

# ATTACHMENT I-3

## HYDROLOGY ANALYSIS

Farmstead at Long Meadow Ranch Lodging

Sherwood Design Engineers  
April 18, 2017

# Hydrology Analysis

FOR

## Farmstead at Long Meadow Ranch Lodging

1000 Mills Lane

St. Helena, CA 94574

PREPARED FOR:

CITY OF ST. HELENA DEPARTMENT OF PUBLIC WORKS

1480 MAIN STREET

ST. HELENA, CA 94574

PREPARED BY:

SHERWOOD DESIGN ENGINEERS

58 MAIDEN LANE, 3<sup>RD</sup> FLOOR

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April 18, 2017

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### A. Background

In the City of St. Helena letter titled “Notification of Incomplete Project and Identification of Outstanding Issues – 1000 Mills Lane, File #PL17-006” and dated March 22, 2017, the project applicant was asked to demonstrate that the proposed project improvements at 1000 Mills Lane will not increase the 10-year runoff volume above the pre-development 10-year runoff volume.

### B. Calculation Methodology

The pre-development and post-development runoff rates and volumes were calculated using HydroCAD, a stormwater modeling software program. The runoff method chosen for use within the program was the SCS TR-20 method. The following inputs were used in the analysis:

#### **Rainfall**

Rainfall data was taken from the National Oceanic and Atmospheric Administration (NOAA) Point Precipitation Frequency Estimates for the St. Helena station located at 38.5067°, -122.4714° and imported into HydroCAD as an IDF file. The 10-year rainfall event was chosen for the runoff analysis.

#### **Time of Concentration**

For the pre-development condition, the time of concentration was calculated using TR-55 methodology within the HydroCAD program. The maximum flow length was assumed to be 900 feet, stretching from the northeast side to the southwest side with an average land slope of one percent. The length of sheet flow was taken to be the maximum allowable, 300 feet, and the remainder of the flow path, 600 feet, was taken to be shallow concentrated flow. The resulting time of concentration was 21.7 minutes.

For the post-development condition, the time of concentration was conservatively assumed to be 6 minutes or 0.1 hours, which is the minimum time of concentration allowable per TR-55. The actual project time of concentration is likely higher due to routing of runoff through raingardens and pervious paving, as well as the large contiguous areas of landscaping and farm area that will primarily drain through sheet flow.

### Site Cover and Curve Number

The total project site area is 414,255 square feet. For the pre-development condition, all 414,255 square feet are fallow vineyard, and a Curve Number (CN) of 90 is assigned based on the most closely matching category in the TR-55 reference table of Cultivated Agricultural Land, Fallow, Crop Residue, Good Condition, Hydrologic Soil Group D. For the post-development condition, the weighted CN was calculated to be 91. The post-development site cover breakdown is summarized in the following table:

*Table 1: Post-Development Site Cover Summary*

<b>Area Description</b>	<b>Area (sf)</b>	<b>CN</b>	<b>TR-55 Reference Table Description</b>
Impervious Paving & Building Roofs	122,104	98	Impervious Areas, Paved parking lots, driveways, Hydrologic Soil Group D  Impervious Areas, Roofs, Hydrologic Soil Group D
Pervious Paving	83,816	98	Impervious Areas, Paved parking lots, driveways, Hydrologic Soil Group D <sup>1</sup>
Water Features	2,454	98	Ponds and Lake Surfaces, Classified as Impervious, Hydrologic Soil Group D
Farm	27,251	86	Farmsteads, Hydrologic Soil Group D
Raingardens	3,951	80	Open Space (Lawns, parks, etc.), grass cover > 75%, Good Condition, Hydrologic Soil Group D
Landscaping	174,679	84	Open Space (Lawns, parks, etc.), grass cover 50% to 75%, Fair Condition, Hydrologic Soil Group D

<sup>1</sup> A CN of 98 for pervious paving is based on the conservative assumption that the pervious paving subbase storage layer is full.

## C. Results

The pre-development runoff volume is 156,540 cubic feet and the post-development runoff volume is 160,328 cubic feet. See Attachment 1, HydroCAD Report, for a complete summary of calculations and hydrograph outputs. The increase in runoff volume is 3,788 cubic feet, so the project must capture and retain at least 3,788 cubic feet of runoff.

The proposed project includes six raingardens, totaling 3,951 square feet. Per BASMAA requirements, the raingardens will have 6 inches of ponding, 18 inches of bioretention soil, and 12 inches of gravel. The storage volume provided in the raingardens is:

$$3,951 \text{ sf raingarden} \\ \times [(6 \text{ inches ponding} + 18 \text{ inches bioretention soil} \times 10\% \text{ porosity} \\ + 12 \text{ inches gravel} \times 40\% \text{ porosity}) \times \left(\frac{1 \text{ ft}}{12 \text{ inches}}\right)] = 4,149 \text{ cf}$$

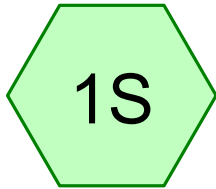
Therefore, storage volume provided in the raingardens is sufficient to decrease the post-development runoff volume below the pre-development volume.

## D. Conclusion

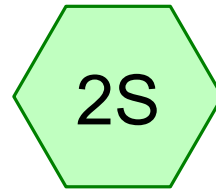
The proposed project will not increase runoff volumes for the 10-year storm above the pre-development condition runoff volume. This result was found using conservative assumptions for time of concentration and curve number, and does not account for storage provided in the pervious paving subbase, which would further improve post-development capture of runoff.

## E. Attachments

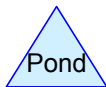
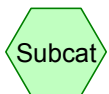
Attachment 1 – HydroCAD Report



Pre-Development



Post-Development



# Farmstead HydroCAD

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## Area Listing (all nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
174,679	84	50-75% Grass cover, Fair, HSG D (2S)
3,951	80	Bioretention area (2S)
414,255	90	Fallow, crop residue, Good, HSG D (1S)
27,251	86	Farmsteads, HSG D (2S)
122,104	98	Impervious surfaces (roofs + paving) (2S)
83,816	98	Pervious paving (2S)
2,454	98	Water features (2S)
<b>828,510</b>	<b>91</b>	<b>TOTAL AREA</b>

# Farmstead HydroCAD

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## Soil Listing (all nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
0	HSG C	
616,185	HSG D	1S, 2S
212,325	Other	2S
<b>828,510</b>		<b>TOTAL AREA</b>



# Farmstead HydroCAD

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## Ground Covers (all nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover
0	0	0	174,679	0	174,679	50-75% Grass cover, Fair
0	0	0	0	3,951	3,951	Bioretention area
0	0	0	414,255	0	414,255	Fallow, crop residue, Good
0	0	0	27,251	0	27,251	Farmsteads
0	0	0	0	122,104	122,104	Impervious surfaces (roofs + paving)
0	0	0	0	83,816	83,816	Pervious paving
0	0	0	0	2,454	2,454	Water features
<b>0</b>	<b>0</b>	<b>0</b>	<b>616,185</b>	<b>212,325</b>	<b>828,510</b>	<b>TOTAL AREA</b>

**Farmstead HydroCAD**

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Type IA 24-hr Rainfall=5.68"

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Time span=0.00-28.00 hrs, dt=0.05 hrs, 561 points  
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN  
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment1S: Pre-Development**      Runoff Area=414,255 sf   0.00% Impervious   Runoff Depth=4.53"  
Flow Length=900'   Slope=0.0100 '/'   Tc=21.7 min   CN=90   Runoff=10.47 cfs   156,540 cf

**Subcatchment2S: Post-Development**      Runoff Area=414,255 sf   50.30% Impervious   Runoff Depth=4.64"  
Tc=6.0 min   CN=91   Runoff=11.59 cfs   160,328 cf

**Total Runoff Area = 828,510 sf   Runoff Volume = 316,869 cf   Average Runoff Depth = 4.59"**  
**74.85% Pervious = 620,136 sf   25.15% Impervious = 208,374 sf**

**Summary for Subcatchment 1S: Pre-Development**

Runoff = 10.47 cfs @ 8.11 hrs, Volume= 156,540 cf, Depth= 4.53"

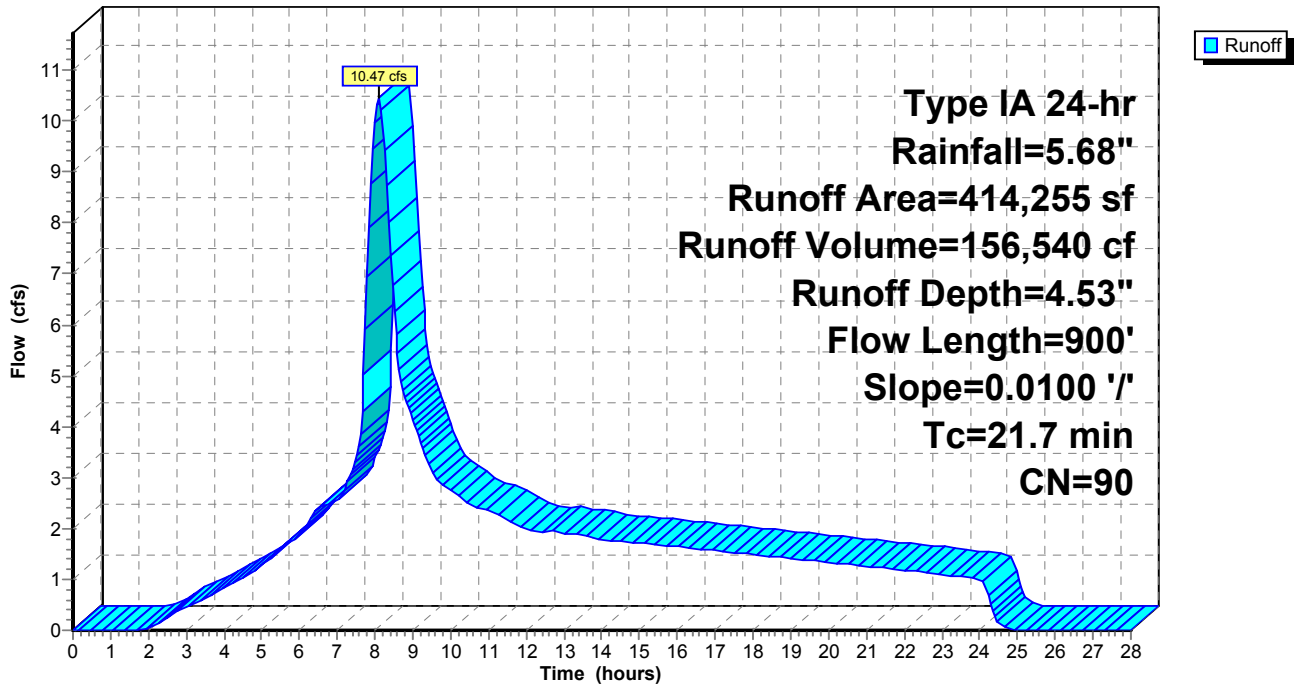
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-28.00 hrs, dt= 0.05 hrs  
Type IA 24-hr Rainfall=5.68"

Area (sf)	CN	Description
414,255	90	Fallow, crop residue, Good, HSG D
414,255		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
11.7	300	0.0100	0.43		<b>Sheet Flow,</b> Fallow n= 0.050 P2= 3.90"
10.0	600	0.0100	1.00		<b>Shallow Concentrated Flow,</b> Nearly Bare & Untilled Kv= 10.0 fps
21.7	900	Total			

**Subcatchment 1S: Pre-Development**

Hydrograph



**Summary for Subcatchment 2S: Post-Development**

Runoff = 11.59 cfs @ 7.89 hrs, Volume= 160,328 cf, Depth= 4.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-28.00 hrs, dt= 0.05 hrs  
Type IA 24-hr Rainfall=5.68"

	Area (sf)	CN	Description
*	122,104	98	Impervious surfaces (roofs + paving)
*	83,816	98	Pervious paving
*	2,454	98	Water features
	27,251	86	Farmsteads, HSG D
*	3,951	80	Bioretention area
	174,679	84	50-75% Grass cover, Fair, HSG D
	414,255	91	Weighted Average
	205,881		49.70% Pervious Area
	208,374		50.30% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					Direct Entry,

**Subcatchment 2S: Post-Development**

Hydrograph

