PRELIMINARY HYDROLOGY ANALYSIS

FOR

TIERRA ROBLES
TRACT MAP #1996

FEBRUARY 15, 2016

BY

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DATE: 2/16/16

Tierra Robles Preliminary Hydrology Analysis

Project Overview and Analysis Purpose

A Preliminary Hydrology Analysis was performed for the proposed Tierra Robles Subdivision project (Figure A). The purpose of the analysis was to understand the pre-construction versus post-construction stormwater runoff quantities and conveyance conditions. The proposed development consists of approximately 700 acres on which 166 lots are proposed. See Table 1 for impervious areas by basin (includes area in basin upstream of project boundary). This impervious area includes all roadways, driveways and structures. There are two ponds located upstream of the project through the Clough Creek basin. In order to complete the analysis, the project was divided into nine separate drainage basins within project boundary. Some of these basins join downstream but for the sake of this analysis were studied separately.

Basin ID	Total Area	Pre-Devel.	Post-Devel.
	AC	% Impervious	% Impervious
Clough Creek	933	0%	3%
E	206	0%	3%
F	69	0%	11%
G	34	0%	16%
J	36	0%	11%
L	68	0%	11%
M	7	0%	11%
N	15	0%	11%
P	17	0%	9%

Table 1: Pre and Post Development Percent Impervious

A Preliminary Hydrology Analysis is required as part of the planning phase of the proposed subdivision. It provides information regarding the pre-development and post-development characteristics including stormwater runoff quantities, stream stage, and floodplain delineation. A more detailed analysis of some or all of the basins may be required as the project enters the design phase.

Analysis Methods and Assumptions

Hydrology

In order to determine if there would be any additional stormwater runoff quantity produced by the proposed development, a hydrology model was developed using the WinTR-55 watershed hydrology analysis software. WinTR-55 was developed by the NRCS and uses the NRCS method to determine the peak flow rate produced by a particular design storm considering the following variables: soil type(A, B, C, D), ground cover type (lawn, range land, impervious, ect), flow type (overland, sheet, channel), design storm type and duration for a specified location (i.e. Type 1A, 100yr-24hr). This analysis tool is a widely accepted method used to quantify a peak flow rate for a given area. For this analysis, a WinTR-55 model

was developed for each basin identified on Figure B in order to determine pre and post development stormwater runoff quantities. The following observations were used for the project hydrology analysis:

1. Precipitation data from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 database (see attached precipitation data)
2. Rainfall data was selected based on a 24-hour duration and a Type 1A storm
3. Soil on the project is largely Type C per the NRCS Soil Survey Database (see attached soils map and report)
4. Vegetation type is considered "pasture, grassland, or range" in good condition

As mentioned above, several factors affect the quantity of stormwater runoff. The NRCS curve number (CN) is a factor that is utilized by the hydrology model which represents the site's type and condition of land cover by soil type. For the existing conditions on the Tierra Robles project, the land cover type was identified as oak rangeland and pasture yielding a CN of 74. For the post development condition, the following CN assumption was made:

1. All additional stormwater runoff from a 100 year-24 hour storm as a result of structures being built would be retained onsite and infiltrated and/or slowly released to the natural streams. Slowly releasing excess stormwater runoff from impervious areas to the natural streams helps to meet the following important hydrological low impact development (LID) goals: (1) reduces the peak discharge of the drainage area to predevelopment value and (2) delays the timing of that peak flow to existing condition timing. A stormwater facility that successfully performs these functions ensures that the post-development hydrograph retains the shape of the pre-development hydrograph. Mandating that all additional flow due to proposed structures be retained onsite, slowly infiltrated and/or released downstream allowed the WinTR-55 model to be developed without factoring in any impervious area due to proposed structures.
2. All proposed roads as part of the project were identified as having no curb or gutters but sloping shoulders into road side ditches. This road type uses a CN of 92.
3. Each proposed lot will have a maximum of 5000 SF of open space landscape with a CN of 74. Table 2 shows each basin's pre-development versus post-development area weighted Curve Numbers.

Basin	Pre-devel. CN	Post-devel. CN
Clough Creek	74	74
E	74	74
F	74	75
G	74	76
J	74	75
L	74	75
M	74	75
N	74	75
P	74	75

Table 2: Basin area weighted CNs

Upstream Dam Breach

The Dams that are upstream of the project pose a flood risk to all of the downstream channels. By visual inspection, the dam structures appear to be in good condition and there has not been a record of a previous dam breach but a break analysis was performed to verify the potential risk attributed to this type of failure. An approximate peak flow resulting from a dam failure upstream of the project in Clough Creek was estimated using methods outlined in the Guidelines for Calculating and Routing a Dam-Break Flood by The US Army Corps of Engineers. The ponds are primarily filled with irrigation water and not stormwater runoff therefor it was assumed that a dam breaching event would not likely occur in the same timeframe as the 100-yr flood. The dam breach flow was modeled and mapped independently of any storm flow. Additionally, it was assumed that the dam would not catastrophically break but would fail in one isolated location. The following dam break assumptions were used to determine an appropriate flow rate:

1. Breach width = 10 ft
2. Reservoir water depth = 6 ft
3. Total Dam Width = 400 ft (measured from aerial photograph)

Floodplain Mapping

In addition to a hydrology model, a HEC-RAS river hydraulics model was develop for the Clough Creek basin in order to determine the flow stage and conveyance characteristics of the drainage for various flow rates as determined by the hydrology analysis. The HEC-RAS software analysis method was developed by the Army Corps of Engineers and is a widely accepted method for modeling river hydraulics given channel characteristics such as slope, friction, cross section dimensions, in-stream structures, etc. The HEC-RAS model was developed using the following:

1. Steady State Flow data per Hydrology Analysis
2. Channel geometry imported from CAD topographical surface
3. Main Channel Manning's "n" value = 0.035 (Clean, Straight, full, no rift or deep pools with stones and weeds)
4. Floodplain Manning's "n" value =0.035 (Pasture with high grass)

The model was developed using 10, 25, 100-yr and dam breach scenarios. Resulting floodplains were mapped along with project topography, roads, lots and stream crossing. See attached Figure C.

Analysis Results

General Results

Table 3 presents the peak flow rates (cfs) for pre-development and post-development conditions for 10, 25, and 100-yr storms by basin as determined by the NRCS WinTR-55 Hydrology software. As stated above these flows are calculated based on the utilization of BMP's to mitigate increase flows from all structures.

Basin ID	10-Year Peak Flow, cfs		25-Year Peak Flow, cfs		100-Year Peak Flow, cfs	
	Pre	Post	Pre	Post	Pre	Post
Clough Creek	276	276	372	372	525	525
E	103	103	139	139	196	196
F	38.8	40.68	52.3	54.4	73.5	75.9
G	16.3	18.0	22.1	24.0	31.2	33.3
J	21.1	22.1	28.4	29.5	39.8	41.0
L	28.3	29.8	38.4	40.0	54.3	56.0
M	4.2	4.4	5.6	5.8	7.8	8.1
N	8.9	9.3	11.9	12.4	16.7	17.2
P	10.0	10.5	13.5	14.0	18.9	19.5

Table 3: Peak Flow Rates by Basin

Table 4 presents the percent differences of a 100-yr pre-development and post-development runoff by basin. Additionally, the time of concentration (Tc) required in order to reduce the post development flow to the pre-development flow quantity was calculated. The post development flow increased an average of 0-6.7% across all the basins. The required value of time in excess of the existing Tc value in order to negate this increase in flow ranged from 0-8 minutes. See Figure E for an example calculation of increase in Tc values by the utilization of check dams within a basin. During the project design phase, check dams will be similarly designed for each basin.

Basin	100-Year Peak Flow, cfs		Percent Difference	Increase Tc, min
	Pre Devel.	Post Devel.		
Clough Creek	525	525	0%	0
E	196	195	0%	0
F	73.5	75.9	3%	4
G	31.2	33.3	6.7%	8
J	39.8	41.0	3%	6
L	54.3	56.0	3%	5
M	7.8	8.1	3%	8
N	16.7	17.2	3%	6
P	18.9	19.5	3%	8

Table 4: 100-Yr Pre and Post Development Runoff, Percent Differences, and Required Increase in Tc Values

Dam Breach Results

The additional flow through Clough Creek in the event that the upstream pond's dam was breached was estimated to be 600 cfs. This flow scenario is assumed to be an isolated event and therefore the HEC-RAS model and floodplain delineation were performed using this flow rate. See Figure C (attached) for the delineation of the Dam Breach Floodplain.

Clough Creek Results

There are a number of reasons that the hydrology analysis resulted in a zero flow change between the pre and post development conditions in the Clough Creek drainage. First, use of onsite LID facilities to retain the additional stormwater runoff that would result from roof impervious areas significantly reduces the total impervious area in the basin. Additionally, the post-development CN is calculated by the area weighted average of the CNs in the basin. The area weighted CN for the post-development condition is roughly 74.2 which is only 0.2 higher than the pre-development condition. This near zero increase in the CN yields no net increase in the stormwater runoff as a result of development.

The Clough Creek HEC-RAS model provided important information regarding the stream hydraulics and stage under various storm frequencies. Specifically, Figure C shows the extent of the floodplain for flows that result from various storm frequencies and the Dam Breach scenario. As can be seen in Table 4, the hydrology analysis for the Clough Creek Basin resulted in no flow change between the pre-development and post development conditions. Therefore, the 100-yr floodplain in Figure C is representative of both pre-development and post-development. There is only one proposed building envelope that has the potential to be affected by the 100-year or Dam Breach floodplains. Lot #140 will have a requirement that any structure finish floor elevation be 1.00 ft minimum above the 100-yr floodplain elevation at that location of the Clough Creek drainage. At Lot #140, the floodplain is approximately 607.1 ft and therefore any structure finish floor elevation will be required to be at or above 608.1 ft.

Figure B shows the FEMA delineated 100-year floodplain for Clough and Salmon Creeks in the area of the project. The FEMA floodplain does not extend up Clough Creek far enough to intersect with the proposed project's southwestern boundary. There is no need to extend the floodplain outside project boundary because there is no net increase of flows.

The HEC-RAS model was also used to determine the stream hydraulics around the area of the proposed stream crossings. The model results showed that the stream crossing structures will convey a 100-yr flow and Dam Breach flow. The hydraulic model can be used during the bridge design to set minimum member elevation in order to convey the design flow rate. Image 1 shows the HEC-RAS model output cross section of Clough Creek and the water surface level for the Dam Breach and 100-yr flows.

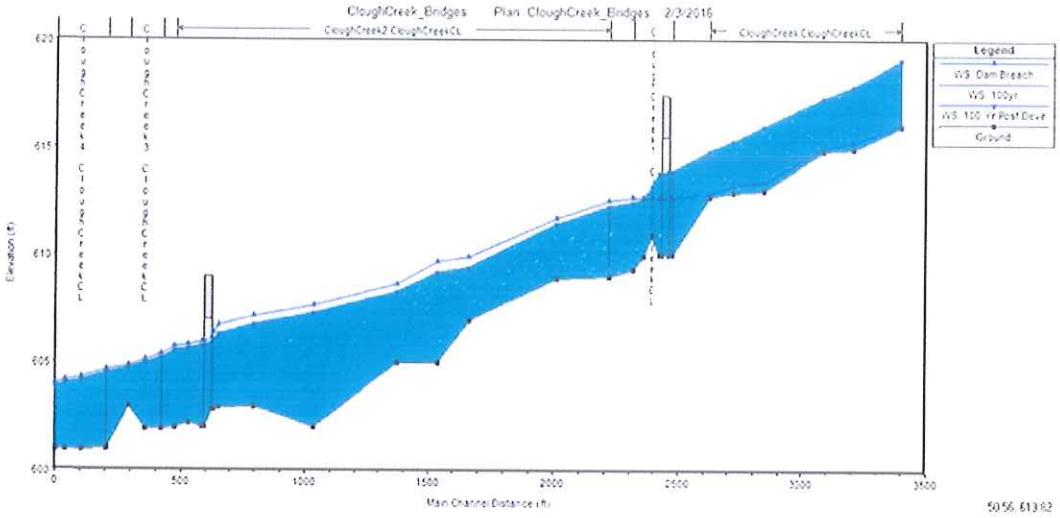


Image 1: Clough Creek Flow Profile for 100 Yr Storm and Dam Breach Scenarios

Project Proposed Low Impact Developments

It is a common stormwater management Best Management Practice (BMP) to incorporate Low Impact Developments (LIDs) into a project design in order to help meet stormwater management requirements. There are many LIDs that can be utilized in a project design in order to facilitate the creation of a post-development hydrograph that resembles the pre-development hydrograph in timing and intensity. It will be required that the land owners utilize these LIDs to retain and slowly release or infiltrate any excess stormwater as a result of a proposed structure. Figure D shows a typical Bioretention LID that could be used to meet this requirement. Actual design of the LID will be completed at the time of the Building Permit is submitted. The Bioretention LID is a recommended method for retaining stormwater runoff onsite but alternative LIDs may be utilized. All LID facilities shall be designed by a qualified licensed engineer and sized to a 100yr-24hr storm.

Additionally, Figure E is a typical detail for a Check Dam LID. Permanent check dams will be required to be installed in all roadside diches. The Check Dam LID is a multi-purpose BMP. It functions to collect any stormwater runoff from the impermeable road surface and create many pools of water with low velocities. The slow velocities allows for suspended solids to settle out of the flow stream. In this way, a check dam functions as a water treatment LID. Also, check dams function to increase the time it takes to the runoff to reach the natural streams by ponding effect. The slower velocities and longer flow path will increase the basin's time of concentration (Tc) and effectively reduce the post-development runoff flow to a pre-development quantity. The placement of check dams will be determined during final construction drawing phase.

Analysis Conclusions and Discussion

The pre-development and post-development peak runoff data presented in Table 3 and Table 4 shows that the proposed development increases the peak runoff flow 3.0-6.7% per Basin and no increase with utilization of BMPs. The Clough Creek Basin yielded no increase between pre-development and post-development. Table 4 also shows the additional time of concentration required in order to reduce the post-development hydraulic conditions to the pre-development hydraulic conditions. The final design of the project will address the need to provide necessary LID facilities to reduce the post-development runoff quantities to pre-development values.

The mandatory onsite Low Impact Development Facilities (Bioretention Basin or approved other) will be designed to retain and infiltrate or slowly release the additional stormwater runoff produced by impervious roof structures. These LID facilities significantly reduce the overall stormwater runoff that would have been produced as a result of development and contribute to maintaining the existing hydrological characteristics of the basins (ie. peak flow rate quantity and timing of stormwater runoff).

The additional Low Impact Development Facilities along the proposed roads (Check Dams) will collect any additional stormwater runoff as a result of the proposed roads. A major concern related to development which includes impervious surfaces is that stormwater is given a short and direct route to the natural streams therefore increasing the peak flow rate of those streams and decreasing the time it takes for stormwater to reach the streams. The implementation of checkdams will create small pools of slow moving water effectively increasing the time it takes for the peak flow rate to occur. The check dam LID will effectively return the hydrology of the post-development conditions to the pre-development conditions.

Shasta County is required to comply with the California Phase II Small MS4 Permit. This project is located outside areas within the county that are required to show compliance (see attached figure). Therefore, nothing further is required regarding the permit.

The Tierra Robles Preliminary Hydrology Analysis provided pre-development and post-development stormwater runoff quantities for the individual basins within the project boundary. Additionally, a stream hydraulic model was developed for the Clough Creek Basin in order to understand how the project flows would impact the channel and floodplain for both pre and post development conditions as well as in the case of an upstream dam breach. Stormwater Low Impact Development facilities were incorporated into the project in order to meet the goal of retaining the same hydrological characteristics of the basins before and after development. Given the small percentage of area to be developed and the low percent increase of stormwater runoff that results from development along with the incorporation of mandatory stormwater LID facilities, it is reasonable to conclude that there will be no increase of stormwater quantity, stream stage, or channel floodplain extense. The hydrological characteristics within project boundaries will be retained and the downstream channels will not be at risk of additional stormwater runoff as a result of the development of the Tierra Robles Subdivision.

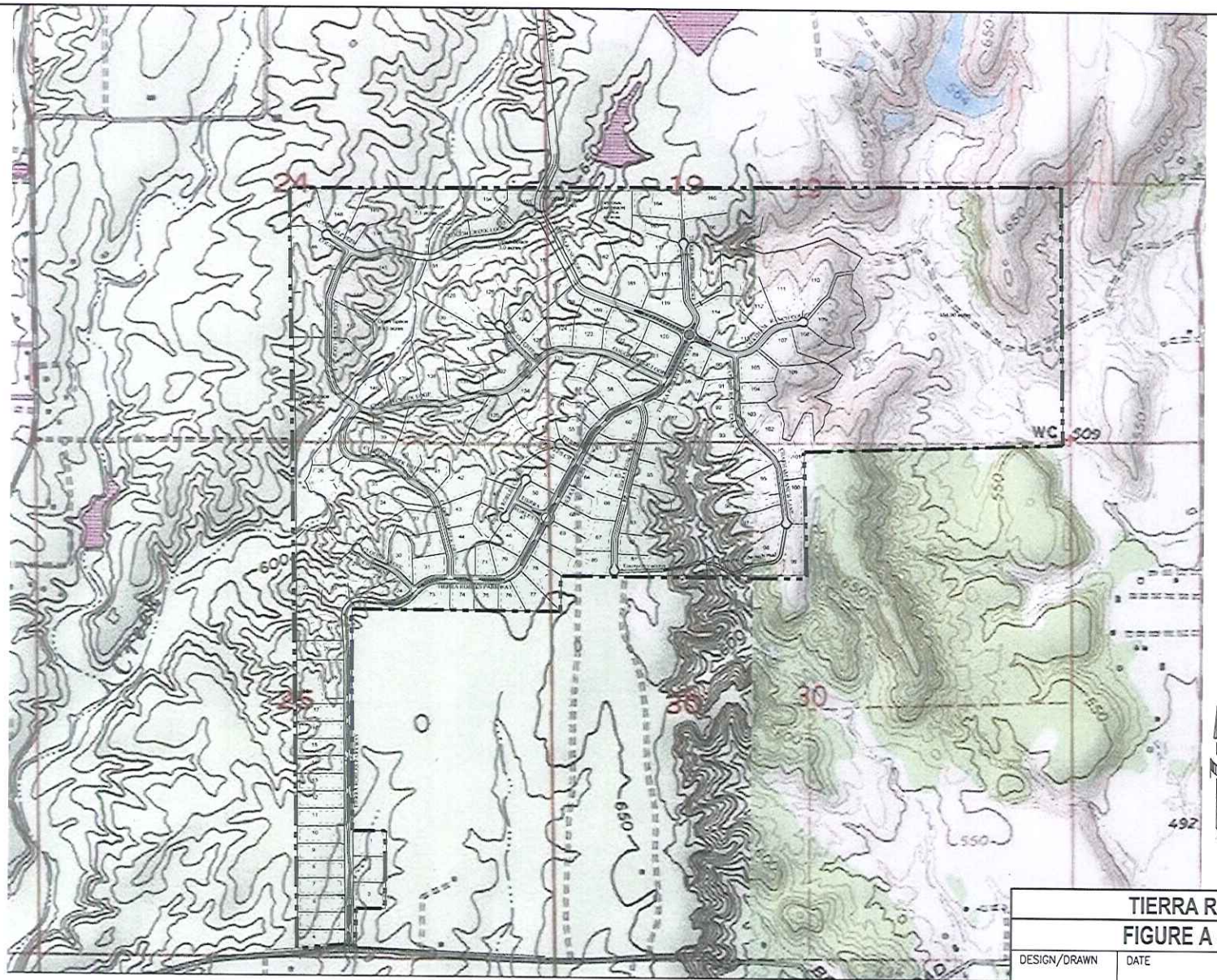
References Cited

U.S. Army Corps of Engineers, 2010 Hydrologic Engineering Center HEC-RAS river analysis system: Hydraulic Reference Manual, version 4.1

U.S. Army Corps of Engineers, 1977 Hydrologic Engineering Center: Guidelines for Calculating and Routing a Dam-Break Flood

Natural Resources Conservation Service, 2009 Conservation Engineering Division Small Watershed Hydrology: WinTR-55 User Guide

Figures



TIERRA ROBLES - HYDROLOGY

FIGURE A - PROJECT OVERVIEW

DESIGN/DRAWN	DATE	
DJK	Feb 9, 2016	$S_2 - J_2$ ENGINEERING, INC.

19032 Lahalah Way
Cottonwood, CA 96022
Phone (530) 347-5168
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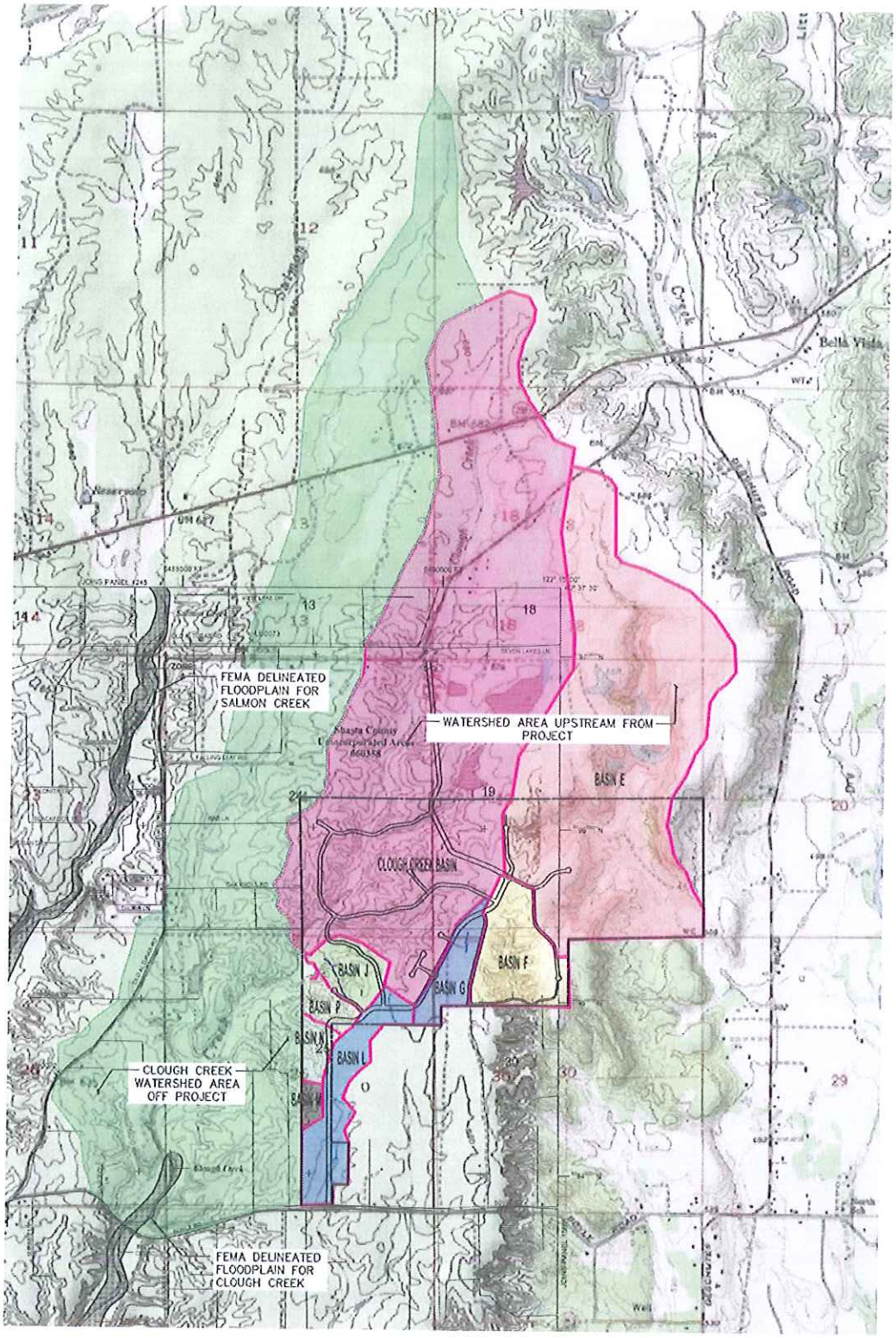

LEGEND

STREAM CL

PROJECT BOUNDARY

LOT LINES

N

SCALE:1"=2000'

TIERRA ROBLES - HYDROLOGY

FIGURE B - WATERSHED BASINS

DESIGN/DRAWN	DATE
DJK	JAN 11, 2016

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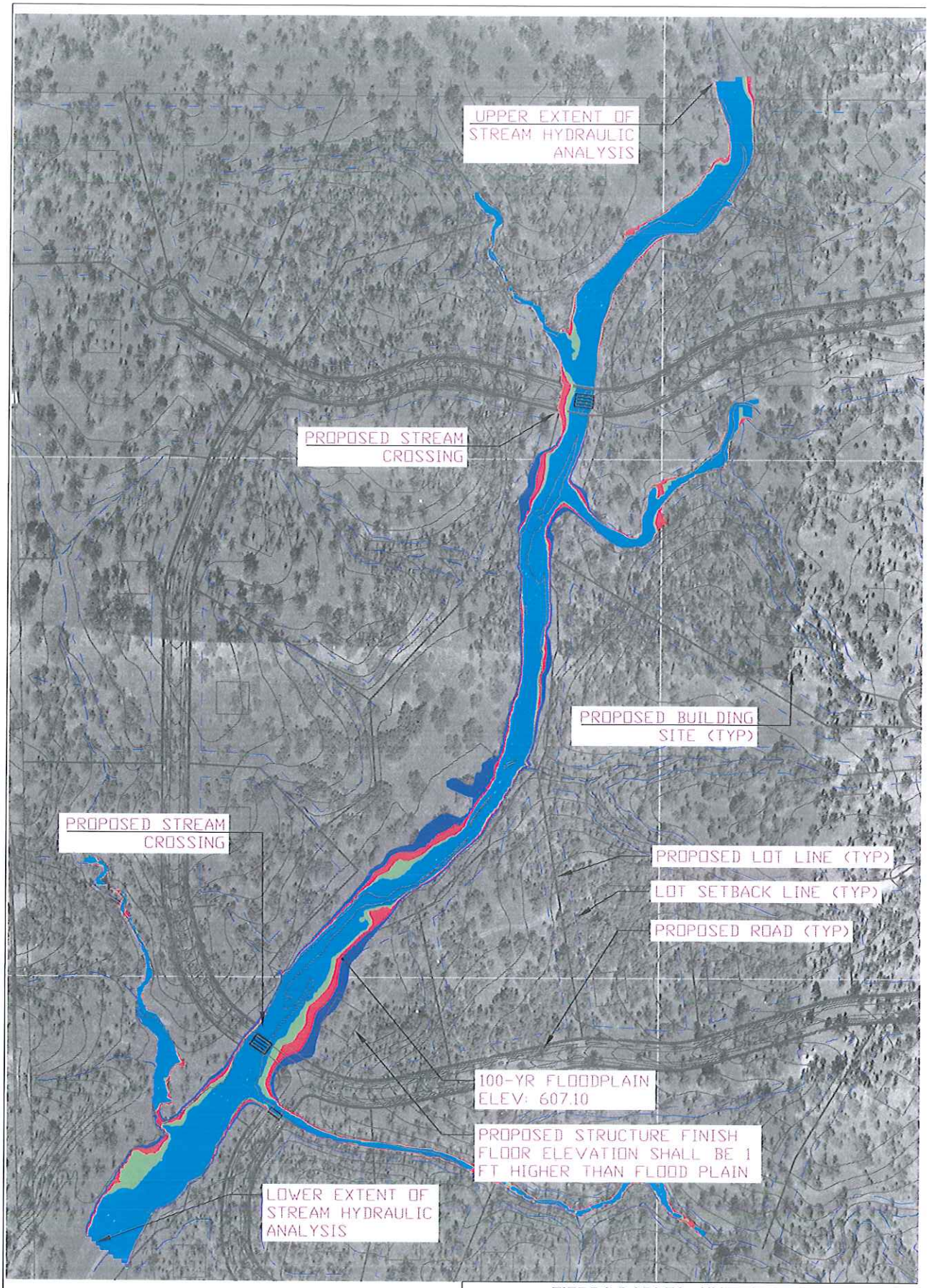

LEGEND

- 10-YR FLOODPLAIN (PRE AND POST DEVELOPMENT)
- 25-YR FLOODPLAIN (PRE AND POST DEVELOPMENT)
- 100-YR FLOODPLAIN (PRE AND POST DEVELOPMENT)
- DAM BREACH FLOW

SCALE: 1" = 200'

TIERRA ROBLES - HYDROLOGY

FIGURE C - CLOUGH CREEK FLOODPLAIN AREAS

DESIGN/DRAWN	DATE
DJK	FEB 08, 2016

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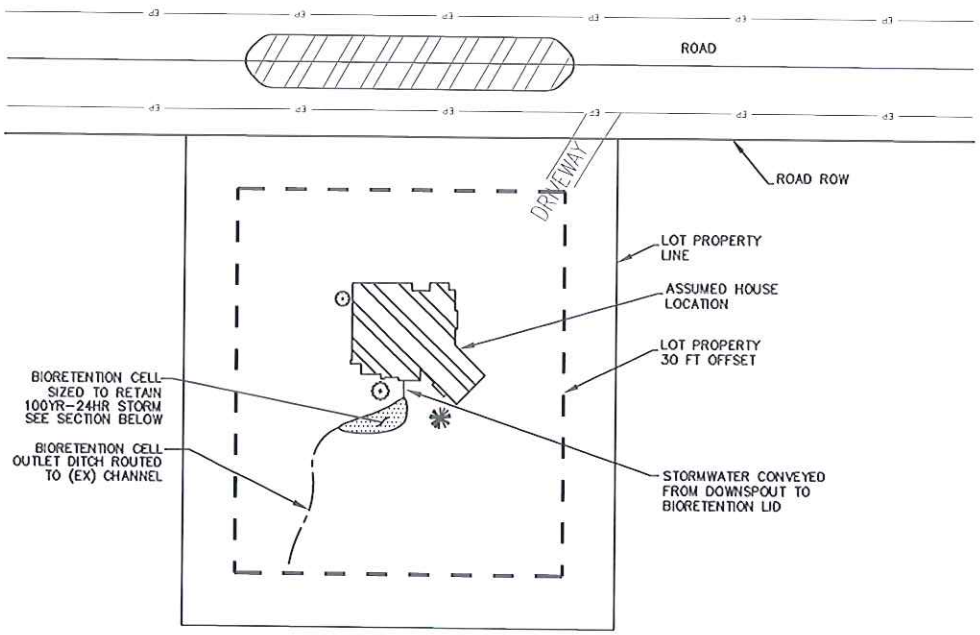
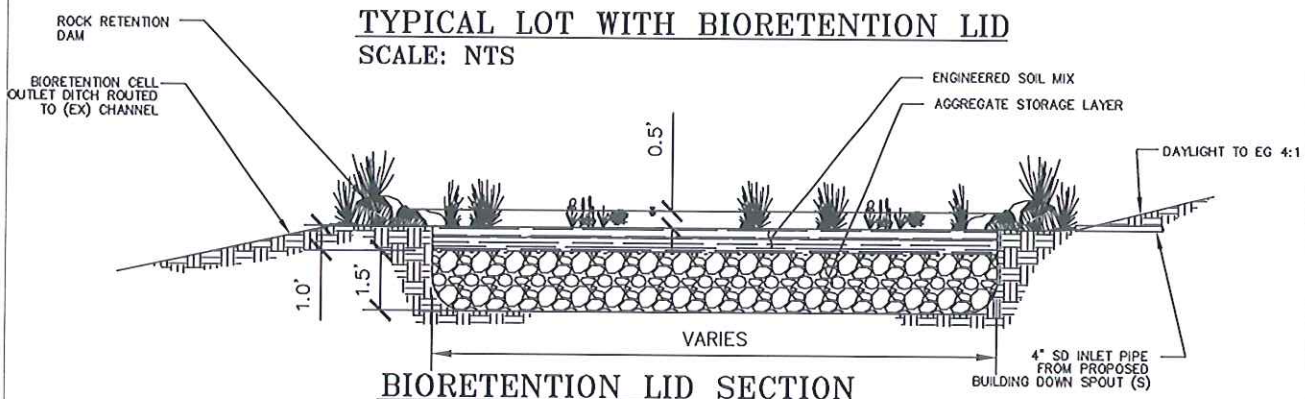


TYPICAL LOT WITH BIORETENTION LID

SCALE: NTS



BIORETENTION LID SECTION

SCALE: NTS

NOTES

1. THE ABOVE STORMWATER BIORETENTION LID DETAIL IS A TYPICAL DETAIL. EACH INDIVIDUAL LAND OWNER SHALL HAVE LID FACILITIES DESIGN BY A QUALIFIED ENGINEER ALONG WITH GRADING PLAN.
2. BIORETENTION LID SHALL BE INTEGRATED INTO EXISTING SITE TOPOGRAPHY.

BIORETENTION TYP. SIZE	
STRUCTURE ROOF AREA, SF	REQUIRED LID BOTTOM AREA, SF
2500	375
3000	450
3500	525

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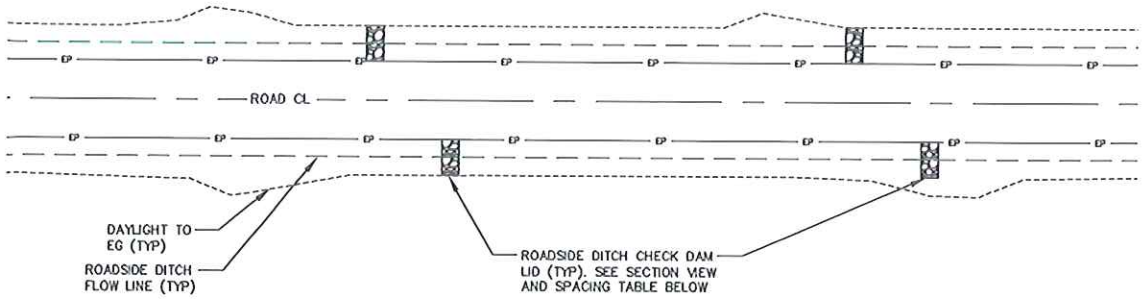
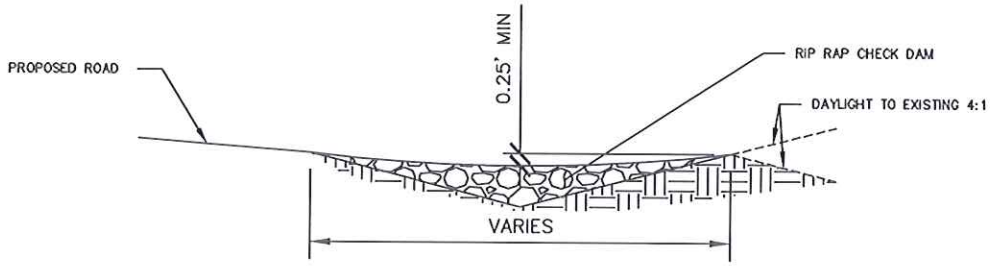
TYPICAL BIORETENTION LID DETIAL

FIGURE D



TYPICAL ROADSIDE DITCH CHECK DAM LID
SCALE: NTS

ROADSIDE DITCH CHECK DAM SECTION VIEW
SCALE: NTS



CHECK DAM CROSS SECTION
SCALE: NTS

Check Dam Example Calculation (Basin N)

Post-Development Drainage Conditions:
Road Side Ditch: Length=580 ft
Slope= 2.7%
Contributing road surface area=0.41 AC
Runoff from road= 0.69 CFS

Number of Checkdams= $\frac{580}{40}$=15 (for slopes 2-5%)
Approximate storage in check dams:
Ditch depth: ~1'
Water depth at check dam=~0.75' (tapers to 0' depth)
Volume of checkdam=$(40X\frac{1}{2}X\frac{3}{4}')X(2(4X\frac{1}{2}X0.375'))$=22.5 CF
Time to fill checkdam=22.5 CF/.69 CFS=0.54 min
Time to fill 15 checkdams=0.54 min X 15= 8.1 min

8.1 minutes added to existing Tc value is adequate to mitigate for the additional runoff that results from development.

ROCK CHECK DAM SPACING	
CHANNEL SLOPE, %	SPACING, FT
<2	100
2-5	40
5-10	20
10-15	13

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TYPICAL ROCK CHECK DAM LID

FIGURE E

Attachments

Precipitation Data

NOAA Atlas 14, Volume 6, Version 2
Location name: Palo Cedro, California, US*
Latitude: 40.6084°, Longitude: -122.2572°
Elevation: 661 ft*
* source: Google Maps

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)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.204 (0.176-0.239)	0.246 (0.211-0.289)	0.302 (0.258-0.355)	0.348 (0.295-0.414)	0.413 (0.337-0.511)	0.465 (0.370-0.590)	0.519 (0.401-0.677)	0.576 (0.431-0.777)	0.656 (0.468-0.929)	0.721 (0.494-1.06)
10-min	0.292 (0.252-0.343)	0.352 (0.303-0.414)	0.432 (0.370-0.509)	0.499 (0.423-0.594)	0.592 (0.483-0.733)	0.666 (0.530-0.845)	0.743 (0.575-0.971)	0.825 (0.618-1.11)	0.941 (0.671-1.33)	1.03 (0.709-1.52)
15-min	0.353 (0.304-0.415)	0.426 (0.366-0.500)	0.523 (0.448-0.616)	0.603 (0.512-0.718)	0.716 (0.584-0.886)	0.805 (0.641-1.02)	0.899 (0.695-1.17)	0.998 (0.747-1.35)	1.14 (0.812-1.61)	1.25 (0.857-1.84)
30-min	0.475 (0.409-0.557)	0.572 (0.492-0.672)	0.702 (0.602-0.827)	0.810 (0.688-0.964)	0.962 (0.785-1.19)	1.08 (0.861-1.37)	1.21 (0.934-1.58)	1.34 (1.00-1.81)	1.53 (1.09-2.16)	1.68 (1.15-2.47)
60-min	0.671 (0.578-0.787)	0.808 (0.695-0.949)	0.992 (0.850-1.17)	1.15 (0.972-1.36)	1.36 (1.11-1.68)	1.53 (1.22-1.94)	1.71 (1.32-2.23)	1.89 (1.42-2.56)	2.16 (1.54-3.06)	2.37 (1.63-3.49)
2-hr	0.954 (0.822-1.12)	1.12 (0.965-1.32)	1.35 (1.16-1.59)	1.54 (1.31-1.84)	1.82 (1.49-2.25)	2.04 (1.63-2.59)	2.28 (1.76-2.98)	2.54 (1.90-3.42)	2.91 (2.07-4.12)	3.21 (2.20-4.73)
3-hr	1.15 (0.993-1.35)	1.35 (1.16-1.58)	1.61 (1.38-1.90)	1.84 (1.56-2.19)	2.16 (1.76-2.67)	2.42 (1.93-3.07)	2.70 (2.09-3.52)	3.00 (2.24-4.04)	3.43 (2.45-4.86)	3.79 (2.60-5.58)
6-hr	1.61 (1.38-1.88)	1.87 (1.61-2.20)	2.23 (1.91-2.63)	2.53 (2.15-3.01)	2.96 (2.42-3.67)	3.31 (2.63-4.20)	3.67 (2.84-4.79)	4.07 (3.05-5.49)	4.64 (3.31-6.57)	5.11 (3.51-7.53)
12-hr	2.18 (1.88-2.56)	2.60 (2.24-3.06)	3.15 (2.70-3.72)	3.60 (3.06-4.29)	4.22 (3.44-5.22)	4.69 (3.73-5.95)	5.18 (4.01-6.76)	5.68 (4.26-7.67)	6.38 (4.55-9.03)	6.92 (4.75-10.2)
24-hr	2.97 (2.62-3.43)	3.65 (3.22-4.23)	4.53 (3.98-5.26)	5.22 (4.55-6.10)	6.13 (5.19-7.39)	6.81 (5.66-8.37)	7.49 (6.08-9.41)	8.17 (6.47-10.5)	9.07 (6.91-12.1)	9.75 (7.20-13.5)
2-day	3.90 (3.44-4.51)	4.80 (4.23-5.57)	5.96 (5.24-6.92)	6.88 (6.00-8.05)	8.11 (6.86-9.78)	9.03 (7.50-11.1)	9.96 (8.09-12.5)	10.9 (8.63-14.0)	12.1 (9.26-16.3)	13.1 (9.67-18.1)
3-day	4.54 (4.01-5.26)	5.58 (4.92-6.46)	6.92 (6.08-8.03)	7.99 (6.97-9.35)	9.43 (7.98-11.4)	10.5 (8.74-12.9)	11.6 (9.44-14.6)	12.8 (10.1-16.4)	14.3 (10.9-19.1)	15.4 (11.4-21.3)
4-day	5.11 (4.50-5.91)	6.27 (5.52-7.26)	7.76 (6.82-9.01)	8.97 (7.82-10.5)	10.6 (8.95-12.8)	11.8 (9.80-14.5)	13.0 (10.6-16.4)	14.3 (11.3-18.4)	16.0 (12.2-21.4)	17.3 (12.8-23.9)
7-day	6.36 (5.61-7.36)	7.80 (6.87-9.04)	9.65 (8.48-11.2)	11.1 (9.70-13.0)	13.1 (11.1-15.8)	14.5 (12.1-17.9)	16.0 (13.0-20.1)	17.5 (13.8-22.5)	19.5 (14.8-26.0)	21.0 (15.5-29.0)
10-day	7.28 (6.42-8.42)	8.94 (7.87-10.4)	11.0 (9.70-12.8)	12.7 (11.1-14.9)	14.9 (12.6-18.0)	16.5 (13.7-20.3)	18.2 (14.8-22.8)	19.8 (15.7-25.5)	21.9 (16.7-29.4)	23.6 (17.4-32.6)
20-day	9.71 (8.56-11.2)	12.0 (10.6-13.9)	14.8 (13.0-17.2)	17.0 (14.9-19.9)	19.9 (16.8-24.0)	22.0 (18.3-27.0)	24.0 (19.5-30.2)	26.0 (20.6-33.6)	28.7 (21.8-38.4)	30.6 (22.6-42.3)
30-day	11.8 (10.4-13.6)	14.6 (12.8-16.9)	18.0 (15.8-20.9)	20.7 (18.0-24.2)	24.0 (20.3-29.0)	26.5 (22.0-32.6)	28.9 (23.4-36.3)	31.2 (24.7-40.2)	34.1 (26.0-45.7)	36.3 (26.8-50.2)
45-day	14.7 (12.9-17.0)	18.2 (16.0-21.0)	22.4 (19.7-26.0)	25.6 (22.4-30.0)	29.7 (25.1-35.8)	32.6 (27.1-40.1)	35.4 (28.7-44.5)	38.1 (30.1-49.1)	41.5 (31.6-55.5)	43.9 (32.4-60.7)
60-day	17.3 (15.2-20.0)	21.4 (18.8-24.8)	26.3 (23.1-30.5)	30.0 (26.2-35.1)	34.6 (29.3-41.8)	37.9 (31.5-46.6)	41.0 (33.3-51.5)	44.0 (34.8-56.7)	47.7 (36.4-63.9)	50.4 (37.2-69.6)

[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.

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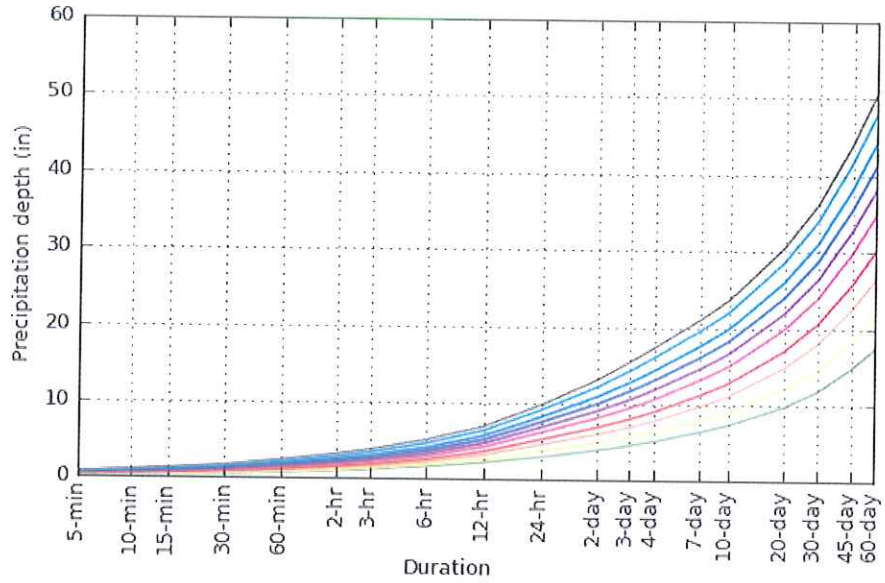
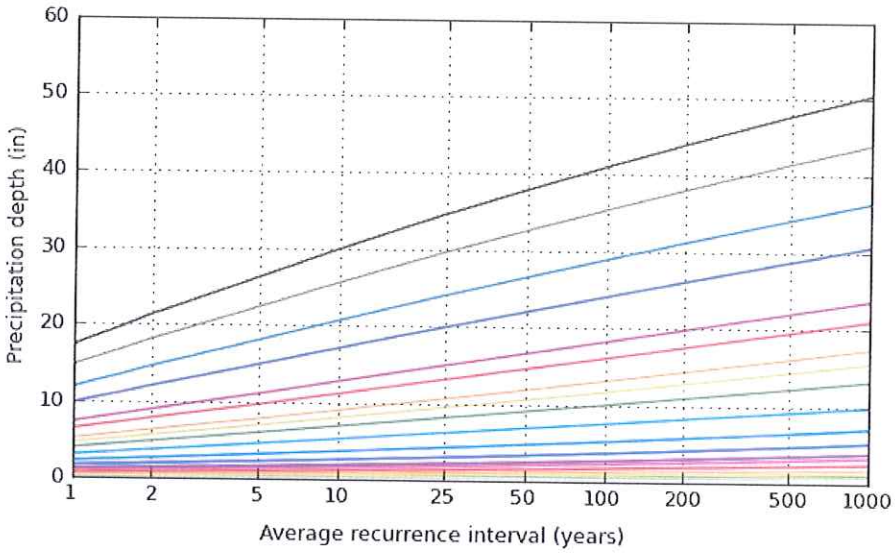
PF graphical

PDS-based depth-duration-frequency (DDF) curves
Latitude: 40.6084°, Longitude: -122.2572°





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Created (GMT): Wed Aug 26 17:06:39 2015

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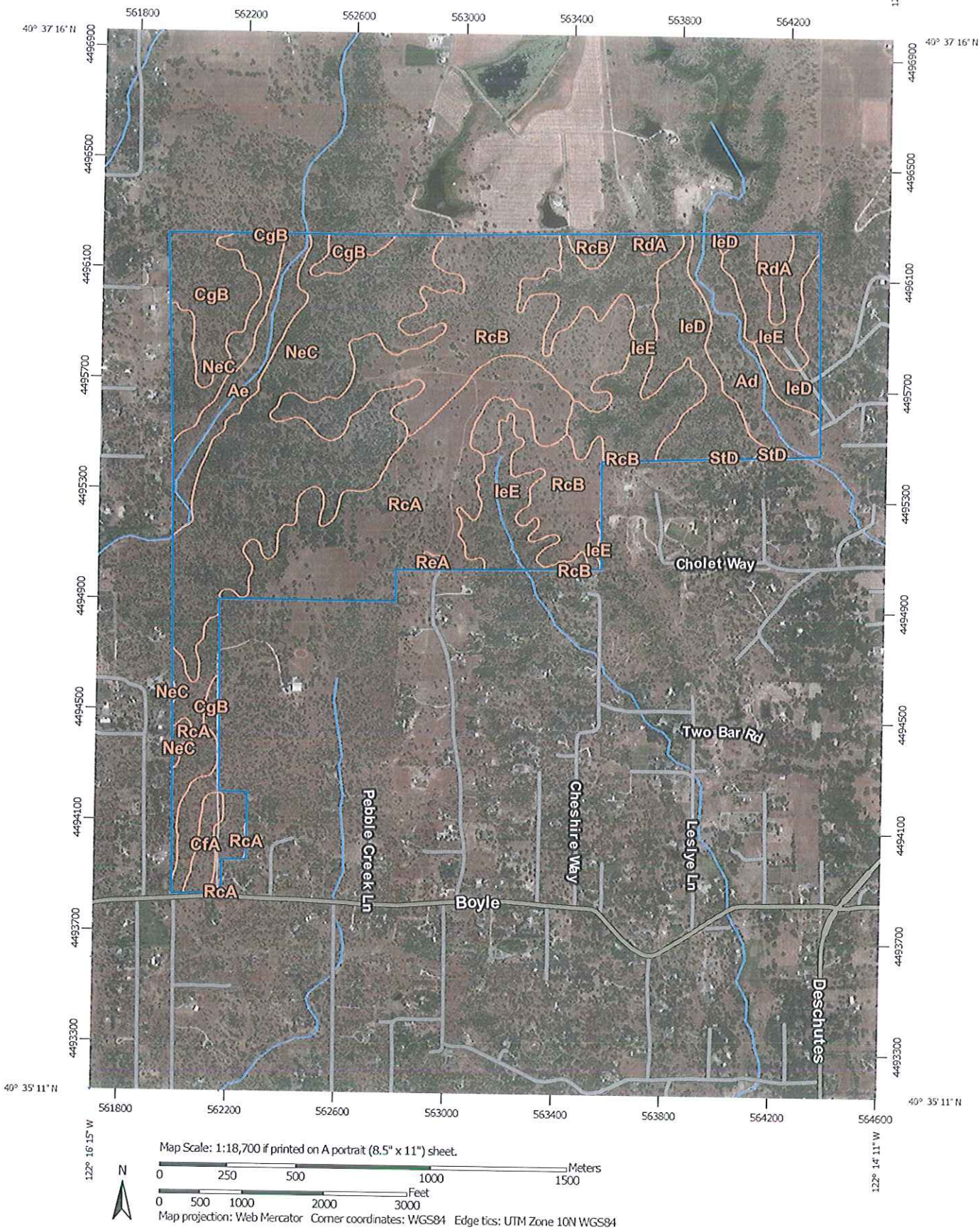
Maps & aerials

Small scale terrain

Soils Report

Soil Map—Shasta County Area, California
(ChathamPropBoundary)



Map Scale: 1:18,700 if printed on A portrait (8.5" x 11") sheet.

N

0 250 500 1000 1500 Meters

0 500 1000 2000 3000 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

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.

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

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
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: Shasta County Area, California
Survey Area Data: Version 10, Sep 16, 2015

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

Date(s) aerial images were photographed: May 26, 2015—Jun 26, 2015

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

Shasta County Area, California (CA607)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Ad	Anderson gravelly sandy loam	33.4	4.7%
Ae	Anderson gravelly sandy loam, moderately deep	27.5	3.8%
CfA	Churn gravelly loam, deep, 0 to 3 percent slopes	6.7	0.9%
CgB	Clough gravelly loam, 3 to 8 percent slopes	51.9	7.3%
IeD	Inks-Pentz complex, 5 to 30 percent slopes	51.3	7.2%
IeE	Inks-Pentz complex, 30 to 50 percent slopes	105.1	14.7%
NeC	Newtown gravelly loam, 8 to 15 percent slopes	173.7	24.3%
RcA	Red Bluff gravelly loam, moderately deep, 0 to 3 percent slopes	119.9	16.7%
RcB	Red Bluff gravelly loam, moderately deep, 3 to 8 percent slopes	135.5	18.9%
RdA	Redding gravelly loam, 0 to 3 percent slopes	8.2	1.1%
ReA	Redding-Red Bluff gravelly loams, 0 to 3 percent slopes	1.1	0.2%
StD	Supan gravelly loam, 15 to 30 percent slopes	1.3	0.2%
Totals for Area of Interest		**715.7**	**100.0%**

Map Unit Description

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 in this report, 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*. All the soils of a series have major horizons that are similar in composition, thickness, and arrangement. Soils of a given 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.

Additional information about the map units described in this report is available in other soil reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the soil reports define some of the properties included in the map unit descriptions.

Report—Map Unit Description

Shasta County Area, California

Ad—Anderson gravelly sandy loam

Map Unit Setting

National map unit symbol: hfld
Elevation: 350 to 1,500 feet
Mean annual precipitation: 25 inches
Mean annual air temperature: 63 degrees F
Frost-free period: 225 to 300 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Anderson

Setting

Landform: Flood plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 14 inches: gravelly sandy loam
H2 - 14 to 24 inches: gravelly sandy loam
H3 - 24 to 60 inches: very gravelly sand

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High (1.98 to 5.95 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: Low (about 3.6 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: A

Minor Components

Honcut

Percent of map unit: 5 percent

Tujunga

Percent of map unit: 5 percent

Unnamed

Percent of map unit: 3 percent

Cobbly alluvial land

Percent of map unit: 2 percent
Landform: Fans

Ae—Anderson gravelly sandy loam, moderately deep

Map Unit Setting

National map unit symbol: hflf
Elevation: 350 to 1,500 feet
Mean annual precipitation: 25 inches
Mean annual air temperature: 63 degrees F
Frost-free period: 225 to 300 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Anderson

Setting

Landform: Flood plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 14 inches: gravelly sandy loam
H2 - 14 to 20 inches: gravelly sandy loam
H3 - 20 to 60 inches: stratified sandy loam to clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Somewhat excessively drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water storage in profile: Very low (about 1.7 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: B

Minor Components

Honcut

Percent of map unit: 7 percent

Perkins
Percent of map unit: 6 percent

Cobbly alluvial land
Percent of map unit: 2 percent
Landform: Fans

CfA—Churn gravelly loam, deep, 0 to 3 percent slopes

Map Unit Setting
National map unit symbol: hfmf
Elevation: 400 to 800 feet
Mean annual precipitation: 35 inches
Mean annual air temperature: 63 degrees F
Frost-free period: 250 to 275 days
Farmland classification: Prime farmland if irrigated

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

Description of Churn

Setting
Landform: Terraces
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile
H1 - 0 to 13 inches: gravelly loam
H2 - 13 to 40 inches: gravelly loam
H3 - 40 to 60 inches: stratified gravelly loam to gravelly clay loam

Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Moderate (about 6.7 inches)

Interpretive groups
Land capability classification (irrigated): 2s
Land capability classification (nonirrigated): 3s

Hydrologic Soil Group: C

Minor Components

Cobbly alluvial land
Percent of map unit: 5 percent
Landform: Drainageways

Honcut
Percent of map unit: 4 percent

Perkins
Percent of map unit: 3 percent

Tahama
Percent of map unit: 3 percent

CgB—Clough gravelly loam, 3 to 8 percent slopes

Map Unit Setting
National map unit symbol: hfmh
Elevation: 200 to 1,000 feet
Mean annual precipitation: 35 inches
Mean annual air temperature: 61 degrees F
Frost-free period: 200 to 250 days
Farmland classification: Not prime farmland

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

Description of Clough

Setting
Landform: Terraces
Landform position (two-dimensional): Summit, shoulder, backslope
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile
H1 - 0 to 18 inches: gravelly loam
H2 - 18 to 29 inches: very gravelly clay
H3 - 29 to 44 inches: indurated
H4 - 44 to 60 inches: stratified very gravelly sandy loam to very gravelly sandy clay loam

Properties and qualities
Slope: 3 to 8 percent
Depth to restrictive feature: 29 to 44 inches to duripan
Natural drainage class: Moderately well drained

Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.1 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D

Minor Components

Newtown

Percent of map unit: 8 percent

Red bluff

Percent of map unit: 7 percent

IeD—Inks-Pentz complex, 5 to 30 percent slopes

Map Unit Setting

National map unit symbol: hfp7
Elevation: 200 to 3,500 feet
Mean annual precipitation: 25 to 30 inches
Mean annual air temperature: 61 degrees F
Frost-free period: 175 to 280 days
Farmland classification: Not prime farmland

Map Unit Composition

Inks and similar soils: 50 percent
Pentz and similar soils: 35 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Inks

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Mountainflank
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from volcanic rock

Typical profile

H1 - 0 to 14 inches: gravelly loam
H2 - 14 to 19 inches: very gravelly loam
H3 - 19 to 23 inches: unweathered bedrock

Properties and qualities

Slope: 8 to 30 percent
Depth to restrictive feature: 19 to 23 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: SHALLOW LOAMY (R018XD076CA)

Description of Pentz

Setting

Landform: Mountains
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Residuum weathered from volcanic rock

Typical profile

H1 - 0 to 5 inches: very stony sandy loam
H2 - 5 to 18 inches: sandy loam
H3 - 18 to 22 inches: weathered bedrock

Properties and qualities

Slope: 5 to 30 percent
Depth to restrictive feature: 18 to 22 inches to paralithic bedrock
Natural drainage class: Somewhat excessively drained
Runoff class: Low
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 storage in profile: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6s
Hydrologic Soil Group: D
Ecological site: SHALLOW LOAMY (R018XD076CA)

Minor Components

Supan

Percent of map unit: 10 percent

Tuscan
Percent of map unit: 5 percent

IeE—Inks-Pentz complex, 30 to 50 percent slopes

Map Unit Setting

National map unit symbol: hfp8
Elevation: 200 to 3,500 feet
Mean annual precipitation: 25 to 30 inches
Mean annual air temperature: 61 degrees F
Frost-free period: 175 to 280 days
Farmland classification: Not prime farmland

Map Unit Composition

Inks and similar soils: 50 percent
Pentz and similar soils: 35 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Inks

Setting

Landform: Mountains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Mountainflank
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Residuum weathered from volcanic rock

Typical profile

H1 - 0 to 14 inches: very stony loam
H2 - 14 to 19 inches: very cobbly loam
H3 - 19 to 23 inches: unweathered bedrock

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: 19 to 23 inches to lithic bedrock
Natural drainage class: Somewhat excessively drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.06 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 2.2 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: SHALLOW LOAMY (R017XD086CA)

Description of Pentz

Setting

Landform: Mountains
Down-slope shape: Concave
Across-slope shape: Convex
Parent material: Residuum weathered from volcanic rock

Typical profile

H1 - 0 to 5 inches: very stony sandy loam
H2 - 5 to 18 inches: sandy loam
H3 - 18 to 22 inches: weathered bedrock

Properties and qualities

Slope: 30 to 50 percent
Depth to restrictive feature: 18 to 22 inches to paralithic bedrock
Natural drainage class: Somewhat excessively drained
Runoff class: Medium
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 storage in profile: Very low (about 2.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7e
Hydrologic Soil Group: D
Ecological site: SHALLOW LOAMY (R018XD076CA)

Minor Components

Supan

Percent of map unit: 10 percent

Tuscan

Percent of map unit: 5 percent

NeC—Newtown gravelly loam, 8 to 15 percent slopes

Map Unit Setting

National map unit symbol: hfr7
Elevation: 600 to 1,000 feet
Mean annual precipitation: 30 inches
Mean annual air temperature: 61 degrees F
Frost-free period: 200 to 250 days
Farmland classification: Not prime farmland

Map Unit Composition

Newtown and similar soils: 85 percent
Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Newtown

Setting

Landform: Terraces
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 10 inches: gravelly loam
H2 - 10 to 18 inches: very gravelly clay loam
H3 - 18 to 35 inches: clay loam
H4 - 35 to 65 inches: silty clay loam
H5 - 65 to 72 inches: gravelly silty clay loam

Properties and qualities

Slope: 8 to 15 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: UPLAND TERRACE (R017XD088CA)

Minor Components

Perkins

Percent of map unit: 10 percent

Red bluff

Percent of map unit: 5 percent

RcA—Red Bluff gravelly loam, moderately deep, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: hfrv
Elevation: 100 to 1,500 feet
Mean annual precipitation: 14 to 25 inches
Mean annual air temperature: 61 to 63 degrees F

Frost-free period: 230 to 320 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Red Bluff

Setting

Landform: Terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 6 inches: gravelly loam
H2 - 6 to 24 inches: gravelly clay loam
H3 - 24 to 30 inches: gravelly clay loam
H4 - 30 to 40 inches: indurated

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 30 to 40 inches to duripan
Natural drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: C
Ecological site: ACID TERRACE (R017XD089CA)

Minor Components

Perkins

Percent of map unit: 5 percent

Newtown

Percent of map unit: 5 percent

Redding

Percent of map unit: 4 percent

Unnamed

Percent of map unit: 1 percent
Landform: Depressions

RcB—Red Bluff gravelly loam, moderately deep, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: hfrw
Elevation: 100 to 1,500 feet
Mean annual precipitation: 14 to 25 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 230 to 320 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

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

Description of Red Bluff

Setting

Landform: Terraces
Landform position (two-dimensional): Backslope, shoulder, summit
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 6 inches: gravelly loam
H2 - 6 to 24 inches: gravelly clay loam
H3 - 24 to 30 inches: gravelly clay loam
H4 - 30 to 40 inches: indurated

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: 30 to 40 inches to duripan
Natural drainage class: Moderately well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e

Hydrologic Soil Group: C
Ecological site: ACID TERRACE (R017XD089CA)

Minor Components

Perkins
Percent of map unit: 5 percent

Newtown
Percent of map unit: 5 percent

Redding
Percent of map unit: 4 percent

Unnamed
Percent of map unit: 1 percent
Landform: Depressions

RdA—Redding gravelly loam, 0 to 3 percent slopes

Map Unit Setting
National map unit symbol: hfrx
Elevation: 100 to 1,500 feet
Mean annual precipitation: 14 to 25 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 230 to 320 days
Farmland classification: Not prime farmland

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

Description of Redding

Setting
Landform: Terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile
H1 - 0 to 6 inches: gravelly loam
H2 - 6 to 13 inches: clay
H3 - 13 to 28 inches: indurated

Properties and qualities
Slope: 0 to 3 percent
Depth to restrictive feature: 13 to 28 inches to duripan
Natural drainage class: Well drained
Runoff class: Very high

Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.1 inches)

Interpretive groups
Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: D
Ecological site: ACID TERRACE (R017XD089CA)

Minor Components

Igo
Percent of map unit: 5 percent

Clough
Percent of map unit: 5 percent

Red bluff
Percent of map unit: 4 percent

Unnamed
Percent of map unit: 1 percent
Landform: Depressions

ReA—Redding-Red Bluff gravelly loams, 0 to 3 percent slopes

Map Unit Setting
National map unit symbol: hfrz
Elevation: 100 to 1,500 feet
Mean annual precipitation: 14 to 30 inches
Mean annual air temperature: 61 to 63 degrees F
Frost-free period: 200 to 320 days
Farmland classification: Not prime farmland

Map Unit Composition
Redding and similar soils: 45 percent
Red bluff and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Redding

Setting
Landform: Terraces
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 6 inches: gravelly loam
H2 - 6 to 13 inches: clay
H3 - 13 to 28 inches: indurated

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 13 to 28 inches to duripan
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Very low (about 1.1 inches)

Interpretive groups

Land capability classification (irrigated): 4s
Land capability classification (nonirrigated): 4s
Hydrologic Soil Group: D
Ecological site: ACID TERRACE (R017XD089CA)

Description of Red Bluff

Setting

Landform: Terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

H1 - 0 to 6 inches: gravelly loam
H2 - 6 to 24 inches: gravelly clay loam
H3 - 24 to 30 inches: gravelly clay loam
H4 - 30 to 40 inches: indurated

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: 30 to 40 inches to duripan
Natural drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 to 0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 4.2 inches)

Interpretive groups

Land capability classification (irrigated): 3s
Land capability classification (nonirrigated): 3s
Hydrologic Soil Group: C
Ecological site: ACID TERRACE (R017XD089CA)

Minor Components

Newtown
Percent of map unit: 5 percent

Unnamed
Percent of map unit: 5 percent
Landform: Depressions

Perkins
Percent of map unit: 5 percent

StD—Supan gravelly loam, 15 to 30 percent slopes

Map Unit Setting
National map unit symbol: hftb
Elevation: 800 to 4,000 feet
Mean annual precipitation: 35 inches
Mean annual air temperature: 54 to 57 degrees F
Frost-free period: 175 to 260 days
Farmland classification: Not prime farmland

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

Description of Supan

Setting
Landform: Hills
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Concave
Across-slope shape: Concave
Parent material: Residuum weathered from tuff breccia

Typical profile
H1 - 0 to 10 inches: gravelly loam
H2 - 10 to 33 inches: clay loam
H3 - 33 to 43 inches: unweathered bedrock

Properties and qualities
Slope: 15 to 30 percent
Depth to restrictive feature: 33 to 37 inches to lithic bedrock
Natural drainage class: Well drained
Runoff class: Very 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 storage in profile: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: LOAMY (R018XD075CA)

Minor Components

Toomes

Percent of map unit: 5 percent

Inks

Percent of map unit: 5 percent

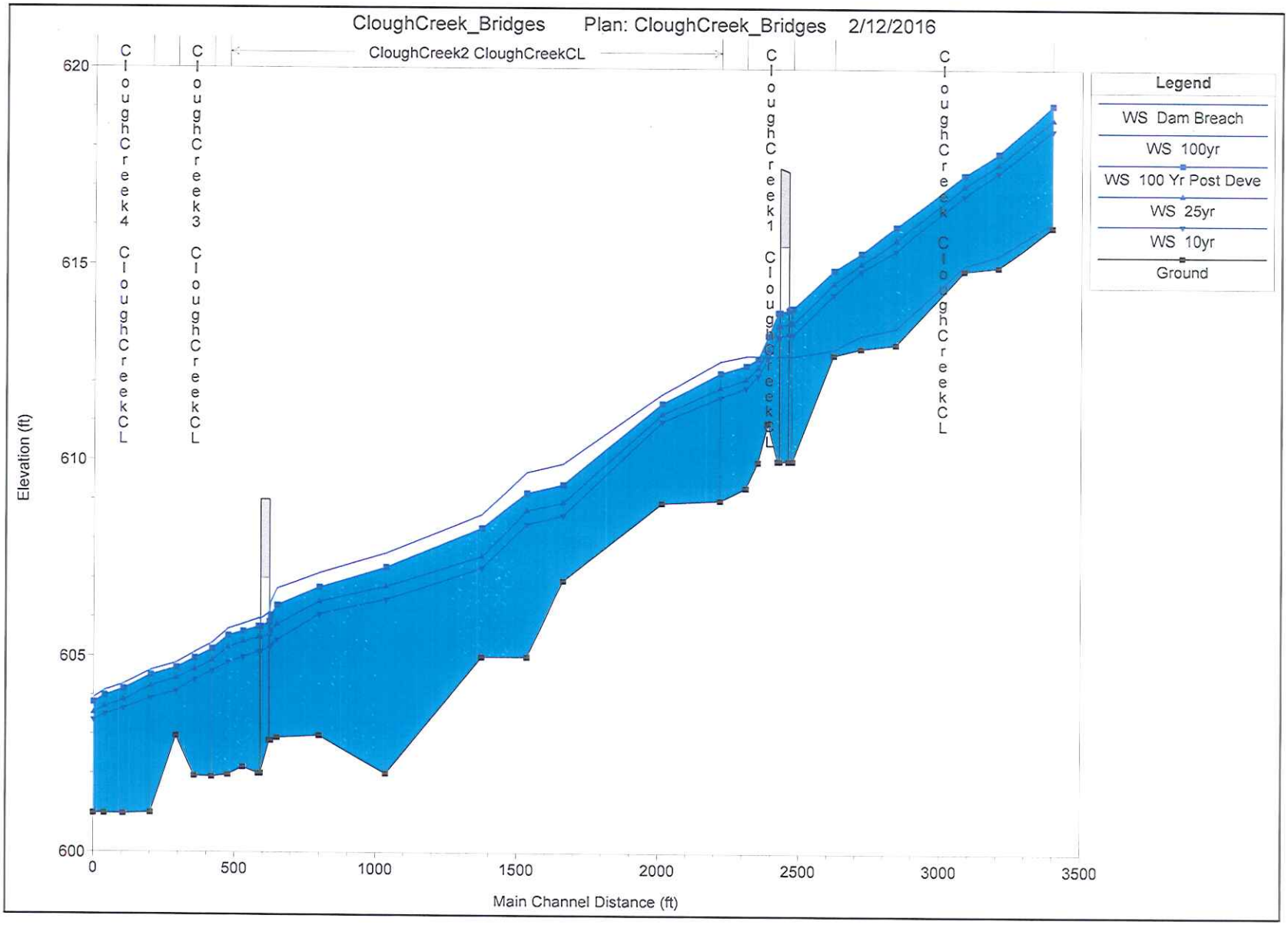
Aiken

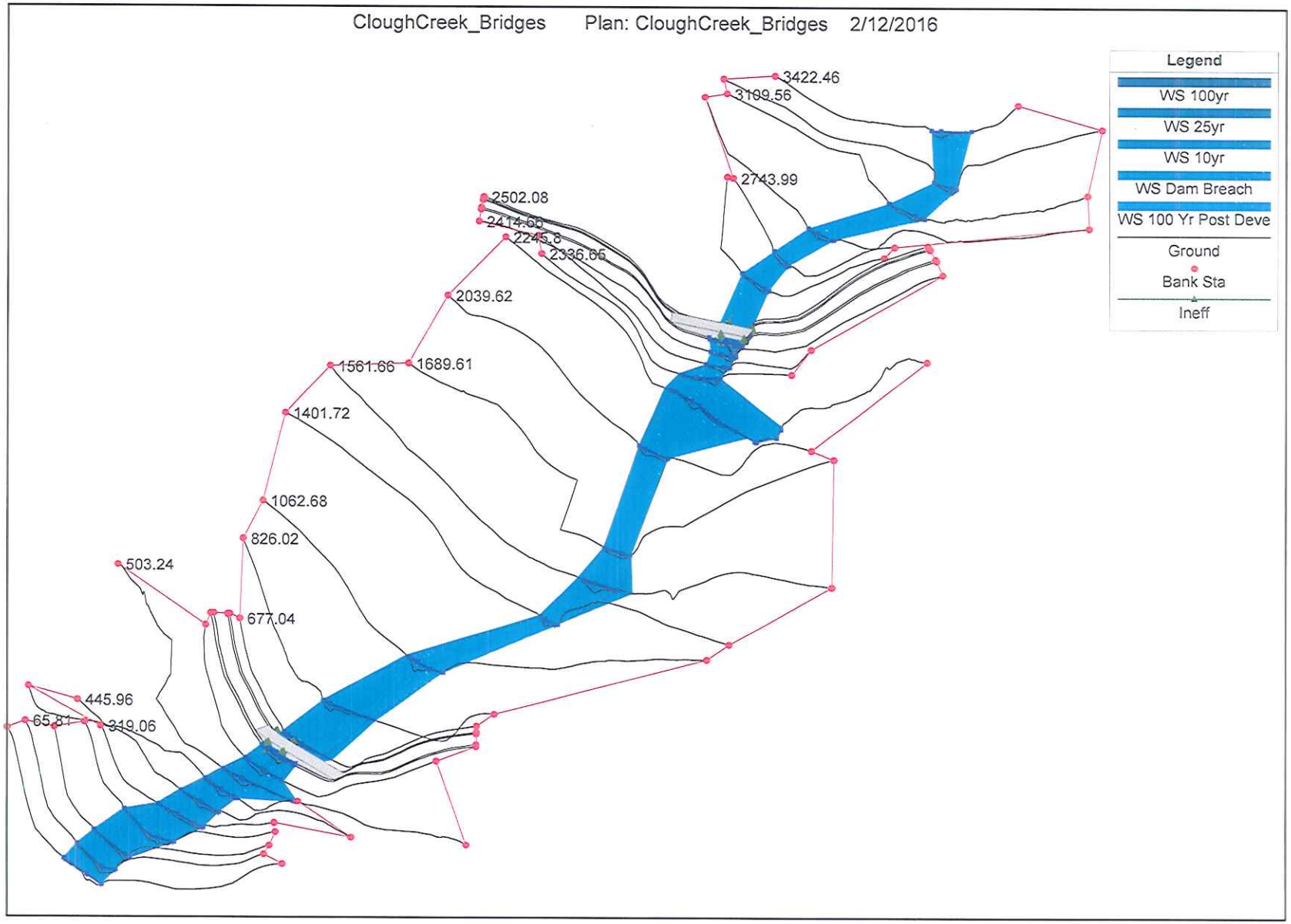
Percent of map unit: 5 percent

Data Source Information

Soil Survey Area: Shasta County Area, California
Survey Area Data: Version 10, Sep 16, 2015

HEC-RAS Model Output Data


CloughCreek_Bridges Plan: CloughCreek_Bridges 2/12/2016
CloughCreek2 CloughCreekCL
CloughCreek4 CloughCreekCL
CloughCreek3 CloughCreekCL
CloughCreek1 CloughCreekCL
CloughCreek CloughCreekCL
Legend
WS Dam Breach
WS 100yr
WS 100 Yr Post Deve
WS 25yr
WS 10yr
Ground
Elevation (ft)
620
615
610
605
600
0
500
1000
1500
2000
2500
3000
3500
Main Channel Distance (ft)


CloughCreek_Bridges Plan: CloughCreek_Bridges 2/12/2016
Legend
WS 100yr
WS 25yr
WS 10yr
WS Dam Breach
WS 100 Yr Post Deve
Ground
Bank Sta
Ineff
3422.46
3199.56
2743.99
2502.08
2414.69
2245.8
2236.66
2039.62
1689.61
1561.66
1401.72
1062.68
826.02
677.04
503.24
445.96
319.06
65.81

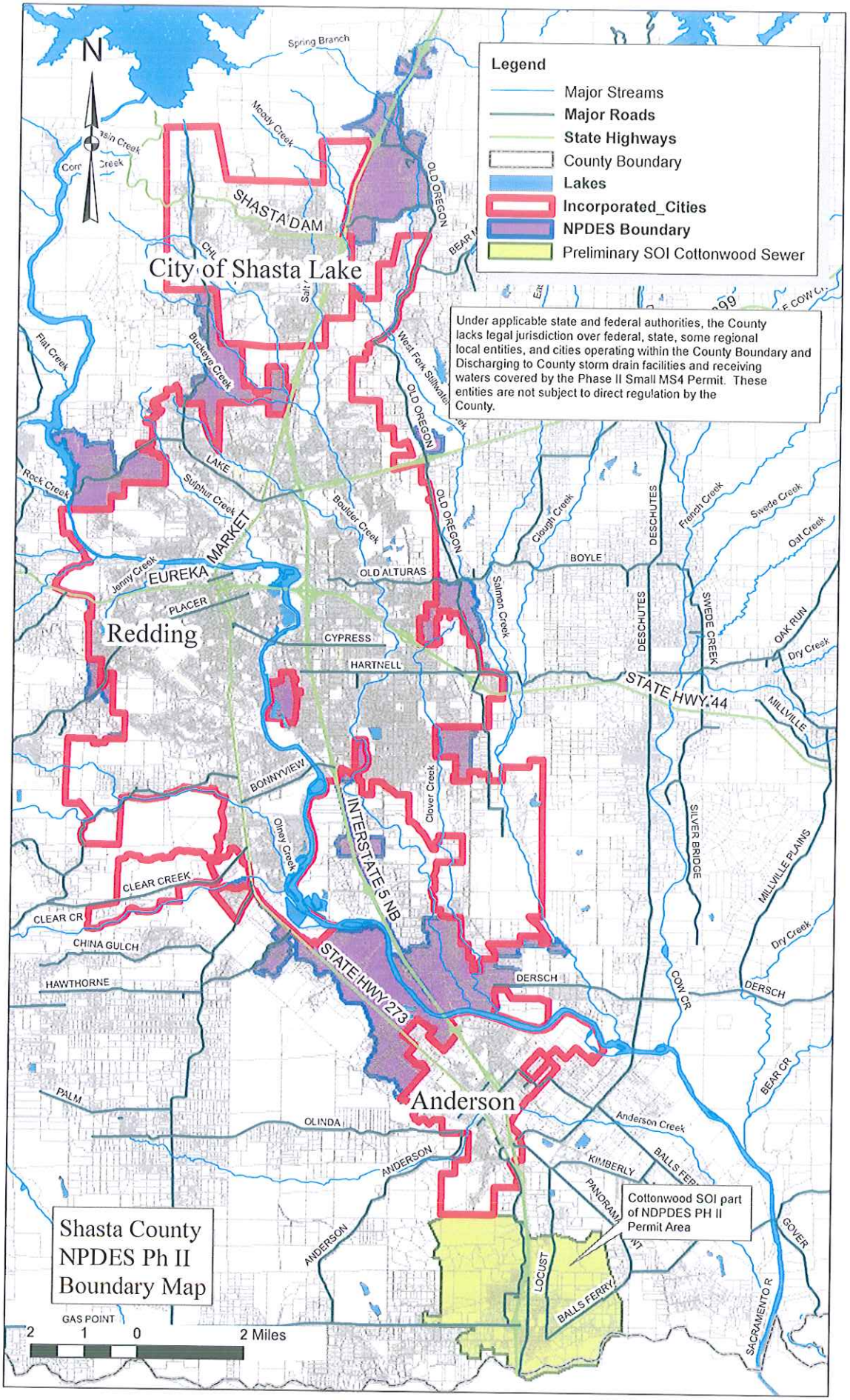
HEC-RAS Plan: CloughCreek_Brid

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
CloughCreek4	CloughCreekCL	229.09	100yr	525.00	600.99	604.52		604.61	0.001985	2.34	224.23	162.19	0.35
CloughCreek4	CloughCreekCL	229.09	Dam Breach	600.00	600.99	604.65		604.74	0.001953	2.45	244.62	163.62	0.35
CloughCreek4	CloughCreekCL	132.67	100yr	525.00	600.96	604.16		604.33	0.004322	3.29	159.67	124.29	0.51
CloughCreek4	CloughCreekCL	132.67	Dam Breach	600.00	600.96	604.28		604.46	0.004202	3.43	175.04	125.29	0.51
CloughCreek4	CloughCreekCL	65.81	100yr	525.00	600.97	603.99		604.10	0.002302	2.68	195.80	129.10	0.38
CloughCreek4	CloughCreekCL	65.81	Dam Breach	600.00	600.97	604.12		604.24	0.002354	2.83	211.91	130.90	0.39
CloughCreek4	CloughCreekCL	27.35	100yr	525.00	600.97	603.82	603.29	603.98	0.004000	3.26	161.04	119.83	0.50
CloughCreek4	CloughCreekCL	27.35	Dam Breach	600.00	600.97	603.94	603.38	604.12	0.004000	3.42	175.19	121.05	0.50
CloughCreek3	CloughCreekCL	445.96	100yr	502.00	601.91	605.19		605.39	0.004762	3.64	137.78	98.98	0.54
CloughCreek3	CloughCreekCL	445.96	Dam Breach	600.00	601.91	605.34		605.58	0.004977	3.91	153.42	102.44	0.56
CloughCreek3	CloughCreekCL	384.02	100yr	502.00	601.93	604.95		605.12	0.003850	3.24	155.03	113.38	0.49
CloughCreek3	CloughCreekCL	384.02	Dam Breach	600.00	601.93	605.10		605.29	0.004096	3.50	171.63	117.20	0.51
CloughCreek3	CloughCreekCL	319.06	100yr	502.00	602.95	604.72		604.86	0.003808	3.10	161.77	124.98	0.48
CloughCreek3	CloughCreekCL	319.06	Dam Breach	600.00	602.95	604.84		605.02	0.004212	3.38	177.27	129.70	0.51
CloughCreek2	CloughCreekCL	2245.8	100yr	455.00	609.00	612.26		612.32	0.002237	1.97	231.36	238.39	0.35
CloughCreek2	CloughCreekCL	2245.8	Dam Breach	600.00	609.00	612.56		612.61	0.001977	1.87	321.20	325.94	0.33
CloughCreek2	CloughCreekCL	2039.62	100yr	455.00	608.93	611.47		611.69	0.004132	3.74	121.62	75.27	0.52
CloughCreek2	CloughCreekCL	2039.62	Dam Breach	600.00	608.93	611.71		612.00	0.004649	4.29	139.88	76.98	0.56
CloughCreek2	CloughCreekCL	1689.61	100yr	455.00	608.95	609.40		609.76	0.007531	4.87	93.48	61.21	0.69
CloughCreek2	CloughCreekCL	1689.61	Dam Breach	600.00	608.95	609.92		610.27	0.005279	4.72	127.07	66.63	0.60
CloughCreek2	CloughCreekCL	1561.66	100yr	455.00	605.00	609.19		609.30	0.001607	2.73	166.68	81.38	0.34
CloughCreek2	CloughCreekCL	1561.66	Dam Breach	600.00	605.00	609.70		609.82	0.001917	2.80	213.93	114.68	0.38
CloughCreek2	CloughCreekCL	1401.72	100yr	455.00	605.00	608.29		608.77	0.008389	5.54	82.06	47.53	0.74
CloughCreek2	CloughCreekCL	1401.72	Dam Breach	600.00	605.00	608.63		609.21	0.008668	6.07	98.93	51.29	0.77
CloughCreek2	CloughCreekCL	1062.68	100yr	455.00	602.00	607.29		607.41	0.002070	2.78	163.41	92.81	0.37
CloughCreek2	CloughCreekCL	1062.68	Dam Breach	600.00	602.00	607.64		607.79	0.002124	3.03	197.86	100.87	0.38
CloughCreek2	CloughCreekCL	826.02	100yr	455.00	602.97	606.77		606.88	0.002351	2.65	171.68	116.44	0.38
CloughCreek2	CloughCreekCL	826.02	Dam Breach	600.00	602.97	607.14		607.26	0.002298	2.76	217.70	136.94	0.39
CloughCreek2	CloughCreekCL	677.04	100yr	455.00	602.91	606.30		606.44	0.003803	3.06	148.69	117.49	0.48
CloughCreek2	CloughCreekCL	677.04	Dam Breach	600.00	602.91	606.74		606.87	0.002988	2.90	206.97	147.59	0.43
CloughCreek2	CloughCreekCL	654.84	100yr	455.00	602.84	606.05	605.31	606.34	0.004104	4.32	105.21	107.02	0.54
CloughCreek2	CloughCreekCL	654.84	Dam Breach	600.00	602.84	606.40	605.60	606.76	0.004194	4.66	123.39	129.57	0.56
CloughCreek2	CloughCreekCL	649.84		Bridge									
CloughCreek2	CloughCreekCL	611.08	100yr	455.00	602.00	605.77		606.05	0.003467	4.23	107.47	97.90	0.50
CloughCreek2	CloughCreekCL	611.08	Dam Breach	600.00	602.00	605.97		606.38	0.004533	5.13	117.06	106.71	0.58
CloughCreek2	CloughCreekCL	555.97	100yr	455.00	602.16	605.65		605.79	0.003335	3.04	149.60	108.23	0.45
CloughCreek2	CloughCreekCL	555.97	Dam Breach	600.00	602.16	605.83		606.03	0.004298	3.51	171.01	120.42	0.52
CloughCreek2	CloughCreekCL	503.24	100yr	455.00	601.96	605.53		605.61	0.002754	2.26	201.30	196.69	0.39
CloughCreek2	CloughCreekCL	503.24	Dam Breach	600.00	601.96	605.71		605.81	0.002959	2.53	237.05	206.27	0.42
CloughCreek1	CloughCreekCL	2502.08	100yr	393.00	610.00	613.92		614.19	0.007167	4.19	93.82	72.94	0.65
CloughCreek1	CloughCreekCL	2502.08	Dam Breach	1.00	610.00	612.70		612.70	0.000000	0.03	37.93	27.68	0.00
CloughCreek1	CloughCreekCL	2493.35	100yr	393.00	610.00	613.91	612.69	614.14	0.003029	3.60	103.36	74.44	0.46
CloughCreek1	CloughCreekCL	2493.35	Dam Breach	1.00	610.00	612.70	610.06	612.70	0.000000	0.02	52.93	30.42	0.00
CloughCreek1	CloughCreekCL	2488.35		Bridge									
CloughCreek1	CloughCreekCL	2449.89	100yr	393.00	610.00	613.81	612.54	614.00	0.002423	3.55	110.67	75.54	0.42
CloughCreek1	CloughCreekCL	2449.89	Dam Breach	1.00	610.00	612.70	610.06	612.70	0.000000	0.02	60.49	36.60	0.00
CloughCreek1	CloughCreekCL	2414.66	100yr	393.00	610.97	613.21	613.21	613.78	0.017707	6.06	64.90	58.09	1.01
CloughCreek1	CloughCreekCL	2414.66	Dam Breach	1.00	610.97	612.70		612.70	0.000000	0.03	39.62	41.40	0.00
CloughCreek1	CloughCreekCL	2379	100yr	393.00	609.97	612.63	612.57	613.19	0.015289	6.00	65.49	53.20	0.95
CloughCreek1	CloughCreekCL	2379	Dam Breach	1.00	609.97	612.70		612.70	0.000000	0.01	69.39	54.39	0.00
CloughCreek1	CloughCreekCL	2336.65	100yr	393.00	609.32	612.45		612.68	0.006607	3.90	100.84	83.40	0.62
CloughCreek1	CloughCreekCL	2336.65	Dam Breach	1.00	609.32	612.70		612.70	0.000000	0.01	123.36	94.16	0.00
CloughCreek	CloughCreekCL	3422.46	100yr	371.00	615.98	619.10		619.27	0.004389	3.31	112.25	87.65	0.51
CloughCreek	CloughCreekCL	3422.46	Dam Breach	1.00	615.98	616.10	616.10	616.15	0.041510	1.82	0.55	5.71	1.03
CloughCreek	CloughCreekCL	3231.09	100yr	371.00	614.97	617.88		618.20	0.007078	4.58	81.02	55.16	0.67
CloughCreek	CloughCreekCL	3231.09	Dam Breach	1.00	614.97	615.29		615.29	0.000684	0.45	2.22	8.51	0.16
CloughCreek	CloughCreekCL	3109.56	100yr	371.00	614.88	617.33		617.49	0.004337	3.21	115.54	93.58	0.51
CloughCreek	CloughCreekCL	3109.56	Dam Breach	1.00	614.88	615.01	615.01	615.03	0.032464	1.27	0.79	11.71	0.85

HEC-RAS Plan: CloughCreek_Brid (Continued)

River	Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
CloughCreek	CloughCreekCL	2867.79	100yr	371.00	613.00	615.99		616.24	0.006179	4.03	92.05	68.83	0.61
CloughCreek	CloughCreekCL	2867.79	Dam Breach	1.00	613.00	613.41		613.43	0.002777	0.91	1.10	4.14	0.31
CloughCreek	CloughCreekCL	2743.99	100yr	371.00	612.69	615.33		615.57	0.004696	3.92	94.63	59.86	0.55
CloughCreek	CloughCreekCL	2743.99	Dam Breach	1.00	612.69	613.23	613.03	613.23	0.000998	0.45	2.23	11.46	0.18
CloughCreek	CloughCreekCL	2647.19	100yr	371.00	612.72	614.69		615.08	0.005209	3.55	104.57	83.64	0.56
CloughCreek	CloughCreekCL	2647.19	Dam Breach	1.00	612.72	612.86	612.86	612.91	0.085305	1.68	0.60	11.95	1.32

Shasta County MS4 Permit Map


N
Legend
Major Streams
Major Roads
State Highways
County Boundary
Lakes
Incorporated_Cities
NPDES Boundary
Preliminary SOI Cottonwood Sewer
Under applicable state and federal authorities, the County lacks legal jurisdiction over federal, state, some regional local entities, and cities operating within the County Boundary and Discharging to County storm drain facilities and receiving waters covered by the Phase II Small MS4 Permit. These entities are not subject to direct regulation by the County.
City of Shasta Lake
Redding
Anderson
SHASTA DAM
STATE HWY 44
STATE HWY 273
INTERSTATE 5 NB
Cottonwood SOI part of NDPES PH II Permit Area
Shasta County NPDES Ph II Boundary Map
2 1 0 2 Miles
Spring Branch
Moody Creek
Flat Creek
Buckeye Creek
Rock Creek
Sulphur Creek
Boulder Creek
Jenny Creek
Clough Creek
French Creek
Swede Creek
Salmon Creek
Clover Creek
Olney Creek
Anderson Creek
Dry Creek
OLD OREGON
LAKE
EUREKA
MARKET
PLACER
OLD ALTURAS
CYPRESS
HARTNELL
BOYLE
DESCHUTES
SWEDE CREEK
OAK RUN
MILLVILLE
BONNYVIEW
SILVER BRIDGE
MILLVILLE PLAINS
CLEAR CREEK
CLEAR CR
CHINA GULCH
HAWTHORNE
DERSCH
COW CR
BEAR CR
PALM
OLINDA
ANDERSON
KIMBERLY
BALLS FERRY
LOCUST
GOVER
SACRAMENTO R
GAS POINT