HOGAN LAND SERVICES
A CALIFORNIA CORPORATION

Drainage Analysis – 2960 Foothill Blvd

Prepared September 24, 2015

Site:
2960 Foothill Blvd
Calistoga, California
APN: 011-400-003
HLS Project # 1607

Owners:
RKMS Investments
2960 Foothill Blvd
Calistoga, California

Analysis Prepared by:
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PREPARED: September 24, 2015

SUBJECT: 10-Year event hydrology calculations and reasoning for drainage network sizing, capacity and velocity

PROJECT: Drainage Analysis – 2960 Foothill Blvd Project

ADDRESS: 2960 Foothill Blvd, Calistoga, California

APN: 011-400-003

REFERENCES:

1. Flood Control Design Criteria, by the Sonoma County Water Agency, Revised August 1983.

PROJECT DESCRIPTION:

The subject parcel is located at 2960 Foothill Blvd in Calistoga, California. The site currently is a 2.16 parcel but ultimately will be subdivided into Lot 1, 1.0 acre and Lot 2, 1.16 acre. This drainage analysis will review the effects of the proposed development and lot subdivision. Currently the property has a pet clinic and ac parking lot. The rear or to be Lot 2 is undeveloped with scattered walnut and oaks trees along with native grass. Topography of the site consists of shallow slopes range from 1-3%. The USDA existing soils classifications for the site is Bale Loam. This soil type was taken as hydrologic soil group B based on the attached web soil survey. Lot 2 development consists of a future paved driveway and main residence. Lot 2 will be accessed through a driveway easement over Lot 1. This hydrology report will determine if there are any adverse impacts to drainage conditions from the future development. The existing onsite detention basin will be re-evaluated to determine if it will have enough capacity to retain the increase in runoff. Any increase in stormwater volume due to the new impervious surfaces will be retained within a separate BMP to comply with the no increase in post development stormwater levels requirements. The requirement for no increase in stormwater levels is to preserve the pre-development conditions and prevent additional stormwater discharge offsite.

The parcel is located within the jurisdiction of BASMAA and is subject to additional drainage improvements, see associated Stormwater Control Plan. This analysis focuses strictly on the 10 year event sizing of the proposed improvements. BASMAA requirements are addressed within the Stormwater Control Plan.

EXISTING AND PROPOSED DRAINAGE PATTERN:

The existing land surfaces are open grass land and scattered trees. The predevelopment conditions include a veterinarian clinic, hardscape, and ac driveway & parking lot. Runoff from the veterinarian clinic and parking lot drains into the existing swale which conveys stormwater into the re-sized existing detention basin. Overflow from the basin will drain into the earth swale. Two additional detention basins will be added on lot 2 to accommodate the proposed impervious surfaces for that lot. The overflow for these bioretention facilities will be routed to the existing earth swale. The swale flows along the private road then turns at the north property corner and then follows the rear property line before leaving the site. Stormwater runoff flows within the existing earth swale for about 500 ft before discharging into Blossom Creek.

EXISTING ON-SITE AND OFF-SITE CONDITIONS & IMPACTS OF DEVELOPMENT:
No negative impacts of development are expected and the drainage course on a global scale remains unchanged from pre to post development conditions. Stormwater onsite eventually discharges into Blossom Creek.

DESIGN CRITERIA & ASSUMPTIONS:
This evaluation is based on the policies and procedures detailed in Flood Control Design Criteria, Revised August 1983, issued by the Sonoma County Water Agency. The hydraulic design of the individual drainage improvements is based on the rational formula (Q = C i A K) and is based on the 10-year, 15-minute initial time of concentration storm. A mean annual precipitation of 45 was used resulting in a K factor of 1.50.

METHODOLOGIES USED:
Rational Formula calculations for the 10 yr 15 min. storm are included based on the composite runoff coefficients for each tributary for sizing of the individual drainage improvements. Composite C values for the individual 10 year tributary were based on the contributing surface types of vegetated (C=0.4) and impervious surfaces (C=0.9). A composite C value (not less than 0.4, residential minimum) was assigned to the tributary area. Rational Formula calculations for the 10 yr 15 minute storm have been included based on the composite runoff coefficients for each tributary for evaluation of the individual drainage improvements. The calculation spreadsheets have been attached with this submittal.

AutoCAD Hydraflow software was used to computationally confirm the swale and pipe sizes for this development.

100 YEAR STORM IMPACT AND FLOODING CONCERNS:
These improvements are outside of the 0.2% annual chance floodplain per FEMA Flood Map 06055CO228E and therefore flooding during the 100-year storm event is unlikely.

CONCLUSIONS:
The pipes and swales have been analyzed and sized based on the 10 year storm event with results attached.

ATTACHEMENTS:
- Rational Method Spreadsheet with Composite Runoff Coefficient Calculations
- Swale and Pipe Hydraulic Calculations
- 10-Yr Post-Development Watershed Map

Watershed Exhibit

By JConklin at 9/24/2015, 12:00 PM

1607 - RKMS Investments

Storm Frequency	10	Mean Precipitation	35

Post-Development - Tributary 1

Tributary	Point of Conc.	Area (ac.)	Avg. Slope %	Length	Velocity fps	Time of Concentration: Travel Time (sec.)	Time of Concentration: Total Time	Intensity: I	K-Factor: K	Runnoff Coefficient: C_comp	ΔA	Total Area: A	KΔAC	ΣKΔAC	Flow: Q (cfs)
1	EARTH SWALE	1.52				INITIAL	15	1.72	1.17	0.55	1.52	1.52	0.98	0.98	1.68

Total Flow CFS

Storm Frequency	10	Precipitation	35

Post-Development - Tributary 2

Tributary	Point of Conc.	Area (ac.)	Avg. Slope %	Length	Velocity fps	Time of Concentration: Travel Time (sec.)	Time of Concentration: Total Time	Intensity: I	K-Factor: K	Runnoff Coefficient: C_comp	ΔA	Total Area: A	KΔAC	ΣKΔAC	Flow: Q (cfs)
2	8" HDPE	2.00				INITIAL	15	1.72	1.17	0.46	2.00	2.00	0.93	0.93	1.60
1B	TRIBUTARY 2	1.42	5	130	3	43.3	15.7	1.68	1.17	0.46	1.42	3.42	0.66	1.60	2.68

Total Flow CFS

Storm Frequency	10	Precipitation	35

Post-Development - Tributary 3

Tributary	Point of Conc.	Area (ac.)	Avg. Slope %	Length	Velocity fps	Time of Concentration: Travel Time (sec.)	Time of Concentration: Total Time	Intensity: I	K-Factor: K	Runnoff Coefficient: C_comp	ΔA	Total Area: A	KΔAC	ΣKΔAC	Flow: Q (cfs)
3	EARTH SWALE	1.28				INITIAL	15	1.72	1.17	0.46	1.28	1.28	0.72	0.72	1.23

Total Flow CFS

Tributary	Acres	Post-Dev. Imp.	Post-Dev. Vegitated	C_comp
1	1.52	0.46	1.07	0.55
2	3.42	0.00	3.42	0.40
3	1.28	0.21	1.07	0.46
Total Watershed	6.22			
C_vegitated	0.4	C_Impervious	0.9	

Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Sep 24 2015

SWALE 1 - (E) 12 INCH EARTH SWALE

Trapezoidal

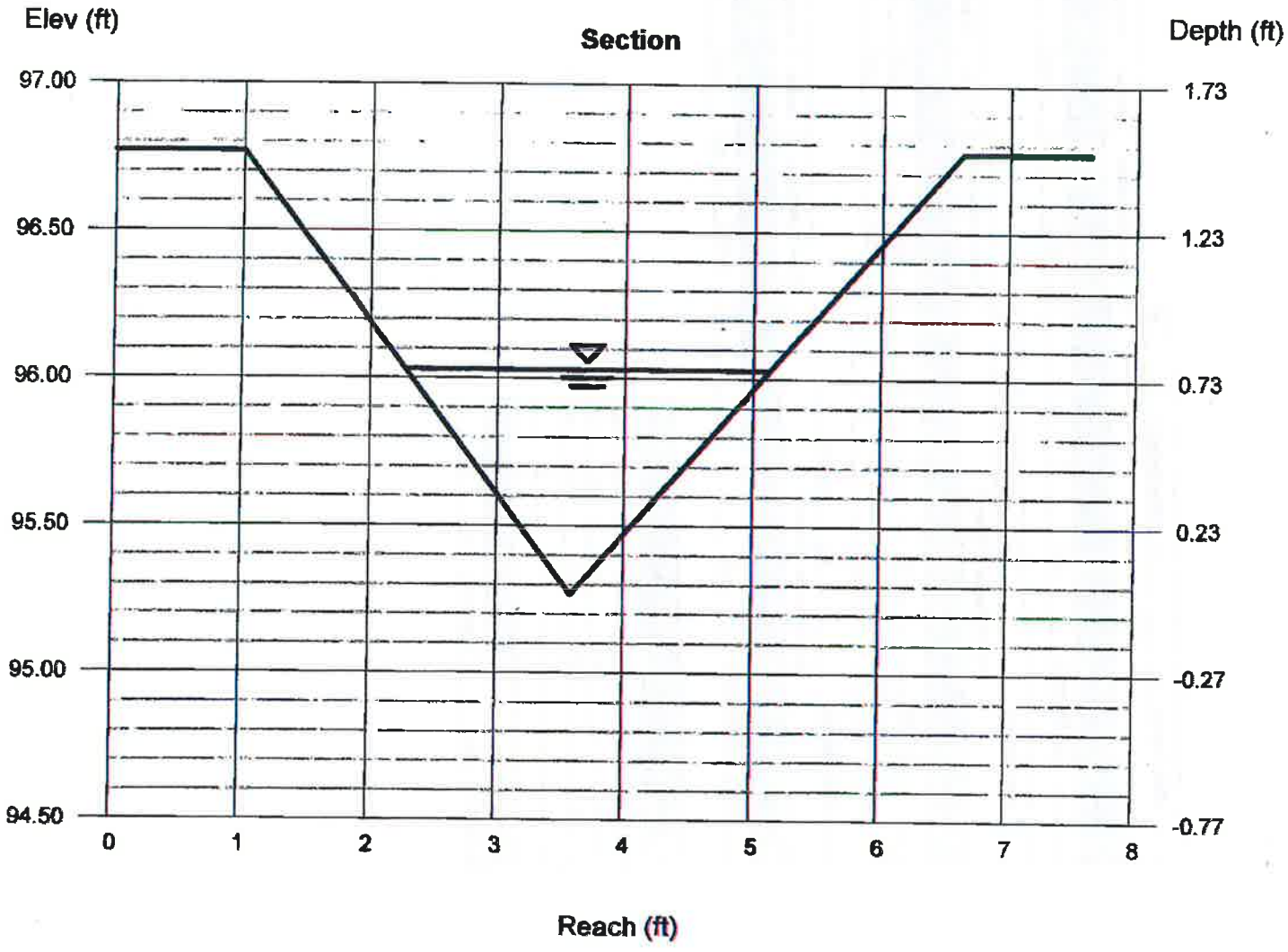
Bottom Width (ft)	= 0.01
Side Slopes (z:1)	= 1.72, 2.03
Total Depth (ft)	= 1.50
Invert Elev (ft)	= 95.27
Slope (%)	= 0.57
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 1.68

Highlighted

Depth (ft)	= 0.76
Q (cfs)	= 1.680
Area (sqft)	= 1.09
Velocity (ft/s)	= 1.54
Wetted Perim (ft)	= 3.24
Crit Depth, Yc (ft)	= 0.55
Top Width (ft)	= 2.86
EGL (ft)	= 0.80



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Sep 24 2015

SWALE 2 - (E) 12 INCH EARTH SWALE

Trapezoidal

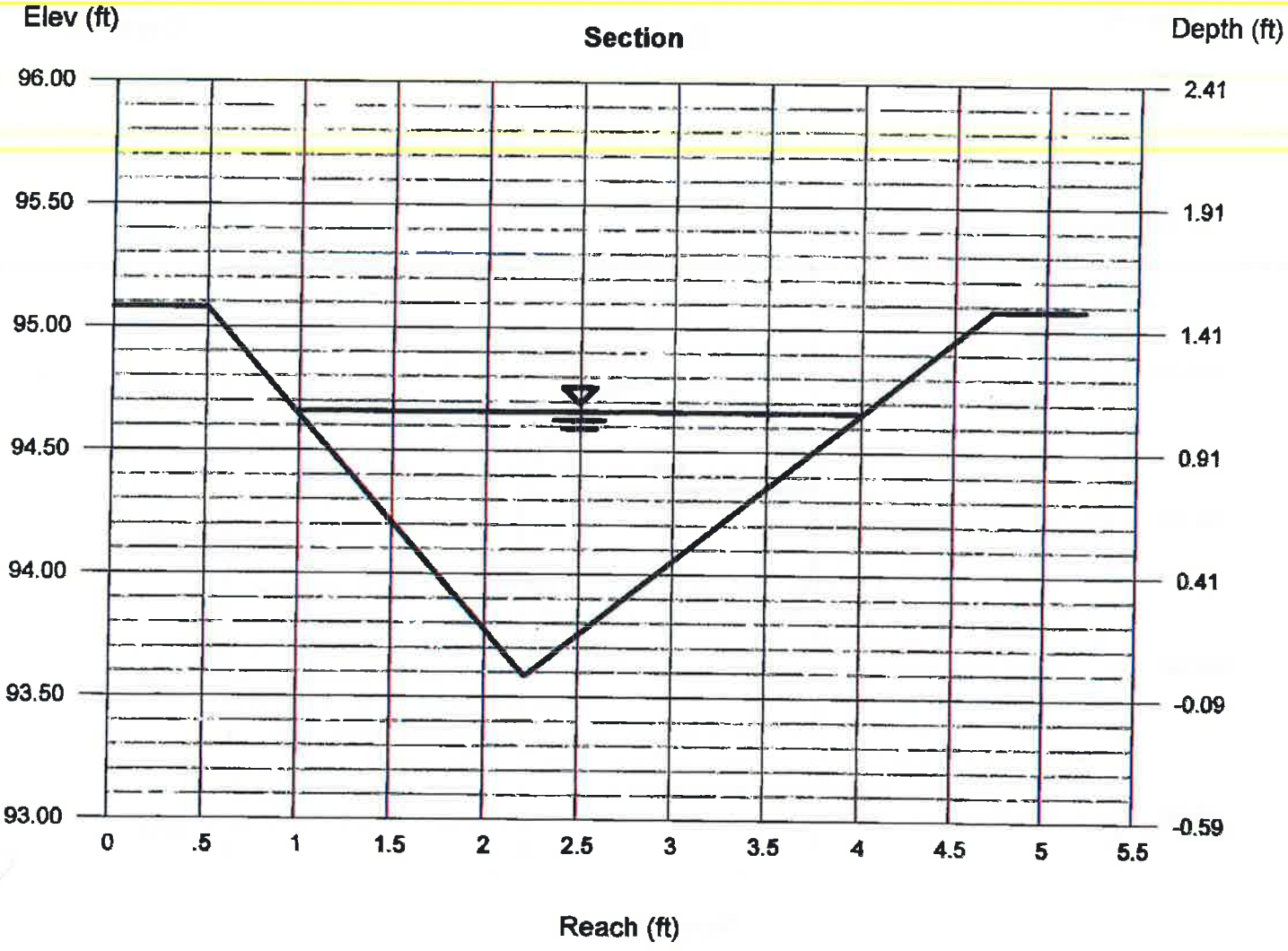
Bottom Width (ft)	= 0.01
Side Slopes (z:1)	= 1.15, 1.67
Total Depth (ft)	= 1.49
Invert Elev (ft)	= 93.59
Slope (%)	= 2.00
N-Value	= 0.035

Calculations

Compute by:	Known Q
Known Q (cfs)	= 5.59

Highlighted

Depth (ft)	= 1.07
Q (cfs)	= 5.590
Area (sqft)	= 1.63
Velocity (ft/s)	= 3.44
Wetted Perim (ft)	= 3.72
Crit Depth, Yc (ft)	= 1.00
Top Width (ft)	= 3.03
EGL (ft)	= 1.25



Channel Report

Hydraflow Express Extension for Autodesk® AutoCAD® Civil 3D® by Autodesk, Inc. Thursday, Sep 24 2015

PIPE 1 - (P) 12 INCH HDPE

Circular

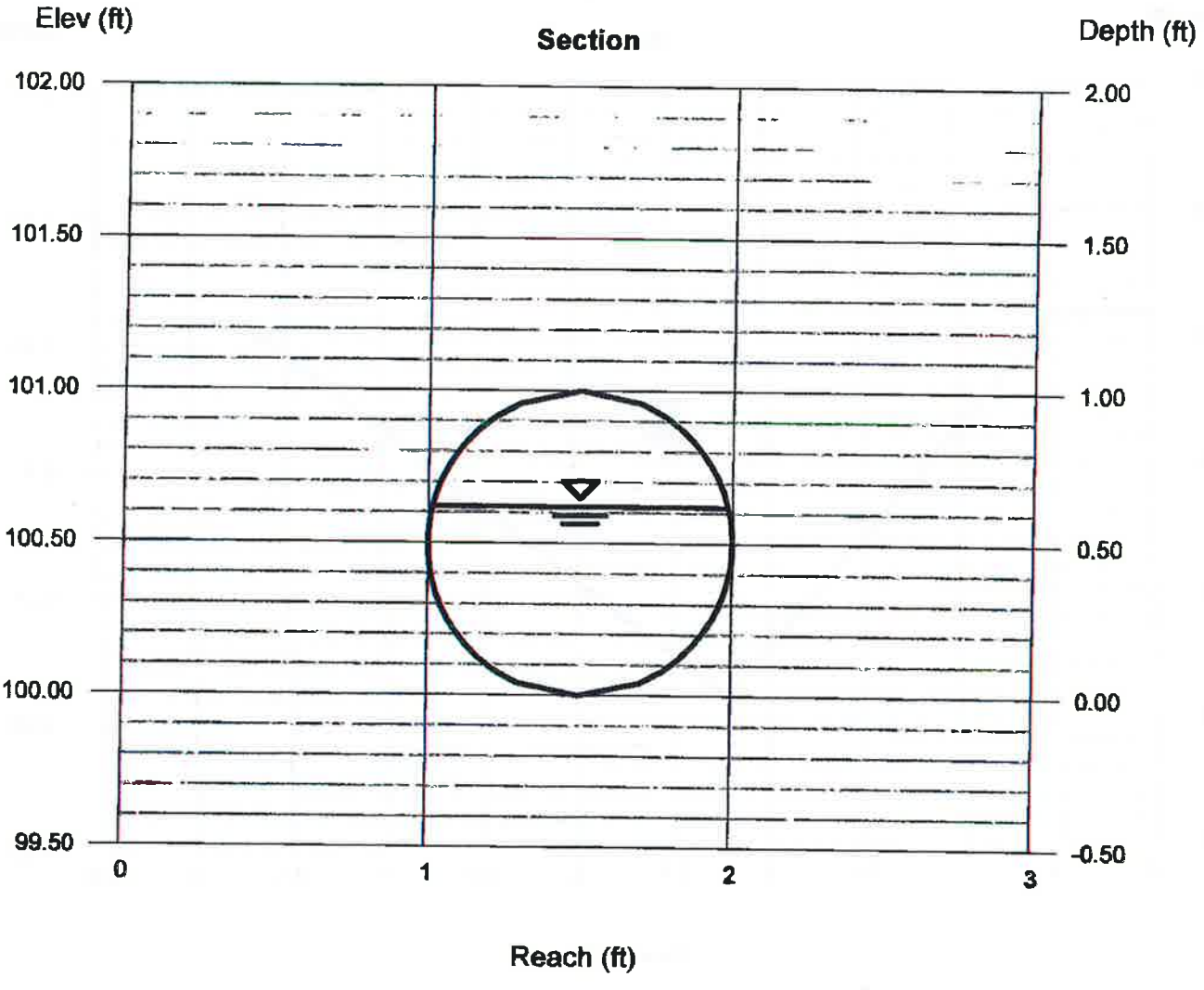
Diameter (ft)	= 1.00
Invert Elev (ft)	= 100.00
Slope (%)	= 1.00
N-Value	= 0.012

Calculations

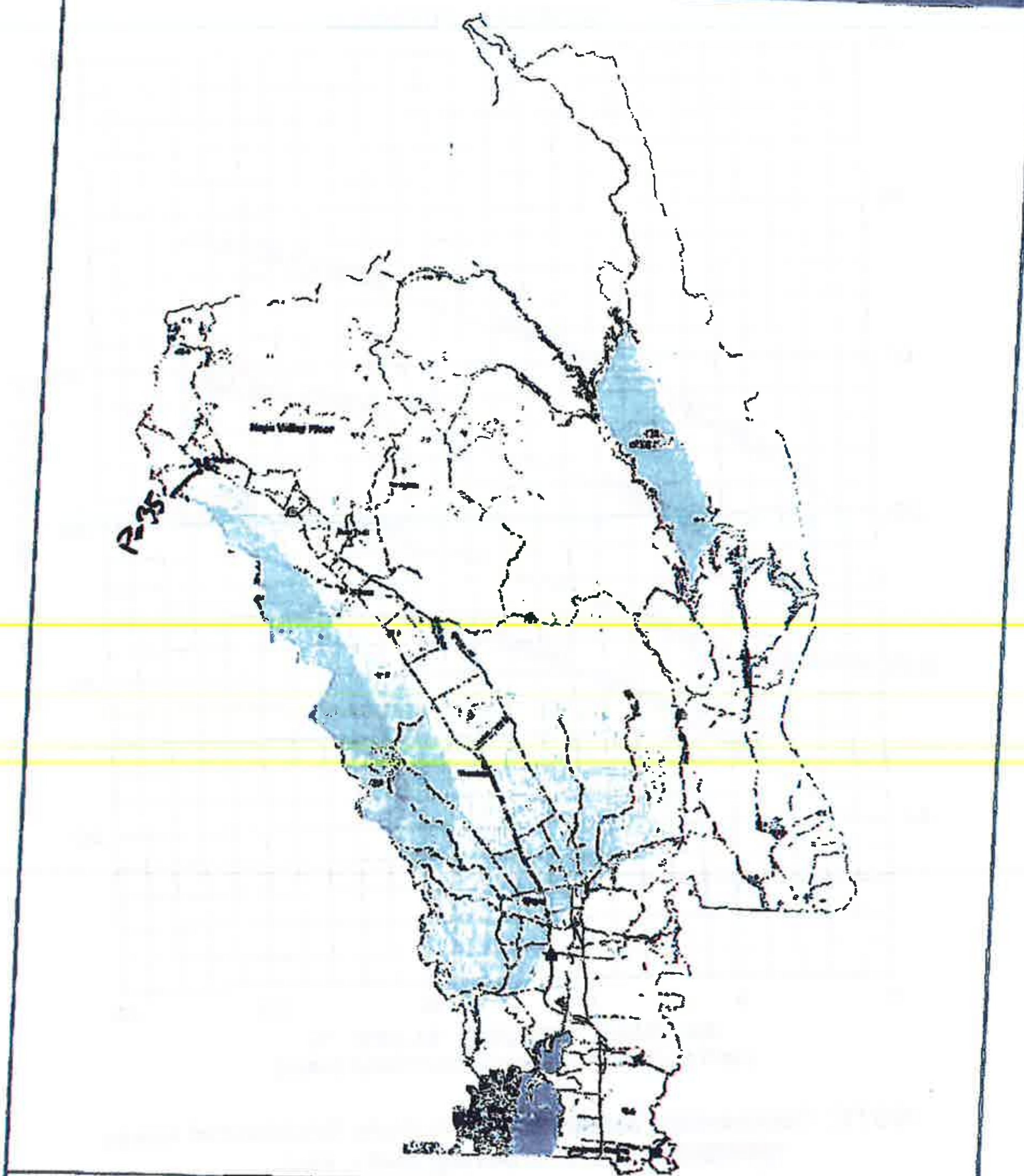
Compute by:	Known Q
Known Q (cfs)	= 2.68

Highlighted

Depth (ft)	= 0.62
Q (cfs)	= 2.680
Area (sqft)	= 0.51
Velocity (ft/s)	= 5.23
Wetted Perim (ft)	= 1.81
Crit Depth, Yc (ft)	= 0.71
Top Width (ft)	= 0.97
EGL (ft)	= 1.05



Napa County Baseline Data Report



LEGEND

Precipitation

- 0.0 - 15.0 in/yr
- 15.1 - 25.0 in/yr
- 25.1 - 35.0 in/yr
- 35.1 - 45.0 in/yr
- 45.1 - 75.0 in/yr

- Lakes
- Streams
- Major Roads

Jones & Stokes | EDAW

Isohyetal Map

Napa County

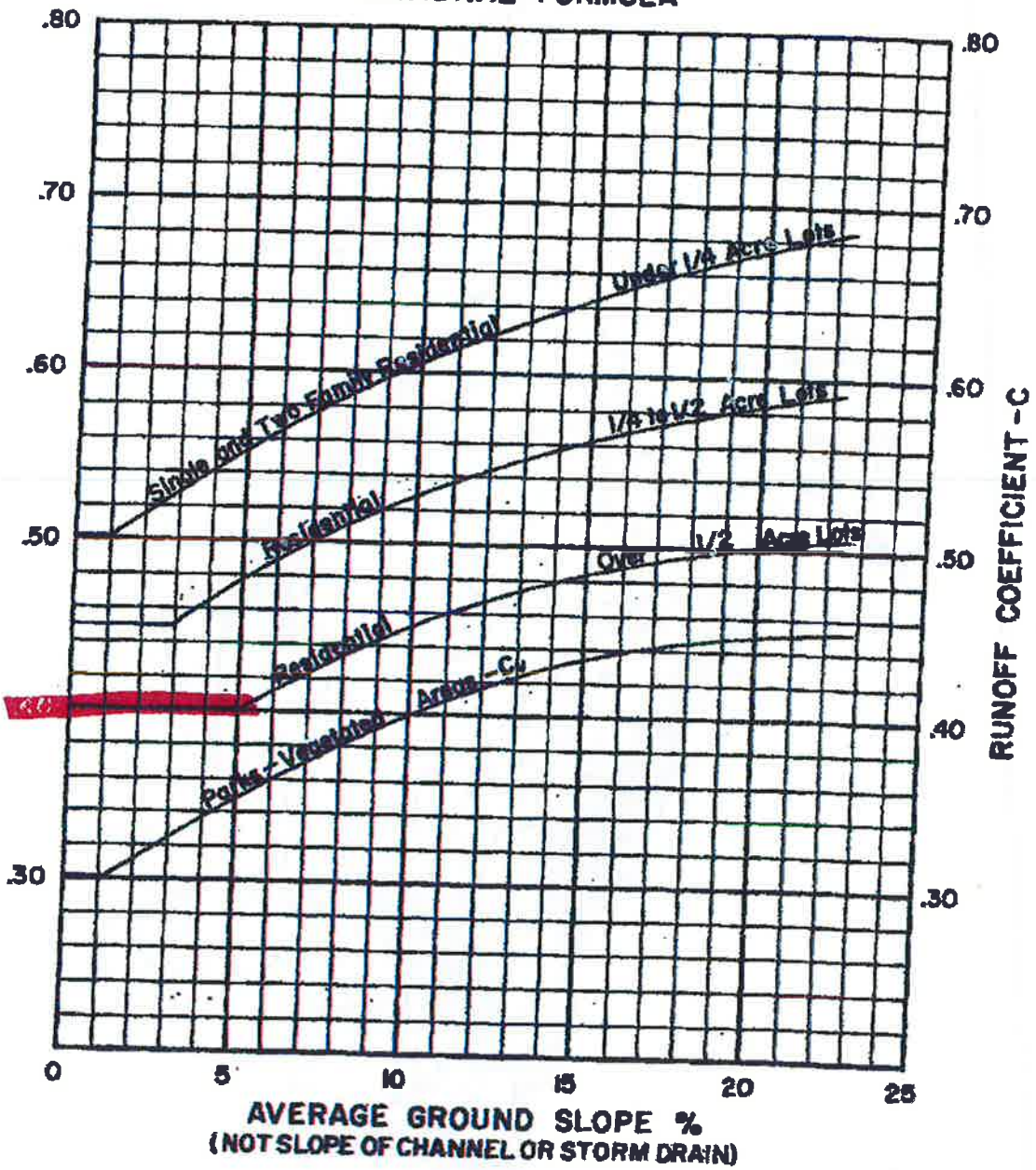
1 inch = 22,000 feet

Horizontal Datum: NAD 83,
CA State Plane Coordinates, Zone II, feet
Source: Napa County, 2004; DWR 2003;
Jones & Stokes 2005

Disclaimer: This map was prepared for informational purposes only. No liability is assumed for the accuracy of the data delineated hereon.

Map 3-2

RUNOFF COEFFICIENTS FOR RATIONAL FORMULA



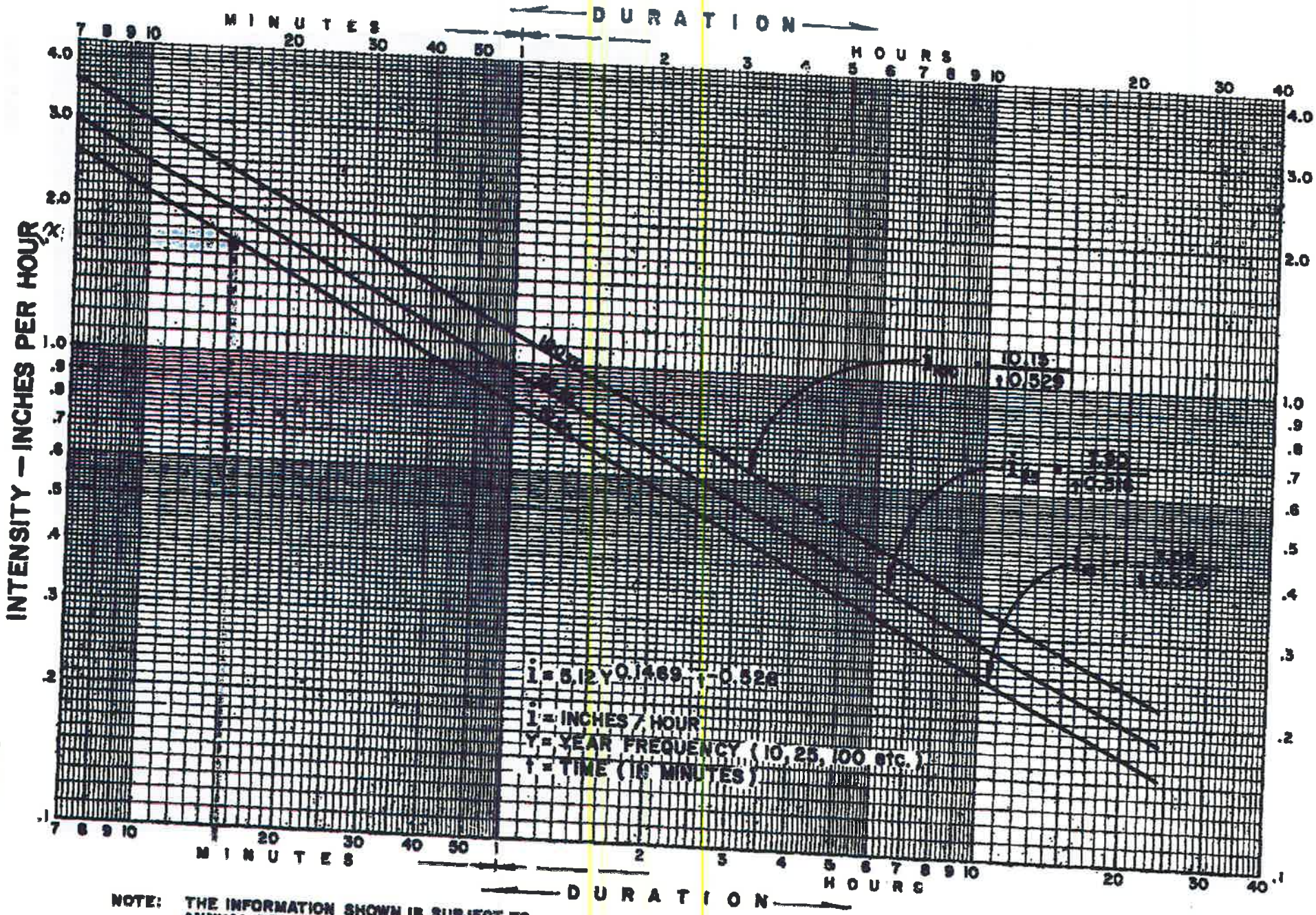
NOTE: Commercial, Industrial & Multiple Residential Areas
C_p = 0.9 (Based on paving, roofs, etc.)
When vegetated area exceeds 20% of total, C_v from vegetated curve may be used to reduce above C_p as follows:

$$C_T = C_v \frac{A_v}{A_T} + C_p \frac{A_p}{A_T}$$

SONOMA COUNTY WATER AGENCY

115-2
7/84

PLATE No. B-1



NOTE: THE INFORMATION SHOWN IS SUBJECT TO ANNUAL REVISION AS ADDITIONAL RAINFALL DATA BECOMES AVAILABLE

PLATE No. B-2

RAINFALL INTENSITY vs DURATION

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Napa County, California

2960 FOOTHILL BLVD, CALISTOGA

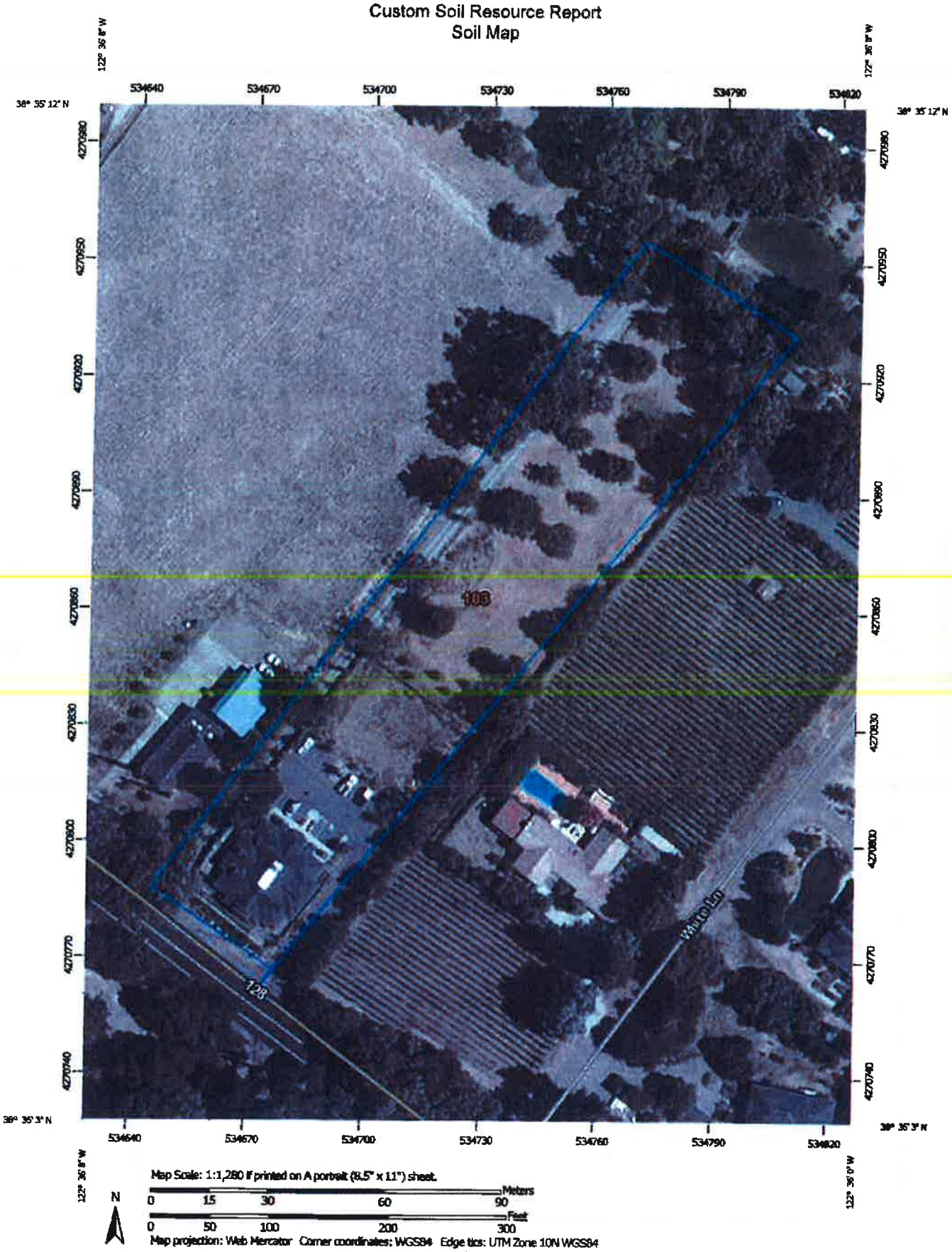
May 6, 2014

Contents

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

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 1:24,000.

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: 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: Napa County, California
Survey Area Data: Version 5, Nov 25, 2013

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

Date(s) aerial images were photographed: Nov 2, 2010—Feb 17, 2012

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

Napa County, California (CA055)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
103	Bale loam, 0 to 2 percent slopes	2.2	100.0%
Totals for Area of Interest		2.2	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.

Napa County, California

103—Bale loam, 0 to 2 percent slopes

Map Unit Setting

Elevation: 20 to 400 feet
Mean annual precipitation: 25 to 35 inches
Mean annual air temperature: 57 to 61 degrees F
Frost-free period: 220 to 270 days

Map Unit Composition

Bale and similar soils: 85 percent
Minor components: 3 percent

Description of Bale

Setting

Landform: Flood plains, alluvial fans
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from rhyolite and/or alluvium derived from igneous rock

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.57 to 1.98 in/hr)
Depth to water table: About 48 to 72 inches
Frequency of flooding: Rare
Frequency of ponding: None
Maximum salinity: Nonsaline (0.0 to 2.0 mmhos/cm)
Available water capacity: Moderate (about 7.2 inches)

Interpretive groups

Farmland classification: Prime farmland if irrigated
Land capability classification (irrigated): 2w
Land capability (nonirrigated): 3w
Hydrologic Soil Group: B

Typical profile

0 to 24 inches: Loam
24 to 60 inches: Stratified gravelly sandy loam to loam

Minor Components

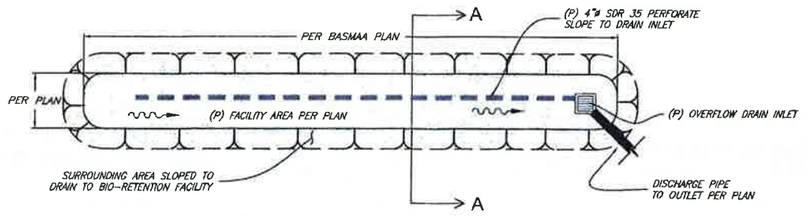
Clear lake

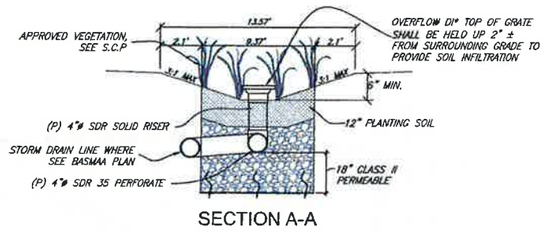
Percent of map unit: 3 percent
Landform: Alluvial fans

STORMWATER RUNOFF MANAGEMENT PLAN

2960 FOOTHILL BLVD, CALISTOGA

APN: 011-400-003

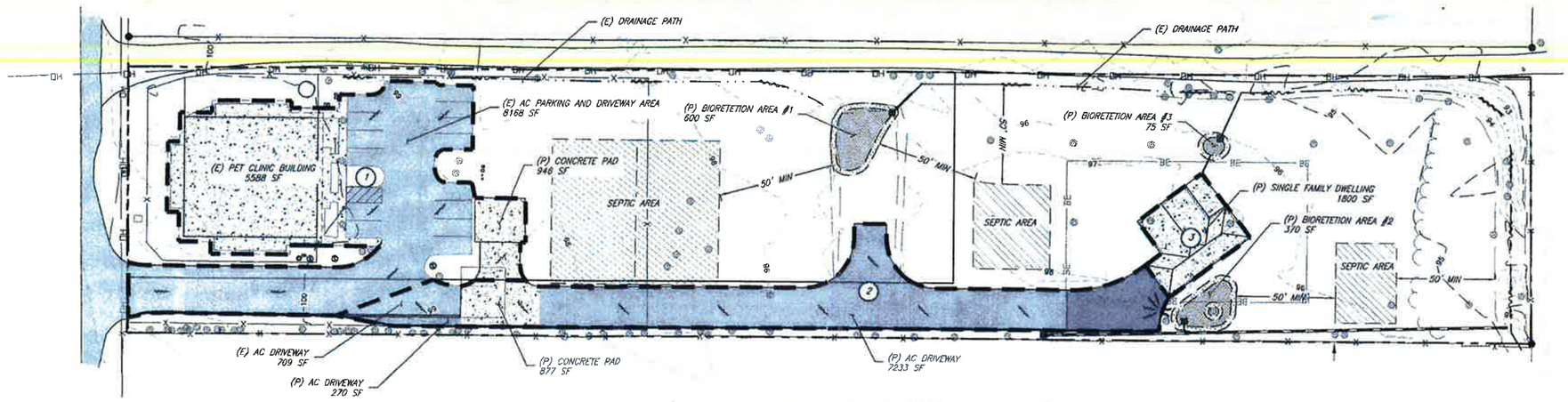




SECTION A-A

TYPICAL BIO-RETENTION FACILITY DETAIL

N.T.S



POST-DEVELOPMENT CONDITIONS

85TH PERCENTILE 24 HOUR STORM

DRAINAGE MANAGEMENT AREA (1)

(E) PETS CLINIC BUILDING	- 5793 SF
(E) AC DRIVEWAY/ PARKING	- 8168 SF
(P) CONCRETE PAD	- 946 SF
TOTAL	14907 SF

BASMAA
BIORETENTION SURFACE AREA: 4% OF TOTAL IMPERVIOUS AREA
14907 SF * 0.04 = 596 SF OF BIORETENTION

TOTAL SF AVAILABLE: 600 SF

DRAINAGE MANAGEMENT AREA (2)

(E) AC DRIVEWAY	- 709 SF
(P) AC DRIVEWAY	- 7503 SF
(P) CONCRETE PAD	- 877 SF
TOTAL	9089 SF

BASMAA
BIORETENTION SURFACE AREA: 4% OF TOTAL IMPERVIOUS AREA
9089 SF * 0.04 = 364 SF OF BIORETENTION

TOTAL SF AVAILABLE: 370 SF

DRAINAGE MANAGEMENT AREA (3)

(P) SINGLE FAMILY DWELLING	- 1800 SF
TOTAL	1800 SF

BASMAA
BIORETENTION SURFACE AREA: 4% OF TOTAL IMPERVIOUS AREA
1800 SF * 0.04 = 72 SF OF BIORETENTION

TOTAL SF AVAILABLE: 75 SF

LEGEND

- (E) FLOWLINE
- DRAINAGE MANAGEMENT AREA
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- EXISTING AC DRIVEWAY
- PROPOSED AC DRIVEWAY

NORTH

GRAPHIC SCALE

30 0 30

(IN FEET)
1 inch = 30 ft.

THIS MAP WAS PREPARED BY ME OR UNDER MY DIRECTION AT THE REQUEST OF RKMS INVESTMENTS IN APRIL 2015

KENNETH E. CARR PCE 21184

DRN:	VL	PM:	DATE:	04/15
CHK:	KEC		JOB #:	1607

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LANDS OF RKMS INVESTMENTS

HYDROLOGY MAP-85TH% STORM

2960 FOOTHILL BLVD, CALISTOGA
CALISTOGA, CALIFORNIA

APN: 011-400-003

H1 OF 1

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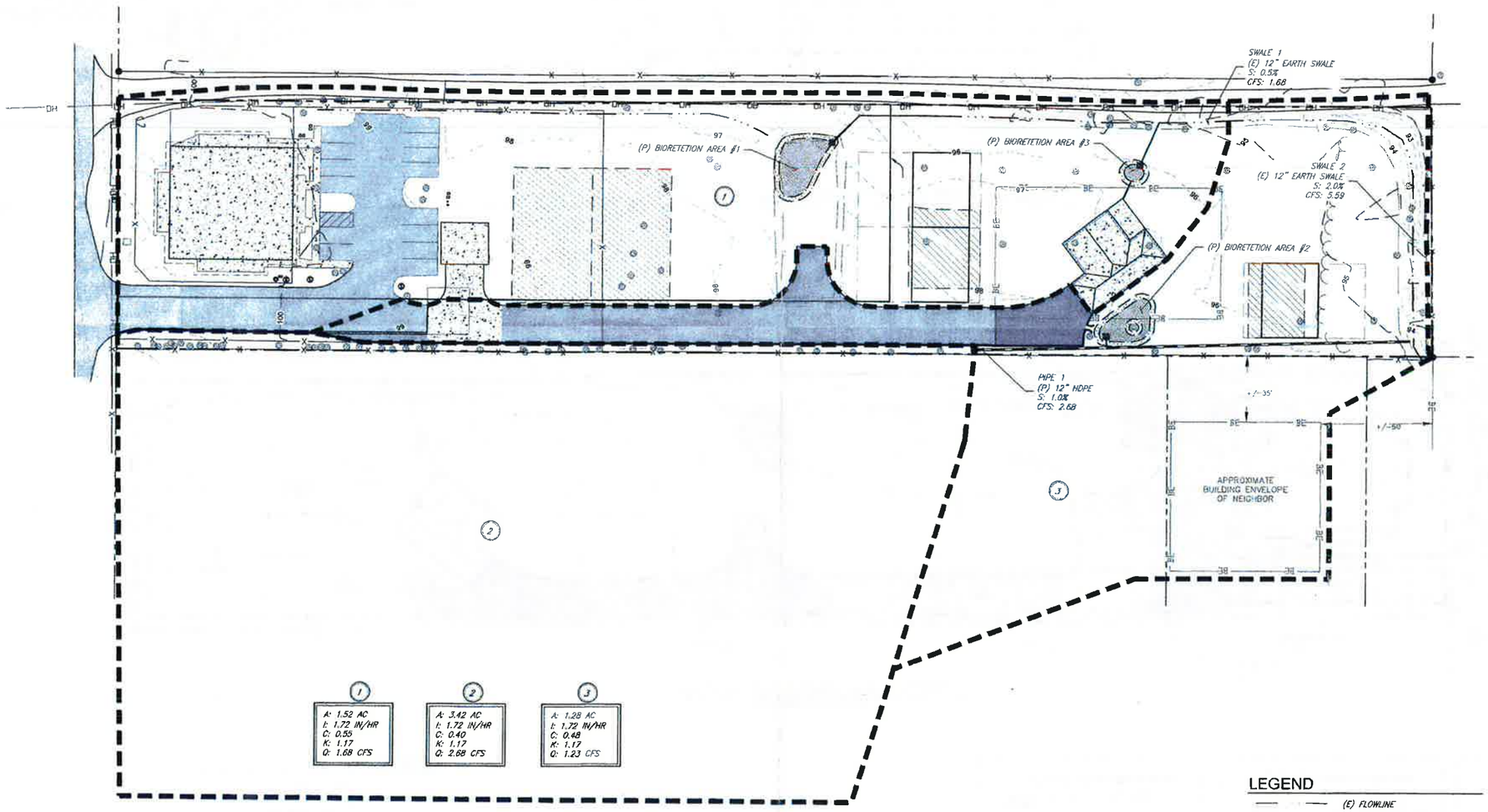
LANDS OF RKMS INVESTMENTS

HYDROLOGY MAP- 10 YEAR STORM EVENT

2960 FOOTHILL BLVD , CALISTOGA

APN: 011-400-003



POST DEVELOPMENT CONDITIONS
10 YEAR STORM EVENT

LEGEND

- (E) FLOWLINE
- DRAINAGE MANAGEMENT AREA
- EXISTING MINOR CONTOUR
- EXISTING MAJOR CONTOUR
- PROPOSED MINOR CONTOUR
- PROPOSED MAJOR CONTOUR
- EXISTING AC DRIVEWAY
- PROPOSED AC DRIVEWAY

NORTH

GRAPHIC SCALE
(IN FEET)
1 inch = 30 ft.

THIS MAP WAS PREPARED BY ME OR UNDER MY DIRECTION AT THE REQUEST OF RKMS INVESTMENTS IN APRIL 2015

KENNETH E. CARR RCE 21184 9-30-2015

DRN:	VL	PM:	SK
CHK:	KEC	DATE:	041015
		JOB #:	1607

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SANTA ROSA, CA 95404

LANDS OF RKMS INVESTMENTS
10 YEAR STORM EVENT

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