Appendix E

Hydrology Study/Water Quality Plan

Hydrology Study/ Water Quality Plan

FOR

APN 7567-013-005
77 Portuguese Bend Road
Rolling Hills, CA 90274

Prepared by:

P.A. Arca Engineering, Inc.
500 E. Carson Plaza Drive, Suite 201
Carson, CA 90746

For Owner:

Wei-min Shen, Ph.D.
Ying Sai, Ph.D.
P.O. Box 3996
Palos Verdes Estates, California 90274

Revision Date: April 23, 2021
First Submittal Date: November 2016

Table of Contents

Section 1.0 – Purpose

The purpose of this study is to evaluate and determine the storm water runoff quantities for the proposed development located at 77 Portuguese Bend Road in the City of Rolling Hills.

The objectives of this study include the following:

1. Prepare a hydrologic analysis of the existing and proposed onsite watershed condition based on land uses, drainage patterns, ground slopes, and soil types to generate a 25-year storm event.

2. Analyze potential physical environmental effects related to drainage and hydrology, water quality, and flood hazards that may occur due to the proposed development.

3. Demonstrate that the proposed drainage system will provide adequate flood protection for the proposed project without adversely impacting existing facilities or adjacent properties.

4. To document that the Low Impact Development (LID) requirements of Los Angeles County will be met.

Section 2.0 – Project Location

The proposed development consists of 19.84 acres of undeveloped land. The entrance to the site is located at the southwest corner of Portuguese Bend Road and Pinto Road in the City of Rolling Hills. The site is bounded by residential areas to the northeast of the property, Paintbrush Canyon Creek immediately northwest of the property, Klondike Canyon Creek approximately 200 feet southeast of the property, and the Portuguese Bend Reserve to the west. The access road to the site is between APN 7567-013-008 and APN 7567-013-011. The access of the road is composed of mostly unpaved dirt road. The location of the proposed residential development sits on top of a high point and is somewhat flat. The entire site as a whole generally slopes downwards to the southwest. The proposed development consists of the construction of a single family residence with an attached guest house, including a pool area and trellis.

Section 3.0 – Hydrologic Parameters

<u>3.1 – Rainfall</u>

Rainfall data was taken from the County of Los Angeles 2006 Hydrology Manual and the Los Angeles County GIS Hydrology Map accessible from the internet. All referenced plates and tables can be found in Appendix A. The project area rainfall is shown on Plate 1-H1.2 (San Pedro) of the Hydrology Manual. The 50-year rainfall depth at the project site is:

50-Year Rainfall = 4.90 inches.

The system will be designed for a 25-year storm so the 50-year rainfall depth must be adjusted by the appropriate factor from Table 5.3.1 of the Hydrology Manual. From Table 5.3.1 the 25 year adjustment factor = 0.878. The 25-year rainfall depth at the project site becomes:

25-Year Rainfall = 4.90 x 0.878 = 4.30 inches.

3.2 – Soil Type

Soils data is also shown on Plate 1-H1.2. The soils number for the project location is 002. The Runoff Coefficient Curve for Soil No. 20 can be found in the Hydrology Manual, also located in Appendix A.

3.3 – Land Use

3.3.1 – Existing Land Use

The existing land use of the site is completely undeveloped. Natural slopes and ground cover are present throughout the project site. Dirt hiking trails are located throughout the site to assist pedestrians in traveling through Portuguese Bend Reserve.

3.3.2 – Proposed Land Use

The project composes of a small 1-story single family residence. A guest house will be located southwest of the main residence, with a pool area and man-made pond in between the two structures. A trellis will be constructed north of the main residence.

3.4 – Flooding

According to the most recent Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) for the Project site, the site is in a Zone X designation. When an area is designated Zone X, if falls under one of the three categories:

- Areas of 0.2% annual chance of flooding
- Areas of 1% annual chance of flooding with average depths of less than 1 foot or drainage areas less than 1 square mile
- Areas protected by levees from 1% annual chance of flooding.

These maps do not determine whether or not flooding will occur but offers the chance of flooding occurrence. Again, any location has the potential to flood and while the project site is outside of the floodplain and the elevation sits relatively high it should be noted that the map does not identify all areas subject to flooding. Appendix C contains a copy of the latest FEMA mapping taken from FIRM panels 06037C2026F with an effective date of September 26, 2008. See Appendix A for FEMA Map.

3.5 – Basin Parameters

Watershed drainage areas and drainage patterns were defined based upon analyzing the prepared geological contour maps provided in the *Preliminary Geologic Investigation of the Proposed Residence at #77 Portuguese Bend Road, Rolling hills, California* prepared by Coast Geotechnical, Inc., dated May 5, 2012 and the United States Geological Survey (USGS) topographic map of the San Pedro and Torrance quadrangles.

3.5.1 – Existing Site Conditions

The drainage on-site is currently uncontrolled. The runoff will be divided into eight subareas labeled A to H. Runoff is coming on-site from two separate areas. The first area is primarily consists of sheet flow from the hills located northwest of the project site which is labeled Subarea B. The second area consists of sheet flow from the Portuguese Bend Road which is labeled to be Subarea H. It is understood that a poor drainage system was implemented in that area of the City of Rolling Hills. During heavy or peak rainfall events a substantial amount of rain from the street (Subarea H) is conveyed down the access road (Subarea B) and continues southwest, following the natural grade through the project site (Subarea A). Runoff continues to flow southwest along the Burma Road Trail until it descends at the end of ridge down the hillside (Subarea F). At the bottom of the hill the water will eventually flow into Klondike Canyon Creek. See Appendix A for a map of the existing hydrological conditions on and adjacent to the site.

3.5.2 – Proposed Site Conditions

Subareas A, B, C, and D are tributary to the project site. Subarea A is the equivalent of Subarea H in the existing condition. Runoff from Subarea A sheet flows into the proposed access driveway, Subarea C. All runoff from the access driveway is captured via storm drain pipe at the entrance gate of the private property. No runoff from the access driveway shall reach the private property site. Subarea B is defined as the portion of runoff from the upstream side of the access driveway. This runoff will be captured by concrete gutters upstream of the access driveway, and conveyed via a Smartditch system near the private property entrance. Subarea D is the private property of the project, which includes the main house, the guest house, the pool area and trellis. All runoff associated with impervious surfaces of Subarea D will be capture and treated via stormwater planter boxes and trench drains located on-site. All runoff from Subarea D will be captured and conveyed to dispersal basins surrounding the perimeter of the property. Refer to Section 4 for more information regarding the proposed stormwater planter boxes. See Appendix B for the map of the proposed conditions after project completion.

3.5.3 – Time of Concentration

The time of concentration was calculated using the HydroCalc program of the LA County Hydrology Manual. The HydroCalc program gives the time of concentration (Tc), peak flow (Qpeak), and runoff volume from the site. The outputs from the HydroCalc program can be found in Appendix B.

3.6 – 25-Year Storm Results

The hydrology calculations were prepared using the Los Angeles County HydroCalc Calculator, which utilizes the modified rational method in accordance with the LACDPW Hydrology Manual. The calculations analyze the 25-year flow rates for both existing and proposed conditions. The results are summarized in Table 1 below:

Table 1. 25-Year storm peak flow and volume results

Sub-Area (Existing)	Area (acres)	25-Yr Q_{peak} (cfs)
A	**1.28**	**2.58**
B	**5.65**	**12.48**
C	8.31	16.75
D	8.56	17.26
E	5.46	11.01
F	2.74	6.08
G	0.65	1.44
H	**2.76**	**6.16**
Sub-Area (Proposed)	Area (acres)	Peak Flow Rate (cfs)
A	**2.76**	**6.16**
B	**4.35**	**7.54**
C	0.67	1.24
D	1.87	4.25

The project will be affected by runoff from proposed subareas A, B, C and D. All other subareas from the existing condition will be untouched and undisturbed during construction to preserve he natural course of water drainage in those subareas. There is impervious area in existing subarea H but no change flow will occur during construction since there will be no addition or removal of impervious surfaces in that area so no increase is to be expected.

Section 4.0 – Stormwater Quality Management

4.1 – Standards and Objects

According to Chapter 8.32 of the City of Rolling Hills Municipal Code, this project is required to comply with the requirements set forth by the Municipal National Pollutant Discharge Elimination System (NPDES) Permit. Typically, single-family hillside residential developments located in an area with known erosive soil conditions are exempt from having to capture and treat the calculated design stormwater volume. However, since the proposed project disturbs an area greater than one acre and adds more than 10,000 square feet of impervious surface, the design and implementation of LID Best Management Practices (BMPs) is required.

The storm water quality design volume (SWQDv) that must be captured and treated by the LID BMPs is calculated based on either the 85^{th} percentile 24-hour rainfall or the 0.75-inch, 24-hour rainfall (whichever one is greater), and the impervious and pervious surface area of the proposed development. However, thru an agreement with the City of Rolling Hills, the design of the LID BMP for this project will be required to account for only the impervious areas of the proposed development, which consist of the roof of the proposed home and guest house, as well as impervious area from the proposed pool area. Additionally, the following measures must be implemented for single-family hillside residential developments:

- Conserve natural area;
- Protect slopes and channels;
- Provide storm drain system stenciling and signage; and
- Divert roof runoff and surface flow to vegetated areas before discharge unless the diversion would result in slope instability.

4.2 – SWQDv Calculations

Using the LA County 85th Percentile Precipitation Isohyet Map, the 85th percentile, 24-hour rain event for the project site is determined to be 1.0 inches. Since this is greater than 0.75 inches, the 85th percentile, 24-hour rain event will be used to determine the SWQDv.

The catchment area and SWQDv are determined using the equations from the *Developer Technical Information for Projects within the City of Rolling Hills* prepared by Geosyntec Consultants, dated April 2014. The equations and table shown below summarize the Design flow rate and volume.

$$\text{Catchment Area } [ft^2] = (\text{Impervious Area } [ft^2] \times 0.9) + (\text{Pervious Area } [ft^2] \times 0.1)$$

$$\text{SWQDv } [ft^3] = \text{Catchment Area } [ft^2] \times \text{Project Design Storm } [in] \times 0.083 \text{ } [ft/in]$$

$$V_{SP} = 1.5 * \text{SWQDv}$$

Table 2. Runoff Calculations for Impervious Areas of Project Site

BMP ID	Tributary Area (ft^2)	Impervious-ness (%)	Project Design Storm, 85th Percentile (in)	Storm Water Quality Design Volume SWQDv (ft^3)	Biofiltration Volume, V_{SP} Required (ft^3)
P.B. #1	5,428	100%	1.0	411	617
P.B. #2	7,781	100%	1.0	584	876
P.B. #3	2,873	100%	1.0	215	323
P.B. #4	1,273	100%	1.0	95	143
P.B. #5	1,273	100%	1.0	103	155

4.3 – Proposed Stormwater Management System

Because the site is known to have erosive soil conditions and is surrounded by potential geotechnical hazards, the design and implementation of infiltration-based LID BMPs and the retention of 100% of the calculated SWQDv on site are not feasible. As a result, stormwater planter boxes, a vegetation-based LID BMP, shall be used to capture and treat the calculated SWQDv for this project. Per the requirements of the Los Angeles

County Low Impact Development Standards Manual, stormwater planter boxes must be sized to treat 1.5 times the volume of the calculated SWQDv. Appendix E of the Los Angeles County Low Impact Development Standards Manual contains a fact sheet with general operational and maintenance procedures about the stormwater planter box (VEG-2). The VEG-2 fact sheet is provided in Appendix C of this report.

A total of five stormwater planter boxes are proposed for this project. The runoff from the proposed impervious surfaces shall be collected and drained directly to the planter boxes, which shall be designed to ensure that all water would be drained within 96 hours. Each stormwater planter box shall be designed according to the latest Los Angeles County LID manual. The calculations used to size each planter box are provided in Appendix B. Once filtered through the media within the stormwater planter box, the treated water will be collected via underdrain and conveyed to another area of the project site where it would be disposed of in a non-erosive drainage device. In the event stormwater runoff increases overtime and to reach the peak runoff, the excess runoff of the 85th percentile rain volume will overflow the proposed atrium grate to act as a relief and to avoid flooding over the stormwater planter box.

4.4 – Hydromodification

Hydromodification requirements are exempted since there is no natural drainage systems tributary to the project site and the proposed project is a single-family home that is proposed to incorporate LID BMPs in accordance with the LID Standards Manual of LACDPW.

Section 5.0 – Inspection/Maintenance Responsibilities

All proposed drainage and LID facilities on-site will be maintained by the owner of the project unless otherwise noted.

Section 6.0 – Limitations

The concepts, findings, and interpretations contained in this report are intended for the exclusive use of Wei-Min and Ying Sai Shen and their authorized representatives for the specific application to the referenced property. This report is to serve as a guide in the planning process in the development of the single family residence with attached guest house. The assumptions and finding in this report were developed solely for initial recommendations for the planning of proposed development and as an aid to more detail civil engineering work. Further, it is anticipated that this report will require coordination, review, and approval with the representatives of the City of the Rolling Hills and/or Los Angeles County prior to initiation of the final design.

Work for this project was performed and this report prepared in accordance with generally accepted professional practices for the nature and conditions of the work completed in the same or similar localities, at the time the work was performed. This report was prepared in May 2016 and is based on the conditions encountered and information reviewed at the time of preparation. P. A. Arca Engineering, Inc. (AEI) disclaims responsibility for any changes that may have occurred after this time. Any design changes should be coordinated and reviewed by AEI in order to update the report if necessary. This report does not represent legal advice. Legal advice can only be given qualified legal practitioners. No other warranty, expressed or implied is made. No responsibility is accepted for the use of any part of this report in any other context or for any other purpose.

Where this report indicates that information has been provided to AEI by third parties, AEI has made no independent verification of this information of this information except as expressly stated in the report. AEI assumes no liability for an inaccuracy in or omission to that information.

Except as required by law, no third party may use or rely on this report unless otherwise agreed with AEI in writing. Where such agreement is provided, AEI will provide a letter of reliance to the agreed third party in the form required by AEI. This report should not be used for any other purposed without great care, updating, review of analytical methods used, and the consultation with AEI staff familiar with the site. It is the responsibility of third parties to independently make inquiries or seek advice in relation to their particular requirements and proposed use of the site.

Section 7.0 – References

Los Angeles County Department of Public Works Hydrology Manual, January, 2006

County of Los Angeles Department of Public Works Low Impact Development Standards Manual, February, 2014

Geosyntec Consultants, *Developer Technical Information for Projects within the City of Rolling Hills*, April, 2014

Coast Geotechnical, Inc., *Preliminary Geologic Investigation of Proposed Residence at #77 Portuguese Bend Road, Rolling Hills, California*, May, 2012

APPENDIX A

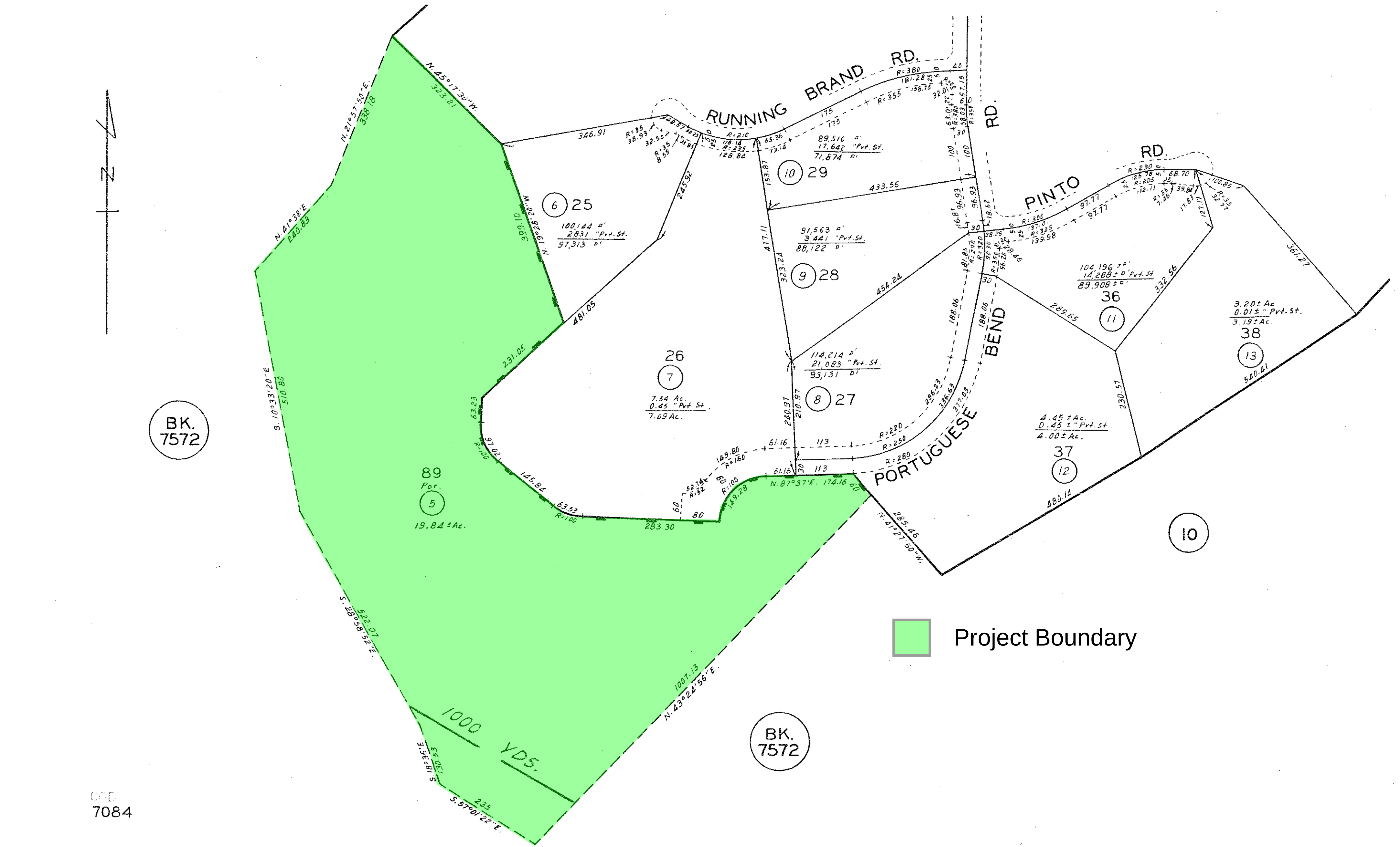
MAPS

Hydrology – Existing/Proposed/LID

FEMA

Assessors Map

Figure A-1 - Los Angeles County Assessor's Map



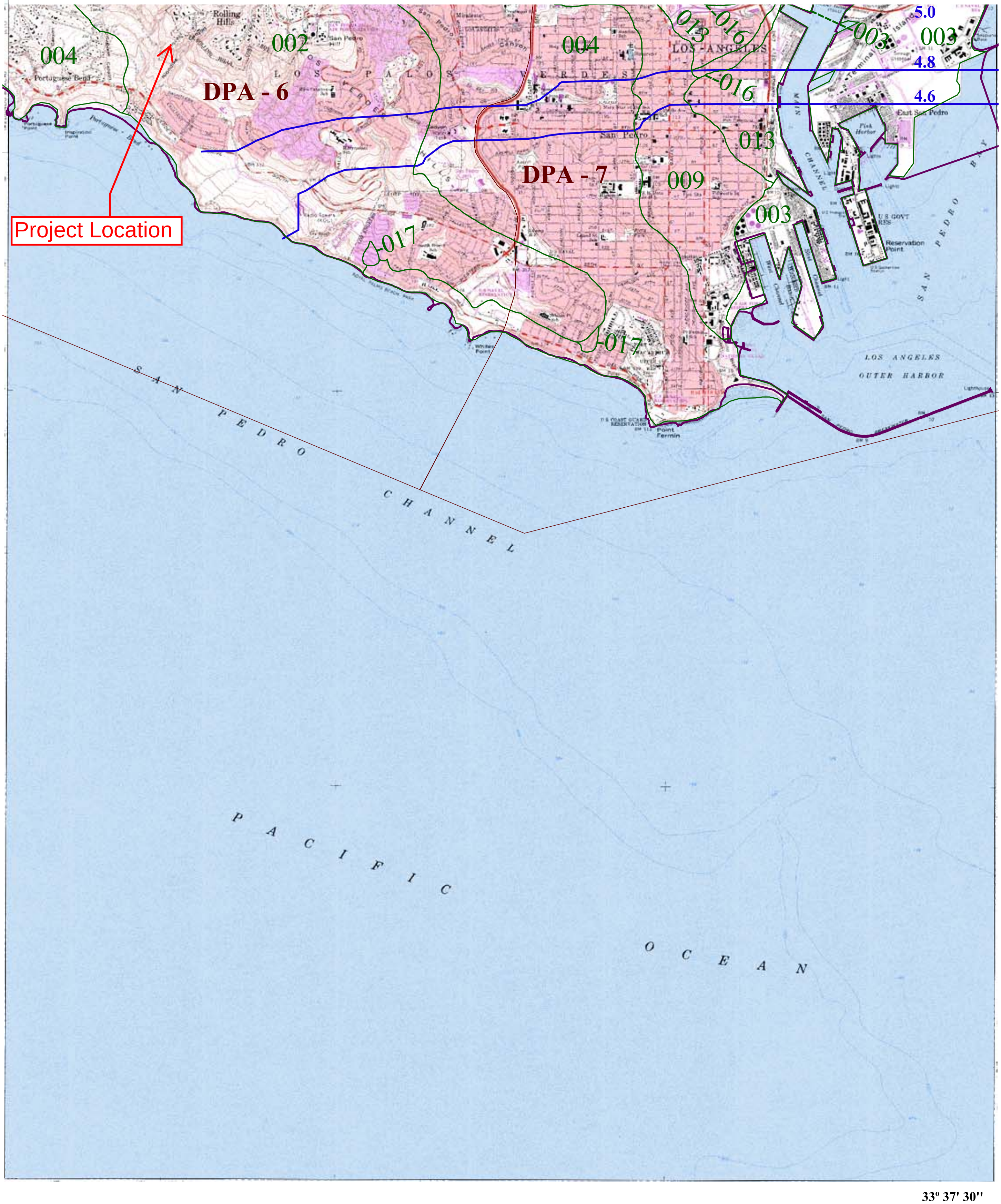
RECORD OF SURVEY R.S. 57-4-8

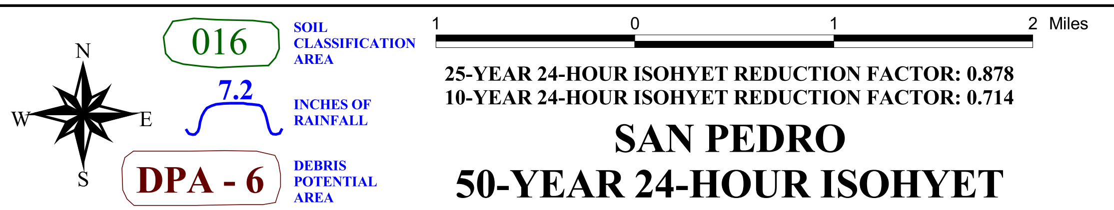
L.A.C.A. MAP NO. 51 A.M. 1-1

FOR PREV. ASSM'T SEE: 7571 - 20, 22 & 24

ASSESSOR'S MAP
COUNTY OF LOS ANGELES, CALIF.

Figure A-2 - LACDPW 50-Year, 24-Hour Rainfall Isohyet Map No. 1-H1.2 (San Pedro)





25-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.878
10-YEAR 24-HOUR ISOHYET REDUCTION FACTOR: 0.714

SAN PEDRO

50-YEAR 24-HOUR ISOHYET

1-H1.2

LOS ANGELES COUNTY PUBLIC WORKS Public Service That Works

Figure A-3 - LACDPW 85th Percentile, 24-Hour Rainfall Isohyet Map

Figure A-4 - LACDPW Runoff Coefficient Curve for Soil Type No. 002

$C_D = (0.9 * IMP) + (1.0 - IMP) * C_U$

Where: C_D = Developed Runoff Coefficient

IMP = Proportion Impervious

C_U = Undeveloped runoff coefficient

Los Angeles County Department of Public Works

RUNOFF COEFFICIENT CURVE
SOIL TYPE NO. 002

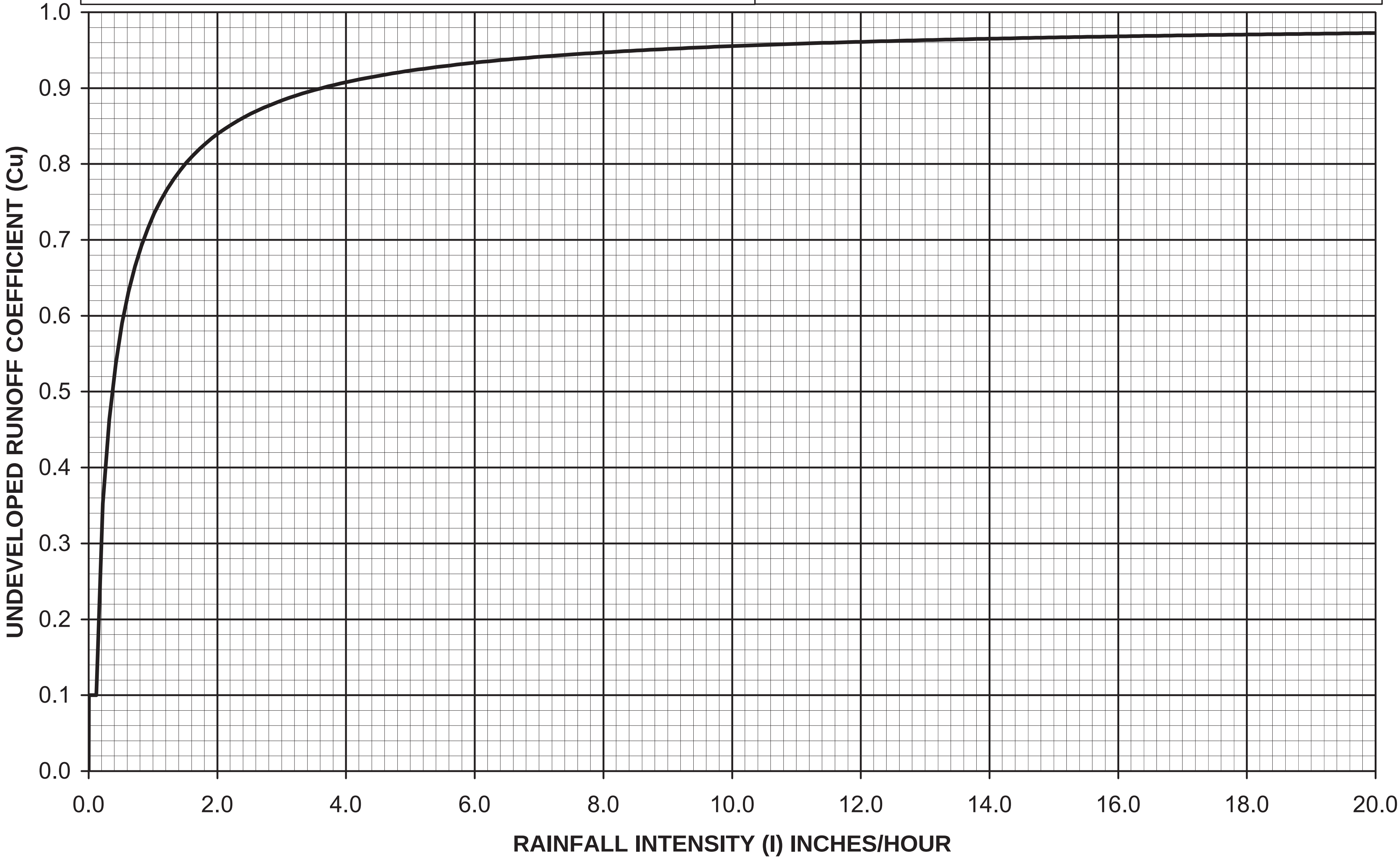


Figure A-5 - FEMA FIRM Map No. 06037C2026F (Effective September 26, 2008)

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole–foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures.** Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Universal Transverse Mercator (UTM) zone 11. The **horizontal datum** was NAD83, GRS1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum.** For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC–3, #9202
1315 East–West Highway
Silver Spring, MD 20910–3282

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713–3242,** or visit its website at http://www.ngs.noaa.gov/.

Base map information shown on this FIRM was derived from U.S. Geological Survey Digital Orthophoto Quadrangles produced at a scale of 1:12,000 from photography dated 1994 or later and from National Geospatial Intelligence Agency imagery produced at a scale of 1:4,000 from photography dated 2003 or later.

This map reflects more detailed and up–to–date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables *in the Flood Insurance Study report (which contains authoritative hydraulic data*) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de–annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

Contact the **FEMA Map Service Center** at 1–800–358–9616 for information on available products associated with this FIRM. Available products may include previously issued Letters of Map Change, *a Flood Insurance Study report*, and/or digital versions of this map. The FEMA Map Service Center may also be reached by Fax at 1–800–358–9620 and its website at http://www.msc.fema.gov/.

If you have **questions about this map** or questions concerning the National Flood Insurance Program in general, please call **1–877–FEMA MAP** (1–877–336–2627) or visit the FEMA website at http://www.fema.gov/.

LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Area formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

1% annual chance floodplain boundary
0.2% annual chance floodplain boundary
Floodway boundary
Zone D boundary
CBRS and OPA boundary
Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.

513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988 (NAVD 88)

A — A	Cross section line
23 - - - 23	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83)
$^{42}75^{000m}$N	1000-meter Universal Transverse Mercator grid values, zone 11
6000000 FT	5000-foot grid ticks: California State Plane coordinate system, V zone (FIPSZONE 0405), Lambert Conformal Conic
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
September 26, 2008
EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1–800–638–6620.

N

MAP SCALE 1" = 500'

250 0 500 1000 FEET
150 0 150 300 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 2026F

FIRM
FLOOD INSURANCE RATE MAP
LOS ANGELES COUNTY, CALIFORNIA
AND INCORPORATED AREAS

PANEL 2026 OF 2350
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
RANCHO PALOS VERDES, CITY OF	060464	2026	F
ROLLING HILLS, CITY OF	060151	2026	F

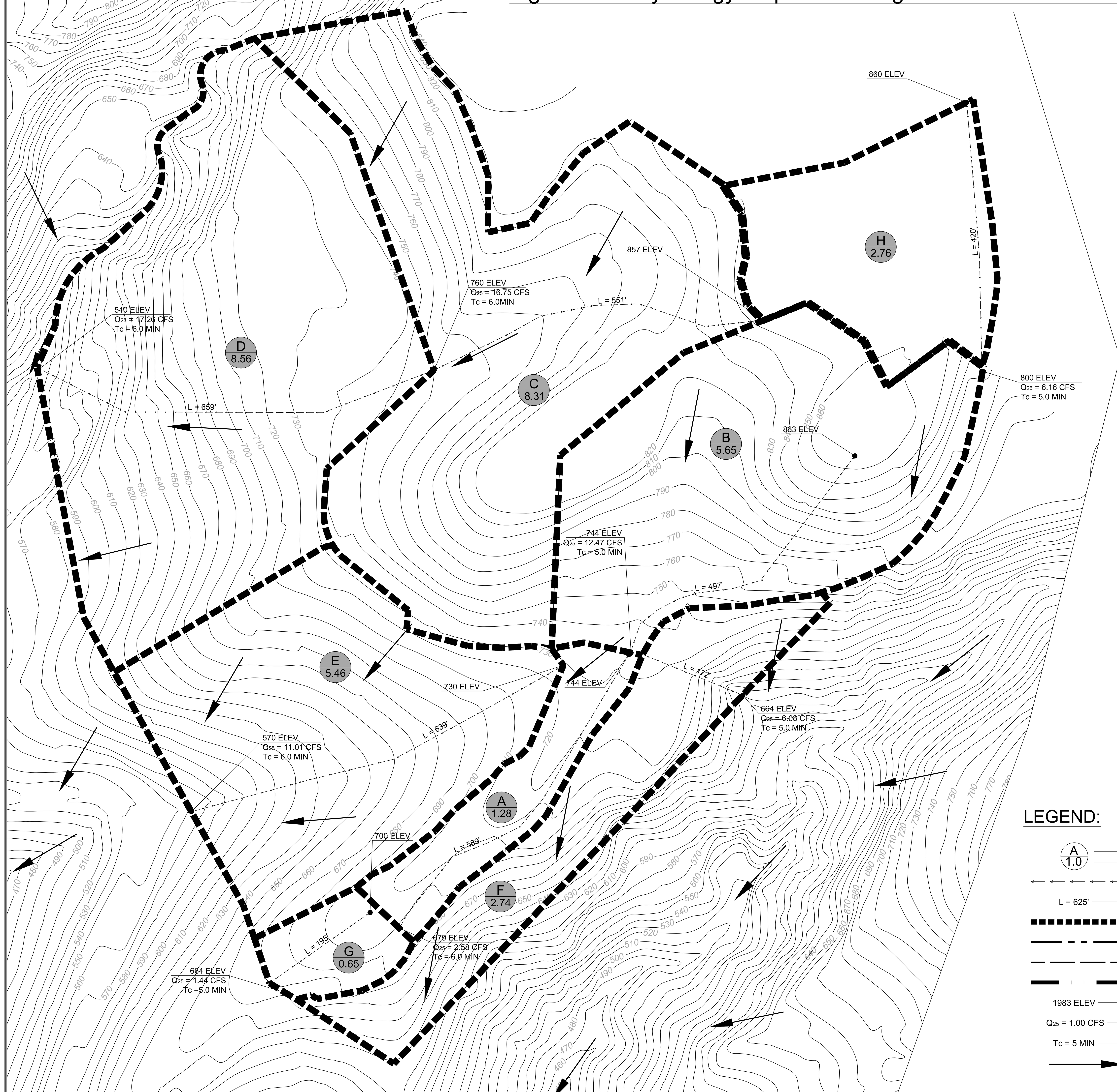
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

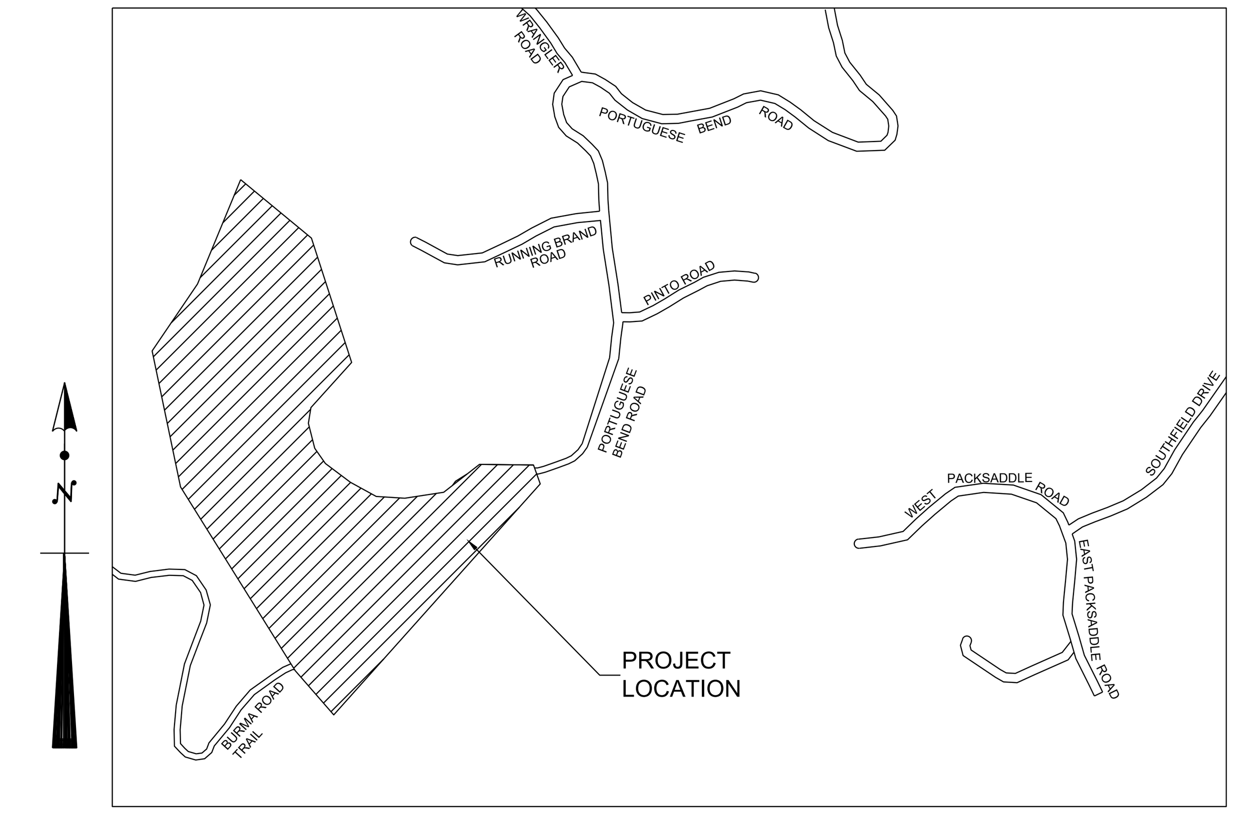
MAP NUMBER
06037C2026F

EFFECTIVE DATE
SEPTEMBER 26, 2008

Federal Emergency Management Agency

Figure A-6 - Hydrology Map for Existing Conditions with 10-ft Contours





KEY MAP
SCALE:1"=500'

PROJECT AREA
TG:823-D4

HYDROLOGY SUMMARY:

LA COUNTY HYDROLOGY MAP:	SAN PEDRO 1-H1.2
50-YEAR 24-HOUR ISOHYET:	4.90 INCHES
25-YEAR 24-HOUR ISOHYET:	4.30 INCHES
85TH PERCENTILE ISOHYET:	1.0 INCHES
SOIL CLASSIFICATION TYPE:	002
LAND USE DESCRIPTION:	SINGLE FAMILY HOME - HILLSIDE RESIDENCE

SUBAREA	AREA ACRES	IMPERVIOUS %	LENGTH FT	SLOPE FT/FT	Q25 CFS
A*	1.28	0	589	0.11	2.58
B*	5.65	0	497	0.24	12.48
C	8.31	0	551	0.18	16.75
D	8.56	0	659	0.33	17.26
E	5.46	0	639	0.25	11.01
F	2.74	0	172	0.66	6.08
G	0.65	0	195	0.18	1.44
H	2.76	14	420	0.14	6.16

*SUBAREAS EFFECTING PROJECT SITE

LEGEND:

- A 1.0 — AREA DESIGNATION / AREA IN ARES
- PATH OF TRAVEL
- L = 625' — INITIAL SUB AREA FLOW LENGTH
- SUBAREA BOUNDARY
- PROPERTY LINE
- CITY OF ROLLING HILLS EASEMENT
- LANDSLIDE BOUNDARY
- 1983 ELEV — FINISH GRADE/FLOWLINE/ELEVATION
- Q_{25} = 1.00 CFS — DISCHARGE IN CFS FOR 25 YEAR STORM
- Tc = 5 MIN — TIME OF CONCENTRATION IN MINUTES
- FLOWLINE

80 40 0 80 160 240
SCALE: 1"=80'

NOTES:

1. ALL BMP DEVICES TO BE MAINTAINED BY OWNER. DEVICES TO BE REVIEWED AND APPROVED PER GRADING PLAN.

REVISIONS | DATE | BY

OWNER/CLIENT: WEI-MEN SHEN, YING SAI, 77 PORTUGUESE BEND ROAD, ROLLING HILLS, CA 90274

PLAN: HYDROLOGY MAP EXISTING CONDITIONS 10 FT CONTOURS

PROJECT ADDRESS: 77 PORTUGUESE BEND ROAD, ROLLING HILLS, CA 90274

STAMP

P.A. ARCA ENGINEERING, INC.
500 EAST CARSON PLAZA DRIVE, SUITE 201, CARSON, CA 90746
TEL: (310) 768-3828 www.paarcaengineering.com FAX: (310) 768-3877

PERFECTO A. ARCA RCE #028918 | DATE

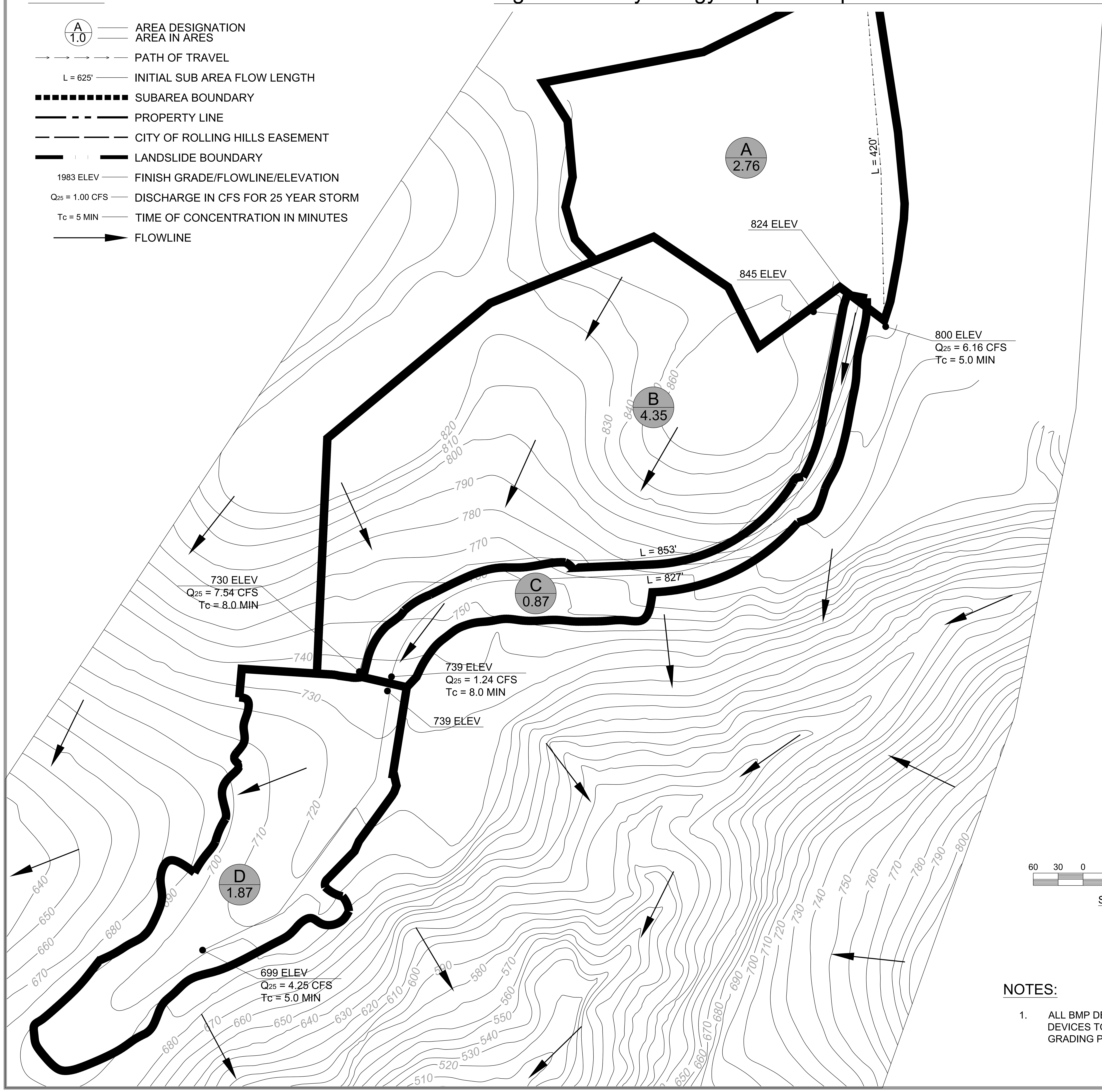
DATE:	03/17/2016
SCALE:	AS SHOWN
DRAWN:	K.M.V.
DESIGNER:	K.M.V.
CHECKED:	P.A.A.
JOB NO.:	AEI 13-0525

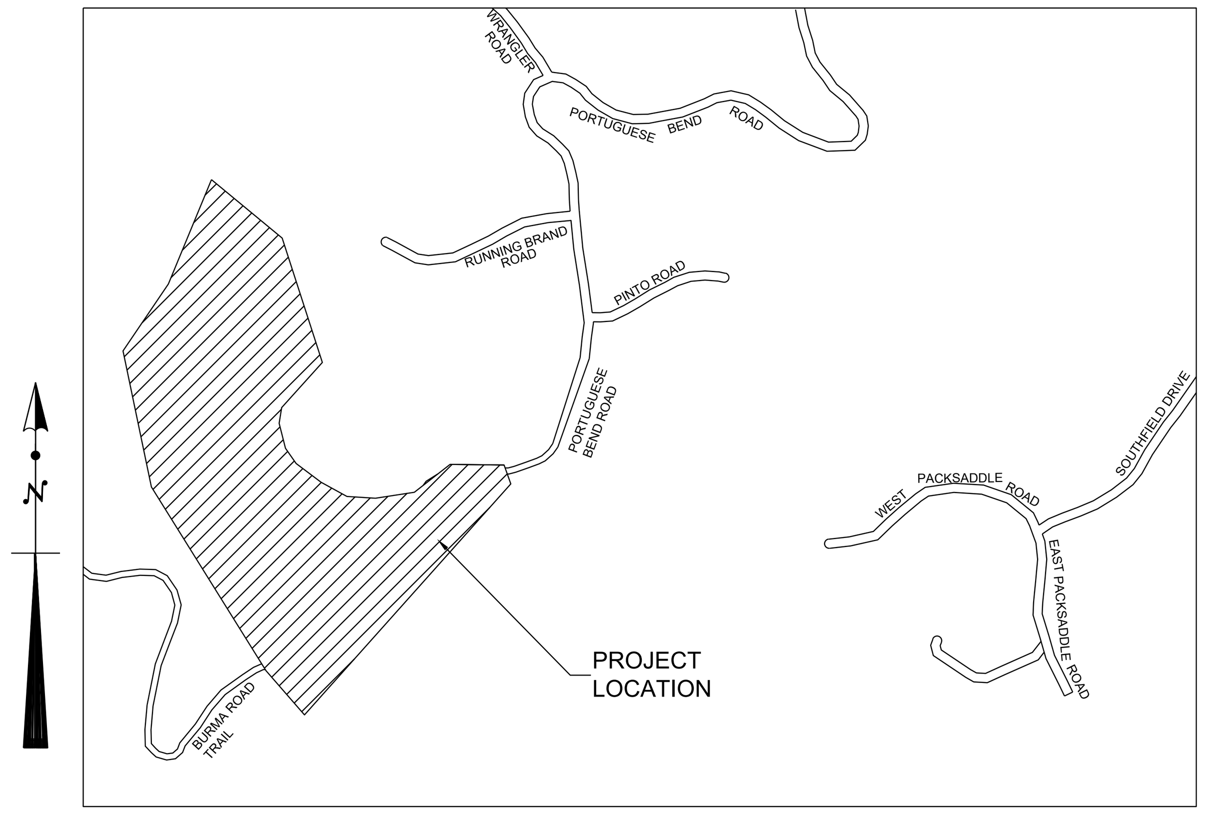
INDEX
C1.01
SHEET 1 OF 4 SHEET(S)

Figure A-7 - Hydrology Map for Proposed Conditions with 10-ft Contours

LEGEND:

- (A / 1.0) — AREA DESIGNATION / AREA IN ARES
- PATH OF TRAVEL
- L = 625' — INITIAL SUB AREA FLOW LENGTH
- SUBAREA BOUNDARY
- PROPERTY LINE
- CITY OF ROLLING HILLS EASEMENT
- LANDSLIDE BOUNDARY
- 1983 ELEV — FINISH GRADE/FLOWLINE/ELEVATION
- Q_{25} = 1.00 CFS — DISCHARGE IN CFS FOR 25 YEAR STORM
- Tc = 5 MIN — TIME OF CONCENTRATION IN MINUTES
- FLOWLINE





KEY MAP
SCALE:1"=500'

PROJECT AREA
TG:823-D4

HYDROLOGY SUMMARY:

LA COUNTY HYDROLOGY MAP: SAN PEDRO 1-H1.2
50-YEAR 24-HOUR ISOHYET: 4.90 INCHES
25-YEAR 24-HOUR ISOHYET: 4.30 INCHES
85TH PERCENTILE ISOHYET: 1.0 INCHES
SOIL CLASSIFICATION TYPE: 002
LAND USE DESCRIPTION: SINGLE FAMILY HOME - HILLSIDE RESIDENCE

SUBAREA	AREA ACRES	IMPERVIOUS %	LENGTH FT	SLOPE FT/FT	Q25 CFS
A*	2.76	14	420	0.14	6.16
B*	4.35	0	853	0.13	7.54
C	0.67	100	827	0.103	1.24
D	1.87	60	419	0.095	4.25

*SUBAREAS AFFECTING PROJECT SITE

NOTES:

1. ALL BMP DEVICES TO BE MAINTAINED BY OWNER. DEVICES TO BE REVIEWED AND APPROVED PER GRADING PLAN.

REVISIONS | DATE | BY

OWNER/CLIENT: WEI-MEN SHEN, YING SAI, 77 PORTUGUESE BEND ROAD, ROLLING HILLS, CA 90274

PLAN: HYDROLOGY MAP PROPOSED CONDITIONS 10 FT CONTOURS

PROJECT ADDRESS: 77 PORTUGUESE BEND ROAD, ROLLING HILLS, CA 90274

STAMP

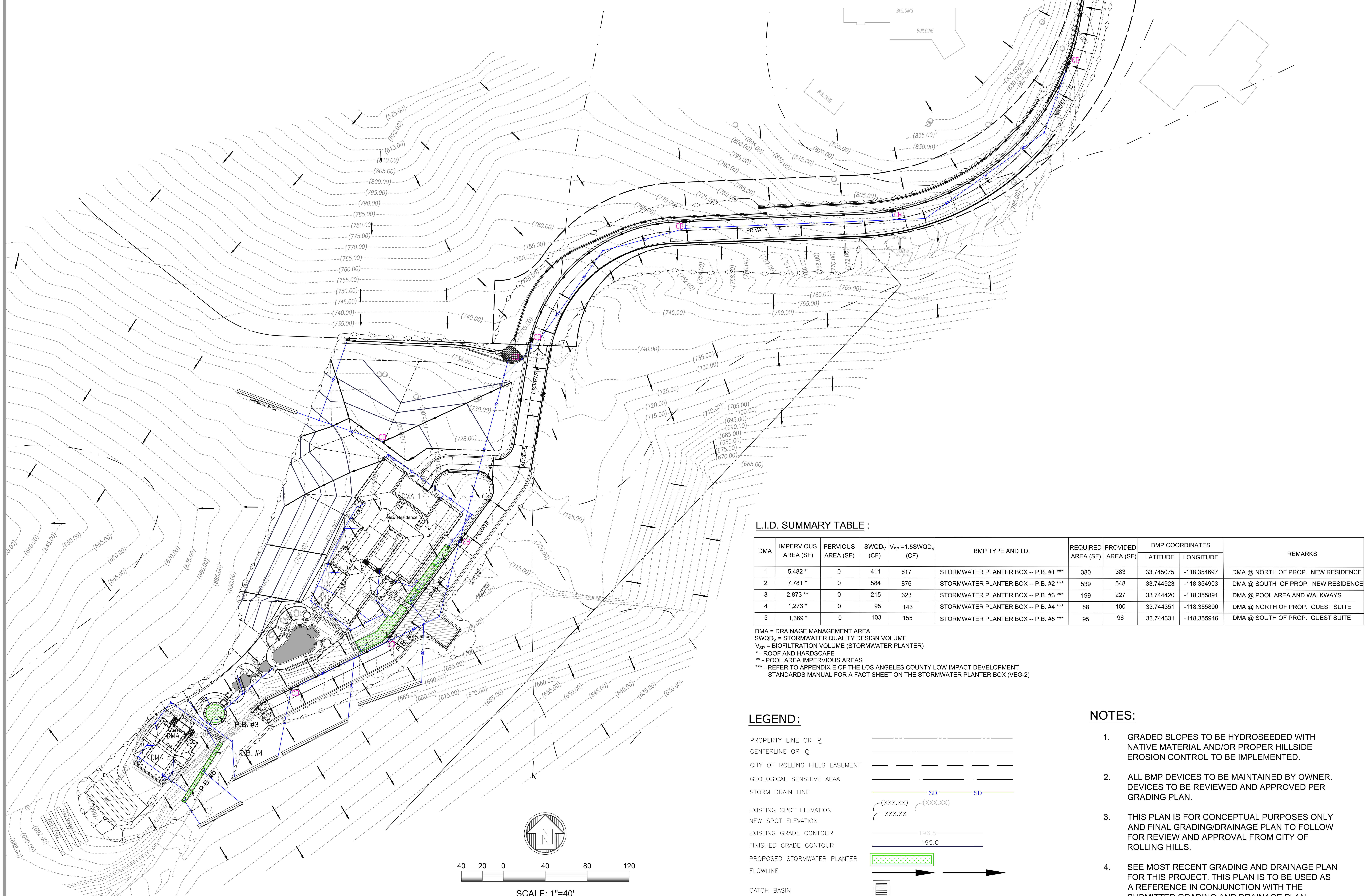
P.A. ARCA ENGINEERING, INC.

PERFECTO A. ARCA RCE #028918 | DATE

DATE:	03/17/2016
SCALE:	AS SHOWN
DRAWN:	K.M.V.
DESIGNER:	K.M.V.
CHECKED:	P.A.A.
JOB NO.:	AEI 13-0525

INDEX
C2.01
SHEET 2 OF 4 SHEET(S)

Figure A-8 - Conceptual Grading Plan with Low Impact Development



L.I.D. SUMMARY TABLE :

DMA	IMPERVIOUS AREA (SF)	PERVIOUS AREA (SF)	$SWQD_V$ (CF)	V_{SP} =1.5$SWQD_V$ (CF)	BMP TYPE AND I.D.	REQUIRED AREA (SF)	PROVIDED AREA (SF)	BMP COORDINATES LATITUDE	BMP COORDINATES LONGITUDE	REMARKS
1	5,482 *	0	411	617	STORMWATER PLANTER BOX -- P.B. #1 ***	380	383	33.745075	-118.354697	DMA @ NORTH OF PROP. NEW RESIDENCE
2	7,781 *	0	584	876	STORMWATER PLANTER BOX -- P.B. #2 ***	539	548	33.744923	-118.354903	DMA @ SOUTH OF PROP. NEW RESIDENCE
3	2,873 **	0	215	323	STORMWATER PLANTER BOX -- P.B. #3 ***	199	227	33.744420	-118.355891	DMA @ POOL AREA AND WALKWAYS
4	1,273 *	0	95	143	STORMWATER PLANTER BOX -- P.B. #4 ***	88	100	33.744351	-118.355890	DMA @ NORTH OF PROP. GUEST SUITE
5	1,369 *	0	103	155	STORMWATER PLANTER BOX -- P.B. #5 ***	95	96	33.744331	-118.355946	DMA @ SOUTH OF PROP. GUEST SUITE

DMA = DRAINAGE MANAGEMENT AREA
$SWQD_V$ = STORMWATER QUALITY DESIGN VOLUME
V_{SP} = BIOFILTRATION VOLUME (STORMWATER PLANTER)
* - ROOF AND HARDSCAPE
** - POOL AREA IMPERVIOUS AREAS
*** - REFER TO APPENDIX E OF THE LOS ANGELES COUNTY LOW IMPACT DEVELOPMENT STANDARDS MANUAL FOR A FACT SHEET ON THE STORMWATER PLANTER BOX (VEG-2)

LEGEND:

- PROPERTY LINE OR ℙ
- CENTERLINE OR ℄
- CITY OF ROLLING HILLS EASEMENT
- GEOLOGICAL SENSITIVE AEAA
- STORM DRAIN LINE — SD — SD —
- EXISTING SPOT ELEVATION (XXX.XX)
- NEW SPOT ELEVATION XXX.XX
- EXISTING GRADE CONTOUR 196.5
- FINISHED GRADE CONTOUR 195.0
- PROPOSED STORMWATER PLANTER
- FLOWLINE
- CATCH BASIN

NOTES:

1. GRADED SLOPES TO BE HYDROSEEDED WITH NATIVE MATERIAL AND/OR PROPER HILLSIDE EROSION CONTROL TO BE IMPLEMENTED.
2. ALL BMP DEVICES TO BE MAINTAINED BY OWNER. DEVICES TO BE REVIEWED AND APPROVED PER GRADING PLAN.
3. THIS PLAN IS FOR CONCEPTUAL PURPOSES ONLY AND FINAL GRADING/DRAINAGE PLAN TO FOLLOW FOR REVIEW AND APPROVAL FROM CITY OF ROLLING HILLS.
4. SEE MOST RECENT GRADING AND DRAINAGE PLAN FOR THIS PROJECT. THIS PLAN IS TO BE USED AS A REFERENCE IN CONJUNCTION WITH THE SUBMITTED GRADING AND DRAINAGE PLAN.

REVISIONS | DATE | BY

OWNER/CLIENT:
WEI-MEN SHEN
YING SAI
77 PORTUGUESE BEND ROAD
ROLLING HILLS, CA 90274

PLAN:
CONCEPT DRAINAGE PLAN
LOW IMPACT DEVELOPMENT PLAN

PROJECT ADDRESS:
77 PORTUGUESE BEND ROAD
ROLLING HILLS, CA 90274

STAMP

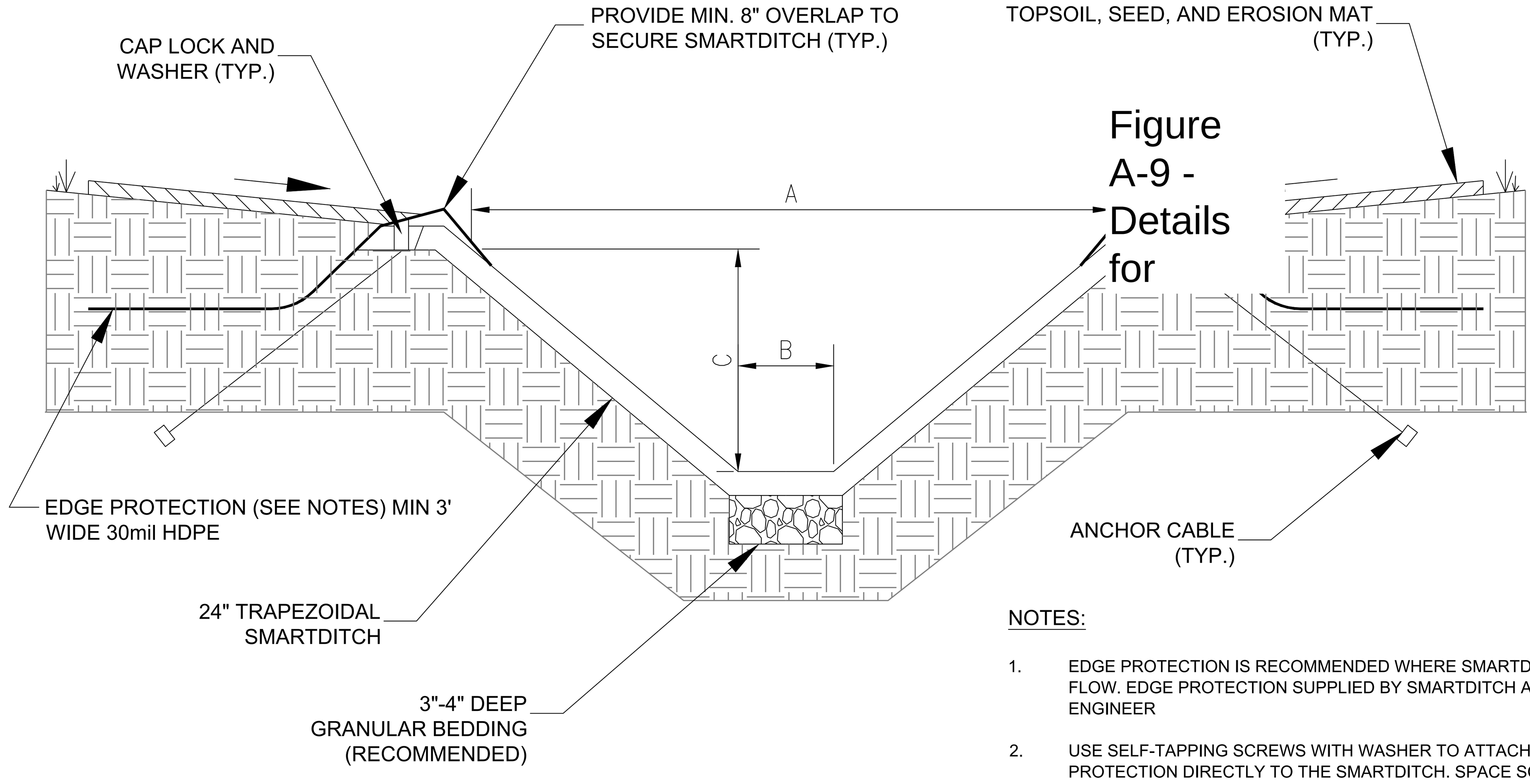
PREPARED BY:
P.A. ARCA ENGINEERING, INC.
500 EAST CARSON PLAZA DRIVE, SUITE 201, CARSON, CA 90746
TEL. (310) 768-3828 www.paarcaengineering.com FAX: (310) 768-3877
PERFECTO A. ARCA RCE #028918

DATE

DATE:	03/17/2016
SCALE:	AS SHOWN
DRAWN:	K.M.V.
DESIGNER:	K.M.V.
CHECKED:	P.A.A.
JOB NO.:	AEI 13-0525

INDEX
C3.01
SHEET 3 OF 4 SHEET(S)

Figure A-9 - Details for SmartDitch and L.I.D. Stormwater Planter Box



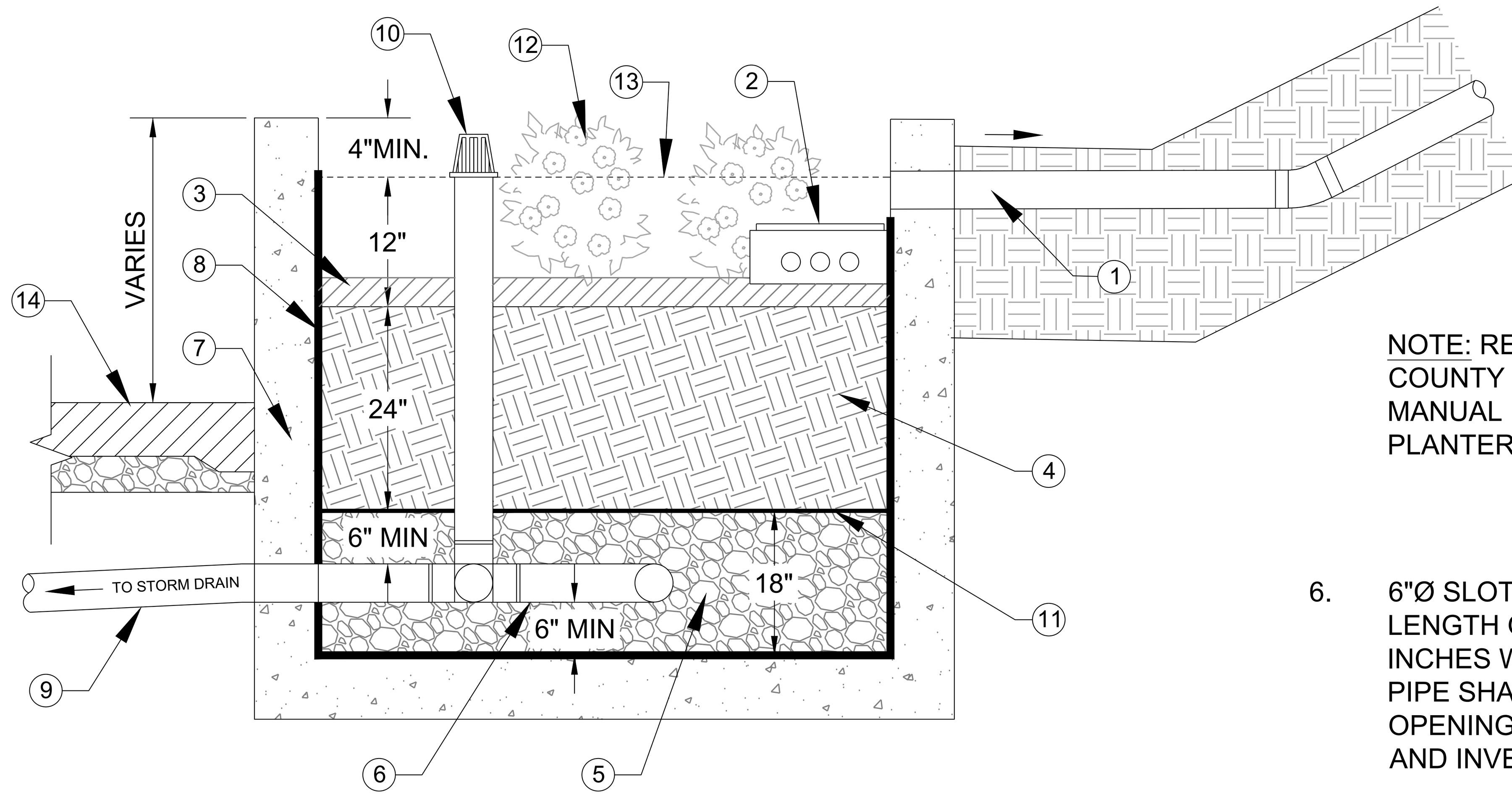
A	MAXIMUM FLOW WIDTH ACROSS TOP	34.50"
B	BOTTOM CHANNEL WIDTH (INTERIOR)	8.00"
C	MAXIMUM FLOW DEPTH	13.50"

NOTES:

1. EDGE PROTECTION IS RECOMMENDED WHERE SMARTDITCH RECEIVES LATERAL FLOW. EDGE PROTECTION SUPPLIED BY SMARTDITCH AS REQUIRED BY DESIGN ENGINEER
2. USE SELF-TAPPING SCREWS WITH WASHER TO ATTACH THE HDPE EDGE PROTECTION DIRECTLY TO THE SMARTDITCH. SPACE SCREWS EVERY THIRD RIB. (SCREWS AND WASHERS PROVIDED BY SMARTDITCH)
3. TO MINIMIZE THE ACCUMULATION OF SEDIMENTS AND LIKELY HOOD OF VEGETATION TO START GROWING A MINIMUM SLOPE OF 0.005 (0.5%) IS RECOMMENDED TO MAINTAIN THE SELF-CLEANSING VELOCITY.

12" TRAPEZOIDAL SMARTDITCH TYPICAL SECTION DETAIL

NOT TO SCALE



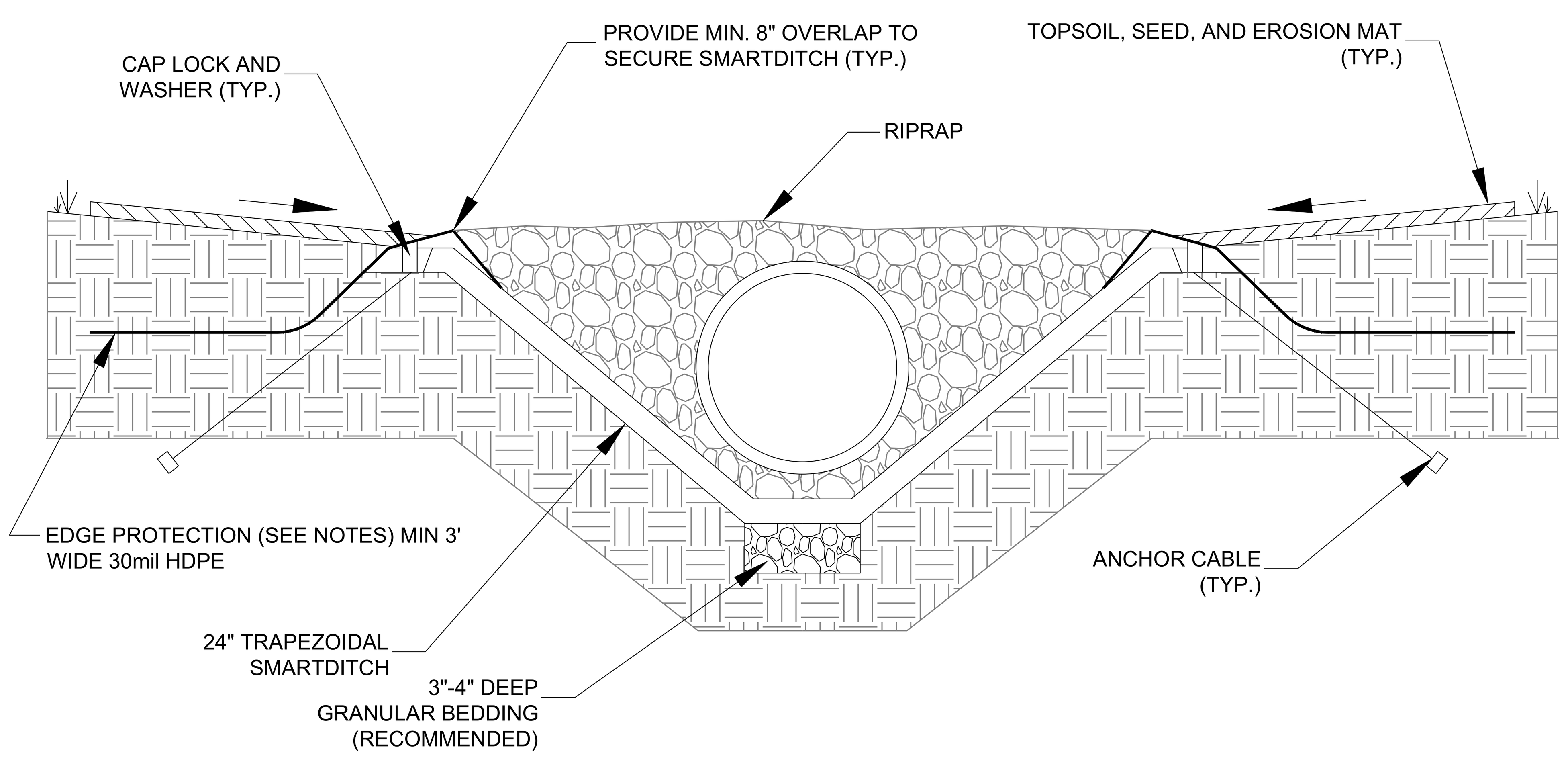
NOTE: REFER TO APPENDIX E OF THE LOS ANGELES COUNTY LOW IMPACT DEVELOPMENT STANDARDS MANUAL FOR A FACT SHEET ABOUT THE STORMWATER PLANTER BOX (VEG-2).

NOTE:

1. STORM DRAIN PIPE FROM THE ROOF DOWNSPOUTS AND HARDSCAPES AS SHOWN ON PLAN.
2. SHALLOW ENERGY DISSIPATOR BASIN.
3. 3" MULCH.
4. 24" UNIFORM MIX OF SAND AND ORGANIC MATERIAL SUCH AS COMPOST: MINIMUM INFILTRATION RATE 5" PER HOUR. NO MORE THAN 30% COMPOST.
5. MINIMUM 18" GRAVEL DRAIN ROCK SHALL CONFORM TO THE REQUIREMENTS OF CLASS C2 PERMEABLE MATERIAL PER CALTRANS SPECIFICATION 68-1.025.
6. 6"Ø SLOTTED PVC SDR26 UNDERDRAIN TO RUN LENGTH OF PLANTER. SLOTS SHOULD BE 0.04 TO 0.1 INCHES WIDE WITH A LENGTH OF 1 TO 1.25 INCHES. PIPE SHALL HAVE A MINIMUM OF 1 SQUARE INCH OPENING PER LINEAR FOOT. SEE PLAN FOR SIZE AND INVERT ELEVATION.
7. PLANTER WALL MATERIAL SHALL BE CMU, BRICK OR CONCRETE. SEE STRUCTURAL PLAN FOR WALL DETAILS.
8. WATERPROOFING MEMBRANE SHALL BE 30 MIL PVC OR EQUIVALENT.
9. SOLID PVC PIPE AS SHOWN ON PLAN.
10. 6" SOLID PVC OVERFLOW PIPE AND ATRIUM DRAIN WITH STRAINER.
11. USE GEOMEMBRANE LINER (FILTER FABRIC) FOR SEPARATION BETWEEN SOIL MIX AND DRAIN ROCK.
12. PLANTER VEGETATION. SEE LANDSCAPE PLANS.
13. MINIMUM 12" PONDING DEPTH.
14. FINISH SURFACE PER CIVIL PLANS.

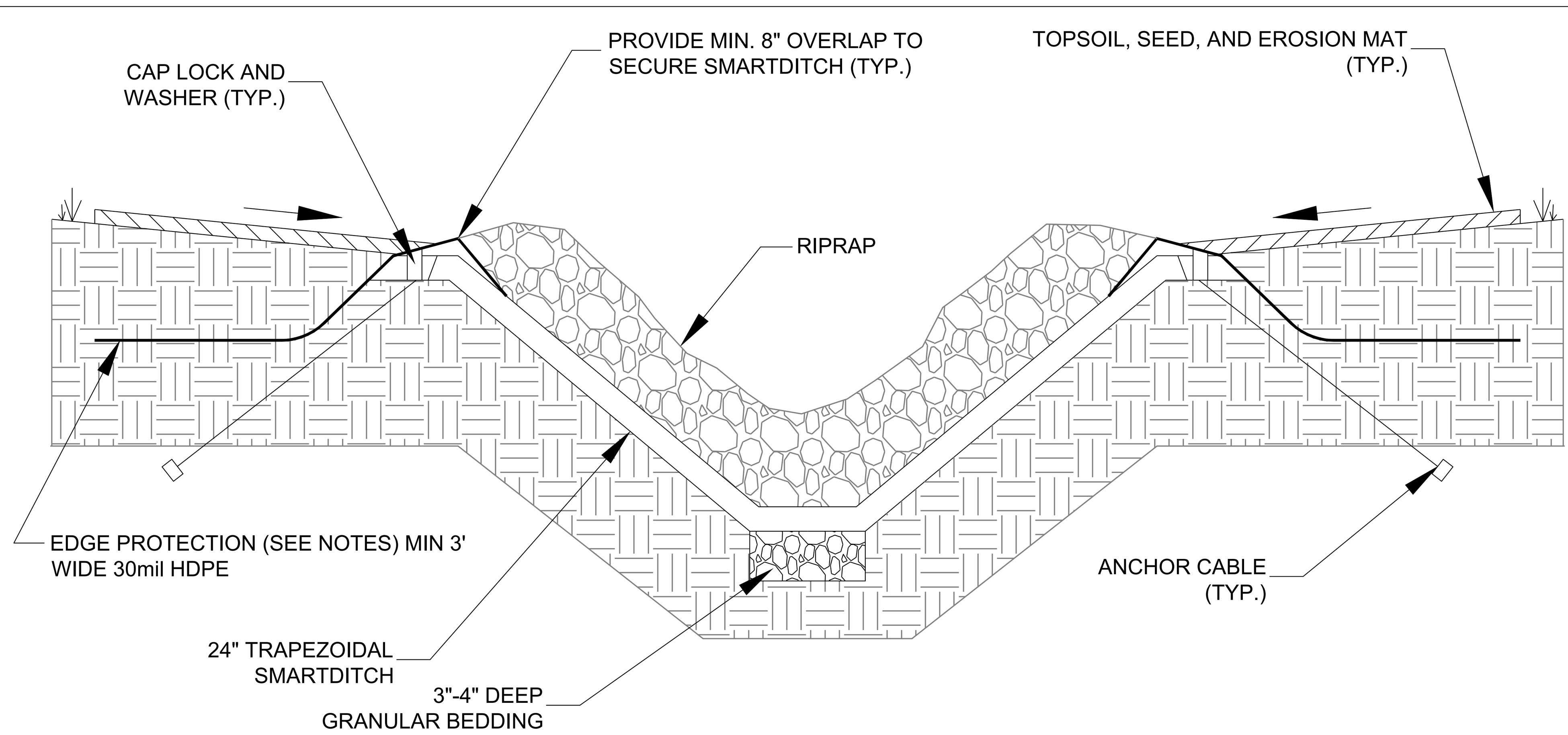
TYPICAL L.I.D STORMWATER PLANTER BOX SECTION DETAIL

NOT TO SCALE



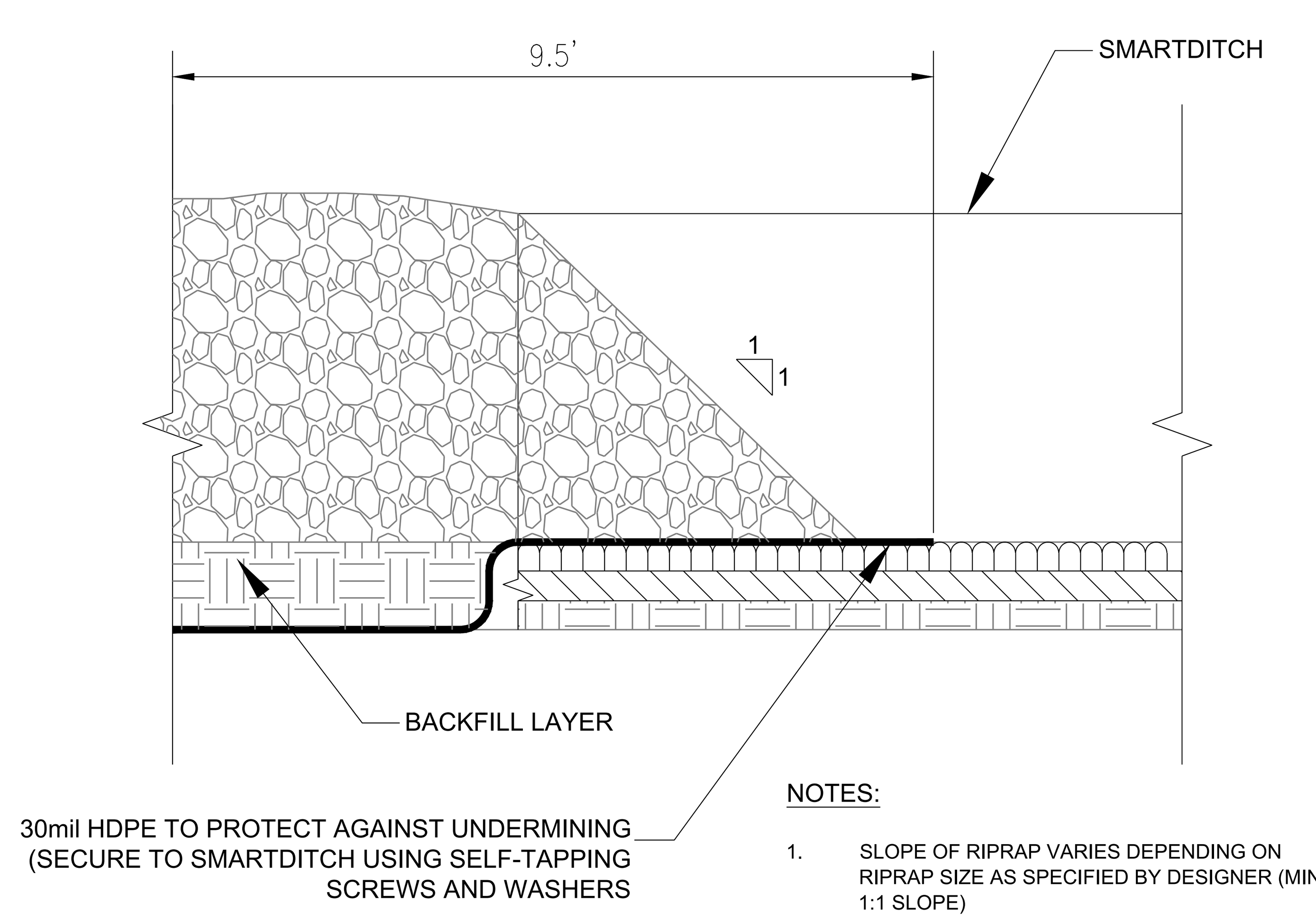
RCP TO SMARTDITCH TYPICAL SECTION DETAIL

NOT TO SCALE



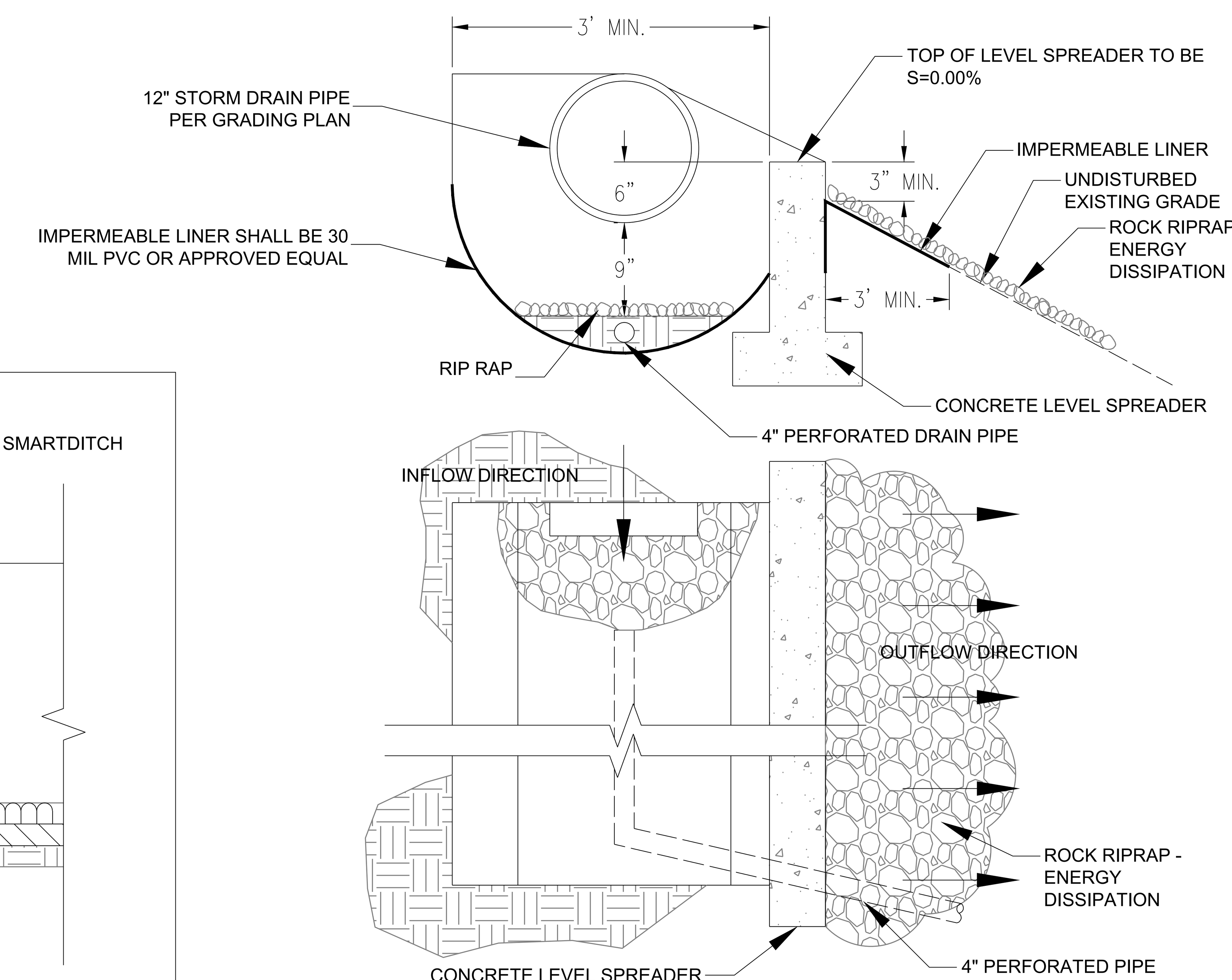
RIPRAP ENTRANCE TO SMARTDITCH TYPICAL SECTION DETAIL

NOT TO SCALE



NOTES:

1. SLOPE OF RIPRAP VARIES DEPENDING ON RIPRAP SIZE AS SPECIFIED BY DESIGNER (MIN. 1:1 SLOPE)



TYPICAL LEVEL SPREADER DETAIL

NOT TO SCALE

REVISIONS	DATE / BY
OWNER/CLIENT:	WEI-MEN SHEN YING SAI 77 PORTUGUESE BEND ROAD ROLLING HILLS, CA 90274
PLAN:	DETAILS
PROJECT ADDRESS:	77 PORTUGUESE BEND ROAD ROLLING HILLS, CA 90274
STAMP	
PREPARED BY:	P.A. ARCA ENGINEERING, INC. 500 EAST CARSON PLAZA DRIVE, SUITE 201, CARSON, CA 90746 PERFECTO A. ARCA RCE #028918
DATE:	03/17/2016
SCALE:	AS SHOWN
DRAWN:	K.M.V.
DESIGNER:	K.M.V.
CHECKED:	P.A.A.
JOB NO.:	AEI 13-0525

INDEX

C3.02

SHEET 4 OF 4 SHEET(S)

APPENDIX B

HYDROLOGY CALCULATIONS

Proposed Conditions

Existing Conditions

LID

PROPOSED CONDITIONS

Peak Flow Hydrologic Analysis

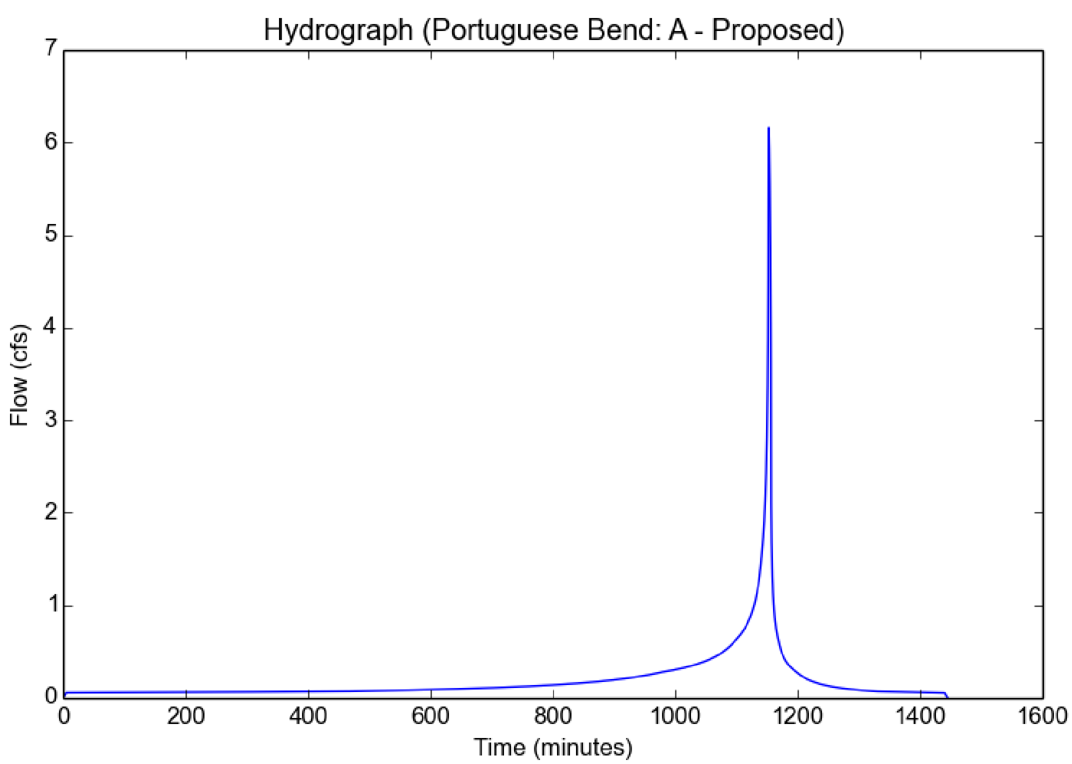
File location: C:/Users/Kevin/Desktop/Portuguese Bend Hydrology Calculations/Proposed-25yr/A - Proposed.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Portuguese Bend
Subarea ID	A - Proposed
Area (ac)	2.76
Flow Path Length (ft)	420.0
Flow Path Slope (vft/hft)	0.14
50-yr Rainfall Depth (in)	4.9
Percent Impervious	0.14
Soil Type	2
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.3022
Peak Intensity (in/hr)	2.5668
Undeveloped Runoff Coefficient (Cu)	0.8645
Developed Runoff Coefficient (Cd)	0.8695
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	6.1598
Burned Peak Flow Rate (cfs)	6.1598
24-Hr Clear Runoff Volume (ac-ft)	0.3879
24-Hr Clear Runoff Volume (cu-ft)	16895.6013



Peak Flow Hydrologic Analysis

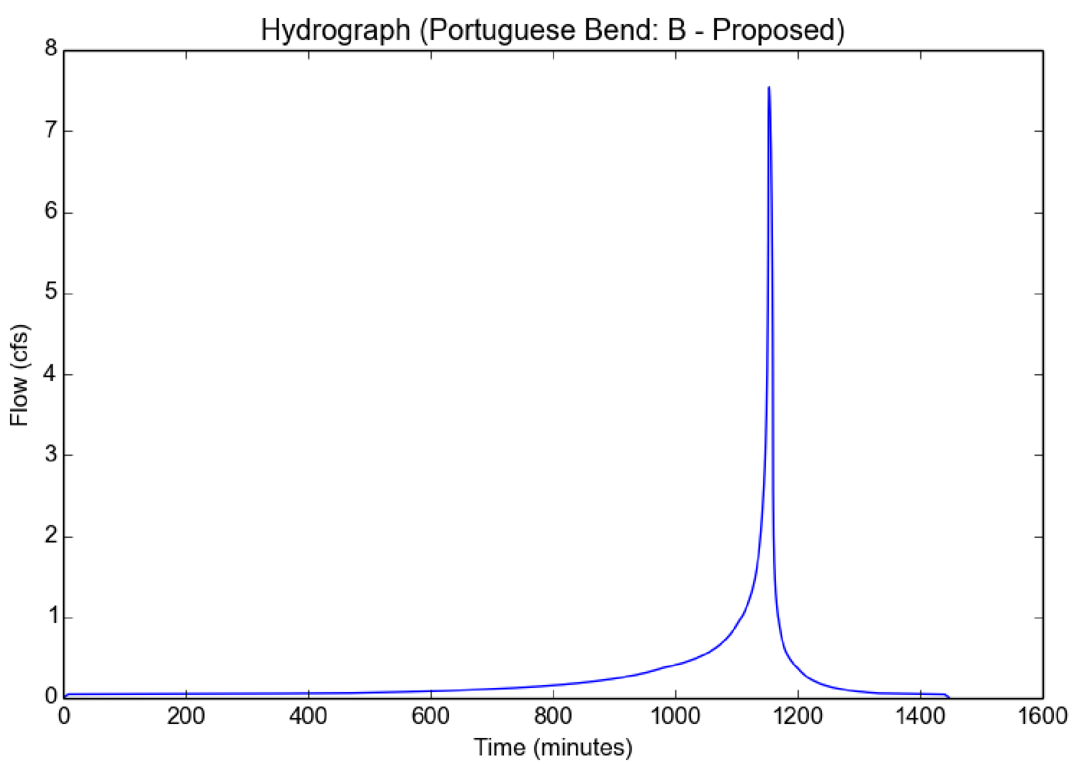
File location: C:/Users/Kevin/Desktop/Portuguese Bend Hydrology Calculations/Proposed-25yr/B - Proposed.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Portuguese Bend
Subarea ID	B - Proposed
Area (ac)	4.35
Flow Path Length (ft)	853.0
Flow Path Slope (vft/hft)	0.13
50-yr Rainfall Depth (in)	4.9
Percent Impervious	0.01
Soil Type	2
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.3022
Peak Intensity (in/hr)	2.0581
Undeveloped Runoff Coefficient (Cu)	0.842
Developed Runoff Coefficient (Cd)	0.8426
Time of Concentration (min)	8.0
Clear Peak Flow Rate (cfs)	7.5434
Burned Peak Flow Rate (cfs)	7.5434
24-Hr Clear Runoff Volume (ac-ft)	0.493
24-Hr Clear Runoff Volume (cu-ft)	21475.4996



Peak Flow Hydrologic Analysis

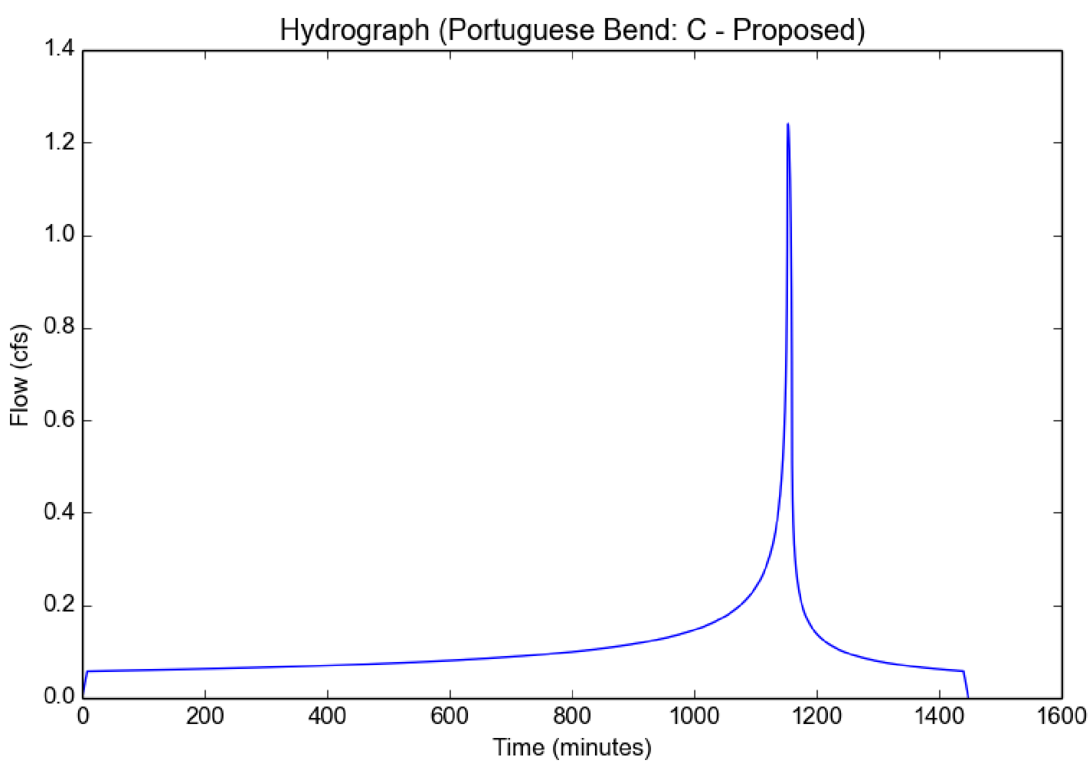
File location: C:/Users/Kevin/Desktop/Portuguese Bend Hydrology Calculations/Proposed-25yr/C - Proposed.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Portuguese Bend
Subarea ID	C - Proposed
Area (ac)	0.67
Flow Path Length (ft)	827.0
Flow Path Slope (vft/hft)	0.103
50-yr Rainfall Depth (in)	4.9
Percent Impervious	1.0
Soil Type	2
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.3022
Peak Intensity (in/hr)	2.0581
Undeveloped Runoff Coefficient (Cu)	0.842
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	8.0
Clear Peak Flow Rate (cfs)	1.241
Burned Peak Flow Rate (cfs)	1.241
24-Hr Clear Runoff Volume (ac-ft)	0.2144
24-Hr Clear Runoff Volume (cu-ft)	9339.2233



Peak Flow Hydrologic Analysis

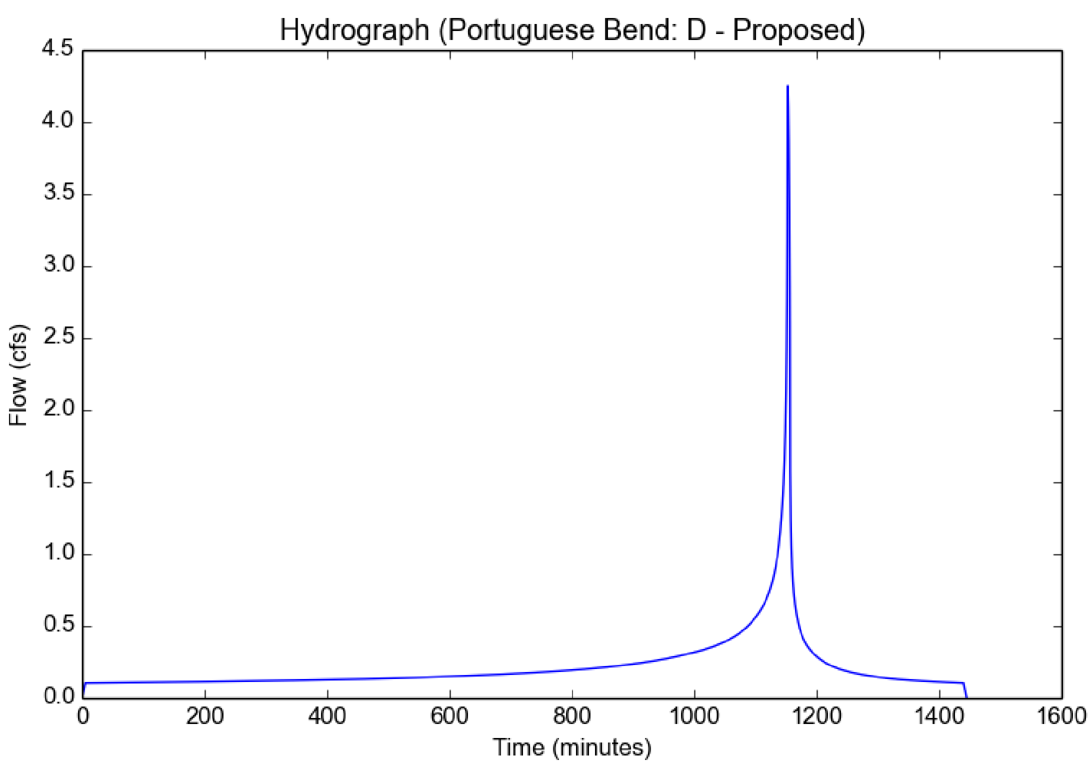
File location: C:/Users/Kevin/Desktop/Portuguese Bend Hydrology Calculations/Proposed-25yr/D - Proposed.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Portuguese Bend
Subarea ID	D - Proposed
Area (ac)	1.87
Flow Path Length (ft)	419.0
Flow Path Slope (vft/hft)	0.095
50-yr Rainfall Depth (in)	4.9
Percent Impervious	0.6
Soil Type	2
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.3022
Peak Intensity (in/hr)	2.5668
Undeveloped Runoff Coefficient (Cu)	0.8645
Developed Runoff Coefficient (Cd)	0.8858
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	4.2518
Burned Peak Flow Rate (cfs)	4.2518
24-Hr Clear Runoff Volume (ac-ft)	0.4423
24-Hr Clear Runoff Volume (cu-ft)	19266.7378



EXISTING CONDITIONS

Peak Flow Hydrologic Analysis

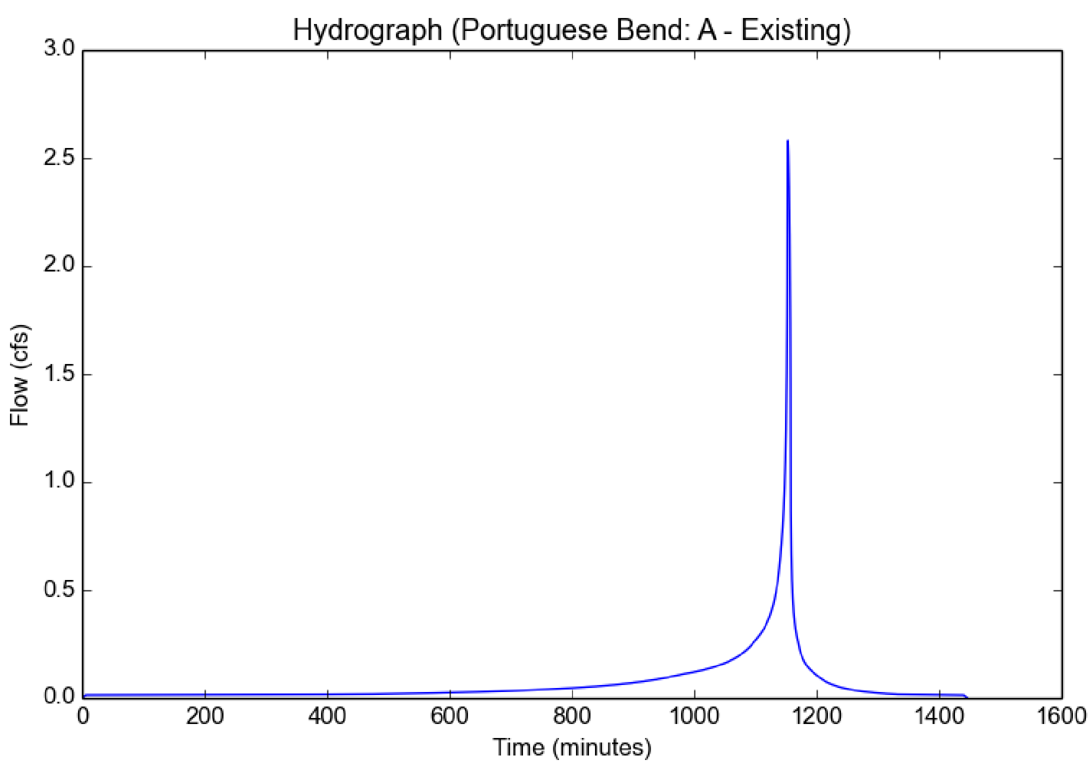
File location: C:/Users/Kevin/Desktop/Portuguese Bend Hydrology Calculations/Existing/A - Existing.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Portuguese Bend
Subarea ID	A - Existing
Area (ac)	1.28
Flow Path Length (ft)	589.0
Flow Path Slope (vft/hft)	0.11
50-yr Rainfall Depth (in)	4.9
Percent Impervious	0.01
Soil Type	2
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.3022
Peak Intensity (in/hr)	2.356
Undeveloped Runoff Coefficient (Cu)	0.8552
Developed Runoff Coefficient (Cd)	0.8556
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	2.5804
Burned Peak Flow Rate (cfs)	2.5804
24-Hr Clear Runoff Volume (ac-ft)	0.1451
24-Hr Clear Runoff Volume (cu-ft)	6321.5561



Peak Flow Hydrologic Analysis

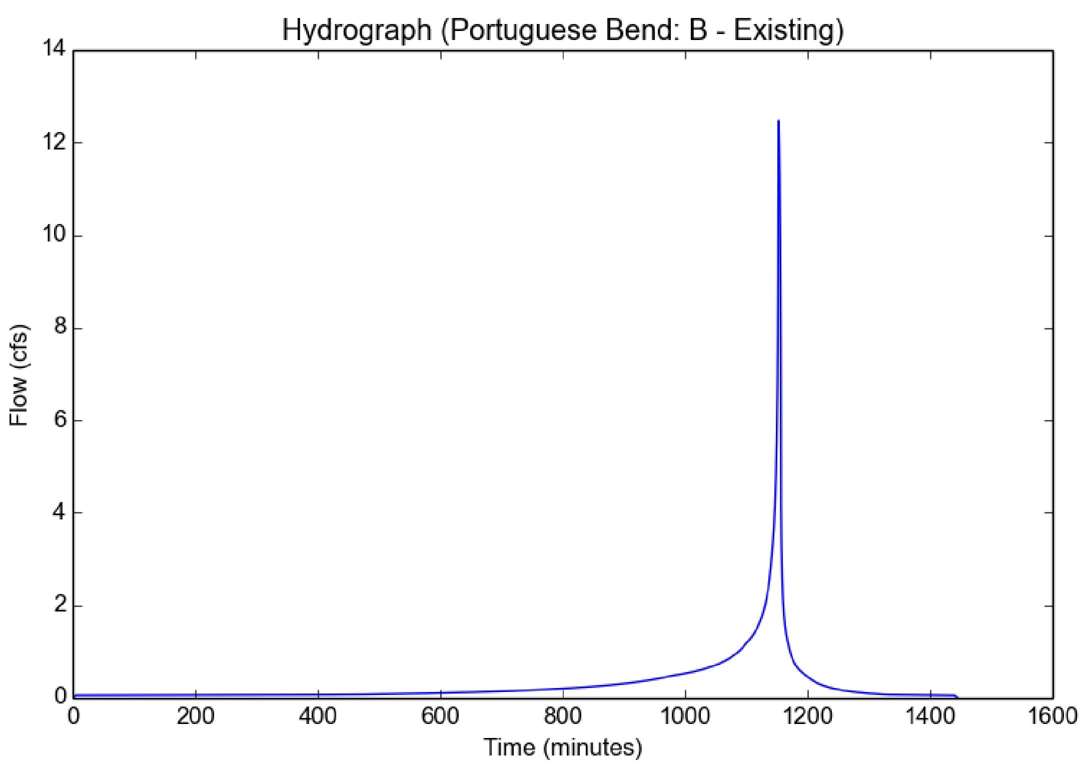
File location: C:/Users/Kevin/Desktop/Portuguese Bend Hydrology Calculations/Existing/B - Existing.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Portuguese Bend
Subarea ID	B - Existing
Area (ac)	5.62
Flow Path Length (ft)	497.0
Flow Path Slope (vft/hft)	0.24
50-yr Rainfall Depth (in)	4.9
Percent Impervious	0.01
Soil Type	2
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.3022
Peak Intensity (in/hr)	2.5668
Undeveloped Runoff Coefficient (Cu)	0.8645
Developed Runoff Coefficient (Cd)	0.8649
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	12.4761
Burned Peak Flow Rate (cfs)	12.4761
24-Hr Clear Runoff Volume (ac-ft)	0.6373
24-Hr Clear Runoff Volume (cu-ft)	27762.0911



Peak Flow Hydrologic Analysis

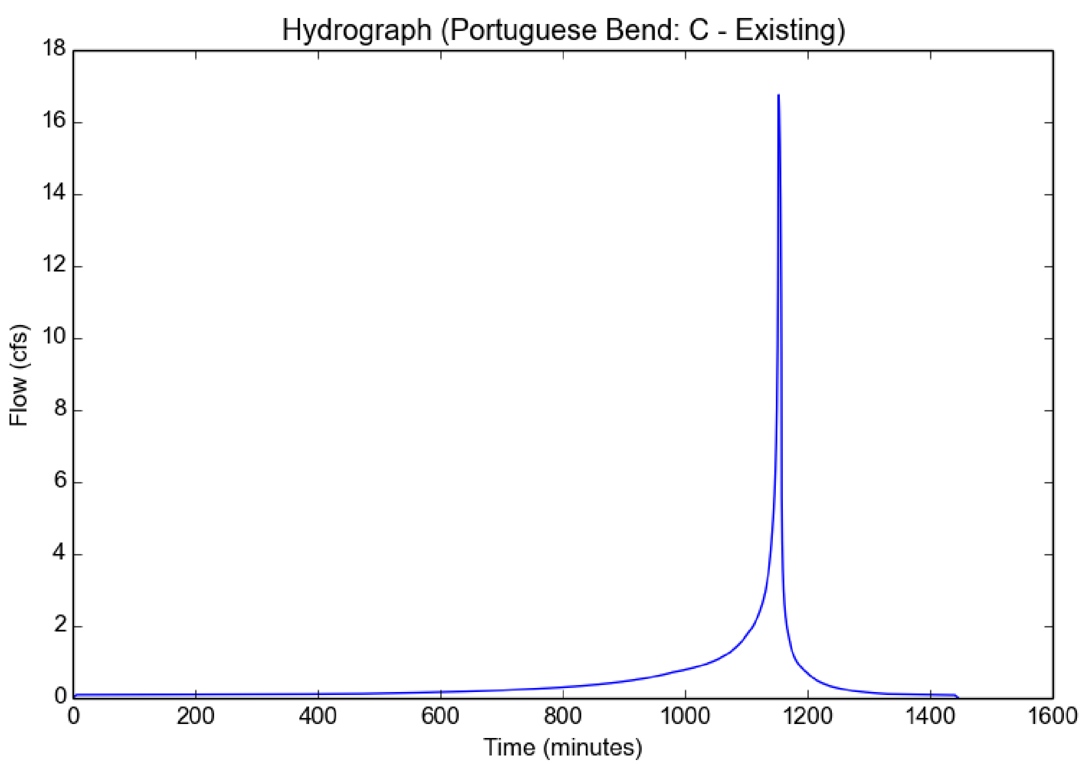
File location: C:/Users/Kevin/Desktop/Portuguese Bend Hydrology Calculations/Existing/C - Existing.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Portuguese Bend
Subarea ID	C - Existing
Area (ac)	8.31
Flow Path Length (ft)	551.0
Flow Path Slope (vft/hft)	0.18
50-yr Rainfall Depth (in)	4.9
Percent Impervious	0.01
Soil Type	2
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.3022
Peak Intensity (in/hr)	2.356
Undeveloped Runoff Coefficient (Cu)	0.8552
Developed Runoff Coefficient (Cd)	0.8556
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	16.7522
Burned Peak Flow Rate (cfs)	16.7522
24-Hr Clear Runoff Volume (ac-ft)	0.9422
24-Hr Clear Runoff Volume (cu-ft)	41040.7275



Peak Flow Hydrologic Analysis

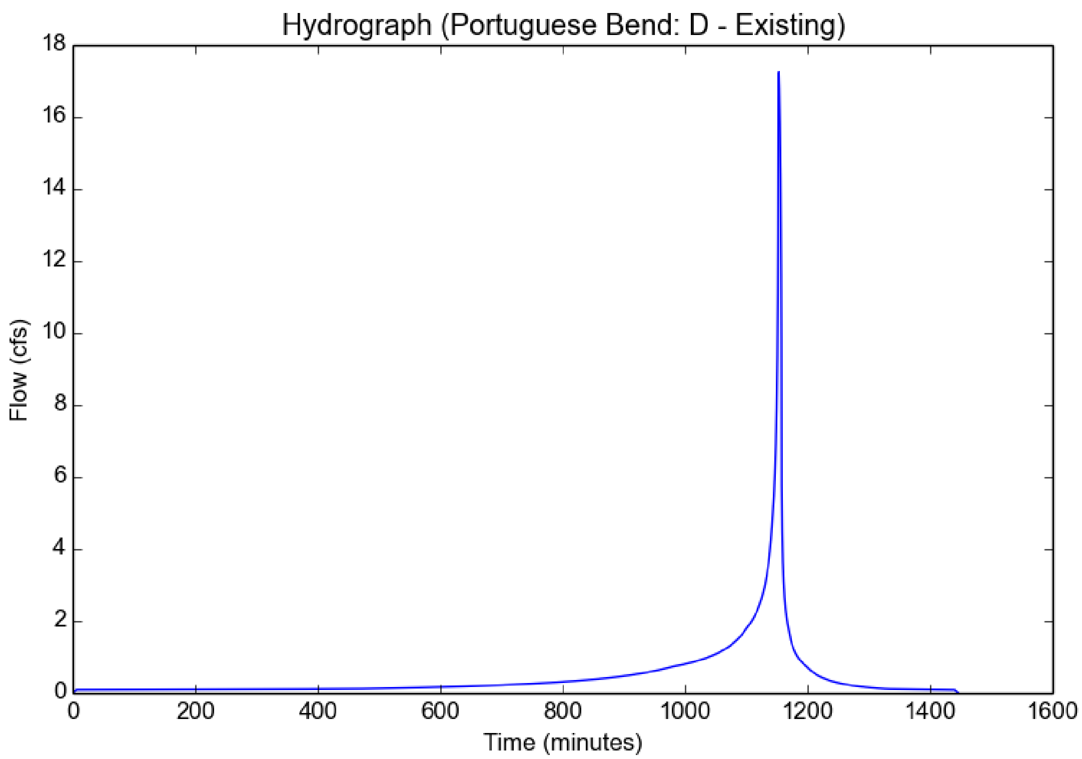
File location: C:/Users/Kevin/Desktop/Portuguese Bend Hydrology Calculations/Existing/D - Existing.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Portuguese Bend
Subarea ID	D - Existing
Area (ac)	8.56
Flow Path Length (ft)	659.0
Flow Path Slope (vft/hft)	0.33
50-yr Rainfall Depth (in)	4.9
Percent Impervious	0.01
Soil Type	2
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.3022
Peak Intensity (in/hr)	2.356
Undeveloped Runoff Coefficient (Cu)	0.8552
Developed Runoff Coefficient (Cd)	0.8556
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	17.2562
Burned Peak Flow Rate (cfs)	17.2562
24-Hr Clear Runoff Volume (ac-ft)	0.9705
24-Hr Clear Runoff Volume (cu-ft)	42275.4064



Peak Flow Hydrologic Analysis

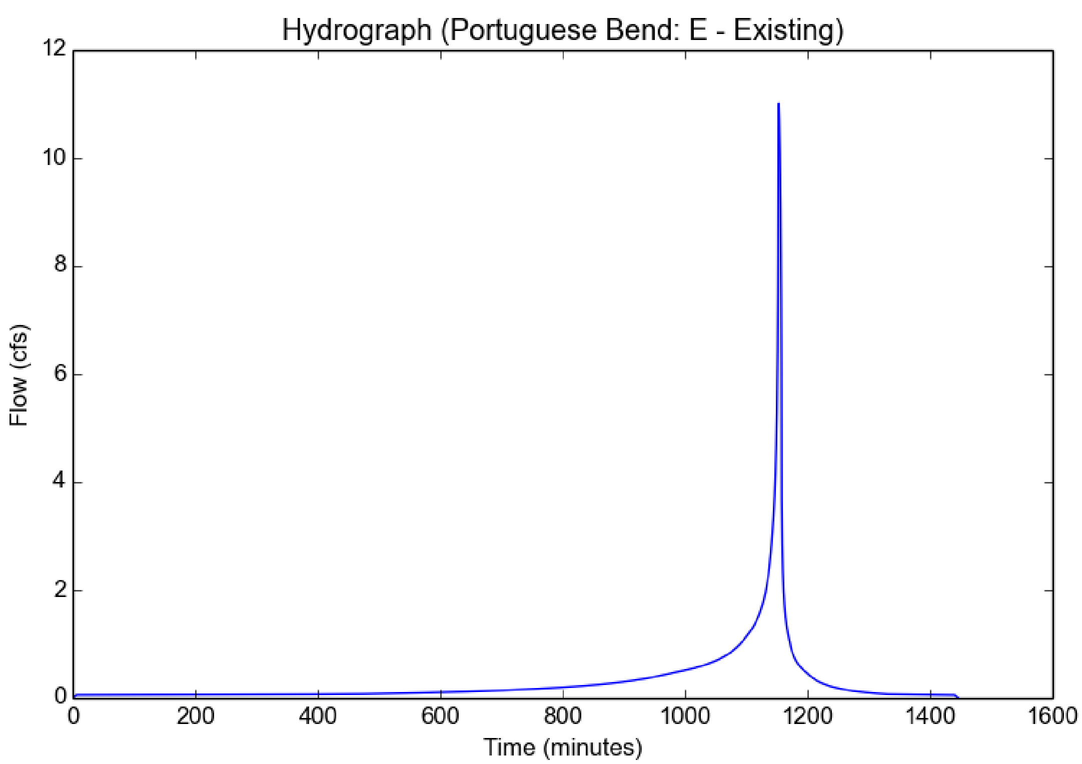
File location: C:/Users/Kevin/Desktop/Portuguese Bend Hydrology Calculations/Existing/E - Existing.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Portuguese Bend
Subarea ID	E - Existing
Area (ac)	5.46
Flow Path Length (ft)	639.0
Flow Path Slope (vft/hft)	0.25
50-yr Rainfall Depth (in)	4.9
Percent Impervious	0.01
Soil Type	2
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.3022
Peak Intensity (in/hr)	2.356
Undeveloped Runoff Coefficient (Cu)	0.8552
Developed Runoff Coefficient (Cd)	0.8556
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	11.0068
Burned Peak Flow Rate (cfs)	11.0068
24-Hr Clear Runoff Volume (ac-ft)	0.619
24-Hr Clear Runoff Volume (cu-ft)	26965.3877



Peak Flow Hydrologic Analysis

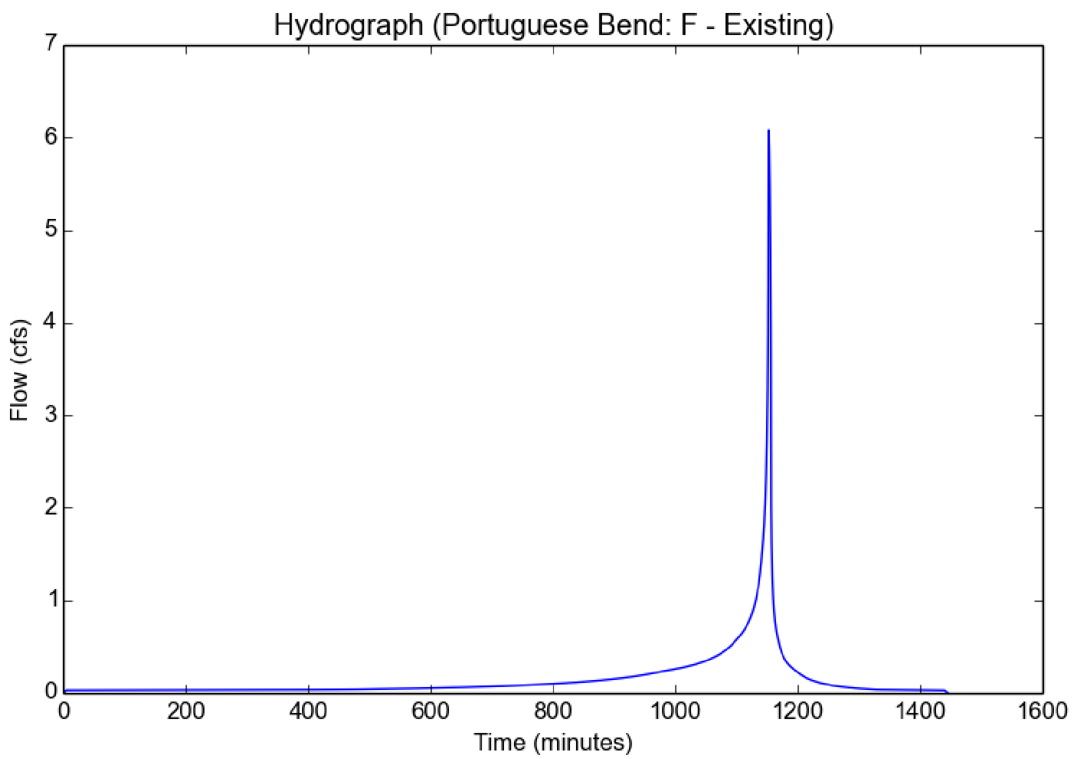
File location: C:/Users/Kevin/Desktop/Portuguese Bend Hydrology Calculations/Existing/F - Existing.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Portuguese Bend
Subarea ID	F - Existing
Area (ac)	2.74
Flow Path Length (ft)	172.0
Flow Path Slope (vft/hft)	0.66
50-yr Rainfall Depth (in)	4.9
Percent Impervious	0.01
Soil Type	2
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.3022
Peak Intensity (in/hr)	2.5668
Undeveloped Runoff Coefficient (Cu)	0.8645
Developed Runoff Coefficient (Cd)	0.8649
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	6.0827
Burned Peak Flow Rate (cfs)	6.0827
24-Hr Clear Runoff Volume (ac-ft)	0.3107
24-Hr Clear Runoff Volume (cu-ft)	13535.2544



Peak Flow Hydrologic Analysis

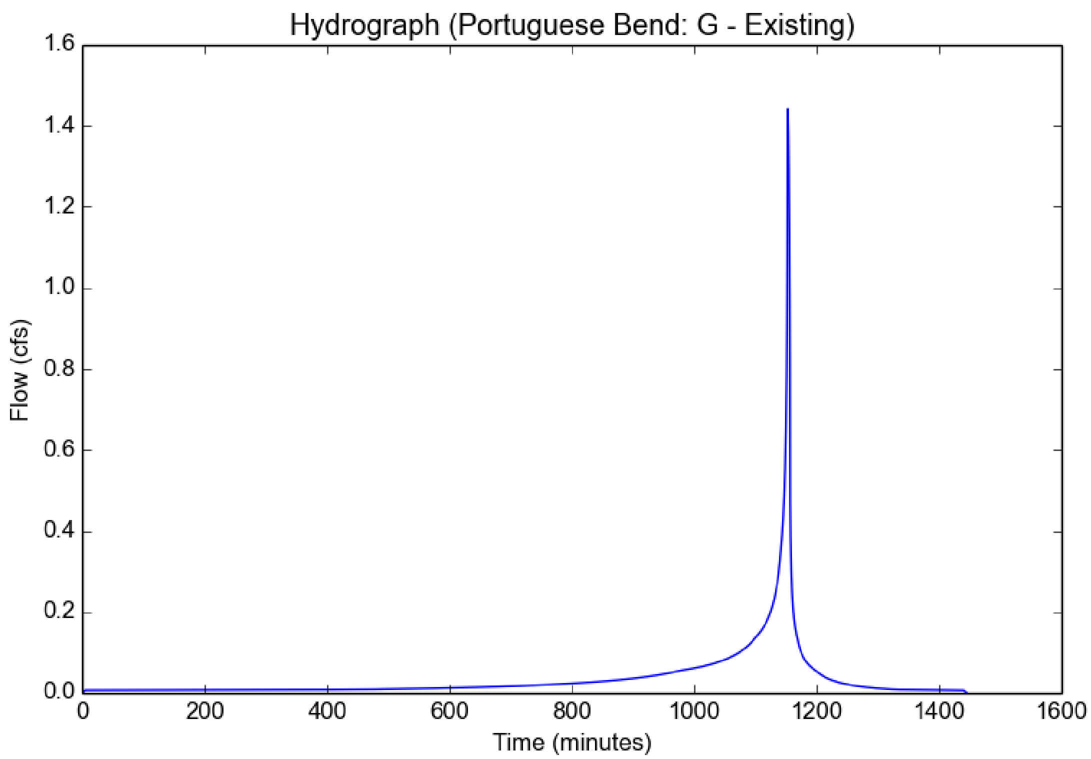
File location: C:/Users/Kevin/Desktop/Portuguese Bend Hydrology Calculations/Existing/G - Existing.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Portuguese Bend
Subarea ID	G - Existing
Area (ac)	0.65
Flow Path Length (ft)	195.0
Flow Path Slope (vft/hft)	0.18
50-yr Rainfall Depth (in)	4.9
Percent Impervious	0.01
Soil Type	2
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.3022
Peak Intensity (in/hr)	2.5668
Undeveloped Runoff Coefficient (Cu)	0.8645
Developed Runoff Coefficient (Cd)	0.8649
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.443
Burned Peak Flow Rate (cfs)	1.443
24-Hr Clear Runoff Volume (ac-ft)	0.0737
24-Hr Clear Runoff Volume (cu-ft)	3210.918



Peak Flow Hydrologic Analysis

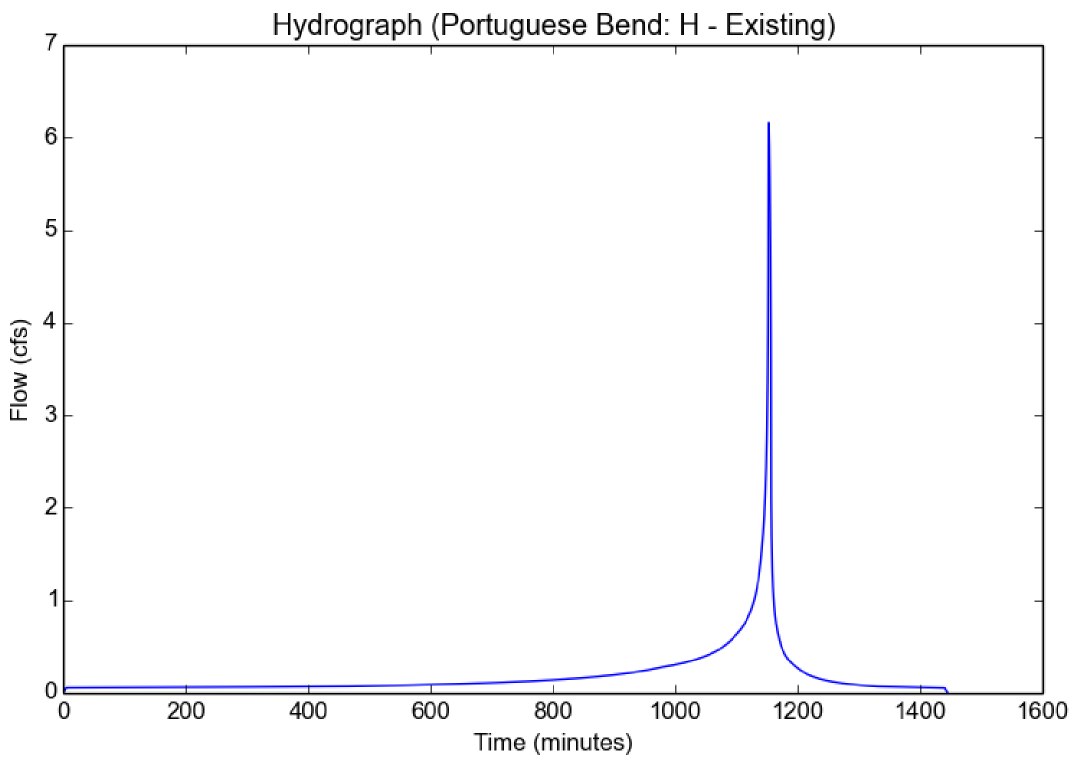
File location: C:/Users/Kevin/Desktop/Portuguese Bend Hydrology Calculations/Existing/H - Existing.pdf
Version: HydroCalc 0.3.1-beta

Input Parameters

Project Name	Portuguese Bend
Subarea ID	H - Existing
Area (ac)	2.76
Flow Path Length (ft)	420.0
Flow Path Slope (vft/hft)	0.14
50-yr Rainfall Depth (in)	4.9
Percent Impervious	0.14
Soil Type	2
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.3022
Peak Intensity (in/hr)	2.5668
Undeveloped Runoff Coefficient (Cu)	0.8645
Developed Runoff Coefficient (Cd)	0.8695
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	6.1598
Burned Peak Flow Rate (cfs)	6.1598
24-Hr Clear Runoff Volume (ac-ft)	0.3879
24-Hr Clear Runoff Volume (cu-ft)	16895.6013



Stormwater Planter Box (P.B.) Calculation:

Reference:

- *Los Angeles County "Appendix E Stromwater Quality Control Measure Fact Sheets."* *https://dpw.lacoutny.gov/ldd/lib/fpHydrology*
- *Los Angeles County "Appendix F Stromwater Quality Control Measure Examples."* *https://dpw.lacoutny.gov/ldd/lib/fpHydrology*
- *Los Angeles County Hydrology Map for 85th Percentile , 24-hr Rainfall* *http://dpw.lacounty.gov/wrd/hydrologygis/*

Given:
85^{th} percentile 24-hour rain = 1 in = 0.083 ft.
Soil media infiltration, f_{design} = 5 in/hr
Equation:
$f_{design} = K_{SAT,\ MEDIA}/FS$ - eq1
Where:
f_{design} = *corrected in-situ infiltration rate of filter media used in biofiltration BMP*
$K_{SAT,MEDIA}$ = *saturated infiltration rate of typical filter media (in/hr) = 5.0 in/hr*
FS = factor of safety = 2
f_{design} = *(5.0in/hr)/2 = 2.5 in/hr*

$SWQD_V = (0.90*A_{imp} + 0.10*A_{pervious})1/12$

Biofiltration Volume

$V_{SP} =$	$1.5 * SWQDv$	

Maximum depth

$d_{max} =$	t_p	$\left(\frac{f_{design}}{12}\right)$		

Minimum required surface Area, A_{min}

$$A_{min} = \frac{V_M}{(T_{fill} * f_{design}/12) + d_p}$$

DMA 1 (P.B. #1)

A = 5,482 sf
Ai = 5,482 sf = 100%
Ap = 0 sf
dp = 12 inch = 1 ft

*SWQDv = (0.9*5,482)*1/12 = 411*

V_{SP} = 1.5 (411 cu.ft.) = 617 cu.ft.

$$d_{max} = 48\ hours \left(\frac{2.5\ in/hr}{12}\right) = 10\ ft$$

Use d_{fill} = 2 feet

$$A_{min} = \frac{617\ cu.ft.}{((3\ hrs * 2.5\ in/hr)/12) + 1.0} = \mathbf{380\ sf}$$

DMA 2 (P.B. #2)

A = 7,781 sf
Ai = 7,781 sf = 100%
Ap = 0 sf
dp = 12 inch = 1 ft

*SWQDv = (0.9*7,781)*1/12 = 584 sf*

V_{SP} = 1.5 (584 cu.ft.) = 876 cu.ft.

$$d_{max} = 48\ hours \left(\frac{2.5\ in/hr}{12}\right) = 10\ ft$$

Use d_{fill} = 2 feet

$$A_{min} = \frac{876\ cu.ft.}{((3\ hrs * 2.5\ in/hr)/12) + 1\ ft} = \mathbf{539\ sf}$$

DMA 3 (P.B. #3)

A = 2,873 sf
Ai = 2,873 sf
Ap = 0 sf
dp = 12 inch = 1 ft.

*SWQDv = (0.9*2,873)*1/12 = 215 sf*

V_{SP} = 1.5 (215 cu.ft.) = 323 cu.ft.

d_{max} =	*48 hours*	(	$\frac{2.5\ in/hr}{12}$	)	= 10 ft

Use d_{fill} = 2 feet

A_{min} =	$\frac{323\ cu.ft.}{((3\ hrs * 2.5\ in/hr)/12) + 1}$	***= 199 sf***

DMA 4 (P.B. #4)

A = 1,273 sf
Ai = 1,273 sf
Ap = 0 sf
dp = 12 inch = 1 ft.

*SWQDv = (0.9*1,273)*1/12 = 95 sf*

V_{SP} = 1.5 (95 cu.ft.) = 143 cu.ft.

d_{max} =	*48 hours*	(	$\frac{2.5\ in/hr}{12}$	)	= 10 ft

Use d_{fill} = 2 feet

A_{min} =	$\frac{143\ cu.ft.}{((3\ hrs * 2.5\ in/hr)/12) + 1}$	***= 88 sf***

DMA 5 (P.B. #5)

A = 1,369 sf
Ai = 1,369 sf
Ap = 0 sf
dp = 12 inch = 1 ft.

*SWQDv = (0.9*1,369)*1/12 = 103 sf*

V_{SP} = 1.5 (103 cu.ft.) = 155 cu.ft.

$$d_{max} = 48\ hours \left(\frac{2.5\ in/hr}{12}\right) = 10\ ft$$

Use d_{fill} = 2 feet

$$A_{min} = \frac{155\ cu.ft.}{((3\ hrs * 2.5\ in/hr)/12) + 1} = \mathbf{95\ sf}$$

APPENDIX C

BMP Fact Sheets

Stormwater Planter Box (VEG-2)

VEG-2: Stormwater Planter

Description

A stormwater planter is a stormwater quality control measure that is completely contained within an impermeable structure with an underdrain. Stormwater planters function as a soil- and plant-based filtration device that remove pollutants though a variety of physical, biological, and chemical treatment processes. A stormwater planter consists of a ponding area, mulch layer, planting soils, plantings, and an underdrain within the planter box. As stormwater runoff passes through the planting soil, pollutants are filtered, adsorbed, and biodegraded by the soil and plants. Stormwater planters are typically planted with native, drought-tolerant vegetation that does not require fertilization and can withstand wet soils for at least 96 hours.

Stormwater planters may be placed adjacent to or near buildings, other structures, or sidewalks. Stormwater planters can be used directly adjacent to buildings beneath downspouts as long as the planters are properly lined on the building side and the overflow outlet discharges away from the building to ensure water does not percolate into footings or foundations. They can also be placed further away from buildings by conveying roof runoff in shallow engineered open conveyances, shallow pipes, or other innovative drainage structures.

A schematic of a typical stormwater planter is presented in Figure E-9.

LID Ordinance Requirements

Stormwater planters can be used as a stormwater quality control measure to treat stormwater runoff for the following alternative compliance measures:

- Off-site infiltration;
- Groundwater replenishment projects; and
- Off-site retrofit of existing development.

The project applicant must ensure that all pollutants of concern are addressed when using a stormwater planter (see Section 7.4). The following table identifies the pollutants of concern that are treated to the water quality benchmark (see Table 7-2 of the LID Standards Manual) by a stormwater planter:

Pollutant of Concern	Treated by Stormwater Planters?
Suspended solids	No
Total phosphorus	No
Total nitrogen	Yes
Total Kjeldahl nitrogen	Yes
Cadmium, total	No
Chromium, total	Yes
Copper, total	No
Lead, total	Yes
Zinc, total	No

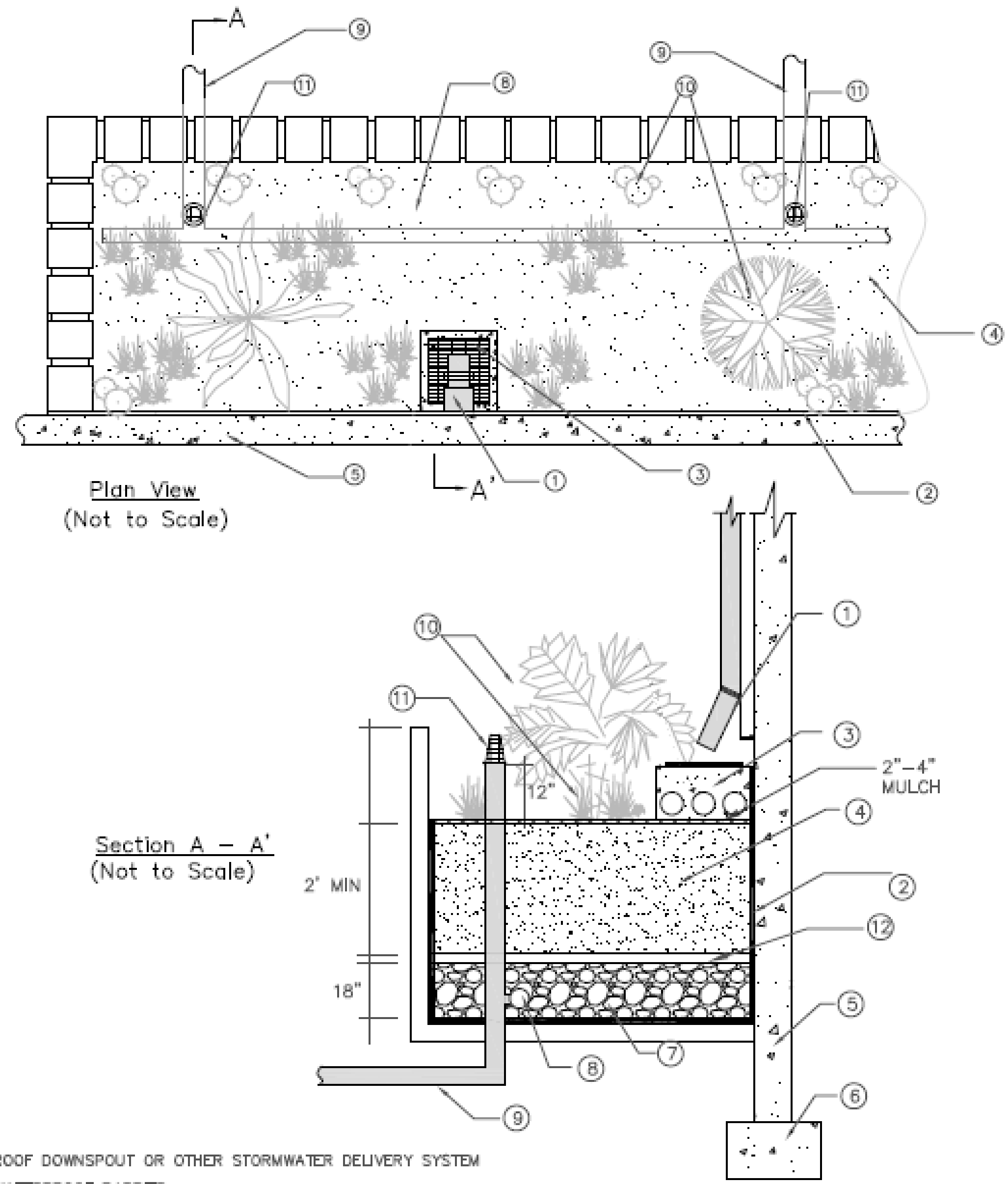
Source: Treatment Best Management Practices Performance, Los Angeles Regional Water Quality Control Board, December 9, 2013.

Advantages

- Has a low cost when integrated into site landscaping
- Can be useful for disconnecting downspouts
- Requires little space
- Is suitable for parking lots and sites with limited open area available for stormwater runoff treatment
- Reduces peak flows during small storm events
- Enhances site aesthetics
- May conserve water
- Requires little maintenance

Disadvantages

- May not be appropriate for industrial sites or locations with contaminated soils or where spills may occur because of the potential threat to groundwater contamination
- Is not suitable for areas with steep slopes
- Requires irrigation, which may conflict with water conservation ordinances or landscape requirements, to maintain vegetation
- May result in potentially increased cost due to waterproofing exterior building walls, if needed



NOTES:

1. ROOF DOWNSPOUT OR OTHER STORMWATER DELIVERY SYSTEM
2. WATERPROOF BARRIER
3. SHALLOW ENERGY DISSIPATOR BASIN DISPERSES FLOW AT SOIL SURFACE
4. SOIL MIX (SEE PLANTING MEDIA SECTION)
5. BUILDING
6. FOUNDATION. INSTALL FOUNDATION DRAINS AS NEEDED
7. GRAVEL BEDDING (SEE UNDERDRAIN)
8. PERFORATED PIPE SHALL RUN ENTIRE LENGTH OF PLANTER
9. CONNECTION TO DOWNSTREAM CONVEYANCE SYSTEM
10. PLANTS
11. SET OVERFLOW 2" BELOW THE TOP OF THE PLANTER
12. OPTIONAL CHOKING GRAVEL LAYER

Figure E-9. Stormwater Planter Schematic

General Constraints and Implementation Considerations

- Stormwater planters are suitable for smaller tributary areas such as urban infill projects.
- Stormwater planters can be integrated into other landscaping areas.
- For stormwater planters next to buildings, waterproofing of exterior building walls must be provided as directed by an architect or structural engineer.
- The site topography must be relatively flat.
- During construction activities should avoid compaction of native soils below planting media layer or gravel zone.
- Stormwater runoff must be diverted around the stormwater planter during the period of vegetation establishment. If diversion is not feasible, the graded and seeded areas must be protected with suitable sediment controls (i.e., silt fences).
- All damaged areas should be repaired, seeded, or re-planted immediately.
- The general landscape irrigation system should incorporate the stormwater planter, as applicable.

Design Specifications

The following sections describe the design specifications for stormwater planters.

Geotechnical

Due to the potential to contaminate groundwater, cause slope instability, impact surrounding structures, and potential for insufficient infiltration capacity, an extensive geotechnical site investigation must be conducted during the site planning process to verify site suitability for a stormwater planter. All geotechnical investigations must be performed according to the most recent GMED Policy GS 200.1. Soil infiltration rates and the groundwater table depth must be evaluated to ensure that conditions are satisfactory for proper operation of a stormwater planter. The project applicant must demonstrate through infiltration testing, soil logs, and the written opinion of a licensed civil engineer that sufficiently permeable soils exist on-site to allow the construction of a properly functioning stormwater planter.

Geometry

- The minimum soil depth should be 12 to 18 inches. The minimum soil depth is required to provide a beneficial root zone for the chosen vegetation and adequate storage capacity for stormwater runoff. A deeper planting soil depth will provide a smaller surface area footprint.
- The minimum stormwater planter width is 30 inches.
- Any stormwater planter shape configuration is possible as long as the other design specifications are met.

- The distance between the downspouts and the overflow outlet should be maximized in order to increase the opportunity for stormwater runoff retention and filtration.

Sizing

Stormwater planters are sized using a simple sizing method where the SWQDv must be completely filtered within 96 hours. If the incoming stormwater runoff flow rate is lower than the long term filtration rate, above ground storage does not need to be provided. If the incoming stormwater runoff flow rate is higher than the long term filtration rate, above ground storage shall be provided (see steps below).

Step 1: Calculate the design volume

Stormwater planters areas should be sized to capture and treat the SWQDv (see Section 6 for SWQDv calculation procedures) that is not reliability retained on the project site, as calculated by the equation below:

$$V_{SP} = \mathrm{SWQDv} - \mathrm{V_r}$$

Where:

V_{SP} = Biofiltration volume [ft^3];
SWQDv = Stormwater quality design volume [ft^3]; and
V_R = Volume of stormwater runoff reliably retained on-site [ft^3].

Step 2: Calculate the design infiltration rate

Determine the corrected in-situ infiltration rate (f_{design}) of the native soil using the procedures described in the most recent GMED Policy GS 200.1.

Step 3: Calculate the surface area

Select a surface ponding depth (d) that satisfies the geometric criteria and meets the site constraints. Selecting a deeper ponding depth (up to 1.5 ft) generally yields a smaller footprint, however, it will require greater consideration for public safety, energy dissipation, and plant selection.

Calculate the time for the selected ponding depth to filter through the planting media using the following equation:

$$t_p = \frac{d}{\left(\frac{f_{design}}{12}\right)}$$

Where:

t_p = Required detention time for surface ponding (max 96 hr) [hr];
d = Ponding depth (max 1.5 ft) [ft]; and
f_{design} = Design infiltration rate [in/hr].

If t_p exceeds 96 hours, reduce surface ponding depth (d). In nearly all cases, t_p should not approach 96 hours unless f_{design} is low.

Calculate the required infiltrating surface (filter bottom area) using the following equation:

$$A = \frac{V_B}{d}$$

Where:

A = Bottom surface area of biofiltration area [ft^2];
V_B = Biofiltration design volume [ft^3]; and
d = Ponding depth (max 1.5 ft) [ft].

Flow Entrance and Energy Dissipation

The following types of flow entrance can be used for stormwater planters:

- Piped entrances, such as roof downspouts, should include rock, splash blocks, or other erosion controls at the entrance to dissipate energy and disperse flows.
- Woody plants (trees, shrubs, etc.) can restrict or concentrate flows and can be damaged by erosion around the root ball and must not be placed directly in the entrance flow path.

Drainage

Stormwater planters must be designed to drain below the planting soil depth in less than 96 hours. Soils must be allowed to dry out periodically in order to restore hydraulic capacity to receive stormwater runoff from subsequent storm events, maintain infiltration rates, maintain adequate soil oxygen levels for healthy soil biota and vegetation, and provide proper soil conditions for biodegradation and retention of pollutants.

Underdrain

Stormwater planters require an underdrain to collect and discharge stormwater runoff that has been filtered through the soil media, but not infiltrated, to another stormwater quality control measure, storm drain system, or receiving water. The underdrain shall have a mainline diameter of eight inches using slotted PVC SDR 26 or PVC C9000. Slotted PVC allows for pressure water cleaning and root cutting, if necessary. The slotted pipe should have two to four rows of slots cut perpendicular to the axis of the pipe or at right angles to the pitch of corrugations. Slots should be 0.04 to 0.1 inches wide with a length of 1 to 1.25 inches. Slots should be longitudinally-spaced such that the pipe has a minimum of one square inch opening per lineal foot and should face down.

The underdrain should be placed in a gravel envelope (Class 2 Permeable Material per Caltrans Spec. 68-1.025) that measures three feet wide and six inches deep. The underdrain is elevated from the bottom of the stormwater planter by six inches within the gravel envelope to create a fluctuating anaerobic/aerobic zone below the underdrain to facilitate denitrification within the anaerobic/anoxic zone and reduce nutrient concentrations. The top and sides of the underdrain pipe should be covered with gravel to a minimum depth of 12 inches. The underdrain and gravel envelope should be covered with a geomembrane liner to prevent clogging. The following aggregate should be used for the gravel envelope:

Particle Size (ASTM D422)	% Passing by Weight
¾ inch	100%
¼ inch	30-60%
#8	20-50%
#50	3-12%
#200	0-1%

Underdrains should be sloped at a minimum of 0.5 percent, and must drain freely to an acceptable discharge point.

Rigid non-perforated observation pipes with a diameter equal to the underdrain diameter should be connected to the underdrain to provide a clean-out port as well as an observation well to monitor drainage rates. The wells/clean-outs should be connected to the perforated underdrain with the appropriate manufactured connections. The wells/clean-outs should extend six inches above the top elevation of the stormwater planter mulch, and should be capped with a lockable screw cap. The ends of underdrain pipes not terminating in an observation well/clean-out should also be capped.

Hydraulic Restriction Layer

A geomembrane liner may be placed between the planting media and the drain rock. If a geomembrane liner is used, it should meet a minimum permittivity rate of 75 gal/min/ft^2 and should not impede the infiltration rate of the soil media. The geomembrane liner must meet the minimum requirements presented in Table E-16.

Table E-16 Geomembrane Liner Specifications for Stormwater Planters

Parameter	Test Method	Specification
Trapezoidal Tear	ASTM D4533	40 lbs (minimum)
Permeability	ASTM D4491	0.2 cm/sec (minimum)
AOS (sieve size)	ASTM D4751	#60 – #70 (minimum)
Ultraviolet Resistance	ASTM D4355	>70%

Preferably, aggregate should be used in place of a geomembrane layer to reduce the potential for clogging. This aggregate layer should consist of two to four inches of washed sand underlain with two inches of choking stone (typically #8 or #89 washed).

Vegetation

Prior to installation, a licensed landscape architect must certify that all plants, unless otherwise specifically permitted, conform to the standards of the current edition of American Standard for Nursery Stock as approved by the American Standards Institute, Inc. All plant grades shall be those established in the current edition of American Standards for Nursery Stock.

- Shade trees must have a single main trunk. Trunks must be free of branches below the following heights:

CALIPER (in)	Height (ft)
1½-2½	5
3	6

- Plants must be tolerant of summer drought, ponding fluctuations, and saturated soil conditions for up to 96 hours.
- It is recommended that a minimum of three types of tree, shrubs, and/or herbaceous groundcover species be incorporated to protect against facility failure due to disease and insect infestations of a single species.
- Native plant species and/or hardy cultivars that are not invasive and do not require chemical inputs must be used to the maximum extent practicable.

The stormwater planter should be vegetated to resemble a terrestrial forest community ecosystem, which is dominated by understory trees, a shrub layer, and herbaceous ground cover. Stormwater planters should be planted to cover at least 50 percent of the planter surface. Select vegetation that:

- Is suited to well-drained soil;
- Will be dense and strong enough to stay upright, even in flowing water;
- Has minimum need for fertilizers;

- Is not prone to pests and is consistent with Integrated Pest Management practices; and
- Is consistent with local water conservation ordinance requirements.

Irrigation System

Provide an irrigation system to maintain viability of vegetation, if applicable. The irrigation system must be designed to local code or ordinance specifications.

Planter Walls

Planter walls must be made of stone, concrete, brick, clay, plastic, wood, or other stable, permanent material. The use of pressure-treated wood or galvanized metal at or around a stormwater planter is prohibited.

Overflow Device

An overflow device is required at the 18-inch ponding depth. The following, or equivalent, should be provided:

- A vertical PVC pipe (SDR 26) to act as an overflow riser.
- The overflow riser(s) should be eight inches or greater in diameter, so it can be cleaned without damage to the pipe.
- The inlet to the riser should be a maximum of 18 inches above the planting soil, and be capped with a spider cap to exclude floating mulch and debris. Spider caps should be screwed in or glued (e.g., not removable). The overflow device should convey stormwater runoff in excess of the SWQDv to an approved discharge location (another stormwater quality control measure, storm drain system, or receiving water).

Maintenance Requirements

Maintenance and regular inspections are important for proper function of stormwater planters. Stormwater planters require annual plant, soil, and mulch layer maintenance to ensure optimal infiltration, storage, and pollutant removal capabilities. In general, stormwater planter maintenance requirements are typical landscape care procedures and include:

- Irrigate plants as needed during prolonged dry periods. In general, plants should be selected to be drought-tolerant and not require irrigation after establishment (two to three years).
- Inspect flow entrances, ponding area, and surface overflow areas periodically, and replace soil, plant material, and/or mulch layer in areas if erosion has occurred. Properly-designed facilities with appropriate flow velocities should not cause erosion except potentially during in extreme events. If erosion occurs, the flow velocities and gradients within the stormwater planter and flow dissipation

and erosion protection strategies in the flow entrance should be reassessed. If sediment is deposited in the stormwater planter, identify the source of the sediment within the tributary area, stabilize the source, and remove excess surface deposits.

- Prune and remove dead plant material as needed. Replace all dead plants, and if specific plants have a high mortality rate, assess the cause and, if necessary, replace with more appropriate species.
- Remove weeds as needed until plants are established. Weed removal should become less frequent if the appropriate plant species are used and planting density is attained.
- Select the proper soil mix and plants for optimal fertility, plant establishment, and growth to preclude the use of nutrient and pesticide supplements. By design, stormwater planters are located in areas where phosphorous and nitrogen levels are often elevated such that these should not be limiting nutrients. Addition of nutrients and pesticides may contribute pollutant loads to receiving waters.
- Analyze soil for fertility and pollutant levels if necessary. Stormwater planter soil media are designed to maintain long-term fertility and pollutant processing capability.
- Excavate and clean the stormwater planter if it does not drain within 96 hours after a storm event. Replace stormwater planter soil media as needed to improve the infiltration rate.
- Eliminate standing water to prevent vector breeding.
- Inspect, and clean if necessary, the underdrain.
- Inspect overflow devices for obstructions or debris, which should be removed immediately. Repair or replace damaged pipes upon discovery.
- Repair structural deficiencies to the stormwater planter including rot, cracks, and failure.
- Implement Integrated Pest Management practices if pests are present in the stormwater planter.
- Provide training and/or written guidance to all property owners and tenants. Provide a copy of the Maintenance Plan to all property owners and tenants.

A summary of potential problems that may need to be addressed by maintenance activities is presented in Table E-17.

The County requires execution of a maintenance agreement to be recorded by the property owner for the on-going maintenance of any privately-maintained stormwater quality control measures. The property owner is responsible for compliance with the maintenance agreement. A sample maintenance agreement is presented in Appendix H.

Table E-17. Stormwater Planter Troubleshooting Summary

Problem	Conditions When Maintenance Is Needed	Maintenance Required
Vegetation	Overgrown vegetation	Mow and prune vegetation as appropriate.
	Presence of invasive, poisonous, nuisance, or noxious vegetation or weeds	Remove this vegetation and plant native species as needed.
Trash and Debris	Trash, plant litter, and dead leaves present	Remove and properly dispose of trash and debris.
Irrigation (if applicable)	Not functioning correctly	Check irrigation system for clogs or broken lines and repair as needed.
Inlet/Overflow	Inlet/overflow areas clogged with sediment and/or debris	Remove material. Ensure the downspout is clear of debris.
	Overflow pipe blocked or broken	Repair as needed.
Erosion/Sediment Accumulation	Splash pads or spreader incorrectly placed Presence of erosion or sediment accumulation	Check inlet structure to ensure proper function. Repair, or replace if necessary, the inlet device. Repair eroded areas with gravel as needed. Re-grade the stormwater planter as needed.
Contaminants and Pollution	Any evidence of oil, gasoline, contaminants, or other pollutants	Remove any evidence of visual contamination from floatables such as oil and grease.
Standing water	Standing water observed more than 96 hours after storm event	Inspect, and clean as needed, the underdrain to ensure proper function. Clear clogs as needed. Remove and replace planter media (sand, gravel, topsoil, mulch) and vegetation.