TETRA TECH EC, INC.

California Energy Commission
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October 31, 2012

Eric Solorio, Project Manager
California Energy Commission
Docket No. 11-AFC-3
1516 9th St.
Sacramento, CA 95814

Cogentrix Quail Brush Generation Project - Docket Number 11-AFC-03: Hydrology Responses to Comments from Don Weston at the October 19, 2012 CEC Public Workshop

Docket Clerk:

Pursuant to the provisions of Title 20, California Code of Regulations, and on behalf of Quail Brush Genco, LLC, a wholly owned subsidiary of Cogentrix Energy, LLC, Tetra Tech hereby submits the *Hydrology Responses to Comments from Don Weston at the October 19, 2012 CEC Public Workshop.* The Quail Brush Generation Project is a 100 megawatt natural gas fired electric generation peaking facility to be located in the City of San Diego, California.

The topics addressed in this letter include the following:

- Hydrology

If you have any questions regarding this submittal, please contact Rick Neff at (704) 525-3800 or me at (303) 980-3653.

Sincerely,

Constance C. Farmer

Constance E. Farmer
Project Manager/Tetra Tech

cc: Lori Ziebart, Cogentrix
John Collins, Cogentrix
Rick Neff, Cogentrix
Proof of Service List

BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA
1516 NINTH STREET, SACRAMENTO, CA 95814
1-800-822-6228 – WWW.ENERGY.CA.GOV

APPLICATION FOR CERTIFICATION FOR THE
QUAIL BRUSH GENERATION PROJECT

DOCKET NO. 11-AFC-03
PROOF OF SERVICE
(Revised 10/29/2012)

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<u>DECLARATION OF SERVICE</u>

I, Constance Farmer, declare that on October 31, 2012, I served and filed copies of the attached Hydrology Responses to Comments from Don Weston at the October 19, 2012 CEC Public Workshop, dated October 31, 2012. This document is accompanied by the most recent Proof of Service list, located on the web page for this project at: http://www.energy.ca.gov/sitingcases/quailbrush/index.html.

The document has been sent to the other parties in this proceeding (as shown on the Proof of Service list) and to the Commission's Docket Unit or Chief Counsel, as appropriate, in the following manner:

(*Check all that Apply*)

For service to all other parties:

_x_ Served electronically to all e-mail addresses on the Proof of Service list;

___ Served by delivering on this date, either personally, or for mailing with the U.S. Postal Service with first-class postage thereon fully prepaid, to the name and address of the person served, for mailing that same day in the ordinary course of business; that the envelope was sealed and placed for collection and mailing on that date to those addresses marked *"hard copy required" or where no e-mail address is provided.

AND

For filing with the Docket Unit at the Energy Commission:

_x_ by sending an electronic copy to the e-mail address below (preferred method); *OR*

___ by depositing an original and 12 paper copies in the mail with the U.S. Postal Service with first class postage thereon fully prepaid, as follows:

CALIFORNIA ENERGY COMMISSION – DOCKET UNIT
Attn: Docket No. 11-AFC-03
1516 Ninth Street, MS-4
Sacramento, CA 95814-5512
docket@energy.ca.gov

OR, if filing a Petition for Reconsideration of Decision or Order pursuant to Title 20, § 1720:

___ Served by delivering on this date one electronic copy by e-mail, and an original paper copy to the Chief Counsel at the following address, either personally, or for mailing with the U.S. Postal Service with first class postage thereon fully prepaid:

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I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct, that I am employed in the county where this mailing occurred, and that I am over the age of 18 years and not a party to the proceeding.

Constance C. Farmer

ADDITIONAL CLARIFICATIONS REGARDING ANALYSIS OF SOIL AND WATER IMPACTS

Based on a discussion at the CEC Workshop for the Quail Brush Project held on October 19, 2012, the Applicant wishes to provide additional information regarding the analysis that was done with regard to Soil and Water Impacts in order to: (1) correct a minor mapping area in a previously submitted figure; and (2) to explain the rational for selecting the runoff coefficient used in the hydrologic calculations presented in the Drainage Study (Tetra Tech 2012a) and Water Quality Technical Report (Tetra Tech 2012b).

Correction to Figure 1-1-Project Vicinity Map

Due to a minor mapping inconsistency, a portion of the eastern Little Sycamore Canyon Watershed boundary shown in Figure 1-1 in the Water Quality Technical Report (Tetra Tech 2012b) does not agree with the sub-basin watershed boundaries. Figure 1-1 has been revised to correct the inconsistency in the figure and is attached. The Little Sycamore Canyon Watershed boundary plotted from data in a USGS database did not correctly identify the eastern ridgeline. The three sub-basin watershed boundaries were based on a recent digital terrain model of the Project vicinity.

Runoff Coefficient Selection

The Rational Method (RM) is a mathematical formula used to determine the maximum runoff rate from a given rainfall event and can be applied using any chosen design storm frequency (i.e., 10-year, 25-year, etc.). The procedure for the RM specific to San Diego is correspondingly outlined by both the City's Drainage Design Manual (City of San Diego 1984) and the San Diego County's Hydrology Manual (County of San Diego 2003) as the design basis for the hydrologic evaluation in the Drainage Study (Tetra Tech 2012a).

The runoff coefficient, C, in the RM formula represents the runoff potential of a land use and soil type (i.e., the higher the C-value, the higher the runoff potential). The City's Drainage Design Manual, which is similar to the County's Hydrology Manual, typically utilizes runoff coefficients estimated for developed or urbanized watershed areas. These areas are either already equipped with adequate urban drainage systems that discharge into controlled stormwater conveyances or are used to design such conveyances for new urban drainage areas.

However, the Project stormwater does not drain into a prescribed urban drainage system nor will it be connected to a regulated sewer system. Rather, the Project stormwater discharges into the natural drainage of Little Sycamore Canyon to the west, which is part of the greater San Diego River watershed. The area surrounding the Project is intended to remain natural or non-urbanized and is not planned for an urban drainage system in the future.

Estimates of appropriate runoff coefficients for natural, undeveloped or non-urbanized watersheds, as a result, contrast from those presented in the City's Drainage Design Manual for an urban environment. Also, the anticipated development of the Project will involve specific surface and land use types that are different from those outlined in the City's Drainage Design Manual, such as landscaping, gravel drives, asphalt pavement, concrete structures, building roofs, and other miscellaneous structures. Therefore, runoff coefficient sources, other than the City's Drainage Design Manual and County's Hydrology Manual, were required for the Project's undeveloped and developed areas.

The runoff coefficients for the Project's undeveloped areas were conservatively estimated utilizing the California Department of Transportation (Caltrans) Highway Design Manual (Caltrans Manual) (Caltrans 2010), whereas those runoff coefficients for the Project's anticipated developed areas were conservatively estimated from both the Caltrans Manual and a standard engineering reference, Hydrologic Analysis and Design (McCuen 1998). The Caltrans Manual includes a procedure to estimate the runoff coefficient for undeveloped lands, which is included in Attachment A. Table 1-1 shows the range for the runoff coefficient used to represent Project's undeveloped areas.

Table 1-1 Runoff Coefficient – Undeveloped Areas

Characteristic	Category	Low Value	High Value
Relief	High	0.20	0.28
Soil Infiltration	High	0.08	0.12
Vegetal Cover	High	0.08	0.12
Surface Storage	Extreme	0.10	0.12
Total		**0.46**	**0.64**

Source: Caltrans Highway Design Manual, 2010.

In order to conservatively estimate the overall runoff from the undeveloped basins (i.e., existing basins), a runoff coefficient of 0.64 was selected.

McCuen's Hydrologic Analysis and Design and the Caltrans Manual also show typical runoff coefficient values for various land uses and developed areas, and those references are included in Attachment A. In general for the post development conditions, runoff coefficients for the main plant site area, the switchyard areas, and the access road are conservatively estimated to be either 0.75 or 0.85 depending upon the specific surface types. The runoff coefficients proposed for areas with landscaping features, graded slopes and retaining wall structures are estimated as 0.44, which is referenced in Attachment A. Table 1-2 presents the corresponding runoff coefficients used for the Project's developed areas.

Table 1-2 Runoff Coefficient – Developed Areas

C-Value	Area Description
0.44	Landscaping [Source 1]
0.75	Gravel Areas and Drives [Source 2]
0.85	Asphalt Pavement, Concrete, Building Roofs, Miscellaneous Structures (Note 1) [Source 3]
0.00	Structures with Mandatory Secondary Containment

Source 1: McCuen Hydrologic Analysis and Design, 1998. Modeled as Meadow, > 6% Slope, Soil Group C.
Source 2: Caltrans Highway Design Manual, 2010.
Source 3: McCuen Hydrologic Analysis and Design, 1998, and Caltrans Highway Design Manual, 2010.
Note 1: C-Value of 0.85 is similar to those outlined in City & County Manuals for Impervious Commercial and Industrial Land Use

Moreover, in order to consider the different undeveloped and developed land uses that may be present within a given study area as an aggregate, a weighted C-value is calculated by assigning an appropriate C-value for each different type of land use, which is then multiplied by that corresponding land use area. The sum of the products for all different land uses divided by the total study area (A_T) is the weighted runoff coefficient (C_w) as given by the following equation:

$$C_w = \frac{\sum AC}{A_T}$$

Tables 1-3 and 1-4 represent the weighted runoff coefficients used in the hydrologic analyses for the developed subareas of the Central and South watersheds, respectively. A further definition of those subareas that comprise different surface types and various land uses and their associated weighted runoff coefficients are presented in Attachment B.

Table 1-3 Developed Subarea Weighted Runoff Coefficient Analysis - Central Watershed (Note 1)

Subarea	Area Description	Area (ac)	C_w-Value	A*C
C02	Landscaping/Slopes/Retaining Walls	0.27	0.44	0.120
C03	Developed SDGE Switch Yard	1.32	0.69	0.908
C04	Landscaping/Drainage Area	0.25	0.44	0.109
C05	Developed Plant Site - Northeast	1.12	0.70	0.785
C06	Developed Plant Site - Northwest	1.27	0.64	0.809
C07	Developed Plant Switch Yard	0.31	0.75	0.231
C08	Landscaping/Walls/Basin/Drainage	0.74	0.44	0.326
C09	Developed Plant Site - Main Buildings	0.68	0.85	0.577
C10	Landscaping/Slopes/Retaining Walls	0.37	0.44	0.161
C11	Landscaping/Slopes/Retaining Walls	0.51	0.44	0.223
Total		**6.8**	**0.62**	**4.25**

Note 1: See Subarea Summary for further Breakdown of Disturbed or Developed Areas Only, Attachment B.

Table 1-4 Developed Subarea Weighted Runoff Coefficient Analysis - South Watershed (Note 1)

Subarea	Area Description	Area (ac)	C_w-Value	A*C
S02	Landscaping/Slopes/Retaining Walls	0.33	0.44	0.146
S03	Access Road/Retaining Walls	0.51	0.64	0.332
S04	Developed Plant Site - South	1.01	0.76	0.773
S05	Landscaping Area/Retaining Walls	0.20	0.44	0.089
S06	Access Road/Retaining Walls	0.40	0.64	0.257
S07	Access Road/Retaining Walls/Basin	0.75	0.55	0.411
S08	Access Road/Retaining Walls	0.16	0.63	0.102
Total		**3.4**	**0.62**	**2.11**

Note 1: See Subarea Summary for further Breakdown of Disturbed or Developed Areas Only, Attachment B.

The Rational Method utilized for the hydrologic evaluation is presented as an overview in the Drainage Study (Tetra Tech 2012a) and was discussed in further detail with respect to an initial evaluation of the Project in Appendix I (the Preliminary Hydrologic and Hydraulic Evaluation for the Quail Brush Generation Project) of the Quail Brush Generation Project Application for Certification (AFC) (Tetra Tech 2011).

The combination of the use of the developed and undeveloped land use runoff coefficients, coupled with the weighted runoff coefficients for the Project's subareas provides a conservative estimate of the stormwater runoff from the different areas within the Project site and hence, for the entire Project hydrology.

REFERENCES

City of San Diego. 1984. Drainage Design Manual. April.

County of San Diego. 2003. San Diego County Hydrology Manual. Prepared by the County of San Diego Department of Public Works Flood Control Section. June.

Caltrans. 2010. California Department of Transportation Highway Design Manual, Chapter 810 Hydrology, Figure 819.2A and Table 819.2B. Available at: http://www.dot.ca.gov/hq/oppd/hdm/pdf/english/chp0810.pdf

McCuen, Richard H. 1998. Hydrologic Analysis and Design 2nd Edition, Chapter 7 Peak Discharge Estimation, Section 7.6 Rational Method, Tables 7-9 and 7-10.

Tetra Tech. 2011. Quail Brush Generation Project Application for Certification, Appendix I: Preliminary Hydrologic and Hydraulic Evaluation for the Quail Brush Generation Project. August.

Tetra Tech. 2012a. Drainage Study for the Quail Brush Generation Project. September.

Tetra Tech 2012b. Water Quality Technical Report for the Quail Brush Generation Project. September.

FIGURES

Printing Date: 10/18/2012 4:01:00 PM
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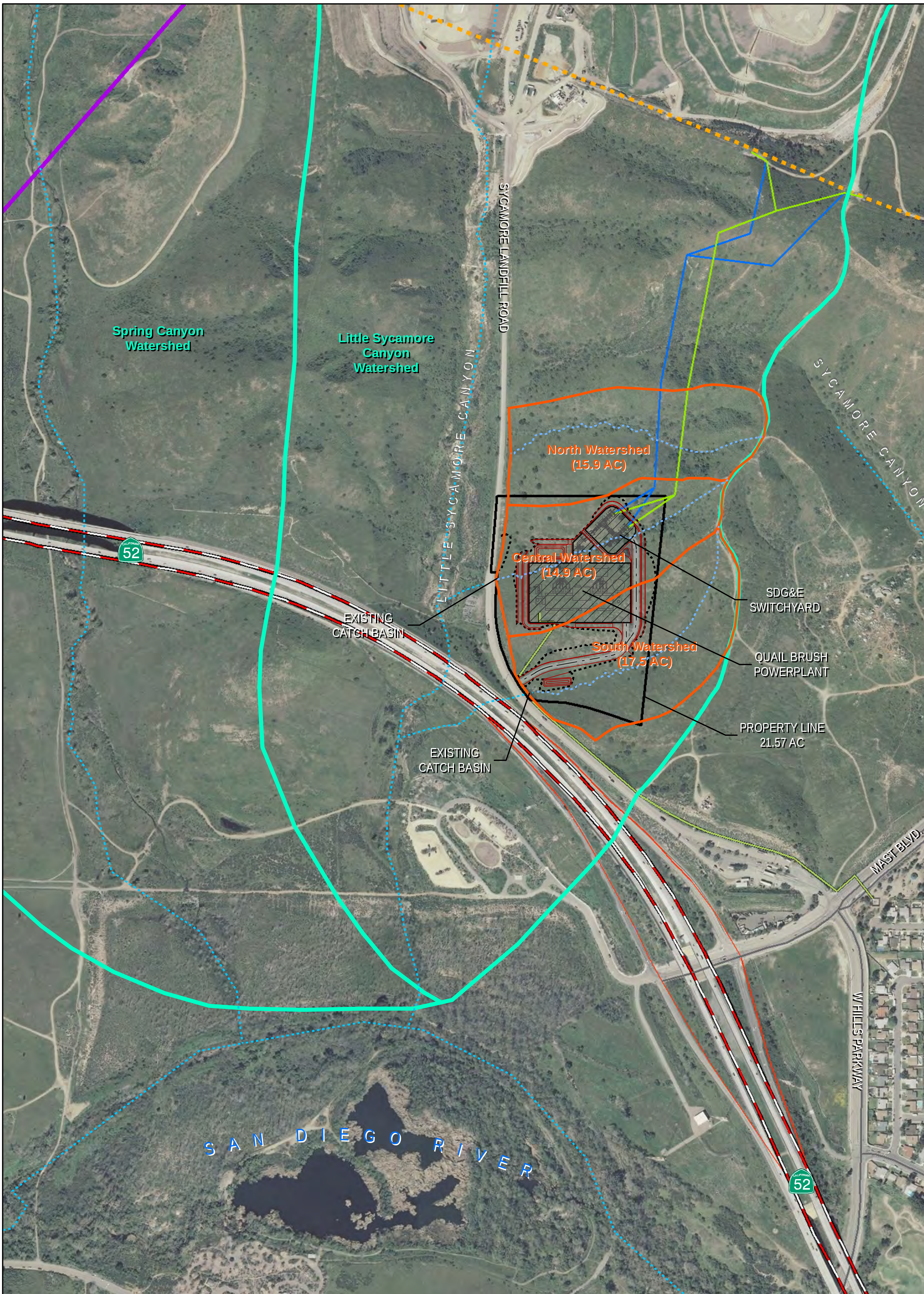

Local Watershed Boundary
Watershed Boundary
Drainage Watercourse
SDG&E Switchyard and QB Power Plant
Limits of Grading
Retaining Walls
Access Road Centerline
Access Road
Project Boundary
Plant Site and SDG&E Switchyard
Proposed SDG&E 138 kV Loop
Alternative 1 SDG&E 138 kV Loop
Existing 138 kV T-Line
Proposed Gas Lateral
Existing SDG&E 230 kV T-Lines (2)

Cogentrix

QUAIL BRUSH GENERATION PROJECT

FIGURE 1-1
PROJECT VICINITY MAP

0 250 500 1,000
Feet

TETRA TECH EC, INC.

ATTACHMENT A
Rational Method Runoff Coefficient References

Attachment A

Figure 819.2A

Runoff Coefficients for Undeveloped Areas

Watershed Types

	Extreme	High	Normal	Low
Relief	.28 -.35 Steep, rugged terrain with average slopes above 30%	.20 -.28 Hilly, with average slopes of 10 to 30%	.14 -.20 Rolling, with average slopes of 5 to 10%	.08 -.14 Relatively flat land, with average slopes of 0 to 5%
Soil Infiltration	.12 -.16 No effective soil cover, either rock or thin soil mantle of negligible infiltration capacity	.08 -.12 Slow to take up water, clay or shallow loam soils of low infiltration capacity, imperfectly or poorly drained	.06 -.08 Normal; well drained light or medium textured soils, sandy loams, silt and silt loams	.04 -.06 High; deep sand or other soil that takes up water readily, very light well drained soils
Vegetal Cover	.12 -.16 No effective plant cover, bare or very sparse cover	.08 -.12 Poor to fair; clean cultivation crops, or poor natural cover, less than 20% of drainage area over good cover	.06 -.08 Fair to good; about 50% of area in good grassland or woodland, not more than 50% of area in cultivated crops	.04 -.06 Good to excellent; about 90% of drainage area in good grassland, woodland or equivalent cover
Surface Storage	.10 -.12 Negligible surface depression few and shallow; drainageways steep and small, no marshes	.08 -.10 Low; well defined system of small drainageways; no ponds or marshes	.06 -.08 Normal; considerable surface depression storage; lakes and pond marshes	.04 -.06 High; surface storage, high; drainage system not sharply defined; large flood plain storage or large number of ponds or marshes

Given An undeveloped watershed consisting of;
1) rolling terrain with average slopes of 5%,
2) clay type soils,
3) good grassland area, and
4) normal surface depressions.

Solution:

Relief	0.14
Soil Infiltration	0.08
Vegetal Cover	0.04
Surface Storage	<u>0.06</u>
C=	0.32

Find The runoff coefficient, C, for the above watershed.

Caltrans. 2010. California Department of Transportation Highway Design Manual, Chapter 810 Hydrology, Figure 819.2A and Table 819.2B. Available at: http://www.dot.ca.gov/hq/oppd/hdm/pdf/english/chp0810.pdf

Table 819.2B

Runoff Coefficients for Developed Areas

Type of Drainage Area	Runoff Coefficient
Business:	
Downtown areas	0.70 - 0.95
Neighborhood areas	0.50 - 0.70
Residential:	
Single-family areas	0.30 - 0.50
Multi-units, detached	0.40 - 0.60
Multi-units, attached	0.60 - 0.75
Suburban	0.25 - 0.40
Apartment dwelling areas	0.50 - 0.70
Industrial:	
Light areas	0.50 - 0.80
Heavy areas	0.60 - 0.90
Parks, cemeteries:	0.10 - 0.25
Playgrounds:	0.20 - 0.40
Railroad yard areas:	0.20 - 0.40
Unimproved areas:	0.10 - 0.30
Lawns:	
Sandy soil, flat, 2%	0.05 - 0.10
Sandy soil, average, 2-7%	0.10 - 0.15
Sandy soil, steep, 7%	0.15 - 0.20
Heavy soil, flat, 2%	0.13 - 0.17
Heavy soil, average, 2-7%	0.18 - 0.25
Heavy soil, steep, 7%	0.25 - 0.35
Streets:	
Asphaltic	0.70 - 0.95
Concrete	0.80 - 0.95
Brick	0.70 - 0.85
Drives and walks	0.75 - 0.85
Roofs:	0.75 - 0.95

Frequency of Floods in California" published in June, 1977 by the U.S. Department of the Interior, Geological Survey.

The Regional Flood-Frequency equations are applicable only to sites within the flood-frequency regions for which they were derived and on streams with virtually natural flows. For example, the equations are not generally applicable to small basins on the floor of the Sacramento and San Joaquin Valleys as the annual peak data which are the basis for the regression analysis were obtained principally in the adjacent mountain and foothill areas. Likewise, the equations are not directly applicable to streams in urban areas affected substantially by urban development. In urban areas the equations may be used to estimate peak discharge values under natural conditions and then by use of the techniques described in the publication or HDS No. 2, adjust the discharge values to compensate for urbanization. Further limitations on the use of USGS Regional Flood-Frequency equations are:

Region	Drainage Area (A) mi^2	Mean Annual Precip (P) in	Altitude Index (H) 1000 ft
(1)North Coast	0.2-3000	19-104	0.2-5.7
Northeast	0.2-25	all	all
Sierra	0.2-9000	7-85	0.1-9.7
Central Coast	0.2-4000	8-52	0.1-2.4
South Coast	0.2-600	7-40	all
(2)South Lahontan-Colorado Desert	0.2-90	all	all

Notes:
(1) In the North Coast region use a minimum value of 1 for altitude index (H)
(2) Use upper limit of 25 square miles

A method for directly estimating design discharges for some gaged and ungaged streams is also provided in HDS No. 2. The

Caltrans. 2010. California Department of Transportation Highway Design Manual, Chapter 810 Hydrology, Figure 819.2A and Table 819.2B. Available at: http://www.dot.ca.gov/hq/oppd/hdm/pdf/english/chp0810.pdf

TABLE 7–9 Runoff Coefficients for the Rational Formula versus Hydrologic Soil Group (A, B, C, D) and Slope Range

	A			B			C			D		
Land Use	0–2%	2–6%	6%+	0–2%	2–6%	6%+	0–2%	2–6%	6%+	0–2%	2–6%	6%+
Cultivated land	0.08[a]	0.13	0.16	0.11	0.15	0.21	0.14	0.19	0.26	0.18	0.23	0.31
	0.14[b]	0.18	0.22	0.16	0.21	0.28	0.20	0.25	0.34	0.24	0.29	0.41
Pasture	0.12	0.20	0.30	0.18	0.28	0.37	0.24	0.34	0.44	0.30	0.40	0.50
	0.15	0.25	0.37	0.23	0.34	0.45	0.30	0.42	0.52	0.37	0.50	0.62
Meadow	0.10	0.16	0.25	0.14	0.22	0.30	0.20	0.28	0.36	0.24	0.30	0.40
	0.14	0.22	0.30	0.20	0.28	0.37	0.26	0.35	0.44	0.30	0.40	0.50
Forest	0.05	0.08	0.11	0.08	0.11	0.14	0.10	0.13	0.16	0.12	0.16	0.20
	0.08	0.11	0.14	0.10	0.14	0.18	0.12	0.16	0.20	0.15	0.20	0.25
Residential lot	0.25	0.28	0.31	0.27	0.30	0.35	0.30	0.33	0.38	0.33	0.36	0.42
size 1/8 acre	0.33	0.37	0.40	0.35	0.39	0.44	0.38	0.42	0.49	0.41	0.45	0.54
Residential lot	0.22	0.26	0.29	0.24	0.29	0.33	0.27	0.31	0.36	0.30	0.34	0.40
size 1/4 acre	0.30	0.34	0.37	0.33	0.37	0.42	0.36	0.40	0.47	0.38	0.42	0.52
Residential lot	0.19	0.23	0.26	0.22	0.26	0.30	0.25	0.29	0.34	0.28	0.32	0.39
size 1/3 acre	0.28	0.32	0.35	0.30	0.35	0.39	0.33	0.38	0.45	0.36	0.40	0.50
Residential lot	0.16	0.20	0.24	0.19	0.23	0.28	0.22	0.27	0.32	0.26	0.30	0.37
size 1/2 acre	0.25	0.29	0.32	0.28	0.32	0.36	0.31	0.35	0.42	0.34	0.38	0.48
Residential lot	0.14	0.19	0.22	0.17	0.21	0.26	0.20	0.25	0.31	0.24	0.29	0.35
size 1 acre	0.22	0.26	0.29	0.24	0.28	0.34	0.28	0.32	0.40	0.31	0.35	0.46
Industrial	0.67	0.68	0.68	0.68	0.68	0.69	0.68	0.69	0.69	0.69	0.69	0.70
	0.85	0.85	0.86	0.85	0.86	0.86	0.86	0.86	0.87	0.86	0.86	0.88
Commercial	0.71	0.71	0.72	0.71	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72
	0.88	0.88	0.89	0.89	0.89	0.89	0.89	0.89	0.90	0.89	0.89	0.90
Streets	0.70	0.71	0.72	0.71	0.72	0.74	0.72	0.73	0.76	0.73	0.75	0.78
	0.76	0.77	0.79	0.80	0.82	0.84	0.84	0.85	0.89	0.89	0.91	0.95
Open space	0.05	0.10	0.14	0.08	0.13	0.19	0.12	0.17	0.24	0.16	0.21	0.28
	0.11	0.16	0.20	0.14	0.19	0.26	0.18	0.23	0.32	0.22	0.27	0.39
Parking	0.85	0.86	0.87	0.85	0.86	0.87	0.85	0.86	0.87	0.85	0.86	0.87
	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97	0.95	0.96	0.97

[a] Runoff coefficients for storm recurrence intervals less than 25 years.

[b] Runoff coefficients for storm recurrence intervals of 25 years or longer.

problem with tables such as Table 7–10 is that for each land use a range of values is provided. This can lead to inconsistency in application. As a general rule, the mean of the range should be used unless a different value can be fully justified. It would be improper for a low value to be selected to reduce the size and therefore the cost of the drainage system.

A primary use of the Rational Method has been for design problems for small urban areas such as the sizing of inlets and culverts, which are characterized by small drainage areas and short times of concentration. For such designs, short-duration storms are critical, which is why the time of concentration is used as the input duration for obtaining i from the intensity-duration-frequency curve. If the storm duration occurs at a constant rate i and uniformly over the entire watershed, the volume of rainfall would equal iAt_c, which would have units of acre-inches

TABLE 7–10 Runoff Coefficients for the Rational Method

Description of Area	Range of Runoff Coefficients	Recommended Value*
Business		
Downtown	0.70–0.95	0.85
Neighborhood	0.50–0.70	0.60
Residential		
Single-family	0.30–0.50	0.40
Multiunits, detached	0.40–0.60	0.50
Multiunits, attached	0.60–0.75	0.70
Residential (suburban)	0.25–0.40	0.35
Apartment	0.50–0.70	0.60
Industrial		
Light	0.50–0.80	0.65
Heavy	0.60–0.90	0.75
Parks, cemeteries	0.10–0.25	0.20
Playgrounds	0.20–0.35	0.30
Railroad yard	0.20–0.35	0.30
Unimproved	0.10–0.30	0.20

It is often desirable to develop a composite runoff coefficient based on the percentage of different types of surface in the drainage area. This procedure often is applied to typical "sample" block as a guide to selection of reasonable values of the coefficient for an entire area. Coefficients with respect to surface type currently in use are listed below.

Character of Surface	Range of Runoff Coefficients	Recommended Value*
Pavement		
Asphaltic and Concrete	0.70–0.95	0.85
Brick	0.75–0.85	0.80
Roofs	0.75–0.95	0.85
Lawns, sandy soil		
Flat, 2%	0.05–0.10	0.08
Average, 2 to 7%	0.10–0.15	0.13
Steep, 7%	0.15–0.20	0.18
Lawns, heavy soil		
Flat, 2%	0.13–0.17	0.15
Average, 2 to 7%	0.18–0.22	0.20
Steep, 7%	0.25–0.35	0.30

The coefficients in these two tabulations are applicable for storms of 5- to 10-year frequencies. Less frequent, higher intensity storms will require the use of higher coefficients because infiltration and other losses have a proportionally smaller effect on runoff. The coefficients are based on the assumption that the design storm does not occur when the ground surface is frozen.

*Recommended value not included in original source.

Source: Design and Construction of Sanitary and Storm Sewers, American Society of Civil Engineers, New York, p. 332, 1969.

McCuen, Richard H. 1998. Hydrologic Analysis and Design 2nd Edition, Chapter 7 Peak Discharge Estimation, Section 7.6 Rational Method, Tables 7-9 and 7-10.

Attachment A

ATTACHMENT B

Preliminary Post-Development Subarea Weighted Runoff Coefficient Analysis for Disturbed Areas Only

Attachment B

TETRA TECH EC,INC

CLIENT:	Cogentrix	MADE BY: GPH	DATE: 10/29/2012
JOB TITLE:	Quail Brush Generation Project	CHECKED: WLS	JOB # : 106-4346
SUBJECT:	Prelim. Watershed Hydrology Analysis - Rational Method	APPROVED: WLS	SHEET: 1 of 1

Quail Brush Site - Preliminary Post-Development Subarea Weighted Runoff Coefficient Analysis (Disturbed Areas Only):

The watershed characteristics were estimated utilizing GIS, AutoCAD and Civil3D.
The runoff coefficient for undeveloped areas was conservatively estimated utilizing the CALTRANS Highway Design Manual.
The runoff coefficients for developed areas were conservatively estimated from Hydrologic Analysis and Design, McCuen 1998.

Subarea	Area Description	A (ft^2)	*a (ft^2)*	A (ac)	*a (ac)*	C	A*C	Reference for C
C02	Landscaped Slope/Retaining Walls	11,900		0.27		0.44	0.12	McCuen, Tbl. 7-9
C03	Developed SDGE Switch Yard	57,550		1.32		0.69	0.91	Weighted Analysis
C03-A	*Developed SDGE- Pavement*		*10,691*		*0.25*	0.85		McCuen, Tbl. 7-10
C03-B	*Developed SDGE- Gravel*		*30,312*		*0.70*	0.75		Caltrans, Tbl. 819.2B
C03-C	*Developed SDGE- Landscaped*		*15,401*		*0.35*	0.44		McCuen, Tbl. 7-9
C03-D	*Developed SDGE - Building*		*1,146*		*0.03*	0.85		McCuen, Tbl. 7-10
C04	Landscaped/Drainage Area	10,787		0.25		0.44	0.11	McCuen, Tbl. 7-9
C05	Developed Plant Site - Northeast	48,949		1.12		0.70	0.78	Weighted Analysis
C05-A	*Developed Plant - Pavement*		*10,020*		*0.23*	0.85		McCuen, Tbl. 7-10
C05-B	*Developed Plant - Gravel*		*18,334*		*0.42*	0.75		Caltrans, Tbl. 819.2B
C05-C	*Developed Plant - Landscaped*		*5,878*		*0.13*	0.44		McCuen, Tbl. 7-9
C05-D	*Developed Plant - Miscellaneous*		*10,988*		*0.25*	0.85		McCuen, Tbl. 7-10
C05-E	*Developed Plant - Contained*		*3,729*		*0.09*	0.00		Containment
C06	Developed Plant Site - Northwest	55,271		1.27		0.64	0.81	Weighted Analysis
C06-A	*Developed Plant - Pavement*		*11,300*		*0.26*	0.85		McCuen, Tbl. 7-10
C06-B	*Developed Plant - Gravel*		*20,795*		*0.48*	0.75		Caltrans, Tbl. 819.2B
C06-C	*Developed Plant - Landscaped*		*4,772*		*0.11*	0.44		McCuen, Tbl. 7-9
C06-D	*Developed Plant - Miscellaneous*		*9,338*		*0.21*	0.85		McCuen, Tbl. 7-10
C06-E	*Developed Plant - Contained*		*9,066*		*0.21*	0.00		Containment
C07	Developed Plant Switch Yard	13,365		0.31		0.75	0.23	Weighted Analysis
C07-A	*Developed Plant - Pavement*		*392*		*0.01*	0.85		McCuen, Tbl. 7-10
C07-B	*Developed Plant - Gravel*		*12,806*		*0.29*	0.75		Caltrans, Tbl. 819.2B
C07-C	*Developed Plant - Building*		*167*		*0.00*	0.85		McCuen, Tbl. 7-10
C08	Landscaped/Walls/Pond/Drainage	32,231		0.74		0.44	0.33	Weighted Analysis
C08-A	*Landscaped Slope/Walls/Pond*		*22,476*		*0.52*	0.44		McCuen, Tbl. 7-9
C08-B	*Landscaped Slope/Drainage*		*9,755*		*0.22*	0.44		McCuen, Tbl. 7-9
C09	Developed Plant Site - Main Buildings	29,583		0.68		0.85	0.58	McCuen, Tbl. 7-10
C10	Landscaped Slope/Retaining Walls	15,948		0.37		0.44	0.16	McCuen, Tbl. 7-9
C11	Landscaped Slope/Retaining Walls	22,032		0.51		0.44	0.22	McCuen, Tbl. 7-9
Total	**Central Watershed**	**297,616**		**6.8**		**0.62**	**4.25**	**Weighted Analysis**

Subarea	Area Description	A (ft^2)	*a (ft^2)*	A (ac)	*a (ac)*	C	A*C	Reference for C
S02	Landscaped Slope/Retaining Walls	14,455		0.33		0.44	0.15	McCuen, Tbl. 7-9
S03	Access Road/Retaining Walls	22,417		0.51		0.64	0.33	Weighted Analysis
S03-A	*Access Road Pavement*		*11,202*		*0.26*	0.85		McCuen, Tbl. 7-10
S03-B	*Landscaped Slope/Retaining Walls*		*11,215*		*0.26*	0.44		McCuen, Tbl. 7-9
S04	Developed Plant Site - South	44,134		1.01		0.76	0.77	Weighted Analysis
S04-A	*Developed Plant - Pavement*		*20,079*		*0.46*	*0.85*		McCuen, Tbl. 7-10
S04-B	*Developed Plant - Gravel*		*10,442*		*0.24*	*0.75*		Caltrans, Tbl. 819.2B
S04-C	*Developed Plant - Landscaped*		*6,832*		*0.16*	0.44		McCuen, Tbl. 7-9
S04-D	*Developed Plant - Miscellaneous*		*6,780*		*0.16*	*0.85*		McCuen, Tbl. 7-10
S05	Landscaped Area/Retaining Walls	8,774		0.20		0.44	0.09	McCuen, Tbl. 7-9
S06	Access Road/Retaining Walls	17,639		0.40		0.64	0.26	Weighted Analysis
S06-A	*Access Road Pavement*		*8,408*		*0.19*	0.85		McCuen, Tbl. 7-10
S06-B	*Landscaped Slope/Retaining Walls*		*9,232*		*0.21*	0.44		McCuen, Tbl. 7-9
S07	Access Road/Retaining Walls/Pond	32,798		0.75		0.55	0.41	Weighted Analysis
S07-A	*Access Road Pavement*		*8,474*		*0.19*	0.85		McCuen, Tbl. 7-10
S07-B	*Landscaped Slope/Retaining Walls*		*24,325*		*0.56*	0.44		McCuen, Tbl. 7-9
S08	Access Road/Retaining Walls	7,083		0.16		0.63	0.10	Weighted Analysis
S08-A	*Access Road Pavement*		*3,270*		*0.08*	*0.85*		McCuen, Tbl. 7-10
S08-B	*Landscaped Slope/Retaining Walls*		*3,813*		*0.09*	0.44		McCuen, Tbl. 7-9
Total	**South Watershed**	**147,300**		**3.4**		**0.62**	**2.11**	**Weighted Analysis**