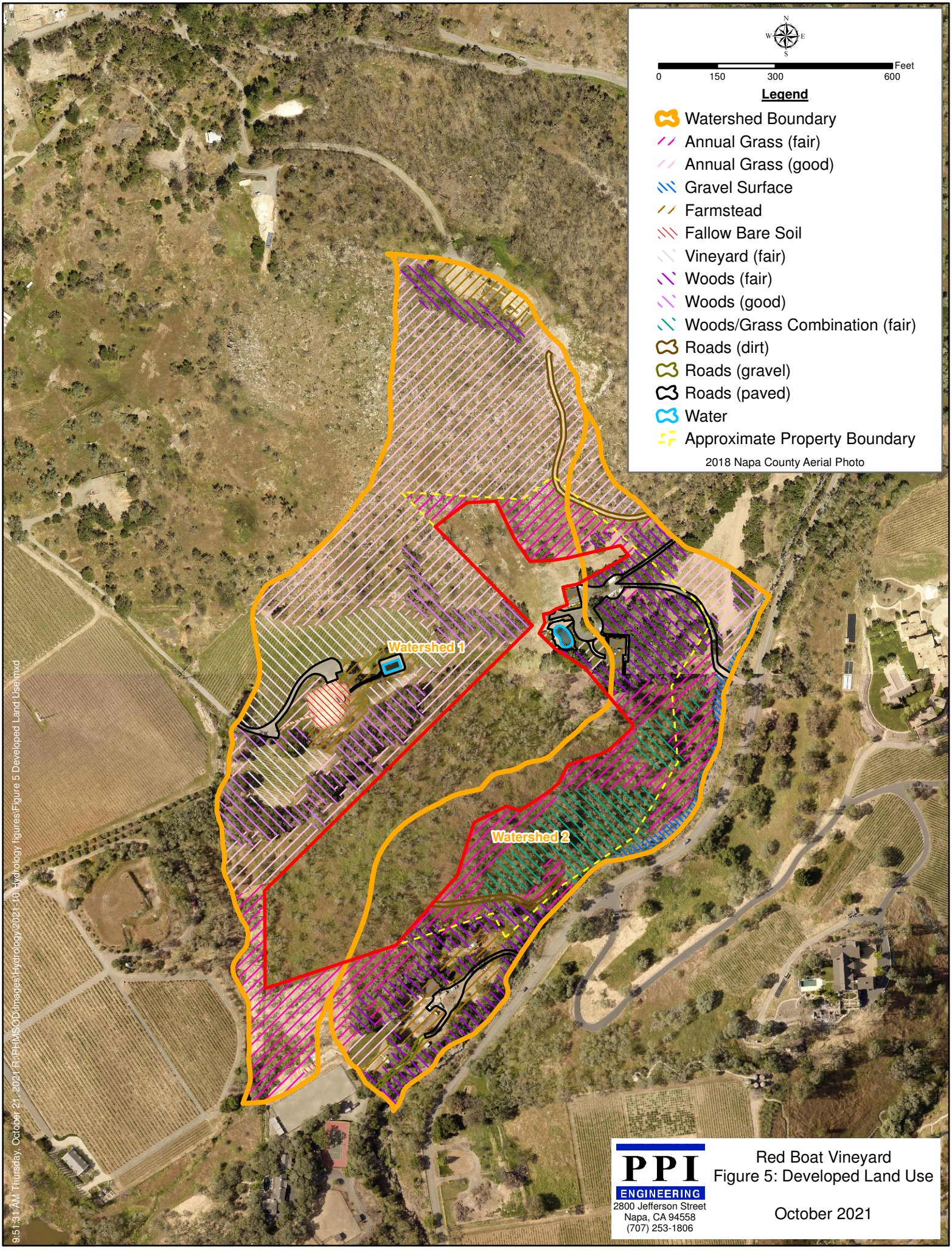
Red Boat Vineyard
Figure 4: Existing Land Use

October 2021


N
W
E
S
0
150
300
600
Feet
Legend
Watershed Boundary
Annual Grass (fair)
Annual Grass (good)
Gravel Surface
Farmstead
Fallow Bare Soil
Vineyard (fair)
Woods (fair)
Woods (good)
Woods/Grass Combination (fair)
Roads (dirt)
Roads (gravel)
Roads (paved)
Water
Approximate Property Boundary
2018 Napa County Aerial Photo
Watershed 1
Watershed 2
9:51:31 AM Thursday, October 21, 2021 P:\PHMSOD\Images\Hydrology\2021-10_Hydrology figures\Figure 5 Developed Land Use.mxd
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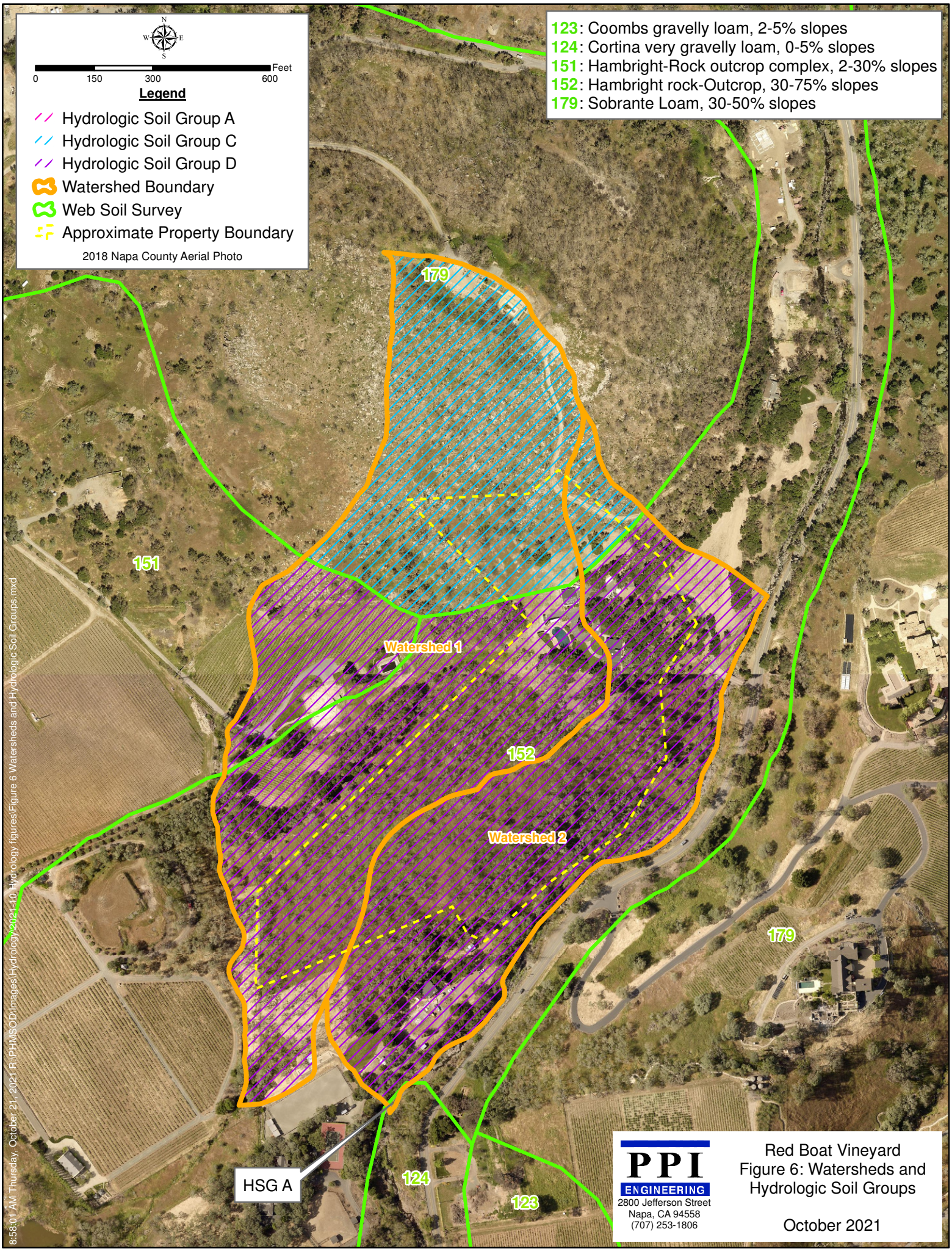
Red Boat Vineyard
Figure 5: Developed Land Use
October 2021



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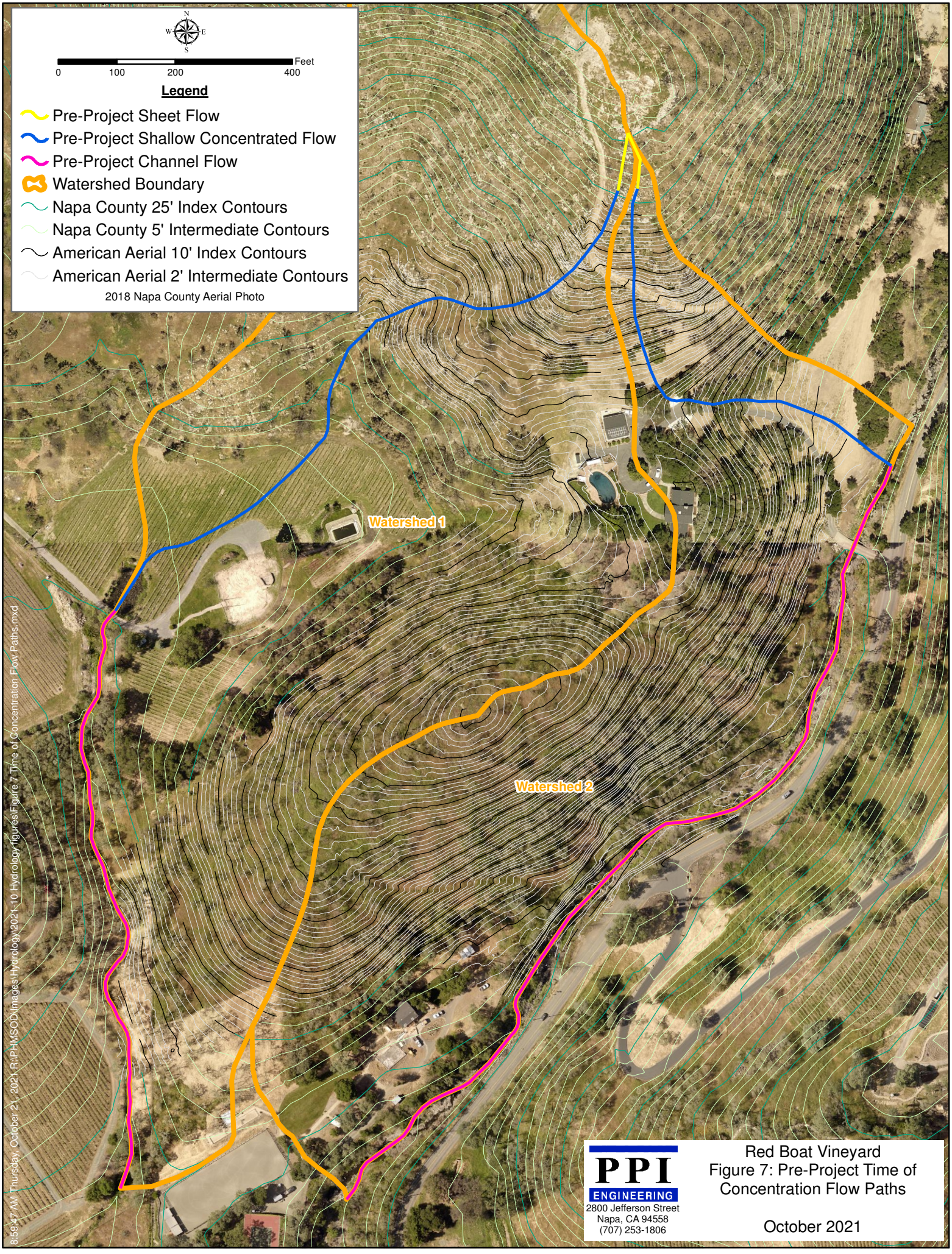
Red Boat Vineyard
Figure 6: Watersheds and Hydrologic Soil Groups

October 2021



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Red Boat Vineyard
Figure 7: Pre-Project Time of Concentration Flow Paths

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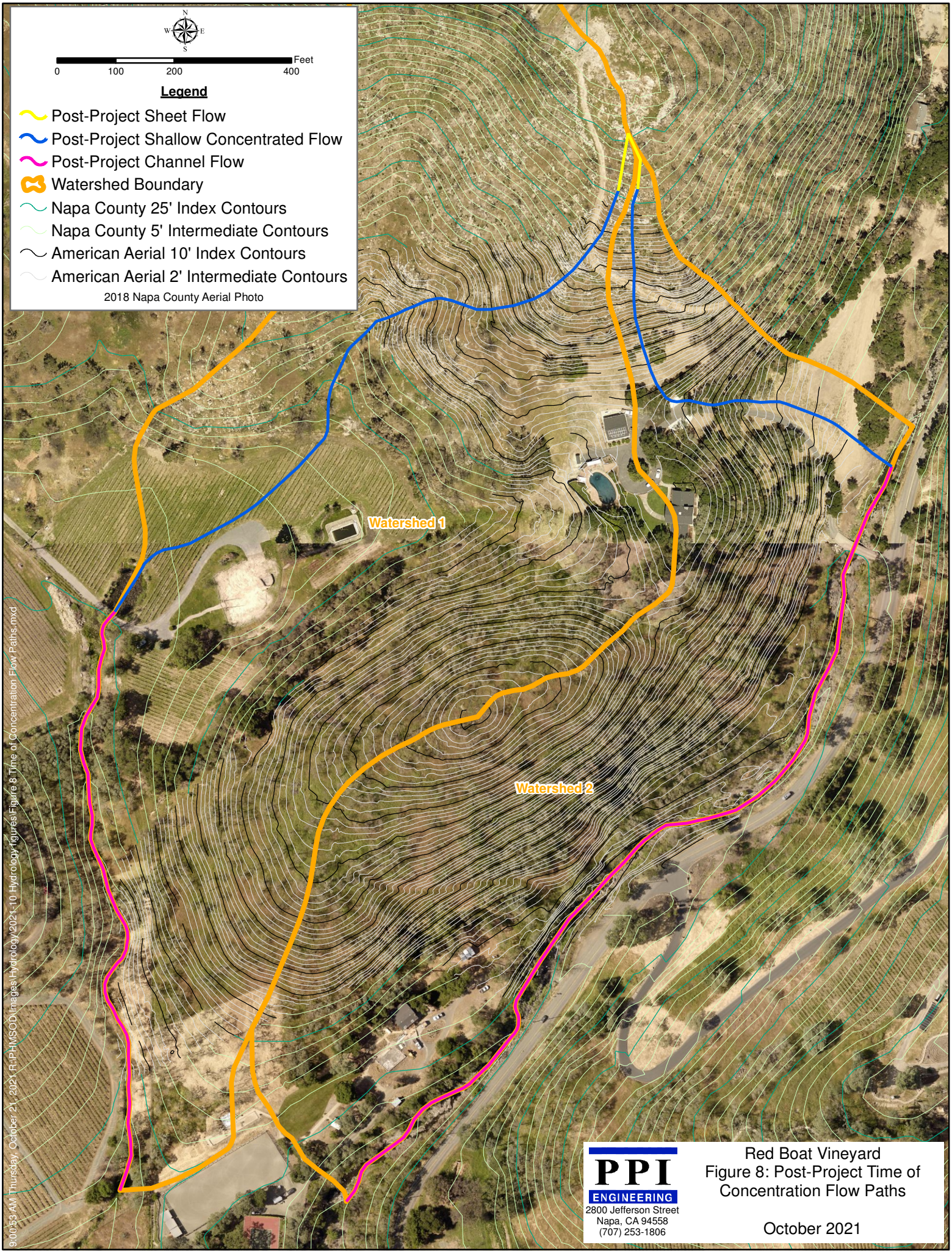

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Red Boat Vineyard
Figure 8: Post-Project Time of Concentration Flow Paths

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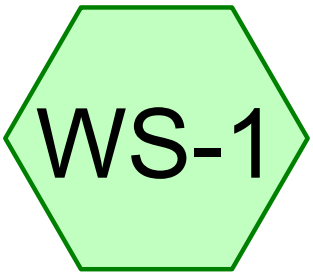
ATTACHMENT B

HYDROCAD ANALYSES



Subcat WS-1



Subcat WS-2

Subcat Reach Pond Link

Routing Diagram for Red Boat Vineyard Pre-Project
Prepared by PPI Engineering, Printed 10/13/2021
HydroCAD® 10.10-6a s/n 09429 © 2020 HydroCAD Software Solutions LLC

Summary for Subcatchment WS-1: Subcat WS-1

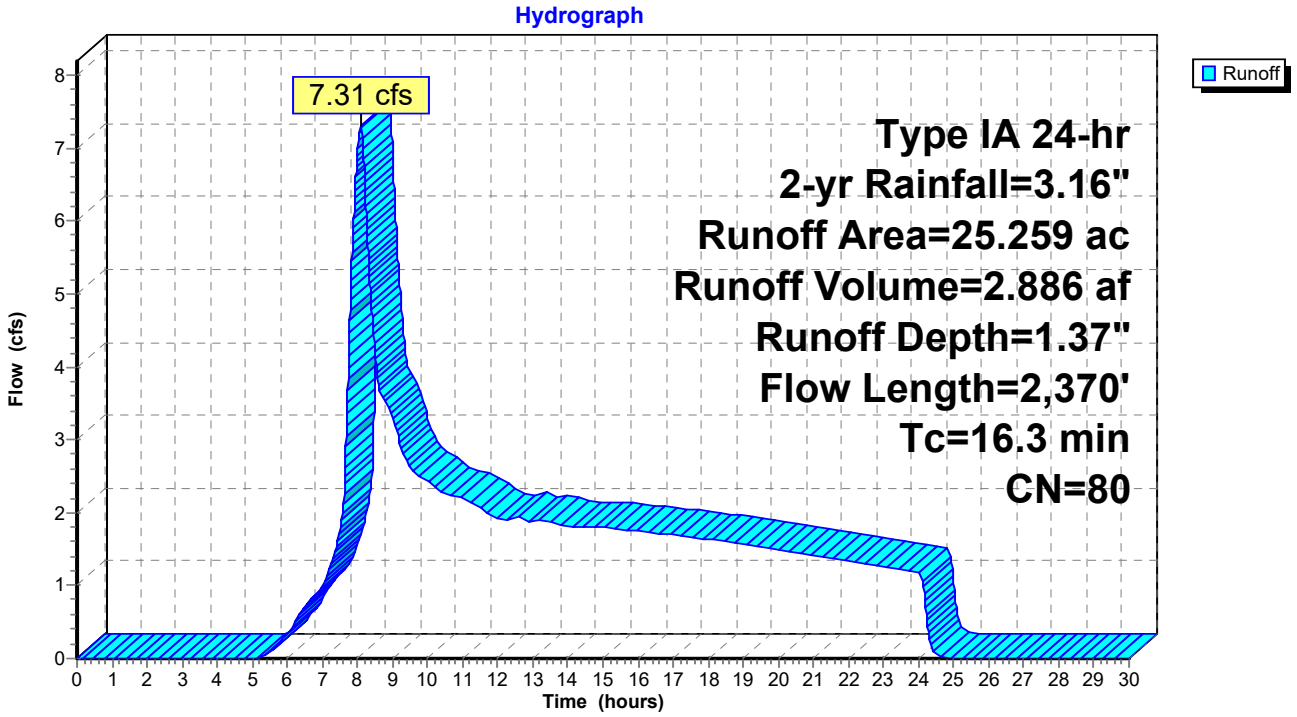
Runoff = 7.31 cfs @ 8.09 hrs, Volume= 2.886 af, Depth= 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-yr Rainfall=3.16"

Area (ac)	CN	Description
1.839	79	Annual Grass, Fair, HSG C
6.795	84	Annual Grass, Fair, HSG D
6.595	75	Annual Grass, Good, HSG C
2.839	81	Annual Grass, Good, HSG D
0.108	87	Dirt roads, HSG C
0.184	89	Dirt roads, HSG D
0.274	94	Fallow, bare soil, HSG D
0.472	82	Farmsteads, HSG C
0.671	86	Farmsteads, HSG D
0.388	93	Paved roads w/open ditches, 50% imp, HSG D
2.112	84	Vineyard, Fair, HSG D
0.056	98	Water Surface, HSG D
0.459	73	Woods, Fair, HSG C
0.261	79	Woods, Fair, HSG D
0.241	70	Woods, Good, HSG C
1.966	77	Woods, Good, HSG D
25.259	80	Weighted Average
25.009		99.01% Pervious Area
0.250		0.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	100	0.2500	0.32		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.16"
7.8	1,227	0.1400	2.62		**Shallow Concentrated Flow, Shallow** Short Grass Pasture Kv= 7.0 fps
3.3	1,043	0.0300	5.34	21.34	**Trap/Vee/Rect Channel Flow, Stream (assumed)** Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.035 Earth, dense weeds
16.3	2,370	Total			

Subcatchment WS-1: Subcat WS-1



Summary for Subcatchment WS-2: Subcat WS-2

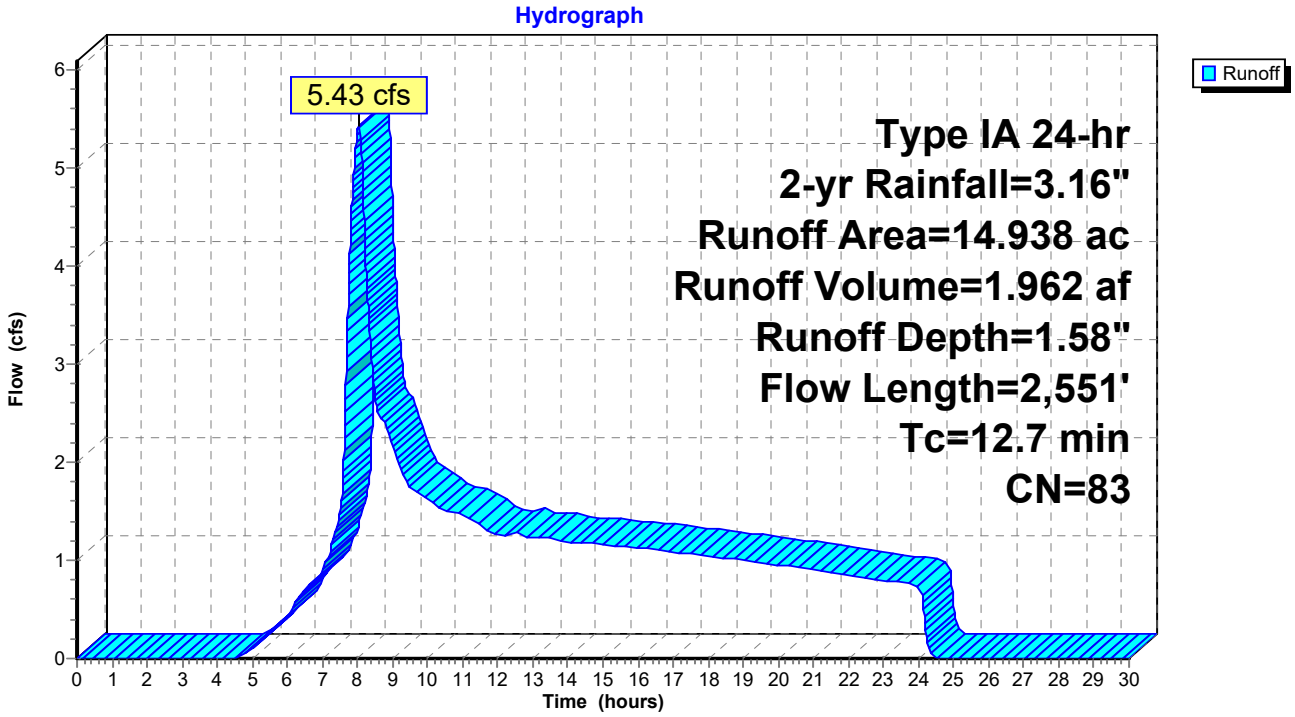
Runoff = 5.43 cfs @ 8.05 hrs, Volume= 1.962 af, Depth= 1.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-yr Rainfall=3.16"

Area (ac)	CN	Description
0.300	79	Annual Grass, Fair, HSG C
5.690	84	Annual Grass, Fair, HSG D
0.480	75	Annual Grass, Good, HSG C
0.798	81	Annual Grass, Good, HSG D
0.057	87	Dirt roads, HSG C
0.161	89	Dirt roads, HSG D
0.894	86	Farmsteads, HSG D
0.044	91	Gravel Roads, HSG D
0.372	96	Gravel surface, HSG D
0.492	93	Paved roads w/open ditches, 50% imp, HSG D
0.019	36	Woods, Fair, HSG A
0.074	73	Woods, Fair, HSG C
3.419	79	Woods, Fair, HSG D
0.145	77	Woods, Good, HSG D
1.991	82	Woods/grass comb., Fair, HSG D
14.938	83	Weighted Average
14.691		98.35% Pervious Area
0.246		1.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.2300	0.31		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.16"
4.0	789	0.2200	3.28		**Shallow Concentrated Flow, Shallow** Short Grass Pasture Kv= 7.0 fps
3.3	1,662	0.0300	8.35	233.77	**Trap/Vee/Rect Channel Flow, Soda Creek (assumed)** Bot.W=10.00' D=2.00' Z= 2.0 '/' Top.W=18.00' n= 0.040 Winding stream, pools & shoals
12.7	2,551	Total			

Subcatchment WS-2: Subcat WS-2



Summary for Subcatchment WS-1: Subcat WS-1

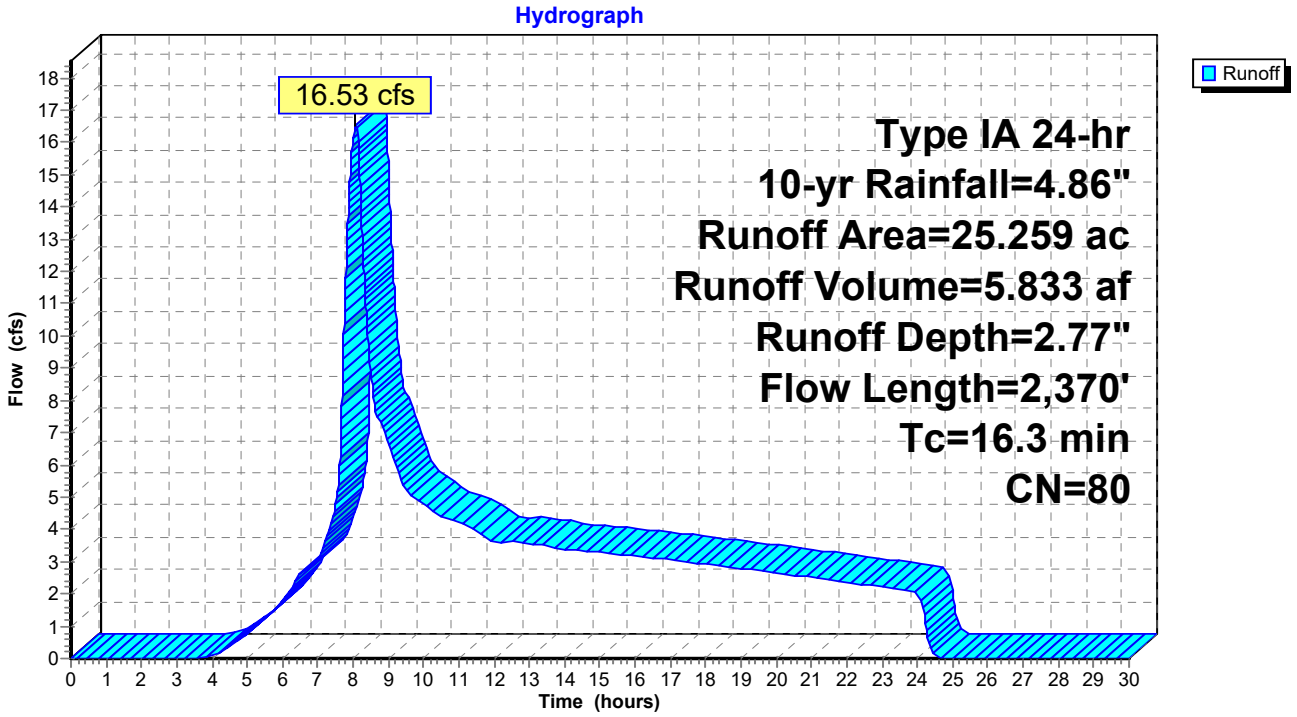
Runoff = 16.53 cfs @ 8.07 hrs, Volume= 5.833 af, Depth= 2.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-yr Rainfall=4.86"

Area (ac)	CN	Description
1.839	79	Annual Grass, Fair, HSG C
6.795	84	Annual Grass, Fair, HSG D
6.595	75	Annual Grass, Good, HSG C
2.839	81	Annual Grass, Good, HSG D
0.108	87	Dirt roads, HSG C
0.184	89	Dirt roads, HSG D
0.274	94	Fallow, bare soil, HSG D
0.472	82	Farmsteads, HSG C
0.671	86	Farmsteads, HSG D
0.388	93	Paved roads w/open ditches, 50% imp, HSG D
2.112	84	Vineyard, Fair, HSG D
0.056	98	Water Surface, HSG D
0.459	73	Woods, Fair, HSG C
0.261	79	Woods, Fair, HSG D
0.241	70	Woods, Good, HSG C
1.966	77	Woods, Good, HSG D
25.259	80	Weighted Average
25.009		99.01% Pervious Area
0.250		0.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	100	0.2500	0.32		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.16"
7.8	1,227	0.1400	2.62		**Shallow Concentrated Flow, Shallow** Short Grass Pasture Kv= 7.0 fps
3.3	1,043	0.0300	5.34	21.34	**Trap/Vee/Rect Channel Flow, Stream (assumed)** Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.035 Earth, dense weeds
16.3	2,370	Total			

Subcatchment WS-1: Subcat WS-1



Summary for Subcatchment WS-2: Subcat WS-2

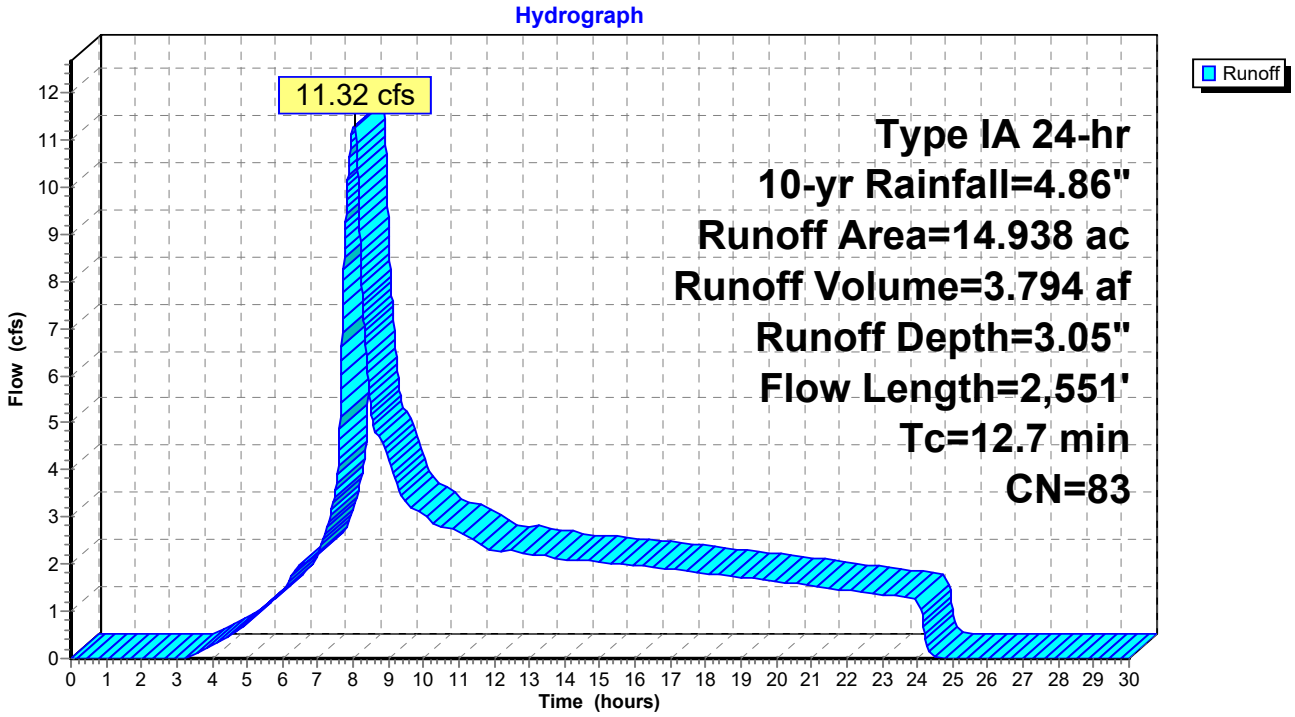
Runoff = 11.32 cfs @ 8.03 hrs, Volume= 3.794 af, Depth= 3.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-yr Rainfall=4.86"

Area (ac)	CN	Description
0.300	79	Annual Grass, Fair, HSG C
5.690	84	Annual Grass, Fair, HSG D
0.480	75	Annual Grass, Good, HSG C
0.798	81	Annual Grass, Good, HSG D
0.057	87	Dirt roads, HSG C
0.161	89	Dirt roads, HSG D
0.894	86	Farmsteads, HSG D
0.044	91	Gravel Roads, HSG D
0.372	96	Gravel surface, HSG D
0.492	93	Paved roads w/open ditches, 50% imp, HSG D
0.019	36	Woods, Fair, HSG A
0.074	73	Woods, Fair, HSG C
3.419	79	Woods, Fair, HSG D
0.145	77	Woods, Good, HSG D
1.991	82	Woods/grass comb., Fair, HSG D
14.938	83	Weighted Average
14.691		98.35% Pervious Area
0.246		1.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.2300	0.31		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.16"
4.0	789	0.2200	3.28		**Shallow Concentrated Flow, Shallow** Short Grass Pasture Kv= 7.0 fps
3.3	1,662	0.0300	8.35	233.77	**Trap/Vee/Rect Channel Flow, Soda Creek (assumed)** Bot.W=10.00' D=2.00' Z= 2.0 '/' Top.W=18.00' n= 0.040 Winding stream, pools & shoals
12.7	2,551	Total			

Subcatchment WS-2: Subcat WS-2



Summary for Subcatchment WS-1: Subcat WS-1

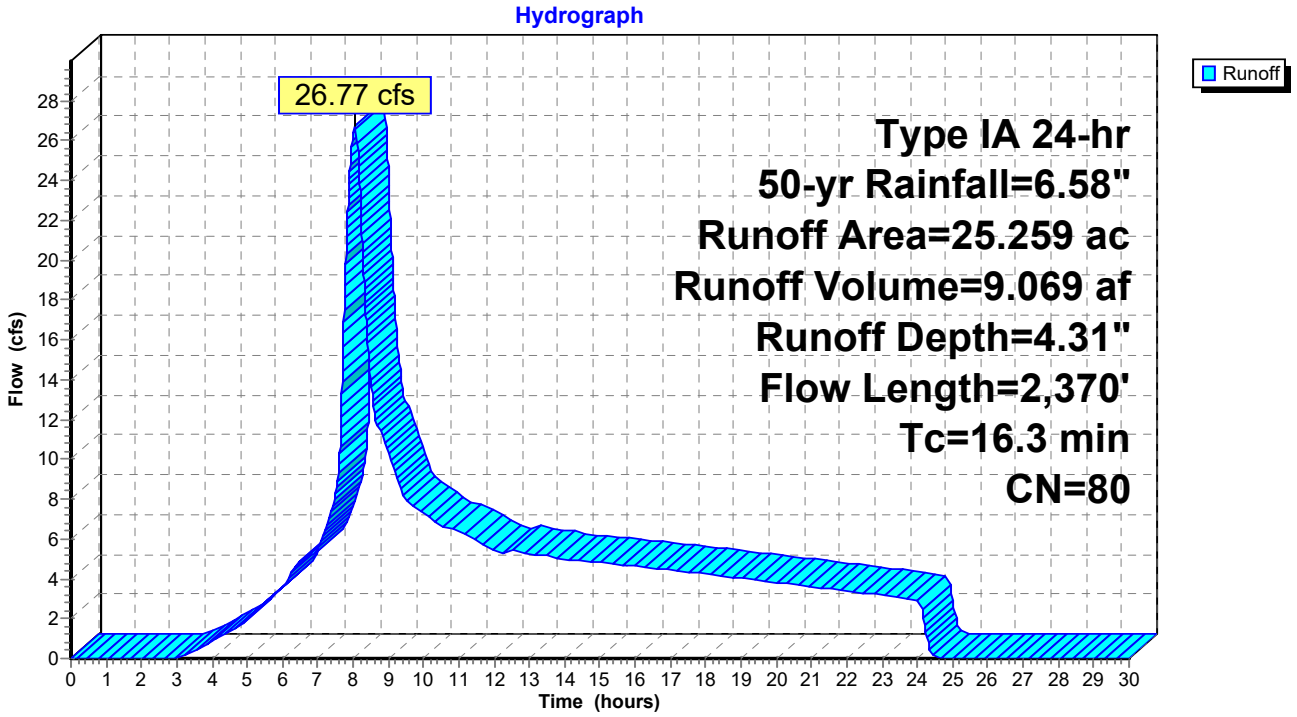
Runoff = 26.77 cfs @ 8.06 hrs, Volume= 9.069 af, Depth= 4.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 50-yr Rainfall=6.58"

Area (ac)	CN	Description
1.839	79	Annual Grass, Fair, HSG C
6.795	84	Annual Grass, Fair, HSG D
6.595	75	Annual Grass, Good, HSG C
2.839	81	Annual Grass, Good, HSG D
0.108	87	Dirt roads, HSG C
0.184	89	Dirt roads, HSG D
0.274	94	Fallow, bare soil, HSG D
0.472	82	Farmsteads, HSG C
0.671	86	Farmsteads, HSG D
0.388	93	Paved roads w/open ditches, 50% imp, HSG D
2.112	84	Vineyard, Fair, HSG D
0.056	98	Water Surface, HSG D
0.459	73	Woods, Fair, HSG C
0.261	79	Woods, Fair, HSG D
0.241	70	Woods, Good, HSG C
1.966	77	Woods, Good, HSG D
25.259	80	Weighted Average
25.009		99.01% Pervious Area
0.250		0.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	100	0.2500	0.32		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.16"
7.8	1,227	0.1400	2.62		**Shallow Concentrated Flow, Shallow** Short Grass Pasture Kv= 7.0 fps
3.3	1,043	0.0300	5.34	21.34	**Trap/Vee/Rect Channel Flow, Stream (assumed)** Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.035 Earth, dense weeds
16.3	2,370	Total			

Subcatchment WS-1: Subcat WS-1



Summary for Subcatchment WS-2: Subcat WS-2

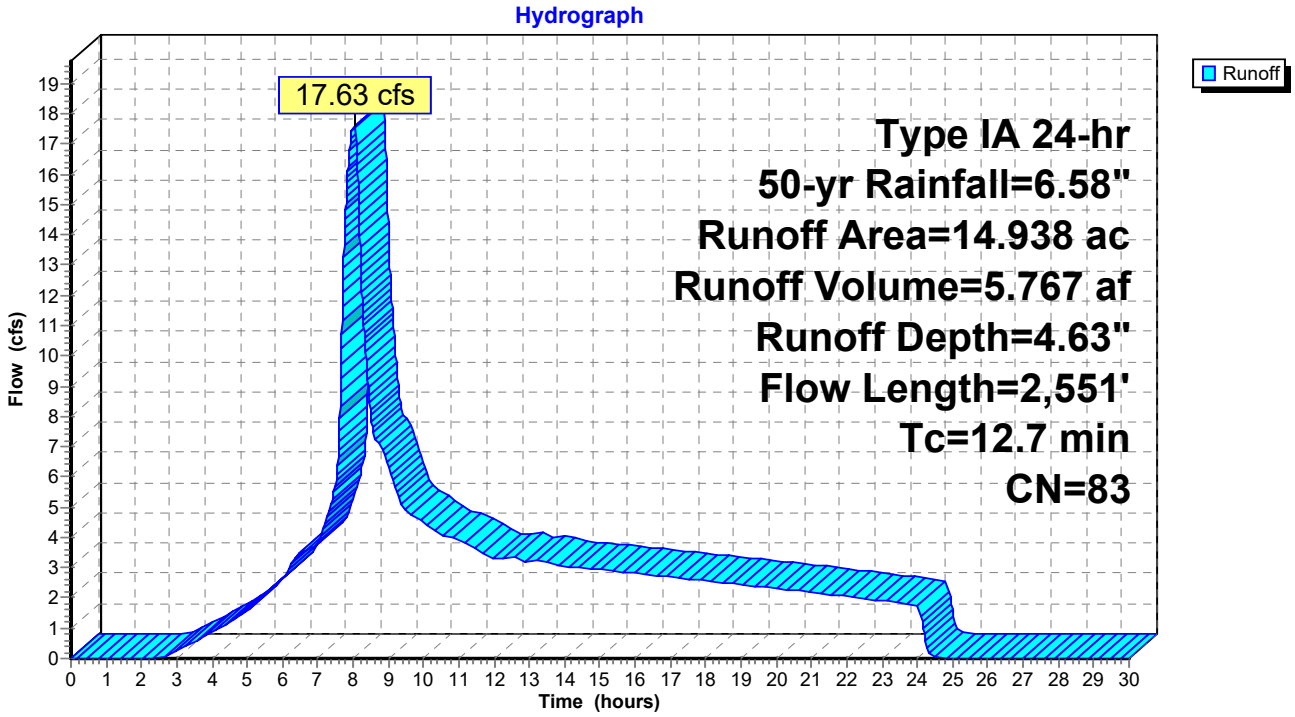
Runoff = 17.63 cfs @ 8.03 hrs, Volume= 5.767 af, Depth= 4.63"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 50-yr Rainfall=6.58"

Area (ac)	CN	Description
0.300	79	Annual Grass, Fair, HSG C
5.690	84	Annual Grass, Fair, HSG D
0.480	75	Annual Grass, Good, HSG C
0.798	81	Annual Grass, Good, HSG D
0.057	87	Dirt roads, HSG C
0.161	89	Dirt roads, HSG D
0.894	86	Farmsteads, HSG D
0.044	91	Gravel Roads, HSG D
0.372	96	Gravel surface, HSG D
0.492	93	Paved roads w/open ditches, 50% imp, HSG D
0.019	36	Woods, Fair, HSG A
0.074	73	Woods, Fair, HSG C
3.419	79	Woods, Fair, HSG D
0.145	77	Woods, Good, HSG D
1.991	82	Woods/grass comb., Fair, HSG D
14.938	83	Weighted Average
14.691		98.35% Pervious Area
0.246		1.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.2300	0.31		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.16"
4.0	789	0.2200	3.28		**Shallow Concentrated Flow, Shallow** Short Grass Pasture Kv= 7.0 fps
3.3	1,662	0.0300	8.35	233.77	**Trap/Vee/Rect Channel Flow, Soda Creek (assumed)** Bot.W=10.00' D=2.00' Z= 2.0 '/' Top.W=18.00' n= 0.040 Winding stream, pools & shoals
12.7	2,551	Total			

Subcatchment WS-2: Subcat WS-2



Summary for Subcatchment WS-1: Subcat WS-1

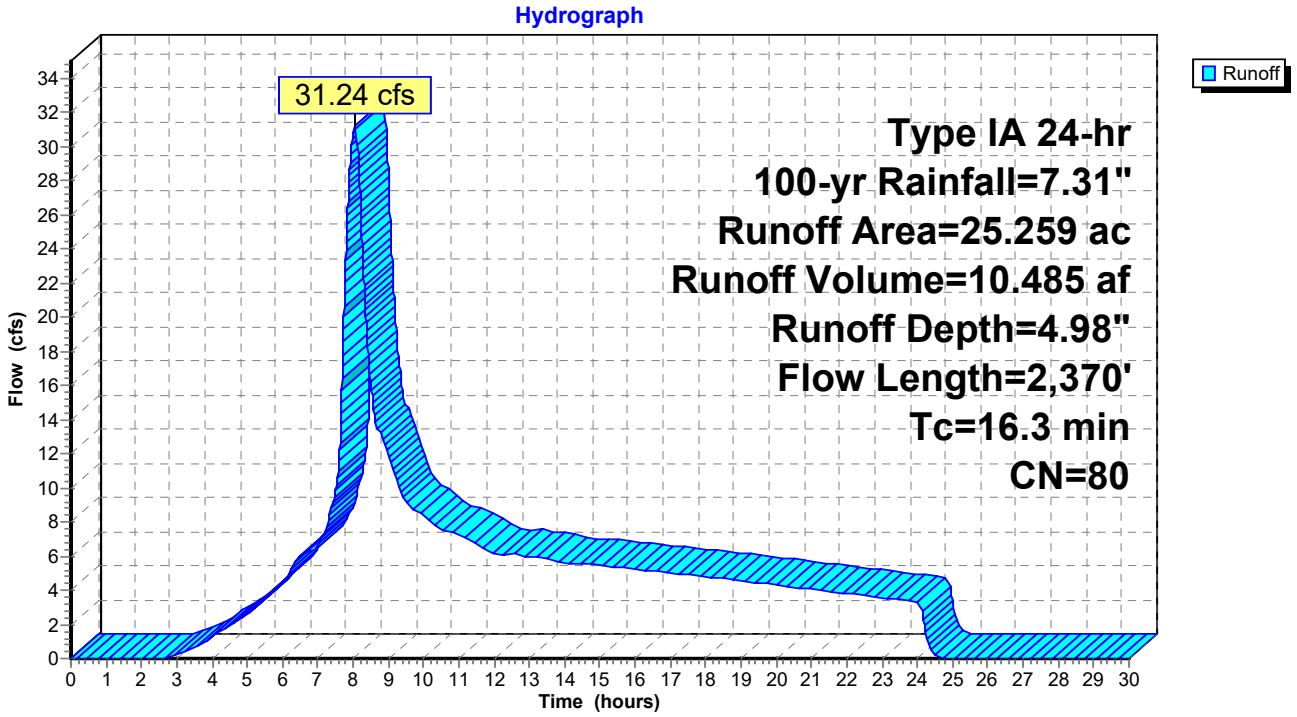
Runoff = 31.24 cfs @ 8.06 hrs, Volume= 10.485 af, Depth= 4.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-yr Rainfall=7.31"

Area (ac)	CN	Description
1.839	79	Annual Grass, Fair, HSG C
6.795	84	Annual Grass, Fair, HSG D
6.595	75	Annual Grass, Good, HSG C
2.839	81	Annual Grass, Good, HSG D
0.108	87	Dirt roads, HSG C
0.184	89	Dirt roads, HSG D
0.274	94	Fallow, bare soil, HSG D
0.472	82	Farmsteads, HSG C
0.671	86	Farmsteads, HSG D
0.388	93	Paved roads w/open ditches, 50% imp, HSG D
2.112	84	Vineyard, Fair, HSG D
0.056	98	Water Surface, HSG D
0.459	73	Woods, Fair, HSG C
0.261	79	Woods, Fair, HSG D
0.241	70	Woods, Good, HSG C
1.966	77	Woods, Good, HSG D
25.259	80	Weighted Average
25.009		99.01% Pervious Area
0.250		0.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	100	0.2500	0.32		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.16"
7.8	1,227	0.1400	2.62		**Shallow Concentrated Flow, Shallow** Short Grass Pasture Kv= 7.0 fps
3.3	1,043	0.0300	5.34	21.34	**Trap/Vee/Rect Channel Flow, Stream (assumed)** Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.035 Earth, dense weeds
16.3	2,370	Total			

Subcatchment WS-1: Subcat WS-1



Summary for Subcatchment WS-2: Subcat WS-2

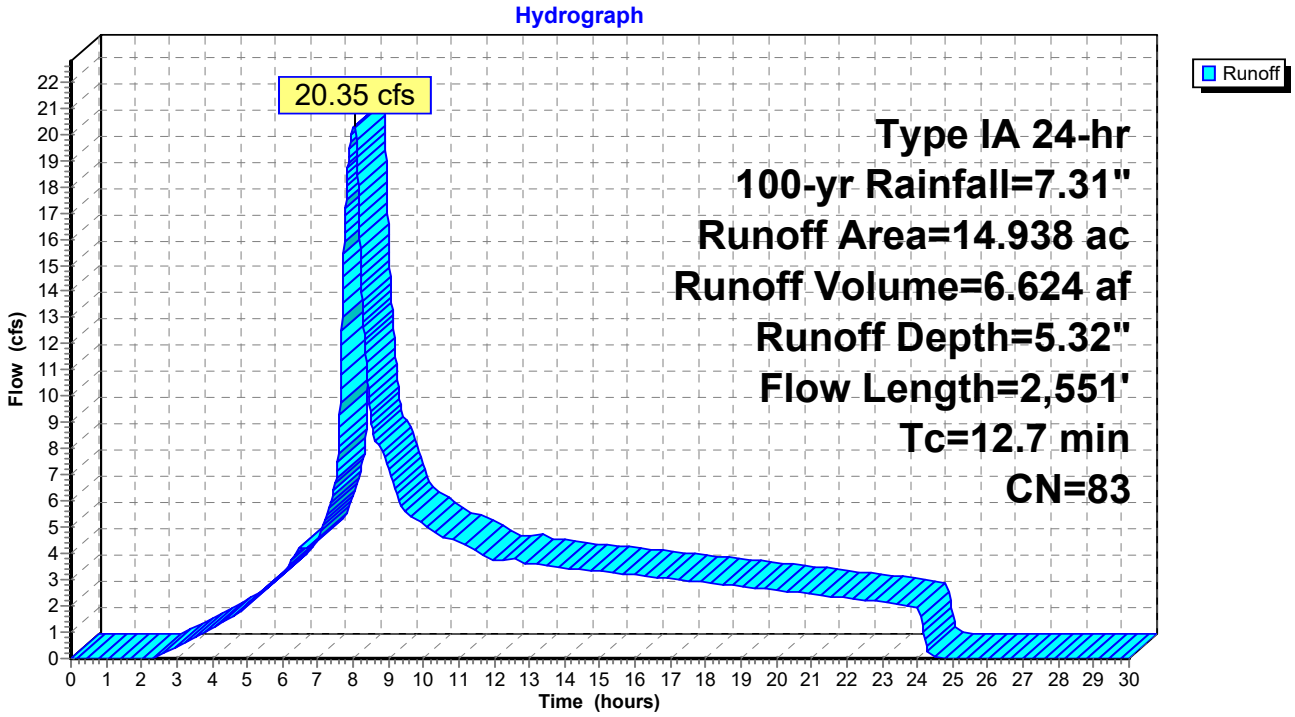
Runoff = 20.35 cfs @ 8.03 hrs, Volume= 6.624 af, Depth= 5.32"

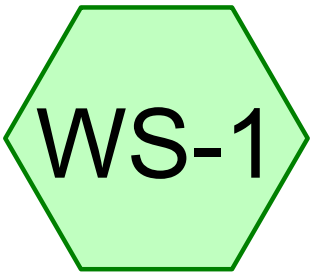
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-yr Rainfall=7.31"

Area (ac)	CN	Description
0.300	79	Annual Grass, Fair, HSG C
5.690	84	Annual Grass, Fair, HSG D
0.480	75	Annual Grass, Good, HSG C
0.798	81	Annual Grass, Good, HSG D
0.057	87	Dirt roads, HSG C
0.161	89	Dirt roads, HSG D
0.894	86	Farmsteads, HSG D
0.044	91	Gravel Roads, HSG D
0.372	96	Gravel surface, HSG D
0.492	93	Paved roads w/open ditches, 50% imp, HSG D
0.019	36	Woods, Fair, HSG A
0.074	73	Woods, Fair, HSG C
3.419	79	Woods, Fair, HSG D
0.145	77	Woods, Good, HSG D
1.991	82	Woods/grass comb., Fair, HSG D
14.938	83	Weighted Average
14.691		98.35% Pervious Area
0.246		1.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.2300	0.31		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.16"
4.0	789	0.2200	3.28		**Shallow Concentrated Flow, Shallow** Short Grass Pasture Kv= 7.0 fps
3.3	1,662	0.0300	8.35	233.77	**Trap/Vee/Rect Channel Flow, Soda Creek (assumed)** Bot.W=10.00' D=2.00' Z= 2.0 '/' Top.W=18.00' n= 0.040 Winding stream, pools & shoals
12.7	2,551	Total			

Subcatchment WS-2: Subcat WS-2

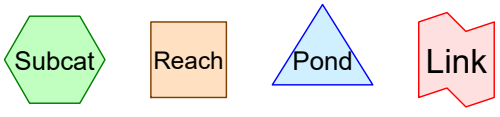




Subcat WS-1



Subcat WS-2



Routing Diagram for Red Boat Vineyard Post-Project
Prepared by PPI Engineering, Printed 10/13/2021
HydroCAD® 10.10-6a s/n 09429 © 2020 HydroCAD Software Solutions LLC

Summary for Subcatchment WS-1: Subcat WS-1

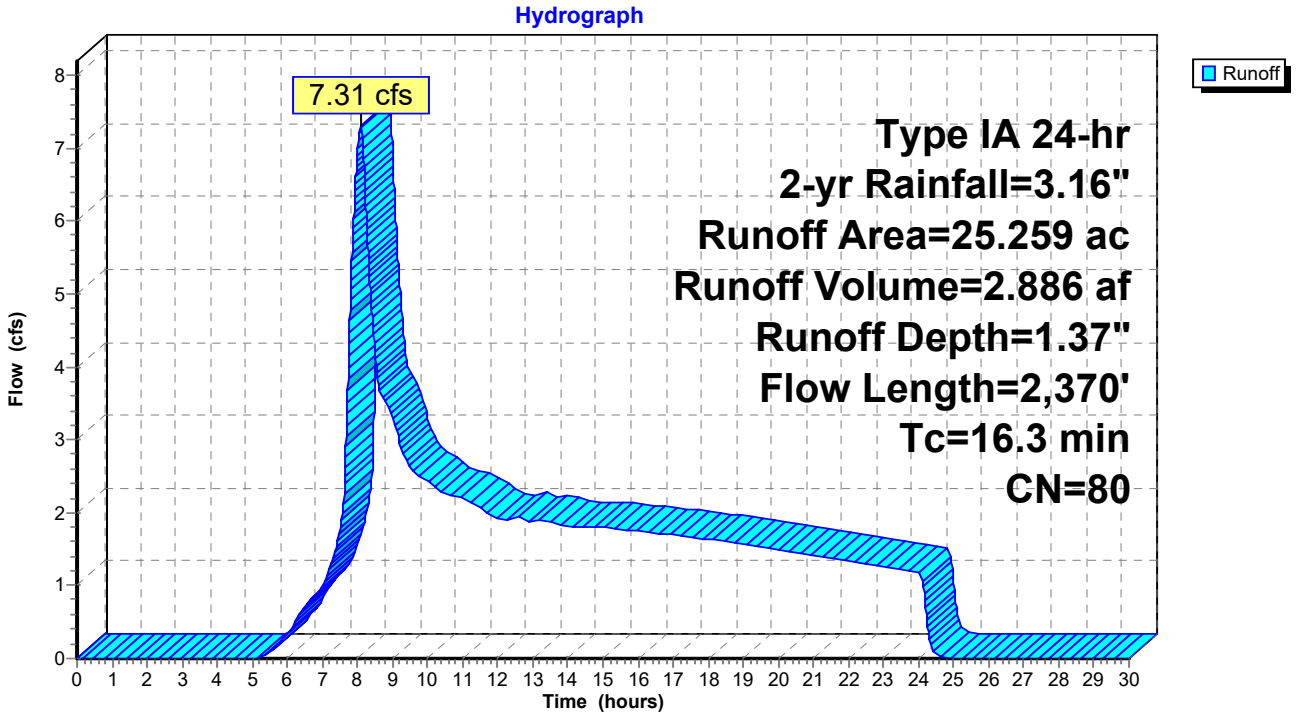
Runoff = 7.31 cfs @ 8.09 hrs, Volume= 2.886 af, Depth= 1.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-yr Rainfall=3.16"

Area (ac)	CN	Description
0.838	79	Annual Grass, Fair, HSG C
1.651	84	Annual Grass, Fair, HSG D
6.595	75	Annual Grass, Good, HSG C
2.839	81	Annual Grass, Good, HSG D
0.108	87	Dirt roads, HSG C
0.274	94	Fallow, bare soil, HSG D
0.472	82	Farmsteads, HSG C
0.671	86	Farmsteads, HSG D
0.388	93	Paved roads w/open ditches, 50% imp, HSG D
2.112	84	Vineyard, Fair, HSG D
1.007	75	Vineyard, Good, HSG C
5.473	81	Vineyard, Good, HSG D
0.056	98	Water Surface, HSG D
0.453	73	Woods, Fair, HSG C
0.114	79	Woods, Fair, HSG D
0.241	70	Woods, Good, HSG C
1.966	77	Woods, Good, HSG D
25.259	80	Weighted Average
25.009		99.01% Pervious Area
0.250		0.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	100	0.2500	0.32		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.16"
7.8	1,227	0.1400	2.62		**Shallow Concentrated Flow, Shallow** Short Grass Pasture Kv= 7.0 fps
3.3	1,043	0.0300	5.34	21.34	**Trap/Vee/Rect Channel Flow, Stream (assumed)** Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.035 Earth, dense weeds
16.3	2,370	Total			

Subcatchment WS-1: Subcat WS-1



Summary for Subcatchment WS-2: Subcat WS-2

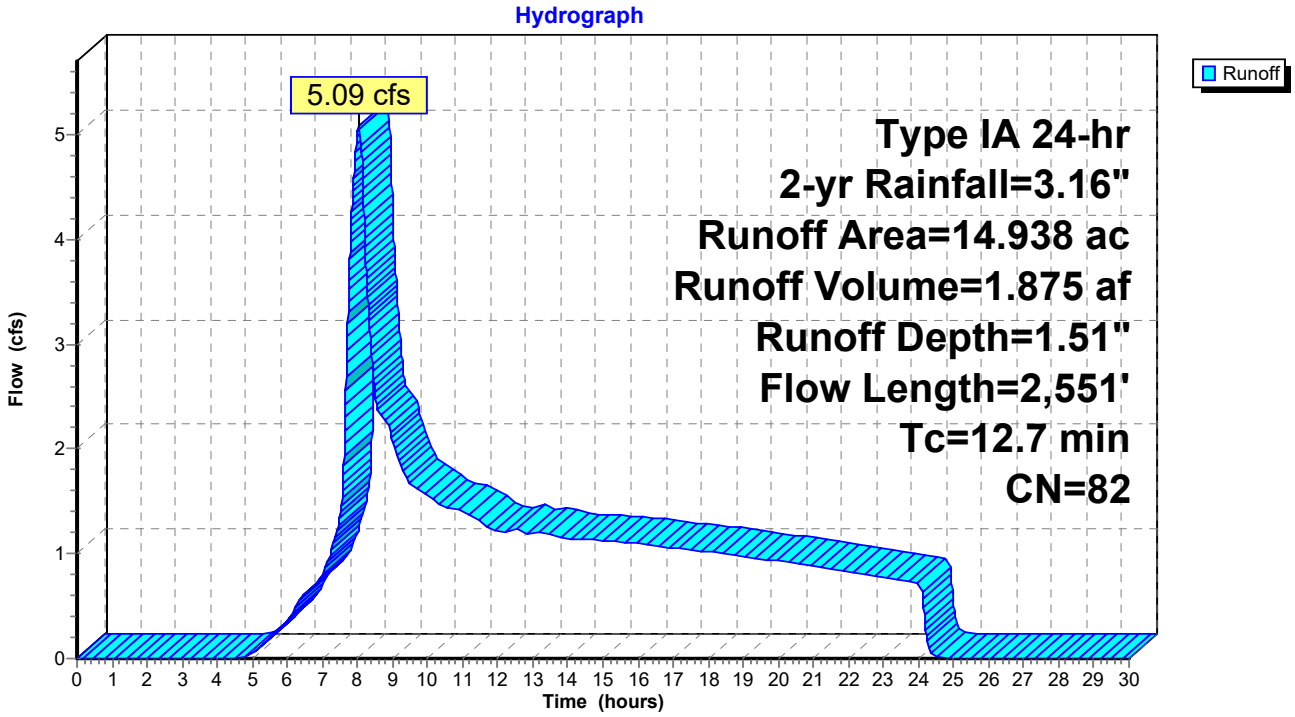
Runoff = 5.09 cfs @ 8.05 hrs, Volume= 1.875 af, Depth= 1.51"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-yr Rainfall=3.16"

Area (ac)	CN	Description
0.252	79	Annual Grass, Fair, HSG C
3.320	84	Annual Grass, Fair, HSG D
0.480	75	Annual Grass, Good, HSG C
0.798	81	Annual Grass, Good, HSG D
0.057	87	Dirt roads, HSG C
0.104	89	Dirt roads, HSG D
0.894	86	Farmsteads, HSG D
0.044	91	Gravel Roads, HSG D
0.372	96	Gravel surface, HSG D
0.492	93	Paved roads w/open ditches, 50% imp, HSG D
0.058	75	Vineyard, Good, HSG C
2.451	81	Vineyard, Good, HSG D
0.019	36	Woods, Fair, HSG A
0.065	73	Woods, Fair, HSG C
3.395	79	Woods, Fair, HSG D
0.145	77	Woods, Good, HSG D
1.991	82	Woods/grass comb., Fair, HSG D
14.938	82	Weighted Average
14.691		98.35% Pervious Area
0.246		1.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.2300	0.31		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.16"
4.0	789	0.2200	3.28		**Shallow Concentrated Flow, Shallow** Short Grass Pasture Kv= 7.0 fps
3.3	1,662	0.0300	8.35	233.77	**Trap/Vee/Rect Channel Flow, Soda Creek (assumed)** Bot.W=10.00' D=2.00' Z= 2.0 '/' Top.W=18.00' n= 0.040 Winding stream, pools & shoals
12.7	2,551	Total			

Subcatchment WS-2: Subcat WS-2



Summary for Subcatchment WS-1: Subcat WS-1

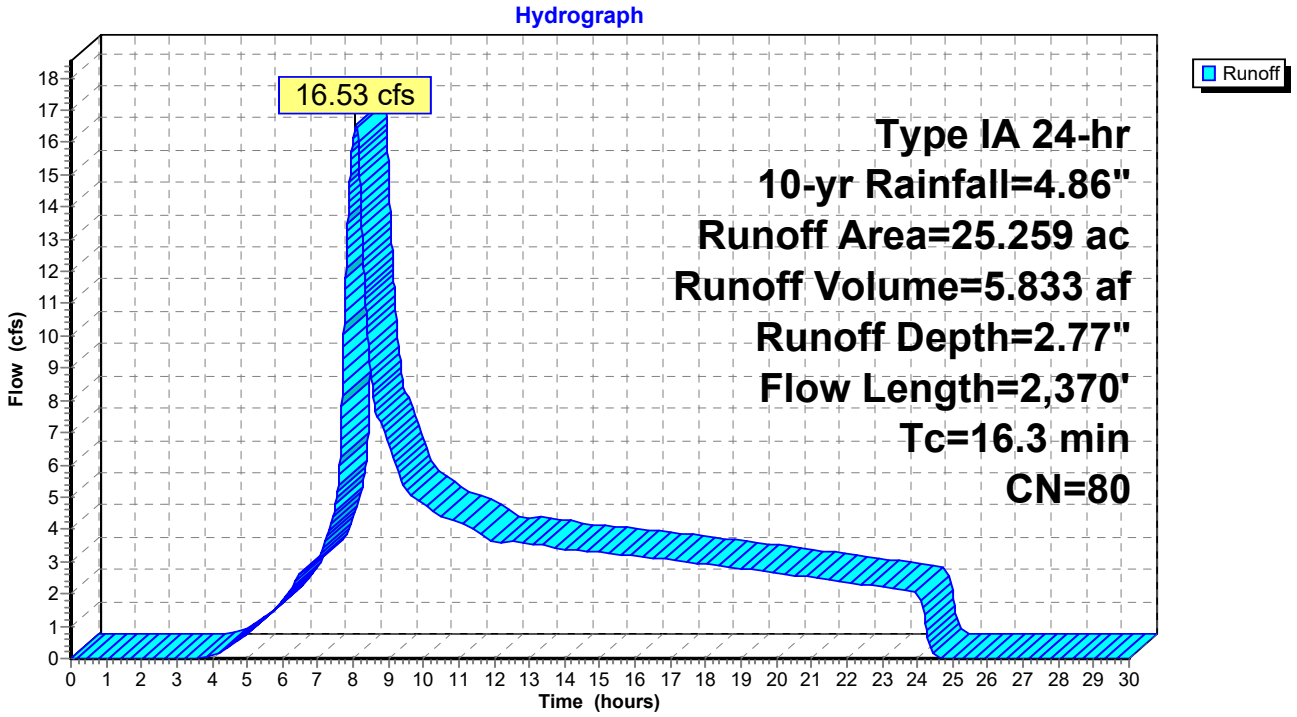
Runoff = 16.53 cfs @ 8.07 hrs, Volume= 5.833 af, Depth= 2.77"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-yr Rainfall=4.86"

Area (ac)	CN	Description
0.838	79	Annual Grass, Fair, HSG C
1.651	84	Annual Grass, Fair, HSG D
6.595	75	Annual Grass, Good, HSG C
2.839	81	Annual Grass, Good, HSG D
0.108	87	Dirt roads, HSG C
0.274	94	Fallow, bare soil, HSG D
0.472	82	Farmsteads, HSG C
0.671	86	Farmsteads, HSG D
0.388	93	Paved roads w/open ditches, 50% imp, HSG D
2.112	84	Vineyard, Fair, HSG D
1.007	75	Vineyard, Good, HSG C
5.473	81	Vineyard, Good, HSG D
0.056	98	Water Surface, HSG D
0.453	73	Woods, Fair, HSG C
0.114	79	Woods, Fair, HSG D
0.241	70	Woods, Good, HSG C
1.966	77	Woods, Good, HSG D
25.259	80	Weighted Average
25.009		99.01% Pervious Area
0.250		0.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	100	0.2500	0.32		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.16"
7.8	1,227	0.1400	2.62		**Shallow Concentrated Flow, Shallow** Short Grass Pasture Kv= 7.0 fps
3.3	1,043	0.0300	5.34	21.34	**Trap/Vee/Rect Channel Flow, Stream (assumed)** Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.035 Earth, dense weeds
16.3	2,370	Total			

Subcatchment WS-1: Subcat WS-1



Summary for Subcatchment WS-2: Subcat WS-2

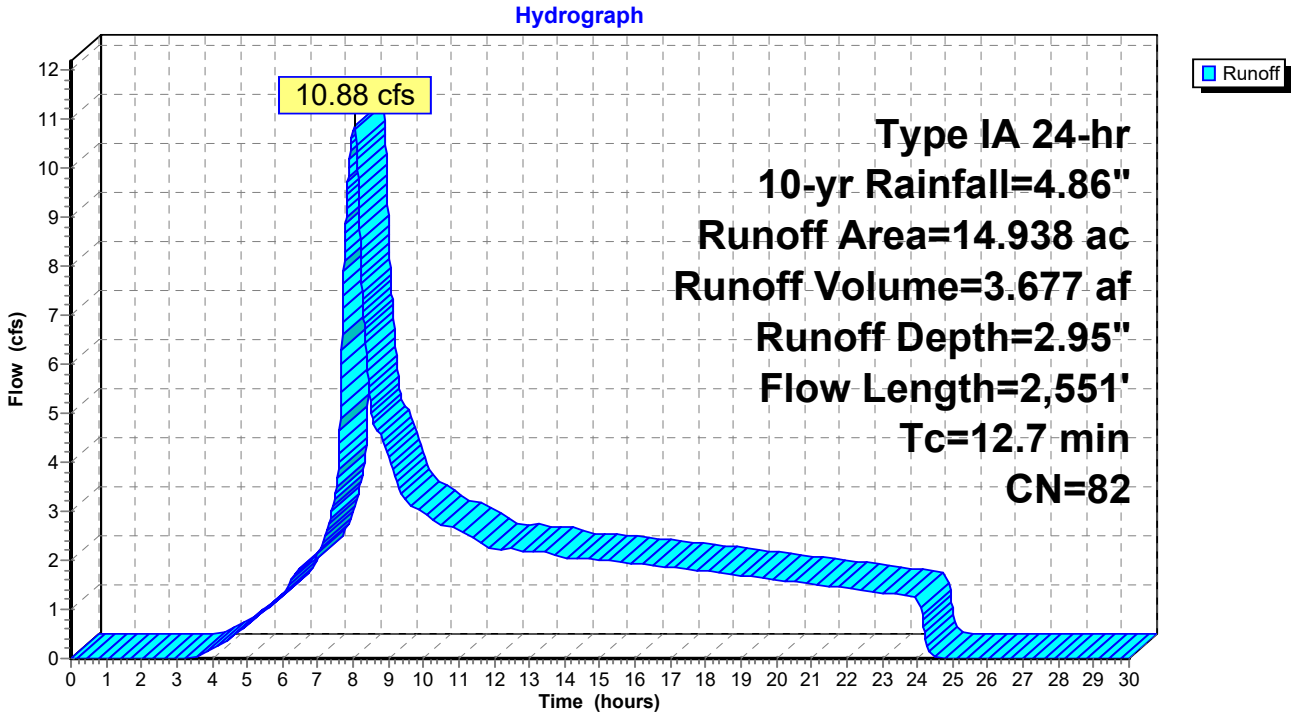
Runoff = 10.88 cfs @ 8.03 hrs, Volume= 3.677 af, Depth= 2.95"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-yr Rainfall=4.86"

Area (ac)	CN	Description
0.252	79	Annual Grass, Fair, HSG C
3.320	84	Annual Grass, Fair, HSG D
0.480	75	Annual Grass, Good, HSG C
0.798	81	Annual Grass, Good, HSG D
0.057	87	Dirt roads, HSG C
0.104	89	Dirt roads, HSG D
0.894	86	Farmsteads, HSG D
0.044	91	Gravel Roads, HSG D
0.372	96	Gravel surface, HSG D
0.492	93	Paved roads w/open ditches, 50% imp, HSG D
0.058	75	Vineyard, Good, HSG C
2.451	81	Vineyard, Good, HSG D
0.019	36	Woods, Fair, HSG A
0.065	73	Woods, Fair, HSG C
3.395	79	Woods, Fair, HSG D
0.145	77	Woods, Good, HSG D
1.991	82	Woods/grass comb., Fair, HSG D
14.938	82	Weighted Average
14.691		98.35% Pervious Area
0.246		1.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.2300	0.31		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.16"
4.0	789	0.2200	3.28		**Shallow Concentrated Flow, Shallow** Short Grass Pasture Kv= 7.0 fps
3.3	1,662	0.0300	8.35	233.77	**Trap/Vee/Rect Channel Flow, Soda Creek (assumed)** Bot.W=10.00' D=2.00' Z= 2.0 '/' Top.W=18.00' n= 0.040 Winding stream, pools & shoals
12.7	2,551	Total			

Subcatchment WS-2: Subcat WS-2



Summary for Subcatchment WS-1: Subcat WS-1

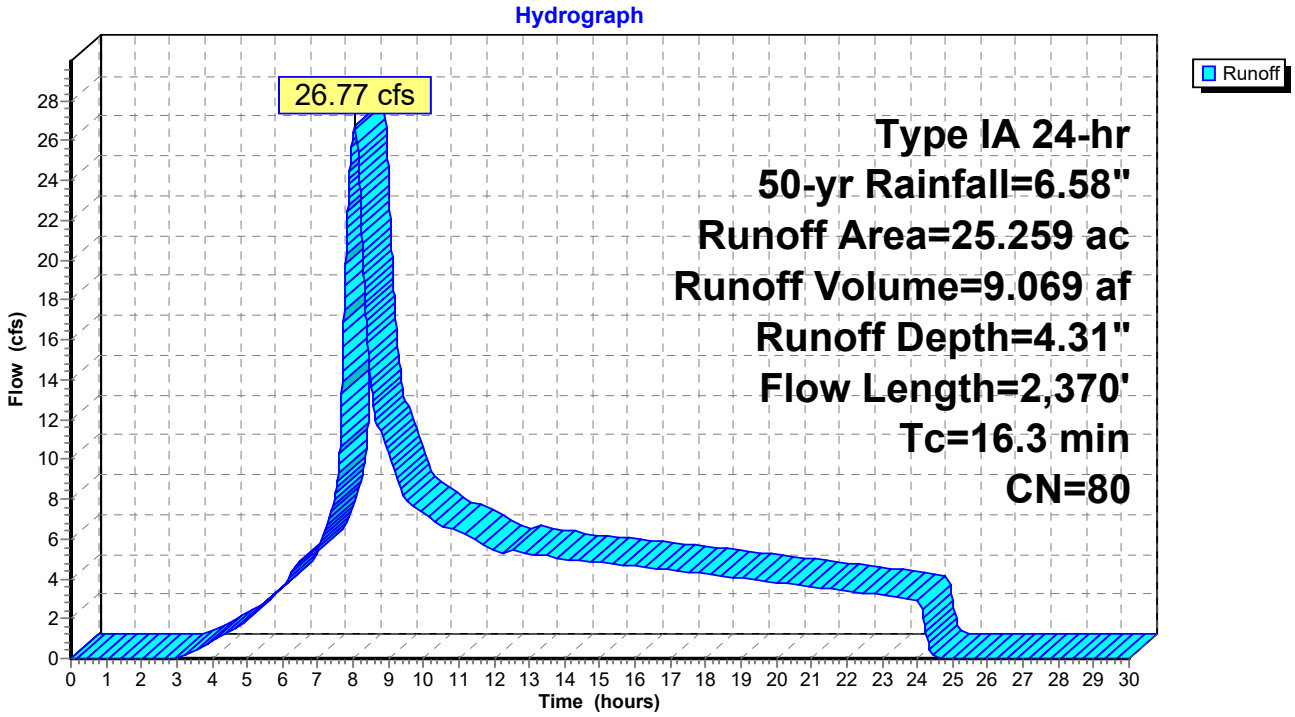
Runoff = 26.77 cfs @ 8.06 hrs, Volume= 9.069 af, Depth= 4.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 50-yr Rainfall=6.58"

Area (ac)	CN	Description
0.838	79	Annual Grass, Fair, HSG C
1.651	84	Annual Grass, Fair, HSG D
6.595	75	Annual Grass, Good, HSG C
2.839	81	Annual Grass, Good, HSG D
0.108	87	Dirt roads, HSG C
0.274	94	Fallow, bare soil, HSG D
0.472	82	Farmsteads, HSG C
0.671	86	Farmsteads, HSG D
0.388	93	Paved roads w/open ditches, 50% imp, HSG D
2.112	84	Vineyard, Fair, HSG D
1.007	75	Vineyard, Good, HSG C
5.473	81	Vineyard, Good, HSG D
0.056	98	Water Surface, HSG D
0.453	73	Woods, Fair, HSG C
0.114	79	Woods, Fair, HSG D
0.241	70	Woods, Good, HSG C
1.966	77	Woods, Good, HSG D
25.259	80	Weighted Average
25.009		99.01% Pervious Area
0.250		0.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	100	0.2500	0.32		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.16"
7.8	1,227	0.1400	2.62		**Shallow Concentrated Flow, Shallow** Short Grass Pasture Kv= 7.0 fps
3.3	1,043	0.0300	5.34	21.34	**Trap/Vee/Rect Channel Flow, Stream (assumed)** Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.035 Earth, dense weeds
16.3	2,370	Total			

Subcatchment WS-1: Subcat WS-1



Summary for Subcatchment WS-2: Subcat WS-2

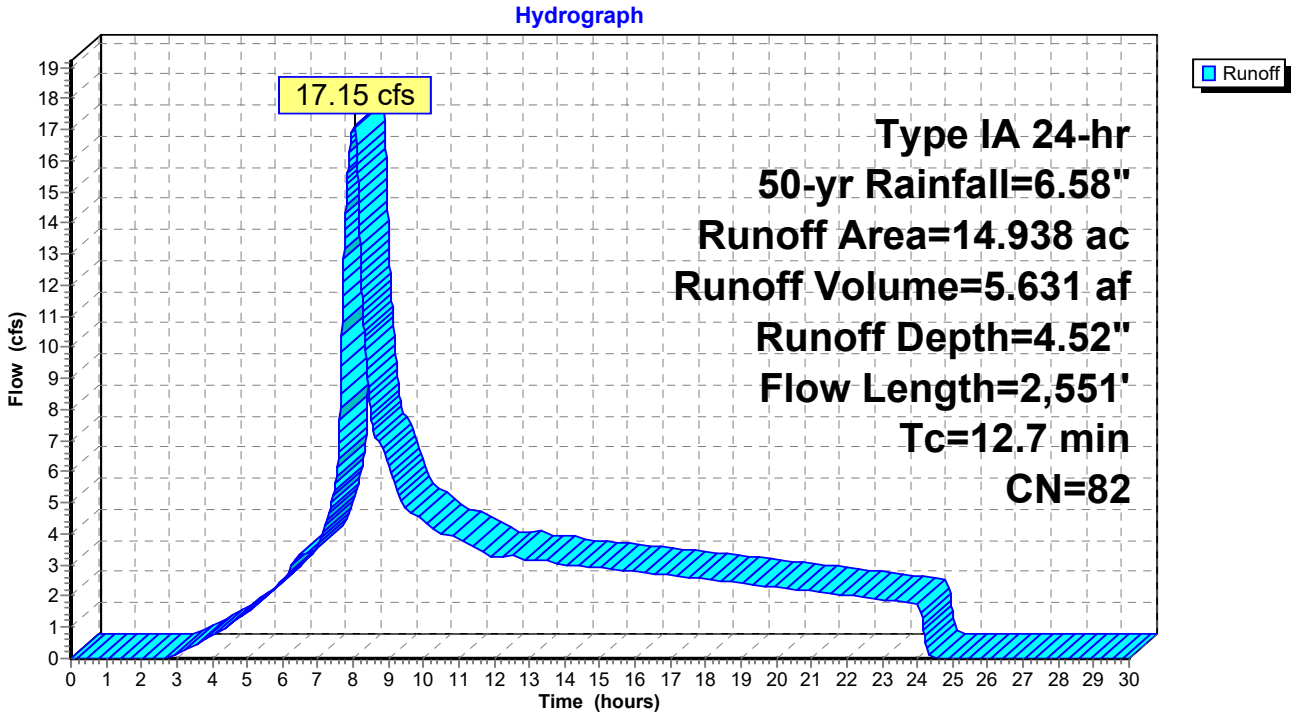
Runoff = 17.15 cfs @ 8.03 hrs, Volume= 5.631 af, Depth= 4.52"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 50-yr Rainfall=6.58"

Area (ac)	CN	Description
0.252	79	Annual Grass, Fair, HSG C
3.320	84	Annual Grass, Fair, HSG D
0.480	75	Annual Grass, Good, HSG C
0.798	81	Annual Grass, Good, HSG D
0.057	87	Dirt roads, HSG C
0.104	89	Dirt roads, HSG D
0.894	86	Farmsteads, HSG D
0.044	91	Gravel Roads, HSG D
0.372	96	Gravel surface, HSG D
0.492	93	Paved roads w/open ditches, 50% imp, HSG D
0.058	75	Vineyard, Good, HSG C
2.451	81	Vineyard, Good, HSG D
0.019	36	Woods, Fair, HSG A
0.065	73	Woods, Fair, HSG C
3.395	79	Woods, Fair, HSG D
0.145	77	Woods, Good, HSG D
1.991	82	Woods/grass comb., Fair, HSG D
14.938	82	Weighted Average
14.691		98.35% Pervious Area
0.246		1.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.2300	0.31		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.16"
4.0	789	0.2200	3.28		**Shallow Concentrated Flow, Shallow** Short Grass Pasture Kv= 7.0 fps
3.3	1,662	0.0300	8.35	233.77	**Trap/Vee/Rect Channel Flow, Soda Creek (assumed)** Bot.W=10.00' D=2.00' Z= 2.0 '/' Top.W=18.00' n= 0.040 Winding stream, pools & shoals
12.7	2,551	Total			

Subcatchment WS-2: Subcat WS-2



Summary for Subcatchment WS-1: Subcat WS-1

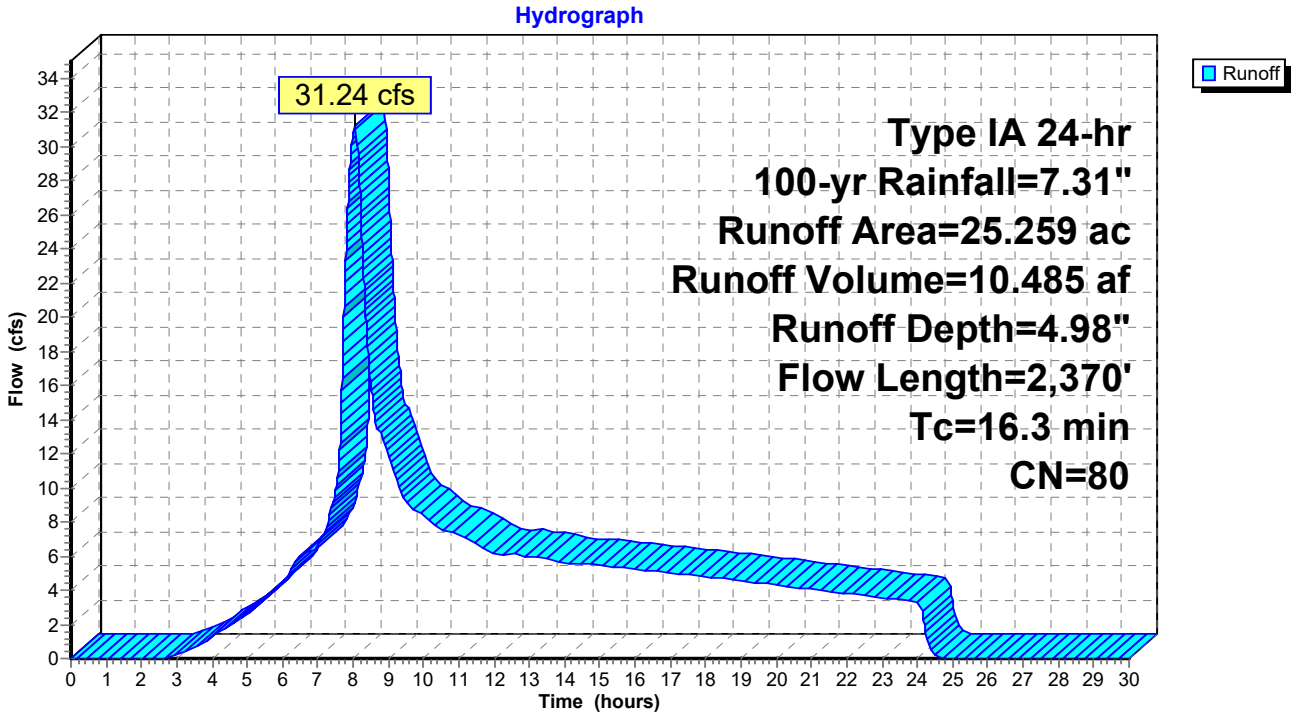
Runoff = 31.24 cfs @ 8.06 hrs, Volume= 10.485 af, Depth= 4.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-yr Rainfall=7.31"

Area (ac)	CN	Description
0.838	79	Annual Grass, Fair, HSG C
1.651	84	Annual Grass, Fair, HSG D
6.595	75	Annual Grass, Good, HSG C
2.839	81	Annual Grass, Good, HSG D
0.108	87	Dirt roads, HSG C
0.274	94	Fallow, bare soil, HSG D
0.472	82	Farmsteads, HSG C
0.671	86	Farmsteads, HSG D
0.388	93	Paved roads w/open ditches, 50% imp, HSG D
2.112	84	Vineyard, Fair, HSG D
1.007	75	Vineyard, Good, HSG C
5.473	81	Vineyard, Good, HSG D
0.056	98	Water Surface, HSG D
0.453	73	Woods, Fair, HSG C
0.114	79	Woods, Fair, HSG D
0.241	70	Woods, Good, HSG C
1.966	77	Woods, Good, HSG D
25.259	80	Weighted Average
25.009		99.01% Pervious Area
0.250		0.99% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.2	100	0.2500	0.32		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.16"
7.8	1,227	0.1400	2.62		**Shallow Concentrated Flow, Shallow** Short Grass Pasture Kv= 7.0 fps
3.3	1,043	0.0300	5.34	21.34	**Trap/Vee/Rect Channel Flow, Stream (assumed)** Bot.W=2.00' D=1.00' Z= 2.0 '/' Top.W=6.00' n= 0.035 Earth, dense weeds
16.3	2,370	Total			

Subcatchment WS-1: Subcat WS-1



Summary for Subcatchment WS-2: Subcat WS-2

Runoff = 19.85 cfs @ 8.03 hrs, Volume= 6.482 af, Depth= 5.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Type IA 24-hr 100-yr Rainfall=7.31"

Area (ac)	CN	Description
0.252	79	Annual Grass, Fair, HSG C
3.320	84	Annual Grass, Fair, HSG D
0.480	75	Annual Grass, Good, HSG C
0.798	81	Annual Grass, Good, HSG D
0.057	87	Dirt roads, HSG C
0.104	89	Dirt roads, HSG D
0.894	86	Farmsteads, HSG D
0.044	91	Gravel Roads, HSG D
0.372	96	Gravel surface, HSG D
0.492	93	Paved roads w/open ditches, 50% imp, HSG D
0.058	75	Vineyard, Good, HSG C
2.451	81	Vineyard, Good, HSG D
0.019	36	Woods, Fair, HSG A
0.065	73	Woods, Fair, HSG C
3.395	79	Woods, Fair, HSG D
0.145	77	Woods, Good, HSG D
1.991	82	Woods/grass comb., Fair, HSG D
14.938	82	Weighted Average
14.691		98.35% Pervious Area
0.246		1.65% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.4	100	0.2300	0.31		**Sheet Flow, Sheet** Grass: Dense n= 0.240 P2= 3.16"
4.0	789	0.2200	3.28		**Shallow Concentrated Flow, Shallow** Short Grass Pasture Kv= 7.0 fps
3.3	1,662	0.0300	8.35	233.77	**Trap/Vee/Rect Channel Flow, Soda Creek (assumed)** Bot.W=10.00' D=2.00' Z= 2.0 '/' Top.W=18.00' n= 0.040 Winding stream, pools & shoals
12.7	2,551	Total			

Subcatchment WS-2: Subcat WS-2

