Appendix G Solana Torrance Preliminary Drainage Study

Appendices

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Solana Torrance
Preliminary Drainage Study

S/W Corner of Hawthorne Boulevard & Via Valmonte
Torrance, California 90505

October 09, 2018

Prepared for

ReyLenn Properties LLC

Prepared by

KHR ASSOCIATES
Consulting Engineers - Surveyors - Planners

ATTESTATION

This report has been prepared by, and under the direction of, the undersigned, a duly Registered Civil Engineer in the State of California. Except as noted, the undersigned attests to the technical information contained herein, and has judged to be acceptable the qualifications of any technical specialists providing engineering data for this report, upon which findings, conclusions, and recommendations are based.

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Registered Civil Engineer No. C30560
Exp. 3/31/20

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Section 1 - Purpose and Scope

This Drainage Study presents an analysis of the hydrologic effects that may be associated with the development of the *Solana* mixed-use project. The study details the general project characteristics, the design, criteria, and methodology applied to the analysis of the project. It evaluates the hydrologic effect of the project on local water resources in terms of both water quantity and water quality. The report provides a design analysis for the drainage facilities proposed as part of the project.

The plans and specifications in the Drainage Study are not for construction purposes; the contractor shall refer to final approved construction documents for plans and specifications. This Hydrology Study fulfills the requirements of the Los Angeles County Hydrology Manual (January 2006).

Section 2 - Project Information

2.1 Project Description

Solana Torrance is a proposed multi-family residential development (hereinafter referred to as *Project*) that will be situated within a 24.68-acre parcel of vacant hillside land, of which only 5.76 acres of previously disturbed land (from a former diatomaceous earth quarry operation) will be utilized. The balance of the site (18.92 acres) will be preserved as natural open space. Figure 1 illustrates the location of the *Project* site relative to other districts that comprise the City of Torrance. Figure 2 provides an aerial view of the *Project* site and surrounding environs.

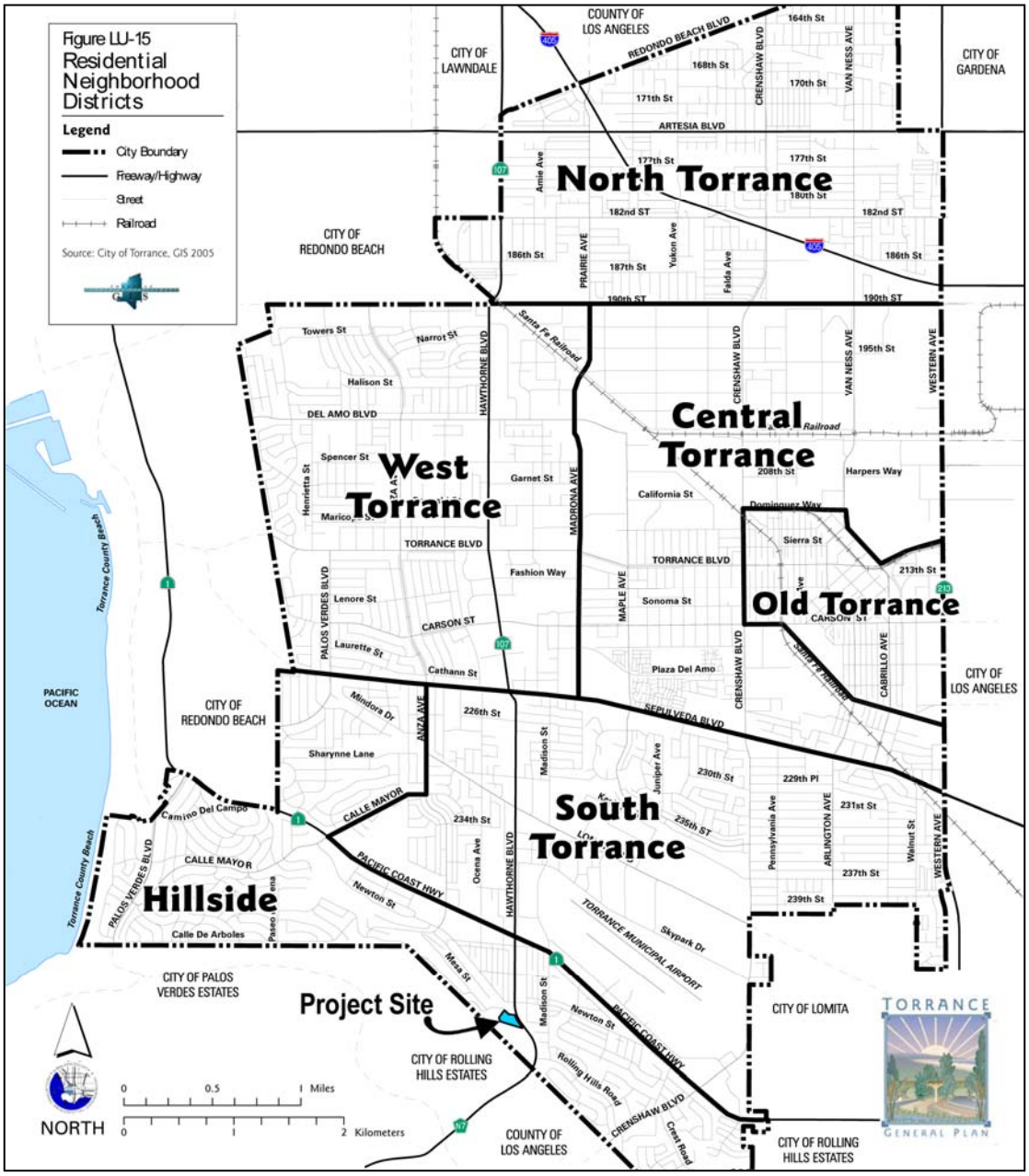


Figure 1 - Project Location Map

Figure 2 – Aerial View of Project Site

The *Project* will consist of 248 multi-family dwelling units; 546 parking spaces including surface parking and subterranean parking structures; a 5,000 square-foot community room/fitness center; and 96,385 square feet of landscaped areas. Site access will be via a right-in/right-out only driveway on Hawthorne Boulevard and a right turn "exit-only" driveway on Via Valmonte (right-out only). Figure 3 illustrates the *Project* Architect's conceptual site plan.

Figure 3 – *Solana Torrance* Site Plan

2.2 Hydrologic Setting

This section summarizes the project's size and location in the context of the larger watershed perspective, topography, soil and vegetation conditions, percent impervious area, natural and infrastructure drainage features, and other relevant hydrologic and environmental factors to be protected specific to the project area's watershed.

2.2.1 Watershed

The proposed project is located within the area tributary to the Walteria Sump and is located in the southern portion of the Los Angeles Basin. The Walteria Sump is maintained by Los Angeles county Department of Public Works and is part of 2,282 acre watershed. Over 90% of this watershed is developed, with approximately 61% of the surfaces impervious. The stormwater in the Walteria Sump either evaporates, percolates into the ground, or is pumped to Machado/Harbor Lakes.

2.2.2 Existing Topography, Drainage Patterns, and Facilities (Narrative)

The existing site is a vacant lot and is zoned Light Agricultural (A1) per the City of Torrance Zoning Information Map (See Appendix). The existing site has also been altered by previous diatomite and diatomaceous soil mining activities. Although the total project site area is 24.68 acres, only the 12.13 acres that have drainage conditions that are altered by the proposed project (inclusive of the 5.76 acre multi-family development area and the 6.37 acre upstream tributary drainage area) were analyzed for this report. The existing site's topography within the area influenced by the proposed project (12.13 acres out of 24.68 acres) generally slopes toward the center of the site which is a topographic low. The area of the topographic low was previously mined to approximately elevation 110 feet and later backfilled to create two level pads, the lower pad at approximately elevation 190 to elevation 220 feet and the upper pad at approximately elevation 235 feet to elevation 245 feet. Due to the fact that the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps are not updated regularly, the area which was filled in is shown as a special flood hazard area - Zone A, which is subject to inundation by the 1% annual chance of flood. An application for a Letter of Map Revision (LOMR) is being submitted to FEMA to remove the area from Zone A so the entire site is within Zone X, which is outside the 0.2% annual chance floodplain.

Existing slopes bounding the proposed development on the northwest and east to northeast are considered graded slopes (from past mining operations).

The existing site condition has a low point near the center which the majority of runoff drains towards. Due to this depressed condition and no site connections to an existing storm drain system, the runoff ponds on the existing surface until evaporation and infiltration occurs. The easterly section of the site that runs along Hawthorne Boulevard, and a portion of the northern section of the site flows towards the curb face of Via Valmonte where the runoff directly flows to an existing catch basin located on the corner curb of Via Valmonte. The flow discharges into the 18-inch storm drain which then routes the water through the public storm drain system. The southern portion of the site drains towards the curb face on Hawthorne Boulevard. The runoff then flows in Hawthorne Boulevard until it is collected in an existing catch basins approximately 440 feet north of the proposed southeast property line. From the catch basin the runoff is routed

through the existing public storm drain system. Both storm water networks ultimately discharge into the Walteria Sump.

The City of Torrance Department of Public Works provided the Master Drainage Plan that describes the drainage area and shows the existing storm drain system for the project area. According to the Master Drainage Plan, the 50 acres designated as 070201 (which includes the Solana site) was intended to be served by the drain at node 070201, which is shown to enter a county storm drain (SD-1047). This County drain flows to the north along Hawthorne, east on Newton, and north on Park Street. A short time after the Master Plan was written, the County designed and constructed a new drain to serve this site (SD-1065) and take the flows north on Hawthorne and then northwest on Newton. See appendix for Master Drainage Plan.

2.2.3 Adjacent Land Use

The proposed project is bounded by numerous residential buildings and Via Valmonte on the north and west, Hawthorne Boulevard on the east, and excavated hillside areas towards the south and west side.

2.2.4 Soil Conditions

According to the Geotechnical Report by Geocon West, Inc. dated June 2017 the site is underlain by artificial fill, overburden soil, Pleistocene age marine sand, San Pedro Sand and Lomita Marl, and Miocene age sedimentary bedrock of the Monterey Formation. The artificial fill was encountered to the depths between 2 and 74 feet below the existing ground surface. The fill consists of light to dark brown and yellowish brown sand, silty sand, and clayey sand, with lesser amounts of gravelly sand, sandy silt and clay. The overburden soil was encountered within the upper five feet in boring B1. The overburden soil was derived from in-situ weathering of the underlying sedimentary bedrock and consists of light gray sandy silt with varied amounts of gravel and roots. They are underlain by the sedimentary bedrock of the Monterey Formation. Late Pleistocene age marine sand was encountered below the fill soils to a maximum depth of 15 feet. The marine sand consists of light brown to brown and reddish brown, fine to medium-grained sand, silty sand and sandy silt with lenses of coarse-grained sand and rounded gravel. Based on the percolation test borings, the maximum infiltration rate at the depth of the proposed infiltration systems were found to be 93.7 in/hr. To ensure long term operation of the infiltration systems, a conservative approach to the drawdown time used for the infiltration systems was established by applying a reduction factor of 5.2 and a safety factor of 3 to the tested infiltration rate, resulting in an engineering design infiltration rate of 6.01 in/hr. Test results can be found on the Appendix section of the report.

The site is not located within an area of known ground subsidence. There is no large-scale extraction of groundwater, gas, oil, or geothermal energy is occurring or planned at the site or in the general site vicinity. There is no reported data for the historically highest groundwater level in the immediate area and groundwater is not anticipated to adversely impact the proposed development. Groundwater was not encountered in the borings drilled to the maximum depth of 120.5 feet beneath the existing ground surface within the proposed building area. The soils are considered corrosive with respect to corrosion of buried ferrous metals on site.

2.2.5 Downstream Conditions

This section summarizes the existing downstream conditions and any conditions of concern with respect to erosion and/or sedimentation due to the proposed project.

The stormwater will be collected by an existing City catch basin and lateral and an existing County of Los Angeles maintained storm drain system. The proposed condition will be connecting to the County line on Via Valmonte at an allowable flow rate implemented by the County. The County storm drain network discharges into the Walteria Sump.

2.2.6 Impervious Cover

The proposed project will have a net increase in total impervious area compared to the existing condition of the site. Currently, the project site consists of a vacant lot with a total imperviousness percentage of 1% and perviousness of 99%. The proposed mixed-use project increases the site's overall total imperviousness percentage to 45% and decreases perviousness to 55%.

2.3 Proposed Runoff Management Facilities

The proposed facilities managing runoff from the site include:

- Roof drains, area drains, and catch basins directed to underground retention tanks for infiltration. Overflow is directed by the private storm drain to the public storm drain system in Hawthorne Boulevard. Detention is needed to cap maximum flows to 1.01 cfs/acre and meet the County's Q allowable restriction.
- On-site runoff is collected throughout the site by a private storm drain network and discharged to the catch basin off of Via Valmonte and Hawthorne Boulevard.
- Stormwater treatment controls will pre-treat the first flush from the project site before the runoff reaches the CMP infiltration tanks. CDS Units will be used for pre-treatment prior to infiltration.
- Proposed CMP infiltration tanks will be placed in three different areas (Tank 1 in subarea 1, Tank 2 in subarea 2, and tank 3 in subarea 3) on the site to meet Low-impact Development (LID) requirements. Infiltration is the preferred method for stormwater management per the County of Los Angeles LID Standards Manual. The use of infiltration helps to minimize the project's stormwater impact on the existing municipal storm drain system by reducing the quantity and increasing the quality of runoff. Using the design infiltration rate of 6.01 inches per hour, the times for the tanks at capacity to completely drawdown was calculated to be from 11.5 to 11.6 hours. The LID CMP infiltration calculations can be found in the Appendix section of this report.
- The site's storm drain system that discharges to the catch basin located in Via Valmonte will be limited to 1.01 cfs/acre to meet the Q allowable requirements of the County. This will be accomplished by sizing the project's connection pipe to the catch basin to only allow flows up to a maximum flow rate of 12.25 cfs, which is the Q allowable. The difference in volume from flow rates between the Q allowable and the project's 50-year storm event will be collected and infiltrated by three CMPs (Tank A in subarea 1, Tank B

in subarea 2, and tank C in subarea 3) used for storm events in excess of the Q allowable. Weir structures or other type of diverters will be used to direct detention flows to these CMPs.

Section 3 - Design Criteria and Methodology

This section summarizes the design criteria and methodology applied during the drainage analysis of the project site. The design criteria and methodology follows the County of Los Angeles Drainage Design Manual (January 2006) and County of Los Angeles Low-impact Development (LID) Standards Manual (LID January 2009).

3.1 Design Criteria

3.1.1 Drainage Design Criteria

Local storm drain facilities (street gutters, curb inlets) have been designed to conform to standards found in the County of Los Angeles Drainage Design Manual.

3.1.2 Flood Peak Attenuation

Land development projects with a new connection to county maintained facilities need to be analyzed to assure that the existing facility has the ability to accept any additional stormwater. For the proposed project a connection to a County maintained facility will be utilized to drain the site. The Los Angeles County Department of Public Works – Design Division – Hydraulic Analysis Unit provided the proposed project with an allowable discharge of 1.01 cfs per acre for the 50-year 24-hour storm event (see Appendix section).

3.2 Methodology

3.2.1 Runoff Calculation Method: Peak Flow

Runoff calculations for this study were accomplished using the LACDPW Modified Rational Method. The LACDPW Modified Rational Method is a physically-based numerical method where runoff is assumed to be directly proportional to rainfall and area, less losses for infiltration and depression storage. Flows were computed based on the rational formula:

$$Q=CiA$$

Where... Q = Peak discharge (cfs);
C = runoff coefficient, based on land use and soil type;
i = Rainfall intensity (in/hr);
A = watershed area (acre)

The runoff coefficient represents the ratio of rainfall that runs off the watershed versus the portion that infiltrates to the soil or is held in depression storage. The runoff coefficient is dependent on the land use coverage and soil type. The County of Los Angeles Drainage Design Manual methodology assumes hydrologic Soil Type 4 for all soils near the project site (see Isohyet Map in the Appendix section).

For a typical drainage study, rainfall intensity varies with the watershed time of concentration. The watershed time of concentration at any given point is defined as the time it would

theoretically take runoff to travel from the most upstream point in the watershed to a concentration point, as calculated by Hydrocalc software, provided by the County. Hydrocalc also generates a comma-separated values (csv) text file that contains inputs, outputs, and a detailed hydrograph table in an iterative process of every 0.2 minutes for the entire duration of the specified storm event.

Modified Rational Method calculations were accomplished using the Hydrocalc software provided by the County. A storm event of 50-years is used to perform the calculations as required by the City of Torrance. Peak discharges were computed for 50-year hypothetical storm return frequencies and can be seen in the Hydrology and Drainage Analysis section of this report. A set of peak discharges were computed for the existing and proposed conditions using 6 and 13 subareas, respectively, to better compare the two conditions. A set of peak discharges for the proposed condition utilizing 3 subareas was performed to better analyze flows exceeding the Q allowable restriction imposed by the county, and to determine how much storage would be needed to detain the volume from those flows higher than the restricted Q. As part of this process, the csv text file was generated for each of the 3 subareas to determine the time, duration, and flow rate that exceeds the Q allowable in order to determine the volume higher than the Q that would need to be detained. Data outputs from the csv text file are provided in 0.2 minute increments. Detention volumes were determined by subtracting the subarea's Q allowable from each time interval's peak flow rate in exceedance of the subarea's Q allowable, multiplying the result by 12 seconds to determine the volume of the exceedance, and then totaling the sum of each volume exceedance. The detention tanks are required to detain the difference in volume between the 50-year peak storm and the Q allowable. The portion of the csv text file showing the Q allowable exceedance data outputs is found in the Appendix section

Section 4 - Hydrology and Drainage Analysis

This section summarizes the quantitative hydrologic analysis of the existing and proposed conditions of the site.

4.1 Summary of Drainage Delineation

The property is currently a vacant lot. Although the total project site area is 24.68 acres, only the 12.13 acres that have drainage conditions that are altered by the proposed project (inclusive of the 5.76 acre multi-family development area and the 6.37 acre upstream tributary drainage area) were analyzed for this report. To further analyze the existing conditions, the area that will be effected by the proposed project was broken into five subareas, E1, E2, E3, E4, E5, and E6. Area E1 drains towards a catch basin on Via Valmonte (Catch Basin #1). Areas E2, E3, and E4 sheet flow towards a low point on the site where the runoff is retained until evaporation and infiltration occur. Area E5 drains to the easterly towards Hawthorne Boulevard and then flows in the street towards catch basins #1 and #2 at Hawthorne Boulevard and Via Valmonte. From catch basins #1 and #2, the runoff travels through the storm drain line in the county's storm drain system. Area E6 and the southern portion of the site sheet flow toward Hawthorne Boulevard where the runoff is collected in catch basin #2. An Existing Condition Hydrology Map was created and can be found in the Appendix section of this report. The map shows the existing subareas that will be disturbed due to the proposed project and quantifies the peak discharge during a 50-Year 24-Hour storm event.

Although the total project site area is 24.68 acres, only the 12.13 acres that have drainage conditions that are altered by the proposed project (inclusive of the 5.76 acre multi-family development area and the 6.37 acre upstream tributary drainage area) were analyzed for this report. The drainage conditions influenced by the proposed project have a total area of 12.13 acres and generally drains north towards Via Valmonte. The project proposes to upsize the existing City storm drain within Via Valmonte from an 18-inch RCP to a 24-inch RCP storm drain, which then connects to the existing County's 30-inch storm drain. The existing 18 inch RCP is to be increased to a 24 inch RCP in order to handle 11.46 cfs (12.25 cfs minus the 0.79 cfs of existing site flows into Via Valmonte) of new flow from the proposed project that will be added to the existing 6 to 8 cfs currently flowing in Via Valmonte. To further analyze the proposed conditions, the site is broken into 12 subareas, 1A, 1B, 1C, 2A, 2B, 2C, 3A, 3B, 3C, 3D, 3E, and 4A. Area 1A will sheet flow untreated to Via Valmonte and then gutter flow towards catch basin #1 which is located on the southwest corner of Via Valmonte and Hawthorne Boulevard. Subareas 1B, 1C, 2A, 2B, 2C, 3A, 3B, 3C, 3D, and 3E are collected on-site by roof drains, area drains, and catch basins that tie into the onsite storm drain system which will direct the runoff to three CMP tanks (Tanks 1, 2, and 3) for infiltration of the first flush. During larger storm events, runoff exceeding the LID infiltration tank's capacity will bypass the treatment system and discharge through an outlet pipe, which has been restricted to the allowable flow rate pre-established by LACFCD to be 1.01 cfs/acre, into the proposed municipal catch basin in Via Valmonte. The difference in volume of flow rates between the Q allowable and the project's 50-year storm event will be collected and infiltrated by three CMPs (Tanks A, B, and C) used for storm events in excess of the Q allowable. Weir structures or other type of diverters will be used to direct detention flows to these CMPs. The hydraulic grade line (HGL) will be determined in final design. To better analyze the size of the CMPs needed for both LID and to detain flows

over the Q allowable, the project area was divided into three subareas. Subarea 1 consists of subareas 1A through 1D. Subarea 2 consists of subareas 2A through 2C. Subarea 3 consists of subareas 3A through 3E. An area weighted average was used to determine the length and slope for each flow path in order to have more accurate data inputted into the HydroCalc software. The new municipal catch basin discharges to a proposed 24-inch storm drain that connects to an existing 30-inch County storm drain within Via Valmonte. The existing 30-inch County storm drain system travels east towards the intersection where it travels north on Hawthorne Boulevard and eventually discharges to the Walteria Sump. Subarea 4A sheet flows toward Hawthorne Boulevard into catch basins #1 and #2, mimicking the existing drainage patterns.

The proposed runoff from the site will be restricted to satisfy the allowable flow rate of 1.01 cfs per acre which was set by the County. Three underground infiltration tanks along with their associated aggregate filled trenches will be used for infiltration of the LID design storm (Tanks 1, 2, and 3) and three underground infiltration tanks along with their associated aggregate filled trenches will be used to hold the difference in volume over the Q allowable (Tanks A, B, and C). Flows over the LID design storm and under the Q allowable will bypass the tanks and discharge by a restricted 15-inch pipe (sized to the maximum allowable flow rate) to the existing County storm drain system. The outlet pipes at each subarea (subarea 1, 2 and 3) that connect to the on-site main are also sized to only allow flows under the Q allowable, as determined by that specific subarea's area. Each subarea has a weir/diverter that directs flows over the Q allowable to an infiltration tank (Tanks A, B, or C) sized to handle the volume difference between the Q allowable and the 50-year storm event. Similar to the existing conditions, a Proposed Condition Hydrology Map was created for each subarea and can be found in the Appendix section of this report. The map shows the proposed subareas that will be disturbed due to the proposed project and the peak discharge during a 50-Year 24-Hour storm event.

4.2 Summary of Results

The following table summarizes the results of the total peak runoff for existing conditions. The majority of the existing site flows to an on-site depression and ponds/percolates/evaporates.

EXISTING CONDITIONS				
Subarea	**Area (Acres)**	**Proportion Impervious**	**Rainfall Isohyet (in)**	**50 Year Storm (cfs)**
E1	0.54	0.01	5.40	0.79
E2	6.18	0.01	5.40	12.98
E3	3.78	0.01	5.40	5.52
E4	0.58	0.01	5.40	1.22
E5	1.05	0.01	5.40	1.95
E6	0.12	0.01	5.40	0.22

Q_{site}=18.5cfs $Q_{Via\ Valmonte}$=0.79cfs $Q_{Hawthorne}$=3.39cfs

The following table summarizes the results of the total peak runoff for proposed conditions for comparison to the existing conditions.

PROPOSED CONDITIONS – BROKEN UP SUBAREAS				
Subarea	**Area (ac)**	**Proportion Impervious**	**Rainfall Isohyet (in)**	**50 Year Storm (CFS)**
1A	0.54	0.01	5.40	1.32
1B	0.40	1.00	5.40	1.16
1C	0.77	1.00	5.40	2.23
1D	0.29	1.00	5.40	0.84
2A	6.18	0.01	5.40	15.15
2B	0.36	1.00	5.40	1.04
2C	0.60	1.00	5.40	1.74
3A	0.58	0.01	5.40	1.42
3B	0.49	1.00	5.40	1.42
3C	0.97	0.95	5.40	2.81
3D	0.51	1.00	5.40	1.48
3E	0.43	1.00	5.40	1.25
4A	0.12	0.01	5.40	0.26

Q_{site}=12.25cfs (1.32cfs to sheet flow on Via Valmonte) $Q_{Hawthorne}$=1.51cfs

The following table summarizes the results of the total peak runoff for proposed conditions for the purpose of analyzing the volume needed to be detained in order to meet the Q allowable restriction. The time when the Q allowable starts to be exceeded and the duration of that exceedance are taken from the comma-separated values (csv) text file generated by HydroCalc. Data outputs from the csv text file are provided in 0.2 minute increments. Using the csv text files, detention volumes were determined by subtracting the subarea's Q allowable from each time interval's peak flow rate in exceedance of the subarea's Q allowable, multiplying the result by 12 seconds to determine the volume of the exceedance, and then totaling the sum of each volume exceedance. The portion of the csv text file showing the Q allowable exceedance data outputs is found in the Appendix section.

PROPOSED CONDITIONS – Q ALLOWABLE DETENTION								
Subarea	**Area (ac)**	**Proportion Impervious**	**Rainfall Isohyet (in)**	**50 Year Storm (cfs)**	**"Q" Allowable (cfs)**	**Start of when Q Allowable is being exceeded (min)**	**Duration that "Q" Allowable is exceeded (min)**	**Detention volume needed to meet "Q" allowable (cf)**
1	2	0.01	5.40	5.56	2.02	1146.6	10.6	1,119
2	7.14	0.01	5.40	17.93	7.211	1149.0	8.0	2,983
3	2.98	0.01	5.40	8.35	3.01	1146.2	11.0	1,716
Total	**12.13**			**31.84**	**12.25**			**5,818**
4A	0.12	0.01	5.40	0.26	-		-	

The following table summarizes the results of the required volume to be detained over Q, the volume over Q that can be detained by the infiltration systems (tank and trench), the tank dimensions, tank volume, trench dimensions, trench volume (void space is 40% of aggregate area), and drawdown analysis for the Q exceedance volume.

Q EXCEEDANCE INFILTRATION SYSTEM (TANK & TRENCH) DRAWDOWN & STORAGE CAPACITY							
"Q" Detention Subarea (Tank)	**Detention volume needed to meet "Q" allowable (cf)**	**Infiltration system to meet "Q" Allowable (cf)**	**CMP Diameter & Length (ft)**	**CMP Volume (cf)**	**Trench Width, Length, & Height (ft)**	**Trench Volume (cf)**	**Full Capacity Drawdown Time (hr)**
1 (A)	1,119	1,135	6x24	679	10x28 x6.5	457	8.10
2 (B)	2,983	3,002	8x40	2,011	12x44x8.5	991	11.36
3 (C)	1,716	1,724	8x22	1,106	12x26x8.5	618	11.04

The proposed conditions has a higher flow rate of 12.25 cfs (rate based on Q allowable restriction) and 1.51 cfs compared to the existing flow rate of 0.79 cfs and 3.39 cfs due to an increase of imperviousness, the proposed removal of the on-site ponding area, and the design of the private storm drain system. The proposed project will be connecting into the County's storm drain system at a flow rate that does not exceed the Q allowable flow rate established for the project by the County. The calculations indicate that each subarea's flow rate surpasses the Q allowable, and therefore detention of the volume during the Q allowable exceedance will be required. To meet the Q allowable, each subarea will restrict the outlet pipe to the private main and direct flows higher than the Q allowable into infiltration tanks sized to receive the detention volume, and prevent negative hydrological impacts to the site.

CMP tank #A, located at the Via Valmonte driveway on-site, is 6 feet in diameter and 24 feet long and sits within in an aggregate filled 10-foot wide by 28-foot long by 6.5 foot deep trench, and holds a volume of 1,135 cubic feet that draws down in 8.0 hours, which detains more than the required detention volume of 1,119 cubic feet. CMP tank #B, located westerly from the center of the site, is 8 feet in diameter and 40 feet long and sits within in an aggregate filled 12-foot wide by 44-foot long by 8.5 foot deep trench, and holds a volume of 3,002 cubic feet that draws down in 11.36 hours, which detains more than the required detention volume of 2,983 cubic feet. CMP tank #C, located on-site west of the driveway from Hawthorne Boulevard, is 8 feet in diameter and 22 feet long and sits within in an aggregate filled 12-foot wide by 26-foot long by 8.5 foot deep trench, and holds a volume of 1,716 cubic feet that draws down in 11.04 hours, which is above the detention volume of 1,724 cubic feet. All the tanks are sufficient to hold the required detention volume of stormwater in order to reach the allowable flow rate to be discharged.

The following table summarizes the results of the required first flush volume to be infiltrated, the volume detained by the infiltration systems (tank and trench), the tank dimensions, tank volume, trench dimensions, trench volume, and drawdown analysis for the LID first flush volume.

LID INFILTRATION SYSTEMS (TANK & TRENCH) DRAWDOWN & STORAGE CAPACITY							
LID Subarea (Tank)	**LID Mitigation Volume (cf)**	**LID Infiltration System Capacity (cf)**	**CMP Diameter & Length (ft)**	**CMP Volume (cf)**	**Trench Width, Length, & Height (ft)**	**Trench Volume (cf)**	**Full Capacity Drawdown Time (hr)**
1 (1)	4,333	4,350	8x59	2,966	12x63x8.5	1,384	11.5
2 (2)	6,030	6,550	8x90	4,524	12x94x8.5	2,026	11.6
3 (3)	6,821	6,833	8x94	4,725	12x98x8.5	2,108	11.61

LID CMP tank #1, located near the Via Valmonte driveway on-site, is 8 feet in diameter and 59 feet long and sits within in an aggregate filled 12-foot wide by 63-foot long by 8.5 foot deep trench, and holds a volume of 4,350 cf that draws down in 11.5 hours, which detains more than the required detention volume of 4,333 cubic feet.
LID CMP tank #2, located at the southwest portion of the site, is 8 feet in diameter and 90 feet long and sits within in an aggregate filled 12-foot wide by 94-foot long by 8.5 foot deep trench, and holds a volume of 6,550 cubic feet that draws down in 11.6 hours, which detains more than the required detention volume of 6,030 cubic feet.
LID CMP tank #3, located at the southeast portion of the site, is 8 feet in diameter and 94 feet long and sits within in an aggregate filled 12-foot wide by 98-foot long by 8.5 foot deep trench, and holds a volume of 6,833 cubic feet that draws down in 11.6 hours, which detains more than the required detention volume of 6,821 cubic feet. All the tanks are sufficient to hold the required mitigation volume of stormwater to meet LID requirements.

4.3 Conclusion

As shown in the Summary of Results section, the proposed development will have a net increase in stormwater runoff. A proposed 24-inch RCP pipe will replace the existing 18-inch RCP storm drain line and connect to the County's storm drain system to allow for an additional 11.46 cfs from the proposed project. An allowable flow rate of 12.25 cfs is required from the County for the proposed Project to connect to the County storm drain system. Due to the allowable Q implemented by the County, the pipe connection from the site will be restricted to a certain flow rate and the volume in excess of that flow was calculated for detention on-site via CMP tanks and associated trench. These systems will collect stormwater runoff that exceeds the Q allowable and are sufficient to hold the required volume of stormwater before the runoff is allowed to bypass the system and to be discharged into the County storm drain system. At around the 19th hour of a 4 day storm, which is at the peak of the storm, the infiltration systems need to hold 5,818 cubic feet. According to the calculations, it shows that these systems will hold 5,861 cubic feet of volume meeting the required storage that needs to be held at the peak of a 50-year (4 day) storm event. This is a preliminary report and final designs establishing compliance with this preliminary report will be provided during final engineering design of the project for review and approval by the City of Torrance.

APPENDIX

1.3.5 Region 5 West Torrance

Region 5, on the west side of Torrance, has the highest concentration of drainage sumps in the City, which correlates with the rolling terrain that varies from 60 to 120 feet in elevation. Much of the runoff from this region joins with an even larger basin, primarily in the City of Redondo Beach, but including parts of Hermosa and Manhattan Beach, to form the Herondo Drainage basin which flows west under 190th and Anita Streets and into the Santa Monica Bay. The area is mostly residential and commercial with several regional shopping centers along Hawthorne Boulevard The Entradero Park and Henrietta Detention Basins, drain northward to the Herondo drainage system. The Susana/Doris Way Detention Basins and pump station discharges through Redondo Beach and into the Santa Monica Bay. The Bishop-Montgomery, Ocean and Del Amo Retention Basins drain primarily by percolation. The El Dorado Detention basin discharge into the Madrona Vernal Marsh Nature Preserve, which includes a pump station that discharges southward into Basin 7. The Amie detention basin discharges by force main and gravity drain into region 4 and leaves the City at Torrance and Western Boulevards.

1.3.6 Region 6 East Torrance

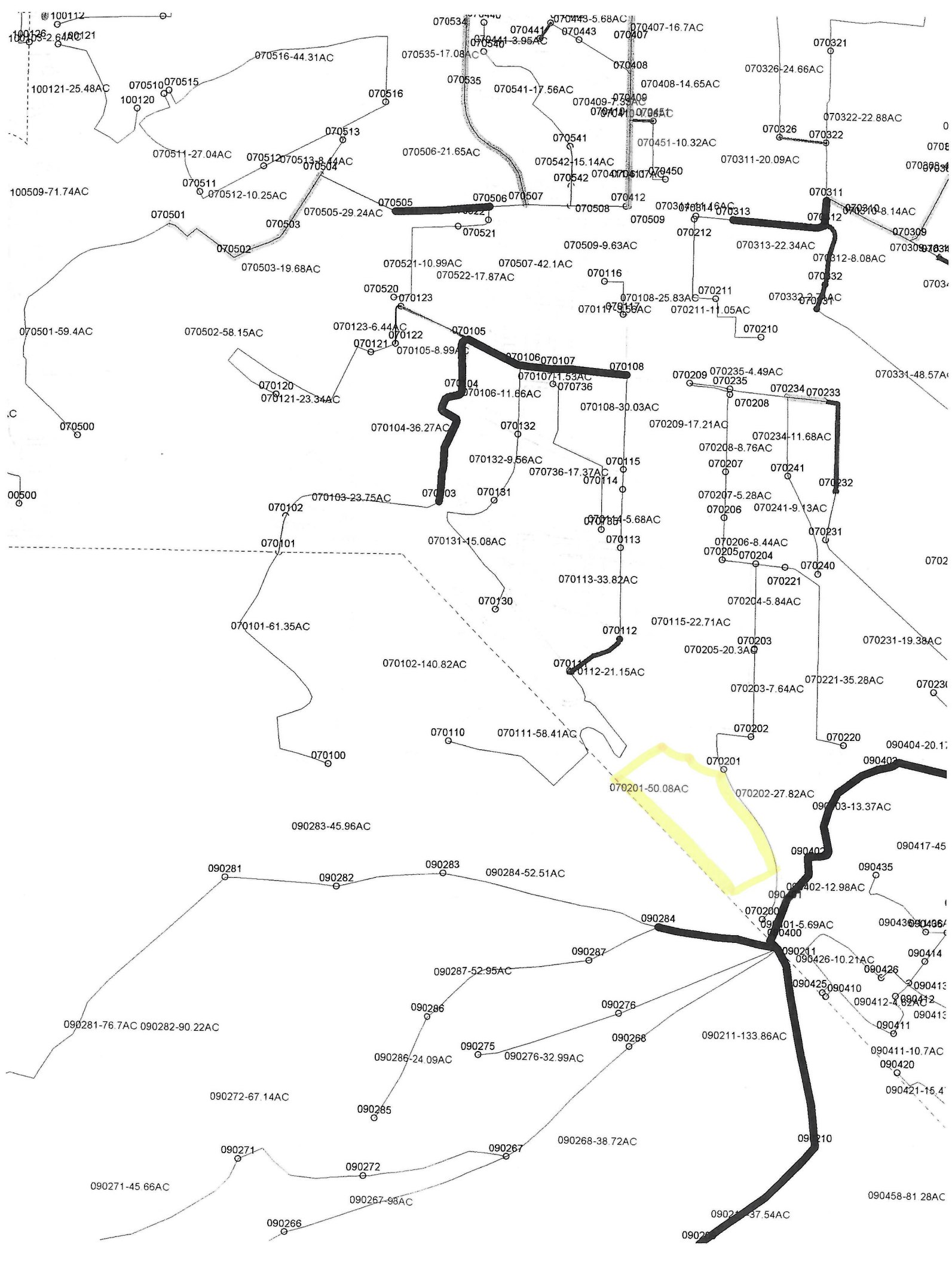
Region 6 drains the small residential and light industrial area around Sepulveda Boulevard and Western Avenue and slopes to the east where it eventually enters the Harbor Lakes area.

1.3.7 Region 7 Walteria Basin

The Walteria Basin drainage region is irregular in shape, but lies mostly south of Torrance Boulevard. The eastern side of the tributary area follows Juniper Avenue, Telo Avenue and Garnier Street, while the western and southern border follows the coastal bluffs and Palos Verdes ridge line. This area is mostly residential, with some commercial contribution, and is gently sloped; however, it does include drainage from a steep hillside that includes the south-middle section of Torrance and the eastern side of Palos Verdes Estates. The runoff from region 7 discharges into the Walteria Detention Basin and is pumped through a force main system into a 54 inch drain line that lies under Skypark Drive. The discharge eventually leaves the City near the intersection of Crenshaw Boulevard and Amsler Street.

1.3.8 Region 8 Southeast Torrance

Region 8 consists primarily of the residential area north of Lomita, south of Plaza del Amo, west of Western Avenue and east of Garnier Street and Juniper and Telo Avenues. The area includes the Vine and Walnut street basins which have been by-passed by Los Angeles County drainage facilities and their continued dedication to drainage will be further investigated in Chapter 7 of this report. Like region 5 the terrain is irregular with many small hills and basins, however the flows are eventually collected in the County storm drain system and discharge to the Harbor Lakes Basin and Los Angeles Harbor.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070107
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090287
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090414
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090411
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090268
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090420
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090421-15.4
090285
090268-38.72AC
090271
090267
090272
090271-45.66AC
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090267-98AC
090266

REDONDO BEACH BLVD.
ARTESIA BLVD.
190th ST.
DEL AMO BLVD.
CARSON ST.
SEPULVEDA BLVD.
LOMITA BLVD.
PACIFIC COAST HWY.
VAN NESS AVE.
CRENSHAW BLVD.
YUKON AVE.
PRAIRIE AVE.
HAWTHORNE BLVD.
ANZA AVE.

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1" = 3000'
3000 0 3000

LEGEND

09 REGIONAL DRAINAGE AREA TAG
REGIONAL DRAINAGE BOUNDARY
CITY LIMIT BOUNDARY

CITY OF TORRANCE
STORM DRAIN MASTER PLAN

REGIONAL DRAINAGE MAP BASIN

BOYLE ENGINEERING CORPORATION

FIGURE 2

NODE_ID	USNODE	DSNODE	AREA	Expr1	Expr2	USELEVTOPO	DSELEVTOPO	LENGTHTOP	TOPOSLOPE	DIAHTE	PIPENO_WI	SIDESLOPE	MANNIN	Q10LAF	Q25LAF	Q50LAF	BALHGL_U	BALHGL_D	STWID	QST25	QST50	PIPECAP	Q10TOT	Q25TOT	Q50TOT	Q10DEF	Q25DEF	Q50DEF	MAXDEF	MAXDEFY	PARALLELQ	PARALLELD	REPLQ	REPLDIA	ADVOCDI	RECDIA	RECWIDT
051110-051111	51110	51111		05	11	106.76	109.49	252	-0.0108	10	20	0	0	377	438	525	78.22	77.5	0	0	0	3065.8	3065.8	3065.8	3065.8				0								
051156-051157	51156	51157	212750.8	05	11	113.91	114.66	164	-0.0046	1.5	1	0	0	15	18	19	86.86	77.5	0	0	0	23.3	23.3	23.3	23.3				0								
051161-051162	51161	51162	1136937	05	11	100	97.43	127	0.0202	2	1	0	0	71	89	97	92.6	91.38	0	0	0	20.6	20.6	20.6	20.6	50	68	76	76	50-Yr	76	3.50	97	3.75	0	3.75	0
051162-051163	51162	51163	500792.5	05	11	97.43	91.79	416	0.0136	2.5	1	0	0	107	129	142	91.38	87.37	0	0	0	37.3	37.3	37.3	37.3	70	92	105	105	50-Yr	105	3.75	142	4.25	0	4.25	0
051163-051164	51163	51164	427462.9	05	11	91.79	89.18	283	0.0092	3	1	0	0	137	160	179	87.37	84.65	0	0	0	60.7	60.7	60.7	60.7	76	99	118	118	50-Yr	118	4.00	179	4.75	0	4.75	0
051164-051165	51164	51165	857407.1	05	11	89.18	90.21	212	-0.0049	4	1	0	0	195	225	257	84.65	82.61	0	0	0	130.7	130.7	130.7	130.7	64	94	126	126	50-Yr	126	4.00	257	5.25	0	5.25	0
051165-051166	51165	51166	317309.2	05	11	90.21	93.79	353	-0.0101	4.5	1	0	0	212	239	278	82.61	79.21	0	0	0	178.9	178.9	178.9	178.9	33	60	99	99	50-Yr	99	3.75	278	5.50	0	5.50	0
051166-051167	51166	51167	660964.3	05	11	93.79	96.51	177	-0.0153	4.5	1	0	0	235	266	307	79.21	77.5	0	0	0	178.9	178.9	178.9	178.9	56	87	128	128	50-Yr	128	4.00	307	5.75	0	5.75	0
051171-051172	51171	51172	118393.6	05	11	94.14	92.16	410	0.0048	2.25	1	0	0	6	7	8	93.14	81.07	32	48.3	95	49.4	49.4	97.7	144.4				0								
051172-051173	51172	51173	517959.9	05	11	92.16	93.07	121	-0.0075	3.5	1	0	0	38	45	49	81.07	77.5	0	0	0	160.5	160.5	160.5	160.5				0								
051181-051182	51181	51182	997226.9	05	11	93.51	91.03	396	0.0063	2.5	1	0	0	62	71	87	82.56	78.81	32	55	108.1	37.1	37.1	92.1	145.3	25	0	0	25	10-Yr	25	2.25	62	3.25	0	3.25	0
051182-051183	51182	51183	1028791	05	11	91.03	97.94	139	-0.0499	3.75	1	0	0	113	132	163	78.81	77.5	0	0	0	109.5	109.5	109.5	109.5	4	23	54	54	50-Yr	54	3.00	163	4.50	0	4.50	0
			20212757.93		11 Total																																
			91290886.94	05 Total																																	
060101-060102	60101	60102	2627404	06	01	65.93	64	703	0.0027	2.75	1	0	0	67	76	88	59.73	55	33	53.8	94.8	40.2	40.2	94	135	27	0	0	27	10-Yr	27	2.50	67	3.50	0	3.50	0
060111-060112	60111	60112	306564.1	06	01	60	59	394	0.0025	2	1	0	0	25	29	31	58.37	57.16	33	51.7	91.2	11.7	11.7	63.4	102.9	13	0	0	13	10-Yr	13	2.25	25	2.75	0	2.75	0
060112-060102	60112	60102	594594.1	06	01	59	64	698	-0.0072	2.75	1	0	0	56	67	73	57.16	55	0	0	0	27.3	27.3	27.3	27.3	29	40	46	46	50-Yr	46	3.50	73	4.00	0	4.00	0
060121-060122	60121	60122	937288.6	06	01	65.44	64	201	0.0072	4	1	0	0	43	48	58	62.56	61	0	0	0	18.9	18.9	18.9	18.9	24	29	39	39	50-Yr	39	2.75	58	3.25	0	3.25	0
			4465850.8	06 Total																																	
070101-070102	70101	70102	2672451	07	01	350	310.33	371	0.1069	1.5	1	0	0	66	76	89	314.6	309.33	0	0	0	11.6	11.6	11.6	11.6	54	64	77	77	50-Yr	77	3.25	89	3.25	0	3.25	0
070102-070103	70102	70103	6134025	07	01	310.33	146.76	1675	0.0977	1.5	1	0	0	237	270	338	309.33	145.76	23	187.4	348.4	30.5	30.5	217.8	378.8	207	52	0	207	10-Yr	207	3.25	237	3.25	0	3.25	0
070103-070104	70103	70104	1034452	07	01	146.76	73.73	1346	0.0543	2	1	0	0	291	321	412	145.76	72.73	0	0	0	49	49	49	49	242	272	363	363	50-Yr	363	4.25	412	4.50	0	4.50	0
070104-070105	70104	70105	1579743	07	01	73.73	71.94	579	0.0031	4.25	1	0	0	340	381	476	72.73	70.94	0	0	0	87.3	87.3	87.3	87.3	253	294	389	389	50-Yr	389	7.50	476	8.50	0	8.50	0
070121-070122	70121	70122	1016769	07	01	78.16	75.38	261	0.0107	3	1	0	0	44	50	57	77.16	74.38	0	0	0	64.1	64.1	64.1	64.1				0								
070122-070123	70122	70123		07	01	75.38	73.77	418	0.0039	3.25	1	0	0	44	49	57	74.38	72.77	0	0	0	47.9	47.9	47.9	47.9	0	1	9	9	50-Yr	9	1.75	57	3.50	0	3.50	0
070123-070105	70123	70105	280322	07	01	73.77	71.94	775	0.0024	3.75	1	0	0	53	60	70	72.77	70.94	0	0	0	55	55	55	55	0	5	15	15	50-Yr	15	2.50	70	4.25	0	4.25	0
070105-070106	70105	70106	391421.6	07	01	71.94	71.37	613	0.0009	4.75	1	0	0	388	436	542	70.94	69.12	0	0	0	115.5	115.5	115.5	115.5	272	320	426	426	50-Yr	426	8.00	542	8.50	0	8.50	0
070131-070132	70131	70132	656984.3	07	01	112.67	77.19	733	0.0484	3.25	1	0	0	37	41	46	111.67	76.19	72	71.8	170.2	168.7	168.7	240.5	338.9				0								
070132-070106	70132	70106	416281.9	07	01	77.19	71.37	709	0.0082	4.25	1	0	0	66	71	84	76.19	69.12	60	29.6	73.9	156.8	156.8	186.3	230.7				0								
070106-070107	70106	70107	507801.2	07	01	71.37	72.5	318	-0.0036	6	1	0	0	447	507	621	69.12	68.18	0	0	0	215.4	215.4	215.4	215.4	232	292	406	406	50-Yr	406	7.75	621	9.00	0	9.00	0
070736-070107	70736	70107	756551.9	07	01	72.42	72.5	154	-0.0005	2.5	1	0	0	26	28	32	70.14	68.18	0	0	0	42.9	42.9	42.9	42.9				0								
070107-070108	70107	70108	66602.89	07	01	72.5	68.63	733	0.0053	6.25	1	0	0	470	532	648	68.18	66	36	52	105.4	240.2	240.2	292.2	345.5	230	240	302	302	50-Yr	302	7.00	543	8.50	0	9.00	0
070111-070112	70111	70112	2544125	07	01	231.7	141.54	610	0.1479	2	1	0	0	67	76	89	162.87	136.12	0	0	0	44	44	44	44	23	32	45	45	50-Yr	45	2.25	89	2.75	0	2.75	0
070112-070113	70112	70113	921428.2	07	01	141.54	96.95	915	0.0487	3	1	0	0	106	125	147	136.12	95.95	32	153.3	301.6	129.8	129.8	283	431.4				0								
070113-070114	70113	70114	1473343	07	01	96.95	83.59	593	0.0225	3	1	0	0	161	190	221	95.95	82.59	32	104.2	205	92.9	92.9	197.1	297.9	68	0	0	68	10-Yr	68	2.75	161	3.75	0	3.75	0
070114-070115	70114	70115	247573.8	07	01	83.59	81.62	198	0.0099	3.5	1	0	0	169	197	232	82.59	79.75	32	69.2	136.2	111.7	111.7	180.9	247.9	57	16	0	57	10-Yr	57	2.75	169	4.25	0	4.25	0
070115-070108	70115	70108	989421.9	07	01	81.62	68.63	960	0.0135	4.5	1	0	0	212	248	289	79.75	66	36	83.3	168.7	218.4	218.4	301.6	387				0								
070117-070108	70117	70108	155068.5	07	01	72.1	68.63	630	0.0055	3	1	0	0	10	11	13	67.61	66	36	53.1	107.6	31.6	31.6	84.7	139.2				0								
			26310216.99		01 Total																																
070201-070202	70201	70202	2181568	07	02	172.49	150.11	728	0.0308	2	1	0	0	62	75	88	159.4	142.4	48	125.2	281.5	32.1	32.1	157.3	313.7	30	0	0	30	10-Yr	30	2.00	62	2.75	0	2.75	0
070202-070203	70202	70203	1211843	07	02	150.11	122.53	893	0.0309	3.25	1	0	0	111	133	154	142.4	121.53	32	122	240.1	117.3	117.3	239.3	357.4				0								
070203-070204	70203	70204	332645.2	07	02	122.53	103.56	854	0.0222	3.75	1	0	0	115	138	162	121.53	102.56	32	103.5	203.7	167.3	167.3	270.8	371				0								
070221-070204	70221	70204	1536723	07	02	104.84	103.56	298	0.0043	3.75	1	0	0	51	62	74	103.84	102.56	40	47.5	99.4	73.6	73.6	121.2	173				0								
070204-070205	70204	70205	254178.5	07	02	103.56	102.83	344	0.0021	5	1	0	0	168	202	235	102.56	97.2	39	33.4	69.2	302.1	302.1	335.4	371.3				0								
070205-070206	70205	70206	884235.2	07	02	102.83	94.17	421	0.0206	4.75	1	0	0	207	248	288	97.2	90.63	72	46.8	111	263.4	263.4	310.3	374.4				0								
070206-070207	70206	70207	367803.9	07	02	94.17	84.37	465	0.0211	4.5	1	0	0	213	254	294	90.63	83.37	84	47.4	106.5	228.1	228.1	275.4	334.5				0								
070207-070208	70207	70208	230050.2	07	02	84.37	72.13	788	0.0155	4.75	1	0	0	218	258	299	83.37	71.13	84	40.7	91.4	262.6	262.6	303.3	354				0								
070208-070209	70208	70209	381372.4	07	02	72.13	72.19	433	-0.0001	6	1	0	0	232	268	310	71.13	66	0	0	0	427.2	427.2	427.2	427.2				0								
070231-070232	70231	70232	844158.6	07	02	96.98	87.71	501	0.0185	2	1	0	0	47	55	62	92.03	86.71	0	0	0	21.6	21.6	21.6	21.6	25	33	40	40	50-Yr	40	2.75	62	3.00	0	3.00	0
070232-070233	70232	70233		07	02	87.71	77.54	1038	0.0098	0	0	0	0	47	55	62	86.71	76.54	0	0	0	0	0	0	0	47	55	62	62	50-Yr	62	3.25	62	3.25	0	3.25	0
070233-070234	70233	70234	5259417	07	02	77.54	74.53	368	0.0082	2.5	1	0	0	195	220	252	76.54	73.53	0	0	0	34.5	34.5	34.5	34.5	161	186	218	218	50-Yr	218	5.00	252	5.50	0	5.50	0
070241-070234	70241	70234	397508.7	07	02	78.44	74.53	802	0.0049	2.5	1	0	0	30	34	36	77.44	73.53	60	22.8	57	26.7	26.7	49.5	83.6	3	0	0	3	10-Yr	3	1.25	30	2.75	0	2.75	0
070234-070235	70234	70235	508577.7	07	02	74.53	71.51	587	0.0051	6.5	1	0	0	242	269	310	73.53	69.11	36	51.4	104	421.6	421.6	473	525.6				0								
070235-070209	70235	70209	195453	07	02	71.51	72.19	414	-0.0016	6.5	1	0	0	243	272	311	69.11	66	0	0	0	421.6	421.6	421.6	421.6				0								
070211-070212	70211	70212	481134.8	07	02	74.59	76	1023	-0.0014	2.5	1	0	0	18	20	24	70.41	66	0	0	0	25	25	25	25				0								
			15066669.2		02 Total																																
070301-070302	70301	70302	65821.33	07	03	84.69	82.52	767	0.0028	2	1	0	0	7	9	9	82.87	80.89	75	17.4	40.2	10.7	10.7	28.1	50.9				0								
070302-070303	70302	70303	135984.3	07	03	82.52	81.47	636	0.0017	3	1	0	0	43	45	47	80.89	79.26	55	27.4	66.5	31.6	31.6	58.9	98	11	0	0	11	10-Yr	11	2.25	43	3.50	0	3.50	0
070303-070304	70303	70304	2070708	07	03	81.47	88.88	931	-0.008	4	1	0	0	104	112	125	79.26	76.87	0	0	0	68	68	68	68	36	44	57	57	50-Yr	57	3.75	125	5.25	0	5.25	0
070304-070305	70304	70305	1154801	07	03	88.88	74.22	1419	0.0103	4	1	0	0	175	201	217	76.87	73.22	55	68.4	166.2	68	68	136.4	234.2	107	65	0	107	10-Yr	107	4.75	175	5.75	0	5.75	0
070305-070306	70305	70306	2997395	07	03	74.22	75.44	431	-0.0028	5.75	1	0	0	255	285	322	73.22	72.36	0	0	0	157	157	157	157	98	128	165	165	50-Yr	165	6.00	322	7.75	0	7.75	0
070306-070307	70306	70307	1543786	07	03	75.44	75.09	681	0.0005	5.75	1	0	0	305	342	393	72.36	71	0	0	0	157	157	157	157	148	185	236	236	50-Yr	236	6.75	393	8.50	0	8.50	0
070307-070308	70307	70308	908867.9	07	03	75.09	73.5	657	0.0024	6.5	1	0	0	334	375	429	71	69.68	35	35	70.4	217.7	217.7	252.7	288.1	116	122	141	141	50-Yr	141	5.75	359	8.00	0	8.50	0
070336-070337	70336	70337	312164.7	07	03	75.8	74.05	346	0.0051	2	1	0	0	30	34	36	72.17	70.73	0	0	0	13.6	13.6	13.6	13.6	16	20	22	22	50-Yr	22	2.50	36	3.00	0	3.00	0
070337-070308	70337	70308	335171.3	07	03	74.05	73.5	250	0.0022	2.5	1	0	0	55	62	69	70.73	69.68	35	33.4	67.1	24.7	24.7	58	91.8	30	4	0	30	10-Yr	30	2.75	55	3.50	0	3.50	0
070308-070309	70308	70309	184921.7	07	03	73.5	72.22	778	0.0016	6.75	1	0	0	345	388	442	69.68	68.13	35	28.9	58	240.8	240.8	269.6	298.8	104	118	143	143	50-Yr	143	5.75	384	8.50	0	8.50	0
070341-070342	70341	70342	1551650	07	03	75.81	75.92	114	-0.001	3.25	1	0	0	54	61	74	74.81	74.52	0	0	0	38.3	38.3	38.3	38.3	16	23	36	36	50-Yr	36	3.25	74	4.25	0	4.25	0
070342-070343	70342	70343	199672.5	07	03	75.92	74.96	443	0.0022	3.5	1	0	0	70	78	94	74.52	73.4	72	15.2	36	46.7	46.7	61.9	82.7	23	16	11	23	10-Yr	23	2.75	70	4.25	0	4.25	0
070343-070344	70343	70344	552843.3	07	03	74.96	74.26	455	0.0015	4.25	1	0	0	97	110	130	73.4	72.25	72	12.8	30.4	78.4	78.4	91.2	108.7	19	19	21	21	50-Yr	21	2.75	100	4.75	0	4.75	0
070344-070345	70344	70345	1388327	07	03	74.26	73.74	431	0.0012	4.75	1	0	0	146	166	196	72.25	71.16	72	11.3	26.9	105.5	105.5	116.8	132.3	41	49	64	64	50-Yr	64	4.00	169	5.75	0	5.75	0

Existing Storm Drain system shows the site connecting to the County line north of Via Valmonte on Hawthorne Blvd.

Proposed Storm Drain system will have the site connecting onto the County line on Via Valmonte. See Proposed Drainage plan.

1 2 3 4 5 6

BOUNDARY – CITY OF PALOS VERDES ESTATES

CITY OF TORRANCE

STORM DRAINS

DRAWN PVT. ENGR. DATE 05-03-95
CHECKED N.A. REV. 01-07-04

LEGEND

L.A.C.F.C.D. S.D.
PRIVATE S.D.
TORR. S.D.
CATCH BASIN
STA. DEPTH 2+00 (6.6') 30" R.C.P. PIPE SIZE
FLOW M.H.

PlotMapSet-SD.dwg Jun 07, 2011

103	104	105
109	110	111
	113	114

SHEET NO. 110

BLUFF
PASEO DE LAS
TORTUGAS
NEECE
ST.
NEWTON
AVE.
VALMONTE
SEAL END
PARK
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8.5'x8" R.C.B. ST-76
#301
(14.2') 35+07
30" RG RCP SD-1065
(15.4') 38+00
30" RG RCP SD-1065
#300
2-4" C.I. PIPES PER ST-804
(12.9') 41+00
#300
30" RG RCP SD-1065
21"R.C.P. ST-406
R.C. BOX CULVERT
47.5'
47'
R.C. BOX CULVERT
18"R.C.P. ST-406
42" RCP SD-1047
6'
15'
39" RCP SD-1047
39" RCP SD-1047
13'
#4
123+22.40
24" RG RCP SD-1065
(9.2') 60+50
24" RG RCP SD-1065
#300
30"R.C.P. SD-238
30" RG RCP SD-1065
#300
(8.7') 54+84.04
#300
(16.2') 52+00
#307
(15.6') 49+00
#14
18"R.C.P. ST-406
#14
#302
(10')
#4
#14
#302
127+35
18"R.C.P. SD-288
(12.9') 44+00
#300
#302
27'
47.5'
30" RG RCP SD-1065
39" RCP SD-1047
46+30.25
R.C. BOX CULVERT
21"R.C.P. ST-552
(12.9')
40'
#6
#4 (12')
#302
130+45.94
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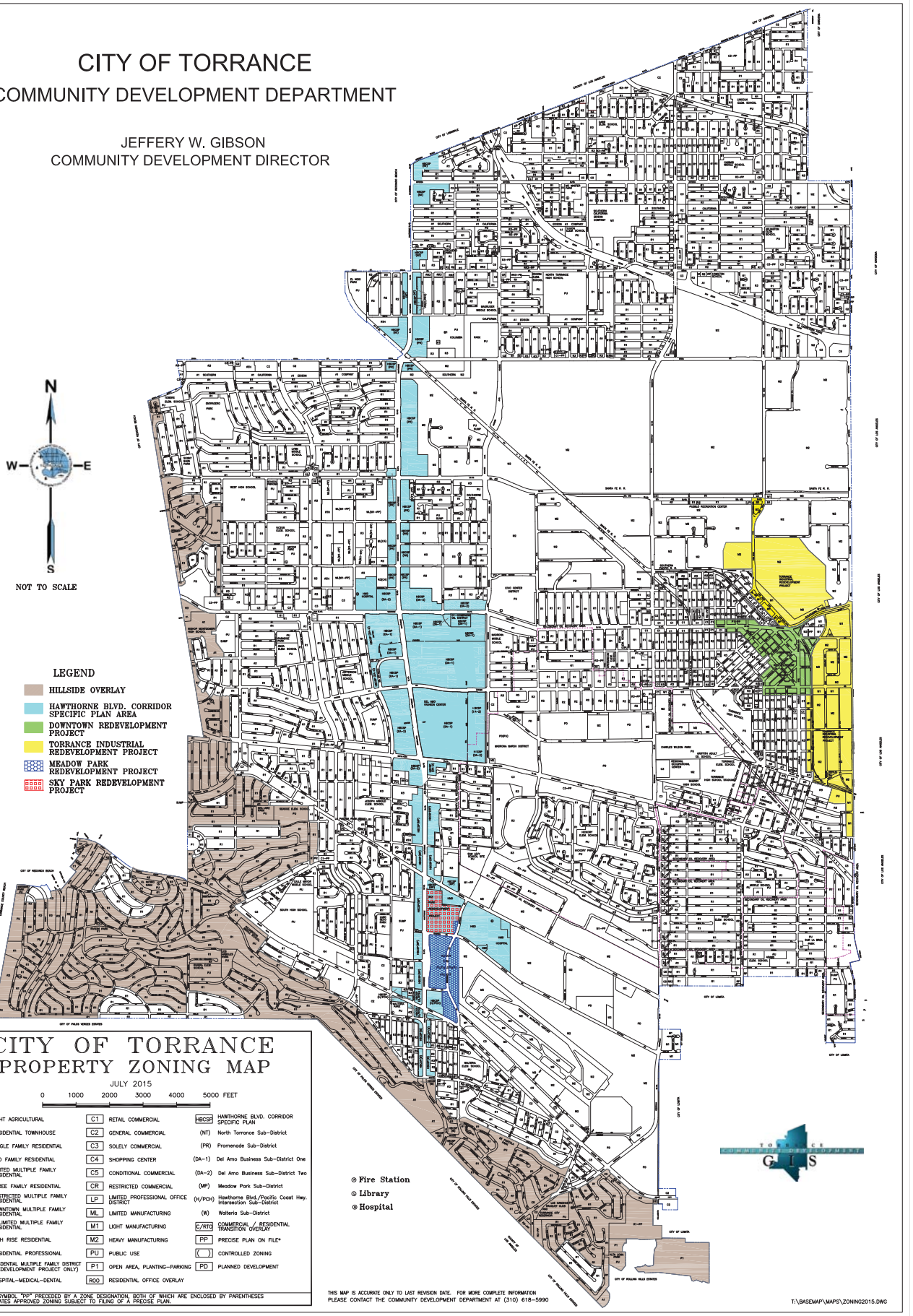
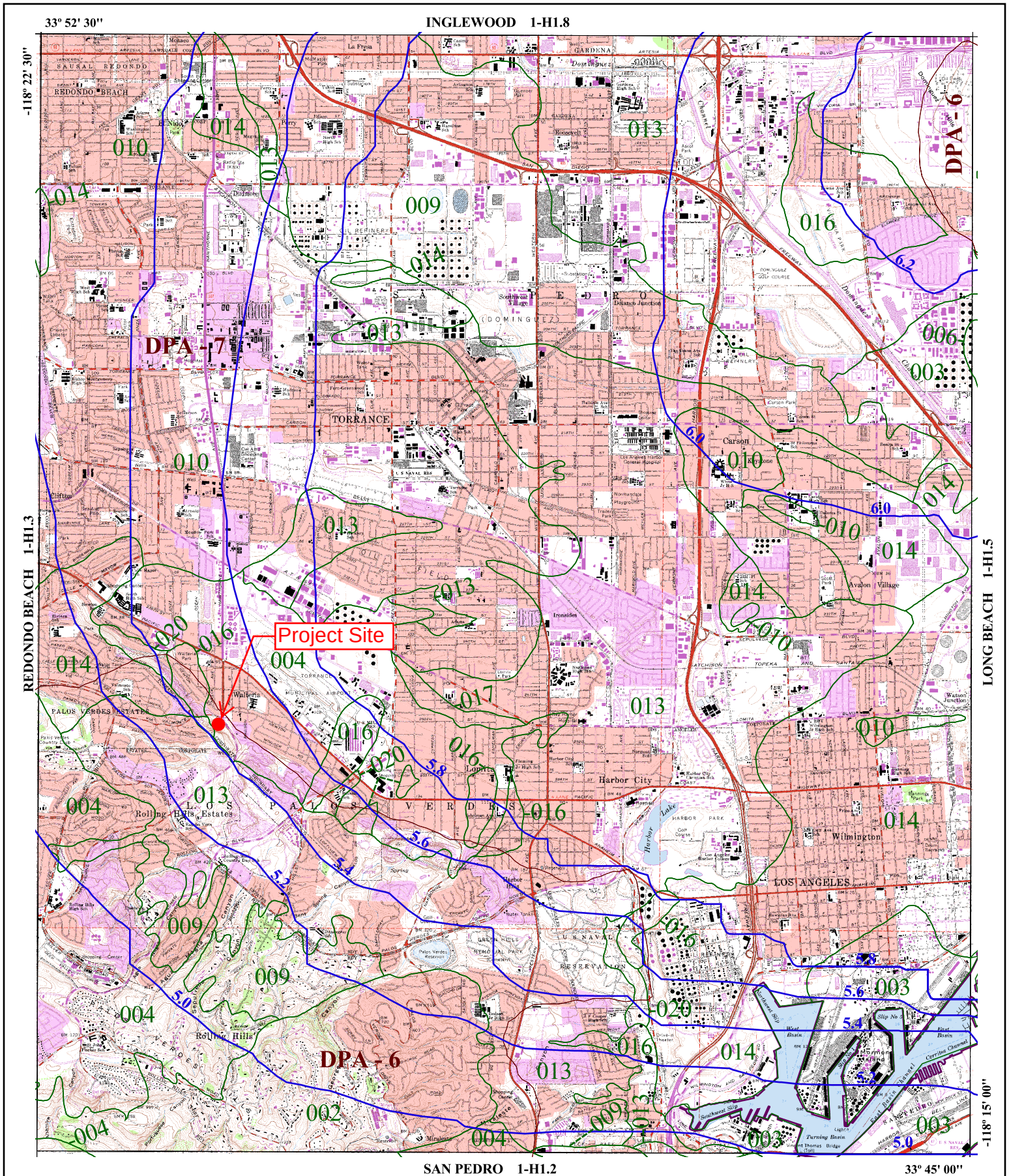
CITY OF TORRANCE

COMMUNITY DEVELOPMENT DEPARTMENT

JEFFERY W. GIBSON
COMMUNITY DEVELOPMENT DIRECTOR





016 SOIL CLASSIFICATION AREA

7.2 INCHES OF RAINFALL

DPA - 6 DEBRIS POTENTIAL AREA

N W E S

1 0 1 2 Miles

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

TORRANCE
50-YEAR 24-HOUR ISOHYET

1-H1.4

LOS ANGELES COUNTY PUBLIC WORKS Public Service That Works

PRELIMINARY GEOTECHNICAL INVESTIGATION

PROPOSED MULTI-FAMILY RESIDENTIAL DEVELOPMENT HAWTHORNE BOULEVARD AND VIA VALMONTE TORRANCE, CALIFORNIA

GEOCON
WEST, INC.
GEOTECHNICAL
ENVIRONMENTAL
MATERIALS

PREPARED FOR

REYLENN PROPERTIES, LLC
SOLANA BEACH, CALIFORNIA

PROJECT NO. A9201-06-01E

JUNE 2017

embankment. Where offsite structures are within the shoring surcharge area it is recommended that the beam deflection be limited to less than ½ inch at the elevation of the adjacent offsite foundation, and no deflection at all if deflections will damage existing structures. The allowable deflection will be assessed and designed by the project shoring engineer.

8.21.19 Because of the depth of the excavation, some means of monitoring the performance of the shoring system is suggested. The monitoring should consist of periodic surveying of the lateral and vertical locations of the tops of all soldier piles and the lateral movement along the entire lengths of selected soldier piles.

8.21.20 Due to the depth of the depth of the excavation and proximity to adjacent structures, it is suggested that prior to excavation the existing improvements be inspected to document the present condition. For documentation purposes, photographs should be taken of preconstruction distress conditions and level surveys of adjacent grade and pavement should be considered. During excavation activities, the adjacent structures and pavement should be periodically inspected for signs of distress. In the even that distress or settlement is noted, an investigation should be performed and corrective measures taken so that continued or worsened distress or settlement is mitigated. Documentation and monitoring of the offsite structures and improvements is not the responsibility of the geotechnical engineer.

8.22 Stormwater Infiltration

8.22.1 During the 2017 site exploration, borings P1, P2, and P3 were utilized to perform percolation testing. The borings were advanced to the depths listed in the table below. Boring logs were not prepared for the percolation test borings; however, the soil conditions were observed to be similar to those from adjacent borings. Slotted casing was placed in the borings, and the annular space between the casing and excavation was filled with gravel. The borings were then filled with water to pre-saturate the soils. On May 5, 2017, the casings were refilled with water and percolation test readings were performed after repeated flooding of the cased excavations. Based on the test results, the average infiltration rates (adjusted percolation rate), for the earth materials encountered, are provided in the following table. The Reduction Factor (Rf), to convert the field-measured percolation rate to an infiltration rate, is also shown in the table below. This value has been calculated in accordance with the Boring Percolation Test Procedure in the County of Los Angeles Department of Public Works GMED *Guidelines for Design, Investigation, and Reporting Low Impact Development Stormwater Infiltration* (December 2014). Calculation of the percolation rate, reduction factor, and infiltration rate are provided as Figures 11 through 13.

Boring	Infiltration Depth (ft)	Measured Percolation Rate (in / hour)	Reduction Factor (Rf)	Design Infiltration Rate (in / hour)
P1	12-15	487.34	5.2	93.7
P2	20-25	26.2	15.32	1.7
P3	21-25	160.1	6.8	23.5

8.22.2 Based on the number of tests performed and consistency of the results and soils throughout the site, it is suggested that a CFv correction factor of 3.0 be used in the infiltration system design. Additional testing may be considered to lower the suggested CFv factor. In addition, provided proper maintenance is performed to minimize long-term siltation and plugging, a CFs correction factor of 1.0 may be used. Additional correction factors may be required and should be applied by the engineer in responsible charge of the design of the stormwater infiltration system and based on applicable guidelines.

8.22.3 The results of the percolation testing indicate that the soils at depths in the above table are conductive to infiltration. It is our opinion that the soil zone encountered at the depth and location as listed in the table above are suitable for infiltration of stormwater. It should be noted that the water absorbed into the ground very quickly and it is likely that that a volume-controlled infiltration system may be required to prevent percolation from occurring too quickly. It is recommended that the project civil engineer design the infiltration system in such a way as to limit the speed at which water is released into the ground from the retention chamber.

8.22.4 It is our further opinion that infiltration of stormwater and will not induce excessive hydro-consolidation, will not create a perched groundwater condition, will not affect soil structure interaction of existing or proposed foundations due to expansive soils, will not saturate soils supported by existing or proposed retaining walls, and will not increase the potential for liquefaction. Resulting settlements are anticipated to be less than ¼ inch, if any.

8.22.5 The infiltration system must be located such that the closest distance between an adjacent foundation is at least 10 feet in all directions from the zone of saturation. The zone of saturation may be assumed to project downward from the discharge of the infiltration facility at a gradient of 1:1. Additional property line or foundation setbacks may be required by the governing jurisdiction and should be incorporated into the stormwater infiltration system design as necessary.

8.22.6 Where the 10-foot horizontal setback cannot be maintained between the infiltration system and an adjacent footing, and the infiltration system penetrates below the foundation influence line, the proposed stormwater infiltration system must be designed to resist the surcharge from the adjacent foundation. The foundation surcharge line may be assumed to project

PERCOLATION TEST RESULTS

Boring P1 (Tank A)

Project No: A9201-06-01E
Project Name: Torrance
Testing Date: 5/5/2017
Tested By: JO

Boring Diameter, DIA: 8 inches
Boring Depth: 15 feet
Boring Depth: 180 inches

Reading Number	Adjusted Initial Water Depth (ft)	Adjusted Final Water Depth (ft)	Water Drop (ft)	Water Drop (in)	ΔT (min)	Percolation Rate (in/hour)
1	13.00	14.70	1.70	20.4	2	597.07
2	12.00	14.70	2.70	32.4	5	377.60
3						
Average:	12.50	14.70			Preadjusted Perc Rate*	**487.34**

* Based only on Stabilized Readings

Initial Water Depth, d_1 = 30 inches
Final Water Depth, d_2 = 3.6 inches
Water Level Drop, Δd = 26.4 inches
Boring Diameter, DIA = 8 inches

$$R_f = \left(\frac{2d_1 - \Delta d}{DIA}\right) + 1$$

Reduction Factor, R_f = **5.2**

Infiltration Rate = **93.7** inches/hour

FIGURE 11

PERCOLATION TEST RESULTS

Boring P2 (Tank B)

Project No: A9201-06-01E
Project Name: Torrance
Testing Date: 5/5/2017
Tested By: RA

Boring Diameter, DIA: 8 inches
Boring Depth: 25 feet
Boring Depth: 300 inches

Reading Number	Adjusted Initial Water Depth (ft)	Adjusted Final Water Depth (ft)	Water Drop (ft)	Water Drop (in)	ΔT (min)	Percolation Rate (in/hour)
1	20.00	20.94	0.94	11.3	30	22.56
2	19.05	20.28	1.23	14.8	30	29.52
3	20.00	21.10	1.10	13.2	30	26.40
Average:	19.68	20.77			Preadjusted Perc Rate*	**26.16**

* Based only on Stabilized Readings

Initial Water Depth, d_1 = 63.8 inches
Final Water Depth, d_2 = 50.72 inches
Water Level Drop, Δd = 13.08 inches
Boring Diameter, DIA = 8 inches

$$R_f = \left(\frac{2d_1 - \Delta d}{DIA}\right) + 1$$

Reduction Factor, R_f = **15.315**

Infiltration Rate = **1.7** inches/hour

FIGURE 12

PERCOLATION TEST RESULTS

Boring P3 (Tank C)

Project No: A9201-06-01E
Project Name: Torrance
Testing Date: 5/5/2017
Tested By: RA

Boring Diameter, DIA: 8 inches
Boring Depth: 25 feet
Boring Depth: 300 inches

Reading Number	Adjusted Initial Water Depth (ft)	Adjusted Final Water Depth (ft)	Water Drop (ft)	Water Drop (in)	ΔT (min)	Percolation Rate (in/hour)
1	21.20	23.95	2.75	33.0	10	198.00
2	21.90	24.20	2.30	27.6	10	165.60
3	22.75	24.37	1.62	19.4	10	116.64
Average:	21.95	24.17			Preadjusted Perc Rate*	**160.08**

* Based only on Stabilized Readings

Initial Water Depth, d_1 = 36.6 inches
Final Water Depth, d_2 = 9.92 inches
Water Level Drop, Δd = 26.68 inches
Boring Diameter, DIA = 8 inches

$$R_f = \left(\frac{2d_1 - \Delta d}{DIA}\right) + 1$$

Reduction Factor, R_f = **6.815**

Infiltration Rate = **23.5** inches/hour

FIGURE 13

Office Use Only
☐ Sent Initials: _____
☐ Fax ☐ Email ☑ Other: _____
Date: _____ Time: _____

LOS ANGELES COUNTY
DEPARTMENT OF PUBLIC WORKS
DESIGN DIVISION – HYDRAULIC ANALYSIS UNIT

INFORMATION REQUEST SUMMARY

INFORMATION REQUESTED BY

*Requester's Name: Jennifer Pierce
Company: KHR Associates
*Phone Number: (949) 756-6440 Fax Number: _____
*Email: jpierce@khrdesign.com

Method of Contact: ☐ Walk-in ☐ Phone ☐ Fax ☒ Email ☐ Prelim. Mtg. Date: 08/02/2016

Intended Use: Storm drain connection to 30" RCP in Via Valmonte

Proposed Project Type: Multi-Family Residential Acreage Involved: 24.68 ±1/4

*Will information be used in any litigation? ☐ YES ☒ NO
Case Info. Name: _____ No: _____ Location: _____

INFORMATION REQUESTED (Attach Assessor Map)

LACFCD Facility: Name: Palos Verdes - Walteria Drain; Project ID No. FC000052
Unit: _____ Line: B Station: 47+14
City: Torrance
*Street/Cross-street: Via Valmonte / Hawthorne Boulevard
*Thomas Guide: Page: 793 Grid: D4 ☒ Site Map/Plans Submitted
Info. Requested: Allowable Q (and storm drain event) to connect to existing 30" RCP in Via Valmonte at approximately station 47+14; HGL and line hydrology

***Required Information. See Page 2 of 2 for Instructions.**

BELOW SECTION TO BE COMPLETED BY THE HYDRAULIC ANALYSIS UNIT

INFORMATION PROVIDED: Allowable q per acre. Hydrology map and calculation for Walteria Lake special study. Unable to find HGL calculation for Palos Verdes-Walteria Drain after a diligent search on our database.

REFERENCES SEARCHED: Walteria Lake hydrology study.

COMMENTS, ETC: Allowable q per acre = 1.01 cfs.

COUNTY OF LOS ANGELES
DEPARTMENT OF PUBLIC WORKS
DESIGN DIVISION
Hydraulic Analysis Unit
OFFICIAL RECORD DOCUMENT
Issued By: _____
Date: 8/18/2016
Public Service That Works

INFORMATION PROVIDED BY: Ambrose C. Ajaelo PE Date: 08/18/2016

INFORMATION REVIEWED BY: Date:

Print Save a Copy

Peak Flow Hydrologic Analysis

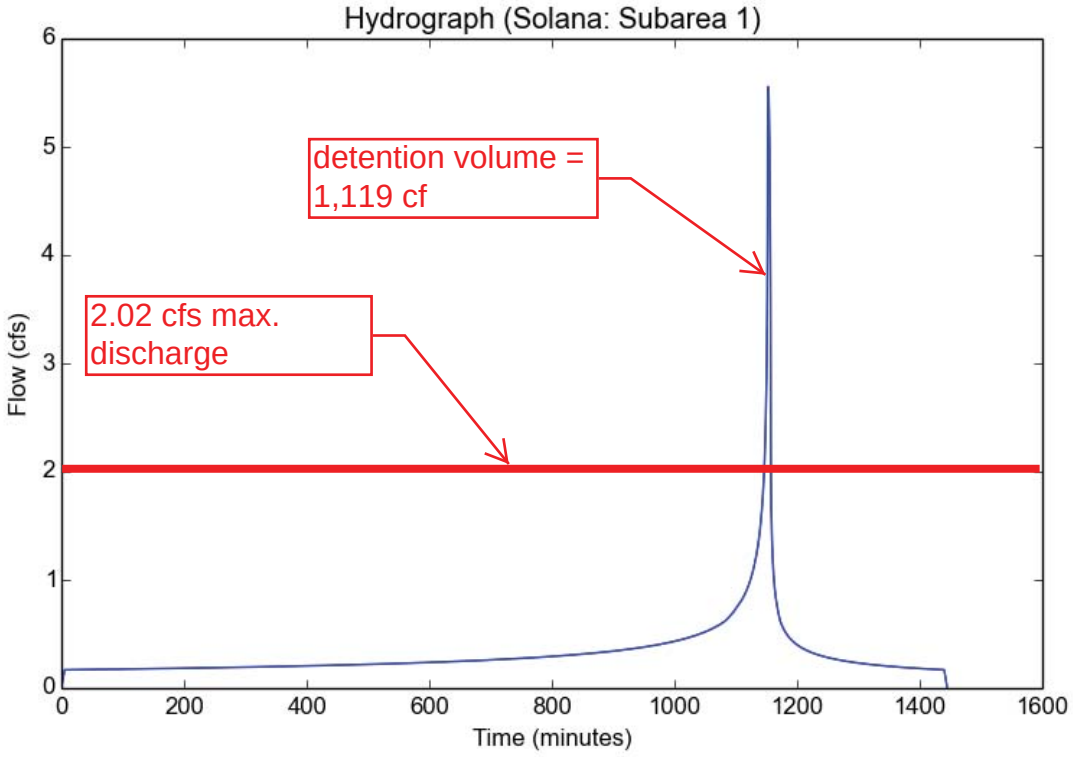
File location: C:/Users/Mike/Desktop/CSV_Results/Solana - Subarea 1.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea 1
Area (ac)	2.0
Flow Path Length (ft)	183.0
Flow Path Slope (vft/hft)	0.0995
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.7557
Soil Type	4
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.7455
Developed Runoff Coefficient (Cd)	0.8623
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	5.556
Burned Peak Flow Rate (cfs)	5.556
24-Hr Clear Runoff Volume (ac-ft)	0.6459
24-Hr Clear Runoff Volume (cu-ft)	28135.9711



Inputs: Solana

Subarea ID	Area (ac)	Flow Path Length (ft)	Flow Path Slope (vft/hft)	50-yr Rainfall Depth (in)	Percent Impervious	Soil Type	Design Storm Frequency	Fire Factor	$V_{actual/min}$ $(cf/0.1\ min)$	Tank V_{actual}
Subarea 1	2	183	0.0995	5.4	0.7557	4	50-yr	0	6.31	4,350

Outputs: Solana

Area (ac)	Modeled (50-yr) Rainfall Depth (in)	Time of Concentration (min)	Clear Peak Flow Rate (cfs)	24-Hr Clear Runoff Volume (ac-ft)	Burned Peak Flow Rate (cfs)	Peak Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)
Subarea 1	5.4	5	5.555979788	0.64591302	5.555979788	3.221788206	0.745480701	0.862250935

Hydrograph: Solana - Subarea 1

Time (min)	Incremental Masscurve	Incremental Design Storm Depth (in)	Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)	Clear Peak Flow Rate (cfs)	Incremental Volume (cu-ft)	Cumulative Volume (cu-ft)	Over Q (cfs)	Over Q Vol. (cf)
1146	0.750689394	4.05372273	1.21055923	0.540557234	0.812188132	1.96640368	23.45242988	20559.75582		
1146.2	0.751567486	4.058464426	1.224819819	0.54366738	0.812947941	1.9914295	23.74699908	20583.50282		
1146.4	0.752459929	4.063283616	1.239637559	0.546899038	0.813737435	2.017478976	24.05345086	20607.55627	Over Q (cfs)	Over Q Vol. (cf)
1146.6	0.753367482	4.068184403	1.255051318	0.550260684	0.814558685	2.044625902	24.37262926	20631.9289	0.024625902	0.295510821
1146.8	0.754290976	4.073171272	1.271104014	0.553761678	0.815413978	2.072951961	24.70546717	20656.63437	0.052951961	0.635423528
1147	0.755231321	4.078249136	1.2878432	0.557412391	0.816305847	2.102547868	25.05299897	20681.68737	0.082547868	0.990574419
1147.2	0.756189518	4.083423399	1.305321745	0.561224354	0.81723711	2.133514739	25.41637564	20707.10374	0.113514739	1.362176871
1147.4	0.757166672	4.088700026	1.323598656	0.565210435	0.818210909	2.16596572	25.79688276	20732.90063	0.14596572	1.751588642
1147.6	0.758164006	4.094085633	1.342740065	0.569385059	0.81923077	2.200027955	26.19596205	20759.09659	0.180027955	2.16033546
1147.8	0.759182886	4.099587583	1.362820419	0.57376446	0.820300658	2.235844972	26.61523756	20785.71183	0.215844972	2.590139663
1148	0.760224837	4.10521412	1.383923935	0.578367006	0.82142506	2.273579602	27.05654744	20812.76837	0.253579602	3.04295522
1148.2	0.761291577	4.110974515	1.406146393	0.583213587	0.822609079	2.31341758	27.52198309	20840.29036	0.29341758	3.521010955
1148.4	0.762385049	4.116879266	1.429597363	0.588328099	0.823858555	2.355572035	28.01393769	20868.30429	0.335572035	4.026864418
1148.6	0.763507468	4.122940326	1.454403004	0.593738056	0.825180207	2.400289144	28.53516707	20896.83946	0.380289144	4.563469729
1148.8	0.764661374	4.129171419	1.480709618	0.599475367	0.826581832	2.447855337	29.08886689	20925.92833	0.427855337	5.134264048
1149	0.765849707	4.135588416	1.508688236	0.604775038	0.827876542	2.498015198	29.67522321	20955.60355	0.478015198	5.736182378
1149.2	0.767075899	4.142209853	1.538540605	0.608529016	0.828793639	2.550265331	30.28968318	20985.89323	0.530265331	6.363183976
1149.4	0.768343999	4.149057596	1.570507151	0.612548854	0.829775685	2.606337294	30.93961575	21016.83285	0.586337294	7.036047527
1149.6	0.769658843	4.156157755	1.604877764	0.616871008	0.830831587	2.66676628	31.63862144	21048.47147	0.64676628	7.761195358
1149.8	0.771026284	4.163541935	1.64200673	0.621540028	0.831972229	2.732207997	32.39384566	21080.86532	0.712207997	8.546495969
1150	0.772453523	4.171249022	1.682333932	0.626611231	0.833211124	2.803478693	33.21412014	21114.07944	0.783478693	9.401744316
1150.2	0.773949588	4.179327774	1.726415875	0.632154598	0.834565368	2.881613801	34.11055497	21148.18999	0.861613801	10.33936562
1150.4	0.775526067	4.187840763	1.7749727	0.638260688	0.836057086	2.967957007	35.09742485	21183.28742	0.947957007	11.37548409
1150.6	0.777198258	4.196870592	1.82896262	0.645049997	0.837715714	3.064301455	36.19355078	21219.48097	1.044301455	12.53161746
1150.8	0.778987088	4.206530277	1.889706228	0.652688592	0.839581823	3.173126	37.42456473	21256.90553	1.153126	13.83751201
1151	0.780922557	4.216981806	1.959108909	0.661416078	0.841713948	3.298018588	38.82686753	21295.7324	1.278018588	15.33622305
1151.2	0.783050462	4.228472495	2.04009682	0.669886916	0.843783374	3.442799555	40.44490886	21336.17731	1.422799555	17.07359466
1151.4	0.785447409	4.241416006	2.137588688	0.677980417	0.845760616	3.61577665	42.35145723	21378.52877	1.59577665	19.1493198

Inputs: Solana

Subarea ID	Area (ac)	Flow Path Length (ft)	Flow Path Slope (vft/hft)	50-yr Rainfall Depth (in)	Percent Impervious	Soil Type	Design Storm Frequency	Fire Factor	$V_{actual/min}$ $(cf/0.1\ min)$	Tank V_{actual}
Subarea 1	2	183	0.0995	5.4	0.7557	4	50-yr	0	6.31	4,350

Outputs: Solana

Area (ac)	Modeled (50-yr) Rainfall Depth (in)	Time of Concentration (min)	Clear Peak Flow Rate (cfs)	24-Hr Clear Runoff Volume (ac-ft)	Burned Peak Flow Rate (cfs)	Peak Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)
Subarea 1	5.4	5	5.555979788	0.64591302	5.555979788	3.221788206	0.745480701	0.862250935

Hydrograph: Solana - Subarea 1

Time (min)	Incremental Masscurve	Incremental Design Storm Depth (in)	Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)	Clear Peak Flow Rate (cfs)	Incremental Volume (cu-ft)	Cumulative Volume (cu-ft)	Over Q (cfs)	Over Q Vol. (cf)
1151.6	0.788261517	4.256612193	2.261133475	0.688236758	0.84826624	3.836086382	44.71117819	21423.23994	1.816086382	21.79303658
1151.8	0.791870458	4.276100474	2.435150424	0.702683156	0.851795495	4.148500322	47.90752022	21471.14746	2.128500322	25.54200386
1152	0.8	4.32	2.90101037	0.728853172	0.85818883	4.97922939	54.76637827	21525.91384	2.95922939	35.51075268
1152.2	0.804237385	4.342881876	3.113501734	0.739867669	0.860879671	5.3607007	62.03958054	21587.95342	3.3407007	40.0884084
1152.4	0.806118483	4.353039809	3.172077398	0.74290394	0.861621433	5.466259744	64.96176267	21652.91519	3.446259744	41.35511693
1152.6	0.807585289	4.360960561	3.202499145	0.744480852	0.862006672	5.521151261	65.92446603	21718.83965	3.501151261	42.01381513
1152.8	0.808834657	4.367707145	3.217434747	0.74525504	0.862195806	5.548117491	66.41561251	21785.25526	3.528117491	42.33740989
1153	0.809943791	4.37369647	3.221788206	0.745480701	0.862250935	5.555979788	66.62458367	21851.87985	3.535979788	42.43175746
1153.2	0.81095262	4.37914415	3.21803562	0.745286186	0.862203415	5.549202605	66.63109436	21918.51094	3.529202605	42.35043126
1153.4	0.811885018	4.384179096	3.207597967	0.74474515	0.86207124	5.530355914	66.47735111	21984.98829	3.510355914	42.12427097
1153.6	0.812756619	4.38888574	3.191344962	0.743902675	0.861865423	5.501019753	66.188254	22051.17655	3.481019753	41.77223704
1153.8	0.813578331	4.39332299	3.169818851	0.742786868	0.861592832	5.462186401	65.77923693	22116.95578	3.442186401	41.30623681
1154	0.81435813	4.397533901	3.143345817	0.741414638	0.861257596	5.414460923	65.25988394	22182.21567	3.394460923	40.73353108
1154.2	0.815102053	4.401551088	3.112094819	0.739794741	0.860861855	5.358167439	64.63577017	22246.85144	3.338167439	40.05800926
1154.4	0.815814808	4.405399965	3.076108434	0.737929386	0.860406149	5.293405223	63.90943597	22310.76087	3.273405223	39.28086267
1154.6	0.816500148	4.409100802	3.035316564	0.735814938	0.859889589	5.220074227	63.0808767	22373.84175	3.200074227	38.40089072
1154.8	0.817161124	4.412670071	2.989537622	0.733441985	0.859309877	5.137878412	62.14771583	22435.98947	3.117878412	37.41454094
1155	0.817800256	4.416121381	2.938468312	0.730794805	0.858663171	5.046309037	61.10512469	22497.09459	3.026309037	36.31570844
1155.2	0.818419654	4.419466131	2.881660288	0.72785016	0.857943794	4.944605121	59.94548495	22557.04008	2.924605121	35.09526145
1155.4	0.819021108	4.422713981	2.818478623	0.724575136	0.857143706	4.831682422	58.65772526	22615.6978	2.811682422	33.74018907
1155.6	0.819606149	4.425873206	2.748031364	0.7209235	0.856251611	4.706012564	57.22616992	22672.92397	2.686012564	32.23215077
1155.8	0.820176103	4.428950955	2.669048137	0.716829402	0.855251423	4.565414434	55.62856199	22728.55253	2.545414434	30.54497321
1156	0.820732123	4.431953463	2.579659888	0.712195959	0.854119473	4.406675487	53.83253952	22782.38507	2.386675487	28.64010584
1156.2	0.821275222	4.434886199	2.476964453	0.70615444	0.85264353	4.223935428	51.78366548	22834.16874	2.203935428	26.44722513
1156.4	0.821806296	4.437753996	2.35605588	0.69611695	0.850191371	4.006196757	49.38079311	22883.54953	1.986196757	23.83436109
1156.6	0.822326139	4.440561152	2.207387506	0.683774919	0.847176213	3.740092374	46.47773479	22930.02727	1.720092374	20.64110849
1156.8	0.822835464	4.443311503	2.006532353	0.667100489	0.843102649	3.383425485	42.74110716	22972.76837	1.363425485	16.36110582
1157	0.823334907	4.446008499	1.512101991	0.605204323	0.827981416	2.503984696	35.32446109	23008.09284	0.483984696	5.80781635

Inputs: Solana

Subarea ID	Area (ac)	Flow Path Length (ft)	Flow Path Slope (vft/hft)	50-yr Rainfall Depth (in)	Percent Impervious	Soil Type	Design Storm Frequency	Fire Factor	$V_{actual/min}$ $(cf/0.1\ min)$	Tank V_{actual}
Subarea 1	2	183	0.0995	5.4	0.7557	4	50-yr	0	6.31	4,350

Outputs: Solana

Area (ac)	Modeled (50-yr) Rainfall Depth (in)	Time of Concentration (min)	Clear Peak Flow Rate (cfs)	24-Hr Clear Runoff Volume (ac-ft)	Burned Peak Flow Rate (cfs)	Peak Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)
Subarea 1	5.4	5	5.555979788	0.64591302	5.555979788	3.221788206	0.745480701	0.862250935

Hydrograph: Solana - Subarea 1

Time (min)	Incremental Masscurve	Incremental Design Storm Depth (in)	Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)	Clear Peak Flow Rate (cfs)	Incremental Volume (cu-ft)	Cumulative Volume (cu-ft)			Over Q (cfs)	Over Q Vol. (cf)
1157.2	0.823825046	4.448655249	1.26928047	0.553363974	0.815316819	2.069731429	27.44229675	23035.53513			0.049731429	0.596777153
1157.4	0.824306402	4.451254569	1.178577114	0.533582132	0.810484115	1.910436058	23.88100492	23059.41614	Duration		Q Drawdown	Total
1157.6	0.824779448	4.45380902	1.114181509	0.519537848	0.807053096	1.798407273	22.25305998	23081.6692		10.6	67	1119
1157.8	0.825244619	4.45632094	1.063365542	0.508455199	0.804345605	1.7106268	21.05420444	23102.7234				1052

Q ALLOWABLE CMP INFILTRATION:

Subarea 1-Infiltration Tank A

$K_{sat,measured}$:	93.70	in/hr
CMP Diameter:	6.00	feet
CMP_{Length}:	24	linear feet
G_{depth} (Porous Stone):	6.50	feet
G_{width} (Porous Stone):	10.00	feet
G_{length} (Porous Stone):	28	feet
T (Max. Drawdown Time):	1440	min
Allowable Q V_{design} (CF) :	From HydroCalc csv file	
Allowable Q V_{design} (CF) :	1,119	C.F.
Reduction Factor (RF):	5.20	unitless
Safety Factor (SF):	3.00	unitless

Determine $K_{sat,design}$

$K_{sat,design} = K_{sat,measured} / (RF x SF)$

$K_{sat,design} =$ 6.01 in/hr 0.1001 in/min

Determine A_{min}

$A_{min} = (V_{design} \times 12\ in/ft) \div (T \times K_{sat,design})$

$A_{min} =$ 93 S.F.

Determine V_{CMP}

$V_{CMP} = (\pi r2) x CMP_{Length}$

$V_{CMP} =$ 679 C.F.

Determine V_{Stone}

$V_{stone} = ((G_{depth} \times G_{width} \times G_{length}) - V_{CMP}) \times 0.40$

$V_{stone} =$ 457 C.F.

Determine V_{Actual}

$V_{actual} = V_{CMP} + V_{stone}$

$V_{actual} =$ 1,135 C.F.

$V_{actuals} >= V_{design}$ TRUE

Determine A_{actual}

$A_{actual} = G_{width} \times G_{length}$

$A_{actual} =$ 280 S.F.

Determine T_{actual}

$T_{actual} = (V_{actual} \times 12\ in/ft) \div (A_{actual} \times K_{sat,design})$

$T_{actual} =$ 486.0 min

$T_{actuals} <= T_{max}$ TRUE

Determine $T_{actual/min}$

$T_{actual/min} = A_{actual} \times (K_{sat,design} \div 12)$

$T_{actual/min} =$ 2.34 cf/min

Peak Flow Hydrologic Analysis

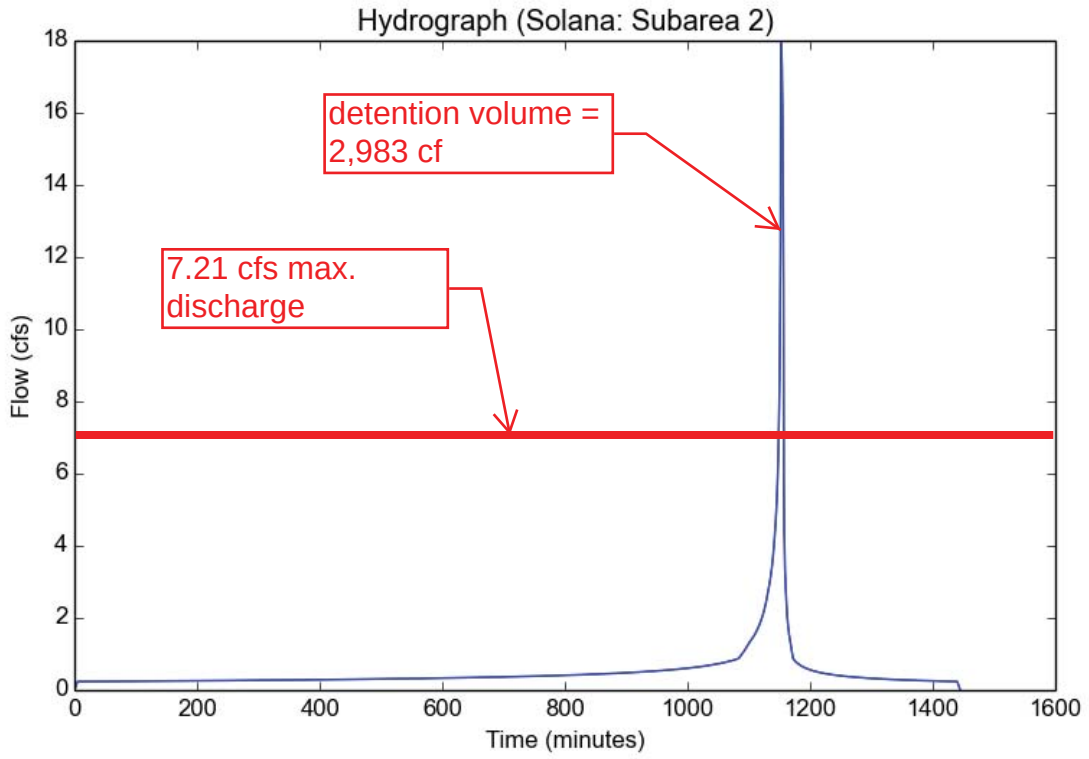
File location: C:/Users/Mike/Desktop/CSV_Results/Solana - Subarea 2.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea 2
Area (ac)	7.14
Flow Path Length (ft)	332.0
Flow Path Slope (vft/hft)	1.2163
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.2212
Soil Type	4
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.7455
Developed Runoff Coefficient (Cd)	0.7797
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	17.935
Burned Peak Flow Rate (cfs)	17.935
24-Hr Clear Runoff Volume (ac-ft)	1.0766
24-Hr Clear Runoff Volume (cu-ft)	46894.6384



Inputs: Solana

Subarea ID	Area (ac)	Flow Path Length (ft)	Flow Path Slope (vft/hft)	50-yr Rainfall Depth (in)	Percent Impervious	Soil Type	Design Storm Frequency	Fire Factor
Subarea 2	7.14	332	1.2163	5.4	0.2212	4	50-yr	0

Outputs: Solana

Area (ac)	Modeled (50-yr) Rainfall Depth (in)	Time of Concentration (min)	Clear Peak Flow Rate (cfs)	24-Hr Clear Runoff Volume (ac-ft)	Burned Peak Flow Rate (cfs)	Peak Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)
Subarea 2	5.4	5	17.93497018	1.076552763	17.93497018	3.221788206	0.745480701	0.77966037

Hydrograph: Solana - Subarea 2

Time (min)	Incremental Masscurve	Incremental Design Storm Depth (in)	Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)	Clear Peak Flow Rate (cfs)	Incremental Volume (cu-ft)	Cumulative Volume (cu-ft)		Over Q (cfs)	Over Q Vol. (cf)
1148.4	0.762385049	4.116879266	1.429597363	0.588328099	0.657269924	6.708967838	79.60735055	32343.5036	10806.444		
1148.6	0.763507468	4.122940326	1.454403004	0.593738056	0.661483198	6.869130896	81.46859241	32424.97219	10808.326		
1148.8	0.764661374	4.129171419	1.480709618	0.599475367	0.665951416	7.040615955	83.45848111	32508.43068	10810.208	Over Q (cfs)	Over Q Vol. (cf)
1149	0.765849707	4.135588416	1.508688236	0.604775038	0.6700788	7.218111613	85.55236541	32593.98304	10812.09	0.007111613	0.085339357
1149.2	0.767075899	4.142209853	1.538540605	0.608529016	0.673002398	7.393052421	87.6669842	32681.65002	10813.972	0.182052421	2.184629049
1149.4	0.768343999	4.149057596	1.570507151	0.612548854	0.676133048	7.581764555	89.84890186	32771.49893	10815.854	0.370764555	4.449174663
1149.6	0.769658843	4.156157755	1.604877764	0.616871008	0.679499141	7.786263262	92.20816691	32863.70709	10817.736	0.575263262	6.903159148
1149.8	0.771026284	4.163541935	1.64200673	0.621540028	0.683135374	8.009029972	94.77175941	32958.47885	10819.618	0.798029972	9.57635967
1150	0.772453523	4.171249022	1.682333932	0.626611231	0.687084827	8.253169689	97.57319797	33056.05205	10821.5	1.042169689	12.50603626
1150.2	0.773949588	4.179327774	1.726415875	0.632154598	0.691402001	8.52264237	100.6548724	33156.70692	10823.382	1.31164237	15.73970845
1150.4	0.775526067	4.187840763	1.7749727	0.638260688	0.696157424	8.822615417	104.0715467	33260.77847	10825.264	1.611615417	19.339385
1150.6	0.777198258	4.196870592	1.82896262	0.645049997	0.701444938	9.160024319	107.8958384	33368.67431	10827.146	1.949024319	23.38829182
1150.8	0.778987088	4.206530277	1.889706228	0.652688592	0.707393876	9.544513615	112.2272276	33480.90154	10829.028	2.333513615	28.00216338
1151	0.780922557	4.216981806	1.959108909	0.661416078	0.714190842	9.990128353	117.2078518	33598.10939	10830.91	2.779128353	33.34954023
1151.2	0.783050462	4.228472495	2.04009682	0.669886916	0.72078793	10.49920696	122.9360119	33721.0454	10832.792	3.288206956	39.45848348
1151.4	0.785447409	4.241416006	2.137588688	0.677980417	0.727091149	11.09714376	129.5781043	33850.6235	10834.674	3.886143758	46.63372509
1151.6	0.788261517	4.256612193	2.261133475	0.688236758	0.735078787	11.86747434	137.7877086	33988.41121	10836.556	4.656474344	55.87769213
1151.8	0.791870458	4.276100474	2.435150424	0.702683156	0.746329642	12.9764141	149.0633307	34137.47454	10838.438	5.765414103	69.18496924
1152	0.8	4.32	2.90101037	0.728853172	0.76671085	15.88104595	173.1447603	34310.6193	10840.32	8.670045948	104.0405514
1152.2	0.804237385	4.342881876	3.113501734	0.739867669	0.77528894	17.23498511	198.6961863	34509.31549	10842.202	10.02398511	120.2878213
1152.4	0.806118483	4.353039809	3.172077398	0.74290394	0.777653589	17.61279044	209.0866533	34718.40214	10844.084	10.40179044	124.8214852
1152.6	0.807585289	4.360960561	3.202499145	0.744480852	0.778881688	17.80978708	212.5354651	34930.93761	10845.966	10.59878708	127.185445
1152.8	0.808834657	4.367707145	3.217434747	0.74525504	0.779484625	17.90669815	214.2989114	35145.23652	10847.848	10.69569815	128.3483778
1153	0.809943791	4.37369647	3.221788206	0.745480701	0.77966037	17.93497018	215.05001	35360.28653	10849.73	10.72397018	128.6876422
1153.2	0.81095262	4.37914415	3.21803562	0.745286186	0.779508882	17.91059966	215.0734191	35575.35995	10851.612	10.69959966	128.395196
1153.4	0.811885018	4.384179096	3.207597967	0.74474515	0.779087523	17.84285681	214.5207389	35789.88069	10853.494	10.63185681	127.5822818
1153.6	0.812756619	4.38888574	3.191344962	0.743902675	0.778431403	17.73749599	213.4821169	36003.3628	10855.376	10.52649599	126.3179519

Inputs: Solana

Subarea ID	Area (ac)	Flow Path Length (ft)	Flow Path Slope (vft/hft)	50-yr Rainfall Depth (in)	Percent Impervious	Soil Type	Design Storm Frequency	Fire Factor
Subarea 2	7.14	332	1.2163	5.4	0.2212	4	50-yr	0

Outputs: Solana

Area (ac)	Modeled (50-yr) Rainfall Depth (in)	Time of Concentration (min)	Clear Peak Flow Rate (cfs)	24-Hr Clear Runoff Volume (ac-ft)	Burned Peak Flow Rate (cfs)	Peak Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)
Subarea 2	5.4	5	17.93497018	1.076552763	17.93497018	3.221788206	0.745480701	0.77966037

Hydrograph: Solana - Subarea 2

Time (min)	Incremental Masscurve	Incremental Design Storm Depth (in)	Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)	Clear Peak Flow Rate (cfs)	Incremental Volume (cu-ft)	Cumulative Volume (cu-ft)		Over Q (cfs)	Over Q Vol. (cf)
1153.8	0.813578331	4.39332299	3.169818851	0.742786868	0.777562413	17.59818644	212.0140946	36215.3769	10857.258	10.38718644	124.6462373
1154	0.81435813	4.397533901	3.143345817	0.741414638	0.77649372	17.42722836	210.1524888	36425.52939	10859.14	10.21622836	122.5947403
1154.2	0.815102053	4.401551088	3.112094819	0.739794741	0.775232144	17.22593501	207.9189802	36633.44837	10861.022	10.01493501	120.1792201
1154.4	0.815814808	4.405399965	3.076108434	0.737929386	0.773779406	16.9948376	205.3246357	36838.773	10862.904	9.783837599	117.4060512
1154.6	0.816500148	4.409100802	3.035316564	0.735814938	0.772132674	16.73378305	202.3717239	37041.14473	10864.786	9.522783046	114.2733965
1154.8	0.817161124	4.412670071	2.989537622	0.733441985	0.770284618	16.44195519	199.0544294	37240.19916	10866.668	9.230955188	110.7714623
1155	0.817800256	4.416121381	2.938468312	0.730794805	0.768222994	16.11782833	195.3587011	37435.55786	10868.55	8.906828329	106.8819399
1155.2	0.818419654	4.419466131	2.881660288	0.72785016	0.765929704	15.75904537	191.2612422	37626.8191	10870.432	8.548045375	102.5765445
1155.4	0.819021108	4.422713981	2.818478623	0.724575136	0.763379116	15.36219351	186.7274333	37813.54653	10872.314	8.151193514	97.81432217
1155.6	0.819606149	4.425873206	2.748031364	0.7209235	0.760535222	14.92241895	181.7076748	37995.25421	10874.196	7.711418947	92.53702736
1155.8	0.820176103	4.428950955	2.669048137	0.716829402	0.757346738	14.43275959	176.1310712	38171.38528	10876.078	7.22175959	86.66111508
1156	0.820732123	4.431953463	2.579659888	0.712195959	0.753738213	13.88293199	169.8941495	38341.27943	10877.96	6.671931987	80.06318384
1156.2	0.821275222	4.434886199	2.476964453	0.70615444	0.749033078	13.24704411	162.7798566	38504.05929	10879.842	6.036044113	72.43252935
1156.4	0.821806296	4.437753996	2.35605588	0.69611695	0.74121588	12.46891068	154.2957288	38658.35501	10881.724	5.25791068	63.09492816
1156.6	0.822326139	4.440561152	2.207387506	0.683774919	0.731603907	11.53062393	143.9972076	38802.35222	10883.606	4.319623928	51.83548714
1156.8	0.822835464	4.443311503	2.006532353	0.667100489	0.71861786	10.2953801	130.9560242	38933.30825	10885.488	3.084380102	37.01256123
1157	0.823334907	4.446008499	1.512101991	0.605204323	0.670413126	7.238053788	105.2006033	39038.50885	10887.37	0.027053788	0.324645453
1157.2	0.823825046	4.448655249	1.26928047	0.553363974	0.630039863	5.709838673	77.68735476	39116.1962	10889.252	Duration	Total
1157.4	0.824306402	4.451254569	1.178577114	0.533582132	0.614633764	5.172168077	65.29204049	39181.48825	10891.134	8.0	75 2983
1157.6	0.824779448	4.45380902	1.114181509	0.519537848	0.603696076	4.802556812	59.84834933	39241.33659	10893.016		2908

Q ALLOWABLE CMP INFILTRATION:

Subarea 2-Infiltration Tank B

$K_{sat,measured}$:	93.70	in/hr
CMP Diameter:	8.00	feet
CMP_{Length}:	40	linear feet
G_{depth} (Porous Stone):	8.50	feet
G_{width} (Porous Stone):	12.00	feet
G_{length} (Porous Stone):	44	feet
T (Max. Drawdown Time):	1440	min
Allowable Q V_{design} (CF) :	From HydroCalc csv file	
Allowable Q V_{design} (CF) :	2,983	C.F.
Reduction Factor (RF):	5.20	unitless
Safety Factor (SF):	3.00	unitless

Determine $K_{sat,design}$

$K_{sat,design} = K_{sat,measured} / (RFxSF)$

$K_{sat,design} =$ 6.01 in/hr 0.1001 in/min

Determine A_{min}

$A_{min} = (V_{design} \times 12\ in/ft) \div (T \times K_{sat,design})$

$A_{min} =$ 248 S.F.

Determine V_{CMP}

$V_{CMP} = (\pi r2) x CMP_{Length}$

$V_{CMP} =$ 2,011 C.F.

Determine V_{Stone}

$V_{stone} = ((G_{depth} \times G_{width} \times G_{length}) - V_{CMP}) \times 0.40$

$V_{stone} =$ 991 C.F.

Determine V_{Actual}

$V_{actual} = V_{CMP} + V_{stone}$

$V_{actual} =$ 3,002 C.F.

$V_{actuals} >= V_{design}$ TRUE

Determine A_{actual}

$A_{actual} = G_{width} \times G_{length}$

$A_{actual} =$ 528 S.F.

Determine T_{actual}

$T_{actual} = (V_{actual} \times 12\ in/ft) \div (A_{actual} \times K_{sat,design})$

$T_{actual} =$ 681.4 min

$T_{actuals} < = T_{max}$ TRUE

Determine $T_{actual/min}$

$T_{actual/min} = A_{actual} \times (K_{sat,design} \div 12)$

$T_{actual/min} =$ 4.40 cf/min

Peak Flow Hydrologic Analysis

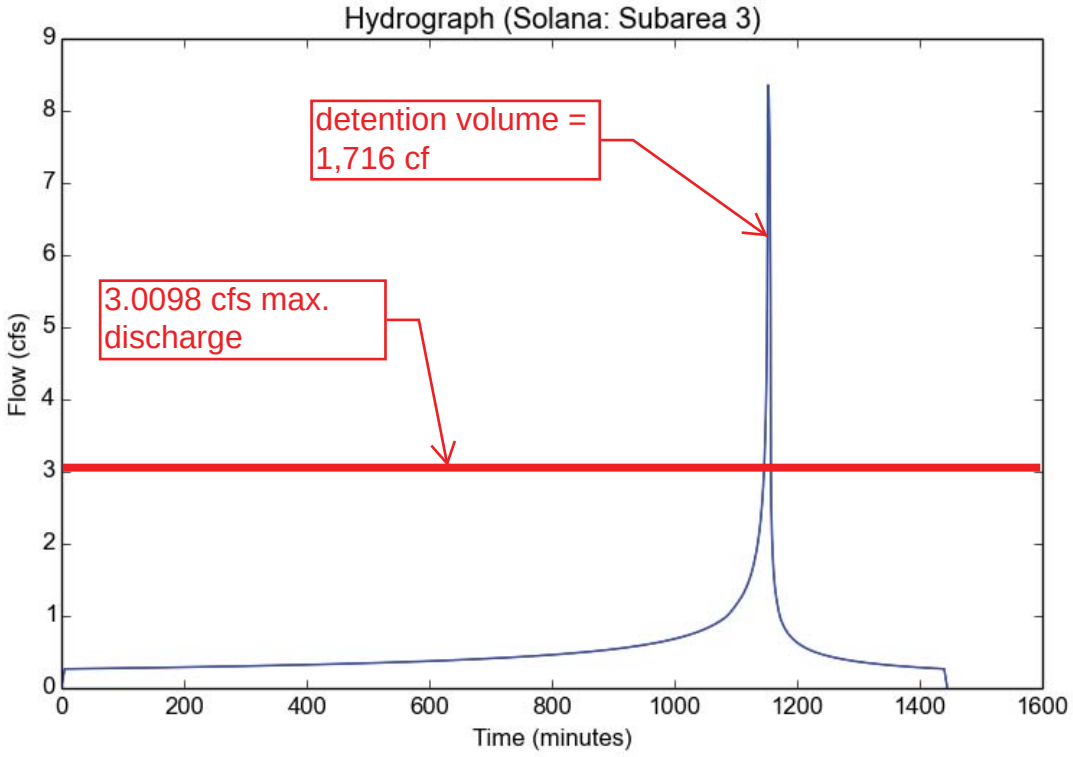
File location: C:/Users/Mike/Desktop/CSV_Results/Solana - Subarea 3.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea 3
Area (ac)	2.98
Flow Path Length (ft)	162.0
Flow Path Slope (vft/hft)	0.1366
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.8074
Soil Type	4
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.7455
Developed Runoff Coefficient (Cd)	0.8702
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	8.3551
Burned Peak Flow Rate (cfs)	8.3551
24-Hr Clear Runoff Volume (ac-ft)	1.012
24-Hr Clear Runoff Volume (cu-ft)	44084.4526



Inputs: Solana

Subarea ID	Area (ac)	Flow Path Length (ft)	Flow Path Slope (vft/hft)	50-yr Rainfall Depth (in)	Percent Impervious	Soil Type	Design Storm Frequency	Fire Factor
Subarea 3	2.98	162	0.1366	5.4	0.8074	4	50-yr	0

Outputs: Solana

Area (ac)	Modeled (50-yr) Rainfall Depth (in)	Time of Concentration (min)	Clear Peak Flow Rate (cfs)	24-Hr Clear Runoff Volume (ac-ft)	Burned Peak Flow Rate (cfs)	Peak Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)
Subarea 3	5.4	5	8.355108323	1.012039774	8.355108323	3.221788206	0.745480701	0.870239583

Hydrograph: Solana - Subarea 3

Time (min)	Incremental Masscurve	Incremental Design Storm Depth (in)	Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)	Clear Peak Flow Rate (cfs)	Incremental Volume (cu-ft)	Cumulative Volume (cu-ft)		Over Q (cfs)	Over Q Vol. (cf)
1145.6	0.748973526	4.04445704	1.183571423	0.53467136	0.829637704	2.926167722	34.91305983	32255.02923	11238.336		
1145.8	0.749824955	4.049054758	1.196820486	0.537560899	0.830194229	2.960908513	35.32245741	32290.35169	11240.298		
1146	0.750689394	4.05372273	1.21055923	0.540557234	0.830771323	2.996979723	35.74732941	32326.09901	11242.26	Over Q (cfs)	Over Q Vol. (cf)
1146.2	0.751567486	4.058464426	1.224819819	0.54366738	0.831370337	3.034471022	36.18870447	32362.28772	11244.222	0.024471022	0.293652264
1146.4	0.752459929	4.063283616	1.239637559	0.546899038	0.831992755	3.073481014	36.64771222	32398.93543	11246.184	0.063481014	0.761772167
1146.6	0.753367482	4.068184403	1.255051318	0.550260684	0.832640208	3.114118445	37.12559676	32436.06103	11248.146	0.104118445	1.249421343
1146.8	0.754290976	4.073171272	1.271104014	0.553761678	0.833314499	3.156503626	37.62373243	32473.68476	11250.108	0.146503626	1.758043514
1147	0.755231321	4.078249136	1.2878432	0.557412391	0.834017626	3.200770108	38.1436424	32511.8284	11252.07	0.190770108	2.289241292
1147.2	0.756189518	4.083423399	1.305321745	0.561224354	0.834751811	3.247066675	38.6870207	32550.51542	11254.032	0.237066675	2.8448001
1147.4	0.757166672	4.088700026	1.323598656	0.565210435	0.83551953	3.29555973	39.25575843	32589.77118	11255.994	0.28555973	3.426716762
1147.6	0.758164006	4.094085633	1.342740065	0.569385059	0.836323562	3.346436161	39.85197535	32629.62316	11257.956	0.336436161	4.037233935
1147.8	0.759182886	4.099587583	1.362820419	0.57376446	0.837167035	3.399906822	40.4780579	32670.10122	11259.918	0.389906822	4.678881864
1148	0.760224837	4.10521412	1.383923935	0.578367006	0.838053485	3.456210786	41.13670565	32711.23792	11261.88	0.446210786	5.354529434
1148.2	0.761291577	4.110974515	1.406146393	0.583213587	0.838986937	3.515620596	41.83098829	32753.06891	11263.842	0.505620596	6.067447153
1148.4	0.762385049	4.116879266	1.429597363	0.588328099	0.839971992	3.5784488	42.56441637	32795.63333	11265.804	0.5684488	6.821385596
1148.6	0.763507468	4.122940326	1.454403004	0.593738056	0.84101395	3.64505618	43.34102988	32838.97436	11267.766	0.63505618	7.620674156
1148.8	0.764661374	4.129171419	1.480709618	0.599475367	0.842118956	3.715862238	44.16551051	32883.13987	11269.728	0.705862238	8.470346857
1149	0.765849707	4.135588416	1.508688236	0.604775038	0.843139672	3.790664016	45.03915752	32928.17902	11271.69	0.780664016	9.367968187
1149.2	0.767075899	4.142209853	1.538540605	0.608529016	0.843862688	3.868984692	45.95789225	32974.13692	11273.652	0.858984692	10.30781631
1149.4	0.768343999	4.149057596	1.570507151	0.612548854	0.844636909	3.952994752	46.93187666	33021.06879	11275.614	0.942994752	11.31593702
1149.6	0.769658843	4.156157755	1.604877764	0.616871008	0.845469356	4.04348741	47.97889297	33069.04769	11277.576	1.03348741	12.40184892
1149.8	0.771026284	4.163541935	1.64200673	0.621540028	0.846368609	4.141433998	49.10952845	33118.15721	11279.538	1.131433998	13.57720798
1150	0.772453523	4.171249022	1.682333932	0.626611231	0.847345323	4.248043013	50.33686207	33168.49408	11281.5	1.238043013	14.85651616
1150.2	0.773949588	4.179327774	1.726415875	0.632154598	0.848412976	4.364846617	51.67733778	33220.17141	11283.462	1.354846617	16.2581594
1150.4	0.775526067	4.187840763	1.7749727	0.638260688	0.849589009	4.493831944	53.15207136	33273.32348	11285.424	1.483831944	17.80598333
1150.6	0.777198258	4.196870592	1.82896262	0.645049997	0.850896629	4.637649223	54.788887	33328.11237	11287.386	1.627649223	19.53179068
1150.8	0.778987088	4.206530277	1.889706228	0.652688592	0.852367823	4.799959855	56.62565447	33384.73803	11289.348	1.789959855	21.47951826

Inputs: Solana

Subarea ID	Area (ac)	Flow Path Length (ft)	Flow Path Slope (vft/hft)	50-yr Rainfall Depth (in)	Percent Impervious	Soil Type	Design Storm Frequency	Fire Factor
Subarea 3	2.98	162	0.1366	5.4	0.8074	4	50-yr	0

Outputs: Solana

Area (ac)	Modeled (50-yr) Rainfall Depth (in)	Time of Concentration (min)	Clear Peak Flow Rate (cfs)	24-Hr Clear Runoff Volume (ac-ft)	Burned Peak Flow Rate (cfs)	Peak Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)
Subarea 3	5.4	5	8.355108323	1.012039774	8.355108323	3.221788206	0.745480701	0.870239583

Hydrograph: Solana - Subarea 3

Time (min)	Incremental Masscurve	Incremental Design Storm Depth (in)	Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)	Clear Peak Flow Rate (cfs)	Incremental Volume (cu-ft)	Cumulative Volume (cu-ft)		Over Q (cfs)	Over Q Vol. (cf)
1151	0.780922557	4.216981806	1.959108909	0.661416078	0.854048737	4.986059976	58.71611899	33443.45415	11291.31	1.976059976	23.71271971
1151.2	0.783050462	4.228472495	2.04009682	0.669886916	0.85568022	5.202098078	61.12894832	33504.58309	11293.272	2.192098078	26.30517693
1151.4	0.785447409	4.241416006	2.137588688	0.677980417	0.857239028	5.46062486	63.97633763	33568.55943	11295.234	2.45062486	29.40749832
1151.6	0.788261517	4.256612193	2.261133475	0.688236758	0.8592144	5.789539354	67.50098528	33636.06042	11297.196	2.779539354	33.35447225
1151.8	0.791870458	4.276100474	2.435150424	0.702683156	0.861996776	6.255293606	72.26899776	33708.32941	11299.158	3.245293606	38.94352327
1152	0.8	4.32	2.90101037	0.728853172	0.867037121	7.495545363	82.50503381	33790.83445	11301.12	4.485545363	53.82654436
1152.2	0.804237385	4.342881876	3.113501734	0.739867669	0.869158513	8.064257082	93.35881467	33884.19326	11303.082	5.054257082	60.65108498
1152.4	0.806118483	4.353039809	3.172077398	0.74290394	0.869743299	8.221501321	97.71455042	33981.90781	11305.044	5.211501321	62.53801585
1152.6	0.807585289	4.360960561	3.202499145	0.744480852	0.870047012	8.30324794	99.14849557	34081.05631	11307.006	5.29324794	63.51897528
1152.8	0.808834657	4.367707145	3.217434747	0.74525504	0.870196121	8.34340172	99.87989796	34180.93621	11308.968	5.33340172	64.00082064
1153	0.809943791	4.37369647	3.221788206	0.745480701	0.870239583	8.355108323	100.1910603	34281.12727	11310.93	5.345108323	64.14129988
1153.2	0.81095262	4.37914415	3.21803562	0.745286186	0.870202119	8.345017424	100.2007545	34381.32802	11312.892	5.335017424	64.02020909
1153.4	0.811885018	4.384179096	3.207597967	0.74474515	0.870097916	8.316954431	99.97183113	34481.29985	11314.854	5.306954431	63.68345317
1153.6	0.812756619	4.38888574	3.191344962	0.743902675	0.869935655	8.273269015	99.54134068	34580.84119	11316.816	5.263269015	63.15922818
1153.8	0.813578331	4.39332299	3.169818851	0.742786868	0.869720751	8.215434548	98.93222138	34679.77341	11318.778	5.205434548	62.46521458
1154	0.81435813	4.397533901	3.143345817	0.741414638	0.869456459	8.144346925	98.15868884	34777.9321	11320.74	5.134346925	61.61216311
1154.2	0.815102053	4.401551088	3.112094819	0.739794741	0.869144467	8.060482779	97.22897823	34875.16108	11322.702	5.050482779	60.60579334
1154.4	0.815814808	4.405399965	3.076108434	0.737929386	0.8687852	7.963982891	96.14679402	34971.30788	11324.664	4.953982891	59.44779469
1154.6	0.816500148	4.409100802	3.035316564	0.735814938	0.868377957	7.854689949	94.91203704	35066.21991	11326.626	4.844689949	58.13627939
1154.8	0.817161124	4.412670071	2.989537622	0.733441985	0.867920926	7.73215314	93.52105854	35159.74097	11328.588	4.72215314	56.66583768
1155	0.817800256	4.416121381	2.938468312	0.730794805	0.86741108	7.595602712	91.96653512	35251.70751	11330.55	4.585602712	55.02723255
1155.2	0.818419654	4.419466131	2.881660288	0.72785016	0.866843941	7.443890284	90.23695798	35341.94446	11332.512	4.433890284	53.20668341
1155.4	0.819021108	4.422713981	2.818478623	0.724575136	0.866213171	7.275381851	88.31563281	35430.2601	11334.474	4.265381851	51.18458221
1155.6	0.819606149	4.425873206	2.748031364	0.7209235	0.865509866	7.087775807	86.17894595	35516.43904	11336.436	4.077775807	48.93330969
1155.8	0.820176103	4.428950955	2.669048137	0.716829402	0.864721343	6.87778901	83.7933889	35600.23243	11338.398	3.86778901	46.41346811
1156	0.820732123	4.431953463	2.579659888	0.712195959	0.863828942	6.640586915	81.11025555	35681.34269	11340.36	3.630586915	43.56704298
1156.2	0.821275222	4.434886199	2.476964453	0.70615444	0.862665345	6.367638355	78.04935162	35759.39204	11342.322	3.357638355	40.29166026

Inputs: Solana

Subarea ID	Area (ac)	Flow Path Length (ft)	Flow Path Slope (vft/hft)	50-yr Rainfall Depth (in)	Percent Impervious	Soil Type	Design Storm Frequency	Fire Factor
Subarea 3	2.98	162	0.1366	5.4	0.8074	4	50-yr	0

Outputs: Solana

Area (ac)	Modeled (50-yr) Rainfall Depth (in)	Time of Concentration (min)	Clear Peak Flow Rate (cfs)	24-Hr Clear Runoff Volume (ac-ft)	Burned Peak Flow Rate (cfs)	Peak Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)
Subarea 3	5.4	5	8.355108323	1.012039774	8.355108323	3.221788206	0.745480701	0.870239583

Hydrograph: Solana - Subarea 3

Time (min)	Incremental Masscurve	Incremental Design Storm Depth (in)	Intensity (in/hr)	Undeveloped Runoff Coefficient (Cu)	Developed Runoff Coefficient (Cd)	Clear Peak Flow Rate (cfs)	Incremental Volume (cu-ft)	Cumulative Volume (cu-ft)		Over Q (cfs)	Over Q Vol. (cf)
1156.4	0.821806296	4.437753996	2.35605588	0.69611695	0.860732125	6.04324029	74.46527187	35833.85731	11344.284	3.03324029	36.39888348
1156.6	0.822326139	4.440561152	2.207387506	0.683774919	0.858355049	5.64627219	70.13707488	35903.99439	11346.246	2.63627219	31.63526629
1156.8	0.822835464	4.443311503	2.006532353	0.667100489	0.855143554	5.113302158	64.55744609	35968.55183	11348.208	2.103302158	25.2396259
1157	0.823334907	4.446008499	1.512101991	0.605204323	0.843222353	3.799613831	53.47749594	36022.02933	11350.17	0.789613831	9.475365974
1157.2	0.823825046	4.448655249	1.26928047	0.553363974	0.833237901	3.151685532	41.70779618	36063.73712	11352.132	0.141685532	1.700226389
1157.4	0.824306402	4.451254569	1.178577114	0.533582132	0.829427919	2.913083393	36.38861355	36100.12574	11354.094	Duration	Total
1157.6	0.824779448	4.45380902	1.114181509	0.519537848	0.826722989	2.744936014	33.94811644	36134.07385	11356.056	11.0	108	1,716
1157.8	0.825244619	4.45632094	1.063365542	0.508455199	0.824588471	2.61298012	32.1474968	36166.22135	11358.018			1,608

Q ALLOWABLE CMP INFILTRATION:

Subarea 3-Infiltration Tank C

$K_{sat,measured}$:	93.70	in/hr
CMP Diameter:	8.00	feet
CMP_{Length}:	22	linear feet
G_{depth} (Porous Stone):	8.50	feet
G_{width} (Porous Stone):	12.00	feet
G_{length} (Porous Stone):	26	feet
T (Max. Drawdown Time):	1440	min
Allowable Q V_{design} (CF) :	From HydroCalc csv file	
Allowable Q V_{design} (CF) :	1,716	C.F.
Reduction Factor (RF):	5.20	unitless
Safety Factor (SF):	3.00	unitless

Determine $K_{sat,design}$

$K_{sat,design} = K_{sat,measured} / (RFxSF)$

$K_{sat,design} =$ 6.01 in/hr 0.1001 in/min

Determine A_{min}

$A_{min} = (V_{design} \times 12\ in/ft) \div (T \times K_{sat,design})$

$A_{min} =$ 143 S.F.

Determine V_{CMP}

$V_{CMP} = (\pi r2) x CMP_{Length}$

$V_{CMP} =$ 1,106 C.F.

Determine V_{Stone}

$V_{stone} = ((G_{depth} \times G_{width} \times G_{length}) - V_{CMP}) \times 0.40$

$V_{stone} =$ 618 C.F.

Determine V_{Actual}

$V_{actual} = V_{CMP} + V_{stone}$

$V_{actual} =$ 1,724 C.F.

$V_{actuals} >= V_{design}$ TRUE

Determine A_{actual}

$A_{actual} = G_{width} \times G_{length}$

$A_{actual} =$ 312 S.F.

Determine T_{actual}

$T_{actual} = (V_{actual} \times 12\ in/ft) \div (A_{actual} \times K_{sat,design})$

$T_{actual} =$ 662.5 min

$T_{actuals} <= T_{max}$ TRUE

Determine $T_{actual/min}$

$T_{actual/min} = A_{actual} \times (K_{sat,design} \div 12)$

$T_{actual/min} =$ 2.60 cf/min

Peak Flow Hydrologic Analysis

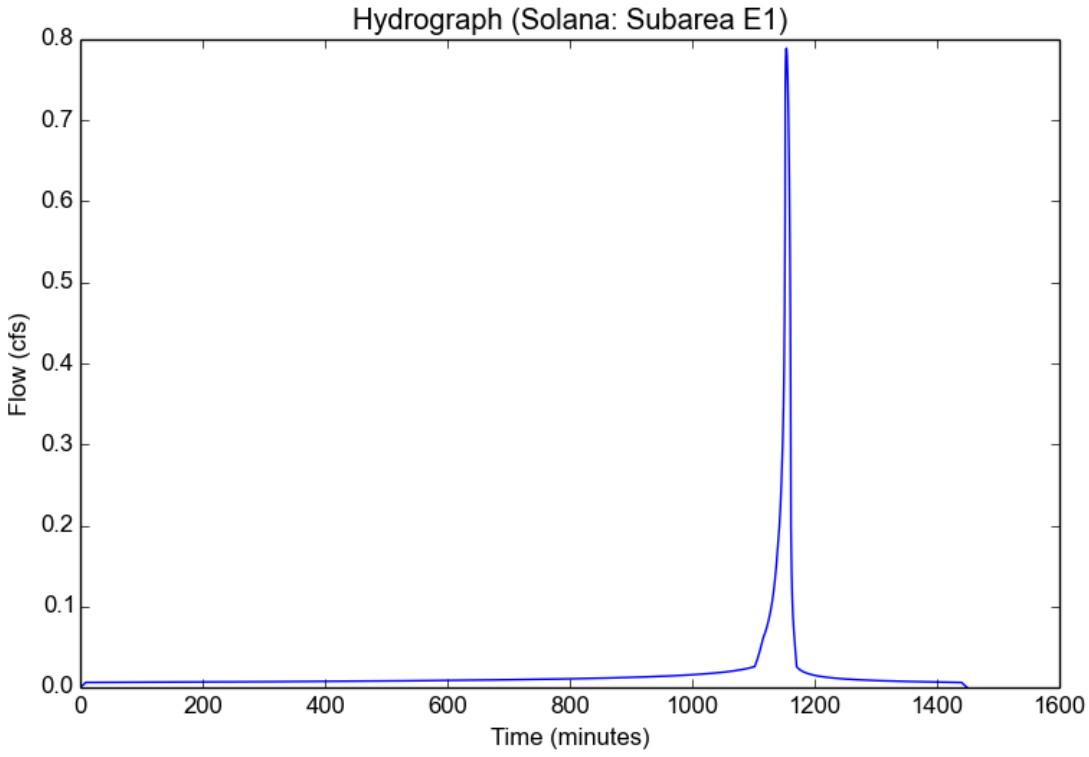
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-25 Year/Solana - E1.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea E1
Area (ac)	0.54
Flow Path Length (ft)	853.0
Flow Path Slope (vft/hft)	0.13
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	4
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.1459
Undeveloped Runoff Coefficient (Cu)	0.6787
Developed Runoff Coefficient (Cd)	0.6809
Time of Concentration (min)	9.0
Clear Peak Flow Rate (cfs)	0.789
Burned Peak Flow Rate (cfs)	0.789
24-Hr Clear Runoff Volume (ac-ft)	0.0369
24-Hr Clear Runoff Volume (cu-ft)	1605.5563



Peak Flow Hydrologic Analysis

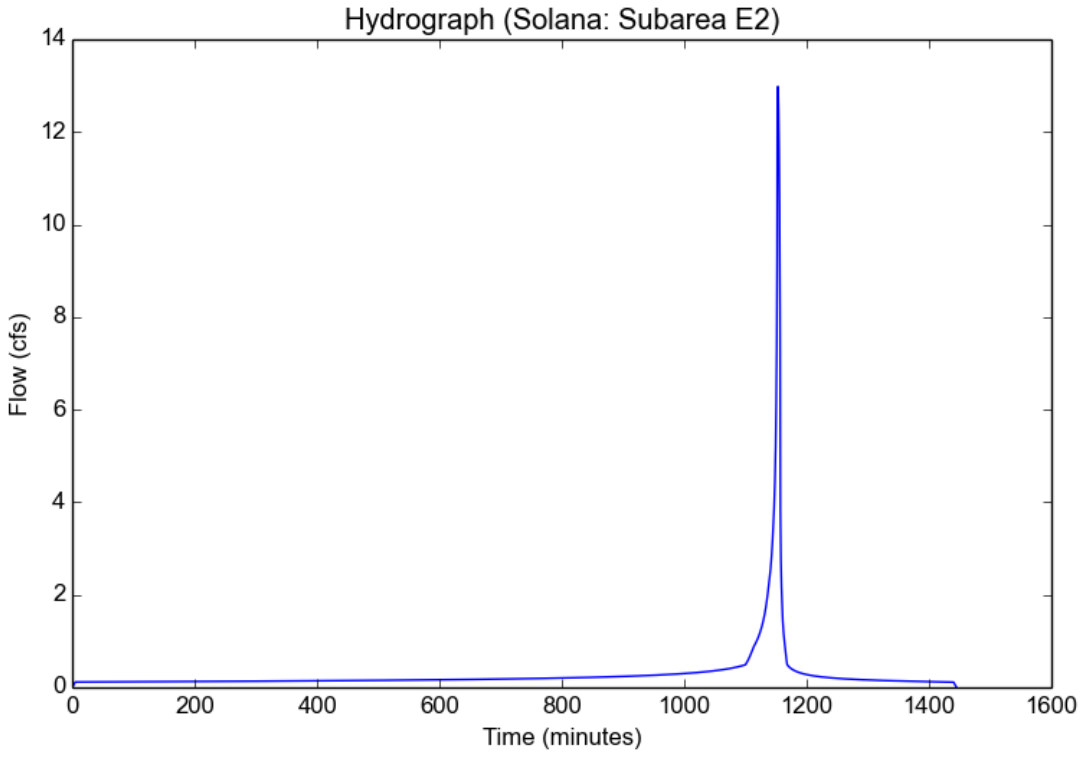
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-25 Year/Solana - E2.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea E2
Area (ac)	6.18
Flow Path Length (ft)	363.0
Flow Path Slope (vft/hft)	1.4
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.1
Soil Type	4
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.8287
Undeveloped Runoff Coefficient (Cu)	0.7251
Developed Runoff Coefficient (Cd)	0.7426
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	12.9817
Burned Peak Flow Rate (cfs)	12.9817
24-Hr Clear Runoff Volume (ac-ft)	0.5827
24-Hr Clear Runoff Volume (cu-ft)	25382.4344



Peak Flow Hydrologic Analysis

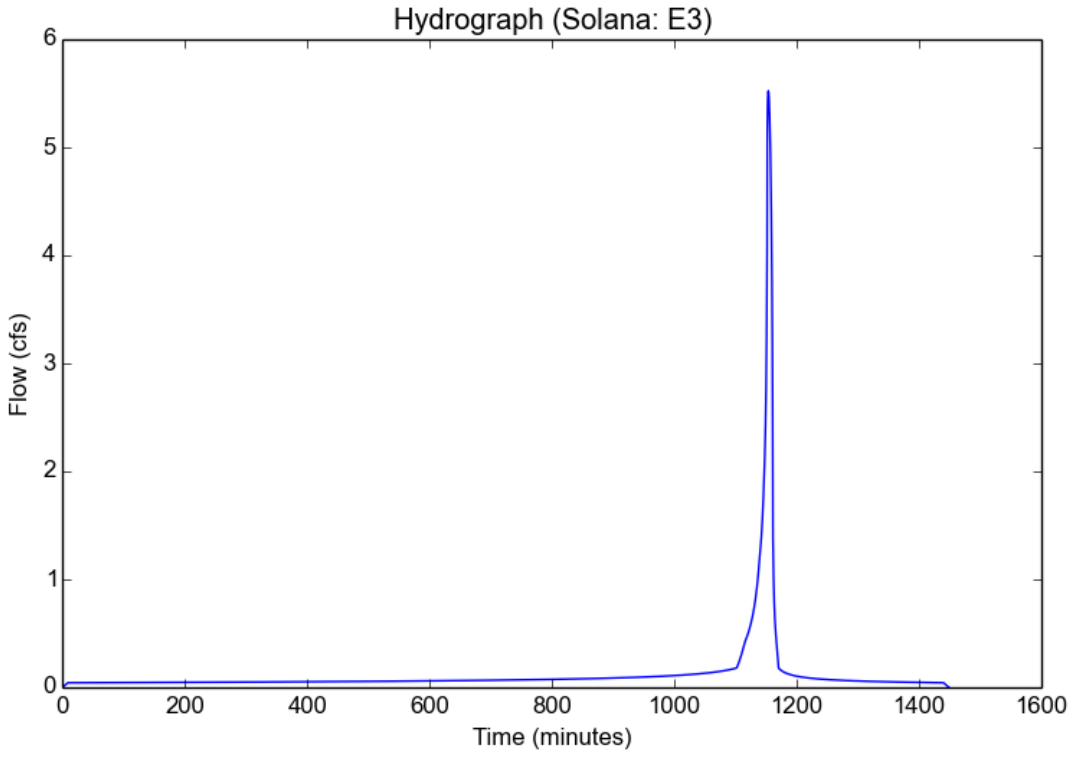
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-25 Year/Solana - E3.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	E3
Area (ac)	3.78
Flow Path Length (ft)	702.0
Flow Path Slope (vft/hft)	0.06
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	4
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.1459
Undeveloped Runoff Coefficient (Cu)	0.6787
Developed Runoff Coefficient (Cd)	0.6809
Time of Concentration (min)	9.0
Clear Peak Flow Rate (cfs)	5.5231
Burned Peak Flow Rate (cfs)	5.5231
24-Hr Clear Runoff Volume (ac-ft)	0.258
24-Hr Clear Runoff Volume (cu-ft)	11238.8941



Peak Flow Hydrologic Analysis

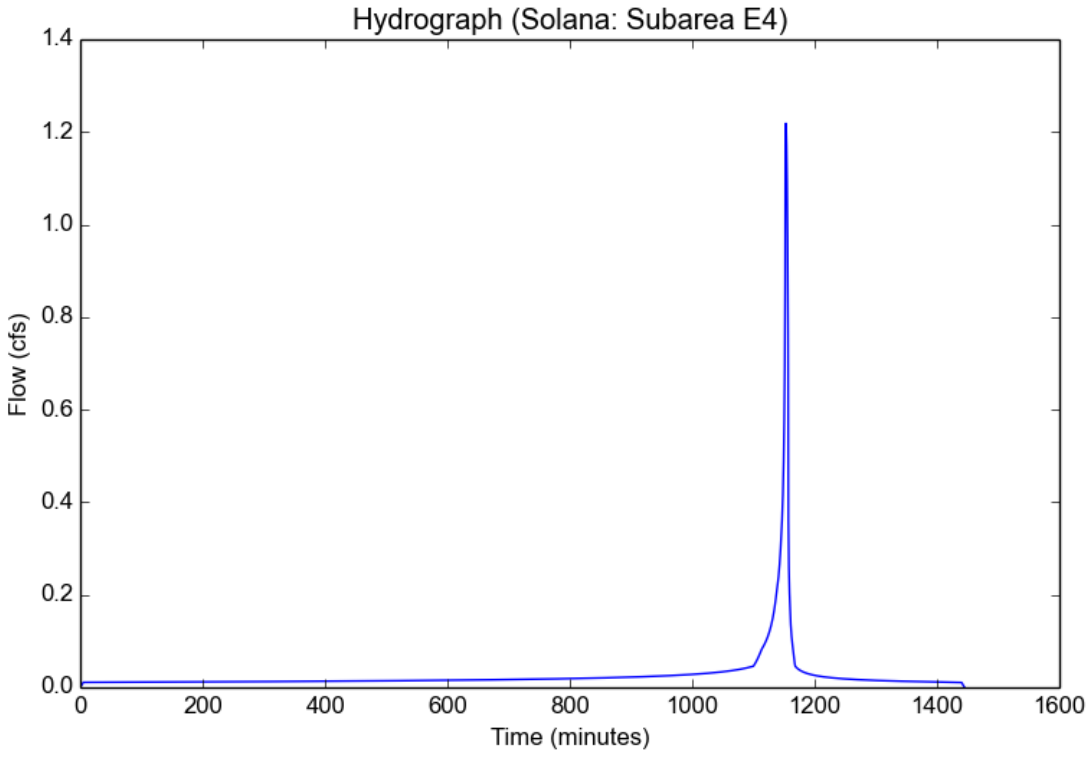
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-25 Year/Solana - E4.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea E4
Area (ac)	0.58
Flow Path Length (ft)	334.0
Flow Path Slope (vft/hft)	0.63
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.1
Soil Type	4
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.8287
Undeveloped Runoff Coefficient (Cu)	0.7251
Developed Runoff Coefficient (Cd)	0.7426
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.2183
Burned Peak Flow Rate (cfs)	1.2183
24-Hr Clear Runoff Volume (ac-ft)	0.0547
24-Hr Clear Runoff Volume (cu-ft)	2382.1702



Peak Flow Hydrologic Analysis

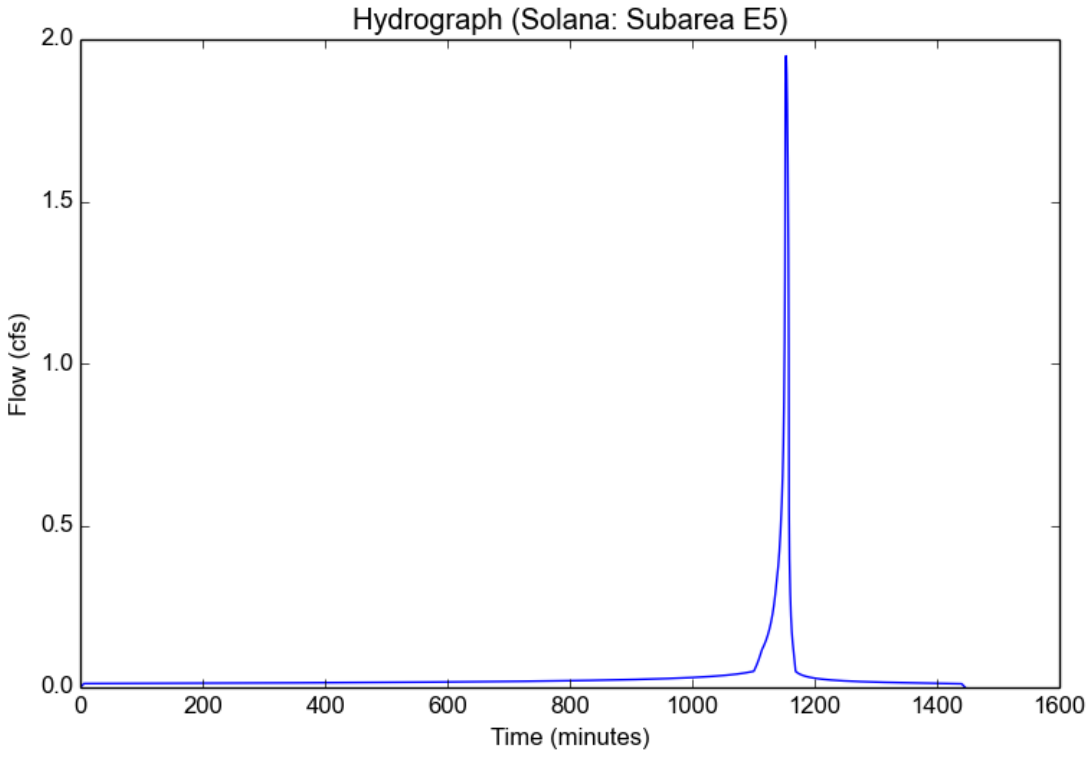
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-25 Year/Solana - Subarea E5-updated.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea E5
Area (ac)	1.05
Flow Path Length (ft)	502.0
Flow Path Slope (vft/hft)	0.14
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	4
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.5964
Undeveloped Runoff Coefficient (Cu)	0.7131
Developed Runoff Coefficient (Cd)	0.7149
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	1.9491
Burned Peak Flow Rate (cfs)	1.9491
24-Hr Clear Runoff Volume (ac-ft)	0.0718
24-Hr Clear Runoff Volume (cu-ft)	3129.3951



Peak Flow Hydrologic Analysis

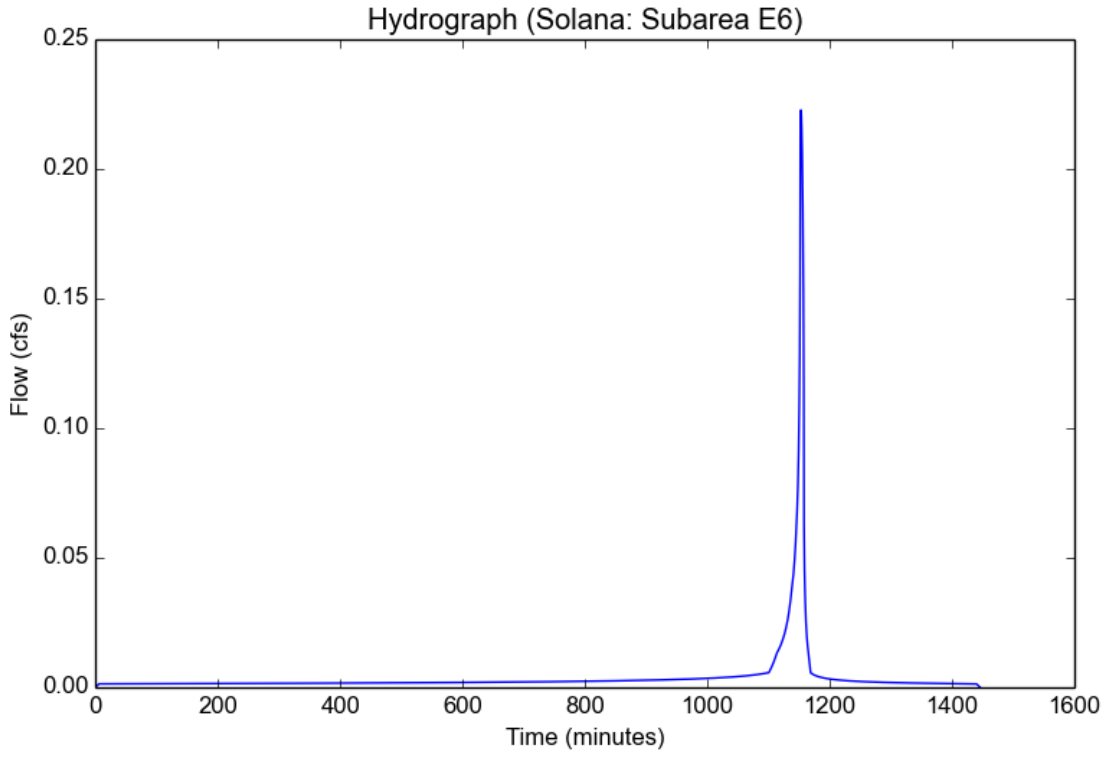
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-25 Year/Solana - E6-updated.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea E6
Area (ac)	0.12
Flow Path Length (ft)	822.0
Flow Path Slope (vft/hft)	0.57
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	4
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.5964
Undeveloped Runoff Coefficient (Cu)	0.7131
Developed Runoff Coefficient (Cd)	0.7149
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	0.2228
Burned Peak Flow Rate (cfs)	0.2228
24-Hr Clear Runoff Volume (ac-ft)	0.0082
24-Hr Clear Runoff Volume (cu-ft)	357.6452



Peak Flow Hydrologic Analysis

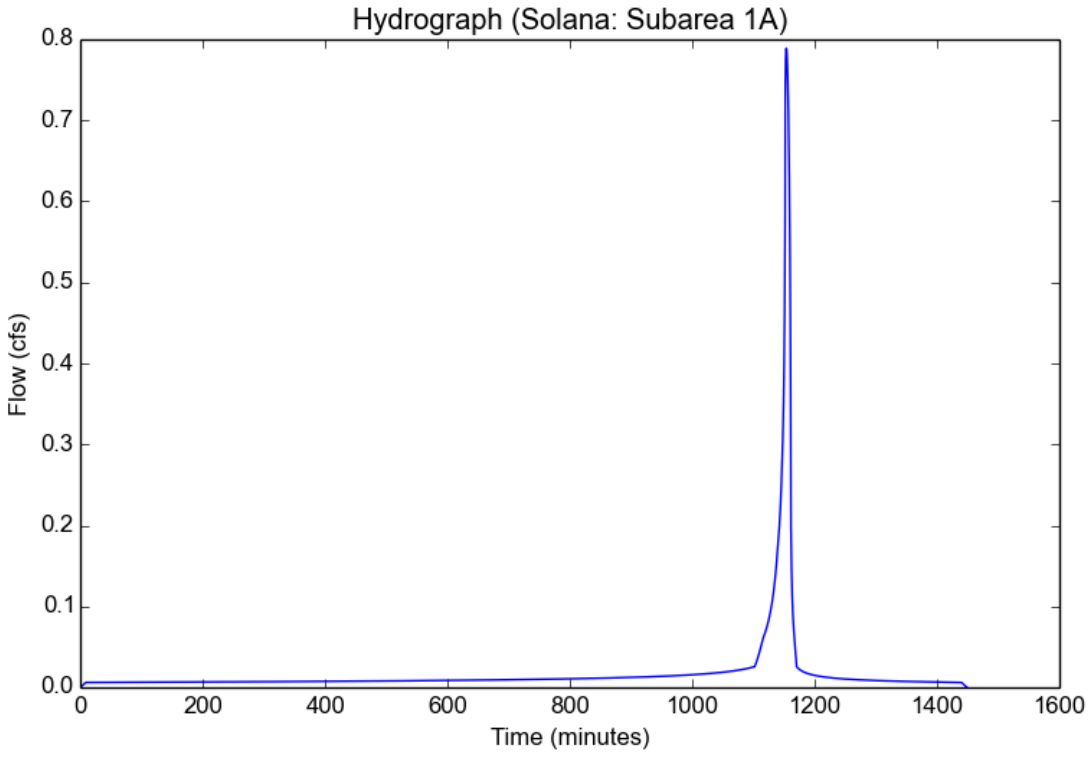
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-25 Year/Solana - Subarea 1A-25 year.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea 1A
Area (ac)	0.54
Flow Path Length (ft)	853.0
Flow Path Slope (vft/hft)	0.13
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	4
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.1459
Undeveloped Runoff Coefficient (Cu)	0.6787
Developed Runoff Coefficient (Cd)	0.6809
Time of Concentration (min)	9.0
Clear Peak Flow Rate (cfs)	0.789
Burned Peak Flow Rate (cfs)	0.789
24-Hr Clear Runoff Volume (ac-ft)	0.0369
24-Hr Clear Runoff Volume (cu-ft)	1605.5563



Peak Flow Hydrologic Analysis

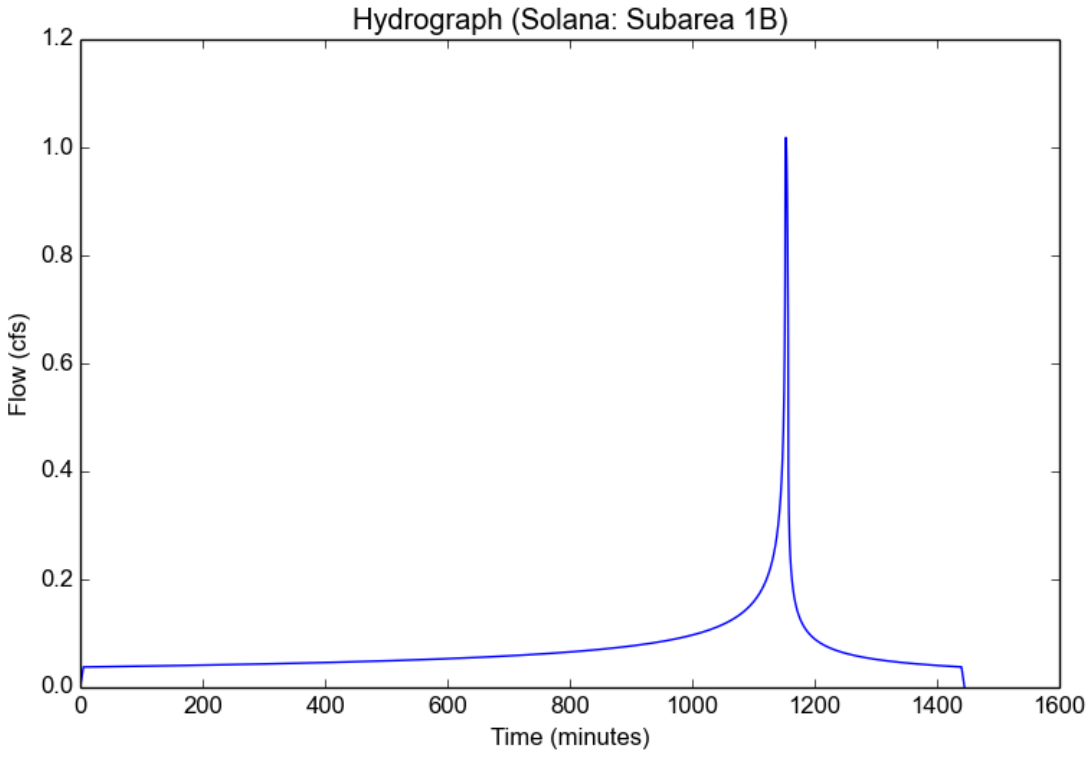
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-25 Year/Solana - Subarea 1B-25 year.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea 1B
Area (ac)	0.4
Flow Path Length (ft)	30.0
Flow Path Slope (vft/hft)	0.02
50-yr Rainfall Depth (in)	5.4
Percent Impervious	1.0
Soil Type	4
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.8287
Undeveloped Runoff Coefficient (Cu)	0.7251
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.0183
Burned Peak Flow Rate (cfs)	1.0183
24-Hr Clear Runoff Volume (ac-ft)	0.1411
24-Hr Clear Runoff Volume (cu-ft)	6144.5971



Peak Flow Hydrologic Analysis

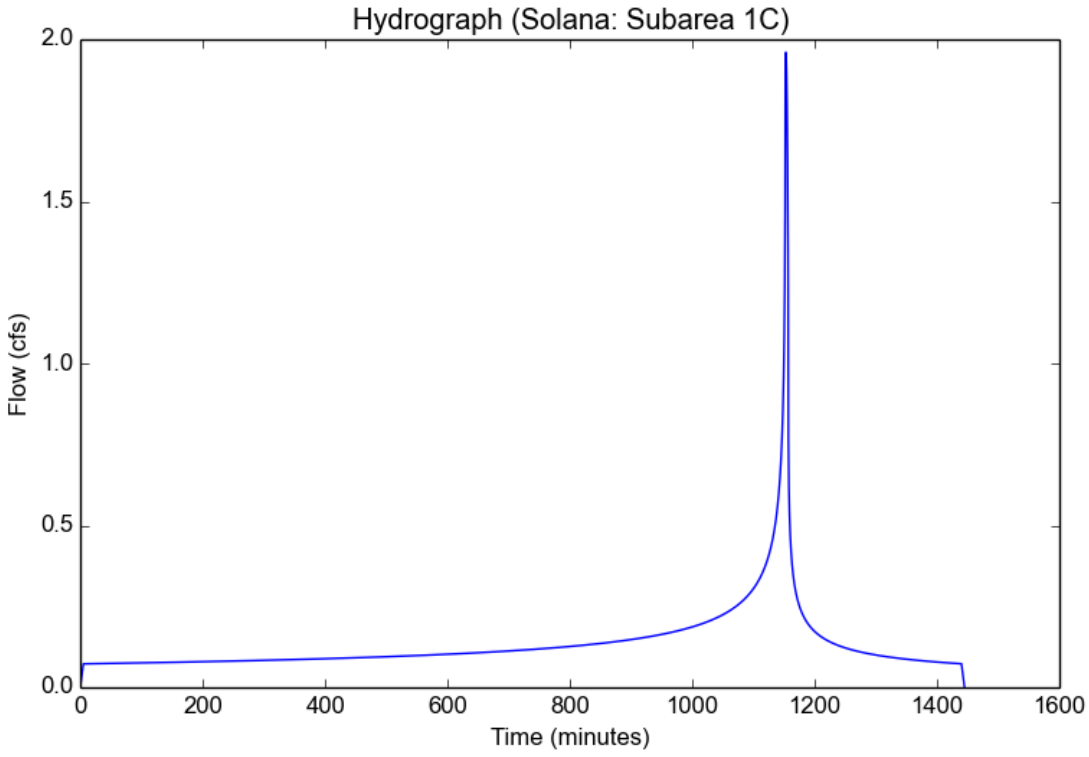
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-25 Year/Solana - Subarea 1C-25 year.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea 1C
Area (ac)	0.77
Flow Path Length (ft)	208.0
Flow Path Slope (vft/hft)	0.015
50-yr Rainfall Depth (in)	5.4
Percent Impervious	1.0
Soil Type	4
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.8287
Undeveloped Runoff Coefficient (Cu)	0.7251
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.9603
Burned Peak Flow Rate (cfs)	1.9603
24-Hr Clear Runoff Volume (ac-ft)	0.2715
24-Hr Clear Runoff Volume (cu-ft)	11828.3495



Peak Flow Hydrologic Analysis

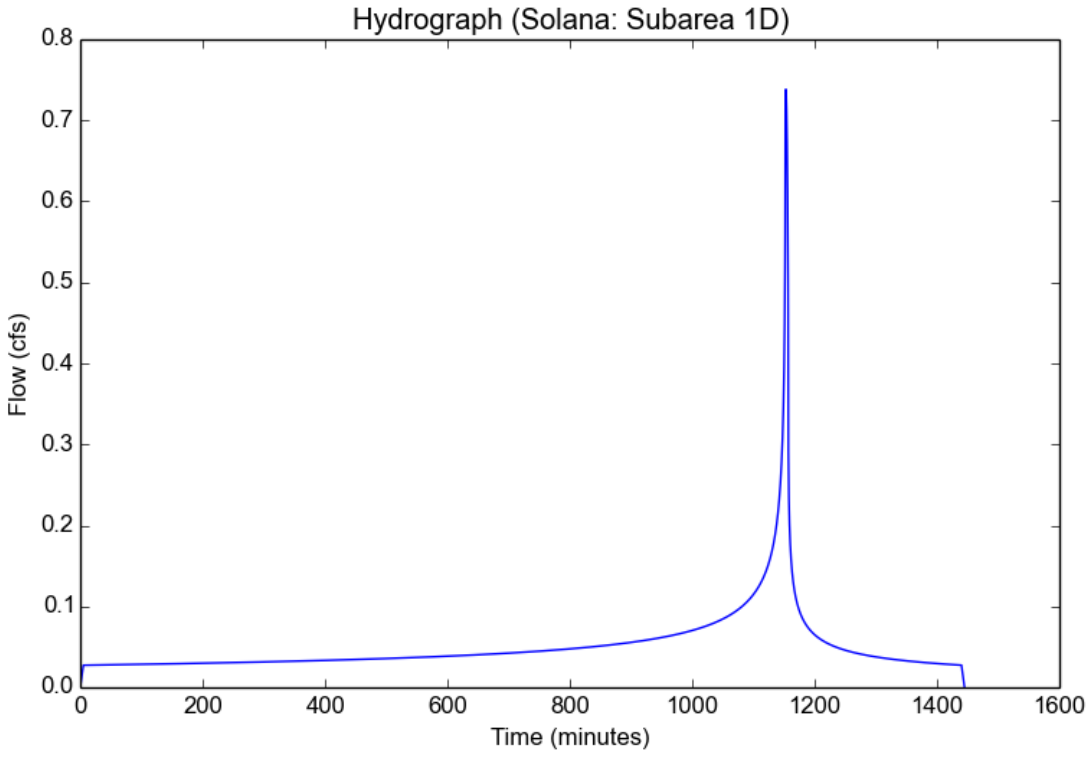
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-25 Year/Solana - Subarea 1D-25 year.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea 1D
Area (ac)	0.29
Flow Path Length (ft)	30.0
Flow Path Slope (vft/hft)	0.02
50-yr Rainfall Depth (in)	5.4
Percent Impervious	1.0
Soil Type	4
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.8287
Undeveloped Runoff Coefficient (Cu)	0.7251
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.7383
Burned Peak Flow Rate (cfs)	0.7383
24-Hr Clear Runoff Volume (ac-ft)	0.1023
24-Hr Clear Runoff Volume (cu-ft)	4454.8329



Peak Flow Hydrologic Analysis

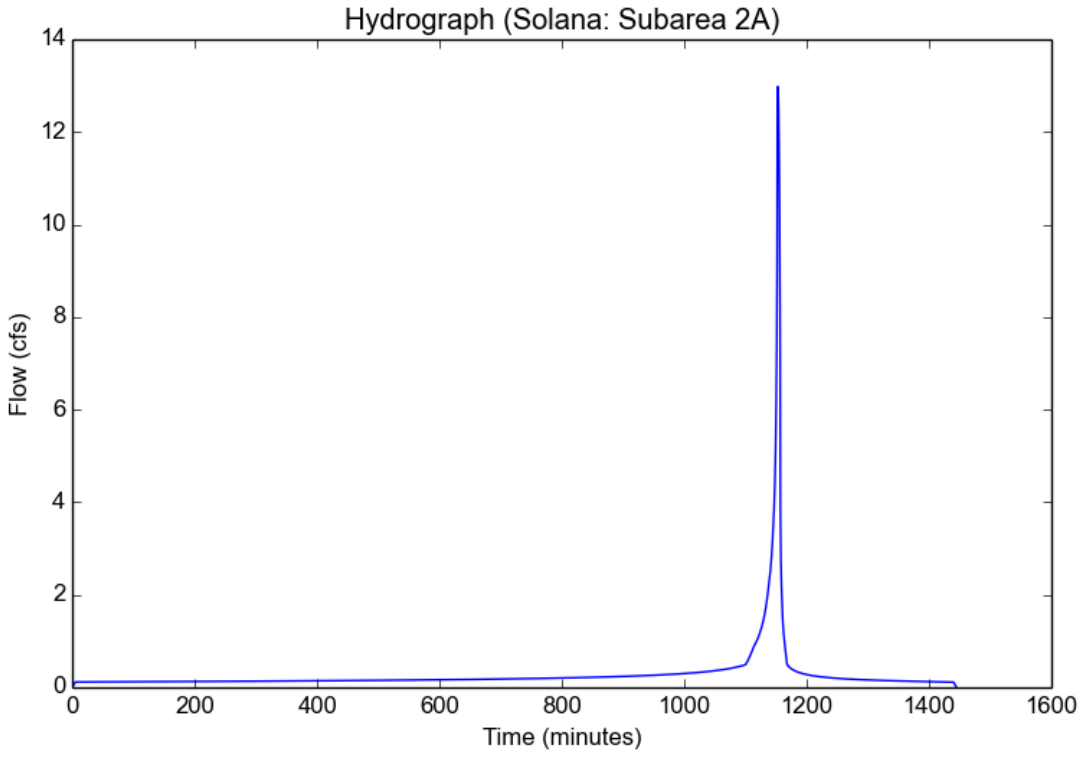
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-25 Year/Solana - Subarea 2A-25 year.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea 2A
Area (ac)	6.18
Flow Path Length (ft)	363.0
Flow Path Slope (vft/hft)	1.4
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.1
Soil Type	4
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.8287
Undeveloped Runoff Coefficient (Cu)	0.7251
Developed Runoff Coefficient (Cd)	0.7426
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	12.9817
Burned Peak Flow Rate (cfs)	12.9817
24-Hr Clear Runoff Volume (ac-ft)	0.5827
24-Hr Clear Runoff Volume (cu-ft)	25382.4344



Peak Flow Hydrologic Analysis

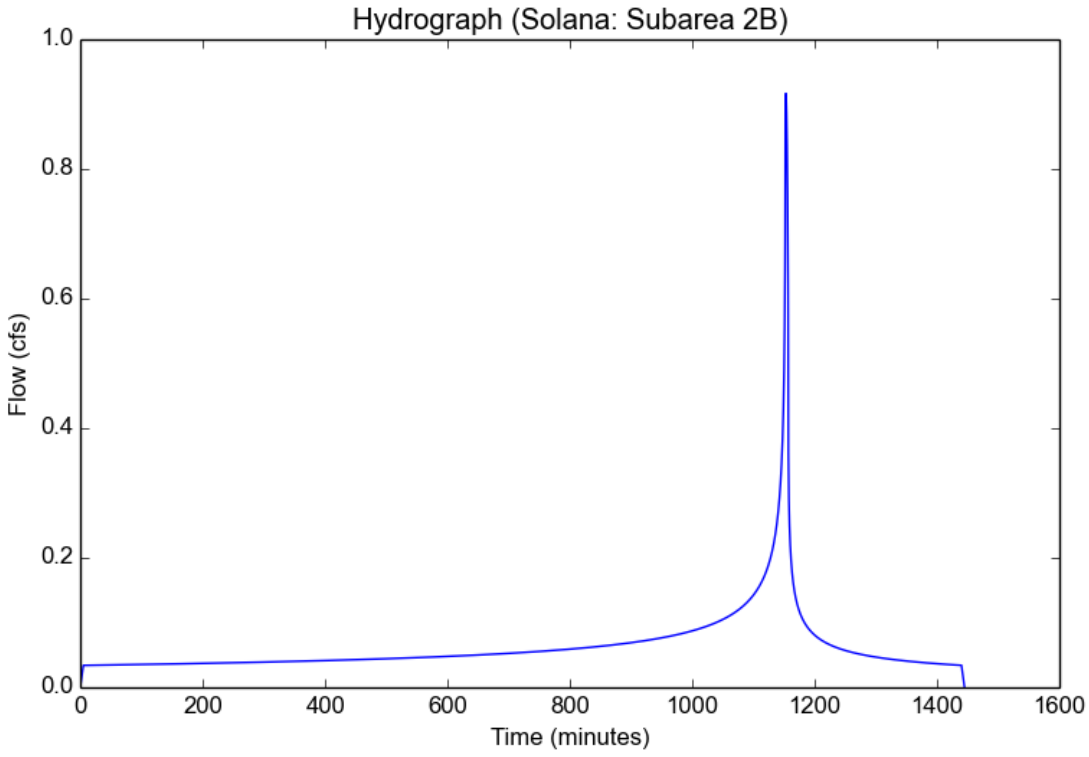
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-25 Year/Solana - Subarea 2B-25 year.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea 2B
Area (ac)	0.36
Flow Path Length (ft)	30.0
Flow Path Slope (vft/hft)	0.02
50-yr Rainfall Depth (in)	5.4
Percent Impervious	1.0
Soil Type	4
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.8287
Undeveloped Runoff Coefficient (Cu)	0.7251
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.9165
Burned Peak Flow Rate (cfs)	0.9165
24-Hr Clear Runoff Volume (ac-ft)	0.127
24-Hr Clear Runoff Volume (cu-ft)	5530.1374



Peak Flow Hydrologic Analysis

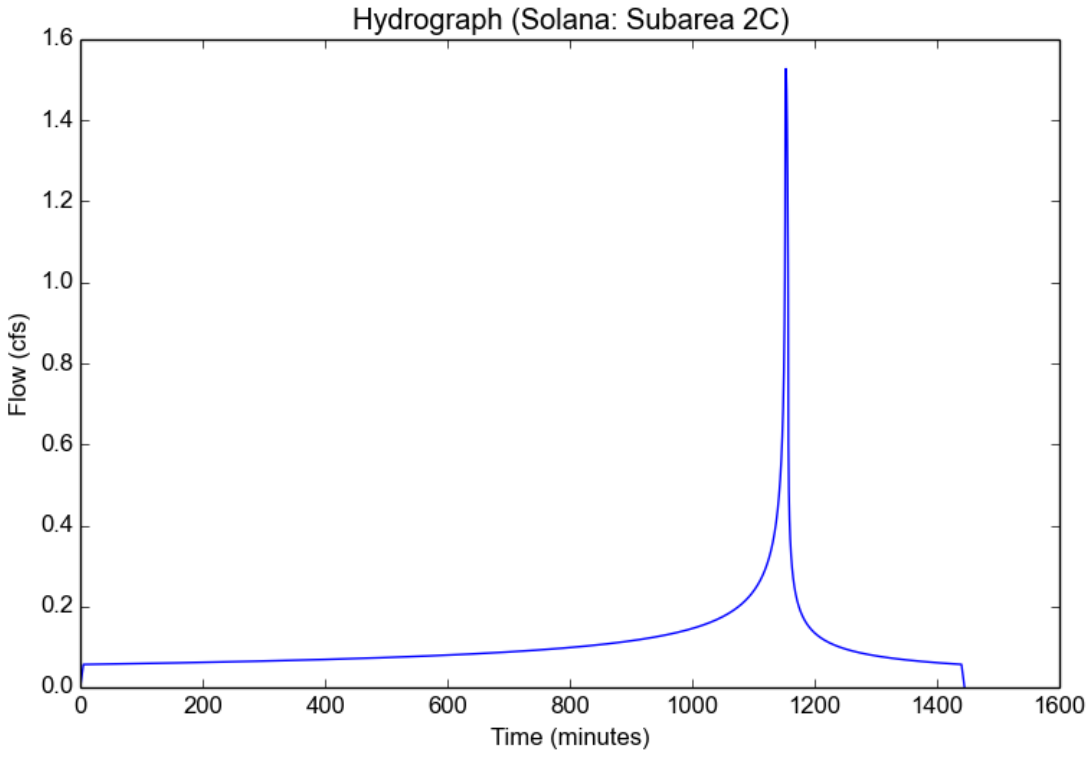
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-25 Year/Solana - Subarea 2C-25 year.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea 2C
Area (ac)	0.6
Flow Path Length (ft)	192.0
Flow Path Slope (vft/hft)	0.045
50-yr Rainfall Depth (in)	5.4
Percent Impervious	1.0
Soil Type	4
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.8287
Undeveloped Runoff Coefficient (Cu)	0.7251
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.5275
Burned Peak Flow Rate (cfs)	1.5275
24-Hr Clear Runoff Volume (ac-ft)	0.2116
24-Hr Clear Runoff Volume (cu-ft)	9216.8957



Peak Flow Hydrologic Analysis

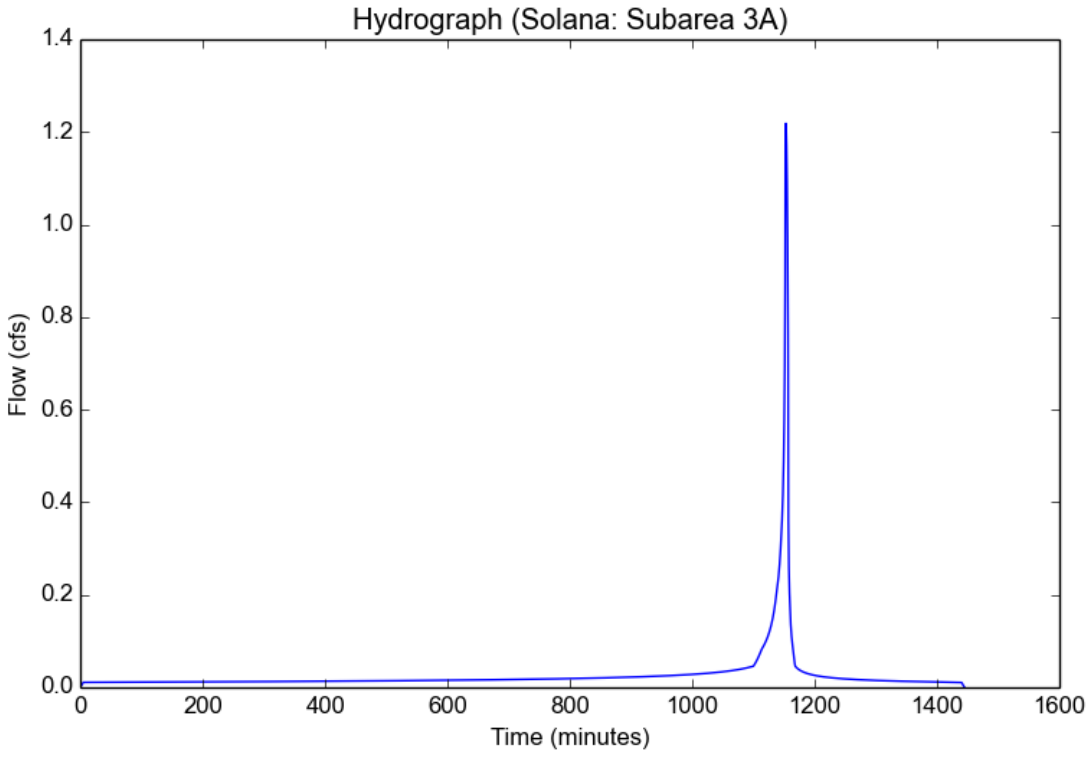
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-25 Year/Solana - Subarea 3A-25 year.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea 3A
Area (ac)	0.58
Flow Path Length (ft)	334.0
Flow Path Slope (vft/hft)	0.63
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.1
Soil Type	4
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.8287
Undeveloped Runoff Coefficient (Cu)	0.7251
Developed Runoff Coefficient (Cd)	0.7426
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.2183
Burned Peak Flow Rate (cfs)	1.2183
24-Hr Clear Runoff Volume (ac-ft)	0.0547
24-Hr Clear Runoff Volume (cu-ft)	2382.1702



Peak Flow Hydrologic Analysis

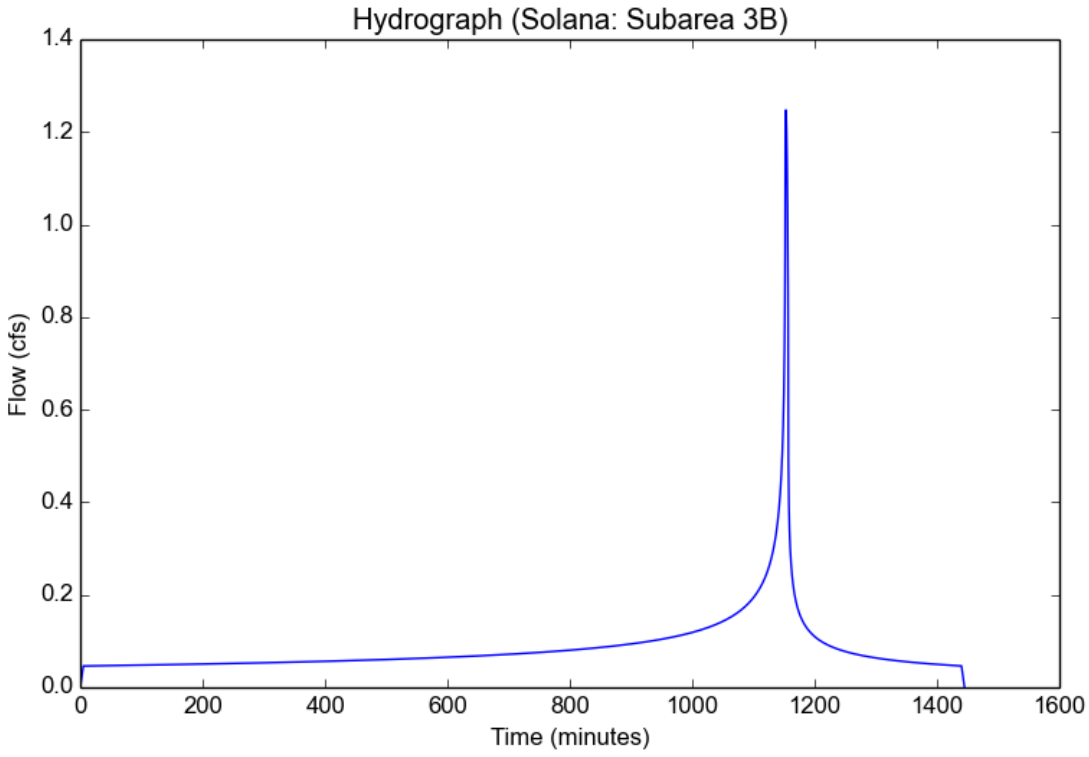
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-25 Year/Solana - Subarea 3B-25 year.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea 3B
Area (ac)	0.49
Flow Path Length (ft)	30.0
Flow Path Slope (vft/hft)	0.02
50-yr Rainfall Depth (in)	5.4
Percent Impervious	1.0
Soil Type	4
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.8287
Undeveloped Runoff Coefficient (Cu)	0.7251
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.2475
Burned Peak Flow Rate (cfs)	1.2475
24-Hr Clear Runoff Volume (ac-ft)	0.1728
24-Hr Clear Runoff Volume (cu-ft)	7527.1315



Peak Flow Hydrologic Analysis

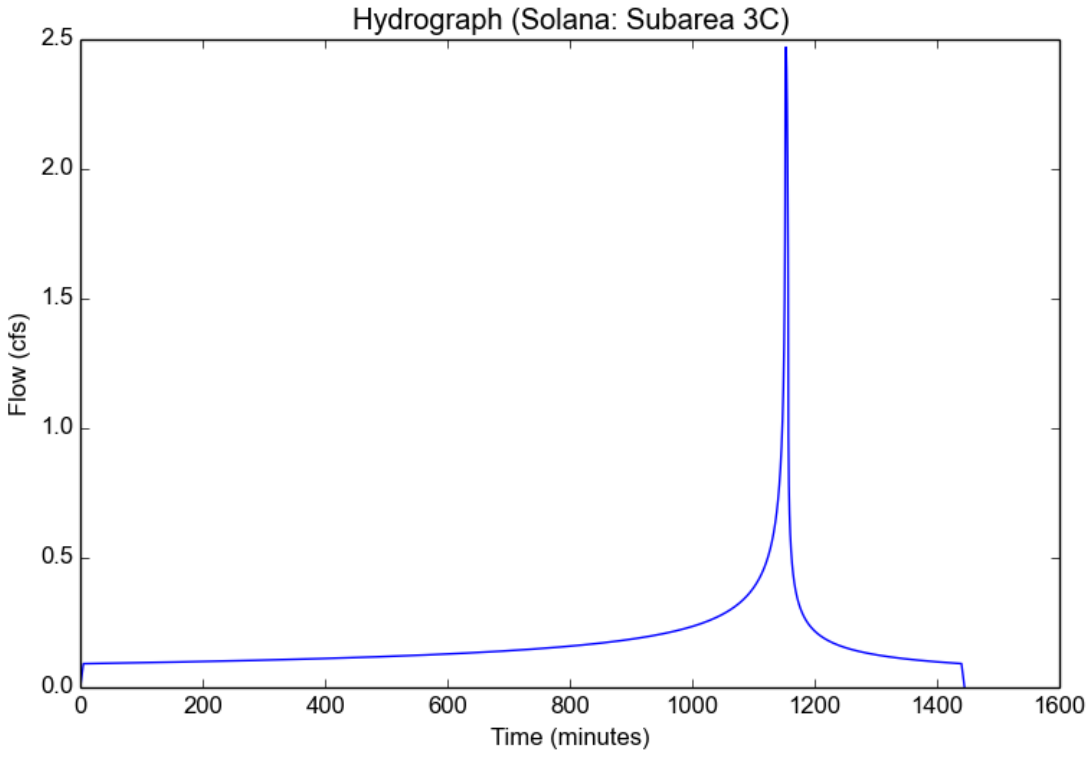
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-25 Year/Solana - Subarea 3C-25 year.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea 3C
Area (ac)	0.97
Flow Path Length (ft)	254.0
Flow Path Slope (vft/hft)	0.011
50-yr Rainfall Depth (in)	5.4
Percent Impervious	1.0
Soil Type	4
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.8287
Undeveloped Runoff Coefficient (Cu)	0.7251
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	2.4695
Burned Peak Flow Rate (cfs)	2.4695
24-Hr Clear Runoff Volume (ac-ft)	0.3421
24-Hr Clear Runoff Volume (cu-ft)	14900.648



Peak Flow Hydrologic Analysis

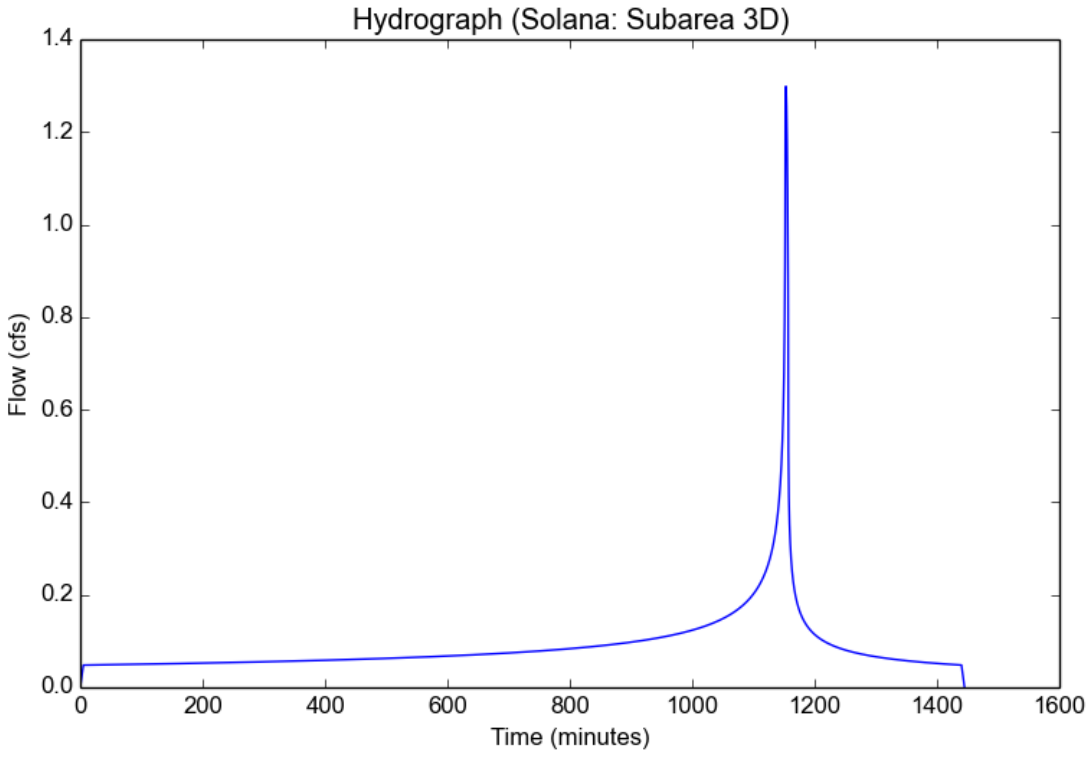
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-25 Year/Solana - Subarea 3D-25 year.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea 3D
Area (ac)	0.51
Flow Path Length (ft)	30.0
Flow Path Slope (vft/hft)	0.02
50-yr Rainfall Depth (in)	5.4
Percent Impervious	1.0
Soil Type	4
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.8287
Undeveloped Runoff Coefficient (Cu)	0.7251
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.2984
Burned Peak Flow Rate (cfs)	1.2984
24-Hr Clear Runoff Volume (ac-ft)	0.1799
24-Hr Clear Runoff Volume (cu-ft)	7834.3613



Peak Flow Hydrologic Analysis

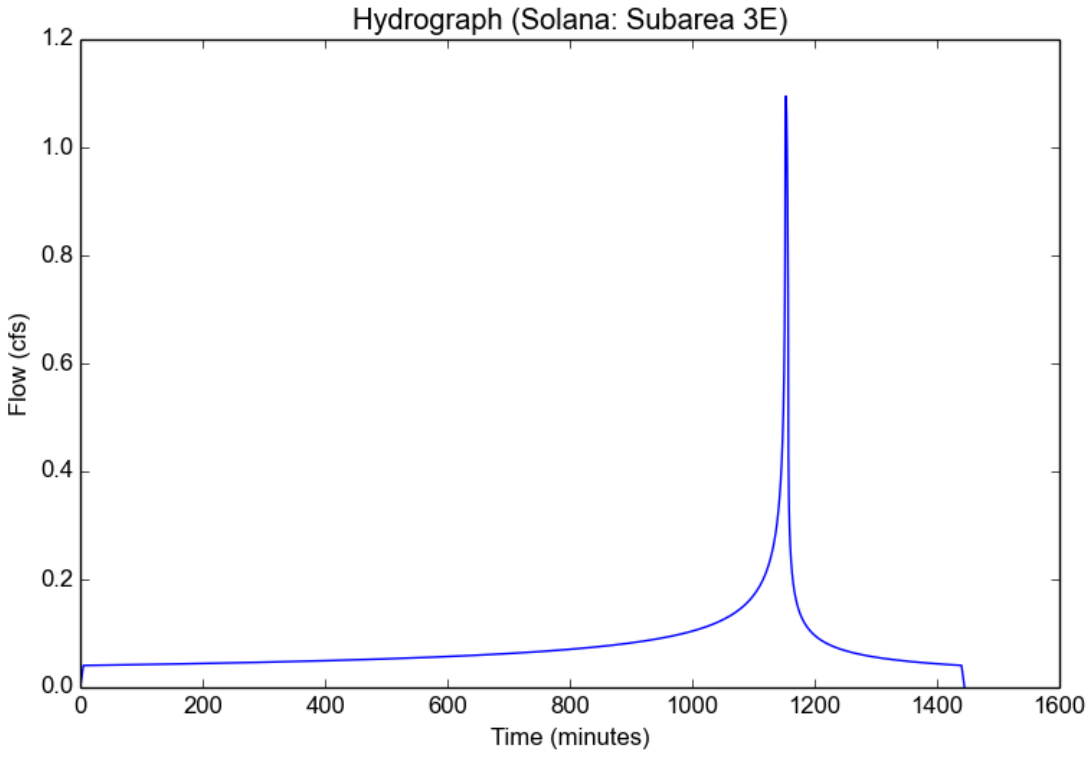
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-25 Year/Solana - Subarea 3E-25 year.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea 3E
Area (ac)	0.43
Flow Path Length (ft)	30.0
Flow Path Slope (vft/hft)	0.02
50-yr Rainfall Depth (in)	5.4
Percent Impervious	1.0
Soil Type	4
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.8287
Undeveloped Runoff Coefficient (Cu)	0.7251
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.0947
Burned Peak Flow Rate (cfs)	1.0947
24-Hr Clear Runoff Volume (ac-ft)	0.1516
24-Hr Clear Runoff Volume (cu-ft)	6605.4419



Peak Flow Hydrologic Analysis

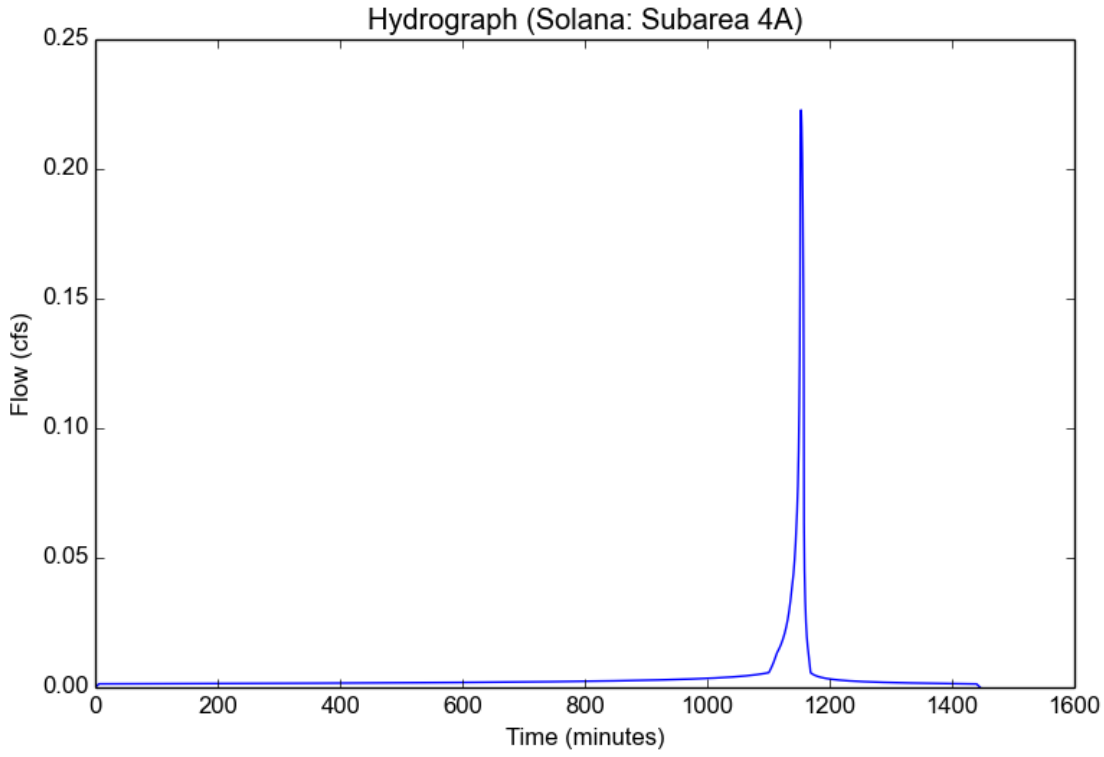
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-25 Year/Solana - Subarea 4A-25 year-updated.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea 4A
Area (ac)	0.12
Flow Path Length (ft)	821.76
Flow Path Slope (vft/hft)	0.57
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	4
Design Storm Frequency	25-yr
Fire Factor	0
LID	False

Output Results

Modeled (25-yr) Rainfall Depth (in)	4.7412
Peak Intensity (in/hr)	2.5964
Undeveloped Runoff Coefficient (Cu)	0.7131
Developed Runoff Coefficient (Cd)	0.7149
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	0.2228
Burned Peak Flow Rate (cfs)	0.2228
24-Hr Clear Runoff Volume (ac-ft)	0.0082
24-Hr Clear Runoff Volume (cu-ft)	357.6452



Peak Flow Hydrologic Analysis

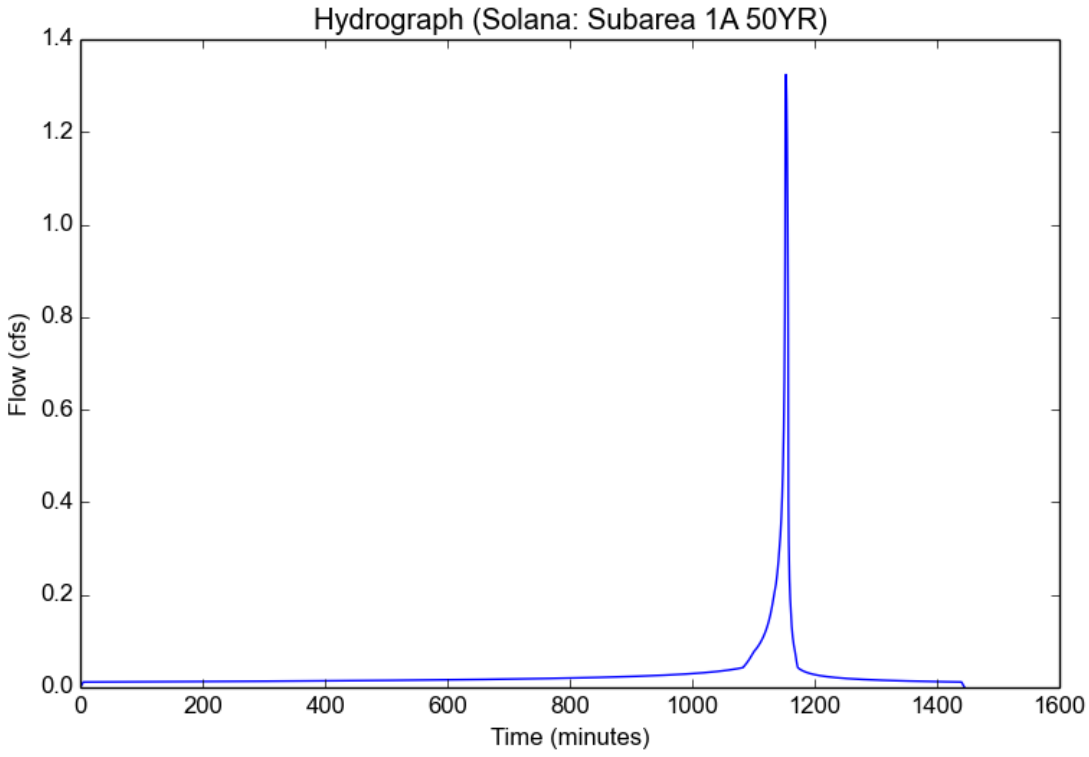
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/LID/Solana - Subarea 1A 50YR.pdf
Version: HydroCalc 0.2.0-beta

Input Parameters

Project Name	Solana
Subarea ID	Subarea 1A 50YR
Area (ac)	0.54
Flow Path Length (ft)	340.0
Flow Path Slope (vft/hft)	0.32
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.1
Soil Type	4
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.7455
Developed Runoff Coefficient (Cd)	0.7609
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.3238
Burned Peak Flow Rate (cfs)	1.3238
24-Hr Clear Runoff Volume (ac-ft)	0.0603
24-Hr Clear Runoff Volume (cu-ft)	2628.2864



Peak Flow Hydrologic Analysis

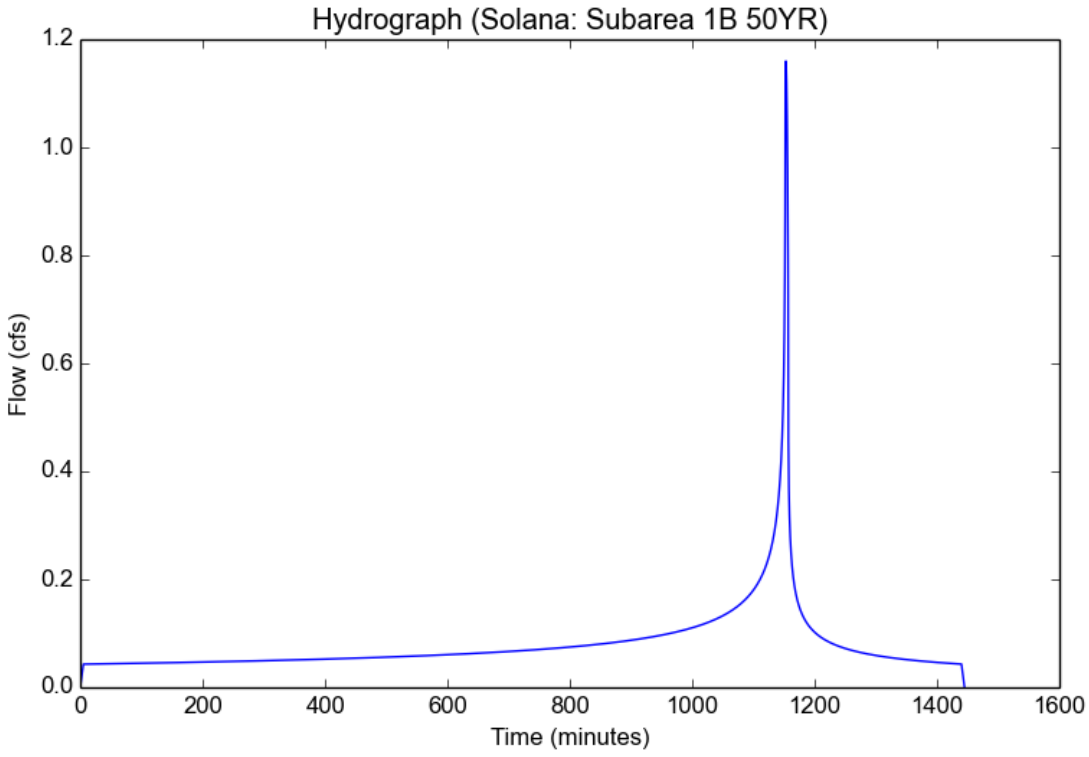
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/LID/Solana - Subarea 1B 50YR.pdf
Version: HydroCalc 0.2.0-beta

Input Parameters

Project Name	Solana
Subarea ID	Subarea 1B 50YR
Area (ac)	0.4
Flow Path Length (ft)	30.0
Flow Path Slope (vft/hft)	0.02
50-yr Rainfall Depth (in)	5.4
Percent Impervious	1.0
Soil Type	4
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.7455
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.1598
Burned Peak Flow Rate (cfs)	1.1598
24-Hr Clear Runoff Volume (ac-ft)	0.1607
24-Hr Clear Runoff Volume (cu-ft)	6998.4022



Peak Flow Hydrologic Analysis

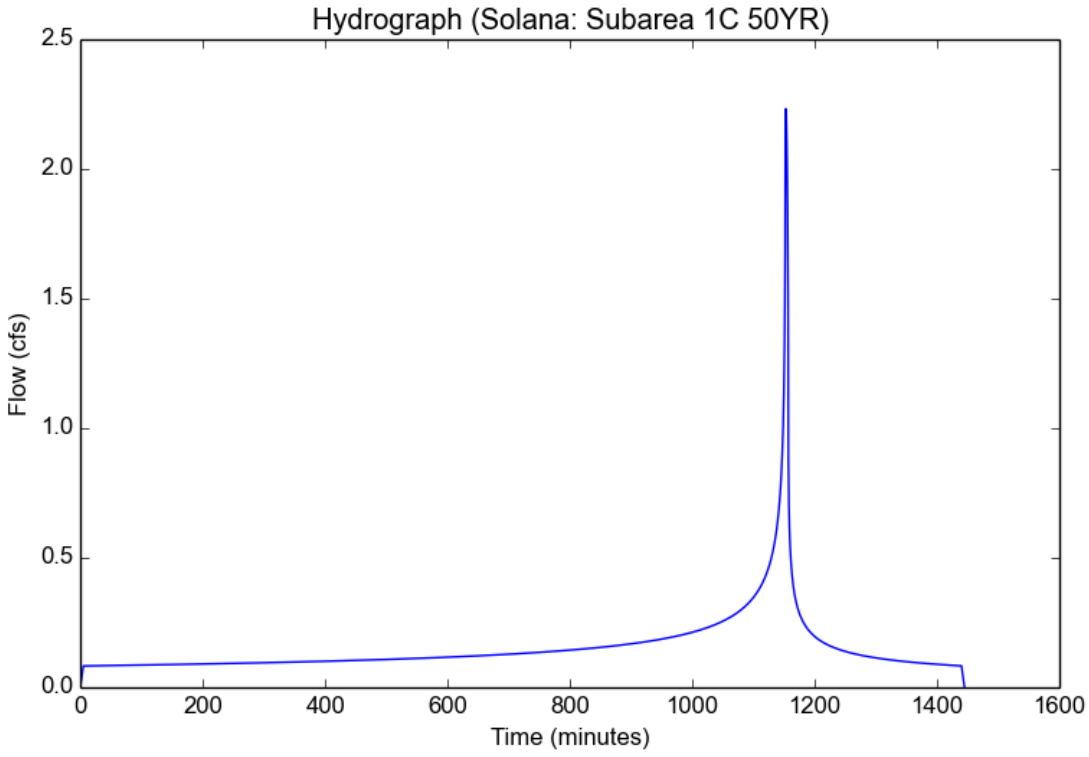
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/LID/Solana - Subarea 1C 50YR.pdf
Version: HydroCalc 0.2.0-beta

Input Parameters

Project Name	Solana
Subarea ID	Subarea 1C 50YR
Area (ac)	0.77
Flow Path Length (ft)	208.0
Flow Path Slope (vft/hft)	0.015
50-yr Rainfall Depth (in)	5.4
Percent Impervious	1.0
Soil Type	4
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.7455
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	2.2327
Burned Peak Flow Rate (cfs)	2.2327
24-Hr Clear Runoff Volume (ac-ft)	0.3093
24-Hr Clear Runoff Volume (cu-ft)	13471.9242



Peak Flow Hydrologic Analysis

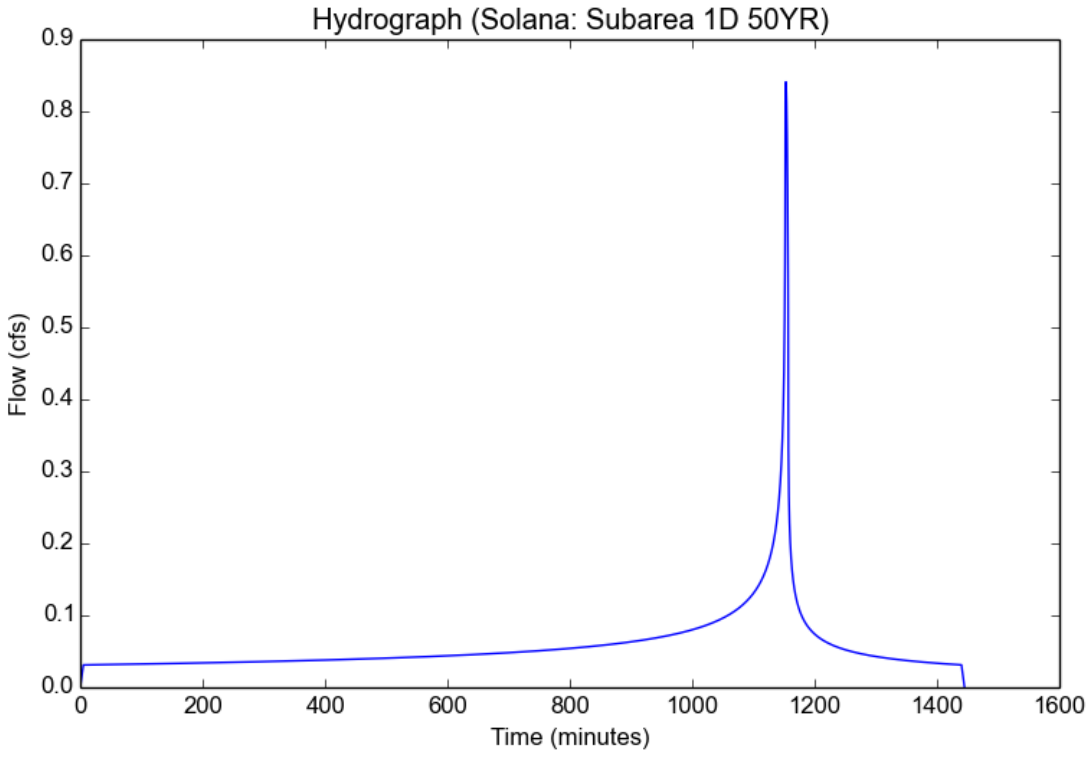
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/LID/Solana - Subarea 1D 50YR.pdf
Version: HydroCalc 0.2.0-beta

Input Parameters

Project Name	Solana
Subarea ID	Subarea 1D 50YR
Area (ac)	0.29
Flow Path Length (ft)	30.0
Flow Path Slope (vft/hft)	0.02
50-yr Rainfall Depth (in)	5.4
Percent Impervious	1.0
Soil Type	4
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.7455
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	0.8409
Burned Peak Flow Rate (cfs)	0.8409
24-Hr Clear Runoff Volume (ac-ft)	0.1165
24-Hr Clear Runoff Volume (cu-ft)	5073.8416



Peak Flow Hydrologic Analysis

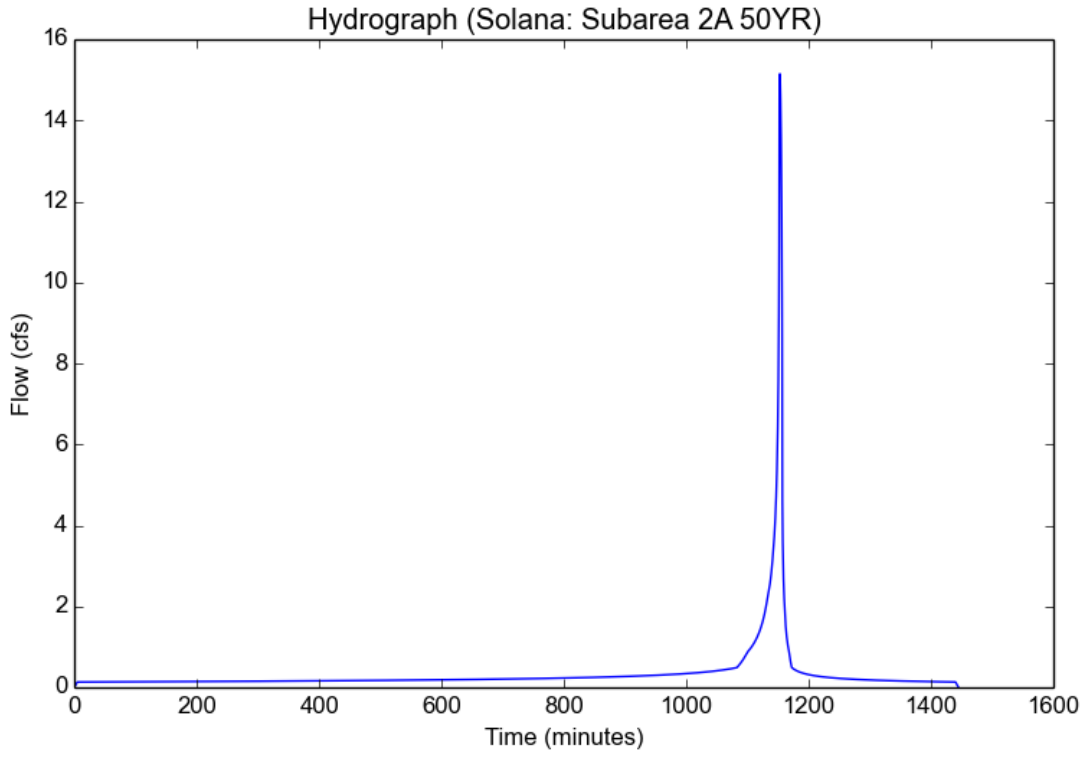
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/LID/Solana - Subarea 2A 50YR.pdf
Version: HydroCalc 0.2.0-beta

Input Parameters

Project Name	Solana
Subarea ID	Subarea 2A 50YR
Area (ac)	6.18
Flow Path Length (ft)	363.0
Flow Path Slope (vft/hft)	1.4
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.1
Soil Type	4
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.7455
Developed Runoff Coefficient (Cd)	0.7609
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	15.1507
Burned Peak Flow Rate (cfs)	15.1507
24-Hr Clear Runoff Volume (ac-ft)	0.6905
24-Hr Clear Runoff Volume (cu-ft)	30079.2773



Peak Flow Hydrologic Analysis

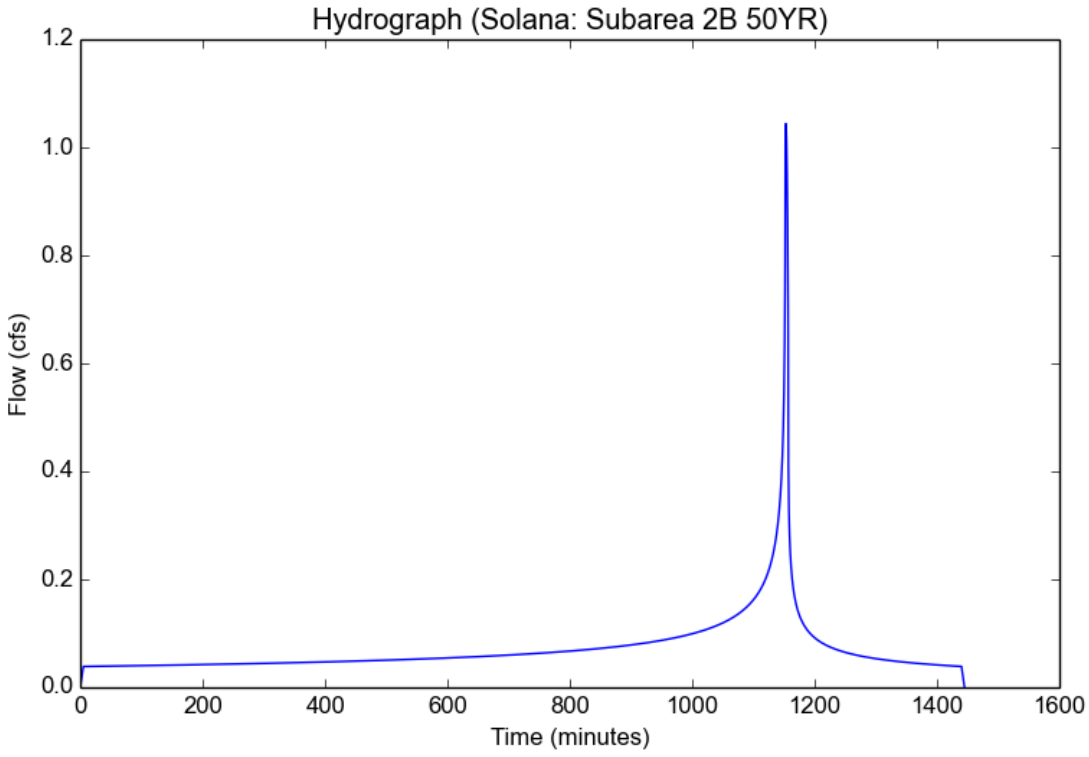
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/LID/Solana - Subarea 2B 50YR.pdf
Version: HydroCalc 0.2.0-beta

Input Parameters

Project Name	Solana
Subarea ID	Subarea 2B 50YR
Area (ac)	0.36
Flow Path Length (ft)	30.0
Flow Path Slope (vft/hft)	0.02
50-yr Rainfall Depth (in)	5.4
Percent Impervious	1.0
Soil Type	4
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.7455
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.0439
Burned Peak Flow Rate (cfs)	1.0439
24-Hr Clear Runoff Volume (ac-ft)	0.1446
24-Hr Clear Runoff Volume (cu-ft)	6298.562



Peak Flow Hydrologic Analysis

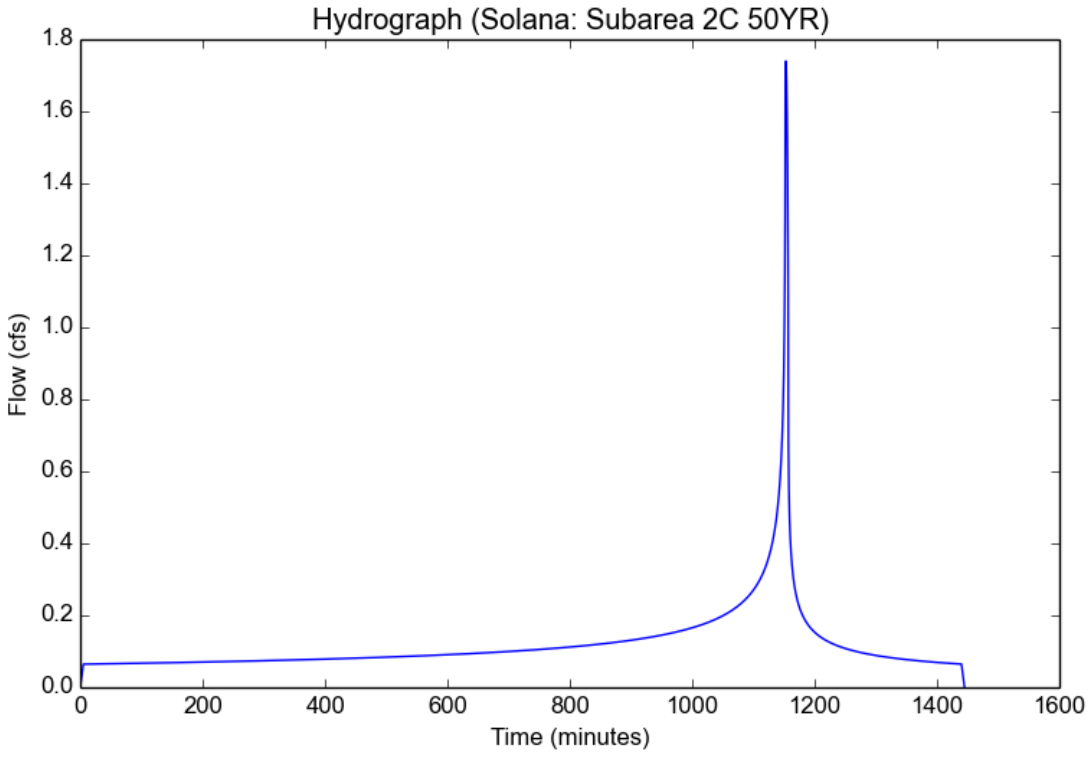
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/LID/Solana - Subarea 2C 50YR.pdf
Version: HydroCalc 0.2.0-beta

Input Parameters

Project Name	Solana
Subarea ID	Subarea 2C 50YR
Area (ac)	0.6
Flow Path Length (ft)	192.0
Flow Path Slope (vft/hft)	0.045
50-yr Rainfall Depth (in)	5.4
Percent Impervious	1.0
Soil Type	4
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.7455
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.7398
Burned Peak Flow Rate (cfs)	1.7398
24-Hr Clear Runoff Volume (ac-ft)	0.241
24-Hr Clear Runoff Volume (cu-ft)	10497.6033



Peak Flow Hydrologic Analysis

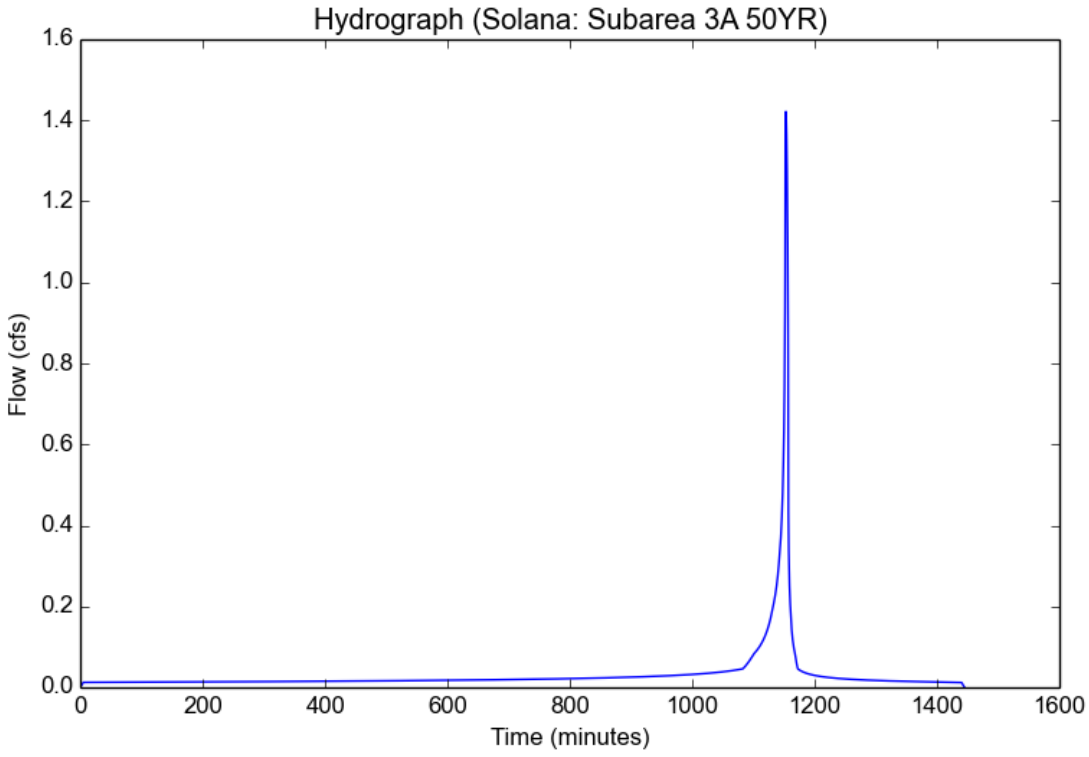
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/LID/Solana - Subarea 3A 50YR.pdf
Version: HydroCalc 0.2.0-beta

Input Parameters

Project Name	Solana
Subarea ID	Subarea 3A 50YR
Area (ac)	0.58
Flow Path Length (ft)	334.0
Flow Path Slope (vft/hft)	0.63
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.1
Soil Type	4
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.7455
Developed Runoff Coefficient (Cd)	0.7609
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.4219
Burned Peak Flow Rate (cfs)	1.4219
24-Hr Clear Runoff Volume (ac-ft)	0.0648
24-Hr Clear Runoff Volume (cu-ft)	2822.9742



Peak Flow Hydrologic Analysis

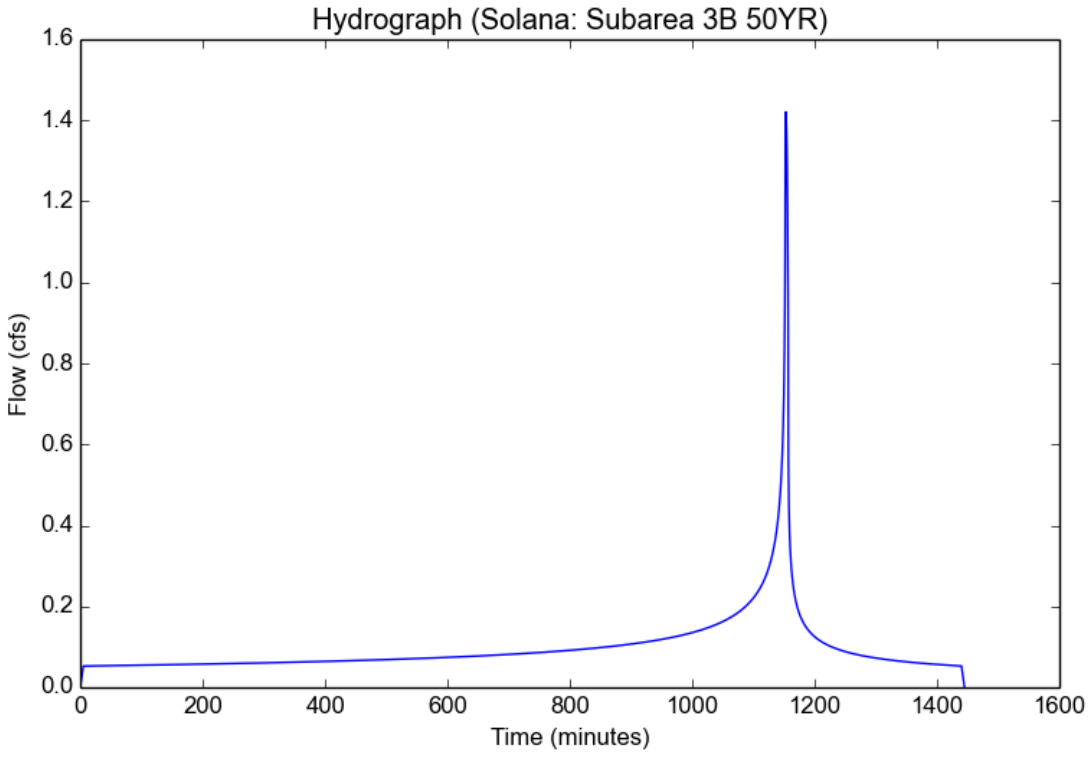
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/LID/Solana - Subarea 3B 50YR.pdf
Version: HydroCalc 0.2.0-beta

Input Parameters

Project Name	Solana
Subarea ID	Subarea 3B 50YR
Area (ac)	0.49
Flow Path Length (ft)	30.0
Flow Path Slope (vft/hft)	0.02
50-yr Rainfall Depth (in)	5.4
Percent Impervious	1.0
Soil Type	4
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.7455
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.4208
Burned Peak Flow Rate (cfs)	1.4208
24-Hr Clear Runoff Volume (ac-ft)	0.1968
24-Hr Clear Runoff Volume (cu-ft)	8573.0427



Peak Flow Hydrologic Analysis

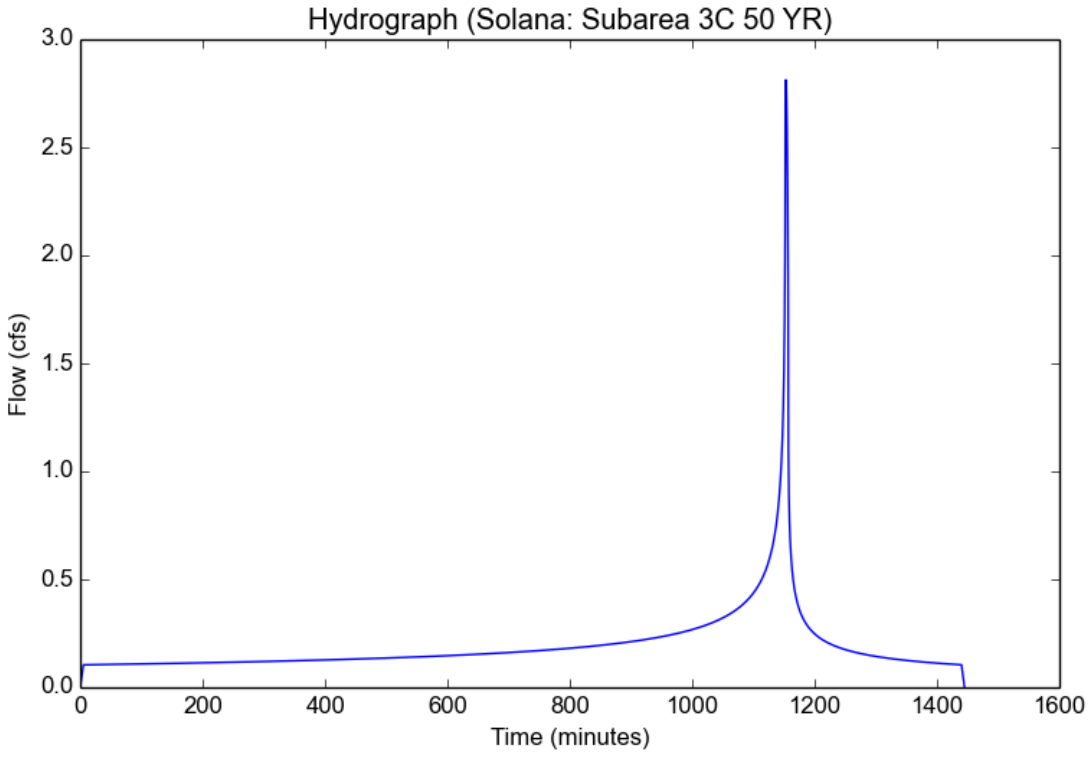
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-50 Year/Solana - Subarea 3C 50YR-updated.pdf
Version: HydroCalc 0.3.1

Input Parameters

Project Name	Solana
Subarea ID	Subarea 3C 50 YR
Area (ac)	0.97
Flow Path Length (ft)	254.0
Flow Path Slope (vft/hft)	0.011
50-yr Rainfall Depth (in)	5.4
Percent Impervious	1.0
Soil Type	4
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.7455
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	2.8126
Burned Peak Flow Rate (cfs)	2.8126
24-Hr Clear Runoff Volume (ac-ft)	0.3896
24-Hr Clear Runoff Volume (cu-ft)	16971.1253



Peak Flow Hydrologic Analysis

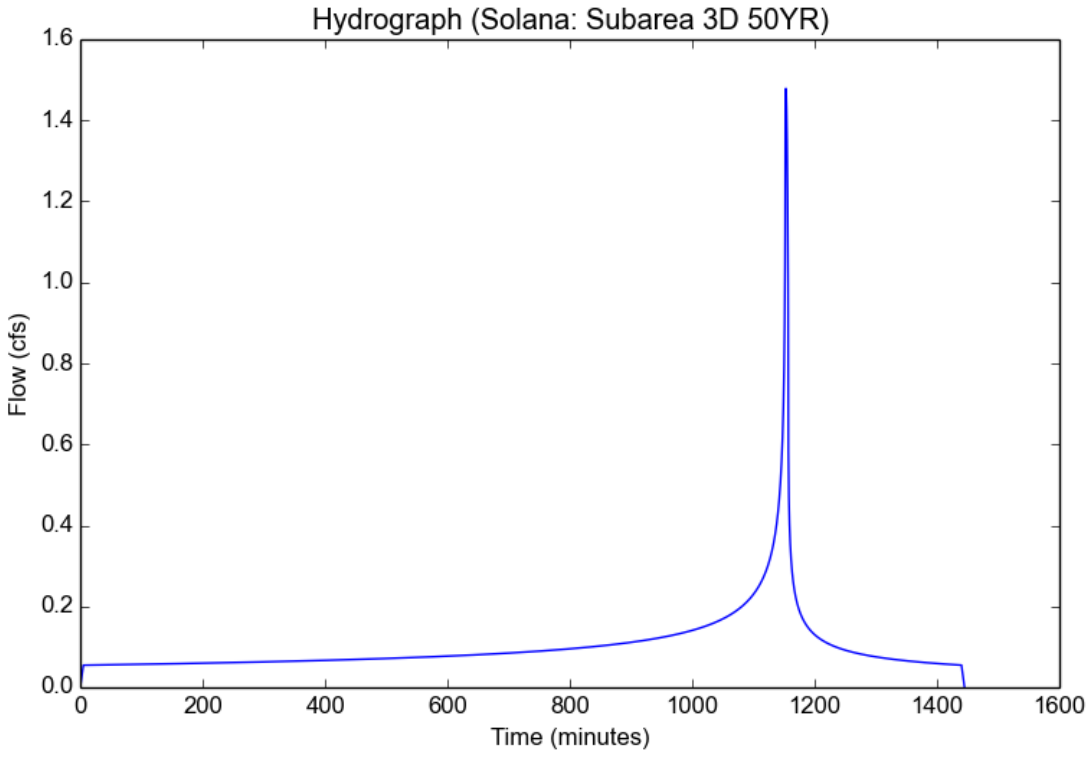
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/LID/Solana - Subarea 3D 50YR.pdf
Version: HydroCalc 0.2.0-beta

Input Parameters

Project Name	Solana
Subarea ID	Subarea 3D 50YR
Area (ac)	0.51
Flow Path Length (ft)	30.0
Flow Path Slope (vft/hft)	0.02
50-yr Rainfall Depth (in)	5.4
Percent Impervious	1.0
Soil Type	4
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.7455
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.4788
Burned Peak Flow Rate (cfs)	1.4788
24-Hr Clear Runoff Volume (ac-ft)	0.2048
24-Hr Clear Runoff Volume (cu-ft)	8922.9628



Peak Flow Hydrologic Analysis

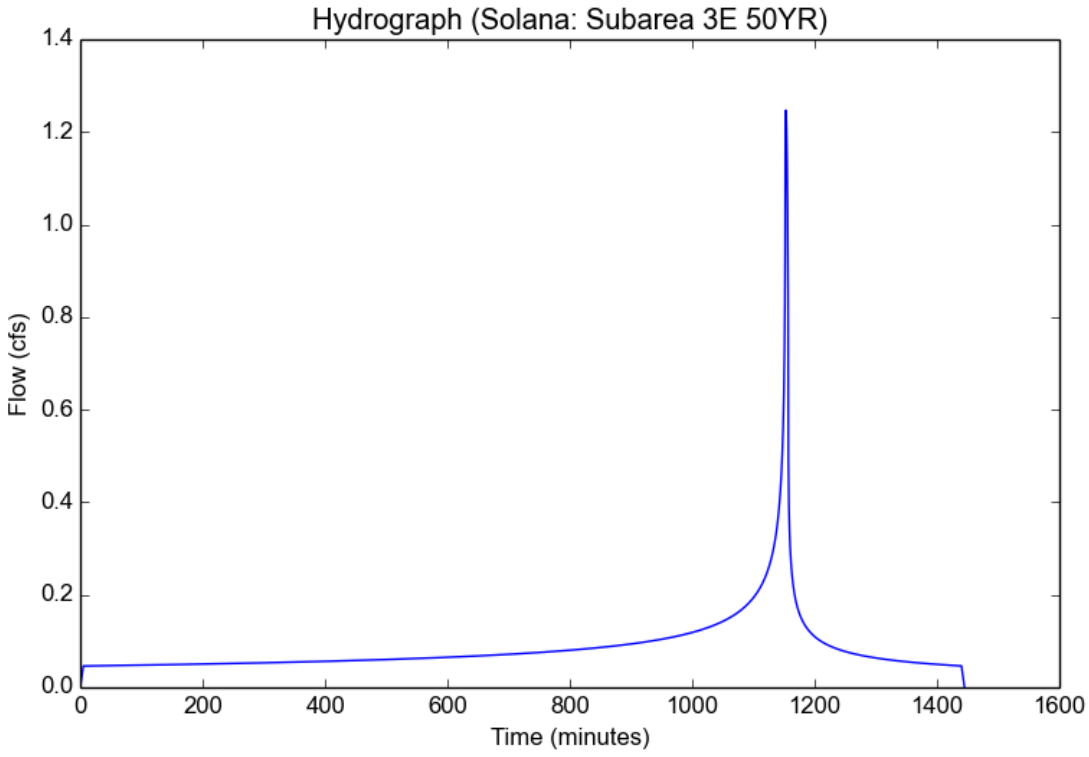
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/LID/Solana - Subarea 3E 50YR.pdf
Version: HydroCalc 0.2.0-beta

Input Parameters

Project Name	Solana
Subarea ID	Subarea 3E 50YR
Area (ac)	0.43
Flow Path Length (ft)	30.0
Flow Path Slope (vft/hft)	0.02
50-yr Rainfall Depth (in)	5.4
Percent Impervious	1.0
Soil Type	4
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	3.2218
Undeveloped Runoff Coefficient (Cu)	0.7455
Developed Runoff Coefficient (Cd)	0.9
Time of Concentration (min)	5.0
Clear Peak Flow Rate (cfs)	1.2468
Burned Peak Flow Rate (cfs)	1.2468
24-Hr Clear Runoff Volume (ac-ft)	0.1727
24-Hr Clear Runoff Volume (cu-ft)	7523.2824



Peak Flow Hydrologic Analysis

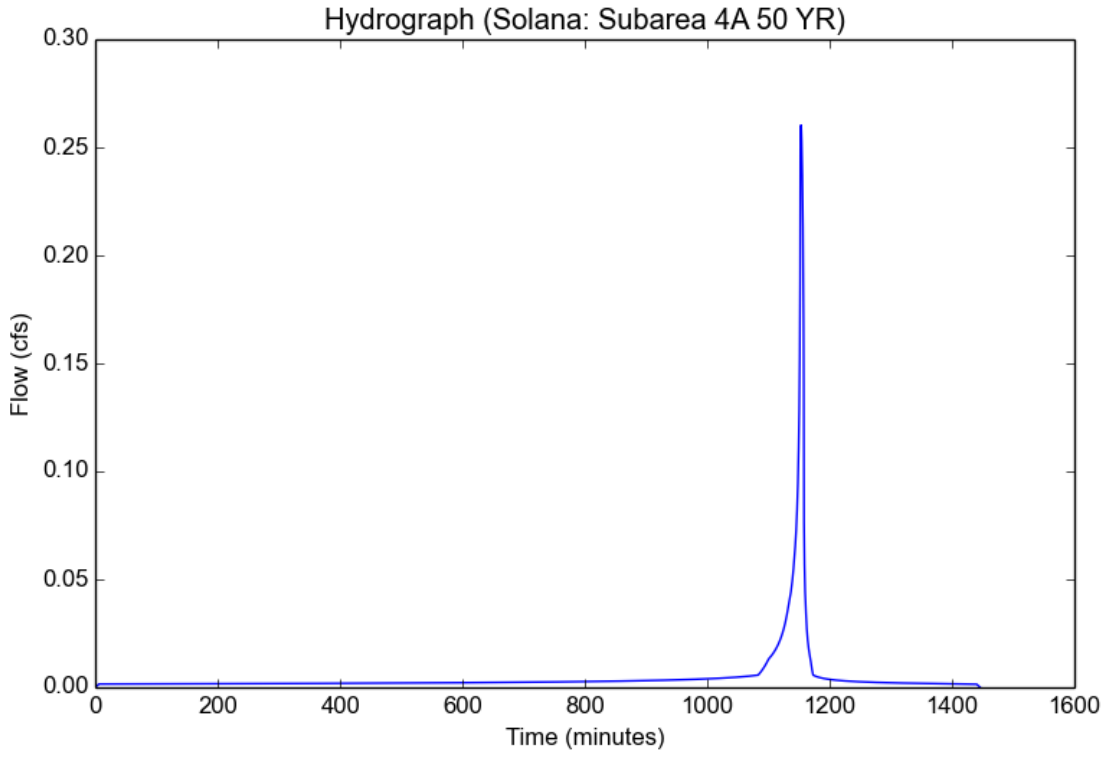
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/Drainage Study/Calculations/Solana-50 Year/Solana - Subarea 4A 50YR-updated.pdf
Version: HydroCalc 0.3.1

Input Parameters

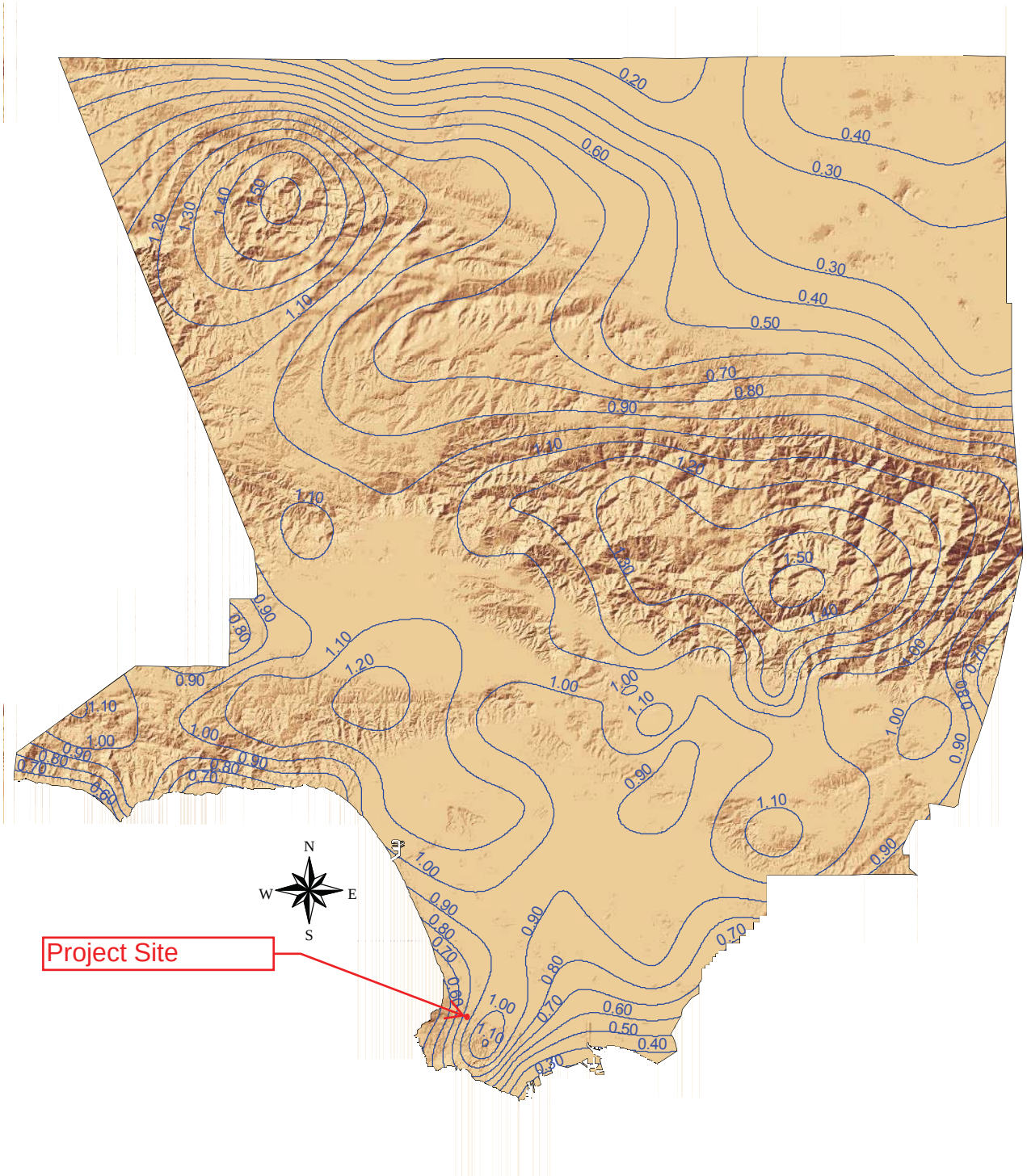
Project Name	Solana
Subarea ID	Subarea 4A 50 YR
Area (ac)	0.12
Flow Path Length (ft)	821.76
Flow Path Slope (vft/hft)	0.57
50-yr Rainfall Depth (in)	5.4
Percent Impervious	0.01
Soil Type	4
Design Storm Frequency	50-yr
Fire Factor	0
LID	False

Output Results

Modeled (50-yr) Rainfall Depth (in)	5.4
Peak Intensity (in/hr)	2.9572
Undeveloped Runoff Coefficient (Cu)	0.7318
Developed Runoff Coefficient (Cd)	0.7334
Time of Concentration (min)	6.0
Clear Peak Flow Rate (cfs)	0.2603
Burned Peak Flow Rate (cfs)	0.2603
24-Hr Clear Runoff Volume (ac-ft)	0.0099
24-Hr Clear Runoff Volume (cu-ft)	432.2331



85th Percentile 24-hr Rainfall Isohyetal Map



10 0 10 20 30 40 Miles

85th Percentile 24-hr Rainfall Depth

Peak Flow Hydrologic Analysis

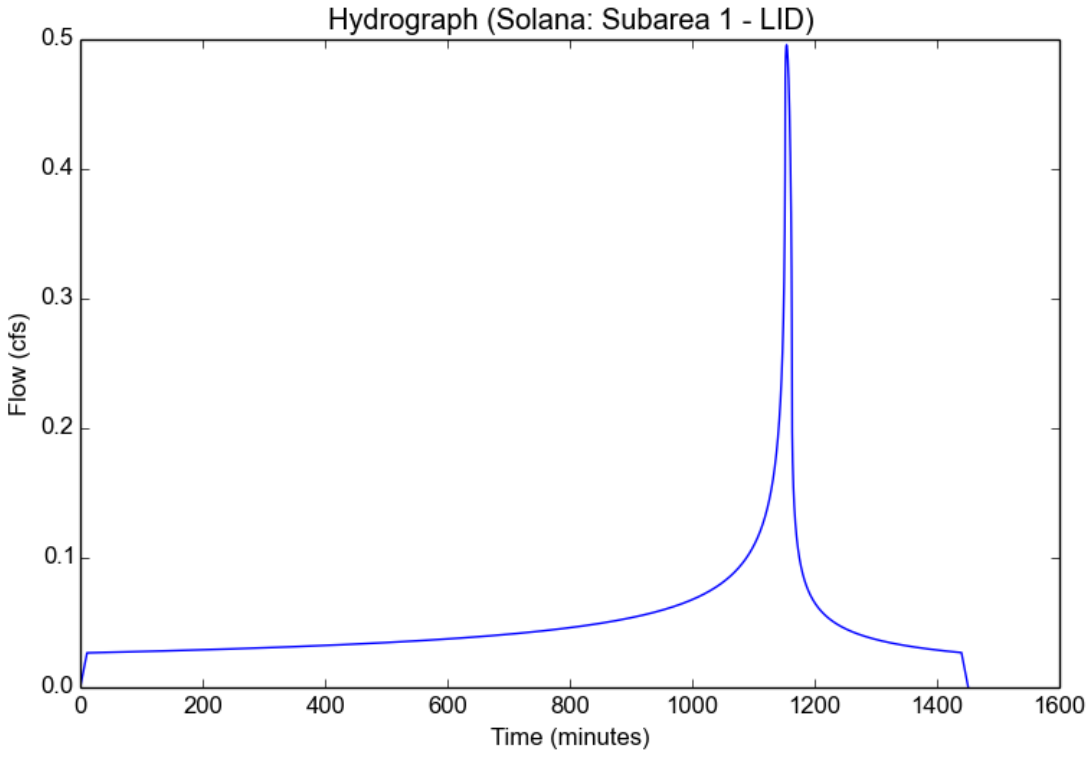
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/LID/Calculations/Solana - Subarea 1 - LID.pdf
Version: HydroCalc 0.2.0-beta

Input Parameters

Project Name	Solana
Subarea ID	Subarea 1 - LID
Area (ac)	2.0
Flow Path Length (ft)	183.0
Flow Path Slope (vft/hft)	0.1
85th Percentile Rainfall Depth (in)	0.85
Percent Impervious	0.76
Soil Type	4
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.85
Peak Intensity (in/hr)	0.3501
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.708
Time of Concentration (min)	11.0
Clear Peak Flow Rate (cfs)	0.4957
Burned Peak Flow Rate (cfs)	0.4957
24-Hr Clear Runoff Volume (ac-ft)	0.0995
24-Hr Clear Runoff Volume (cu-ft)	4332.9666



LID CALCULATIONS CMP INFILTRATION:

Subarea 1-Infiltration Tank 1

$K_{sat,measured}$:	93.70	in/hr	
CMP Diameter:	8.00	feet	
CMP_{Length}:	59	linear feet	
G_{depth} (Porous Stone):	8.50	feet	
G_{width} (Porous Stone):	12.00	feet	
G_{length} (Porous Stone):	63	feet	
T (Max. Drawdown Time):	24	hr	1,440 min
V_{design} (CF) :	From HydroCalc		
V_{design} (CF) :	4,333	C.F.	
Reduction Factor (RF):	5.20	unitless	
Safety Factor (SF):	3.00	unitless	

Determine $K_{sat,design}$

$K_{sat,design} = K_{sat,measured} / (RF x SF)$

$K_{sat,design} =$ 6.01 in/hr 0.1001 in/min

Determine A_{min}

$A_{min} = (V_{design} \times 12 \text{ in/ft}) \div (T \times K_{sat,design})$

$A_{min} =$ 361 S.F.

Determine V_{CMP}

$V_{CMP} = (\pi r2) x CMP_{Length}$

$V_{CMP} =$ 2,966 C.F.

Determine V_{Stone}

$V_{stone} = ((G_{depth} \times G_{width} \times G_{length}) - V_{CMP}) \times 0.40$

$V_{stone} =$ 1,384 C.F.

Determine V_{Actual}

$V_{actual} = V_{CMP} + V_{stone}$

$V_{actual} =$ 4,350 C.F.

$V_{actuals} >= V_{design}$ TRUE

Determine A_{actual}

$A_{actual} = G_{width} \times G_{length}$

$A_{actual} =$ 756 S.F.

Determine T_{actual}

$T_{actual} = (V_{actual} \times 12 \text{ in/ft}) \div (A_{actual} \times K_{sat,design})$

$T_{actual} =$ 11.50 hr 689.7 min

$T_{actuals <} = T_{max}$ TRUE

Determine $T_{actual/min}$

$T_{actual/min} = A_{actual} \times (K_{sat,design} \div 12)$

$T_{actual/min} =$ 6.31 cf/min

Peak Flow Hydrologic Analysis

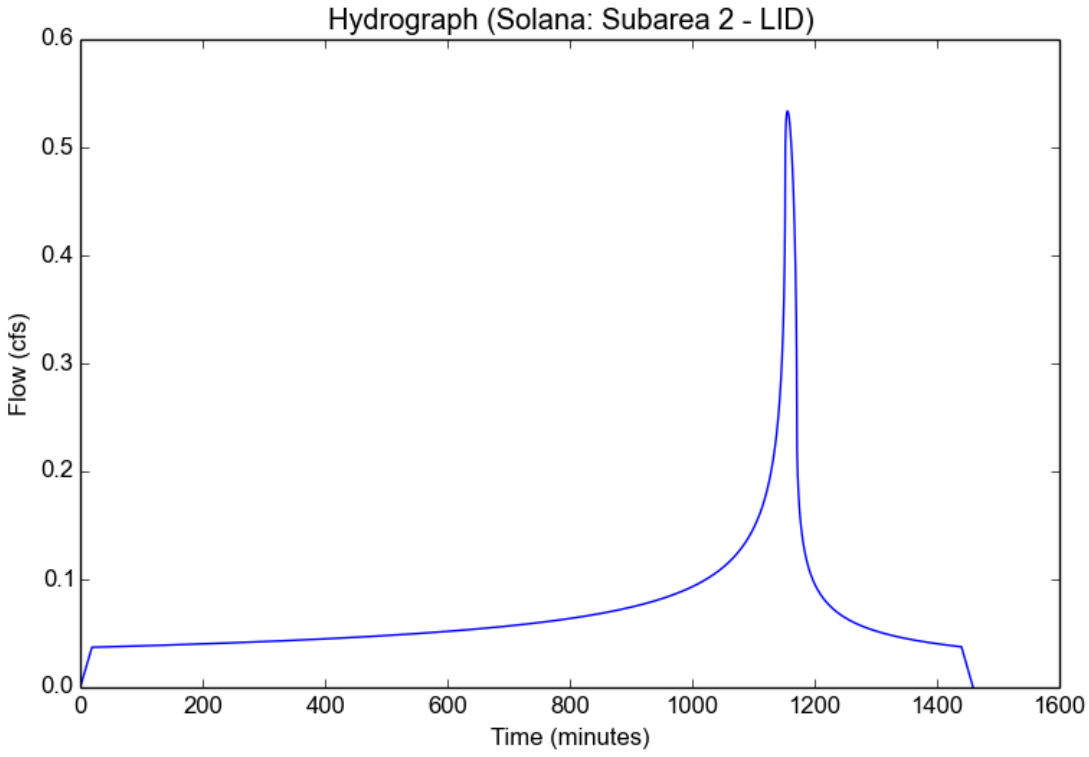
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/LID/Calculations/Solana - Subarea 2 - LID.pdf
Version: HydroCalc 0.2.0-beta

Input Parameters

Project Name	Solana
Subarea ID	Subarea 2 - LID
Area (ac)	7.14
Flow Path Length (ft)	332.0
Flow Path Slope (vft/hft)	1.216
85th Percentile Rainfall Depth (in)	0.85
Percent Impervious	0.22
Soil Type	4
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.85
Peak Intensity (in/hr)	0.2708
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.276
Time of Concentration (min)	19.0
Clear Peak Flow Rate (cfs)	0.5336
Burned Peak Flow Rate (cfs)	0.5336
24-Hr Clear Runoff Volume (ac-ft)	0.1384
24-Hr Clear Runoff Volume (cu-ft)	6030.186



LID CALCULATIONS CMP INFILTRATION:

Subarea 2-Infiltration Tank 2

$K_{sat,measured}$:	93.70	in/hr	
CMP Diameter:	8.00	feet	
CMP_{Length}:	90	linear feet	
G_{depth} (Porous Stone):	8.50	feet	
G_{width} (Porous Stone):	12.00	feet	
G_{length} (Porous Stone):	94	feet	
T (Max. Drawdown Time):	24	hr	1,440 min
V_{design} (CF) :	From HydroCalc		
V_{design} (CF) :	6,030	C.F.	
Reduction Factor (RF):	5.20	unitless	
Safety Factor (SF):	3.00	unitless	

Determine $K_{sat,design}$

$K_{sat,design} = K_{sat,measured} / (RFxSF)$

$K_{sat,design} =$ 6.01 in/hr 0.1001 in/min

Determine A_{min}

$A_{min} = (V_{design} \times 12\ in/ft) \div (T \times K_{sat,design})$

$A_{min} =$ 502 S.F.

Determine V_{CMP}

$V_{CMP} = (\pi r2) x CMP_{Length}$

$V_{CMP} =$ 4,524 C.F.

Determine V_{Stone}

$V_{stone} = ((G_{depth} \times G_{width} \times G_{length}) - V_{CMP}) \times 0.40$

$V_{stone} =$ 2,026 C.F.

Determine V_{Actual}

$V_{actual} = V_{CMP} + V_{stone}$

$V_{actual} =$ 6,550 C.F.

$V_{actuals} >= V_{design}$ TRUE

Determine A_{actual}

$A_{actual} = G_{width} \times G_{length}$

$A_{actual} =$ 1,128 S.F.

Determine T_{actual}

$T_{actual} = (V_{actual} \times 12\ in/ft) \div (A_{actual} \times K_{sat,design})$

$T_{actual} =$ 11.60 hr 696.0 min

$T_{actuals} < = T_{max}$ TRUE

Determine $T_{actual/min}$

$T_{actual/min} = A_{actual} \times (K_{sat,design} \div 12)$

$T_{actual/min} =$ 9.41 cf/min

Peak Flow Hydrologic Analysis

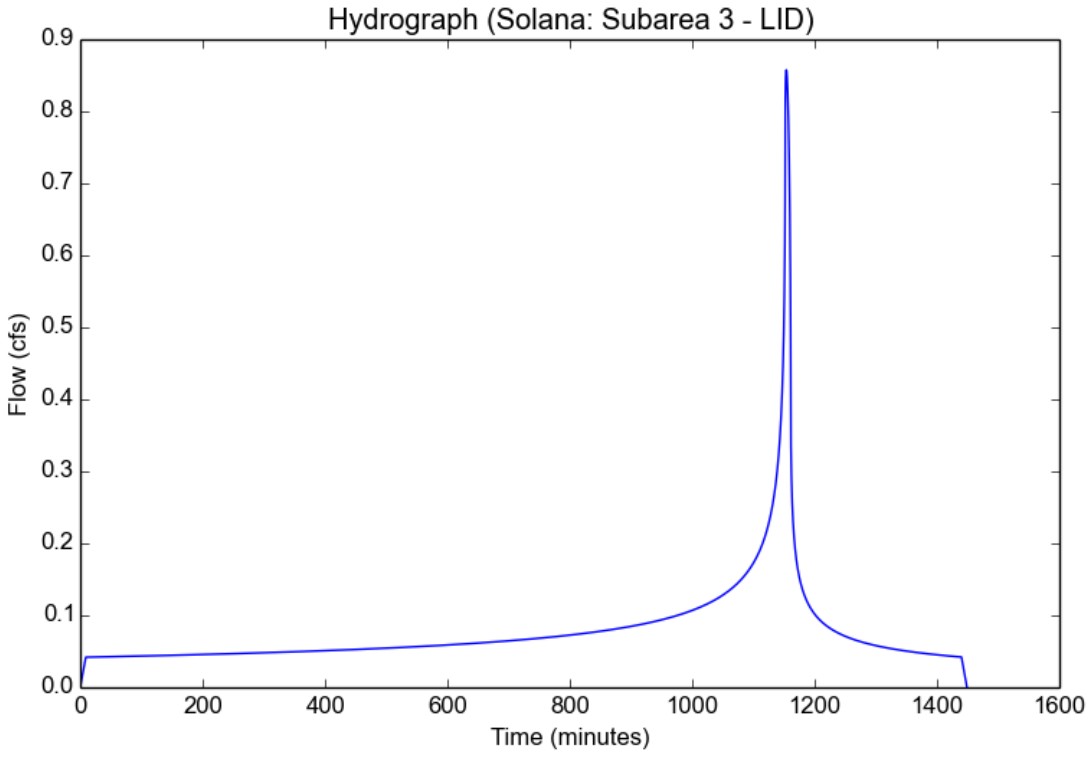
File location: R:/ReyLenn/ReyLenn-Torrance/Documents/LID/Calculations/Solana - Subarea 3 - LID.pdf
Version: HydroCalc 0.2.0-beta

Input Parameters

Project Name	Solana
Subarea ID	Subarea 3 - LID
Area (ac)	2.98
Flow Path Length (ft)	162.0
Flow Path Slope (vft/hft)	0.137
85th Percentile Rainfall Depth (in)	0.85
Percent Impervious	0.81
Soil Type	4
Design Storm Frequency	85th percentile storm
Fire Factor	0
LID	True

Output Results

Modeled (85th percentile storm) Rainfall Depth (in)	0.85
Peak Intensity (in/hr)	0.3847
Undeveloped Runoff Coefficient (Cu)	0.1
Developed Runoff Coefficient (Cd)	0.748
Time of Concentration (min)	9.0
Clear Peak Flow Rate (cfs)	0.8576
Burned Peak Flow Rate (cfs)	0.8576
24-Hr Clear Runoff Volume (ac-ft)	0.1566
24-Hr Clear Runoff Volume (cu-ft)	6820.8694



LID CALCULATIONS CMP INFILTRATION:

Subarea 3-Infiltration Tank 3

$K_{sat,measured}$:	93.70	in/hr	
CMP Diameter:	8.00	feet	
CMP_{Length}:	94	linear feet	
G_{depth} (Porous Stone):	8.50	feet	
G_{width} (Porous Stone):	12.00	feet	
G_{length} (Porous Stone):	98	feet	
T (Max. Drawdown Time):	24	hr	1,440 min
V_{design} (CF) :	From HydroCalc		
V_{design} (CF) :	6,821	C.F.	
Reduction Factor (RF):	5.20	unitless	
Safety Factor (SF):	3.00	unitless	

Determine $K_{sat,design}$

$K_{sat,design} = K_{sat,measured} / (RFxSF)$

$K_{sat,design} =$ 6.01 in/hr 0.1001 in/min

Determine A_{min}

$A_{min} = (V_{design} \times 12\ in/ft) \div (T \times K_{sat,design})$

$A_{min} =$ 568 S.F.

Determine V_{CMP}

$V_{CMP} = (\pi r2) x CMP_{Length}$

$V_{CMP} =$ 4,725 C.F.

Determine V_{Stone}

$V_{stone} = ((G_{depth} \times G_{width} \times G_{length}) - V_{CMP}) \times 0.40$

$V_{stone} =$ 2,108 C.F.

Determine V_{Actual}

$V_{actual} = V_{CMP} + V_{stone}$

$V_{actual} =$ 6,833 C.F.

$V_{actuals} >= V_{design}$ TRUE

Determine A_{actual}

$A_{actual} = G_{width} \times G_{length}$

$A_{actual} =$ 1,176 S.F.

Determine T_{actual}

$T_{actual} = (V_{actual} \times 12\ in/ft) \div (A_{actual} \times K_{sat,design})$

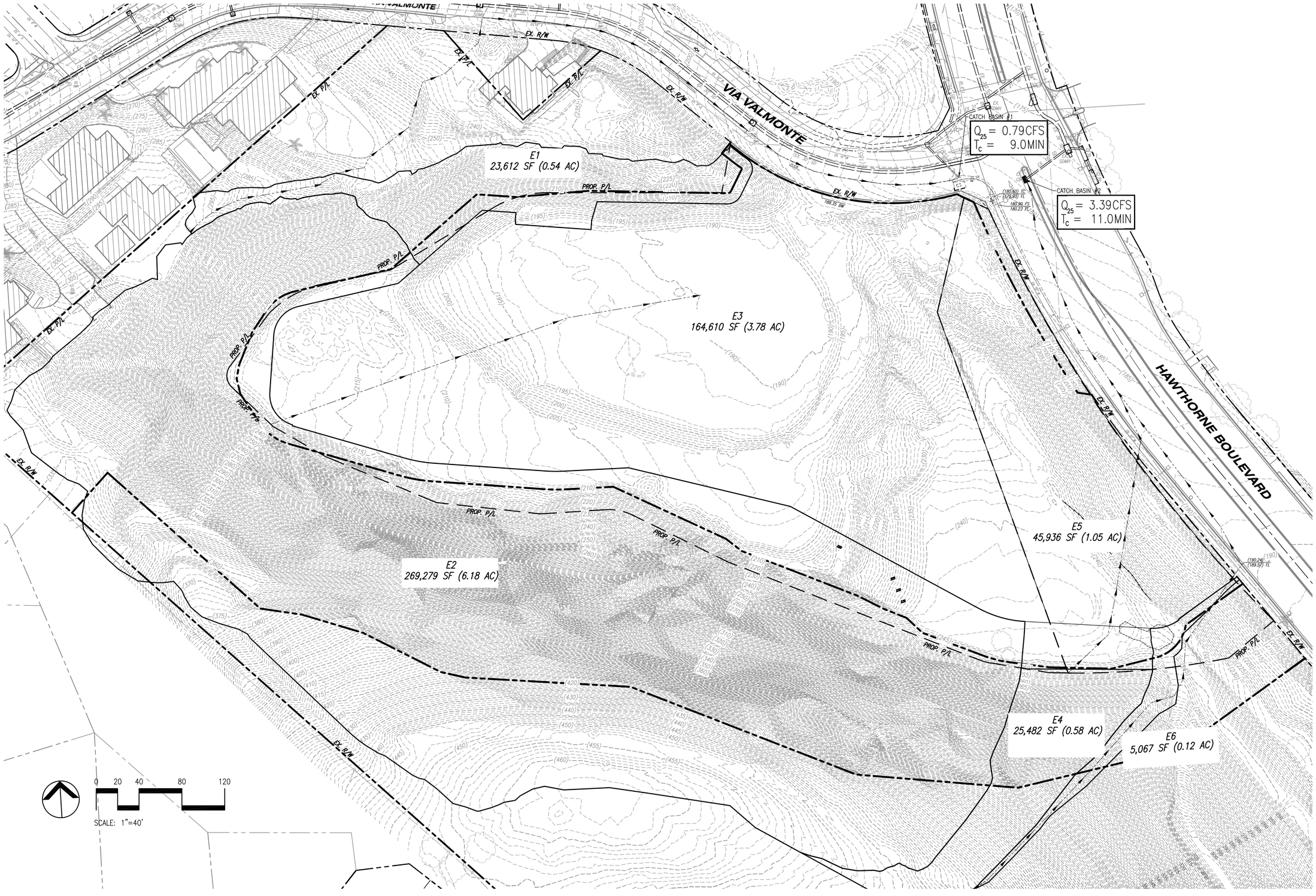
$T_{actual} =$ 11.61 hr 696.5 min

$T_{actuals} <= T_{max}$ TRUE

Determine $T_{actual/min}$

$T_{actual/min} = A_{actual} \times (K_{sat,design} \div 12)$

$T_{actual/min} =$ 9.81 cf/min



SOLANA

REYLENN PROPERTIES LLC

EXISTING DRAINAGE PLAN

TORRANCE , CALIFORNIA

KHR ASSOCIATES
CONSULTING ENGINEERS/SURVEYORS/PLANNERS
20411 SW Birch Street - Suite 310
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Tel (949) 756-6440
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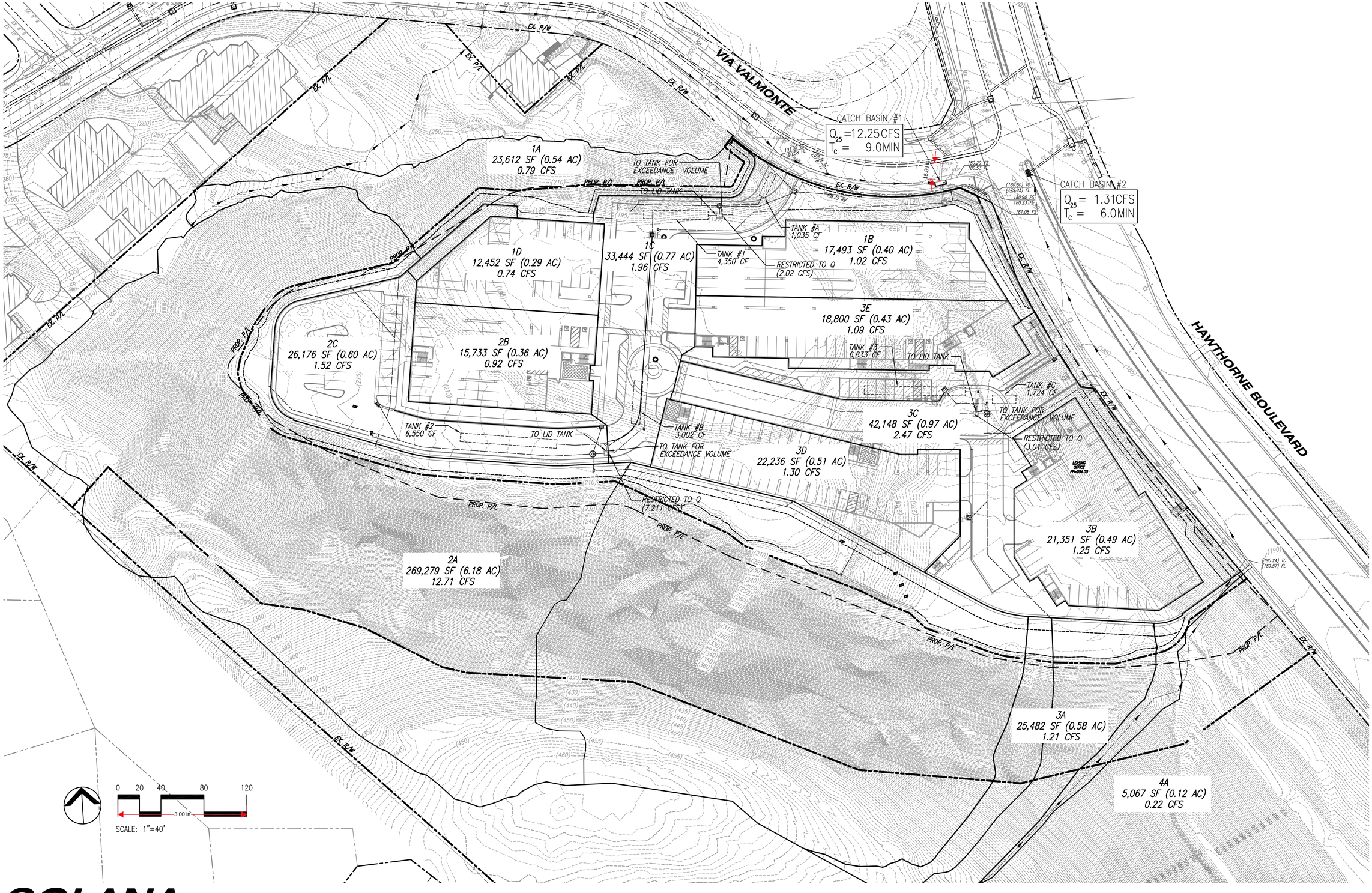

SOLANA

REYLENN PROPERTIES LLC

PROPOSED DRAINAGE PLAN

TORRANCE , CALIFORNIA

KHR ASSOCIATES
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