DRAINAGE STUDY FOR

PROSPECT ESTATES II

TM2016-03

SANTEE, CALIFORNIA

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

I. PROJECT DESCRIPTION

This drainage report has been prepared to document the design and calculations for the proposed drainage system associated with the residential development of the Prospect Estates Phase II project in the City of Santee. The project site is 6.8 acres in size and is bounded on the north by vacant land (zoned residential), on the east by the Prospect Estates Phase 1 residential development, on the west by a mobile home development, and on the south by Prospect Avenue and residential uses. The site is mostly undeveloped with one existing house and some small out-buildings, and slopes from south to north at approximately a 5% grade. A portion of the site was partially graded and some storm drain inlets and cleanouts installed for the St. George Church project, approved in 2001.

The proposed design consists of 53 residential units, 38 multi-family attached units, and 15 single-family detached units. Vehicular access to the site is provided by two new streets connecting to Marrokal Lane. Access within the subdivision is via private streets. Parking is allowed on some streets, as well as in garages and most driveways.

II. HYDROLOGY / HYDRAULICS METHODOLOGY

This drainage system has been designed in general conformance with the City of Santee Department of Public Works "Public Works Standards" (Standards), and the County of San Diego Hydrology Manual (Manual). Drainage basins are less than one square mile, therefore, the Rational Method was utilized to calculate storm runoff. Runoff values for the 2-year, 10-year and 100-year storms were calculated, with the 100-year storm values being used to size the proposed inlets and pipes. Additionally:

- The runoff coefficients were calculated based on each drainage basin's percentage of impervious cover and the values from the "Runoff Coefficients for Urban Areas", Table 3-1 of the Manual (Soil Type 'D').
- Times of concentration for urban watersheds were calculated using either the "Overland Time of Flow Nomograph" (Figure 3-3 of the Manual), or the trial and error method using the "Gutter and Roadway Discharge – Velocity Chart", Figure 3-6 of the Manual.
- Times of concentration for natural watersheds were calculated using the "Nomograph for Determination of Time of Concentration for Natural Watersheds", Figure 3-4 of the Manual.
- The intensities of rainfall were obtained from the "Intensity – Duration Design Chart", Figure 3-1 of the Manual, for each of the selected storm frequencies (2, 10 & 100-year).
- Inlets were sized based on non-routed flow values using Table C, Table D and Table E of the Standards for curb inlets on grade and grated inlets in sumps, respectively.
- Manning's equation was used for pipe design and capacity analysis using routed 100-year storm values.

III. EXISTING CONDITION DRAINAGE

The site slopes from the south to the north, with a minimum elevation of 340 MSL along the northerly property line to 372 MSL in the southeast corner. The entire site drains via surface flow to the northerly property line, where it enters the property on the north. The runoff continues flowing to the north via surface flow to Mission Gorge Road, where it enters the public storm drain system, which flows under Mission Gorge Road and Highway 52 and into the San Diego River.

As shown in Figure 2, the Existing Condition Drainage area contains one on-site basin of 6.82 acres, which generates 7.69 cfs of 100-year storm runoff (See Appendix 1 for hydrological calculations and Table 1 for a hydrology summary). This runoff flows across the ground to the north, where it exits the property to the north.

Also shown in Figure 2 are several off-site basins that contribute flow to the project site. Basin EX-A conveys 0.66 cfs of 100-year storm flow onto the site along the southerly boundary. Basin EX-B conveys 1.80 cfs of 100-year storm flow onto the site along the easterly boundary. Basin EX-C conveys 0.61 cfs of 100-year storm flow onto the site along the easterly boundary. Basin EX-D conveys 0.30 cfs of 100-year storm flow onto the site in the southeast corner.

IV. PROPOSED CONDITION DRAINAGE

The Proposed Condition Drainage has been separated into 13 on-site drainage basins (see Figure 3). Basin A1 collects runoff from the southern portion of the project. This basin comprises 1.51 acres and generates 3.98 cfs of 100-year storm runoff. This runoff, together with the runoff from Basin EX-B, is collected in a new curb inlet and conveyed into the new private storm drain system in Street 'A', and ultimately discharges into the biofiltration basin in Lot 'A'.

Basin A2 collects runoff from the eastern portion of the site, totaling 0.78 acres. This basin generates 2.01 cfs of 100-year storm runoff which is collected in a new curb inlet and conveyed into the new private storm drain system in Street 'A'. The flow from this basin, together with the flow from Basins A1 and EX-B, is conveyed into the biofiltration area in Lot 'A'.

Basin A3 collects runoff from the central and western portion of the site and totals 0.77 acres. This basin generates 2.51 cfs of 100-year storm runoff that is captured in a new grated inlet and conveyed into the private storm drain system in Street 'C'. The storm drain system ultimately discharges into the biofiltration basin in Lot 'A'.

Basin A4 collects runoff from the central portion of the site, totaling 0.18 acres. This basin generates 0.38 cfs of 100-year storm runoff that is captured in a new grated inlet and conveyed into the private storm drain system in Street 'C', and ultimately discharges into the biofiltration basin in Lot 'A'.

Basin A5 collects runoff from the eastern portion of the site and totals 0.26 acres. This basin generates 0.46 cfs of 100-year storm runoff, and a new grated inlet captures this runoff and conveys it into the private storm drain system in Street ‘C’, and ultimately discharges into the biofiltration basin in Lot ‘A’.

Basin A6 collects runoff from the northeasterly portion of the site and totals 0.54 acres. This basin generates 1.44 cfs of 100-year storm runoff that is captured in a new grated inlet in Street ‘C’. The private storm drain system in Street ‘C’ conveys this runoff into the biofiltration basin in Lot ‘A’.

Basin A7 collects runoff from the north-central portion of the site and totals 0.30 acres. This basin generates 0.85 cfs of 100-year storm runoff that is captured in a new grated inlet in Street ‘C’. The private storm drain system in Street ‘C’ conveys this runoff into the biofiltration basin in Lot ‘A’.

Basin A8 collects runoff from the northwesterly portion of the site and totals 0.23 acres. This basin generates 0.84 cfs of 100-year storm runoff that is captured in a new grated inlet in Street ‘C’. The private storm drain system in Street ‘C’ conveys this runoff into the biofiltration basin in Lot ‘A’.

Basin B1 collects runoff along the northerly and easterly boundaries of the site, totaling 0.40 acres. This basin generates 0.63 cfs of 100-year storm runoff and is conveyed in a new PCC brow ditch with the runoff from Basin EX-C. This ditch travels to the north and then west, and ultimately discharges into the biofiltration basin in Lot ‘A’.

Basin C1 collects runoff from a small area along the east side of Marrokal Lane, totaling 0.10 acres. This basin generates 0.24 cfs of 100-year storm runoff, and collects this runoff in a new grated inlet. A private storm drain conveys this runoff into the biofiltration basin in Lot ‘A’.

Basin D1 collects runoff from the west side of Marrokal Lane, and totals 0.37 acres. This basin generates 1.98 cfs of 100-year storm runoff, and directs this runoff into a new curb inlet at the northwest corner of the project. The flow is then conveyed in a new private storm drain that discharges in the biofiltration basin in Lot ‘A’.

Basin D2 collects runoff from the east side of Marrokal Lane and the north side of Prospect Avenue, and totals 1.23 acres. This basin generates 2.94 cfs of 100-year storm runoff, and directs this runoff into a new curb inlet in Marrokal Lane west of Lot ‘A’. The flow is then conveyed with the flow from Basin D1 into the biofiltration basin in Lot ‘A’.

Basin E1 comprises the biofiltration area, and totals 0.13 acres. This basin generates 0.10 cfs of 100-year storm runoff, and together with the runoff from the other proposed condition basins, is captured in the underdrains within the biofiltration area.

Basin OFF-1 comprises the same area as Existing Condition Drainage Basin EX-A, but in the Proposed Condition is entirely impervious. This basin generates 0.90 cfs of 100-year storm runoff that flows in the northerly gutter of Prospect Avenue into Basin B1.

Basin OFF-2 comprises a similar area as Existing Condition Drainage Basin EX-D, but is a little larger due to the proposed inlet location. This basin generates 0.46 cfs of 100-year storm runoff that flows in the gutter into Basin B2.

As shown in Figure 3, the Proposed Condition Drainage conveys the project runoff into the biofiltration area in Lot 'A' in the northwest corner of the site. This biofiltration area will filter the runoff through the soil matrix and be collected in the underdrains. The grated inlet structure will collect the filtered runoff from the underdrains, and will also be utilized as an overflow in the event of system failure or flows above the 100-year storm. The runoff will be conveyed into the existing 36" storm drain in Marrokal Lane, which ties into the storm drain system in Mission Gorge Road, and ultimately empties into the San Diego River. See the Storm Water Quality Management Plan (SWQMP) for more information on the proposed storm water BMP's.

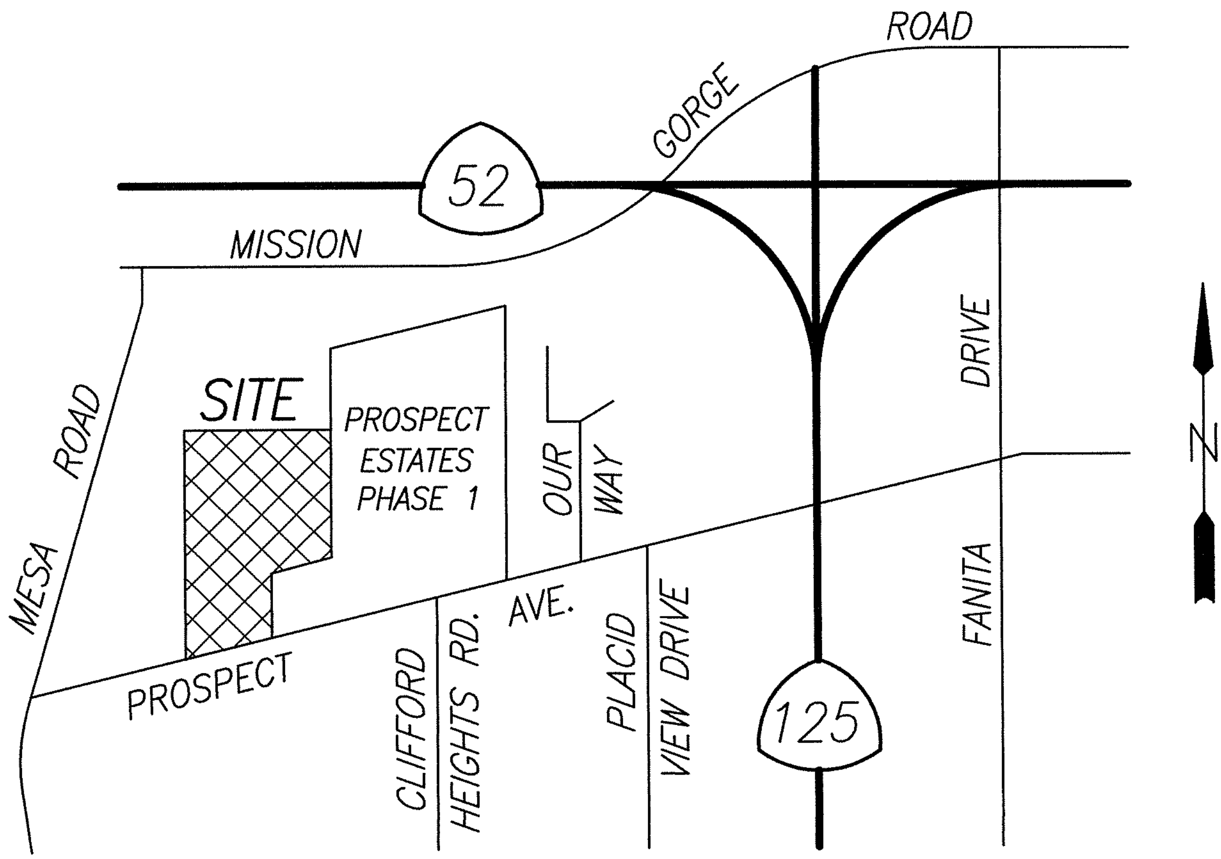
V. CONCLUSIONS

As summarized in Table 1, the Proposed Condition drainage totals 8.97 cfs of routed 100-year storm runoff, compared to the Existing Condition value of 7.69 cfs for the project site. This equates to a difference of 1.28 cfs. As described in the project SWQMP, this project is not required to provide hydromodification since it empties into a hardened conveyance system that empties into the San Diego River, an exempt system. However, the biofiltration basin will detain flows so that the flow leaving the basin in the proposed condition is equal to or less than the existing flow value of 7.69 cfs.

As previously described, off-site flows that come on to the property from the south will be adequately handled with the proposed drainage system. New off-site drainage facilities are not needed to deal with the off-site flows identified. As shown in Appendix 2, the existing 36" storm drain in Marrokal Lane has adequate capacity to handle the proposed condition runoff value from this project.

The on-site drainage facilities (storm drain inlets, cleanouts, and pipes) proposed with this subdivision will be private and maintained by the HOA. The project SWQMP will provide the maintenance requirements for the biofiltration facility so that the HOA will be properly informed of their responsibilities. The existing storm drain in Marrokal Lane is public, and the proposed curb inlet and pipe near Prospect Avenue is proposed to be public. These facilities will be maintained by the City of Santee. The proposed inlets and pipes in Marrokal Lane near the project's northerly boundary are private and will be maintained by the HOA.

FIGURE 1



VICINITY MAP

NO SCALE

TABLE 1 - HYDROLOGY SUMMARY

EXISTING CONDITION

BASIN NUMBER	AREA (acres)	C	L (ft.)	S (%) Heff	Tc (min.)	I_2 (in/hr)	I_{10} (in/hr)	I_{100} (in/hr)	Q_2 (cfs)	Q_{10} (cfs)	Q_{100} (cfs)	COMMENTS
EX-1	6.82	0.36	900	3.30	14.85	1.44	2.22	3.13	**3.53**	**5.45**	**7.69**	Surface flow to northerly neighbors
OFF-SITE BASINS												
EX-A	0.20	0.73	360	1.00	8.43	2.07	3.20	4.51	**0.30**	**0.47**	**0.66**	Surface flow from north side of Prospect Avenue
EX-B	0.31	0.81	215	4.70	4.10	3.29	5.09	7.19	**0.83**	**1.28**	**1.80**	Surface flow from properties to the east
EX-C	0.18	0.65	230	5.20	6.74	2.39	3.69	5.22	**0.28**	**0.43**	**0.61**	Surface flow from properties to the east
EX-D	0.06	0.85	90	0.50	5.64	2.68	4.14	5.85	**0.14**	**0.21**	**0.30**	Surface flow from north side of Prospect Avenue

PROPOSED CONDITION BASINS

ON-SITE BASINS

BASIN NUMBER	AREA (acres)	C	L (ft.)	Slope %	Tc (min.)	I_2 (in/hr)	I_{10} (in/hr)	I_{100} (in/hr)	Q_2 (cfs)	Q_{10} (cfs)	Q_{100} (cfs)	COMMENTS
A1	1.51	0.66	455	2.50	10.19	1.83	2.83	3.99	**1.82**	**2.82**	**3.98**	Gutter flow into curb inlet
A2	0.78	0.67	385	1.00	10.82	1.76	2.72	3.84	**0.92**	**1.42**	**2.01**	Gutter flow into curb inlet
A3	0.77	0.76	345	1.50	9.15	1.96	3.03	4.28	**1.15**	**1.78**	**2.51**	Gutter flow into grated inlet
A4	0.18	0.69	170	1.00	15.46	1.40	2.16	3.05	**0.17**	**0.27**	**0.38**	Overland flow into grated inlet
A5	0.26	0.63	190	1.00	17.36	1.30	2.01	2.83	**0.21**	**0.33**	**0.46**	Overland flow into grated inlet
A6	0.54	0.81	350	2.00	13.71	1.51	2.34	3.30	**0.66**	**1.02**	**1.44**	Gutter flow into grated inlet
A7	0.30	0.83	175	1.00	13.00	1.56	2.42	3.41	**0.39**	**0.60**	**0.85**	Gutter flow into grated inlet
A8	0.23	0.81	130	3.30	8.46	2.06	3.19	4.50	**0.38**	**0.59**	**0.84**	Gutter flow into grated inlet
B1	0.40	0.66	885	2.70	22.57	1.10	1.69	2.39	**0.29**	**0.45**	**0.63**	Ditch flow into biofiltration basin
C1	0.10	0.69	175	2.00	12.61	1.60	2.47	3.48	**0.11**	**0.17**	**0.24**	Overland flow into grated inlet
D1	0.37	0.90	680	3.80	5.51	2.72	4.21	5.94	**0.91**	**1.40**	**1.98**	Gutter flow into curb inlet
D2	1.23	0.67	990	3.00	12.13	1.64	2.53	3.57	**1.35**	**2.08**	**2.94**	Gutter flow into curb inlet
E1	0.13	0.35	95	0.50	24.61	1.04	1.60	2.26	**0.05**	**0.07**	**0.10**	Surface flow into grated inlet
TOTAL	**6.82**								**8.42**	**13.01**	**18.37**	
											8.97	Routed 100-year storm flow
Proposed Condition Q_{100} minus Existing Condition Q_{100} =											**1.28**	CFS increase during 100-year storm

OFF-SITE BASINS

BASIN NUMBER	AREA (acres)	C	L (ft.)	Slope %	Tc (min.)	I_2 (in/hr)	I_{10} (in/hr)	I_{100} (in/hr)	Q_2 (cfs)	Q_{10} (cfs)	Q_{100} (cfs)	COMMENTS
OFF-1	0.20	0.90	360	1.00	7.16	2.30	3.55	5.02	**0.41**	**0.64**	**0.90**	Surface flow from north side of Prospect Avenue
OFF-2	0.08	0.90	125	2.40	5.00	2.90	4.48	6.32	**0.21**	**0.32**	**0.46**	Surface flow into curb inlet

TABLE 2

CURB INLET SIZING SUMMARY

Basin	Q100 (cfs)	Street slope (%)	Flow depth in gutter (ft)	Inlet Condition	Inlet Sizing Equation	a	y	Cw	L	Inlet Description
A1	5.78	3.8	0.32	on-grade	L=Q100/.7(a+y)^1.5	0.33	0.32	-	16'	17' Type 'B-1' curb inlet
A2	2.01	1.0	0.29	on-grade	L=Q100/.7(a+y)^1.5	0.33	0.29	-	6'	7' Type 'B-1' curb inlet
D1	1.98	3.3	0.24	on-grade	L=Q100/.7(a+y)^1.5	0.33	0.24	-	7'	8' Type 'B-1' curb inlet
D2	3.84	3.3	0.29	on-grade	L=Q100/.7(a+y)^1.5	0.33	0.29	-	12'	13' Type 'B-1' curb inlet

APPENDIX 1

HYDROLOGICAL CALCULATIONS

PROSPECT ESTATES – PHASE II
HYDROLOGY CALCS

EXISTING CONDITION

BASIN EX-1

AREA = 297,289 SF = 6.82 AC

IMPERV. SURFACE = 2686 SF (0.90%)

PERV. SURFACE = 294603 SF (99.1%)

C = 0.9(.009) + 0.35(.991) = 0.36

L = 900'

S = 30/900 = 3.3%

$T_C = T_i + T_T$

T_i = 10.1 MIN., L_M = 100' (TABLE 3-2)

$T_T = \left[\frac{11.9 L^3}{\Delta E}\right]^{.385} \times 60$ L = 900-100/5280 = 0.15 mi

$\Delta E = 30'$

$T_T = \left[\frac{11.9(.15)^3}{30}\right]^{.385} \times 60 = 4.75$ MIN.

$T_C = 10.1 + 4.75 = 14.85$ MIN.

$I_2 = 7.44(1.1)14.85^{-.645} = 1.44$ IN/HR

$I_{10} = 7.44(1.7)14.85^{-.645} = 2.22$ IN/HR

$I_{100} = 7.44(2.4)14.85^{-.645} = 3.13$ IN/HR

$Q_2 = CAI_2 = (0.36)(6.82)(1.44) = 3.53$ CFS

$Q_{10} = CAI_{10} = (0.36)(6.82)(2.22) = 5.45$ CFS

$Q_{100} = CAI_{100} = (0.36)(6.82)(3.13) = 7.69$ CFS

BASIN EX-A

AREA = 8,745 SF = 0.20 AC

IMPERV. SURFACE = 5,973 SF (68.3%)
PERV. SURFACE = 2,772 SF (31.7%)

$C = 0.9(.683) + 0.35(.317) = 0.73$

$L = 360'$

$S = 3.5/360 = 1.0\%$

$T_C = T_i + T_T$

$T_i = 4.7$ MIN., $L_m = 65'$ (TABLE 3-2)

$T_T = \left[\frac{11.9 L^3}{\Delta E}\right]^{.385} \times 60 \qquad L = \frac{360-65}{5280} = 0.06$ MI

$= \left[\frac{11.9(0.06)^3}{3.5}\right]^{.385} \times 60$

$T_T = 3.73$ MIN.

$T_C = 4.70 + 3.73 = 8.43$ MIN.

$I_2 = 7.44(1.1)8.43^{-.645} = 2.07$ IN/HR

$I_{10} = 7.44(1.7)8.43^{-.645} = 3.20$ IN/HR

$I_{100} = 7.44(2.4)8.43^{-.645} = 4.51$ IN/HR

$Q_2 = CAI_2 = (0.73)(0.20)(2.07) = 0.30$ CFS

$Q_{10} = CAI_{10} = (0.73)(0.20)(3.20) = 0.47$ CFS

$Q_{100} = CAI_{100} = (0.73)(0.20)(4.51) = 0.66$ CFS

BASIN EX-B

AREA = 13,511 SF = 0.31 AC

IMPERV. SURF. = 11,334 SF (83.9%)
PERV. SURF. = 2,177 SF (16.1%)

$C = 0.9(.839) + 0.35(.161) = 0.81$

$L = 215'$

$S = 10/215 = 4.7\%$

$T_C = T_i + T_T$

$T_i = 3.4$ MIN., $L_M = 95'$ (TABLE 3-2)

$T_T = \left[\frac{11.9 L^3}{\Delta E}\right]^{.385} \times 60 \qquad L = \frac{215-95}{5280} = 0.02$ MI

$= \left[\frac{11.9(.02)^3}{10}\right]^{.385} \times 60$

$T_T = 0.70$ MIN.

$T_C = 3.4 + 0.7 = 4.10$ MIN.

$I_2 = 7.44(1.1)\,4.10^{-.645} = 3.29$ IN/HR

$I_{10} = 7.44(1.7)\,4.10^{-.645} = 5.09$ IN/HR

$I_{100} = 7.44(2.4)\,4.10^{-.645} = 7.19$ IN/HR

$Q_2 = CAI_2 = (0.81)(0.31)(3.29) = 0.83$ CFS

$Q_{10} = CAI_{10} = (0.81)(0.31)(5.09) = 1.28$ CFS

$Q_{100} = CAI_{100} = (0.81)(0.31)(7.19) = 1.80$ CFS

BASIN EX-C

AREA = 7,977 SF = 0.18 AC

IMP. SURF. = 4,318 SF (54.1%)
PERV. SURF. = 3,659 SF (45.9%)

$C = 0.9(.541) + 0.35(.459) = 0.65$

$L = 230'$

$S = 12/230 = 5.2\%$

$T_C = T_i + T_T$

$T_i = 5.7$ MIN., $L_M = 100'$ (TABLE 3-2)

$T_T = \left[\frac{11.9 L^3}{\Delta E}\right]^{.385} \times 60 \qquad L = \frac{230-100}{5280} = 0.03\,mi$

$= \left[\frac{11.9(.03)^3}{12}\right]^{.385} \times 60 \qquad \Delta E = 12$

$T_T = 1.04$ MIN.

$T_C = 5.7 + 1.04 = 6.74$ MIN.

$I_2 = 7.44(1.1)6.74^{-.645} = 2.39$ IN/HR

$I_{10} = 7.44(1.7)6.74^{-.645} = 3.69$ IN/HR

$I_{100} = 7.44(2.4)6.74^{-.645} = 5.22$ IN/HR

$Q_2 = CAI_2 = (0.65)(0.18)(2.39) = 0.28$ CFS

$Q_{10} = CAI_{10} = (0.65)(0.18)(3.69) = 0.43$ CFS

$Q_{100} = CAI_{100} = (0.65)(0.18)(5.22) = 0.61$ CFS

BASIN EX-D

AREA = 2,707 SF = 0.06 AC

IMP. SURF. = 2,442 SF (90.2%)

PERV. SURF. = 265 SF (9.8%)

"C" = 0.9(.902) + 0.35(.098) = 0.85

L = 90'

S = 0.50%

$T_C = T_i + T_T$

T_i = 4.7 MIN, L_M = 50' (TABLE 3-2)

$T_T = \left[\frac{11.9L^3}{\Delta E}\right]^{.385} \times 60$ L = 90-50/5280 = 0.008 mi.

ΔE = 0.30'

$T_T = \left[\frac{11.9(.008)^3}{.30}\right]^{.385} \times 60$ = 0.94 MIN.

T_C = 4.7 + 0.94 = 5.64 MIN.

$I_2 = 7.44(1.1)\,5.64^{-.645}$ = 2.68 IN/HR

$I_{10} = 7.44(1.7)\,5.64^{-.645}$ = 4.14 IN/HR

$I_{100} = 7.44(2.4)\,5.64^{-.645}$ = 5.85 IN/HR

$Q_2 = CAI_2$ = (0.85)(0.06)(2.68) = 0.14 CFS

$Q_{10} = CAI_{10}$ = (0.85)(0.06)(4.14) = 0.21 CFS

$Q_{100} = CAI_{100}$ = (0.85)(0.06)(5.85) = 0.30 CFS

PROPOSED CONDITION

BASIN A1

AREA = 65,829 SF = 1.51 AC

IMPERV. SURF. = 37,432 SF (56.9%)
PERV. SURF. = 28,397 SF (43.1%)

'C' = 0.9(.569) + 0.35(.431) = 0.66

L = 455'

S = 2.5%

$T_C = T_i + T_T$

T_i = 8.45 MIN., L_M = 90' (TABLE 3-2)

T_T = ASSUME V_{10} = 3.5 FPS

$T_T = \frac{(455-90)}{3.5 \times 60} = 1.74$ MIN.

$T_C = 8.45 + 1.74 = 10.19$ MIN.

$I_{10} = 7.44(1.7)10.19^{-.645} = 2.83$ IN/HR

$Q_{10} = CAI_{10} = (0.66)(1.51)(2.83) = 2.82$ CFS

→ FROM FIG. 3-6 : V_{10} = 3.5 FPS ✓

T_C = 10.19 MIN.

$I_2 = 7.44(1.1)10.19^{-.645} = 1.83$ IN/HR

$I_{10} = 7.44(1.7)10.19^{-.645} = 2.83$ IN/HR

$I_{100} = 7.44(2.4)10.19^{-.645} = 3.99$ IN/HR

$Q_2 = CAI_2 = (0.66)(1.51)(1.83) = 1.82$ CFS

$Q_{10} = CAI_{10} = (0.66)(1.51)(2.83) = 2.82$ CFS

$Q_{100} = CAI_{100} = (0.66)(1.51)(3.99) = 3.98$ CFS

BASIN A2

AREA = 33,781 SF = 0.78 AC

IMPERV. SURF. = 20,119 (59.6%)
PERV. SURF. = 13,662 (40.4%)

'C' = 0.9(.596) + 0.35(.404) = 0.67

L = 385'

S = 1.0%

$T_C = T_i + T_T$

T_i = 8.40 MIN., L_m = 65' (TABLE 3-2)

T_T = ASSUME V_{10} = 2.2 FPS

$$T_T = \frac{385-65}{2.2 \times 60} = 2.42 \text{ MIN.}$$

T_C = 8.40 + 2.42 = 10.82 MIN.

$I_{10} = 7.44(1.7)\,10.82^{-.645} = 2.72$ IN/HR

$Q_{10} = CAI_{10} = (0.67)(0.78)(2.72) = 1.42$ CFS

→ FROM FIG. 3-6: V_{10} = 2.2 FPS ✓

T_C = 10.82 MIN.

$I_2 = 7.44(1.1)\,10.82^{-.645} = 1.76$ IN/HR

$I_{10} = 7.44(1.7)\,10.82^{-.645} = 2.72$ IN/HR

$I_{100} = 7.44(2.4)\,10.82^{-.645} = 3.84$ IN/HR

$Q_2 = CAI_2 = (0.67)(0.78)(1.76) = 0.92$ CFS

$Q_{10} = CAI_{10} = (0.67)(0.78)(2.72) = 1.42$ CFS

$Q_{100} = CAI_{100} = (0.67)(0.78)(3.84) = 2.01$ CFS

BASIN A3

AREA = 33,754 SF = 0.77 AC

IMPERV. SURF. = 25,016 SF (74.1%)
PERV. SURF. = 8,738 SF (25.9%)

'C' = 0.9(.741) + 0.35(.259) = 0.76

L = 345'

S = 1.5%

$T_C = T_i + T_T$

T_i = 7.40 MIN; L_M = 72' (TABLE 3-2)

T_T = ASSUME V_{10} = 2.6 FPS

$$T_T = \frac{345-72}{2.6 \times 60} = 1.75 \text{ MIN.}$$

T_C = 7.40 + 1.75 = 9.15 MIN.

$I_{10} = 7.44(1.7)\,9.15^{-.645} = 3.03$ IN/HR

$Q_{10} = CAI_{10} = (0.76)(0.77)(3.03) = 1.78$ CFS

→ FROM FIG. 3-6: V_{10} = 2.6 FPS ✓

T_C = 9.15 MIN.

$I_2 = 7.44(1.1)\,9.15^{-.645} = 1.96$ IN/HR

$I_{10} = 7.44(1.7)\,9.15^{-.645} = 3.03$ IN/HR

$I_{100} = 7.44(2.4)\,9.15^{-.645} = 4.28$ IN/HR

$Q_2 = CAI_2 = (0.76)(0.77)(1.96) = 1.15$ CFS

$Q_{10} = CAI_{10} = (0.76)(0.77)(3.03) = 1.78$ CFS

$Q_{100} = CAI_{100} = (0.76)(0.77)(4.28) = 2.51$ CFS

BASIN A4

AREA = 7,901 SF = 0.18 AC

IMPERV. SURF. = 4,927 SF (62.4%)
PERV. SURF. = 2,974 SF (37.6%)

'C' = 0.9(.624) + 0.35(.376) = 0.69

L = 170'

S = 1.0%

$T_C = T_i + T_T$

T_i = 7.9 MIN., L_m = 65' (TABLE 3-2)

$$T_T = \frac{1.8(1.1-C)\sqrt{D}}{S^{1/3}} \quad D = 170-65 = 105'$$

$$= \frac{1.8(1.1-.69)\sqrt{105}}{1.0^{1/3}} = 7.56 \text{ MIN.}$$

T_C = 7.9 + 7.56 = 15.46 MIN.

$I_2 = 7.44(1.1)\,15.46^{-.645}$ = 1.40 IN/HR

$I_{10} = 7.44(1.7)\,15.46^{-.645}$ = 2.16 IN/HR

$I_{100} = 7.44(2.4)\,15.46^{-.645}$ = 3.05 IN/HR

$Q_2 = CAI_2$ = (0.69)(0.18)(1.40) = 0.17 CFS

$Q_{10} = CAI_{10}$ = (0.69)(0.18)(2.16) = 0.27 CFS

$Q_{100} = CAI_{100}$ = (0.69)(0.18)(3.05) = 0.38 CFS

BASIN A5

AREA = 11,276 SF = 0.26 AC

IMPERV. SURF. = 5,691 SF (50.5%)
PERV. SURF. = 5,585 SF (49.5%)

$C' = 0.9(0.505) + 0.35(0.495) = 0.63$

$L = 190'$

$S = 1.0\%$

$T_C = T_i + T_T$

$T_i = 7.9$ MIN., $L_M = 65'$ (TABLE 3-2)

$$T_T = \frac{1.8(1.1 - 0.63)\sqrt{190-65}}{1.0^{1/3}} = 9.46 \text{ MIN.}$$

$T_C = 7.9 + 9.46 = 17.36$ MIN.

$I_2 = 7.44(1.1)17.36^{-.645} = 1.30$ IN/HR.

$I_{10} = 7.44(1.7)17.36^{-.645} = 2.01$ IN/HR.

$I_{100} = 7.44(2.4)17.36^{-.645} = 2.83$ IN/HR

$Q_2 = CAI_2 = (0.63)(0.26)(1.30) = 0.21$ CFS

$Q_{10} = CAI_{10} = (0.63)(0.26)(2.01) = 0.33$ CFS

$Q_{100} = CAI_{100} = (0.63)(0.26)(2.83) = 0.46$ CFS

BASIN A6

AREA = 23,343 SF = 0.54 AC

IMPERV. SURF. = 19,486 SF (83.5%)
PERV. SURF. = 3,857 SF (16.5%)

'C' = 0.9(.835) + .35(.165) = 0.81

L = 350'

S = 2.0%

$T_C = T_i + T_T$

T_i = 6.9 MIN., L_M = 80' (TABLE 3-2)

$$T_T = \frac{1.8(1.1-.81)\sqrt{350-80}}{2.0^{1/3}} = 6.81 \text{ MIN.}$$

T_C = 6.9 + 6.81 = 13.71 MIN.

$I_2 = 7.44(1.1)13.71^{-.645}$ = 1.51 IN/HR

$I_{10} = 7.44(1.7)13.71^{-.645}$ = 2.34 IN/HR

$I_{100} = 7.44(2.4)13.71^{-.645}$ = 3.30 IN/HR

$Q_2 = CAI_2$ = (0.81)(0.54)(1.51) = 0.66 CFS

$Q_{10} = CAI_{10}$ = (0.81)(0.54)(2.34) = 1.02 CFS

$Q_{100} = CAI_{100}$ = (0.81)(0.54)(3.30) = 1.44 CFS

BASIN A7

AREA = 13,066 SF = 0.30 AC

IMPERV. SURF. = 11,290 SF (86.4%)
PERV. SURF. = 1,776 SF (13.6%)

'C' = .9(.864) + .35(.136) = 0.83

L = 175'

S = 1.0%

$T_C = T_i + T_T$

T_i = 7.9 MIN., L_M = 65' (TABLE 3-2)

$$T_T = \frac{1.8(1.1-.83)\sqrt{175-65}}{1.0^{1/3}} = 5.10 \text{ MIN.}$$

T_C = 7.9 + 5.10 = 13.00 MIN.

$I_2 = 7.44(1.1)13.00^{-.645}$ = 1.56 IN/HR

$I_{10} = 7.44(1.7)13.00^{-.645}$ = 2.42 IN/HR

$I_{100} = 7.44(2.4)13.00^{-.645}$ = 3.41 IN/HR

$Q_2 = CAI_2$ = (0.83)(0.30)(1.56) = 0.39 CFS

$Q_{10} = CAI_{10}$ = (0.83)(0.30)(2.42) = 0.60 CFS

$Q_{100} = CAI_{100}$ = (0.83)(0.30)(3.41) = 0.85 CFS

BASIN A8

AREA = 10,165 SF = 0.23 AC

IMPERV. SURF. = 8,446 (83.1%)
PERV. SURF. = 1,719 (16.9%)

'C' = 0.9(.831) + 0.35(.169) = 0.81

L = 130'

S = 3.3%

$T_C = T_i + T_T$

$T_i = 6.3$ MIN., $L_M = 92'$ (TABLE 3-2)

$$T_T = \frac{1.8(1.1-.81)\sqrt{130-92}}{3.3^{1/3}} = 2.16 \text{ MIN.}$$

$T_C = 6.3 + 2.16 = 8.46$ MIN

$I_2 = 7.44(1.1)8.46^{-.645} = 2.06$ IN/HR

$I_{10} = 7.44(1.7)8.46^{-.645} = 3.19$ IN/HR

$I_{100} = 7.44(2.4)8.46^{-.645} = 4.50$ IN/HR

$Q_2 = CAI_2 = (0.81)(0.23)(2.06) = 0.38$ CFS

$Q_{10} = CAI_{10} = (0.81)(0.23)(3.19) = 0.59$ CFS

$Q_{100} = CAI_{100} = (0.81)(0.23)(4.50) = 0.84$ CFS

BASIN B1

AREA = 17,565 SF = 0.40 AC

IMPERV. SURF. = 10,054 SF (57.2%)
PERV. SURF. = 7,511 SF (42.8%)

'C' = 0.9(.572) + 0.35(.428) = 0.66

L = 885'

S = 2.7%

$T_C = T_i + T_T$

$T_i = 6.5$ MIN., $L_M = 87'$ (TABLE 3-2)

$$T_T = \frac{1.8(1.1-0.66)\sqrt{885-87}}{2.7^{1/3}} = 16.07 \text{ MIN.}$$

$T_C = 6.5 + 16.07 = 22.57$ MIN.

$I_2 = 7.44(1.1)22.57^{-.645} = 1.10$ IN/HR

$I_{10} = 7.44(1.7)22.57^{-.645} = 1.69$ IN/HR

$I_{100} = 7.44(2.4)22.57^{-.645} = 2.39$ IN/HR

$Q_2 = CAI_2 = (0.66)(0.40)(1.10) = 0.29$ CFS

$Q_{10} = CAI_{10} = (0.66)(0.40)(1.69) = 0.45$ CFS

$Q_{100} = CAI_{100} = (0.66)(0.40)(2.39) = 0.63$ CFS

BASIN C1

AREA = 4,427 SF = 0.10 AC

IMPERV. AREA = 2,769 SF (62.5%)
PERV. AREA = 1,658 SF (37.5%)

'C' = 0.9(.625) + 0.35(.325) = 0.69

L = 175'

S = 2.0%

$T_C = T_i + T_T$

$T_i = 6.9$ MIN., $L_M = 80'$ (TABLE 3-2)

$$T_T = \frac{1.8(1.1 - 0.69)\sqrt{175-80}}{2.0^{1/3}} = 5.71 \text{ MIN.}$$

$T_C = 6.9 + 5.71 = 12.61$ MIN.

$I_2 = 7.44(1.1)\,12.61^{-.645} = 1.60$ IN/HR

$I_{10} = 7.44(1.7)\,12.61^{-.645} = 2.47$ IN/HR

$I_{100} = 7.44(2.4)\,12.61^{-.645} = 3.48$ IN/HR

$Q_2 = CAI_2 = (0.69)(0.10)(1.60) = 0.11$ CFS

$Q_{10} = CAI_{10} = (0.69)(0.10)(2.47) = 0.17$ CFS

$Q_{100} = CAI_{100} = (0.69)(0.10)(3.48) = 0.24$ CFS

BASIN D1

AREA = 15,931 SF = 0.37 AC

'C' = 0.90 (ALL IMPERVIOUS)

L = 680'

S = 3.8%

$T_C = T_i + T_T$

$T_i = 2.9$ MIN., $L_M = 84'$ (TABLE 3-2)

$T_T \rightarrow$ ASSUME $V_{10} = 3.8$ FPS

$T_T = \frac{680-84}{3.8 \times 60} = 2.61$ MIN.

$T_C = 2.9 + 2.61 = 5.51$ MIN.

$I_{10} = 7.44(1.7)5.51^{-.645} = 4.21$ IN/HR

$Q_{10} = CAI_{10} = (0.9)(0.37)(4.21) = 1.40$ CFS

FROM FIG. 3-6 $\rightarrow V_{10} = 3.8$ FPS ✓

$T_C = 5.51$ MIN.

$I_2 = 7.44(1.1)5.51^{-.645} = 2.72$ IN/HR

$I_{10} = 7.44(1.7)5.51^{-.645} = 4.21$ IN/HR

$I_{100} = 7.44(2.4)5.51^{-.645} = 5.94$ IN/HR

$Q_2 = CAI_2 = (0.90)(0.37)(2.72) = 0.91$ CFS

$Q_{10} = CAI_{10} = (0.90)(0.37)(4.21) = 1.40$ CFS

$Q_{100} = CAI_{100} = (0.90)(0.37)(5.94) = 1.98$ CFS

BASIN D2

AREA = 53,751 SF = 1.23 AC

IMPERV. SURF. = 31,628 SF (58.8%)
PERV. SURF. = 22,123 SF (41.2%)

'C' = 0.9(.588) + 0.35(.412) = 0.67

L = 990'

S = 3.0%

$T_C = T_i + T_T$

T_i = 8.1 MIN., L_m = 95' (TABLE 3-2)

T_T = ASSUME V_{10} = 3.7 FPS

$$T_T = \frac{990 - 95}{3.7 \times 60} = 4.03 \text{ MIN.}$$

T_C = 8.1 + 4.03 = 12.13 MIN.

$I_{10} = 7.44(1.7)12.13^{-.645} = 2.53$ IN/HR

$Q_{10} = CAI_{10} = (0.67)(1.23)(2.53) = 2.08$ CFS

→ FROM FIG. 3-6: V_{10} = 3.7 FPS ✓

T_C = 12.13 MIN.

$I_2 = 7.44(1.1)12.13^{-.645} =$ 1.64 IN/HR

$I_{10} = 7.44(1.7)12.13^{-.645} =$ 2.53 IN/HR

$I_{100} = 7.44(2.4)12.13^{-.645} =$ 3.57 IN/HR

$Q_2 = CAI_2 = (0.67)(1.23)(1.64) =$ 1.35 CFS

$Q_{10} = CAI_{10} = (0.67)(1.23)(2.53) =$ 2.08 CFS

$Q_{100} = CAI_{100} = (0.67)(1.23)(3.57) =$ 2.94 CFS

BASIN E1

AREA = 5,854 SF = 0.13 AC

IMPERV. SURF. = 40 SF (0.7%)
PERV. SURF. = 5,814 SF (99.3%)

$C' = 0.9(.007) + 0.35(.993) = 0.35$

$L = 95'$

$S = 0.5\%$

$T_C = T_i + T_T$

$T_i = 13.2$ MIN., $L_M = 50'$ (TABLE 3-2)

$T_T = \frac{1.8(1.1-.35)\sqrt{95-50}}{.5^{1/3}} = 11.41$ MIN.

$T_C = 13.2 + 11.41 = 24.61$ MIN.

$I_2 = 7.44(1.1)24.61^{-.645} = 1.04$ IN/HR

$I_{10} = 7.44(1.7)24.61^{-.645} = 1.60$ IN/HR

$I_{100} = 7.44(2.4)24.61^{-.645} = 2.26$ IN/HR

$Q_2 = CAI_2 = (0.35)(0.13)(1.04) = 0.05$ CFS

$Q_{10} = CAI_{10} = (0.35)(0.13)(1.60) = 0.07$ CFS

$Q_{100} = CAI_{100} = (0.35)(0.13)(2.26) = 0.10$ CFS

BASIN OFF-1

AREA = 8,652 SF = 0.20 AC

'c' = 0.90 (ALL IMPERVIOUS)

L = 360'

S = 3.5/350 = 1.0%

$T_C = T_i + T_T$

T_i = 4.7 MIN., L_M = 65' (TABLE 3-2)

T_T → ASSUME V_{10} = 2.0 FPS

$T_T = \frac{360-65}{2.0 \times 60} = 2.46$ MIN.

$T_C = 4.7 + 2.46 = 7.16$ MIN.

$I_{10} = 7.44(1.7)7.16^{-.645} = 3.55$ IN/HR

$Q_{10} = CAI_{10} = (0.90)(0.20)(3.55) = 0.64$ CFS

FROM FIG. 3-6 → V_{10} = 2.0 FPS ✓

T_C = 6.11 MIN.

$I_2 = 7.44(1.1)7.16^{-.645} = 2.30$ IN/HR

$I_{10} = 7.44(1.7)7.16^{-.645} = 3.55$ IN/HR

$I_{100} = 7.44(2.4)7.16^{-.645} = 5.02$ IN/HR

$Q_2 = CAI_2 = (0.90)(0.20)(2.30) = 0.41$ CFS

$Q_{10} = CAI_{10} = (0.90)(0.20)(3.55) = 0.64$ CFS

$Q_{100} = CAI_{100} = (0.90)(0.20)(5.02) = 0.90$ CFS

BASIN OFF-2

AREA = 3,333 SF = 0.08 AC

'C' = 0.90 (ALL IMPERVIOUS)

L = 125'

S = 3/125 = 2.4%

$T_C = T_i + T_T$

T_i = 3.9 MIN., Lm = 80' (TABLE 3-2)

T_T → ASSUME V_{10} = 3.0 FPS

$T_T = \frac{125-80}{3.0 \times 60} = 0.25$ MIN.

T_C = 3.9 + 0.25 = 4.15 → USE 5.0 MIN. (MINIMUM)

$I_{10} = 7.44(1.7)5.0^{-.645}$ = 4.48 IN/HR

$Q_{10} = CAI_{10}$ = (0.9)(0.08)(4.48) = 0.32 CFS

FROM FIG. 3-6 → V_{10} = 3.0 FPS ✓

T_C = 5.00 MIN.

$I_2 = 7.44(1.1)5.00^{-.645}$ = 2.90 IN/HR

$I_{10} = 7.44(1.7)5.00^{-.645}$ = 4.48 IN/HR

$I_{100} = 7.44(2.4)5.00^{-.645}$ = 6.32 IN/HR

$Q_2 = CAI_2$ = (0.9)(0.08)(2.90) = 0.21 CFS

$Q_{10} = CAI_{10}$ = (0.9)(0.08)(4.48) = 0.32 CFS

$Q_{100} = CAI_{100}$ = (0.9)(0.08)(6.32) = 0.46 CFS

APPENDIX 2

HYDRAULIC CALCULATIONS

HYDRAULIC CALCS

BASIN EX-B

$Q_{100} = 1.80$ CFS

+ SIZE BROW DITCH

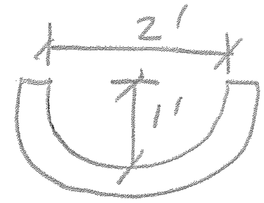
$$Q_{MAX} = \frac{1.486}{n} A R^{2/3} S^{1/2}$$

$$= \frac{1.486}{.015}(1.57)(.5)^{2/3}\sqrt{.01}$$

$Q_{MAX} = 9.8$ CFS

$9.8 > 1.80$ ✓

n = 0.015
A = 1.57
R = 0.50
S = 1.0% MIN.



∴ USE 2' x 1' PCC BROW DITCH @ 1.0% MIN. SLOPE

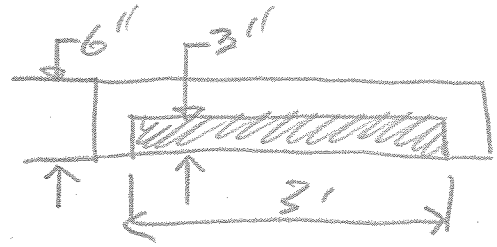
+ SIZE CURB OUTLET

$$Q_{MAX} = CA\sqrt{2gh}$$

$$= (.65)(.75)\sqrt{2(32.2).5}$$

$Q_{MAX} = 2.76$ CFS

$2.76 > 1.80$ ✓



C = 0.65 (KINGS HANDBOOK)
A = 3 X .25 = 0.75 SF
h = 0.5'

∴ USE TYPE 'A' CURB OUTLET W/ 3" MIN. HEIGHT OPENING

BASIN A1

$Q_{100} = 3.98\text{ CFS} + 1.80 = 5.78\text{ CFS}$

+ CHECK DEPTH OF FLOW IN GUTTER

S = 1.0% → d = 0.39' (FIG. 3-6)
S = 3.8% → d = 0.32'

CURB HEIGHT = 0.5' (6")

0.50 > 0.39 → ✓

+ SIZE CURB INLET (ON-GRADE)

$$L = \frac{Q_{100}}{0.7(a+y)^{3/2}}$$

a = 0.33
y = 0.32 (3.8%)

$$= \frac{5.78}{.7(.33+.32)^{3/2}} = 15.8' \approx 16' \text{ OPENING}$$

∴ USE 17' TYPE 'B-1' CURB INLET

+ SIZE PIPE

TRY 18" RCP @ 1.0% MIN. SLOPE

$Q_{MAX} = 105\sqrt{.01} = 10.5\text{ CFS}$

10.5 > 5.78

∴ USE 18" RCP @ 1.0% MIN. SLOPE

BASIN A2

$Q_{100} = 2.01$ CFS

+CHECK DEPTH OF FLOW IN GUTTER

$S = 1.0\% \rightarrow d = 0.29'$ (FIG. 3-6)

CURB HEIGHT = 0.5' (6")

$0.50 > 0.29 \rightarrow$ ✓

+SIZE CURB INLET (ON-GRADE)

$L = \frac{Q_{100}}{.7(a+y)^{3/2}}$ $\quad a = 0.33$, $y = 0.29$

$= \frac{2.01}{.7(.33+.29)^{3/2}} = 5.9' \approx 6'$ OPENING

∴ USE 7' TYPE 'B-1' CURB INLET

+SIZE PIPE -Run #1

TRY 12" PVC @ 1.0% MIN. SLOPE

$Q_{MAX} = 35.6\sqrt{.01} = 3.56$ CFS

$3.56 > 2.01$

∴ USE 12" PVC @ 1.0% MIN. SLOPE

Run #2

$Q_{100} = 5.78 + 2.01 = 7.79$ CFS

$10.5 > 7.79$

∴ USE 18" RCP @ 1.0% MIN. SLOPE

BASIN A3

$Q_{100} = 2.51$ CFS

+ CHECK INLET CAPACITY (TYPE 'I' CATCH BASIN)

$Q_{MAX} = CA\sqrt{2gh}$ — $C = 0.62$ (KINGS)

$= (.62)(6.6)\sqrt{2(32.2)(.08)}$ — $A = 2' \times 3.3' = 6.6$ SF

$Q_{MAX} = 10.0$ CFS — $h = 0.08'$ (1")

$10.0 > 2.51$ ✓

∴ USE TYPE 'I' CATCH BASIN

BASIN A4

$Q_{100} = 0.38$ CFS

+ CHECK INLET CAPACITY (2'x2' GRATED INLET)

$Q_{MAX} = CA\sqrt{2gh}$ $\quad$ $C = 0.67$ (KINGS)

$= (.67)(4)\sqrt{2(32.2).25}$ $\quad$ $A = 2' \times 2' = 4$ SF

$h = 0.25'$

$Q_{MAX} = 10.8$ CFS

$10.8 > 0.38$ ✓

∴ USE 2' x 2' GRATED INLET

+ SIZE STORM DRAIN - RUN #1

TRY 12" PVC @ 1.0% MIN. SLOPE

$Q_{MAX} = 35.6\sqrt{.01} = 3.56$ CFS

$3.56 > 0.38$ ✓

∴ USE 12" PVC @ 1.0% MIN. SLOPE

RUN #2

$Q_{100} = 7.79 + 2.51 + 0.38 = 10.68$ CFS

TRY 18" PIPE @ 1.10% MIN. SLOPE

$Q_{MAX} = 105\sqrt{.0110} = 11.0$ CFS

$11.0 > 10.68$ ✓

∴ USE 18" PIPE @ 1.10% MIN. SLOPE

BASIN A5

$Q_{100} = 0.46$ CFS

+ CHECK INLET CAPACITY (2'x2' GRATED INLET)

$Q_{MAX} = CA\sqrt{2gh}$ C = 0.67 (KINGS)
   A = 2x2 = 4 SF
   h = 0.25'

$= (.67)(4)\sqrt{2(32.2).25}$

$Q_{MAX} = 10.8$ CFS

$10.8 > 0.46$ ✓

∴ USE 2'x2' GRATED INLET

+ SIZE STORM DRAIN

TRY 12" PVC @ 1.0% MIN. SLOPE

$Q_{MAX} = 35.6\sqrt{.01} = 3.56$ CFS

$3.56 > 0.46$ ✓

∴ USE 12" PVC @ 1.0% MIN. SLOPE

BASIN A6

$Q_{100} = 1.44$ CFS

+ CHECK INLET CAPACITY (TYPE 'I' CATCH BASIN)

$Q_{MAX} = CA\sqrt{2gh}$ $\quad C = 0.67$ (KINGS)

$= (.67)(6.6)\sqrt{2(32.2)(.08)}$ $\quad A = 2 \times 3.3 = 6.6$ SF

$Q_{MAX} = 10.0$ CFS $\quad h = 0.08'$

$10.0 > 1.44$ ✓

∴ USE TYPE 'I' CATCH BASIN

+ SIZE STORM DRAIN

$Q_{100} = 0.46 + 1.44 = 1.90$ CFS

TRY 12" PVC @ 1.0% MIN. SLOPE

$Q_{MAX} = 35.6\sqrt{.01} \approx 3.56$ CFS

$3.56 > 1.90$

∴ USE 12" PVC @ 1.0% MIN. SLOPE

BASIN A7

$Q_{100} = 0.85$ CFS

+ CHECK INLET CAPACITY (TYPE 'I' CATCH BASIN)

$Q_{MAX} = CA\sqrt{2gh}$ $C = 0.62$ (KINGS)
$= (.62)(6.6)\sqrt{2(32.2).08}$ $A = 2 \times 3.3 = 6.6$ SF
$h = 0.08'$

$Q_{MAX} = 10.0$ CFS

$10.0 > 0.85$ CFS

∴ USE TYPE 'I' CATCH BASIN

+ SIZE STORM DRAIN

$Q_{100} = 1.90 + 0.85 = 2.75$ CFS

TRY 12" PVC @ 1.0% MIN. SLOPE

$Q_{MAX} = 35.6\sqrt{.01} = 3.56$ CFS

$3.56 > 2.75$ ✓

∴ USE 12" PVC @ 1.0% MIN. SLOPE

BASIN A8

$Q_{100} = 0.84$ CFS

+ CHECK INLET CAPACITY (TYPE 'I' CATCH BASIN)

$Q_{MAX} = CA\sqrt{2gh}$ $\quad C = 0.67$

$= (.67)(6.6)(\sqrt{2(32.2).25})$ $\quad A = 2 \times 3.3 = 6.6$ SF

$h = 0.25$

$Q_{MAX} = 17.7$ CFS

$17.7 > 0.84$ ✓

[IF ALL PIPES/INLETS IN BASINS A1-A7 FAIL, ALL RUNOFF AT BASIN A8 = 14.3 CFS

$17.7 > 14.3$ ✓]

∴ USE TYPE 'I' CATCH BASIN

+ SIZE STORM DRAIN — RUN #1

TRY 18" RCP @ 1.0% MIN. SLOPE

$Q_{MAX} = 105\sqrt{.01} = 10.5$ CFS

$10.5 > 2.75 + 0.84 = 3.59$ CFS ✓

∴ USE 18" RCP @ 1.0% MIN. SLOPE

RUN #2

$Q_{100} = 3.59 + 10.68 = 14.27$ CFS

TRY 24" RCP @ 1.0% MIN. SLOPE

$Q_{MAX} = 226\sqrt{.01} = 22.6$ CFS

$22.6 > 14.27$

∴ USE 24" RCP @ 1.0% MIN. SLOPE

+ SIZE RIP RAP @ BIOFILTRATION BASIN

$Q_{100}/Q_{MAX} = 14.27/22.6 = 0.63$

$d/D = 0.57$

$V_{100}/V_{MAX} = 1.05$

$V_{MAX} = \frac{Q_{MAX}}{A} = \frac{22.6}{3.14} = 7.2 \text{ FPS}$

$V_{100} = 1.05(7.2) = 7.6 \text{ FPS}$

∴ USE NO. 2 BACKING ROCK, 1.0' THICK, NO FILTER BLANKET

BASIN B1

$Q_{100} = 0.63 + 0.61 = 1.24$ CFS (B1 + EX-C)

+ CHECK BROW DITCH CAPACITY

TRY 2'x1' PCC DITCH @ 1.0% MIN. SLOPE

$Q_{MAX} = 9.8$ CFS (SHEET 1)

$9.8 > 1.24$

∴ USE 2'X1' PCC BROW DITCH @ 1.0% MIN. SLOPE

+ SIZE RIP RAP @ BIOFILTRATION BASIN

$Q_{MAX} = \frac{1.486}{n} A R^{2/3} S^{1/2}$ n = 0.015, A = 1.59 SF, R = 0.50, S = 10% (.10)

$= \frac{1.486}{.015}(1.57)(.5)^{2/3}\sqrt{.1}$

$Q_{MAX} = 30.9$ CFS

$Q_{100}/Q_{MAX} = 1.24/30.9 = 0.04$

$d/D = 0.14$

$V_{100}/V_{MAX} = 0.51$

$V_{MAX} = \frac{Q_{MAX}}{A} = \frac{30.9}{1.57} = 19.7$ FPS

$V_{100} = .51(19.2) = 10.0$ FPS

∴ USE LIGHT CLASS ROCK, 2.0' THICK, NO FILTER BLANKET

BASIN C1

$Q_{100} = 0.24$ CFS

+ CHECK INLET CAPACITY (2' x 2' GRATED INLET)

$Q_{MAX} = CA\sqrt{2gh}$ C = 0.67 (KINGS)

$= (.6)(4)\sqrt{2(32.2).25}$ A = 2 x 2 = 4 SF

h = 0.25'

$Q_{MAX} = 10.8$ CFS

$10.8 > 0.24$ ✓

∴ USE 2' X 2' GRATED INLET

+ SIZE STORM DRAIN

TRY 12" PVC @ 1.0% MIN. SLOPE

$Q_{MAX} = 35.6\sqrt{.01} = 3.56$ CFS

$3.56 > 0.24$ ✓

∴ USE 12" PVC @ 1.0% MIN. SLOPE

+ SIZE RIP RAP @ BIOFILTRATION BASIN

$Q_{100}/Q_{MAX} = 0.24/3.56 = 0.07$

$d/D = 0.18 \rightarrow V_{100}/V_{MAX} = 0.58$

$V_{MAX} = Q_{MAX}/A = 3.56/0.79 = 4.51$ FPS

$V_{100} = .58(4.51) = 2.6$ FPS

(LESS THAN 6.0 FPS SO NO RIP RAP NEEDED)

BASIN D1

$Q_{100} = 1.98$ CFS

+ CHECK GUTTER FLOW DEPTH

S = 3.3% → d = 0.24' (FIG. 3-6)

CURB HEIGHT = 0.5' (6")

0.5 > 0.24 → ✓

+ SIZE CURB INLET (ON-GRADE)

$$L = \frac{Q_{100}}{0.7(a+y)^{3/2}} \qquad a = 0.33, \quad y = 0.24$$

$$L = \frac{1.98}{.7(.33+.24)^{3/2}} = 6.6' \approx 7' \text{ OPENING}$$

∴ USE 8' TYPE 'B-1' CURB INLET

+ SIZE PIPE

TRY 18" RCP @ 1.0% MIN. SLOPE

$Q_{MAX} = 105\sqrt{.01} = 10.5$ CFS

10.5 > 1.98

∴ USE 18" RCP @ 1.0% MIN. SLOPE

BASIN D2

$Q_{100} = 2.94 + 0.90 = 3.84$ CFS (D2+OFF-1)

+ CHECK GUTTER FLOW DEPTH

S = 3.3% → d = 0.29' (FIG. 3-6)

CURB HEIGHT = 6" (0.5')

0.5' > 0.29' ✓

+ SIZE CURB INLET (ON-GRADE)

$L = \frac{Q_{100}}{.7(a+y)^{3/2}}$ a = 0.33, y = 0.29

$L = \frac{3.84}{.7(.33+.29)^{3/2}} = 11.2' \approx 12'$ OPENING

∴ USE 13' TYPE 'B-1' CURB INLET

+ SIZE STORM DRAIN

TRY 18" RCP @ 1.0% MIN. SLOPE

$Q_{MAX} = 105\sqrt{.01} = 10.5$ CFS

10.5 > 3.84 + 1.98 = 5.82 ✓

∴ USE 18" RCP @ 1.0% MIN. SLOPE

+ SIZE RIP RAP @ BIOFILTRATION BASIN

$Q_{100}/Q_{MAX} = 5.82/10.5 = 0.55$

$d/D = 0.53 \rightarrow V_{100}/V_{MAX} = 1.03$

$V_{MAX} = Q_{MAX}/A = 10.5/1.77 = 5.9$ FPS

$V_{100} = 1.03 \times 5.9 = 6.1$ FPS

∴ USE NO. 3 BACKING CLASS RIP RAP 0.6' THICK

BASIN OFF-1

Q_{100} = 0.90 CFS

+ CHECK GUTTER DEPTH FLOW

S = 1.0% → d = 0.24' (FIG. 3-6)

CURB HEIGHT = 6" (0.5')

0.50 > 0.24 ✓

BASIN OFF-2

$Q_{100} = 0.46$ CFS

+ CHECK GUTTER FLOW DEPTH

$S = 2.4\% \rightarrow d = 0.21'$ (FIG. 3-6)

CURB HEIGHT = 0.5' (6")

$0.50 > 0.21$ ✓

+ SIZE CURB INLET (ON-GRADE)

$$L = \frac{Q_{100}}{.7(a+y)^{3/2}}$$

$a = 0.33$

$y = 0.21$

$$L = \frac{0.46}{.7(.33+.21)^{3/2}} = 1.7' \simeq 2' \text{ OPENING}$$

∴ USE 5' TYPE 'B' CURB INLET

+ SIZE PIPE

TRY 18" RCP @ 1.0% MIN. SLOPE

$Q_{MAX} = 105\sqrt{.01} = 10.5$ CFS

$10.5 > 0.46$

∴ USE 18" RCP @ 1.0% MIN. SLOPE

BASIN E1

ROUTE ALL FLOWS INTO BASIN

LARGEST T_c = BASIN E1 (24.61 MIN.)
USE RATIOS OF T_c's TO ROUTE FLOWS

BASIN	Q_{100}	T_c	T_c/T_{cE1}	ROUTED Q_{100}
A1	3.98	10.19	0.41	1.63
A2	2.01	10.82	0.44	0.88
A3	2.51	9.15	0.37	0.93
A4	0.38	15.46	0.63	0.24
A5	0.46	17.36	0.71	0.33
A6	1.44	13.71	0.56	0.81
A7	0.85	13.00	0.53	0.45
A8	0.84	8.46	0.34	0.29
B1	0.63	22.57	0.92	0.58
C1	0.24	12.61	0.51	0.12
D1	1.98	5.51	0.22	0.44
D2	2.94	12.13	0.49	1.44
OFF-1	0.90	7.16	0.29	0.26
EX-B	1.80	4.10	0.17	0.31
EX-C	0.61	6.74	0.27	0.16

TOTAL ROUTED Q_{100} = 8.87 CFS
+ BASIN E1 0.10

8.97 CFS

+ CHECK INLET CAPACITY (TYPE 'I' CATCH BASIN)

$Q_{MAX} = CA\sqrt{2gh}$

$= (.62)(6.6)\sqrt{2(32.2).5}$

$C = 0.62$ (KINGS)

$A = 2 \times 3.3 = 6.6$ SF

$h = 0.5'$

$Q_{MAX} = 25.1$ CFS

$25.1 > 8.87$ ✓

∴ USE TYPE 'I' CATCH BASIN

+ SIZE PIPE

TRY 24" RCP @ 1.0% MIN. SLOPE

$Q_{MAX} = 226\sqrt{.01} = 22.6$ CFS

$22.6 > 8.87$

∴ USE 24" RCP @ 1.0% MIN. SLOPE

+ CHECK CAPACITY OF 36" RCP IN MARROKAL

MIN. SLOPE = 3.0%

$Q_{100} = 95.3^{*} + 8.87 + 0.46 = 104.6$ CFS

* TAKEN FROM DRAINAGE CALCS FOR MARROKAL STORM DRAIN DATED 1-5-02 (SEE NEXT SHEET)

$Q_{MAX} = 666\sqrt{.03} = 115.4$ CFS

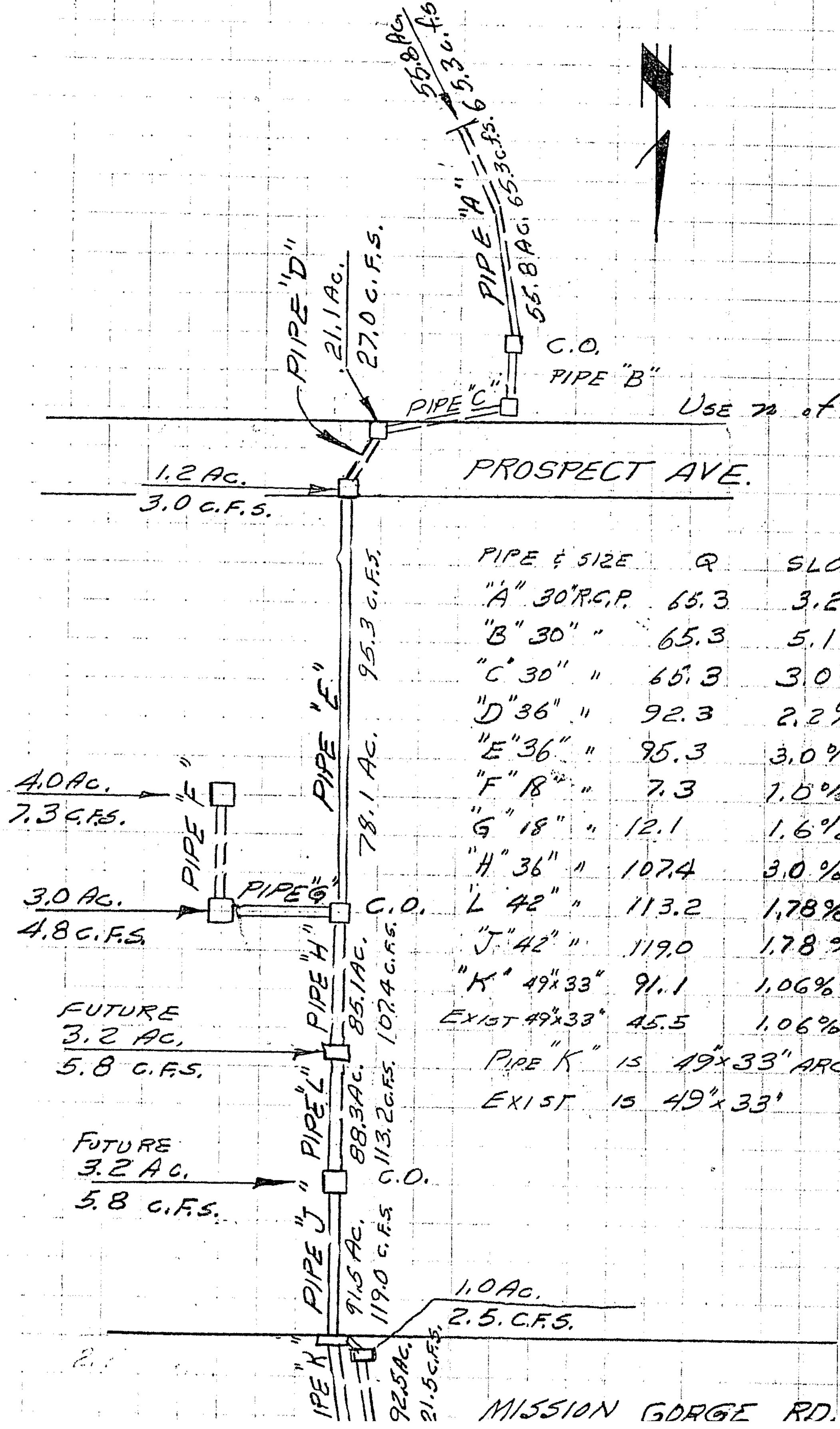
$115.4 > 104.6$ CFS

∴ EXISTING 36" RCP IN MARROKAL IS ADEQUATE

DRAINAGE CALCULATION
SOUTH & NORTH PROSPECT
W.O. # 1643 & 1655

1-5-82
W.O. No. 1643
SHEET 2 OF 4

5. Drainage Layout



PIPE & SIZE	Q	SLOPE	DEPTH	VEL
"A" 30" R.C.P.	65.3	3.2%	2.15'	14.5 FPS
"B" 30" "	65.3	5.1%	1.75'	17.8 FPS
"C" 30" "	65.3	3.0%	2.25'	14.0 F.P.S.
"D" 36" "	92.3	2.2%	2.75'	13.6 F.P.S.
"E" 36" "	95.3	3.0%	2.35'	16.0 F.P.S.
"F" 18" "	7.3	1.0%	1.05'	5.5 F.P.S.
"G" 18" "	12.1	1.6%	1.35'	7.2 F.P.S.
"H" 36" "	107.4	3.0%	2.80'	15.6 F.P.S.
"L" 42" "	113.2	1.78%	2.80'	13.7 F.P.S.
"J" 42" "	119.0	1.78%	2.95'	13.8 F.P.S.
"K" 49"x33"	91.1	1.06%	FULL	10.7 F.P.S.
EXIST 49"x33"	45.5	1.06%	FULL	5.4 F.P.S.

Pipe "K" is 49"x33" ARCH PIPE FULLY LINED
EXIST is 49"x33"

1-5-82
W.O. NO. 1643
SHEET 1 OF 4

DRAINAGE CALCULATION
SOUTH & NORTH Prospect
W.O. #1643 & 1655

1. Time of concentration = 17.5 MINUTES
   Rainfall I_{100} = 2.6 c.f.s./hr.

2. Runoff coefficients
   Soil Type = D

   Multi-Units = 0.70   Rural = 0.45

3 Runoff calc.

3.2 Ac × 0.70 × 2.6 = 5.8 c.f.s.

17.6 Ac. × 0.45 × 2.6 = 20.6 c.f.s.

55.8 Ac. × 0.45 × 2.6 = 65.3 c.f.s.

3.5 Ac. × 0.70 × 2.6 = 6.4 c.f.s.

(street) 1.2 Ac. × 0.95 × 2.6 = 3.0 c.f.s.

3.0 Ac. × 0.70 × 2.6 = 4.8 c.f.s.

4.0 Ac. × 0.70 × 2.6 = 7.3 c.f.s.

4. SIZE INLETS: ALL IN LETS ARE SUMP.

INLET SOUTH SIDE PROSPECT will receive 27 c.F.S. will construct 20 type B-2 and let overage go to 20' type B-2 constructed on North side of Prospect, total for two inlets will be 30 c.f.s.

INLETS IN North Prospect Inc. will receive 7.3 or 4.8 c.f.s.   7.3 × 2 = 14.6 (Use 20' TYPE "B-2")
4.8 × 2 = 9.6 (Use 15' TYPE "B-2")

APPENDIX 3

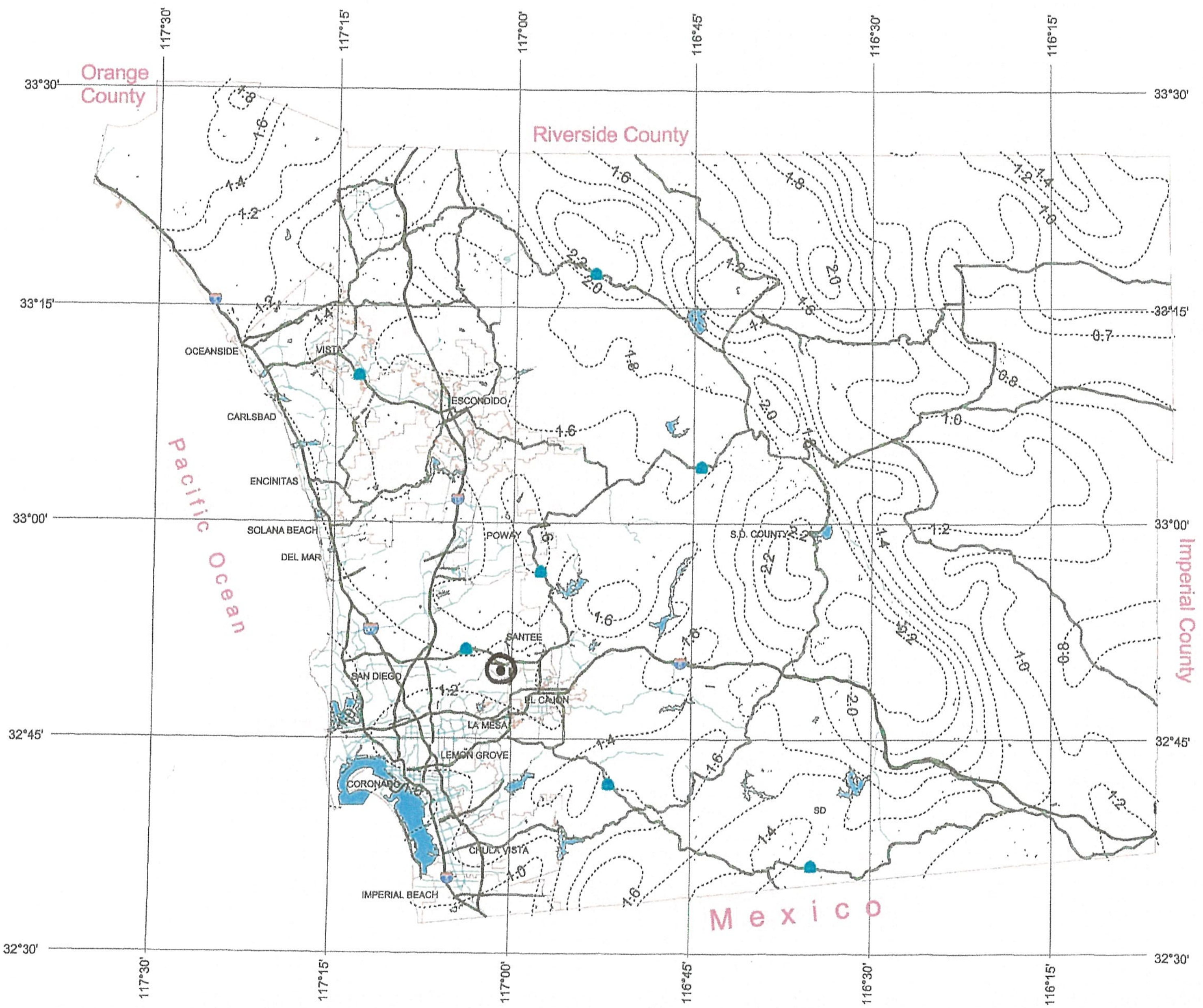
CITY OF SANTEE / COUNTY OF SAN DIEGO DRAINAGE DESIGN MANUAL CHARTS/FIGURES

County of San Diego Hydrology Manual

Rainfall Isopluvials

2 Year Rainfall Event - 6 Hours

.... Isopluvial (inches)



DPW GIS

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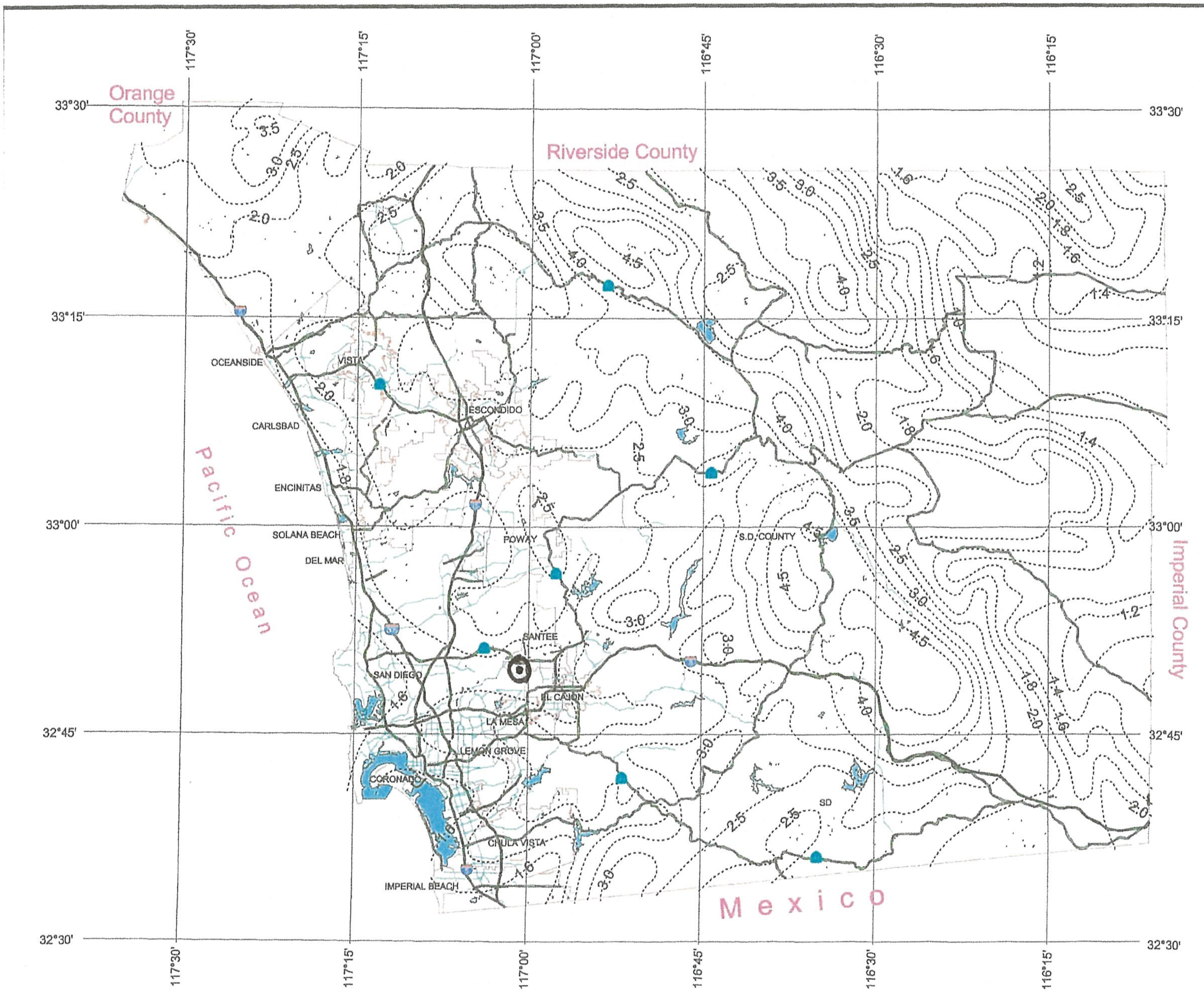
3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

2 Year Rainfall Event - 24 Hours

.... Isopluvial (inches)

DPW GIS

Department of Public Works
Geographic Information Services

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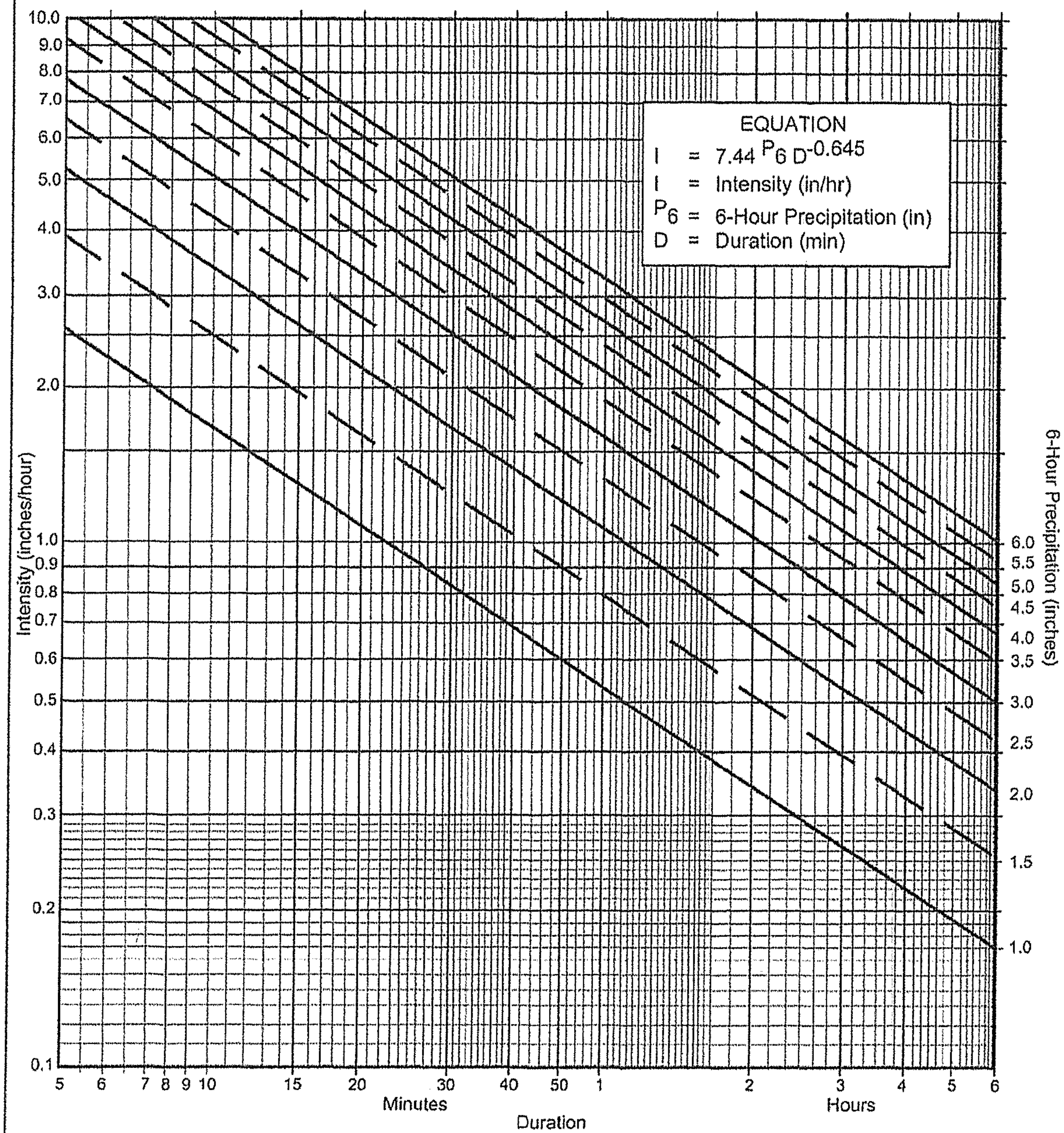
3 0 3 Miles



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 10 year

(b) P_6 = 1.7 in., P_{24} = 2.9, $\frac{P_6}{P_{24}}$ = 59 %(2)

(c) Adjusted $P_6^{(2)}$ = 1.7 in.

(d) t_x = ______ min.

(e) I = ______ in./hr.

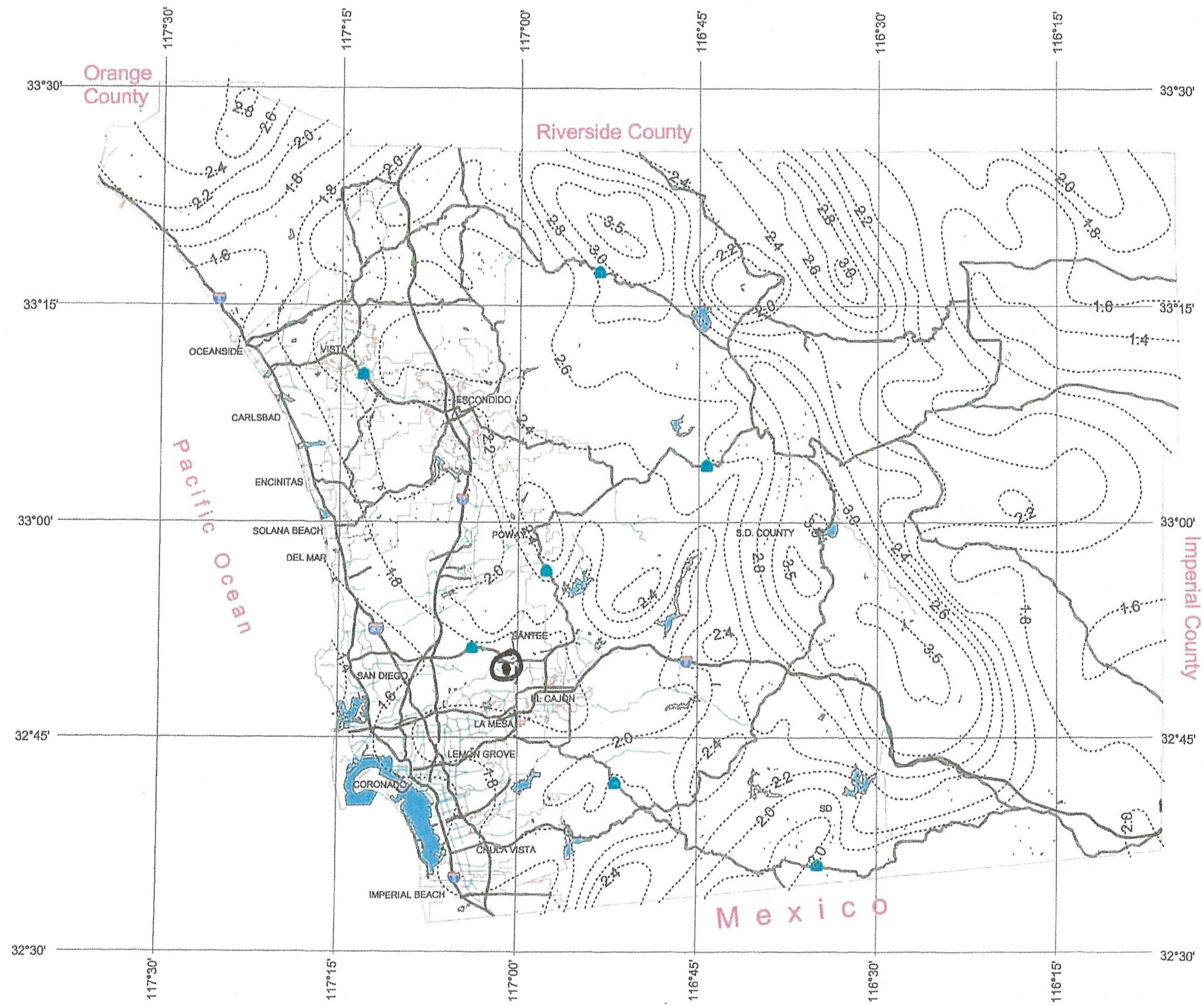
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6 / Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE

3-1



County of San Diego Hydrology Manual

Rainfall Isopluvials

10 Year Rainfall Event - 6 Hours

.... Isopluvial (inches)

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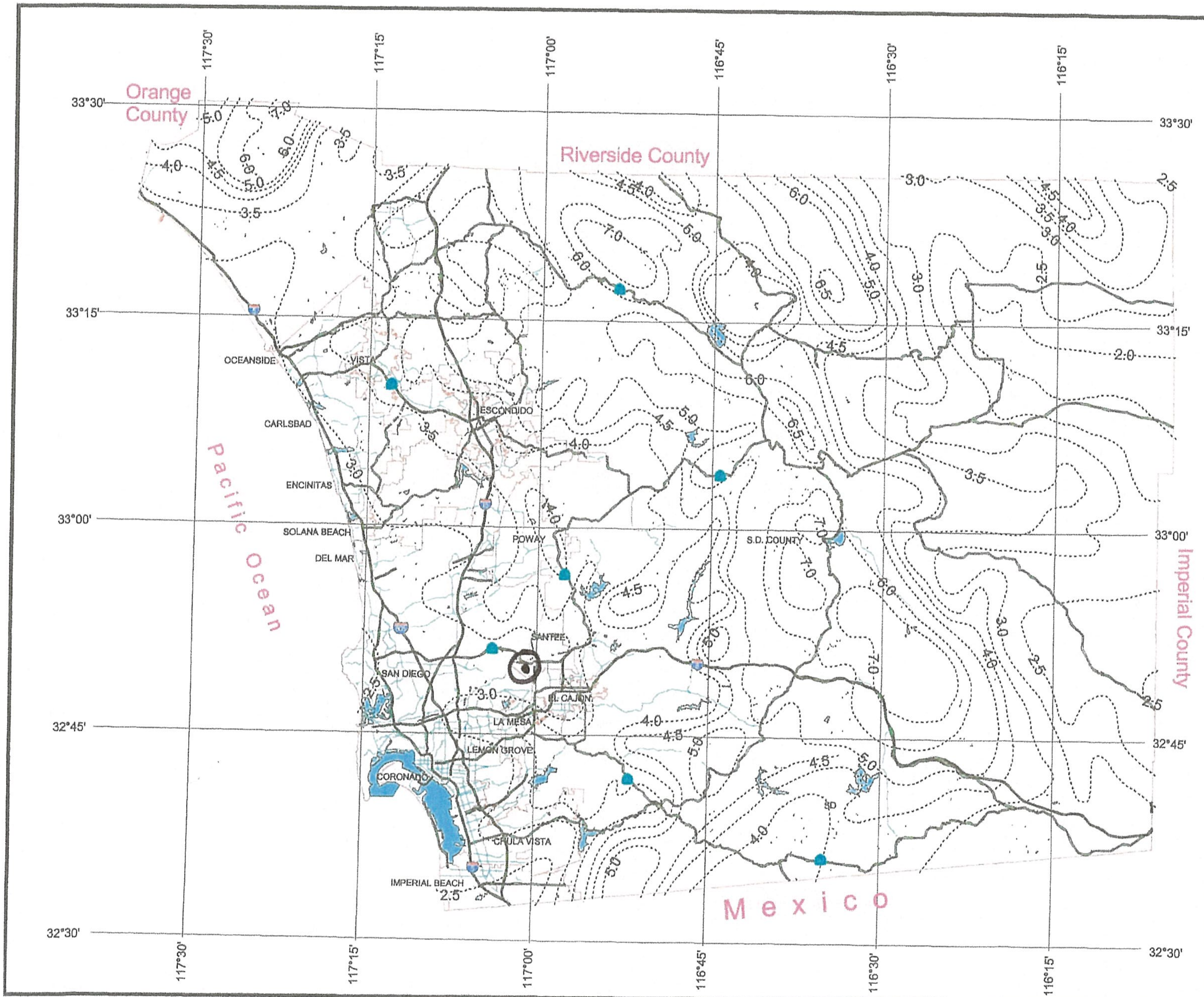
3 0 3 Miles

County of San Diego Hydrology Manual

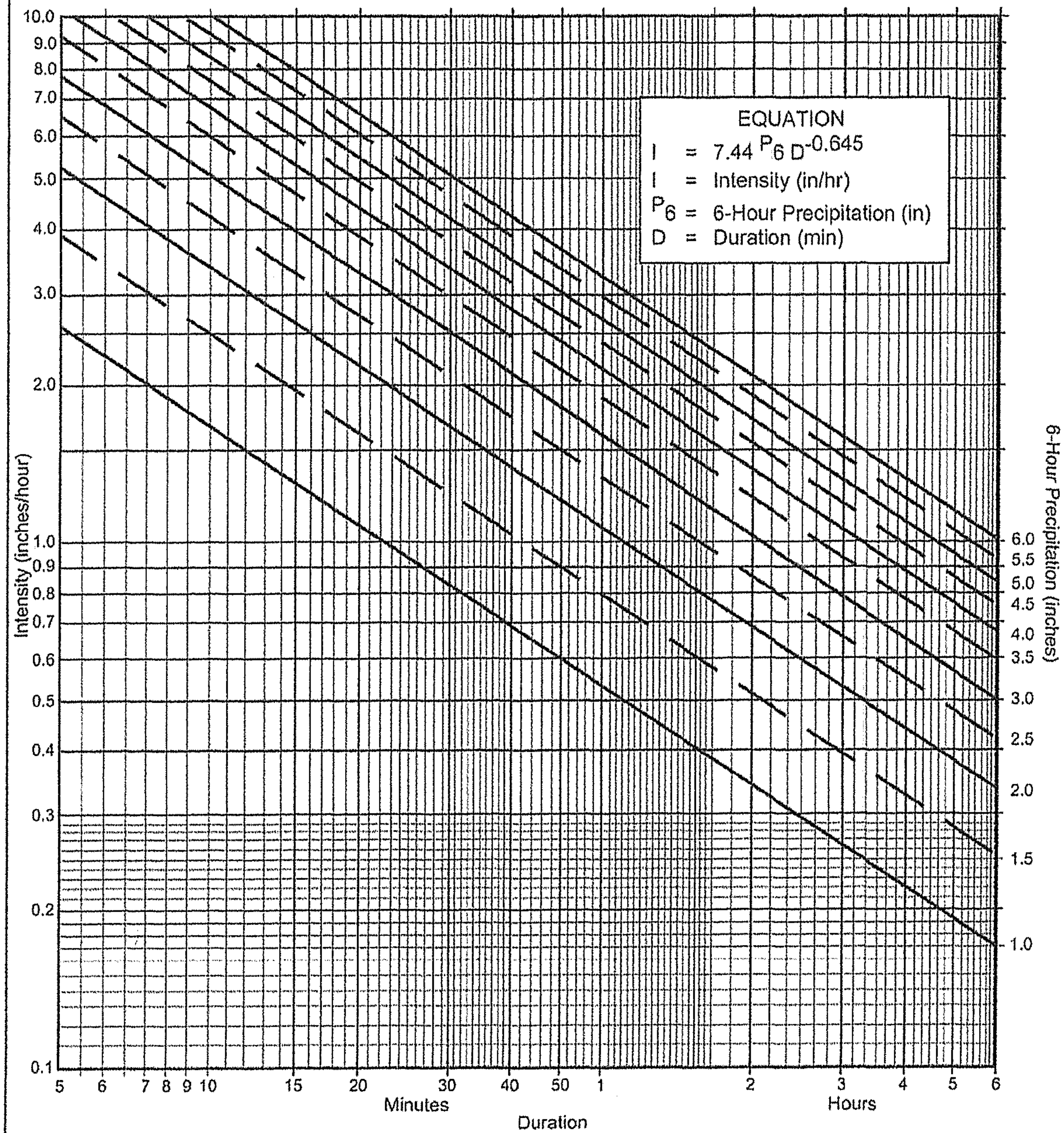
Rainfall Isopluvials

10 Year Rainfall Event - 24 Hours



Isopluvial (inches)

3 0 3 Miles



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 100 year

(b) P_6 = 2.4 in., P_{24} = 4.4, $\frac{P_6}{P_{24}}$ = 55 %(2)

(c) Adjusted $P_6^{(2)}$ = 2.4 in.

(d) t_x = ______ min.

(e) I = ______ in./hr.

Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6 / Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE

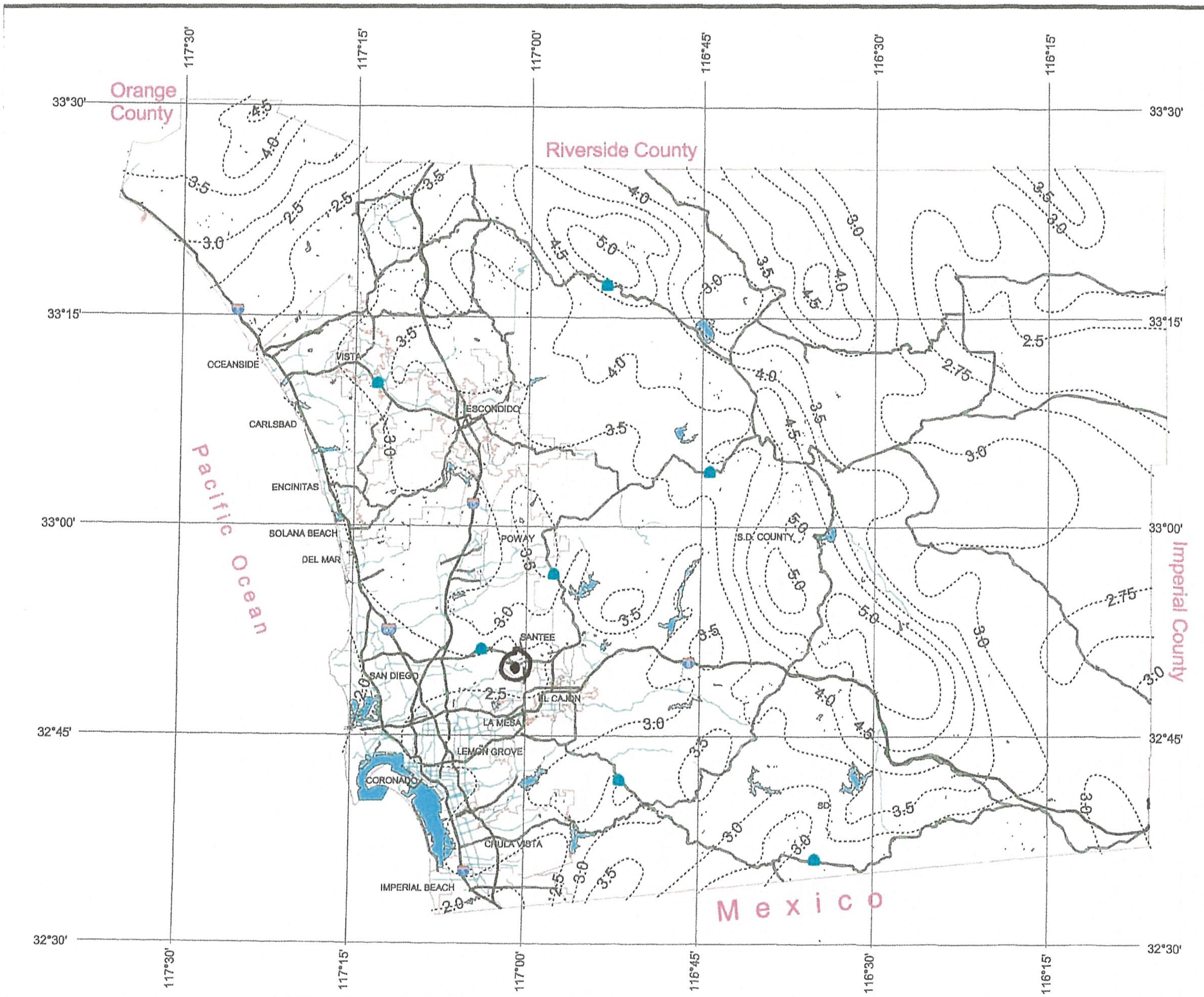
3-1

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

.... Isopluvial (inches)



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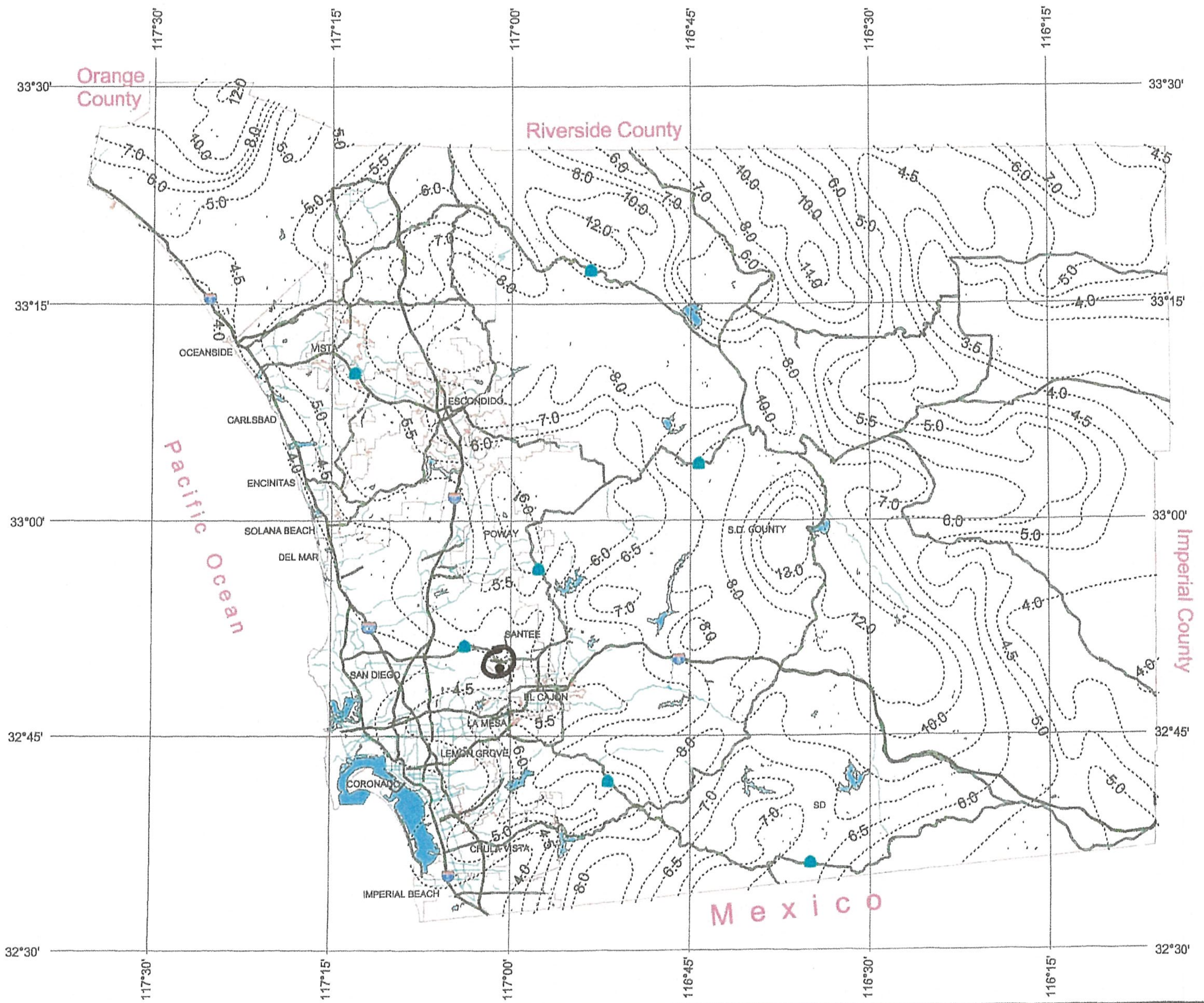

County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

.... Isopluvial (inches)

DPW GIS

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N W E S

3 0 3 Miles

Note that the Initial Time of Concentration should be reflective of the general land-use at the upstream end of a drainage basin. A single lot with an area of two or less acres does not have a significant effect where the drainage basin area is 20 to 600 acres.

Table 3-2 provides limits of the length (Maximum Length (L_M)) of sheet flow to be used in hydrology studies. Initial T_i values based on average C values for the Land Use Element are also included. These values can be used in planning and design applications as described below. Exceptions may be approved by the "Regulating Agency" when submitted with a detailed study.

Table 3-2

MAXIMUM OVERLAND FLOW LENGTH (L_M) & INITIAL TIME OF CONCENTRATION (T_i)

Element*	DU/ Acre	.5%		1%		2%		3%		5%		10%	
		L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i	L_M	T_i
Natural		50	13.2	70	12.5	85	10.9	100	10.3	100	8.7	100	6.9
LDR	1	50	12.2	70	11.5	85	10.0	100	9.5	100	8.0	100	6.4
LDR	2	50	11.3	70	10.5	85	9.2	100	8.8	100	7.4	100	5.8
LDR	2.9	50	10.7	70	10.0	85	8.8	95	8.1	100	7.0	100	5.6
MDR	4.3	50	10.2	70	9.6	80	8.1	95	7.8	100	6.7	100	5.3
MDR	7.3	50	9.2	65	8.4	80	7.4	95	7.0	100	6.0	100	4.8
MDR	10.9	50	8.7	65	7.9	80	6.9	90	6.4	100	5.7	100	4.5
MDR	14.5	50	8.2	65	7.4	80	6.5	90	6.0	100	5.4	100	4.3
HDR	24	50	6.7	65	6.1	75	5.1	90	4.9	95	4.3	100	3.5
HDR	43	50	5.3	65	4.7	75	4.0	85	3.8	95	3.4	100	2.7
N. Com		50	5.3	60	4.5	75	4.0	85	3.8	95	3.4	100	2.7
G. Com		50	4.7	60	4.1	75	3.6	85	3.4	90	2.9	100	2.4
O.P./Com		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
Limited I.		50	4.2	60	3.7	70	3.1	80	2.9	90	2.6	100	2.2
General I.		50	3.7	60	3.2	70	2.7	80	2.6	90	2.3	100	1.9

*See Table 3-1 for more detailed description

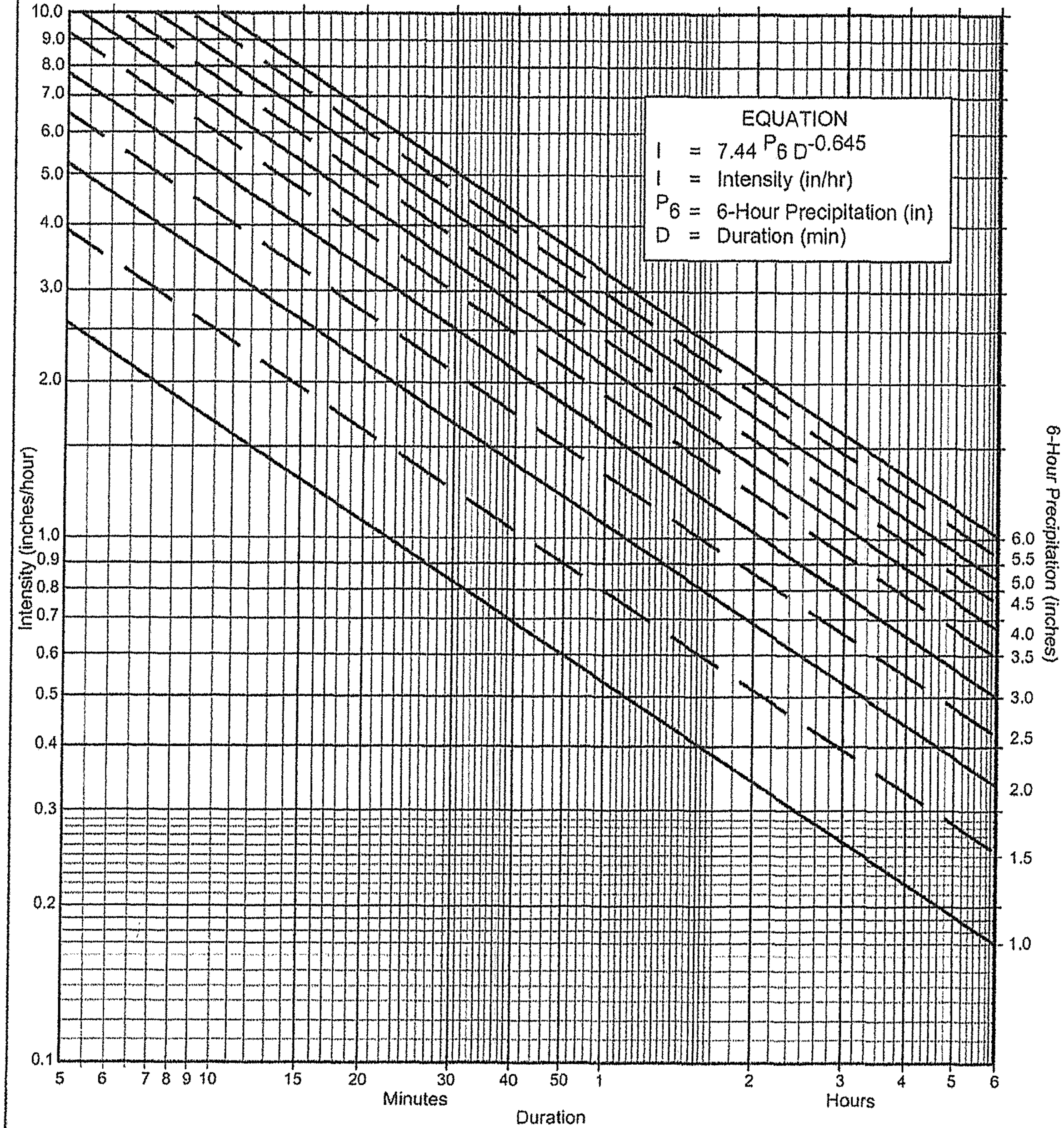
Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

Land Use		Runoff Coefficient "C"				
			Soil Type			
NRCS Elements	County Elements	% IMPER.	A	B	C	D
Undisturbed Natural Terrain (Natural)	Permanent Open Space	0*	0.20	0.25	0.30	0.35
Low Density Residential (LDR)	Residential, 1.0 DU/A or less	10	0.27	0.32	0.36	0.41
Low Density Residential (LDR)	Residential, 2.0 DU/A or less	20	0.34	0.38	0.42	0.46
Low Density Residential (LDR)	Residential, 2.9 DU/A or less	25	0.38	0.41	0.45	0.49
Medium Density Residential (MDR)	Residential, 4.3 DU/A or less	30	0.41	0.45	0.48	0.52
Medium Density Residential (MDR)	Residential, 7.3 DU/A or less	40	0.48	0.51	0.54	0.57
Medium Density Residential (MDR)	Residential, 10.9 DU/A or less	45	0.52	0.54	0.57	0.60
Medium Density Residential (MDR)	Residential, 14.5 DU/A or less	50	0.55	0.58	0.60	0.63
High Density Residential (HDR)	Residential, 24.0 DU/A or less	65	0.66	0.67	0.69	0.71
High Density Residential (HDR)	Residential, 43.0 DU/A or less	80	0.76	0.77	0.78	0.79
Commercial/Industrial (N. Com)	Neighborhood Commercial	80	0.76	0.77	0.78	0.79
Commercial/Industrial (G. Com)	General Commercial	85	0.80	0.80	0.81	0.82
Commercial/Industrial (O.P. Com)	Office Professional/Commercial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (Limited I.)	Limited Industrial	90	0.83	0.84	0.84	0.85
Commercial/Industrial (General I.)	General Industrial	95	0.87	0.87	0.87	0.87

*The values associated with 0% impervious may be used for direct calculation of the runoff coefficient as described in Section 3.1.2 (representing the pervious runoff coefficient, Cp, for the soil type), or for areas that will remain undisturbed in perpetuity. Justification must be given that the area will remain natural forever (e.g., the area is located in Cleveland National Forest).

DU/A = dwelling units per acre

NRCS = National Resources Conservation Service



Directions for Application:

(1) From precipitation maps determine 6 hr and 24 hr amounts for the selected frequency. These maps are included in the County Hydrology Manual (10, 50, and 100 yr maps included in the Design and Procedure Manual).

(2) Adjust 6 hr precipitation (if necessary) so that it is within the range of 45% to 65% of the 24 hr precipitation (not applicaple to Desert).

(3) Plot 6 hr precipitation on the right side of the chart.

(4) Draw a line through the point parallel to the plotted lines.

(5) This line is the intensity-duration curve for the location being analyzed.

Application Form:

(a) Selected frequency 2 year

(b) P_6 = 1.2 in., P_{24} = 1.8, $\frac{P_6}{P_{24}}$ = 67 %(2)

(c) Adjusted $P_6^{(2)}$ = 1.1 in.

(d) t_x = ______ min.

(e) I = ______ in./hr.

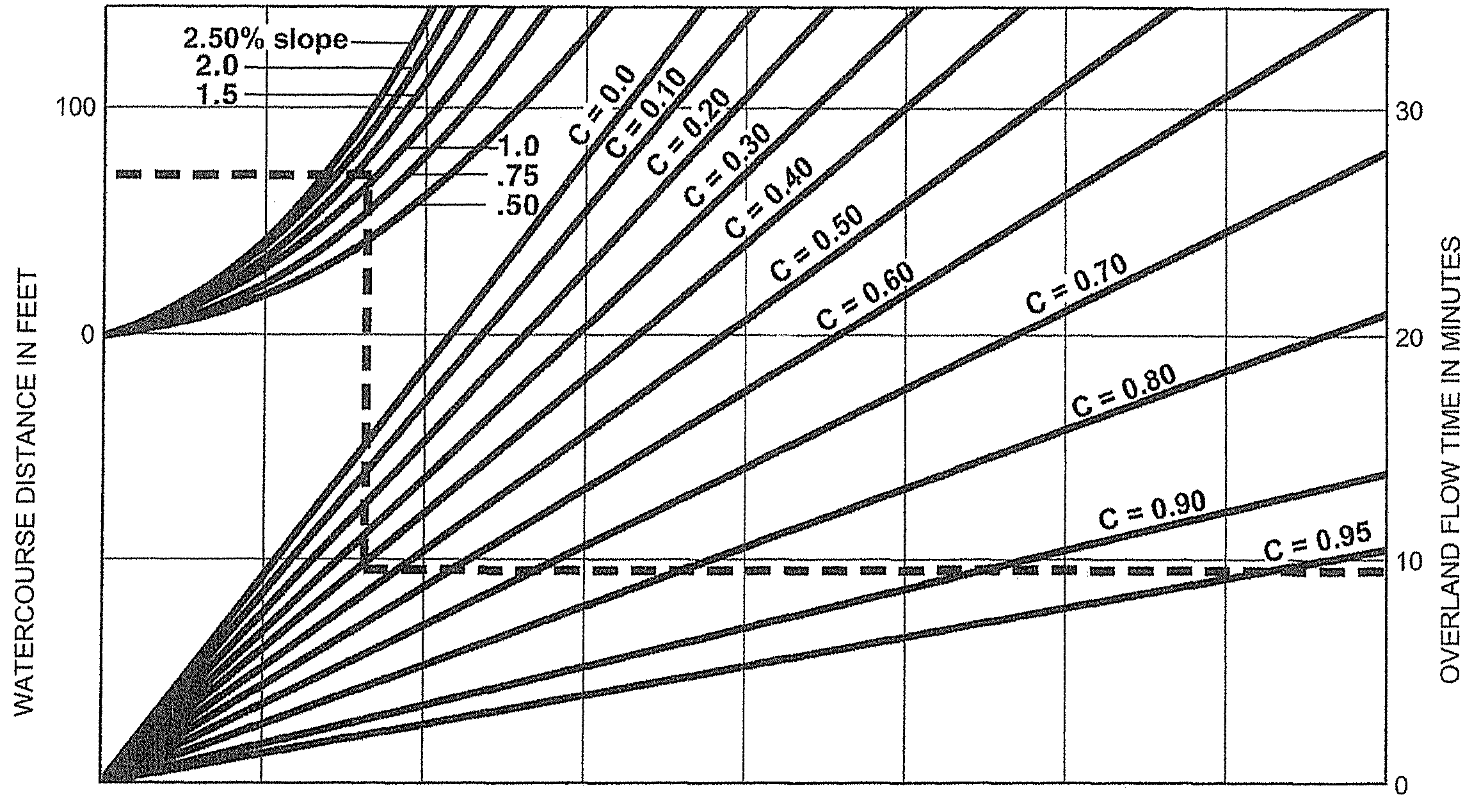
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

P6 / Duration	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
5	2.63	3.95	5.27	6.59	7.90	9.22	10.54	11.86	13.17	14.49	15.81
7	2.12	3.18	4.24	5.30	6.36	7.42	8.48	9.54	10.60	11.66	12.72
10	1.68	2.53	3.37	4.21	5.05	5.90	6.74	7.58	8.42	9.27	10.11
15	1.30	1.95	2.59	3.24	3.89	4.54	5.19	5.84	6.49	7.13	7.78
20	1.08	1.62	2.15	2.69	3.23	3.77	4.31	4.85	5.39	5.93	6.46
25	0.93	1.40	1.87	2.33	2.80	3.27	3.73	4.20	4.67	5.13	5.60
30	0.83	1.24	1.66	2.07	2.49	2.90	3.32	3.73	4.15	4.56	4.98
40	0.69	1.03	1.38	1.72	2.07	2.41	2.76	3.10	3.45	3.79	4.13
50	0.60	0.90	1.19	1.49	1.79	2.09	2.39	2.69	2.98	3.28	3.58
60	0.53	0.80	1.06	1.33	1.59	1.86	2.12	2.39	2.65	2.92	3.18
90	0.41	0.61	0.82	1.02	1.23	1.43	1.63	1.84	2.04	2.25	2.45
120	0.34	0.51	0.68	0.85	1.02	1.19	1.36	1.53	1.70	1.87	2.04
150	0.29	0.44	0.59	0.73	0.88	1.03	1.18	1.32	1.47	1.62	1.76
180	0.26	0.39	0.52	0.65	0.78	0.91	1.04	1.18	1.31	1.44	1.57
240	0.22	0.33	0.43	0.54	0.65	0.76	0.87	0.98	1.08	1.19	1.30
300	0.19	0.28	0.38	0.47	0.56	0.66	0.75	0.85	0.94	1.03	1.13
360	0.17	0.25	0.33	0.42	0.50	0.58	0.67	0.75	0.84	0.92	1.00

Intensity-Duration Design Chart - Template

FIGURE

3-1



EXAMPLE:

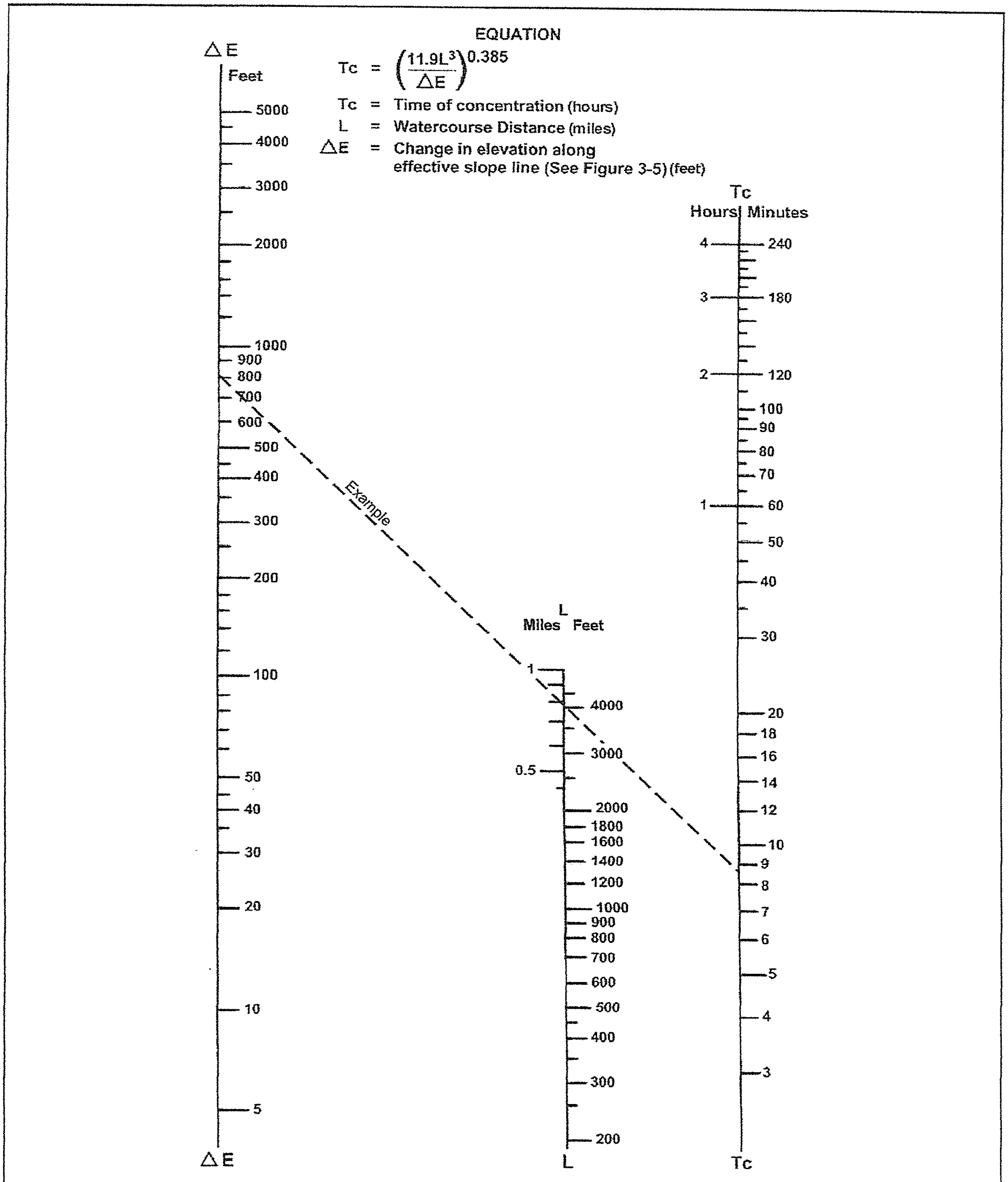
Given: Watercourse Distance (D) = 70 Feet
Slope (s) = 1.3%
Runoff Coefficient (C) = 0.41
Overland Flow Time (T) = 9.5 Minutes

$$T = \frac{1.8\,(1.1-C)\sqrt{D}}{\sqrt[3]{s}}$$

SOURCE: Airport Drainage, Federal Aviation Administration, 1965

FIGURE 3-3

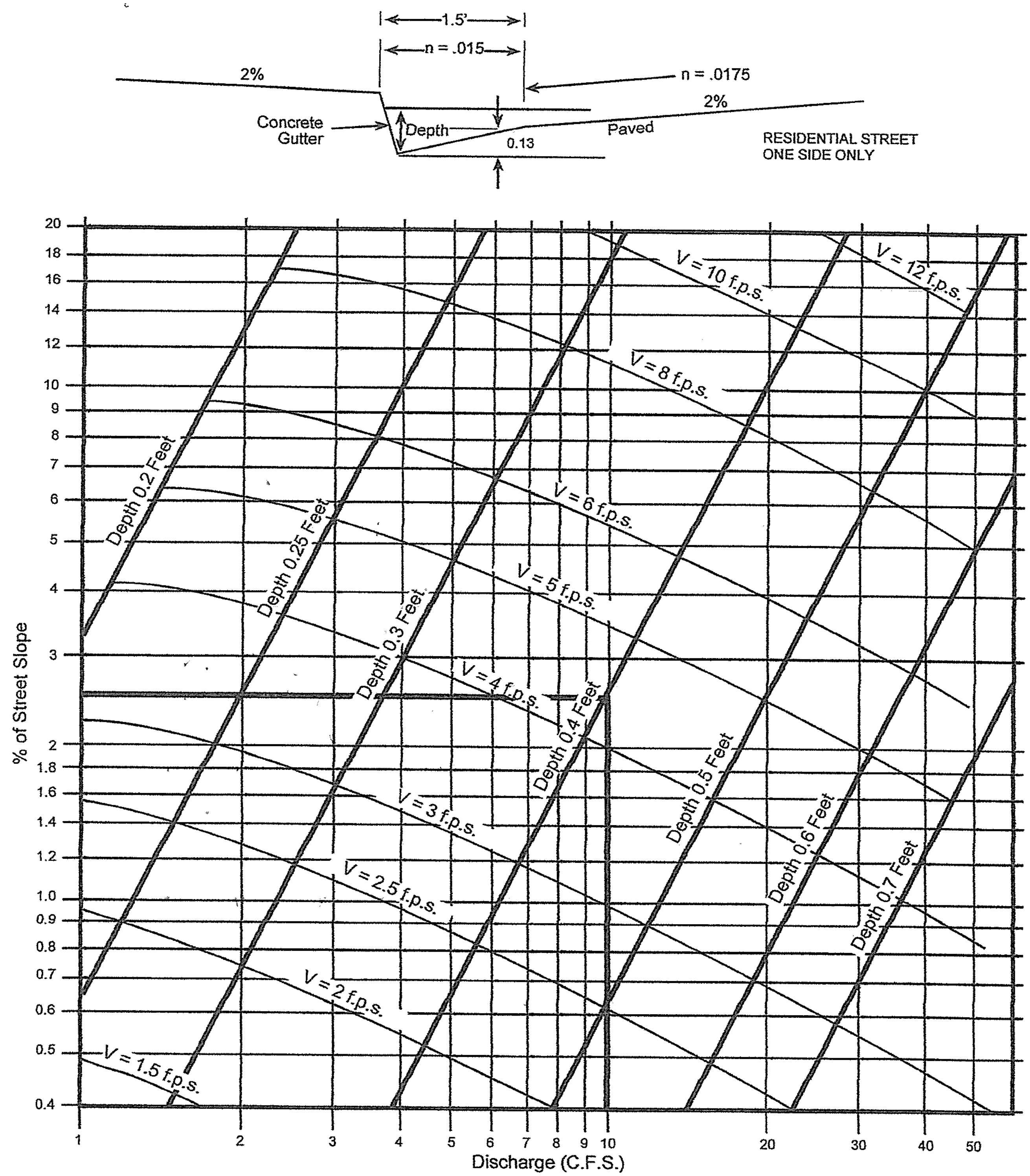
Rational Formula - Overland Time of Flow Nomograph



SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE **3-4**

Nomograph for Determination of
Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds



EXAMPLE:
Given: Q = 10 S = 2.5%
Chart gives: Depth = 0.4, Velocity = 4.4 f.p.s.

SOURCE: San Diego County Department of Special District Services Design Manual

FIGURE 3-6

Gutter and Roadway Discharge - Velocity Chart

4"-Km=1.89 8"-Km=11.78 Q = KM(SF)^1/2

3" Area = 0.0?
4" Area = 0.087
6" Area = 0.196
8" Area = 0.35
10" AREA = 0.55

TABLE III A-1

CONVEYANCE FACTORS - R.C. PIPE OR BOX

PIPE			EQUIVALENT BOX			CONVEYANCE PIPE OR BOX
AREA (sq.ft.)	DIA. (in.)	K_F for L = 100 ft.	H	W	A (sq.ft.)	K_M
0.7854	12	3.126				35.6
.227	15	2.322				64.6
1.77	18	1.821				105
2.41	21	1.483				158
3.14	24	1.241				226
3.98	27	1.060				310
4.91	30	.921				410
5.94	33	.8115				529
7.07	36	.7226	3'-0"	2'-6"	7.50	666
8.30	39	.6495	3'-3"	2'-9"	8.80	825
9.62	42	.5883	3'-6"	2'-11"	10.21	1006
11.04	45	.5366	3'-9"	3'-2"	11.72	1209
12.57	48	.4924	4'-0"	3'-4"	13.34	1436
14.19	51	.4542	4'-3"	3'-7"	15.06	1690
15.90	54	.4208	4'-6"	3'-9"	16.87	1965
17.72	57	.3916	4'-9"	4'-0"	18.80	2273
19.63	60	.3657	5'-0"	4'-2"	20.83	2604
21.65	63	.3426	5'-3"	4'-4"	22.98	2964
23.76	66	.3220	5'-6"	4'-7"	25.21	3357
25.97	69	.3035	5'-9"	4'-10"	27.55	3782
28.27	72	.2868	6'-0"	5'-0"	30.00	4234
30.68	75	.2716	6'-3"	5'-3"	32.55	4720
33.18	78	.2577	6'-6"	5'-5"	35.21	5242
35.79	81	.2451	6'-9"	5'-8"	37.97	5796
38.49	84	.2335	7'-0"	5'-10"	40.83	6388
41.28	87	.2228	7'-3"	6'-1"	43.80	7012
44.18	90	.2130	7'-6"	6'-3"	46.87	7676
47.17	93	.2039	7'-9"	6'-6"	50.05	8380
50.27	96	.1954	8'-0"	6'-8"	53.34	9119
53.46	99	.1876	8'-3"	6'-11"	56.31	9899
56.75	102	.1802	8'-6"	7'-1"	60.21	10719
60.13	105	.1734	8'-9"	7'-4"	63.34	11582
63.62	108	.1670	9'-0"	7'-6"	67.50	12486
67.20	111	.1610	9'-3"	7'-9"	70.88	13427
70.88	114	.1554	9'-6"	7'-11"	75.21	14427
74.66	117	.1501	9'-9"	8'-2"	78.83	15457
78.54	120	.1451	10'-0"	8'-4"	83.33	16537
82.52	123	.1404	10'-3"	8'-7"	87.11	17649
86.59	126	.1360	10'-6"	8'-9"	91.87	18856
90.76	129	.1318	10'-9"	9'-0"	95.89	20065
95.03	132	.1278	11'-0"	9'-2"	100.83	21324
99.40	135	.1240	11'-3"	9'-5"	105.06	22634
103.87	138	.1204	11'-6"	9'-7"	110.21	24032
108.43	141	.1170	11'-9"	9'-10"	114.61	25434
113.10	144	.1138	12'-0"	10'-0"	120.00	26891

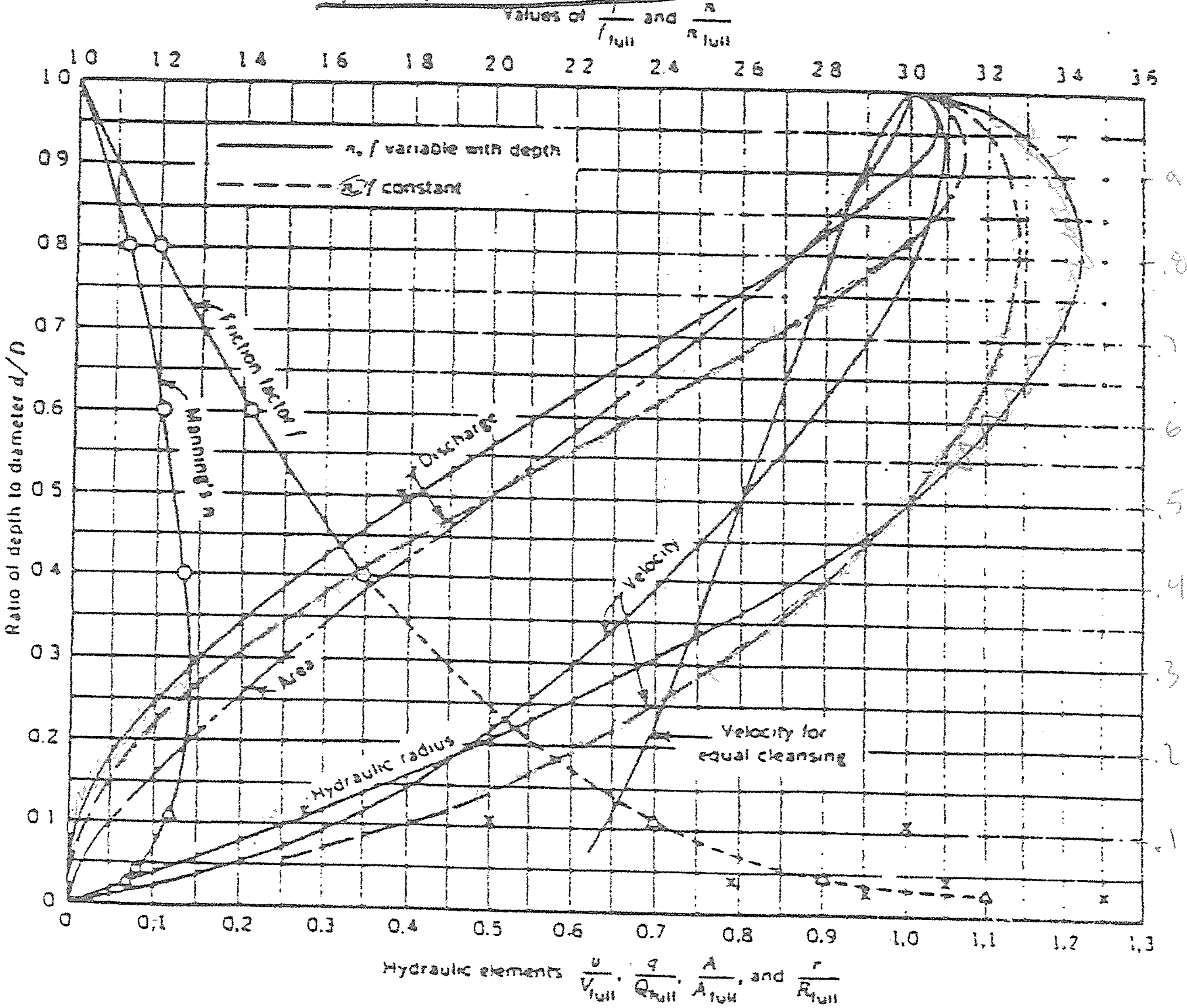
$$S_F = \left(\frac{Q}{K_M}\right)^2 \qquad n = .013$$

$$K_M = \frac{1.486}{n}\ (ar^{2/3})$$

$$K_F = L(185\ n^2/d^{4/3})$$

MEH:HILL\CONVEY.CHT

APPENDIX 5



v = Actual velocity of flow (fps)

V_{full} = Velocity flowing full (fps)

q = Actual quantity of flow (cfs)

Q_{full} = Capacity flowing full (cfs)

A Area occupied by flow (ft^2)

A_{full} = Area of pipe (ft^2)

r = Actual hydraulic radius (ft)

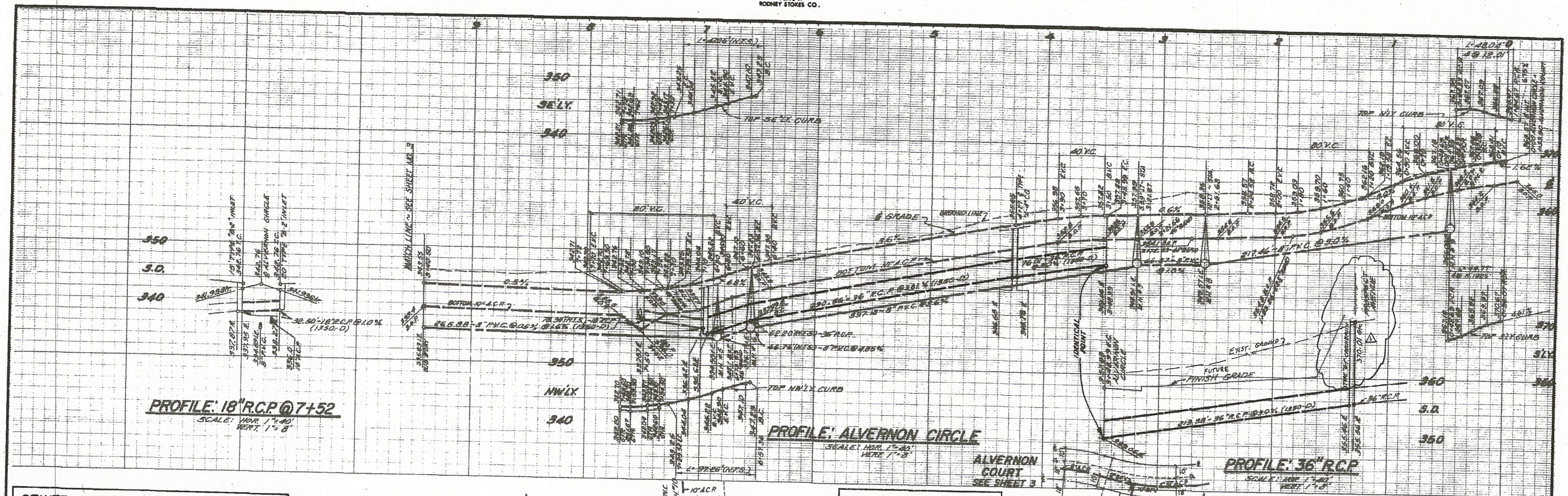
R_{full} = Hydraulic radius of full pipe (ft.)

Fig. II-3. Hydraulic Elements Chart

APPENDIX 4

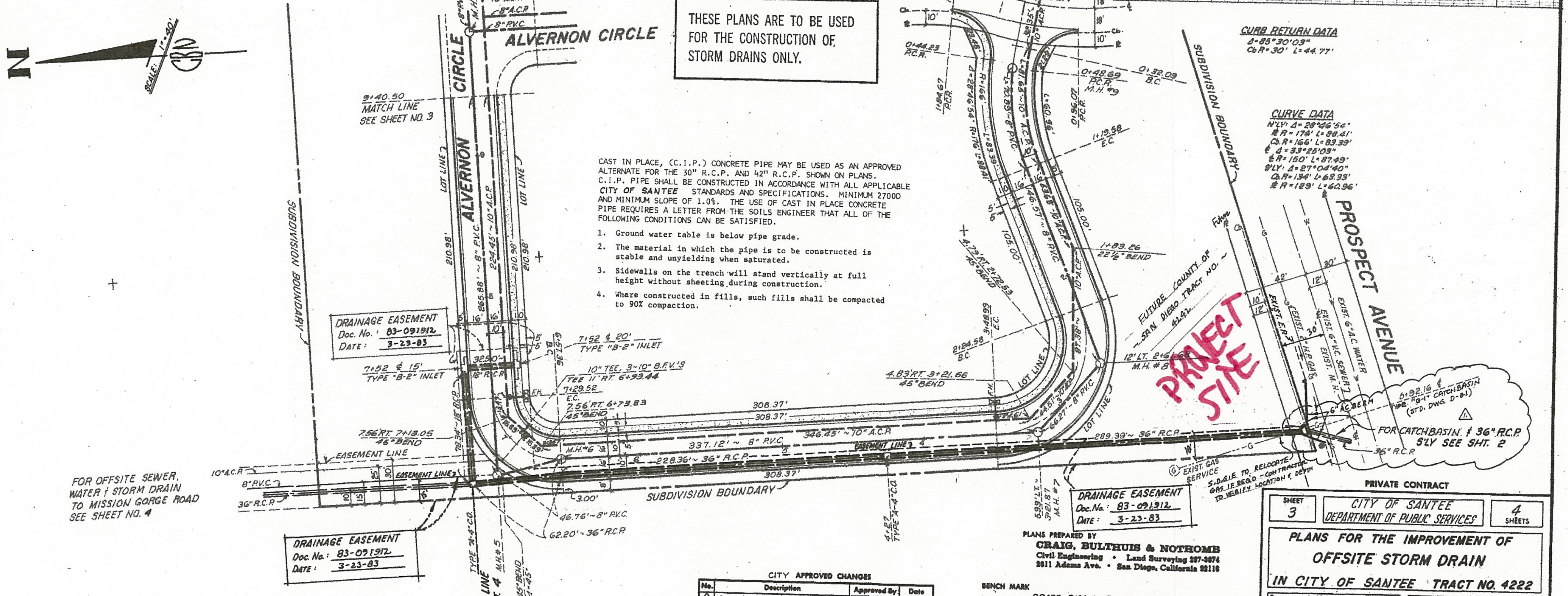
HYDROMODIFICATION EXHIBIT

"PERFECT" PROFILE
PLATE A
RODNEY STOKES CO.



SEWER & WATER LATERAL DATA TABLE

LOT NO.	INV.ELEV. MAIN	DROP TO MAIN	SEWER LENGTH	INV.ELEV. @ R	CB.ELEV. SEWER	DEPTH @ R	CB.ELEV. WATER	REMARKS
1	366.2	0.3'	26'	367.5	372.5	@5'	371.38	CONNECT WATER SERVICE TO EXISTING.
2	366.9	"	26'	369.2	374.2	5'	374.40	
3	368.6	"	26'	371.6	376.6	5'	376.30	
4	370.9	"	26'	374.5	379.5	5'	379.78	
5	372.7	"	26'	376.8	381.8	5'	381.52	
6	374.6	"	26'	379.1	384.1	5'	384.43	
7	375.4	"	26'	380.1	385.1	5'	384.81	
8	377.2	"	26'	382.1	387.1	5'	387.30	
9	377.7	"	26'	382.6	387.6	5'	387.35	
10	379.4	"	25'	384.2	389.2	5'	389.42	SEWER LAT. IN DRIVE.
11	379.9	"	18'	385.1	390.1	5'	389.90	
12	379.9	"	27'	386.2	391.2	5'	391.33	SEWER LAT. IN DRIVE.
13	379.9	"	44'	386.2	391.2	5'	391.20	to Exist. house
14	379.9	0.3'	47'	386.0	391.0	5'	391.23	
15	379.9	"	66'	384.6	389.6	5'	389.40	SEWER LAT. IN DRIVE.
16	378.7	"	70'	383.9	388.9	5'	389.16	
17	375.9	"	31'	380.5	385.5	5'	385.52	
18	372.8	"	26'	376.9	381.9	5'	382.24	
19	370.7	"	26'	374.2	379.2	5'	378.88	
20	368.5	"	26	371.4	376.4	5'	376.96	
21	366.8	"	26'	369.0	374.0	5'	373.73	
22		"	42'	368.9	373.9	5'	373.77	
23				369.0	374.0	5'	374.42	CONNECT LATERALS TO EXISTING LATERALS.



THESE PLANS ARE TO BE USED FOR THE CONSTRUCTION OF STORM DRAINS ONLY.

CAST IN PLACE, (C.I.P.) CONCRETE PIPE MAY BE USED AS AN APPROVED ALTERNATE FOR THE 30" R.C.P. AND 42" R.C.P. SHOWN ON PLANS. C.I.P. PIPE SHALL BE CONSTRUCTED IN ACCORDANCE WITH ALL APPLICABLE *CITY OF SANTEE* STANDARDS AND SPECIFICATIONS. MINIMUM 2700D AND MINIMUM SLOPE OF 1.0%. THE USE OF CAST IN PLACE CONCRETE PIPE REQUIRES A LETTER FROM THE SOILS ENGINEER THAT ALL OF THE FOLLOWING CONDITIONS CAN BE SATISFIED.

1. Ground water table is below pipe grade.
2. The material in which the pipe is to be constructed is stable and unyielding when saturated.
3. Sidewalls on the trench will stand vertically at full height without sheeting during construction.
4. Where constructed in fills, such fills shall be compacted to 90% compaction.

DRAINAGE EASEMENT
Doc. No.: 83-091912
Date: 3-23-83

CITY APPROVED CHANGES

No.	Description	Approved By	Date
1	Revised Inlet to Catchbasin	LMS	5-3-84

PLANS PREPARED BY
CRAIG, BULTHUIS & NOTHOMB
Civil Engineering • Land Surveying 297-3974
2811 Adams Ave. • San Diego, California 92116

BENCH MARK
Description: BRASS DISC MARKED "EC190"
Location: N.W. CURB RETURN, MISSION GORGE ROAD AND CARLTON HILLS BLVD.
Record From: COUNTY OF SAN DIEGO
Elev: 328.501 Datum: U.S.G.S.

PRIVATE CONTRACT

SHEET 3	CITY OF SANTEE DEPARTMENT OF PUBLIC SERVICES	4 SHEETS

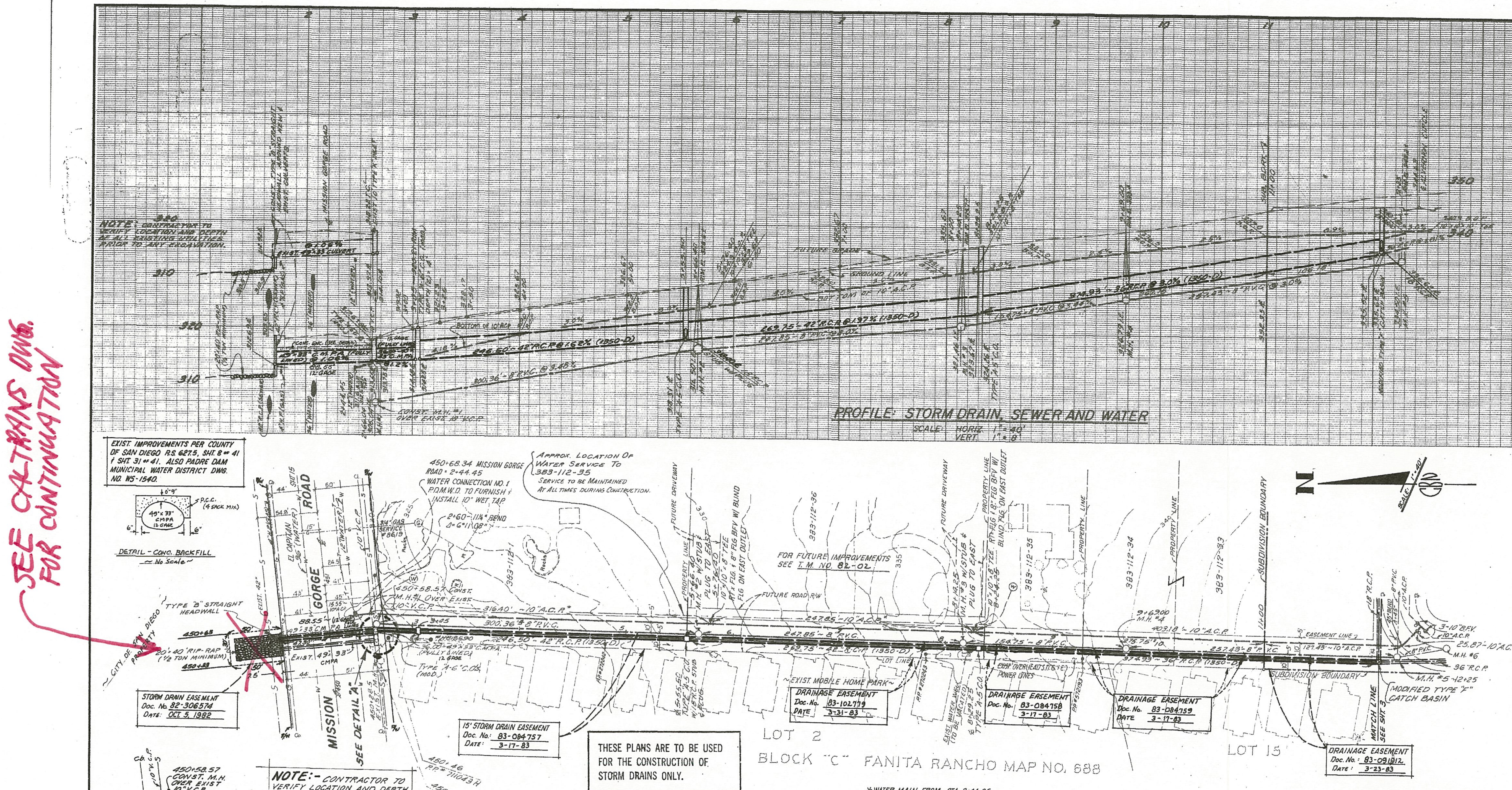
PLANS FOR THE IMPROVEMENT OF
OFFSITE STORM DRAIN
IN CITY OF SANTEE TRACT NO. 4222

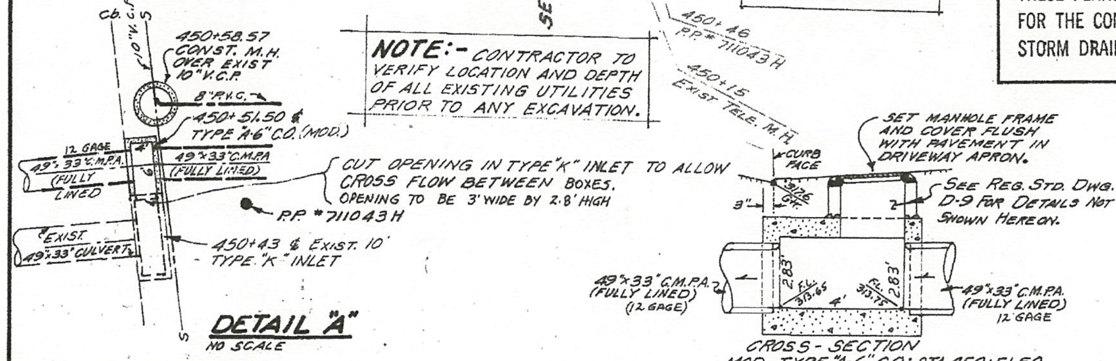
Recommended for Approval — Subdivision Engineer
CITY ENGINEER: JOHN P. SULLIVAN
Engineer of work: R.J. Bulthuis, Jan 20, 1982, RCE 13745
Checked by: R.S.D.
Approval date
T.M. 4222-1

⚠1 CONSTRUCTION CHANGE

FILE NO.

"PERFECT" PROFILE PLATE A RODNEY STOKES CO.





* WATER MAIN FROM STA. 2+44.36 to STA. 11+00 TO BE CONSTRUCTED BY P.D.M.W.D. SEE LETTER DATED NOV. 17, 1981.

CAST IN PLACE, (C.I.P.) CONCRETE PIPE MAY BE USED AS AN APPROVED ALTERNATE FOR THE 36" R.C.P. AND 42" R.C.P. SHOWN ON PLANS. C.I.P. PIPE SHALL BE CONSTRUCTED IN ACCORDANCE WITH ALL APPLICABLE CITY OF SANTEE STANDARDS AND SPECIFICATIONS. MINIMUM 2700D AND MINIMUM SLOPE OF 1.0%. THE USE OF CAST IN PLACE CONCRETE PIPE REQUIRES A LETTER FROM THE SOILS ENGINEER THAT ALL OF THE FOLLOWING CONDITIONS CAN BE SATISFIED.

1. Ground water table is below pipe grade.
2. The material in which the pipe is to be constructed is stable and unyielding when saturated.
3. Sidewalls on the trench will stand vertically at full height without sheeting during construction.
4. Where constructed in fills, such fills shall be compacted to 90% compaction.

COUNTY APPROVED CHANGES

No.	Description	Approved By	Date

PLANS PREPARED BY
CRAIG, BULTHUIS & NOTHOMB
Civil Engineering • Land Surveying 297-3874
2811 Adams Ave. • San Diego, California 92116

BENCH MARK
Description: BRASS DISC MARKED "E.C. 190"
Location: N.W. CURB RETURN, MISSION GORGE ROAD AND CARLTON HILLS BOULEVARD
Record From: COUNTY OF SAN DIEGO
Elev: 328.501 Datum: U.S.G.S.

PRIVATE CONTRACT

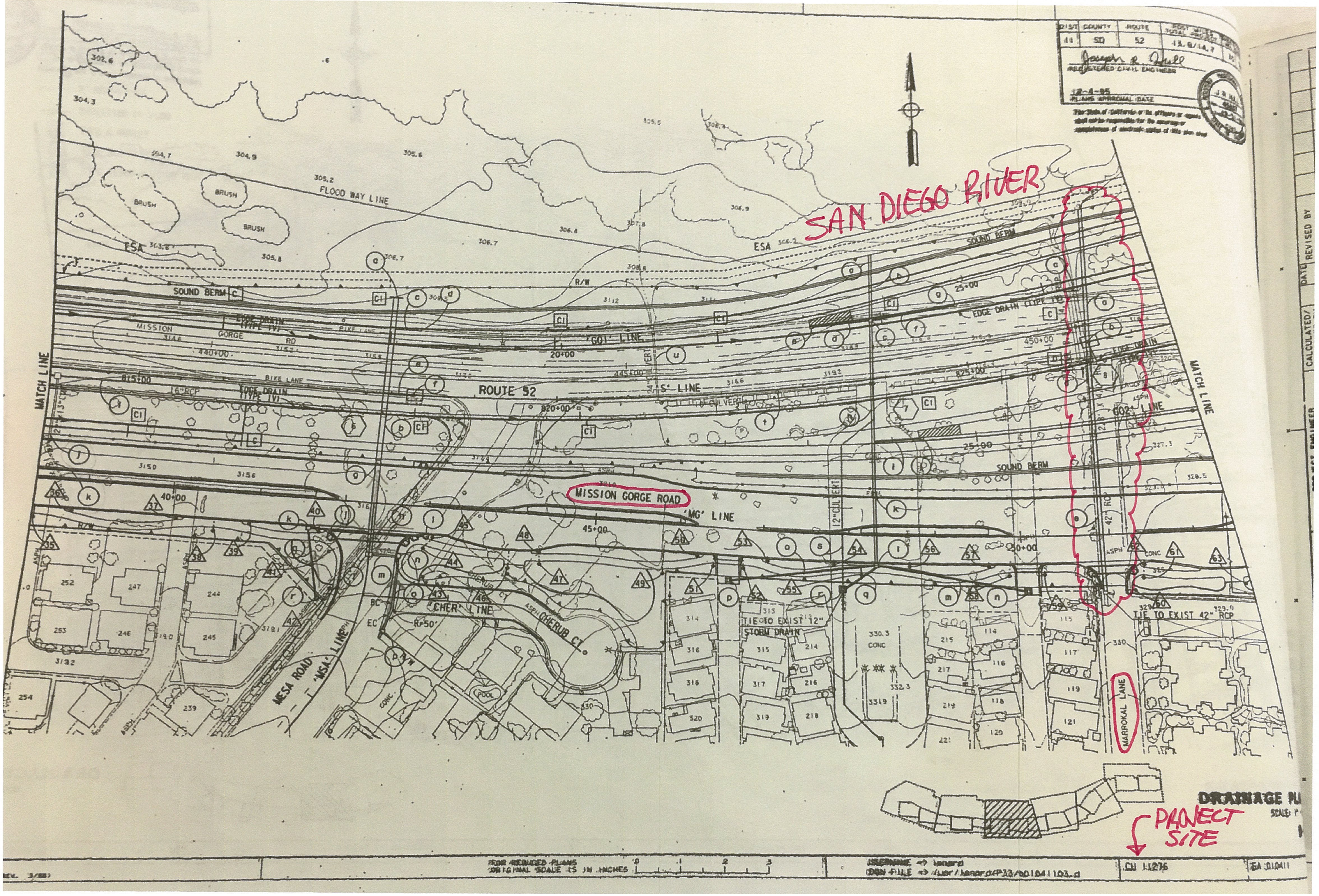
SHEET 4	CITY OF SANTEE DEPARTMENT OF PUBLIC SERVICES	4 SHEETS

PLANS FOR THE IMPROVEMENT OF OFFSITE STORM DRAIN IN CITY OF SANTEE TRACT NO. 4222

Recommended for Approval — Subdivision Engineer	CITY ENGINEER [signature] 8/24/83 JOHN P. SULLIVAN
Engineer of work [signature] R.J. Bulthuis Jan 20, 1982 RCE 13745	Checked by R.S.D. Approval date — T.M. 4222-1

W.O. NO. 1643

FILE NO.



DIST COUNTY ROUTE
11 SD 52
REGISTERED CIVIL ENGINEER
PLANS APPROVAL DATE
SAN DIEGO RIVER
FLOOD WAY LINE
BRUSH
ESA
SOUND BERM
R/W
EDGE DRAIN (TYPE IV)
MISSION GORGE RD
BIKE LANE
'GO1' LINE
'GO2' LINE
ROUTE 52
'S' LINE
MATCH LINE
MISSION GORGE ROAD
'MG' LINE
12" CULVERT
42" RCP
CHERUB CT
'CHER' LINE
MESA ROAD
'MSA' LINE
TIE TO EXIST 12" STORM DRAIN
TIE TO EXIST 42" RCP
CONC
ASPH
POOL
MARPOKAL LANE
DRAINAGE PL
PROJECT SITE
FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES

DIST	COUNTY	ROUTE	POST MILES TOTAL PROJECT	SHEET NO.	TOTAL SHEETS
11	SD	52	13.9/14.7	81	338

Joseph R. Hull
REGISTERED CIVIL ENGINEER

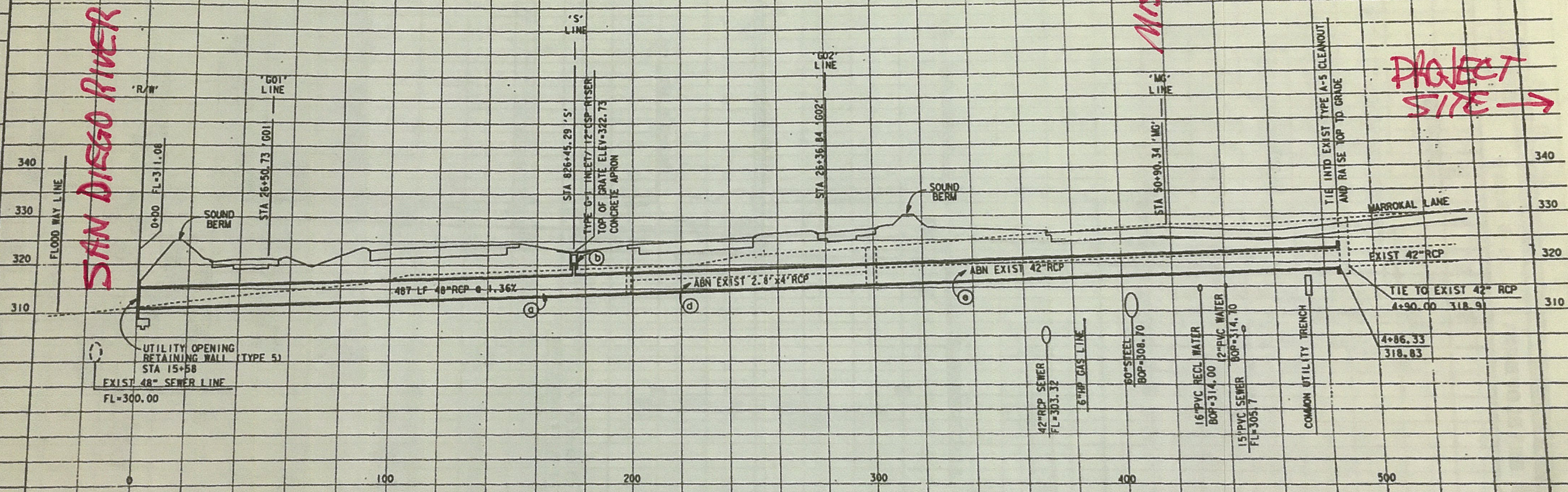
12-4-95
PLANS APPROVAL DATE

REGISTERED PROFESSIONAL ENGINEER
J R HULL
No. 45807
Exp. 12-31-98
CIVIL
STATE OF CALIFORNIA

The State of California or its officers or agents shall not be responsible for the accuracy or completeness of electronic copies of this plan sheet

DRAINAGE SYSTEM (8)
STA 826+45.29 'S' LINE

(a) 487 LF - 48"RCP W/ CONCRETE COLLAR
(b) TYPE G-1 INLET (D=737 H=3'
2 LF - 2"CSP RISER W/ RISER SAFETY CAGE (D93B)
CONCRETE APRON (DEPRESSION=0)
(c) ABANDON CULVERT (90 LF DBL 2.8'x 4'RCP)
(d) ABANDON CULVERT (94 LF 2.8'x 4'RCP)
(e) ABANDON CULVERT (190 LF 42"RCP)



DATE | REVISED BY | DATE REVISED
CALCULATED/DESIGNED BY | CHECKED BY
PROJECT ENGINEER
H D KHUU

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
Caltrans PROJECT DEVELOPMENT

DRAINAGE PROFILES

(8)

HORIZ SCALE: 1" = 20'
VERT SCALE: 1" = 10'

D-14

FOR REDUCED PLANS ORIGINAL SCALE IS IN INCHES 0 1 2 3

USERNAME => richard
DGN FILE => /usr/richard/P13/b01041114.

CU 11276

EA 010411

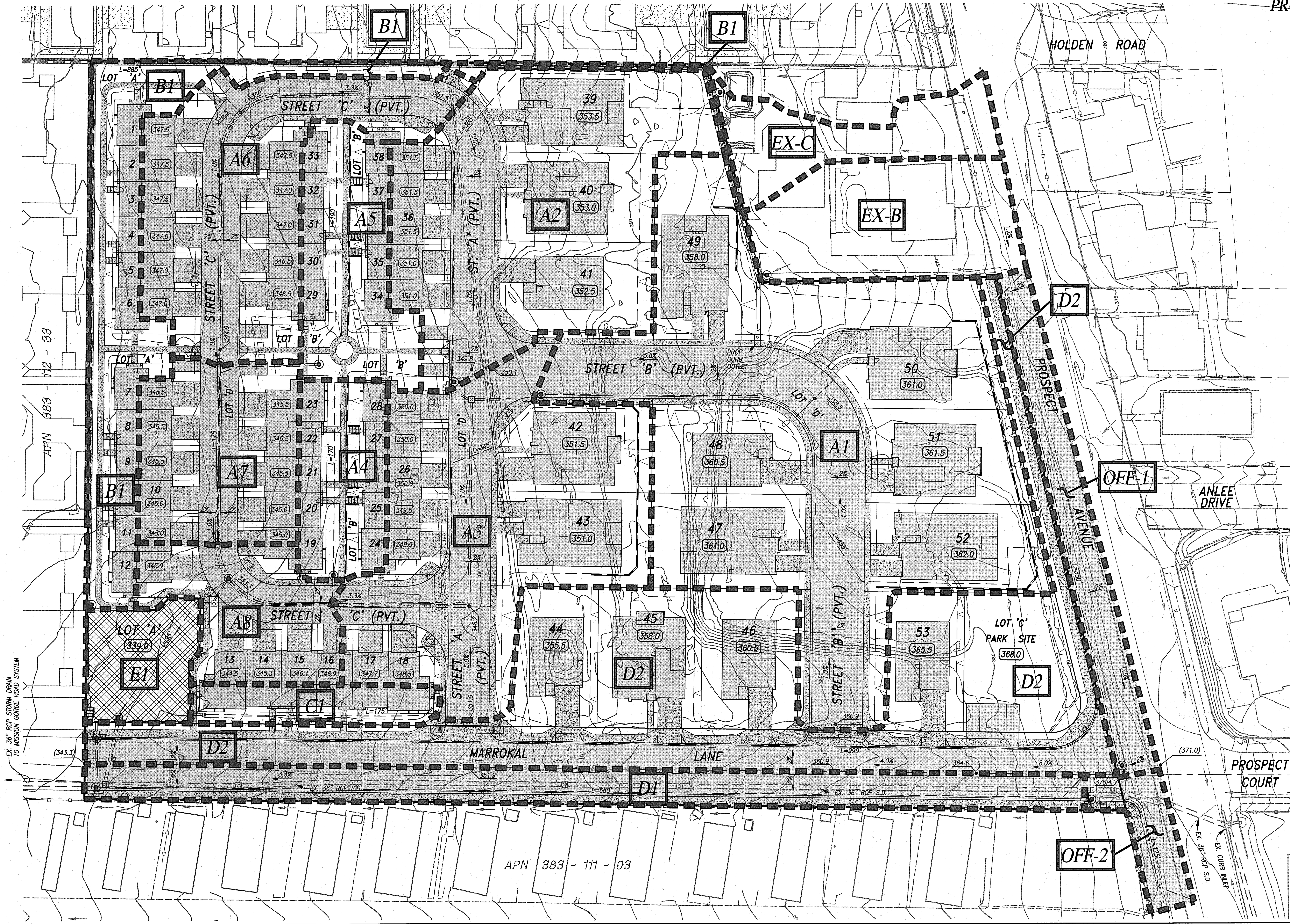
PSPY DC-OE-92-PF (REV. 3/88)

FIGURE 2
EXISTING CONDITION HYDROLOGY
PROSPECT ESTATES PHASE 2
OCTOBER 5, 2018

Planning • Engineering • Mapping
POLARIS
Development Consultants, Inc.
2514 Jamacha Road, Suite 502-31 • El Cajon, CA 92019 • 619-444-2923

FIGURE 3
PROPOSED CONDITION HYDROLOGY
PROSPECT ESTATES PHASE 2

OCTOBER 5, 2018



LEGEND

- SUBDIVISION BOUNDARY
- BASIN LIMITS
- DRAINAGE PATH
- EXISTING BUILDING
- EXISTING CONTOUR
- FLOW DIRECTION
- BASIN CONFLUENCE POINT
- EXISTING STORM DRAIN
- PROPOSED MASONRY WALL
- PROPOSED STORM DRAIN
- PROPOSED PCC BROW DITCH
- PROPOSED IMPERVIOUS SURFACE
- PROPOSED BIOFILTRATION AREA
- 53 — PROPOSED UNIT NUMBER
- (360.0) — PROPOSED PAD ELEVATION
- A1 — DRAINAGE BASIN DESIGNATION

BASIN	AREA (ac)	Q100 (cfs)
A1	1.51	3.98
A2	0.78	2.01
A3	0.77	2.51
A4	0.18	0.38
A5	0.26	0.46
A6	0.54	1.44
A7	0.30	0.85
A8	0.23	0.84
B1	0.40	0.63
C1	0.10	0.24
D1	0.37	1.98
D2	1.23	2.94
E1	0.13	0.10
OFF-1	0.20	0.90
OFF-2	0.08	0.46

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