# Drainage Analysis

## For the

# Residence

**3210 West Dry Creek Road**
**Healdsburg, California**
**APN 090-140-038**

**GRD 22-0090**

**JN 21387**
**July 25, 2022**

**Prepared for:**
**owner**



Timothy L. Schram, RCE 67890
My license expires 6/30/2023




**Prepared by:**

adobe associates, inc.
civil engineering | land surveying | wastewater
1220 N. Dutton Ave., Santa Rosa, CA 95401
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**Website:** www.adobeinc.com

**Prepared By: RMS**
**Checked By: KM**

DRAINAGE REVIEW APPROVED
joshua ricci
November 6, 2022
PERMIT SONOMA ENGINEERING

DRAINAGE APPROVED
joshua ricci
November 6, 2022
PERMIT SONOMA ENGINEERING

# Table of Contents


1. Drainage Narrative
2. Aerial Photo
3. Existing Condition Map
4. Impervious Area Map
5. Weighted Runoff Curve Number Calculator
6. Santa Rosa LID Calculator
7. Post-Construction Hydrology Map
8. 10 and 100-Year Rational Method Drainage Study
9. NOAA Atlas 14 – Point Precipitation Frequency Estimates & Intensity Duration Frequency Curve (IDF Curve)
10. 10-Year Storm Event Stormdrain/Swale Analysis
11. 100-Year Overland Release Map
12. 10 Year Inlet Capacity Calculations

Appendices

I. Soil Analysis

II. Fact Sheet – Bioretention

# Drainage Narrative

# The White Residence
# Drainage Narrative

## Project Description

The White Residence project is located at 3210 West Dry Creek Road, Healdsburg, California. The overall project site is approximately 20.81 acres. The undeveloped area consists of existing native vegetation and trees on the property. For existing conditions, see attached **Section 2, Aerial Photo** and **Section 3, Existing Condition Map**. This project proposes to provide grading and drainage improvements for a new AC driveway, grading for main residence, detached garage, hardscaping, and landscaping. For the project, a total amount of 21,834 square feet of impervous area will be added or replaced. The nearest blue line stream is Dry Creek which is approximately 0.29 miles to the north-east of the residence.

Existing slopes in the area of the proposed improvements are between 30% and 50%. Runoff currently sheet flows toward the north property line. There is an existing 12" Reinforce Concrete Pipe at the entry from Nidva Line and a 24" Corrugate Metal Pipe along the drainage course parallel with Nidva Lane.

The existing drainage courses and existing 24" CMP along Nidva Line will remain. Runoff from the proposed improvements and proposed stormdrain will sheetflow through existing vegetation along the historic drainage patterns to the release point in the north boundary. Runoff from the proposed Residence and Garage will be collected and treated in bio-retention areas the over flow will sheet flow through the existing vegetation.

## Methodology

Post construction conditions are shown on **Section 4, Impervious Area Map.** Attached **Section 5, Runoff Curve Number and Runoff** has been used to calculate pre and post construction curve numbers. There will be an increase in the curve number as a result of the proposed improvements for Tributary DA3 and DA4. Volume capture will be provided with two bio-retention facilities runoff will then flow through existing vegetation prior to discharging from the site. There is no curve number increase in the Tributary DA1 and DA2, therefore no volume capture is required. Treatment will be achieved by discharging to existing vegetation.

The BMP for the project was designed using the *City of Santa Rosa's LID Storm Water Calculator.* Attached **Section 6, Santa Rosa LID Calculator** has been used to calculate the BMP sizing. The type of BMP design used for the calculations was *P2-05 Roadside Bioretention – No Curb and Gutter.* From the curve number analysis in **Section 5, Weighted Runoff Curve Number Calculator** post and pre-constrution curve numbers for DA3 & DA4 were input into the LID calculator. The BMP was sized using the *BMP Sizing Tool* section of the LID calculator until the BMP reached a percent requirement of one hundred percent for both bioretentions

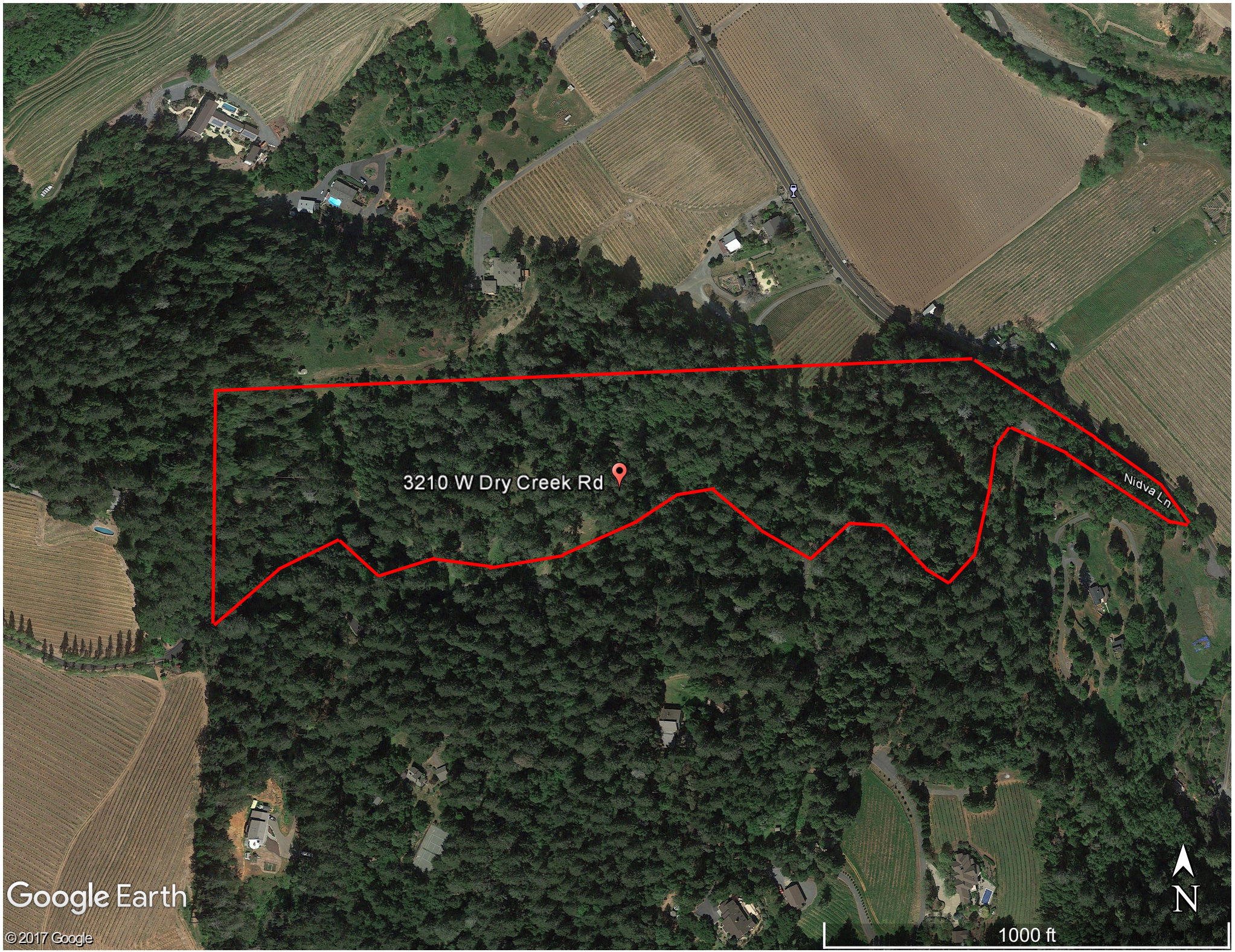
The Rational Method has been used to calculate the 10 and 100 year peak runoff in accordance with the Sonoma County Water Agency (SCWA) Flood Control Design Criteria as shown in **Section 8, 10-yr & 100-yr Rational Method Drainage Study**. Site tributary areas and points of concentration are depicted on the attached **Section 7, Post-Construction Hydrology Maps**.

The worse-case scenario inlets have been analyzed to verify capacity during the 10-yr event see **Section 13, 10 Year Inlet Capacity Calculations**. See **Section 11, Overland Release Map** for depicted flow routes during potential 100-yr flood events or conveyance system failure.

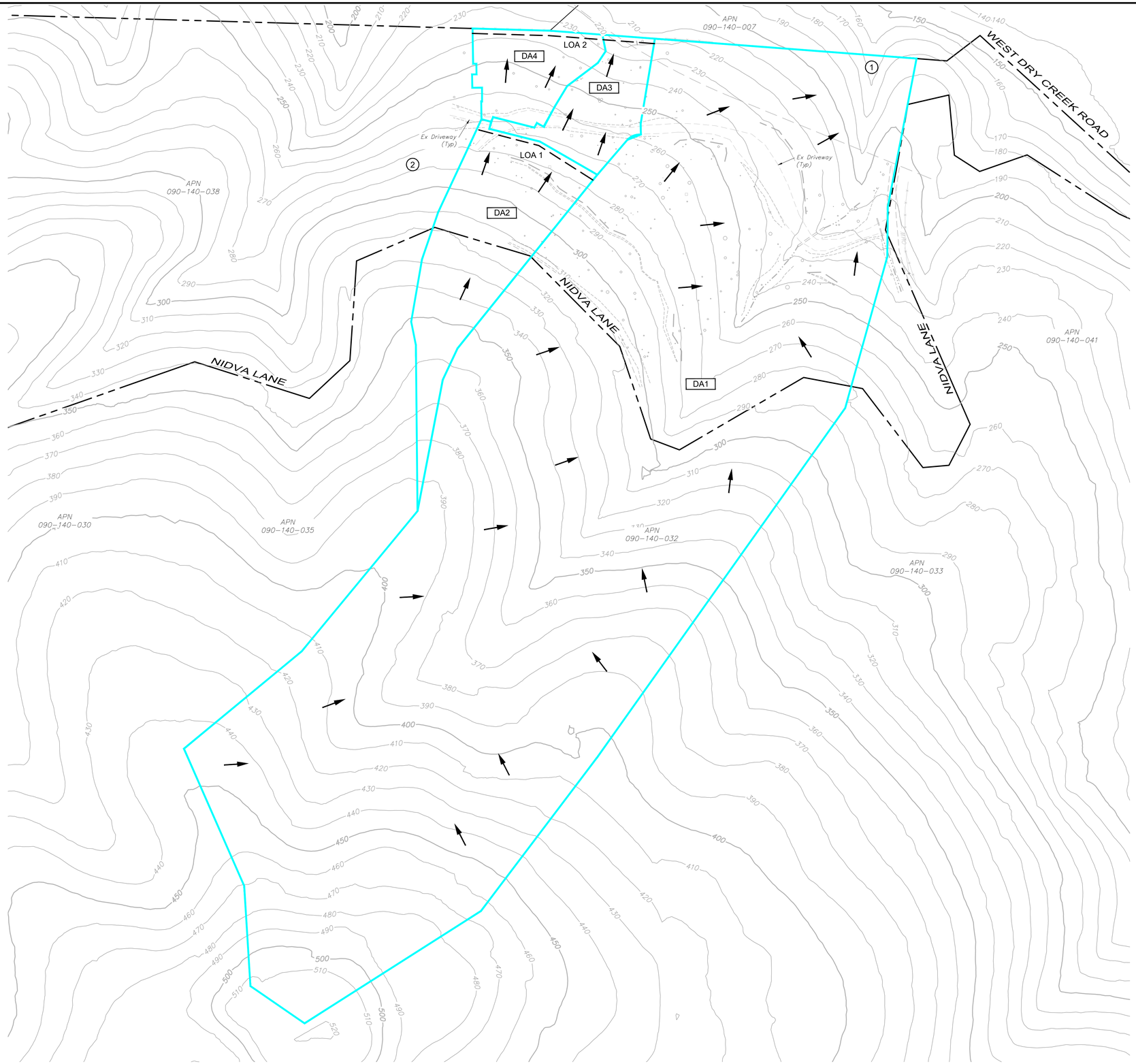
## Conclusion

In accordance with the SCWA Flood Control Design Criteria, all drainage facilities are designed to convey, without surcharge, runoff from the 10-yr storm event. The project adheres and meets Sonoma County Code Chapter 11 and Chapter 11A. Autodesk *Hydraulic Toolbox* has been used to calculate normal depth in the storm drain pipes and swale as presented in **Section 10, 10-Year Storm Event Stormdrain/Swale Analysis.**

# Aerial Photo


3210 W Dry Creek Rd
Nidva Ln
Google Earth
© 2017 Google
N
1000 ft

# Existing Conditions Map




DRAINAGE ROUTING




DRAINAGE AREA TABLE

A1 = 11.01 AC (479,720 SF)

A2 =0.85 AC (37,119 SF)

A3 =0.35 AC (15,099 SF)

A4 =0.33 AC (14,299 SF)

LINETYPE LEGEND

| PROPOSED | EXISTING | DESCRIPTION |
|---|---|---|
| | | PROPERTY BOUNDARY |
| | 320 | INDEX CONTOUR |
| | 319 | INTERMEDIATE CONTOUR |

DRAINAGE AREA LEGEND

- DA1 — DRAINAGE MANAGEMENT AREA
- DRAINAGE AREA BOUNDARY
- 1 — POINT OF CONCENTRATION
- LINE OF ANALYSIS
- DIRECTION OF FLOW

NOTE:

10-FT & 50-FT CONTOURS SHOWN ARE FROM LIDAR AND ARE SHOWN FOR GRAPHIC PURPOSES ONLY

REFER TO SUBMITTED GRADING & DRAINAGE PLANS FOR INVERTS, FLOW LINES, TOP OF GRATE ELEVATIONS AND DRAINAGE SPECIFICATIONS

THIS MAP IS FOR REFERENCE ONLY

# EXISTING CONDITIONS MAP

60' 30' 0 30' 60' 120' 180'

Graphic Scale: 1" = 60'

April 14, 2022

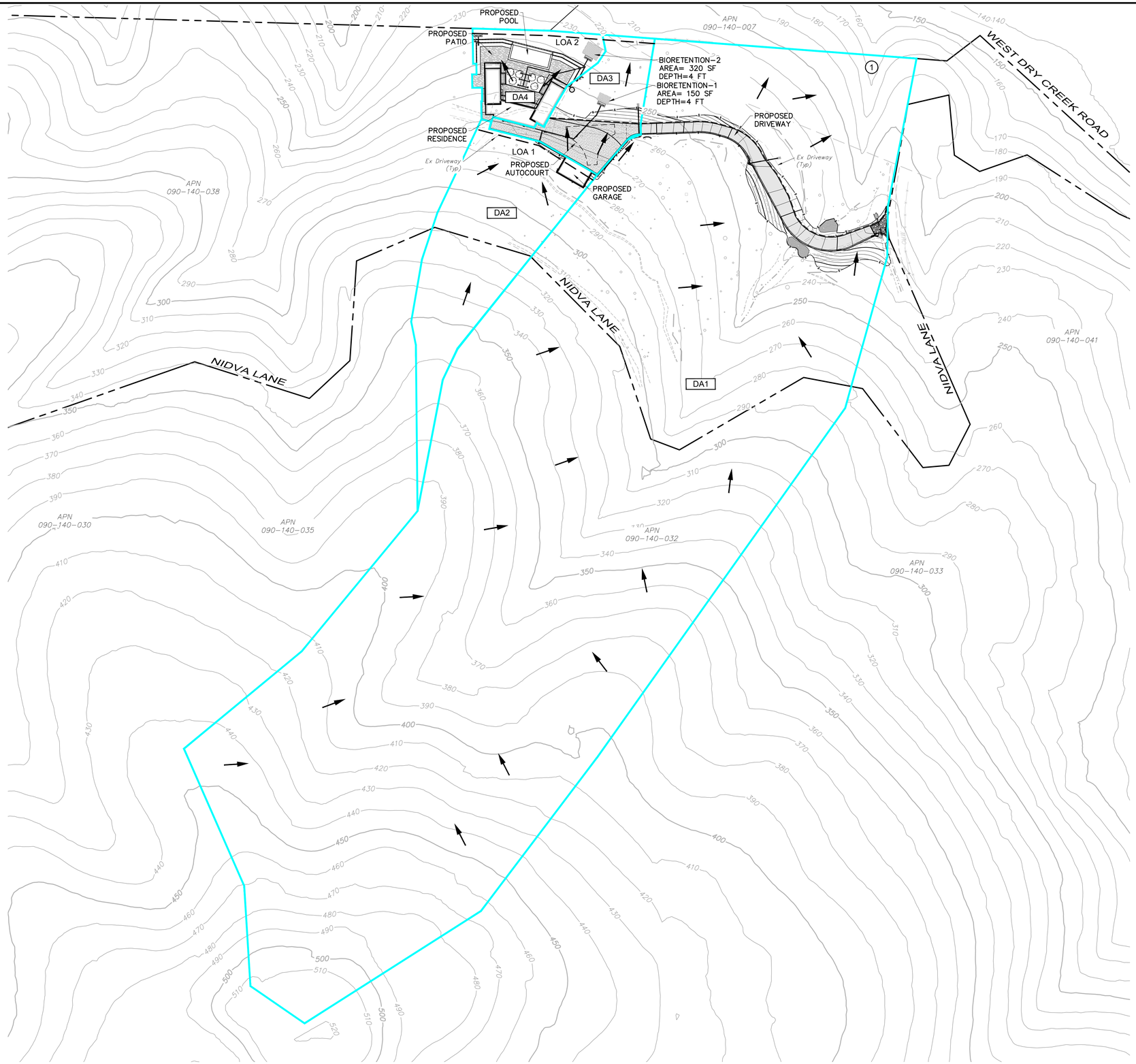
**EXISTING CONDITIONS MAP**

White Residence
3210 West Dry Creek Road, Healdsburg, CA
APN 090-140-038

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"A Service You Can Count On!"

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# Impervious Area Map




DRAINAGE ROUTING

DA1 → 1

DA2 → LOA 1 → LOA 2

DA3 → LOA 2

DA4 → LOA 2

DRAINAGE AREA TABLE

A1 = 11.01 AC (479,682 SF)

A2 =0.85 AC (37,178 SF)

A3 =0.35 AC (15,099 SF)

A4 =0.33 AC (14,299 SF)

LINETYPE LEGEND

| PROPOSED | EXISTING | DESCRIPTION |
|---|---|---|
| | | PROPERTY BOUNDARY |
| | 320 | INDEX CONTOUR |
| | 319 | INTERMEDIATE CONTOUR |

DRAINAGE AREA LEGEND

- DA1 — DRAINAGE MANAGEMENT AREA
- DRAINAGE AREA BOUNDARY
- (1) — POINT OF CONCENTRATION
- LINE OF ANALYSIS
- DIRECTION OF FLOW

NOTE:

1-FT & 5-FT CONTOURS SHOWN ARE FROM LIDAR AND ARE SHOWN FOR GRAPHIC PURPOSES ONLY

2-FT & 10-FT CONTOURS SHOWN ARE FROM LIDAR AND ARE SHOWN FOR GRAPHIC PURPOSES ONLY

REFER TO SUBMITTED GRADING & DRAINAGE PLANS FOR INVERTS, FLOW LINES, TOP OF GRATE ELEVATIONS AND DRAINAGE SPECIFICATIONS

THIS MAP IS FOR REFERENCE ONLY

HATCHING LEGEND

- PROPOSED AC CN=98
- PROPOSED PCC CN=98
- PROPOSED FLAGSTONE CN=98
- PROPOSED BIO-RETENTION AREA

# IMPERVIOUS AREA MAP

60' 30' 0 30' 60' 120' 180'

Graphic Scale: 1" = 60'

N

March 2, 2022

## IMPERVIOUS AREA MAP

White Residence
3210 West Dry Creek Road, Healdsburg, CA
APN 090-140-038

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civil engineering | land surveying | wastewater
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# Weighted Runoff Curve Number Calculator

# Weighted Runoff Curve Number

| Project: | 21387-White Residence | By: | RMS | Date: | 3/23/2022 |
|---|---|---|---|---|---|
| Location: | DA1 | | | | |

## ----- PRE-Construction Conditions -----

**1. Runoff Curve Number**

| Soil Name and Hydrologic Group (Appendix A) | Cover Description (cover type, treatment and hydrologic condition; percent impervious; unconnected/connected impervious ratio) | TR-55 CN* Tables 2-2(a-d) | TR-55 CN* Figure 2-3 | TR-55 CN* Figure 2-4 | Area Acres Miles$^2$ Percent | Product of CNxArea |
|---|---|---|---|---|---|---|
| BoF/BoG Boomer Loam, Hydrologic Soil Group C | Ex. Open Space (Fair) | 79 | | | 11.01 | 870.02 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |

*Use only one CB source per line

**Totals** 11.01 870.02

CN (weighted) = Total Product / Total Area = 79.00 **Use CN** 79

# Weighted Runoff Curve Number

| Project: | 21387-White Residence | By: | RMS | Date: | 3/23/2022 |
|---|---|---|---|---|---|
| Location: | DA1 | | | | |

## ----- POST-Construction Condtitions -----

**1. Runoff Curve Number**

| Soil Name and Hydrologic Group (Appendix A) | Cover Description (cover type, treatment and hydrologic condition; percent impervious; unconnected/connected impervious ratio) | TR-55 CN* Tables 2-2(a-d) | TR-55 CN* Figure 2-3 | TR-55 CN* Figure 2-4 | Area Acres Miles$^2$ Percent | Product of CNxArea |
|---|---|---|---|---|---|---|
| BoF/BoG Boomer Loam, Hydrologic Soil Group C | Ex. Open Space (Fair) | 79 | | | 10.89 | 859.98 |
| BoF/BoG Boomer Loam, Hydrologic Soil Group C | Proposed Driveway | 98 | | | 0.13 | 12.45 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |

*Use only one CB source per line

**Totals** 11.01 872.43

CN (weighted) = Total Product / Total Area = 79.22 **Use CN** 79

# Weighted Runoff Curve Number

| Project: | 21387-White Residence | By: | RMS | Date: | 3/23/2022 |
|---|---|---|---|---|---|
| Location: | DA2 | | | | |

## ----- PRE-Construction Conditions -----

**1. Runoff Curve Number**

| Soil Name and Hydrologic Group (Appendix A) | Cover Description (cover type, treatment and hydrologic condition; percent impervious; unconnected/connected impervious ratio) | TR-55 CN* Tables 2-2(a-d) | TR-55 CN* Figure 2-3 | TR-55 CN* Figure 2-4 | Area Acres Miles$^2$ Percent | Product of CNxArea |
|---|---|---|---|---|---|---|
| BoF/BoG Boomer Loam, Hydrologic Soil Group C | Ex. Open Space (Fair) | 79 | | | 0.81 | 64.03 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |

*Use only one CB source per line

**Totals** 0.81 64.03

CN (weighted) = Total Product / Total Area = 79.00 **Use CN** 79

# Weighted Runoff Curve Number

| Project: | 21387-White Residence | By: | RMS | Date: | 3/23/2022 |
|---|---|---|---|---|---|
| Location: | DA2 | | | | |

## ----- POST-Construction Condtitions -----

**1. Runoff Curve Number**

| Soil Name and Hydrologic Group (Appendix A) | Cover Description (cover type, treatment and hydrologic condition; percent impervious; unconnected/connected impervious ratio) | TR-55 CN* Tables 2-2(a-d) | TR-55 CN* Figure 2-3 | TR-55 CN* Figure 2-4 | Area Acres Miles$^2$ Percent | Product of CNxArea |
|---|---|---|---|---|---|---|
| BoF/BoG Boomer Loam, Hydrologic Soil Group C | Ex. Open Space (Fair) | 79 | | | 0.79 | 62.41 |
| BoF/BoG Boomer Loam, Hydrologic Soil Group C | Proposed Impervious Roofs | 98 | | | 0.02 | 2.02 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| *Use only one CB source per line | | | | **Totals** | 0.81 | 64.42 |

CN (weighted) = Total Product / Total Area = 79.48 **Use CN** 79

# Weighted Runoff Curve Number

| Project: | 21387-White Residence | By: | RMS | Date: | 3/23/2022 |
|---|---|---|---|---|---|
| Location: | DA3 | | | | |

## ----- PRE-Construction Conditions -----

**1. Runoff Curve Number**

| Soil Name and Hydrologic Group (Appendix A) | Cover Description (cover type, treatment and hydrologic condition; percent impervious; unconnected/connected impervious ratio) | TR-55 CN* Tables 2-2(a-d) | TR-55 CN* Figure 2-3 | TR-55 CN* Figure 2-4 | Area Acres Miles$^2$ Percent | Product of CNxArea |
|---|---|---|---|---|---|---|
| BoF/BoG Boomer Loam, Hydrologic Soil Group C | Ex. Open Space (Fair) | 79 | | | 0.35 | 27.38 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |

*Use only one CB source per line

**Totals** 0.35 27.38

CN (weighted) = Total Product / Total Area = 79.00 **Use CN** 79

# Weighted Runoff Curve Number

| Project: | 21387-White Residence | By: | RMS | Date: | 3/23/2022 |
|---|---|---|---|---|---|
| Location: | DA3 | | | | |

## ----- POST-Construction Condtitions -----

**1. Runoff Curve Number**

| Soil Name and Hydrologic Group (Appendix A) | Cover Description (cover type, treatment and hydrologic condition; percent impervious; unconnected/connected impervious ratio) | TR-55 CN* Tables 2-2(a-d) | TR-55 CN* Figure 2-3 | TR-55 CN* Figure 2-4 | Area Acres Miles$^2$ Percent | Product of CNxArea |
|---|---|---|---|---|---|---|
| BoF/BoG Boomer Loam, Hydrologic Soil Group C | Ex. Open Space (Fair) | 79 | | | 0.21 | 16.84 |
| BoF/BoG Boomer Loam, Hydrologic Soil Group C | Proposed Autocourt | 98 | | | 0.13 | 13.08 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| *Use only one CB source per line | | | | **Totals** | 0.35 | 29.92 |

CN (weighted) = Total Product / Total Area = 86.32 **Use CN** 86

# Weighted Runoff Curve Number

| Project: | 21387-White Residence | By: | RMS | Date: | 3/23/2022 |
|---|---|---|---|---|---|
| Location: | DA4 | | | | |

## ----- PRE-Construction Conditions -----

**1. Runoff Curve Number**

| Soil Name and Hydrologic Group (Appendix A) | Cover Description (cover type, treatment and hydrologic condition; percent impervious; unconnected/connected impervious ratio) | TR-55 CN* Tables 2-2(a-d) | TR-55 CN* Figure 2-3 | TR-55 CN* Figure 2-4 | Area Acres Miles$^2$ Percent | Product of CNxArea |
|---|---|---|---|---|---|---|
| BoF/BoG Boomer Loam, Hydrologic Soil Group C | Ex. Open Space (Fair) | 79 | | | 0.33 | 25.93 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |

*Use only one CB source per line

**Totals** 0.33 25.93

CN (weighted) = Total Product / Total Area = 79.00 **Use CN** 79

# Weighted Runoff Curve Number

| Project: | 21387-White Residence | By: | RMS | Date: | 3/23/2022 |
|---|---|---|---|---|---|
| Location: | DA4 | | | | |

## ----- POST-Construction Condtitions -----

**1. Runoff Curve Number**

| Soil Name and Hydrologic Group (Appendix A) | Cover Description (cover type, treatment and hydrologic condition; percent impervious; unconnected/connected impervious ratio) | TR-55 CN* Tables 2-2(a-d) | TR-55 CN* Figure 2-3 | TR-55 CN* Figure 2-4 | Area Acres Miles$^2$ Percent | Product of CNxArea |
|---|---|---|---|---|---|---|
| BoF/BoG Boomer Loam, Hydrologic Soil Group C | Ex. Open Space (Fair) | 79 | | | 0.11 | 8.54 |
| BoF/BoG Boomer Loam, Hydrologic Soil Group C | Proposed Impervious Roofs | 98 | | | 0.09 | 8.65 |
| BoF/BoG Boomer Loam, Hydrologic Soil Group C | Proposed Concrete | 98 | | | 0.004 | 0.35 |
| BoF/BoG Boomer Loam, Hydrologic Soil Group C | Proposed Flagstone | 98 | | | 0.07 | 6.98 |
| BoF/BoG Boomer Loam, Hydrologic Soil Group C | Proposed Impervious Areas | 98 | | | 0.057 | 5.59 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |
| | | | | | | 0.00 |

*Use only one CB source per line

**Totals** 0.33 30.11

CN (weighted) = Total Product / Total Area = 91.74 **Use CN** 92

# Santa Rosa LID Calculator

City of Santa Rosa WATER

# STORM WATER CALCULATOR

## LID BMP Summary Page & Site Global Values

**Project Information:**

| | |
|---|---|
| Project Name: | White Residence |
| Address/Location: | 3210 West Dry Creek Road, Healdsburg CA |
| Designer: | RMS |
| Date: | 3/28/2022 |

**Site Information:**

| | | |
|---|---|---|
| Mean Seasonal Precipitation (MSP) of Project Site: | 45.00 | (inches) |
| K=MSP/3( K= | 1.50 | |
| Impervious area - pre development: | - | $ft^2$ |
| Impervious area - post development: | 15,618.0 | $ft^2$ |

Based upon the pre and post development impervious area, the post construction BMP requirement is:

Treatment Only

**Summary of Saved BMP Results:**

| | | Tributary Area | | Requirements | | BMP Design Results | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Hydromodification Control | | Flow Base Treatment | | Delta Volume Capture | |
| | BMP ID: | Tributary Area ($ft^2$.) | Runoff Reduction Measures (Y/N) | Type of Requirement Met | Type of BMP Design | Percent Achieved | Required $V_{Hydromod}$ ($ft^3$) | Achieved ($ft^3$) | Required Q Treatment (cfs) | Achieved ($ft^3$) | Required Vdelta ($ft^3$) | Achieved ($ft^3$) |
| 1 | DA3 | 15,099 | No | Delta Volume Capture | Priority 2: P2-05 Roadside Bioretention - No Curb AND Gutter | 103.2 | | | | | 293.5246 | 663.0000 |
| 2 | | | | | | | | | | | | |
| 3 | DA4 | 14,299 | No | Delta Volume Capture | Priority 2: P2-05 Roadside Bioretention - No Curb AND Gutter | 101.3 | | | | | 646.3148 | 1422.5000 |
| 4 | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | |
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| 29 | | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |

# STORM WATER CALCULATOR

## BMP Tributary Parameters

Project Name: **White Residence**

| | |
|---|---|
| BMP ID: | DA3 |
| BMP Design Criteria: | Treatment Only |
| Type of BMP Design: | Priority 2: P2-05 Roadside Bioretention - No Curb AND Gutter |
| BMP's Physical Tributary Area: | 15,099.0 $ft^2$ |
| Description/Notes: | Bioretention-1 |

## Delta Volume Capture; $V_{Delta}$

$V_{DELTA}$ = 293.52 $ft^3$

| | |
|---|---|
| Hydrologic soil type within tributary area: | C: 0.05 - 0.15 in/hr infiltration (transmission) rate |
| Predevelopment ground cover description: | Open Space (lawns, parks, golf courses, cemeteries, etc.) - Fair (50% to 75% grass cover) |
| Post development ground cover description: | Open Space (lawns, parks, golf courses, cemeteries, etc.) - Fair (50% to 75% grass cover) |
| $CN_{PRE}$: | |
| $CN_{POST}$: | |
| User Composite Predevelopment CN: | 79.0 |
| User Composite Post development CN: | 86.0 |

## BMP Sizing Tool Delta Volume Capture Requirement

Percent of Goal Achieved = 103.23 %

| | BMP Volume Below Ground | | Ponded Water Above Ground | |
|---|---|---|---|---|
| Porosity: | 0.40 | | | |
| Depth below perforated pipe if present: | 4.00 | ft | | |
| Depth: | | | 0.50 | ft |
| Width: | 10.00 | ft | 9.00 | ft |
| Length: | 15.00 | ft | 14.00 | ft |
| Area: | 0.00 | $ft^2$ | 0.00 | $ft^2$ |

# STORM WATER CALCULATOR

## BMP Tributary Parameters

Project Name: **White Residence**

| | |
|---|---|
| BMP ID: | DA4 |
| BMP Design Criteria: | Treatment Only |
| Type of BMP Design: | Priority 2: P2-05 Roadside Bioretention - No Curb AND Gutter |
| BMP's Physical Tributary Area: | 14,299.0 $ft^2$ |
| Description/Notes: | Bioretention-2 |

## Delta Volume Capture; $V_{Delta}$

$V_{DELTA}$ = 646.31 $ft^3$

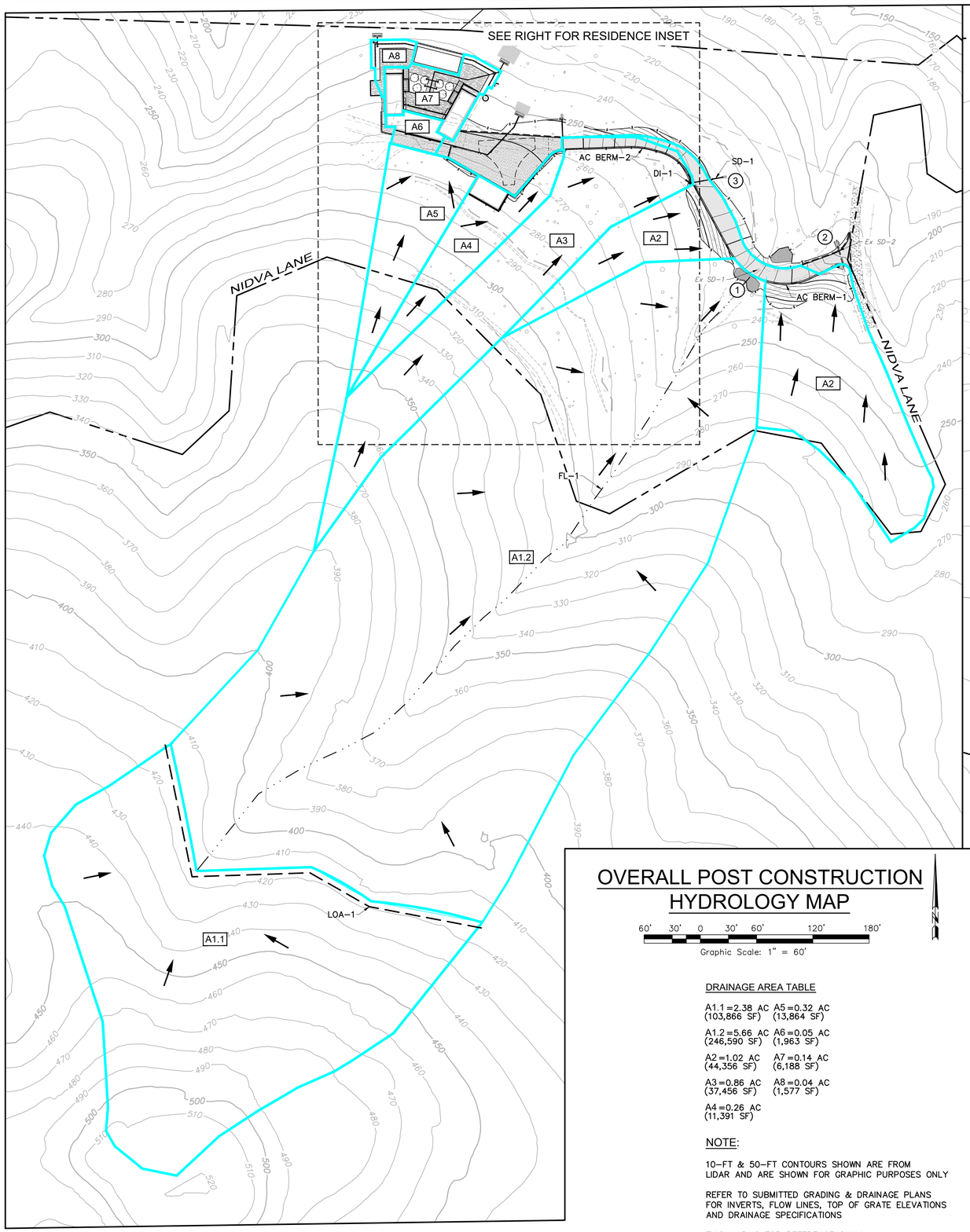
| | |
|---|---|
| Hydrologic soil type within tributary area: | C: 0.05 - 0.15 in/hr infiltration (transmission) rate |
| Predevelopment ground cover description: | Open Space (lawns, parks, golf courses, cemeteries, etc.) - Fair (50% to 75% grass cover) |
| Post development ground cover description: | Open Space (lawns, parks, golf courses, cemeteries, etc.) - Fair (50% to 75% grass cover) |
| $CN_{PRE}$: | |
| $CN_{POST}$: | |
| User Composite Predevelopment CN: | 79.0 |
| User Composite Post development CN: | 92.0 |

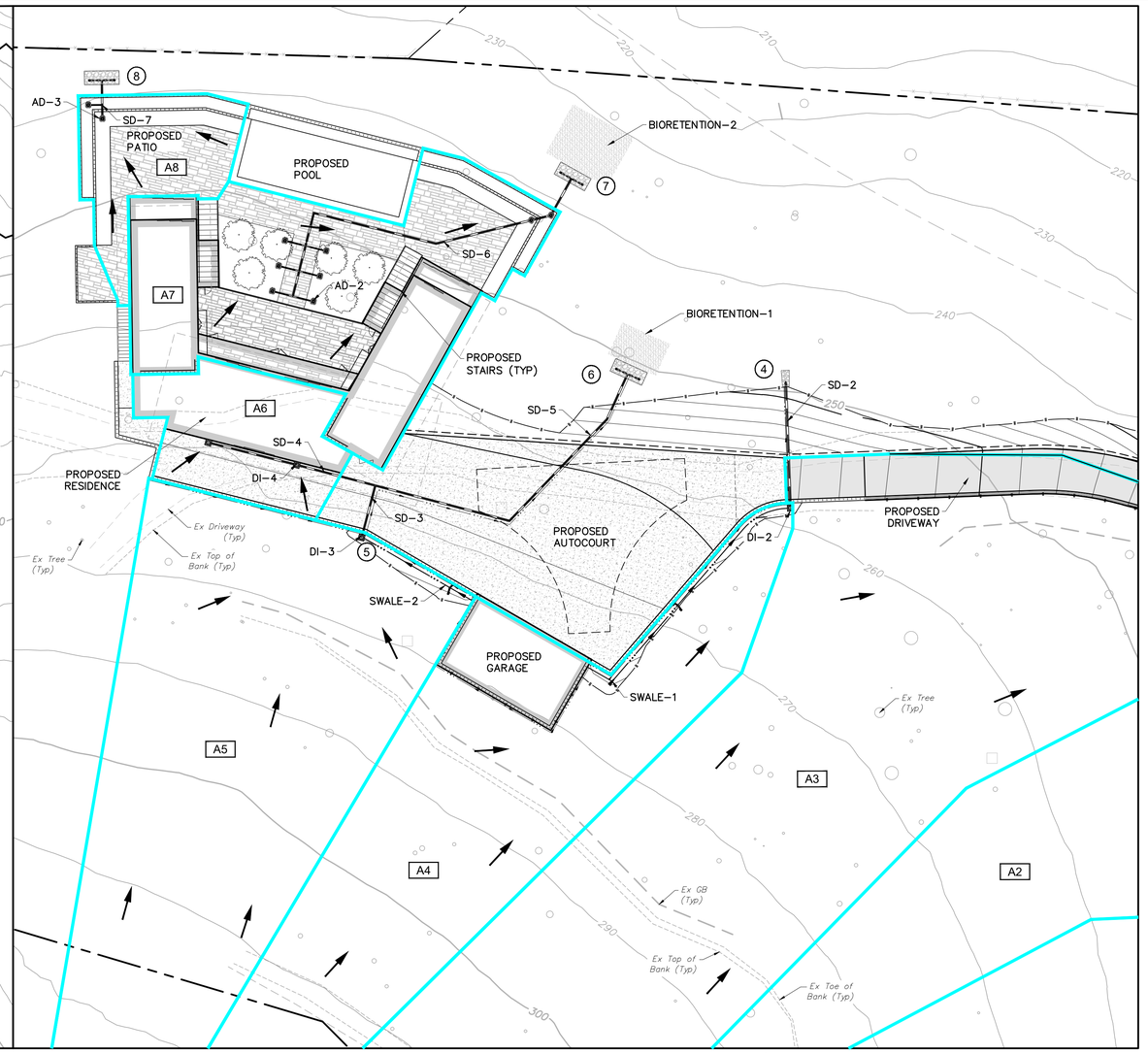
## BMP Sizing Tool Delta Volume Capture Requirement

Percent of Goal Achieved = 101.27 %

| | BMP Volume Below Ground | | Ponded Water Above Ground | |
|---|---|---|---|---|
| Porosity: | 0.40 | | | |
| Depth below perforated pipe if present: | 4.00 | ft | | |
| Depth: | | | 0.50 | ft |
| Width: | 20.00 | ft | 19.00 | ft |
| Length: | 16.00 | ft | 15.00 | ft |
| Area: | 0.00 | $ft^2$ | 0.00 | $ft^2$ |

# Post-Construction Hydrology Map




# OVERALL POST CONSTRUCTION HYDROLOGY MAP

60' 30' 0 30' 60' 120' 180'

Graphic Scale: 1" = 60'

# RESIDENCE POST CONSTRUCTION HYDROLOGY MAP

20' 10' 0 10' 20' 40' 60'

Graphic Scale: 1" = 20'

## DRAINAGE AREA TABLE

A1.1 = 2.38 AC (103,866 SF)
A5 = 0.32 AC (13,864 SF)

A1.2 = 5.66 AC (246,590 SF)
A6 = 0.05 AC (1,963 SF)

A2 = 1.02 AC (44,356 SF)
A7 = 0.14 AC (6,188 SF)

A3 = 0.86 AC (37,456 SF)
A8 = 0.04 AC (1,577 SF)

A4 = 0.26 AC (11,391 SF)

## NOTE:

10–FT & 50–FT CONTOURS SHOWN ARE FROM LIDAR AND ARE SHOWN FOR GRAPHIC PURPOSES ONLY

REFER TO SUBMITTED GRADING & DRAINAGE PLANS FOR INVERTS, FLOW LINES, TOP OF GRATE ELEVATIONS AND DRAINAGE SPECIFICATIONS

THIS MAP IS FOR REFERENCE ONLY

## DRAINAGE ROUTING

A1.1 → LOA–1 → A1.2 → 1
A2 → 2
A3 → 3
A4 → 4
A5 → 5
A6 → 6
A7 → 7
A8 → 8

## DRAINAGE AREA LEGEND

- DA1 — DRAINAGE AREA
- DRAINAGE AREA BOUNDARY
- 1 — POINT OF CONCENTRATION
- LINE OF ANALYSIS
- DIRECTION OF FLOW

March 23, 2022

# POST CONSTRUCTION HYDROLOGY MAP

WHITE RESIDENCE
2310 West Dry Creek Road, Healdsburg, CA
APN 090-140-038

adobe associates, inc.
civil engineering I land surveying I wastewater
1220 N. Dutton Ave., Santa Rosa, CA 95401
P. (707) 541-2300 F. (707) 541-2301
Website: www.adobeinc.com
"A Service You Can Count On!"

T:\2021 PROJECTS\21387\dwg\Adobe–Design\Const Docs\Drainage\21387–Post Construction Hydrology Map.dwg, Roswin Morales–Serrano, 4/20/2022 2:56:19 PM

# 10 and 100-Year Rational Method Drainage Study

# Incremental Rational Method Drainage Study

**10 -Yr Storm Event Post Construction**

**Project:** 21189 - White Residence **Date:** 4/19/2022

| Point of Concentration | Area | Elevation | Distance | Slope | V(ft/s) | Travel Time (min) | Total Time (min) | I | C | A | $A_{total}$ | AC | Sum AC | Q (cfs) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 year | | | | | | | | | | | | | | | |
| **ON SITE FLOW RATES** | | | | | | | | | | | | | | | |
| 1 | A 1.1 | - | - | - | - | 15.00 | 15.00 | 2.13 | 0.47 | 2.38 | 2.38 | 1.12 | 1.12 | 2.38 | Overland Flow to LOA-1 |
| 1 | A 1.2 | - | 879 | 0.20 | 7.36 | 1.99 | 16.99 | 2.00 | 0.47 | 5.66 | 5.66 | 2.66 | 3.78 | 7.55 | Total Flow to Ex SD-1 |
| 2 | A 2 | - | - | - | - | 15.00 | 15.00 | 2.13 | 0.47 | 1.02 | 1.02 | 0.48 | 0.48 | 1.02 | Total to Ex SD-2 & AC Berm-1 |
| 3 | A 3 | - | - | - | - | 15.00 | 15.00 | 2.13 | 0.47 | 0.86 | 0.86 | 0.40 | 0.40 | 0.86 | Total Flow to SD-1 & AC Berm-2 |
| 4 | A 4 | - | - | - | - | 10.00 | 10.00 | 2.62 | 0.47 | 0.26 | 0.26 | 0.12 | 0.12 | 0.32 | Total Flow to SD-2 & Swale-1 |
| 5 | A 5 | - | - | - | - | 10.00 | 10.00 | 2.62 | 0.47 | 0.32 | 0.32 | 0.15 | 0.15 | 0.39 | Overland Flow to SD-3 & Swale-2 |
| 6 | A 6 | - | - | - | - | 7.00 | 7.00 | 3.15 | 0.90 | 0.05 | 0.05 | 0.05 | 0.05 | 0.14 | Overland Flow to SD-4 |
| 6 | | | | | | | | Combines A5 & A6 | | | | | | 0.54 | Total Flow to SD-5 |
| 7 | A 7 | - | - | - | - | 7.00 | 7.00 | 3.15 | 0.90 | 0.14 | 0.14 | 0.13 | 0.13 | 0.40 | Total Flow to SD-6 |
| 8 | A 8 | - | - | - | - | 7.00 | 7.00 | 3.15 | 0.90 | 0.04 | 0.04 | 0.04 | 0.04 | 0.11 | Total Flow to SD-7 |

**ON SITE - POST CONSTRUCTION RUNOFF COEFFICIENT**

| DRAINAGE AREA | ACRES | C | t (min) | LAND* USE | SOIL TYPE | AVE SLOPE (%) |
|---|---|---|---|---|---|---|
| A 1.1 | 2.38 | 0.47 | 15.00 | R | C | >12 |
| A 1.2 | 5.66 | 0.47 | 15.00 | R | C | >12 |
| A 2 | 1.02 | 0.47 | 15.00 | R | C | >12 |
| A 3 | 0.86 | 0.47 | 15.00 | R | C | >12 |
| A 4 | 0.26 | 0.47 | 10.00 | R | C | >12 |
| A 5 | 0.32 | 0.47 | 10.00 | R | C | >12 |
| A 6 | 0.05 | 0.90 | 7.00 | HD | C | >6-12 |
| A 7 | 0.14 | 0.90 | 7.00 | HD | C | >6-12 |
| A 8 | 0.04 | 0.90 | 7.00 | HD | C | >6-12 |

***Land Use Designation**

HD - High Density
LD - Low Density
MD - Medium Density
MLD - Medium/Low Density
R - Rural
B/C - Business or Commercial
I - Industrial
P - Parks and Recreation
AG - Agricultural or Open Space

**Rainfall Intensity vs Duration**

$$I = 8.52 / t^{0.512}$$

**I =** intensity (in/hour)

**t =** time of concentration (minutes)

Reference Table C-1 of the Sonoma County FMDM, 2020.

# Incremental Rational Method Drainage Study

**100 -Yr Storm Event Post Construction**

**Project:** 21189 - White Residence **Date:** 4/19/2022

| Point of Concentration | Area | Elevation | Distance | Slope | V(ft/s) | Travel Time (min) | Total Time (min) | I | C | A | $A_{total}$ | AC | Sum AC | Q (cfs) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 100 year | | | | | | | | | | | | | | | |
| **ON SITE FLOW RATES** | | | | | | | | | | | | | | | |
| 1 | A 1.1 | - | - | - | - | 15.00 | 15.00 | 3.07 | 0.47 | 2.38 | 2.38 | 1.12 | 1.12 | 3.44 | Overland Flow to LOA-1 |
| 1 | A 1.2 | - | 879 | 0.20 | 6.90 | 2.12 | 17.12 | 2.87 | 0.47 | 5.66 | 5.66 | 2.66 | 3.78 | 10.85 | Total Flow to Ex SD-1 |
| 2 | A 2 | - | - | - | - | 15.00 | 15.00 | 3.07 | 0.47 | 1.02 | 1.02 | 0.48 | 0.48 | 1.47 | Total to Ex SD-2 & AC Berm-1 |
| 3 | A 3 | - | - | - | - | 15.00 | 15.00 | 3.07 | 0.47 | 0.86 | 0.86 | 0.40 | 0.40 | 1.24 | Total Flow to SD-1 & AC Berm-2 |
| 4 | A 4 | - | - | - | - | 10.00 | 10.00 | 3.78 | 0.47 | 0.26 | 0.26 | 0.12 | 0.12 | 0.46 | Total Flow to SD-2 & Swale-1 |
| 5 | A 5 | - | - | - | - | 10.00 | 10.00 | 3.78 | 0.47 | 0.32 | 0.32 | 0.15 | 0.15 | 0.57 | Overland Flow to SD-3 & Swale-2 |
| 6 | A 6 | - | - | - | - | 7.00 | 7.00 | 4.54 | 0.90 | 0.05 | 0.05 | 0.05 | 0.05 | 0.20 | Overland Flow to SD-4 |
| 6 | | | | | | | | Combines A5 & A6 | | | | | | 0.77 | Total Flow to SD-5 |
| 7 | A 7 | - | - | - | - | 7.00 | 7.00 | 4.54 | 0.90 | 0.14 | 0.14 | 0.13 | 0.13 | 0.57 | Total Flow to SD-6 |
| 8 | A 8 | - | - | - | - | 7.00 | 7.00 | 4.54 | 0.90 | 0.04 | 0.04 | 0.04 | 0.04 | 0.16 | Total Flow to SD-7 |

**ON SITE - POST CONSTRUCTION RUNOFF COEFFICIENT**

| DRAINAGE AREA | ACRES | C | t (min) | LAND* USE | SOIL TYPE | AVE SLOPE (%) |
|---|---|---|---|---|---|---|
| A 1.1 | 2.38 | 0.47 | 15.00 | R | C | >12 |
| A 1.2 | 5.66 | 0.47 | 15.00 | R | C | >12 |
| A 2 | 1.02 | 0.47 | 15.00 | R | C | >12 |
| A 3 | 0.86 | 0.47 | 15.00 | R | C | >12 |
| A 4 | 0.26 | 0.47 | 10.00 | R | C | >12 |
| A 5 | 0.32 | 0.47 | 10.00 | R | C | >12 |
| A 6 | 0.05 | 0.90 | 7.00 | HD | C | >6-12 |
| A 7 | 0.14 | 0.90 | 7.00 | HD | C | >6-12 |
| A 8 | 0.04 | 0.90 | 7.00 | HD | C | >6-12 |

***Land Use Designation**

HD - High Density
LD - Low Density
MD - Medium Density
MLD - Medium/Low Density
R - Rural
B/C - Business or Commercial
I - Industrial
P - Parks and Recreation
AG - Agricultural or Open Space

Reference Table C-1 of the Sonoma County FMDM, 2020.

**Rainfall Intensity vs Duration**

$$I = 12.30 / t^{0.512}$$

**I =** intensity (in/hour)

**t =** time of concentration (minutes)

# NOAA Atlas 14 – Point Precipitation Frequency Estimates & Intensity Duration Frequency Curve (IDF Curve)

**NOAA Atlas 14, Volume 6, Version 2**
**Location name: Healdsburg, California, USA***
**Latitude: 38.6309°, Longitude: -122.9048°**
**Elevation: 135 ft****
* source: ESRI Maps
** source: USGS

**POINT PRECIPITATION FREQUENCY ESTIMATES**

Sanja Perica, Sarah Dietz, Sarah Heim, Lillian Hiner, Kazungu Maitaria, Deborah Martin, Sandra Pavlovic, Ishani Roy, Carl Trypaluk, Dale Unruh, Fenglin Yan, Michael Yekta, Tan Zhao, Geoffrey Bonnin, Daniel Brewer, Li-Chuan Chen, Tye Parzybok, John Yarchoan

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

## PF tabular

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

| Duration | Average recurrence interval (years) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 5 | 10 | 25 | 50 | 100 | 200 | 500 | 1000 |
| 5-min | **1.99** (1.78-2.27) | **2.52** (2.24-2.87) | **3.18** (2.82-3.64) | **3.71** (3.24-4.27) | **4.37** (3.68-5.24) | **4.86** (4.00-5.98) | **5.34** (4.27-6.77) | **5.82** (4.50-7.61) | **6.43** (4.74-8.83) | **6.89** (4.87-9.85) |
| 10-min | **1.43** (1.27-1.62) | **1.81** (1.61-2.06) | **2.29** (2.02-2.60) | **2.65** (2.33-3.06) | **3.13** (2.64-3.76) | **3.49** (2.86-4.28) | **3.83** (3.06-4.85) | **4.17** (3.22-5.45) | **4.61** (3.40-6.34) | **4.94** (3.49-7.06) |
| 15-min | **1.15** (1.02-1.31) | **1.46** (1.30-1.66) | **1.84** (1.63-2.10) | **2.14** (1.88-2.46) | **2.53** (2.13-3.03) | **2.81** (2.31-3.46) | **3.09** (2.46-3.91) | **3.36** (2.60-4.40) | **3.72** (2.74-5.11) | **3.98** (2.82-5.69) |
| 30-min | **0.798** (0.710-0.906) | **1.01** (0.898-1.15) | **1.28** (1.13-1.46) | **1.48** (1.30-1.71) | **1.75** (1.48-2.10) | **1.95** (1.60-2.40) | **2.14** (1.71-2.71) | **2.33** (1.80-3.05) | **2.58** (1.90-3.54) | **2.76** (1.95-3.95) |
| 60-min | **0.562** (0.500-0.639) | **0.712** (0.632-0.810) | **0.899** (0.796-1.03) | **1.05** (0.916-1.20) | **1.23** (1.04-1.48) | **1.37** (1.13-1.69) | **1.51** (1.20-1.91) | **1.64** (1.27-2.15) | **1.82** (1.34-2.49) | **1.95** (1.38-2.78) |
| 2-hr | **0.442** (0.392-0.502) | **0.549** (0.488-0.624) | **0.682** (0.604-0.778) | **0.785** (0.688-0.904) | **0.918** (0.773-1.10) | **1.01** (0.833-1.25) | **1.11** (0.884-1.40) | **1.20** (0.926-1.57) | **1.32** (0.968-1.81) | **1.40** (0.992-2.01) |
| 3-hr | **0.384** (0.342-0.437) | **0.474** (0.421-0.539) | **0.584** (0.517-0.666) | **0.669** (0.586-0.771) | **0.778** (0.655-0.933) | **0.856** (0.704-1.05) | **0.932** (0.744-1.18) | **1.01** (0.777-1.32) | **1.10** (0.810-1.51) | **1.17** (0.827-1.67) |
| 6-hr | **0.299** (0.266-0.340) | **0.366** (0.325-0.416) | **0.448** (0.397-0.511) | **0.511** (0.448-0.588) | **0.590** (0.497-0.707) | **0.646** (0.531-0.794) | **0.700** (0.559-0.886) | **0.753** (0.581-0.984) | **0.818** (0.602-1.12) | **0.866** (0.612-1.24) |
| 12-hr | **0.219** (0.194-0.248) | **0.271** (0.241-0.309) | **0.335** (0.296-0.382) | **0.382** (0.335-0.440) | **0.441** (0.372-0.529) | **0.483** (0.397-0.594) | **0.523** (0.417-0.662) | **0.560** (0.433-0.733) | **0.607** (0.447-0.834) | **0.641** (0.453-0.916) |
| 24-hr | **0.155** (0.140-0.176) | **0.197** (0.177-0.224) | **0.246** (0.221-0.281) | **0.283** (0.252-0.325) | **0.328** (0.283-0.388) | **0.360** (0.305-0.433) | **0.389** (0.322-0.479) | **0.417** (0.337-0.527) | **0.452** (0.351-0.592) | **0.476** (0.359-0.644) |
| 2-day | **0.103** (0.092-0.116) | **0.131** (0.118-0.149) | **0.166** (0.148-0.189) | **0.191** (0.170-0.219) | **0.222** (0.192-0.263) | **0.244** (0.206-0.294) | **0.264** (0.219-0.325) | **0.283** (0.228-0.357) | **0.306** (0.238-0.401) | **0.322** (0.243-0.436) |
| 3-day | **0.079** (0.071-0.090) | **0.102** (0.092-0.116) | **0.129** (0.116-0.147) | **0.149** (0.133-0.171) | **0.174** (0.150-0.205) | **0.190** (0.161-0.230) | **0.206** (0.171-0.254) | **0.221** (0.179-0.279) | **0.240** (0.186-0.314) | **0.252** (0.190-0.342) |
| 4-day | **0.066** (0.059-0.075) | **0.085** (0.076-0.097) | **0.108** (0.097-0.123) | **0.125** (0.111-0.143) | **0.145** (0.125-0.172) | **0.159** (0.135-0.192) | **0.173** (0.143-0.213) | **0.185** (0.150-0.234) | **0.201** (0.156-0.263) | **0.212** (0.160-0.287) |
| 7-day | **0.047** (0.042-0.053) | **0.060** (0.054-0.068) | **0.076** (0.068-0.086) | **0.087** (0.078-0.100) | **0.102** (0.088-0.121) | **0.112** (0.095-0.135) | **0.122** (0.101-0.150) | **0.131** (0.106-0.165) | **0.142** (0.111-0.187) | **0.150** (0.113-0.203) |
| 10-day | **0.038** (0.034-0.043) | **0.048** (0.043-0.055) | **0.061** (0.054-0.069) | **0.070** (0.062-0.080) | **0.082** (0.070-0.096) | **0.090** (0.076-0.108) | **0.098** (0.081-0.120) | **0.105** (0.085-0.133) | **0.114** (0.089-0.150) | **0.121** (0.091-0.164) |
| 20-day | **0.025** (0.022-0.028) | **0.032** (0.029-0.036) | **0.040** (0.036-0.046) | **0.046** (0.041-0.053) | **0.054** (0.047-0.064) | **0.059** (0.050-0.072) | **0.065** (0.053-0.080) | **0.069** (0.056-0.088) | **0.076** (0.059-0.099) | **0.080** (0.060-0.108) |
| 30-day | **0.020** (0.018-0.023) | **0.025** (0.023-0.029) | **0.032** (0.029-0.036) | **0.037** (0.033-0.042) | **0.043** (0.037-0.051) | **0.047** (0.040-0.057) | **0.051** (0.043-0.063) | **0.055** (0.045-0.070) | **0.060** (0.047-0.079) | **0.063** (0.048-0.086) |
| 45-day | **0.016** (0.015-0.018) | **0.021** (0.019-0.024) | **0.026** (0.023-0.030) | **0.030** (0.027-0.035) | **0.035** (0.030-0.041) | **0.038** (0.033-0.046) | **0.042** (0.035-0.051) | **0.045** (0.036-0.056) | **0.048** (0.038-0.063) | **0.051** (0.038-0.069) |
| 60-day | **0.014** (0.013-0.016) | **0.018** (0.016-0.021) | **0.023** (0.021-0.026) | **0.026** (0.023-0.030) | **0.031** (0.026-0.036) | **0.034** (0.028-0.040) | **0.036** (0.030-0.045) | **0.039** (0.031-0.049) | **0.042** (0.033-0.055) | **0.044** (0.033-0.060) |

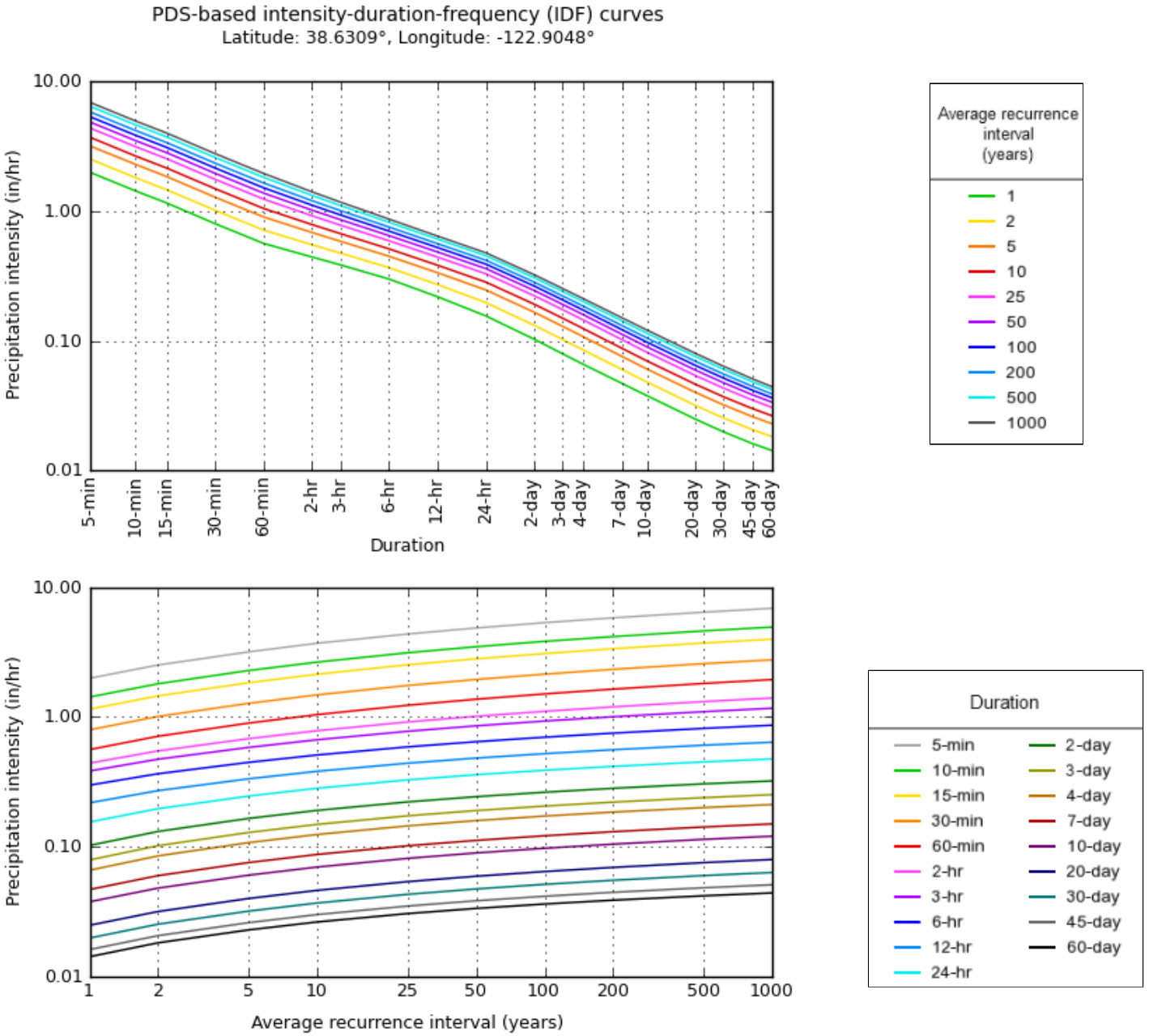
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

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.

Back to Top

## PF graphical



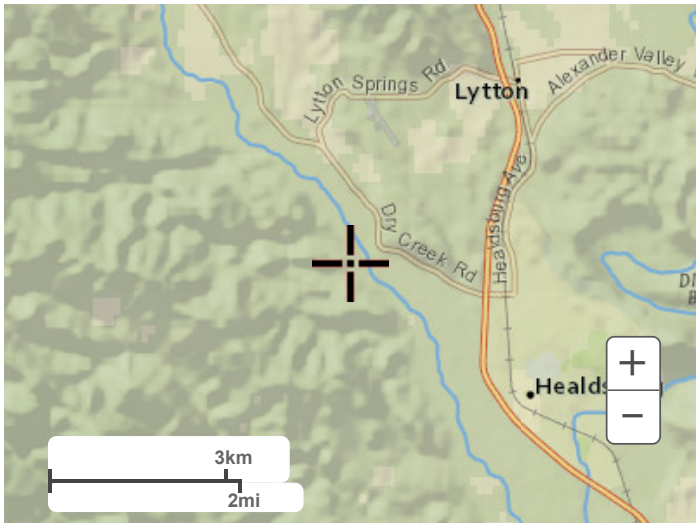

NOAA Atlas 14, Volume 6, Version 2

Created (GMT): Wed Mar 30 18:59:08 2022

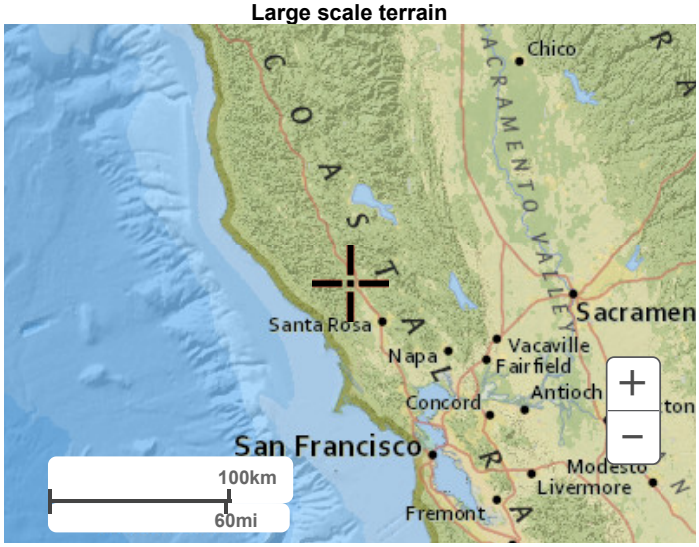
Back to Top

## Maps & aerials

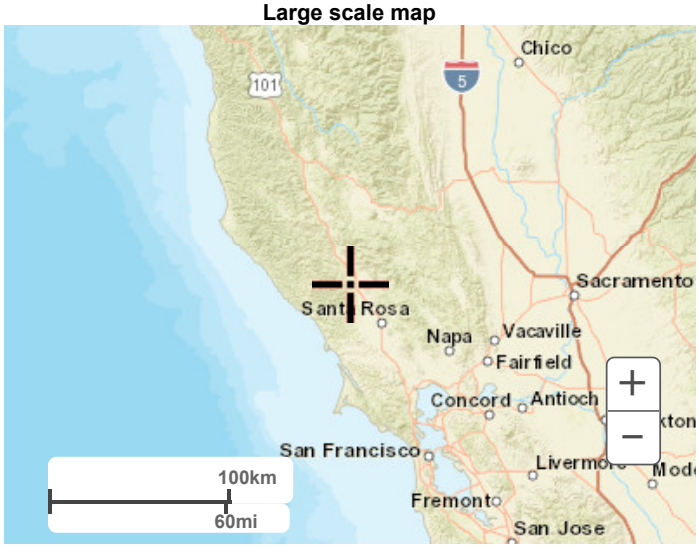
**Small scale terrain**




**Large scale terrain**




**Large scale map**




**Large scale aerial**




Back to Top

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US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
National Water Center
1325 East West Highway
Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Disclaimer

# Intensity Duration Frequency Curve (IDF Curve)

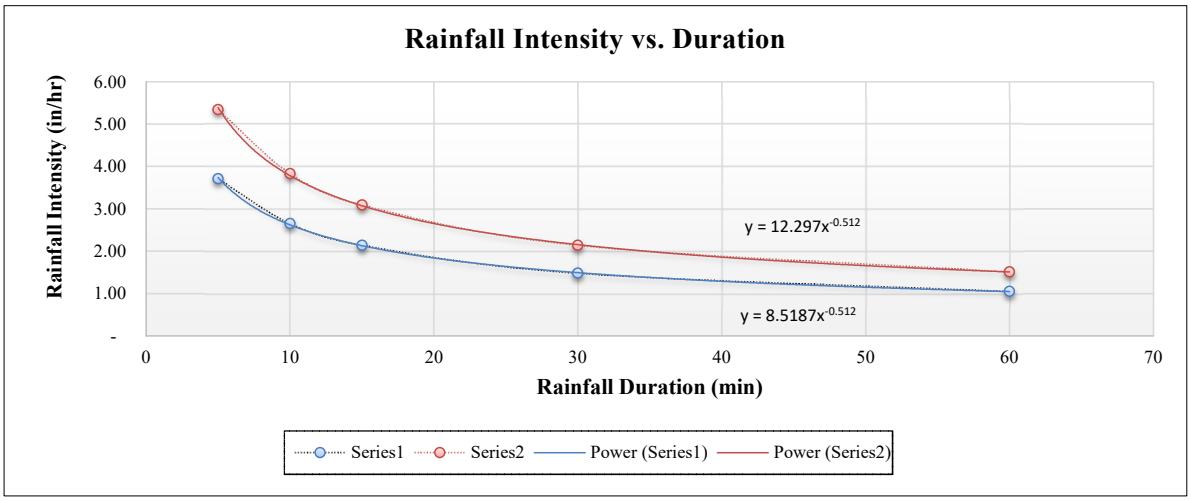
**NOAA Atlas 14 Point Precipitation Frequency Estimates**

https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_map_cont.html

**Project:** White Residence
**JN:** 21387

**Date:** 3/30/2022
**Designer:** RMS

**Location: 2310 West Dry Creek Road, Healdsburg, CA**




| NOAA Atlas 14 Data Rainfall Intensity (in/hr) | | |
|---|---|---|
| **Duration (min)** | **10-yr** | **100-yr** |
| 5 | 3.71 | 5.34 |
| 10 | 2.65 | 3.83 |
| 15 | 2.14 | 3.09 |
| 30 | 1.48 | 2.14 |
| 60 | 1.05 | 1.51 |

**Rainfall Intensity vs Duration**

$$I = a * t^{b}$$

**I =** intensity (in/hour)
**t =** time of concentration/ rainfall duration (minutes)

| 10-Year Trendline Values | |
|---|---|
| a = | 8.520 |
| b = | -0.512 |

| 100-Year Trendline Values | |
|---|---|
| a = | 12.297 |
| b = | -0.512 |

# 10-Year Storm Event
# Stormdrain/Swale Analysis

# Hydraulic Analysis Report

## Project Data

Project Title: 21387-Drainage Calcs

Designer: RMS

Project Date: Friday, April 8, 2022

Project Units: U.S. Customary Units

Notes:

## Channel Analysis: Flow Line-1

Notes: A1.1 & A1.2

## Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 2.7000 ft/ft

Side Slope 2 (Z2): 2.7000 ft/ft

Longitudinal Slope: 0.2000 ft/ft

Manning's n: 0.0150

Flow: 3.4400 cfs

## Result Parameters

Depth: 0.3194 ft

Area of Flow: 0.2754 ft^2

Wetted Perimeter: 1.8390 ft

Hydraulic Radius: 0.1497 ft

Average Velocity: 12.4928 ft/s

Top Width: 1.7245 ft

Froude Number: 5.5095

Critical Depth: 0.6320 ft

Critical Velocity: 3.1898 ft/s

Critical Slope: 0.0052 ft/ft

Critical Top Width: 3.41 ft

Calculated Max Shear Stress: 3.9855 lb/ft^2

Calculated Avg Shear Stress: 1.8687 lb/ft^2

## Channel Analysis: Ex SD-1

Notes: A1.1 & A1.2

### Input Parameters

Channel Type: Circular

Pipe Diameter: 2.0000 ft

Longitudinal Slope: 0.2400 ft/ft

Manning's n: 0.0120

Flow: 7.5500 cfs

### Result Parameters

Depth: 0.3400 ft

Area of Flow: 0.3541 ft^2

Wetted Perimeter: 1.7000 ft

Hydraulic Radius: 0.2083 ft

Average Velocity: 21.3187 ft/s

Top Width: 1.5025 ft

Froude Number: 7.7384

Critical Depth: 0.9766 ft

Critical Velocity: 4.9543 ft/s

Critical Slope: 0.0041 ft/ft

Critical Top Width: 2.00 ft

Calculated Max Shear Stress: 5.0919 lb/ft^2

Calculated Avg Shear Stress: 3.1199 lb/ft^2

## Channel Analysis: Ex SD-2

Notes: A2

### Input Parameters

Channel Type: Circular

Pipe Diameter: 1.0000 ft

Longitudinal Slope: 0.0900 ft/ft

Manning's n: 0.0120

Flow: 1.0200 cfs

### Result Parameters

Depth: 0.2006 ft

Area of Flow: 0.1123 ft^2

Wetted Perimeter: 0.9288 ft

Hydraulic Radius: 0.1209 ft

Average Velocity: 9.0835 ft/s

Top Width: 0.8009 ft

Froude Number: 4.2750

Critical Depth: 0.4243 ft

Critical Velocity: 3.2146 ft/s

Critical Slope: 0.0050 ft/ft

Critical Top Width: 0.99 ft

Calculated Max Shear Stress: 1.1265 lb/ft^2

Calculated Avg Shear Stress: 0.6790 lb/ft^2

## Channel Analysis: SD-1

Notes: A3

## Input Parameters

Channel Type: Circular

Pipe Diameter: 0.6700 ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0120

Flow: 0.8600 cfs

## Result Parameters

Depth: 0.3185 ft

Area of Flow: 0.1652 ft^2

Wetted Perimeter: 1.0193 ft

Hydraulic Radius: 0.1621 ft

Average Velocity: 5.2058 ft/s

Top Width: 0.6692 ft

Froude Number: 1.8464

Critical Depth: 0.4387 ft

Critical Velocity: 3.5154 ft/s

Critical Slope: 0.0072 ft/ft

Critical Top Width: 0.64 ft

Calculated Max Shear Stress: 0.3974 lb/ft^2

Calculated Avg Shear Stress: 0.2023 lb/ft^2

## Channel Analysis: SD-2

Notes: A4

### Input Parameters

Channel Type: Circular

Pipe Diameter: 0.5000 ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0120

Flow: 0.3200 cfs

### Result Parameters

Depth: 0.2113 ft

Area of Flow: 0.0789 ft^2

Wetted Perimeter: 0.7076 ft

Hydraulic Radius: 0.1115 ft

Average Velocity: 4.0566 ft/s

Top Width: 0.4940 ft

Froude Number: 1.7889

Critical Depth: 0.2864 ft

Critical Velocity: 2.7515 ft/s

Critical Slope: 0.0071 ft/ft

Critical Top Width: 0.49 ft

Calculated Max Shear Stress: 0.2637 lb/ft^2

Calculated Avg Shear Stress: 0.1391 lb/ft^2

## Channel Analysis: SD-3

Notes: A5

## Input Parameters

Channel Type: Circular

Pipe Diameter: 0.5000 ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0120

Flow: 0.3900 cfs

## Result Parameters

Depth: 0.2362 ft

Area of Flow: 0.0913 ft^2

Wetted Perimeter: 0.7579 ft

Hydraulic Radius: 0.1205 ft

Average Velocity: 4.2716 ft/s

Top Width: 0.4992 ft

Froude Number: 1.7603

Critical Depth: 0.3174 ft

Critical Velocity: 2.9668 ft/s

Critical Slope: 0.0077 ft/ft

Critical Top Width: 0.48 ft

Calculated Max Shear Stress: 0.2948 lb/ft^2

Calculated Avg Shear Stress: 0.1503 lb/ft^2

## Channel Analysis: SD-4

Notes: A6

## Input Parameters

Channel Type: Circular

Pipe Diameter: 0.5000 ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0120

Flow: 0.1400 cfs

## Result Parameters

Depth: 0.1365 ft

Area of Flow: 0.0434 ft^2

Wetted Perimeter: 0.5497 ft

Hydraulic Radius: 0.0790 ft

Average Velocity: 3.2244 ft/s

Top Width: 0.4455 ft

Froude Number: 1.8201

Critical Depth: 0.1860 ft

Critical Velocity: 2.1038 ft/s

Critical Slope: 0.0061 ft/ft

Critical Top Width: 0.48 ft

Calculated Max Shear Stress: 0.1703 lb/ft^2

Calculated Avg Shear Stress: 0.0986 lb/ft^2

## Channel Analysis: SD-5

Notes: A5 & A6

## Input Parameters

Channel Type: Circular

Pipe Diameter: 0.5000 ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0120

Flow: 0.5400 cfs

## Result Parameters

Depth: 0.2873 ft

Area of Flow: 0.1168 ft^2

Wetted Perimeter: 0.8603 ft

Hydraulic Radius: 0.1357 ft

Average Velocity: 4.6249 ft/s

Top Width: 0.4944 ft

Froude Number: 1.6772

Critical Depth: 0.3745 ft

Critical Velocity: 3.4231 ft/s

Critical Slope: 0.0095 ft/ft

Critical Top Width: 0.43 ft

Calculated Max Shear Stress: 0.3586 lb/ft^2

Calculated Avg Shear Stress: 0.1694 lb/ft^2

## Channel Analysis: SD-6

Notes: A7

## Input Parameters

Channel Type: Circular

Pipe Diameter: 0.5000 ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0120

Flow: 0.4000 cfs

## Result Parameters

Depth: 0.2397 ft

Area of Flow: 0.0930 ft^2

Wetted Perimeter: 0.7648 ft

Hydraulic Radius: 0.1216 ft

Average Velocity: 4.2993 ft/s

Top Width: 0.4996 ft

Froude Number: 1.7557

Critical Depth: 0.3218 ft

Critical Velocity: 2.9948 ft/s

Critical Slope: 0.0078 ft/ft

Critical Top Width: 0.48 ft

Calculated Max Shear Stress: 0.2992 lb/ft^2

Calculated Avg Shear Stress: 0.1518 lb/ft^2

## Channel Analysis: SD-7

Notes: A8

## Input Parameters

Channel Type: Circular

Pipe Diameter: 0.5000 ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0120

Flow: 0.1100 cfs

## Result Parameters

Depth: 0.1208 ft

Area of Flow: 0.0366 ft^2

Wetted Perimeter: 0.5138 ft

Hydraulic Radius: 0.0712 ft

Average Velocity: 3.0075 ft/s

Top Width: 0.4280 ft

Froude Number: 1.8131

Critical Depth: 0.1641 ft

Critical Velocity: 1.9619 ft/s

Critical Slope: 0.0061 ft/ft

Critical Top Width: 0.47 ft

Calculated Max Shear Stress: 0.1507 lb/ft^2

Calculated Avg Shear Stress: 0.0888 lb/ft^2

## Channel Analysis: Swale-1

Notes: A4

## Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 2.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0150

Flow: 0.3200 cfs

## Result Parameters

Depth: 0.2286 ft

Area of Flow: 0.1045 ft^2

Wetted Perimeter: 1.0222 ft

Hydraulic Radius: 0.1022 ft

Average Velocity: 3.0628 ft/s

Top Width: 0.9142 ft

Froude Number: 1.5966

Critical Depth: 0.2756 ft

Critical Velocity: 2.1065 ft/s

Critical Slope: 0.0074 ft/ft

Critical Top Width: 1.10 ft

Calculated Max Shear Stress: 0.2852 lb/ft^2

Calculated Avg Shear Stress: 0.1276 lb/ft^2

## Channel Analysis: Swale-2

Notes: A5

## Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 2.0000 ft/ft

Side Slope 2 (Z2): 2.0000 ft/ft

Longitudinal Slope: 0.0200 ft/ft

Manning's n: 0.0150

Flow: 0.3900 cfs

## Result Parameters

Depth: 0.2462 ft

Area of Flow: 0.1212 ft^2

Wetted Perimeter: 1.1009 ft

Hydraulic Radius: 0.1101 ft

Average Velocity: 3.2181 ft/s

Top Width: 0.9846 ft

Froude Number: 1.6165

Critical Depth: 0.2983 ft

Critical Velocity: 2.1915 ft/s

Critical Slope: 0.0072 ft/ft

Critical Top Width: 1.19 ft

Calculated Max Shear Stress: 0.3072 lb/ft^2

Calculated Avg Shear Stress: 0.1374 lb/ft^2

## Channel Analysis: AC Berm-1

Notes: A2

## Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 50.0000 ft/ft

Side Slope 2 (Z2): 0.0200 ft/ft

Longitudinal Slope: 0.3000 ft/ft

Manning's n: 0.0120

Flow: 1.0200 cfs

## Result Parameters

Depth: 0.0741 ft

Area of Flow: 0.1372 ft^2

Wetted Perimeter: 3.7775 ft

Hydraulic Radius: 0.0363 ft

Average Velocity: 7.4370 ft/s

Top Width: 3.7041 ft

Froude Number: 6.8110

Critical Depth: 0.5782 ft

Critical Velocity: 0.1220 ft/s

Critical Slope: 0.0000 ft/ft

Critical Top Width: 18090.31 ft

Calculated Max Shear Stress: 1.3863 lb/ft^2

Calculated Avg Shear Stress: 0.6797 lb/ft^2

## Channel Analysis: AC Berm-2

Notes: A3

## Input Parameters

Channel Type: Triangular

Side Slope 1 (Z1): 50.0000 ft/ft

Side Slope 2 (Z2): 0.0200 ft/ft

Longitudinal Slope: 0.0300 ft/ft

Manning's n: 0.0120

Flow: 0.8600 cfs

## Result Parameters

Depth: 0.1070 ft

Area of Flow: 0.2862 ft^2

Wetted Perimeter: 5.4565 ft

Hydraulic Radius: 0.0524 ft

Average Velocity: 3.0052 ft/s

Top Width: 5.3506 ft

Froude Number: 2.2900

Critical Depth: 0.5401 ft

Critical Velocity: 0.1179 ft/s

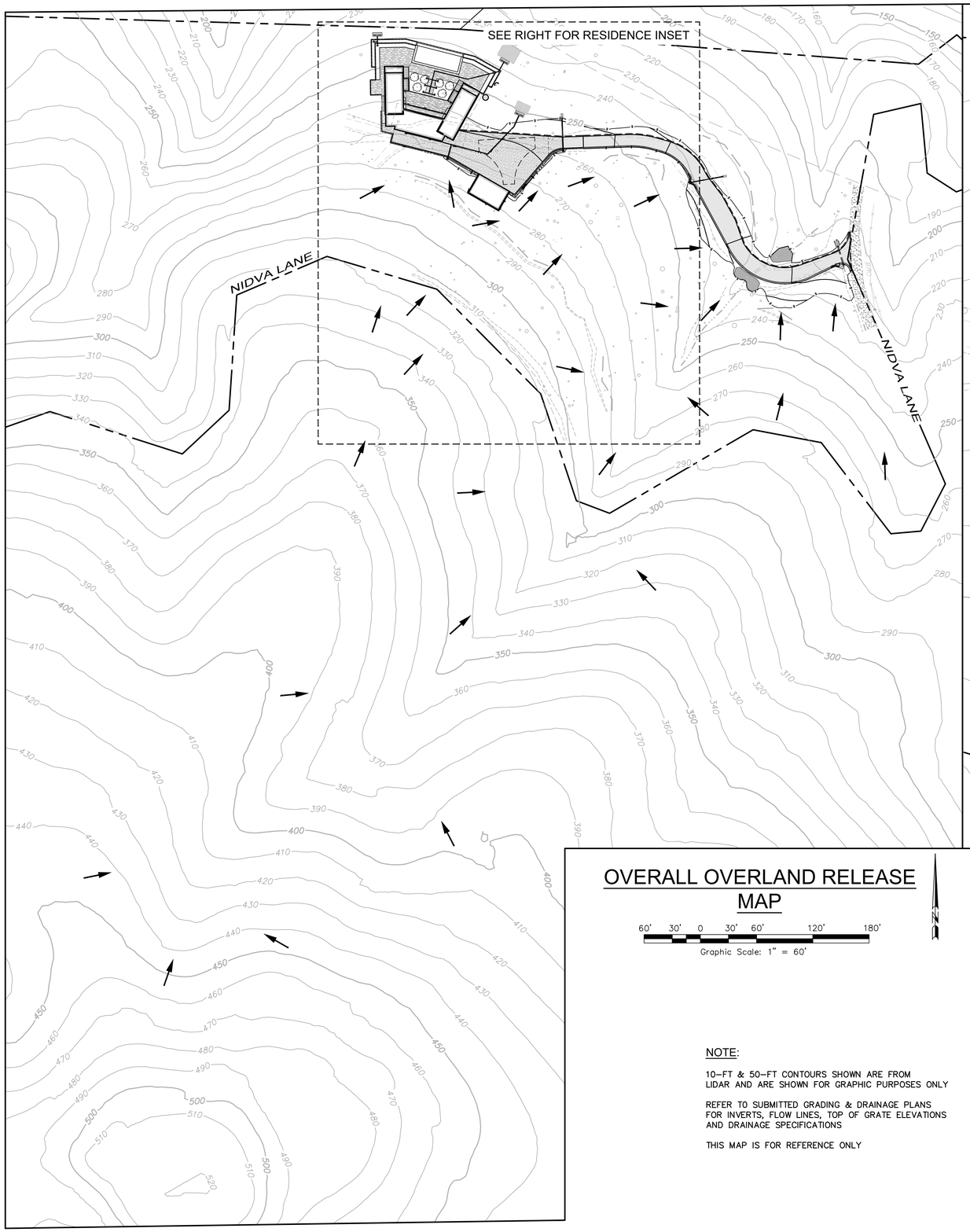
Critical Slope: 0.0000 ft/ft

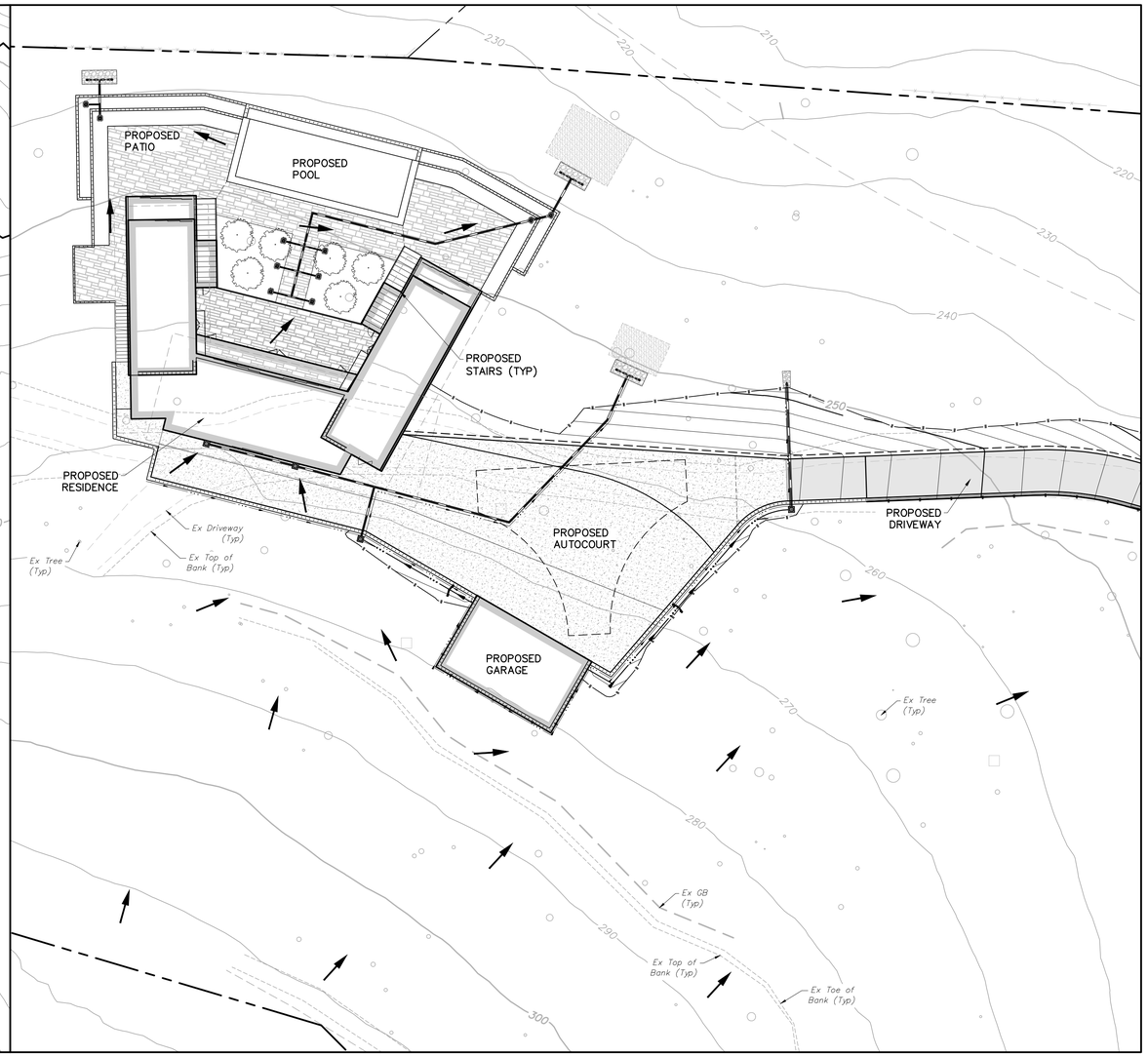
Critical Top Width: 16896.83 ft

Calculated Max Shear Stress: 0.2002 lb/ft^2

Calculated Avg Shear Stress: 0.0982 lb/ft^2

# 100-Year Overland Release Map




## OVERALL OVERLAND RELEASE MAP

60' 30' 0 30' 60' 120' 180'

Graphic Scale: 1" = 60'

## RESIDENCE OVERLAND RELEASE MAP

20' 10' 0 10' 20' 40' 60'

Graphic Scale: 1" = 20'

NOTE:

10-FT & 50-FT CONTOURS SHOWN ARE FROM LIDAR AND ARE SHOWN FOR GRAPHIC PURPOSES ONLY

REFER TO SUBMITTED GRADING & DRAINAGE PLANS FOR INVERTS, FLOW LINES, TOP OF GRATE ELEVATIONS AND DRAINAGE SPECIFICATIONS

THIS MAP IS FOR REFERENCE ONLY

DRAINAGE AREA LEGEND

100-YEAR OVERLAND FLOW DIRECTION

April 14, 2022

# OVERLAND RELEASE MAP

WHITE RESIDENCE
2310 West Dry Creek Road, Healdsburg, CA
APN 090-140-038

adobe associates, inc.
civil engineering I land surveying I wastewater
1220 N. Dutton Ave., Santa Rosa, CA 95401
P. (707) 541-2300 F. (707) 541-2301
Website: www.adobeinc.com
"A Service You Can Count On!"

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# 10-Year Inlet Capacity Calculations

# Inlet Capacity Calculations

**10-Year Storm Event**
**Post Construction**

**Project:** White Residence **Date:** 4/14/2022

**JN:** 21387

| Structure | p or b (ft) | Q (cfs) | H (ft) | GR Elev. | Ponding Elev. | Grate Notes |
|---|---|---|---|---|---|---|
| **DI-4** | 2.00 | 0.14 | 0.08 | 491.61 | 491.69 | Oldcastle Model DI-1212 |
| **DI-5** | 2.00 | 0.14 | 0.08 | 491.61 | 491.69 | Oldcastle Model DI-1212 |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

**Grate Equation:**

Flow through top grate: $H = (Q/3.0*p))^{2/3}$

**Where:** p = 1/2 grate perimeter (ft)

H = water depth (ft) from top grate

| Structure | p or b (ft) | Q (cfs) | h (ft) | SO Elev. | Ponding Elev. | Side Opening Notes |
|---|---|---|---|---|---|---|
| **DI-1** | 0.67 | 0.86 | 0.53 | 463.68 | 464.21 | 12" x 12" Drop Inlet w/ 8" Side Opening. Top grate @ 466.25 GR; Side Opening @ 463.68 SO. |
| **DI-2** | 0.50 | 0.32 | 0.33 | 488.12 | 488.45 | 12" x 12" Drop Inlet w/ 6" Side Opening. Top grate @ 488.62 GR; Side Opening @ 488.12 SO. |
| **DI-3** | 0.67 | 0.71 | 0.47 | 501.92 | 502.39 | 12" x 12" Drop Inlet w/ 8" Side Opening. Top grate @ 502.42 GR; Side Opening @ 501.92 SO. |

**Side Opening Equation:**

Flow through side opening: $h = [\ Q / (F_B*1.66*b)\ ]^{2/3}$

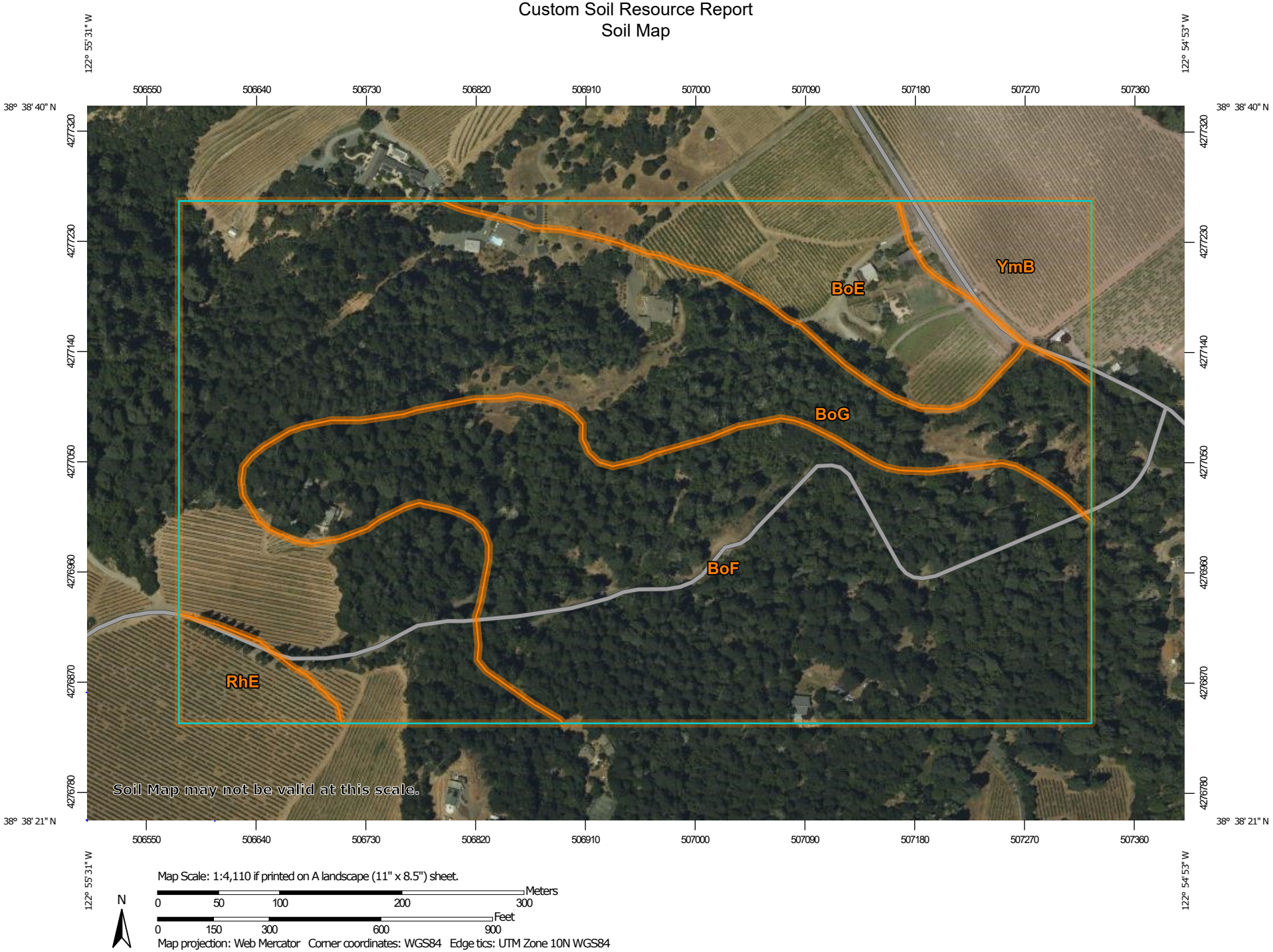
**Where:** b = length of opening (ft)

$F_B = 0.5$ blockage factor

h = water depth (ft) from opening flow line

# Appendix I
# Soil Analysis

# Custom Soil Resource Report
## Soil Map



## MAP LEGEND

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

**Soils**
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

**Special Point Features**
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

**Water Features**
- Streams and Canals

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

**Background**
- Aerial Photography

## MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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 map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

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

Soil Survey Area: Sonoma County, California
Survey Area Data: Version 15, Sep 10, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 2, 2019—Oct 30, 2020

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.

# Map Unit Legend

| Map Unit Symbol | Map Unit Name | Acres in AOI | Percent of AOI |
|---|---|---|---|
| BoE | Boomer loam, 7 to 50 percent slopes, moist, MLRA 15 | 7.8 | 9.9% |
| BoF | Boomer loam, 30 to 50 percent slopes | 31.7 | 40.0% |
| BoG | Boomer loam, 50 to 75 percent slopes | 34.1 | 43.0% |
| RhE | Red Hill clay loam, 15 to 30 percent slopes | 2.0 | 2.5% |
| YmB | Yolo sandy loam, overwash, 0 to 5 percent slopes | 3.7 | 4.6% |
| **Totals for Area of Interest** | | **79.2** | **100.0%** |

# Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

# Sonoma County, California

## BoE—Boomer loam, 7 to 50 percent slopes, moist, MLRA 15

### Map Unit Setting

*National map unit symbol:* 2w8db
*Elevation:* 210 to 1,840 feet
*Mean annual precipitation:* 38 to 73 inches
*Mean annual air temperature:* 57 to 60 degrees F
*Frost-free period:* 300 to 345 days
*Farmland classification:* Not prime farmland

### Map Unit Composition

*Boomer and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Boomer

#### Setting

*Landform:* Hillslopes, ridges
*Landform position (two-dimensional):* Backslope, summit
*Landform position (three-dimensional):* Side slope, interfluve
*Down-slope shape:* Convex
*Across-slope shape:* Convex
*Parent material:* Residuum weathered from igneous, metamorphic and sedimentary rock

#### Typical profile

*A - 0 to 11 inches:* loam
*AB - 11 to 19 inches:* loam
*Bt1 - 19 to 37 inches:* clay loam
*Bt2 - 37 to 47 inches:* gravelly clay loam
*Bt3 - 47 to 55 inches:* gravelly clay loam
*Crt - 55 to 65 inches:* cemented bedrock

#### Properties and qualities

*Slope:* 7 to 50 percent
*Depth to restrictive feature:* 30 to 70 inches to paralithic bedrock
*Drainage class:* Well drained
*Runoff class:* High
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately low (0.01 to 0.14 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Maximum salinity:* Nonsaline (0.2 to 0.5 mmhos/cm)
*Available water supply, 0 to 60 inches:* High (about 9.2 inches)

#### Interpretive groups

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 4e
*Hydrologic Soil Group:* C
*Hydric soil rating:* No

**Minor Components**

**Hugo**
*Percent of map unit:* 5 percent
*Hydric soil rating:* No

**Josephine**
*Percent of map unit:* 5 percent
*Hydric soil rating:* No

**Red hill**
*Percent of map unit:* 5 percent
*Hydric soil rating:* No

## BoF—Boomer loam, 30 to 50 percent slopes

**Map Unit Setting**
*National map unit symbol:* hfbb
*Elevation:* 600 to 5,500 feet
*Mean annual precipitation:* 30 to 60 inches
*Mean annual air temperature:* 54 to 59 degrees F
*Frost-free period:* 120 to 260 days
*Farmland classification:* Not prime farmland

**Map Unit Composition**
*Boomer and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Boomer**

**Setting**
*Landform:* Mountains, hills
*Landform position (two-dimensional):* Backslope
*Landform position (three-dimensional):* Mountainflank, side slope
*Down-slope shape:* Concave
*Across-slope shape:* Convex
*Parent material:* Residuum weathered from metavolcanics

**Typical profile**
*H1 - 0 to 19 inches:* loam
*H2 - 19 to 37 inches:* clay loam
*H3 - 37 to 55 inches:* gravelly clay loam
*H4 - 55 to 65 inches:* weathered bedrock

**Properties and qualities**
*Slope:* 30 to 50 percent
*Depth to restrictive feature:* 40 to 60 inches to paralithic bedrock
*Drainage class:* Well drained
*Runoff class:* High

*Capacity of the most limiting layer to transmit water (Ksat):* Low to moderately high (0.01 to 0.57 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water supply, 0 to 60 inches:* Moderate (about 8.8 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 6e
*Hydrologic Soil Group:* C
*Ecological site:* F004BK103CA - Upper slopes and higher elevation mountains
*Hydric soil rating:* No

**Minor Components**

**Josephine**

*Percent of map unit:* 5 percent
*Hydric soil rating:* No

**Hugo**

*Percent of map unit:* 5 percent
*Hydric soil rating:* No

**Red hill**

*Percent of map unit:* 5 percent
*Hydric soil rating:* No

## BoG—Boomer loam, 50 to 75 percent slopes

**Map Unit Setting**

*National map unit symbol:* hfbc
*Elevation:* 600 to 5,500 feet
*Mean annual precipitation:* 30 to 60 inches
*Mean annual air temperature:* 54 to 59 degrees F
*Frost-free period:* 120 to 260 days
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Boomer and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Boomer**

**Setting**

*Landform:* Mountains, hills
*Landform position (two-dimensional):* Backslope
*Landform position (three-dimensional):* Mountainflank, side slope
*Down-slope shape:* Concave
*Across-slope shape:* Convex

*Parent material:* Residuum weathered from metavolcanics

**Typical profile**

*H1 - 0 to 19 inches:* loam
*H2 - 19 to 37 inches:* clay loam
*H3 - 37 to 55 inches:* gravelly clay loam
*H4 - 55 to 65 inches:* weathered bedrock

**Properties and qualities**

*Slope:* 50 to 75 percent
*Depth to restrictive feature:* 40 to 60 inches to paralithic bedrock
*Drainage class:* Well drained
*Runoff class:* High
*Capacity of the most limiting layer to transmit water (Ksat):* Low to moderately high (0.01 to 0.57 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water supply, 0 to 60 inches:* Moderate (about 8.8 inches)

**Interpretive groups**

*Land capability classification (irrigated):* None specified
*Land capability classification (nonirrigated):* 7e
*Hydrologic Soil Group:* C
*Ecological site:* F004BK103CA - Upper slopes and higher elevation mountains
*Hydric soil rating:* No

**Minor Components**

**Hugo**

*Percent of map unit:* 5 percent
*Hydric soil rating:* No

**Josephine**

*Percent of map unit:* 5 percent
*Hydric soil rating:* No

**Red hill**

*Percent of map unit:* 5 percent
*Hydric soil rating:* No

## RhE—Red Hill clay loam, 15 to 30 percent slopes

**Map Unit Setting**

*National map unit symbol:* hfj3
*Elevation:* 500 to 2,500 feet
*Mean annual precipitation:* 30 to 50 inches
*Mean annual air temperature:* 54 to 55 degrees F
*Frost-free period:* 240 to 260 days
*Farmland classification:* Not prime farmland

**Map Unit Composition**

*Red hill and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

**Description of Red Hill**

**Setting**

*Landform:* Hills
*Landform position (two-dimensional):* Backslope
*Landform position (three-dimensional):* Side slope
*Down-slope shape:* Concave
*Across-slope shape:* Convex
*Parent material:* Residuum weathered from andesite

**Typical profile**

*H1 - 0 to 16 inches:* clay loam
*H2 - 16 to 48 inches:* clay loam
*H3 - 48 to 80 inches:* clay

**Properties and qualities**

*Slope:* 15 to 30 percent
*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Moderately well drained
*Runoff class:* Very high
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high (0.20 to 0.57 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* None
*Frequency of ponding:* None
*Available water supply, 0 to 60 inches:* High (about 10.4 inches)

**Interpretive groups**

*Land capability classification (irrigated):* 4e
*Land capability classification (nonirrigated):* 4e
*Hydrologic Soil Group:* C
*Ecological site:* F005XZ020CA - Very Deep Mesic Mountains 40-60"ppt
*Hydric soil rating:* No

**Minor Components**

**Boomer**

*Percent of map unit:* 5 percent
*Hydric soil rating:* No

**Josephine**

*Percent of map unit:* 5 percent
*Hydric soil rating:* No

**Goulding**

*Percent of map unit:* 5 percent
*Hydric soil rating:* No

## YmB—Yolo sandy loam, overwash, 0 to 5 percent slopes

### Map Unit Setting

*National map unit symbol:* hfkr
*Elevation:* 0 to 3,500 feet
*Mean annual precipitation:* 12 to 30 inches
*Mean annual air temperature:* 59 degrees F
*Frost-free period:* 200 to 350 days
*Farmland classification:* Prime farmland if irrigated and either protected from flooding or not frequently flooded during the growing season

### Map Unit Composition

*Yolo and similar soils:* 85 percent
*Minor components:* 15 percent
*Estimates are based on observations, descriptions, and transects of the mapunit.*

### Description of Yolo

#### Setting

*Landform:* Alluvial fans
*Landform position (two-dimensional):* Backslope
*Landform position (three-dimensional):* Side slope
*Down-slope shape:* Linear
*Across-slope shape:* Linear
*Parent material:* Alluvium derived from sedimentary rock

#### Typical profile

*H1 - 0 to 8 inches:* sandy loam
*H2 - 8 to 60 inches:* loam

#### Properties and qualities

*Slope:* 0 to 5 percent
*Depth to restrictive feature:* More than 80 inches
*Drainage class:* Well drained
*Runoff class:* Low
*Capacity of the most limiting layer to transmit water (Ksat):* Moderately high to high (0.20 to 2.00 in/hr)
*Depth to water table:* More than 80 inches
*Frequency of flooding:* NoneOccasional
*Frequency of ponding:* None
*Maximum salinity:* Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
*Available water supply, 0 to 60 inches:* High (about 9.2 inches)

#### Interpretive groups

*Land capability classification (irrigated):* 2w
*Land capability classification (nonirrigated):* 3w
*Hydrologic Soil Group:* B
*Ecological site:* R014XG918CA - Loamy Fan
*Hydric soil rating:* No

**Minor Components**

**Zamora**

*Percent of map unit:* 5 percent
*Hydric soil rating:* No

**Cortina**

*Percent of map unit:* 5 percent
*Hydric soil rating:* No

**Pleasanton**

*Percent of map unit:* 4 percent
*Hydric soil rating:* No

**Unnamed**

*Percent of map unit:* 1 percent
*Landform:* Flood plains
*Hydric soil rating:* Yes

# Appendix II
# Fact Sheet – Bioretention

# FACT SHEET- BIORETENTION

## BIORETENTION

Also know as: Rain garden, roadside bioretention, and bioretention cell







**DESCRIPTION**

The bioretention area best management practice (BMP) functions as a soil and plant-based filtration and infiltration feature that removes pollutants through a variety of natural physical, biological, and chemical treatment processes.

**ADVANTAGES**

- Can be designed to achieve Treatment, Delta Volume Capture, or Hydromodification requirements.
- Enhances water quality of downstream water bodies through natural processes.
- Aesthetically pleasing.
- The vegetation can provide shade and wind breaks, absorbs noise, reduces heat island effects and improves an area's landscape.
- Provides habitat for birds and attracts other pollinators like butterflies and bees.
- Does not interrupt utility installation.
- Does not interfere with tree planting.

# FACT SHEET- BIORETENTION

**LIMITATIONS**

- Specialized design is required for areas where street slopes exceed 10%.
- Should not be used in areas of know contamination. If soil and/or groundwater contamination is present on the site or within a 100' radius of the proposed BMP location, the North Coast Regional Water Quality Control Board will need to be contacted and the site reviewed.
- Should not be used in areas of high groundwater. In general a minimum of 2' of clearance should be provided between the bottom of the bioretention cell and seasonal high groundwater.
- Should not be used in areas of slope instability where infiltrated storm water may cause failure. Slope stability should be determined by a licensed geotechnical engineer.
- Do not use in locations that can negatively impact building foundation or footings. Location shall be approved by a licensed Geotechnical Engineer.

**KEY DESIGN FEATURES**

**ALL BIORETENTION**

- Structural soil should be used within the bioretention area requiring load bearing capacity (adjacent to roadways and/or buildings).
- Structural soil, if used, shall be installed as described in Appendix E.
- Some BMPs may not require the use of structural soil and a more organic type planting soil and/or treatment media may be used in its place. It may be possible in some cases to use native soil or to amend the native soil so that it is suitable. Use of non-structural soil will depend on evaluation of the criteria in "Chapter 4-Site Assessment" as well as consideration of structural needs and may require evaluation by a licensed Geotechnical Engineer.
- Underlining native soil should remain un-compacted to preserve infiltration capacity. Fence off the area during construction to protect it from compaction.
- Bottom of bioretention should be un-lined to allow infiltration into native soil.
- Moisture barrier must be installed vertically to protect road sub-base and any trenches adjacent to the bioretention area.
- If used, pervious concrete shall be designed and installed as described in Appendix E and protected during construction to prevent sediment loading.
- If the porous gutter design option is used additional trash and sediment capture BMPs is required.
- A curb opening type design may be used in place of a porous gutter if appropriate for the project and does not require additional trash capture.
- Bioretention areas shall be planted with plants from the approved **Plant List** and **Tree List** included in Appendix F and shall be planted to achieve 51% cover.
- All bioretention areas shall be designed with a designated high flow bypass inlet for storms larger than the design storm.

- For designs that include perforated pipe, the 6" perforated pipe must be installed a minimum of 6" below the adjacent road structural section.
- Perforated pipe shall be installed in straight runs only.
- The volume below the perforated pipe must be sufficient to hold and infiltrate the design volume.

**SIZING DESIGN- GOAL AND REQUIREMENTS**

- **For all projects:** The treatment component requires that all of the runoff generated by this water quality design storm from impermeable surfaces must be treated on site for the pollutants of concern.
- ***For projects that increase the amount of impervious surface, but create or replace less than a total of one acre:*** The **Delta Volume Capture** component requires that any increase in volume due to development for the water quality design storm must be infiltrated and/or reused on site. Further discussion of the Treatment and Delta Volume Capture requirements and the accompanying formulas can be found in Chapter 6.
- ***For projects that create or replace one acre or more of impervious surface*:** These larger projects must mitigate their impacts by meeting the **Hydromodification Requirement** by capturing 100% of the post development volume generated by the water quality rain event.
- All calculations shall be completed using the "Storm Water Calculator" available at www.srcity.org/stormwaterLID.

**INSPECTION AND MAINTENANCE REQUIREMENTS**

A maintenance plan shall be provided with the Final SWLID Submittal. The maintenance plan shall include recommended maintenance practices, state the parties responsible for maintenance and upkeep, specify the funding source for ongoing maintenance with provisions for full replacement when necessary and provide site specific inspection checklist.

At a minimum maintenance shall include the following:

- Dry street sweeping upon completion of construction
- Dry street sweeping annually, and
    - When water is observed flowing in the gutter during a low intensity storm.
    - Algae is observed in the gutter.
    - Sediment/debris covers 1/3 of the gutter width or more.
- Inspect twice annually for sedimentation and trash accumulation in the gutter. Obstructions and trash shall be removed and properly disposed of.
- Inspect twice during the rainy season for ponded water.
- Pesticides and fertilizers shall not be used in the bioretention area.
- Plants should be pruned, weeds pulled and dead plants replaced as needed.