Harrison Industries

Regional and Local Hydrology Study

12390 W. Telegraph Road, Santa Paula

November 2018

Prepared for

AGROMIN

County of Ventura
Notice of Preparation of an EIR
PL17-0154
Attachment 14 - Regional and Local Hydrological Study

Agromin

Regional & Local Hydrology Study
12390 W. Telegraph Road

Administrative Draft
November 2018

AGROMIN™
Soil for a Greener World®

AGROMIN

Regional & Local Hydrology Study

Administrative Draft

Prepared for:

Prepared by:

Harrison Industries

Preface

Prepared by preliminary

Mike Harrison, P.E., CPSWQ, QSD
RCE #57,320, Expires: December 31, 2019

Administrative Draft

Table of Contents

List of Figures

List of Tables

List of Equations

Appendices

1. **Exhibits**

    Soil & Rainfall Map

    Regional Drainage Area Map

    Local Drainage Area Map

2. **Rainfall Information**
3. **Soil & Groundwater Information**
4. **Watershed Characteristics**
5. **FEMA FIRM Maps**
6. **Hydraulics**
7. **Hydrologic & Hydraulic Report – Todd Barranca – NextGen Engineering**

Nomenclature

'	feet
"	inch
<	less than
>	greater than
ac	acre
ac-ft	acre - feet
APN	County Assessor's parcel number
ARC	antecedent runoff condition
BMPs	best management practices
C	Rational Method runoff coefficient
Caltrans	California Department of Transportation
CDMG	California Division of Mines & Geology
cfs	cubic feet per second
CGS	California Geologic Survey
City	City of Santa Paula
CMP	corrugated metal pipe
CN	SCS curve number
Cnl	open channel
Consult-ant	Harrison Industries
County	County of Ventura
C_p	pan coefficient
d/s	downstream
DWR	California Department of Water Resources
DSOD	California Department of Water Resources – Safety of Dams
E	evaporation
EGL	energy grade line
FEMA	Federal Emergency Management Agency
FIP	Finance and Implementation Plan
FIRM	FEMA Flood Insurance Rate Map
FIS	FEMA Flood Insurance Study
ft	feet
ft/s	feet per second
g	acceleration due to gravity
gpm	U.S. gallons per minute
gpd	U.S. gallons per day
gpd/ft^2	U.S. gallons per day per square foot
H	total hydraulic head
h	horizontal
HEC	Hydrologic Engineering Center
HEC-HMS	HEC-HMS Computer Program
HEC-RAS	HEC-RAS Computer Program
HGL	hydraulic grade line
hr	hour

i	rainfall intensity
i_a	initial abstraction
i.d.	inside diameter
IGP	RWQCB - Industrial General Permit
imp	impervious
MEP	maximum extent practicable
mi	mile
min	minimum
misc	miscellaneous
msl	mean sea level
MWC	municipal water company
MWD	municipal water district
NPDES	National Pollutant Discharge Elimination System
NRCS	National Resource Conservation Service
o.d.	outside diameter
O&M	Operations and maintenance
ped.	Pedestrian
Q	flow quantity
Qty	quantity
R.C.E.	California, Registered Civil Engineer
RCP	reinforced concrete pipe
req'd	required
RWQCB	California Regional Water Quality Control Board
s	second
SCS	Soil Conservation Service
sf	square feet
SFHA	FEMA, special flood hazard area
SQUIMP	County, Standard Urban Storm Water Mitigation Plan
t_c	storm duration (time of concentration)
t_p	time from start of storm to peak runoff
t_r	rain storm duration
T	transmissivity
TR-20	SCS Technical Release Number 20
TR-55	SCS Technical Release Number 55
u/s	upstream
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
V	volume
v	vertical
VCRAT	WPD Modified Rational Method model
WDR	Waste Discharge Requirements
WPD	County of Ventura Watershed Protection District
w.s.	water surface

Executive Summary

The purpose of this report is to document the regional hydrology surrounding 12390 W. Telegraph Road and to facilitate the planning and implementation of on-site drainage infrastructure which is feasible for the phased development of the project.

This report includes an evaluation of regional rainfall statistics, existing hydrology, alternative storm drainage solutions, and best management practices which the operation can implement during specific rainfall events. Additionally, this report will identify a lead drainage alternative. The results of this report will be the basis for subsequent storm drainage improvements.

Agromin's current Limoneira operation (the "Facility") is located in the unincorporated County of Ventura, between Ventura and Santa Paula, on the southerly side of the V.C.T.C. railroad (see Figure 2). The Facility is situated on APNs 090-0-180-085. According to the Assessor's Office this APN encompasses about 453 acres. However, this APN et al. have been determined to be a single, discrete lot in compliance with the provisions of the Subdivision Map Act and local ordinances pursuant thereto per a Certificate of Compliance recorded in instrument no. 20140507-00057264-0. The gross area of the lot is roughly 1,013 acres.

The Facility has been in operation since 2004 and currently encompasses about fifteen acres. The proposed project will expand the area to seventy acres.

The vicinity of the regional study area is the area bounded by the proposed project boundary and those areas uphill from the Facility that drain southeasterly (see Figure 2 and Appendix 1). The local study area contains the 70-acre project boundary and is located entirely within the County. While the regional study area is about 876.1 acres and is also located entirely within the County. The existing land use in the regional study area primarily contains agricultural lands (see Appendix 1).

The project area zoning is Agricultural Exclusive (AE-40) within the County.

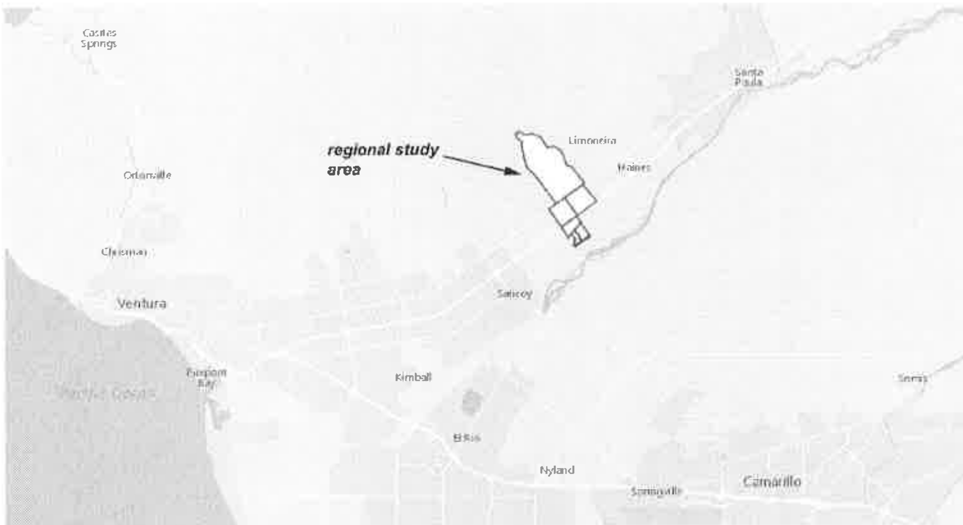
This report addresses the impacts from the 100-year, 24-hour event for both study areas. Its intended use is for the evaluation of drainage infrastructure solely by the buildout Facility.

Authorization

This report has been prepared at the request of County to determine how the Facility would be impacted during the runoff events described above. It is not the intent of this report to suggest remediation for any regional drainage issues outside of the project area.

The conclusions and recommendations made herein are based on the generally accepted principles and practices of civil engineering in the region and at this time. No other warranty is either expressed or implied.

Figure 1. Regional Location Map



Imagery provided by ESRI and its licensors © 2017

The following information is contained within this report:

1. A description of the existing drainage conditions for the study areas.

2. Statistical analysis of nearby rain gauge data.

3. A recommended drainage infrastructure plan showing the locations and sizes of the primary components of the drainage infrastructure that will be needed to accommodate the design storm water runoff generated by the Facility. Drainage infrastructure elements evaluated include:

   - storm drain pipes, swales, and open channels
   - storm drain culverts
   - storm drain filtration
   - pump systems
   - storm water quality treatment systems
   - storm water impoundments

4. Watershed catchment boundaries and hydrologic information that support the drainage infrastructure plan. The U.S. Army Corps of Engineers Hydrologic Modeling System (HEC-HMS v.4.2.1) computer model, along with the SCS Unit Hydrograph transformation method, has been used as the basis for hydrologic

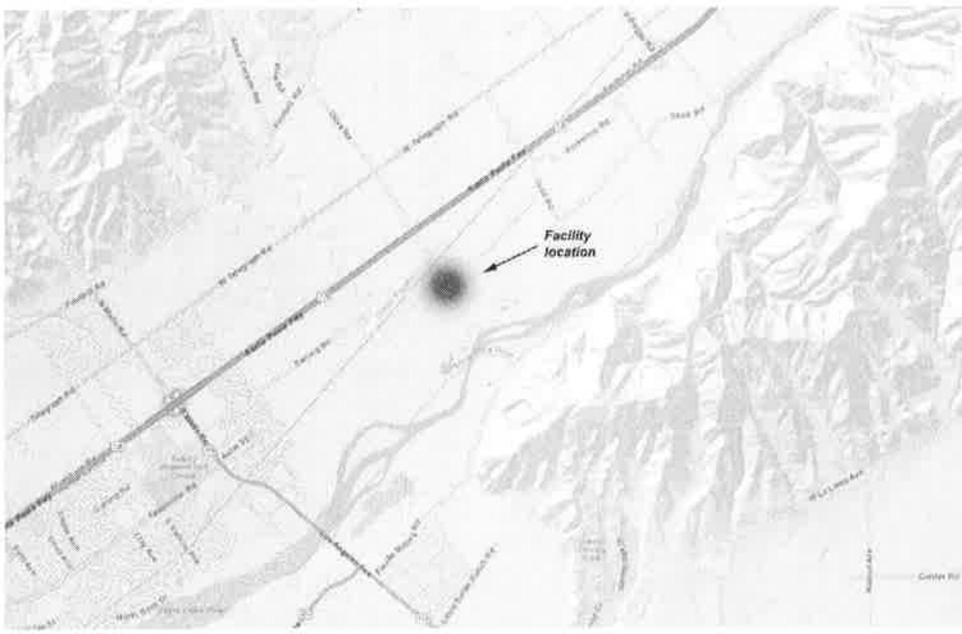
evaluations. Discharges expected at numerous key points of concentration have been estimated using the HEC-HMS computer model for the design storm events.

5. Hydraulic analyses that examine the functional characteristics of the existing and proposed drainage infrastructure. These hydraulic capacities have been evaluated using standard formulas. Volumetric analysis of runoff hydrographs has been evaluated using HEC-HMS.

6. Historic storm water monitoring analysis.

7. Storm water management system alternative analysis.

Figure 2. Vicinity Map



Imagery provided by ESRI and its licensors © 2017

Facility History and Study Approach

The Facility obtained coverage under the IGP in August 2016. Since then changes is the material recovery law have required operational changes at material recovery facilities which in turn has affected how they maintain compliance with the IGP.

The California Integrated Waste Management Act of 1989 (AB939) mandated local jurisdictions to meet solid waste diversions goals of 25% by 1995 and 50% by 2000. AB737 now requires the solid waste diversion goal to increase to 75% by 2020. Commencing April 1, 2016, AB1826 requires commercial operations which generate more than 8 cubic yards per week of organic material to sign up for commercial organic recycling where programs exist. In 2017, it drops to generators of 4 cy per week of organic material. In 2019, it drops further to generators of 2 cy per week of solid waste. And in 2020, if 50% of organic material is not reduced in the landfill the requirement will drop to generators of 2 cy per week of solid waste. In 2020, green material used for alternative daily cover at the landfill will no longer receive credit for diversion. This is not an exhaustive list of the regulations that influence how Agromin will need to change its operations.

In addition to these laws, the RWQCB adopted the General Waste Discharge Requirements for Composting Operations (order WQ 2015-0121-DWQ) in August 2015. Pursuant to this WDR, compost operations shall be designed to contain wastewater (and stormwater runoff) on-site and not allow it to infiltrate into the ground. Furthermore, process areas are to be protected from inundation from a 25-year, 24-hour rainfall event. The WDR gives existing facilities up to six years to develop and implement a plan to achieve these objectives.

These aggressive goals require new sources of solid waste to be processed. Therefore, jurisdictions have been and will be sending more material to be processed. The increased stream of material coupled with the existing facility infrastructure constraints creates a challenging environment for material recovery facilities to maintain regulatory compliance and to remain competitive in the marketplace.

Another overarching objective for this project is to combine organic recycling facilities in western Ventura County with this Facility. With these materials, the Facility capacity would be over 300,000 tons per year of green, wood, agricultural, and food materials. To date, this would be the first commercial organics processing facility in the County.

The regional hydrology surface drains southeasterly towards the Santa Clara River. The railroad bounds the north side of the project boundary. It directs the uphill runoff towards the middle of the project area. It is then conveyed in an earthen open channel through the Facility. This open channel will be replaced with a double-barrel arch pipe through the Facility so the development can occupy the surface area. This runoff will not commingle with the Facility runoff. The local hydrology for the Facility will be retained on-site for operational reuse. The retention basins are sized to contain the 100-year, 24-hour runoff event.

Design Rainfall Event

This report suggests the Facility develop stormwater runoff management controls to the maximum extent practicable.

The current IGP does not define the design storm event for designing passive treatment controls. It only states that you are to reduce pollutants in industrial runoff to the maximum extent practicable (MEP) using BAT/BCT (or best available technology/best conventional technology).

According to the Ventura County Technical Guidance Manual for Stormwater Quality Control Measures, dated July 13, 2011, volume-based BMPs, for disturbed areas of more than 50 acres, can be sized to treat 80% of the average annual runoff volume. This manual would be used to verify compliance with the current MS4 permit in Ventura County which also covers industrial facilities.

According to the Urban Runoff Quality Management Report (WEF Manual of Practice No. 23, ASCE Manual on Engineering Practice No. 87), there is an optimal capture volume for designing cost-effective passive treatment control(s). It further states that this point, known as the "knee of the curve", would satisfy the MEP rule in the NPDES regulations. Urbonas *et al.* (1993) further refines the definition of this "knee", or point of inflection on the curve, as the "maximized" volume because it is the point at which rapidly diminishing returns in the number of runoff events captured begin to occur. It is understood this report is not specific to the IGP. But in our professional opinion, it presents the topic in an objective manner.

The Ventura County Watershed Protection District maintains rainfall stations throughout the county. The gauge nearest to the Facility is located at Saticoy Fire Station and County Yard which are about 2.2 miles southwesterly from the Facility (see Table 1).

Table 1. Rainfall Station

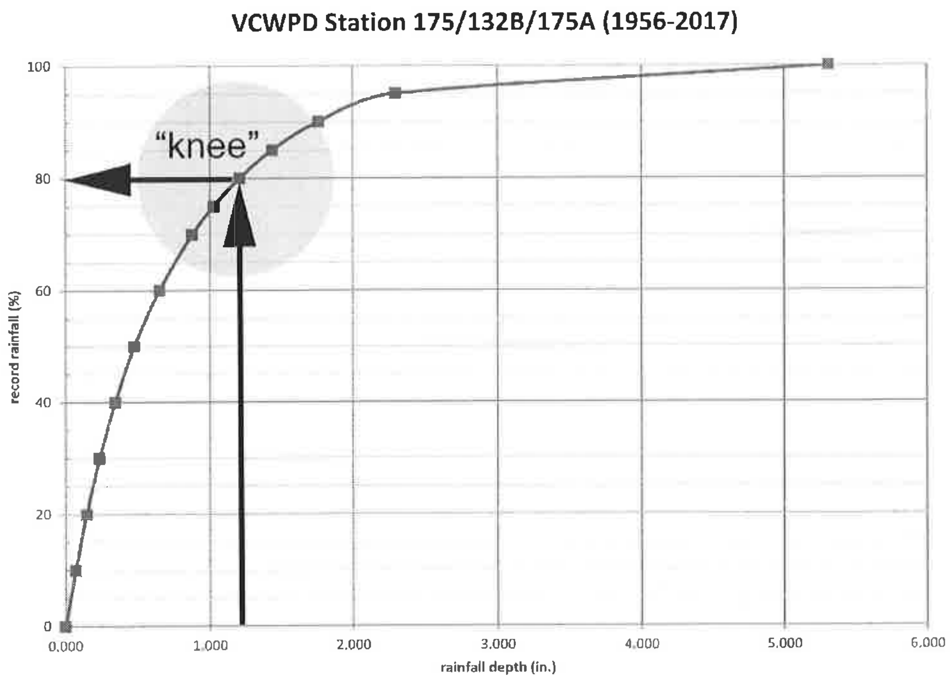
Gauge No.	VC175/132B/175A
Latitude	34°17'06" N
Longitude	-119°09'21" W
Elevation	185
Dataset	daily total
Record Period	1956 - 2017

Using all available records with precipitation values greater than or equal to 0.1 inches, the 80% of the average annual runoff, 24-hour rainfall event is 1.21 inches. This rainfall event would yield roughly the 82nd percentile rainfall event. This value will be compared to the design rainfall event as discussed herein. The largest 24-hour rainfall in 61 years of record was 5.31 inches on January 10, 2005. According to the latest edition of the WPD Hydrology Manual, the 25-year, 24-hour rainfall for the Facility regional drainage area is about 6.4 inches. See Appendix 2 and Figure 3 for more information.

Summary of Objectives and Hydrologic Conditions

Agromin began this operation in 2004 with an Enforcement Agency Notification for up to 200 tons per day or 12,500 cy on-site at any one time of agricultural and green material processing. This project would expand the Facility to a commercial compost center with a solid waste facility permit. The main objectives of the 2015 WDR is that the operation shall manage its wastewater on-site and to achieve a specific hydraulic conductivity on work areas with active composting thus reducing impacts to groundwater resources. The Facility will utilize cement-treated native soil, paving, and liners to achieve the hydraulic conductivity requirements.

Figure 3. Rainfall Gauges 175/132B/175A



According to the WPD Hydrology Manual, the 100-year, 24-hour rainfall for the Facility regional drainage area is about 7.7 inches. According to the NOAA Atlas 14, Volume 6, Version 2 report for the Saticoy Fire Station, the 100-year, 24-hour rainfall is roughly the same.

Given the discussion above regarding the WDR requirements, the statistical analysis of local rain gauges, and the MEP concept, the project proposes to design the infrastructure for the 7.7-inch, 24-hour rainfall event. This design parameter may allow the Facility to submit for a Notice of Non-Applicability, no discharge exemption under the IGP as the Facility will be designed to contain the maximum historic precipitation event. If this approach is approved by the SWRCB the Facility would not be required to obtain coverage under the current IGP.

The detailed study area was subdivided into 4 sub-basins (as shown in Appendix 1). This includes only on-site drainage areas. The main objective of this study is to design drainage infrastructure that will not significantly change the historic runoff patterns as well as identify locations where the on-site design storm can be retained for reuse. The runoff from uphill sub-basin area(s) cascades to lower sub-basin(s) once the local depressions fill up or runoff is conveyed in the storm drainage system.

Table 2. Facility Runoff

basin	area (ac)	comp. CN	I_a (in)	lag time (min)	runoff (in)	runoff (af)
9C	22.53	94	0.1	13.9	7.30	13.7
11C	3.90	98	0.0	8.5	7.57	2.5
13D	38.85	91	0.2	19.1	7.08	22.9
15D	4.29	98	0.0	10.0	7.56	2.7

Regional Study Area

The regional study area is not situated within or adjacent to a FEMA SFHA.

The uphill drainage area between the railroad and State Highway 126 is routed through the project area as described above. There is an unnamed concrete, open channel adjacent to the eastern boundary of the Facility which conveys runoff from the regional drainage area on the uphill side of State Highway 126. This channel can convey the 100-year, 24-hour runoff event from the regional drainage area with a normal depth of 4.75 feet and no flow obstructions.

Table 3. Regional Hydrology

basin	area (ac)	comp. CN	I_a (in)	lag (min)	runoff (in)	runoff (af)
1A	529.7	72	0.8	75.6	4.78	211.1
3B	154.1	77	0.6	99.0	5.47	70.2
7A	132.2	80	0.5	85.2	5.84	64.3
17E	60.2	80	0.5	51.6	5.43	27.2

The peak discharge for the existing earthen ditch that bifurcates the project area is about 66.3 cfs. This ditch will be replaced with a double-barrel, 14-gauge 40x31 pipe arch. The headwall for this new culvert requires roughly 2.75 feet of head to convey the same flow rate.

Burned watersheds were not consider in this report as the entire regional and local catchment areas are developed agricultural lands. According to the Seismic Hazard Zone maps from the California Geologic Survey, the local study area is within a liquefaction zone but the majority of the regional study area is not. And the areal extent of possible landslide areas that could affect the project area are non-existent.

There are two retention basins to contain the local drainage area runoff. The outlet for these basins is a fifty-foot wide spillway that can run six inches deep. Rock rip-rap and an overflow drain will be installed on the downhill side of each basin to help protect the embankment and the adjacent land from erosion on the occasion of a runoff event greater than the 100-year, 24-hour storm. The drain for the westerly basin will be routed to a nearby existing roadside earthen ditch. The drain for the east basin will outlet in the existing concrete trap channel.

Todd Barranca Overflow

Todd Barranca can overflow on the north side of Highway 126 during certain rainfall events. The potential flood conditions are described in the Hydrologic and Hydraulic Report by NextGen Engineering which can be found in the Appendix of this report.

If Todd Barranca were to overflow to the west, the runoff would travel in an existing ditch along the north side of Highway 126 to a double, box culvert at Highway station 462+00. The outfall for this culvert is the existing concrete trap channel that runs adjacent to the eastern boundary of the project area. According to the above-mentioned report, the westerly overflow from the 100-year, 24-hour rainfall event would be 767 cfs. The runoff would be stored behind the freeway until it can pass through the culvert. The peak discharge, from this event, through the culvert would be 770 cfs. The normal depth of the trap channel would be about 5 feet deep at this flow rate.

This culvert was installed in the mid-1960s with the construction of the freeway. It is intended to serve the regional drainage are between the freeway, Foothill Road, Todd Barranca and the Ellsworth Barranca and not any overflow from the Todd Barranca. This project is only evaluating the greater event and not both events simultaneously.

According to the most recently adopted FEMA FIRMs the buildout Facility area is situated entirely in Zone X (unshaded). According to the above-mentioned report, small portions of the buildout Facility area, *without any project development*, would be located Zone B or X (shaded) if FEMA updates the FIRMs with a similar overflow from Todd Barranca. With the project development, the buildout Facility area would remain in Zone X (unshaded) relative to potential flooding from the existing trap channel directly adjacent to the project area.

Zone X (unshaded) is defined as areas of minimal flooding or outside the 500-year floodplain and protected by a levee from the 100-year flood. Zone B and X (shaded) is defined as areas of moderate flood hazard, usually the area between the limits of the 100-year and 500-year floods. B Zones are also used to designate base floodplains of lesser hazards, such as areas protected by levees from 100-year flood, or shallow flooding areas with average depths of less than one foot or drainage areas less than 1 square mile.

Given the project area is believed to remain in Zone X with future FEMA mapping, no further mitigation measures are proposed beyond the development defined in the entitlement planning documents.

Project Setting

Agromin's current Limoneira operation (the "Facility") is located in the unincorporated County of Ventura, between Ventura and Santa Paula, on the southerly side of the V.C.T.C. railroad (see Figure 2). The Facility is situated on APNs 090-0-180-085. According to the Assessor's Office this APN encompasses about 453 acres. However, this APN et al. have been determined to be a single, discrete lot in compliance with the provisions of the Subdivision Map Act and local ordinances pursuant thereto per a Certificate of Compliance recorded in instrument no. 20140507-00057264-0. The gross area of the lot is roughly 1,013 acres.

The Facility has been in operation since 2004 and currently encompasses about fifteen acres. The proposed project will expand the area to seventy acres for a commercial compost center with a throughput capacity of 300,000 tons per year of green, wood, ag, and food materials.

The existing utilities in the area are domestic and agricultural water systems, electric service systems, telephone systems, and petroleum systems. There are production agricultural and domestic water wells within one mile of the local study area. There is not existing storm drainage infrastructure to convey runoff from the Facility into a public drainage system.

BASIS OF CONTROL

Agromin obtained a new topographic survey of the entire Facility in September 2013. Supplemental surveys were also prepared in January 2014 and November 2015. All surveys were compiled into one file for the topographic mapping shown herein. The horizontal coordinates for the surveys are based on the California Coordinate System of 1983, Zone V in U.S. Survey Feet. The aerial survey was prepared at a scale of one-inch equals forty feet with a contour interval of one foot for National Map Accuracy Standards.

WATERSHED CHARACT-ERISTICS

The detailed study area consists of approximately seventy acres that is divided into 4 sub-basin watersheds (as shown in Appendix 1). These proposed watersheds are defined by the physical constraints and topographic features that will be created and points of interest in the study area. The land use within the local study area will consist of an organics recycling facility. The terrain slope within the sub-basin areas vary roughly from 0.5% to 3%.

Storm water runoff generated from the proposed detailed study area generally drains southeasterly as overland flow and as concentrated flow. Concentrated flow generally occurs within the lower elevations. The overland flow from the sub-basins cascades down the respective low points. At each low point, the storm water is further conveyed through a storm drain network and through downstream sub-basins to the south and east.

Industrial activity will occur everywhere within the local study area.

Flood Insurance Study

The detailed study area is located on the following FEMA FIRMs (see Appendix 5).

Ventura County, California and Incorporated Areas, community panel number 06111C 0770 E, January 20, 2010. According to this map, the detailed study area is located entirely in SFHA Zone X (unshaded).

Ventura County, California and Incorporated Areas, community panel number 06111C 0790 E, January 20, 2010. According to this map, the detailed study area is located entirely in SFHA Zone X (unshaded).

Zone X (unshaded) is defined as areas of minimal flooding or outside the 500-year floodplain and protected by a levee from the 100-year flood.

Native Soil Properties

The soil types within the study area were identified from the current County Hydrology Manual. Individual soil types are given unique values ranging from 1-7. There are two (composite) soil types within the study area; 3 and 4 (NRCS Type C and B respectively according to the County). Soil values can be seen in Appendix 3. According to the NRCS, the Facility is covered by Mocho loam (MoA), Mocho clay loam (MsA) and Mocho clay loam (MsB). All of which are Type B soils.

EXISTING GROUNDWATER CONDITIONS

The project is located entirely within the Santa Paula Basin. The depth to the seasonal high groundwater table is high enough that may be significant. The historic high groundwater level, according to the CGS on the Saticoy and Santa Paula Quadrangle maps and the 2015 Groundwater Section Annual Report from the Ventura County Watershed Protection District, is about twelve to thirteen feet deep near the Facility. Additional design requirements may be required if it is found to encroach on any new drainage infrastructure, appurtenances, or excavations.

The western and eastern retention basins have a maximum cut of five and ten feet respectively. Each basin will be lined to satisfy the WDR hydraulic conductivity requirements. The eastern basin may require a fill cap to offset a potential buoyancy force that may exist.

Proposed System Study Approach

The purpose of this design report is to facilitate the planning and implementation of drainage infrastructure improvements to accommodate storm water runoff within the Facility. Additional study objectives include:

- ✓ Develop a phased plan that alleviates localized flooding
- ✓ Provide study services consistent with City, County, and State standards
- ✓ Develop phased solutions that maximize the cost to benefit ratio
- ✓ Develop solutions that limit O&M costs
- ✓ Develop phased solutions that can be adapted
- ✓ Involve staff in the development and implementation of the phased solutions
- ✓ Develop phased solutions that will minimize any disturbance to the City, County, and surrounding community
- ✓ Site and operate storm drainage facilities in such a manner that minimizes adverse environmental impacts

DESIGN ANALYSIS

The approach to design process is to explore a range of solutions. The drainage design presented in this report has been developed based on evaluations of the following constraints:

- Watershed characteristics
- Topography
- Existing land use & its adaptability
- Location of transportation corridors
- Property boundaries & acquisition
- Logical points of drainage outfall
- Agency objectives
- Retrofitting opportunities
- Design level of protection
- Environmental impacts
- Financing (expenses)
- Structure relocation
- Operation and maintenance
- Regulatory compliance
- Agency compliance
- Hydrologic criteria
- Flexibility of service area
- Hydraulic capacities & characteristics

Formulation of the infrastructure design was characterized by an evaluation of all of the above constraints relative to the existing improvements, their level of importance to the successful completion of the project, and their interrelationships with each other.

Retention Basin Approach

Based on the above-mentioned constraints, the proposed design is to utilize storm water impoundments.

This approach will provide additional water quality enhancements allowing any dry weather runoff to be captured.

UTILITY CONFLICT ANALYSIS

The location of the utilities shown herein is for information only. The location, type, size, and/or depths indicated were obtained from sources of varying reliability. The consultant is not responsible or liable for the accuracy or completeness of those records. All utilities should be field verified as to their actual location, type, size, and depth prior to performing any excavation or other work close to any underground pipeline, conduit, duct, wire, structure or other utilities and structures subject to concerns for safety, displacement, and/or damage by reason of such operations.

The existing utilities in the area are domestic and agricultural water systems, electric service systems, telephone systems, and petroleum systems. There are production agricultural and domestic water wells within one mile of the study area. Ground water monitoring should be considered at any domestic well within one mile of a proposed storm water impoundment. There is no existing storm drainage infrastructure to convey runoff from the Facility.

For the most part, the drainage collection system has been placed away or adjacent to existing utilities. Any conflicts will need to be addressed during the preparation of the construction documents for those facilities and prior to construction of new facilities.

RIGHT-OF-WAY ANALYSIS

The property boundaries shown herein are based on a Record Boundary Map prepared by Diamond West, Inc. dated April 1, 2014. Field verification/staking should be performed during the construction process to locate any drainage improvements defined herein.

There are no planned right-of-way acquisitions or easements for drainage purposes. All work will be performed within the Facility boundary. Plan approval and all necessary permits are required prior to construction.

LAND USE ANALYSIS

The County and City General Plans and Zoning Codes regulate land use in the study area. Generally, existing land use in the area is consistent with these policy documents. There are no known pending formal applications in the County or City to change land use within the study area(s). No provisions have been made for changes in future land use within the study area(s).

ENVIRONMENTAL ANALYSIS

Environmental documentation for this project will be prepared by the County for the creation of a Facility CUP.

Proposed Drainage Description

In order to adequately evaluate the impacts and requirements of the proposed project, the existing drainage conditions were analyzed. Research efforts were made to identify any drainage studies that documented the existing drainage conditions for the study area. The results of these efforts did not find any study that adequately documented those conditions on-site. The purpose of this drainage study is to document the impacts of certain rainfall events on the study area(s). This information will be the basis of comparison between pre-development and post-development of storm drainage infrastructure improvements.

This proposed drainage description will analyze the effects of the 100-year, 24-hour event for the regional and local study areas.

RELATED DOCUMENTS

The Consultant pursued the County and City for any drainage reports on the study area.

WPD does have hydrologic studies along the Santa Clara River. According to their June 2011 study, the study areas are a part of sub-area 860. However, the study did not calculate runoff from the sub-areas. It only used these areas to calculate the overall runoff in the Santa Clara River. This was confirmed with WPD staff. The City does not have any hydrologic studies in this region.

According to the USEPA MyWATERS Mapper and the Basin Plan for the Coastal Watersheds of Los Angeles and Ventura Counties, the region surrounding the Facility discharges into the Santa Clara River, Reach 2. This reach is not identified on the USEPA 2012 303(d) list of impaired water bodies.

METHODOLOGY

Due to the complex nature of the sub-basins, a hydrograph method was chosen to estimate the design storm runoff. The complex aspects of the sub-basins include consideration of available storage and varying times of travel. The Modified Rational Method, as defined in the current County Hydrology Manual is typically employed to generate the effective runoff within each sub-basin.

The County Hydrology Manual utilizes a Modified Rational Method approach for its hydrologic calculations. In general, the Rational Method is understood to provide peak discharge relative to rainfall intensity. It is not generally preferred in watershed catchments where ponding of storm water occurs. Additionally, it does not typically provide a reasonable relationship between peak storm water discharge and storm water runoff volume. This phenomenon can be seen in Figure 4. As seen on the synthetic rainfall distribution, the County method yields little runoff before or after the peak. This typically produces a sharp, narrow peak, which ultimately requires less storage volume for detention basin analysis. The runoff yield could be as low as 15%. Previous versions of the Manual required a minimum yield of 40%.

The VCRAT method is considered the 'standard of practice' for hydrology calculations in the county. However, the program does not allow for specific rainfall parameters to be entered. Therefore, the Army Corps of Engineers HEC-HMS program was utilized to generate runoff hydrographs for each sub-basin area.

Table 4. SCS CN

Commercial Organics Processing Facility

SCS Curve Number by Land Use

Land Use	Description	Effective Impervious Cover	SCS Curve Number Soil Type A			B		C	D
			7	6	5	4	3	2	1
OS	Open Space (fair condition)	0	42	61	65	71	77	81	84
OS	Open Space (good condition)	0	29	52	57	64	71	76	80
OR	Orchard (fair condition)	5	45	63	67	72	78	82	85
CB	Covered Berries	80	87	91	91	93	94	95	95
BP	Berries with Plastic Beds	65	78	85	86	89	91	92	93
WR	Windrows	65	78	85	86	89	91	92	93
PS	Pavement/Equipment/Structures	90	92	94	95	95	96	96	97
1A	100% OR	5	45	63	67	72	78	82	85
3B	75% OR & 25% CB	24	55	70	73	77	82	85	87
7A	55% OR & 45% BP	32	60	73	76	80	84	86	88
9C	75% PS & 25% WR	84	89	89	92	93	94	95	95
11C	90% pond & 10% PS	95	94	96	97	97	98	98	98
13D	40% WR & 60%PS	80	87	87	91	91	93	94	95
15D	90% pond & 10% PS	95	94	96	97	97	98	98	98
17E	55% OR & 45% BP	32	60	73	76	80	84	86	88

1. calculated by using open space (fair condition) for pervious area and a curve number of 98 for impervious area

Equation 1. Rational Method

$$Q = CiA$$

Where C = runoff coefficient
i = rainfall intensity (in/hr)
A = drainage area (ac)

Equation 2. Manning Equation

$$V = \frac{1.486}{n} R^{2/3} S^{1/2}$$

Where	V	= average velocity (ft/s)
	n	= roughness coefficient
	R	= hydraulic radius (ft)
	S	= head loss per unit length of pipe (ft/ft)

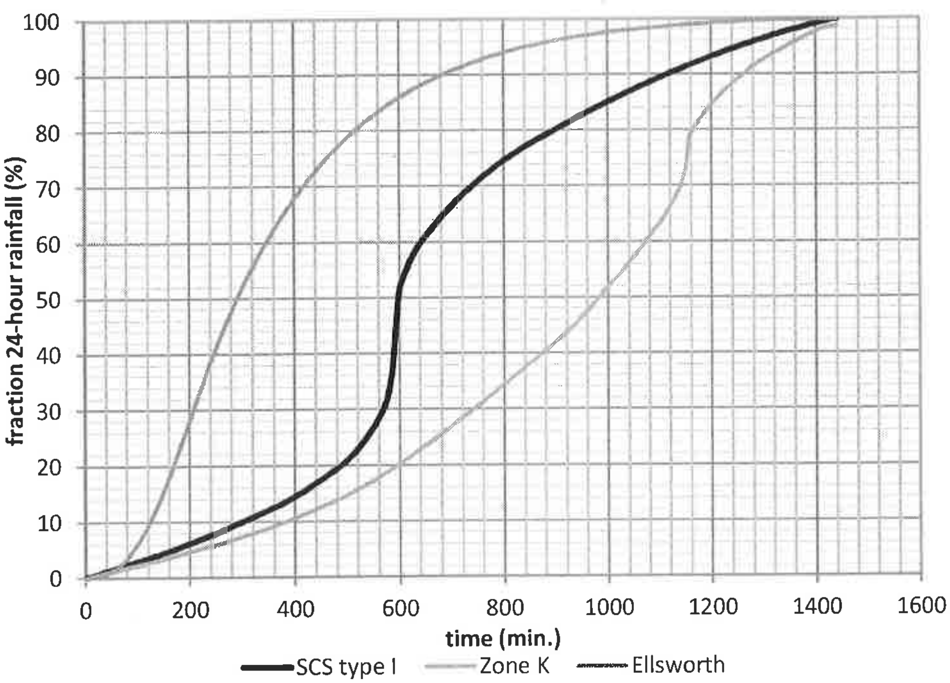
The rainfall intensity can be taken from County Standards. The runoff coefficient in the rational formula is dependent on the soil type, antecedent moisture condition, recurrence interval, land use, slope, amount of urban development, rainfall intensity, surface and channel roughness, and the duration of storm. Equation 3 provides a relationship between all of these factors and was used to calculate the runoff coefficients.

Equation 3. Rational Runoff Coefficient

$$C = 7.2\left(10^{-7}\right)CN^{3}T^{0.05}\left[\left((0.01CN)^{0.6}\right)\right]^{-S^{0.2}}\left(0.001CN^{1.48}\right)^{(0.15-0.11)}\left[(P+1)/2\right]^{0.7}$$

Where	CN	= SCS composite curve number
	T	= recurrence interval (years)
	S	= average sub-basin land slope (%)
	I	= rainfall intensity of recurrence interval (in/hr)
	P	= percent impervious (decimal)

Figure 4. Synthetic Rainfall Distribution Comparison



The rainfall for the 100-year, 24-hour storm event for the study area per the County Hydrology Manual is about 7.7 inches. For the design storm event and normal antecedent moisture conditions, the average runoff yield is roughly 61% for the regional study area and 94% for the local study area.

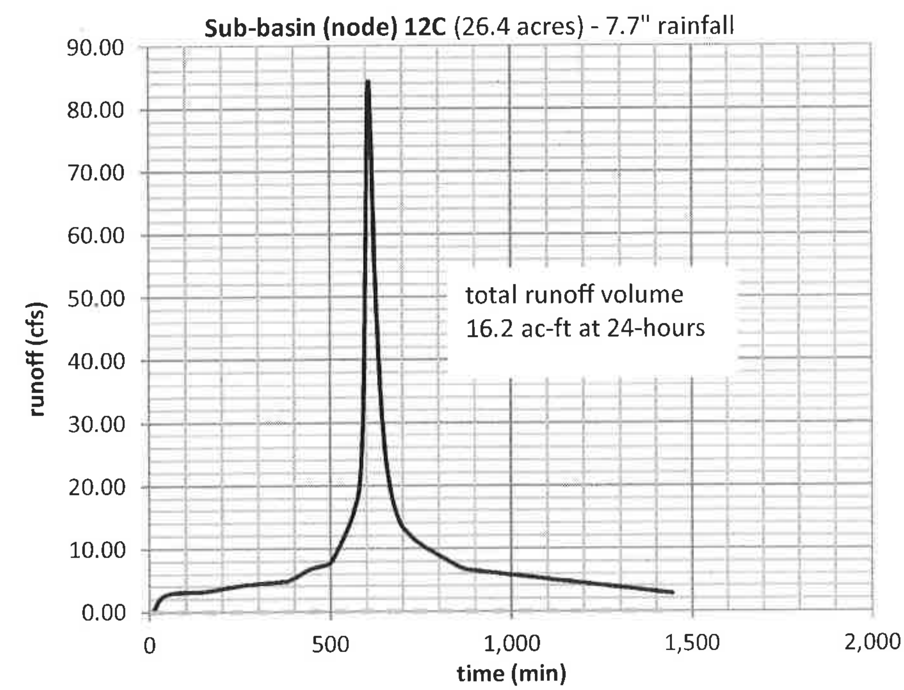
Hydrologic Model

The computer model HEC-HMS was used to simulate, combine, and route outflow hydrographs within each watershed. The simulation of the hydrologic data is generated by the development of the synthetic unit hydrograph, design storm pattern, and the runoff hydrograph.

See Figure 5 for the combined hydrographs at the downstream end of the Facility for the regional study. The total volume of runoff can be increased 1-3% because the runoff is still occurring at the end of the design storm.

The development of the synthetic unit hydrograph involves the identification of several watershed characteristics including composite curve numbers, soil cover, percent impervious, antecedent moisture conditions, land use, basin area, initial abstractions, hydraulic length, basin slope, and lag time. These parameters are calculated in the following steps.

Figure 5. Combined hydrograph – node 12C



- The sub-basin watershed boundaries were delineated by WMS on the recently prepared survey map and known physical constraints.

- The transformation method used was the Ellsworth S-Graph .

- Rainfall excess is that part of the total precipitation depth that appears as surface flow during and after a storm event. Rainfall excess equals to total rainfall depth minus losses due to interception by vegetation, infiltration into the soil, and surface depression storage. The loss method used is the SCS Curve Number. The information is based on:

  1. Soil data
  2. SCS curve number

- The catchment time of concentration is defined as the time from the center of mass of net rainfall and the center of mass of runoff. The lag time for each sub-basin was calculated from the Curve Number Method. This method is shown in equation 4.

Equation 4. Lag Time

$$L = \frac{l^{0.8} * (S+1)^{0.7}}{1{,}900 * Y^{0.5}} = 0.6 * T_C$$

Where	T_c	= time of concentration (min.)
	L	= lag time (hr)
	l	= hydraulic length of watershed (ft)
	S	= potential maximum retention after runoff
	Y	= average land slope (%)

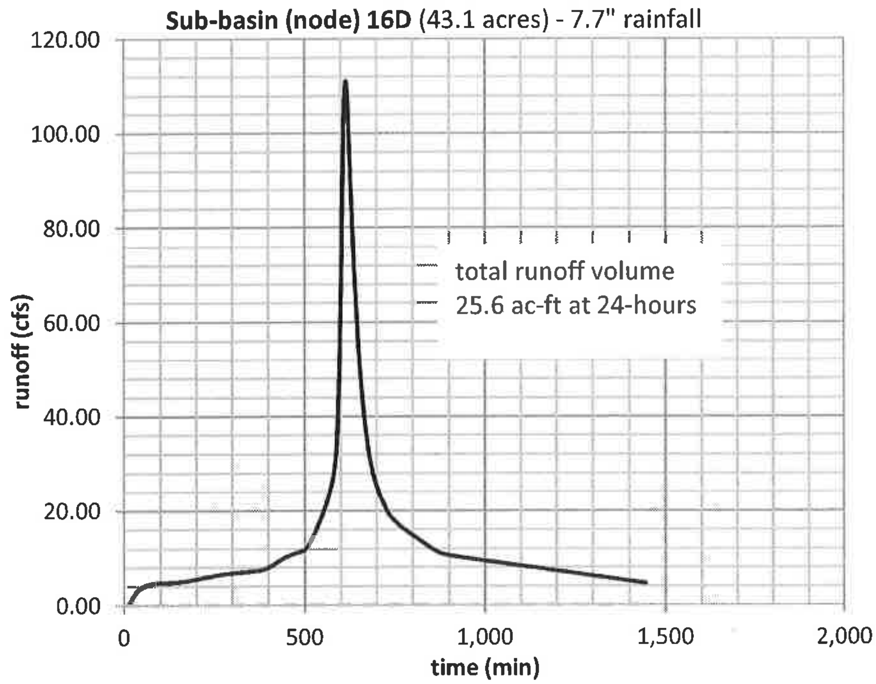
- To adequately define the unit hydrograph, the unit time period of the synthetic critical storm pattern should generally be 30 percent of the basin time of concentration and should use multiples of 1 minute. The unit time period utilized in this report is 1 minute.

- See Appendix for catchment soil characteristics, catchment hydrologic characteristics, and hydrograph plots for various locations.

Flow Routing

Flow routing methods for storage areas, channel, and sheet flow were estimated from existing and proposed dimensions and parameters. The Modified Puls method was used to route flow through storage areas as required. The hydrologic model was used to route flow through existing conveyances and sub-basins. Existing and Proposed dimensions were used for all conveyance routing. The discharge relationship from the storage areas used the Normal Depth method with similar dimensions. See Appendix 1 for a diagram of the entire watershed hydrologic model.

Figure 6. Combined hydrograph – node 16D



Hydraulic Model

Manning's Equation and Caltrans HDS No. 5 was used to simulate the hydraulic analysis of the existing and proposed storm drainage conveyance systems. The simulation of the hydraulic system utilized either the design storm event or the capacity of the existing system whichever was less. This capacity was defined from street grades, drain locations, and assumed maximum energy gradients.

Runoff captured in the retention basins will be used in the operations. The basins are interconnected with a culvert so the entire site can use both basins to balance the runoff volume. A wet well with a submersible pump will be used to remove the water into a water truck. If needed water can be hauled off-site if it cannot be used in operations and the basins are full. The Hazen-Williams formula was used to model the pipe headloss and equation 8 was used to model the total dynamic head (TDH) of the pump system. The following hydraulic formulas were used accordingly.

Equation 5. Orifice Equation

$$Q = C * A * \sqrt{(2 * g * H)}$$

Where
- Q = discharge (cfs)
- C = discharge coefficient (0.60)
- A = orifice area (ft^2)
- g = gravitational acceleration (32.2 ft/s^2)
- H = effective head on the orifice measured from the centroid of the opening (ft)

Equation 6. Broad Crested Weir Equation

$$Q = C * L * H^{1.5}$$

Where		
	Q	= discharge (cfs)
	C	= weir coefficient (3.08)
	L	= weir length (ft)
	H	= head above weir crest (ft)

Equation 7. Hazen-Williams Equation

$$h_f = \left(10{,}500 * \left(\frac{Q}{C}\right)^{1.85}\right) * D^{-4.87}$$

Where		
	Q	= flow rate (gpm)
	C	= coefficient of pipe friction
	D	= pipe diameter (in)
	h_f	= friction loss (ft/1,000 ft)

Equation 8. TDH Equation

$$TDH = H_{stat} + H_{ent} + h_{fs} + \sum h_{fvs} + h_{fd} + \sum h_{fvd} + \frac{v_d^{\,2}}{2g}$$

Where		
	H_{stat}	= total static head (ft)
	H_{ent}	= entrance headloss (ft)
	h_{fs}, h_{fd}	= friction headloss (ft)
	h_{fvs}, h_{fvd}	= fitting and valve losses (ft)

ASSUMPTIONS

The rainfall and runoff parameters are based on County rain gauge data, the County Hydrology Manual, and the County Design Standards.

Rainfall

According to the isohyet rainfall map in the County Hydrology Manual, the study area has an average 100-year, 24-hour rainfall depth of about 7.7 inches within the regional watershed. A statistical analysis was performed on County gauges 175/132B/175A to compare to the design storm rainfall event. The 85th percentile, 24-hour rainfall is 1.35 inches.

The mean annual precipitation (MAP) is identified from DWR, Bulletin No. 195, October 1976 and the current information found on their web site (http://ferix.water.ca.gov/webapp/precipitation/). According to Station No. U03 8008 04 and NOAA Station USC00047957 (Santa Paula), the MAP is about 17.38-inches. Bulletin No. 195, Plate 4 reports the mean 24-hour storm at roughly 3.0-inches.

Magnitude and Frequency of Floods Comparison

Regional regression equations have been developed by USGS using generalized least squares regression. These equations are a function of drainage area and mean annual precipitation. They are also only valid in a rural watershed. However, the results can still be compared to urban watersheds with the understanding that urban watershed runoff should be two to five times that of the rural watershed. For sub-basin 1A:

Equation 9. Runoff Regression Equation

$$Q_{100} = 3.28 * A^{0.891} * P^{1.59} \approx 259.6\, cfs$$

Where	A	= drainage area (sm)	= 529.7 ac
	P	= mean annual rainfall (in)	= 17.38 in

As seen on the existing drainage area map, the discharge at node 2A is 380.6 cfs. This is nearly one and a half times the amount from the regression equation. The results are reasonable.

Proposed System Development

The build-out project area will be protected from off-site run-on by the by-pass culvert through the project area and the existing WPD channel along the east side of the development. All on-site runoff will be conveyed through a storm drainage network to two retention basins sized to contain the 100-year, 24-hour rainfall event.

The working areas and basins will be improved to satisfy the hydraulic conductivity requirements of the WDR for compost operations (WQ 2015-0121-DWQ). Accordingly, the Facility will be processing Tier II feedstocks. This requires working surfaces to have a hydraulic conductivity of 1.0 x 10^{-5} centimeters per second or less and ponds to meet a hydraulic conductivity of 1.0 x 10^{-6} cm/s or less. These criteria will be achieved by using a combination of asphalt pavement, cement treated native soil, and synthetic geomembrane liners. The basins will also be equipped with a pan lysimeter monitoring device or equivalent alternative to measure their containment efficiency.

Table 5. West Basin Rating Table

Stage (msl)	*Volume* (ac-ft)	*Discharge* (cfs)
168	0.0	0.0
170	1.8	0.0
172	5.6	0.0
174	10.0	0.0
176	14.8	0.0
177.9	19.9	0.0
178	20.1	0.0
178.5	21.5	53.2

The basins are interconnected with a pipe culvert. So, they will always equalize to the same level. The spillway elevation for both basins is 178.0 msl. And the 100-year, 24-hour water level is 177.6 msl. The spillway capacity for each is about 53 cfs.

The wet well is offline from the pipe culvert. A submersible pump will drain the ponds through a skid mounted filtration system and then into a water truck for operational use. Straw wattles will be used around all catch basins to keep any large debris from entering the storm drain system.

Table 6. East Basin Rating Table

Stage (msl)	*Volume* (ac-ft)	*Discharge* (cfs)
168	0.0	0.0
170	2.0	0.0
172	6.8	0.0
174	12.0	0.0
176	17.8	0.0
177.9	23.7	0.0
178	24.0	0.0
178.5	25.6	53.2

References

1) County of Ventura (2017). *Hydrology Manual for Department of Public Works*, Ventura, CA.

2) U.S. Soil Conservation Service (1985). *National Engineering Handbook, Section 4.* U.S. Department of Agriculture, Washington, D.C.

3) Pfrang, E.O., ed. (1992). "Design and Construction of Urban Stormwater Management Systems." *ASCE Manuals and Reports on Engineering Practice No. 77*, ASCE, New York NY.

4) Water Environment Federation (1998). "Urban Runoff Quality Management." *WEF Manual of Practice No. 23, ASCE Manuals and Reports on Engineering Practice No. 87*, Alexandria, VA.

5) U.S. Soil Conservation Service (1970). *Soil Survey of Ventura Area, California.* U.S. Department of Agriculture, Washington, D.C.

6) U.S. Soil Conservation Service (1986). *Urban Hydrology for Small Watersheds, Technical Release No. 55.* U.S. Department of Agriculture, Washington, D.C.

7) Brater, E.F. and King, H.W. (1976). *Handbook of Hydraulics. 6th ed.*, McGraw-Hill, New York, NY.

8) Chow, V.T. (1988). *Open-Channel Hydraulics*, McGraw-Hill, New York, NY.

9) Gupta, R.S. (1989). *Hydrology & Hydraulic Systems*, Prentice Hall, Englewood Cliffs, NJ.

10) Viessman, W., Lewis, G.L. and Knapp, J.W. (1989). *Introduction to Hydrology, 3rd Edition*, Harper Collins, New York, NY.

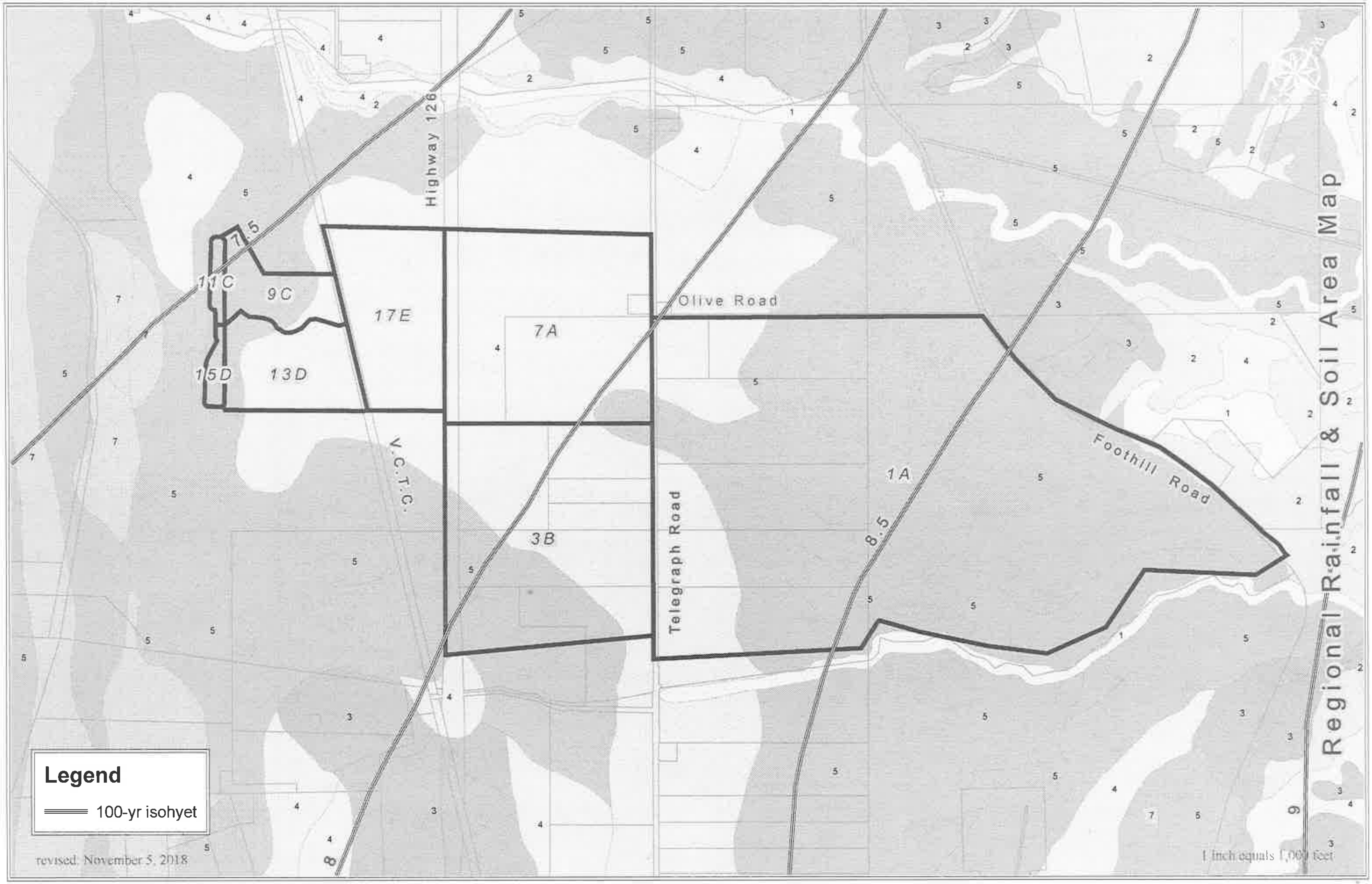
11) Federal Emergency Management Agency (2010). *Flood Insurance Rate Maps, Ventura (Unincorporated Areas) and Ventura County, California.*

12) U.S. Geological Survey (2012). *Scientific Investigations Report 2012-5113, Methods for Determining Magnitude and Frequency of Floods in California, Based on Data through Water Year 206.* U.S. Department of the Interior, Reston, VA.

13) U.S. Geological Survey (1982). *Guidelines for Determining Flood Flow Frequencies, Bulletin No. 17B*, U.S. Department of the Interior, Reston, VA.

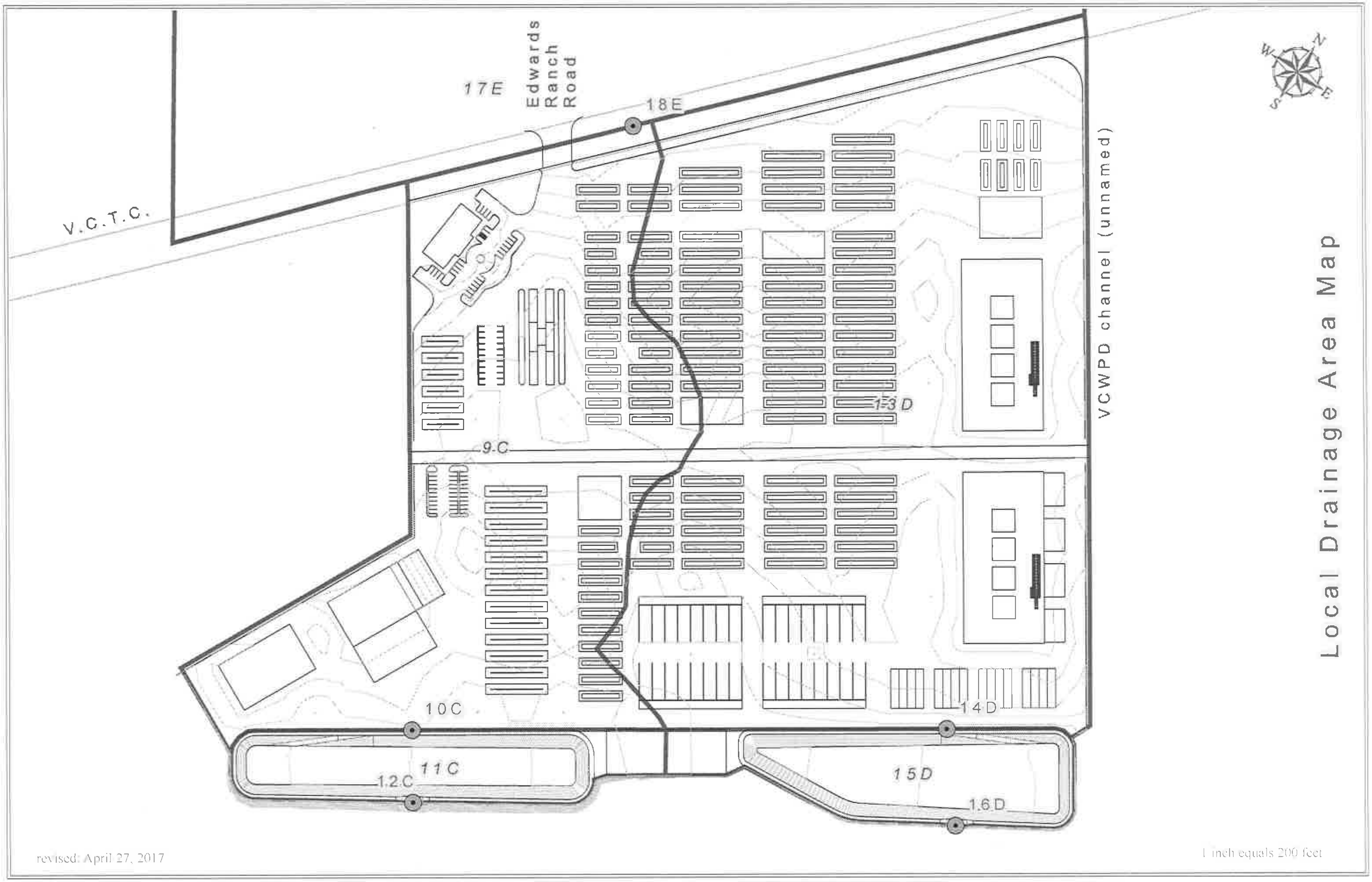
14) Ven Te Chow, David R. Maident, Larry W. Mays (1988), *Applied Hydrology*, McGraw-Hill, New York, NY.

Appendix 1 – Exhibits



Regional Rainfall & Soil Area Map
Highway 126
Olive Road
Foothill Road
Telegraph Road
V.C.T.C.
1A
3B
7A
9C
11C
13D
15D
17E
7.5
8
8.5
9
Legend
100-yr isohyet
revised: November 5, 2018
1 inch equals 1,000 feet


Regional Drainage Area Map
V.C.T.C.
Highway 126
Telegraph Road
Olive Road
12C
10C
11C
9C
18E
17E
7A
16D
15D
14D
13D
8A
4B
2A
1A
3B
S
W
N
E
revised: April 27, 2017
1 inch equals 500 feet


17E
Edwards Ranch Road
18E
V.C.T.C.
VCWPD channel (unnamed)
W
N
E
S
13 D
9.C
10C
14D
11C
1.2.C
15D
1.6D
revised: April 27, 2017
1 inch equals 200 feet
Local Drainage Area Map

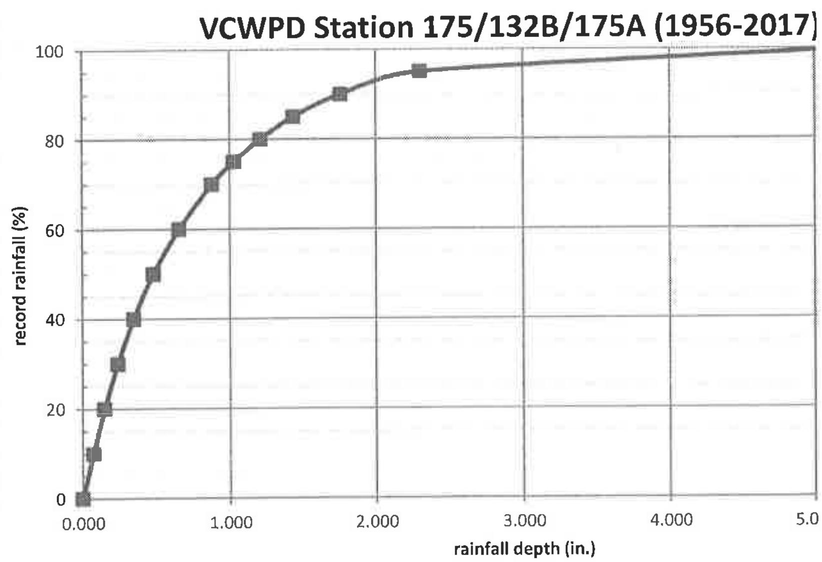
Appendix 2 – Rainfall Information

date	precip (in)	excess (in)
1/10/2005 8:00	5.31	3.01
11/29/1970 8:00	4.79	2.49
12/6/1997 8:00	4.72	2.42
2/11/1962 8:00	4.37	2.07
2/17/1980 8:00	4.32	2.02
2/10/1962 8:00	3.94	1.64
12/4/1974 8:00	3.91	1.61
1/11/2001 8:00	3.89	1.59
1/25/1969 8:00	3.85	1.55
1/10/1995 8:00	3.85	1.55
3/1/1991 8:00	3.64	1.34
2/15/1986 8:00	3.63	1.33
2/18/2017 8:00	3.63	1.33
1/20/1969 8:00	3.50	1.20
12/19/2010 8:00	3.37	1.07
3/11/1995 8:00	3.29	0.99
3/4/1978 8:00	3.21	0.91
3/6/2001 8:00	3.17	0.87
2/26/2004 8:00	3.17	0.87
3/8/1968 8:00	3.10	0.80
3/27/1979 8:00	3.10	0.80
12/20/1964 8:00	3.00	0.70
1/3/1977 8:00	3.00	0.70
1/17/1973 8:00	2.98	0.68
2/11/1992 8:00	2.96	0.66
2/2/1998 8:00	2.94	0.64
3/2/1970 8:00	2.93	0.63
3/5/2001 8:00	2.91	0.61
2/8/1962 8:00	2.90	0.60
2/11/1973 8:00	2.88	0.58
1/7/1974 8:00	2.88	0.58
2/20/1996 8:00	2.87	0.57
11/8/2002 8:00	2.87	0.57
2/8/1993 8:00	2.82	0.52
3/19/1991 8:00	2.81	0.51
1/5/2008 8:00	2.76	0.46
2/10/1963 8:00	2.75	0.45
12/11/1996 8:00	2.75	0.45
3/1/1978 8:00	2.72	0.42
12/28/2004 8:00	2.72	0.42
9/29/1976 8:00	2.71	0.41
1/23/1983 8:00	2.71	0.41
1/11/1980 8:00	2.68	0.38
1/8/1974 8:00	2.66	0.36
1/5/1995 8:00	2.66	0.36
2/19/1958 8:00	2.65	0.35
3/26/1993 8:00	2.63	0.33
2/28/1991 8:00	2.61	0.31
3/23/2005 8:00	2.61	0.31
2/3/1975 8:00	2.55	0.25
2/3/1998 8:00	2.54	0.24
2/8/1998 8:00	2.53	0.23
3/21/2011 8:00	2.50	0.20
12/7/1992 8:00	2.49	0.19
12/19/1970 8:00	2.48	0.18
12/3/1966 8:00	2.46	0.16
1/26/1958 8:00	2.45	0.15
12/27/1971 8:00	2.45	0.15
2/19/1993 8:00	2.45	0.15
1/7/2016 8:00	2.45	0.15
4/18/2000 8:00	2.42	0.12
1/11/1995 8:00	2.41	0.11

records truncated

rainfall event	rainfall depth (in)	treatment (%)
calculator	2.300	95.0
81.5th percentile	1.210	
85th percentile	1.35	
50-yr, 24-hr		
8% of 50-yr, 24-hr	0.00	
94.35th percentile	2.19	

rainfall depth (in)	treatment (%)
0.000	0
0.072	10
0.147	20
0.238	30
0.346	40
0.480	50
0.653	60
0.880	70
1.028	75
1.208	80
1.436	85
1.760	90
2.300	95
5.310	100



NOAA Atlas 14, Volume 6, Version 2 SATICOY
FIRE STATION
Station ID: 93-0175
Location name: Ventura, California, USA*
Latitude: 34.2856°, Longitude: -119.155°
Elevation:
Elevation (station metadata): 185 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF tabular | PF graphical | Maps & aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.150 (0.126–0.181)	0.188 (0.157–0.227)	0.233 (0.194–0.283)	0.268 (0.221–0.327)	0.312 (0.248–0.395)	0.343 (0.267–0.444)	0.372 (0.282–0.496)	0.401 (0.295–0.550)	0.437 (0.307–0.627)	0.463 (0.314–0.689)
10-min	0.215 (0.180–0.259)	0.269 (0.225–0.325)	0.334 (0.279–0.405)	0.384 (0.317–0.469)	0.447 (0.356–0.566)	0.491 (0.383–0.637)	0.534 (0.405–0.711)	0.575 (0.423–0.789)	0.626 (0.441–0.899)	0.663 (0.450–0.988)
15-min	0.260 (0.218–0.314)	0.325 (0.272–0.393)	0.404 (0.337–0.490)	0.464 (0.384–0.568)	0.540 (0.430–0.685)	0.594 (0.463–0.770)	0.645 (0.490–0.859)	0.695 (0.512–0.954)	0.757 (0.533–1.09)	0.802 (0.544–1.19)
30-min	0.391 (0.328–0.472)	0.489 (0.409–0.591)	0.608 (0.507–0.736)	0.698 (0.577–0.854)	0.812 (0.647–1.03)	0.893 (0.696–1.16)	0.971 (0.736–1.29)	1.05 (0.769–1.43)	1.14 (0.801–1.63)	1.21 (0.818–1.80)
60-min	0.614 (0.514–0.740)	0.767 (0.642–0.927)	0.954 (0.795–1.16)	1.10 (0.905–1.34)	1.27 (1.01–1.62)	1.40 (1.09–1.82)	1.52 (1.16–2.03)	1.64 (1.21–2.25)	1.79 (1.26–2.56)	1.89 (1.28–2.82)
2-hr	0.892 (0.747–1.08)	1.12 (0.932–1.35)	1.38 (1.15–1.68)	1.58 (1.31–1.94)	1.84 (1.46–2.33)	2.01 (1.57–2.61)	2.18 (1.65–2.90)	2.34 (1.72–3.21)	2.54 (1.79–3.65)	2.68 (1.82–3.99)
3-hr	1.12 (0.934–1.35)	1.40 (1.17–1.69)	1.73 (1.44–2.10)	1.98 (1.64–2.42)	2.30 (1.83–2.91)	2.52 (1.96–3.26)	2.72 (2.07–3.63)	2.92 (2.15–4.01)	3.17 (2.23–4.55)	3.34 (2.27–4.98)
6-hr	1.57 (1.31–1.89)	1.97 (1.65–2.38)	2.46 (2.05–2.98)	2.82 (2.33–3.45)	3.28 (2.61–4.15)	3.59 (2.80–4.66)	3.89 (2.95–5.18)	4.18 (3.07–5.73)	4.53 (3.19–6.50)	4.78 (3.24–7.12)
12-hr	2.02 (1.69–2.43)	2.57 (2.15–3.10)	3.23 (2.69–3.91)	3.73 (3.08–4.56)	4.35 (3.47–5.51)	4.79 (3.73–6.21)	5.20 (3.96–6.93)	5.60 (4.12–7.68)	6.09 (4.29–8.74)	6.44 (4.37–9.59)
24-hr	2.56 (2.27–2.95)	3.31 (2.92–3.81)	4.21 (3.72–4.87)	4.90 (4.29–5.72)	5.77 (4.88–6.96)	6.39 (5.29–7.87)	6.98 (5.64–8.80)	7.54 (5.93–9.79)	8.26 (6.23–11.2)	8.77 (6.39–12.3)
2-day	3.12 (2.77–3.60)	4.12 (3.64–4.75)	5.34 (4.71–6.18)	6.29 (5.50–7.34)	7.51 (6.35–9.05)	8.39 (6.95–10.3)	9.24 (7.47–11.7)	10.1 (7.92–13.1)	11.1 (8.41–15.1)	11.9 (8.70–16.7)
3-day	3.46 (3.07–3.99)	4.62 (4.08–5.33)	6.06 (5.35–7.01)	7.19 (6.29–8.39)	8.66 (7.33–10.4)	9.74 (8.07–12.0)	10.8 (8.73–13.6)	11.8 (9.31–15.4)	13.2 (9.95–17.8)	14.2 (10.3–19.9)
4-day	3.77 (3.34–4.35)	5.06 (4.47–5.84)	6.69 (5.90–7.74)	7.97 (6.97–9.29)	9.65 (8.16–11.6)	10.9 (9.02–13.4)	12.1 (9.79–15.3)	13.3 (10.5–17.3)	14.9 (11.3–20.2)	16.1 (11.7–22.6)
7-day	4.38 (3.88–5.04)	5.89 (5.21–6.79)	7.81 (6.89–9.04)	9.35 (8.18–10.9)	11.4 (9.63–13.7)	12.9 (10.7–15.9)	14.4 (11.6–18.2)	15.9 (12.5–20.7)	17.9 (13.5–24.2)	19.4 (14.2–27.2)
10-day	4.71 (4.17–5.42)	6.34 (5.61–7.32)	8.44 (7.45–9.77)	10.1 (8.86–11.8)	12.4 (10.5–14.9)	14.1 (11.6–17.3)	15.7 (12.7–19.9)	17.5 (13.7–22.6)	19.7 (14.9–26.7)	21.5 (15.6–30.0)
20-day	5.44 (4.82–6.27)	7.41 (6.55–8.55)	9.98 (8.80–11.5)	12.1 (10.6–14.1)	14.9 (12.6–18.0)	17.1 (14.1–21.0)	19.3 (15.6–24.3)	21.5 (16.9–27.9)	24.5 (18.5–33.2)	26.9 (19.6–37.7)
30-day	6.43 (5.70–7.41)	8.80 (7.78–10.2)	11.9 (10.5–13.8)	14.5 (12.7–16.9)	18.0 (15.2–21.7)	20.7 (17.1–25.5)	23.5 (19.0–29.6)	26.3 (20.7–34.2)	30.3 (22.8–40.9)	33.3 (24.3–46.7)
45-day	7.57 (6.70–8.72)	10.3 (9.15–11.9)	14.1 (12.4–16.3)	17.1 (15.0–20.0)	21.4 (18.1–25.8)	24.7 (20.5–30.4)	28.2 (22.8–35.5)	31.8 (25.0–41.2)	36.7 (27.7–49.7)	40.7 (29.6–56.9)
60-day	8.64 (7.65–9.95)	11.8 (10.4–13.6)	16.0 (14.1–18.5)	19.5 (17.0–22.7)	24.3 (20.6–29.4)	28.2 (23.4–34.7)	32.2 (26.1–40.6)	36.4 (28.7–47.3)	42.3 (31.9–57.3)	47.1 (34.3–65.9)

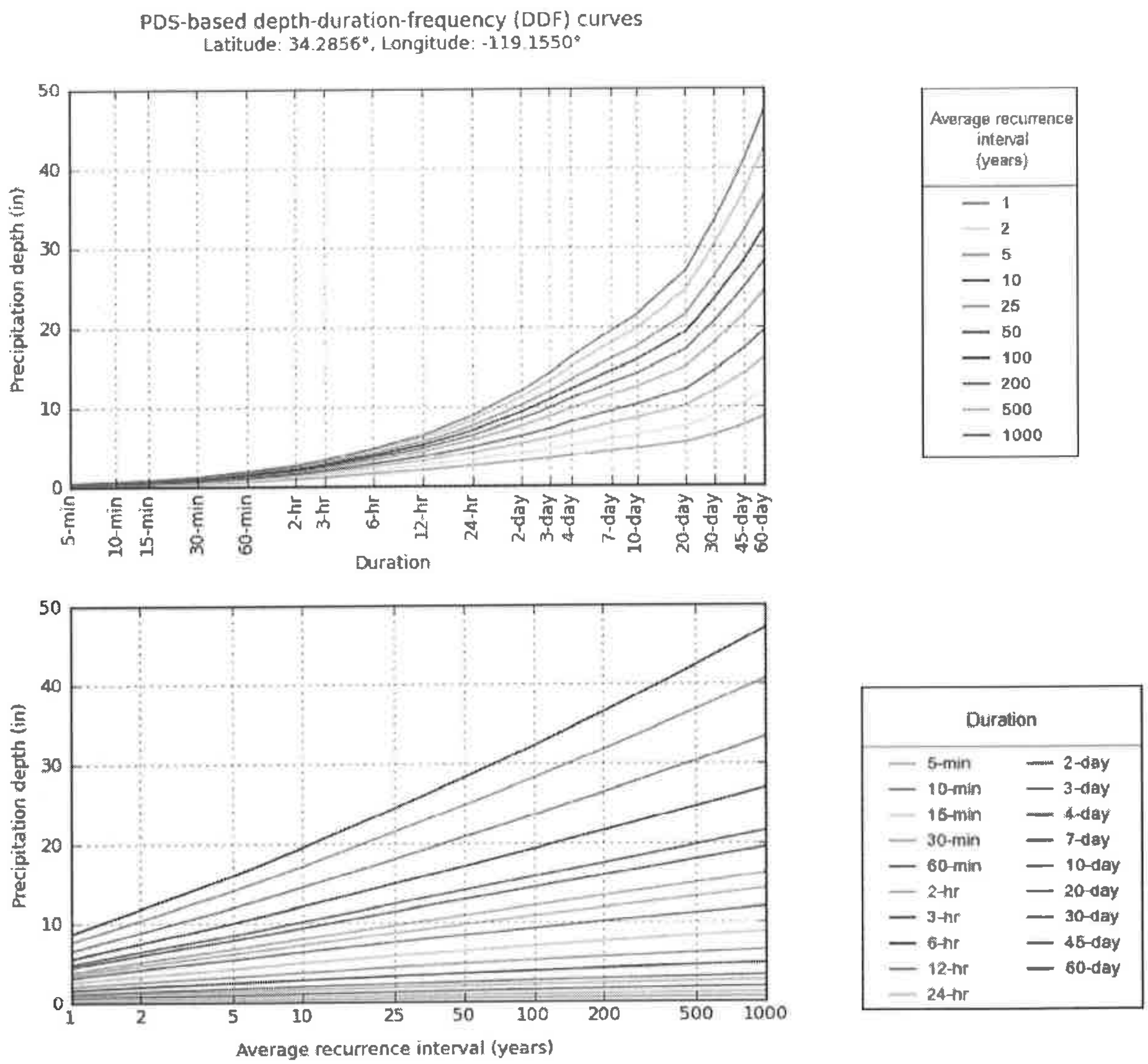
[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

Back to Top

PF graphical

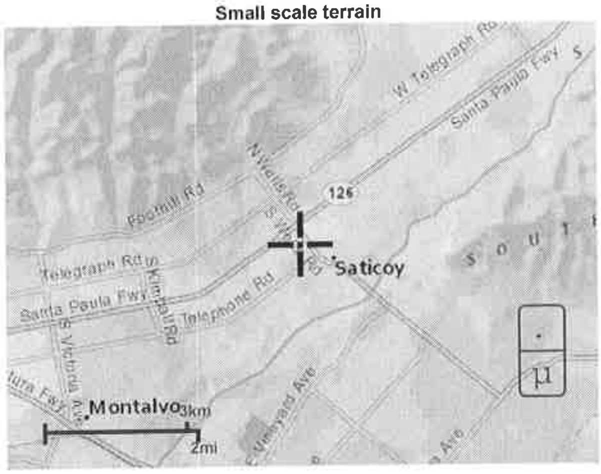


NOAA Atlas 14, Volume 6, Version 2 Created (GMT): Fri May 19 20:03:48 2017

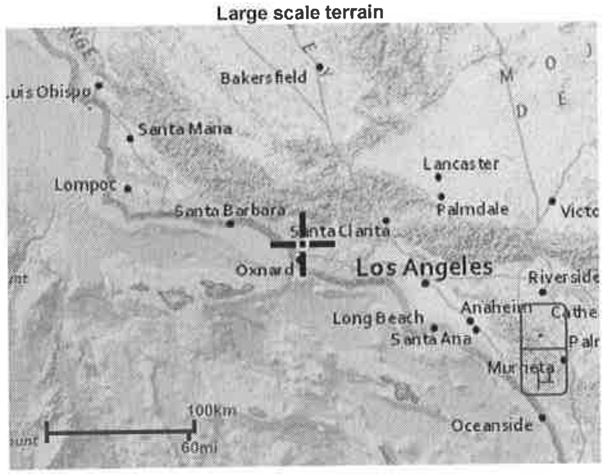
Back to Top

Maps & aerials

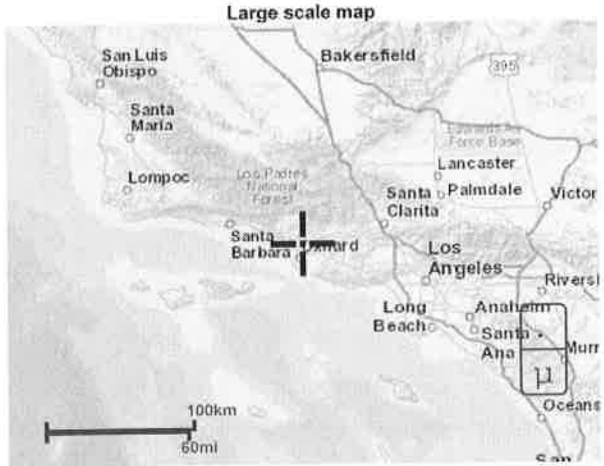
Small scale terrain



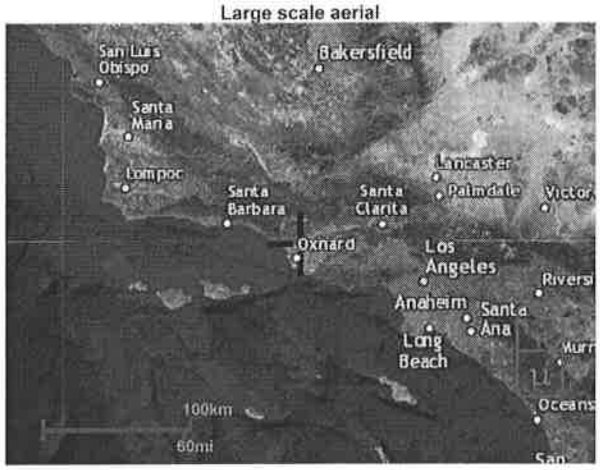
Large scale terrain



Large scale map



Large scale aerial



Back to Top

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

Disclaimer

Station Number	Station	County	Latitude	Longitude	Elevation	Years Recorded
U03 8008 04	Santicoy FS 175	Ventura	34.285	-119.156	180	42

Rainfall Statistics	5-Min	10-Min	15-Min	30-Min	1-Hour	2-Hour	3-Hour	6-Hour	12-Hour	24-Hour	48-Hour	72-Hour	1-Year
PR=0.5	0.2	---	0.35	0.5	0.7	0.99	1.21	1.7	2.41	3.4	---	---	---
PR=0.20	0.27	---	0.47	0.66	0.94	1.33	1.63	2.31	3.27	4.63	---	---	---
PR=0.10	0.31	---	0.53	0.76	1.08	1.53	1.87	2.66	3.78	5.36	---	---	---
PR=0.04	0.34	---	0.6	0.86	1.22	1.74	2.15	3.06	4.36	6.21	---	---	---
PR=0.02	0.37	---	0.65	0.93	1.32	1.89	2.33	3.33	4.75	6.79	---	---	---
PR=0.01	0.39	---	0.69	0.99	1.41	2.02	2.5	3.58	5.12	7.34	---	---	---
PR=0.00	0.41	---	0.73	1.04	1.5	2.15	2.66	3.81	5.47	7.86	---	---	---
PR=0.00	0.43	---	0.77	1.11	1.6	2.3	2.85	4.11	5.91	8.52	---	---	---
PR=0.00	0.45	---	0.8	1.16	1.67	2.41	2.99	4.32	6.23	9	---	---	---
PR=0.0001	0.5	---	0.9	1.3	1.89	2.75	3.42	4.97	7.22	10.5	---	---	---

Annual Maxima	5-Min	10-Min	15-Min	30-Min	1-Hour	2-Hour	3-Hour	6-Hour	12-Hour	24-Hour	48-Hour	72-Hour	1-Year
2007	---	---	---	---	---	---	---	---	---	---	---	---	---
2006	---	---	---	---	---	---	---	---	---	---	---	---	---
2005	---	---	---	---	---	---	---	---	---	---	---	---	---
2004	---	---	---	---	---	---	---	---	---	---	---	---	---
2003	---	---	---	---	---	---	---	---	---	---	---	---	---
2002	---	---	---	---	---	---	---	---	---	---	---	---	---
2001	---	---	---	---	---	---	---	---	---	---	---	---	---
2000	---	---	---	---	---	---	---	---	---	---	---	---	---
1999	---	---	---	---	---	---	---	---	---	---	---	---	---
1998	0.34	---	0.65	0.84	1.13	2	2.65	2.65	3.45	3.69	---	---	---
1997	0.07	---	0.15	0.27	0.49	0.87	1.32	1.72	2.31	2.79	---	---	15.82
1996	0.09	---	0.18	0.21	0.33	0.57	1.01	1.37	2.34	3.5	---	---	13.95
1995	0.23	---	0.34	0.6	0.95	1.58	2.54	3.61	4.94	5.78	---	---	33.28
1994	0.17	---	0.24	0.33	0.49	0.85	1.47	1.81	1.89	1.91	---	---	13.31
1993	0.17	---	0.39	0.56	0.95	1.32	1.97	2.25	2.62	3.07	---	---	28.85
1992	0.28	---	0.46	0.62	0.73	0.94	1.44	1.66	2.75	4.1	---	---	16.32
1991	0.34	---	0.68	0.96	1.17	1.55	2.29	2.85	2.98	4.35	---	---	17.02
1990	0.08	---	0.16	0.23	0.4	0.61	1.08	1.34	1.64	1.72	---	---	6.11
1989	0.04	---	0.08	0.14	0.21	0.35	0.57	0.73	1.13	1.31	---	---	8.59
1988	0.1	---	0.31	0.5	0.87	1.25	1.4	1.43	1.69	2.03	---	---	12.1
1987	0	---	0.13	0.25	0.5	0.86	1.13	1.17	1.26	1.4	---	---	7.1
1986	0.13	---	0.4	0.79	1.59	2.98	3.01	3.05	3.11	3.33	---	---	25.48
1985	0.06	---	0.15	0.25	0.41	0.65	1.21	1.3	1.33	1.33	---	---	11.04
1984	0.12	---	0.35	0.48	0.62	0.75	1.22	1.4	2.18	2.21	---	---	10.86
1983	0.2	---	0.38	0.63	0.81	1.12	1.43	1.83	2.63	2.94	---	---	31.51
1982	0.13	---	0.23	0.29	0.46	0.53	0.89	0.93	1.06	1.29	---	---	12.71
1981	0.15	---	0.38	0.5	0.73	0.87	0.94	1.29	1.59	2.88	---	---	11.8
1980	0.17	---	0.5	0.75	0.96	1.42	2.47	3.19	4.5	4.82	---	---	27.12
1979	0.12	---	0.34	0.57	0.93	1.4	2	2.6	3.07	3.07	---	---	19
1978	0.18	---	0.38	0.53	0.77	1.35	2.15	2.65	3.8	4.05	---	---	33.07
1977	0.2	---	0.46	0.68	0.78	1.41	2.31	2.69	2.99	3	---	---	10.48
1976	0.2	---	0.48	0.65	0.76	0.94	1.43	1.7	2.7	2.75	---	---	11.12
1975	0.23	---	0.5	0.61	1.05	1.4	2.34	2.77	3.59	4	---	---	16.28
1974	0.15	---	0.24	0.29	0.44	0.63	1.15	1.63	2.79	4.4	---	---	14.43
1973	0.24	---	0.45	0.64	0.95	1.58	2.35	2.73	3.02	3.05	---	---	21.65
1972	0.2	---	0.45	0.68	1.09	1.45	1.93	2.34	2.45	2.45	---	---	7.47
1971	0.11	---	0.23	0.45	0.95	1.52	2.22	2.81	3.72	5.03	---	---	14.75
1970	0.18	---	0.41	0.6	0.82	1.02	1.63	2.08	2.58	2.99	---	---	14.16
1969	0.19	---	0.52	0.7	0.9	1.29	2.37	2.82	3.62	4.1	---	---	24.76
1968	0.2	---	0.6	0.82	0.88	0.91	1.43	1.92	2.64	3.1	---	---	13.85
1967	0.25	---	0.43	0.68	0.9	1.19	1.68	2.11	2.58	2.7	---	---	19.36
1966	0.23	---	0.35	0.45	0.69	0.89	1.39	1.5	2.02	2.69	---	---	14.82
1965	0.08	---	0.2	0.3	0.41	0.52	0.87	1.19	2.09	2.95	---	---	14.28
1964	0.23	---	0.37	0.56	0.63	0.81	1.3	1.5	1.54	1.54	---	---	8.53
1963	0.21	---	0.32	0.4	0.54	0.86	1.31	1.63	2	2.77	---	---	11.99
1962	0.2	---	0.3	0.47	0.67	1.25	1.53	1.78	2.89	5.77	---	---	24.48
1961	0.21	---	0.4	0.61	0.81	1.1	1.2	1.21	1.61	2.45	---	---	7.34
1960	0.24	---	0.38	0.58	0.79	1.12	1.6	2.02	2.2	2.3	---	---	11.36
1959	0.22	---	0.25	0.3	0.46	0.66	0.87	1.1	1.22	1.57	---	---	6.49
1958	0.22	---	0.48	0.67	0.9	1.4	2.17	2.37	2.39	2.75	---	---	29.26
1957	0.24	---	0.32	0.41	0.53	0.61	0.68	0.74	0.93	1.05	---	---	---
1956	---	---	---	---	---	---	---	---	---	---	---	---	---
1955	---	---	---	---	---	---	---	---	---	---	---	---	---
1954	---	---	---	---	---	---	---	---	---	---	---	---	---
1953	---	---	---	---	---	---	---	---	---	---	---	---	---
1952	---	---	---	---	---	---	---	---	---	---	---	---	---

Monthly Rainfall Total

Station	Statio No	County	Lat	Long.	Elev.	Source Ob Tir	Yrs Rec	Slope	Interce
Santa Paula	U03 7957 00	Ventur	34.317	-119.133	237	CD	111		

Return Period for Rainfall For Indicated Monthly Total Rain

	Sum	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
RP 2	16.02	0.26	0.99	2.14	2.77	3.23	2.14	0.83	0.08	0.01	0.00	0.01	0.12
RP 5	23.22	0.94	2.93	4.45	6.53	7.18	4.83	1.92	0.63	0.08	0.01	0.07	0.46
RP 10	27.96	1.50	4.33	6.03	9.34	9.77	6.83	2.65	1.15	0.14	0.03	0.16	0.96
RP 25	33.82	2.28	6.15	8.03	13.06	12.99	9.49	3.57	1.95	0.23	0.06	0.30	1.86
RP 50	38.09	2.89	7.53	9.50	15.92	15.32	11.52	4.24	2.61	0.31	0.08	0.43	2.68
RP 100	42.26	3.53	8.90	10.96	18.80	17.61	13.58	4.90	3.31	0.39	0.11	0.58	3.62
RP 200	46.37	4.18	10.29	12.41	21.72	19.86	15.67	5.56	4.05	0.48	0.14	0.74	4.66
RP 500	51.74	5.07	12.13	14.31	25.64	22.80	18.46	6.41	5.08	0.60	0.19	0.97	6.16
RP 1000	55.76	5.76	13.54	15.75	28.65	25.01	20.61	7.06	5.90	0.69	0.23	1.15	7.39
RP 10000	69.03	8.17	18.30	20.55	38.91	32.27	27.93	9.19	8.83	1.02	0.36	1.84	12.00
Average	17.52	0.53	1.54	2.69	3.95	4.05	2.99	1.07	0.34	0.04	0.01	0.04	0.26
Stdev	[illegible]	0.84	1.99	2.62	4.15	4.01	2.74	1.33	0.72	0.12	0.03	0.16	0.63
Rec Max	42.24	4.16	10.37	10.66	18.63	20.89	11.79	5.72	3.95	0.64	0.26	1.11	4.06
Rec Min	6.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Z	3.16	4.61	4.15	3.16	3.52	3.92	2.96	3.91	4.97	6.84	10.34	8.59	4.94
Yrs Rec	111	110	110	110	110	110	110	110	109	109	109	110	109
Calc CV	0.451	1.599	1.289	0.972	1.051	0.990	0.916	1.241	2.090	2.988	4.819	4.156	2.409
Reg CV	0.447	1.501	1.380	0.935	1.055	1.058	0.995	1.106	2.104	2.251	3.709	3.214	2.959
Skew	1.0	2.4	1.8	0.9	1.8	1.4	1.1	1.6	3.0	3.6	6.3	5.8	3.5
Reg Skew	1.2	2.4	1.7	1.4	1.9	1.2	1.9	1.3	3.2	3.0	4.4	4.4	4.8
Kurtosis	0.5	6.1	4.0	-0.3	3.2	2.7	0.8	2.5	9.8	12.9	43.8	35.4	14.8

Monthly Total Rain

Year	Sum	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1897	13.70	0.00	0.00	0.00	5.03	4.98	3.24	0.00	0.00	0.00	0.00	0.00	0.45
1898	6.32	1.07	0.00	0.00	0.92	0.70	1.55	0.00	1.22	0.00	0.00	0.00	0.86
1899	6.54	0.08	0.00	0.26	3.44	0.00	2.41	0.35	0.00	0.00	0.00	0.00	0.00
1900	9.57	1.84	1.17	1.66	1.67	0.00	1.36	0.38	1.49	0.00	0.00	0.00	0.00
1901	16.80	0.00	4.71	0.00	4.57	4.34	0.42	0.91	1.14	0.00	0.00	0.00	0.71
1902	12.38	2.24	0.54	0.00	1.30	4.49	3.31	0.50	0.00	0.00	0.00	0.00	0.00
1903	18.40	0.00	4.75	1.03	1.66	1.98	6.23	2.65	0.10	0.00	0.00	0.00	0.00
1904	13.36	0.00	0.00	0.00	0.31	3.83	5.94	1.46	0.00	0.00	0.00	0.00	1.82
1905	22.44	0.38	0.00	2.18	2.54	8.02	5.50	0.67	3.15	0.00	0.00	0.00	0.00
1906	17.93	0.00	1.50	0.00	3.35	3.60	9.03	0.40	0.05	0.00	0.00	0.00	0.00
1907	27.83	0.00	0.00	6.25	13.23	1.95	6.22	0.18	0.00	0.00	0.00	0.00	0.00
1908	15.13	3.30	0.00	0.65	5.08	4.56	0.05	0.94	0.00	0.00	0.00	0.00	0.55
1909	25.35	0.15	2.40	1.10	10.88	5.94	4.88	0.00	0.00	0.00	0.00	0.00	0.00
1910	16.72	0.13	1.36	7.27	2.82	0.00	2.36	0.00	0.00	0.00	0.00	0.00	2.78
1911	19.29	0.62	0.33	0.32	9.54	2.88	5.53	0.00	0.00	0.00	0.00	0.00	0.07
1912	11.07	0.00	0.00	1.21	0.18	0.00	7.17	1.67	0.84	0.00	0.00	0.00	0.00
1913	15.41	0.56	0.11	0.00	3.79	9.51	0.00	0.47	0.00	0.47	0.00	0.50	0.00
1914	28.48	0.00	3.09	2.33	12.73	8.40	0.66	0.76	0.51	0.00	0.00	0.00	0.00
1915	23.12	0.15	0.13	4.33	5.38	9.30	0.98	1.16	1.69	0.00	0.00	0.00	0.00
1916	24.49	0.00	0.68	2.60	18.17	0.56	1.04	0.00	0.00	0.00	0.00	0.00	1.44
1917	19.94	2.36	0.00	6.43	3.24	7.24	0.12	0.37	0.19	0.00	0.00	0.00	0.00
1918	21.88	0.00	0.30	0.00	0.26	13.00	6.28	0.00	0.00	0.00	0.26	0.00	1.78
1919	12.08	0.00	3.01	1.17	1.43	1.89	2.65	0.00	0.22	0.00	0.00	0.00	1.71
1920	12.53	0.33	0.12	2.18	0.41	2.93	5.74	0.82	0.00	0.00	0.00	0.00	0.00
1921	17.44	0.30	1.86	1.33	6.60	1.02	1.99	0.23	3.95	0.00	0.00	0.00	0.17
1922	20.93	0.34	0.00	10.66	4.55	3.43	1.49	0.00	0.46	0.00	0.00	0.00	0.00
1923	15.07	0.43	1.63	7.01	1.86	1.03	0.00	2.97	0.00	0.00	0.00	0.00	0.14
1924	7.57	0.72	0.00	0.04	1.94	0.18	3.46	1.23	0.00	0.00	0.00	0.00	0.00
1925	10.01	1.02	1.12	1.08	0.31	1.25	2.25	2.02	0.88	0.08	0.00	0.00	0.00
1926	16.41	0.81	0.89	2.23	2.04	4.42	0.12	5.72	0.16	0.02	0.00	0.00	0.00
1927	23.32	0.13	5.49	1.28	1.89	10.66	2.34	1.53	0.00	0.00	0.00	0.00	0.00
1928	11.16	1.84	1.27	2.64	0.00	2.27	2.25	0.29	0.59	0.00	0.00	0.00	0.00
1929	14.17	0.06	2.04	3.29	2.47	2.10	1.51	1.89	0.00	0.12	0.00	0.00	0.69
1930	11.59	0.00	0.00	0.00	6.58	0.92	3.14	0.17	0.76	0.00	0.00	0.00	0.02
1931	14.19	0.02	2.68	0.00	3.94	4.09	0.00	2.00	1.25	0.00	0.00	0.21	0.00
1932	20.54	0.05	3.13	8.70	2.03	5.78	0.09	0.54	0.02	0.05	0.00	0.00	0.15
1933	11.15	0.24	0.00	0.90	8.84	0.00	0.23	0.32	0.13	0.40	0.00	0.09	0.00
1934	14.94	0.44	0.00	6.86	3.19	3.85	0.00	0.00	0.00	0.52	0.00	0.00	0.08
1935	21.39	1.62	3.16	4.76	3.97	0.82	3.31	3.50	0.00	0.00	0.00	0.25	0.00
1936	16.31	0.37	1.12	1.74	0.17	10.32	1.91	0.69	0.00	0.00	0.00	0.00	0.00
1937	26.49	4.16	0.00	6.35	3.24	7.93	4.48	0.12	0.21	0.00	0.00	0.00	0.00
1938	26.98	0.00	0.00	4.92	0.87	9.49	11.17	0.19	0.09	0.00	0.00	0.00	0.25
1939	15.68	0.00	0.00	6.99	2.95	1.33	2.29	0.53	0.00	0.00	0.00	0.00	1.59
1940	13.29	0.00	0.31	1.22	3.57	5.24	0.73	2.22	0.00	0.00	0.00	0.00	0.00

Monthly Rainfall Total

Station	Statio No	County	Lat	Long.	Elev.	Source	Ob Tir	Yrs Rec	Slope	Interce
Santa Paula	U03 7957 00	Ventur	34.317	-119.133	237	CD		111		

Return Period for Rainfall For Indicated Monthly Total Rain

	Sum	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1941	38.11	1.80	0.15	7.31	5.97	10.52	8.70	3.66	0.00	0.00	0.00	0.00	0.00
1942	14.27	1.01	0.44	6.50	0.47	0.54	1.91	3.32	0.00	0.00	0.00	0.08	0.00
1943	28.98	1.07	0.19	1.00	16.53	2.96	6.42	0.81	0.00	0.00	0.00	0.00	0.00
1944	24.37	0.14	0.20	7.90	1.44	10.02	3.49	1.18	0.00	0.00	0.00	0.00	0.00
1945	16.04	0.00	3.25	0.90	0.23	6.65	5.01	0.00	0.00	0.00	0.00	0.00	0.00
1946	13.16	0.96	0.26	6.23	0.25	1.40	3.65	0.24	0.00	0.00	0.00	0.00	0.17
1947	13.00	0.23	8.32	4.08	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.34	0.00
1948	8.36	0.10	0.02	1.27	0.00	1.24	3.81	1.80	0.06	0.06	0.00	0.00	0.00
1949	9.60	0.01	0.00	3.36	2.20	1.27	1.46	0.02	1.23	0.05	0.00	0.00	
1950	13.74	0.00	1.27	4.31	3.06	2.61	1.03	0.98	0.02	0.15	0.06	0.00	0.25
1951	8.23	0.51	0.97	0.21	2.68	1.25	0.69	1.89	0.01	0.00	0.00	0.02	0.00
1952	32.54	0.85	2.56	4.95	12.07	0.12	10.29	1.70	0.00	0.00	0.00	0.00	0.00
1953	11.40	0.00	3.41	4.47	1.38	0.00	0.67	1.47	0.00	0.00	0.00	0.00	0.00
1954	14.68	0.00	2.09	0.08	4.97	3.41	3.64	0.47	0.02	0.00	0.00	0.00	0.00
1955	13.41	0.00	0.96	1.10	5.29	1.60	0.36	2.20	1.86	0.00	0.00	0.04	0.00
1956	15.88	0.00	1.37	3.31	7.03	0.75	0.00	2.36	1.06	0.00	0.00	0.00	0.00
1957	11.48	0.00	0.00	0.28	5.34	1.97	1.95	1.21	0.58	0.15	0.00	0.00	0.00
1958	31.05	2.02	0.50	4.39	2.72	7.27	8.41	5.48	0.00	0.00	0.00	0.00	0.26
1959	6.13	0.05	0.07	0.00	2.07	3.91	0.00	0.00	0.00	0.00	0.00	0.00	0.03
1960	11.42	0.08	0.00	1.39	3.95	2.80	0.50	2.70	0.00	0.00	0.00	0.00	0.00
1961	7.23	0.00	4.71	0.58	1.31	0.00	0.53	0.00	0.00	0.00	0.00	0.04	0.06
1962	27.29	0.00	3.80	1.25	2.71	18.10	1.35	0.00	0.08	0.00	0.00	0.00	0.00
1963	15.30	0.38	0.00	0.03	0.70	5.44	2.99	2.91	0.13	0.52	0.00	0.15	2.05
1964	9.93	0.48	3.65	0.10	2.75	0.00	2.00	0.81	0.00	0.11	0.00	0.03	0.00
1965	14.46	0.64	1.41	5.10	0.57	0.12	1.14	5.22	0.00	0.00	0.00	0.08	0.18
1966	19.31	0.00	10.37	5.68	1.73	1.43	0.00	0.00	0.00	0.00	0.00	0.00	0.10
1967	23.21	0.15	3.72	6.68	4.30	0.00	2.91	5.22	0.11	0.00	0.00	0.00	0.12
1968	14.93	0.00	6.95	1.09	0.99	1.26	3.49	1.05	0.00	0.00	0.00	0.10	0.00
1969	31.20	0.62	0.69	1.61	18.63	7.67	0.89	0.99	0.00	0.00	0.10	0.00	0.00
1970	14.06	0.00	1.83	0.05	2.41	3.65	6.12	0.00	0.00	0.00	0.00	0.00	0.00
1971	18.54	0.02	7.09	7.76	1.03	0.77	0.78	0.63	0.46	0.00	0.00	0.00	0.00
1972	9.22	0.08	0.43	8.20	0.15	0.23	0.00	0.08	0.03	0.02	0.00	0.00	0.00
1973	24.07	0.29	4.82	0.95	6.11	9.07	2.82	0.00	0.01	0.00	0.00	0.00	0.00
1974	16.12	0.17	2.10	1.11	9.61	0.07	2.97	0.07	0.00	0.00	0.02	0.00	0.00
1975	18.17	0.96	0.11	6.78	0.00	3.86	4.84	1.55	0.00	0.00	0.00	0.00	0.07
1976	12.34	0.22	0.00	0.12	0.00	5.21	1.85	*0.70*	0.00	0.11	0.02	0.05	4.06
1977	13.24	0.00	0.29	0.62	6.90	0.12	2.12	0.00	2.08	0.00	0.00	1.11	0.00
1978	37.24	0.03	0.17	4.62	8.39	8.93	11.79	2.42	0.00	0.00	0.00	0.00	0.89
1979	23.77	0.23	3.50	2.45	6.51	4.11	6.90	0.00	0.00	0.00	0.00	0.00	0.07
1980	29.24	0.46	0.86	1.78	8.57	13.04	3.87	0.40	0.26	0.00	0.00	0.00	0.00
1981	*11.88*	0.00	0.00	1.32	3.03	1.61	6.22	0.76					
1982	*14.64*											0.00	1.00
1983	34.90	0.51	5.10	2.74	9.97	4.99	5.80	3.45	0.17	0.00	0.00	1.11	1.06
1984	12.42	3.60	3.35	4.02	0.01	0.00	0.39	0.07	0.00	0.00	0.00	0.07	0.91
1985	11.69	0.38	2.92	4.19	1.35	1.40	1.45	0.00	0.00	0.00	0.00	0.00	0.00
1986	25.62	0.53	4.06	0.62	4.04	9.21	4.98	1.27	0.00	0.00	0.02	0.00	0.89
1987	7.58	0.00	1.42	0.40	2.02	1.33	2.26	0.02	0.00	0.05	0.05	0.00	0.03
1988	13.14	1.18	0.84	3.71	2.62	1.47	0.61	2.63	0.00	0.08	0.00	0.00	0.00
1989	8.56	0.00	1.04	3.30	0.48	2.94	0.66	0.00	0.08	0.00	0.00	0.00	0.06
1990	6.12	0.32	0.48	0.00	2.15	2.42	0.00	0.00	0.75	0.00	0.00	0.00	0.00
1991	12.52	0.00	0.60	0.00	1.08	2.87	7.92	0.02	0.00	0.00	0.00	0.00	0.03
1992	22.45	0.27	0.20	3.66	*2.12*	10.03	5.98	0.02	0.00	0.00	0.17	0.00	0.00
1993	29.01	1.43	0.00	4.53	9.76	8.92	3.59	0.00	0.12	0.64	0.02	0.00	0.00
1994	13.14	0.32	0.93	1.55	0.39	6.47	2.40	0.47	0.37	0.00	0.00	0.00	0.24
1995	34.01	0.90	1.32	1.14	18.26	1.36	9.44	0.45	0.88	0.26	0.00	0.00	0.00
1996	14.15	0.00	0.12	2.29	2.33	6.31	2.22	0.59	0.29	0.00	0.00	0.00	0.00
1997	15.74	1.65	2.61	5.94	5.28	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.06
1998	42.24	0.00	2.39	6.84	3.88	**20.89**	3.19	1.59	3.46	0.00	0.00	0.00	0.00
1999	10.78	0.00	1.37	0.61	2.47	0.30	3.23	2.32	0.00	0.36	0.00	0.00	0.12
2000	16.17	0.00	0.13	0.00	1.95	8.57	2.02	3.50	0.00	0.00	0.00	0.00	0.00
2001	23.37	1.80	0.00	0.00	6.12	7.83	6.15	1.47	0.00	0.00	0.00	0.00	0.00
2002	10.86	0.30	3.30	1.29	1.20	4.00	0.59	0.00	0.13	0.00	0.00	0.00	0.05
2003	21.32	0.00	5.03	4.07	0.00	5.43	3.97	1.09	1.73	0.00	0.00	0.00	0.00
2004	10.19	0.00	0.52	1.37	0.75	6.73	0.82	0.00	0.00	0.00	0.00	0.00	0.00
2005	37.50	3.73	0.03	7.04	12.85	8.65	4.27	0.00	0.93	0.00	0.00	0.00	0.00
2006	16.38	1.39	0.55	2.08	1.94	0.94	3.76	4.16	1.56	0.00	0.00	0.00	0.00
2007	8.50	0.22	0.00	0.96	4.54	1.56	0.00	0.90	0.00	0.00	0.00	0.00	0.32
2008													

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Summary of Monthly Normals 1981-2010

Generated on 12/08/2016

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Elev: 237 ft. Lat: 34.312° N Lon: 119.133° W

Station: **SANTA PAULA, CA US GHCND:USC00047957**

Temperature (°F)																					
Mean							Cooling Degree Days Base (above)						Heating Degree Days Base (below)				Mean Number of Days					
Month	Daily Max	Daily Min	Mean	Long Term Max Std. Dev.	Long Term Min Std. Dev.	Long Term Avg Std. Dev.	55	57	60	65	70	72	55	57	60	65	Max >= 100	Max >= 90	Max >= 50	Max <= 32	Min <= 32	Min <= 0
1	69.3	41.1	55.2	3.4	2.6	2.4	71	46	23	5	1	-7777	65	102	171	309	0.0	0.1	31.0	0.0	1.7	0.0
2	69.2	42.5	55.9	2.6	2.5	2.0	71	46	23	6	1	-7777	47	78	139	262	0.0	0.2	28.0	0.0	0.8	0.0
3	71.0	43.9	57.5	2.9	2.8	2.4	104	66	28	5	1	1	28	52	107	239	0.0	0.5	31.0	0.0	0.3	0.0
4	74.0	45.9	60.0	2.6	2.2	2.0	157	109	55	13	3	2	9	20	57	165	0.1	0.7	30.0	0.0	0.0	0.0
5	75.1	50.0	62.5	2.8	2.5	2.2	234	175	97	22	3	1	-7777	3	18	98	-7777	0.5	31.0	0.0	0.0	0.0
6	77.2	53.1	65.1	2.4	1.9	1.7	305	245	158	44	5	2	0	-7777	3	40	0.0	0.5	30.0	0.0	0.0	0.0
7	80.7	56.9	68.8	2.4	1.7	1.6	428	366	273	124	27	11	0	0	-7777	6	0.1	1.0	31.0	0.0	0.0	0.0
8	82.7	56.1	69.4	2.8	2.5	2.3	446	384	291	141	40	20	0	-7777	-7777	5	-7777	2.8	31.0	0.0	0.0	0.0
9	81.6	54.7	68.1	3.1	2.3	2.4	394	334	245	109	33	19	0	-7777	-7777	15	0.1	3.1	30.0	0.0	0.0	0.0
10	78.5	50.2	64.4	2.9	2.2	1.9	290	229	143	44	10	6	-7777	1	8	65	0.2	2.4	31.0	0.0	0.0	0.0
11	73.8	44.4	59.1	3.2	2.0	2.3	142	99	51	13	3	1	19	36	78	190	0.0	0.7	30.0	0.0	0.2	0.0
12	69.2	41.1	55.2	2.9	1.9	1.8	68	43	20	4	-7777	-7777	63	100	171	309	0.0	0.0	30.9	0.0	1.8	0.0
Summary	75.2	48.3	61.8	2.8	2.3	2.1	2710	2142	1407	530	127	63	231	392	752	1703	0.5	12.5	364.9	0	4.8	0

@ Denotes mean number of days greater than 0 but less than 0.05.
-7777: a non-zero value that would round to zero
Empty or blank cells indicate data is missing or insufficient occurrences to compute value.

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Elev: 237 ft. Lat: 34.312° N Lon: 119.133° W

Station: **SANTA PAULA, CA US GHCND:USC00047957**

Summary of Monthly Normals 1981-2010

Generated on 12/08/2016

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Precipitation (in.)								
	Totals	Mean Number of Days				Precipitation Probabilities Probability that precipitation will be equal to or less than the indicated amount		
	Means	Daily Precipitation				Monthly Precipitation vs. Probability Levels		
Month	Mean	>= 0.01	>= 0.10	>= 0.50	>= 1.00	.25	.50	.75
1	3.72	5.9	4.8	2.3	1.2	1.11	2.14	5.29
2	4.85	5.7	4.6	2.7	1.7	1.37	4.19	7.10
3	2.69	4.7	3.8	1.8	0.9	0.59	2.13	3.97
4	0.83	1.8	1.3	0.5	0.2	0.00	0.45	1.47
5	0.35	0.8	0.7	0.2	0.1	0.00	0.01	0.29
6	0.07	0.3	0.2	0.1	0.0	0.00	0.00	0.01
7	0.01	0.2	-7777	0.0	0.0	0.00	0.00	0.00
8	0.04	0.2	0.1	-7777	0.0	0.00	0.00	0.00
9	0.16	1.0	0.3	0.2	-7777	0.00	0.00	0.07
10	0.69	1.3	1.0	0.4	0.2	0.00	0.30	0.71
11	1.44	3.0	2.1	0.9	0.4	0.20	1.05	2.40
12	2.53	4.0	3.1	1.4	0.8	0.62	1.92	4.03
Summary	17.38	28.9	22.0	10.5	5.5	3.89	12.19	25.34

@ Denotes mean number of days greater than 0 but less than 0.05.
-7777: a non-zero value that would round to zero
Empty or blank cells indicate data is missing or insufficient occurrences to compute value.

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Summary of Monthly Normals 1981-2010

Generated on 12/08/2016

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Elev: 237 ft. Lat: 34.312° N Lon: 119.133° W

Station: **SANTA PAULA, CA US GHCND:USC00047957**

Snow (in.)													
	Totals	Mean Number of Days									Snow Probabilities Probability that snow will be equal to or less than the indicated amount		
	Means	Snowfall >= Thresholds					Snow Depth >= Thresholds				Monthly Snow vs. Probability Levels Values derived from the incomplete gamma distribution.		
Month	Snowfall Mean	0.1	1.0	3.0	5.0	10.0	1	3	5	10	.25	.50	.75
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	-7777	-7777	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Summary	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

@ Denotes mean number of days greater than 0 but less than 0.05.
-7777: a non-zero value that would round to zero
Empty or blank cells indicate data is missing or insufficient occurrences to compute value.

U.S. Department of Commerce
National Oceanic & Atmospheric Administration
National Environmental Satellite, Data, and Information Service

Summary of Monthly Normals 1981-2010

Generated on 12/08/2016

National Centers for Environmental Information
151 Patton Avenue
Asheville, North Carolina 28801

Elev: 237 ft. Lat: 34.312° N Lon: 119.133° W

Station: **SANTA PAULA, CA US GHCND:USC00047957**

Growing Degree Units (Monthly)												
Base	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
40	471	444	541	598	699	755	893	911	845	754	573	470
45	317	305	386	449	544	605	738	756	694	600	423	316
50	174	173	234	299	389	455	583	601	544	445	275	174
55	71	71	104	157	234	305	428	446	394	290	142	68
60	23	23	28	55	97	158	273	291	245	143	51	20
Growing Degree Units for Corn (Monthly)												
50/86	303	273	330	366	419	464	579	591	535	466	363	303

Growing Degree Units (Accumulated Monthly)												
Base	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
40	471	915	1456	2054	2753	3508	4401	5312	6157	6911	7484	7954
45	317	622	1008	1457	2001	2606	3344	4100	4794	5394	5817	6133
50	174	347	581	880	1269	1724	2307	2908	3452	3897	4172	4346
55	71	142	246	403	637	942	1370	1816	2210	2500	2642	2710
60	23	46	74	129	226	384	657	948	1193	1336	1387	1407
Growing Degree Units for Corn (Monthly)												
50/86	303	576	906	1272	1691	2155	2734	3325	3860	4326	4689	4992

Note: For corn, temperatures below 50 are set to 50, and temperatures above 86 are set to 86
M indicates the value is missing
-7777: a non-zero value that would round to zero
Empty or blank cells indicate data is missing or insufficient occurrences to compute value.

Appendix 3 – Soil & Groundwater Information

Soil Features

This table gives estimates of various soil features. The estimates are used in land use planning that involves engineering considerations.

A *restrictive layer* is a nearly continuous layer that has one or more physical, chemical, or thermal properties that significantly impede the movement of water and air through the soil or that restrict roots or otherwise provide an unfavorable root environment. Examples are bedrock, cemented layers, dense layers, and frozen layers. The table indicates the hardness and thickness of the restrictive layer, both of which significantly affect the ease of excavation. *Depth to top* is the vertical distance from the soil surface to the upper boundary of the restrictive layer.

Subsidence is the settlement of organic soils or of saturated mineral soils of very low density. Subsidence generally results from either desiccation and shrinkage, or oxidation of organic material, or both, following drainage. Subsidence takes place gradually, usually over a period of several years. The table shows the expected initial subsidence, which usually is a result of drainage, and total subsidence, which results from a combination of factors.

Potential for frost action is the likelihood of upward or lateral expansion of the soil caused by the formation of segregated ice lenses (frost heave) and the subsequent collapse of the soil and loss of strength on thawing. Frost action occurs when moisture moves into the freezing zone of the soil. Temperature, texture, density, saturated hydraulic conductivity (Ksat), content of organic matter, and depth to the water table are the most important factors considered in evaluating the potential for frost action. It is assumed that the soil is not insulated by vegetation or snow and is not artificially drained. Silty and highly structured, clayey soils that have a high water table in winter are the most susceptible to frost action. Well drained, very gravelly, or very sandy soils are the least susceptible. Frost heave and low soil strength during thawing cause damage to pavements and other rigid structures.

Risk of corrosion pertains to potential soil-induced electrochemical or chemical action that corrodes or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to such factors as soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design may be needed if the combination of factors results in a severe hazard of corrosion. The steel or concrete in installations that intersect soil boundaries or soil layers is more susceptible to corrosion than the steel or concrete in installations that are entirely within one kind of soil or within one soil layer.

For uncoated steel, the risk of corrosion, expressed as *low*, *moderate*, or *high*, is based on soil drainage class, total acidity, electrical resistivity near field capacity, and electrical conductivity of the saturation extract.

For concrete, the risk of corrosion also is expressed as *low*, *moderate*, or *high*. It is based on soil texture, acidity, and amount of sulfates in the saturation extract.

Report—Soil Features

Soil Features–Ventura Area, California									
Map symbol and soil name	Restrictive Layer				Subsidence		Potential for frost action	Risk of corrosion	
	Kind	Depth to top	Thickness	Hardness	Initial	Total		Uncoated steel	Concrete
		In	*In*		*In*	*In*			
MoA—Mocho loam, 0 to 2 percent slopes									
Mocho		—	—		—	—		High	Low
MsA—Mocho clay loam, 0 to 2 percent slopes									
Mocho		—	—		—	—		High	Low
MsB—Mocho clay loam, 2 to 5 percent slopes									
Mocho		—	—		—	—		High	Low
PcA—Pico sandy loam, 0 to 2 percent slopes									
Pico		—	—		—	—		High	Low

Data Source Information

Soil Survey Area: Ventura Area, California
Survey Area Data: Version 6, Jan 3, 2008

Hydrologic Soil Group—Ventura Area, California

Map Scale: 1:6,090 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

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

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

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: Ventura Area, California
Survey Area Data: Version 6, Jan 3, 2008

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

Date(s) aerial images were photographed: May 5, 2010—Aug 31, 2010

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.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Ventura Area, California (CA674)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
MoA	Mocho loam, 0 to 2 percent slopes	B	88.3	65.0%
MsA	Mocho clay loam, 0 to 2 percent slopes	B	43.1	31.7%
MsB	Mocho clay loam, 2 to 5 percent slopes	B	2.6	1.9%
PcA	Pico sandy loam, 0 to 2 percent slopes	B	1.9	1.4%
Totals for Area of Interest			**135.9**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

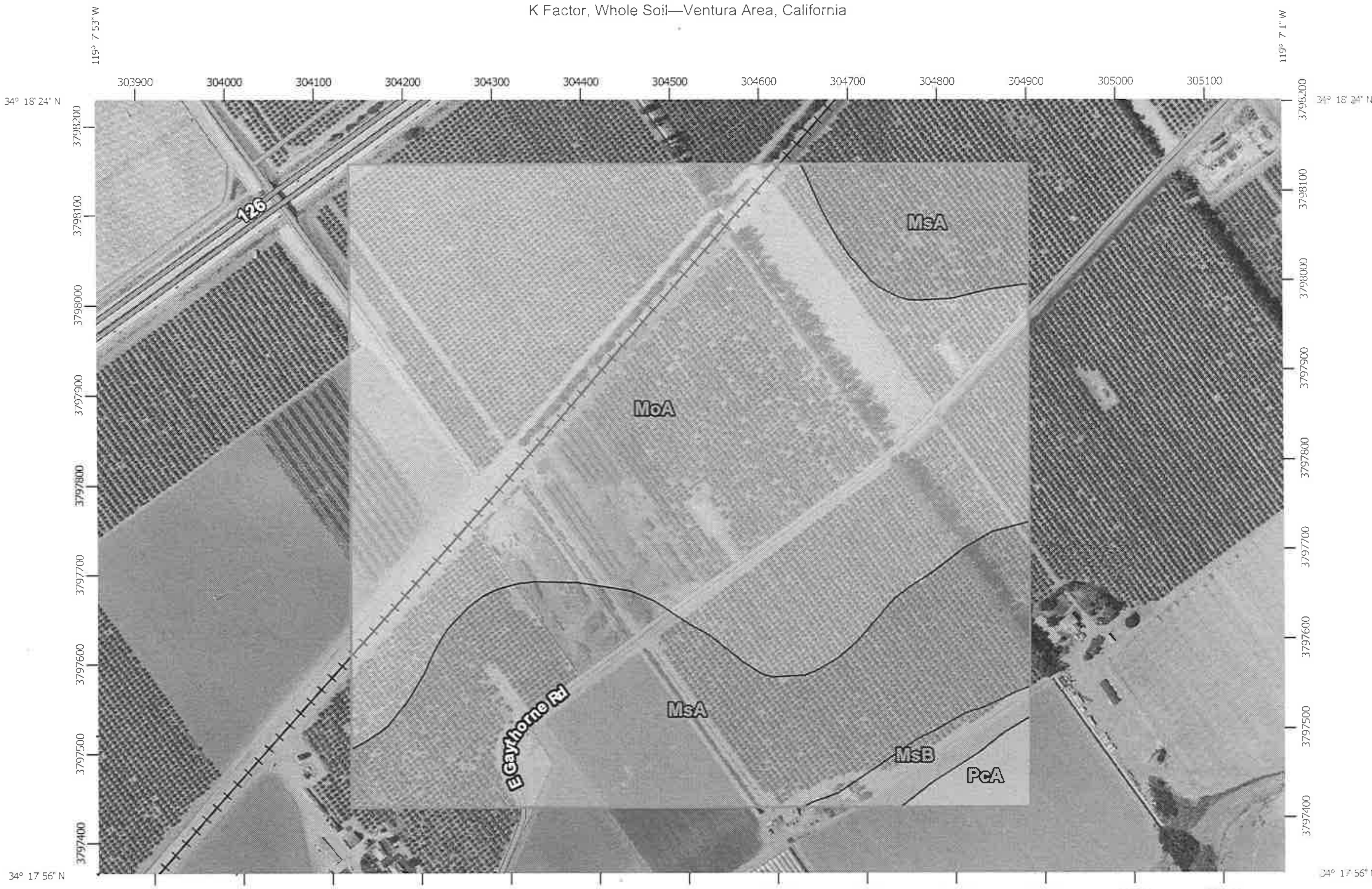
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

K Factor, Whole Soil—Ventura Area, California



Map Scale: 1:6,090 if printed on A landscape (11" x 8.5") sheet.

N

0 50 100 200 300 Meters

0 250 500 1000 1500 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Soil Rating Lines

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

Soil Rating Points

.02
.05
.10
.15
.17
.20
.24
.28
.32
.37
.43
.49
.55
.64
Not rated or not available

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: Ventura Area, California
Survey Area Data: Version 6, Jan 3, 2008

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

Date(s) aerial images were photographed: May 5, 2010—Aug 31, 2010

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.

K Factor, Whole Soil

K Factor, Whole Soil— Summary by Map Unit — Ventura Area, California (CA674)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
MoA	Mocho loam, 0 to 2 percent slopes	.20	88.3	65.0%
MsA	Mocho clay loam, 0 to 2 percent slopes	.15	43.1	31.7%
MsB	Mocho clay loam, 2 to 5 percent slopes	.15	2.6	1.9%
PcA	Pico sandy loam, 0 to 2 percent slopes	.17	1.9	1.4%
Totals for Area of Interest			**135.9**	**100.0%**

Description

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Rating Options

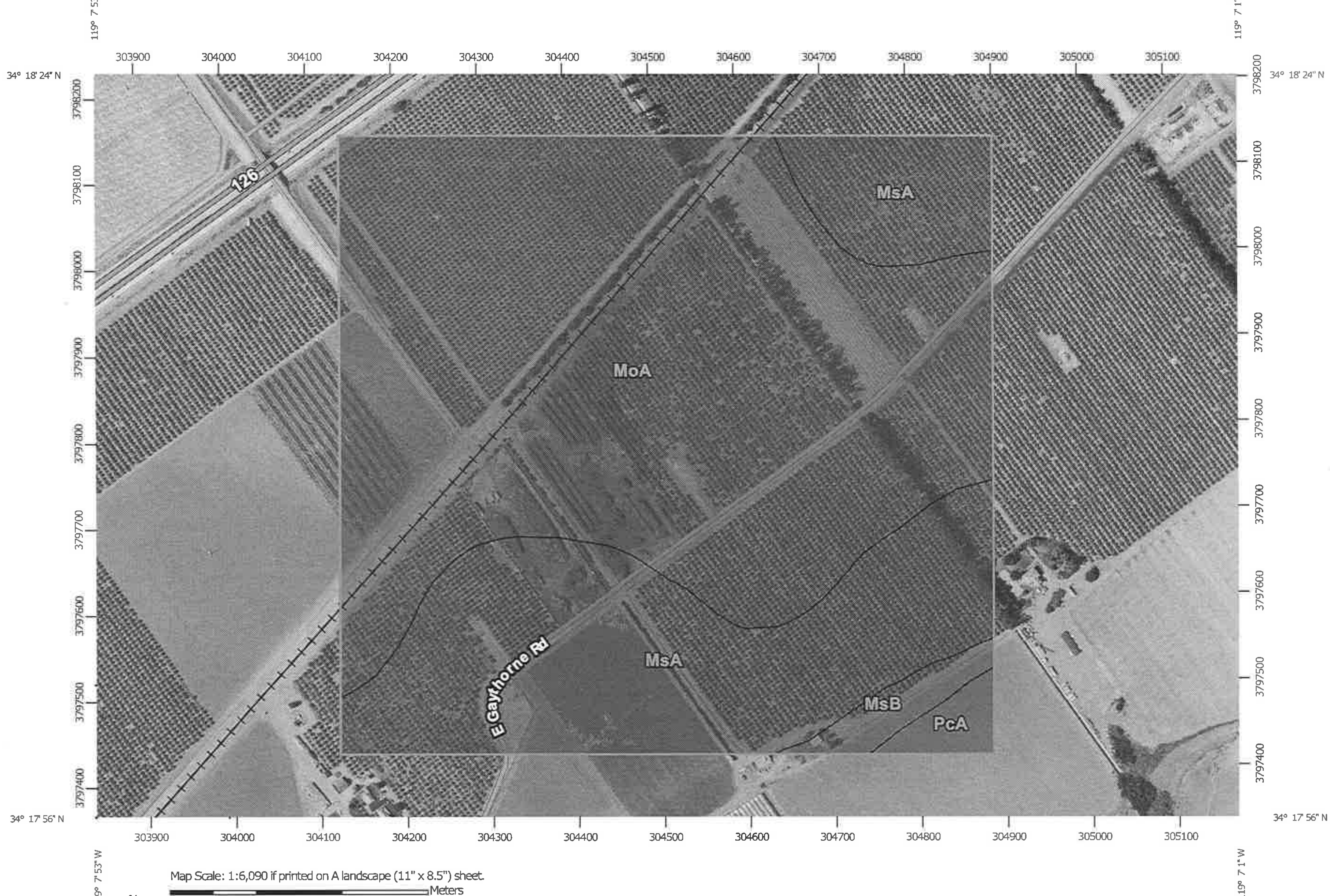
Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

Layer Options (Horizon Aggregation Method): Surface Layer (Not applicable)

Septic Tank Absorption Fields (CA)—Ventura Area, California



Map Scale: 1:6,090 if printed on A landscape (11" x 8.5") sheet.

N

0 50 100 200 300 Meters

0 250 500 1000 1500 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 11N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- Limitations
- No limitations
- Not rated or not available

Soil Rating Lines

- Limitations
- No limitations
- Not rated or not available

Soil Rating Points

- Limitations
- No limitations
- Not rated or not available

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: Ventura Area, California
Survey Area Data: Version 6, Jan 3, 2008

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

Date(s) aerial images were photographed: May 5, 2010—Aug 31, 2010

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.

Septic Tank Absorption Fields (CA)

Septic Tank Absorption Fields (CA)— Summary by Map Unit — Ventura Area, California (CA674)						
Map unit symbol	**Map unit name**	**Rating**	**Component name (percent)**	**Rating reasons (numeric values)**	**Acres in AOI**	**Percent of AOI**
MoA	Mocho loam, 0 to 2 percent slopes	Limitations	Mocho (85%)	Permeability ranges .6 - 2"/hr (slow perc) (0.50)	88.3	65.0%
MsA	Mocho clay loam, 0 to 2 percent slopes	Limitations	Mocho (85%)	Permeability < . 6"/hr in 24-60" (slow perc) (1.00)	43.1	31.7%
MsB	Mocho clay loam, 2 to 5 percent slopes	Limitations	Mocho (85%)	Permeability < . 6"/hr in 24-60" (slow perc) (1.00)	2.6	1.9%
PcA	Pico sandy loam, 0 to 2 percent slopes	Limitations	Pico (85%)	Seepage in bottom layer (1.00)	1.9	1.4%
Totals for Area of Interest					**135.9**	**100.0%**

Septic Tank Absorption Fields (CA)— Summary by Rating Value		
Rating	**Acres in AOI**	**Percent of AOI**
Limitations	135.9	100.0%
Totals for Area of Interest	**135.9**	**100.0%**

Description

Septic tank absorption fields are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between the depths of 24 and 60 inches is evaluated. This interpretation shows the degree and kind of soil limitations that affect septic tanks.

The ratings for septic tanks are based on the soil properties that affect absorption of the effluent, construction and maintenance of the system, and public health. Saturated hydraulic conductivity (Ksat), depth to a water table, ponding, depth to bedrock or cemented pan, and flooding affect absorption of the effluent. Stones and boulders, ice, and bedrock or a cemented pan interfere with installation. Subsidence interferes with installation and maintenance. Excessive slope may cause lateral seepage and surfacing of the effluent in down slope areas. Some soils are underlain by loose sand and gravel or fractured bedrock at a depth of less than 4 feet below the distribution lines. In these soils the absorption field may not adequately filter the effluent, particularly when the system is new. As a result, the ground water may become contaminated.

The ratings are both verbal and numerical. Rating class terms indicate the extent to which the soils are limited by all of the soil features that affect these uses. "No limitations" indicates that the soil has features that are very favorable for the specified use. Good performance and very low maintenance costs can be expected. "Limitations" indicates that the soil has features that are favorable to unfavorable for the specified use. The most limiting limitations are displayed for each soil. The limitations listed can be overcome or minimized by special planning, design, or installation. Fair to poor performance and moderate to high maintenance costs can be expected, depending on the number of limitations and the severity of each limitation.

Numerical ratings indicate the severity of individual limitations. The ratings are shown as decimal fractions ranging from 0.01 to 1.0. They indicate gradations between the point at which a soil feature has the greatest negative impact on the use (1.0) and the point at which a soil feature is not a limitation (0.0).

The components listed for each map unit in the accompanying Summary by Map Unit table in Web Soil Survey or the Aggregation Report in Soil Data Viewer are determined by the aggregation method chosen. An aggregated rating class is shown for each map unit. The components listed for each map unit are only those that have the same rating class as the one shown for the map unit. The percent composition of each component in a particular map unit is given to help the user better understand the extent to which the rating applies to the map unit.

Other components with different ratings may occur in each map unit. The ratings for all components, regardless the aggregated rating of the map unit, can be viewed by generating the equivalent report from the Soil Reports tab in Web Soil Survey or from the Soil Data Mart site. Onsite investigation may be needed to validate these interpretations and to confirm the identity of the soil on a given site.

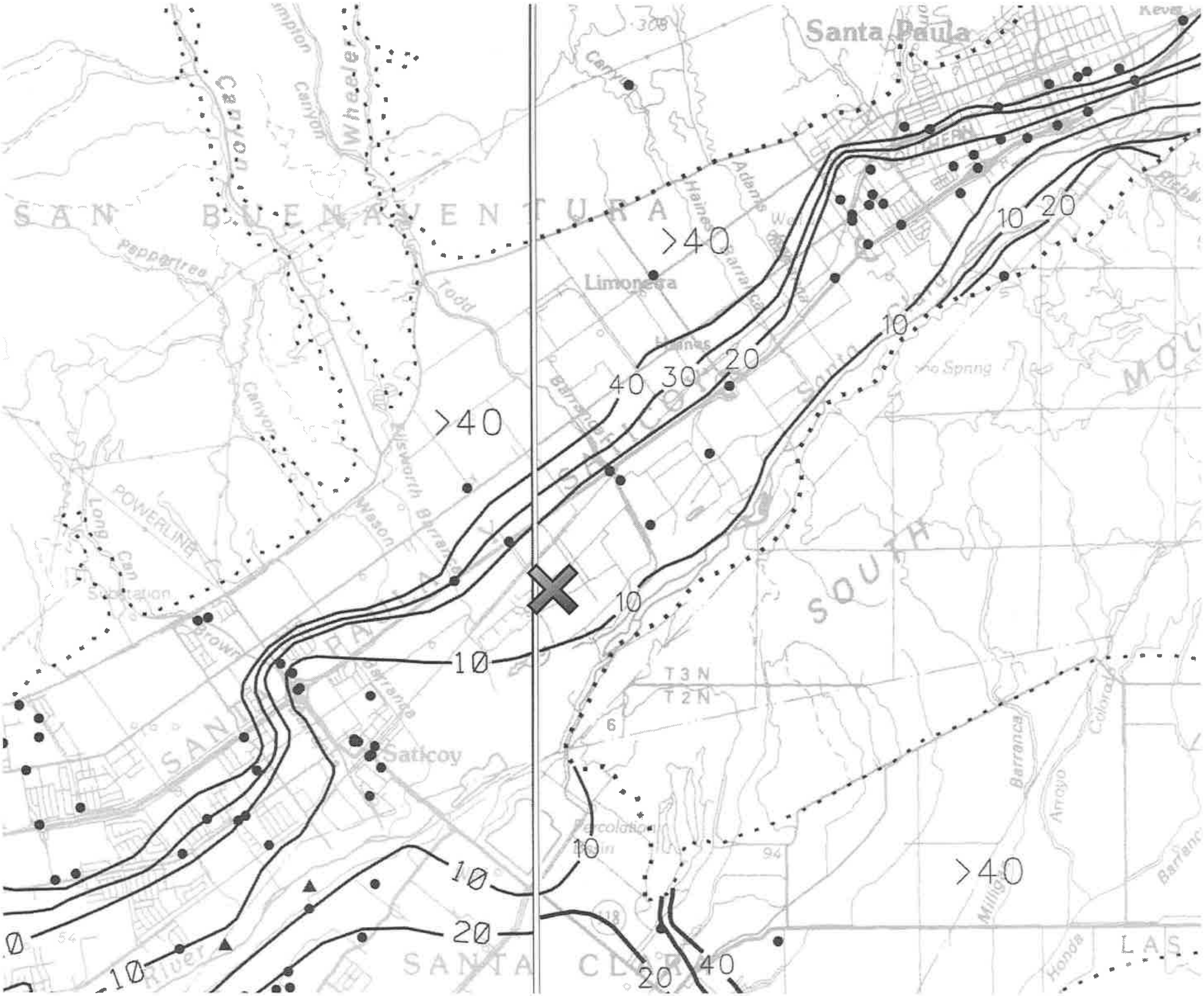
The California version of this interpretation differs from the national version in that the limiting features were edited in order to convey more information to the user. The rating classes were edited to read "no limitations" and "limitations".

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher


Santa Paula
Limoneira
Saticoy
SAN BUENAVENTURA
SOUTH MOU
SANTA CLARA
>40
>40
>40
40
30
20
10
10
20
10
10
10
10
10
20
20
40
T 3 N
T 2 N

Appendix 4 – Watershed Characteristics

Biogenic Energy Park

SCS Curve Number by Land Use

Land Use	Description	Effective Impervious Cover	SCS Curve Number Soil Type A			B		C	D
			7	6	5	$\boxed{4}$	$\boxed{3}$	2	1
OS	Open Space (fair condition)	0	42	61	65	71	77	81	84
OS	Open Space (good condition)	0	29	52	57	64	71	76	80
OR	Orchard (fair condition)	5	45	63	67	72	78	82	85
CB	Covered Berries	80	87	91	91	93	94	95	95
BP	Berries with Plastic Beds	65	78	85	86	89	91	92	93
WR	Windrows	65	78	85	86	89	91	92	93
PS	Pavement/Equipment/Structures	90	92	94	95	95	96	96	97
1A	100% OR	5	45	63	67	72	78	82	85
3B	75% OR & 25% CB	24	55	70	73	77	82	85	87
7A	55% OR & 45% BP	32	60	73	76	80	84	86	88
9C	75% PS & 25% WR	84	89	89	92	93	94	95	95
11C	90% pond & 10% PS	95	94	96	97	97	98	98	98
13D	40% WR & 60%PS	80	87	87	91	91	93	94	95
15D	90% pond & 10% PS	95	94	96	97	97	98	98	98
17E	55% OR & 45% BP	32	60	73	76	80	84	86	88

1. calculated by using open space (fair condition) for pervious area and a curve number of 98 for impervious area

sub-basin	land use	soil group	composite curve number	watershed length (ft)	upper elevation (ft)	lower elevation (ft)	hydraulic length (ft)	average land slope (%)	S	Ia	lag (hr)	T_c (hr)	lag (min)
1A		C	78	10,350.0			8,280.0	3.60	2.8	0.6	0.97	1.6	57.96
3B		B	77	4,930.0			3,944.0	0.40	3.0	0.6	1.65	2.7	98.99
7A		B	80	4,580.0			3,664.0	0.40	2.5	0.5	1.42	2.4	85.19
9C		C	94	1,630.0			1,304.0	1.00	0.6	0.1	0.23	0.4	13.86
11C		C	98	425.0			340.0	0.20	0.2	0.0	0.14	0.2	8.52
13D		B	91	2,050.0			1,640.0	1.00	1.0	0.2	0.32	0.5	19.07
15D		C	98	515.0			412.0	0.20	0.2	0.0	0.17	0.3	9.94
17E		B	80	2,450			1,960	0.40	2.5	0.5	0.9	1.4	51.64

EXHIBIT 14A. AMC II NRCS CURVE NUMBERS FOR UNDEVELOPED LAND

UNDEVELOPED LAND USE AND CONDITION		% Impervious		HYDROLOGIC SOIL GROUP AND VCWPD NUMBERS						
Poor: Less than 50% Cover Fair: From 50% to 75% Cover Good: More Than 75% Cover				A (1), (2)		B		C		D (3)
		Effective	Average	7	6	5	4	3	2	1
Grassland (Annual Grass)	Poor	0	0	46	57	60	63	68	72	76
"	Fair	0	0	21	42	47	53	60	66	70
"	Good	0	0	-	-	41	47	54	59	64
Open Brush (Sagebrush, Flattop Buckwheat)	Poor	0	0	31	51	55	60	66	70	75
"	Fair	0	0	22	40	44	49	54	58	61
"	Good	0	0	-	-	33	39	46	51	56
Big Brush (Scrub Oak, Manzanita, Ceanothis)	Fair	0	0	23	39	42	46	51	54	59
"	Good	0	0	-	-	29	34	41	46	51
Chamise (Narrow Leaf Chaparral)	Fair	0	0	21	43	48	55	63	68	75
"	Good	0	0	-	-	44	49	55	60	64
Oak Savannah (Sparse Oaks & Annual Grass)	Poor	0	0	34	53	57	62	67	71	-
"	Fair	0	0	22	41	45	51	57	61	-
Orchard	Poor	0	0	42	56	59	62	65	67	71
Woodland	Fair	0	0	-	-	35	39	43	47	-
Pinon & Juniper	Fair	0	0	-	-	43	48	54	58	62
Forest	Fair	0	0	22	41	45	50	56	60	64
Pasture or Range	Poor	0	0	61	76	78	81	84	87	89
"	Fair	0	0	40	61	65	71	77	81	84
"	Good	0	0	29	52	57	64	71	76	80
	NOTE: WPD MODIFIED RATIONAL METHOD USES SOIL TYPES 1-7 AND EFFECTIVE IMPERVIOUS PERCENTAGE IN VCRat MODEL									
Note (1)	Curve numbers for soil types 6 and 7 not all available									
Note (2)	For CNs<30, ensure that P-0.2*S > 0									
Note (3)	Curve numbers for soil type 1 not all available									
Reference:	Boyle, 1967. Revised Hydrologic Analysis, Zone II except Pasture from NRCS TR-55 Table 2-2c. For other land use types see TR-55									

Exhibit 14b. AMC II NRCS Curve Numbers for Developed Land

DEVELOPED LAND USE	Condition (1)	% IMPERVIOUS EFFEC-TIVE	% IMPERVIOUS AVER-AGE	HYDROLOGIC SOIL GROUP (5) A 7	A 6	B 5	B 4	C 3	C 2	D 1
Open Spaces, Lawns, Parks, Golf Courses, Cemeteries, etc.	Good	0	0	29	52	57	64	71	76	80
"	Fair	0	0	42	61	65	71	77	81	84
Residential 1 ac. Lot	-	10	20	45	62	66	71	76	80	84
Residential 1/2 ac. Lot	-	13	25	45	65	68	73	78	81	85
Residential 1/3 ac. Lot	-	15	30	48	67	70	75	79	82	86
Residential 1/4 ac. Lot	-	19	38	53	70	73	77	81	84	87
Residential 1/5 ac. Lot	-	23	47	59	74	77	80	84	86	89
Residential 1/6 ac. Lot	-	28	56	66	79	81	84	86	88	90
Residential 1/8 ac. Lot	-	32	65	72	83	84	87	89	90	92
Residential - Condos	-	37	69	74	84	86	88	90	92	93
Industrial Unpaved Yards, etc.	-	36	72	77	86	87	89	91	92	93
Commercial & Business	-	50	85	88	90	91	93	93	95	95
Industrial Parks, Paved Parking, etc.	-	70	93	93	94	95	96	96	97	97
Parking Lots, Roofs, Driveways, Paved Streets with Curbs & Drains	-	90	100	98	98	98	98	98	98	98
Public Facilities & Institutions; Includes Schools, Government CenterS, Military Bases, etc. (2)	-	23	47	59	74	77	80	84	86	89
Transportation and utilities (3)	-	70	93	79	87	88	90	91	92	93
Newly graded/under construction - No veg.	-	0	0	71	83	85	88	90	92	94
Paved Streets with open ditches including right-of-way (3)	-	70	93	79	87	88	90	91	92	93
Gravel streets including right-of-way	-	0	0	71	82	84	86	88	90	91
Dirt street including right-of-way	-	0	0	66	79	81	83	86	88	89
Natural desert landscaping- native vegetation	-	0	0	55	72	75	79	83	86	88
Farmsteads- buildings, lanes, driveways, and surrounding lots (2)	-	23	47	51	69	72	76	80	83	86
Agriculture- Straight Row + Crop Residue Cover on >5% of surface	Good	0	0	57	72	74	77	80	83	85
Agriculture- Straight Row + Crop Residue Cover on <5% of surface	Poor	0	0	64	78	80	83	86	88	90

DEVELOPED LAND USE		% IMPERVIOUS		HYDROLOGIC SOIL GROUP (5)						
	Condition (1)	EFFEC-TIVE	AVER-AGE	A		B		C		D
				7	6	5	4	3	2	1
Agriculture- Straight Row Good	Good	0	0	60	75	77	80	84	86	89
Agriculture- Straight Row Poor	Good	0	0	65	79	81	84	87	89	91
Strawberries, 36" beds on 48" centers, beds covered with plastic (4)	-	72	72	90	94	94	95	96	96	97
Fallow - Bare Soil or Newly Graded Lands	-	0	0	71	83	85	88	90	92	94
Fallow - with crop residue cover on >5% of surface	Good	0	0	68	80	82	84	87	88	90
Orchard or Tree Farm, 50/50 woods-grass	Poor	0	0	39	60	64	69	75	79	83
Orchard or Tree Farm, 50/50 woods-grass	Fair	0	0	26	48	53	59	67	72	77
Orchard or Tree Farm, 50/50 woods-grass	Good	0	0	21	42	47	54	61	66	72

NOTE: WPD MODIFIED RATIONAL METHOD USES SOIL TYPES 1-7 AND EFFECTIVE IMPERVIOUS PERCENTAGE IN VCRat MODEL

Note (1)	Poor is < 50% cover; Fair is from 50 to 75% cover; Good is >75% cover; also consider density of canopy and vegetative cover and degree of surface roughness
Note (2)	% Impervious and CNs assumed same as residential 1/5 ac lots
Note (3)	Assumed same as industrial parks
Note (4)	Calculated assuming planted on 200'x208' parcel with 8' road along one boundary.
Note (5)	TR-55 Notes: CNs developed using average % imperviousness with CN=98, pervious areas equivalent to open space in good condition. Greater than 30% impervious area considered directly connected.
Reference:	TR-55 Manual Table 2-2. For other land use types, see TR-55 Manual.

Appendix 5 – FEMA FIRM Maps

...d insurance is available in this community, contact your In...
...nal Flood Insurance Program at 1-800-638-6620.

METERS
300 0 300 600

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0770E

FIRM
FLOOD INSURANCE RATE MAP

VENTURA COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 770 OF 1275
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
OXNARD, CITY OF	[illegible]	[illegible]	[illegible]
SAN BUENAVENTURA, CITY OF	[illegible]	[illegible]	[illegible]
VENTURA COUNTY	060413	[illegible]	[illegible]

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

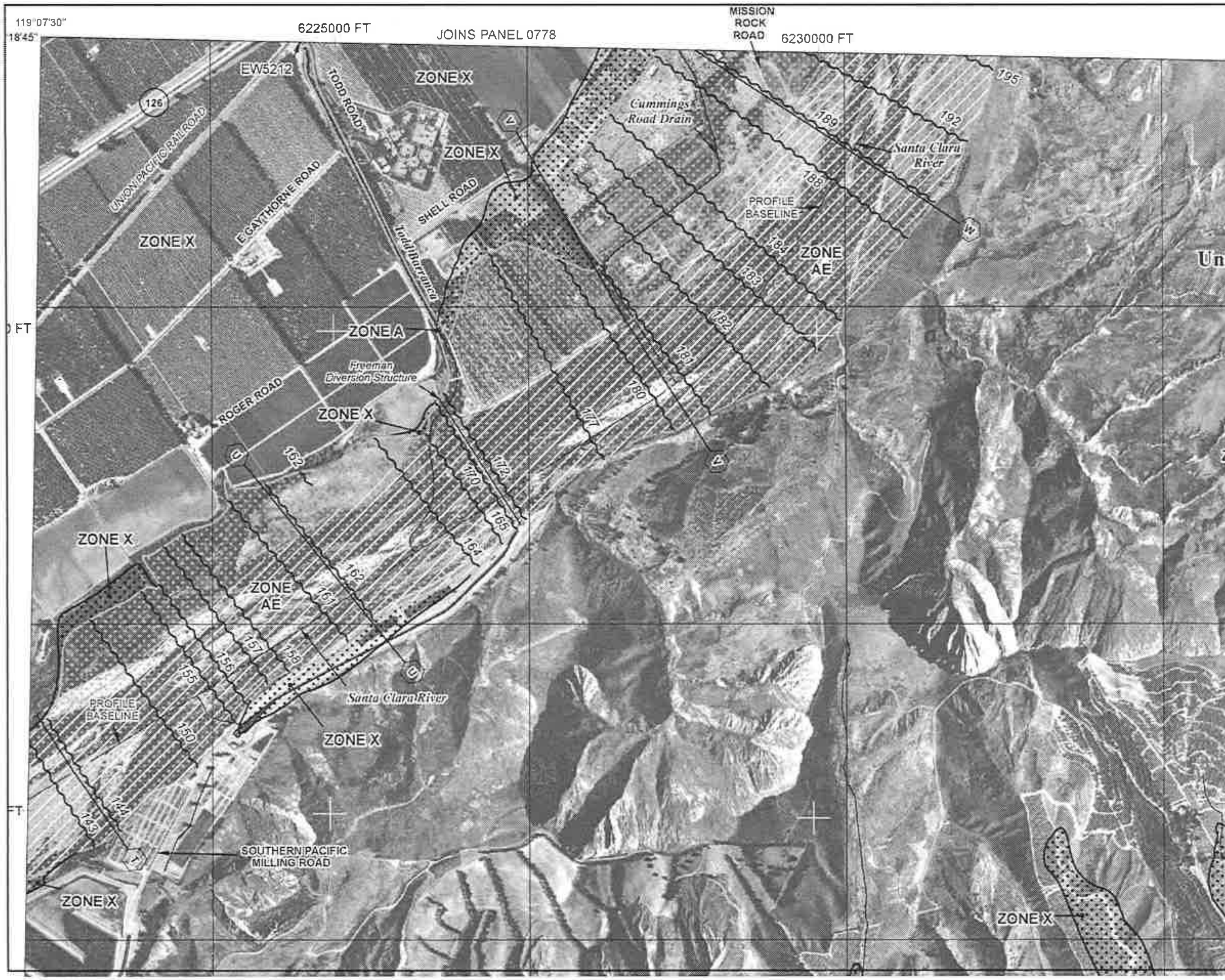
MAP NUMBER
06111C0770E

EFFECTIVE DATE
JANUARY 20, 2010

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

…d insurance is available in this community, contact your In…
…nal Flood Insurance Program at 1-800-638-6620.



METERS
300 0 300 600

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0790E

FIRM
FLOOD INSURANCE RATE MAP

VENTURA COUNTY,
CALIFORNIA
AND INCORPORATED AREAS

PANEL 790 OF 1275
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX

Notice to User: The Map Number shown below should be used when placing map orders; the Community Number shown above should be used on insurance applications for the subject community.

MAP NUMBER
06111C0790E

EFFECTIVE DATE
JANUARY 20, 2010

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Appendix 6 – Hydraulics

Worksheet for trap channel

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.013	
Channel Slope	0.00700	ft/ft
Normal Depth	5.00	ft
Left Side Slope	1.10	ft/ft (H:V)
Right Side Slope	1.10	ft/ft (H:V)
Bottom Width	3.33	ft

Results

Discharge	762.37	ft³/s
Flow Area	44.15	ft²
Wetted Perimeter	18.20	ft
Hydraulic Radius	2.43	ft
Top Width	14.33	ft
Critical Depth	6.51	ft
Critical Slope	0.00219	ft/ft
Velocity	17.27	ft/s
Velocity Head	4.63	ft
Specific Energy	9.63	ft
Froude Number	1.73	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	5.00	ft
Critical Depth	6.51	ft
Channel Slope	0.00700	ft/ft

Worksheet for trap channel

GVF Output Data

Critical Slope	0.00219	ft/ft

Worksheet for 18E - double barrel

Project Description

Friction Method	Manning Formula
Solve For	Discharge

Input Data

Roughness Coefficient	0.012	
Channel Slope	0.00800	ft/ft
Normal Depth	1.90	ft
Diameter	2.50	ft

Results

Discharge	36.79	ft^3/s
Flow Area	4.00	ft^2
Wetted Perimeter	5.29	ft
Hydraulic Radius	0.76	ft
Top Width	2.14	ft
Critical Depth	2.05	ft
Percent Full	76.0	%
Critical Slope	0.00682	ft/ft
Velocity	9.19	ft/s
Velocity Head	1.31	ft
Specific Energy	3.21	ft
Froude Number	1.18	
Maximum Discharge	42.75	ft^3/s
Discharge Full	39.74	ft^3/s
Slope Full	0.00686	ft/ft
Flow Type	SuperCritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Average End Depth Over Rise	0.00	%
Normal Depth Over Rise	76.00	%
Downstream Velocity	Infinity	ft/s

Worksheet for 18E - double barrel

GVF Output Data

Upstream Velocity	Infinity	ft/s
Normal Depth	1.90	ft
Critical Depth	2.05	ft
Channel Slope	0.00800	ft/ft
Critical Slope	0.00682	ft/ft

Worksheet for 18E - double barrel

Project Description

Solve For	Discharge

Input Data

Headwater Elevation	189.00	ft
Centroid Elevation	186.25	ft
Tailwater Elevation	187.00	ft
Discharge Coefficient	0.60	
Diameter	2.50	ft

Results

Discharge	33.41	ft^3/s
Headwater Height Above Centroid	2.75	ft
Tailwater Height Above Centroid	0.75	ft
Flow Area	4.91	ft^2
Velocity	6.81	ft/s

Worksheet for spillway

Project Description

Solve For	Discharge

Input Data

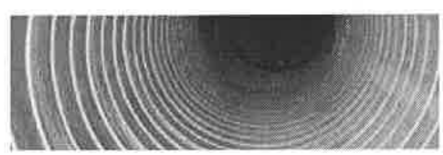
Headwater Elevation		178.50	ft
Crest Elevation		178.00	ft
Tailwater Elevation		170.00	ft
Crest Surface Type	Paved		
Crest Breadth		15.00	ft
Crest Length		50.00	ft

Results

Discharge	53.17	ft^3/s
Headwater Height Above Crest	0.50	ft
Tailwater Height Above Crest	-8.00	ft
Weir Coefficient	3.01	US
Submergence Factor	1.00	
Adjusted Weir Coefficient	3.01	US
Flow Area	25.00	ft^2
Velocity	2.13	ft/s
Wetted Perimeter	51.00	ft
Top Width	50.00	ft

CONTECH®
ENGINEERED SOLUTIONS

ULTRA FLO® Storm Sewer Pipe



Tomorrow's Environments Engineered

Table 4

Galvanized, ALUMINIZED STEEL Type 2 or **Polymer Coated**** ULTRA FLO H 20 and H 25 Live Load

Diameter (Inches)	Minimum/Maximum Cover (Feet) Specified Thickness and Gage (0.064") 16	(0.079") 14	(0.109") 12	(0.138") 10
18	1.0/108	1.0/151		
21	1.0/93	1.0/130	1.0/216	
24	1.0/81	1.0/113	1.0/189	
30	1.0/65	1.0/91	1.0/151	
36	1.0/54	1.0/75	1.0/126	
42	1.0/46	1.0/65	1.0/108	
48	1.0/40	1.0/56	1.0/94	1.0/137
54	1.25/36	1.25/50	1.0/84	1.0/122
60	1.25*/32*	1.25/45	1.0/75	1.0/109
66		1.5/41	1.25/68	1.25/99
72		1.5*/37*	1.25/63	1.25/91
78		1.75*/34*	1.5/58	1.5/84
84			1.75/54	1.75/78
90			2.0*/50*	2.0/73
96			2.0*/47*	2.0/68
102			2.5*/43*	2.5/61
108				2.5*/54*
114				2.5*/49*
120				2.5*/43*

Table 5

Galvanized, ALUMINIZED STEEL Type 2 or **Polymer Coated**** **Steel** ULTRA FLO E 80 Live Load

Diameter (Inches)	Minimum/Maximum Cover (Feet) Specified Thickness and Gage (0.064") 16	(0.079") 14	(0.109") 12	(0.138") 10
18	1.0 / 93	1.0 / 130		
21	1.0 / 79	1.0 / 111	1.0 / 186	
24	1.0 / 69	1.0 / 97	1.0 / 162	
30	1.0 / 55	1.0 / 78	1.0 / 130	
36	1.5 / 46	1.25 / 65	1.0 / 108	
42	1.5 / 39	1.5 / 55	1.25 / 93	
48	2.0 / 34	1.75 / 48	1.5 / 81	1.5 / 118
54	3.0* / 28*	2.0 / 43	1.5 / 72	1.5 / 104
60		2.0 / 39	1.75 / 65	1.75 / 94
66		2.5* / 35*	2.0 / 58	2.0 / 85
72			2.0 / 49	2.0 / 78
78			2.5 / 42	2.5 / 72
84			2.75* / 35*	2.5 / 67
90				2.5 / 62
96				2.5* / 58*
102				3.0* / 52*

Table 6

Aluminum ULTRA FLO HL 93 Live Load

Diameter (Inches)	Minimum/Maximum Cover (Feet) Specified Thickness and Gage (0.060") 16	(0.075") 14	(0.105") 12	(0.135") 10
18	1.0/43	1.0/61		
21	1.0/38	1.0/52	1.0/84	
24	1.0/33	1.0/45	1.0/73	
30	1.0/26	1.25/36	1.25/58	
36	1.5*/21*	1.50/30	1.5/49	1.5/69
42		1.75*/25*	1.75/41	1.75/59
48			2.0/36	2.0/51
54			2.0/32	2.0/46
60			2.0*/29*	2.0/41
66				2.0/37
72				2.5*/34*

Table 7

Galvanized, ALUMINIZED STEEL Type 2 or **Polymer Coated**** Pipe-Arch ULTRA FLO H 20 and H 25 Live Load

Equiv. Pipe Dia. (Inches)	Span (Inches)	Rise (Inches)	Minimum/Maximum Cover (Feet) Specified Thickness and Gage (0.064") 16	(0.079") 14	(0.109") 12
18	20	16	1.0/16		
21	23	19	1.0/15		
24	27	21	1.0/13		
30	33	26	1.0/13	1.0/13	
36	40	31	1.0/13	1.0/13	
42	46	36	M.L.[8]	M.L.[8]	1.0/13
48	53	41	M.L.[8]	M.L.[8]	1.25/13
54	60	46	M.L.[8]	M.L.[8]	1.25/13
60	66	51	M.L.[8]	M.L.[8]	1.25/13

Table 8

Galvanized, ALUMINIZED STEEL Type 2 or **Polymer Coated**** Pipe-Arch ULTRA FLO E 80 Live Load

Span x Rise (Inches)	Round Equivalent	Minimum Cover (Inches)	Minimum Gage	Max Cover (Feet)
20x16	18	24	16	22
23x19	21	24	16	21
27x21	24	24	16	18
33x26	30	24	16	18
40x31	36	24	16	17
46x36	42	24	12	18
53x41	48	24	12	18
60x46	54	24	12	18
66x51	60	24	12	18

Table 9

Aluminum ULTRA FLO Pipe-Arch HL 93 Live Load

Equiv. Pipe Dia. (Inches)	Span (Inches)	Rise (Inches)	Minimum/Maximum Cover (Feet) Specified Thickness and Gage (0.060") 16	(0.075") 14	(0.105") 12	(0.135") 10
18	20	16	1.0/16			
21	23	19	1.0/15			
24	27	21	1.25/13	1.25/13		
30	33	26	1.5/13	1.5/13	1.5/13	
36	40	31		1.75/13	1.75/13	
42	46	36			2.0/13	2.0/13
48	53	41			2.0/13	2.0/13
54	60	46			2.0*/13*	2.0/13
60	66	51				2.0/13

NOTES

1. The tables for Steel H 20 and H 25 loading are based on the NCSPA CSP Design Manual, 2008 and were calculated using a load factor of K=0.86. The tables for Steel E 80 loading are based on the AREMA Manual. The tables for Aluminum HL 93 loading are based on AASHTO LRFD Design Criteria.
2. The haunch areas of a pipe-arch are the most critical zone for backfilling. Extra care should be taken to provide good material and compaction to a point above the spring line.
3. E 80 minimum cover is measured from top of pipe to bottom of tie.
4. H 20, H 25 and HL 93 minimum cover is measured from top of pipe to bottom of flexible pavement or top of rigid pavement.
5. The H 20, H 25 and HL 93 pipe-arch tables are based on 2 tons per square foot corner bearing pressures.
6. The E 80 pipe-arch tables minimum and maximum covers are based on 3 tons per square foot corner bearing pressures shown.
7. Larger size pipe-arches may be available on special order.
8. M.L. (Heavier gage is required to prevent crimping at the haunches.)
9. For construction loads, see Page 15.
10. Sewer gage (trench conditions) tables for corrugated steel pipe can be found in the AISI book "Modern Sewer Design," 4th Edition, 1999. These tables may reduce the minimum gage due to a higher flexibility factor allowed for a trench condition.
11. All heights of cover are based on trench conditions. If embankment conditions exist, there may be restriction on gages for the large diameters. Your Contech Sales Representative can provide further guidance for a project in embankment conditions.
12. All steel ULTRA FLO is installed in accordance with ASTM A798 "Installing Factory-Made Corrugated Steel Pipe for Sewers and Other Applications."

* These sizes and gage combinations are installed in accordance with ASTM A796 paragraphs 18.2.3 and ASTM A798. For aluminum ULTRA FLO refer to ASTM B790 and B788.

** Contact your local Contech representative for more specific information on Polymer Coated ULTRA FLO for gages 12 and 10.

Appendix 7 – Hydrologic & Hydraulic Report – NextGen Engineering

NextGen
ENGINEERING

Hydrologic and Hydraulic (H&H) Report

Todd Barranca

Ventura County, California

November 27, 2018

Prepared by:

NextGen Engineering, Inc.
374 Poli St., Suite 207, Ventura, CA 93001
Mail: 5142 E. Homes St., Tucson AZ 85711
805-798-7664
www. NGenEng.com

On Behalf of:

AGROMIN™
Soil Products for a Greener World ®

Ventura County, CA

Contents

Figures

Tables

Executive Summary

This Hydrology and Hydraulic (H&H) Report summarizes the preparation and results of hydrologic and hydraulic models and analysis of Todd Barranca near Ventura, California. The results of the models will be used by Agromin Inc., whose property is west of Todd Barranca, to determine if there are flood conditions on their property. These results are part of a Conditional Use Permit (CUP) application to Ventura County. The floodplain generated by the 2D hydraulic model, using updated hydrology, produced the floodplain seen in Figure ES-1.

The results of the model under proposed conditions (with a curb) show that there is no flooding on the Agromin property, as seen in Figure ES-2.

Figure ES-1: Existing 100-Yr Flood Depths near Agromin Property

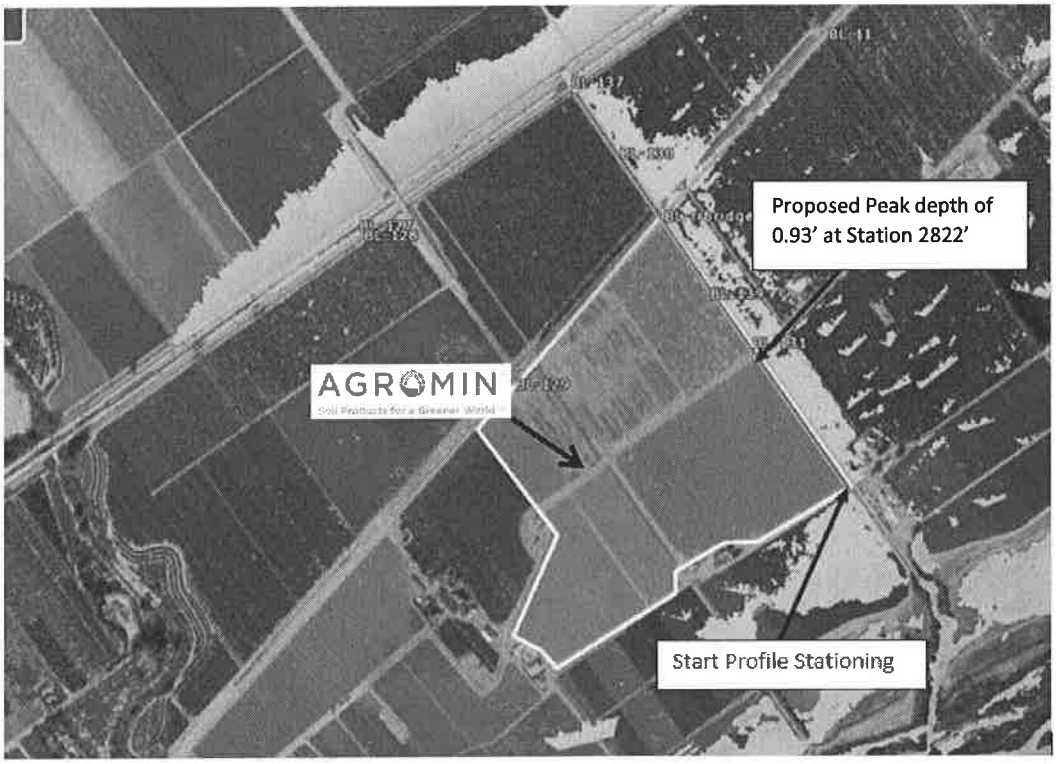


Figure ES-2: 100-Yr Flood Depths near Agromin Property under proposed conditions

Goals

The goal of this analysis is to refine the floodplain map near the Agromin property by the creation of a detailed hydrologic model and a 2D hydraulic model for the Todd Barranca. Agromin Inc. is a producer of mulch, compost, and other soil products. Their products are stored in mounds on their property and are thus susceptible to being moved by floodwaters. This detailed study of the area and delineation of an accurately defined 100-year floodplain around Agromin's property will be used to address concerns for a Conditional Use Permit in Ventura County.

The goals for the Hydrologic and Hydraulic models specifically include:

- **Hydrologic HEC-HMS model:** Hydrographs, based on the county methods and the best available data in the area, for use by floodplain 2D modeling.

Figure 1: Project Location

- **Hydraulic HEC-RAS model:** 100-yr floodplain map of the studied area using unsteady flow and 2D techniques.

Introduction

Agromin Inc. has property located in Ventura County near State Highway 126 between Santa Paula and the City of Ventura. The property is located in the flat alluvial plains north of the Santa Clara River. Surrounding the property is agricultural land, predominantly lemon and avocado orchards. To the north of the property are the Santa Paula Mountains, to the south is the Santa Clara River, to the west is the town of Saticoy at a distance of 1.3 miles, and to east is the city of Santa Paula, at a distance of 3 miles. Figure 1 shows the project location, neighboring cities, and the Los Padres National Forest to the North which is home to the Headwaters of Todd Barranca in the Santa Paula Mountains.

The Agromin property considered for the CUP is parcel of approximately 70 acres. The lot is located approximately 3,700 ft. west of Todd Barranca, a tributary to the Santa Clara River, and is outside of the Santa Clara River 100-yr FEMA Floodplain. However, previous hydraulic models of the area (discussed later in this report) have shown Todd Barranca backing up and overflowing before it crosses under State Highway 126 during a 100 year event. The backwater flows both east and west of Todd Barranca, pooling north of the freeway and eventually passing through the double 8'x6' culverts (noted in Figure 2) and potentially overflowing the channels south of the freeway and flooding the property. The owners of Agromin Inc. are therefore particularly interested in the overflow of the Barranca north of Freeway 126, the backwater behind State Highway 126 and the resultant floodplain caused by the overflow. Such an analysis requires an accurate understanding of flow rate in Todd Barranca and a 2D floodplain model to better understand the extent of flooding caused by the overflow. Figure 2 shows key elements of the study, and Figure 6, in the hydraulics section of this report shows prominent hydraulic structures within the studied area.

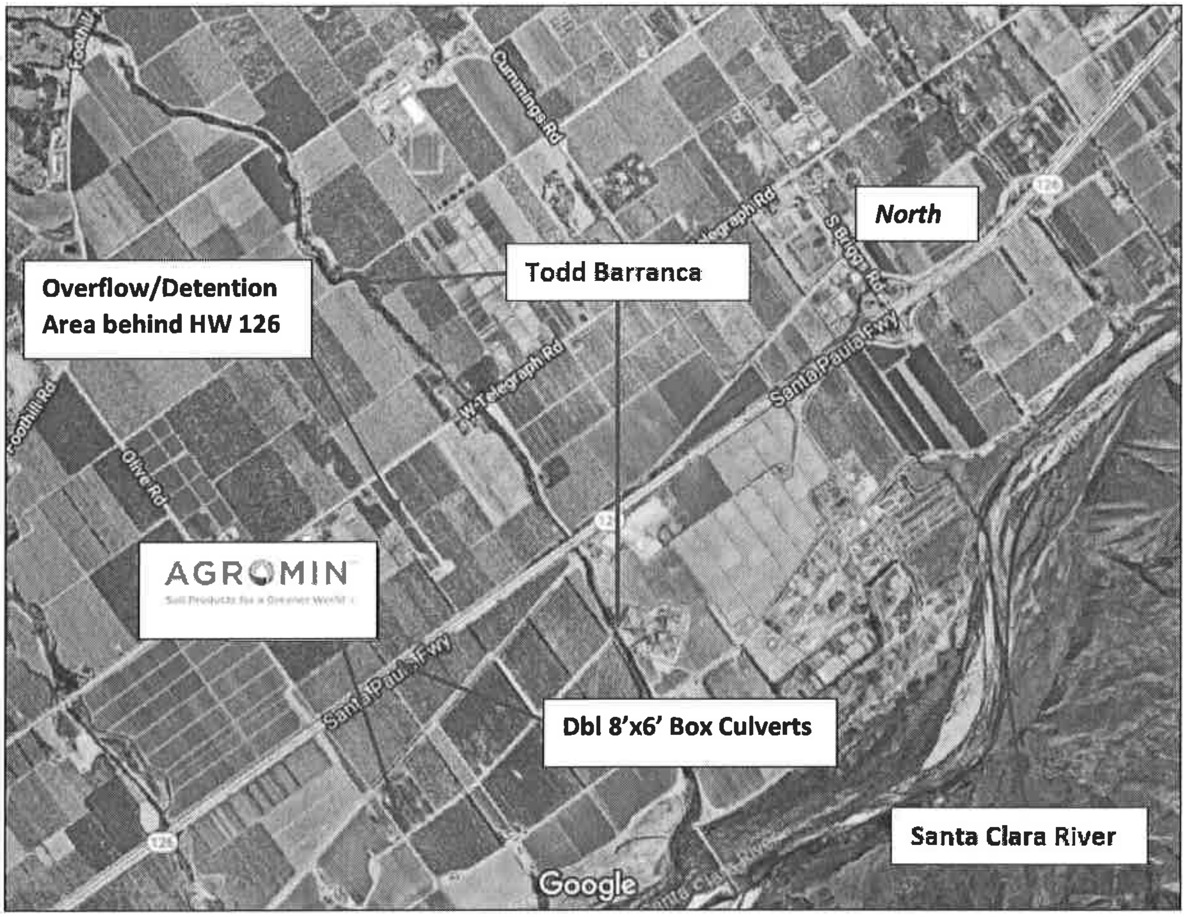


Figure 2: Key Elements of The Study

Purpose and Benefits

This H&H report and analysis broadens the County's knowledge of flooding in and around Todd Barranca, and provides the county with a well delineated floodplain for the studied reach. The methods used in the models are in accordance with Ventura County's Hydrology Design Manual (VCHDM, 2017), and produce results that can be easily verified by the county. More specifically, the H&H report provides information on potential flood conditions on or around the Agromin Property and will be used by Agromin Inc. to apply for a Conditional Use Permit. The floodplain boundaries and tables produced through the HEC-RAS study will provide Agromin Inc. with the floodplain information they need to better understand flooding risks, and to protect their property and the neighboring properties from the flooding produced by a 100-yr event.

Background and Pre-Design Studies

Todd Barranca has been the subject of a number of hydrologic and hydraulic studies. The Effective FEMA floodplain, determined by a FEMA study completed in April of 2018, does not include Agromin Inc. in the floodplain, or model any overflow behind State Highway 126. However, a number of other studies have been completed in the area; a few of which do include the property in the 100-yr floodplain or indicate overflow conditions around highway 126. Relevant studies are listed in chronological order below:

- **HSPF Hydrologic Study, 2009, Revised in 2011. AGUA TERRA Consultants** completed a Feasibility Study of the area, which included the creation of Hydrologic Simulation Program – Fortran (HSPF) hydrologic model and, hydraulic and sediment transport models of the watershed to evaluate natural, existing and future conditions of the Santa Clara River. The original document had an addendum added by Ventura County Watershed Protection District, Los Angeles County Department of Public Works, and the Los Angeles District of the U.S. Army Corps of Engineers in 2011. Figure 3 shows the results of the HSPF model for the area. There are certain inconsistencies in the HSPF hydrology used in the OAR, including greater run off in Wheeler Canyon than Todd Barranca, even though Wheeler Canyon has a much smaller cumulative drainage area, as seen in Figure 3.

Name	HSPF Sub-Area	Study	Area (ac.)	Cum. Area (sq. mi)	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr	200-yr	500-yr	Multiplier
Adams Upstream	3841	CDM	1,122	-	81	270	491	907	1,332	1,873	2,519	3,657	Undeveloped
Adams Intermediate 1	2841	CDM	3,552	-	211	702	1,277	2,360	3,466	4,875	6,557	9,516	Undeveloped
Adams Intermediate 2	1841	CDM	4,717	-	267	888	1,616	2,986	4,386	6,169	8,298	12,043	Undeveloped
Adams Barranca	841	CDM	5,398	-	299	994	1,808	3,340	4,906	6,900	9,281	13,469	Undeveloped
Adams Barranca	842	CDM	412	9.1	298	991	1,803	3,330	4,892	6,880	9,254	13,430	Undeveloped
O'Hara Canyon	843	CDM	2,006	-	144	480	872	1,612	2,368	3,330	4,479	6,500	Undeveloped
Haines Barranca	844	CDM	227	3.5	128	425	773	1,428	2,097	2,950	3,968	5,758	Undeveloped
SCR @ Freeman Div	850	FEMA	1,722	1,584.9	9,784	32,544	59,212	109,384	160,686	226,000	303,970	441,152	Undeveloped
Wheeler Upstream	2851	CDM	819	-	69	229	417	770	1,131	1,591	2,140	3,106	Undeveloped
Wheeler Intermediate	1851	CDM	2,907	-	197	656	1,193	2,204	3,238	4,554	6,125	8,889	Undeveloped
Wheeler Canyon	851	CDM	4,788	7.5	298	992	1,805	3,335	4,899	6,890	9,267	13,449	Undeveloped
Todd Barranca	852	CDM	1,246	9.4	288	958	1,742	3,219	4,728	6,650	8,944	12,981	Undeveloped
Briggs Road Drain	853	CDM	800	1.3	53	177	322	595	875	1,230	1,654	2,401	Undeveloped
Cummings Road Drain	854	WPD	1,223	1.9	78	259	472	871	1,280	1,800	2,421	3,514	Undeveloped
Santa Clara River	860	FEMA	2,287	1,608.6	9,784	32,544	59,212	109,384	160,686	226,000	303,970	441,152	Undeveloped

Figure 3: HSPF Hydrology

- **Hydraulic Study: May 2012. CMD Smith** prepared an Overflow Analysis Report (OAR) for Todd Barranca for The U.S. Army Corps of Engineers (USACE). The OAR used the above mentioned 2011 HSPF hydrology. The red names in Figure 3 were calculated using USGS regression equations. The study included a hydraulic model which suggested overflow conditions between Telegraph Road and State Highway 126 during the 100-year, 24-hour storm event.

- **Hydrologic & Hydraulic Studies: June 2018. Harrison Industries** having noted the inconsistencies in the 2011 HSPF hydrology used by the USAC, created their own HEC-HMS hydrologic model. Using the hydrology generated by HEC-HMS, Harrison Industries created a HEC-RAS model to understand hydraulics of the area. The model used similar flows to the OAR, however did not account for runoff volume or duration. The model was modified to account for potential overflow volume and duration and confirmed the potential of westerly overflow of about 200 AF around State Highway 126 for a duration of 100 minutes; however conservation of mass, energy and momentum were not accounted for in the model.

The 2012 hydraulic study by the CDM Smith included the Agromin Property in the 100-yr. floodplain, as shown in Figure 4. The OAR floodplain shown in Figure 4 is recognized by Ventura County, however is based on the broad assumptions of the USPF hydrology. Harrison's attempt to redefine the floodplain using updated hydrology and a new hydraulic model in 2018 was inconclusive but supported the hypotheses of overflow around State Highway 126 during a 100-yr event.

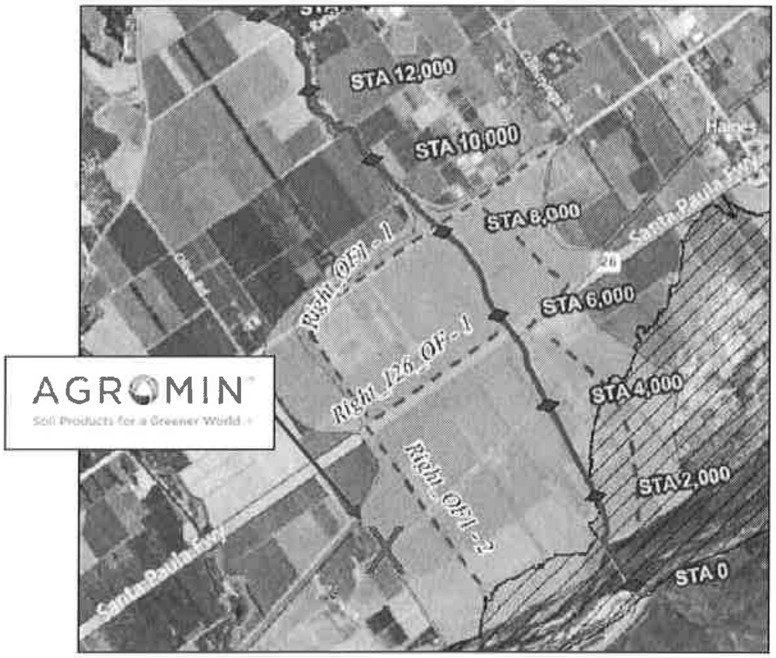


Figure 4: Overflow Analysis Report Floodplain (OAR, 2012)

Questions about the HSPF hydrology, which was used by the OAR to define the floodplain shown in Figure 4, as well as the limitations of the one dimensional HEC-RAS study done by Harrison Industries, prompted the need for a new hydrologic and a 2D hydraulic study of the area.

Topographic Data

All topographic data was georeferenced to NAVD 88 vertical datum and NAD 83 horizontal datum.

HEC-HMS Model

2005 LiDAR 1' contour intervals of The Todd Barranca Watershed, provided by the County, were used in combination with 2017 USGS NED 20' contour intervals to topographically map the watershed. County 1' intervals were used to delineate the farthest downstream sub-watershed (236 in the HEC-HMS model, see Exhibit 1). USGS 20' intervals were used to determine the values that were used in the other four sub-basins of the HEC-HMS model. The use of 1' contours adds precision to the model through better delineation of sub watershed 236, and improves upon the methods used in previous studies of the area.

HEC-RAS Model

2005 LiDAR 10' gridded points of the Todd Barranca Watershed, provided by the county, were used in the HEC-RAS model. The terrain file was modified to accurately model flow in the below mentioned culvert areas. Modifications were based on as-built drawings and field measurements.

- Double Box Culvert under highway 126 (west 2D area)
- Double round culvert at highway 126 and Todd Barranca
- Culvert at railroad bridge and Todd Barranca
- Railroad tunnel under highway 126.

Hydrology

A detailed HEC-HMS 4.2.1 study of the Todd Barranca was completed to produce a unit hydrograph at the foothills of the steep Santa Paula Mountains for use in a 2D HEC-RAS model. The results from the hydraulic model were compared to the 2018 HEC-HMS study completed by Harrison Industries, and calibrated with hydrographs produced by the 2011 HSPF study, per Ventura County standards. The following section describes in detail the methods and values used to model flow within Todd Barranca as the result of a design 100-yr storm.

Description of the Watershed Extents of Study

The Agromin fields are located within the Adams Canyon – Santa Clara River Watershed, in the Todd Barranca sub-watershed. The Todd Barranca watershed is elongated N.S. and the studied section stretches 6.3 miles with an area of 8.3 mi^2. The Barranca runs southeast leaving the Santa Paula Mountains at the base of Wheeler Canyon. Todd Barranca leaves the steep Santa Paula Mountains and enters the alluvial plains and continues through agricultural land, passing under the Santa Paula Freeway and draining into the Santa Clara River. NRCS soil surveys (NRCS, 2017, USDA 1970) characterized the watershed as containing loamy soils with 0-2% slopes. Run-off and stormwater flows from upstream developments. Hampton Canyon (located in the upstream foothills of Todd Barranca), and Wheeler Canyon (located downstream from Hampton Canyon), drain into Todd Barranca and were included in the HEC-HMS study.

The downstream extent of the hydrologic model is the upstream extent of the hydraulic model. The hydrologic study will consequently provide a hydrograph that represents the flow from the steep canyons that has accumulated within the channel. The hydraulic model will be used to model the gradual incline of the agricultural lands and the consequential flooding within the alluvial plains caused by overflow from the channel. The hydrologic model does not extend into the alluvial plains, as it is assumed infiltration of the tilled agricultural land would allow a majority of the rainfall to infiltrate, and would not compound the peak flow within the channel.

Local rainfall that drains into the box culverts under highway 126 is not included in the model because, while the culverts will direct local runoff; the peak of local runoff and the peak from the overflow from the channel can be assumed to not be coincident, and thus would not compound the detention effect behind the highway.

Basis of Hydrology

The studied watershed was broken down into five sub-basins and six reaches. Basin boundaries and reach extents were determined using the HEC-GeoHMS 10.1 plugin of ArcGIS Desktop 10.5.1. The VCWPD methods used have been compared with runoff data from 2005 storms (10 to 50-yr) storms in a number of undeveloped watersheds and generally create storm models with peaks that deviate 10% or less from stream gages in the modeled undeveloped watershed. The methods and values used are explained in detail within the following section.

HEC-HMS Methods and Assumptions

The model was completed adhering to the parameters laid out in the Ventura County Design Hydrology Manual (VCDHM, 2017). Specific attention was given to Section 5: HEC-HMS Design Storm Modeling of the manual. The HEC-HMS model uses more precise values for infiltration, sub-basin area, lag time, slope, and rainfall intensity as described in the following sections.

Design Storm

NOAA Atlas 14 100-yr rainfall isohyet was received from *Appendix E* of the VCDHM. The centroid of the studied watershed was determined using ArcGIS. Rainfall depth at the centroid was used with a SCS type 1 rainfall distribution to produce the 100-yr, 24 hour duration design storm. Exhibit 3 shows the centroid of the watershed and resultant rainfall yield. Rainfall at the watershed centroid was determined by performing inverse distance weighting of the NOAA isohyets in ArcMap. Rainfall at the centroid of the watershed was calculated to be 10.93 in.

Sub-Basins

The study was separated into five sub-basins. Delineation of sub-watersheds was done using HEC-GeoHMS plugin for ArcGIS, and using the topographic data described in the "Topographic Data" section of this report. The drainage point for the studied area is 1827 ft downstream of Foothill Road. The names of sub-basins were automatically generated in HEC-GeoHMS, and the assigned sub-basin number has no relevance to their characteristics. *TABLE* 1 is a summary of the values used in each sub basin, which is followed by a discussion on how the values in *TABLE* 1 were determined.

TABLE 1: SUMMARY OF VALUES USED IN SUB-BASINS IN HEC-HMS MODEL

Sub-Basin	142	232	332	172	236
Sub-Basin Area (sm)	1.2573	3.2454	2.9112	0.7118	0.1400
Initial Loss (in)	0	0	0	0	0
Infiltration Rate (in/hr)	0.208	0.471	0.641	0.492	N/A
% Impervious	0	0	0	0	0
Lag Time (hrs)	0.451	1.411	0.586	0.366	0.265

Sub-basin watershed area was determined using the HEC-GeoHMS plugin for ArcGIS. It is described in square miles based on the GRS 1980 ellipsoid for the EPSG:2229 NAD83 California Zone 5 projected coordinate system. The Topographic Data section of this report describes the topographic information used to delineate the watersheds.

SubBasin 236

Runoff contributed by SubBasin 236 was not included in the hydrologic model. The terrain in this watershed is relatively flat and is classified as agricultural land by the county. For this reason flow does converge to the drainage point where the 2D hydraulic model will begin, however it may not converge at the time of the peak hydrograph. The hydrograph at the outlet of 172 was thus routed to the outlet of 236 with no runoff added by SubBasin 236.

Figure 5: Agricultural Fields of SubBasin 236.

Transform Method: User-Specified S-Graph

After reviewing the S-Graph options in Section 5.2.6 of the VCDHM, the Ellsworth Barranca S-Graph was chosen due to the narrow nature of the watershed, and proximity of Todd Barranca to the Ellsworth Barranca.

Loss Method: Initial and Constant

Initial loss was set to zero, as specified in Section 5.2.5 of the VCDHM.

Infiltration for each sub-basin was determined through taking the weighted average of infiltration rates for NRCS soil types in the sub-basin. Weighting of infiltration rates was based on the percent concentration of each soil type within each sub-basin.

Soil number infiltration rates for each soil were determined through referencing ranges covered by multiple sources such as ASCE, SMAA, etc. *TABLE* 2 lists infiltration rates for each soil number. Exhibit 2 is a soil map for the studied area and was used to determine weighted values.

TABLE 2: INFILTRATION RATES FOR SOILS WITHIN THE TODD BARRANCA WATERSHED STUDY AREA

VCWPD Soil Number	Infiltration Rate (in./hr)
1	0.06
2	0.20
3	0.25
4	0.60
5	0.90
6	2.00
7	7.00

According to Ventura County's County View on-line maps for Land Use (Accessed July 2018), the majority of the watershed is classified as open space, with a small section of watershed 236 being classified as agricultural. The agricultural lands are mostly lemon and avocado orchards, and are thus classified as "orchards or tree farm". Exhibit 14a from the VCWM specifies 0% impervious for both open space and orchard and tree farm.

Lag time

The model used the USACE lag time equation, as specified in section 5.2.1 of the VCDHM. Key values, such as Manning's n and sub-basin slope are noted in *TABLE* 3.

TABLE 3: MANNING'S N AND SLOPES OF SUB-BASINS

Sub-Basin	Manning's N (n)	Sub-Basin Land Use	S_3 Slope (S)
142	**0.055**	**Undeveloped, steep slope.**	**691.15**
232	**0.045**	**Undeveloped, gradual slope**	**150.18**
332	**0.045**	**Undeveloped, gradual slope**	**193.66**
172	**0.045**	**Undeveloped, gradual slope**	**190.47**
236	**0.055**	**Undeveloped, steep slope**	**256.06**

Sub-Basin slope was determined to be a "S_3 slope" as defined in Section 5.2.2 of the VCDHM. The "S_3 slope" is a weighted average for elongated catchments and accounts for the fact that the travel time in different channel reaches do not vary linearly and therefore is representative of the basin response time. Values used to determine the slope were generated by HEC-GeoHMS.

Electronic File "E-1" (Attached on CD) was used to determine slopes and lag time, and contains all values used to determine lag time.

Reaches

The study consists of six reaches that were used to connect upstream sub-basins to downstream sub-basins. *TABLE* 4 is a summary of the values used in each reach, which is followed by an explanation of how the values in *TABLE* 4 were determined. Reaches were generated automatically by the HEC-GeoHMS plugin for ArcGIS.

TABLE 4: SUMMARY OF VALUES USED IN REACHES IN HEC-HMS MODEL

Reach	R1	R2	R3	R4	R5	R6
Length	4834	3234.7	4025	9756.3	6286.3	2694.3
Slope	0.04	0.026	0.0252	0.0164	0.0147	0.0141
Manning's N	.04	.04	.04	.04	.04	.05
Shape	Trap.	Trap.	Trap.	Trap.	Trap.	Triangle
Bottom Width	300	50	300	295	29.5	-
Side Slope	0.41	0.37	.057	0.44	0.48	0.14

Routing Method: Muskingum-Cunge

A routing method was not specified in Section 5 of the VCDHM so the Muskingum-Cunge, a traditional conservation of mass method and standard method, was chosen.

Reach Length

Reach length was measured from the inlet to the outlet of the sub-basin, and is the full length of the reach, measured at the centerline of the creek. Reach lengths were determined using HEC-GeoHMS.

Reach Slope

Reach slope was determined through the use of HEC-GeoHMS which calculated the average slope from inlet to outlet of each sub-basin.

Manning's N for Reaches

Manning's n roughness coefficient was determined by comparing observations from a visit to the Todd Barranca with standard values. **TABLE 4** lists Manning's n values used in the routing portion of this hydrologic model (Acrement, 1989). Willows and sycamores were observed growing within the channel along with a number of smaller trees and bushes. Vegetation seems to become sparser upstream. All reaches were determined to have a large amount of vegetation and consequently assigned a Manning's n ranging from 0.04-0.05.

Reach Shape

Shape and dimensions of the channel were determined by cutting cross sections of the studied reach. ArcMAP and the 3-D Analyst Line interpolation plugin were used to generate the cross-sections. Topography used to determine the cross-section shape is discussed in the Topographic Data section of this report. Reach shape and dimensions are discussed in TABLE 4. Cross sections corresponding to Reaches 1-5 were then simplified into trapezoidal sections and then organized by reach. Reach 6 cross sections were then simplified as a triangular channel given that these channels were roughly were estimated as triangular. The average shape of all reaches were calculated in excel and the results are found in Appendix C.

Calibration

The resultant raw hydrograph at the outlet of sub-basin 332; was calibrated with the peak flow value of the County Standard HSPF hydrograph at the same location, by increasing infiltration rates by 38%. The resultant calibrated hydrograph, at the outlet of sub-basin 236, was the final hydrograph that was used in the 2-D floodplain model.

TABLE 5: HYDROGRAPH FLOW AND VOLUME AT OUTLET OF SUB-BASIN 332

	Peak Flow (cfs)	Volume (acre-ft)
HEC-HMS (NextGen) Results	6838	1455
HSPF Model	6890	2999

The calibrated HEC-HMS hydrograph using a 1-minute time step produced a peak and volume that is compared to the HSPF models peak and volume in *TABLE 5: HYDROGRAPH FLOW AND VOLUME AT OUTLET OF SUB-BASIN 332*. The difference of the peaks was less than 0.8 percent. The calibrated HEC-HMS hydrograph is compared to the HSPF and Harrison hydrograph in Appendix A.

Analysis and Resultant Hydrograph

Figure 5 shows the HEC-HMS resultant hydrograph at the outlet of sub-basin 236, which was used in the 2D HEC-RAS model.

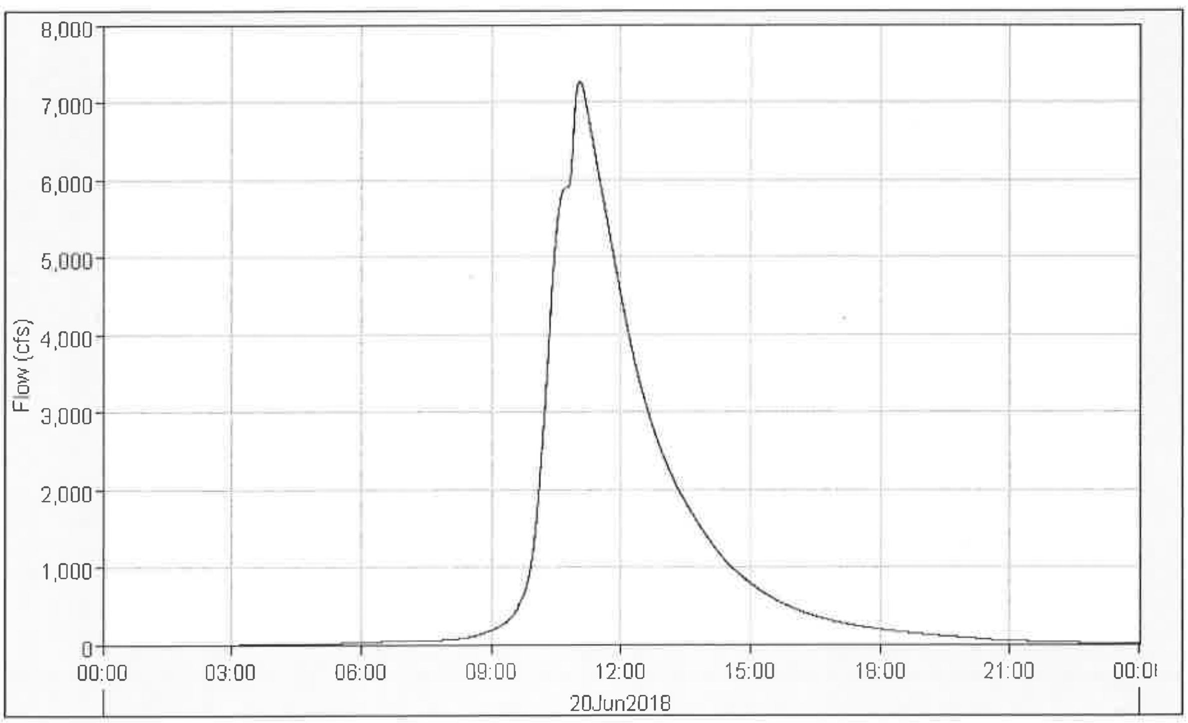


Figure 5: Hydrograph at the Outlet of Sub-Basin 236 used in HEC-RAS model (1 minute time intervals)

Hydraulics

The following section describes in detail the methods used to determine 100-year floodplain extents, depths, and velocities, along Todd Barranca and near Agromin's property. A hybrid one-dimensional and two-dimensional (1D/2D) HEC-RAS model was created to determine flooding within the studied area.

Description of Hydraulic Structures and Project Components

The area of interest for the hydraulic HEC-RAS study contains a number of hydraulic structures; the most significant are noted in Figure 6 and discussed below.

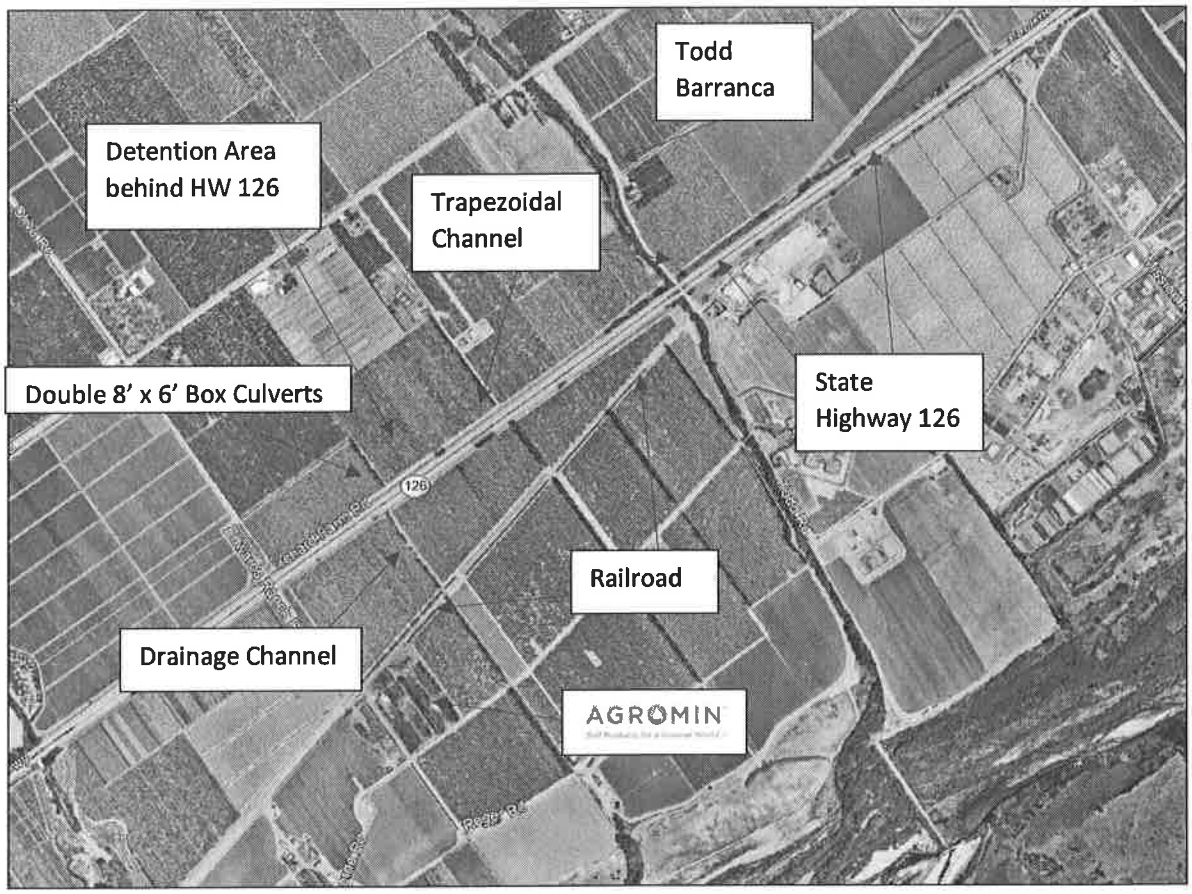


Figure 6: Prominent Hydraulic Structures in Studied Area

Trapezoidal Channel: An existing concrete trapezoidal channel on the Northside of the Highway 126 parallels the freeway from about 700 ft. West of Todd Barranca to about 700 Ft. West of Edwards Ranch Road. It is assumed that this channel was intended to drain the local drainage area on the north side of the freeway and not to receive overflow from Todd Barranca. The Channel drains into existing double box converts roughly 1,300 ft. east of Edwards ranch Road. From there, a private concrete channel drains water into the Santa Clara River roughly 3,900 ft. from the box culverts.

Double 8' x 6' Box Culvert: This double box culvert conveys runoff from north of Highway 126 under the highway, to drain toward the Santa Clara River to the South. The culvert was presumably designed to drain the runoff from the trapezoidal channel and not intended to receive overflow from Todd Barranca.

Harrison Industries estimated the capacity of the culvert at 1,065 cfs with roughly a high-water elevation 2.5 above the box soffit and 5.5 ft. of tail water depth.

Detention Area behind HW 126: There is backwater capacity behind HW 126 that could allow runoff to pond until it passed through the box culverts. Harrison industries estimated about 70 AF of storage behind the freeway.

State Highway 126: The highway is elevated above the grade of the land, causing a detention effect behind the highway. Based on as-built plans and topographic information, the low point of the highway is about 750 ft. West of Edwards Ranch Road, and would be the initial overflow location of ponded water north of the Freeway.

Railroad. The railroad track crosses under State Highway 126 approximately 900 ft. East of Todd Barranca, and crosses over the Barranca around Todd Road. The railroad is also elevated above the grade of the land and has a ponding effect on water that overflowed from Todd Barranca.

HEC-RAS Methods and Assumptions

The HEC-RAS model expands upon an existing 1D hydraulic model, provided by Ventura County, by adding 2D elements outside of the Todd Barranca channel. The model added key specific hydraulic elements within the 2D area, and used topography discussed in the "Topographic Data" section of this report. Results from the model have been compared to the OAR floodplain (Figure 4).

HEC-RAS v. 5.03 and GeoHEC-RAS was used to add 2D elements to an existing 1D HEC-RAS model.

Utilization and Modification of Existing 1D HEC-RAS Model

The 1D HEC-RAS model from the County was utilized to model the main channel. The model was modified in the following ways:

- *Eliminated* all reaches within the model with the exception of Todd Barranca
- *Eliminated* all sections upstream of section 16071.
- *Added* addition sections as required.
- *Added* 2D areas east and west of Todd Barranca
- *Added* six lateral structures to model which routes overflow from 1D to 2D areas.
- *Added* double box culvert under highway 126.

Manning's N Values

Manning's N Values are listed below:

- Manning's N values for Todd Barranca in 1D model remained the same.
  - 0.052 for the main channel.
  - 0.075 for both over banks
  - 0.015 for the ditch area
  - USDA National Land Cover Database (NLCD) was used for Manning's N values in the 2D areas. Figure 7 and Figure 8 show land use and Manning's N values used in the model.

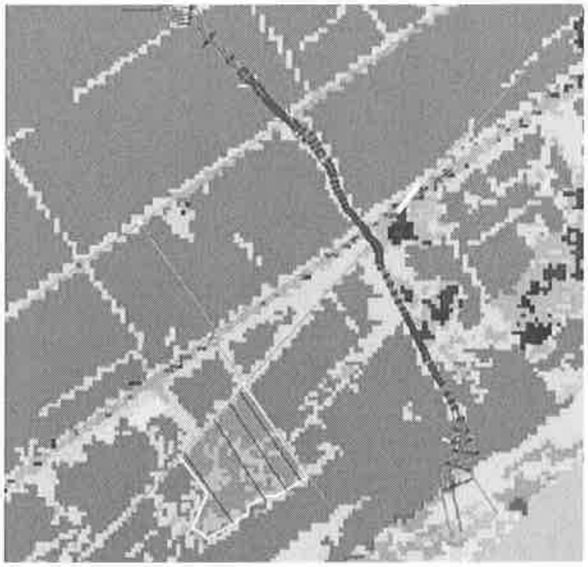


Figure 7: Map of Land Cover Area

General Options | Manning's Definition | Spatial Reference

Land Cover Manning's Definition

	Land Cover ID	Land Cover Name	Manning's	Color
2	1	Agricultural, Cultivated Crops	0.035	
3	2	Agricultural, Pasture/Hay	0.03	
4	3	Developed, High Density	0.15	
5	4	Developed, Low Density	0.1	
6	5	Developed, Medium Density	0.08	
7	6	Developed, Open Space	0.04	
8	7	Open Water	0.04	
9	8	Undeveloped, Bareen Land	0.025	
10	9	Undeveloped, Deciduous Forest	0.16	
11	10	Undeveloped, Evergreen Forest	0.16	
12	11	Undeveloped, Grassland	0.035	
13	12	Undeveloped, Mixed Forest	0.16	
14	13	Undeveloped, Shrub/Scrub	0.1	
15	14	Wetlands, Forested	0.12	

Figure 8: NLCD Manning's N Values

Model Extents

The HEC-RAS 1D reach of the model begins at section 16071, approximately 1827 feet downstream of Foothill Rd. The downstream end of the HEC-RAS 1D model is section 1365 at the Santa Clara River. The 2D area limits are sufficient for flood analysis at the Agromin Property, but were not extended to the Santa Clara River.

Structures

A number of hydraulic structures are present in the studied area. Structures that affected the flow around Agromin's property were added to the model, otherwise the terrain file was simply modified to model the structures effect on the floodplain.

Lateral Structures

- **Six lateral structures were created to route overflow from Todd Barranca to 2D areas.**
- **Weir crest elevations were cut to 2005 LiDAR 1' contours.**
- **Structure width: 3 feet**
- **Weir Coefficient (for lateral structures): 0.3**

Culverts in 2D Areas

- **Double box 8' x 6' culvert was added under Highway 126 (west 2D area). The terrain file was adjusted to allow for the culvert to be added to the model. Figure 9 shows flow through the double box culvert. The flow through this culvert greatly influences the floodplain around the Agromin property.**

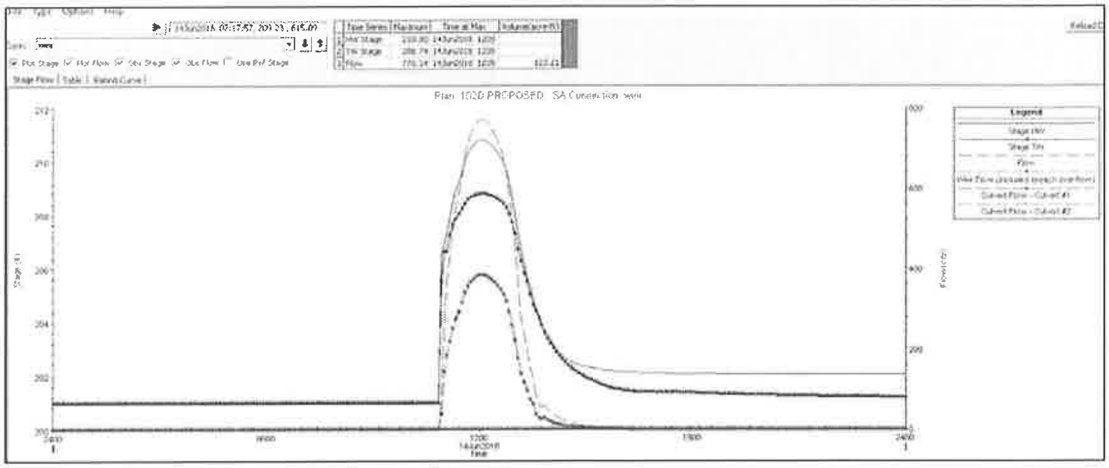


Figure 9: Flow Through Double Box 8x6 Culvert

- Double box culverts under Telegraph Road were not added to the model because no backwater reaches this area.
- Double 3.5' corrugated metal pipe located 40 feet upstream of Highway 126 at Todd Barranca was added to the model by adjusting the terrain file to account for flow back into Todd Barranca, however the culvert details were not added because the culverts do not affect flow at the Agromin property.
- Single concrete culvert located at Todd Barranca and Railroad Bridge was added to the model by adjusting the terrain file to account for flow back into Todd Barranca. However, culvert details were not added because the culvert does not affect flow at the Agromin Property.

Analysis and Resultant Floodplain

Unsteady flow analysis was performed using HEC-RAS 5.03. The 24- hour hydrograph, explained in the Hydrology section of this report, provided the flow used in the model. The model performed computations every 15 seconds during the modeled time period and the output was plotted at 5 minutes intervals. Figure 10 shows the maximum extents of the flooding and maximum depths, at the peak flow.

Figure 10: Proposed Flood Boundaries and Depths

Conclusions

The results from the 2D HEC-RAS model corroborate the results of the OAR produced in 2012 in that the 2D HEC-RAS model also models backwater behind highway 126. However, the floodplain extents produced in the OAR are much less detailed than the study herein.

Valuable information provided by the 2D HEC-RAS model include a better defined boundary of flooding and, more importantly, shallow flooding (less than 1 foot in most places) on and around the Agromin Property. This area would be classified as a Special Flood Hazard Area, Zone X. Precautions would have to be taken accordingly for a Zone X Flood Hazard Area, and additional mitigation strategies could be taken. Additionally the model did not show flooding over Highway 126 west of Todd Barranca.

The model does indicate that proposed flooding on the Agromin Property is an average of 0.27' (Approx. 3 inches) deep, and thus qualifies as a Zone X for FEMA floodplain maps, and the average velocity at the profile line is 0.87 ft/sec.

"Islands" within the floodplain are filled depressions within the topography. While they appear isolated, they are connected to the other floodwaters and are filled with overflow from the channel, and not pooled rainfall.

Recommendations

The flooding under the Existing Conditions is minimal and may not require a curb depending on land use. The construction of a curb on the eastern side of the property would keep water off of the Agromin Property. Figure 11 shows the floodplain with the wall. Appendix D further discusses this idea.

Figure 11: Floodplain with Proposed Conditions

References

AQUA TERRA Consultants. (2009). *Hydrologic Modeling of the Santa Clara River Watershed with the U.S. EPA Hydrologic Simulation Program - FORTRAN (HSPF).* Ventura, CA.

Arcement, G. J., & Schneider, V. R. (1989). *Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains.* United States Geological Survey.

CDM Smith. (May 2012). *Santa Clara River Watershed Feasibility Study, Without Project Conditions Overflow Analysis Report (OAR).* Los Angeles, CA.

NRCS. (2017, September 13). *Soil Survey*. Retrieved from https://websoilsurvey.sc.egov.usda.gov/DSD/Download/Cache/SSA/wss_SSA_CA674_solidb_US_2003_[2017-10-03]

US Department of Agriculture . (April 1970). *Soil Survey Ventura Area, California.* Soild Conservation Service.

Ventura County GIS. (2018, July 2). Retrieved from Venutra County County View: http://gis.ventura.org/CountyViewNew/

Ventura County Watershed Protection District. (Updated July 2017). *Design Hydrology Manual.* Public Works Agency, Countny of Venutra California.

Ventura County Watershed Protection District, Los Angeles County Department of Public Works, U.S. Army Corps of Engineers, Los Angeles District. (2009). *Hydrologic Modeling of the Santa Clara River with U.S. EPA Hydrolic Simulation Program - FORTRAN (HSPF).* Ventura, CA.

Appendixes

Appendix A: Hydrograph at the Outlet of County Sub-Basin 851 and NextGen Sub-Basin 332 and Harrison HE-HMS Model Sub-Basin 6A

Appendix B: Maximum Water Surface Profile Elevations and Velocities

Appendix C: Average Cross Section Determination Spreadsheet

Appendix D: Proposed Conditions

Exhibits

Exhibit 1: Hydrology Map

Exhibit 2: Soils Map

Exhibit 3: Isohyet Map

Exhibit 4: Annotated FIRM with Proposed Conditions and Curb

Exhibit 5: Existing vs Proposed Floodplain on Agromin Property

Electronic Files

E1: Basin Slopes Spreadsheet

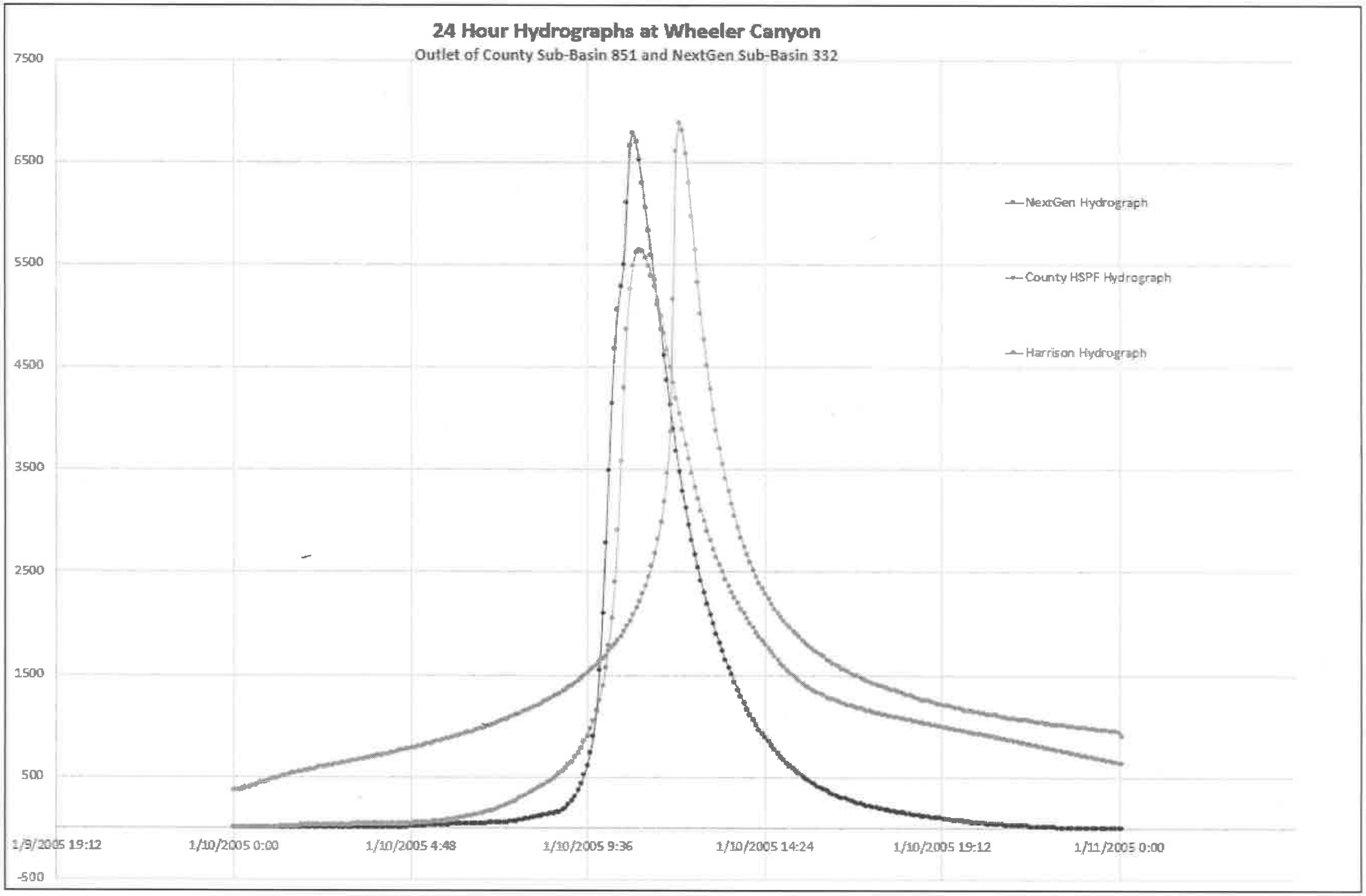
E2: 2018 HEC-HMS 4.2.1 Study

E3: 2018 HEC-RAS 5.03 2-D Study

E4: 2018 HEC-HMS Study Completed By Harrison Industries

Appendix A: Hydrograph at the Outlet of County Sub-Basin 851 and NextGen Sub-Basin 332 and Harrison HE-HMS Model Sub-Basin 6A)

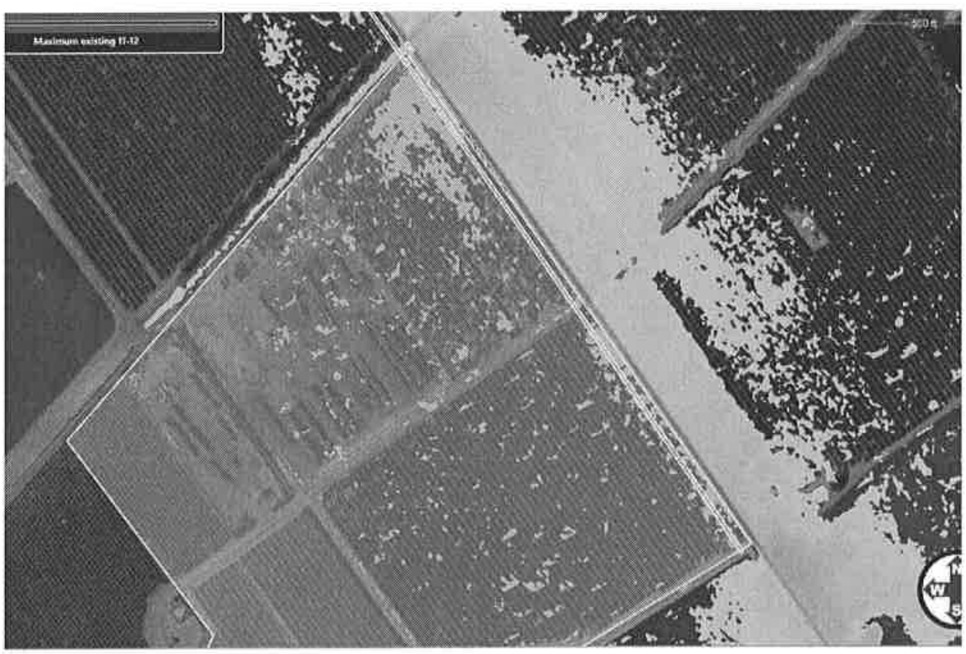
HEC–HMS used for NextGen and Harrison Hydrographs


24 Hour Hydrographs at Wheeler Canyon
Outlet of County Sub-Basin 851 and NextGen Sub-Basin 332
7500
6500
5500
4500
3500
2500
1500
500
-500
1/9/2005 19:12
1/10/2005 0:00
1/10/2005 4:48
1/10/2005 9:36
1/10/2005 14:24
1/10/2005 19:12
1/11/2005 0:00
NextGen Hydrograph
County HSPF Hydrograph
Harrison Hydrograph

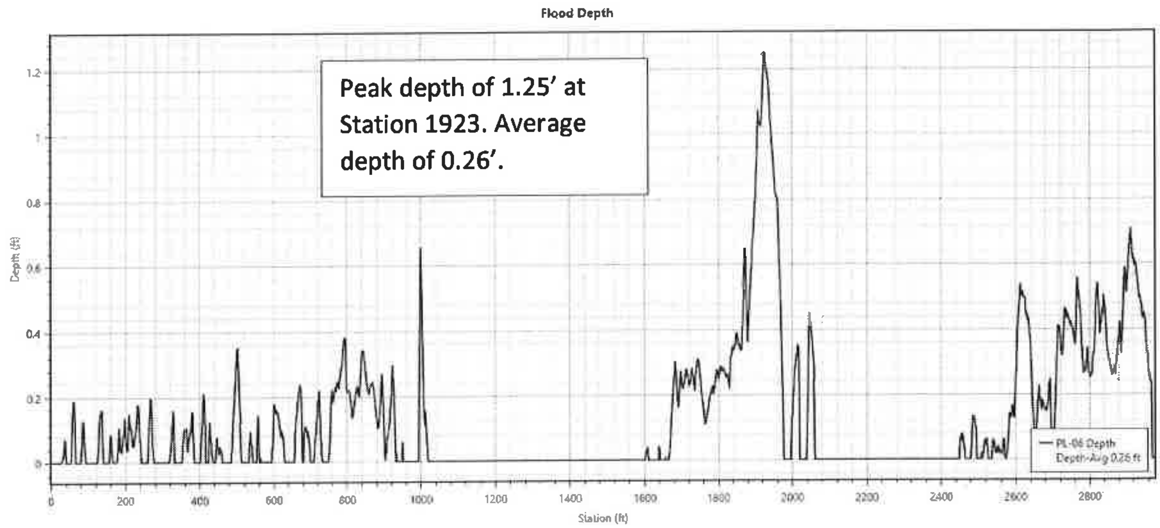
Appendix B: Maximum Water Surface Profile Elevations and Velocities In the Existing Floodplain

Existing floodplain.

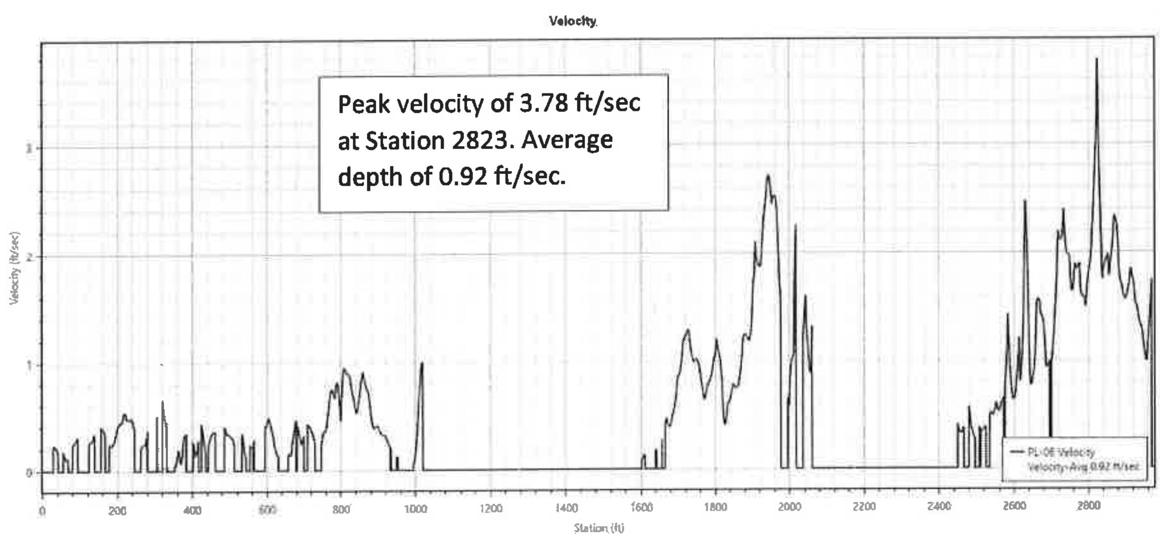
Zoomed in existing floodplain view.



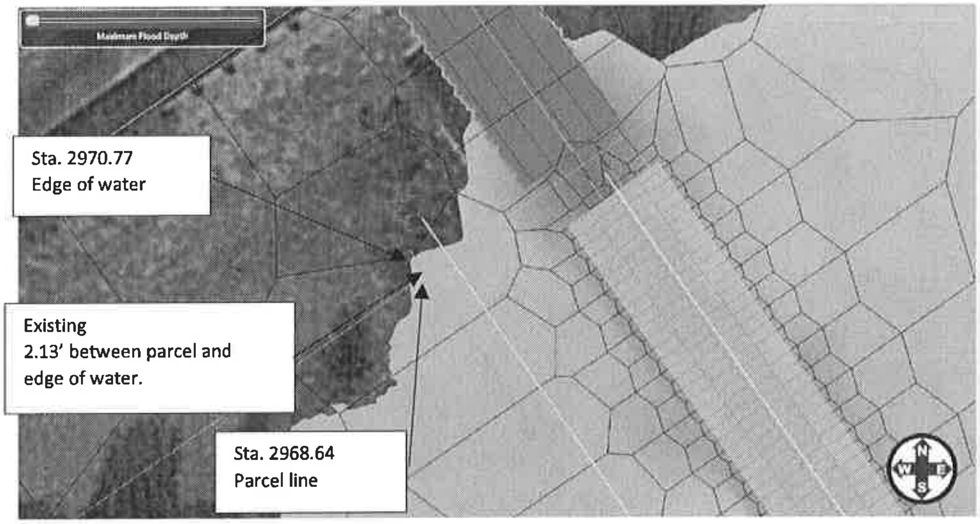
Existing flood depth at Station 1923.



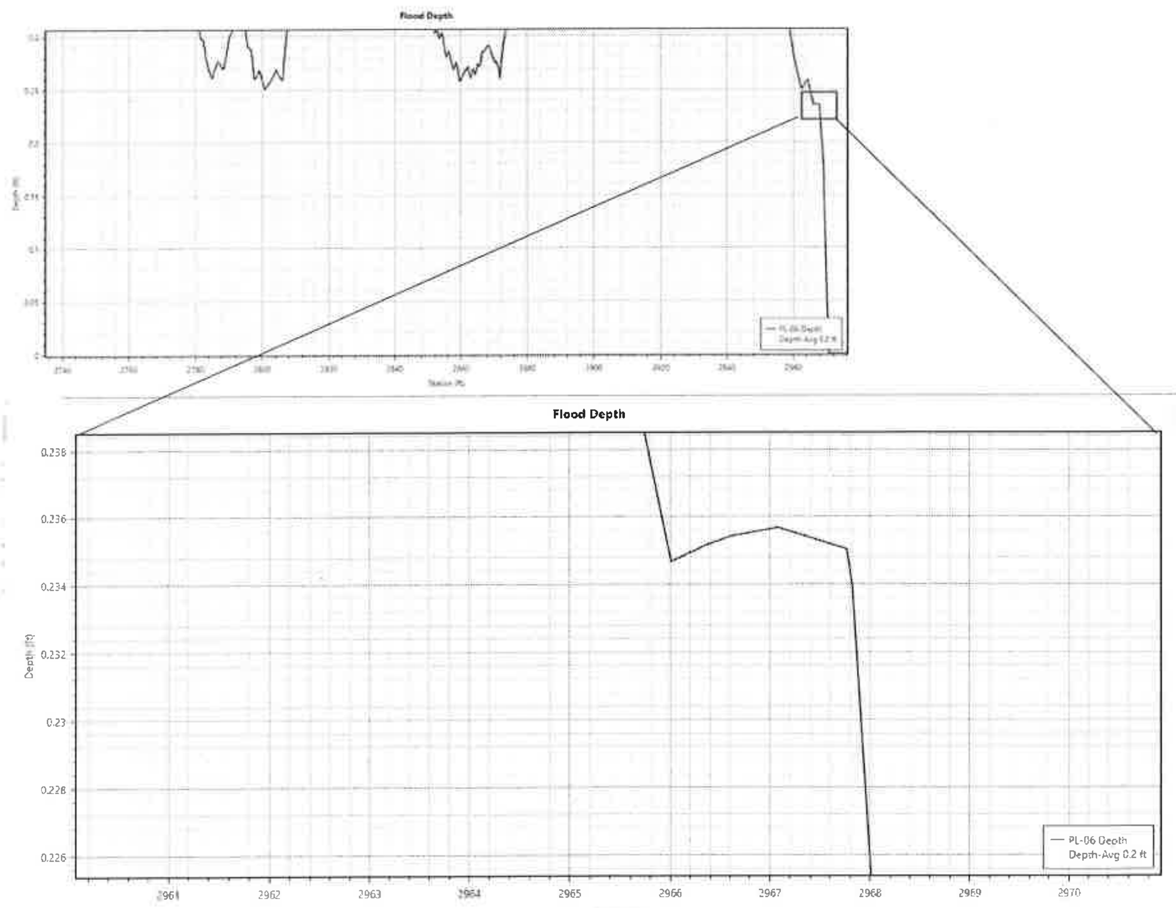
Existing velocity at Station 2823.



Detailed view of edge of parcel line under exiting conditions.



Flood depth at Station 2968.64 under existing conditions.



Appendix C: Average Cross Section Determination Spreadsheet

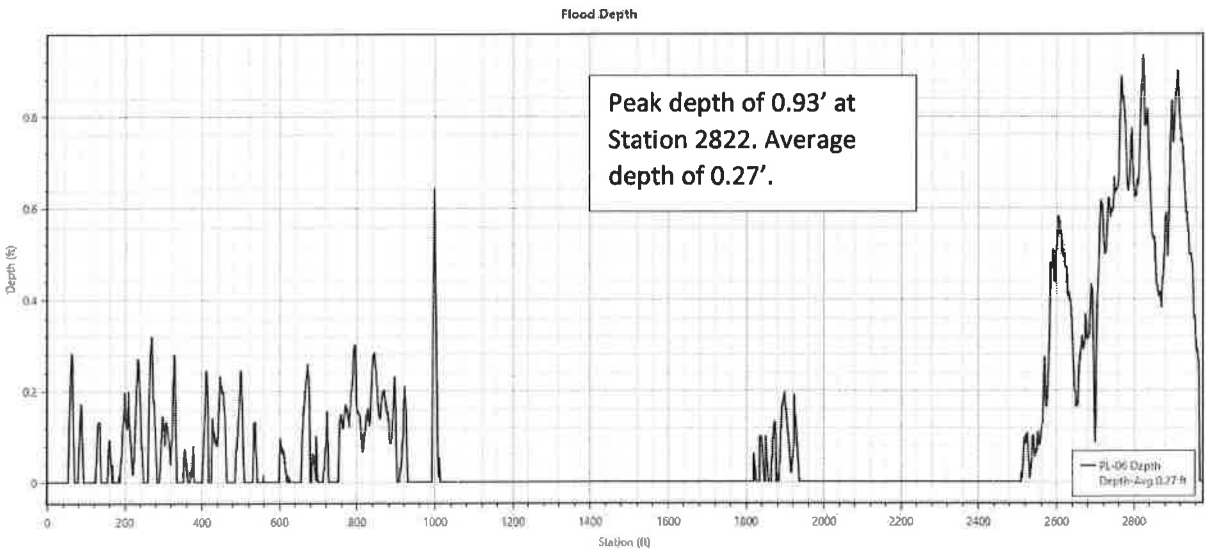
Trapezoidal Channels						
Sub-Basin	Reach	Station	L slope	Base Width (ft)	R slope	Avg Slope
232	R1	1	0.04	205	0.22	0.13
		2	0.07	364	0.44	0.25
		3	0.32	465	0.61	0.47
		4	0.28	231	0.27	0.28
		5	1.13	327	0.19	0.66
		6	0.83	711	0.45	0.64
		7	0.21	216	0.33	0.27
		8	0.21	182	0.15	0.18
		9	1.29	326	0.29	0.79
		Average	0.39	338	0.33	0.41
232	R2	1	0.25	314	0.29	0.27
		2	0.26	692	1.35	0.80
		3	0.35	108	0.29	0.32
		4	0.37	488	0.40	0.39
		5	0.37	596	0.12	0.25
		6	0.09	308	0.28	0.19
		Average	0.28	418	0.46	0.37
232	R3	1	0.40	400	0.37	0.38
		2	0.07	308	0.60	0.34
		3	0.30	167	0.23	0.27
		4	0.79	609	0.08	0.43
		5	0.12	308	1.67	0.90
		6	0.22	308	1.48	0.85
		7	1.61	720	0.60	1.11
		8	0.21	348	0.34	0.28
		Average	0.47	395.78	0.67	0.57
332	R4	1	0.17	432	0.27	0.22
		2	0.24	157	0.69	0.46
		3	0.11	245	0.68	0.40
		4	0.19	432	0.48	0.34
		5	1.31	308	0.16	0.74
		6	1.19	692	0.68	0.94
		7	0.02	273	0.23	0.12
		8	0.35	308	0.31	0.33
		9	0.22	308	0.27	0.25
		10	0.38	348	0.22	0.30
		11	0.22	178	0.77	0.50
		12	0.12	348	1.03	0.57
		13	0.20	320	1.18	0.69
		14	0.05	308	1.16	0.60
		15	0.13	1077	0.11	0.12
		Average	0.33	382	0.55	0.44
172	R5	1	0.32	615	1.07	0.70
		2	0.99	640	1.55	1.27
		3	0.34	320	0.36	0.35
		4	0.23	186	1.16	0.69
		5	0.10	261	0.17	0.13
		6	0.36	500	0.30	0.33
		7	0.02	615	0.66	0.34
		8	0.17	348	0.21	0.19
		9	0.59	653	0.20	0.40
		10	0.35	340	0.37	0.36
		Average	0.35	448	0.60	0.48

Triangular Channels						
Sub-Basin	Reach	Station	Height (ft)	L Slope	R Slope	Avg Slope
236	R6	1	11	0.24	0.13	0.18
		2	9	0.11	0.06	0.08
		3	6	0.07	0.06	0.06
		4	21	0.27	0.27	0.27
		5	8	0.08	0.08	0.08
		Average	11	0.15	0.12	0.14

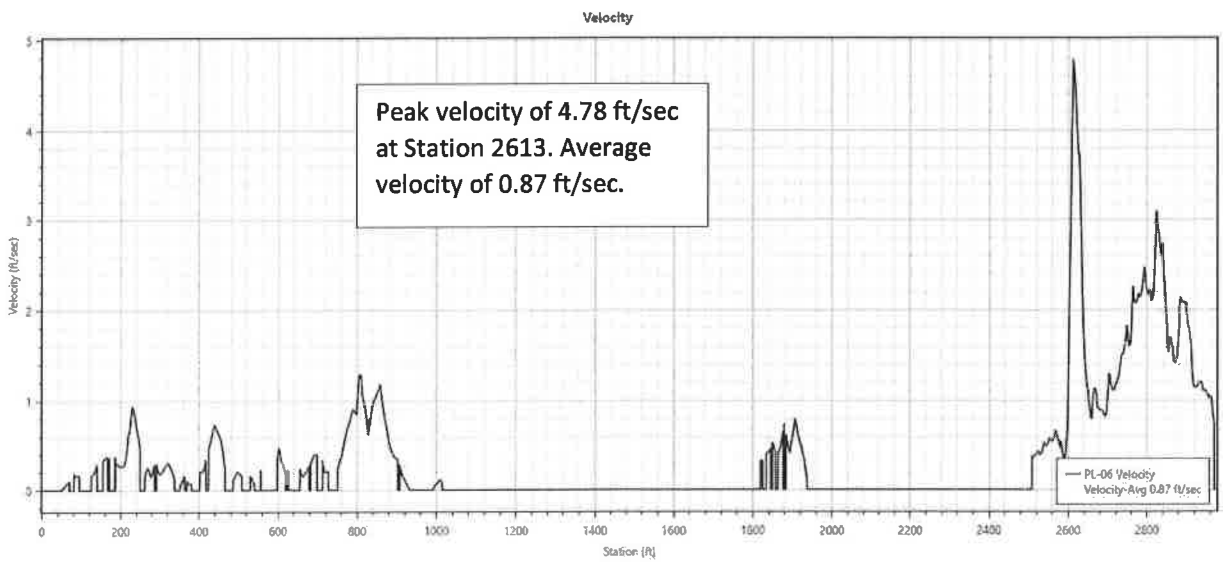
Appendix D: Proposed Conditions

PROPOSED CONDITIONS – 7239.4 cfs Peak - There is no water on the Agromin Property or the property to the north and it does not overtop Highway 126 to the north.

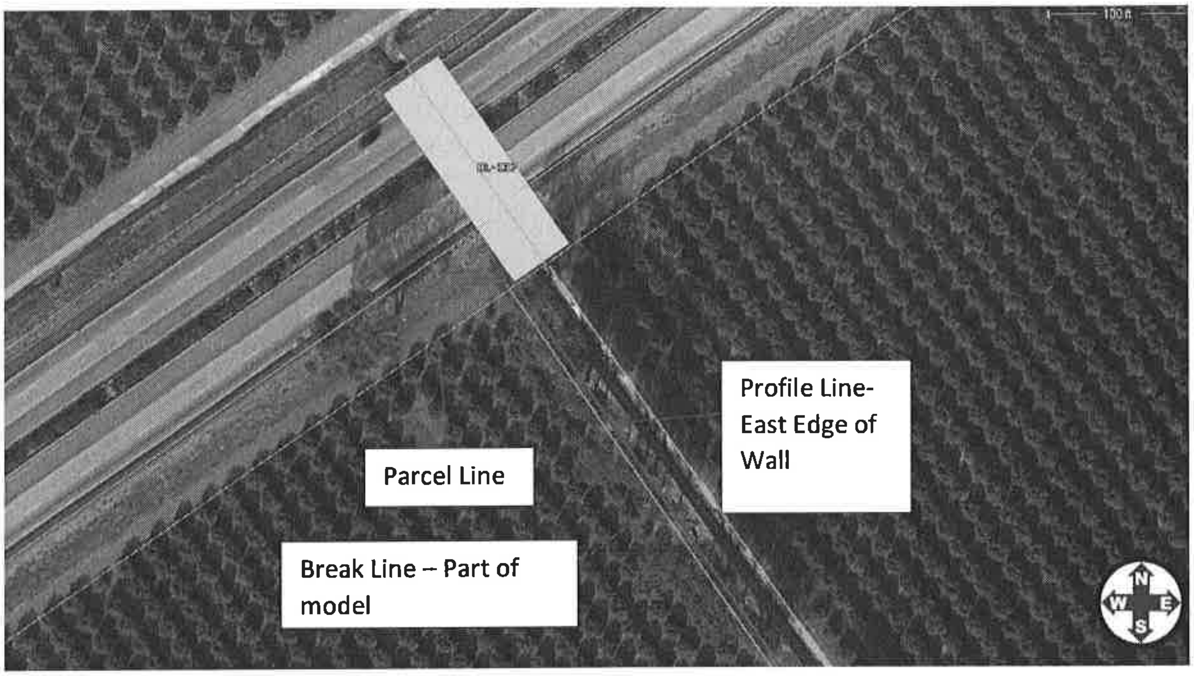
Flood depth along proposed wall at Station 2822.



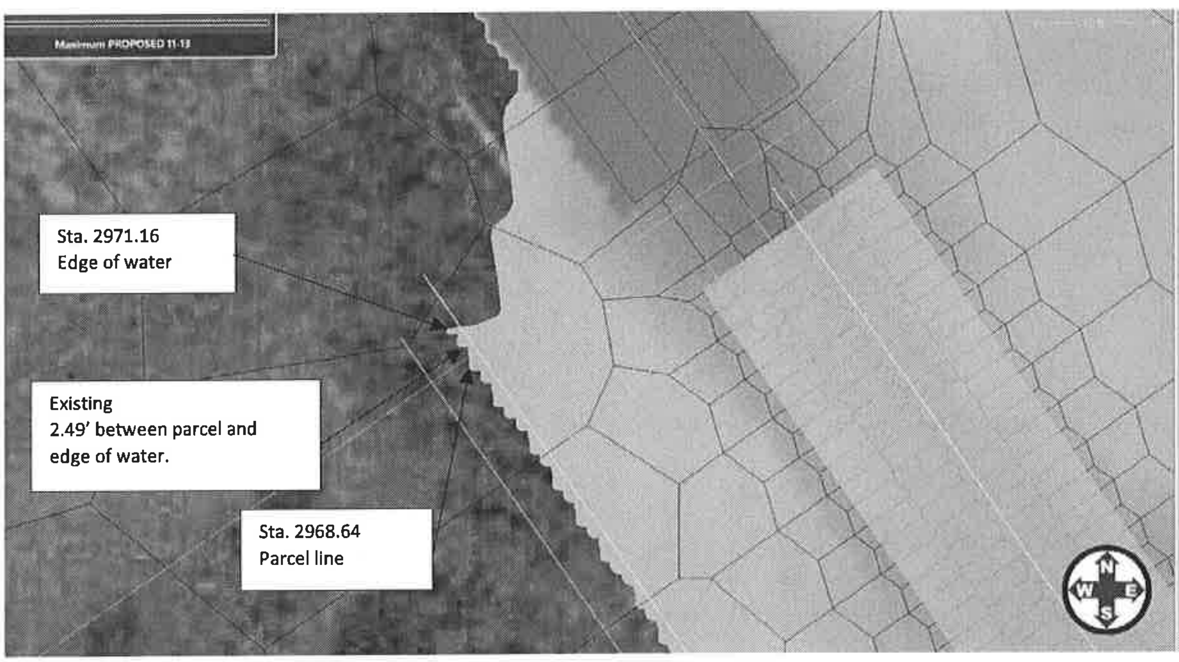
Velocity along proposed wall at Station 2613.



Detail of Double Box culvert under Hwy 126:

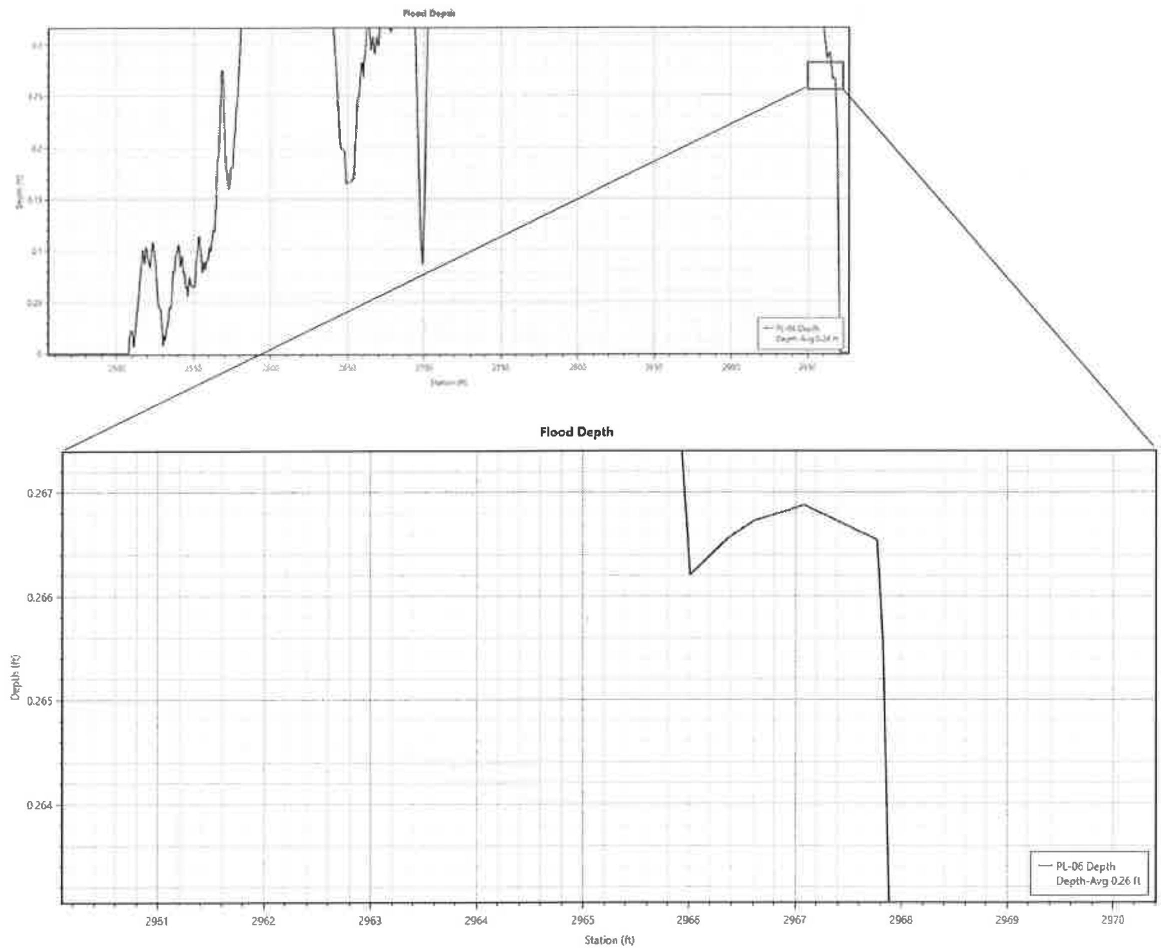


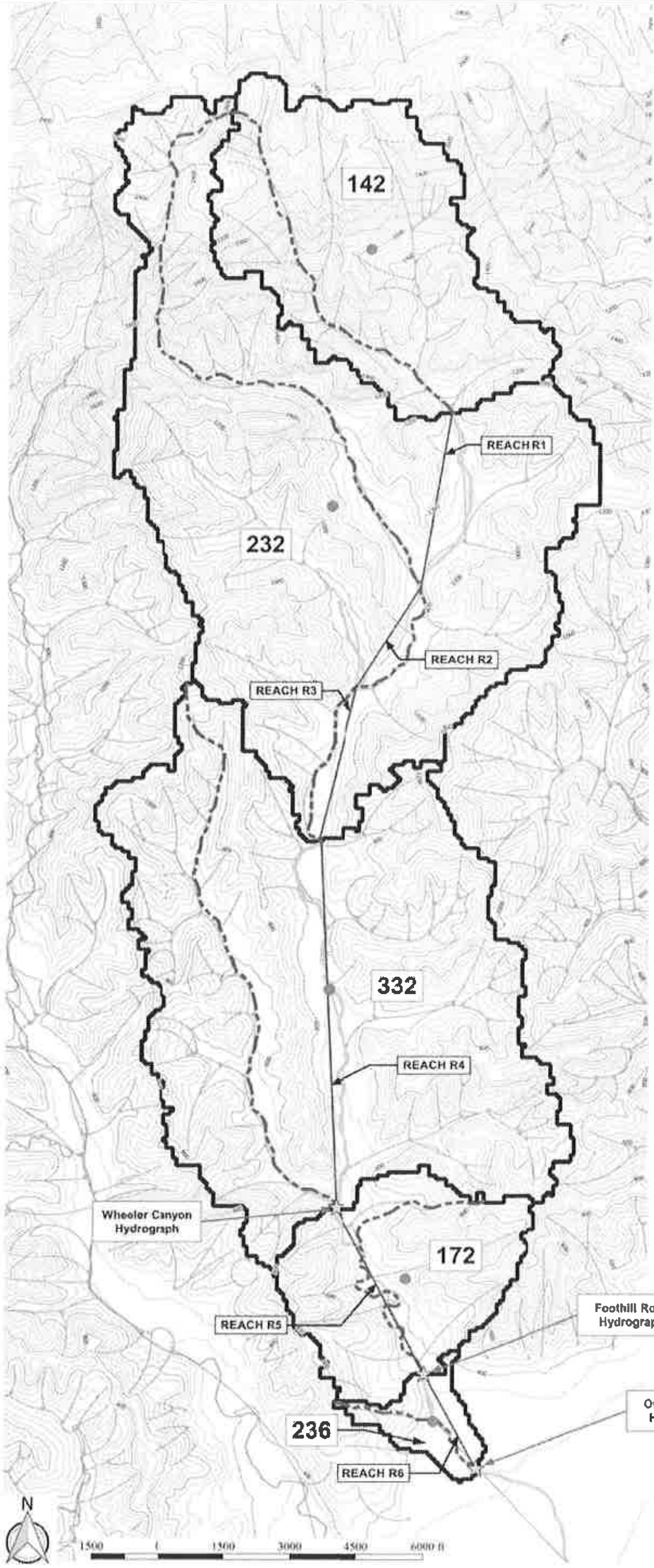
Detailed view of end of wall with parcel line:



The current has the wall extending to culvert to the 208' contour line. This is approximately 8' beyond the parcel line. This prevents any water to flow on to the Agromin property.

Flood depth at Station 2968.64 under proposed conditions.





Legend

- Todd Barranca
- Sub-Basin Longest Flow Path
- Todd Barranca Reach
- Overland Water Flow Path
- 40-foot Elevation Contours
- Sub-Basin Centroid
- Hydrograph Location
- Todd Barranca Watershed Sub-Basin Boundary

Sub-Basin Location	Elevation (ft)	100-Year Rainfall (in)	CA Zone 5 State Plane Coordinates (US ft) Northing	Easting
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Sub-Basin	Elevation (ft)	100-Year Rainfall (in)	CA Zone 5 State Plane Coordinates (US ft) Northing	Easting
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Sub-Basin	Area (mi^2)	Cumulative Area (mi^2)
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Total		[illegible]

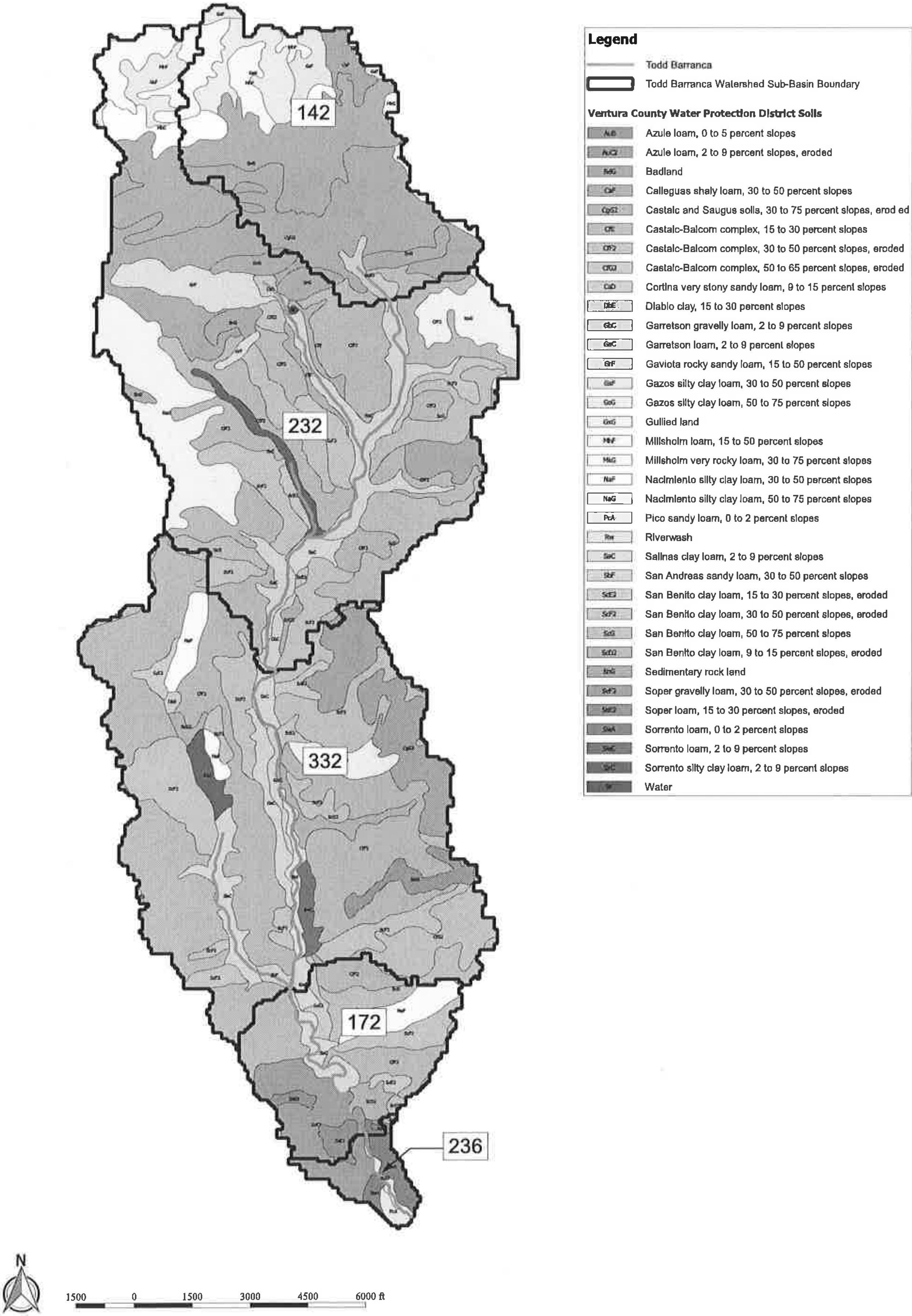
Sub-Basin	Reach	Length (ft)	[illegible] Elevation (ft)	Slope	[illegible]
[illegible]	R1	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	R2	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	R3	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	R4	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	R5	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	R6	[illegible]	[illegible]	[illegible]	[illegible]

Sub Basin	Longest Flowpath Length (mi)	Longest Flow Path to Centroid (mi)	Basin S1 Slope (ft/mi)	Basin N Factor	Elongation Ratio	Southern California Flood Exponent	Lag Time (hr)
142	1.7601	0.8842	691.154	0.055	0.2196	0.38	0.4509
232	13.1357	1.8881	150.177	0.045	0.0473	0.38	1.4118
332	2.6196	1.0657	193.663	0.045	0.2246	0.38	0.5866
172	1.5795	0.5079	190.422	0.045	0.1642	0.38	0.3663
236	0.7479	0.3125	256.063	0.055	0.1725	0.38	0.2650

NextGen
Harrison

TODD BARRANCA
VENTURA COUNTY, CA
HYDROLOGY MAP

SHEET NUMBER
1 OF 5



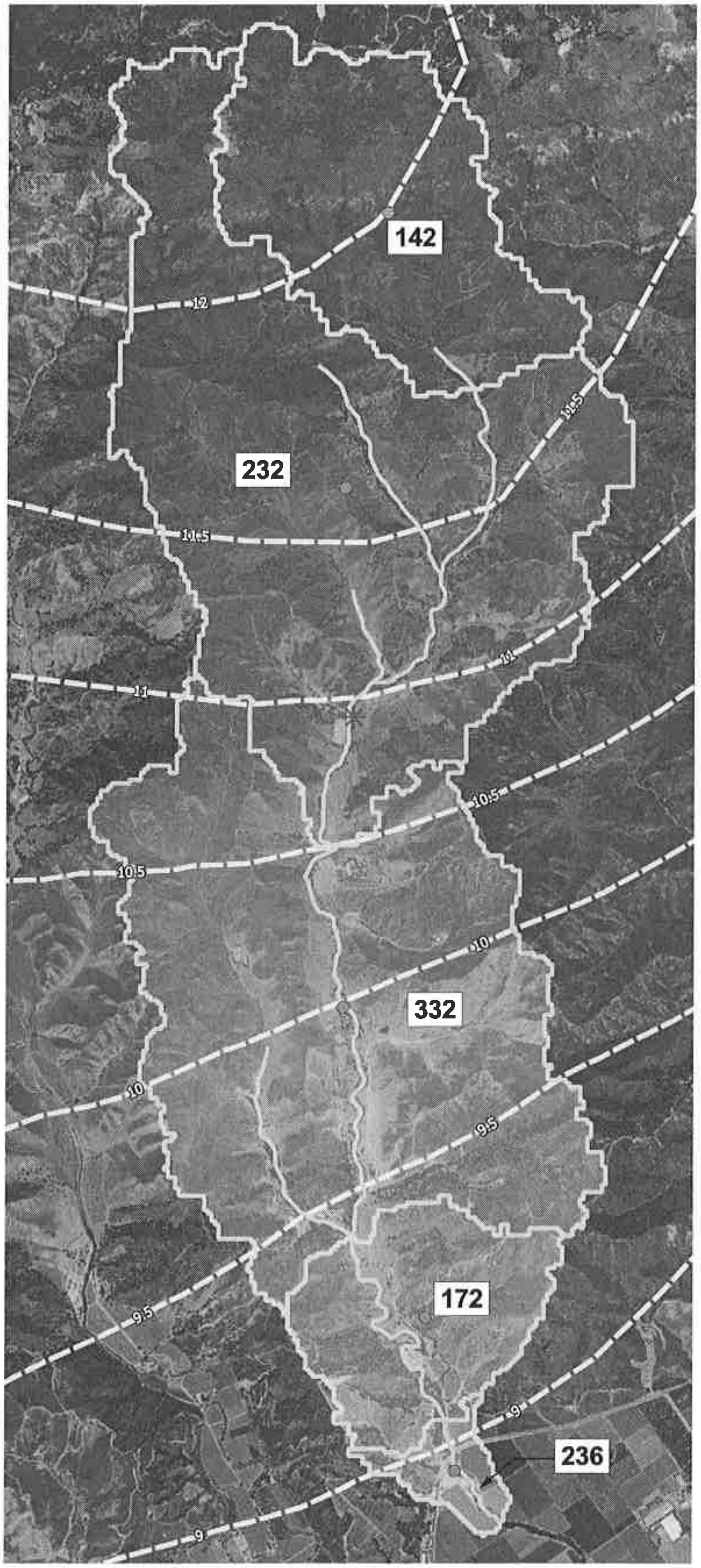
PREPARED BY: NextGen

DESIGNED BY:
DRAWN BY:
CHECKED BY:

Harrison

TODD BARRANCA
VENTURA COUNTY, CA
SOILS MAP

SHEET NUMBER
2 OF 5



Legend

- Watershed Centroid
- Sub-Basin Centroid
- 24-Hour 100-Year Rainfall Isohyets (Inches)
- Todd Barranca
- Todd Barranca Watershed Sub-Basin Boundary

Todd Barranca Watershed Centroid				
Sub-Basin Location	Elevation (ft)	100-Year Rainfall (in)	CA Zone 5 State Plane Coordinates (US ft)	
			Northing	Easting
232	720	10.93	1961481.948	6215420.577

Sub-Basin Centroids				
Sub-Basin	Elevation (ft)	100-Year Rainfall (in)	CA Zone 5 State Plane Coordinates (US ft)	
			Northing	Easting
142	1693	12.00	1972055.124	6215985.978
232	1120	11.60	1966291.284	6215106.586
332	562	9.99	1955394.895	6215082.197
172	521	9.23	1948883.711	6216834.184
236	353	8.95	1945672.572	6217470.209

Sub-Basin	Longest Flowpath Length (mi)	Longest Flow Path to Centroid (mi)	Basin S3 Slope (ft/mi)	Basin N Factor	Elongation Ratio	Southern California Flood Exponent	Lag Time (hr)
142	1.7601	0.8842	601.154	0.055	0.2190	0.38	0.4509
232	13.1357	1.8881	150.177	0.045	0.0473	0.38	1.4116
332	2.6196	1.0657	193.665	0.045	0.2246	0.38	0.5866
172	1.5795	0.5079	190.472	0.045	0.1842	0.38	0.3663
236	0.7479	0.3129	236.063	0.055	0.1725	0.38	0.2650

N

1500 0 1500 3000 4500 6000 ft

DATE: 11/16/2018

NextGen

DESIGNED BY: Sara Hardee

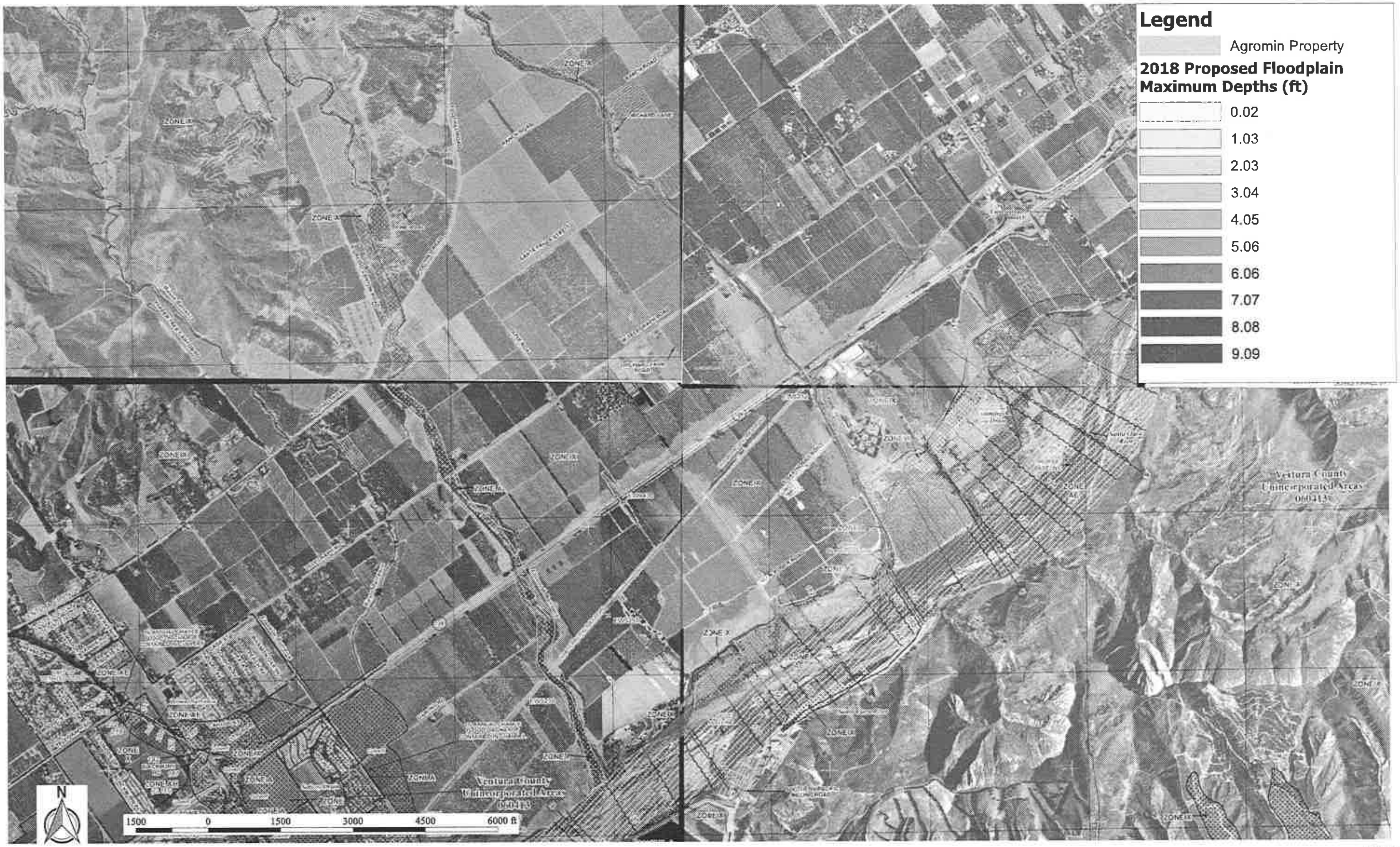
DRAWN BY: Sara Hardee

CHECKED BY:

Harrison

TODD BARRANCA
VENTURA COUNTY, CA
ISOHYET MAP

SHEET NUMBER
3 OF 5



DATE 11/18/2019

PREPARED BY
NextGen ENGINEERING

DESIGNED BY: Sam Harber
DRAWN BY: Sam Harber
CHECKED BY: Bill O'Brien

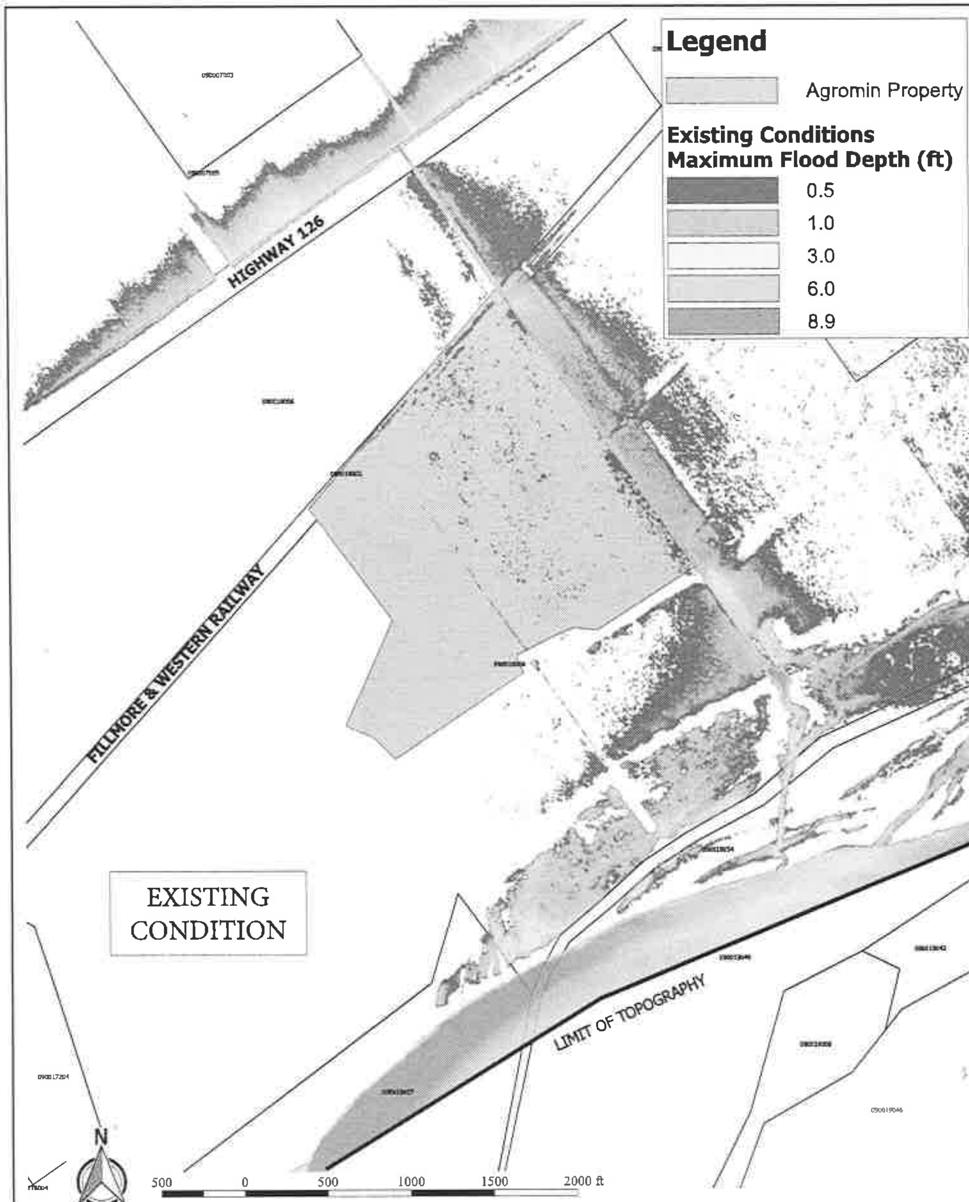
Harrison
EJ Harrison & Sons, Inc.

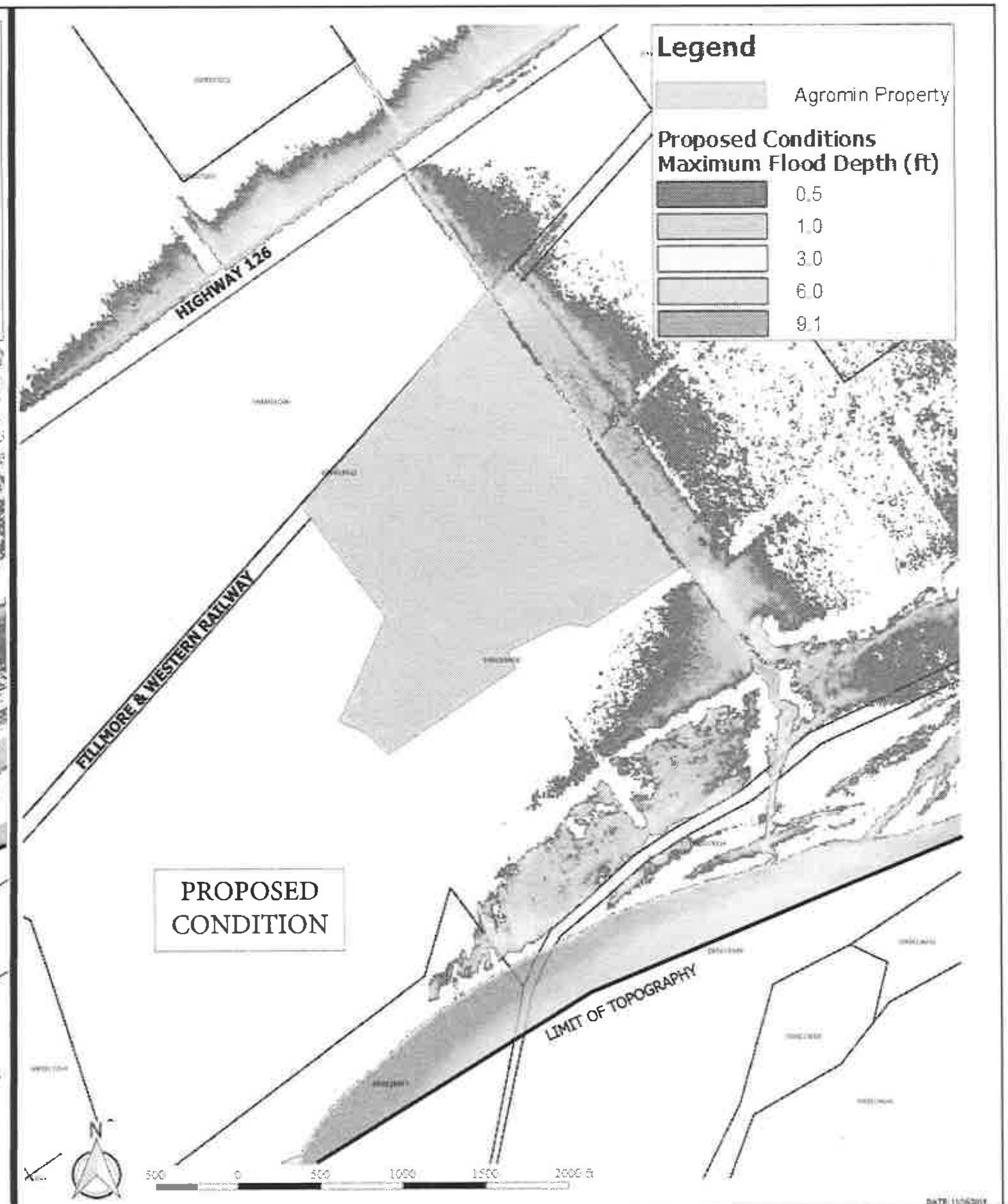
TODD BARRANCA VENTURA COUNTY, CA

PROPOSED CONDITION ANNOTATED FIRM WITH CURB

SHEET NUMBER

4 OF 5





NextGen ENGINEERING

Harrison

EJ Harrison & Sons, Inc.

TODD BARRANCA VENTURA COUNTY, CA

PROPOSED vs EXISTING CONDITIONS

SHEET NUMBER

5 OF 5