APPENDIX 7C

Storm Drain Calculations

CH2MHILL
Lockwood Greene

EDISON
MISSION ENERGY
An *EDISON INTERNATIONAL* Company

SUN VALLEY SIMPLE CYCLE

STORM DRAIN CALCULATIONS

Lockwood Greene

Project number: 050-025482.00

CH2MHILL
Lockwood Greene

Preliminary
(to be verified in final design)

Edison Mission Energy, Sun Valley, CA.

Storm drainage, Rational Method

Design Criteria:

Rainfall Intensity: 25 yr, 5 min Storm Event
Tc = 5 min
i = 4.23 in/hr (Based on the IDF curve, from NOAA Atlas 14)

$$Q = CiA$$

Units:

Q = CFS

C = see table 3. (Recommended Runoff Coefficient)

i = 4.33 in/hr

A= see drawing. CSK – 1 Drainage Areas

Pipe:

A.D.S. N12 Corrugated HDPE Pipe with smooth interior.

Manning Coefficient:

N = .012 (From Table 4)

EDISON MISSION ENERGY, - ROMOLAND, CA.
STORM DRAINAGE RUNOFF (POST DEVELOPMENT)

Preliminary
(to be verified in final design)

Computed by JGY
Checked by DEM
Date 9/16/2005

DRAINAGE AREA	TYPE OF SURFACE	AREA	AREA (ACRES)	COEFFICIENT ©	I (25yr) (in/hr)	Q (25yr) (cfs)	Q'(25yr) (cfs) LINE TOTAL	BRANCH TOTAL	Q CUM (cfs)	PIPE SIZE, SLOPE, & CAPACITY AT THE INLET
A1	ASPHALT	9084.22	0.209	0.8	4.23	0.71				
	CONCRETE	904.59	0.021	0.9	4.23	0.08				
	EQUIPMENT	18666.64	0.429	1	4.23	1.81				
	GRAVEL/GRASS	101191.77	2.323	0.2	4.23	1.97	4.56			15" HDPE @ 0.75% Q = 6.06 cfs
								4.56		
									4.56	15" HDPE @ 0.75% Q = 6.06 cfs
A2-1	ASPHALT	7643.02	0.175	0.8	4.23	0.59				
	CONCRETE	3445.11	0.079	0.9	4.23	0.30				
	EQUIPMENT	10210.66	0.234	1	4.23	0.99				
	GRAVEL/GRASS	42342.39	0.972	0.2	4.23	0.82	2.71			12" HDPE @ 0.75% Q = 3.34 cfs
A2-2	ASPHALT	7643.02	0.175	0.8	4.23	0.59				
	CONCRETE	3445.11	0.079	0.9	4.23	0.30				
	EQUIPMENT	10210.66	0.234	1	4.23	0.99				
	GRAVEL/GRASS	42342.39	0.972	0.2	4.23	0.82	2.71			12" HDPE @ 0.75% Q = 3.34 cfs
								5.42		15" HDPE @ 0.75% Q = 6.06 cfs
									9.98	
A2-3	ASPHALT	7643.02	0.175	0.8	4.23	0.59				
	CONCRETE	3445.11	0.079	0.9	4.23	0.30				
	EQUIPMENT	10210.66	0.234	1	4.23	0.99				
	GRAVEL/GRASS	42342.39	0.972	0.2	4.23	0.82	2.71			12" HDPE @ 0.75% Q = 3.34 cfs
A2-4	ASPHALT	7643.02	0.175	0.8	4.23	0.59				
	CONCRETE	3445.11	0.079	0.9	4.23	0.30				
	EQUIPMENT	10210.66	0.234	1	4.23	0.99				
	GRAVEL/GRASS	42342.39	0.972	0.2	4.23	0.82	2.71			12" HDPE @ 0.75% Q = 3.34 cfs
								5.42		15" HDPE @ 0.75% Q = 6.06 cfs
									15.40	
A3	ASPHALT	8431.5	0.194	0.8	4.23	0.66				
	CONCRETE	2540.52	0.058	0.9	4.23	0.22				
	EQUIPMENT	3582.2	0.082	1	4.23	0.35				
	GRAVEL/GRASS	49086.96	1.127	0.2	4.23	0.95	2.18			12" HDPE @ 0.75% Q = 3.334 cfs
								2.18		15" HDPE @ 0.75% Q = 6.06 cfs
									17.58	
A4	ASPHALT	0	0.000	0.8	4.23	0.00				
	CONCRETE	5400	0.124	0.9	4.23	0.47				
	EQUIPMENT	8452.36	0.194	1	4.23	0.82				
	GRAVEL/GRASS	122804.61	2.819	0.2	4.23	2.39	3.68			
								3.68		SHEET FLOW INTO DITCH
									21.25	
A5	ASPHALT	0	0.000	0.8	4.23	0.00				
	CONCRETE	7200	0.165	0.9	4.23	0.63				
	EQUIPMENT	0	0.000	1	4.23	0.00				
	GRAVEL/GRASS	84376.35	1.937	0.2	4.23	1.64	2.27			
								2.27		SHEET FLOW INTO DITCH
									23.52	
A6	ASPHALT	0	0.000	0.8	4.23	0.00				
	CONCRETE	0	0.000	0.9	4.23	0.00				
	EQUIPMENT	0	0.000	1	4.23	0.00				
	GRAVEL/GRASS	77282.99	1.774	0.2	4.23	1.50	1.50			
								1.50		SHEET FLOW INTO DITCH
TOTAL			**17.29957369**						**25.02**	

PRELIMINARY
(to be verified in final design)

EME - SUN VALLEY
Romoland, California

Job No.	023482.01
Sheet No.	1 of 2
Date	15-Sep-05
Computed By	D. MICKANEN
Checked By	J. GARCIA

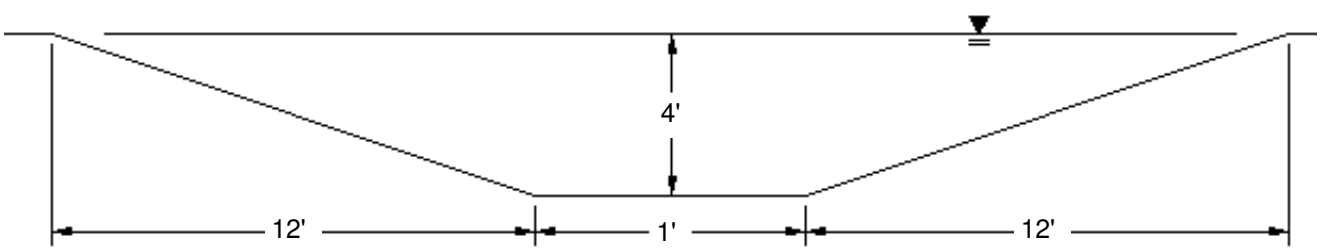
Hydraulics: Manning's Equation

$Q=1.49/n*A*(R_H)^{2/3}*S^{1/2}$

Where:
Q = flow rate, cfs (ft^3/s)
n = Manning's roughness coefficient. It is 0.025 for natural channels in good condition.
A = cross-sectional area of ditch in flow (ft^2)
R_H = hydraulic radius, cross-sectional area divided by wetteed perimeter, (ft)
S = slope of energy grade line, equal to the slope of the ditch bottom, (ft/ft)
P = wetted perimeter (ft)

Capacity Calculation for Perimeter Drainage Ditch

1. Drainage ditch will be designed for post-development storm runoff flows using rational method flows.
2. Based on Rational Method calculations for 25-yr storm, design ditch for a minimum peak flow (QP) of 25 cfs.
2. Assume new ditch will be constructed of native/earth materials and will be in good condition.
3. Assume trapazoidal shape ditch with 3:1 side slopes (horizontal:vertical).
4. Assume ditch constant slope of 0.005.
5. Assume ditch flows full.
6.



A = 1/2*h*(w+b) = 1/2 * (4 ft) * (25 ft + 1 ft)
A = 52 ft^2

Where:

h =	4 ft
w =	25 ft
b =	1 ft

P = 2*SQRT[(12ft)^2 + (4ft)^2] + 1ft
P = 26 ft

R_H = A/P = 52 ft^2 / 26 ft
R_H = 2 ft

EME - SUN VALLEY

Romoland, California

Job No.	023482.01
Sheet No.	2 of 2
Date	15-Sep-05
Computed By	D. MICKANEN
Checked By	J. GARCIA

Capacity Calculation for West Ditch (cont.)

$$Q = V*A = 1.49/n * A*R_H^{2/3}*S^{1/2}$$

Where:

n =	0.025	
A =	52	ft^2
R_H =	2	ft
S =	0.005	ft/ft

Q = 1.49/0.025 * (52) * (2)^0.667 * (0.005)^0.5

Q =	**348 cfs**	**>>**	**Q_P =**	**25 cfs**	**OK**

POINT PRECIPITATION FREQUENCY ESTIMATES FROM NOAA ATLAS 14

California 33.603 N 117.056 W 2125 feet

from "Precipitation-Frequency Atlas of the United States" NOAA Atlas 14, Volume 1, Version 3
G.M. Bonnin, D. Todd, B. Lin, T. Parzybok, M.Yekta, and D. Riley
NOAA, National Weather Service, Silver Spring, Maryland, 2003

Extracted: Thu Sep 15 2005

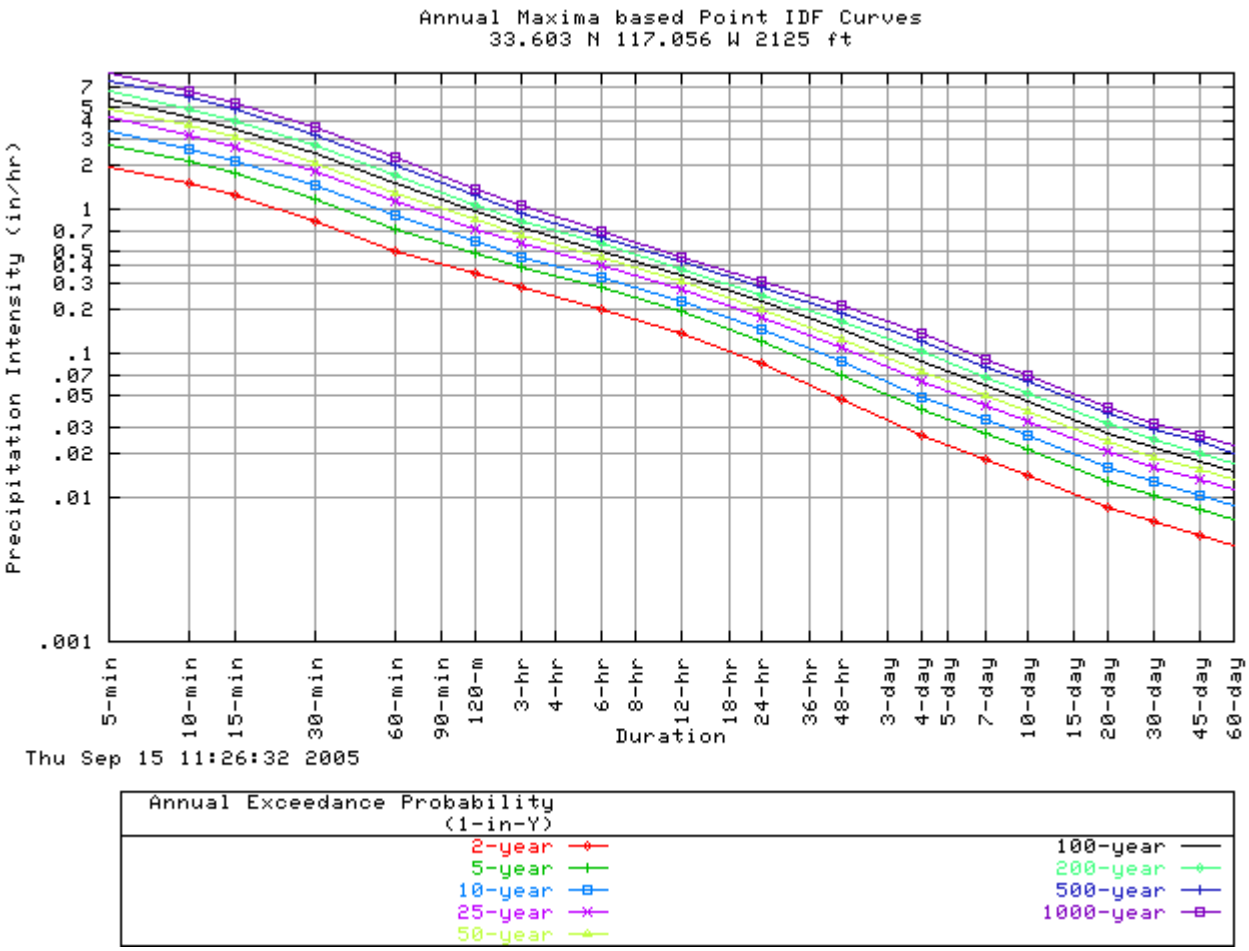
Confidence Limits | Seasonality | Location Maps | Other Info. | Grids | Maps | Help | Docs | U.S. Map

Precipitation Intensity Estimates (in/hr)

AEP* (1-in-Y)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
2	1.96	1.49	1.23	0.83	0.51	0.35	0.28	0.20	0.14	0.08	0.05	0.03	0.02	0.01	0.01	0.01	0.01	0.00
5	2.78	2.11	1.74	1.17	0.73	0.49	0.39	0.28	0.19	0.12	0.07	0.04	0.03	0.02	0.01	0.01	0.01	0.01
10	3.39	2.58	2.13	1.43	0.89	0.59	0.47	0.33	0.23	0.14	0.09	0.05	0.03	0.03	0.02	0.01	0.01	0.01
25	4.23	3.22	2.66	1.79	1.11	0.72	0.57	0.40	0.27	0.18	0.11	0.06	0.04	0.03	0.02	0.02	0.01	0.01
50	4.94	3.76	3.10	2.09	1.29	0.83	0.65	0.46	0.31	0.20	0.13	0.08	0.05	0.04	0.02	0.02	0.02	0.01
100	5.69	4.33	3.58	2.41	1.49	0.95	0.73	0.51	0.34	0.23	0.14	0.09	0.06	0.05	0.03	0.02	0.02	0.02
200	6.50	4.95	4.09	2.75	1.71	1.07	0.82	0.57	0.38	0.25	0.16	0.10	0.07	0.05	0.03	0.02	0.02	0.02
500	7.71	5.86	4.84	3.26	2.02	1.24	0.94	0.64	0.43	0.29	0.19	0.12	0.08	0.06	0.04	0.03	0.02	0.02
1000	8.68	6.60	5.46	3.68	2.27	1.38	1.04	0.70	0.46	0.32	0.21	0.14	0.09	0.07	0.04	0.03	0.03	0.02

Text version of table

* These precipitation frequency estimates are based on an annual maxima series. **AEP** is the Annual Exceedance Probability. Please refer to the documentation for more information. NOTE: Formatting forces estimates near zero to appear as zero.



Confidence Limits -

* Upper bound of the 90% confidence interval Precipitation Intensity Estimates (in/hr)																		
AEP** (1-in-Y)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
2	2.28	1.73	1.43	0.96	0.60	0.40	0.32	0.23	0.15	0.09	0.05	0.03	0.02	0.02	0.01	0.01	0.01	0.01
5	3.21	2.44	2.02	1.36	0.84	0.55	0.43	0.32	0.22	0.14	0.08	0.05	0.03	0.02	0.01	0.01	0.01	0.01
10	3.90	2.97	2.45	1.65	1.02	0.66	0.52	0.37	0.26	0.16	0.10	0.06	0.04	0.03	0.02	0.01	0.01	0.01
25	4.85	3.70	3.06	2.06	1.27	0.81	0.63	0.45	0.31	0.20	0.12	0.07	0.05	0.04	0.02	0.02	0.01	0.01
50	5.65	4.30	3.55	2.39	1.48	0.93	0.72	0.51	0.35	0.23	0.14	0.08	0.06	0.04	0.03	0.02	0.02	0.02
100	6.49	4.94	4.08	2.75	1.70	1.06	0.81	0.57	0.39	0.25	0.16	0.10	0.07	0.05	0.03	0.02	0.02	0.02
200	7.41	5.64	4.66	3.14	1.94	1.19	0.91	0.63	0.43	0.28	0.18	0.11	0.08	0.06	0.04	0.03	0.02	0.02
500	8.74	6.65	5.49	3.70	2.29	1.39	1.04	0.72	0.48	0.32	0.22	0.14	0.09	0.07	0.04	0.03	0.03	0.02
1000	9.81	7.47	6.17	4.16	2.57	1.54	1.15	0.78	0.52	0.35	0.24	0.16	0.10	0.08	0.05	0.04	0.03	0.03

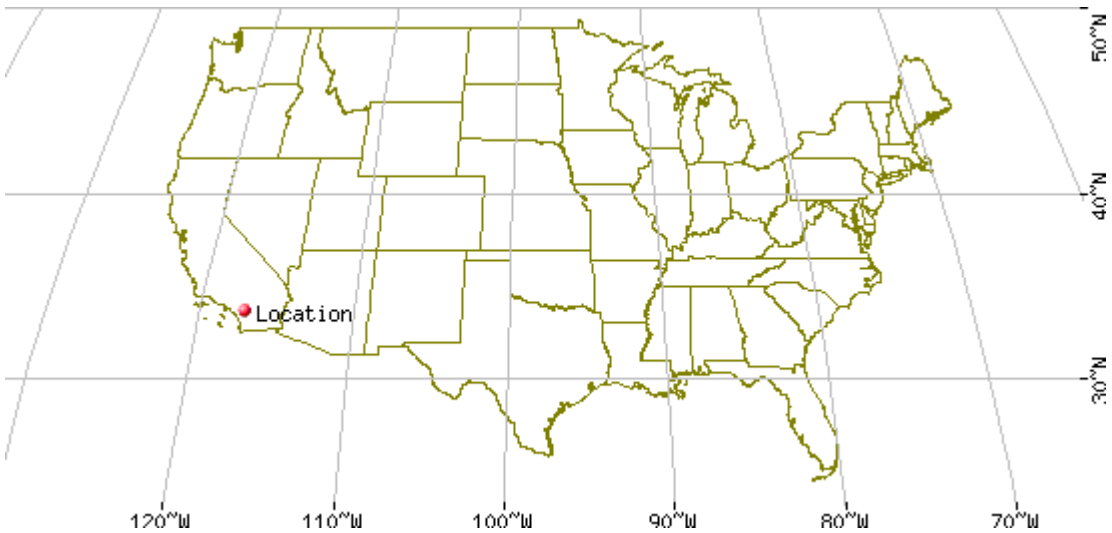
* The **upper** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **greater** than.
** These precipitation frequency estimates are based on an annual maxima series. **AEP** is the Annual Exceedance Probability.
Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

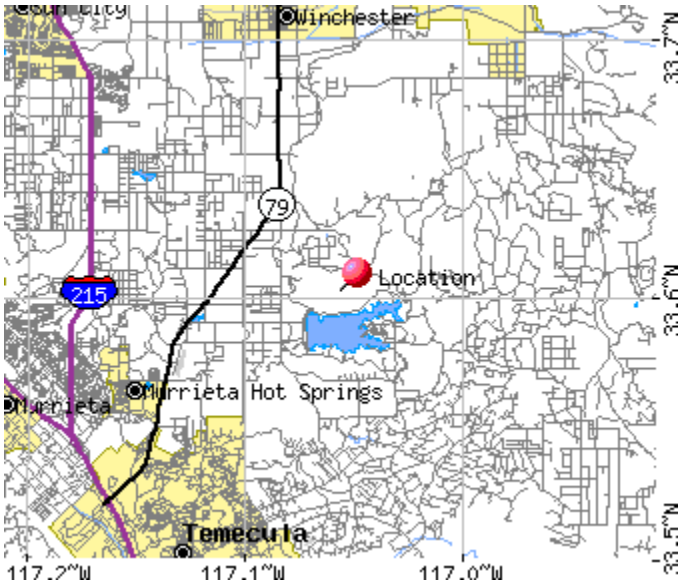
* Lower bound of the 90% confidence interval Precipitation Intensity Estimates (in/hr)																		
AEP** (1-in-Y)	5 min	10 min	15 min	30 min	60 min	120 min	3 hr	6 hr	12 hr	24 hr	48 hr	4 day	7 day	10 day	20 day	30 day	45 day	60 day
2	1.71	1.30	1.07	0.72	0.45	0.32	0.25	0.18	0.12	0.07	0.04	0.02	0.02	0.01	0.01	0.01	0.00	0.00
5	2.41	1.84	1.52	1.02	0.63	0.44	0.35	0.25	0.17	0.11	0.06	0.04	0.02	0.02	0.01	0.01	0.01	0.01
10	2.95	2.24	1.85	1.25	0.77	0.52	0.42	0.30	0.20	0.13	0.08	0.04	0.03	0.02	0.01	0.01	0.01	0.01
25	3.65	2.78	2.30	1.55	0.96	0.64	0.50	0.36	0.24	0.16	0.09	0.06	0.04	0.03	0.02	0.01	0.01	0.01
50	4.24	3.23	2.67	1.80	1.11	0.73	0.57	0.40	0.27	0.18	0.11	0.07	0.04	0.03	0.02	0.02	0.01	0.01
100	4.85	3.69	3.05	2.05	1.27	0.83	0.64	0.45	0.30	0.20	0.12	0.08	0.05	0.04	0.02	0.02	0.02	0.01
200	5.51	4.20	3.47	2.33	1.44	0.93	0.72	0.50	0.33	0.22	0.14	0.09	0.06	0.05	0.03	0.02	0.02	0.01
500	6.44	4.90	4.05	2.73	1.69	1.07	0.82	0.56	0.37	0.25	0.16	0.10	0.07	0.05	0.03	0.02	0.02	0.02
1000	7.18	5.47	4.52	3.04	1.88	1.18	0.89	0.61	0.40	0.27	0.18	0.11	0.08	0.06	0.04	0.03	0.02	0.02

* The **lower** bound of the confidence interval at 90% confidence level is the value which 5% of the simulated quantile values for a given frequency are **less** than.
** These precipitation frequency estimates are based on an annual maxima series. **AEP** is the Annual Exceedance Probability.

Please refer to the documentation for more information. NOTE: Formatting prevents estimates near zero to appear as zero.

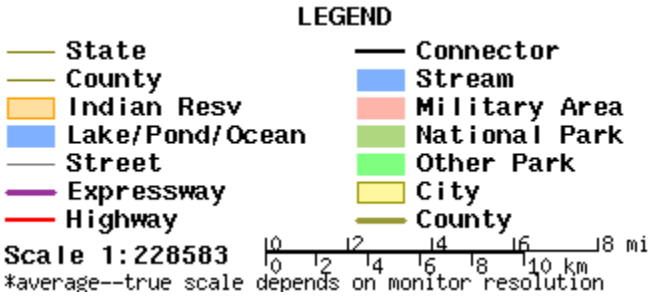
Maps -





These maps were produced using a direct map request from the U.S. Census Bureau Mapping and Cartographic Resources **Tiger Map Server**.

Please read disclaimer for more information.



Other Maps/Photographs -

View USGS digital orthophoto quadrangle (DOQ) covering this location from TerraServer; **USGS Aerial Photograph** may also be available from this site. A DOQ is a computer-generated image of an aerial photograph in which image displacement caused by terrain relief and camera tilts has been removed. It combines the image characteristics of a photograph with the geometric qualities of a map. Visit the USGS for more information.

Watershed/Stream Flow Information -

Find the Watershed for this location using the U.S. Environmental Protection Agency's site.

Climate Data Sources -

Precipitation frequency results are based on data from a variety of sources, but largely NCDC. The following links provide general information about observing sites in the area, regardless of if their data was used in this study. For detailed information about the stations used in this study, please refer to our documentation.

Using the **National Climatic Data Center's (NCDC)** station search engine, locate other climate stations within:

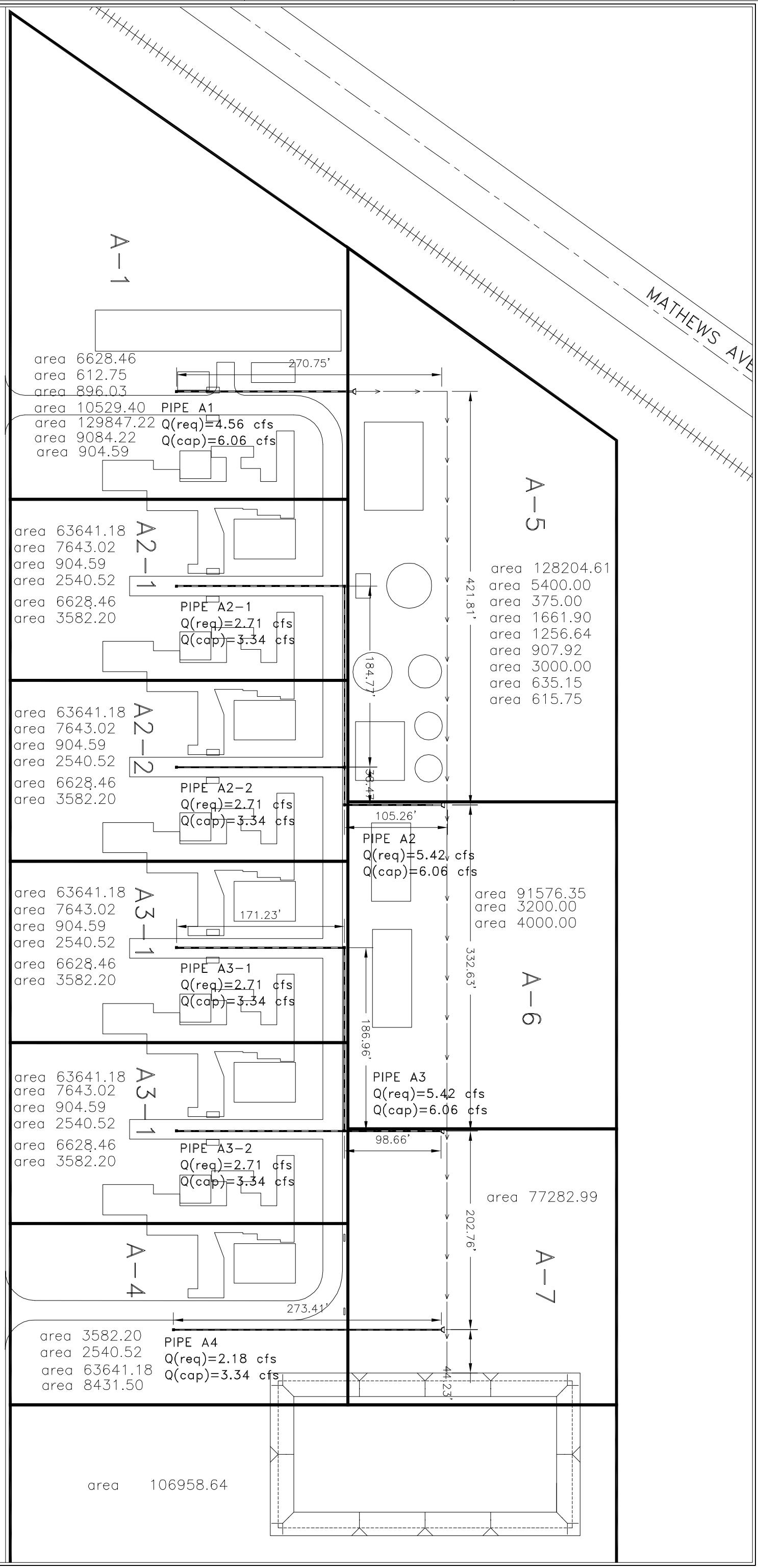
+/-30 minutes ...OR... +/-1 degree of this location (33.603/-117.056). Digital ASCII data can be obtained directly from **NCDC**.

Find Natural Resources Conservation Service (NRCS) SNOTEL (SNOwpack TELemetry) stations by visiting the **Western Regional Climate Center's state-specific SNOTEL station maps**.

Hydrometeorological Design Studies Center
DOC/NOAA/National Weather Service
1325 East-West Highway
Silver Spring, MD 20910

(301) 713-1669
Questions?: HDSC.Questions@noaa.gov

Disclaimer



NO	DATE	REVISION	BY	CK.	APPR.
A	16-SEP-05	PRELIMINARY ISSUE	JGY		

DESIGNED BY J. GARCIA
CHECKED BY
APPR. BY
CLIENT APPR.

CH2MHILL
Lockwood Greene
Atlanta, Georgia

SHEET TITLE
SUN VALLEY
DRAINAGE AREAS

JOB NAME

EDISON
MISSION ENERGY

PRELIMINARY ISSUE

JOB NO. 023482.00
FILENAME CSUNVLLY.DWG
SCALE 1"=50'-0"
REV. NO. A
DWG. NO. CSK-1

LGAD_3. ANSI D. 22 x 34 in.

RATIONAL METHOD

TABLE 3.4 Recommended Runoff Coefficients[a]

Description of Area	Runoff Coefficients
Business	
Downtown	0.70 to 0.95
Neighborhood	0.50 to 0.70
Residential	
Single-family	0.30 to 0.50
Multi-units, detached	0.40 to 0.60
Multi-units, attached	0.60 to 0.75
Residential (suburban)	0.25 to 0.40
Apartment	0.50 to 0.70
Industrial	
Light	0.50 to 0.80
Heavy	0.60 to 0.90
Parks, cemeteries	0.10 to 0.25
Playgrounds	0.20 to 0.35
Railroad yard	0.20 to 0.35
Unimproved	0.10 to 0.30

It often is desirable to develop a composite runoff based on the percentage of different types of surface in the drainage area. This procedure often is applied to typical "sample" blocks 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:

Character of Surface	Runoff Coefficients
Pavement	
Asphalt and Concrete	0.70 to 0.95
Brick	0.70 to 0.85
Roofs	0.75 to 0.95
Lawns, sandy soil	
Flat, 2 percent	0.13 to 0.17
Average, 2 to 7 percent	0.18 to 0.22
Steep, 7 percent	0.25 to 0.35

The coefficients in these two tabulations are applicable for storms of 5-to 10-yr 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.

Appendix A: Design Use Values of Manning's n

channel material	n
clean, uncoated cast iron	0.013–0.015
clean, coated cast iron	0.012–0.014
dirty, tuberculated cast iron	0.015–0.035
riveted steel	0.015–0.017
lock-bar and welded	0.012–0.013
galvanized iron	0.015–0.017
brass and glass	0.009–0.013
wood stave	
small diameter	0.011–0.012
large diameter	0.012–0.013
concrete	
with rough joints	0.016–0.017
dry mix, rough forms	0.015–0.016
wet mix, steel forms	0.012–0.014
very smooth, finished	0.011–0.012
vitrified sewer	0.013–0.015
common-clay drainage tile	0.012–0.014
asbestos	0.011
planed timber	0.011
canvas	0.012
unplaned timber	0.014
brick	0.016
rubble masonry	0.017
smooth earth	0.018
firm gravel	0.023
corrugated metal pipe	0.022
natural channels, good condition	0.025
natural channels with stones and weeds	0.035
very poor natural channels	0.060

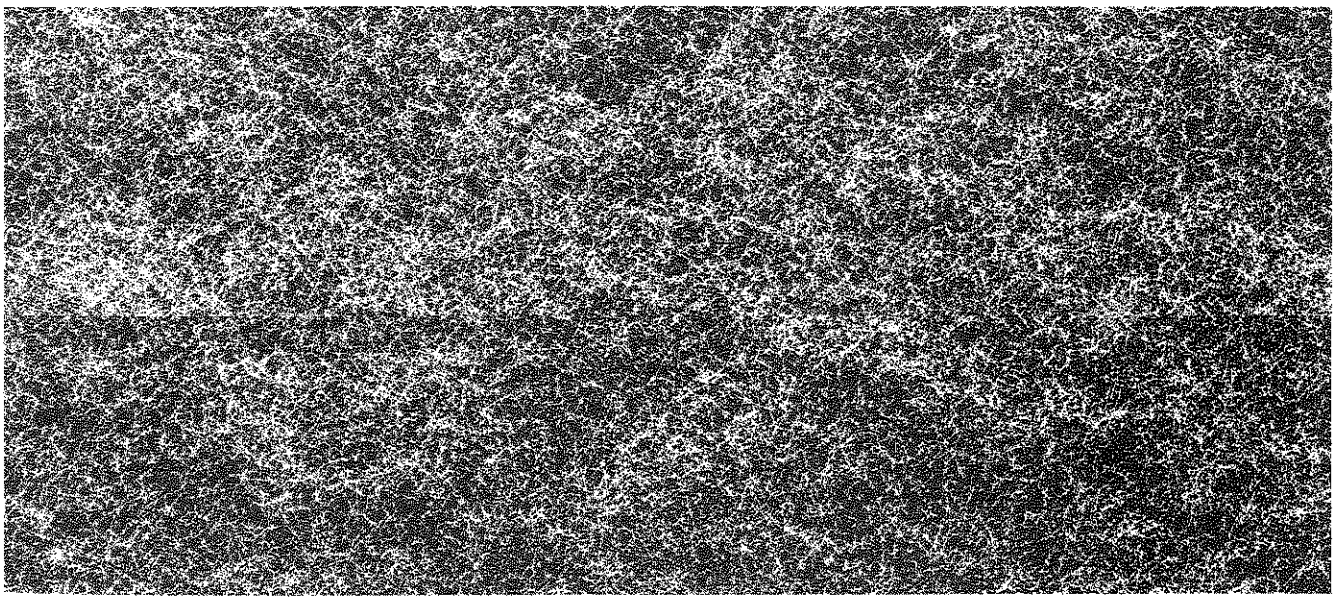


TABLE 4

CIRCULAR PIPE FLOW CAPACITY
Full Flow (cubic feet per second)

Mannings "n"= 0.012

Dia. (in.)	*Conv. Factor	% Slope (feet per 100 feet) 0.02	0.05	0.10	0.20	0.35	0.50	0.75	1.00	1.25	1.50	1.75	2.0	2.5	5.0	10.0	20.0
		(c.f.s.)															
3	0.957	0.014	0.021	0.030	0.043	0.057	0.068	0.083	0.096	0.107	0.12	0.13	0.14	0.15	0.21	0.30	0.43
4	2.062	0.029	0.046	0.065	0.092	0.122	0.146	0.179	0.206	0.231	0.25	0.27	0.29	0.33	0.46	0.65	0.92
5	3.738	0.053	0.084	0.118	0.167	0.221	0.264	0.324	0.374	0.418	0.46	0.49	0.53	0.59	0.84	1.18	1.67
6	6.079	0.086	0.136	0.192	0.272	0.360	0.430	0.526	0.608	0.680	0.74	0.80	0.86	0.96	1.36	1.92	2.72
8	13.091	0.185	0.293	0.414	0.585	0.774	0.926	1.134	1.309	1.464	1.60	1.73	1.85	2.07	2.93	4.14	5.85
10	23.74	0.34	0.53	0.75	1.06	1.40	1.68	2.06	2.37	2.65	2.91	3.14	3.36	3.75	5.31	7.51	10.61
12	38.60	0.55	0.86	1.22	1.73	2.28	2.73	3.34	3.86	4.32	4.73	5.11	5.46	6.10	8.63	12.21	17.26
15	69.98	0.99	1.56	2.21	3.13	4.14	4.95	6.06	7.00	7.82	8.57	9.26	9.90	11.06	15.65	22.13	31.30
18	113.80	1.61	2.54	3.60	5.09	6.73	8.05	9.86	11.38	12.72	13.94	15.05	16.09	17.99	25.45	35.99	50.89
21	171.65	2.43	3.84	5.43	7.68	10.16	12.14	14.87	17.17	19.19	21.02	22.71	24.28	27.14	38.38	54.28	76.77
24	245.08	3.47	5.48	7.75	10.96	14.50	17.33	21.22	24.51	27.40	30.02	32.42	34.66	38.75	54.80	77.50	109.60
27	335.51	4.74	7.50	10.61	15.00	19.85	23.72	29.06	33.55	37.51	41.09	44.38	47.45	53.05	75.0	106.1	150.0
30	444.35	6.28	9.94	14.05	19.87	26.29	31.42	38.48	44.44	49.68	54.42	58.78	62.84	70.26	99.4	140.5	198.7
36	722.57	10.22	16.16	22.85	32.31	42.75	51.09	62.58	72.26	80.79	88.50	95.59	102.19	114.25	161.6	228.5	323.1
42	1089.9	15.41	24.37	34.47	48.74	64.5	77.1	94.4	109.0	121.9	133.5	144.2	154.1	172.3	243.7	344.7	487.4
48	1556.1	22.01	34.80	49.21	69.59	92.1	110.0	134.8	155.6	174.0	190.6	205.9	220.1	246.0	348.0	492.1	695.9

* Conveyance Factor = (1.486 x R2/3 x A) / n