BURNS McDONNELL

Preliminary Drainage Study

High Desert Solar Project

Project No. 98975

Revision C
2/22/2019

Preliminary Drainage Study

prepared for

High Desert Solar Project
Victorville, CA

Project No. 98975

Revision C
2/22/2019

prepared by

Burns & McDonnell Engineering Company, Inc.
Phoenix, AZ

INDEX AND CERTIFICATION

High Desert Solar Project
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Certification

I hereby certify, as a Professional Engineer in the state of California, that the information in this document was assembled under my direct personal charge. This report is not intended or represented to be suitable for reuse by High Desert Solar Project or others without specific verification or adaptation by the Engineer.

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Date: February 22, 2019

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LIST OF ABBREVIATIONS

Abbreviation	**Term/Phrase/Name**
Ac-ft	Acre-feet
BMcD	Burns & McDonnell
CFS	Cubic feet per second
FEMA	Federal Emergency Management Agency
MW	Megawatt
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
PV	Photovoltaic
Q	Flow Rate
SWMP	Storm Water Management Plan
USDA	United States Department of Agriculture
USGS	United States Geological Survey
V	Volume
WQMP	Water Quality Management Plan

1.0 INTRODUCTION / PURPOSE

Burns and McDonnell Engineering Company Inc. has been retained by HDSI, LLC to provide engineering and permitting support for the High Desert Solar Project (Project). The purpose of this drainage study is to describe and document drainage management and to support a Conditional Use Permit (CUP) through the City of Victorville, CA.

The Project is planned to be a nominal 108-Megawatt AC (MWac) solar photovoltaic (PV) power plant and will interconnect to the existing High Desert Power Plant located in the northwest portion of the City of Victorville, California. In addition to the PV arrays, the development will include internal access roads, equipment pads, chain link perimeter security fences, and an overhead transmission line (gen-tie) to the point of interconnection. The project site consists of approximately 607 acres and is located east of the intersection of Colusa Road and Helendale Road (Figure 2-1). The owner and future operator of the Project is:

HDSI, LLC
200 West Madison St., Suite 3810
Chicago, IL 60606

2.0 SITE DISCUSSION

The High Desert Solar Project is a large single development located within portions of Sections 2 and 11 Township 6 North, Range 5 West, of the San Bernardino Meridian (34.6310°, -117.3726°). It is approximately 8 miles northwest of Victorville, California, within San Bernardino County. The site is considered part of Zone 6 of the San Bernardino County Flood Control District Overall District Zones. Due to the location and distance away from the City of Victorville, the High Desert Solar Project does not tie into the Victorville Master Plan of Drainage.

The property and surrounding areas are mostly vacant desert terrain with sparse, native desert scrub. However, the site also contains several disturbed/developed areas consisting of old structures and illegal dumping as well as large tracks of undeveloped land. There are several underground utilities that cross the site, including: a natural gas pipeline, reclaimed water pipeline(s), and telecom communications cables. See Figure 2-1 for an aerial view of the site.

The site falls within the Alto (Upper Basin) subarea of the Mojave River Watershed. The Mojave River is approximately ½ mile east of the eastern border of the site. The existing site is divided by a small ridge running north to south. To the west of the ridge, the property slopes gradually toward the northwest with grades between 0-2%. To the east of the ridge, the property slopes east toward the Mojave River with varying grades up to 10%.

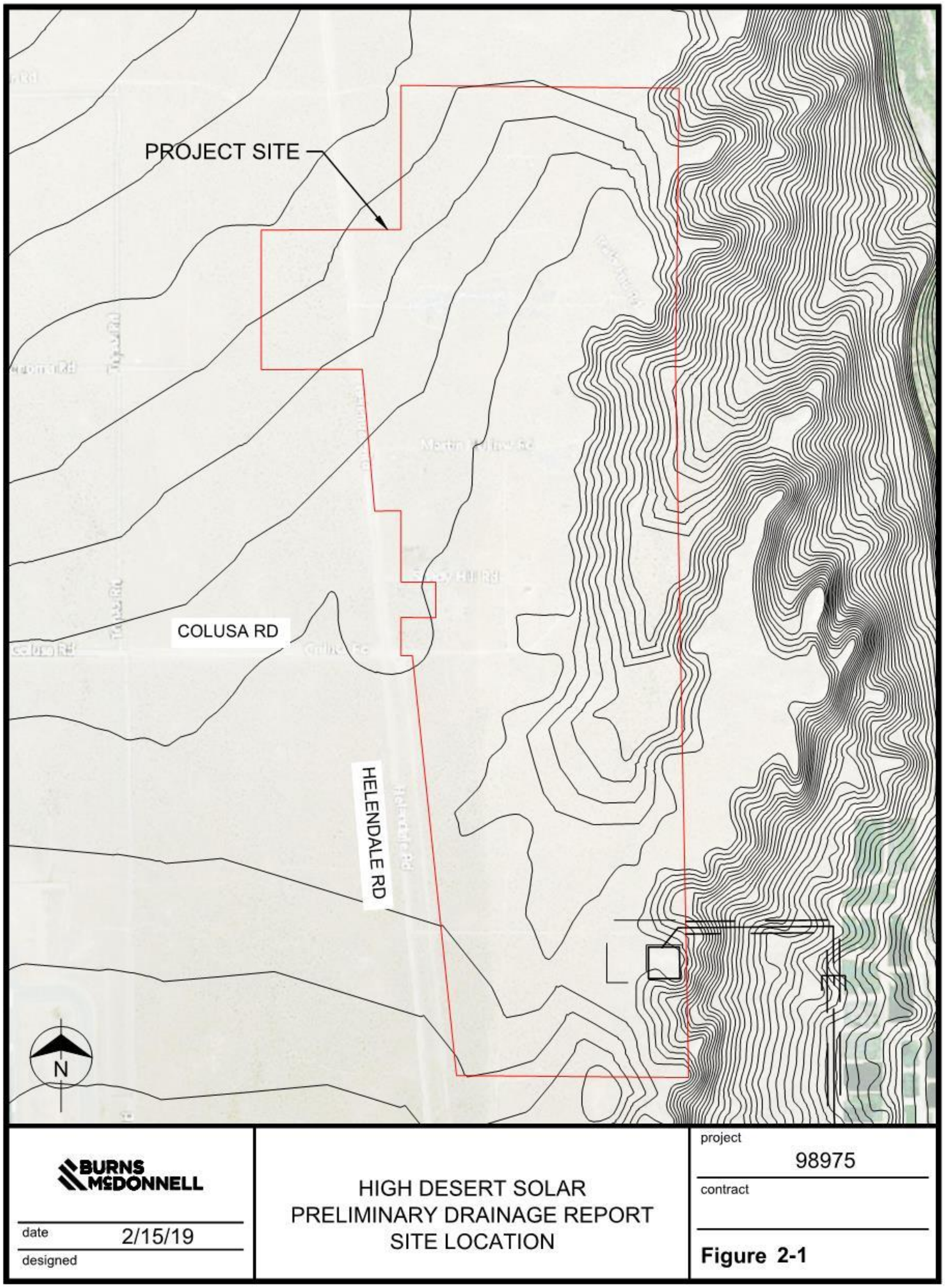
The soils information was gathered through the United States Department of Agriculture's (USDA) Web Soil Survey. The site consists of National Resource Conservation Service (NRCS) soil groups A and C. A further report of the site's properties may be found in Appendix B.

For the hydrologic analysis, the site was divided into eleven separate subareas. Topographical features such as flowlines, ridges, etc. and post-developed roads determined how the subareas were divided. See Figure 2-2 for the division of subareas. A topographical survey with 1' contours was used to subdivide the northern half of the site while 20' USGS contours were used for the southern portion of the site.

The Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM), Numbers 06071C5150J and 06071C5125H covers the Project. The effective dates of these are August 28, 2008, last revised on September 2, 2016 and August 28, 2008. The entire Project site falls within Zone X, which is defined as "areas determined to be outside the 0.2% annual chance floodplain." The Zone X is not regulated by FEMA nor the local floodplain administrator. The FEMA FIRM can be found in Appendix G.

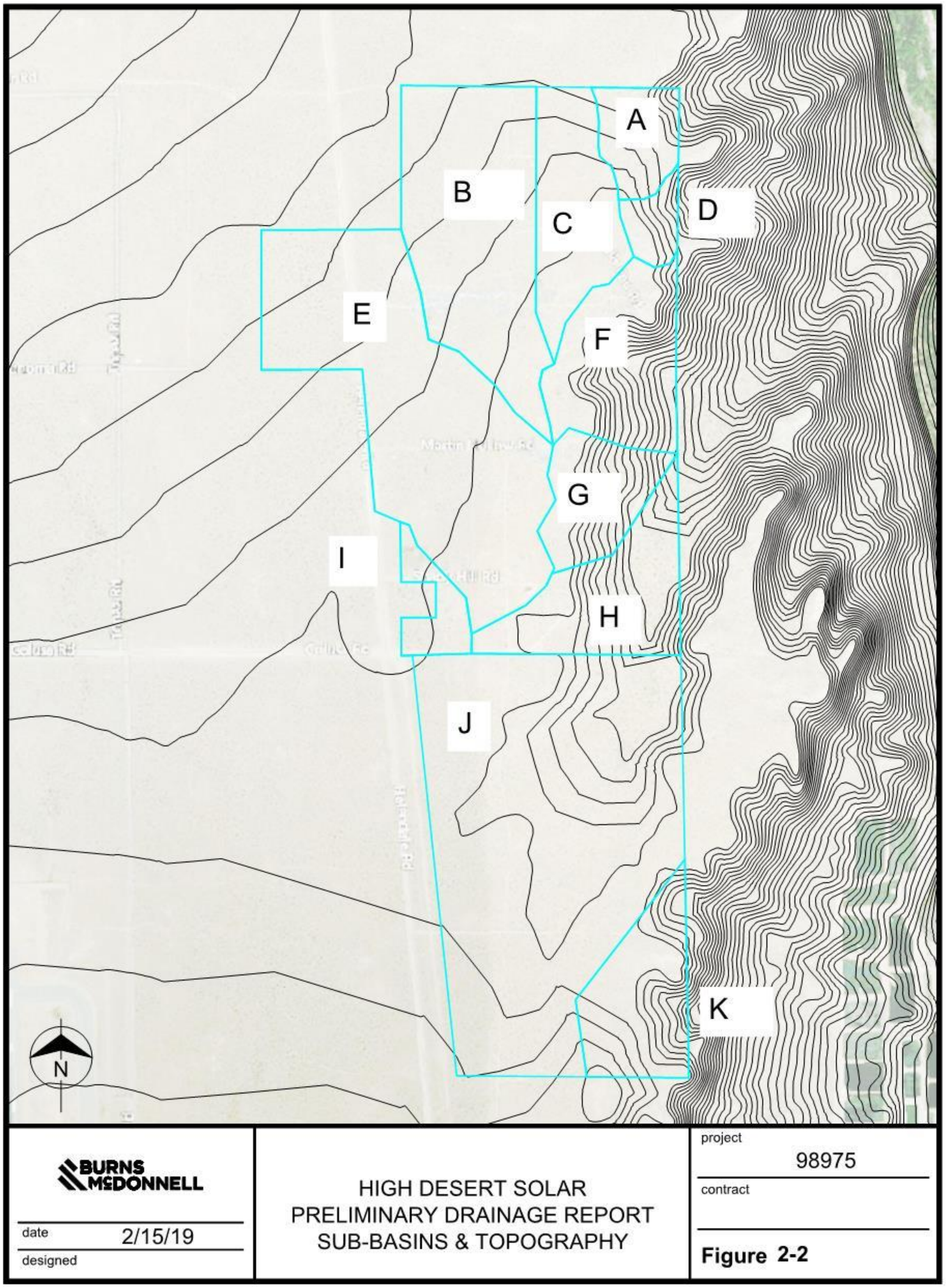
In its pre-developed state, the site has little impervious surfaces; primarily existing foundations for old homes. The net gain of impervious areas due to the construction of the solar farm was estimated to be approximately 0.28%, a minimal increase to the pre-developed site conditions.

Figure 2-1: Aerial View



(not to scale)

Figure 2-2: Subarea & Topography View



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3.0 RAINFALL DATA

Rainfall data for the site was collected through the NOAA National Weather Service – Precipitation Frequency Data Server. The results for each can be found in Appendix C. The data from these tables were used to calculate the pre- and post- development peak flow rates and runoff volumes. The pre- and post-development hydrographs were also created for the 100 year and 10-year events, and can be found in Appendix D.

4.0 ONSITE RUNOFF

The site was subdivided into eleven separate drainage areas based on the site characteristics explained in Section 2.0, each with their respective downstream outlets (Figure 5-1). The Rational Method was used to estimate the peak flow rates across the site.

4.1 Rational Method

The methodology for calculating peak flow discharge and runoff volume was adapted from the San Bernardino Hydrology Manual. As advised by the manual, the Rational Method is preferred for sites less than 640 acres when determining the peak flow discharge:

$$Q = CIA$$

where Q = Peak flow discharge (cfs)

C = Runoff coefficient

I = Intensity (in/hr), and

A = Area (acre)

To estimate the intensity for each subarea, a rainfall duration was needed for each subarea, in combination with NOAA's rainfall frequency data. A time of concentration (Tc) was calculated for each subarea by using the length of the most distant point from the outlet. The times of concentration were then used as the rainfall durations to find the NOAA intensities. A runoff coefficient was estimated for each subarea using the methods of the Hydrology Manual. See Appendix A for further information regarding the Rational Method Calculations.

Columns 3 and 4 of Tables 4-1 and 4-2 show the results of the Rational Method peak flow rate results. The tables show the peak flow rates generated from the 607 acres site under both pre- and post- developed conditions for the 10-year and 100-year storm events in respect to the time of concentration estimated for each subarea. The results for both the 10-year and 100-year are provided in accordance with City of Victorville's requirements. The detailed calculations can be found in Appendix A.

4.2 Pre-Developed

Table 4-1: Pre-developed Characteristics

Subarea	Area (acre)	100yr Q (cfs)	10yr Q (cfs)	100yr/24hr V (ac-ft)	100yr/1hr V (ac-ft)	10yr/24hr V (ac-ft)
A	16.35	22.74	9.76	2.03	0.20	0.83
B	78.76	66.67	22.42	9.77	0.98	4.01
C	35.90	13.89	0.74	4.45	0.45	1.83
D	7.91	21.15	10.56	0.98	0.10	0.40
E	119.70	64.70	0.00	3.83	0.09	0.50
F	41.86	40.64	14.91	5.19	0.52	2.13
G	24.57	41.01	15.31	0.79	0.02	0.10
H	39.74	54.39	23.27	4.93	0.49	2.02
I	10.58	10.75	4.04	1.31	0.13	0.54
J	197.52	64.81	0.00	6.32	0.15	0.82
K	33.67	46.40	19.90	4.18	0.42	1.71
Total	606.56	447.13	120.92	43.76	3.56	14.88

Q = Peak flow rate
V = Volume
cfs = cubic feet per second
ac-ft = acre-feet

4.3 Post-Developed

Table 4-2: Post-developed Characteristics

Subarea	Area (acre)	100yr Q (cfs)	10yr Q (cfs)	100yr/24hr V (ac-ft)	100yr/1hr V (ac-ft)	10yr/24hr V (ac-ft)
A	16.35	22.76	9.79	2.03	0.20	0.83
B	78.76	66.78	22.53	9.77	0.98	4.01
C	35.90	13.94	0.80	4.45	0.45	1.83
D	7.91	21.16	10.57	0.98	0.10	0.40
E	119.70	64.98	0.28	3.84	0.09	0.50
F	41.86	40.70	14.97	5.19	0.52	2.13
G	24.57	41.06	15.37	0.79	0.02	0.10
H	39.74	54.45	23.33	4.93	0.49	2.02
I	10.58	10.76	4.06	1.31	0.13	0.54
J	197.52	65.28	0.38	6.35	0.15	0.83
K	33.67	46.45	19.94	4.25	0.44	1.76
Total	606.56	448.33	122.02	43.90	3.58	14.96

Q = Peak flow rate
V = Volume
cfs = cubic feet per second
ac-ft = acre-feet

4.4 Site Plan

The civil sitework will primarily consist of cutting and crushing the existing site vegetation as necessary to accommodate the new solar arrays, minimized grading focusing on the eastern portion of the site, installation of compacted dirt roads around the perimeter of the site, interior dirt access roads throughout the site, and construction of chain link fences around the perimeter of the site.

Because the site is relatively flat, slopes generally less than 1%, it is conducive to solar development. Little to no grading is anticipated for roughly 80% the site. Additionally, to minimize the impact of the development of solar arrays, the existing vegetation will be cut and crushed in place. The existing vegetation will be cut using a skid-steer mounted bush whacker that will leave roots intact and mulch the cut material on-site. This method will allow for the vegetation to remain/regrow helping to stabilize the ground surface. The vegetation will largely remain in place throughout the life of the project with operations and maintenance trimming the vegetation under the solar arrays. The maintenance plan for the site will include trimming the existing vegetation every 6 months or as necessary to prevent shading of the panels.

Grading will primarily be focused on the eastern portion of the site where large elevation changes occur. For solar sites, slopes of 10% or less are preferred for the constructability of the solar arrays. Therefore, Sub-basins A, D, F, G, and H will undergo moderate grading where slopes exceed 10%. The smooth, near planar ground surfaces will promote sheet-flows which exhibit less scour potential as compared to concentrated flows. For the west side of the site, the existing topography and drainage will be maintained. Chain link fencing is proposed around the site perimeters for security, which will allow passage of runoff.

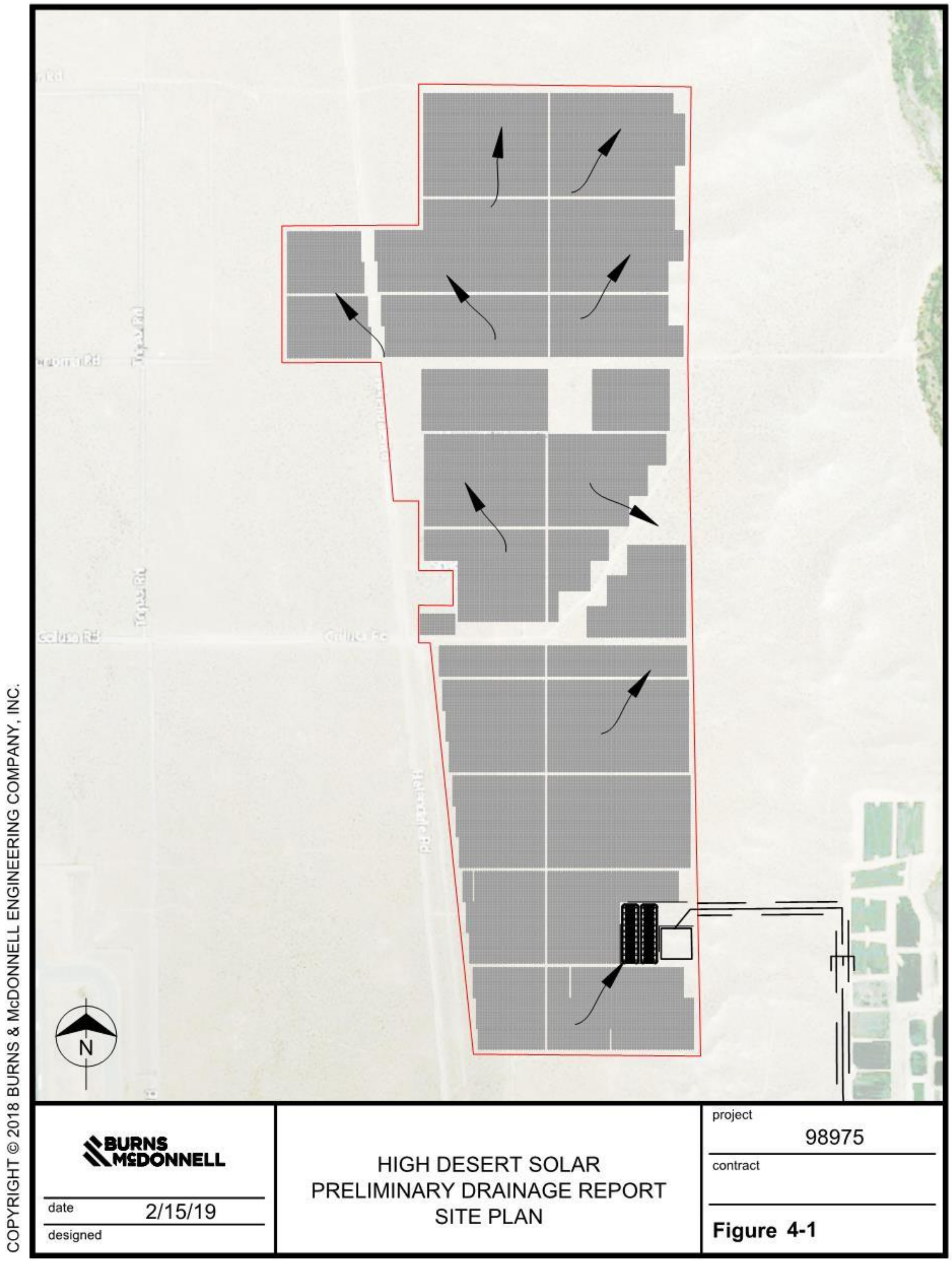
The solar racking system throughout the site will be elevated above the ground, supported on vertical posts driven into the ground with no excavation nor concrete foundations. The ground surfaces beneath the solar cells will remain as bare ground, consisting of the native, on-site soil. Precipitation will fall on the solar cells, run off the lower edges onto the ground surface, sheet flow across the site under the solar cells, and infiltrate into the ground similar to the pre-developed conditions. Concrete equipment foundations for inverter skids and substation equipment will be located sporadically throughout the site. Excess runoff will primarily be shallow sheet-like flows across the surfaces of the site. After flowing across the site, the majority of the runoff will have sheet-like flows off the site in a manner similar to pre-project conditions. However, to compensate for the impact of the addition of impervious areas, small retention swales will be installed adjacent to the roadway at most of the historic outfall locations with a retention basin being constructed downstream of the substation and battery storage area in sub-basin K. As part of final designs, erosion control will be designed where flows enter and exit the retention basins.

In general, existing runoff locations and characteristics entering and leaving the site will be preserved to the greatest extent practical.

The Project also includes the construction of a two-mile transmission line. As shown on Figure 4-1 the point of interconnection is on the southeast corner of the site. There will be no grading for the transmission line, and thus is not included in the preliminary drainage report.

Figure 4-1 below details the planned site for the High Desert Solar Project.

Figure 4-1: Site Plan

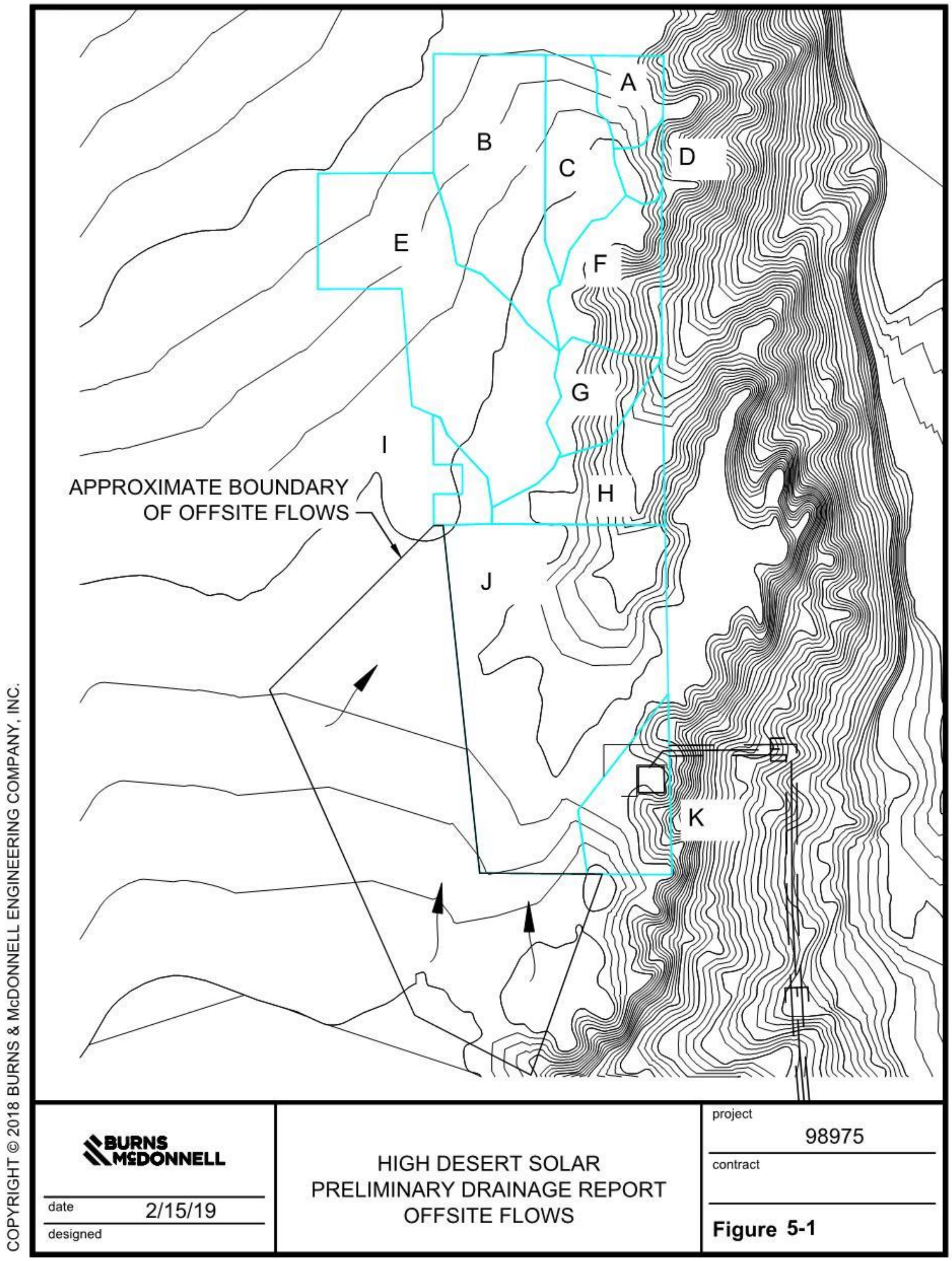


(not to scale)

5.0 OFFSITE FLOWS

Figure 5-1 is an aerial overview of the conditions existing outside the project site. Shown below are the United States Geological Survey (USGS) existing 20 ft contours and flow lines off the site. The majority of the offsite runoff enters at the southeast corner of the project as sheet flow, and will follow its historical flow path across the site. The Rational Method was used to calculate the offsite flows, similar to the method used in Section 4.0. The approximate 100-YR, 24-HR flow rate is 120 CFS at the southern boundary. The velocity was estimated using the Rational Method calculation for velocity of shallow, concentrated flow. Using the slope and approximate length of the flow line, the velocity is calculated to be 1 ft/s. These flows do not pose a threat for erosion of native soil, therefore, mitigation of these flows is not anticipated.

Figure 5-1: Offsite Flows



(not to scale)

6.0 STORMWATER TREATMENT

A stormwater retention basin will be installed along the downstream boundary of sub-basin K where the substation and battery storage areas will be located. The basin will be installed at the historic discharge locations as shown on Figure 6-1. There is an existing pond located in sub-basin H which will be preserved for stormwater retention. The remaining sub-basins on the site do not require a large volume for stormwater treatment, so low-water crossings will be installed at the historic outfall locations to allow maintenance vehicles drive the perimeter of the site. Roads adjacent to the low-water crossings may be elevated up to 1' above existing grade which will create a natural swale/retention area at the crossing. The swale will be designed to have sufficient volume to retain the increase of pre-versus-post runoff. In Rip rap will be placed at the outfall points of each basin/swale to protect from erosion as stormwater leaves the site. Additional techniques to control erosion may be developed during final design. The following methods were used to size the retention basins for the site.

1. Catchment Yield Fraction Method
2. LID BMP Design Capture Volume (DCV)

The LID BMP Design Capture Volume resulted in the largest retention volume; therefore, this method was selected for retention basin volume sizing. The two methods are explained below:

6.1 Catchment Yield Fraction Method

To estimate site stormwater volume, the catchment yield fraction method was used, consistent with the San Bernardino County Hydrology Manual. The methodology for this process included the following parameters: the NRCS curve numbers, initial abstraction values, and the NOAA Atlas 14 precipitation depths.

The minimum design volumes of the storm water retention basins vary dependent on the subarea they serve. To determine the controlling methodology for retention volume, the runoff volume was initially calculated using the following formula (San Bernardino County Hydrology Manual):

$$V = Y * P_{24} * A$$

where V = Volume (ac-ft)

Y = Yield fraction

P_{24} = 24-hour precipitation depth (in), and

A = Area (acre)

Columns 5 through 7 on Tables 4-1 and 4-2 show the results of the Catchment Yield Fraction Method. The tables show the flood volumes generated under the 10yr- 24hr, 100yr - 1hr, and 100yr - 24hr storm events. The results for both the 10-year and 100-year are provided in accordance with City of Victorville's requirements. The detailed calculations can be found in Appendix A. Retention basin volumes will be designed to retain the 100yr-24hr stormwater volume.

6.2 LID BMP Design Capture Volume

Because the site is located within the Mojave River Watershed, an alternate methodology for calculating retention volume was performed based on the Mojave River Watershed Water Quality Management Plan. As advised by Form 4.2-1 "LID BMP Performance Criteria for Design Capture Volume", the equation for calculating retention volume is as follows:

$$DCV = AR_cP_6C_2$$

where DCV = Design Capture Volume (ft^3)

A = Area (ft^2)

R_c = Runoff Coefficient

P_6 = Mean 6-hr Precipitation (inches)

C_2 = Function of drawdown rate

New storm retention has been designed along the downstream boundaries of the site, designed to retain the Design Capture Volume (DCV) in accordance with the Mojave River Watershed Water Quality Management Plan. See Appendix A, sheet "Retention" for detailed calculations. The proposed retention basin locations are shown on Figure 6-1.

6.3 Retention Basin Design

As noted in Table 6-1, the total combined minimum required stormwater retention volume using the San Bernardino County method was determined to be 0.014 ac-ft (post-construction conditions for the 100 year – 24 hour storm event). These values were then compared with the values calculated from Form 4.2-1 LID BMP Performance Criteria for Design Capture Volume. Results from this methodology show that the total required stormwater retention volume should be 1.64 ac-ft. To be conservative, the larger of the two volumes was chosen for the retention basin sizing. . The site will utilize an existing basin located in sub-basin H to achieve the volume needed for the WQMP and San Bernardino County Hydrology Manual.

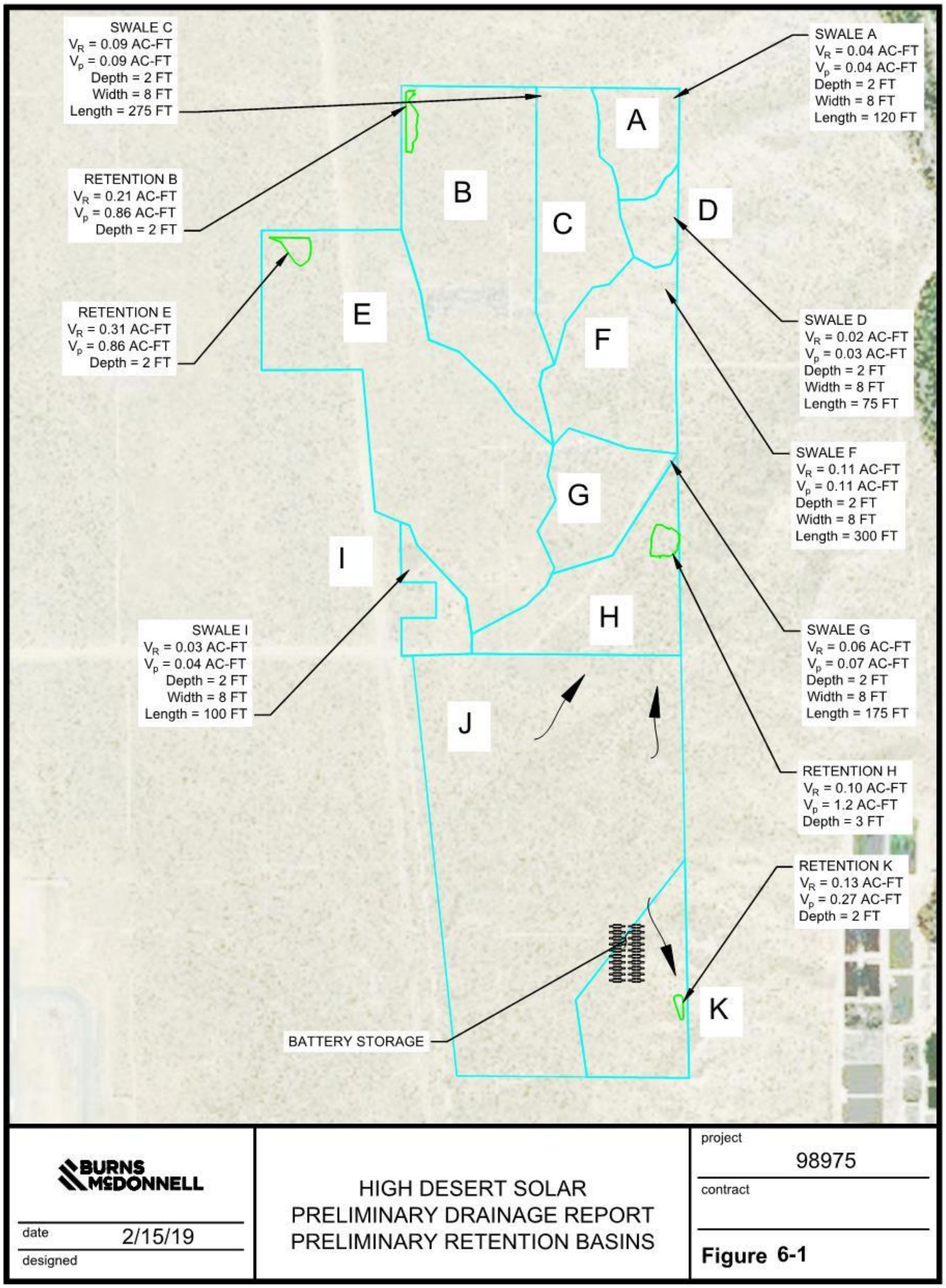
Table 6-1: Retention Volume

San Bernardino County Hydrology Manual				**Mojave River WQMP**	
Subarea	Pre-dev 100yr-24hr V (ac-ft)	Post-dev 100yr-24hr V (ac-ft)	Retention Volume Required (Δ Pre vs. Post) V (ac-ft)	LID BMP Design Capture Volume Required V (ac-ft)	Basin Volume Provided V (ac-ft)
A	2.03	2.03	**0.00**	0.04	0.04
B	9.77	9.77	**0.00**	0.21	0.86
C	4.45	4.45	**0.00**	0.09	0.09
D	0.98	0.98	**0.00**	0.02	0.03
E	3.83	3.83	**0.00**	0.31	0.86
F	5.19	5.19	**0.00**	0.11	0.11
G	0.79	0.79	**0.00**	0.06	0.07
H*	4.93	4.93	**0.00**	0.10	1.20
I	1.31	1.31	**0.00**	0.03	0.03
J*	6.32	6.34	**0.02**	0.53	
K	4.18	4.24	**0.06**	0.13	0.27
Total	43.76	43.84	**0.08**	1.64	3.56

V = Volume
ac-ft = acre-feet

*The retention basin in Subarea H will utilize an existing topography to assist in providing retention for the LID BMP Design Capture Volume

Figure 6-1: Drainage Map



(not to scale)

7.0 CONCLUSION

The increase in total combined peak flow between pre- and post- development conditions for the proposed High Desert Solar Project site for the 100yr – 24hr design storm event will be 1.19 cfs. These flows will be mitigated by routing them to retention basins/swales located at the historic discharge locations across the site. The total retention provided for the Project is approximately 3.82 ac-ft. The preliminary grading design and retention areas were designed to maintain the pre-developed flow rates, volumes, locations, and characteristics leaving the site in order to avoid adverse impacts downstream. Also, rip rap will be used to protect outfall locations from erosion and to provide stabilized access road at low water crossings along the site perimeter

Grading will be minimized to the greatest extent practical; and existing drainage patterns on the site will be kept as close as possible to their existing conditions. Vegetation will largely remain in place and maintained to keep low growth under the solar panels. Erosion potential appears to be within practical tolerances. However, it is recommended for full design to consider cost-effective erosion control devices such as riprap. The proposed drainage controlling facilities will require future maintenance to ensure their functionality.

APPENDICES

APPENDIX A – CALCULATIONS

Client : HDSI
Project Name : High Desert Solar
Project Number : 98975

WORKSHEET TITLE:	Pre Evaluation - High Desert Solar	**CALCULATION NO.:**	98975-C001
ISSUED DATE:	2/22/2019	**REVISION:**	C
PERFORMED BY:	BNS	**REVIEWED BY:**	NT
OBJECTIVE:	Estimate Pre Construction Site Conditions		

REFERENCES:

1 Williamson and Schmid, Civil Engineers. (August 1986). San Bernardino Hydrology Manual. *San Bernardino County,* (1). Retrieved August, 2018.

2 NOAA's National Weather Service. (n.d.). NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: CA. Retrieved August, 2018.

3 Victorville, CA. (2005, August). Storm Water Management Program for the Mojave River Watershed. Retrieved August, 2018.

4 United States Department of Agriculture. (1986, June). Urban Hydrology for Small Watersheds. Retrieved August, 20187.

DESIGN INPUTS/ASSUMPTIONS:

1 10 and 100 year storm
2 Sheet flow exists up to 200ft
3 Shallow concentrated flow exists up to 1200ft
4 Channel flow exists beyond 1400ft
5 Vchannel flow = 5ft/sec

EQUATIONS:

1 Rational Method

$$Q = CIA$$

2 Time of Concentration

$$Tc = Tsheet + Tshallow + Tchannel$$

3 Tsheet

$$Tsheet = \frac{0.007(n * L_0)^{0.8}}{\sqrt{P_2}(S_{Decimal})^{0.4}}$$

4 Vshallow (unpaved)

$$V_{Shallow} = 16.1345\sqrt{S_{Decimal}}$$

5 Tshallow

$$T_{Shallow} = \frac{Length}{Vshallow}$$

6 Potential Max Retention

$$S = \frac{1000}{CN} - 10$$

7 Initial Abstraction

$$I_a = 0.2S$$

8 Storm Runoff Yield

$$Y = \frac{(P_{24} - I_a)^2}{(P_{24} - I_a + S)P_{24}}$$

9 Peak Volume

$$V = Y * P_{24} * A$$

10

$$C = \begin{cases} 0.9(a_i + \frac{(I - F_p)a_p}{I}, for\ I > F_p \\ 0.90a_i, for\ I \leq F_p \end{cases}$$

VARIABLES:

1	Q	peak runoff rate (cubic feet per second)
2	C	runoff coefficient dependent on land use
3	I	rainfall intensity (inches per hour)
4	A	drainage area served by detention basin (acres)
5	Tc	time of concentration
6	n	Manning's rougness coefficient for sheet flow (smooth surfaces/gravel)
7	Lo	Distance to collection point (Limited to 200ft)
8	P2	2yr, 24hr rainfall (in)
9	Sdecimal	Slope of hydraulic grade line
10	CN	Cuve number
11	P24	24 hour precipitation depth (in)
12	Ia	Initial abstraction (in)
13	S	Potential max retention (in)
14	Y	Storm runoff yield
15	Fp	Infiltration rate for pervious area (in/hr)

PROCEDURE FOR PEAK DISCHARGE (PRECON):

1 Determine watershed boundaries based on aerial survey

Watershed	Area (SF)	Area (AC)	Area Fraction	Notes
A	712026.948	16.35	0.03	
B	3430953.27	78.76	0.13	
C	1563588.6	35.90	0.06	
D	344433.029	7.91	0.01	
E	5214136.51	119.70	0.20	
F	1823631.26	41.86	0.07	
G	1070254.88	24.57	0.04	
H	1730866.09	39.74	0.07	
I	460879.566	10.58	0.02	
J	8603971.2	197.52	0.33	
K	1466787.25	33.67	0.06	
Total	26421528.6	606.55	1.00	

2 Solve for Tsheet using EQ3

Establish values:

n=	0.025
Lo=	200
P2=	1.03

Watershed	Approx High I	Approx Low E	Approx Distance	Sdecimal	Tsheet (hrs)	Tsheet (min)
A	2797	2796.01543	200	0.00492287	0.20939577	12.5637463
B	2801.71	2801	200	0.00355	0.23865146	14.3190874
C	2799	2798.93	200	0.00035	0.6028763	36.1725782
D	2801	2792.96	200	0.0402	0.09039929	5.42395728
E	2800.31	2795.94	200	0.02185	0.11536521	6.9219125
F	2801.48	2801	200	0.0024	0.27910713	16.7464279
G	2801	2789.2	200	0.059	0.07753801	4.65228034
H	2801	2799.08	200	0.0096	0.16030495	9.61829711
I	2801	2798.17	200	0.01415	0.1372628	8.23576803
J	2810.3	2809.61	200	0.00345	0.24139473	14.4836841
K	2820	2817.53	200	0.01235	0.14494013	8.69640783
Offsite	2820.002	2819.741	200	0.001305	0.35613219	21.3679312

3 Solve for Vshallow using EQ4

Watershed	Approx High I	Approx Low E	Approx Distance	Sdecimal	Vshallow (ft/s)
A	2796.01543	2754.59	1200	0.03452119	2.99777045
B	2801	2789.11	1200	0.00990833	1.606038
C	2798.93	2793.92	1200	0.004175	1.04251845
D	2792.96	2759.54	462.7049	0.07222746	4.33617384
E	2795.94	2789.05	1200	0.00574167	1.22257215
F	2801	2783.8	1200	0.01433333	1.931653
G	2789.2	2731.12	1200	0.0484	3.54959
H	2799.08	2768.09	1200	0.025825	2.59283975
I	2798.17	2793.58	1183	0.00387997	1.00500791
J	2809.61	2804.28	1200	0.00444167	1.07529715
K	2817.53	2800.08	1200	0.01454167	1.94564053
Offsite	2819.741	2814.039	1200	0.00475167	1.11218874

4 Solve for Tshallow using EQ5

Watershed	Approx Distar	Vshallow	Tshallow (s)	Tshalllow (min)
A	1200	2.99777045	400.297494	6.6716249
B	1200	1.606038	747.1803302	12.4530055
C	1200	1.04251845	1151.058761	19.1843127
D	462.7049	4.33617384	106.7081066	1.77846844
E	1200	1.22257215	981.5371612	16.3589527
F	1200	1.931653	621.2295909	10.3538265
G	1200	3.54959	338.0672134	5.63445356
H	1200	2.59283975	462.8130215	7.71355036
I	1183	1.00500791	1177.105158	19.6184193
J	1200	1.07529715	1115.9706	18.59951
K	1200	1.94564053	616.7634684	10.2793911
Offsite	1200	1.11218874	1078.953557	17.9825593

5 Solve for Tchannel

Watershed	Approx Distar	Vchannel	Tchannel (s)	Tchannel (min)
A	98.2559	5	19.65118	0.32751967
B	2153.7825	5	430.7565	7.179275
C	1184.1708	5	236.83416	3.947236
D	0	5	0	0
E	3050.7491	5	610.14982	10.1691637
F	522.6395	5	104.5279	1.74213167
G	277.2042	5	55.44084	0.924014
H	834.8433	5	166.96866	2.782811

I		5	0	0
J	3626.2708	5	725.25416	12.0875693
K	281.7598	5	56.35196	0.93919933
Offsite	3881	5	776.2	12.9366667

Client : HDSI
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6 Solve for Tc using EQ2

Watershed	Tsheet (min)	Tshalllow (mi	Tchannel (min)	Tc (min)
A	12.5637463	6.6716249	0.327519667	19.5628909
B	14.3190874	12.4530055	7.179275	33.9513679
C	36.1725782	19.1843127	3.947236	59.3041268
D	5.42395728	1.77846844	0	7.20242572
E	6.9219125	16.3589527	10.16916367	33.4500289
F	16.7464279	10.3538265	1.742131667	28.8423861
G	4.65228034	5.63445356	0.924014	11.2107479
H	9.61829711	7.71355036	2.782811	20.1146585
I	8.23576803	19.6184193	0	27.8541873
J	14.4836841	18.59951	12.08756933	45.1707634
K	8.69640783	10.2793911	0.939199333	19.9149983
Offsite	21.3679312	17.9825593	12.93666667	52.2871572

7a Solve rainfall intensity by interpolating rain data from NOAA (ref 2)

100yr

Watershed	X	X1	X2	Y1	Y2	Y	Intensity (in/hr)
A	19.5628909	15	30	2.31	1.55	2.07881353	2.07881353
B	33.9513679	30	60	1.55	0.946	1.47044579	1.47044579
C	59.3041268	30	60	1.55	0.946	0.96001025	0.96001025
D	7.20242572	5	10	4	2.87	3.50225179	3.50225179
E	33.4500289	30	60	1.55	0.946	1.48053942	1.48053942
F	28.8423861	15	30	2.31	1.55	1.60865244	1.60865244
G	11.2107479	10	15	2.87	2.31	2.73439624	2.73439624
H	20.1146585	15	30	2.31	1.55	2.0508573	2.0508573
I	27.8541873	15	30	2.31	1.55	1.65872118	1.65872118
J	45.1707634	30	60	1.55	0.946	1.24456196	1.24456196
K	19.9149983	15	30	2.31	1.55	2.06097342	2.06097342
Offsite	52.2871572	30	60	1.55	0.946	1.10128524	1.10128524

7b 10yr

Watershed	X	X1	X2	Y1	Y2	Y	Intensity (in/hr)
A	19.5628909	15	30	1.33	0.892	1.19676359	1.19676359
B	33.9513679	30	60	0.892	0.545	0.84629584	0.84629584
C	59.3041268	30	60	0.892	0.545	0.55304893	0.55304893
D	7.20242572	5	10	2.3	1.65	2.01368466	2.01368466
E	33.4500289	30	60	0.892	0.545	0.85209467	0.85209467
F	28.8423861	15	30	1.33	0.892	0.92580233	0.92580233
G	11.2107479	10	15	1.65	1.33	1.57251213	1.57251213
H	20.1146585	15	30	1.33	0.892	1.18065197	1.18065197
I	27.8541873	15	30	1.33	0.892	0.95465773	0.95465773
J	45.1707634	30	60	0.892	0.545	0.71652484	0.71652484
K	19.9149983	15	30	1.33	0.892	1.18648205	1.18648205
Offsite	52.2871572	30	60	0.892	0.545	0.63421188	0.63421188

8 Find Fp using Figure C-6 of San Bernardino County Hydrology Manual

Watershed	Area Fraction	Land use	Soil group	CN	Fp	
A	0.02694874	Desert shrub	C	85	0.533	60522290.6
B	0.12985446	Desert shrub	C	85	0.53	291631028
C	0.05917858	Desert shrub	C	85	0.53	132905031
D	0.01303608	Desert shrub	C	85	0.53	29276807.4
E	0.19734424	Desert shrub	A	63	0.88	328490600
F	0.06902066	Desert shrub	C	85	0.53	155008657
G	0.04050693	Desert shrub	A	63	0.88	67426057.4
H	0.06550969	Desert shrub	C	85	0.53	147123618
I	0.01744333	Desert shrub	C	85	0.53	39174763.1
J	0.32564245	Desert shrub	A	63	0.88	542050186
K	0.05551485	Desert shrub	C	85	0.53	124676916
Offsite	1	Desert shrub	C	85	0.54	

9 Solve C using EQ 10

100yr

Watershed	Intensity (in/h	Fp (in/hr)	ai	ap	C
A	2.07881353	0.533	0	1	0.66924337
B	1.47044579	0.53	0	1	0.57560858
C	0.96001025	0.53	0	1	0.4031303
D	3.50225179	0.53	0	1	0.76380191
E	1.48053942	0.88	0	1	0.36505984
F	1.60865244	0.53	0	1	0.60347852
G	2.73439624	0.88	0	1	0.61035654
H	2.0508573	0.53	0	1	0.66741434
I	1.65872118	0.53	0	1	0.61242906
J	1.24456196	0.88	0	1	0.26363152
K	2.06097342	0.53	0	1	0.66855597
Offsite	1.10128524	0.54	0	1	0.45869743

10yr

Watershed	Intensity (in/h	Fp (in/hr)	ai	ap	C
A	1.19676359	0.533	0	1	0.49916895
B	0.84629584	0.53	0	1	0.33636731
C	0.55304893	0.53	0	1	0.03750851
D	2.01368466	0.53	0	1	0.66312081
E	0.85209467	0.88	0	1	0
F	0.92580233	0.53	0	1	0.38477122
G	1.57251213	0.88	0	1	0.39634729
H	1.18065197	0.53	0	1	0.49598594
I	0.95465773	0.53	0	1	0.40034448
J	0.71652484	0.88	0	1	0
K	1.18648205	0.53	0	1	0.49797116
Offsite	0.63421188	0.54	0	1	0.13369458

9 Solve peak discharge using EQ1

100yr

Watershed	Area (ac)	Intensity (in/h	Runoff coefficient	Q (cfs)	Q (gpm)
A	16.3458895	2.07881353	0.669	22.74	10336.7852
B	78.7638491	1.47044579	0.576	66.67	30302.6443
C	35.8950552	0.96001025	0.403	13.89	6314.41699
D	7.90709432	3.50225179	0.764	21.15	9614.4035
E	119.700103	1.48053942	0.365	64.70	29407.3489
F	41.8648131	1.60865244	0.603	40.64	18473.5566
G	24.5696713	2.73439624	0.610	41.01	18638.9615
H	39.7352179	2.0508573	0.667	54.39	24722.0167
I	10.580339	1.65872118	0.612	10.75	4885.46699
J	197.52	1.24456196	0.264	64.81	29457.9323
K	33.6728018	2.06097342	0.669	46.40	21089.5218
Total	606.554835	20.8502233	0.459	447.13	203243.055
Offsite	235.64	1.10128524	0.000	0	0

10yr

Watershed	Area (ac)	Intensity (in/h	Runoff coefficient	Q (cfs)	Q (gpm)
A	16.3458895	1.19676359	0.499168954	9.76	4438.55711
B	78.7638491	0.84629584	0.336367314	22.42	10191.5502
C	35.8950552	0.55304893	0.037508507	0.74	338.458383
D	7.90709432	2.01368466	0.663120805	10.56	4799.30503
E	119.700103	0.85209467	0	0.00	0
F	41.8648131	0.92580233	0.384771223	14.91	6778.71425
G	24.5696713	1.57251213	0.396347289	15.31	6960.59815
H	39.7352179	1.18065197	0.495985937	23.27	10576.5537
I	10.580339	0.95465773	0.400344485	4.04	1838.05475
J	197.52	0.71652484	0	0.00	0
K	33.6728018	1.18648205	0.497971162	19.90	9043.19588
Total	606.554835	11.9985187	0.463948209	120.92	54964.9874

Client : HDSI
Project Name : High Desert Solar
Project Number : 98975

Procedure for Runoff Volume (PRECON):

1 Determine CN of each watershed based on NRCS guidelines

Watershed	Area Fraction	Land use	Soil group	CN
A	0.02694874	Desert shrub	C	85
B	0.12985446	Desert shrub	C	85
C	0.05917858	Desert shrub	C	85
D	0.01303608	Desert shrub	C	85
E	0.19734424	Desert shrub	A	63
F	0.06902066	Desert shrub	C	85
G	0.04050693	Desert shrub	A	63
H	0.06550969	Desert shrub	C	85
I	0.01744333	Desert shrub	C	85
J	0.32564245	Desert shrub	A	63
K	0.05551485	Desert shrub	C	85

2 Solve potential max retention using EQ6

Watershed	CN	S
A	85	1.76470588
B	85	1.76470588
C	85	1.76470588
D	85	1.76470588
E	63	5.87301587
F	85	1.76470588
G	63	5.87301587
H	85	1.76470588
I	85	1.76470588
J	63	5.87301587
K	85	1.76470588

3 Solve initial abstraction using EQ7

Watershed	S	Ia
A	1.76470588	0.35294118
B	1.76470588	0.35294118
C	1.76470588	0.35294118
D	1.76470588	0.35294118
E	5.87301587	1.17460317
F	1.76470588	0.35294118
G	5.87301587	1.17460317
H	1.76470588	0.35294118
I	1.76470588	0.35294118
J	5.87301587	1.17460317
K	1.76470588	0.35294118

4a Solve storm runoff yield using EQ8

100yr/24hr
P24= 2.88

Watershed	Area Fraction	Ia	S	Y	Yfraction	Runoff Volume (ac-ft)
A	0.02694874	0.35294118	1.764705882	0.51665699	0.01392326	2.03
B	0.12985446	0.35294118	1.764705882	0.51665699	0.06709021	9.77
C	0.05917858	0.35294118	1.764705882	0.51665699	0.03057503	4.45
D	0.01303608	0.35294118	1.764705882	0.51665699	0.00673518	0.98
E	0.19734424	1.17460317	5.873015873	0.13325397	0.0262969	3.83
F	0.06902066	0.35294118	1.764705882	0.51665699	0.03566	5.19
G	0.04050693	1.17460317	5.873015873	0.13325397	0.00539771	0.79
H	0.06550969	0.35294118	1.764705882	0.51665699	0.03384604	4.93
I	0.01744333	0.35294118	1.764705882	0.51665699	0.00901222	1.31
J	0.32564245	1.17460317	5.873015873	0.13325397	0.04339315	6.32
K	0.05551485	0.35294118	1.764705882	0.51665699	0.02868214	4.18
Total	1	6.34733894	31.73669468	4.53301785	0.30061184	43.76

4b 100yr/1hr

P24= 0.946

Watershed	Area Fraction	Ia	S	Y	Yfraction	Runoff Volume (ac-ft)
A	0.02694874	0.35294118	1.764705882	0.15768992	0.00424955	0.20
B	0.12985446	0.35294118	1.764705882	0.15768992	0.02047674	0.98
C	0.05917858	0.35294118	1.764705882	0.15768992	0.00933187	0.45
D	0.01303608	0.35294118	1.764705882	0.15768992	0.00205566	0.10
E	0.19734424	1.17460317	5.873015873	0.00978711	0.00193143	0.09
F	0.06902066	0.35294118	1.764705882	0.15768992	0.01088386	0.52
G	0.04050693	1.17460317	5.873015873	0.00978711	0.00039645	0.02
H	0.06550969	0.35294118	1.764705882	0.15768992	0.01033022	0.49
I	0.01744333	0.35294118	1.764705882	0.15768992	0.00275064	0.13
J	0.32564245	1.17460317	5.873015873	0.00978711	0.0031871	0.15
K	0.05551485	0.35294118	1.764705882	0.15768992	0.00875413	0.42
Total					0.07434764	3.56

4c 10yr/24hr

P24= 1.74

Watershed	Area Fraction	Ia	S	Y	Yfraction	Runoff Volume (ac-ft)
A	0.02694874	0.35294118	1.764705882	0.35082192	0.00945421	0.83
B	0.12985446	0.35294118	1.764705882	0.35082192	0.04555579	4.01
C	0.05917858	0.35294118	1.764705882	0.35082192	0.02076114	1.83
D	0.01303608	0.35294118	1.764705882	0.35082192	0.00457334	0.40
E	0.19734424	1.17460317	5.873015873	0.02853505	0.00563123	0.50
F	0.06902066	0.35294118	1.764705882	0.35082192	0.02421396	2.13
G	0.04050693	1.17460317	5.873015873	0.02853505	0.00115587	0.10
H	0.06550969	0.35294118	1.764705882	0.35082192	0.02298223	2.02
I	0.01744333	0.35294118	1.764705882	0.35082192	0.0061195	0.54
J	0.32564245	1.17460317	5.873015873	0.02853505	0.00929222	0.82
K	0.05551485	0.35294118	1.764705882	0.35082192	0.01947583	1.71
Total					0.11134554	14.88

WORKSHEET TITLE:	Post Evaluation - High Desert Solar	**CALCULATION NO.:**	98975-C002
ISSUED DATE:	2/22/2019	**REVISION:**	C
PERFORMED BY:	BNS	**REVIEWED BY:**	NT
OBJECTIVE:	Estimate Post Construction Site Conditions		

REFERENCES:

1 Williamson and Schmid, Civil Engineers. (August 1986). San Bernardino Hydrology Manual. *San Bernardino County,* (1). Retrieved July, 2017.
2 NOAA's National Weather Service. (n.d.). NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: CA. Retrieved July, 2017.
3 Victorville, CA. (2005, August). Storm Water Management Program for the Mojave River Watershed. Retrieved July, 2017.
4 United States Department of Agriculture. (1986, June). Urban Hydrology for Small Watersheds. Retrieved July, 2017.

DESIGN INPUTS/ASSUMPTIONS:

1 10 and 100 year storm
2 Sheet flow exists up to 200ft
3 Shallow concentrated flow exists up to 1200ft
4 Channel flow exists beyond 1400ft
5 Vchannel flow = 5ft/sec

EQUATIONS:

1 Rational Method

$$Q = CIA$$

2 Time of Concentration

$$Tc = Tsheet + Tshallow + Tchannel$$

3 Tsheet

$$Tsheet = \frac{0.007(n * L_0)^{0.8}}{\sqrt{P_2}(S_{Decimal})^{0.4}}$$

4 Vshallow (unpaved)

$$V_{Shallow} = 16.1345\sqrt{S_{Decimal}}$$

5 Tshallow

$$T_{Shallow} = \frac{Length}{Vshallow}$$

6 Potential Max Retention

$$S = \frac{1000}{CN} - 10$$

7 Initial Abstraction

$$I_a = 0.2S$$

8 Storm Runoff Yield

$$Y = \frac{(P_{24} - I_a)^2}{(P_{24} - I_a + S)P_{24}}$$

9 Peak Volume

$$V = Y * P_{24} * A$$

10

$$C = \begin{cases} 0.9(a_i + \frac{(I - F_p)a_p}{I}, for\ I > F_p \\ 0.90a_i, for\ I \leq F_p \end{cases}$$

VARIABLES:

1	Q	peak runoff rate (cubic feet per second)
2	C	runoff coefficient dependent on land use
3	I	rainfall intensity (inches per hour)
4	A	drainage area served by detention basin (acres)
5	Tc	time of concentration
6	n	Manning's rougness coefficient for sheet flow (smooth surfaces/gravel)
7	Lo	Distance to collection point (Limited to 200ft)
8	P2	2yr, 24hr rainfall (in)
9	Sdecimal	Slope of hydraulic grade line
10	CN	Cuve number
11	P24	24 hour precipitation depth (in)
12	Ia	Initial abstraction (in)
13	S	Potential max retention (in)
14	Y	Storm runoff yield
15	Fp	Infiltration rate for pervious area (in/hr)

PROCEDURE FOR PEAK DISCHARGE (POSTCON):

1 Determine wateshed boundaries based on aerial survey

Watershed	Area (SF)	Area (AC)	Area Fraction	Notes
A	712026.948	16.35	0.03	
B	3430953.27	78.76	0.13	
C	1563588.6	35.90	0.06	
D	344433.029	7.91	0.01	
E	5214136.51	119.70	0.20	
F	1823631.26	41.86	0.07	
G	1070254.88	24.57	0.04	
H	1730866.09	39.74	0.07	
I	460879.566	10.58	0.02	
J	8603971.2	197.52	0.33	
K	1466787.25	33.67	0.06	
Total	26421528.6	606.55	1.00	

2 Solve for Tsheet using EQ3

Establish values:

n=	0.025
Lo=	200
P2=	1.03

Watershed	Approx High I	Approx Low EL (ft)	Approx Distar	Sdecimal	Tsheet (hrs)	Tsheet (min)
A	2797	2796.015425	200	0.00492287	0.20939577	12.5637463
B	2801.71	2801	200	0.00355	0.23865146	14.3190874
C	2799	2798.93	200	0.00035	0.6028763	36.1725782
D	2801	2792.96	200	0.0402	0.09039929	5.42395728
E	2800.31	2795.94	200	0.02185	0.11536521	6.9219125
F	2801.48	2801	200	0.0024	0.27910713	16.7464279
G	2801	2789.2	200	0.059	0.07753801	4.65228034
H	2801	2799.08	200	0.0096	0.16030495	9.61829711
I	2801	2798.17	200	0.01415	0.1372628	8.23576803
J	2810.3	2809.61	200	0.00345	0.24139473	14.4836841
K	2820	2817.53	200	0.01235	0.14494013	8.69640783

3 Solve for Vshallow using EQ4

Watershed	Approx High I	Approx Low EL (ft)	Approx Distar	Sdecimal	Vshallow (ft/s)
A	2796.01543	2754.59	1200	0.03452119	2.99777045
B	2801	2789.11	1200	0.00990833	1.606038
C	2798.93	2793.92	1200	0.004175	1.04251845
D	2792.96	2759.54	462.7049	0.07222746	4.33617384
E	2795.94	2789.05	1200	0.00574167	1.22257215
F	2801	2783.8	1200	0.01433333	1.931653
G	2789.2	2731.12	1200	0.0484	3.54959
H	2799.08	2768.09	1200	0.025825	2.59283975
I	2798.17	2793.58	1183	0.00387997	1.00500791
J	2809.61	2804.28	1200	0.00444167	1.07529715
K	2817.53	2800.08	1200	0.01454167	1.94564053

4 Solve for Tshallow using EQ5

Watershed	Approx Distar	Vshallow	Tshallow (s)	Tshalllow (min)
A	1200	2.997770453	400.297494	6.6716249
B	1200	1.606037996	747.18033	12.4530055
C	1200	1.042518454	1151.05876	19.1843127
D	462.7049	4.336173838	106.708107	1.77846844
E	1200	1.222572153	981.537161	16.3589527
F	1200	1.931652995	621.229591	10.3538265
G	1200	3.54959	338.067213	5.63445356
H	1200	2.592839752	462.813022	7.71355036
I	1183	1.005007914	1177.10516	19.6184193
J	1200	1.075297145	1115.9706	18.59951
K	1200	1.945640528	616.763468	10.2793911

5 Solve for Tchannel

Watershed	Approx Distar	Vchannel	Tchannel (s)	Tchannel (min)
A	98.2559	5	19.65118	0.32751967
B	2153.7825	5	430.7565	7.179275
C	1184.1708	5	236.83416	3.947236
D	0	5	0	0
E	3050.7491	5	610.14982	10.1691637
F	522.6395	5	104.5279	1.74213167
G	277.2042	5	55.44084	0.924014
H	834.8433	5	166.96866	2.782811
I	0	5	0	0
J	3626.2708	5	725.25416	12.0875693
K	281.7598	5	56.35196	0.93919933

6 Solve for Tc using EQ2

Watershed	Tsheet (min)	Tshalllow (min)	Tchannel (mi	Tc (min)
A	12.5637463	6.671624901	0.32751967	19.5628909
B	14.3190874	12.4530055	7.179275	33.9513679
C	36.1725782	19.18431268	3.947236	59.3041268
D	5.42395728	1.778468443	0	7.20242572
E	6.9219125	16.35895269	10.1691637	33.4500289
F	16.7464279	10.35382652	1.74213167	28.8423861
G	4.65228034	5.634453557	0.924014	11.2107479
H	9.61829711	7.713550358	2.782811	20.1146585
I	8.23576803	19.6184193	0	27.8541873
J	14.4836841	18.59950999	12.0875693	45.1707634
K	8.69640783	10.27939114	0.93919933	19.9149983

7a Solve rainfall intensity by interpolating rain data from NOAA (ref 2)

100yr

Watershed	X	X1	X2	Y1	Y2	Y	Intensity (in/hr)
A	19.5628909	15	30	2.31	1.55	2.07881353	2.07881353
B	33.9513679	30	60	1.55	0.946	1.47044579	1.47044579
C	59.3041268	30	60	1.55	0.946	0.96001025	0.96001025
D	7.20242572	5	10	4	2.87	3.50225179	3.50225179
E	33.4500289	30	60	1.55	0.946	1.48053942	1.48053942
F	28.8423861	15	30	2.31	1.55	1.60865244	1.60865244
G	11.2107479	10	15	2.87	2.31	2.73439624	2.73439624
H	20.1146585	15	30	2.31	1.55	2.0508573	2.0508573
I	27.8541873	15	30	2.31	1.55	1.65872118	1.65872118
J	45.1707634	30	60	1.55	0.946	1.24456196	1.24456196
K	19.9149983	15	30	2.31	1.55	2.06097342	2.06097342

7b 10yr

Watershed	X	X1	X2	Y1	Y2	Y	Intensity (in/hr)
A	19.5628909	15	30	1.33	0.892	1.19676359	1.19676359
B	33.9513679	30	60	0.892	0.545	0.84629584	0.84629584
C	59.3041268	30	60	0.892	0.545	0.55304893	0.55304893
D	7.20242572	5	10	2.3	1.65	2.01368466	2.01368466
E	33.4500289	30	60	0.892	0.545	0.85209467	0.85209467
F	28.8423861	15	30	1.33	0.892	0.92580233	0.92580233
G	11.2107479	10	15	1.65	1.33	1.57251213	1.57251213
H	20.1146585	15	30	1.33	0.892	1.18065197	1.18065197
I	27.8541873	15	30	1.33	0.892	0.95465773	0.95465773
J	45.1707634	30	60	0.892	0.545	0.71652484	0.71652484
K	19.9149983	15	30	1.33	0.892	1.18648205	1.18648205

8 Find Fp using Figure C-6 of San Bernardino County Hydrology Manual

Watershed	Area Fraction	Land use	Soil group	CN	Fp	
A	0.02694874	Newly Graded Areas	C	85.0	0.533	60529245.8
B	0.12985446	Newly Graded Areas	C	85.0	0.53	291664542
C	0.05917858	Newly Graded Areas	C	85.0	0.53	132920305
D	0.01303608	Newly Graded Areas	C	85.0	0.53	29280171.9
E	0.19734424	Newly Graded Areas	A	63.0	0.88	328627726
F	0.06902066	Newly Graded Areas	C	85.0	0.53	155026471
G	0.04050693	Newly Graded Areas	A	63.0	0.88	67454203.9
H	0.06550969	Newly Graded Areas	C	85.0	0.53	147140525
I	0.01744333	Newly Graded Areas	C	85.0	0.53	39179265
J	0.32564245	Newly Graded Areas	A	63.1	0.88	542644548
K	0.05551485	Newly Graded Areas	C	85.4	0.53	125231399
						72.6565987

9 Solve C using EQ 10

100yr

Watershed	Intensity (in/h	Fp (in/hr)	ai	ap	C
A	2.07881353	0.533	0.003	0.997	0.66993564
B	1.47044579	0.53	0.003	0.997	0.57658175
C	0.96001025	0.53	0.003	0.997	0.40462091
D	3.50225179	0.53	0.003	0.997	0.76421051
E	1.48053942	0.88	0.003	0.997	0.36666466
F	1.60865244	0.53	0.003	0.997	0.60436809
G	2.73439624	0.88	0.003	0.997	0.61122547
H	2.0508573	0.53	0.003	0.997	0.6681121
I	1.65872118	0.53	0.003	0.997	0.61329178
J	1.24456196	0.88	0.003	0.997	0.26554063
K	2.06097342	0.53	0.003	0.997	0.6692503

10yr

Watershed	Intensity (in/h	Fp (in/hr)	ai	ap	C
A	1.19676359	0.533	0.003	0.997	0.50037145
B	0.84629584	0.53	0.003	0.997	0.33805821
C	0.55304893	0.53	0.003	0.997	0.04009598
D	2.01368466	0.53	0.003	0.997	0.66383144
E	0.85209467	0.88	0.003	0.997	0.0027
F	0.92580233	0.53	0.003	0.997	0.38631691
G	1.57251213	0.88	0.003	0.997	0.39785825
H	1.18065197	0.53	0.003	0.997	0.49719798
I	0.95465773	0.53	0.003	0.997	0.40184345
J	0.71652484	0.88	0.003	0.997	0.0027
K	1.18648205	0.53	0.003	0.997	0.49917725

9 Solve peak discharge using EQ1

100yr

Watershed	Area (ac)	Intensity (in/hr)	Runoff coeffic	Q (cfs)	Q (gpm)
A	16.35	2.078813529	0.66993564	22.76	10347.4777
B	78.76	1.470445793	0.57658175	66.78	30353.8766
C	35.90	0.960010246	0.40462091	13.94	6337.76509
D	7.91	3.502251787	0.76421051	21.16	9619.54671
E	119.70	1.480539419	0.36666466	64.98	29536.625
F	41.86	1.608652437	0.60436809	40.70	18500.7877
G	24.57	2.734396236	0.61122547	41.06	18665.4967
H	39.74	2.050857304	0.6681121	54.45	24747.8627
I	10.58	1.658721175	0.61329178	10.76	4892.34902
J	197.52	1.244561963	0.26554063	65.28	29671.2539
K	33.67	2.060973419	0.6692503	46.45	21111.4245
Total	606.554835	20.85022331	#DIV/0!	448.33	203784.466

10yr

Watershed	Area (ac)	Intensity (in/hr)	Runoff coeffic	Q (cfs)	Q (gpm)
A	16.35	1.196763587	0.50037145	9.79	4449.24955
B	78.76	0.846295844	0.33805821	22.53	10242.7825
C	35.90	0.553048933	0.04009598	0.80	361.806485
D	7.91	2.013684656	0.66383144	10.57	4804.44824
E	119.70	0.852094666	0.0027	0.28	125.176688
F	41.86	0.925802325	0.38631691	14.97	6805.94541
G	24.57	1.572512135	0.39785825	15.37	6987.1334
H	39.74	1.180651973	0.49719798	23.33	10602.3997
I	10.58	0.95465773	0.40184345	4.06	1844.93678
J	197.52	0.716524837	0.0027	0.38	173.693437
K	33.67	1.186482049	0.49917725	19.94	9065.0985
Total	606.55	9.140854119	#DIV/0!	122.02	55462.6706

PROCEDURE FOR RUNOFF VOLUME (POSTCON):

Determine CN of each watershed based on NRCS guidelines

	Watershed	Area Fraction	Land use	Soil group	CN
1	A	0.02694874	Desert shrub - poor	C	85.0097681
	B	0.12985446	Desert shrub - poor	C	85.0097681
	C	0.05917858	Desert shrub - poor	C	85.0097681
	D	0.01303608	Desert shrub - poor	C	85.0097681
	E	0.19734424	Desert shrub - poor	A	63.0262988
	F	0.06902066	Desert shrub - poor	C	85.0097681
	G	0.04050693	Desert shrub - poor	A	63.0262988
	H	0.06550969	Desert shrub - poor	C	85.0097681
	I	0.01744333	Desert shrub - poor	C	85.0097681
	J	0.32564245	Desert shrub - poor	A	63.06908
	K	0.05551485	Desert shrub - poor	C	85.3780255

Solve potential max retention using EQ6

	Watershed	CN	S
2	A	85.0097681	1.763354046
	B	85.0097681	1.763354046
	C	85.0097681	1.763354046
	D	85.0097681	1.763354046
	E	63.0262988	5.866392578
	F	85.0097681	1.763354046
	G	63.0262988	5.866392578
	H	85.0097681	1.763354046
	I	85.0097681	1.763354046
	J	63.06908	5.855630047
	K	85.3780255	1.712615678

Solve initial abstraction using EQ7

	Watershed	S	Ia
3	A	1.76335405	0.352670809
	B	1.76335405	0.352670809
	C	1.76335405	0.352670809
	D	1.76335405	0.352670809
	E	5.86639258	1.173278516
	F	1.76335405	0.352670809
	G	5.86639258	1.173278516
	H	1.76335405	0.352670809
	I	1.76335405	0.352670809
	J	5.85563005	1.171126009
	K	1.71261568	0.342523136

Solve storm runoff yield using EQ8

4a 100yr/24hr

P24= 2.88

Watershed	Area Fraction	Ia	S	Y	Yfraction	Runoff Volume (ac-ft)
A	0.02694874	0.352670809	1.76335405	0.5168978	0.01392975	2.03
B	0.12985446	0.352670809	1.76335405	0.5168978	0.06712148	9.77
C	0.05917858	0.352670809	1.76335405	0.5168978	0.03058928	4.45
D	0.01303608	0.352670809	1.76335405	0.5168978	0.00673832	0.98
E	0.19734424	1.173278516	5.86639258	0.13355444	0.0263562	3.84
F	0.06902066	0.352670809	1.76335405	0.5168978	0.03567663	5.19
G	0.04050693	1.173278516	5.86639258	0.13355444	0.00540988	0.79
H	0.06550969	0.352670809	1.76335405	0.5168978	0.03386181	4.93
I	0.01744333	0.352670809	1.76335405	0.5168978	0.00901642	1.31
J	0.32564245	1.171126009	5.85563005	0.13404392	0.04365039	6.35
K	0.05551485	0.342523136	1.71261568	0.52603339	0.02920267	4.25
Total					0.30155282	43.90

4b 100yr/1hr

P24=	0.946					
Watershed	Area Fraction	Ia	S	Y	Yfraction	Runoff Volume (ac-ft)
A	0.02694874	0.352670809	1.76335405	0.15790616	0.00425537	0.20
B	0.12985446	0.352670809	1.76335405	0.15790616	0.02050482	0.98
C	0.05917858	0.352670809	1.76335405	0.15790616	0.00934466	0.45
D	0.01303608	0.352670809	1.76335405	0.15790616	0.00205848	0.10
E	0.19734424	1.173278516	5.86639258	0.00968311	0.00191091	0.09
F	0.06902066	0.352670809	1.76335405	0.15790616	0.01089879	0.52
G	0.04050693	1.173278516	5.86639258	0.00968311	0.00039223	0.02
H	0.06550969	0.352670809	1.76335405	0.15790616	0.01034438	0.49
I	0.01744333	0.352670809	1.76335405	0.15790616	0.00275441	0.13
J	0.32564245	1.171126009	5.85563005	0.00951509	0.00309852	0.15
K	0.05551485	0.342523136	1.71261568	0.16621653	0.00922749	0.44
Total					0.07479005	3.58

4c 10yr/24hr

P24=	1.74					
Watershed	Area Fraction	Ia	S	Y	Yfraction	Runoff Volume (ac-ft)
A	0.02694874	0.352670809	1.76335405	0.35107917	0.00946114	0.83
B	0.12985446	0.352670809	1.76335405	0.35107917	0.04558919	4.01
C	0.05917858	0.352670809	1.76335405	0.35107917	0.02077637	1.83
D	0.01303608	0.352670809	1.76335405	0.35107917	0.00457669	0.40
E	0.19734424	1.173278516	5.86639258	0.02869253	0.00566231	0.50
F	0.06902066	0.352670809	1.76335405	0.35107917	0.02423171	2.13
G	0.04050693	1.173278516	5.86639258	0.02869253	0.00116225	0.10
H	0.06550969	0.352670809	1.76335405	0.35107917	0.02299909	2.02
I	0.01744333	0.352670809	1.76335405	0.35107917	0.00612399	0.54
J	0.32564245	1.171126009	5.85563005	0.02894965	0.00942723	0.83
K	0.05551485	0.342523136	1.71261568	0.36088322	0.02003438	1.76
Total					0.17004436	14.96

WORKSHEET TITLE:	Retention Analysis	**CALCULATION NO.:**	98975-C003
ISSUED DATE:	2/22/2019	**REVISION:**	C
PERFORMED BY:	BNS	**REVIEWED BY:**	NT
OBJECTIVE:	Determine Retention Quantities		

RUNOFF ESTIMATION:

100yr/24hr

Watershed	Pre	Post	Retention Req (ac-ft)	Basin V (CF)	
A	2.03	2.03	0.00	41.15	
B	9.77	9.77	0.00	198.29	
C	4.45	4.45	0.00	90.37	
D	0.98	0.98	0.00	19.91	
E	3.83	3.84	0.01	376.00	
F	5.19	5.19	0.00	105.40	
G	0.79	0.79	0.00	77.18	
H	4.93	4.93	0.00	100.03	
I	1.31	1.31	0.00	26.64	
J	6.32	6.35	0.04	1631.22	
K	4.18	4.25	0.08	3300.76	
Total	43.76	43.90	0.14	5966.94	0.136982083
		0.14			

100yr/1hr

Watershed	Pre	Post	Retention Req (ac-ft)	ft^3
A	0.20	0.20	0.00	12.14
B	0.98	0.98	0.00	58.49
C	0.45	0.45	0.00	26.65
D	0.10	0.10	0.00	5.87
E	0.09	0.09	0.00	-42.75
F	0.52	0.52	0.00	31.09
G	0.02	0.02	0.00	-8.78
H	0.49	0.49	0.00	29.51
I	0.13	0.13	0.00	7.86
J	0.15	0.15	0	0.00
K	0.42	0.44	0.02	985.95
Total	3.56	3.58	0.02	921.51

10yr/24hr

Watershed	Pre	Post	Retention Req (ac-ft)	ft^3
A	0.83	0.83	0.00	26.56
B	4.01	4.01	0.00	127.98
C	1.83	1.83	0.00	58.32
D	0.40	0.40	0.00	12.85
E	0.50	0.50	0.00	119.06
F	2.13	2.13	0.00	68.02
G	0.10	0.10	0.00	24.44
H	2.02	2.02	0.00	64.56
I	0.54	0.54	0.00	17.19
J	0.82	0.83	0.01	517.24
K	1.71	1.76	0.05	2139.88
Total	14.88	14.96	0.07	3176.10
	648284.511	651460.6124	3176.101349	138350974.8

FLOW RATE ESTIMATION:

100yr

Watershed	Pre	Post	Increase (cfs)
A	22.74	22.76	0.02
B	66.67	66.78	0.11
C	13.89	13.94	0.05
D	21.15	21.16	0.01
E	64.70	64.98	0.28
F	40.64	40.70	0.06
G	41.01	41.06	0.06
H	54.39	54.45	0.06
I	10.75	10.76	0.02
J	64.81	65.28	0.47
K	46.40	46.45	0.05
Total	447.13	448.33	1.19

10yr

Watershed	Pre	Post	Increase (cfs)
A	9.76	9.79	0.02
B	22.42	22.53	0.11
C	0.74	0.80	0.05
D	10.56	10.57	0.01
E	0.00	0.28	0.28
F	14.91	14.97	0.06
G	15.31	15.37	0.06
H	23.27	23.33	0.06
I	4.04	4.06	0.02
J	0.00	0.38	0.38
K	19.90	19.94	0.05
Total	120.92	122.02	1.09

MAXIMUM WATER QUALITY CAPTURE VOLUME (DCV)

1 Compute the project site drainage area

Watershed	Area		
A	16.34588954	712026.9483	0.918308401
B	78.76384908	3430953.266	4.424935342
C	35.8950552	1563588.605	2.016576135
D	7.90709432	344433.0286	0.444218782
E	119.7001034	5214136.506	6.724724913
F	41.86481312	1823631.26	2.351955793
G	24.56967126	1070254.88	1.38031861
H	39.73521795	1730866.094	2.232315615
I	10.58033898	460879.566	0.594401066
J	197.52	8603971.2	11.09662921
K	33.67280177	1466787.245	1.891730436
Total	606.55	26421528.6	

2 Compute 'C' as a function of site imperviousness (ASCE and WEF, 1998)

	Dirt Area	Impervious Area	i	c
A	711491.9347	535.0135956	0.00075	0.041
B	3428375.264	2578.001644	0.00075	0.041
C	1562413.732	1174.872894	0.00075	0.041
D	344174.2233	258.8053072	0.00075	0.041
E	5210218.629	3917.876882	0.00075	0.041
F	1822260.992	1370.267684	0.00075	0.041
G	1069450.696	804.1843259	0.00075	0.041
H	1729565.53	1300.564388	0.00075	0.041
I	460533.2633	346.3026706	0.00075	0.041
J	8586989.418	16981.78223	0.00197	0.042
K	1424134.708	42652.53682	0.02908	0.062

3 Determine 2yr - 1hr rainfall depth

P21= 0.317

4 Compute mean storm rainfall depth by multiplying P21 by appropriate coefficient (a1 - given) for Mojave Rivershed

a1= 1.2371

P6= 0.3921607

5 Calculate DCV

a2 = drawdown time (1.582 for 24hr, or 1.963 for 48hr)

DCV = Area * C * a2 * P6 / 12

Watershed	Area	C	a2	P6	DCV (CF)	DCV (ac-ft)
A	712026.9483	0.041	1.963	0.3921607	1853.6	0.04
B	3430953.266	0.041	1.963	0.3921607	8931.9	0.21
C	1563588.605	0.041	1.963	0.3921607	4070.5	0.09
D	344433.0286	0.041	1.963	0.3921607	896.7	0.02
E	5214136.506	0.041	1.963	0.3921607	13574.1	0.31
F	1823631.26	0.041	1.963	0.3921607	4747.5	0.11
G	1070254.88	0.041	1.963	0.3921607	2786.2	0.06
H	1730866.094	0.041	1.963	0.3921607	4506.0	0.10
I	460879.566	0.041	1.963	0.3921607	1199.8	0.03
J	8603971.2	0.042	1.963	0.3921607	22919.6	0.53

BURNS McDONNELL

K		1466787.245	0.062	1.963	0.3921607	5821.6	0.13
	Total	26421528.6	0.040	1.963	0.3921607	71307.5	1.64

BURNS McDONNELL

WORKSHEET TITLE: Retention Analysis

CALCULATION NO.: 98975-C004

ISSUED DATE: 2/22/2019

REVISION: A

PERFORMED BY: BNS

REVIEWED BY: NT

OBJECTIVE: Determine Impervious Area

	Total Area	Inverters per basin	SF for all inverters	Steel posts per acre	SF for steel posts	Total Impervious	CN	Total Dirt Area	CN	Weighted Average	Percent Impervious
A	712026.9483	0.97	473.37	1988.38	61.64	535.01	98	711491.93	85	85.01	0.000751
B	3430953.266	4.66	2280.99	9581.14	297.02	2578.00	98	3428375.26	85	85.01	0.000751
C	1563588.605	2.12	1039.51	4366.42	135.36	1174.87	98	1562413.73	85	85.01	0.000751
D	344433.0286	0.47	228.99	961.85	29.82	258.81	98	344174.22	85	85.01	0.000751
E	5214136.506	7.07	3466.49	14560.79	451.38	3917.88	98	5210218.63	63	63.03	0.000751
F	1823631.26	2.47	1212.40	5092.60	157.87	1370.27	98	1822260.99	85	85.01	0.000751
G	1070254.88	1.45	711.53	2988.75	92.65	804.18	98	1069450.70	63	63.03	0.000751
H	1730866.094	2.35	1150.72	4833.55	149.84	1300.56	98	1729565.53	85	85.01	0.000751
I	460879.566	0.63	306.40	1287.03	39.90	346.30	98	460533.26	85	85.01	0.000751
J	8603971.2	11.67	5720.14	24027.11	744.84	16981.78	98	8586989.42	63	63.07	0.001974
K	1466787.245	1.99	975.16	4096.09	126.98	42652.54	98	1424134.71	85	85.38	0.029079

	SF	Quantity
Inverter Foundations	490	34
Steel Posts	0.031	70000
Substation foundations	5000	2
BESS foundations	2104	20

APPENDIX B – SITE CONDITIONS

Table 2-2a Runoff curve numbers for urban areas [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	Average percent impervious area [2]	A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

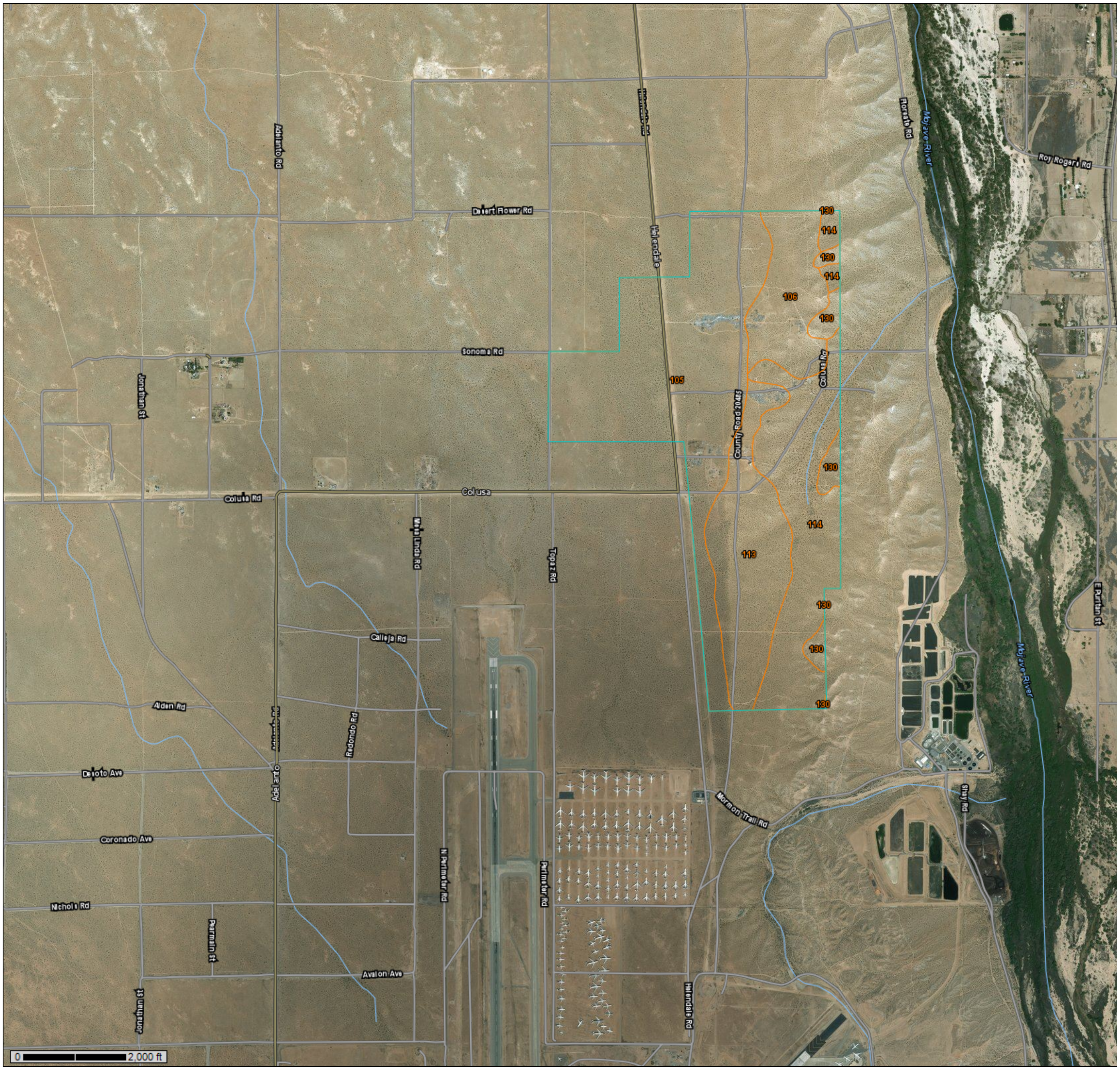
Table 2-2d Runoff curve numbers for arid and semiarid rangelands [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition [2]	A [3]	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

1 Average runoff condition, and I_a, = 0.2S. For range in humid regions, use table 2-2c.
2 Poor: <30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: > 70% ground cover.
3 Curve numbers for group A have been developed only for desert shrub.

Soil Map

Scale (not to scale)



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Soil Chemical Properties

Soil Erosion

Report — Hydrologic Soil Group and Surface Runoff

Absence of an entry indicates that the data were not estimated. The dash indicates no documented presence.

San Bernardino County, California, Mojave River Area			
Map symbol and soil name	**Pct. of map unit**	**Surface Runoff**	**Hydrologic Soil Group**
105—BRYMAN LOAMY FINE SAND, 0 TO 2 PERCENT SLOPES			
Bryman	80	—	C

Soil Health
Soil Physical Properties
Soil Qualities and Features
Vegetative Productivity
Waste Management
Water Features
Hydrologic Soil Group and Surface Runoff
View Description View Soil Report
Options
Include minor soils?
View Description View Soil Report
Water Features
Water Management
Irrigation - General and Sprinkler
Irrigation - Micro
Irrigation - Surface
Wildlife Management

San Bernardino County, California, Mojave River Area			
106—BRYMAN LOAMY FINE SAND, 2 TO 5 PERCENT SLOPES			
Bryman	80	—	C
113—CAJON SAND, 2 TO 9 PERCENT SLOPES			
Cajon	85	Very low	A
114—CAJON SAND, 9 TO 15 PERCENT SLOPES			
Cajon, slope	85	—	A
130—HAPLARGIDS-CALCIORTHIDS COMPLEX, 15 TO 50 PERCENT SLOPES			
Haplargids	50	—	—

Description — Hydrologic Soil Group and Surface Runoff

Water Features

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

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

The four hydrologic soil groups are:

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

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

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

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

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas.

Surface runoff refers to the loss of water from an area by flow over the land surface. Surface runoff classes are based on slope, climate, and vegetative cover. The concept indicates relative runoff for very specific conditions. It is assumed that the surface of the soil is bare and that the retention of surface water resulting from irregularities in the ground surface is minimal. The classes are negligible, very low, low, medium, high, and very high.

APPENDIX C – RAINFALL DATA

NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: CA

Data description

Data type: Precipitation depth **Units:** English **Time series type:** Partial duration

Select location

1) Manually:

a) By location (decimal degrees, use "-" for S and W): Latitude: Longitude: Submit

b) By station (list of CA stations): Select station

c) By address Search

2) Use map (if ESRI interactive map is not loading, try adding the host: **https://js.arcgis.com/** to the firewall, or contact us at hdsc.questions@noaa.gov):

a) Select location
Move crosshair or double click

b) Click on station icon
Show stations on map

Location information:
Name: Victorville, California, USA*
Latitude: 34.6406°
Longitude: -117.3734°
Elevation: 2788.97 ft **

* Source: ESRI Maps
** Source: USGS

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 6, Version 2

PF tabular PF graphical Supplementary information Print page

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.081** (0.066-0.099)	**0.112** (0.092-0.137)	**0.155** (0.127-0.191)	**0.192** (0.156-0.238)	**0.245** (0.193-0.314)	**0.288** (0.222-0.377)	**0.333** (0.251-0.447)	**0.382** (0.280-0.526)	**0.451** (0.317-0.647)	**0.506** (0.344-0.752)
10-min	**0.116** (0.095-0.142)	**0.160** (0.132-0.197)	**0.222** (0.182-0.274)	**0.275** (0.224-0.341)	**0.351** (0.277-0.450)	**0.413** (0.318-0.540)	**0.478** (0.360-0.640)	**0.547** (0.401-0.754)	**0.646** (0.455-0.927)	**0.725** (0.493-1.08)
15-min	**0.140** (0.115-0.171)	**0.194** (0.160-0.238)	**0.269** (0.221-0.331)	**0.333** (0.271-0.413)	**0.425** (0.335-0.544)	**0.499** (0.385-0.653)	**0.578** (0.435-0.774)	**0.662** (0.485-0.912)	**0.781** (0.550-1.12)	**0.877** (0.597-1.30)
30-min	**0.187** (0.154-0.230)	**0.260** (0.214-0.319)	**0.360** (0.296-0.443)	**0.446** (0.363-0.553)	**0.569** (0.448-0.729)	**0.669** (0.516-0.875)	**0.774** (0.584-1.04)	**0.887** (0.650-1.22)	**1.05** (0.737-1.50)	**1.18** (0.800-1.75)
60-min	**0.229** (0.189-0.281)	**0.317** (0.261-0.390)	**0.440** (0.361-0.542)	**0.545** (0.444-0.676)	**0.695** (0.548-0.891)	**0.817** (0.631-1.07)	**0.946** (0.713-1.27)	**1.08** (0.795-1.49)	**1.28** (0.900-1.84)	**1.44** (0.977-2.13)
2-hr	**0.315** (0.260-0.387)	**0.425** (0.350-0.522)	**0.577** (0.474-0.711)	**0.707** (0.576-0.877)	**0.893** (0.703-1.14)	**1.04** (0.805-1.37)	**1.20** (0.905-1.61)	**1.37** (1.00-1.89)	**1.60** (1.13-2.30)	**1.79** (1.22-2.66)
3-hr	**0.371** (0.305-0.454)	**0.495** (0.407-0.607)	**0.666** (0.547-0.820)	**0.813** (0.662-1.01)	**1.02** (0.805-1.31)	**1.19** (0.919-1.56)	**1.37** (1.03-1.83)	**1.56** (1.14-2.14)	**1.82** (1.28-2.61)	**2.02** (1.38-3.00)
6-hr	**0.485** (0.400-0.594)	**0.643** (0.529-0.789)	**0.859** (0.705-1.06)	**1.04** (0.849-1.29)	**1.31** (1.03-1.67)	**1.51** (1.17-1.98)	**1.73** (1.31-2.32)	**1.96** (1.44-2.71)	**2.29** (1.61-3.28)	**2.54** (1.73-3.77)
12-hr	**0.596** (0.491-0.731)	**0.805** (0.663-0.988)	**1.09** (0.895-1.34)	**1.33** (1.08-1.65)	**1.66** (1.31-2.13)	**1.93** (1.49-2.52)	**2.20** (1.66-2.95)	**2.49** (1.83-3.43)	**2.88** (2.03-4.14)	**3.19** (2.17-4.73)
24-hr	**0.739** (0.655-0.850)	**1.03** (0.910-1.18)	**1.42** (1.25-1.63)	**1.74** (1.52-2.02)	**2.18** (1.85-2.62)	**2.53** (2.10-3.11)	**2.88** (2.34-3.63)	**3.25** (2.56-4.21)	**3.76** (2.84-5.08)	**4.15** (3.03-5.80)
2-day	**0.801** (0.711-0.922)	**1.14** (1.01-1.31)	**1.59** (1.41-1.84)	**1.97** (1.72-2.29)	**2.47** (2.10-2.98)	**2.87** (2.38-3.52)	**3.27** (2.65-4.12)	**3.68** (2.90-4.77)	**4.24** (3.20-5.72)	**4.66** (3.40-6.51)
3-day	**0.866** (0.768-0.996)	**1.24** (1.10-1.43)	**1.75** (1.55-2.02)	**2.17** (1.90-2.53)	**2.73** (2.32-3.29)	**3.17** (2.63-3.89)	**3.61** (2.92-4.55)	**4.06** (3.20-5.27)	**4.68** (3.53-6.32)	**5.15** (3.76-7.19)

4-day	**0.908** (0.805-1.04)	**1.31** (1.16-1.51)	**1.86** (1.64-2.15)	**2.31** (2.02-2.69)	**2.91** (2.47-3.51)	**3.37** (2.80-4.15)	**3.85** (3.12-4.85)	**4.33** (3.41-5.61)	**4.98** (3.76-6.73)	**5.47** (3.99-7.65)
7-day	**0.949** (0.841-1.09)	**1.38** (1.22-1.59)	**1.98** (1.75-2.28)	**2.47** (2.16-2.87)	**3.14** (2.66-3.78)	**3.65** (3.03-4.49)	**4.16** (3.37-5.24)	**4.67** (3.68-6.05)	**5.35** (4.05-7.23)	**5.85** (4.27-8.18)
10-day	**0.980** (0.869-1.13)	**1.44** (1.27-1.65)	**2.08** (1.84-2.40)	**2.61** (2.28-3.04)	**3.34** (2.83-4.03)	**3.90** (3.24-4.80)	**4.46** (3.61-5.62)	**5.02** (3.96-6.51)	**5.78** (4.37-7.81)	**6.33** (4.62-8.84)
20-day	**1.09** (0.968-1.25)	**1.65** (1.46-1.90)	**2.46** (2.17-2.84)	**3.14** (2.75-3.66)	**4.13** (3.50-4.97)	**4.90** (4.07-6.02)	**5.68** (4.60-7.16)	**6.49** (5.11-8.40)	**7.53** (5.69-10.2)	**8.31** (6.06-11.6)
30-day	**1.20** (1.07-1.38)	**1.84** (1.63-2.12)	**2.80** (2.47-3.23)	**3.63** (3.18-4.23)	**4.86** (4.12-5.85)	**5.83** (4.84-7.16)	**6.81** (5.52-8.58)	**7.83** (6.17-10.1)	**9.18** (6.94-12.4)	**10.2** (7.41-14.2)
45-day	**1.37** (1.21-1.57)	**2.13** (1.89-2.45)	**3.29** (2.91-3.80)	**4.33** (3.79-5.04)	**5.89** (4.99-7.09)	**7.17** (5.95-8.81)	**8.48** (6.87-10.7)	**9.83** (7.75-12.7)	**11.7** (8.81-15.7)	**13.0** (9.50-18.2)
60-day	**1.49** (1.32-1.72)	**2.34** (2.07-2.69)	**3.66** (3.23-4.22)	**4.86** (4.26-5.66)	**6.67** (5.65-8.03)	**8.19** (6.80-10.1)	**9.79** (7.93-12.3)	**11.4** (9.00-14.8)	**13.7** (10.3-18.5)	**15.4** (11.2-21.5)

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

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

Please refer to NOAA Atlas 14 document for more information.

Estimates from the table in CSV format: Precipitation frequency estimates ▼ Submit

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NOAA ATLAS 14 POINT PRECIPITATION FREQUENCY ESTIMATES: CA

Data description

Data type: Precipitation intensity **Units:** English **Time series type:** Partial duration

Select location

1) Manually:

a) **By location** (decimal degrees, use "-" for S and W): Latitude: 34.6406 Longitude: -117.3734 Submit

b) **By station** (list of CA stations): Select station

c) **By address** Search

2) Use map (if ESRI interactive map is not loading, try adding the host: **https://js.arcgis.com/** to the firewall, or contact us at hdsc.questions@noaa.gov):

a) Select location
Move crosshair or double click

b) Click on station icon
Show stations on map

Location information:
Name: Victorville, California, USA*
Latitude: 34.6406°
Longitude: -117.3734°
Elevation: 2788.97 ft **

* Source: ESRI Maps
** Source: USGS

POINT PRECIPITATION FREQUENCY (PF) ESTIMATES

WITH 90% CONFIDENCE INTERVALS AND SUPPLEMENTARY INFORMATION
NOAA Atlas 14, Volume 6, Version 2

PF tabular PF graphical Supplementary information Print page

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.972** (0.792-1.19)	**1.34** (1.10-1.64)	**1.86** (1.52-2.29)	**2.30** (1.87-2.86)	**2.94** (2.32-3.77)	**3.46** (2.66-4.52)	**4.00** (3.01-5.36)	**4.58** (3.36-6.31)	**5.41** (3.80-7.76)	**6.07** (4.13-9.02)
10-min	**0.696** (0.570-0.852)	**0.960** (0.792-1.18)	**1.33** (1.09-1.64)	**1.65** (1.34-2.05)	**2.11** (1.66-2.70)	**2.48** (1.91-3.24)	**2.87** (2.16-3.84)	**3.28** (2.41-4.52)	**3.88** (2.73-5.56)	**4.35** (2.96-6.46)
15-min	**0.560** (0.460-0.684)	**0.776** (0.640-0.952)	**1.08** (0.884-1.32)	**1.33** (1.08-1.65)	**1.70** (1.34-2.18)	**2.00** (1.54-2.61)	**2.31** (1.74-3.10)	**2.65** (1.94-3.65)	**3.12** (2.20-4.48)	**3.51** (2.39-5.21)
30-min	**0.374** (0.308-0.460)	**0.520** (0.428-0.638)	**0.720** (0.592-0.886)	**0.892** (0.726-1.11)	**1.14** (0.896-1.46)	**1.34** (1.03-1.75)	**1.55** (1.17-2.08)	**1.77** (1.30-2.44)	**2.09** (1.47-3.01)	**2.35** (1.60-3.49)
60-min	**0.229** (0.189-0.281)	**0.317** (0.261-0.390)	**0.440** (0.361-0.542)	**0.545** (0.444-0.676)	**0.695** (0.548-0.891)	**0.817** (0.631-1.07)	**0.946** (0.713-1.27)	**1.08** (0.795-1.49)	**1.28** (0.900-1.84)	**1.44** (0.977-2.13)
2-hr	**0.158** (0.130-0.194)	**0.212** (0.175-0.261)	**0.288** (0.237-0.356)	**0.354** (0.288-0.438)	**0.446** (0.352-0.572)	**0.522** (0.402-0.682)	**0.600** (0.452-0.804)	**0.684** (0.502-0.942)	**0.802** (0.564-1.15)	**0.895** (0.609-1.33)
3-hr	**0.124** (0.102-0.151)	**0.165** (0.136-0.202)	**0.222** (0.182-0.273)	**0.271** (0.220-0.336)	**0.340** (0.268-0.436)	**0.397** (0.306-0.519)	**0.456** (0.343-0.610)	**0.518** (0.380-0.714)	**0.605** (0.426-0.868)	**0.674** (0.458-1.00)
6-hr	**0.081** (0.067-0.099)	**0.107** (0.088-0.132)	**0.143** (0.118-0.177)	**0.174** (0.142-0.216)	**0.218** (0.172-0.279)	**0.253** (0.195-0.331)	**0.289** (0.218-0.388)	**0.328** (0.240-0.452)	**0.382** (0.269-0.548)	**0.424** (0.288-0.629)
12-hr	**0.049** (0.041-0.061)	**0.067** (0.055-0.082)	**0.091** (0.074-0.111)	**0.110** (0.090-0.137)	**0.138** (0.109-0.177)	**0.160** (0.124-0.209)	**0.183** (0.138-0.245)	**0.207** (0.151-0.285)	**0.239** (0.168-0.343)	**0.265** (0.180-0.393)
24-hr	**0.031** (0.027-0.035)	**0.043** (0.038-0.049)	**0.059** (0.052-0.068)	**0.072** (0.063-0.084)	**0.091** (0.077-0.109)	**0.105** (0.087-0.129)	**0.120** (0.097-0.151)	**0.136** (0.107-0.176)	**0.157** (0.118-0.211)	**0.173** (0.126-0.242)
2-day	**0.017** (0.015-0.019)	**0.024** (0.021-0.027)	**0.033** (0.029-0.038)	**0.041** (0.036-0.048)	**0.052** (0.044-0.062)	**0.060** (0.050-0.073)	**0.068** (0.055-0.086)	**0.077** (0.060-0.099)	**0.088** (0.067-0.119)	**0.097** (0.071-0.136)
3-day	**0.012** (0.011-0.014)	**0.017** (0.015-0.020)	**0.024** (0.022-0.028)	**0.030** (0.026-0.035)	**0.038** (0.032-0.046)	**0.044** (0.037-0.054)	**0.050** (0.041-0.063)	**0.056** (0.044-0.073)	**0.065** (0.049-0.088)	**0.071** (0.052-0.100)

4-day	**0.009** (0.008-0.011)	**0.014** (0.012-0.016)	**0.019** (0.017-0.022)	**0.024** (0.021-0.028)	**0.030** (0.026-0.037)	**0.035** (0.029-0.043)	**0.040** (0.032-0.050)	**0.045** (0.036-0.058)	**0.052** (0.039-0.070)	**0.057** (0.042-0.080)
7-day	**0.006** (0.005-0.006)	**0.008** (0.007-0.009)	**0.012** (0.010-0.014)	**0.015** (0.013-0.017)	**0.019** (0.016-0.022)	**0.022** (0.018-0.027)	**0.025** (0.020-0.031)	**0.028** (0.022-0.036)	**0.032** (0.024-0.043)	**0.035** (0.025-0.049)
10-day	**0.004** (0.004-0.005)	**0.006** (0.005-0.007)	**0.009** (0.008-0.010)	**0.011** (0.010-0.013)	**0.014** (0.012-0.017)	**0.016** (0.013-0.020)	**0.019** (0.015-0.023)	**0.021** (0.016-0.027)	**0.024** (0.018-0.033)	**0.026** (0.019-0.037)
20-day	**0.002** (0.002-0.003)	**0.003** (0.003-0.004)	**0.005** (0.005-0.006)	**0.007** (0.006-0.008)	**0.009** (0.007-0.010)	**0.010** (0.008-0.013)	**0.012** (0.010-0.015)	**0.014** (0.011-0.018)	**0.016** (0.012-0.021)	**0.017** (0.013-0.024)
30-day	**0.002** (0.001-0.002)	**0.003** (0.002-0.003)	**0.004** (0.003-0.004)	**0.005** (0.004-0.006)	**0.007** (0.006-0.008)	**0.008** (0.007-0.010)	**0.009** (0.008-0.012)	**0.011** (0.009-0.014)	**0.013** (0.010-0.017)	**0.014** (0.010-0.020)
45-day	**0.001** (0.001-0.001)	**0.002** (0.002-0.002)	**0.003** (0.003-0.004)	**0.004** (0.004-0.005)	**0.005** (0.005-0.007)	**0.007** (0.006-0.008)	**0.008** (0.006-0.010)	**0.009** (0.007-0.012)	**0.011** (0.008-0.015)	**0.012** (0.009-0.017)
60-day	**0.001** (0.001-0.001)	**0.002** (0.001-0.002)	**0.003** (0.002-0.003)	**0.003** (0.003-0.004)	**0.005** (0.004-0.006)	**0.006** (0.005-0.007)	**0.007** (0.006-0.009)	**0.008** (0.006-0.010)	**0.009** (0.007-0.013)	**0.011** (0.008-0.015)

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

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

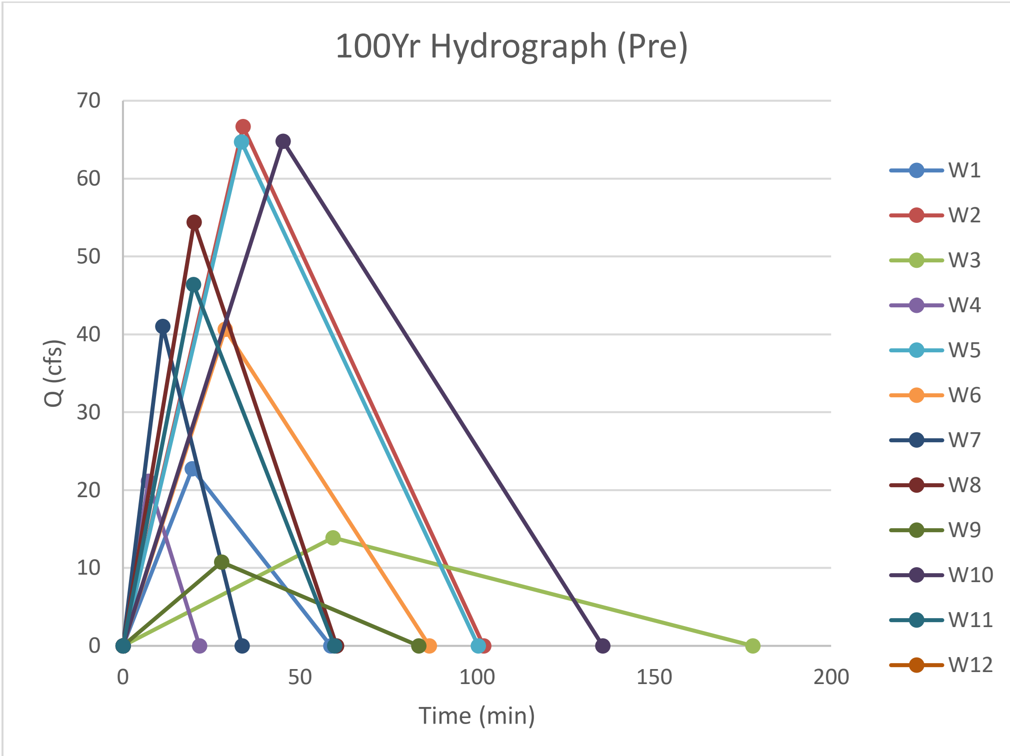
Please refer to NOAA Atlas 14 document for more information.

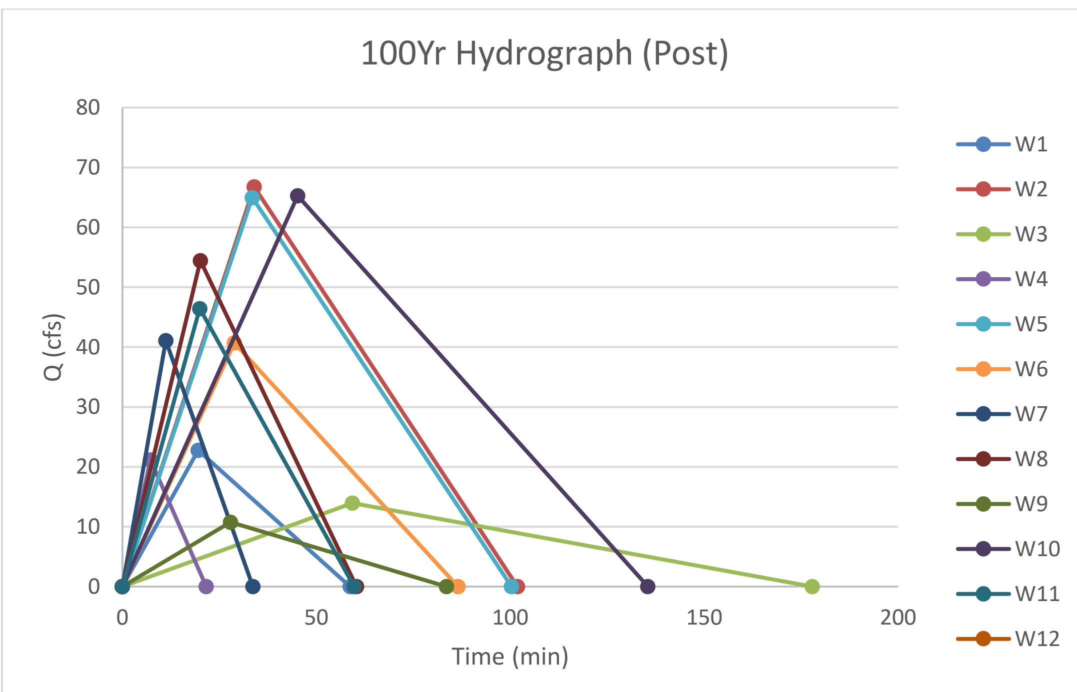
Estimates from the table in CSV format: Precipitation frequency estimates ▼ Submit

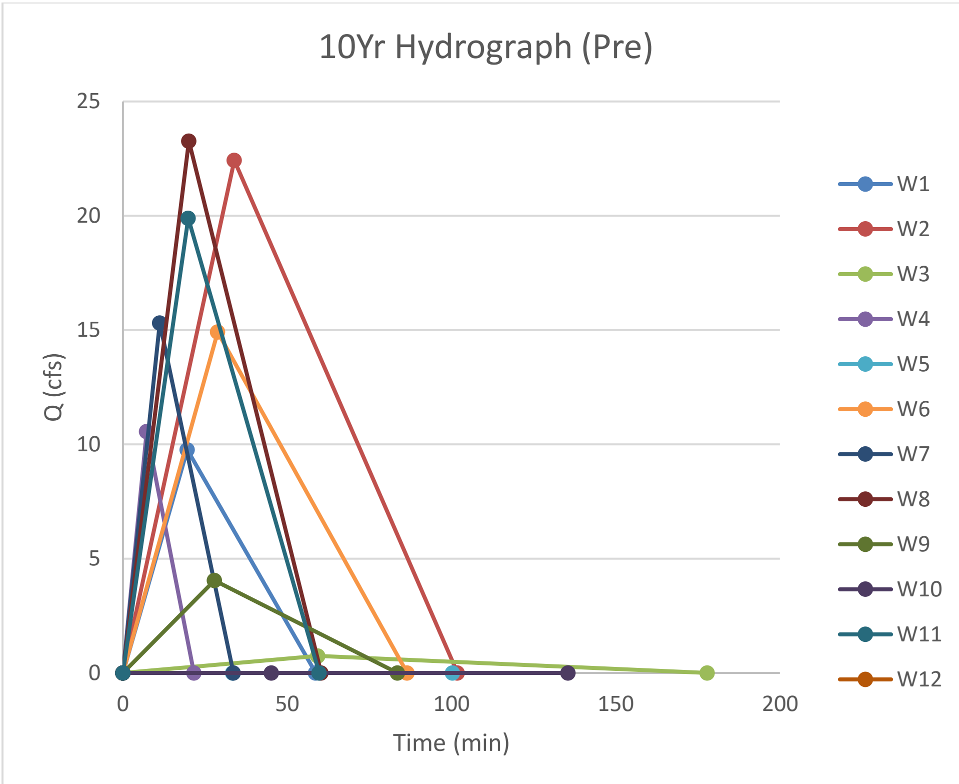
Main Link Categories:
Home | OWP

US Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service
Office of Water Prediction (OWP)
1325 East West Highway
Silver Spring, MD 20910
Page Author: HDSC webmaster
Page last modified: April 21, 2017

APPENDIX D – HYDROGRAPHS



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Q (cfs)
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20
15
10
5
0
0
50
100
150
200
Time (min)
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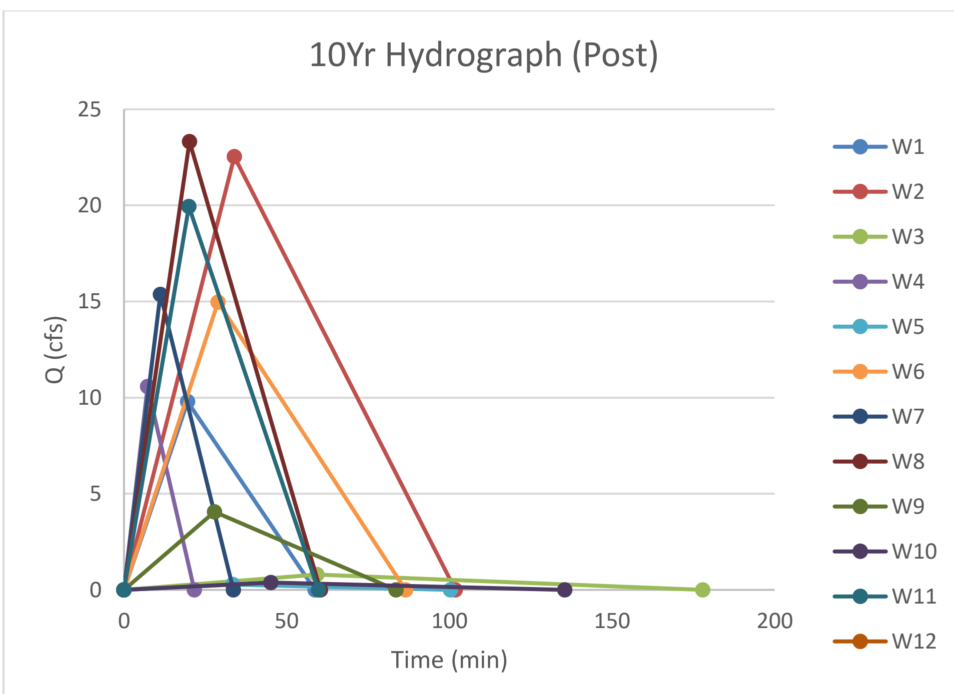
W9
W10
W11
W12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Q (cfs)
25
20
15
10
5
0
0
50
100
150
200
Time (min)
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W2
W3
W4
W5
W6
W7
W8
W9
W10
W11
W12

APPENDIX E – FEMA FIRM MAP

NOTES TO USERS

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

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

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

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

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

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

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

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

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

Base map information shown on this FIRM was provided in digital format by the San Bernardino County ISD.GIS Department, United States Geological Survey, the Bureau of Land Management, the United States Department of Agriculture, and the National Geodetic Survey. The imagery was flown by U.S. Department of Agricuture Farm Sevice Agency in 2012 and was produced with a 1-meter ground sampling distance.

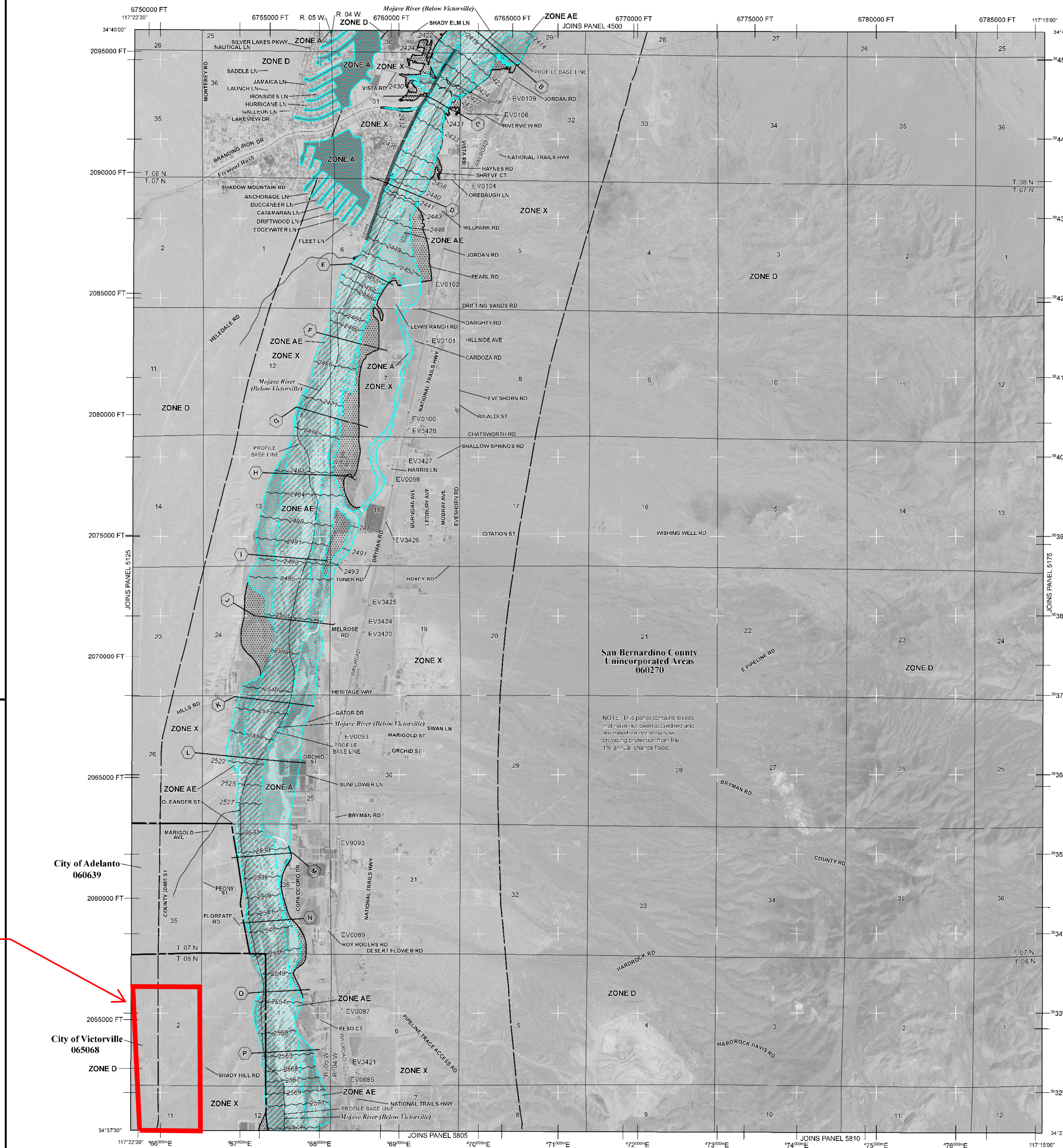
This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result,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

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

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

For information and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products, or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.

PROJECT SITE



LEGEND

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

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

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

	1% annual chance floodplain boundary
	0.2% annual chance floodplain boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities
~~ 513 ~~~	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

* Referenced to the North American Vertical Datum of 1988

(A)———(A)	Cross section line
(23)- - - - -(23)	Transect line
97°07'30", 32°22'30"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
4275000mE	1000-meter Universal Transverse Mercator grid values, zone 11
6000000 FT	5000-foot grid ticks: California State Plane coordinate system, Zone V (FIPSZONE = 405), Lambert projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
● M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories List on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
August 28, 2008

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
September 2, 2016 – to change Base Flood Elevations, to add Base Flood Elevations, to change Special Flood Hazard Areas, to add Special Flood Hazard Areas, to change zone designations, to incorporate previously issued Letters of Map Revision, and to reflect updated topographic information.

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

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

MAP SCALE 1" = 2000'

1,000 0 1,000 2,000 3,000 4,000 FEET
600 0 600 1,200 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 5150J

FIRM
FLOOD INSURANCE RATE MAP
SAN BERNARDINO COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 5150 OF 9400

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
ADELANTO, CITY OF	060639	5150	J
SAN BERNARDINO COUNTY	060270	5150	J
VICTORVILLE, CITY OF	065068	5150	J

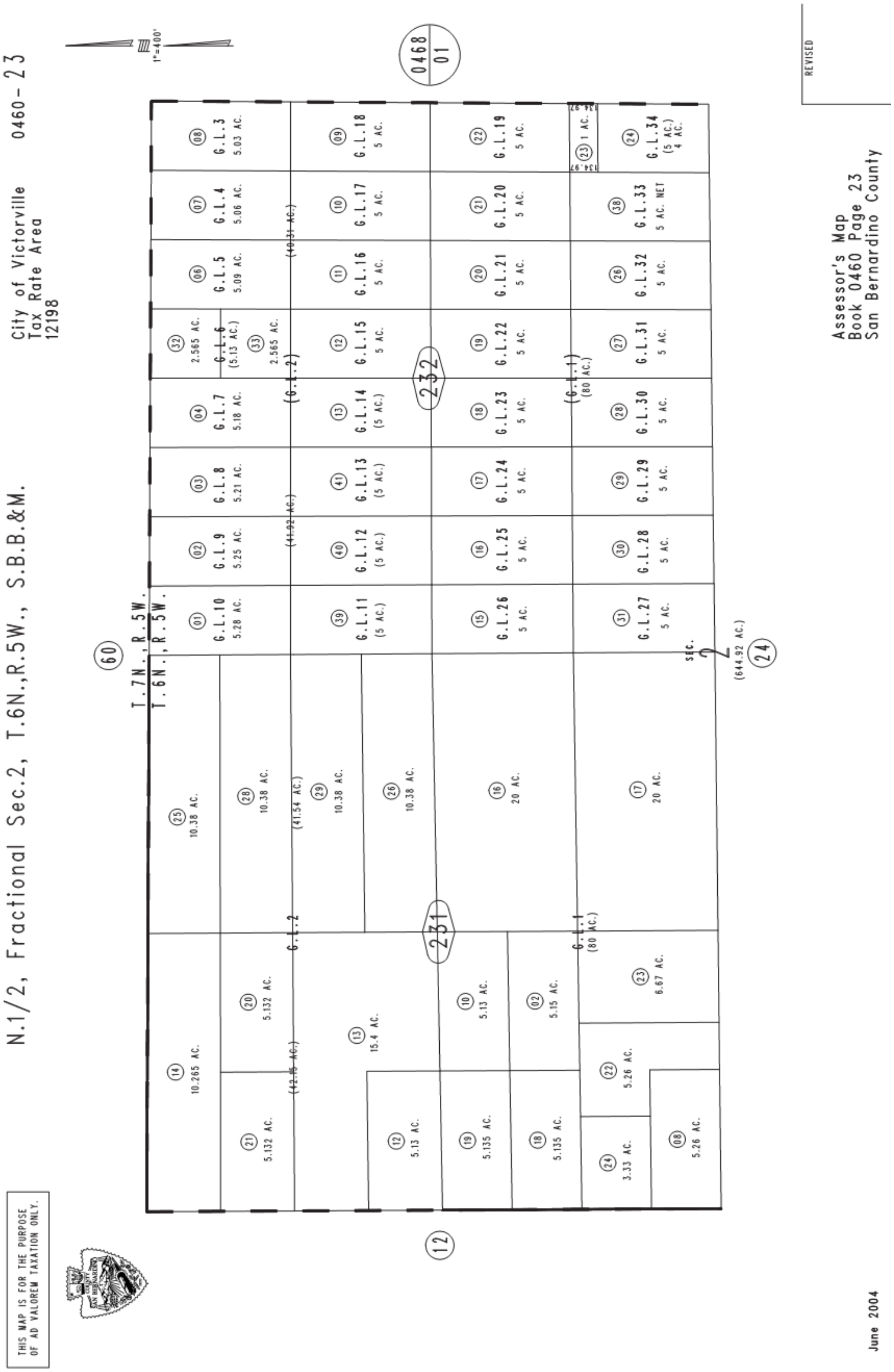
Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER 06071C5150J

MAP REVISED SEPTEMBER 2, 2016

Federal Emergency Management Agency

APPENDIX F – PARCEL MAPS

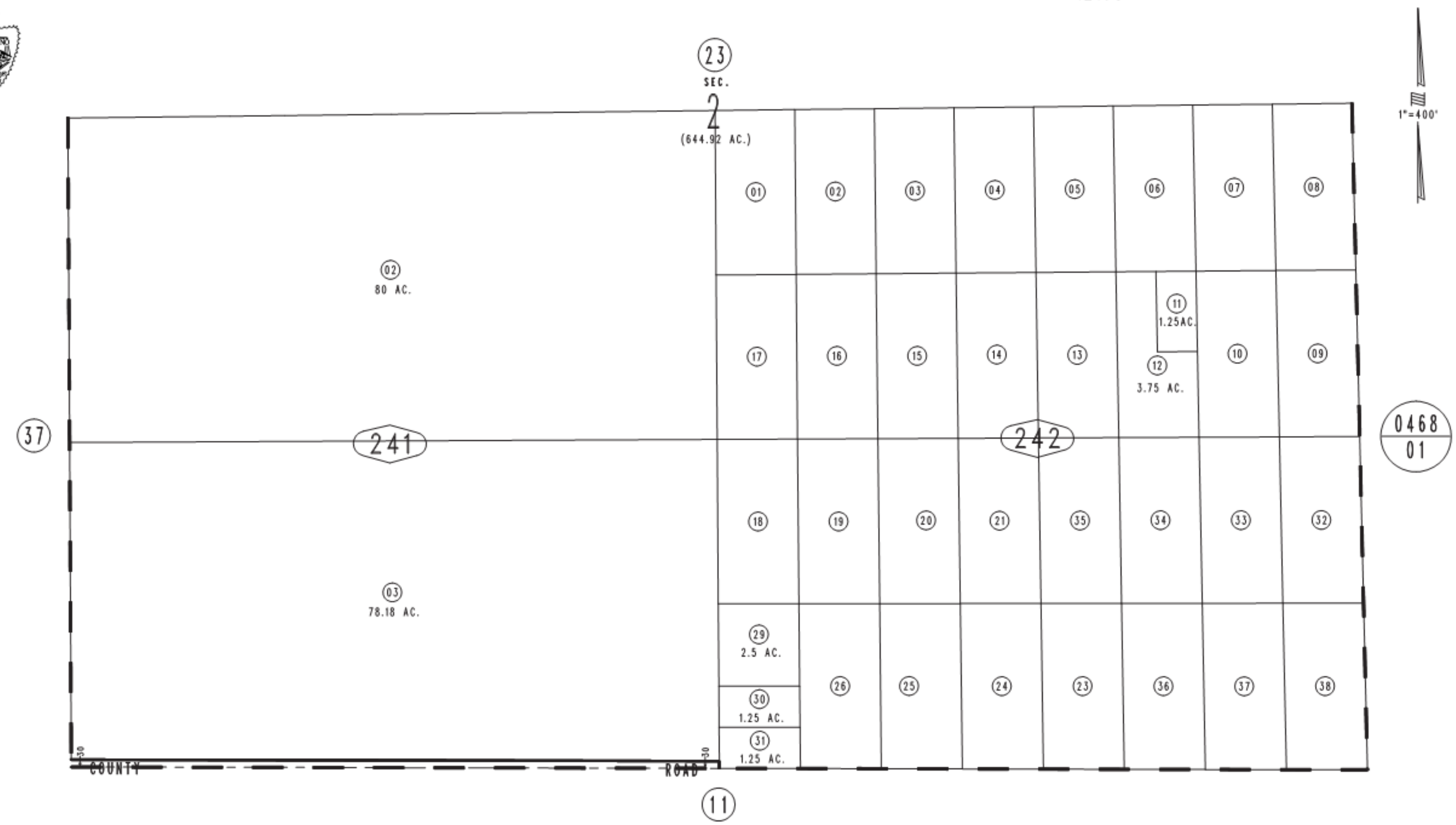


THIS MAP IS FOR THE PURPOSE
OF AD VALOREM TAXATION ONLY.

S.1/2, Fractional Sec.2, T.6N.,R.5W., S.B.B.&M.

City of Victorville
Tax Rate Area
12198

0460- 24



REVISED

Assessor's Map
Book 0460 Page 24
San Bernardino County

June 2004

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