

Reyes Holdings, LLC

APN: 3090-431-07
Victorville, CA 92395

HYDROLOGY STUDY



Prepared For:

Reyes Holdings, LLC
APN 3090-431-07
Victorville, San Bernardino County, California

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Date: 1/18/2022

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Introduction

The purpose of this report is to address the drainage conditions for the onsite development of a new warehouse and parking lot on the subject property at APN 3090-431-07 in Victorville. The results of this report will quantify the sub area storm runoff, size the above ground detention system, and ribbon gutter to safely convey storm water generated from the project site to above ground detention system. The intention of this hydrology study is to show that the detention system will be able to retain all of the 100-yr 1-hr and 10-yr 24hr storms, and the drainage devices are sized to convey the peak flow from the same storms. The pre-developed flow rates will not be analyzed in this study as all of the post-developed runoff will be retained with the current design.

Project Location

The project site is located on at the corner of Ottawa St and Enterprise Way. The site is 7.5 acres of undeveloped land; there is an existing drainage easement on the eastern and northern portions of the site that will not be considered in the hydrology study.

Rainfall Data

The rainfall data used for sizing the drainage devices is from the San Bernardino County Hydrology Manual. The rainfall data used for the basin sizing calculations is from the NOAA Atlas 14.

Basin Sizing Calculations

The total area of development is 5.2 Acres. The 10-yr, 24-hr storm will produce more runoff than the 100-yr, 1-hr storm. The depth of rainfall for the 10-yr, 24-hr storm is 2.28 inches according to the NOAA Atlas 14 table shown in Figure 1. Based on this data, the maximum runoff produced from the 10-yr storm can be calculated below:

$$\text{Runoff Volume} = (5.2 \text{ ac}) * (2.28 \text{ in}) * (43560 \text{ ft} / 1 \text{ ac}) * (1 \text{ ft} / 12 \text{ in}) = 43,037 \text{ Cu. Ft.}$$

This is a conservative approach as no losses are considered for this calculation. As the basin sizing calculations show in Figure 2, the volume of the basin (62,663 Cu. Ft) is significantly larger than the runoff. The top of the basin is considered to be at an elevation of 90.00 as this is the elevation of the lowest catch basin.

Storm Drain Sizing Calculations

The San Bernardino County Rational Method was used to calculate the peak flow rate for the storm drain system. The peak runoff rate for the 100-year, 1-hr storm was used as it produces a much larger flow rate than the 10-yr, 24-hr storm. See Figure 3 for peak flow rate calculations and Figure 5 for storm drain sizing calculations. These calculations show that the 15" storm drain at a minimum slope of 0.4% has capacity (at 12" deep) for the peak flow rate of 5.6 CFS produced by the 100-yr storm.

Conclusion

In conclusion, the proposed storm drain, and onsite detention basin have been analyzed to ensure proper capacity for a 10-yr, 24-hr and 100-yr, 1-hr storm event. It is recommended that the site be developed with pre-cautions as described in this report to account for the storm water runoff from the areas within the project site.

The onsite storm water detention facility shall comply with the Victorville requirements for storm water volume storage.

It is of our opinion that this analysis sufficiently quantifies the onsite tributary area and calculates the required storm drain devices on-site to safely collect and convey the storm water runoff.

Please contact our office for any additional questions.

Sincerely,

A handwritten signature in black ink, appearing to read 'Ryan Duke', with a long horizontal flourish extending to the right.

Ryan Duke P.E.
RCE 79729
Principle Engineer

FIGURE 1:
NOAA Atlas 14



NOAA Atlas 14, Volume 6, Version 2
 Location name: Victorville, California, USA*
 Latitude: 34.4915°, Longitude: -117.2884°
 Elevation: 2914.08 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerials](#)

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.092 (0.076-0.113)	0.128 (0.108-0.157)	0.178 (0.148-0.219)	0.221 (0.180-0.273)	0.282 (0.223-0.361)	0.332 (0.257-0.434)	0.386 (0.291-0.517)	0.444 (0.326-0.611)	0.527 (0.371-0.758)	0.595 (0.405-0.884)
10-min	0.132 (0.109-0.161)	0.184 (0.151-0.225)	0.255 (0.210-0.313)	0.316 (0.258-0.392)	0.405 (0.319-0.518)	0.477 (0.369-0.623)	0.553 (0.418-0.741)	0.636 (0.467-0.878)	0.756 (0.532-1.08)	0.853 (0.581-1.27)
15-min	0.160 (0.132-0.195)	0.222 (0.183-0.272)	0.309 (0.254-0.379)	0.383 (0.312-0.474)	0.489 (0.388-0.628)	0.576 (0.448-0.753)	0.669 (0.505-0.895)	0.770 (0.565-1.06)	0.914 (0.643-1.31)	1.03 (0.702-1.53)
30-min	0.217 (0.179-0.268)	0.302 (0.249-0.370)	0.420 (0.345-0.515)	0.520 (0.425-0.644)	0.666 (0.525-0.852)	0.784 (0.606-1.02)	0.910 (0.687-1.22)	1.05 (0.788-1.44)	1.24 (0.875-1.78)	1.40 (0.955-2.08)
60-min	0.262 (0.217-0.321)	0.365 (0.301-0.447)	0.507 (0.417-0.622)	0.629 (0.513-0.778)	0.804 (0.635-1.03)	0.947 (0.732-1.24)	1.10 (0.830-1.47)	1.26 (0.928-1.74)	1.50 (1.08-2.15)	1.70 (1.16-2.52)
2-hr	0.370 (0.305-0.452)	0.497 (0.410-0.609)	0.673 (0.554-0.826)	0.823 (0.672-1.02)	1.04 (0.820-1.33)	1.21 (0.938-1.58)	1.40 (1.05-1.87)	1.60 (1.17-2.19)	1.88 (1.32-2.89)	2.11 (1.43-3.13)
3-hr	0.446 (0.368-0.545)	0.594 (0.490-0.727)	0.796 (0.655-0.978)	0.969 (0.791-1.20)	1.22 (0.959-1.55)	1.41 (1.09-1.85)	1.62 (1.22-2.17)	1.85 (1.38-2.54)	2.16 (1.52-3.10)	2.42 (1.65-3.59)
6-hr	0.607 (0.501-0.742)	0.803 (0.662-0.983)	1.07 (0.879-1.31)	1.29 (1.08-1.60)	1.61 (1.27-2.06)	1.87 (1.44-2.44)	2.13 (1.61-2.85)	2.42 (1.77-3.32)	2.81 (1.98-4.04)	3.13 (2.13-4.65)
12-hr	0.778 (0.643-0.952)	1.04 (0.859-1.27)	1.40 (1.15-1.71)	1.69 (1.38-2.09)	2.10 (1.68-2.69)	2.43 (1.88-3.17)	2.77 (2.09-3.70)	3.12 (2.29-4.30)	3.62 (2.55-5.19)	4.01 (2.73-5.98)
24-hr	1.02 (0.902-1.17)	1.39 (1.23-1.60)	1.88 (1.66-2.17)	2.28 (2.00-2.66)	2.85 (2.41-3.43)	3.29 (2.73-4.04)	3.74 (3.03-4.71)	4.22 (3.32-5.46)	4.87 (3.88-6.58)	5.39 (3.94-7.53)
2-day	1.17 (1.03-1.34)	1.61 (1.43-1.88)	2.21 (1.95-2.55)	2.70 (2.37-3.15)	3.38 (2.87-4.07)	3.92 (3.25-4.82)	4.47 (3.62-5.63)	5.05 (3.98-6.54)	5.86 (4.43-7.91)	6.50 (4.75-9.07)
3-day	1.27 (1.12-1.46)	1.76 (1.58-2.03)	2.43 (2.15-2.81)	2.98 (2.61-3.47)	3.74 (3.17-4.51)	4.34 (3.60-5.34)	4.96 (4.02-6.25)	5.62 (4.42-7.27)	6.52 (4.93-8.81)	7.25 (5.29-10.1)
4-day	1.35 (1.20-1.55)	1.88 (1.67-2.17)	2.59 (2.29-3.00)	3.18 (2.79-3.71)	4.00 (3.39-4.81)	4.64 (3.85-5.70)	5.30 (4.29-6.67)	5.99 (4.72-7.76)	6.96 (5.28-9.39)	7.72 (5.64-10.8)
7-day	1.46 (1.30-1.69)	2.02 (1.79-2.33)	2.77 (2.45-3.20)	3.39 (2.97-3.95)	4.25 (3.60-5.11)	4.91 (4.08-6.04)	5.60 (4.54-7.05)	6.32 (4.98-8.18)	7.31 (5.53-9.87)	8.10 (5.92-11.3)
10-day	1.55 (1.37-1.78)	2.13 (1.89-2.46)	2.91 (2.57-3.38)	3.56 (3.12-4.14)	4.45 (3.77-5.35)	5.14 (4.28-6.32)	5.85 (4.74-7.37)	6.60 (5.20-8.55)	7.63 (5.77-10.3)	8.44 (6.16-11.8)
20-day	1.78 (1.58-2.05)	2.47 (2.19-2.85)	3.39 (3.00-3.92)	4.16 (3.64-4.84)	5.23 (4.43-6.29)	6.06 (5.03-7.45)	6.93 (5.81-8.73)	7.83 (6.17-10.1)	9.08 (6.87-12.3)	10.1 (7.36-14.1)
30-day	2.02 (1.80-2.33)	2.82 (2.49-3.25)	3.90 (3.44-4.50)	4.80 (4.21-5.60)	6.08 (5.15-7.32)	7.09 (5.89-8.72)	8.14 (6.90-10.3)	9.25 (7.29-12.0)	10.8 (8.16-14.6)	12.0 (8.78-16.8)
45-day	2.37 (2.10-2.72)	3.31 (2.93-3.81)	4.61 (4.07-5.32)	5.72 (5.01-6.66)	7.31 (6.20-8.81)	8.60 (7.14-10.8)	9.95 (8.06-12.5)	11.4 (8.98-14.8)	13.4 (10.2-18.1)	15.1 (11.0-21.0)
60-day	2.59 (2.30-2.98)	3.61 (3.20-4.16)	5.06 (4.47-5.85)	6.31 (5.53-7.36)	8.14 (6.90-9.80)	9.64 (8.00-11.8)	11.2 (9.10-14.2)	13.0 (10.2-16.8)	15.4 (11.7-20.8)	17.5 (12.8-24.4)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

FIGURE 2:
Basin Volume Calculation

Victorville Reyes Main Basin

ONSITE RETENTION BASIN SIZING CALCULATION

Basin Sizing

Basin A

Depth	Volume	Volume
Depth 0'	4,964	
Depth 1'	6,204	5,584
Depth 2'	7,562	6,883
Depth 3'	9,052	8,307
Depth 4'	10,669	9,861
Depth 5'	12,412	11,541
Depth 6'	14,282	13,347
Depth 7'		7,141
Depth 8'		0
Depth 9'		
Depth 10'		

Depth 6' Free Board

Total Volume CF	62,663	
Total Volume AC-FT	1.44	468,719.24
Peak Flow Mitigation Req'd		

FIGURE 3:
Rational Method Calculations

The following calculation in the rational equation given in the San Bernardino County Hydrology Manual to calculate the peak flow rate for a given storm.

$$I = 1.2 \frac{\text{in}}{\text{hr}} = \text{rainfall intensity (obtained from Figure 4, 100yr, 1hr isohyet)}$$

$$C = \text{runoff coefficient} = 0.9 \left[a_i + \frac{(I - F_p)a_p}{I} \right] = 0.9$$

for: $a_i = 0.9 =$ impervious fraction

$a_p = 0.1 =$ pervious fraction

$F_p = 0 =$ infiltration rate for pervious area

$a_p = 0.1 =$ pervious fraction

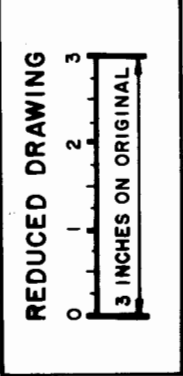
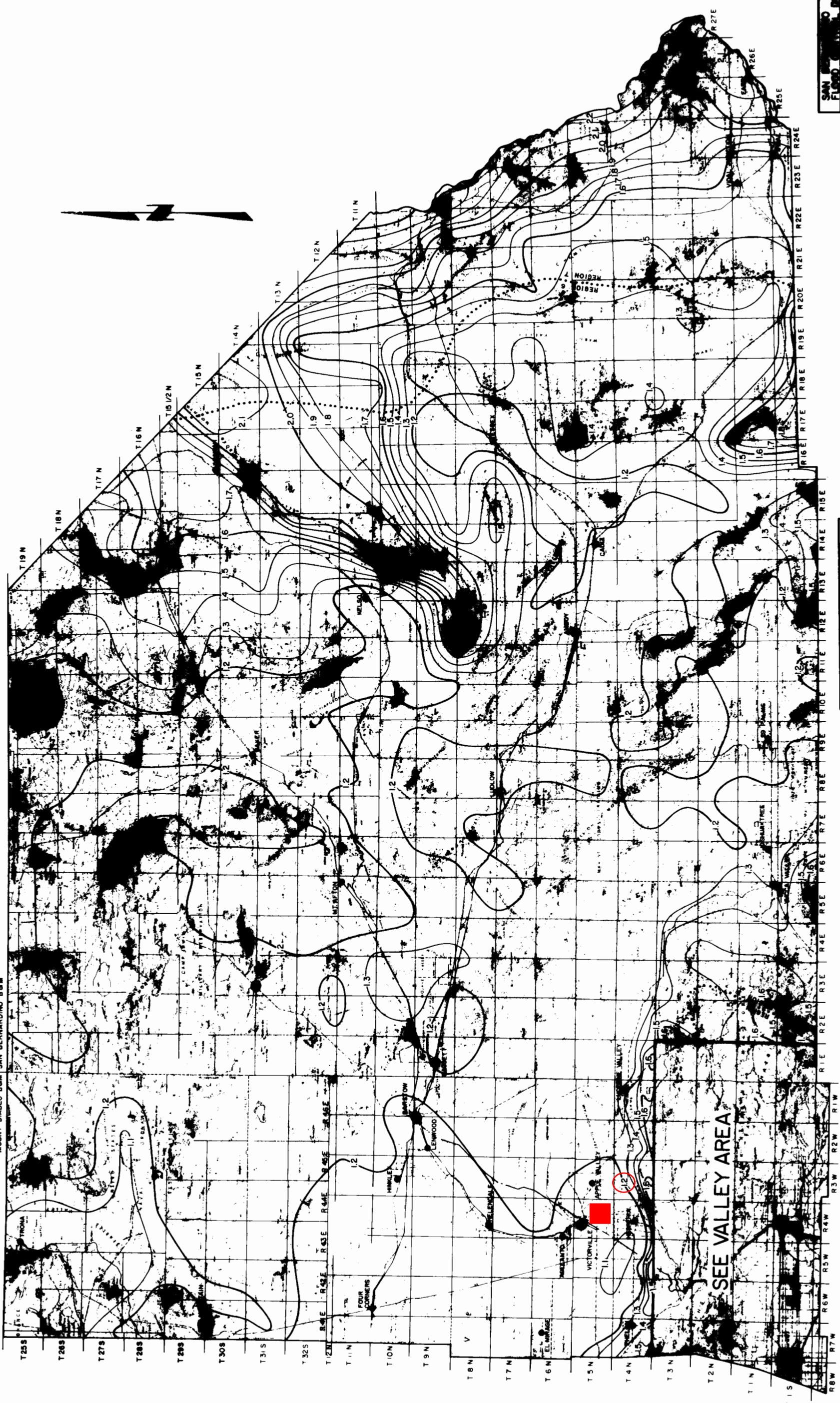
$A = 5.19$ acres = area of project

Then

$$Q = \text{peak runoff rate} = CIA = 5.605 \text{ cfs}$$

FIGURE 4:
100-yr, 1-hr Isohyet

MOUNT DIABLO B&M SAN BERNARDINO B&M



SAN BERNARDINO COUNTY
HYDROLOGY MANUAL

SAN BERNARDINO COUNTY
FLOOD CONTROL DISTRICT

DESERT AREA
 ISOHYETS
 100-YEAR 1-HOUR
 BASED ON USBC, NOAA, ETAS 8, 1973

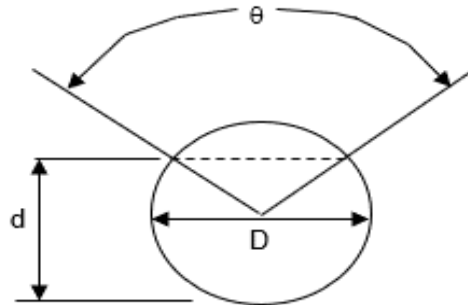
APPROVED BY: [Signature]
 DATE: 1982

LEGEND:
 0.2 ISOLINES PRECIPITATION (INCHES)

FIGURE 5:
Storm Drain Sizing Calculation



15" HDPE Minimum 0.4% Slope



R = A/P

D = 15 in

A = Cross Section Area

d = 11.7 in

P = Wetted Perimeter

n = 0.009

S = Slope of Channel

Angle = 111.8884 θ

n = Manning's Roughness Coefficient

S = 0.004 ft/ft

Mannings Formula = $Q = (1.486/n) A R_h^{2/3} S^{1/2}$

Area, ft ²	Wetted Perimeter	Hydraulic Radius	Velocity (ft/s)	Flow Rate (cfs)
1.027	2.706	0.379	5.473	5.621
Flow Depth = 11.7 INCHES. 78% FULL				

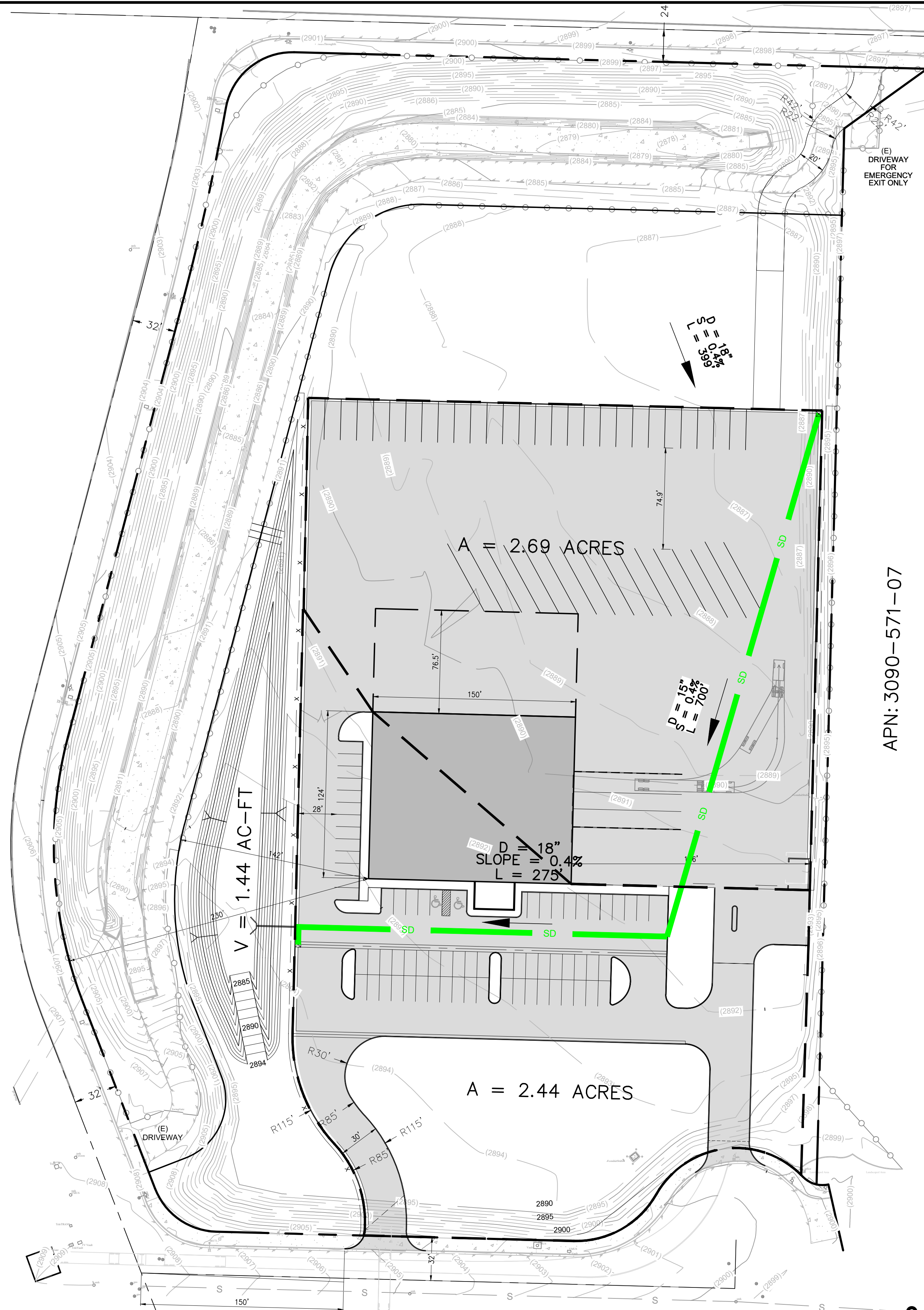
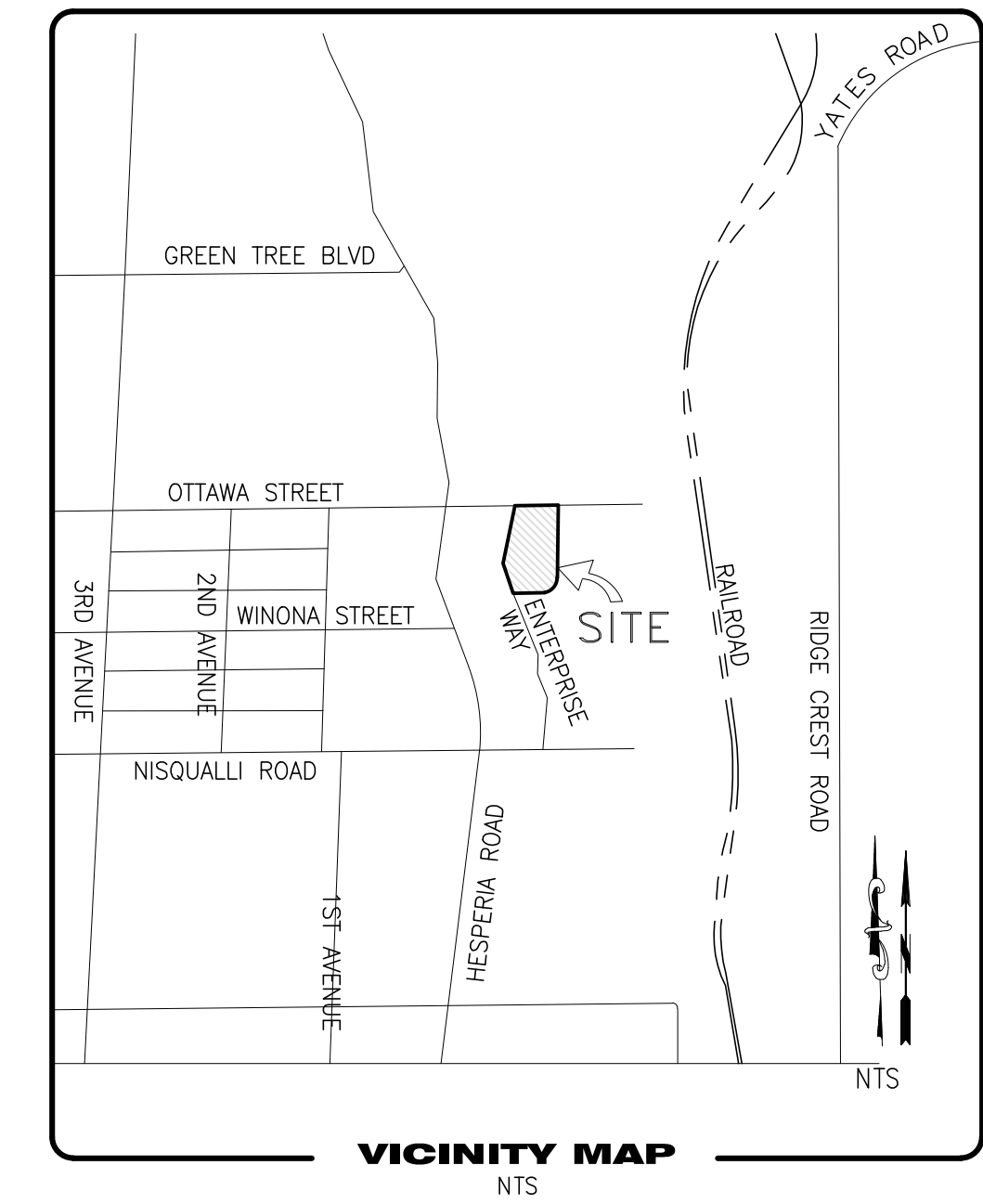
FIGURE 6:
Site Map

CITY OF VICTORVILLE CONCEPTUAL GRADING

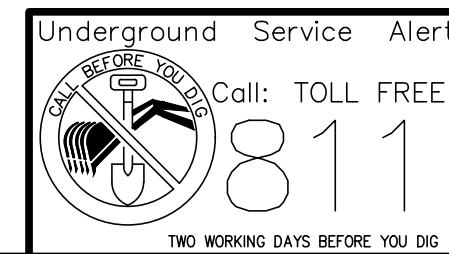
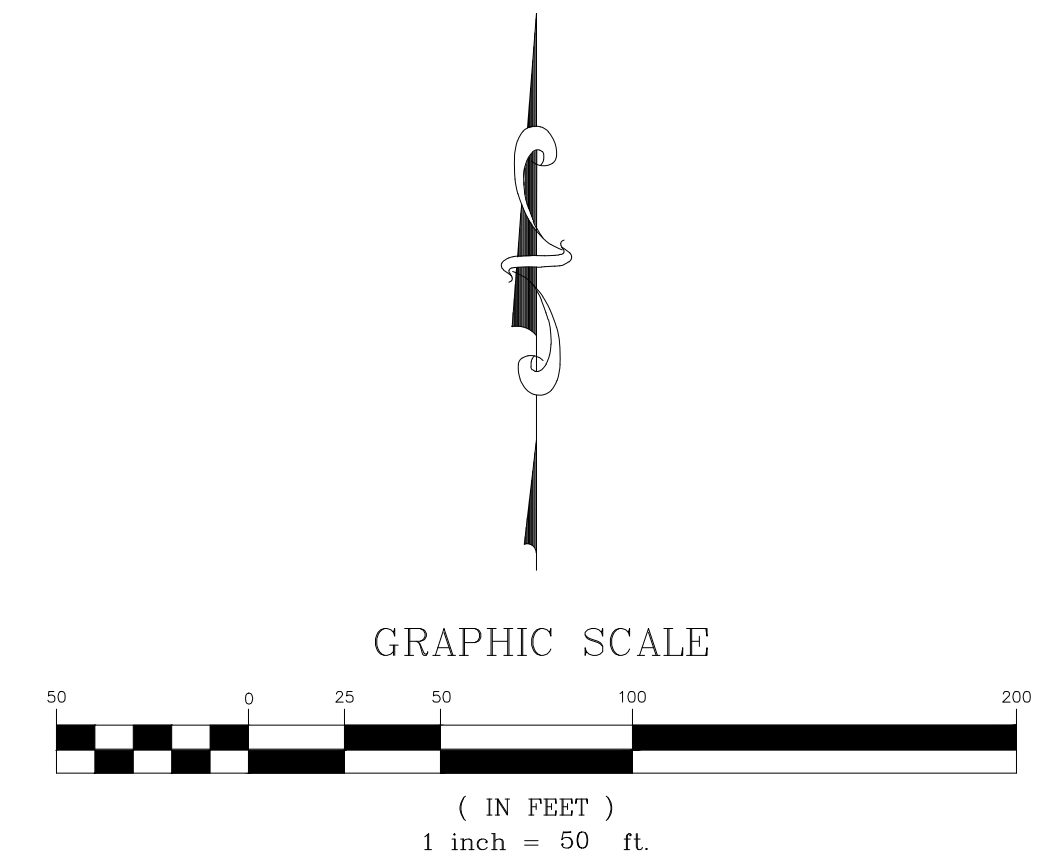
SITE AREA
= 5.2 ACRES

RUNOFF VOLUME
= 43,037 CU FT

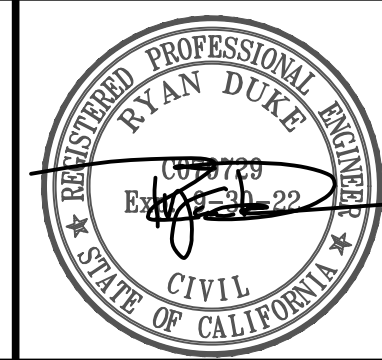
PEAK FLOW RATE
= 5.605 CFS



APN: 3090-571-07



PREPARED FOR:
REYES HOLDINGS, LLC
6250 NORTH RIVER RD
ROSEMONT, IL 60018



REV #	APPR.	DATE	REVISION DESCRIPTION	CITY	APPR.	DATE

CITY OF VICTORVILLE
**WAREHOUSE EXPANSION
INDUSTRIAL BUILDING**
VICTORVILLE, CA
APN: 3090-431-07

SCALE: PER PLAN
DESIGNED: GB
DRAWN: GB
CHECKED: RD
DUKE ENG 21094
SHEET NO.
C1.00