Appendix 5: LID Infeasibility

LID Technical Infeasibility Analysis

This section will be addressed as part of the final WQMP and permit plans.

Appendix 6: BMP Design Details

BMP Sizing, Design Details and other Supporting Documentation

Santa Ana Watershed - BMP Design Volume, V_{BMP}

(Rev. 10-2011)

Legend: Required Entries | Calculated Cells

*(Note this worksheet shall **only** be used in conjunction with BMP designs from the **LID BMP Design Handbook**)*

Company Name: Greenbergfarrow
Date: 3/31/2015
Designed by:
Case No:
Company Project Number/Name: 20080068

BMP Identification

BMP NAME / ID: Biocell / Bioswale & Undergound Detention System

Must match Name/ID used on BMP Design Calculation Sheet

Design Rainfall Depth

85th Percentile, 24-hour Rainfall Depth,
from the Isohyetal Map in Handbook Appendix E

D_{85}= 0.65 inches

Drainage Management Area Tabulation

Insert additional rows if needed to accommodate all DMAs draining to the BMP

DMA Type/ID	DMA Area (square feet)	Post-Project Surface Type	Effective Imperivous Fraction, I_f	DMA Runoff Factor	DMA Areas x Runoff Factor	*Design Storm Depth (in)*	*Design Capture Volume, V_{BMP} (cubic feet)*	*Proposed Volume on Plans (cubic feet)*
DMA-1	*550,076.00*	*Mixed Surface Types*	*0.85*	*0.66*	*363748.3*			
DMA-2	*66,700*	*Mixed Surface Types*	*0.15*	*0.14*	*9434.4*			
DMA-3	*26,066.00*	*Mixed Surface Types*	*0.15*	*0.14*	*3686.9*			
	642842	***Total***			376869.6	0.65	*20413.8*	

Proposed Volume must be greater than the Design Capture Volume

Notes:

Santa Ana Watershed

V_{BMP} and Q_{BMP} worksheets

These worksheets are to be used to determine the required

Design Capture Volume (V_{BMP})
or the
Design Flow Rate (Q_{BMP})

for BMPs in the Santa Ana Watershed

To verify which watershed your project is located within, visit

www.rcflood.org/npdes

and use the 'Locate my Watershed' tool

If your project is not located in the Santa Ana Watershed,

Do not use these worksheets! Instead visit

www.rcflood.org/npdes/developers.aspx

To access worksheets applicable to your watershed

Use the tabs across the bottom
to access the worksheets for the Santa Ana Watershed

Effective Impervious Fraction

Developed Cover Types	Effective Impervious Fraction
Roofs	1.00
Concrete or Asphalt	1.00
Grouted or Gapless Paving Blocks	1.00
Compacted Soil (e.g. unpaved parking)	0.40
Decomposed Granite	0.40
Permeable Paving Blocks w/ Sand Filled Gap	0.25
Class 2 Base	0.30
Gravel or Class 2 Permeable Base	0.10
Pervious Concrete / Porous Asphalt	0.10
Open and Porous Pavers	0.10
Turf block	0.10
Ornamental Landscaping	0.10
Natural (A Soil)	0.03
Natural (B Soil)	0.15
Natural (C Soil)	0.30
Natural (D Soil)	0.40

Mixed Surface Types

Use this table to determine the effective impervious fraction for the V_{BMP} and Q_{BMP} calculation sheets

PRELIMINARY HYDROLOGY REPORT

Proposed Commercial Retail Center

South corner of Central Avenue (Hwy 74) and Cambern Avenue

Lake Elsinore, CA

DATE: 2015

Prepared By:

Farman Shir, PE
Greenberg Farrow
19000 MacArthur Blvd.
Irvine, CA 92612
(949) 296-0450

Project No. 20080068.8

TABLE OF CONTENTS

SECTION I

INTRODUCTION

1.1 PURPOSE

This report presents a preliminary hydrologic analysis for the proposed construction of the lots located at the southeast corner of Central Avenue and Cambern Avenue, in the City of Lake Elsinore, County of Riverside, in the state of California. The main objective of this report will be to analyze the pre/post construction "peak" run-off quantities, detention basin and underground storage sizing. This report will also provide data and details to accommodate for the influence of off-site flow due to an upstream flood control channel and how it will be carried through the project site continuing the natural drainage course as an alternate to the proposed City Master Planned Drainage Facilities.

1.2 PROJECT DESCRIPTION

The existing 17.65-acre site consists of a commercial parcel and four residential tracts. It slopes from a northwesterly to southeasterly direction at approximately 2% gradient. Cambern Avenue fronts the northeasterly side of the project site, which is a partially improved street. The existing street right-of-way half width, on the southwesterly side of the centerline of Cambern Avenue is approximately 30 feet. The proposed ultimate street half width right-of-way varies from 45 to 57 feet.

Three natural drainage patterns exist on the site and collect along the southerly property line. The two easterly flow paths have combined about half way through the site creating a natural drainage channel and outlet into the adjacent property at the most southeasterly corner of the site. During heavy rainfall, a 750cfs flow north of the project site (per the November 22, 2010 memo by Hunsaker & Associates Appendix C), has been directed to flow across Cambern Avenue and along the easterly property line, creating the need for an engineered channel to properly convey flow across the site. The design to redirect the off-site flow through a proposed box culvert is included as an alternate in case the City master planned drainage facilities in proximity the site are not in place for store opening.

The developed 17.65-acre site will be a commercial retail shopping center consisting of a major retail building with two outparcels. The site will be graded to generally follow the existing condition drainage pattern to minimize adverse effects to the current topography and minimize the use of import soil. There will be no off-site runoff entering the project site and all generated on-site drainage will be detained on-site either above or below ground level.

Full street improvements will be made to Third St. along the project site frontage. The improved street will be graded to maintain the natural drainage. A cross-gutter will be provided on Third St.(see Appendix D) approximately ±680' south of the intersection of Third St. and Cambern Ave. to allow the storm water to cross from the west side of Third St. to the east side of Third St. Full street concrete paving will be installed 75' north and south of the Third Cross-gutter West to East crossing for a total of 150' linear feet of full street concrete paving. Approximately ±500' of full street improvements will be made on Third St. from the proposed concrete cross-gutter to Dexter Ave. The project side of Third St.

will include a sidewalk and 8” curb. The other side of Third Street will include a ribbon curb to allow storm water runoff to flow across the center line, over the ribbon curb, and resume its current flow line. The improvements to Third Street are proposed on order to convey the off-site storm water in case the City facilities are not complete otherwise the improvements to Third Street are depicted on the project plans.

SECTION II

FLOW VOLUMES

2.1 METHODOLOGY

The City of Lake Elsinore, California uses the Riverside County Flood Control and Water Conservation District Hydrology Manual requirements for drainage system design. This manual allows the use of the Rational Method for drainage basins less than 300 to 500 acres. The proposed site comprises of approximately 17.65 acres, which falls below the acreage limit.

The calculations were performed using the methods outlined in the Riverside County Flood Control District Hydrology Manual.

2.2 DESIGN CRITERIA

Design Storm: 2-year and 100-year, 3hr, 6hr and 24hr, duration storm events were used for sizing detention facilities and for calculating the flow through the proposed open channel at the eastern property line.

Soil Type:“B” (assumed for all areas). Infiltration was not considered in the calculations due to the preliminary nature of this report

Rainfall Intensity: Rainfall intensity for on-site runoff, was based on IDF curves, Time of Concentration chart and the Standard Intensity Curve Data as presented in the Riverside County Hydrology Manual (1978). Rainfall intensity for sizing of detention facilities was obtained by using the 2-year and 100-year, 3hr, 6hr, and 24hr Precipitation Maps from the Riverside County Hydrology Manual.

Runoff Coefficients: A conservative on-site runoff coefficient of 0.90 (1.00 for building roof) was used for calculation of the post-developed runoff.

2.3 DRAINAGE STRUCTURES

Open Channel (Alternate Design)

An open channel will be constructed along the eastern property line and will handle the 100-year, 3hr storm event producing 697cfs off-site from across Cambern Ave. and the 2.73cfs (Q38) from the rainfall over the 0.844 acres taken up by the open channel. The 697 cfs flow will be conveyed via an underground 3'x18' concrete box culvert crossing under Cambern Ave. The box culvert will connect to the proposed inlet structure, which collects the sheet-flow runoff from the north side of Cambern Ave. and connect to the north end of the proposed open channel.

During a 100-year, 3hr event the open channel will fill up and overtop via five 20' wide, 0.67' deep concrete spillways flowing east onto Third St. These spillways will flow at a depth of 0.67' and outflow 697cfs (Max capacity of spillways is 697.89 cfs).

During peak runoff (697cfs), it would take ±34 seconds to for the water level to reach the five concrete spillways. A detailed channel depth vs time analysis was not performed due to the short duration it would take to the water level to reach the concrete spillways during peak runoff. See calculation below.

Time for water level to reach spillways = Channel Volume ÷ inflow = ±23,386cf ÷ 697cfs = 33.55 seconds

The four 3" channel dewatering pipes will be installed at the south end of the channel. Then will be installed though the curb on Third Street and will provide up to 1.62cfs outflow onto Third Street depending on hydraulic head. The invert elevation of these pipes is 0.05' above the channel bottom. The function of these channel dewatering pipes is to dewater the channel after the end of a storm event. Since they will be under pressure, the average outflow (±1.09cfs) is used for dewatering calculations. The pipes will dewater the channel (±23,385cf at the spillway invert elevation) ±5.95 hrs after the end of the storm event.

Channel dewatering = 23,385cf ÷ 1.09cfs x 1/60 x 1/60 = 5.94hrs

The outflow from the four 3" channel dewatering pipes was omitted for channel and spillway sizing due to the relatively small outflow compared to the spillway outflow. It **was not** omitted when considering the runoff crossing Third Street.

The project will include half street improvements along the Third St. frontage. Third St. will be designed to maintain the current drainage pattern. Flood waters currently flow from Cambern Ave south ±680' on Third St. and then cross the street and flow onto the property on east side of Third St. just southeast of the project site.

The Proposed Third St. Cross-gutter West to East Crossing will be sized to accommodate the 100-year, 3hr peak discharge from the Third St. Spillways and Channel dewatering pipes (697cfs+2.73cfs) and the post-developed runoff from Cambern Ave. Q26 (56cfs) minus the pre-developed flow across the property abutting the southeast corner of the project property Q10 (423.9cfs). The proposed Third St. Cross-gutter West to East Crossing will be 0.60' deep, 115' wide and will convey the required 331.83cfs (Max Cross-gutter capacity = 332.32cfs) of storm water discharge from the Open Channel's Third St. Spillways, Channel Dewatering Pipes and runoff from Cambern Ave. (see Appendix C). It will flow west to east across Third St. and maintain the existing drainage pattern.

The Cross-gutter will convey 331.83cfs and then overtop allowing the remaining 423.9cfs to discharge to Third St south of the Cross-gutter. The remaining 423.9cfs will continue south along the west side of

Third St. where it will converge with (Q25) 12.7cfs of storm water runoff from the three lots on the west side of Third St. between the project site and Dexter Ave. The proposed Third St. 8" gutter will fill to a depth of 8” at the flow line from the project site's southern property line to Dexter Ave. The 8" curb and gutter will convey 20.02cfs south on Third St. where it will enter Dexter Ave., flow east and join the current drainage pattern approximately 330' east of Third St. The remaining 416.6cfs will spill over 505.36' of the Third St. centerline and maintain the current drainage pattern. The 416.6cfs will be distributed evenly along the 505.36' of Third St. centerline.

The Cross-gutter will discharge 331.83cfs to the existing ditch along the east side of Third St. The existing ditch along the east side of Third St. is approximately 2’ deep and 50’ wide with a 7’ wide base. (see Appendix C) and can handle in excess of 600cfs at the Third St. Cross-gutter’s point of discharge.

During a 2-year, 3hr storm event, the Open Channel will fill up and overtop via the Third St. spillways. These spillways will flow at a depth of 0.27’ and outflow a total of 263.57cfs (2yr Q2 (263.57cfs) – Channel Dewatering Pipes (1.51cfs w/±2.33ft of head) onto Third St.

During 2-year, 3hr peak runoff (263.57cfs), it would take ±89 seconds to for the water level to reach the five concrete spillways. A detailed channel depth vs time analysis was not performed due to the short duration it would take to the water level to reach the concrete spillways during peak runoff. See calculation below.

Time for water level to reach spillways = Channel Vol ÷ inflow = ±23,386cf ÷ 263.57cfs = 88.73 seconds

The 285.75cfs (Q2 spillway + Q38 Open Channel + Q26 Cambern Ave. Runoff = 285.75cfs) on Third Street will initially flow along the curb down to Dexter Ave (Approx 20.02cfs) and the excess runoff will enter the cross gutter from the west to east side of Third St. at approximately the same location that the runoff is currently flowing.

<u>Flooding of Adjacent Properties (Alternate Design)</u>

The proposed drainage conveyance is designed to follow its existing path across downstream properties and the runoff not to exceed pre-developed condition. The closest house to the proposed water crossing, on the east side of Third St., is about 250’ northeast, sits about 5’ above the road and is not expected to be impacted by the proposed design.

Flood conditions for the property abutting the southeast corner of the project site will likely be improved by the proposed design due to the rerouting of the current 423.9cfs (100-year storm event) flowing through their property. The storm water run-off currently flowing onto that property, flows from the northwest corner, southeast and across Third St. The 423.9cfs will enter Third St. on the west side and cross to the east side of Third St. approximately 200’ north of where it currently enters Third St. It will enter Third St. via spillways and Channel Dewatering pipes at the proposed Open Channel. Flooding along the Third St. frontage of the property immediately south will likely be reduced. After the proposed improvements, the property will have no storm water run-on from the proposed project except during a storm event exceeding a 100-year, 3hr event. Further design and analysis is required to determine the exact flood condition impact of the improvements.

Underground Storage (On-site Design)

An underground storage system will be used to detain the on-site contributing area (17.032acres) minus the Open Channel area (0.844 acres). The total area routed to the underground storage system is 16.19 acres.

A 24" outflow pipe with a 0.2% slope will connect to the proposed 30" storm drain at Crane St. The Max flow will be restricted to ±18.06cfs by a 17.4" diameter orifice restrictor plate. Currently the proposed 24" underground storage outflow pipe is connected at the flowline of a 60" diameter storage pipe. The average flow through the 24" outflow pipe/restrictor plate is ±11.10cfs. Flow through the orifice restrictor plate ranged from 3.72cfs (no head) to 18.06cfs (±4.25ft of head). Due to the preliminary nature of this report, the average flow through the orifice was used for simplicity.

The total estimated remaining capacity of the existing 30" storm drain in Crane St. is ±18.17cfs. See next section – *"Existing 30" Storm Drain on Crane St.".* This leaves an average of ±7.07cfs capacity (18.17cfs – 11.10cfs = 7.07cfs) in the existing Crane St. 30" storm drain.

It is important to note that the storm drainage storage and pipe network are in a preliminary state and the remaining capacity in the existing 30" Crane St. storm drain is estimated. Pipe sizing and storage may change pending further analysis.

The 2-year and 100-year, 3hr, 6hr, and 24hr events were analyzed. The 100-year, 6hr storm required the greatest storage volume at 45,353cf (1.04ac-ft) given a constant average outflow of 11.10cfs. The proposed underground storage system is currently ±58,860cf. It will outflow 18.06cfs (Max) to the proposed 30" storm drain in Crane St. It is anticipated that the underground storage system will be revised to more closely accommodate the 45,353cf of required storage pending further analysis.

Existing 30" Storm Drain on Crane St.

An existing 30" storm drain terminates at the northwest corner of the intersection of Dexter Ave. and Crane St. A proposed 30" storm drain will connect to the existing 30" storm drain and extend north along Crane St to the southern property line of the project site.

The existing 30" storm drain flows southeast along Dexter Ave. for approximately 180' and then south across Dexter Ave. Additional information regarding the existing storm drain was not available at the time of this writing.

Based on the elevation at the point of discharge and the surface elevation at the southern property line of the project site and Crane St, it is assumed the existing 30" storm drain is running at 2.0%. Confirmation will be needed. The assumed capacity for the 30" storm drain is 58.17 cfs.

Plate 60 of the Hydrology Map (see Appendix D) shows 40 cfs currently routed to the 36” storm drain running south under Interstate 15 approximately 260’ south of where the 30” storm drain crosses Dexter Ave. Based on surface elevations, it is assumed that the 30” storm drain ultimately discharges to this 36” storm drain under Interstate 15. Confirmation will be needed.

Based on the above assumptions, the remaining capacity available for the project is 18.17 cfs (Total capacity (58.17cfs) – Used capacity (40cfs) = Remaining capacity (18.17cfs)). The remaining capacity controls the sizing of the on-site underground storage and underground storage outflow pipe.

SECTION III

SUMMARY of the Off-Site:

As presented in this report, the proposed drainage conveyance system will improve the existing flooding condition as follows:

The ponding associated with the significant runoff (+/- 750cfs) flowing towards Cambern Avenue and backing up on the north-east side of Cambern Ave will be eliminated via the proposed 18’x3’ box culvert.

Currently, the properties adjacent to Cambern Ave. and Third St. experience runoff across the land during all rain events. The proposed Third St. improvements will alleviate some of this by rerouting the runoff crossing Third St. approximately 200’ south of its current crossing route.

The proposed system will also significantly improve the drainage condition of the properties to the south-west of our project, between LA Fitness and Third Street. Currently these parcels experience flooding and have runoff across their properties during all rain events. However, once the proposed improvements are in-place, the referenced properties will not have any off-site drainage flowing across their properties during a 2-yr rain event. Even in a 100-yr scenario, they are subject to significantly less runoff across their parcels.

The proposed diversion of off-site storm water via box culvert and open channel is presented as an alternate design in case the City of Lake Elsinore is unable to complete the master planned drainage facilities within Third Street and Cambern Avenue. Should the City master planned facilities be complete prior to grand opening the Third Street improvements will be constructed per the primary site plan.

SUMMARY of the On-Site:

The pre-developed runoff was calculated by the rational method as outline in Section D of the Riverside County Flood Control District Hydrology Manual. “Plate 60”, provided by the city (see Appendix D) shows pre-developed flows and the corresponding contributing area. Plate 60 was overlayed on the site property line. The areas bound by the project site property line and each contributing area boundary, were used to divide the site into four areas. The time of concentration was calculated for each contributing area by using Plate D-3. The rainfall intensity was then calculated from Plate 4.1 for the 10-year and 100-year storms and Plate D-7 for the 2-year storm.

The post-developed runoff was calculated by the rational method as outline in Section D of the Riverside County Flood Control District Hydrology Manual. The proposed site design was divided into sub-areas. The time of concentration was calculated for each contributing sub-area by using Plate D-3. The rainfall intensity was then calculated from Plate 4.1 for the 10-year and 100-year storms and Plate D-7 for the 2-year storm.

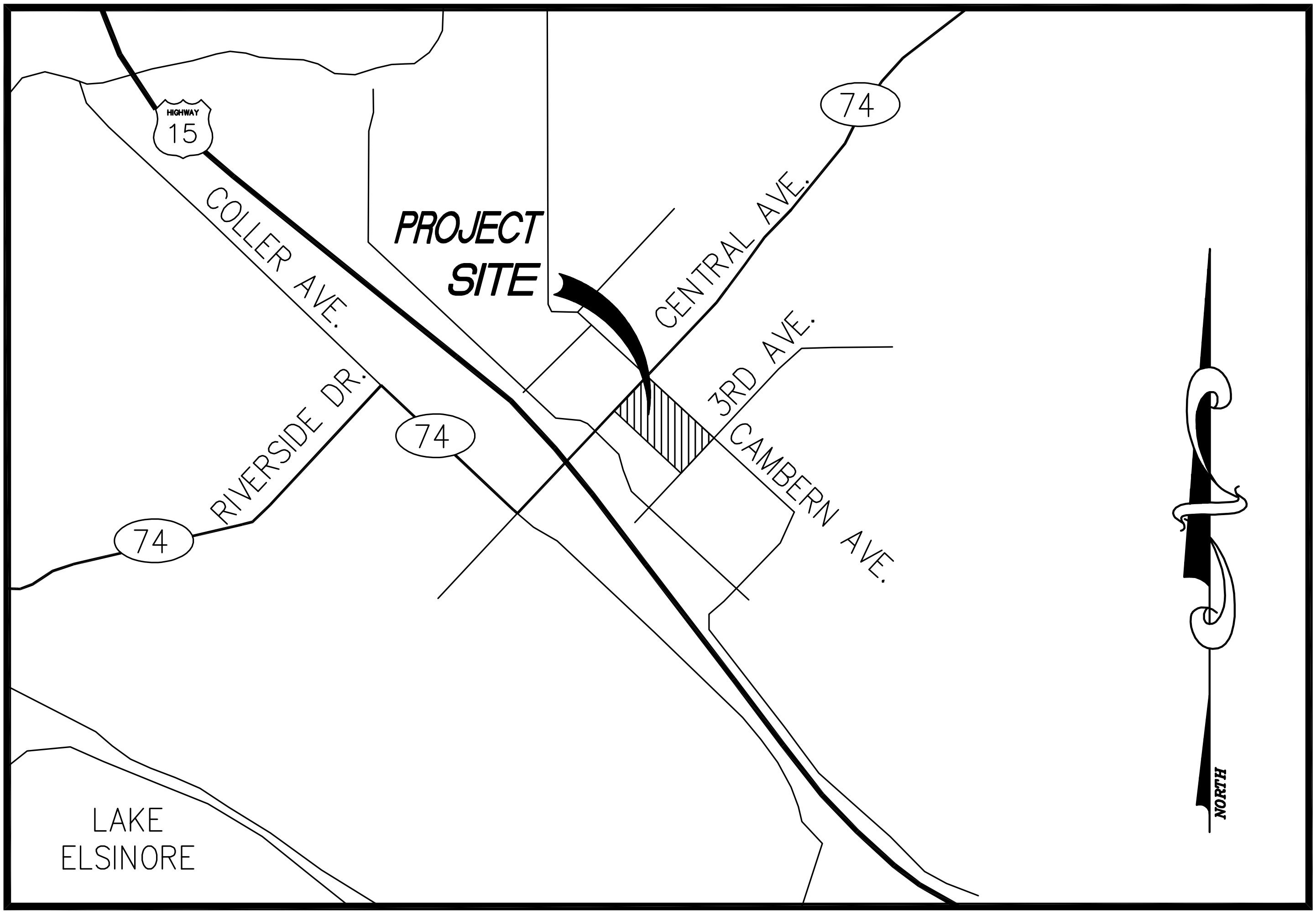
Site Condition	2-Year Peak Runoff (cfs)	10-Year Peak Runoff (cfs)	100-year Peak Runoff (cfs)
Pre-developed	13.53	23.54	36.00
Post-developed	21.99	40.10	64.07
Required Detention	8.46	16.56	28.07

The minimum detention requirement, 16.56cfs, the 10-year peak runoff, is the difference between the pre-developed and post-developed peak runoff. The total post-development peak flow detention provided is 28.07cfs and is governed by the limited excess capacity of the existing 30” storm drain on Crane St. The peak flow was evaluated using the 2-year and 100-year, 3hr, 6hr and 24hr storm events. Peak flow occurred at time 155 minutes of the 100-year, 3hr storm event. Maximum required detention occurred at time 335 minutes of the 100-year, 6hr storm event for the Underground Storage.

The open channel and underground storage were designed based on the precipitation maps for each design storm (Plates E-5.1-E-5.5 See Appendix D). The precipitation pattern for each design storm was obtained from Plate E-5.9 See Appendix C).

APPENDIX A

Vicinity Map

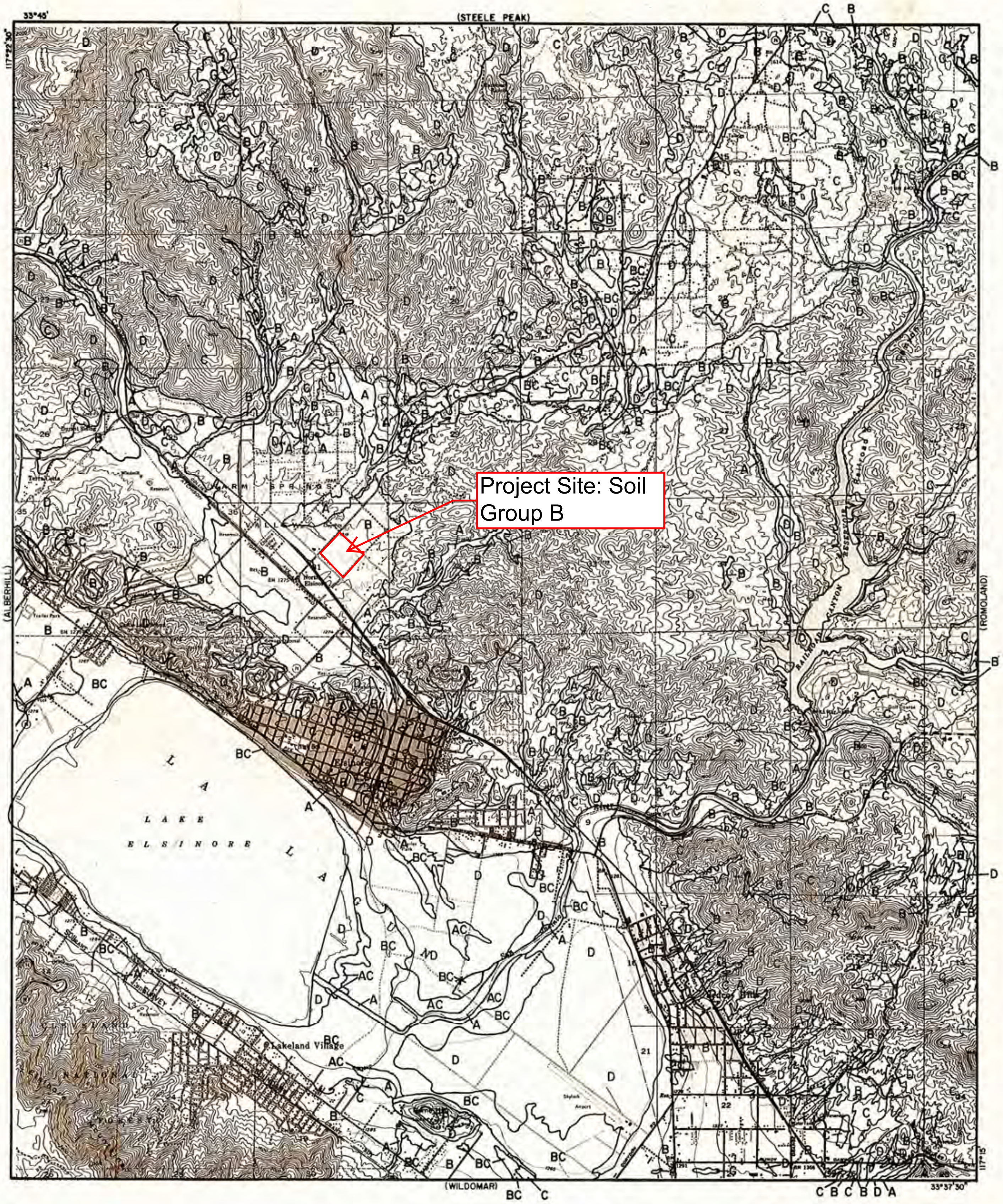


SITE VICINITY MAP

NO SCALE

APPENDIX B

Soil Group Map



LEGEND

—— SOILS GROUP BOUNDARY

A SOILS GROUP DESIGNATION

RCFC & WCD

HYDROLOGY MANUAL

0 FEET 5000

HYDROLOGIC SOILS GROUP MAP FOR ELSINORE

PLATE C-1.41

APPENDIX C

Hydrology Calculations – Pre-developed Conditions

HUNSAKER & ASSOCIATES
SAN DIEGO, INC.

PLANNING
ENGINEERING
SURVEYING

IRVINE
LOS ANGELES
RIVERSIDE
SAN DIEGO
ARIZONA

November 22, 2010

Farman Shir
Greenberg Farrow
1920 Main Street
Suite 1150
Irvine, CA, 92614

Re: Highway 74 and Cambern Property, Lake Elsinore
Preliminary Drainage Analysis

Dear Farman:

Hunsaker and Associates is pleased to present a preliminary drainage analysis for the property at Highway 74 and Cambern Avenue in the City of Lake Elsinore. Our analysis is based on site visits, a meeting with Riverside County Flood Control and an existing drainage study for T 25478 and T 25479 upstream of the property.

Site Conditions

The property is located southerly of the intersection of Highway 74 and Cambern Avenue. Highway 74 is paved and improved. Cambern Avenue to the northeast and Third Street to the southeast exist as graded dirt roads. There are currently single family homes on the four lots fronting Third Street. The remainder of the property is vacant.

The slope of the property is generally north to south at a grade of approximately one percent. A small drainage swale, approximately one foot deep, runs along the back of the four lots fronting Third Street. The drainage pattern is not well defined and there is no existing drainage crossing of Cambern Avenue.

Design Parameters

We met with the Riverside County Flood Control District and reviewed information regarding the property. They stated that the City of Lake Elsinore would be the lead agency and they would not be involved in the review or acceptance of any drainage facilities unless asked by the City. The design requirements for the property will be to collect and safely convey the 100 year frequency storm through the property to an adequate outfall.

DAVE HAMMAR
LEX WILLIMAN
ALISA VIALPANDO
DAN SMITH
RAY MARTIN
CHUCK CATER

9707 Waples Street
San Diego, CA 92121
(858) 558-4500 PH
(858) 558-1414 FX
www.HunsakerSD.com
Info@HunsakerSD.com

Hydrologic Conditions

The drainage basin tributary to the property is largely developed. A drainage study was performed by Hunsaker and Associates for T 25478 and T 25479 a Master Plan Community approximately 0.5 miles to the northeast of the property. At a point approximately 2500 LF upstream of the property the design flow for the 100 year frequency storm was calculated to be 690 CFS at the outlet of the storm drain system for T 25478.

The flows are conveyed overland to an older subdivision bisected by Conard Avenue. An undersized storm drain system conveys the flows to an outlet downstream of Conard Avenue. There are no drainage improvements between Conard Avenue and Cambern Avenue. As the flows reach Cambern Avenue there is no defined channel. The stormwater is in a "sheet flow" condition as it approaches Cambern Avenue.

Further hydrologic calculations were not a scope of this report. However there is approximately 50 acres of tributary land between T 25478 and Cambern Avenue. We have approximated a design flow of 750 CFS at Cambern Avenue for the 100 year frequency storm for our analysis.

Hydraulic Analysis

The lack of a defined channel upstream of Cambern Avenue will require some grading to the northeast in order to properly capture the flows. This can be accomplished by designing Cambern Avenue 2-3 feet higher than the existing ground and grading the area upstream to capture the design flows. The depth of the grading upstream will be partially dependant on whether the flows are to be conveyed in a culvert or open channel.

Culvert – If the flows are to be capture in a storm drain, the area upstream of Cambern will have to be lowered approximately eight feet to adequately accept the flows. It is approximated that a 96" storm drain would be required to convey flows southeasterly on Cambern and southwesterly in Third Street, leaving the entire property available for development. The alignment could be designed more directly across the site if feasible with the land plan.

After the flows are conveyed through the property to the southerly boundary finding an adequate outfall is a challenge. The nearest defined watercourse downstream of the property is either at Interstate 15 or the dip crossing in Dexter Avenue. Since the storm drain invert will be over ten feet deep, it is likely that the facility will have to be extended down Third Street to the swale parallel to the Interstate 15 or down Third Street and Dexter Avenue to be outlet downstream of the dip crossing.

Open Channel – If an open channel is proposed, the area upstream of Cambern Avenue would have to be lowered approximately 3-4 feet. Flows could be conveyed in a double 5X8 box culvert and conveyed through the property in an open channel with a 20 foot base width and 3:1 side slopes.

This channel can be grass lined, but may require invert and side slope protection due to erosive velocities. There are many products available to provide the channel stabilization.

After the flows are conveyed across the site in the grass lined channel the same outlet conditions are a challenge. Since it is unlikely that we will be able to daylight the channel at our boundary and we will have concentrated the flows from the existing sheet flow condition, it is anticipated that the City would require the channel to be continued between the offsite residence and the LA Fitness Site. An easement would be required from the property owners.

If we can adequately daylight the channel as it reaches Dexter Avenue we can try to make a case that this is an adequate outfall. However, it is likely that the City will ask us to capture the flows at Dexter Avenue and extend a storm drain to one of the outfalls described above.

Please see attached Exhibits A (Culvert Alternative) and B (Open Channel Alternative) showing the approximate alignments of the drainage devices described above.

Conclusion

The 100 year frequency design flows to this property can be conveyed safely to adequate outfalls. However, these outfalls are approximately 1000 feet downstream of the property. Offsite grading and drainage easements will be required at the inlets and outfalls to capture and adequately release these flows.

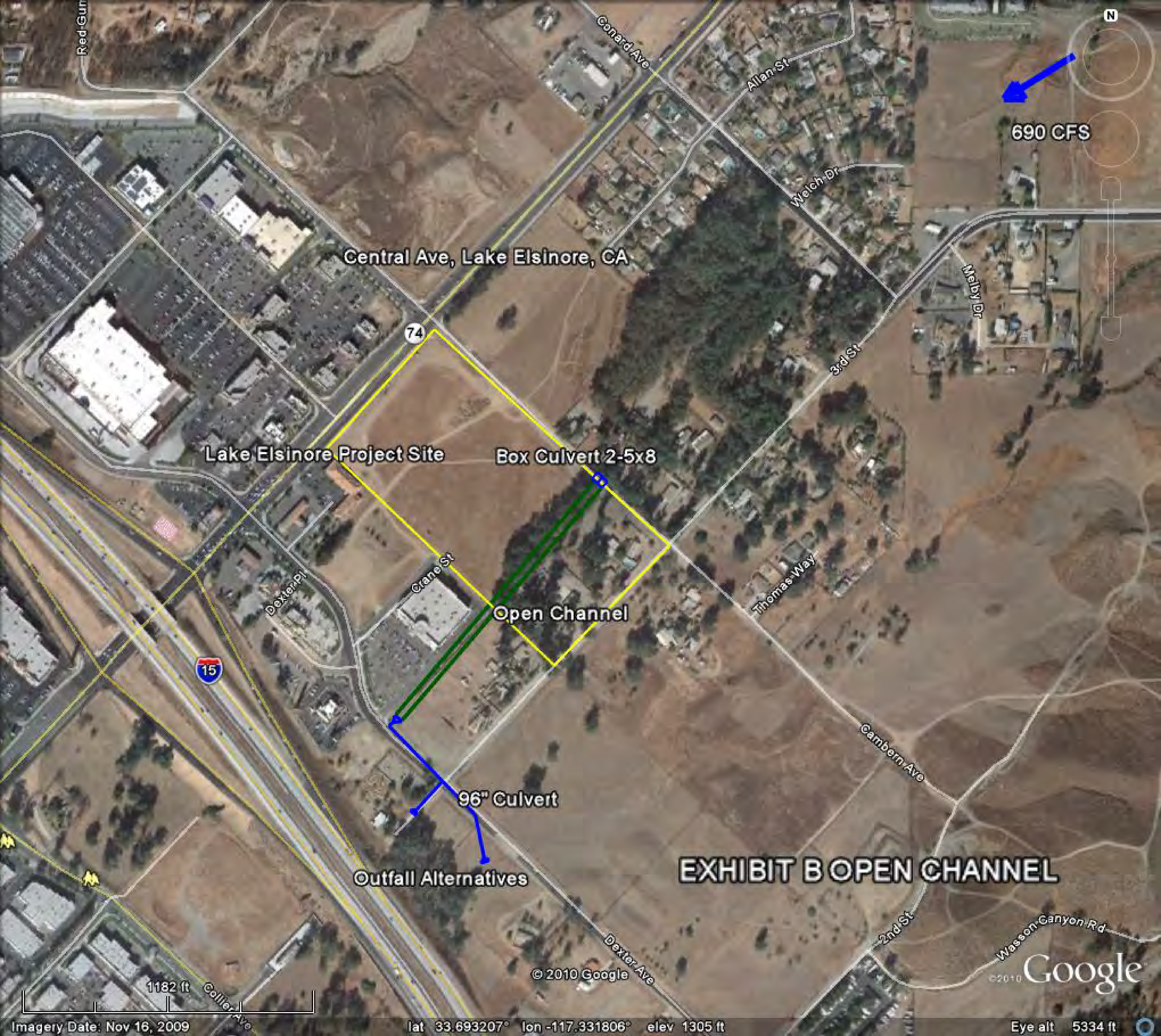
Additional hydrology and topography for the offsite areas will be required to further refine the designs of the drainage facilities proposed. Hunsaker and Associates appreciates the opportunity to provide this preliminary analysis. If you have any questions or require additional information please do not hesitate to call.

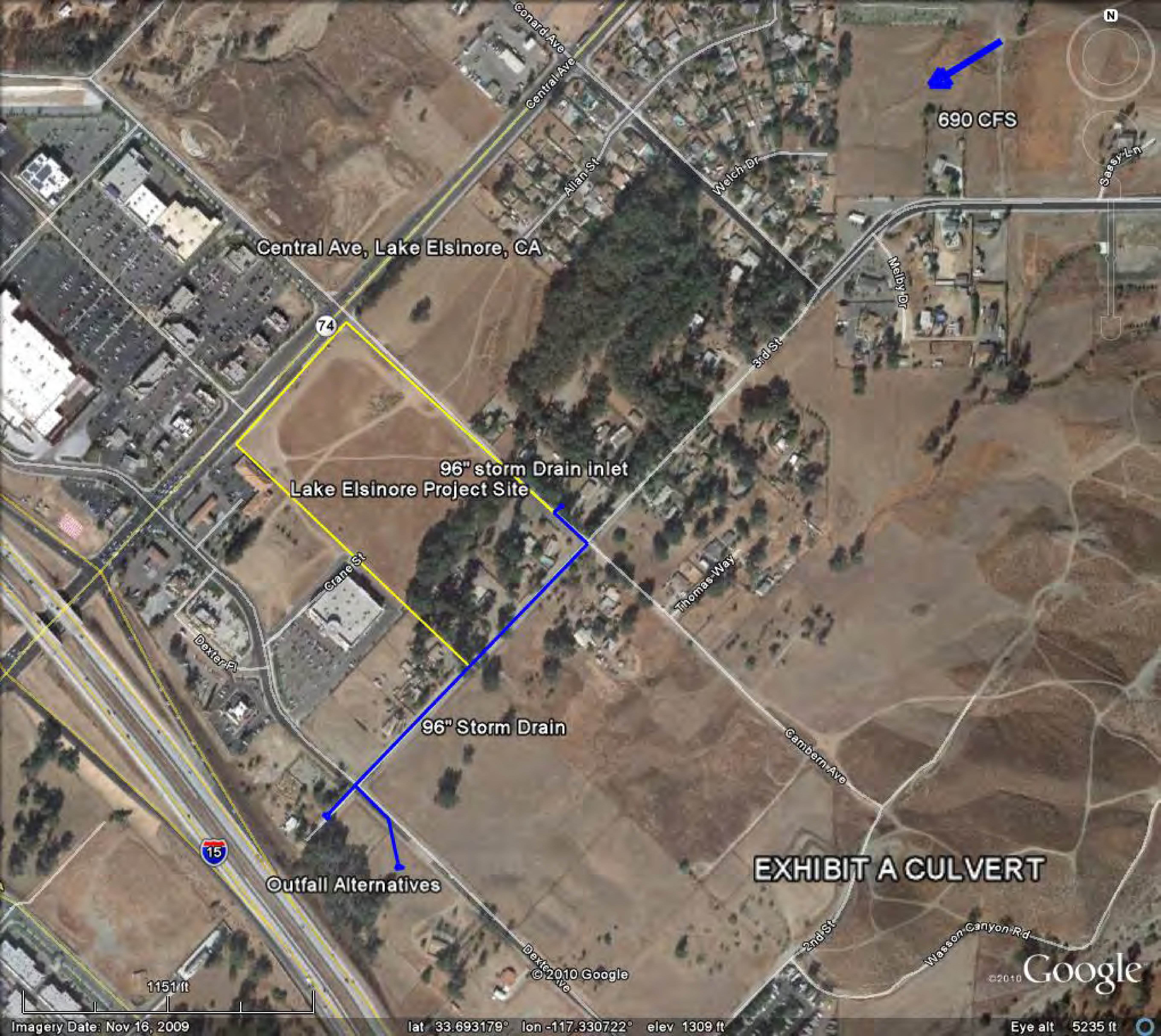
Very Truly Yours,

Hunsaker & Associates
San Diego, Inc.

David A. Hammar, RCE
President

cc: John Guell, Southland Development


690 CFS
Central Ave, Lake Elsinore, CA
Lake Elsinore Project Site
Box Culvert 2-5x8
Open Channel
96" Culvert
Outfall Alternatives
EXHIBIT B OPEN CHANNEL
Conard Ave
Allan St
Welch Dr
Melby Dr
3rd St
Crane St
Dexter Pl
Thomas Way
Cambern Ave
2nd St
Wasson Canyon Rd
Dexter Ave
Collier Ave
74
15
1182 ft
© 2010 Google
Imagery Date: Nov 16, 2009
lat 33.693207° lon -117.331806° elev 1305 ft
Eye alt 5334 ft


690 CFS
Central Ave, Lake Elsinore, CA
96" storm Drain inlet
Lake Elsinore Project Site
96" Storm Drain
Outfall Alternatives
EXHIBIT A CULVERT
Conard Ave
Central Ave
Allan St
Welch Dr
Sassy Ln
Melby Dr
3rd St
Crane St
Dexter Pl
Thomas Way
Cambern Ave
2nd St
Wasson Canyon Rd
Dexter Ave
74
15
N
1151 ft
© 2010 Google
©2010 Google
Imagery Date: Nov 16, 2009
lat 33.693179° lon -117.330722° elev 1309 ft
Eye alt 5235 ft

APPENDIX C

Hydrology Calculations – Post-developed Conditions

Drainage Area Calculations

Label	Description of Drainage	Pre	Post	Q2yr (cfs)	Q10yr (cfs)	Q100yr (cfs)	Tc (minutes)	L (ft)	H (ft)	S (%)	I2 (in/hr)	I10 (in/hr)	I100 (in/hr)	A (acres)	C
Q1*	Cambern Ave. between Central & Concrete Culvert	X		20.04	34.74	53.00									
Q2*	(Pre) Run-on across Cambern/ (Post)3'x18' Culvert under Cambern	X	X	263.57	456.86	697.00									
Q3*	Third St. north of Cambern Ave.	X		31.39	54.40	83.00									
Q4***	Cambern Ave. between Concrete Culvert & Third St.	X		60.50	104.87	160.00									
Q5	West side of property (Area "A")	X		2.04	3.56	5.48	27.50	647.00	11.97	1.85	0.82	1.43	2.20	2.930	0.85
Q6	West side of property (Area "B")	X		4.08	7.12	10.88	27.70	696.00	14.62	2.10	0.82	1.43	2.18	5.860	0.85
Q7	East side of property (Area "C")	X		5.49	9.51	14.51	23.00	444.00	9.99	2.25	0.90	1.56	2.38	7.173	0.85
Q8***	East side of property (Area "D") from Existing Cambern V-Ditch	X		162.23	281.19	429.00									
Q9***	Northeast corner of property	X		62.81	108.87	166.10									
Q10***	Flow onto property abutting southeast corner of project site	X		160.30	277.85	423.90									
Q11***	Lot 5 abutting southwest corner of project site	X	X	10.79	18.69	28.52									
Q12	Lot 6 abutting southern property line of project site	X	X	1.68	2.90	4.46	25.00	430.90	5.39	1.25	0.86	1.49	2.29	2.292	0.85
Q13	Lot 7 (LA Fitness) abutting southern property line of project site	X	X	4.50	8.02	12.30	11.00	830.00	11.21	1.35	1.24	2.21	3.39	3.945	0.92
Q14***	V-ditch along LA Fitness eastern property line	X	X	TBD	TBD	TBD									
Q15*	Southwest corner of Dexter Ave. & Third St.	X	X	6.05	10.49	16.00									
Q38	Open Channel (rainfall on open channel area)		X	1.00	1.79	2.73	9.75	463.00	3.00	0.65	1.32	2.35	3.59	0.844	0.90
Q37	Truck Entrance (Rear of Building)		X	0.61	1.13	1.74	5.40	182.00	3.60	1.98	1.69	3.12	4.78	0.404	0.90
Q36	NEC of Walmart Property		X	0.89	1.65	2.52	4.50	126.00	3.99	3.17	1.84	3.41	5.20	0.538	0.90
Q35	Walmart building (north side)		X	0.26	0.48	0.73	5.50	126.00	1.20	0.95	1.67	3.10	4.74	0.171	0.90
Q34	Walmart Roof (NEC)		X	1.90	3.43	5.25	8.00	335.00	3.35	1.00	1.43	2.58	3.95	1.330	1.00
Q33	Walmart Roof (NWC)		X	1.19	2.17	3.32	7.70	279.00	2.79	1.00	1.45	2.63	4.03	0.824	1.00
Q32	Walmart Roof (SWC)		X	1.05	1.91	2.93	6.60	215.00	2.15	1.00	1.55	2.83	4.34	0.676	1.00
Q31	Walmart Roof (SEC)		X	1.22	2.23	3.41	7.00	242.00	2.42	1.00	1.50	2.75	4.21	0.811	1.00
Q30***	Third St. Centerline Overflow from southern property to Dexter Ave		X	N/A	N/A	416.60									
Q29***	Third St. 8" Curb from southern property to Dexter Ave.		X	N/A	N/A	20.02									
Q28***	Third St. Cross-gutter West to East Crossing		X	N/A	N/A	332.32									
Q27***	Gutter flow from Open Channel Third St. Spillway Outflow + Q38+ Q26		X	285.75	495.35	755.73									
Q26**	(Postdeveloped) Cambern Ave. between Central & Third		X	21.18	36.71	56.00									
Q25	(Postdeveloped) property abutting southeast corner of project site		X	4.64	8.27	12.68	12.00	648.00	9.72	1.50	1.19	2.12	3.25	4.240	0.92
Q24***	Onsite flow into New Storm Drain on Crane St.		X	11.10	11.10	11.10									
Q23	Walmart building (south side)		X	0.63	1.17	1.79	6.75	203.00	1.75	0.86	1.52	2.80	4.29	0.463	0.90
Q22	Truck Turn-around area		X	1.09	1.99	3.04	6.50	235.00	3.29	1.40	1.56	2.86	4.37	0.774	0.90
Q21	Truck Dock		X	0.38	0.68	1.10	3.80	64.00	1.25	1.95	1.97	3.50	5.71	0.215	0.90
Q20	Parking Lot (south)		X	3.20	5.78	8.81	9.20	615.00	9.10	1.48	1.34	2.42	3.69	2.652	0.90
Q19	Parking Lot (north)		X	6.36	11.62	17.76	7.60	478.00	10.80	2.26	1.45	2.65	4.05	4.872	0.90
Q18	Outlot 3		X	0.96	1.76	2.69	6.25	197.00	2.25	1.14	1.58	2.91	4.45	0.672	0.90
Q17	Outlot 2		X	0.87	1.59	2.43	8.75	277.00	1.25	0.45	1.36	2.48	3.79	0.711	0.90
Q16	Outlot 1		X	1.38	2.52	3.86	7.05	363.00	7.99	2.20	1.50	2.74	4.20	1.022	0.90

Equation Used:

Q2yr, Q10yr, & Q100yr were calculated using the rational method (Q = CIA)

Variables

Q2yr = Flow for 2-year storm event (cfs)
Q10yr = Flow for 10-year storm event (cfs)
Q100yr = Flow for 100-year storm event (cfs)
Tc = Time of concentration (minutes)
L = Length of longest run (ft)
H = Elevation diffence between farthest point and point of discharge (ft)
S = Average slope along H (in %)
I2 = 2-year intenstity (in/hr)
I10 = 2-year intenstity (in/hr)
I100 = 2-year intenstity (in/hr)
A = Contributing Area (acres)
C = Weighted coefficient (unitless)

Notes:

For all rows not showing a time of concentration Tc, Q2yr & Q10yr were calculated by dividing Q"X"yr by Q100yr from Area "C" and then multiplying by Q100yr for the drainage area in question. Example: to get Q2yr for Label Q3, divide 5.487 by 14.511. Then multiply by 83.000 to get 31.387

*Q100yr is from "Plate 60" (see Appendix D)

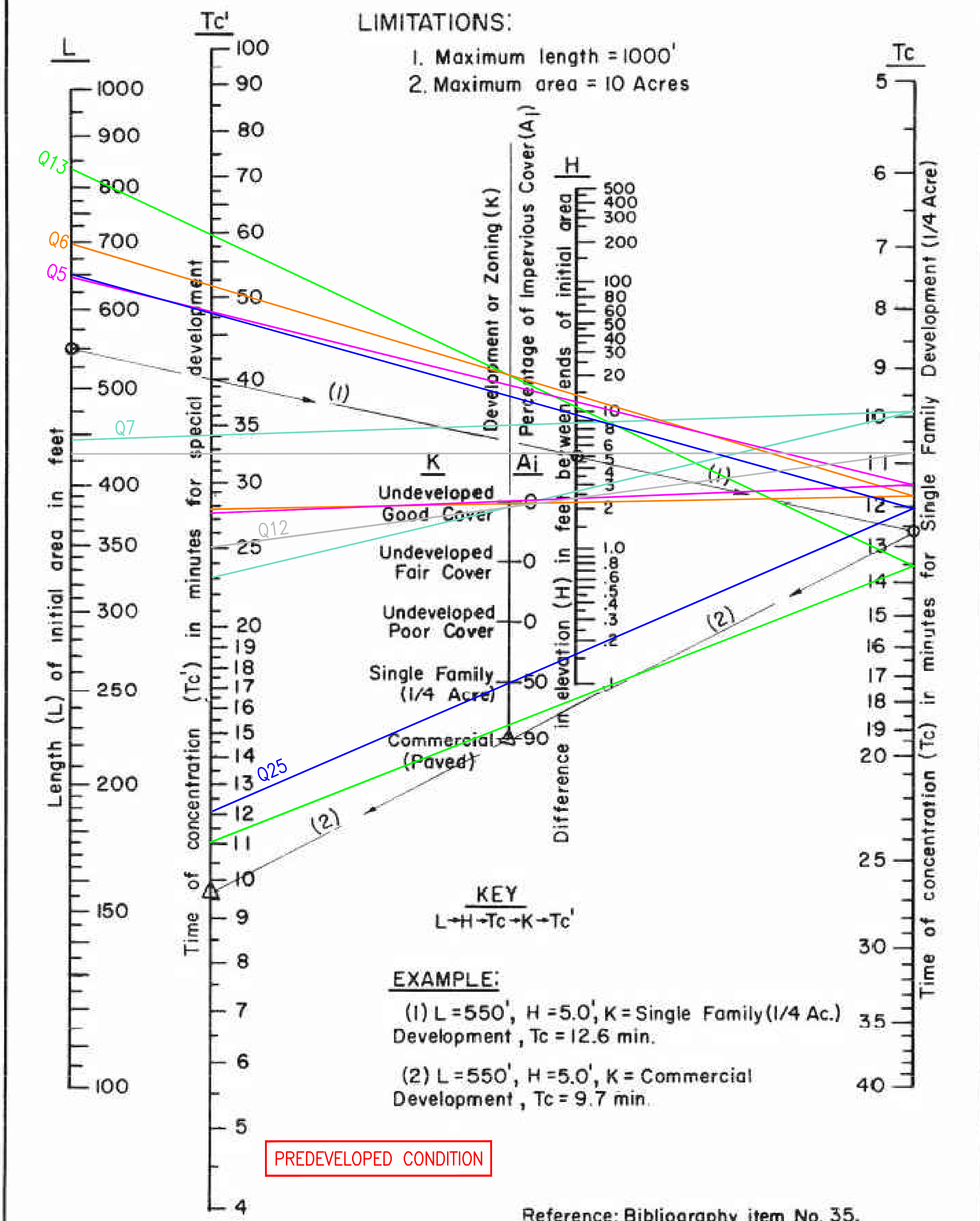
**Q100yr is from "Plate 60" (see Appendix D). 3cfs was added to account for unknow runoff from the property at the northwest corner of Cambern Ave. & Third St.

***Q100yr was calculated on a separate sheet in Appendix C

Tc is from Riverside County Flood Hydrology manual Plate D-3. Rainfall Intensity I (in/hr) from Plate D-4.1

Explaination of Area Calculations

Label	Description of Drainage	Pre	Post	Method of Calculation
Q1	Cambern Ave. between Central & Concrete Culvert	X		From Plate 60
Q2	(Pre) Run-on across Cambern/ (Post)3'x18' Culvert under Cambern	X	X	From Hansaker & Associates Preliminary Drainage Analysis minus Q1
Q3	Third St. north of Cambern Ave.	X		From Plate 60
Q4	Cambern Ave. between Concrete Culvert & Third St.	X		Q2+Q1 = 750cfs, 750cfs-Q8 = 321cfs, Assume flow splits evenly, 321cfs ÷ 2 = 160.5, Rounded down to 160cfs
Q5	West side of property (Area "A")	X		Rational Method as prescribed in Riverside County Hydrology Manua
Q6	West side of property (Area "B")	X		Rational Method as prescribed in Riverside County Hydrology Manua
Q7	East side of property (Area "C")	X		Rational Method as prescribed in Riverside County Hydrology Manua
Q8	East side of property (Area "D") from Existing Cambern V-Ditch	X		From Existing Cambern Ave. V-Ditch calculation (Appendix C)
Q9	Northeast corner of property	X		Q2+Q1 = 750cfs, 750cfs-Q8 = 321cfs, Assume flow splits evenly, 321cfs÷ 2 = 160.5, Rounded to 161cfs and assumed 5cfs for runoff from northeast corner of project site.
Q10	Flow onto property abutting southeast corner of project site	X		Q8+Q7-Q14 = 423.90cfs
Q11	Lot 5 abutting southwest corner of project site	X	X	Total flow for the area from Plate 60 is 35cfs. 35cfs-Q5 = 28.5cfs
Q12	Lot 6 abutting southern property line of project site	X	X	Rational Method as prescribed in Riverside County Hydrology Manua
Q13	Lot 7 (LA Fitness) abutting southern property line of project site	X	X	Rational Method as prescribed in Riverside County Hydrology Manua
Q14	V-ditch along LA Fitness eastern property line	X	X	Proposed runoff from LA Fitness flowing south through V-Ditch. Proposed (Q14) has not been calculated, but will be less than the existing flow through the V-Ditc
Q15	Southwest corner of Dexter Ave. & Third St.	X	X	From Plate 60
Q38	Open Channel (rainfall on open channel area)		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q37	Truck Entrance (Rear of Building)		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q36	NEC of Walmart Property		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q35	Walmart building (north side)		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q34	Walmart Roof (NEC)		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q33	Walmart Roof (NWC)		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q32	Walmart Roof (SWC)		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q31	Walmart Roof (SEC)		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q30	Third St. Centerline Overflow from southern property to Dexter Ave		X	Q27-Q28+Q25-Q29 = 416.6cfs. See Appendix C *"Third St. 8" Curb Between Southern Propery Line of Project Site and Dexter Ave."* for Max Q calculation
Q29	Third St. 8" Curb from southern property to Dexter Ave.		X	From Appendix C *"Third St. 8" Curb Between Southern Propery Line of Project Site and Dexter Ave."* for Max Q calculation
Q28	Third St. Cross-gutter West to East Crossing		X	Q27-Q10. See Appendix C *"Proposed Third St. Cross-gutter West to East Crossing"* for Max Q.
Q27	Gutter flow from Open Channel Third St. Spillway Outflow + Q38+ Q26		X	Q2+Q26+Q38 = 755.7cfs
Q26	(Postdeveloped) Cambern Ave. between Central & Third		X	Q1+3cfs assumed for unknown runoff from property at northwest corner of Cambern & Third St. = 56cf
Q25	(Postdeveloped) property abutting southeast corner of project site		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q24	Onsite flow into New Storm Drain on Crane St.		X	Q24 includes on-site underground storage max discharge into proposed 30" storm drain. Avg discharge is 11.10cfs See Appendix C*"UNDERGROUND STORAGE OUTFLOW ORIFICE RESTRICTOR PLATE"*
Q23	Walmart building (south side)		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q22	Truck Turn-around area		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q21	Truck Dock		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q20	Parking Lot (south)		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q19	Parking Lot (north)		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q18	Outlot 3		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q17	Outlot 2		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q16	Outlot 1		X	Rational Method as prescribed in Riverside County Hydrology Manua



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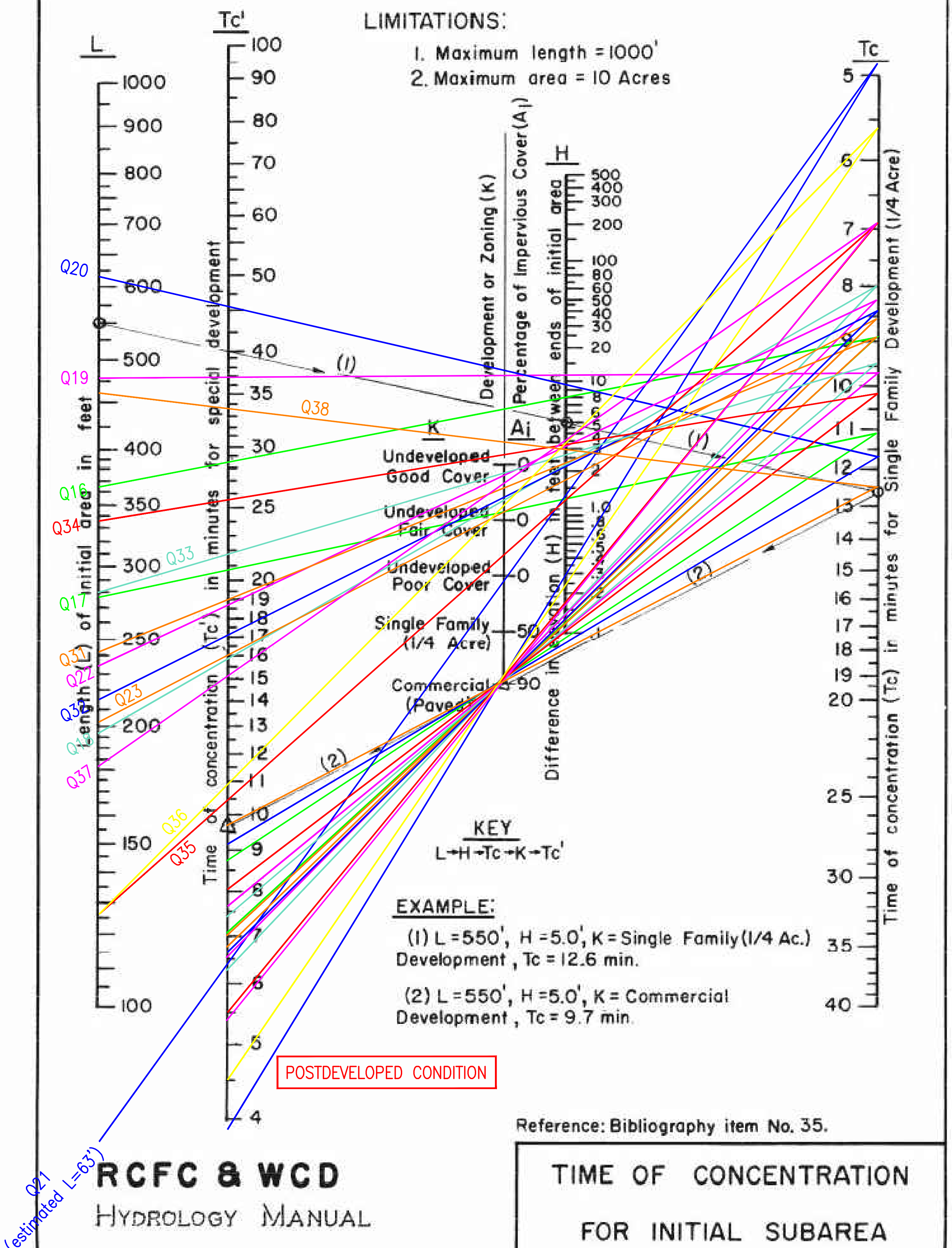
TIME OF CONCENTRATION FOR INITIAL SUBAREA



Reference: Bibliography item No. 35.

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TIME OF CONCENTRATION FOR INITIAL SUBAREA

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RAINFALL INTENSITY-INCHES PER HOUR

DURATION MINUTES	CATHEDRAL CITY FREQUENCY 10 YEAR	CATHEDRAL CITY FREQUENCY 100 YEAR	CHERRY VALLEY FREQUENCY 10 YEAR	CHERRY VALLEY FREQUENCY 100 YEAR	CORONA FREQUENCY 10 YEAR	CORONA FREQUENCY 100 YEAR	DESERT HOT SPRINGS FREQUENCY 10 YEAR	DESERT HOT SPRINGS FREQUENCY 100 YEAR	ELSINORE - WILDOMAR FREQUENCY 10 YEAR	ELSINORE - WILDOMAR FREQUENCY 100 YEAR
5	4.14	6.76	3.65	5.49	3.10	4.78	4.39	6.76	3.23	4.94
6	3.73	6.08	3.30	4.97	2.84	4.38	3.95	6.08	2.96	4.53
7	3.41	5.56	3.03	4.56	2.64	4.07	3.62	5.56	2.75	4.21
8	3.15	5.15	2.82	4.24	2.47	3.81	3.35	5.15	2.58	3.95
9	2.95	4.81	2.64	3.97	2.34	3.60	3.13	4.81	2.44	3.73
10	2.77	4.52	2.49	3.75	2.22	3.43	2.94	4.52	2.32	3.54
11	2.62	4.28	2.36	3.56	2.12	3.27	2.78	4.28	2.21	3.39
12	2.49	4.07	2.25	3.39	2.04	3.14	2.65	4.07	2.12	3.25
13	2.38	3.88	2.16	3.25	1.96	3.02	2.53	3.88	2.04	3.13
14	2.28	3.72	2.07	3.12	1.89	2.92	2.42	3.72	1.97	3.02
15	2.19	3.58	1.99	3.00	1.83	2.82	2.32	3.58	1.91	2.92
16	2.11	3.44	1.92	2.90	1.77	2.73	2.24	3.44	1.85	2.83
17	2.04	3.32	1.86	2.80	1.72	2.66	2.16	3.32	1.80	2.75
18	1.97	3.22	1.80	2.71	1.68	2.58	2.09	3.22	1.75	2.67
19	1.91	3.12	1.75	2.64	1.63	2.52	2.03	3.12	1.70	2.60
20	1.85	3.03	1.70	2.56	1.59	2.46	1.97	3.03	1.66	2.54
22	1.75	2.86	1.61	2.43	1.52	2.35	1.86	2.86	1.59	2.43
24	1.67	2.72	1.54	2.32	1.46	2.25	1.77	2.72	1.52	2.33
26	1.59	2.60	1.47	2.22	1.40	2.17	1.69	2.60	1.46	2.24
28	1.52	2.49	1.41	2.13	1.36	2.09	1.62	2.49	1.41	2.16
30	1.46	2.39	1.36	2.05	1.31	2.02	1.55	2.39	1.37	2.09
32	1.41	2.30	1.31	1.98	1.27	1.96	1.50	2.30	1.33	2.03
34	1.36	2.22	1.27	1.91	1.23	1.90	1.45	2.22	1.29	1.97
36	1.32	2.15	1.23	1.85	1.20	1.85	1.40	2.15	1.25	1.92
38	1.28	2.09	1.20	1.80	1.17	1.81	1.36	2.09	1.22	1.87
40	1.24	2.02	1.16	1.75	1.14	1.76	1.32	2.02	1.19	1.82
45	1.16	1.89	1.09	1.64	1.08	1.66	1.23	1.89	1.13	1.72
50	1.09	1.78	1.03	1.55	1.03	1.58	1.16	1.78	1.07	1.64
55	1.03	1.68	.98	1.47	.98	1.51	1.09	1.68	1.02	1.56
60	.98	1.60	.93	1.40	.94	1.45	1.04	1.60	.98	1.50
65	.94	1.53	.89	1.34	.90	1.40	.99	1.53	.94	1.44
70	.90	1.46	.85	1.29	.87	1.35	.95	1.46	.91	1.39
75	.86	1.41	.82	1.24	.84	1.30	.91	1.41	.88	1.35
80	.83	1.35	.79	1.20	.82	1.26	.88	1.35	.85	1.31
85	.80	1.31	.77	1.16	.80	1.23	.85	1.31	.83	1.27
SLOPE =	.580		.550		.480		.580		.480	

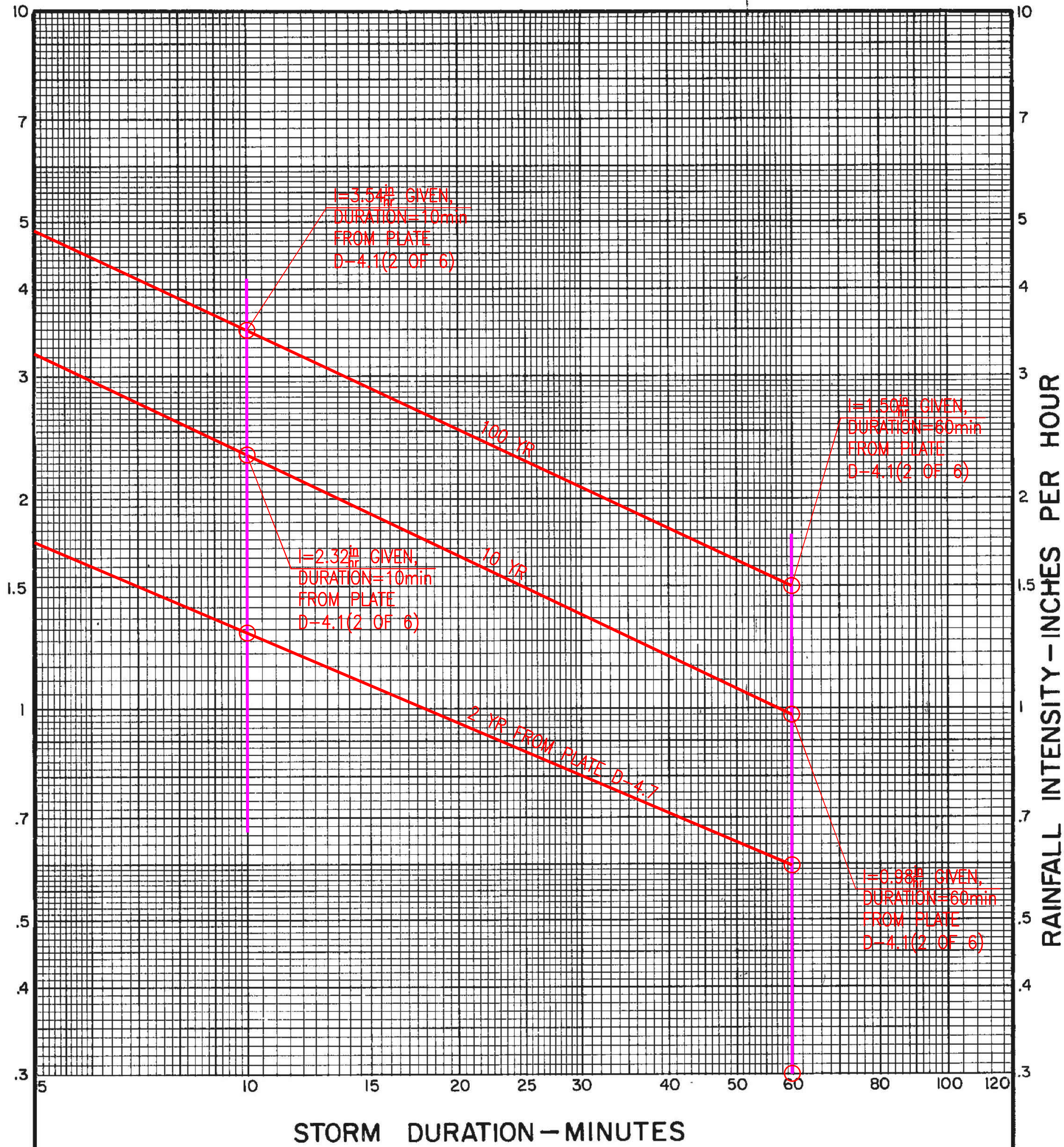
STANDARD INTENSITY - DURATION CURVES DATA

Q16: $I_{10}\approx 2.74\frac{in}{hr}$, $I_{100}\approx 4.20\frac{in}{hr}$: GIVEN, T_c=7.05 Q31: $I_{10}\approx 2.75\frac{in}{hr}$, $I_{100}\approx 4.21\frac{in}{hr}$: GIVEN, T_c=7.00
Q17: $I_{10}\approx 2.48\frac{in}{hr}$, $I_{100}\approx 3.79\frac{in}{hr}$: GIVEN, T_c=8.75 Q32: $I_{10}\approx 2.83\frac{in}{hr}$, $I_{100}\approx 4.34\frac{in}{hr}$: GIVEN, T_c=6.60
Q18: $I_{10}\approx 2.91\frac{in}{hr}$, $I_{100}\approx 4.45\frac{in}{hr}$: GIVEN, T_c=6.25 Q33: $I_{10}\approx 2.63\frac{in}{hr}$, $I_{100}\approx 4.03\frac{in}{hr}$: GIVEN, T_c=7.70
Q19: $I_{10}\approx 2.65\frac{in}{hr}$, $I_{100}\approx 4.05\frac{in}{hr}$: GIVEN, T_c=7.60 Q34: $I_{10}\approx 2.58\frac{in}{hr}$, $I_{100}\approx 3.95\frac{in}{hr}$: GIVEN, T_c=8.00
Q20: $I_{10}\approx 2.42\frac{in}{hr}$, $I_{100}\approx 3.69\frac{in}{hr}$: GIVEN, T_c=9.20 Q35: $I_{10}\approx 3.10\frac{in}{hr}$, $I_{100}\approx 4.74\frac{in}{hr}$: GIVEN, T_c=5.50
Q21: $I_{10}\approx 3.50\frac{in}{hr}$, $I_{100}\approx 5.71\frac{in}{hr}$: GIVEN, T_c=3.80 Q36: $I_{10}\approx 3.41\frac{in}{hr}$, $I_{100}\approx 5.20\frac{in}{hr}$: GIVEN, T_c=4.50
Q22: $I_{10}\approx 2.86\frac{in}{hr}$, $I_{100}\approx 4.37\frac{in}{hr}$: GIVEN, T_c=6.50 Q37: $I_{10}\approx 3.12\frac{in}{hr}$, $I_{100}\approx 4.78\frac{in}{hr}$: GIVEN, T_c=5.40
Q23: $I_{10}\approx 2.80\frac{in}{hr}$, $I_{100}\approx 4.29\frac{in}{hr}$: GIVEN, T_c=6.75 Q38: $I_{10}\approx 2.35\frac{in}{hr}$, $I_{100}\approx 3.59\frac{in}{hr}$: GIVEN, T_c=9.75

USE Tc=27.5min (FROM Q6, PLATE D-3) FOR DURATION SINCE IT IS THE LONGEST Tc.
INTERPOLATE FOR Tc=27.5:

$\frac{(1.46-1.41)}{(26-28)} \times (27.5-26)+1.46 = X, X\approx 1.42\frac{in}{hr}$ for 10yr

$\frac{(2.24-2.16)}{(26-28)} \times (27.5-26)+2.24 = X, X\approx 2.18\frac{in}{hr}$ for 100yr



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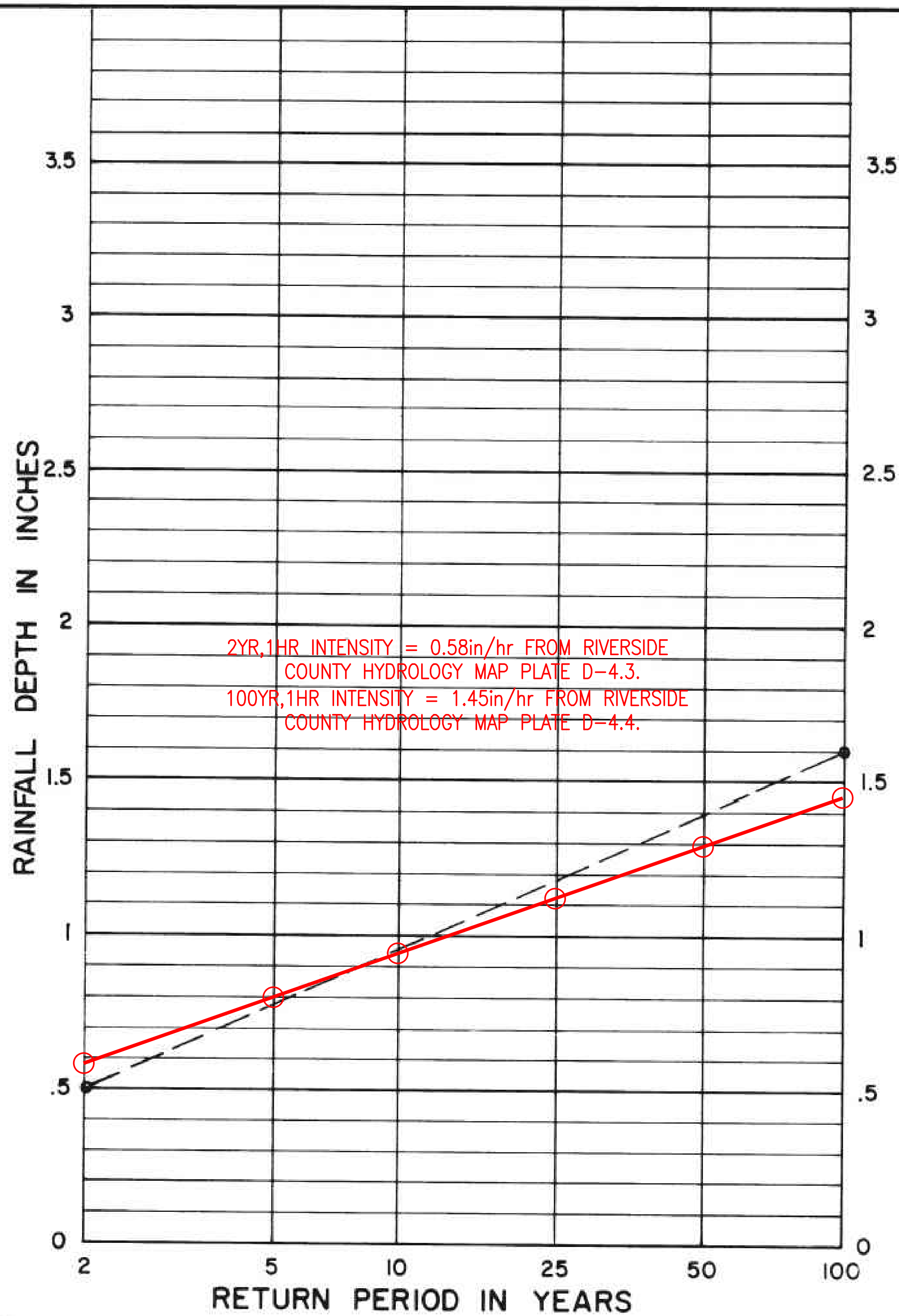
INTENSITY - DURATION CURVES



NOTE:

1. For intermediate return periods plot 2-year and 100-year one hour values from maps, then connect points and read value for desired return period. For example given 2-year one hour = .50" and 100-year one hour = 1.60", 25-year one hour = 1.18"

Reference: NOAA Atlas 2, Volume XI - California, 1973.

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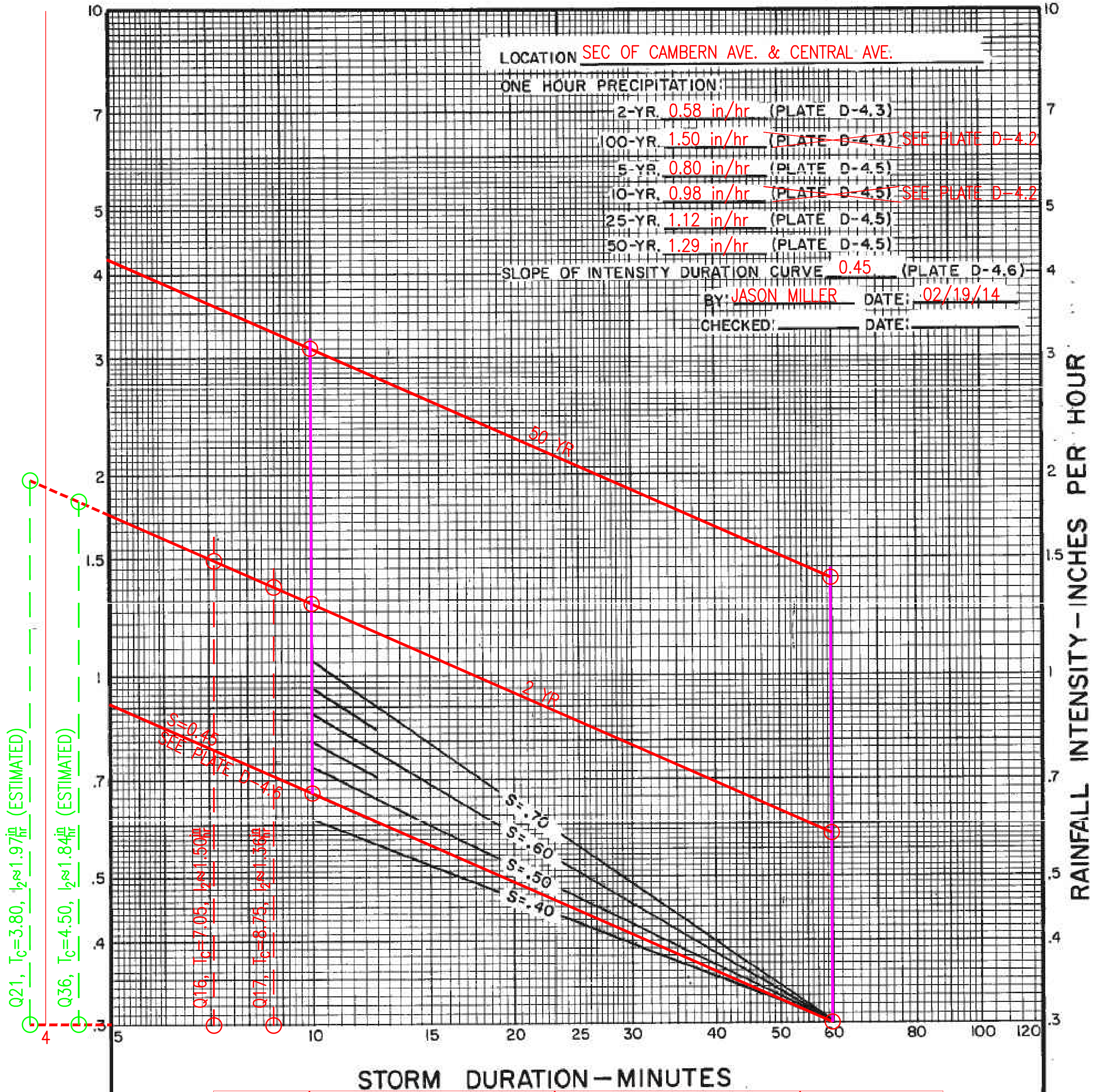
RAINFALL DEPTH VERSUS RETURN PERIOD FOR PARTIAL DURATION SERIES



Q16: $I_2 \approx 1.50 \frac{in}{hr}$: GIVEN, T_c=7.05	Q22: $I_2 \approx 1.56 \frac{in}{hr}$: GIVEN, T_c=6.50	Q35: $I_2 \approx 1.67 \frac{in}{hr}$: GIVEN, T_c=5.50
Q17: $I_2 \approx 1.36 \frac{in}{hr}$: GIVEN, T_c=8.75	Q23: $I_2 \approx 1.52 \frac{in}{hr}$: GIVEN, T_c=6.75	Q36: $I_2 \approx 1.84 \frac{in}{hr}$: GIVEN, T_c=4.50
Q18: $I_2 \approx 1.58 \frac{in}{hr}$: GIVEN, T_c=6.25	Q31: $I_2 \approx 1.50 \frac{in}{hr}$: GIVEN, T_c=7.00	Q37: $I_2 \approx 1.69 \frac{in}{hr}$: GIVEN, T_c=5.40
Q19: $I_2 \approx 1.45 \frac{in}{hr}$: GIVEN, T_c=7.60	Q32: $I_2 \approx 1.55 \frac{in}{hr}$: GIVEN, T_c=6.60	Q38: $I_2 \approx 1.32 \frac{in}{hr}$: GIVEN, T_c=9.75
Q20: $I_2 \approx 1.34 \frac{in}{hr}$: GIVEN, T_c=9.20	Q33: $I_2 \approx 1.45 \frac{in}{hr}$: GIVEN, T_c=7.70	
Q21: $I_2 \approx 1.97 \frac{in}{hr}$: GIVEN, T_c=3.80	Q34: $I_2 \approx 1.43 \frac{in}{hr}$: GIVEN, T_c=8.00	

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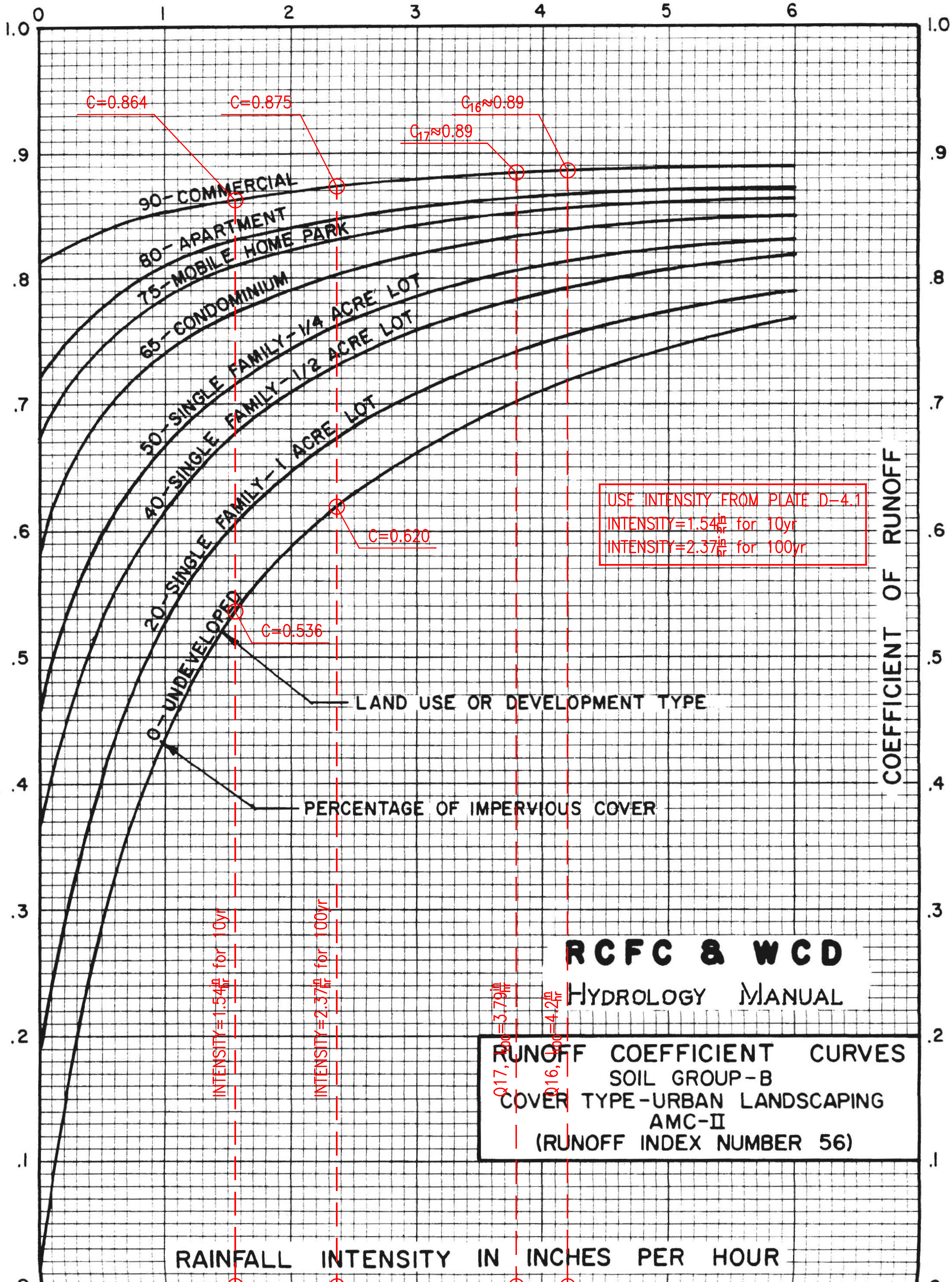
INTENSITY–DURATION CURVES CALCULATION SHEET



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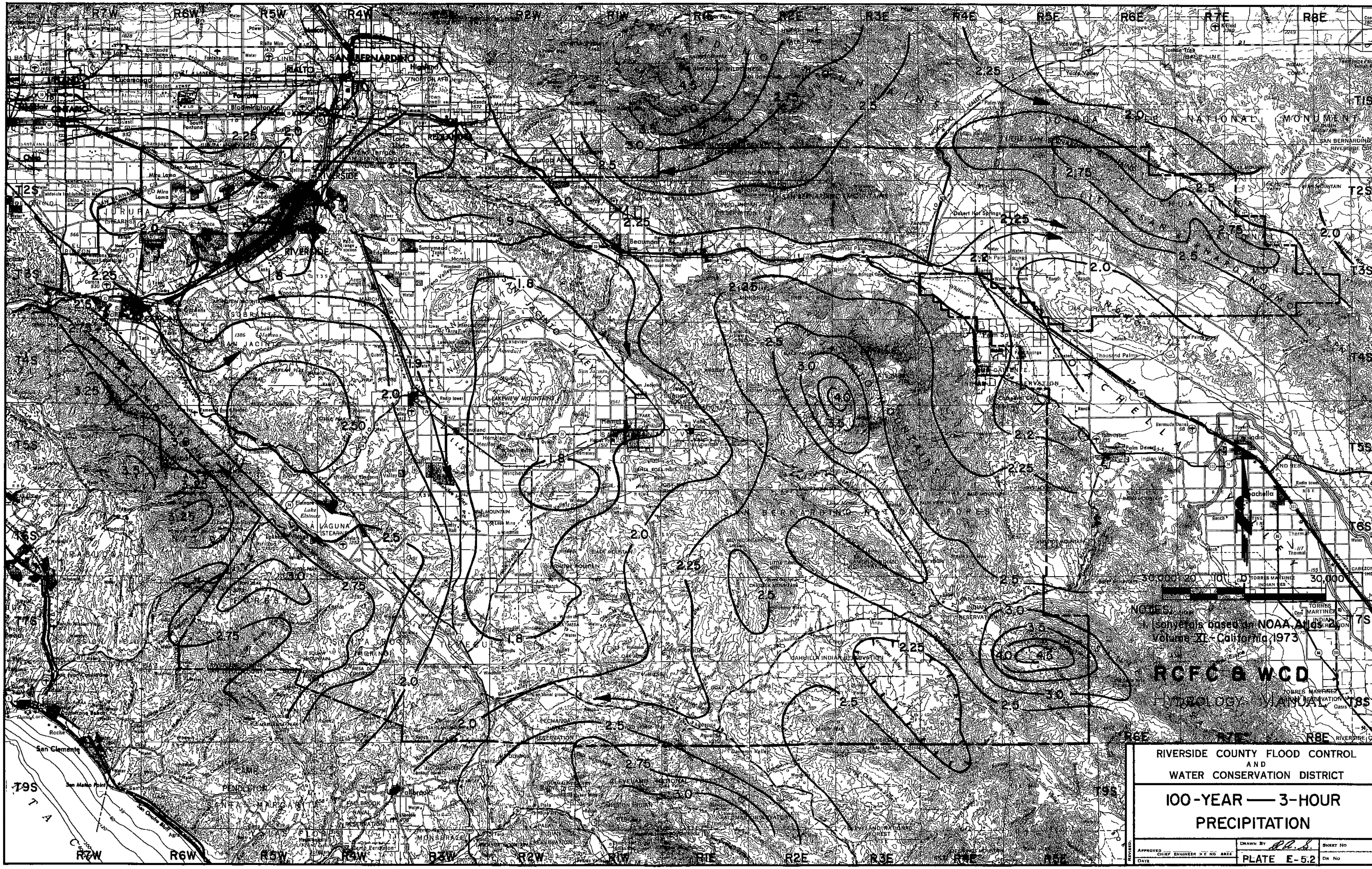
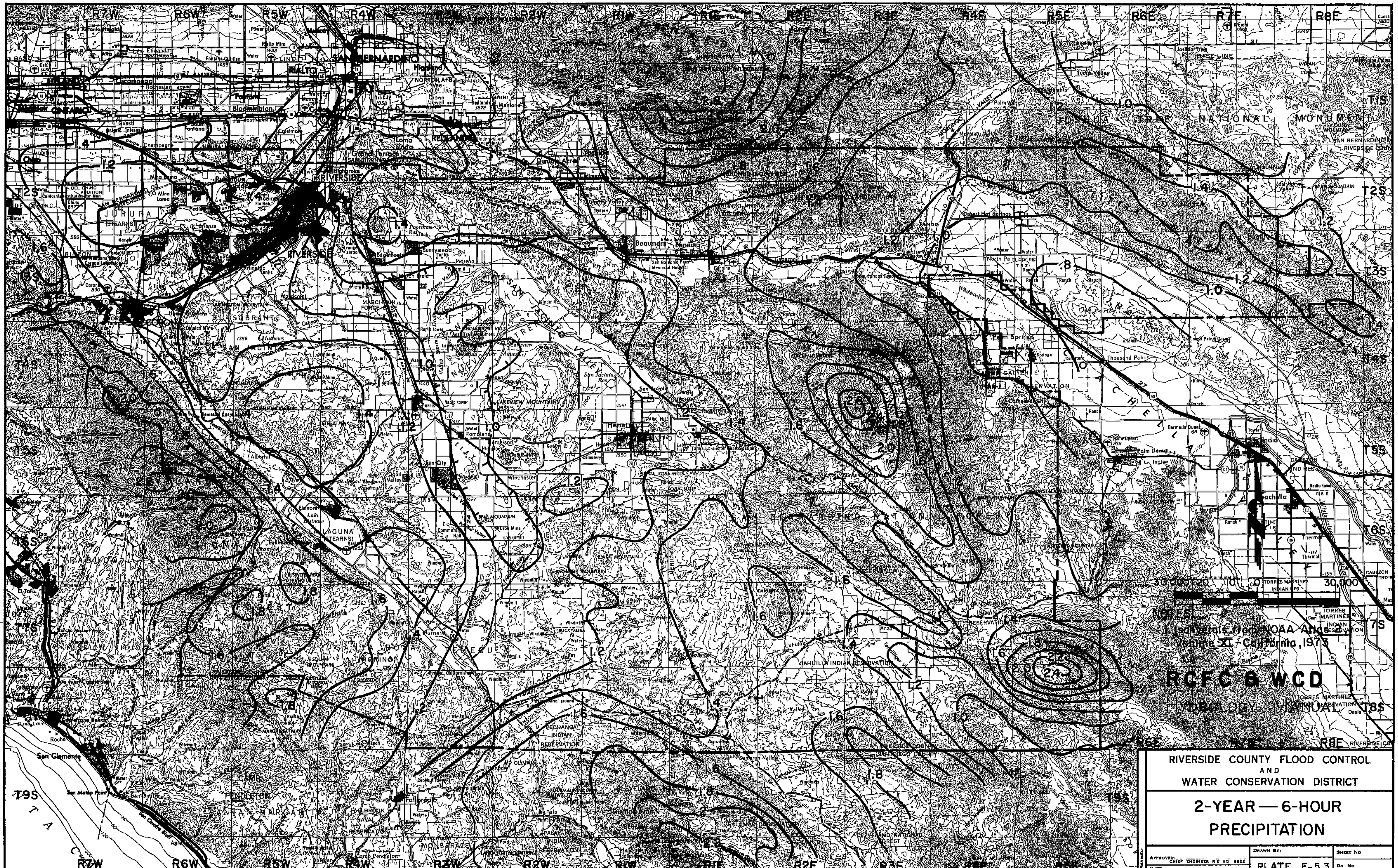
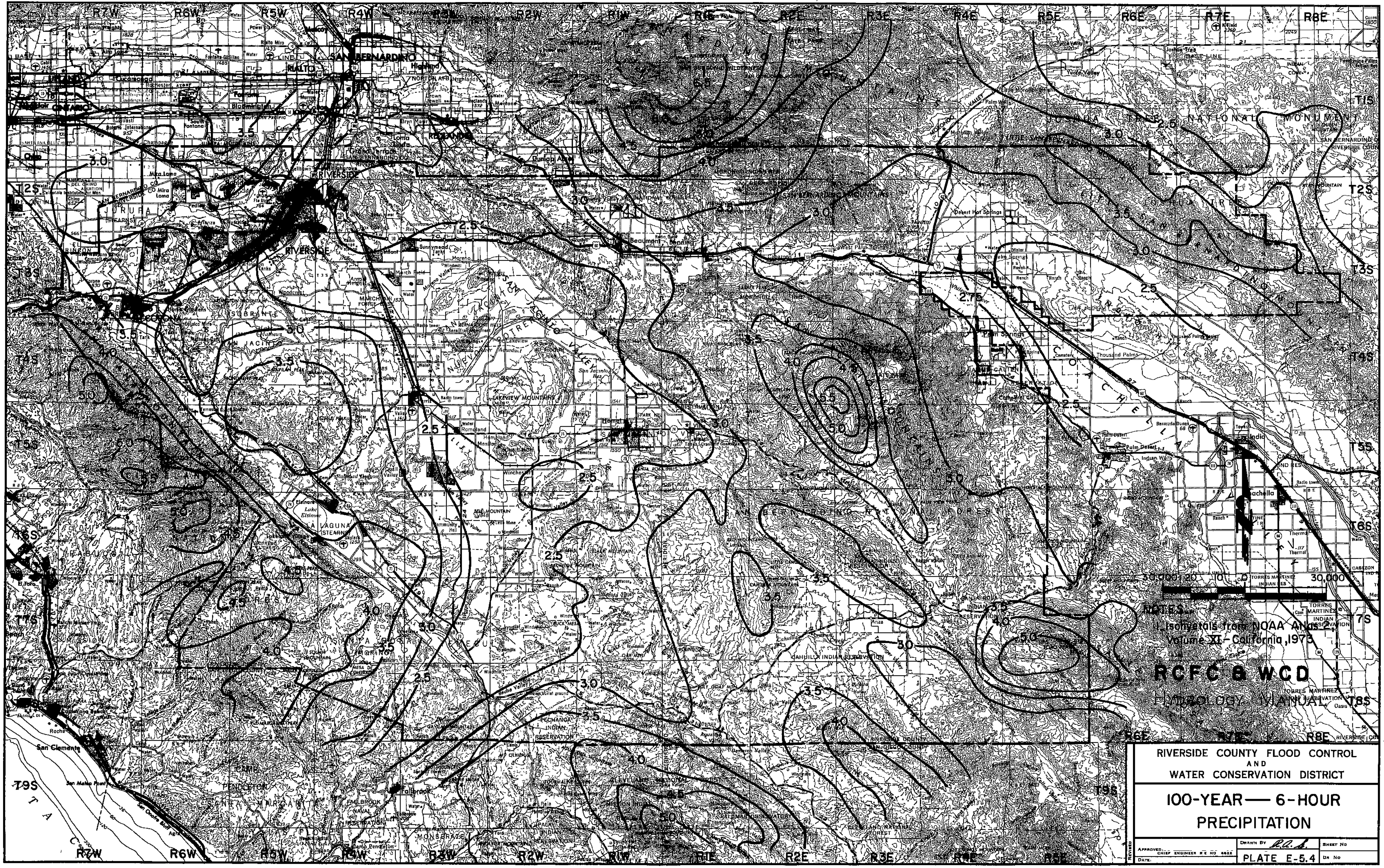
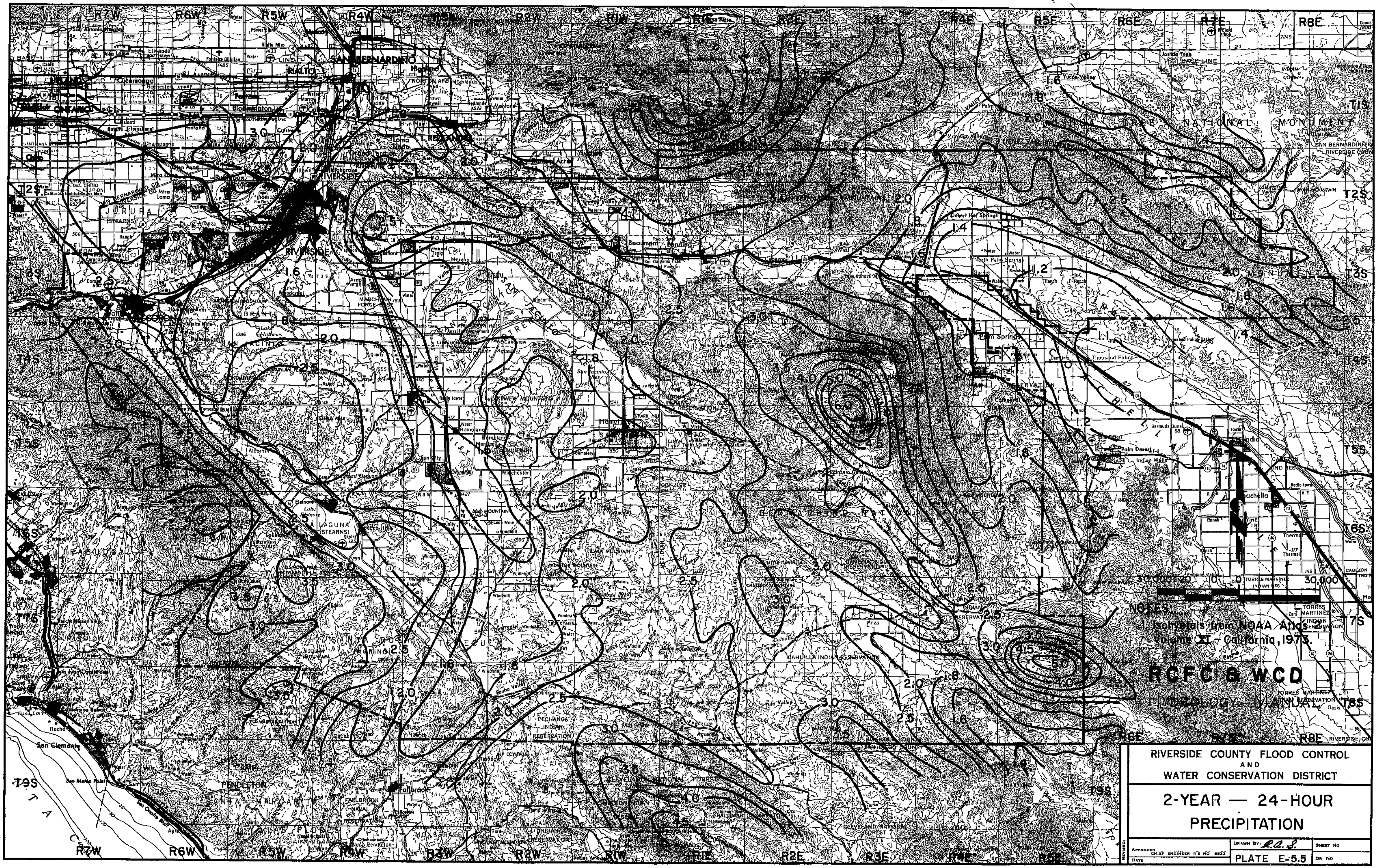
RUNOFF COEFFICIENT CURVES
SOIL GROUP-B
COVER TYPE-URBAN LANDSCAPING
AMC-II
(RUNOFF INDEX NUMBER 56)

PLATE D-5.2


NOTES:
1. Isohyetals based on NOAA Atlas 2, Volume XI - California, 1973
RCFC & WCD
Hydrology Manual
RIVERSIDE COUNTY FLOOD CONTROL
AND
WATER CONSERVATION DISTRICT
100-YEAR — 3-HOUR
PRECIPITATION
PLATE E-5.2


RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
2-YEAR — 6-HOUR PRECIPITATION
PLATE E-5.3
RCFC & WCD
HYDROLOGY MANUAL
NOTES:
Isohyetals from NOAA Atlas Volume XI - California, 1973
APPROVED: CHIEF ENGINEER
DRAWN BY:
SHEET NO
DATE:
REVISED:
DR NO
30,000
20
10
0
30,000
R7W
R6W
R5W
R4W
R3W
R2W
R1W
R1E
R2E
R3E
R4E
R5E
R6E
R7E
R8E
T1S
T2S
T3S
T4S
T5S
T6S
T7S
T8S
T9S
SAN BERNARDINO
RIVERSIDE
JOSHUA TREE NATIONAL MONUMENT
SAN BERNARDINO MOUNTAINS
Beaumont
San Clemente
Fallbrook
Indio
Coachella
Palm Desert
Palm Springs
Hemet
Perris
Corona
Elsinore
LAGUNA (STEARNS)
Sun City
LAKEVIEW MOUNTAINS
Thousand Palms
CAHUILLA INDIAN RESERVATION
TORRES MARTINEZ INDIAN RESERVATION
Ontario
Fontana
Rialto
Bloomington
Colton
Grand Terrace
Moreno
Sunnymead
Romoland
Winchester
Desert Hot Springs
North Palm Springs
Thermal
Cathedral City
Indian Wells
San Jacinto
CAMP PENDLETON
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6


RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
100-YEAR — 6-HOUR PRECIPITATION
PLATE E-5.4
NOTES:
1. Isohyetals from NOAA Atlas 2 Volume XI - California, 1973
RCFC & WCD
HYDROLOGY MANUAL
RIVERSIDE
SAN BERNARDINO
Palm Springs
Hemet
San Clemente
Fallbrook
Beaumont
Indio


NOTES:
1. Isohyetals from NOAA Atlas Volume XI - California, 1973.
RCFC & WCD
HYDROLOGY MANUAL
RIVERSIDE COUNTY FLOOD CONTROL
AND
WATER CONSERVATION DISTRICT
2-YEAR — 24-HOUR
PRECIPITATION
PLATE E-5.5
RIVERSIDE
SAN BERNARDINO
Beaumont
Palm Springs
Indio
Coachella
Thermal
Palm Desert
Hemet
San Clemente
Fallbrook
Desert Hot Springs
Thousand Palms
Bermuda Dunes
Indian Wells
Cathedral City
Redlands
Rialto
Fontana
Ontario
Cucamonga
Lake Elsinore
CAHUILLA INDIAN RESERVATION
PECHANGA INDIAN RESERVATION
TORRES MARTINEZ INDIAN RESERVATION
JOSHUA TREE NATIONAL MONUMENT
SAN BERNARDINO NATIONAL FOREST
CLEVELAND NATIONAL FOREST
CAMP PENDLETON
R7W
R6W
R5W
R4W
R3W
R2W
R1W
R1E
R2E
R3E
R4E
R5E
R6E
R7E
R8E
T1S
T2S
T3S
T4S
T5S
T6S
T7S
T8S
T9S
30,000
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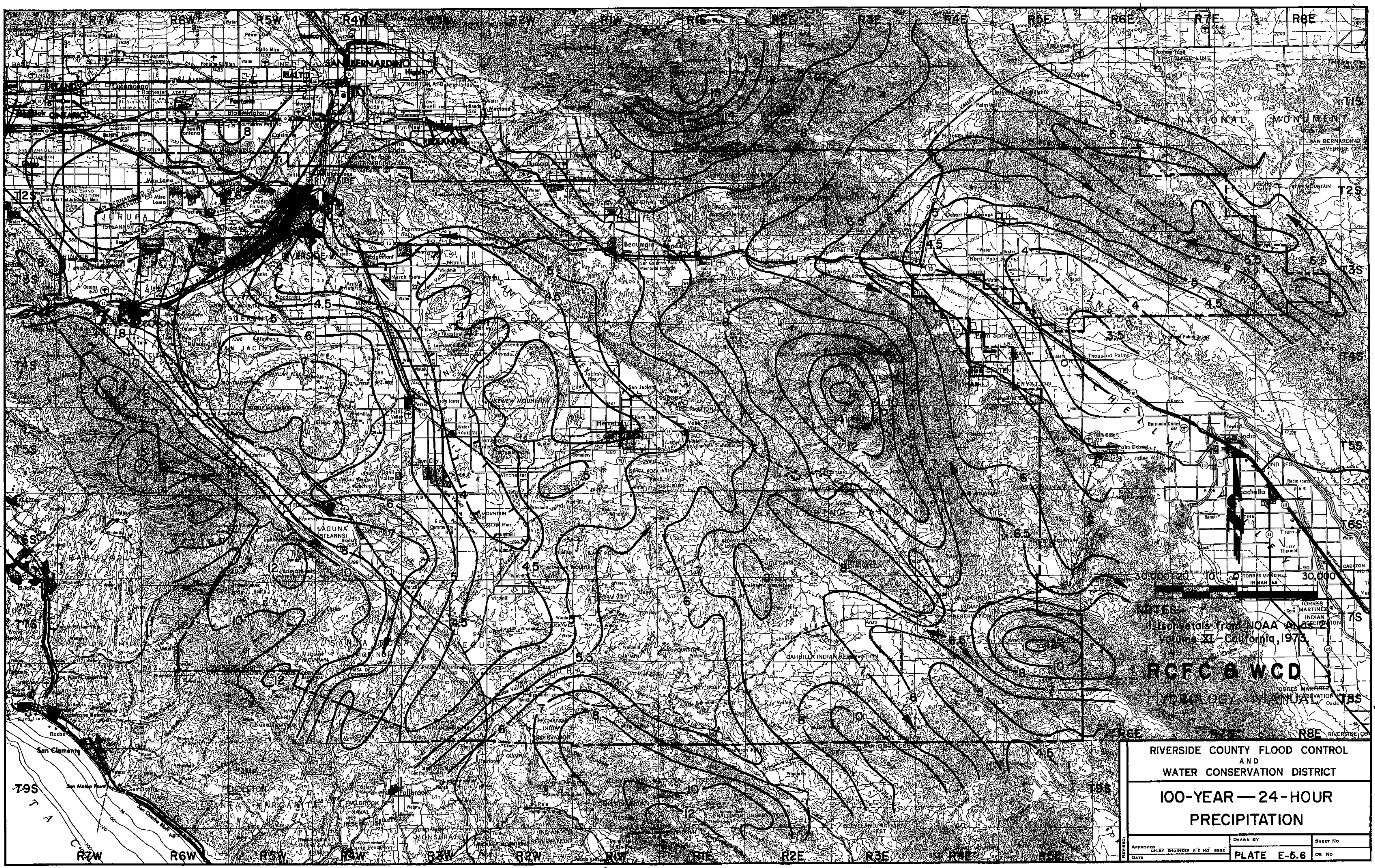
30,000


RIVERSIDE COUNTY FLOOD CONTROL
AND
WATER CONSERVATION DISTRICT
100-YEAR — 24-HOUR
PRECIPITATION
PLATE E-5.6
NOTES:
1. Isohyetals from NOAA Atlas 2
Volume XI - California, 1973.
RCFC & WCD
HYDROLOGY MANUAL
R7W
R6W
R5W
R4W
R3W
R2W
R1W
R1E
R2E
R3E
R4E
R5E
R6E
R7E
R8E
T1S
T2S
T3S
T4S
T5S
T6S
T7S
T8S
T9S
SAN BERNARDINO
RIVERSIDE
Palm Springs
Beaumont
Banning
Hemet
Perris
Coachella
Indio
San Clemente
Fallbrook

RAINFALL PATTERNS IN PERCENT

3-HOUR STORM

TIME PERIOD	5-MIN PERIOD	10-MIN PERIOD	15-MIN PERIOD	30-MIN PERIOD
1	1.3	2.6	3.7	8.5
2	1.3	2.6	4.8	10.0
3	1.1	3.3	5.1	13.9
4	1.5	3.3	4.9	17.4
5	1.5	3.3	6.6	29.9
6	1.8	3.4	7.3	20.3
7	1.5	4.4	8.4	
8	1.8	4.2	9.0	
9	1.8	5.3	12.3	
10	1.5	5.1	17.6	
11	1.6	6.4	16.1	
12	1.8	5.9	4.2	
13	2.2	7.3		
14	2.2	8.5		
15	2.2	14.1		
16	2.0	14.1		
17	2.6	3.8		
18	2.7	2.4		
19	2.4			
20	2.7			
21	3.3			
22	3.1			
23	2.9			
24	3.0			
25	3.1			
26	4.2			
27	5.0			
28	3.5			
29	6.8			
30	7.3			
31	8.2			
32	5.9			
33	2.0			
34	1.8			
35	1.8			
36	.6			

6-HOUR STORM

TIME PERIOD	5-MIN PERIOD	10-MIN PERIOD	15-MIN PERIOD	30-MIN PERIOD
1	.5	1.1	1.7	3.6
2	.6	1.2	1.9	4.3
3	.6	1.3	2.1	4.8
4	.6	1.4	2.2	4.9
5	.6	1.4	2.4	5.3
6	.7	1.5	2.4	5.8
7	.7	1.6	2.4	6.8
8	.7	1.6	2.5	9.0
9	.7	1.6	2.6	11.6
10	.7	1.6	2.7	14.4
11	.7	1.6	2.8	25.1
12	.8	1.7	3.0	4.4
13	.8	1.7	3.2	
14	.8	1.8	3.6	
15	.8	1.8	4.3	
16	.8	1.8	4.7	
17	.8	2.0	5.4	
18	.8	2.0	6.2	
19	.8	2.1	6.9	
20	.8	2.2	7.5	
21	.8	2.5	10.6	
22	.8	2.8	14.5	
23	.8	3.0	3.4	
24	.9	3.2	1.0	
25	.8	3.5		
26	.9	3.9		
27	.9	4.2		
28	.9	4.5		
29	.9	4.8		
30	.9	5.1		
31	.9	6.7		
32	.9	8.1		
33	1.0	10.3		
34	1.0	2.8		
35	1.0	1.1		
36	1.0	.5		
37	1.0			
38	1.1			
39	1.1			
40	1.1			
41	1.2			
42	1.3			
43	1.4			
44	1.4			
45	1.5			
46	1.5			
47	1.6			
48	1.6			

TIME PERIOD	5-MIN PERIOD
49	1.7
50	1.8
51	1.9
52	2.0
53	2.1
54	2.1
55	2.2
56	2.3
57	2.4
58	2.4
59	2.5
60	2.6
61	3.1
62	3.6
63	3.9
64	4.2
65	4.7
66	5.6
67	1.9
68	.9
69	.6
70	.5
71	.3
72	.2

24-HOUR STORM

TIME PERIOD	15-MIN PERIOD	30-MIN PERIOD	60-MIN PERIOD
1	.2	.5	1.2
2	.3	.7	1.3
3	.3	.6	1.8
4	.4	.7	2.1
5	.3	.8	2.8
6	.3	1.0	2.9
7	.3	1.0	3.8
8	.4	1.1	4.6
9	.4	1.3	6.3
10	.4	1.5	8.2
11	.5	1.3	7.0
12	.5	1.6	7.3
13	.5	1.8	10.8
14	.5	2.0	11.4
15	.5	2.1	10.4
16	.6	2.5	8.5
17	.6	3.0	1.4
18	.7	3.3	1.9
19	.7	3.9	1.3
20	.8	4.3	1.2
21	.6	3.0	1.1
22	.7	4.0	1.0
23	.8	3.8	.9
24	.8	3.5	.8
25	.9	5.1	
26	.9	5.7	
27	1.0	6.8	
28	1.0	4.6	
29	1.0	5.3	
30	1.1	5.1	
31	1.2	4.7	
32	1.3	3.8	
33	1.5	.8	
34	1.5	.6	
35	1.6	1.0	
36	1.7	.9	
37	1.9	.8	
38	2.0	.5	
39	2.1	.7	
40	2.2	.5	
41	1.5	.6	
42	1.5	.5	
43	2.0	.5	
44	2.0	.5	
45	1.9	.5	
46	1.9	.4	
47	1.7	.4	
48	1.8	.4	

TIME PERIOD	15-MIN PERIOD
49	2.5
50	2.6
51	2.8
52	2.9
53	3.4
54	3.4
55	2.3
56	2.3
57	2.7
58	2.6
59	2.6
60	2.5
61	2.4
62	2.3
63	1.9
64	1.9
65	.4
66	.4
67	.3
68	.3
69	.5
70	.5
71	.5
72	.4
73	.4
74	.4
75	.3
76	.2
77	.3
78	.4
79	.3
80	.2
81	.3
82	.3
83	.3
84	.2
85	.3
86	.2
87	.3
88	.2
89	.3
90	.2
91	.2
92	.2
93	.2
94	.2
95	.2
96	.2

NOTES:

1. 3 and 6-hour patterns based on the Indio area thunderstorm of September 24,1939.
2. 24-hour patterns based on the general storm of March 2 & 3,1938.

RCFC & WCD
HYDROLOGY MANUAL

RAINFALL PATTERNS IN PERCENT

Proposed Concrete Culvert under Cambern Ave.

Rectangular Ditch	Posposed Concrete Culvert under Cambern Ave

Open Channel using Manning' Equation Q=(1.49/n)*(Rh^0.667)*(s^0.5)*A

Q=Flow (cfs)
n= Coefficient pg A37 of CERM (Use 0.013 for unknown pipe material)
Rh=Hydraulic Radius, Use D/4 for circular pipe flowing full or half full
S=Slope of pipe in decimal form
A=cross sectional area of channel (square feet)
D=pipe diameter in inches

Calculation Cell

Solve for:	Flow Q (cfs), Velocity V (ft/sec)	Hydraulic Radius Rh (ft)	Coefficient n (use 0.013)	Slope (in decimal)	Area
Flow	751.6703466	2.25	0.013	0.005	54
Velocity	13.91982123	2.25	0.013	0.005	54

Hydraulic Radius for Proposed Concrete Culvert using Chow's Table

y=depth of ditch (bottom of ditch to high water level)
Rh=Hydraulic Radius (b+y)/(b+2*y) (see Chow's Table for additional shapes)
b=base of ditch

Calculation Cell

Solve for:	Hydraulic Radius Rh (ft)	Depth of ditch y (ft)	Base b (ft)
Rh	2.25	3.00	18

Existing Cambern Ave. V-Ditch Crossing

V-Ditch Calculation	Existing Cambern Ave. V-Ditch Crossing

Open Channel using Manning' Equation Q=(1.49/n)*(Rh^0.667)*(s^0.5)*A

Q=Flow (cfs)
n= Coefficient pg A37 of CERM (Use 0.013 for unknown pipe material)
Rh=Hydraulic Radius, Use D/4 for circular pipe flowing full or half full
S=Slope of pipe in decimal form
A=cross sectional area of channel (square feet)
D=pipe diameter in inches

Calculation Cell

Solve for:	Flow Q (cfs), Velocity V (ft/sec)	Hydraulic Radius Rh (ft)	Coefficient n (use 0.013)	Slope (in decimal)	Area
Flow	429.4391466	0.499506903	0.013	0.0175	45
Velocity	9.543092147	0.499506903	0.013	0.0175	45

Hydraulic Radius for Existing Cambern Ave. V-Ditch Crossing using Chow's Table

y=depth of v-ditch
z=the inverse of the slope of the sides z=(x/y)
Rh=Hydraulic Radius (z*y)/(2*(1+z^2)^.5) (see Chow's Table for additional shapes)

Calculation Cell

Solve for:	Hydraulic Radius Rh (ft)	Depth of v-ditch y (ft)	Width of Ditch	z
Rh	0.499506903	1.00	45	22.5

The depression crossing Cambern Ave. is approximately 1' deep and will flow 45' wide until the water spills over and continues east on Cambern. It then flows south onto the site and then south on Third St.

OPEN CHANNEL DEWATERING/OUTFLOW PIPES	
VARIABLES	
C = Orifice Coefficient (0.66)	0.66
Number of orifices (qty)	4
A= Area of orifice (SF)	0.05
A total = Total Area of all orifices (SF)	**0.20**
Orifice Diameter (inches)	3.0000
Stage height (ft)	0.33
g = gravity ft²/s	32.20
Ho = Orifice Elev at centerline (ft)	1295.23
Min Orifice Invert (ft)	1295.10
Qt = Flow with water level at top of orifice	0.37
Bottom of Basin (ft)	1295.00
Top of orifice (ft)	1295.35

ORIFICE DISCHARGE (Q) & VELOCITY VS HYDRAULIC HEAD (Depth)

Note: If H (Water Surface Elevation) is below the CL of the orifice, then the orifice is not under pressure and is said to have no head. A straight line interpolation is preformed by the following equation. Qu (Q unsubmerged) is calculated by the equation Qu = Qt x (Hu/Ht). Where, Qt = Full discharge at Ht, Hu = Unsubmerged head, & Ht = Height of orifice opening.

Depth is measured from the orifice invert elevation

Head is measured from the orifice center line elevation

STAGE	HEAD (ft)	DISCHARGE Q (ft³/s)	Velocity (ft/s)	Depth (ft)
1				0.33
	0.10	0.18	0.94	
2				0.67
	0.44	0.69	3.50	
3				1.00
	0.77	0.91	4.65	
4				1.33
	1.10	1.09	5.56	
5				1.67
	1.44	1.25	6.35	
6				2.00
	1.77	1.38	7.05	
7				2.33
	2.10	1.51	7.68	
8				2.66
	2.44	1.62	8.27	
9				3.00
	2.77	1.73	8.81	
10				3.33
	3.10	1.83	9.33	
11				3.66
	3.43	1.93	9.82	
12				4.00
	3.77	2.02	10.28	
13				4.33

	4.10	2.10	10.73	
14				4.66
	4.43	2.19	11.15	
15				5.00
	4.77	2.27	11.56	

STAGE 1 = ORIFICE CL+0.1'

Q = Orifice Discharge (ft³/s)	0.18	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 10
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	0.20	
Orifice Diameter (inches)	3.00	
g = gravity ft²/s	32.20	
H = Water Surface Elev (ft)	1295.33	
Ho = Orifice Elev at centerline (ft)	1295.23	
Min Orifice Invert (ft)	1295.10	
Top of orifice (ft)	1295.35	

STAGE 2 = ORIFICE CL+0.44'

Q = Orifice Discharge (ft³/s)	0.69	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 10
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	0.20	
Orifice Diameter (inches)	3.00	
g = gravity ft²/s	32.20	
H = Water Surface Elev (ft)	1295.67	
Ho = Orifice Elev at centerline (ft)	1295.23	
Min Orifice Invert (ft)	1295.10	
Top of orifice (ft)	1295.35	

STAGE 3 = ORIFICE CL+0.77'

Q = Orifice Discharge (ft³/s)	0.91	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 10
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	0.20	
Orifice Diameter (inches)	3.00	
g = gravity ft²/s	32.20	
H = Water Surface Elev (ft)	1296.00	
Ho = Orifice Elev at centerline (ft)	1295.23	
Min Orifice Invert (ft)	1295.10	
Top of orifice (ft)	1295.35	

STAGE 4 = ORIFICE CL+1.1'

Q = Orifice Discharge (ft^3/s)	1.09	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 10
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	0.20	
Orifice Diameter (inches)	3.00	
g = gravity ft^2/s	32.20	
H = Water Surface Elev (ft)	1296.33	
Ho = Orifice Elev at centerline (ft)	1295.23	
Min Orifice Invert (ft)	1295.10	
Top of orifice (ft)	1295.35	

STAGE 5 = ORIFICE CL+1.44'		
Q = Orifice Discharge (ft^3/s)	1.25	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 10
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	0.20	
Orifice Diameter (inches)	3.00	
g = gravity ft^2/s	32.20	
H = Water Surface Elev (ft)	1296.67	
Ho = Orifice Elev at centerline (ft)	1295.23	
Min Orifice Invert (ft)	1295.10	
Top of orifice (ft)	1295.35	

STAGE 6 = ORIFICE CL+1.77'		
Q = Orifice Discharge (ft^3/s)	1.38	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 10
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	0.20	
Orifice Diameter (inches)	3.00	
g = gravity ft^2/s	32.20	
H = Water Surface Elev (ft)	1297.00	
Ho = Orifice Elev at centerline (ft)	1295.23	
Min Orifice Invert (ft)	1295.10	
Top of orifice (ft)	1295.35	

STAGE 7 = ORIFICE CL+2.1'		
Q = Orifice Discharge (ft^3/s)	1.51	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 10
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	0.20	
Orifice Diameter (inches)	3.00	
g = gravity ft^2/s	32.20	
H = Water Surface Elev (ft)	1297.33	
Ho = Orifice Elev at centerline (ft)	1295.23	
Min Orifice Invert (ft)	1295.10	
Top of orifice (ft)	1295.35	

STAGE 8 = ORIFICE CL+2.44'		
Q = Orifice Discharge (ft^3/s)	1.62	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 10
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	0.20	
Orifice Diameter (inches)	3.00	
g = gravity ft^2/s	32.20	
H = Water Surface Elev (ft)	1297.66	
Ho = Orifice Elev at centerline (ft)	1295.23	
Min Orifice Invert (ft)	1295.10	
Top of orifice (ft)	1295.35	

STAGE 9 = ORIFICE CL+2.77'		
Q = Orifice Discharge (ft^3/s)	1.73	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 10
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	0.20	
Orifice Diameter (inches)	3.00	
g = gravity ft^2/s	32.20	
H = Water Surface Elev (ft)	1298.00	
Ho = Orifice Elev at centerline (ft)	1295.23	
Min Orifice Invert (ft)	1295.10	
Top of orifice (ft)	1295.35	

STAGE 10 = ORIFICE CL+3.1'		
Q = Orifice Discharge (ft^3/s)	1.83	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 10
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	0.20	
Orifice Diameter (inches)	3.00	
g = gravity ft^2/s	32.20	
H = Water Surface Elev (ft)	1298.33	
Ho = Orifice Elev at centerline (ft)	1295.23	
Min Orifice Invert (ft)	1295.10	
Top of orifice (ft)	1295.35	

STAGE 11 = ORIFICE CL+3.43'		
Q = Orifice Discharge (ft^3/s)	1.93	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 10
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	0.20	
Orifice Diameter (inches)	3.00	
g = gravity ft^2/s	32.20	
H = Water Surface Elev (ft)	1298.66	

Ho = Orifice Elev at centerline (ft)	1295.23
Min Orifice Invert (ft)	1295.10
Top of orifice (ft)	1295.35

STAGE 12 = ORIFICE CL+3.77'

Q = Orifice Discharge (ft^3/s)	2.02	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 10
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	0.20	
Orifice Diameter (inches)	3.00	
g = gravity ft^2/s	32.20	
H = Water Surface Elev (ft)	1299.00	
Ho = Orifice Elev at centerline (ft)	1295.23	
Min Orifice Invert (ft)	1295.10	
Top of orifice (ft)	1295.35	

STAGE 13 = ORIFICE CL+4.1'

Q = Orifice Discharge (ft^3/s)	2.10	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 10
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	0.20	
Orifice Diameter (inches)	3.00	
g = gravity ft^2/s	32.20	
H = Water Surface Elev (ft)	1299.33	
Ho = Orifice Elev at centerline (ft)	1295.23	
Min Orifice Invert (ft)	1295.10	
Top of orifice (ft)	1295.35	

STAGE 14 = ORIFICE CL+4.43'

Q = Orifice Discharge (ft^3/s)	2.19	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 10
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	0.20	
Orifice Diameter (inches)	3.00	
g = gravity ft^2/s	32.20	
H = Water Surface Elev (ft)	1299.66	
Ho = Orifice Elev at centerline (ft)	1295.23	
Min Orifice Invert (ft)	1295.10	
Top of orifice (ft)	1295.35	

STAGE 15 = ORIFICE CL+4.77'

Q = Orifice Discharge (ft^3/s)	2.27	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 10
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	0.20	
Orifice Diameter (inches)	3.00	
g = gravity ft^2/s	32.20	
H = Water Surface Elev (ft)	1300.00	
Ho = Orifice Elev at centerline (ft)	1295.23	
Min Orifice Invert (ft)	1295.10	
Top of orifice (ft)	1295.35	

Open Channel Calculations

Trapazoidal Ditch	Open Channel (Eastern property line of project site)

Open Channel using Manning' Equation Q=(1.49/n)*(Rh^0.667)*(s^0.5)*A

Q=Flow (cfs)
n= Coefficient pg A37 of CERM (Use 0.013 for unknown pipe material)
Rh=Hydraulic Radius, Use D/4 for circular pipe flowing full or half full
S=Slope of pipe in decimal form
A=cross sectional area of channel (square feet)
D=pipe diameter in inches

Calculation Cell

Solve for:	Flow Q (cfs), Velocity V (ft/sec)	Hydraulic Radius Rh (ft)	Coefficient n (use 0.013)	Slope (in decimal)	Area
Flow	711.7431534	2.431855476	0.025	0.0075	76.23
Velocity	9.33678543	2.431855476	0.025	0.0075	76.23

Hydraulic Radius for Trapazoidal Ditch using Chow's Table

y=depth of ditch (bottom of ditch to high water level)
z=the inverse of the slope of the sides z=(x/y)
Rh=Hydraulic Radius (b+zy)/(b+(2y*(1+z^2)^0.5) (see Chow's Table for additional shapes)
b=base of ditch

Calculation Cell

Solve for:	Hydraulic Radius Rh (ft)	Depth of ditch y (ft)	Base b (ft)	z
Rh	2.431855476	3.33	20	3.003003003

Contracted Weir	Third St. Spillways (Spillways on eastern side of Open Channel) 100-Year Storm Condition

Contracted Rectangular Weir using Equation 19.47 from CERM 10th ed Q=(0.667*b)*(2*g)^2*((H+(v^2/(2*g))^1.5)-(v^2/(2*g))^1.5)

Q=Flow (cfs)
v= velocity of flow into weir (ft/s)
b=width of weir at base (ft)
H=Total hydraulic head (depth of flow in weir at weir entrance) (ft)
g=acceleration due to gravity (use 32.2 ft/s^2)

Total Spillways: 5

Calculation Cell

Total Spillway Flow: 697.8909453

Solve for:	Flow Q (cfs), Velocity V (ft/sec)	Velocity (v)	Hydraulic Head (H)	Base (b)	Gravity (g)
Flow	139.5781891	9.33678543	0.67	20	32.2

Contracted Weir	Third St. Spillways (Spillways on east side of Open Channel) Minimum depth to handle 2yr, 3hr storm

Contracted Rectangular Weir using Equation 19.47 from CERM 10th ed Q=(0.667*b)*(2*g)^2*((H+(v^2/(2*g))^1.5)-(v^2/(2*g))^1.5)

Q=Flow (cfs)
v= velocity of flow into weir (ft/s)
b=width of weir at base (ft)
H=Total hydraulic head (depth of flow in weir at weir entrance) (ft)
g=acceleration due to gravity (use 32.2 ft/s^2)

Total Spillways: 5

Calculation Cell

Total Spillway Flow: 264.406518

Solve for:	Flow Q (cfs), Velocity V (ft/sec)	Velocity (v)	Hydraulic Head (H)	Base (b)	Gravity (g)
Flow	52.8813036	9.33678543	0.27	20	32.2

Proposed Third St. Cross-gutter West to East Crossing

V-Ditch Calculation	Proposed Third St. V-Ditch West to East Crossing

Open Channel using Manning' Equation Q=(1.49/n)*(Rh^0.667)*(s^0.5)*A

Q=Flow (cfs)
n= Coefficient pg A37 of CERM (Use 0.013 for unknown pipe material)
Rh=Hydraulic Radius, Use D/4 for circular pipe flowing full or half full
S=Slope of pipe in decimal form
A=cross sectional area of channel (square feet)
D=pipe diameter in inches

Calculation Cell

Solve for:	Flow Q (cfs), Velocity V (ft/sec)	Hydraulic Radius Rh (ft)	Coefficient n (use 0.013)	Slope (in decimal)	Area
Flow	332.320743	0.299983669	0.013	0.0088	69
Velocity	4.816242651	0.299983669	0.013	0.0088	69

Hydraulic Radius for Proposed Third St. Cross-gutter West to East Crossing using Chow's Table

y=depth of v-ditch
z=the inverse of the slope of the sides z=(x/y)
Rh=Hydraulic Radius (z*y)/(2*(1+z^2)^.5) (see Chow's Table for additional shapes)

Calculation Cell

Solve for:	Hydraulic Radius Rh (ft)	Depth of v-ditch y (ft)	Width of Ditch	z
Rh	0.299983669	0.60	115	95.83333333

The Proposed Third St. Cross-gutter West to East Crossing will be sized to accommodate the 100-year, 3hr peak discharge from the Third St. Spillways (697cfs)and the post-developed runoff from Cambern Ave. Q26 (56cfs) minus the pre-developed flow across the property abutting the southeast corner of the project property Q10 (423.9cfs). The proposed Third St. Cross-gutter West to East Crossing will be 0.6' deep, 115' wide and will convey a minimum of 331.83cfs of storm water discharge from the Open Channel's Third St. Spillways and runoff from Cambern Ave. to flow west to east across Third St., maintain the existing drainage pattern. The cross-gutter will convey 331.83 cfs and then overtop allowing the remaining 423.9cfs to discharge to Third St south of the cross-gutter.

Exisiting Ditch On East side of Third St.

Trapazoidal Ditch	Existing Ditch on East side of Third St.

Open Channel using Manning' Equation Q=(1.49/n)*(Rh^0.667)*(s^0.5)*A

Q=Flow (cfs)

n= Coefficient pg A37 of CERM (Use 0.013 for unknown pipe material)

Rh=Hydraulic Radius, Use D/4 for circular pipe flowing full or half full

S=Slope of pipe in decimal form

A=cross sectional area of channel (square feet)

D=pipe diameter in inches

Calculation Cell

Solve for:	Flow Q (cfs), Velocity V (ft/sec)	Hydraulic Radius Rh (ft)	Coefficient n (use 0.013)	Slope (in decimal)	Area
Flow	619.915654	1.394213295	0.03	0.01	100
Velocity	6.19915654	1.394213295	0.03	0.01	100

Hydraulic Radius for Trapazoidal Ditch using Chow's Table

y=depth of ditch (bottom of ditch to high water level)

z=the inverse of the slope of the sides z=(x/y)

Rh=Hydraulic Radius (b+zy)/(b+(2y*(1+z^2)^0.5) (see Chow's Table for additional shapes)

b=base of ditch

Calculation Cell

Solve for:	Hydraulic Radius Rh (ft)	Depth of ditch y (ft)	Base b (ft)	z
Rh	1.394213295	2.00	7	1.75

Third St. 8" Curb Between Southern Propery Line of Project Site and Dexter Ave.

Gutter Flow	Third St. 8" Curb from southern property to Dexter Ave. for 100yr, 3hr storm				
Manning Equation for gutter flow Q=(0.56/n)*(Sx^1.667)*(S^0.5)*(T^2.667)					

Q=Flow (cfs)
n= Coefficient (Use 0.016 for rough asphalt)
Sx= Cross sectional slope of street (in decimal form)
S= Longitudinal slope (in decimal form)
T=width of flow (ft)

Calculation Cell

Solve for:	Flow Q (cfs), Velocity V (ft/sec)	Coefficient n (0.016)	Cross Sectional Slope Sx	Slope S	Width T
Flow	**20.0186154**	0.016	0.0158	0.0144	24

Contracted Weir	Third St. Centerline Overflow (Overflow across CL between southern property to Dexter Ave.) for 100yr, 3hr storm				
Contracted Rectangular Weir using Equation 19.47 from CERM 10th ed Q=(0.667*b)*(2*g)^2*((H+(v^2/(2*g))^1.5)-(v^2/(2*g))^1.5)					

Q=Flow (cfs)
v= velocity of flow into weir (ft/s)
b=width of weir at base (ft)
H=Total hydraulic head (depth of flow in weir at weir entrance) (ft)
g=acceleration due to gravity (use 32.2 ft/s^2)

Calculation Cell

Solve for:	Flow Q (cfs), Velocity V (ft/sec)	Velocity (v)	Hydraulic Head (H)	Base (b)	Gravity (g)
Flow	**422.4415509**	0	0.29	505.36	32.2

During a 100-yr, 3hr storm event, 423.9cfs will overtop the south side of the Third St. Cross-gutter and continue south along the west side of Third St where it will converge with (Q25) 12.7cfs of storm water runoff from the three lots on the west side of Third St. between the project site and Dexter Ave. The proposed Third St. 8" gutter will fill to a depth of 8" at the flow line from the project site's southern property line to Dexter Ave. The 8" curb and gutter will convey 20.018cfs south on Third St. where it will enter Dexter Ave., flow east and join the current drainage pattern approximately 330' east of Third St. The remaining 416.58cfs will spill over 505.36' of the Third St. centerline and maintain the current drainage pattern. The 416.58cfs will be distributed evenly along the 505.36' of Third St. centerline.

Proposed 30" Crane St. Storm Drain

Circular Pipe	Proposed 30" Crane St. Storm Drain

Storm Drain Pipe using Manning Equation Q=((s^.5/n)*(D/16)^2.667)

Q=Flow (cfs)
n= Coefficient pg A37 of CERM (Use 0.013 for unknown pipe material)
D=pipe diameter in inches
S=Slope of pipe in decimal form
Existing Q to 36" pipe = 40 (cfs) from Hydrology Map Plate 60

Capacity after project	**7.061223553**
Available Capacity	**18.16557666**
Existing Flow in to SD	**40**
Calculation Cell	

Solve for:	Flow Q (cfs)	Diameter D (inches)	Coefficient n (use 0.013)	Slope (in decimal)
Flow	**58.16557666**	30	0.013	0.02
Pipe Diameter		**0**		0.02
Slope				**#DIV/0!**

The available capacity after the project was calculated by taking the assumed maximum capacity of the existing 30" pipe (58.166cfs), subtracting the existing flow to the storm drain (40cfs from "Plate 60" see Appendix D), the Underground Storage Outflow Pipe (10.144cfs), the Detention Basin Outflow Pipe (1.786cfs), and the Open Channel Outflow Pipe (6.230cfs)

Under Gound Storage Outflow Pipe

Circular Pipe	Underground Storage Outflow Pipe

Storm Drain Pipe using Manning Equation Q=((s^.5/n)*(D/16)^2.667)

Q=Flow (cfs)
n= Coefficient pg A37 of CERM (Use 0.013 for unknown pipe material)
D=pipe diameter in inches
S=Slope of pipe in decimal form

Calculation Cell

Solve for:	Flow Q (cfs)	Diameter D (inches)	Coefficient n (use 0.013)	Slope (in decimal)
Flow	**11.10435311**	24.828	0.013	0.002
Pipe Diameter		**#DIV/0!**		
Slope				**#DIV/0!**

A 24” outflow pipe with a 0.2% slope will connect to the proposed 30” storm drain at Crane St. The Max flow will be restricted to ±18.06cfs by a 17.4” diameter orifice restrictor plate. Currently the proposed 24” underground storage outflow pipe is connected at the flowline of a 60” diameter storage pipe. The average flow through the 24” outflow pipe/restrictor plate is ±11.10cfs. Flow through the orifice restrictor plate ranged from 3.72cfs (no head) to 18.06cfs (±4.25ft of head). Due to the preliminary nature of this report, the average flow through the orifice was used for simplicity.

References:

CERM = *Civil Engineering Reference Manual For the PE Exam* , Tenth Edition, by Michael R. Lindeburg, PE, Copyright 2006
Chow's Table = from *Open Channel Hydraulics* , by Ven Te Chow, copyright 1959

UNDERGROUND STORAGE OUTFLOW ORIFICE RESTRICTOR PLATE	
VARIABLES	
C = Orifice Coefficient (0.66)	0.66
Number of Orifices (qty)	1
A= Area of Orifice (SF)	1.65
A total = Total Area of all orifices (SF)	**1.65**
Orifice Diameter (inches)	17.4000
Stage height (ft)	0.33
g = gravity ft²/s	32.20
Ho = Orifice Elev at centerline (ft)	1295.73
Min Orifice Invert (ft)	1295.00
Qt = Flow with water level at top of orifice	7.44
Bottom of Basin (ft)	1295.00
Top of orifice (ft)	1296.45

ORIFICE DISCHARGE (Q) & VELOCITY VS HYDRAULIC HEAD (Depth)

Note: If H (Water Surface Elevation) is below the CL of the orifice, then the orifice is not under pressure and is said to have no head. A straight line interpolation is preformed by the following equation. Qu (Q unsubmerged) is calculated by the equation Qu = Qt x (Hu/Ht). Where, Qt = Full discharge at Ht, Hu = Unsubmerged head, & Ht = Height of orifice opening.

Depth is measured from the orifice invert elevation

Head is measured from the orifice center line elevation

STAGE	HEAD (ft)	DISCHARGE Q (ft^3/s)	Velocity (ft/s)	Depth (ft)
1				0.33
	0	3.72	2.25	
2				0.67
	0	3.72	2.25	
3				1.00
	0.27	3.72	2.25	
4				1.33
	0.61	3.72	2.25	
5				1.67
	0.94	8.48	5.14	
6				2.00
	1.27	9.86	5.98	
7				2.33
	1.61	11.08	6.71	
8				2.66
	1.94	12.17	7.38	
9				3.00
	2.27	13.18	7.98	
10				3.33
	2.61	14.11	8.55	
11				3.66
	2.94	14.98	9.08	
12				4.00
	3.27	15.81	9.58	
13				4.33

	3.60	16.60	10.05	
14				4.66
	3.94	17.35	10.51	
15				5.00
	4.27	18.06	10.94	

STAGE 1 = ORIFICE CL-0.39'

Q = Orifice Discharge (ft³/s)	3.72	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 1(
C = Orifice Coefficient (0.66)	0.66	
A= Area of Orifice (SF)	1.65	
Orifice Diameter (inches)	17.40	
g = gravity ft²/s	32.20	
H = Water Surface Elev (ft)	1295.33	
Ho = Orifice Elev at centerline (ft)	1295.73	
Min Orifice Invert (ft)	1295.00	
Top of Orifice (ft)	1296.45	

STAGE 2 = ORIFICE CL-0.06'

Q = Orifice Discharge (ft³/s)	3.72	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 1(
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	1.65	
Orifice Diameter (inches)	17.40	
g = gravity ft²/s	32.20	
H = Water Surface Elev (ft)	1295.67	
Ho = Orifice Elev at centerline (ft)	1295.73	
Min Orifice Invert (ft)	1295.00	
Top of orifice (ft)	1296.45	

STAGE 3 = ORIFICE CL+0.27'

Q = Orifice Discharge (ft³/s)	3.72	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 1(
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	1.65	
Orifice Diameter (inches)	17.40	
g = gravity ft²/s	32.20	
H = Water Surface Elev (ft)	1296.00	
Ho = Orifice Elev at centerline (ft)	1295.73	
Min Orifice Invert (ft)	1295.00	
Top of orifice (ft)	1296.45	

STAGE 4 = ORIFICE CL+0.61'

Q = Orifice Discharge (ft^3/s)	3.72	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 1(
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	1.65	
Orifice Diameter (inches)	17.40	
g = gravity ft^2/s	32.20	
H = Water Surface Elev (ft)	1296.33	
Ho = Orifice Elev at centerline (ft)	1295.73	
Min Orifice Invert (ft)	1295.00	
Top of orifice (ft)	1296.45	

STAGE 5 = ORIFICE CL+0.94'

Q = Orifice Discharge (ft^3/s)	8.48	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 1(
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	1.65	
Orifice Diameter (inches)	17.40	
g = gravity ft^2/s	32.20	
H = Water Surface Elev (ft)	1296.67	
Ho = Orifice Elev at centerline (ft)	1295.73	
Min Orifice Invert (ft)	1295.00	
Top of orifice (ft)	1296.45	

STAGE 6 = ORIFICE CL+1.27'

Q = Orifice Discharge (ft^3/s)	9.86	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 1(
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	1.65	
Orifice Diameter (inches)	17.40	
g = gravity ft^2/s	32.20	
H = Water Surface Elev (ft)	1297.00	
Ho = Orifice Elev at centerline (ft)	1295.73	
Min Orifice Invert (ft)	1295.00	
Top of orifice (ft)	1296.45	

STAGE 7 = ORIFICE CL+1.61'

Q = Orifice Discharge (ft^3/s)	11.08	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 1(
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	1.65	
Orifice Diameter (inches)	17.40	
g = gravity ft^2/s	32.20	
H = Water Surface Elev (ft)	1297.33	
Ho = Orifice Elev at centerline (ft)	1295.73	
Min Orifice Invert (ft)	1295.00	
Top of orifice (ft)	1296.45	

STAGE 8 = ORIFICE CL+1.94'		
Q = Orifice Discharge (ft³/s)	12.17	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 1(
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	1.65	
Orifice Diameter (inches)	17.40	
g = gravity ft²/s	32.20	
H = Water Surface Elev (ft)	1297.66	
Ho = Orifice Elev at centerline (ft)	1295.73	
Min Orifice Invert (ft)	1295.00	
Top of orifice (ft)	1296.45	

STAGE 9 = ORIFICE CL+2.27'		
Q = Orifice Discharge (ft³/s)	13.18	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 1(
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	1.65	
Orifice Diameter (inches)	17.40	
g = gravity ft²/s	32.20	
H = Water Surface Elev (ft)	1298.00	
Ho = Orifice Elev at centerline (ft)	1295.73	
Min Orifice Invert (ft)	1295.00	
Top of orifice (ft)	1296.45	

STAGE 10 = ORIFICE CL+2.61'		
Q = Orifice Discharge (ft³/s)	14.11	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 1(
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	1.65	
Orifice Diameter (inches)	17.40	
g = gravity ft²/s	32.20	
H = Water Surface Elev (ft)	1298.33	
Ho = Orifice Elev at centerline (ft)	1295.73	
Min Orifice Invert (ft)	1295.00	
Top of orifice (ft)	1296.45	

STAGE 11 = ORIFICE CL+2.94'		
Q = Orifice Discharge (ft³/s)	14.98	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 1(
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	1.65	
Orifice Diameter (inches)	17.40	
g = gravity ft²/s	32.20	
H = Water Surface Elev (ft)	1298.66	

Ho = Orifice Elev at centerline (ft)	1295.73
Min Orifice Invert (ft)	1295.00
Top of orifice (ft)	1296.45

STAGE 12 = ORIFICE CL+3.27'

Q = Orifice Discharge (ft³/s)	15.81	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 1(
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	1.65	
Orifice Diameter (inches)	17.40	
g = gravity ft²/s	32.20	
H = Water Surface Elev (ft)	1299.00	
Ho = Orifice Elev at centerline (ft)	1295.73	
Min Orifice Invert (ft)	1295.00	
Top of orifice (ft)	1296.45	

STAGE 13 = ORIFICE CL+3.6'		
Q = Orifice Discharge (ft³/s)	16.60	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 1(
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	1.65	
Orifice Diameter (inches)	17.40	
g = gravity ft²/s	32.20	
H = Water Surface Elev (ft)	1299.33	
Ho = Orifice Elev at centerline (ft)	1295.73	
Min Orifice Invert (ft)	1295.00	
Top of orifice (ft)	1296.45	

STAGE 14 = ORIFICE CL+3.94'		
Q = Orifice Discharge (ft³/s)	17.35	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 1(
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	1.65	
Orifice Diameter (inches)	17.40	
g = gravity ft²/s	32.20	
H = Water Surface Elev (ft)	1299.66	
Ho = Orifice Elev at centerline (ft)	1295.73	
Min Orifice Invert (ft)	1295.00	
Top of orifice (ft)	1296.45	

STAGE 15 = ORIFICE CL+4.27'		
Q = Orifice Discharge (ft³/s)	18.06	Formula from RCFCD LID Design Manual (pdf pg 71) from Extended Detention Basin Fact Sheet pg 1(
C = Orifice Coefficient (0.66)	0.66	
A= Area of orifice (SF)	1.65	
Orifice Diameter (inches)	17.40	
g = gravity ft²/s	32.20	
H = Water Surface Elev (ft)	1300.00	
Ho = Orifice Elev at centerline (ft)	1295.73	
Min Orifice Invert (ft)	1295.00	
Top of orifice (ft)	1296.45	

Underground Storage 2 year, 3hr Event

Duration	2 yr event (inches)	2 yr Source
3 hour	1.00	Plate E-5.1

Areas	Acreage
Contributing Area (acres)	16.135
Outflow (cfs)	11.104

Period	3 hour percentage (%)	Time (minutes)	Cumulative Vol (cf)	Outflow (cfs)	Inflow (cfs)	Q net (cfs)	Volume Change
1	1.3	5	0	11.104	2.538	-8.566	
2	1.3	10	0	11.104	2.538	-8.566	0.000
3	1.1	15	0	11.104	2.148	-8.957	0.000
4	1.5	20	0	11.104	2.929	-8.176	0.000
5	1.5	25	0	11.104	2.929	-8.176	0.000
6	1.8	30	0	11.104	3.514	-7.590	0.000
7	1.5	35	0	11.104	2.929	-8.176	0.000
8	1.8	40	0	11.104	3.514	-7.590	0.000
9	1.8	45	0	11.104	3.514	-7.590	0.000
10	1.5	50	0	11.104	2.929	-8.176	0.000
11	1.6	55	0	11.104	3.124	-7.981	0.000
12	1.8	60	0	11.104	3.514	-7.590	0.000
13	2.2	65	0	11.104	4.295	-6.809	0.000
14	2.2	70	0	11.104	4.295	-6.809	0.000
15	2.2	75	0	11.104	4.295	-6.809	0.000
16	2	80	0	11.104	3.905	-7.200	0.000
17	2.6	85	0	11.104	5.076	-6.028	0.000
18	2.7	90	0	11.104	5.271	-5.833	0.000
19	2.4	95	0	11.104	4.686	-6.419	0.000
20	2.7	100	0	11.104	5.271	-5.833	0.000
21	3.3	105	0	11.104	6.443	-4.662	0.000
22	3.1	110	0	11.104	6.052	-5.052	0.000
23	2.9	115	0	11.104	5.662	-5.443	0.000
24	3	120	0	11.104	5.857	-5.247	0.000
25	3.1	125	0	11.104	6.052	-5.052	0.000
26	4.2	130	0	11.104	8.200	-2.905	0.000
27	5	135	0	11.104	9.762	-1.343	0.000
28	3.5	140	0	11.104	6.833	-4.271	0.000
29	6.8	145	651.457	11.104	13.276	2.172	651.457
30	7.3	150	1595.765	11.104	14.252	3.148	944.308
31	8.2	155	3067.203	11.104	16.009	4.905	1471.438
32	5.9	160	3191.530	11.104	11.519	0.414	124.327
33	2	165	1031.625	11.104	3.905	-7.200	-2159.905
34	1.8	170	0	11.104	3.514	-7.590	-1031.625
35	1.8	175	0	11.104	3.514	-7.590	0.000
36	0.6	180	0	11.104	1.171	-9.933	0.000

A peak flow of 4.905cfs occurs at time 155 minutes. Maximum required storage, 3,191.53cf, occurs at time 160 minutes.

Equations

$$Inflow = [\left(\frac{1.00\ in}{12\frac{in}{ft}}\right) x \left(\frac{11.49\ ac}{43560\frac{sf}{ac}}\right) x \left(\frac{\%\ distribution}{100}\right)] \div ((Time\ current\ period - TIme\ previous\ period)\ {*}60sec)$$

$$(Qnet) = Inflow - Outflow$$

$$Cumulative\ Volume = (Cumulative\ Vol\ from\ previous\ period) + (Qnet) x ((Time\ current\ period - TIme\ previous\ period)$$

A 24" outflow pipe with a 0.2% slope will connect to the proposed 30" storm drain at Crane St. The Max flow will be restricted to ±18.06cfs by a 17.4" diameter orifice restrictor plate. Currently the proposed 24" underground storage outflow pipe is connected at the flowline of a 60" diameter storage pipe. The average flow through the 24" outflow pipe/restrictor plate is ±11.10cfs. Flow through the orifice restrictor plate ranged from 3.72cfs (no head) to 18.06cfs (±4.25ft of head). Due to the preliminary nature of this report, the average flow through the orifice was used for simplicity. See Appendix C *"UNDERGROUND STORAGE OUTFLOW ORIFICE RESTRICTOR PLATE"* for calculations.

Underground Storage 2 year, 6hr Event

Duration	2 yr event (inches)	2 yr Source
6 hour	1.40	Plate E-5.3

Areas	Acreage
Contributing Area (acres)	16.135
Outflow (cfs)	11.104

Period	6 hour percentage (%)	Time (minutes)	Cumulative Vol (cf)	Outflow (cfs)	Inflow (cfs)	Q net (cfs)	Volume Change
1	0.5	5	0	11.104	1.367	-9.738	
2	0.6	10	0	11.104	1.640	-9.464	0.000
3	0.6	15	0	11.104	1.640	-9.464	0.000
4	0.6	20	0	11.104	1.640	-9.464	0.000
5	0.6	25	0	11.104	1.640	-9.464	0.000
6	0.7	30	0	11.104	1.913	-9.191	0.000
7	0.7	35	0	11.104	1.913	-9.191	0.000
8	0.7	40	0	11.104	1.913	-9.191	0.000
9	0.7	45	0	11.104	1.913	-9.191	0.000
10	0.7	50	0	11.104	1.913	-9.191	0.000
11	0.7	55	0	11.104	1.913	-9.191	0.000
12	0.8	60	0	11.104	2.187	-8.918	0.000
13	0.8	65	0	11.104	2.187	-8.918	0.000
14	0.8	70	0	11.104	2.187	-8.918	0.000
15	0.8	75	0	11.104	2.187	-8.918	0.000
16	0.8	80	0	11.104	2.187	-8.918	0.000
17	0.8	85	0	11.104	2.187	-8.918	0.000
18	0.8	90	0	11.104	2.187	-8.918	0.000
19	0.8	95	0	11.104	2.187	-8.918	0.000
20	0.8	100	0	11.104	2.187	-8.918	0.000
21	0.8	105	0	11.104	2.187	-8.918	0.000
22	0.8	110	0	11.104	2.187	-8.918	0.000
23	0.8	115	0	11.104	2.187	-8.918	0.000
24	0.9	120	0	11.104	2.460	-8.644	0.000
25	0.8	125	0	11.104	2.187	-8.918	0.000
26	0.9	130	0	11.104	2.460	-8.644	0.000
27	0.9	135	0	11.104	2.460	-8.644	0.000
28	0.9	140	0	11.104	2.460	-8.644	0.000
29	0.9	145	0	11.104	2.460	-8.644	0.000
30	0.9	150	0	11.104	2.460	-8.644	0.000
31	0.9	155	0	11.104	2.460	-8.644	0.000
32	0.9	160	0	11.104	2.460	-8.644	0.000
33	1	165	0	11.104	2.733	-8.371	0.000
34	1	170	0	11.104	2.733	-8.371	0.000
35	1	175	0	11.104	2.733	-8.371	0.000
36	1	180	0	11.104	2.733	-8.371	0.000
37	1	185	0	11.104	2.733	-8.371	0.000
38	1.1	190	0	11.104	3.007	-8.098	0.000
39	1.1	195	0	11.104	3.007	-8.098	0.000
40	1.1	200	0	11.104	3.007	-8.098	0.000
41	1.2	205	0	11.104	3.280	-7.824	0.000
42	1.3	210	0	11.104	3.553	-7.551	0.000
43	1.4	215	0	11.104	3.827	-7.278	0.000
44	1.4	220	0	11.104	3.827	-7.278	0.000
45	1.5	225	0	11.104	4.100	-7.004	0.000
46	1.5	230	0	11.104	4.100	-7.004	0.000
47	1.6	235	0	11.104	4.373	-6.731	0.000
48	1.6	240	0	11.104	4.373	-6.731	0.000
49	1.7	245	0	11.104	4.647	-6.458	0.000
50	1.8	250	0	11.104	4.920	-6.184	0.000
51	1.9	255	0	11.104	5.193	-5.911	0.000
52	2	260	0	11.104	5.467	-5.638	0.000
53	2.1	265	0	11.104	5.740	-5.364	0.000
54	2.1	270	0	11.104	5.740	-5.364	0.000
55	2.2	275	0	11.104	6.013	-5.091	0.000
56	2.3	280	0	11.104	6.287	-4.818	0.000
57	2.4	285	0	11.104	6.560	-4.545	0.000
58	2.4	290	0	11.104	6.560	-4.545	0.000
59	2.5	295	0	11.104	6.833	-4.271	0.000
60	2.6	300	0	11.104	7.106	-3.998	0.000
61	3.1	305	0	11.104	8.473	-2.631	0.000

62	3.6	310	0	11.104	9.840	-1.265	0.000
63	3.9	315	0	11.104	10.660	-0.445	0.000
64	4.2	320	112.613	11.104	11.480	0.375	112.613
65	4.7	325	635.216	11.104	12.846	1.742	522.603
66	5.6	330	1895.802	11.104	15.306	4.202	1260.586
67	1.9	335	122.460	11.104	5.193	-5.911	-1773.343
68	0.9	340	0	11.104	2.460	-8.644	-122.460
69	0.6	345	0	11.104	1.640	-9.464	0.000
70	0.5	350	0	11.104	1.367	-9.738	0.000
71	0.3	355	0	11.104	0.820	-10.284	0.000
72	0.2	360	0	11.104	0.547	-10.558	0.000

A peak flow of 4.202cfs occurs at time 330 minutes. Maximum required storage, 1,895.802cf, occurs at time 330 minutes.

Equations

$$Inflow = \left[\left(\frac{1.40\ in}{12\frac{in}{ft}}\right) x \left(\frac{11.49\ ac}{43560\frac{sf}{ac}}\right) x \left(\frac{\%\ distribution}{100}\right)\right] \div ((Time\ current\ period - TIme\ previous\ period)\ *60sec)$$

$$(Qnet) = Inflow - Outflow$$

$$Cumulative\ Volume = (Cumulative\ Vol\ from\ previous\ period) + (Qnet) x\ ((Time\ current\ period - TIme\ previous\ period)$$

A 24” outflow pipe with a 0.2% slope will connect to the proposed 30” storm drain at Crane St. The Max flow will be restricted to ±18.06cfs by a 17.4” diameter orifice restrictor plate. Currently the proposed 24” underground storage outflow pipe is connected at the flowline of a 60” diameter storage pipe. The average flow through the 24” outflow pipe/restrictor plate is ±11.10cfs. Flow through the orifice restrictor plate ranged from 3.72cfs (no head) to 18.06cfs (±4.25ft of head). Due to the preliminary nature of this report, the average flow through the orifice was used for simplicity. See Appendix C *"UNDERGROUND STORAGE OUTFLOW ORIFICE RESTRICTOR PLATE"* for calculations.

Underground Storage 2 year, 24hr Event

Duration	2 yr event (inches)	2 yr Source
24 hour	2.50	Plate E-5.5

Areas	Acreage
Contributing Area (acres)	16.135
Outflow (cfs)	11.104

Period	24 hour percentage (%)	Time (minutes)	Cumulative Vol (cf)	Outflow (cfs)	Inflow (cfs)	Q net (cfs)	Volume Change
1	0.2	15	0	11.104	0.325	-10.779	
2	0.3	30	0	11.104	0.488	-10.616	0.000
3	0.3	45	0	11.104	0.488	-10.616	0.000
4	0.4	60	0	11.104	0.651	-10.454	0.000
5	0.3	75	0	11.104	0.488	-10.616	0.000
6	0.3	90	0	11.104	0.488	-10.616	0.000
7	0.3	105	0	11.104	0.488	-10.616	0.000
8	0.4	120	0	11.104	0.651	-10.454	0.000
9	0.4	135	0	11.104	0.651	-10.454	0.000
10	0.4	150	0	11.104	0.651	-10.454	0.000
11	0.5	165	0	11.104	0.813	-10.291	0.000
12	0.5	180	0	11.104	0.813	-10.291	0.000
13	0.5	195	0	11.104	0.813	-10.291	0.000
14	0.5	210	0	11.104	0.813	-10.291	0.000
15	0.5	225	0	11.104	0.813	-10.291	0.000
16	0.6	240	0	11.104	0.976	-10.128	0.000
17	0.6	255	0	11.104	0.976	-10.128	0.000
18	0.7	270	0	11.104	1.139	-9.965	0.000
19	0.7	285	0	11.104	1.139	-9.965	0.000
20	0.8	300	0	11.104	1.302	-9.803	0.000
21	0.6	315	0	11.104	0.976	-10.128	0.000
22	0.7	330	0	11.104	1.139	-9.965	0.000
23	0.8	345	0	11.104	1.302	-9.803	0.000
24	0.8	360	0	11.104	1.302	-9.803	0.000
25	0.9	375	0	11.104	1.464	-9.640	0.000
26	0.9	390	0	11.104	1.464	-9.640	0.000
27	1	405	0	11.104	1.627	-9.477	0.000
28	1	420	0	11.104	1.627	-9.477	0.000
29	1	435	0	11.104	1.627	-9.477	0.000
30	1.1	450	0	11.104	1.790	-9.315	0.000
31	1.2	465	0	11.104	1.952	-9.152	0.000
32	1.3	480	0	11.104	2.115	-8.989	0.000
33	1.5	495	0	11.104	2.440	-8.664	0.000
34	1.5	510	0	11.104	2.440	-8.664	0.000
35	1.6	525	0	11.104	2.603	-8.501	0.000
36	1.7	540	0	11.104	2.766	-8.339	0.000
37	1.9	555	0	11.104	3.091	-8.013	0.000
38	2	570	0	11.104	3.254	-7.850	0.000
39	2.1	585	0	11.104	3.417	-7.688	0.000
40	2.2	600	0	11.104	3.579	-7.525	0.000
41	1.5	615	0	11.104	2.440	-8.664	0.000
42	1.5	630	0	11.104	2.440	-8.664	0.000
43	2	645	0	11.104	3.254	-7.850	0.000
44	2	660	0	11.104	3.254	-7.850	0.000
45	1.9	675	0	11.104	3.091	-8.013	0.000
46	1.9	690	0	11.104	3.091	-8.013	0.000
47	1.7	705	0	11.104	2.766	-8.339	0.000
48	1.8	720	0	11.104	2.929	-8.176	0.000
49	2.5	735	0	11.104	4.067	-7.037	0.000
50	2.6	750	0	11.104	4.230	-6.874	0.000
51	2.8	765	0	11.104	4.555	-6.549	0.000
52	2.9	780	0	11.104	4.718	-6.386	0.000
53	3.4	795	0	11.104	5.532	-5.573	0.000
54	3.4	810	0	11.104	5.532	-5.573	0.000
55	2.3	825	0	11.104	3.742	-7.362	0.000
56	2.3	840	0	11.104	3.742	-7.362	0.000
57	2.7	855	0	11.104	4.393	-6.712	0.000
58	2.6	870	0	11.104	4.230	-6.874	0.000
59	2.6	885	0	11.104	4.230	-6.874	0.000
60	2.5	900	0	11.104	4.067	-7.037	0.000
61	2.4	915	0	11.104	3.905	-7.200	0.000
62	2.3	930	0	11.104	3.742	-7.362	0.000

63	1.9	945	0	11.104	3.091	-8.013	0.000
64	1.9	960	0	11.104	3.091	-8.013	0.000
65	0.4	975	0	11.104	0.651	-10.454	0.000
66	0.4	990	0	11.104	0.651	-10.454	0.000
67	0.3	1005	0	11.104	0.488	-10.616	0.000
68	0.3	1020	0	11.104	0.488	-10.616	0.000
69	0.5	1035	0	11.104	0.813	-10.291	0.000
70	0.5	1050	0	11.104	0.813	-10.291	0.000
71	0.5	1065	0	11.104	0.813	-10.291	0.000
72	0.4	1080	0	11.104	0.651	-10.454	0.000
73	0.4	1095	0	11.104	0.651	-10.454	0.000
74	0.4	1110	0	11.104	0.651	-10.454	0.000
75	0.3	1125	0	11.104	0.488	-10.616	0.000
76	0.2	1140	0	11.104	0.325	-10.779	0.000
77	0.3	1155	0	11.104	0.488	-10.616	0.000
78	0.4	1170	0	11.104	0.651	-10.454	0.000
79	0.3	1185	0	11.104	0.488	-10.616	0.000
80	0.2	1200	0	11.104	0.325	-10.779	0.000
81	0.3	1215	0	11.104	0.488	-10.616	0.000
82	0.3	1230	0	11.104	0.488	-10.616	0.000
83	0.3	1245	0	11.104	0.488	-10.616	0.000
84	0.2	1260	0	11.104	0.325	-10.779	0.000
85	0.3	1275	0	11.104	0.488	-10.616	0.000
86	0.2	1290	0	11.104	0.325	-10.779	0.000
87	0.3	1305	0	11.104	0.488	-10.616	0.000
88	0.2	1320	0	11.104	0.325	-10.779	0.000
89	0.3	1335	0	11.104	0.488	-10.616	0.000
90	0.2	1350	0	11.104	0.325	-10.779	0.000
91	0.2	1365	0	11.104	0.325	-10.779	0.000
92	0.2	1380	0	11.104	0.325	-10.779	0.000
93	0.2	1395	0	11.104	0.325	-10.779	0.000
94	0.2	1410	0	11.104	0.325	-10.779	0.000
95	0.2	1425	0	11.104	0.325	-10.779	0.000
96	0.2	1440	0	11.104	0.325	-10.779	0.000

Outflow always exceeds Inflow. The Underground Storage will be empty during the entire storm event.

<u>Equations</u>

$$Inflow = [\left(\frac{2.50\ in}{12\frac{in}{ft}}\right) x \left(\frac{11.49\ ac}{43560\frac{sf}{ac}}\right) x \left(\frac{\%\ distribution}{100}\right)] \div ((Time\ current\ period\ -\ TIme\ previous\ period)\ *60sec)$$

$$(Qnet) = Inflow - Outflow$$

$$Cumulative\ Volume = (Cumulative\ Vol\ from\ previous\ period) + (Qnet) x\ ((Time\ current\ period - TIme\ previous\ period)$$

A 24” outflow pipe with a 0.2% slope will connect to the proposed 30” storm drain at Crane St. The Max flow will be restricted to ±18.06cfs by a 17.4” diameter orifice restrictor plate. Currently the proposed 24” underground storage outflow pipe is connected at the flowline of a 60” diameter storage pipe. The average flow through the 24” outflow pipe/restrictor plate is ±11.10cfs. Flow through the orifice restrictor plate ranged from 3.72cfs (no head) to 18.06cfs (±4.25ft of head). Due to the preliminary nature of this report, the average flow through the orifice was used for simplicity. See Appendix C *"UNDERGROUND STORAGE OUTFLOW ORIFICE RESTRICTOR PLATE"* for calculations.

Underground Storage 100 year, 3hr Event

Duration	100 yr event (inch)	100 yr Source
3 hour	2.50	Plate E-5.2

Areas	Acreage
Contributing Area (acres)	16.135
Outflow (cfs)	11.104

Period	3 hour percentage (%)	Time (minutes)	Cumulative Vol (cf)	Outflow (cfs)	Inflow (cfs)	Q net (cfs)	Volume Change
1	1.3	5	0	11.104	6.345	-4.759	
2	1.3	10	0	11.104	6.345	-4.759	0.000
3	1.1	15	0	11.104	5.369	-5.735	0.000
4	1.5	20	0	11.104	7.321	-3.783	0.000
5	1.5	25	0	11.104	7.321	-3.783	0.000
6	1.8	30	0	11.104	8.786	-2.319	0.000
7	1.5	35	0	11.104	7.321	-3.783	0.000
8	1.8	40	0	11.104	8.786	-2.319	0.000
9	1.8	45	0	11.104	8.786	-2.319	0.000
10	1.5	50	0	11.104	7.321	-3.783	0.000
11	1.6	55	0	11.104	7.809	-3.295	0.000
12	1.8	60	0	11.104	8.786	-2.319	0.000
13	2.2	65	0	11.104	10.738	-0.367	0.000
14	2.2	70	0	11.104	10.738	-0.367	0.000
15	2.2	75	0	11.104	10.738	-0.367	0.000
16	2	80	0	11.104	9.762	-1.343	0.000
17	2.6	85	475.747	11.104	12.690	1.586	475.747
18	2.7	90	1097.920	11.104	13.178	2.074	622.172
19	2.4	95	1280.817	11.104	11.714	0.610	182.897
20	2.7	100	1902.989	11.104	13.178	2.074	622.172
21	3.3	105	3403.712	11.104	16.107	5.002	1500.723
22	3.1	110	4611.585	11.104	15.131	4.026	1207.873
23	2.9	115	5526.608	11.104	14.154	3.050	915.023
24	3	120	6588.056	11.104	14.643	3.538	1061.448
25	3.1	125	7795.929	11.104	15.131	4.026	1207.873
26	4.2	130	10614.478	11.104	20.500	9.395	2818.549
27	5	135	14604.428	11.104	24.404	13.300	3989.950
28	3.5	140	16398.002	11.104	17.083	5.979	1793.573
29	6.8	145	23023.604	11.104	33.190	22.085	6625.603
30	7.3	150	30381.333	11.104	35.630	24.526	7357.728
31	8.2	155	39056.887	11.104	40.023	28.919	8675.554
32	5.9	160	44364.663	11.104	28.797	17.693	5307.776
33	2	165	43961.860	11.104	9.762	-1.343	-402.803
34	1.8	170	43266.206	11.104	8.786	-2.319	-695.654
35	1.8	175	42570.553	11.104	8.786	-2.319	-695.654
36	0.6	180	40117.797	11.104	2.929	-8.176	-2452.755

A peak flow of 28.919cfs occurs at time 155 minutes. Maximum required storage, 44,364.663cf, occurs at time 160 minutes.

Equations

$$Inflow = [\left(\frac{2.50\ in}{12\frac{in}{ft}}\right) x \left(\frac{11.49\ ac}{43560\frac{sf}{ac}}\right) x \left(\frac{\%\ distribution}{100}\right)] \div ((Time\ current\ period\ \text{-}\ TIme\ previous\ period)\ *60sec)$$

$$(Qnet) = Inflow - Outflow$$

$$Cumulative\ Volume = (Cumulative\ Vol\ from\ previous\ period) + (Qnet) x\ ((Time\ current\ period - TIme\ previous\ period)$$

A 24” outflow pipe with a 0.2% slope will connect to the proposed 30” storm drain at Crane St. The Max flow will be restricted to ±18.06cfs by a 17.4” diameter orifice restrictor plate. Currently the proposed 24” underground storage outflow pipe is connected at the flowline of a 60” diameter storage pipe. The average flow through the 24” outflow pipe/restrictor plate is ±11.10cfs. Flow through the orifice restrictor plate ranged from 3.72cfs (no head) to 18.06cfs (±4.25ft of head). Due to the preliminary nature of this report, the average flow through the orifice was used for simplicity. See Appendix C *"UNDERGROUND STORAGE OUTFLOW ORIFICE RESTRICTOR PLATE"* for calculations.

Underground Storage 100 year, 6hr Event		
Duration	100 yr event (inch)	100 yr Source
6 hour	3.50	Plate E-5.4
Areas	Acreage	
Contributing Area (acres)	16.135	
Outflow (cfs)	11.104	

Period	6 hour percentage (%)	Time (minutes)	Cumulative Vol (cf)	Outflow (cfs)	Inflow (cfs)	Q net (cfs)	Volume Change
1	0.5	5	0	11.104	3.417	-7.688	
2	0.6	10	0	11.104	4.100	-7.004	0.000
3	0.6	15	0	11.104	4.100	-7.004	0.000
4	0.6	20	0	11.104	4.100	-7.004	0.000
5	0.6	25	0	11.104	4.100	-7.004	0.000
6	0.7	30	0	11.104	4.783	-6.321	0.000
7	0.7	35	0	11.104	4.783	-6.321	0.000
8	0.7	40	0	11.104	4.783	-6.321	0.000
9	0.7	45	0	11.104	4.783	-6.321	0.000
10	0.7	50	0	11.104	4.783	-6.321	0.000
11	0.7	55	0	11.104	4.783	-6.321	0.000
12	0.8	60	0	11.104	5.467	-5.638	0.000
13	0.8	65	0	11.104	5.467	-5.638	0.000
14	0.8	70	0	11.104	5.467	-5.638	0.000
15	0.8	75	0	11.104	5.467	-5.638	0.000
16	0.8	80	0	11.104	5.467	-5.638	0.000
17	0.8	85	0	11.104	5.467	-5.638	0.000
18	0.8	90	0	11.104	5.467	-5.638	0.000
19	0.8	95	0	11.104	5.467	-5.638	0.000
20	0.8	100	0	11.104	5.467	-5.638	0.000
21	0.8	105	0	11.104	5.467	-5.638	0.000
22	0.8	110	0	11.104	5.467	-5.638	0.000
23	0.8	115	0	11.104	5.467	-5.638	0.000
24	0.9	120	0	11.104	6.150	-4.954	0.000
25	0.8	125	0	11.104	5.467	-5.638	0.000
26	0.9	130	0	11.104	6.150	-4.954	0.000
27	0.9	135	0	11.104	6.150	-4.954	0.000
28	0.9	140	0	11.104	6.150	-4.954	0.000
29	0.9	145	0	11.104	6.150	-4.954	0.000
30	0.9	150	0	11.104	6.150	-4.954	0.000
31	0.9	155	0	11.104	6.150	-4.954	0.000
32	0.9	160	0	11.104	6.150	-4.954	0.000
33	1	165	0	11.104	6.833	-4.271	0.000
34	1	170	0	11.104	6.833	-4.271	0.000
35	1	175	0	11.104	6.833	-4.271	0.000
36	1	180	0	11.104	6.833	-4.271	0.000
37	1	185	0	11.104	6.833	-4.271	0.000
38	1.1	190	0	11.104	7.516	-3.588	0.000
39	1.1	195	0	11.104	7.516	-3.588	0.000
40	1.1	200	0	11.104	7.516	-3.588	0.000
41	1.2	205	0	11.104	8.200	-2.905	0.000
42	1.3	210	0	11.104	8.883	-2.221	0.000
43	1.4	215	0	11.104	9.566	-1.538	0.000
44	1.4	220	0	11.104	9.566	-1.538	0.000
45	1.5	225	0	11.104	10.250	-0.855	0.000
46	1.5	230	0	11.104	10.250	-0.855	0.000
47	1.6	235	0	11.104	10.933	-0.171	0.000
48	1.6	240	0	11.104	10.933	-0.171	0.000
49	1.7	245	153.612	11.104	11.616	0.512	153.612
50	1.8	250	512.219	11.104	12.300	1.195	358.607
51	1.9	255	1075.822	11.104	12.983	1.879	563.602
52	2	260	1844.419	11.104	13.666	2.562	768.598
53	2.1	265	2818.012	11.104	14.350	3.245	973.593
54	2.1	270	3791.605	11.104	14.350	3.245	973.593
55	2.2	275	4970.193	11.104	15.033	3.929	1178.588
56	2.3	280	6353.776	11.104	15.716	4.612	1383.583
57	2.4	285	7942.354	11.104	16.400	5.295	1588.578
58	2.4	290	9530.932	11.104	16.400	5.295	1588.578
59	2.5	295	11324.506	11.104	17.083	5.979	1793.573
60	2.6	300	13323.074	11.104	17.766	6.662	1998.569
61	3.1	305	16346.619	11.104	21.183	10.078	3023.544
62	3.6	310	20395.139	11.104	24.599	13.495	4048.520

63	3.9	315	25058.645	11.104	26.649	15.545	4663.506
64	4.2	320	30337.136	11.104	28.699	17.595	5278.491
65	4.7	325	36640.604	11.104	32.116	21.012	6303.467
66	5.6	330	44789.028	11.104	38.266	27.161	8148.424
67	1.9	335	45352.630	11.104	12.983	1.879	563.602
68	0.9	340	43866.281	11.104	6.150	-4.954	-1486.349
69	0.6	345	41764.946	11.104	4.100	-7.004	-2101.335
70	0.5	350	39458.616	11.104	3.417	-7.688	-2306.330
71	0.3	355	36742.295	11.104	2.050	-9.054	-2716.320
72	0.2	360	33820.980	11.104	1.367	-9.738	-2921.316

A peak flow of 27.161cfs occurs at time 330 minutes. Maximum required storage, 45,352.630cf, occurs at time 335 minutes.

Equations

$$Inflow = \left[\left(\frac{3.50\ in}{12\frac{in}{ft}}\right) x \left(\frac{11.49\ ac}{43560\frac{sf}{ac}}\right) x \left(\frac{\%\ distribution}{100}\right)\right] \div ((Time\ current\ period - TIme\ previous\ period) *60sec)$$

$$(Qnet) = Inflow - Outflow$$

$$Cumulative\ Volume = (Cumulative\ Vol\ from\ previous\ period) + (Qnet) x ((Time\ current\ period - TIme\ previous\ period)$$

A 24” outflow pipe with a 0.2% slope will connect to the proposed 30” storm drain at Crane St. The Max flow will be restricted to ±18.06cfs by a 17.4” diameter orifice restrictor plate. Currently the proposed 24” underground storage outflow pipe is connected at the flowline of a 60” diameter storage pipe. The average flow through the 24” outflow pipe/restrictor plate is ±11.10cfs. Flow through the orifice restrictor plate ranged from 3.72cfs (no head) to 18.06cfs (±4.25ft of head). Due to the preliminary nature of this report, the average flow through the orifice was used for simplicity. See Appendix C *"UNDERGROUND STORAGE OUTFLOW ORIFICE RESTRICTOR PLATE"* for calculations.

Underground Storage 100 year, 24hr Event

Duration	100 yr event (inch)	100 yr Source
24 hour	6.00	Plate E-5.6

Areas	Acreage
Contributing Area (acres)	16.135
Outflow (cfs)	11.104

Period	24 hour percentage (%)	Time (minutes)	Cumulative Vol (cf)	Outflow (cfs)	Inflow (cfs)	Q net (cfs)	Volume Change
1	0.2	15	0	11.104	0.781	-10.323	
2	0.3	30	0	11.104	1.171	-9.933	0.000
3	0.3	45	0	11.104	1.171	-9.933	0.000
4	0.4	60	0	11.104	1.562	-9.542	0.000
5	0.3	75	0	11.104	1.171	-9.933	0.000
6	0.3	90	0	11.104	1.171	-9.933	0.000
7	0.3	105	0	11.104	1.171	-9.933	0.000
8	0.4	120	0	11.104	1.562	-9.542	0.000
9	0.4	135	0	11.104	1.562	-9.542	0.000
10	0.4	150	0	11.104	1.562	-9.542	0.000
11	0.5	165	0	11.104	1.952	-9.152	0.000
12	0.5	180	0	11.104	1.952	-9.152	0.000
13	0.5	195	0	11.104	1.952	-9.152	0.000
14	0.5	210	0	11.104	1.952	-9.152	0.000
15	0.5	225	0	11.104	1.952	-9.152	0.000
16	0.6	240	0	11.104	2.343	-8.762	0.000
17	0.6	255	0	11.104	2.343	-8.762	0.000
18	0.7	270	0	11.104	2.733	-8.371	0.000
19	0.7	285	0	11.104	2.733	-8.371	0.000
20	0.8	300	0	11.104	3.124	-7.981	0.000
21	0.6	315	0	11.104	2.343	-8.762	0.000
22	0.7	330	0	11.104	2.733	-8.371	0.000
23	0.8	345	0	11.104	3.124	-7.981	0.000
24	0.8	360	0	11.104	3.124	-7.981	0.000
25	0.9	375	0	11.104	3.514	-7.590	0.000
26	0.9	390	0	11.104	3.514	-7.590	0.000
27	1	405	0	11.104	3.905	-7.200	0.000
28	1	420	0	11.104	3.905	-7.200	0.000
29	1	435	0	11.104	3.905	-7.200	0.000
30	1.1	450	0	11.104	4.295	-6.809	0.000
31	1.2	465	0	11.104	4.686	-6.419	0.000
32	1.3	480	0	11.104	5.076	-6.028	0.000
33	1.5	495	0	11.104	5.857	-5.247	0.000
34	1.5	510	0	11.104	5.857	-5.247	0.000
35	1.6	525	0	11.104	6.247	-4.857	0.000
36	1.7	540	0	11.104	6.638	-4.466	0.000
37	1.9	555	0	11.104	7.419	-3.685	0.000
38	2	570	0	11.104	7.809	-3.295	0.000
39	2.1	585	0	11.104	8.200	-2.905	0.000
40	2.2	600	0	11.104	8.590	-2.514	0.000
41	1.5	615	0	11.104	5.857	-5.247	0.000
42	1.5	630	0	11.104	5.857	-5.247	0.000
43	2	645	0	11.104	7.809	-3.295	0.000
44	2	660	0	11.104	7.809	-3.295	0.000
45	1.9	675	0	11.104	7.419	-3.685	0.000
46	1.9	690	0	11.104	7.419	-3.685	0.000
47	1.7	705	0	11.104	6.638	-4.466	0.000
48	1.8	720	0	11.104	7.028	-4.076	0.000
49	2.5	735	0	11.104	9.762	-1.343	0.000
50	2.6	750	0	11.104	10.152	-0.952	0.000
51	2.8	765	0	11.104	10.933	-0.171	0.000
52	2.9	780	197.271	11.104	11.324	0.219	197.271
53	3.4	795	2151.643	11.104	13.276	2.172	1954.372
54	3.4	810	4106.016	11.104	13.276	2.172	1954.372
55	2.3	825	2194.765	11.104	8.981	-2.124	-1911.251
56	2.3	840	283.514	11.104	8.981	-2.124	-1911.251
57	2.7	855	0	11.104	10.543	-0.562	-283.514
58	2.6	870	0	11.104	10.152	-0.952	0.000
59	2.6	885	0	11.104	10.152	-0.952	0.000
60	2.5	900	0	11.104	9.762	-1.343	0.000
61	2.4	915	0	11.104	9.371	-1.733	0.000
62	2.3	930	0	11.104	8.981	-2.124	0.000
63	1.9	945	0	11.104	7.419	-3.685	0.000
64	1.9	960	0	11.104	7.419	-3.685	0.000
65	0.4	975	0	11.104	1.562	-9.542	0.000

66	0.4	990	0	11.104	1.562	-9.542	0.000
67	0.3	1005	0	11.104	1.171	-9.933	0.000
68	0.3	1020	0	11.104	1.171	-9.933	0.000
69	0.5	1035	0	11.104	1.952	-9.152	0.000
70	0.5	1050	0	11.104	1.952	-9.152	0.000
71	0.5	1065	0	11.104	1.952	-9.152	0.000
72	0.4	1080	0	11.104	1.562	-9.542	0.000
73	0.4	1095	0	11.104	1.562	-9.542	0.000
74	0.4	1110	0	11.104	1.562	-9.542	0.000
75	0.3	1125	0	11.104	1.171	-9.933	0.000
76	0.2	1140	0	11.104	0.781	-10.323	0.000
77	0.3	1155	0	11.104	1.171	-9.933	0.000
78	0.4	1170	0	11.104	1.562	-9.542	0.000
79	0.3	1185	0	11.104	1.171	-9.933	0.000
80	0.2	1200	0	11.104	0.781	-10.323	0.000
81	0.3	1215	0	11.104	1.171	-9.933	0.000
82	0.3	1230	0	11.104	1.171	-9.933	0.000
83	0.3	1245	0	11.104	1.171	-9.933	0.000
84	0.2	1260	0	11.104	0.781	-10.323	0.000
85	0.3	1275	0	11.104	1.171	-9.933	0.000
86	0.2	1290	0	11.104	0.781	-10.323	0.000
87	0.3	1305	0	11.104	1.171	-9.933	0.000
88	0.2	1320	0	11.104	0.781	-10.323	0.000
89	0.3	1335	0	11.104	1.171	-9.933	0.000
90	0.2	1350	0	11.104	0.781	-10.323	0.000
91	0.2	1365	0	11.104	0.781	-10.323	0.000
92	0.2	1380	0	11.104	0.781	-10.323	0.000
93	0.2	1395	0	11.104	0.781	-10.323	0.000
94	0.2	1410	0	11.104	0.781	-10.323	0.000
95	0.2	1425	0	11.104	0.781	-10.323	0.000
96	0.2	1440	0	11.104	0.781	-10.323	0.000

A peak flow of 13.276cfs occurs at time 795 minutes. Maximum required storage, 4,106.016cf, occurs at time 810 minutes.

Equations

$$Inflow = \left[\left(\frac{6.00\ in}{12\frac{in}{ft}}\right) x \left(\frac{11.49\ ac}{43560\frac{sf}{ac}}\right) x \left(\frac{\%\ distribution}{100}\right)\right] \div \text{((Time current period - TIme previous period) *60sec)}$$

$$(Qnet) = Inflow - Outflow$$

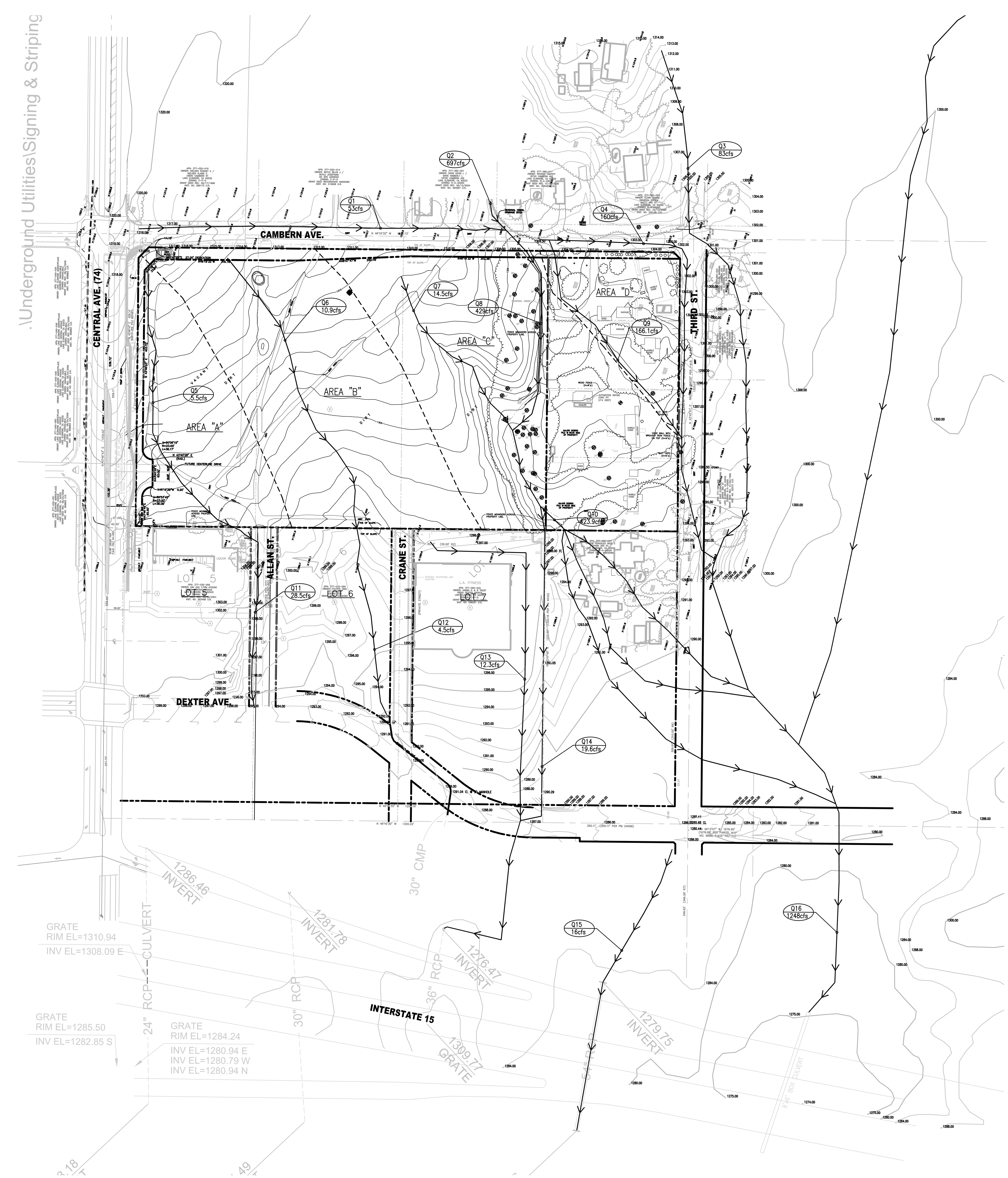
$$Cumulative\ Volume = (Cumulative\ Vol\ from\ previous\ period) + (Qnet) x \text{ ((Time current period} - \text{TIme previous period)}$$

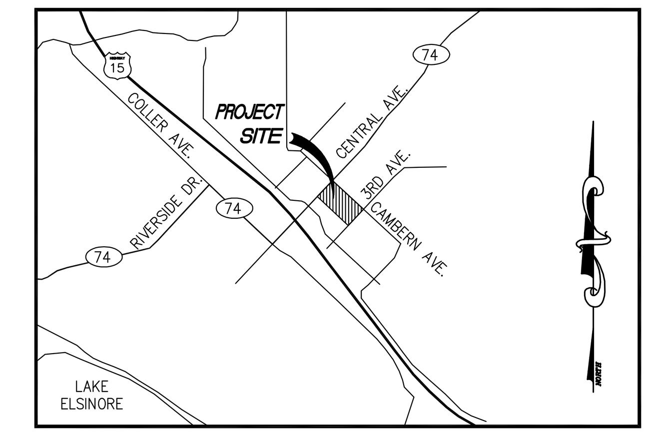
A 24” outflow pipe with a 0.2% slope will connect to the proposed 30” storm drain at Crane St. The Max flow will be restricted to ±18.06cfs by a 17.4” diameter orifice restrictor plate. Currently the proposed 24” underground storage outflow pipe is connected at the flowline of a 60” diameter storage pipe. The average flow through the 24” outflow pipe/restrictor plate is ±11.10cfs. Flow through the orifice restrictor plate ranged from 3.72cfs (no head) to 18.06cfs (±4.25ft of head). Due to the preliminary nature of this report, the average flow through the orifice was used for simplicity. See Appendix C *"UNDERGROUND STORAGE OUTFLOW ORIFICE RESTRICTOR PLATE"* for calculations.

APPENDIX D

APPENDIX D

Hydrology Map - Pre-developed Conditions





SITE VICINITY MAP

NO SCALE

LEGEND

Q## XXcfs — STORM WATER RUNOFF LABEL AND RATE

→ — STORM WATER RUNOFF PATH

- - - - - — DRAINAGE AREA BOUNDARY

DISCLAIMER:

THIS PLAN IS PRELIMINARY AND IS INTENDED FOR CONCEPTUAL PURPOSES ONLY. GREENBERG FARROW DOES NOT GUARANTEE THAT THE INFORMATION PROVIDED IS ACCURATE AND ASSUMES NO RESPONSIBILITY FOR TIME OR MONETARY LOSSES RESULTING FROM THE USE OF INFORMATION PROVIDED BY THIS PLAN.

THE SURVEY DATA IS BASED ON THE "ALTA/ACSM LAND TITLE SURVEY" PROVIDED BY KENNEITH E. TAIT R.C.E., DATED FEBRUARY 7, 2011.

LOT 7 TOPO DATA IS BASED ON THE "PRECISE GRADING PLAN CUP 3506 L.A. FITNESS CENTER", IW CONSULTING ENGINEERS, FREDDY IRIANTO, R.C.E.

LOT 5&6 TOPO DATA IS BASED ON THE "ALTA/ACSM LAND TITLE SURVEY" PROVIDED BY CLE ENGINEERING, INC., JOHN B. ROGERS, R.C.E., DATED FEBRUARY 7, 2008

DEXTER AVENUE TOPO DATA IS BASED ON THE "PLANS FOR THE IMPROVEMENT OF DEXTER AVENUE & SECOND STREET" PROVIDED BY HARRIS & ASSOCIATES, EHAB S. GERGES, R.C.E, DATED FEBRUARY 4, 2009.

EXISTING DRAINAGE DATA IS BASED ON RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT "PLATE 60, CITY OF LAKE ELSINORE MASTER PLAN OF DRAINAGE"

DRAINAGE DESCRIPTION

Q1	CAMBERN AVE. BETWEEN CENTRAL & CONCRETE CULVERT
Q2	RUNON ACROSS CAMBERN AVE.
Q3	THIRD ST. NORTH OF CAMBERN AVE.
Q4	CAMBERN AVE. BETWEEN CONCRETE CULVERT & THIRD ST.
Q5	WEST SIDE OF PROPERTY (AREA "A")
Q6	WEST SIDE OF PROPERTY (AREA "B")
Q7	EAST SIDE OF PROPERTY (AREA "C")
Q8	EAST SIDE OF PROPERTY (AREA "C")
Q9	NORTHEAST CORNER OF PROPERTY
Q10	FLOW ONTO PROPERTY ABUTTING SOUTHEAST CORNER OF PROJECT SITE
Q11	LOT 5 ABUTTING SOUTHWEST CORNER OF PROJECT SITE
Q12	LOT 6 ABUTTING SOUTHERN PROPERTY LINE OF PROJECT SITE
Q13	LOT 7 (LA FITNESS) ABUTTING SOUTHERN PROPERTY LINE OF PROJECT SITE
Q14	V-DITCH ALONG LA FITNESS EASTERN PROPERTY LINE
Q15	SOUTHWEST CORNER OF DEXTER AVE. & THIRD ST.

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET) 1 inch = 100 ft.

100YR DRAINAGE MAP (PREDEVELOPMENT)

ISSUE/REVISION RECORD

DATE	DESCRIPTION
06.10.11	100YR DRAINAGE MAP

GreenbergFarrow
19000 MacArthur Blvd. Suite 250
Irvine, CA 92612
t: 949 296 0450 f: 949 296 0437

PROFESSIONAL SEAL

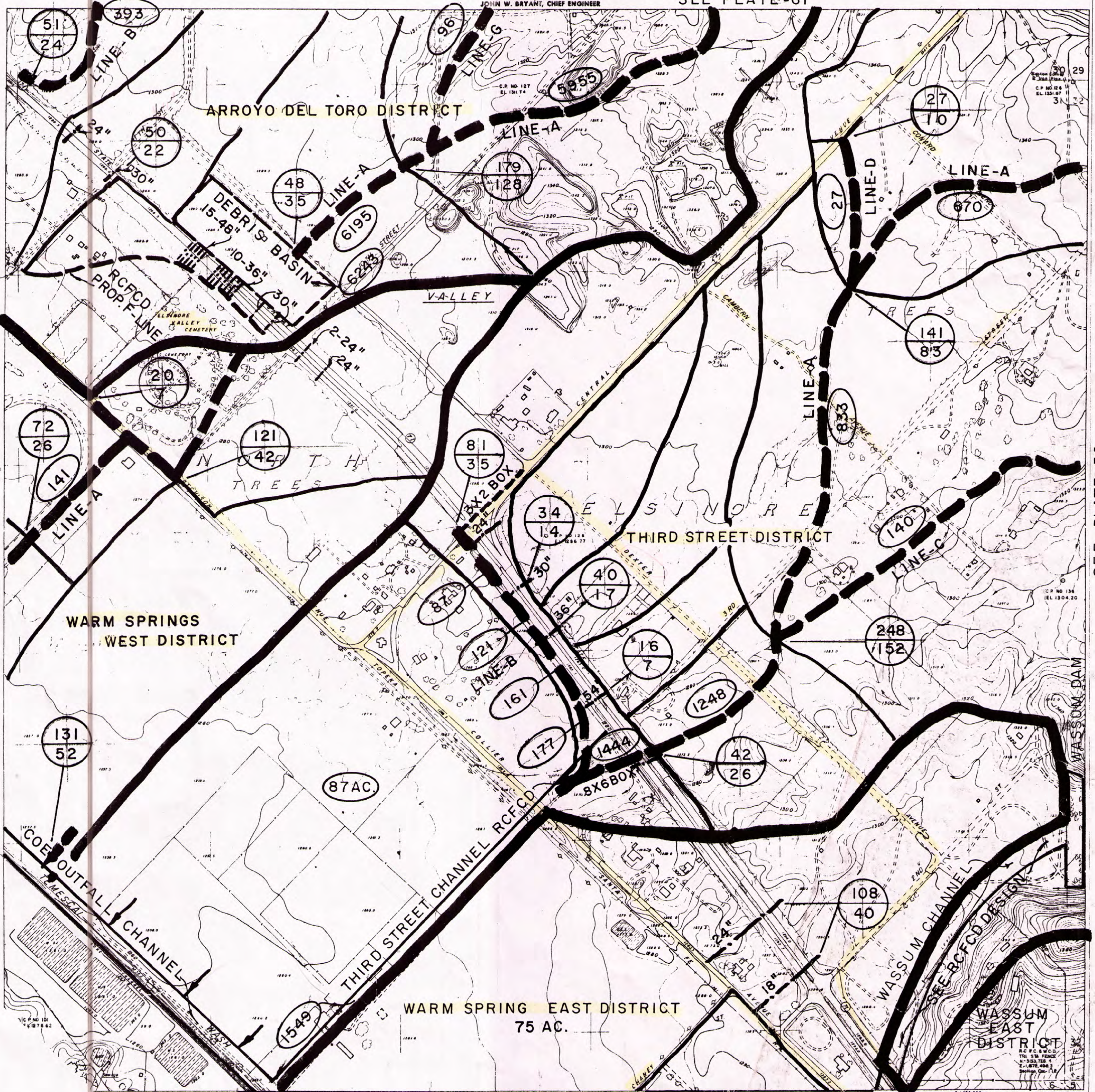
PROFESSIONAL IN CHARGE
FARMAN SHIR, PE
PROFESSIONAL ENGINEER
LICENSE NO. C63868

PROPOSED COMMERCIAL RETAIL STORE
SEC OF CENTRAL AVE. & CAMBERN AVE.
CITY OF LAKE ELSINORE, CALIFORNIA

DRAWN
JASON MILLER
CHECKED
FARMAN SHIR
DATE
06.10.11
SCALE
1"=100'
JOB No.
20080068.8
SHEET:

DM1

RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
RIVERSIDE, CALIFORNIA
JOHN W. BRYANT, CHIEF ENGINEER



SEE PLATE-59

CITY OF LAKE ELSINORE MASTER PLAN OF DRAINAGE

SCALE 1:2400
CONTOUR INTERVAL 4 FEET
DATUM IS MEAN SEA LEVEL
THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS

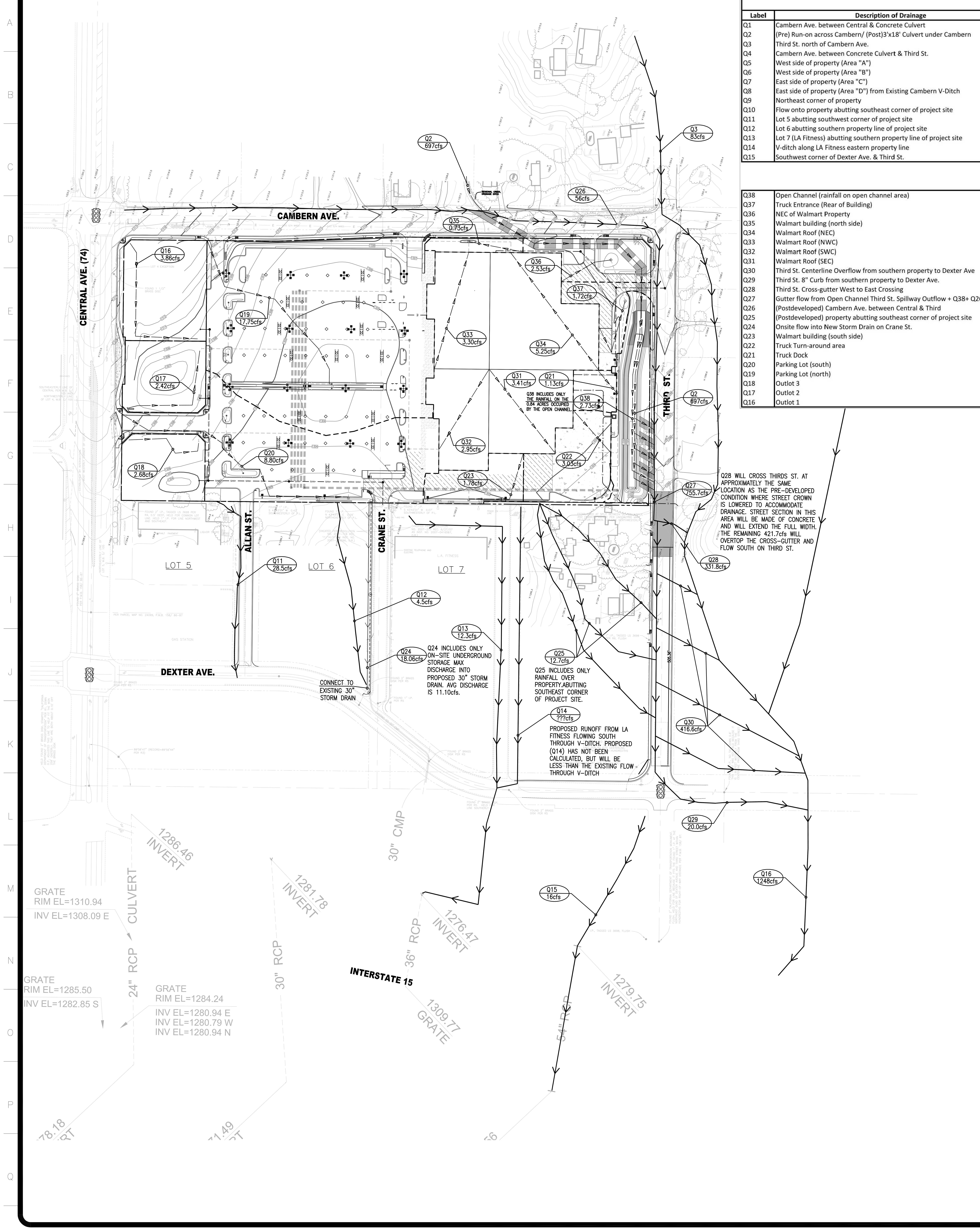
HYDROLOGY MAP
THIRD STREET
ARROYO DEL TORO
WARM SPRING EAST
DISTRICT

SECTION 31
T.5S., R.4W.
SBB&M

PLATE-60

APPENDIX D

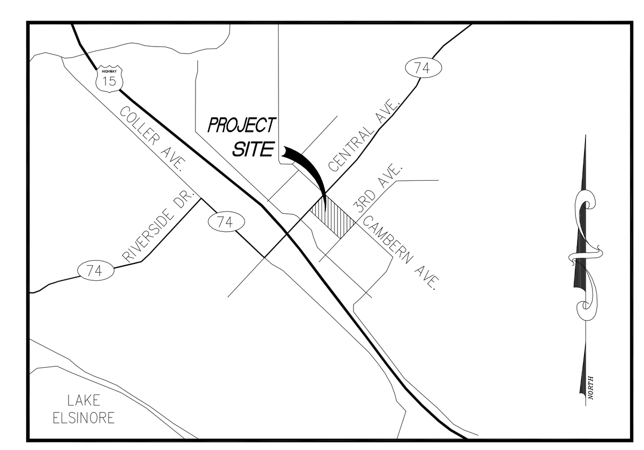
Hydrology Map - Post-developed Conditions



Explaination of Area Calculations

Label	Description of Drainage	Pre	Post	Method of Calculation
Q1	Cambern Ave. between Central & Concrete Culvert	X		From Plate 60
Q2	(Pre) Run-on across Cambern/ (Post)3'x18' Culvert under Cambern	X	X	From Hansaker & Associates Preliminary Drainage Analysis minus Q1
Q3	Third St. north of Cambern Ave.	X		From Plate 60
Q4	Cambern Ave. between Concrete Culvert & Third St.	X		Q2+Q1 = 750cfs, 750cfs-Q8 = 321cfs, Assume flow splits evenly, 321cfs ÷ 2 = 160.5, Rounded down to 160cfs
Q5	West side of property (Area "A")	X		Rational Method as prescribed in Riverside County Hydrology Manua
Q6	West side of property (Area "B")	X		Rational Method as prescribed in Riverside County Hydrology Manua
Q7	East side of property (Area "C")	X		Rational Method as prescribed in Riverside County Hydrology Manua
Q8	East side of property (Area "D") from Existing Cambern V-Ditch	X		From Existing Cambern Ave. V-Ditch calculation (Appendix C)
Q9	Northeast corner of property	X		Q2+Q1 = 750cfs, 750cfs-Q8 = 321cfs, Assume flow splits evenly, 321cfs÷ 2 = 160.5, Rounded to 161cfs and assumed 5cfs for runoff from northeast corner of project site.
Q10	Flow onto property abutting southeast corner of project site	X		Q8+Q7-Q14 = 423.90cfs
Q11	Lot 5 abutting southwest corner of project site	X	X	Total flow for the area from Plate 60 is 35cfs. 35cfs-Q5 = 28.5cfs
Q12	Lot 6 abutting southern property line of project site	X	X	Rational Method as prescribed in Riverside County Hydrology Manua
Q13	Lot 7 (LA Fitness) abutting southern property line of project site	X	X	Rational Method as prescribed in Riverside County Hydrology Manua
Q14	V-ditch along LA Fitness eastern property line	X	X	Proposed runoff from LA Fitness flowing south through V-Ditch. Proposed (Q14) has not been calculated, but will be less than the existing flow through the V-Ditc
Q15	Southwest corner of Dexter Ave. & Third St.	X	X	From Plate 60
Q38	Open Channel (rainfall on open channel area)		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q37	Truck Entrance (Rear of Building)		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q36	NEC of Walmart Property		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q35	Walmart building (north side)		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q34	Walmart Roof (NEC)		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q33	Walmart Roof (NWC)		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q32	Walmart Roof (SWC)		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q31	Walmart Roof (SEC)		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q30	Third St. Centerline Overflow from southern property to Dexter Ave		X	Q27-Q28+Q25-Q29 = 416.6cfs. See Appendix C *"Third St. 8" Curb Between Southern Propery Line of Project Site and Dexter Ave."* for Max Q calculation
Q29	Third St. 8" Curb from southern property to Dexter Ave.		X	From Appendix C *"Third St. 8" Curb Between Southern Propery Line of Project Site and Dexter Ave."* for Max Q calculation
Q28	Third St. Cross-gutter West to East Crossing		X	Q27-Q10. See Appendix C *"Proposed Third St. Cross-gutter West to East Crossing"* for Max Q.
Q27	Gutter flow from Open Channel Third St. Spillway Outflow + Q38+ Q26		X	Q2+Q26+Q38 = 755.7cfs
Q26	(Postdeveloped) Cambern Ave. between Central & Third		X	Q1+3cfs assumed for unknown runoff from property at northwest corner of Cambern & Third St. = 56cf
Q25	(Postdeveloped) property abutting southeast corner of project site		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q24	Onsite flow into New Storm Drain on Crane St.		X	Q24 includes on-site underground storage max discharge into proposed 30" storm drain. Avg discharge is 11.10cfs See Appendix C*"UNDERGROUND STORAGE OUTFLOW ORIFICE RESTRICTOR PLATE"*
Q23	Walmart building (south side)		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q22	Truck Turn-around area		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q21	Truck Dock		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q20	Parking Lot (south)		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q19	Parking Lot (north)		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q18	Outlot 3		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q17	Outlot 2		X	Rational Method as prescribed in Riverside County Hydrology Manua
Q16	Outlot 1		X	Rational Method as prescribed in Riverside County Hydrology Manua

Note: This plan respresents an alternate layout (worst case scenario) for the purposes of conveying off-site storm water along the back of the building via a box culvert then discharging to surface flow onto Third Street. This plan and hydrology report is provided as support for this design alternative. This design alternative would be not be utilized unless the City master planning drainage facilities within Third Street and Cambern are not expected to be complete by store grand opening.



SITE VICINITY MAP

NO SCALE

LEGEND

Q## XXcfs — STORM WATER RUNOFF LABEL AND RATE

→ STORM WATER RUNOFF PATH

- - - - - - DRAINAGE AREA BOUNDARY

DISCLAIMER:

THIS PLAN IS PRELIMINARY AND IS INTENDED FOR CONCEPTUAL PURPOSES ONLY. GREENBERG FARROW DOES NOT GUARANTEE THAT THE INFORMATION PROVIDED IS ACCURATE AND ASSUMES NO RESPONSIBILITY FOR TIME OR MONETARY LOSSES RESULTING FROM THE USE OF INFORMATION PROVIDED BY THIS PLAN.

THE SURVEY DATA IS BASED ON THE "ALTA/ACSM LAND TITLE SURVEY" PROVIDED BY KENNEITH E. TAIT R.C.E., DATED FEBRUARY 7, 2011.

LOT 7 TOPO DATA IS BASED ON THE "PRECISE GRADING PLAN CUP 3506 L.A. FITNESS CENTER", IW CONSULTING ENGINEERS, FREDDY IRIANTO, R.C.E.

LOT 5&6 TOPO DATA IS BASED ON THE "ALTA/ACSM LAND TITLE SURVEY" PROVIDED BY CLE ENGINEERING, INC., JOHN B. ROGERS, R.C.E., DATED FEBRUARY 7, 2008

DEXTER AVENUE TOPO DATA IS BASED ON THE "PLANS FOR THE IMPROVEMENT OF DEXTER AVENUE & SECOND STREET" PROVIDED BY HARRIS & ASSOCIATES, EHAB S. GERGES, R.C.E, DATED FEBRUARY 4, 2009.

EXISTING DRAINAGE DATA IS BASED ON RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT "PLATE 60, CITY OF LAKE ELSINORE MASTER PLAN OF DRAINAGE"

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET) 1 inch = 100 ft.

100YR DRAINAGE MAP (POSTDEVELOPMENT)

ISSUE/REVISION RECORD

DATE	DESCRIPTION
02.19.14	100YR DRAINAGE MAP

GreenbergFarrow
19000 MacArthur Blvd. Suite 250
Irvine, CA 92612
t: 949 296 0450 f: 949 296 0437

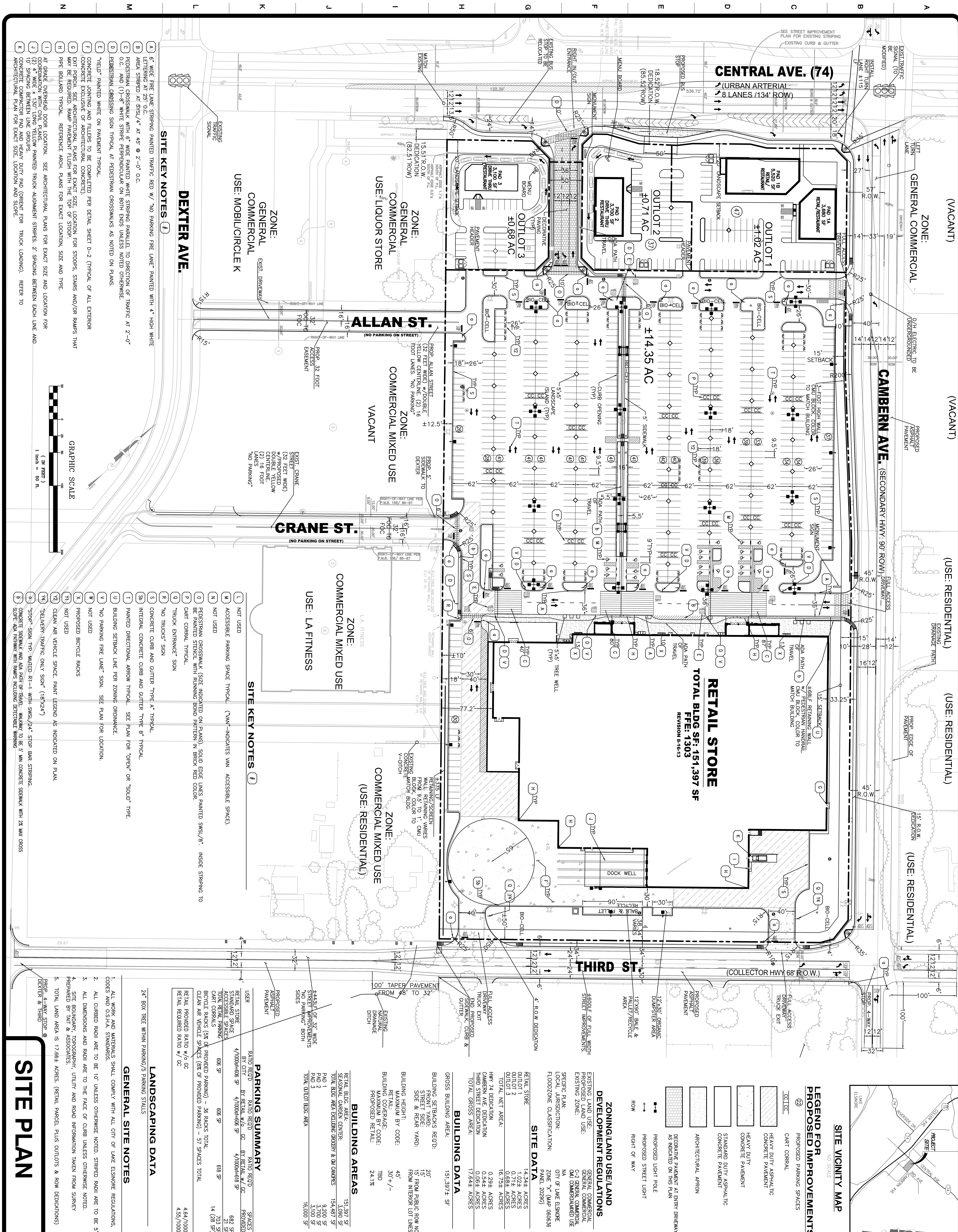
PROFESSIONAL SEAL

PROFESSIONAL IN CHARGE
FARMAN SHIR, PE
PROFESSIONAL ENGINEER
LICENSE NO. C63868

PROPOSED COMMERCIAL RETAIL STORE
SEC OF CENTRAL AVE. & CAMBERN AVE.
CITY OF LAKE ELSINORE, CALIFORNIA

DRAWN: JASON MILLER
CHECKED: FARMAN SHIR
DATE: 02.19.14
SCALE: 1"=100'
JOB No. 20080068.8
SHEET:

DM2



PRELIMINARY - NOT FOR CONSTRUCTION

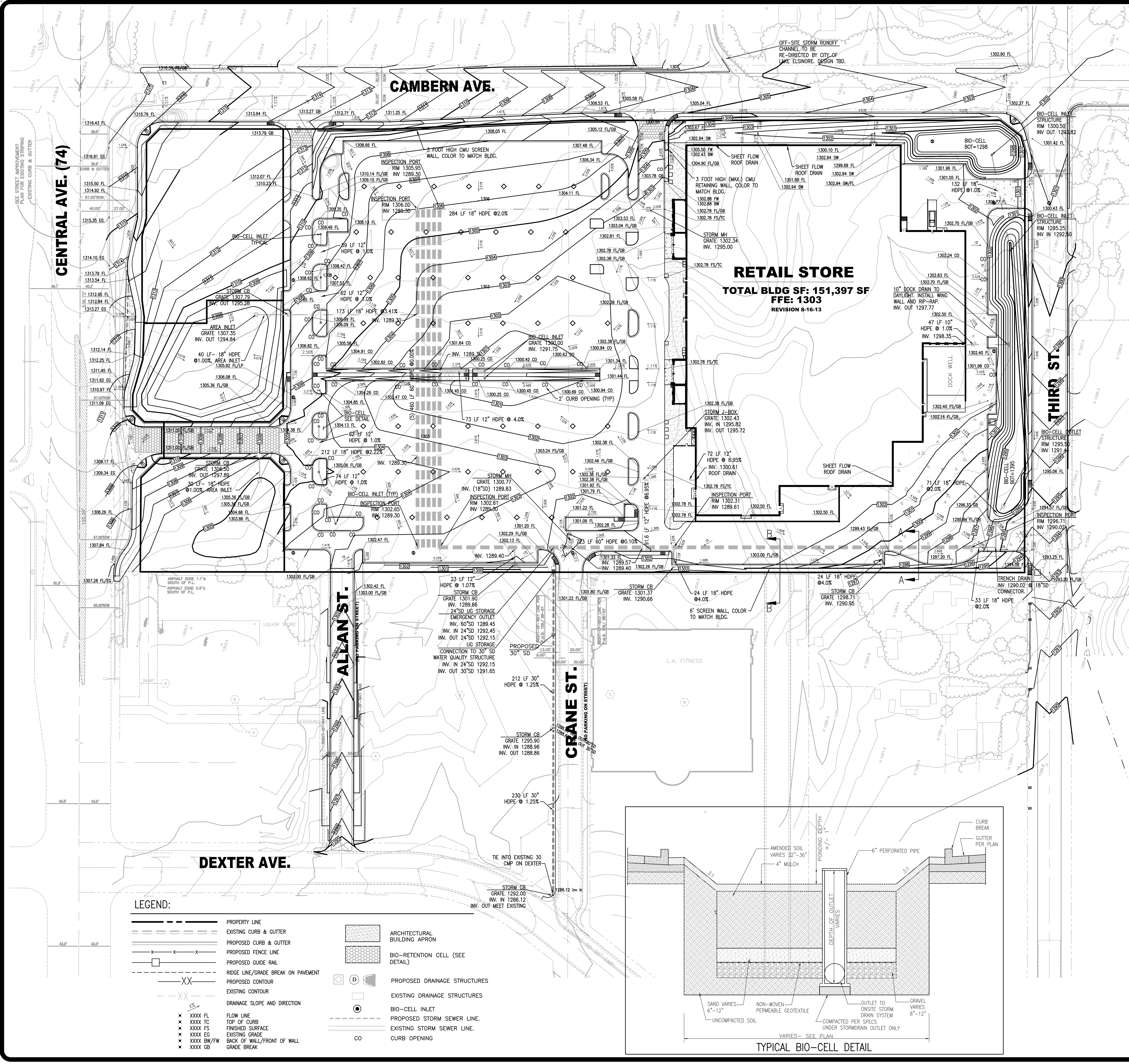
GreenbergFarrow
19000 MacArthur Blvd. Suite 250
Irvine, CA 92612
t: 949 296 0450 f: 949 296 0437

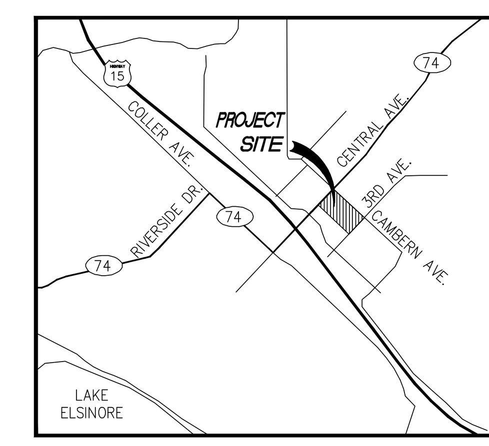
COA#:COA#

PROPOSED COMMERCIAL RETAIL STORE
SEC OF CENTRAL AVE. & CAMBERN AVE.
CITY OF LAKE ELSINORE, CALIFORNIA

ISSUE/REVISION RECORD

C-2.0





SITE VICINITY MAP

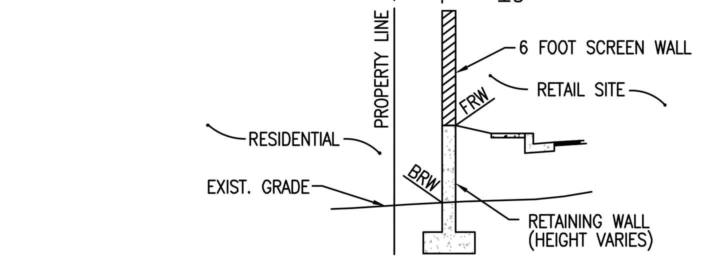
NO SCALE

GRADING NOTES

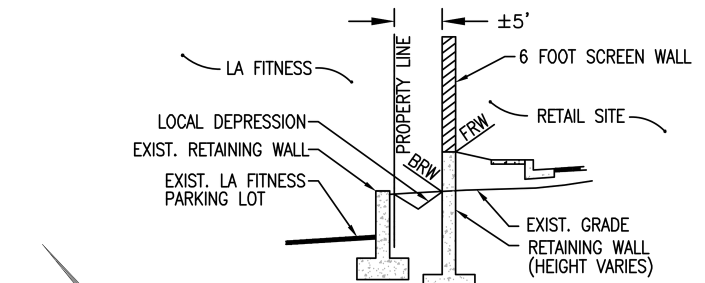
1. CONTRACTOR IS RESPONSIBLE FOR DEMOLITION OF EXISTING STRUCTURES INCLUDING REMOVAL OF ANY EXISTING UTILITIES SERVING THE STRUCTURE. UTILITIES ARE TO BE REMOVED TO THE RIGHT-OF-WAY.
2. THE CONTRACTOR IS SPECIFICALLY CAUTIONED THAT THE LOCATION AND/OR ELEVATION OF EXISTING UTILITIES AS SHOWN ON THESE PLANS IS BASED ON RECORDS OF THE VARIOUS UTILITY COMPANIES, AND WHERE POSSIBLE, MEASUREMENTS TAKEN IN THE FIELD. THE INFORMATION IS NOT TO BE RELIED ON AS BEING EXACT OR COMPLETE. THE CONTRACTOR MUST CALL THE APPROPRIATE UTILITY COMPANIES AT LEAST 72 HOURS BEFORE ANY EXCAVATION TO REQUEST EXACT FIELD LOCATION OF UTILITIES. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO RELOCATE ALL EXISTING UTILITIES WHICH CONFLICT WITH THE PROPOSED IMPROVEMENTS SHOWN ON THE PLANS.
3. ALL CUT OR FILL SLOPES SHALL BE 3:1 OR FLATTER UNLESS OTHERWISE NOTED. CEMENT STABILIZATION OF SIDE SLOPES STEEPER THAN 3:1 IS REQUIRED. REFERENCE SITE SPECIFIC GEOTECHNICAL REPORT PREPARED BY MOORE TWINING & ASSOCIATES FOR CEMENT STABILIZATION SPECIFICATIONS.
4. PRECAST STRUCTURES MAY BE USED AT CONTRACTORS OPTION.
5. STORM PIPE MATERIAL SHALL BE PER MASTER SITE SPECIFICATIONS SECTION 02630.
6. EXISTING PIPES TO BE CLEANED OUT TO REMOVE ALL SILT AND DEBRIS
7. EXISTING GRADE CONTOUR INTERVALS SHOWN AT 1 FOOT.
8. PROPOSED GRADE CONTOUR INTERVALS SHOWN AT 1 FOOT INTERVALS.
9. IF ANY EXISTING STRUCTURES TO REMAIN ARE DAMAGED DURING CONSTRUCTION IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO REPAIR AND/OR REPLACE THE EXISTING STRUCTURE AS NECESSARY TO RETURN IT TO EXISTING CONDITIONS OR BETTER.
10. ALL STORM PIPE ENTERING STRUCTURES SHALL BE GROUTED TO ASSURE CONNECTION AT STRUCTURE IS WATERTIGHT.
11. ALL STORM SEWER MANHOLES IN PAVED AREAS SHALL BE FLUSH WITH PAVEMENT, AND SHALL HAVE TRAFFIC BEARING RING & COVERS. MANHOLES IN UNPAVED AREAS SHALL BE 6" ABOVE FINISH GRADE. LIDS SHALL BE LABELED "STORM SEWER".
12. THE CONTRACTOR SHALL ADHERE TO ALL TERMS & CONDITIONS AS OUTLINED IN THE EPA OR APPLICABLE STATE GENERAL N.P.D.E.S. PERMIT FOR STORM WATER DISCHARGE ASSOCIATED WITH CONSTRUCTION ACTIVITIES AND THE WALMART SPECIAL CONDITIONS, SECTION 8, ENVIRONMENTAL COMPLIANCE AND STORM WATER POLLUTION PREVENTION. THIS APPLIES TO WALMART BUILT PROJECTS ONLY.
13. CONTRACTOR SHALL ADJUST AND/OR CUT EXISTING PAVEMENT AS NECESSARY TO ASSURE A SMOOTH FIT AND CONTINUOUS GRADE.
14. CONTRACTOR SHALL ASSURE POSITIVE DRAINAGE AWAY FROM BUILDINGS FOR ALL NATURAL AND PAVED AREAS.
15. TOPOGRAPHIC INFORMATION IS TAKEN FROM A TOPOGRAPHIC SURVEY BY LAND SURVEYORS. IF THE CONTRACTOR DOES NOT ACCEPT EXISTING TOPOGRAPHY AS SHOWN ON THE PLANS, WITHOUT EXCEPTION, THEN THE CONTRACTOR SHALL SUPPLY, AT THEIR EXPENSE, A TOPOGRAPHIC SURVEY BY A REGISTERED LAND SURVEYOR TO THE OWNER FOR REVIEW.
16. ALL UNSURFACED AREAS DISTURBED BY GRADING OPERATION SHALL STABILIZED PER THE LANDSCAPE PLANS AND EROSION SEDIMENT CONTROL PLANS.
17. CONSTRUCTION SHALL COMPLY WITH ALL APPLICABLE GOVERNING CODES AND BE CONSTRUCTED TO SAME
18. ALL STORM STRUCTURES SHALL HAVE A SMOOTH UNIFORM POURED MORTAR INVERT FROM INVERT IN TO INVERT OUT.

DEWATERING NOTE:

WHEN PERFORMING GRADING OPERATIONS DURING PERIODS OF WET WEATHER, PROVIDE ADEQUATE DEWATERING, DRAINAGE AND GROUND WATER MANAGEMENT TO CONTROL MOISTURE OF SOILS. REFER TO MASTER SITE SPECIFICATIONS.



SECTION A-A
CMU BLOCK, COLOR TO MATCH BLDG
FRW= FRONT OF RETAINING WALL
BRW= BACK OF RETAINING WALL



SECTION B-B
CMU BLOCK, COLOR TO MATCH BLDG
FRW= FRONT OF RETAINING WALL
BRW= BACK OF RETAINING WALL

GRAPHIC SCALE
(IN FEET)
1 inch = 50 ft.

PRELIMINARY - NOT FOR CONSTRUCTION

ISSUE/REVISION RECORD
DATE DESCRIPTION

GreenbergFarrow
19000 MacArthur Blvd. Suite 250
Irvine, CA 92612
t: 949 296 0450 f: 949 296 0437
COA#: COA#

PROFESSIONAL IN CHARGE
FARMIN SHIR, PE
PROFESSIONAL ENGINEER
LICENSE NO. C63868

PROPOSED COMMERCIAL RETAIL STORE
SEC OF CENTRAL AVE. & CAMBERN AVE.
CITY OF LAKE ELSINORE, CALIFORNIA

DRAWN JPM
CHECKED B.L.
DATE 05/06/2015
SCALE 1"=50'
JOB No. 20080068.8
SHEET:

GRADING PLAN

C-3.0

Appendix 7: Hydromodification

Supporting Detail Relating to Hydrologic Conditions of Concern

This section will be addressed as part of the final WQMP and permit plans.

Appendix 8: Source Control

Pollutant Sources/Source Control Checklist

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

How to use this worksheet (also see instructions in Section G of the WQMP Template):

1. Review Column 1 and identify which of these potential sources of stormwater pollutants apply to your site. Check each box that applies.
2. Review Column 2 and incorporate all of the corresponding applicable BMPs in your WQMP Exhibit.
3. Review Columns 3 and 4 and incorporate all of the corresponding applicable permanent controls and operational BMPs in your WQMP. Use the format shown in Table G.1on page 23 of this WQMP Template. Describe your specific BMPs in an accompanying narrative, and explain any special conditions or situations that required omitting BMPs or substituting alternative BMPs for those shown here.

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☒ A. **On-site storm drain inlets**	☒ **Locations of inlets.**	☒ **Mark all inlets with the words "Only Rain Down the Storm Drain" or similar. Catch Basin Markers may be available from the Riverside County Flood Control and Water Conservation District, call 951.955.1200 to verify.**	☒ **Maintain and periodically repaint or replace inlet markings.** ☒ **Provide stormwater pollution prevention information to new site owners, lessees, or operators.** ☒ **See applicable operational BMPs in Fact Sheet SC-44, "Drainage System Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com** ☒ **Include the following in lease agreements: "Tenant shall not allow anyone to discharge anything to storm drains or to store or deposit materials so as to create a potential discharge to storm drains."**
☐ B. **Interior floor drains and elevator shaft sump pumps**		☐ **State that interior floor drains and elevator shaft sump pumps will be plumbed to sanitary sewer.**	☐ **Inspect and maintain drains to prevent blockages and overflow.**
☒ C. **Interior parking garages**		☒ **State that parking garage floor drains will be plumbed to the sanitary sewer.**	☒ **Inspect and maintain drains to prevent blockages and overflow.**

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ D1. **Need for future indoor & structural pest control**		❑ **Note building design features that discourage entry of pests.**	❑ **Provide Integrated Pest Management information to owners, lessees, and operators.**
X D2. **Landscape/ Outdoor Pesticide Use**	❑ **Show locations of native trees or areas of shrubs and ground cover to be undisturbed and retained.** ❑ **Show self-retaining landscape areas, if any.** ❑ **Show stormwater treatment and hydrograph modification management BMPs. (See instructions in Chapter 3, Step 5 and guidance in Chapter 5.)**	**State that final landscape plans will accomplish all of the following.** ❑ **Preserve existing native trees, shrubs, and ground cover to the maximum extent possible.** ❑ **Design landscaping to minimize irrigation and runoff, to promote surface infiltration where appropriate, and to minimize the use of fertilizers and pesticides that can contribute to stormwater pollution.** ❑ **Where landscaped areas are used to retain or detain stormwater, specify plants that are tolerant of saturated soil conditions.** ❑ **Consider using pest-resistant plants, especially adjacent to hardscape.** ❑ **To insure successful establishment, select plants appropriate to site soils, slopes, climate, sun, wind, rain, land use, air movement, ecological consistency, and plant interactions.**	❑ **Maintain landscaping using minimum or no pesticides.** ❑ **See applicable operational BMPs in "What you should know for…..Landscape and Gardening"** at http://rcflood.org/stormwater/**Error! Hyperlink reference not valid.** ❑ **Provide IPM information to new owners, lessees and operators.**

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ E. **Pools, spas, ponds, decorative fountains, and other water features.**	❑ **Show location of water feature and a sanitary sewer cleanout in an accessible area within 10 feet. (Exception: Public pools must be plumbed according to County Department of Environmental Health Guidelines.)**	**If the Co-Permittee requires pools to be plumbed to the sanitary sewer, place a note on the plans and state in the narrative that this connection will be made according to local requirements.**	❑ **See applicable operational BMPs in** "Guidelines for Maintaining Your Swimming Pool, Jacuzzi and Garden Fountain" at http://rcflood.org/stormwater/
❑ F. **Food service**	❑ **For restaurants, grocery stores, and other food service operations, show location (indoors or in a covered area outdoors) of a floor sink or other area for cleaning floor mats, containers, and equipment.** ❑ **On the drawing, show a note that this drain will be connected to a grease interceptor before discharging to the sanitary sewer.**	❑ **Describe the location and features of the designated cleaning area.** ❑ **Describe the items to be cleaned in this facility and how it has been sized to insure that the largest items can be accommodated.**	❑ **See the brochure, "**The Food Service Industry Best Management Practices for: Restaurants, Grocery Stores, Delicatessens and Bakeries" at http://rcflood.org/stormwater/ **Provide this brochure to new site owners, lessees, and operators.**
❑ G. **Refuse areas**	❑ **Show where site refuse and recycled materials will be handled and stored for pickup. See local municipal requirements for sizes and other details of refuse areas.** ❑ **If dumpsters or other receptacles are outdoors, show how the designated area will be covered, graded, and paved to prevent run-on and show locations of berms to prevent runoff from the area.** ❑ **Any drains from dumpsters, compactors, and tallow bin areas shall be connected to a grease removal device before discharge to sanitary sewer.**	❑ **State how site refuse will be handled and provide supporting detail to what is shown on plans.** ❑ **State that signs will be posted on or near dumpsters with the words "Do not dump hazardous materials here" or similar.**	❑ **State how the following will be implemented:** **Provide adequate number of receptacles. Inspect receptacles regularly; repair or replace leaky receptacles. Keep receptacles covered. Prohibit/prevent dumping of liquid or hazardous wastes. Post "no hazardous materials" signs. Inspect and pick up litter daily and clean up spills immediately. Keep spill control materials available on-site. See Fact Sheet SC-34, "Waste Handling and Disposal" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ H. **Industrial processes.**	❑ **Show process area.**	❑ **If industrial processes are to be located on site, state: "All process activities to be performed indoors. No processes to drain to exterior or to storm drain system."**	❑ **See Fact Sheet SC-10, "Non-Stormwater Discharges" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com** See the brochure "Industrial & Commercial Facilities Best Management Practices for: Industrial, Commercial Facilities" at http://rcflood.org/stormwater/

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
X❑ I. **Outdoor storage of equipment or materials. (See rows J and K for source control measures for vehicle cleaning, repair, and maintenance.)**	❑ **Show any outdoor storage areas, including how materials will be covered. Show how areas will be graded and bermed to prevent run-on or run-off from area.** ❑ **Storage of non-hazardous liquids shall be covered by a roof and/or drain to the sanitary sewer system, and be contained by berms, dikes, liners, or vaults.** ❑ **Storage of hazardous materials and wastes must be in compliance with the local hazardous materials ordinance and a Hazardous Materials Management Plan for the site.**	**Include a detailed description of materials to be stored, storage areas, and structural features to prevent pollutants from entering storm drains.** **Where appropriate, reference documentation of compliance with the requirements of Hazardous Materials Programs for:** ▪ **Hazardous Waste Generation** ▪ **Hazardous Materials Release Response and Inventory** ▪ **California Accidental Release (CalARP)** ▪ **Aboveground Storage Tank** ▪ **Uniform Fire Code Article 80 Section 103(b) & (c) 1991** ▪ **Underground Storage Tank** **www.cchealth.org/groups/hazmat/**	❑ **See the Fact Sheets SC-31, "Outdoor Liquid Container Storage" and SC-33, "Outdoor Storage of Raw Materials " in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☒ J. **Vehicle and Equipment Cleaning**	❑ **Show on drawings as appropriate:** **(1) Commercial/industrial facilities having vehicle/equipment cleaning needs shall either provide a covered, bermed area for washing activities or discourage vehicle/equipment washing by removing hose bibs and installing signs prohibiting such uses.** **(2) Multi-dwelling complexes shall have a paved, bermed, and covered car wash area (unless car washing is prohibited on-site and hoses are provided with an automatic shut-off to discourage such use).** **(3) Washing areas for cars, vehicles, and equipment shall be paved, designed to prevent run-on to or runoff from the area, and plumbed to drain to the sanitary sewer.** **(4) Commercial car wash facilities shall be designed such that no runoff from the facility is discharged to the storm drain system. Wastewater from the facility shall discharge to the sanitary sewer, or a wastewater reclamation system shall be installed.**	❑ **If a car wash area is not provided, describe any measures taken to discourage on-site car washing and explain how these will be enforced.**	**Describe operational measures to implement the following (if applicable):** ❑ **Washwater from vehicle and equipment washing operations shall not be discharged to the storm drain system.** Refer to "Outdoor Cleaning Activities and Professional Mobile Service Providers" for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater/ ❑ **Car dealerships and similar may rinse cars with water only.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☒ K. **Vehicle/Equipment Repair and Maintenance**	❑ **Accommodate all vehicle equipment repair and maintenance indoors. Or designate an outdoor work area and design the area to prevent run-on and runoff of stormwater.** ❑ **Show secondary containment for exterior work areas where motor oil, brake fluid, gasoline, diesel fuel, radiator fluid, acid-containing batteries or other hazardous materials or hazardous wastes are used or stored. Drains shall not be installed within the secondary containment areas.** ❑ **Add a note on the plans that states either (1) there are no floor drains, or (2) floor drains are connected to wastewater pretreatment systems prior to discharge to the sanitary sewer and an industrial waste discharge permit will be obtained.**	❑ **State that no vehicle repair or maintenance will be done outdoors, or else describe the required features of the outdoor work area.** ❑ **State that there are no floor drains or if there are floor drains, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.** ❑ **State that there are no tanks, containers or sinks to be used for parts cleaning or rinsing or, if there are, note the agency from which an industrial waste discharge permit will be obtained and that the design meets that agency's requirements.**	**In the Stormwater Control Plan, note that all of the following restrictions apply to use the site:** ❑ **No person shall dispose of, nor permit the disposal, directly or indirectly of vehicle fluids, hazardous materials, or rinsewater from parts cleaning into storm drains.** ❑ **No vehicle fluid removal shall be performed outside a building, nor on asphalt or ground surfaces, whether inside or outside a building, except in such a manner as to ensure that any spilled fluid will be in an area of secondary containment. Leaking vehicle fluids shall be contained or drained from the vehicle immediately.** ❑ **No person shall leave unattended drip parts or other open containers containing vehicle fluid, unless such containers are in use or in an area of secondary containment.** Refer to "Automotive Maintenance & Car Care Best Management Practices for Auto Body Shops, Auto Repair Shops, Car Dealerships, Gas Stations and Fleet Service Operations". Brochure can be found at http://rcflood.org/stormwater/ Refer to Outdoor Cleaning Activities and Professional Mobile Service Providers for many of the Potential Sources of Runoff Pollutants categories below. Brochure can be found at http://rcflood.org/stormwater/

IF THESE SOURCES WILL BE ON THE PROJECT SITE …	… THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☒ L. **Fuel Dispensing Areas**	❑ **Fueling areas[6] shall have impermeable floors (i.e., portland cement concrete or equivalent smooth impervious surface) that are: a) graded at the minimum slope necessary to prevent ponding; and b) separated from the rest of the site by a grade break that prevents run-on of stormwater to the maximum extent practicable.** ❑ **Fueling areas shall be covered by a canopy that extends a minimum of ten feet in each direction from each pump. [Alternative: The fueling area must be covered and the cover's minimum dimensions must be equal to or greater than the area within the grade break or fuel dispensing area[1].] The canopy [or cover] shall not drain onto the fueling area.**		❑ **The property owner shall dry sweep the fueling area routinely.** ❑ **See the Fact Sheet SD-30 , "Fueling Areas" in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

[6] **The fueling area shall be defined as the area extending a minimum of 6.5 feet from the corner of each fuel dispenser or the length at which the hose and nozzle assembly may be operated plus a minimum of one foot, whichever is greater.**

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☒ M. **Loading Docks**	❑ **Show a preliminary design for the loading dock area, including roofing and drainage. Loading docks shall be covered and/or graded to minimize run-on to and runoff from the loading area. Roof downspouts shall be positioned to direct stormwater away from the loading area. Water from loading dock areas shall be drained to the sanitary sewer, or diverted and collected for ultimate discharge to the sanitary sewer.** ❑ **Loading dock areas draining directly to the sanitary sewer shall be equipped with a spill control valve or equivalent device, which shall be kept closed during periods of operation.** ❑ **Provide a roof overhang over the loading area or install door skirts (cowling) at each bay that enclose the end of the trailer.**		❑ **Move loaded and unloaded items indoors as soon as possible.** ❑ **See Fact Sheet SC-30, "Outdoor Loading and Unloading," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
❑ N. **Fire Sprinkler Test Water**		❑ **Provide a means to drain fire sprinkler test water to the sanitary sewer.**	❑ **See the note in Fact Sheet SC-41, "Building and Grounds Maintenance," in the CASQA Stormwater Quality Handbooks at www.cabmphandbooks.com**
O. **Miscellaneous Drain or Wash Water or Other Sources** ❑ **Boiler drain lines** ❑ **Condensate drain lines** ❑ **Rooftop equipment** ❑ **Drainage sumps** ☒ **Roofing, gutters, and trim.** ❑ **Other sources**		❑ **Boiler drain lines shall be directly or indirectly connected to the sanitary sewer system and may not discharge to the storm drain system.** ❑ **Condensate drain lines may discharge to landscaped areas if the flow is small enough that runoff will not occur. Condensate drain lines may not discharge to the storm drain system.** ❑ **Rooftop equipment with potential to produce pollutants shall be roofed and/or have secondary containment.** ❑ **Any drainage sumps on-site shall feature a sediment sump to reduce the quantity of sediment in pumped water.** ❑ **Avoid roofing, gutters, and trim made of copper or other unprotected metals that may leach into runoff.** ❑ **Include controls for other sources as specified by local reviewer.**	

STORMWATER POLLUTANT SOURCES/SOURCE CONTROL CHECKLIST

IF THESE SOURCES WILL BE ON THE PROJECT SITE ...	... THEN YOUR WQMP SHOULD INCLUDE THESE SOURCE CONTROL BMPs, AS APPLICABLE		
1 Potential Sources of Runoff Pollutants	2 Permanent Controls—Show on WQMP Drawings	3 Permanent Controls—List in WQMP Table and Narrative	4 Operational BMPs—Include in WQMP Table and Narrative
☒ P. **Plazas, sidewalks, and parking lots.**			❑ **Sweep plazas, sidewalks, and parking lots regularly to prevent accumulation of litter and debris. Collect debris from pressure washing to prevent entry into the storm drain system. Collect washwater containing any cleaning agent or degreaser and discharge to the sanitary sewer not to a storm drain.**