CEQA Preliminary Drainage Study
for
Hamilton Tentative Parcel Map
15852 Skyline Truck Trail
Jamul, CA

Prepared for:
Craig Hamilton
15852 Skyline Truck Trail
Jamul, CA 91935
(Walsh Engineering Job No 06516)

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Summary

This CEQA Preliminary Drainage Study is prepared for the proposed Hamilton Tentative Parcel Map. The site is located at 15852 Skyline Truck Trail in Jamul. The site encompasses approximately 24.3 acres north of Skyline Truck Trail (see the Vicinity Map attached).

Existing Condition
In the existing condition, there is one single family residence on the site. The rest of the site is relatively undisturbed and natural. Access to the site is via a 60' private road easement that boarders the easterly property boundary. Encompassed in the easement is a graded dirt road ranging in width from 18'-30'. The road lies within three drainage basins, Basins A, B and C. Basins A and B are analyzed at existing 24" drainpipes located near the southeast property corner of the site and near Skyline Truck Trail respectively. Basin C is analyzed at a concentration point in the middle of the site. (see Drainage Basin Map – Existing Condition, attached).

The site lies approximately 1100 feet to the north of Skyline Truck Trail. The site slopes downward to the west (see Project Map, attached). Runoff that enters the site is from Basin A and a portion of Basin C. The runoff from Basin A enters the site near the southeast property corner and runoff from Basin C enters the site along the southerly property line. The onsite runoff collects in an existing drainage course near the center of the site and leaves the site along the westerly property line.

Proposed Condition
In the proposed condition, the existing dirt road will be paved. The paved width of the proposed road will be 16'-24'. The developer proposes to construct an additional single family home within the boundary of the site. The runoff from Basin A will enter the road and will flow down the road to the north and enter into the existing 24" drainpipe as it does in the existing condition. Runoff from Basin B will flow down the road to the south and outlet near Skyline Truck Trail via an asphalt concrete spill way. The runoff will then concentrate at the exiting 24" CMP drainpipe as it does in the existing condition. The size and location of Basins A, B and C will remain the same as the existing condition. As shown in the calculations for Basins A, B and C (attached) the increase in runoff, head and velocity due to the proposed pavement and single family home will be negligible.

Conclusion
Construction of the proposed road and single family residence will have minimal effects on the existing drainage basins, and flow patterns. Both the size and location of the basins will remain the same and as shown in this study the increase in head, velocity and flow rate due to the proposed road and home will be negligible.

For CEQA purposes, the following information is provided in this study for project review and approval for the tentative map.

Q: Will the project substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?
A: No. The overall existing drainage patterns will be maintained, no alterations to streams or rivers will occur and no increase in off-site erosion or siltation will be caused by this project.

Q: Will the project substantially alter the existing drainage pattern of the site or area including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?
A: No. Overall existing drainage patterns will be maintained. No alterations to streams or rivers will occur and the rate or amount of runoff will not increase.

Q: Will the project create or contribute runoff water which will exceed the capacity of existing or planned storm water drainage systems?
A: No.

Q: Will the project place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map, including County Floodplain Maps?
A: No. The project does not propose to place housing within the 100-year floodplain.

Q: Will the project place within a 100-year flood hazard area structures which would impede or redirect flood flows?
A: No. The project will not place structures within a 100-year flood hazard area which would impede or redirect flood flows.

Q: Will the project expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam on-site or off-site?
A: No. The project will not expose people or structures to a significant risk of loss, injury or death involving flooding as a result of failure of Dam(s) or levee(s).

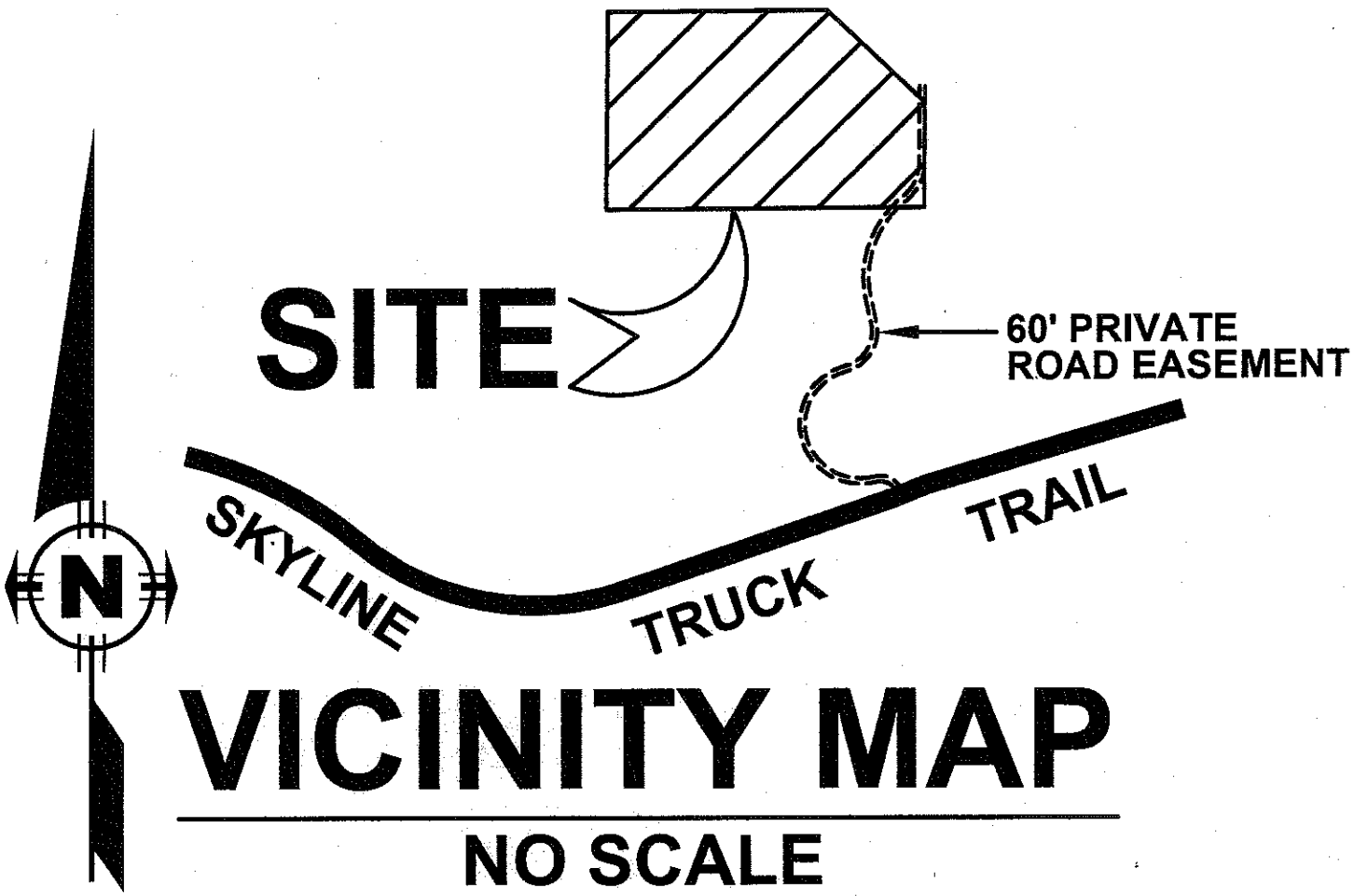
DECLARATION OF RESPONSIBLE CHARGE

I, HEREBY DECLARE THAT I AM THE ENGINEER OF WORK FOR THIS DRAINAGE STUDY, THAT I HAVE EXERCISED RESPONSIBLE CHARGE OVER THE PREPARATION OF SAID STUDY AS DEFINED IN SECTION 6703 OF THE BUSINESS AND PROFESSIONS CODE, AND THAT THE RECOMMENDATIONS ARE CONSISTENT WITH CURRENT STANDARDS.

I UNDERSTAND THAT THE CHECK OF THIS DRAINAGE STUDY BY THE COUNTY OF SAN DIEGO IS CONFINED TO A REVIEW ONLY AND DOES NOT RELIEVE ME, AS ENGINEER OF WORK, OF MY RESPONSIBILITIES.

Ernest M. Bartley III 3/19/07

ERNEST M. BARTLEY III, RCE 69233 Date

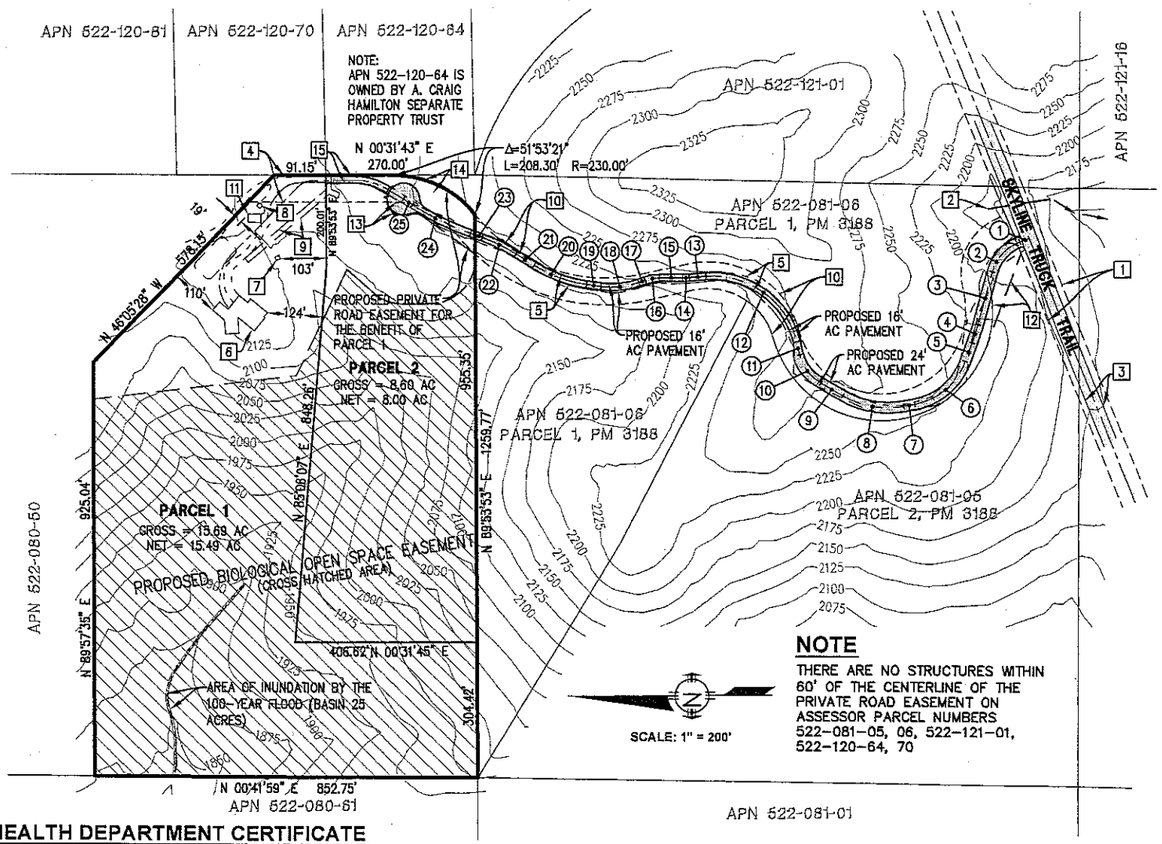


VICINITY MAP

NO SCALE

THOMAS BROS MAP PG.1273, G-6

TENTATIVE PARCEL MAP 21060 RPL 2



NOTE

THERE ARE NO STRUCTURES WITHIN 60' OF THE CENTERLINE OF THE PRIVATE ROAD EASEMENT ON ASSESSOR PARCEL NUMBERS 522-081-05, 06, 522-121-01, 522-120-64, 70

NOTES

1. 60' PUBLIC ROAD EASEMENT PER DOC. RECORDED DECEMBER 23, 1965 AS FILE NO. 231062
2. EXISTING 24" CMP STORM DRAIN PIPE
3. EXISTING 32'± AC PAVEMENT
4. 80' PRIVATE ROAD EASEMENT PER DOC. RECORDED DECEMBER 23, 1982 AS FILE NO. 82-392780
5. EXISTING DIRT ROAD
6. EXISTING HOUSE TO REMAIN
7. EXISTING 82 S.F. SHED TO REMAIN
8. EXISTING WATER TANK TO REMAIN
9. EASEMENT FOR PUBLIC UTILITIES PER DOCUMENT RECORDED APRIL 4, 1989 AS FILE NO. 1989-0172335, O.R.
10. 80' PRIVATE ROAD EASEMENT PER DOC. RECORDED OCTOBER 25, 2005 AS FILE NO. 2005-0922135 AND DOC. RECORDED AUGUST 22, 2007 AS FILE NO. 2007-0559404
11. EXISTING 520 S.F SHED TO BE REMOVED
12. PRIVATE ROAD EASEMENT PER DOC. REC. AUGUST 22, 2007 AS FILE NO. 2007-0559405
13. PROPOSED PRIVATE ROAD EASEMENT FOR THE BENEFIT OF PARCEL 1 (R=38')
14. PROPOSED 20' WIDE TRAIL EASEMENT
15. PROPOSED 16' WIDE AC PRIVATE ROAD (20' GRADED) PER SECTION 3.13 OF THE SAN DIEGO COUNTY STANDARDS FOR PRIVATE ROADS

CENTERLINE DATA

1. N 20°34'08" W 23.14'
2. Δ=54°07'11" L=94.46' R=100.00'
3. N 74°41'19" W 122.64'
4. Δ=4°57'55" L=43.33' R=500.00'
5. N 69°43'24" W 44.03'
6. Δ=59°27'11" L=155.65' R=150.00'
7. N 10°16'13" W 25.18'
8. Δ=40°36'14" L=141.73' R=200.00'
9. N 30°20'01" E 56.97'
10. Δ=46°24'17" L=80.99' R=100.00'
11. N 76°44'18" E 29.97'
12. Δ=80°49'53" L=270.87' R=192.00'
13. N 04°05'35" W 35.75'
14. Δ=4°20'47" L=15.17' R=200.00'
15. N 00°15'13" E 50.70'
16. Δ=19°44'45" L=34.46' R=100.00'
17. N 19°29'32" W 14.33'
18. Δ=27°58'00" L=85.42' R=175.00'
19. N 08°28'27" E 33.40'
20. Δ=24°01'07" L=125.76' R=300.00'
21. N 32°29'34" E 48.06'
22. Δ=12°19'14" L=83.86' R=390.00'
23. N 20°10'20" E 26.92'
24. Δ=13°35'52" L=144.29' R=608.00'
25. N 33°46'12" E 23.90'

LAND DIVISION STATEMENT / OWNER'S CERTIFICATE

I HEREBY CERTIFY THAT I AM THE RECORD OWNER, AS SHOWN ON THE LATEST EQUALIZED COUNTY ASSESSMENT, OF THE PROPERTY SHOWN ON THE TENTATIVE PARCEL MAP. ALL OF MY CONTIGUOUS OWNERSHIP WITHIN AND BEYOND THE BOUNDARIES OF THE TENTATIVE PARCEL MAP ARE SHOWN. THE BASIS OF CREATION OF THE LOTS IN MY OWNERSHIP (e.g. PARCEL MAP, FINAL MAP, CERTIFICATE OF COMPLIANCE, RECORDED DEED BEFORE 2/1/72) IS INDICATED ON THE TENTATIVE PARCEL MAP. I UNDERSTAND THAT PROPERTY IS CONSIDERED AS CONTIGUOUS EVEN IF IT IS SEPARATED BY ROADS, STREETS, UTILITY EASEMENTS OR RAILROAD RIGHT-OF-WAY. "FREEWAY" AS DEFINED IN SECTION 23.5 OF THE STREETS AND HIGHWAY CODE, SHALL NOT BE CONSIDERED AS ROADS OR STREETS.

I FURTHER CERTIFY THAT I WILL NOT, BY THIS APPLICATION, CREATE OR CAUSE TO BE CREATED, OR WILL NOT HAVE PARTICIPATED IN THE CREATION OF MORE THAN FOUR PARCELS ON CONTIGUOUS PROPERTY UNLESS SUCH CONTIGUOUS PARCELS WERE CREATED BY MAJOR SUBDIVISION. FOR PURPOSES OF THIS CERTIFICATION, THE TERM "PARTICIPATED" MEANS HAVING COOPERATED WITH OR ACTED IN A PLANNING, COORDINATING OR DECISION-MAKING CAPACITY IN ANY FORMAL OR INFORMAL ASSOCIATION OR PARTNERSHIP FOR THE PURPOSE OF DIVIDING REAL PROPERTY.
I CERTIFY UNDER PENALTY OF PERJURY THAT THE FOREGOING IS TRUE AND CORRECT.
EXECUTED THIS ____ DAY OF_____, 2008 AT SAN DIEGO, CALIFORNIA.

_____

A. CRAIG HAMILTON SEPARATE PROPERTY TRUST
A. CRAIG HAMILTON, TRUSTEE
15882 SKYLINE TRUCK TRAIL
JAMUL, CA 91935
(619) 666-1998

1. TAX ASSESSOR'S PARCEL NUMBER/TAX RATE AREA: 522-080-49/79011
2. ABBREVIATED LEGAL DESCRIPTION: PARCEL 3 OF PM 3188
3. GENERAL PLAN REGIONAL CATEGORY: RDA
4. GENERAL PLAN LAND USE DESIGNATION: 18
5. COMMUNITY PLAN AREA: JAMUL-DULZURA
6. EXISTING/PROPOSED ZONING:

ZONE	
USE REGULATIONS	A72
ANIMAL REGULATIONS	0
DENSITY	.125
LOT SIZE	8AC
BUILDING TYPE	C
MAXIMUM FLOOR AREA	--
FLOOR AREA RATIO	--
HEIGHT	G
LOT COVERAGE	--
SETBACK	C
OPEN SPACE	--
SPECIAL AREA REGULATIONS	--

7.

GENERAL PLAN SLOPE ANALYSIS TABLE	
AVERAGE SLOPE	MIN. PARCEL SIZE
< 25%	4 AC
> 25% AND < 50%	8 AC
> 50%	20 AC

	PARCEL 1	PARCEL 2
AVERAGE SLOPE	28.6%	37.7%
MIN. PARCEL SIZE	8 AC	8 AC

8. LOCATION AND STATUS OF EXISTING LEGAL ACCESS TO SUBJECT PROPERTY FROM A PUBLICLY MAINTAINED ROAD: 60' PRIVATE ROAD EASEMENT PER PARCEL MAP 3188 CONNECTING TO SKYLINE TRUCK TRAIL (A PUBLICLY MAINTAINED ROAD)
9. ASSOCIATED PERMITS: NONE
10. ALL LOTS WITHIN THIS SUBDIVISION HAVE A MINIMUM 100 SQUARE FEET OF SOLAR ACCESS FOR EACH FUTURE DWELLING UNIT ALLOWED BY THIS SUBDIVISION
11. SEWER: SEPTIC
12. WATER: WELLS
13. FIRE: SAN DIEGO RURAL FIRE PROTECTION DISTRICT
14. SCHOOL DISTRICT(S): GROSSMONT UNION HIGH SCHOOL DISTRICT
    JAMUL DULZURA ELEMENTARY SCHOOL DISTRICT
15. GRADING: CUT =5,400 CY FILL = 2,400 CY
    SHRINKAGE (10% ±) = 500 CY EXPORT = 2,500 CY
16. SOURCE OF TOPOGRAPHY: SAN DIEGO COUNTY 200 SCALE TOPO MAP 206-1827, SUPPLEMENTED WITH FILED SURVEY CONDUCTED BY WALSH ENGINEERING & SURVEYING, INC. DATED APRIL 4, 8, MAY 26 AND SEPTEMBER 26, 2006

PREPARED BY:

LAWRENCE W. WALSH RCE 46316 DATE

Walsh Engineering & Surveying, Inc.
607 Aldwych Road, El Cajon, CA 92020
(619) 588-6747 (619) 792-1232 Fax

REGISTERED PROFESSIONAL ENGINEER LAWRENCE W. WALSH No. C 46316 Exp. 12-31-08 CIVIL STATE OF CALIFORNIA

HEALTH DEPARTMENT CERTIFICATE

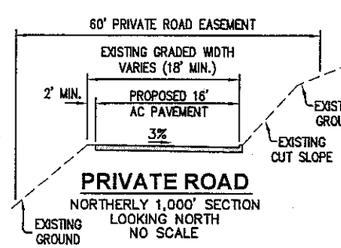
DATA AND RECOMMENDATION IN THE NAME OF A. CRAIG HAMILTON BY LARRY NEWCOMB, REHS

PARCEL NUMBER	LEACH LINE FOOTAGE	TRENCH DEPTH FOOTAGE	ROCK UNDER PIPE FOOTAGE	
1	400 FT	3 FT	1	EXISTING 4 BR
2	420 FT	3 FT	1	4 BR

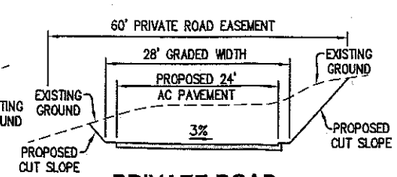
ALL PARCEL TO HAVE 100% RESERVE. WATER FOR ALL PARCELS BY INDIVIDUAL WELLS.

GARY ERBECK, DIRECTOR, DEPARTMENT OF ENVIRONMENTAL HEALTH
BY: LANCE DECLUE DATE: 2-14-07 VPM: 331

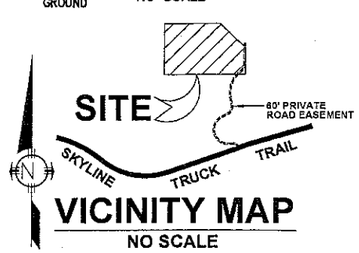
THIS CERTIFICATION DOES NOT IMPLY ALL CONDITIONS PURSUANT TO THE RESOURCE PROTECTION ORDINANCE AND THE GROUNDWATER ORDINANCE HAVE BEEN MET. THE DEPARTMENT OF PLANNING AND LAND USE SHOULD BE CONSULTED REGARDING THE APPLICATION OF THESE ORDINANCES RELATIVE TO THIS PROJECT. ANY RESULTANT CHANGES TO THE SEPTIC SYSTEM DESIGN(S) MUST BE RE-EVALUATED BY THE DEPARTMENT OF ENVIRONMENTAL HEALTH.
ALL PARCELS SHALL HAVE A LAYOUT OF THE SEWAGE DISPOSAL SYSTEM PROPOSED STRUCTURES, CUT AND FILLS APPROVED BY THE SAN DIEGO DEPARTMENT OF ENVIRONMENTAL HEALTH PRIOR TO THE APPROVAL OF THE BUILDING PERMIT AND/OR ISSUANCE OF A SEPTIC TANK PERMIT. AN ADDITIONAL EXPANSION AREA OF 100% OF THE INITIAL TILE AREA SHALL BE PROVIDED BY THE GRAVITY FLOW FOR THE POTENTIAL EXPANSION IN THE EVENT OF FAILURE.
EACH PARCEL SHALL HAVE AN INDIVIDUAL WELL APPROVED BY THE DEPARTMENT OF ENVIRONMENTAL HEALTH PRIOR TO APPROVAL OF A BUILDING PERMIT AND/OR ISSUANCE OF A SEPTIC TANK PERMIT. A LAYOUT SHOWING THE LOCATION OF THE SEWAGE SYSTEM AND THE WELL SHALL BE APPROVED PRIOR TO APPROVAL OF PERMITS.



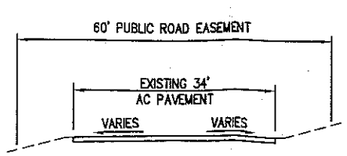
PRIVATE ROAD
NORTHERLY 1,000' SECTION
LOOKING NORTH
NO SCALE



PRIVATE ROAD
SOUTHERLY 700' SECTION
LOOKING NORTH
NO SCALE



VICINITY MAP
NO SCALE
THOMAS BROS MAP PG.1273, G-6



SKYLINE TRUCK TRAIL
(CIRCULATION ELEMENT ROAD)
TYPICAL SECTION
NO SCALE

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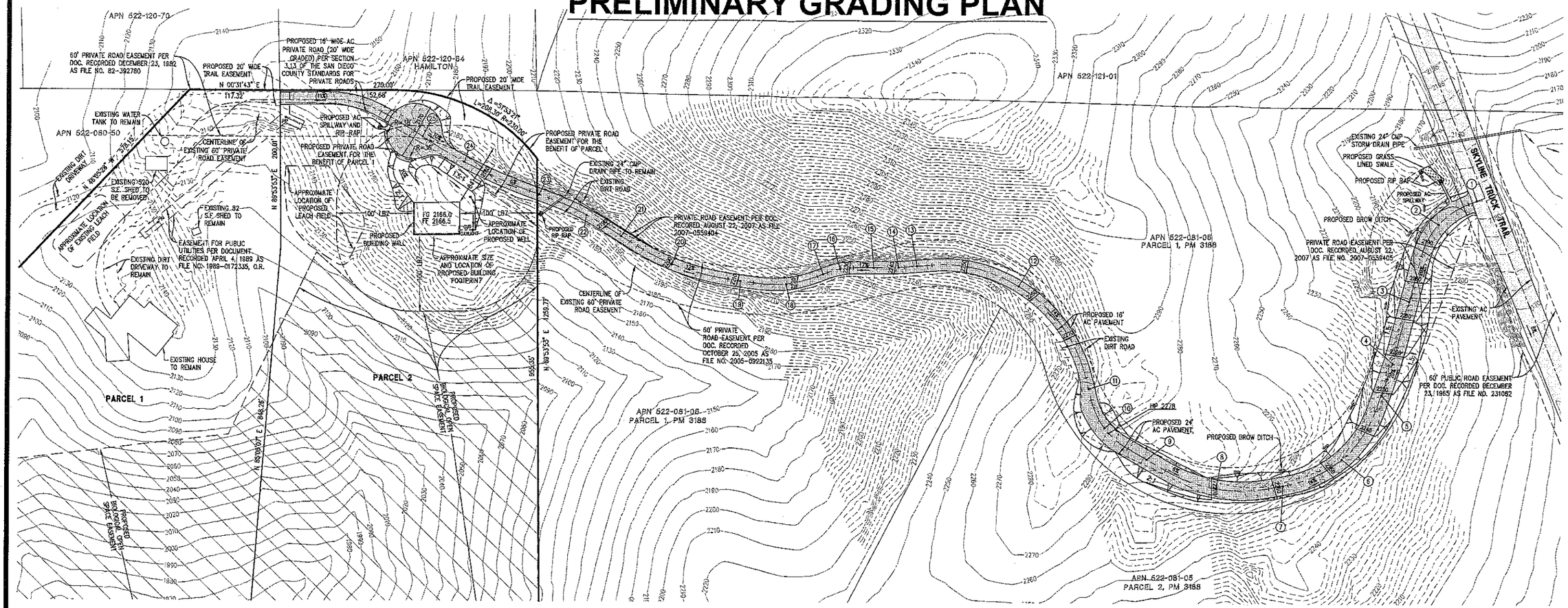
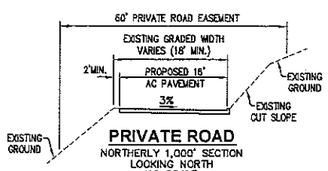
PRELIMINARY GRADING PLAN



NOTE

PLAN SHOWS ALL PROPOSED GRADING



PRIVATE ROAD
NORTHERLY 1,000' SECTION
LOOKING NORTH
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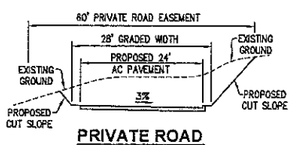

PRIVATE ROAD
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LOOKING NORTH
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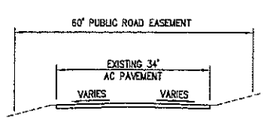

SKYLINE TRUCK TRAIL
(CIRCULATION ELEMENT ROAD)
TYPICAL SECTION
NO SCALE

VICINITY MAP
NO SCALE
THOMAS BROS MAP PG.1273, G-6

CENTERLINE DATA

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25. N 33°46'12" E 23.90'

NOTE

THERE ARE NO STRUCTURES WITHIN 60' OF THE CENTERLINE OF THE PRIVATE ROAD EASEMENT ON ASSESSOR PARCEL NUMBERS 522-081-05, 08, 522-121-01, 522-120-64, 70

NOTE

THIS PLAN IS PROVIDED TO ALLOW FOR FULL AND ADEQUATE DISCRETIONARY REVIEW OF A PROPOSED DEVELOPMENT PROJECT. THE PROPERTY OWNER ACKNOWLEDGES THAT ACCEPTANCE OR APPROVAL OF THIS PLAN DOES NOT CONSTITUTE AN APPROVAL TO PERFORM ANY GRADING SHOWN HEREON, AND AGREES TO OBTAIN VALID GRADING PERMISSIONS BEFORE COMMENCING SUCH ACTIVITY.

60' 30' 0 60' 120' 180'
SCALE: 1"=60'

EARTHWORK:

AREA	CUT (CY)	FILL (CY)
PARCEL 1	0	0
PARCEL 2	1,200	180
PRIVATE ROAD	4,200	2,180
SUBTOTAL	5,400	2,400
SHRINKAGE (10% ±)	500	–
TOTAL	4,900	2,400
EXPORT	2,500	

SOURCE OF TOPOGRAPHY:

SAN DIEGO COUNTY 200 SCALE 206-1827, SUPPLEMENTED WITH FILED SURVEY CONDUCTED BY WALSH ENGINEERING & SURVEYING, INC. DATED APRIL 4, 8, MAY 28 AND SEPTEMBER 26, 2006

ASSESSOR'S PARCEL NUMBER:

522-080-49

OWNER:

A. CRAIG HAMILTON SEPERATE PROPERTY TRUST
A. CRAIG HAMILTON, TRUSTEE
15882 SKYLINE TRUCK TRAIL
JAMUL, CA 91935
(619) 668-1998

PREPARED BY:

REGISTERED PROFESSIONAL ENGINEER LAWRENCE W. WALSH No. C 46316 Exp. 12-31-08 CIVIL STATE OF CALIFORNIA

LAWRENCE W. WALSH RCE 46316 DATE

Walsh Engineering & Surveying, Inc.
807 Aldwych Road, El Cajon, CA 92020
(619) 588-6747 (619) 792-1232 Fax

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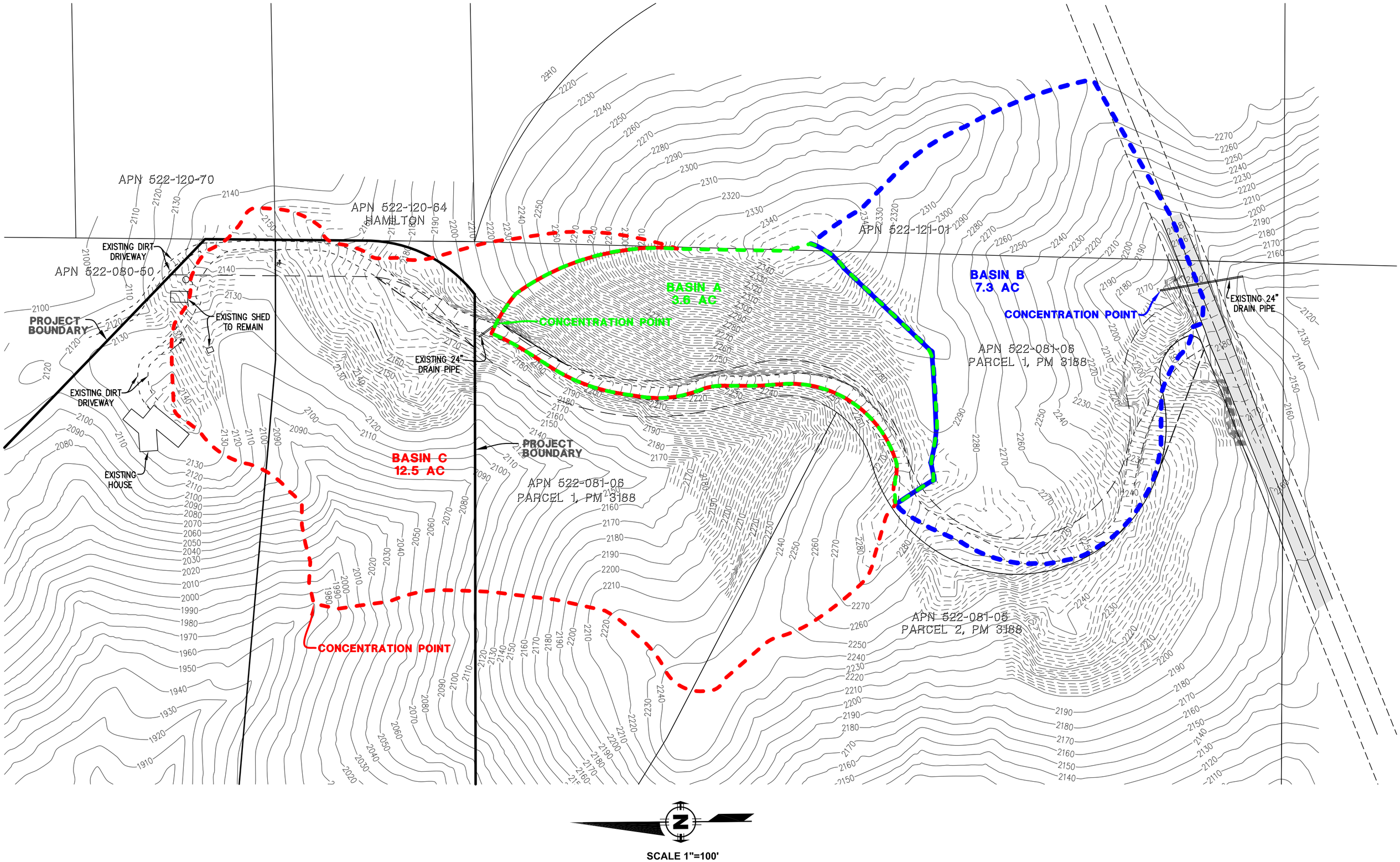
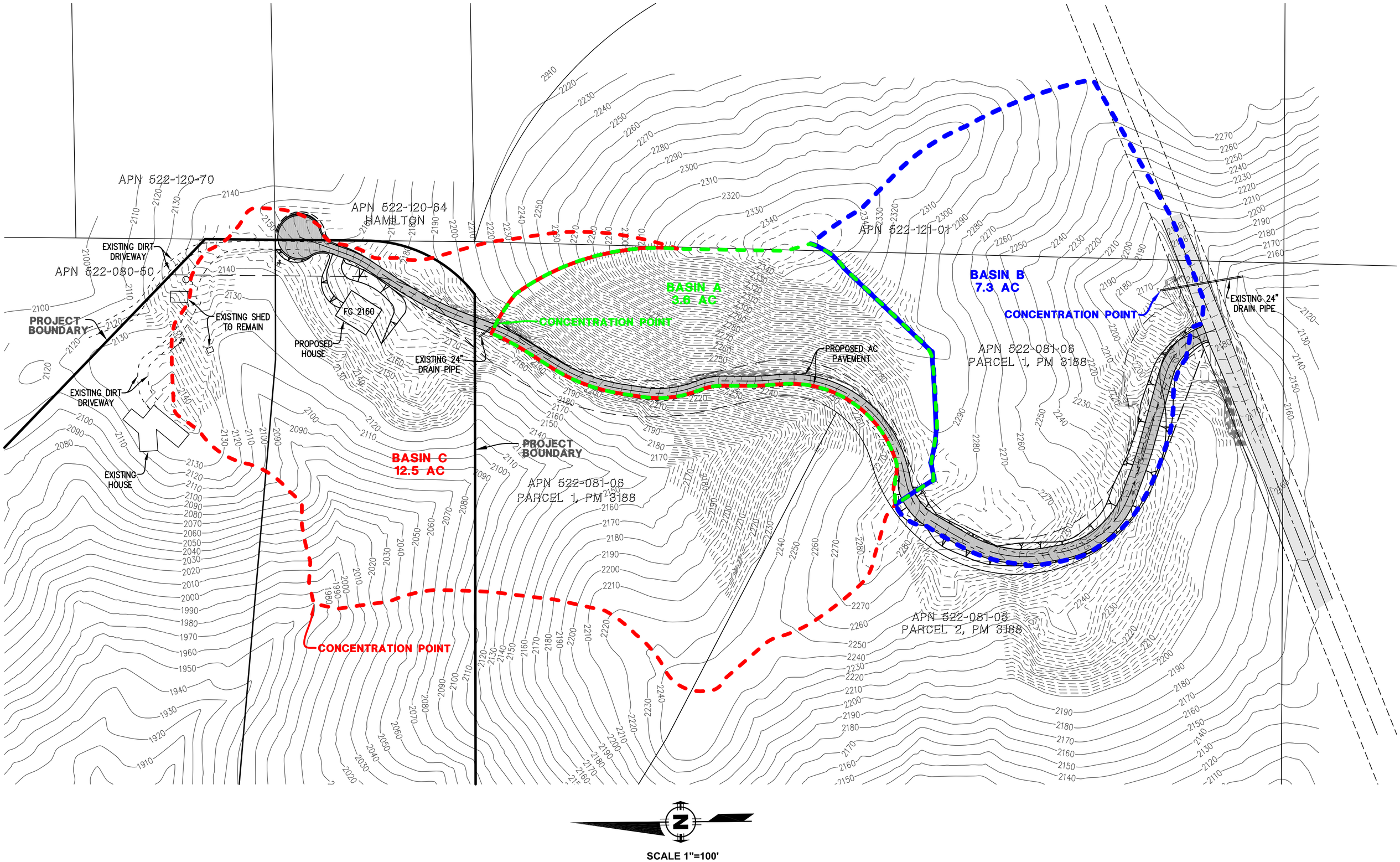
DRAINAGE BASIN MAP

(EXISTING CONDITION)

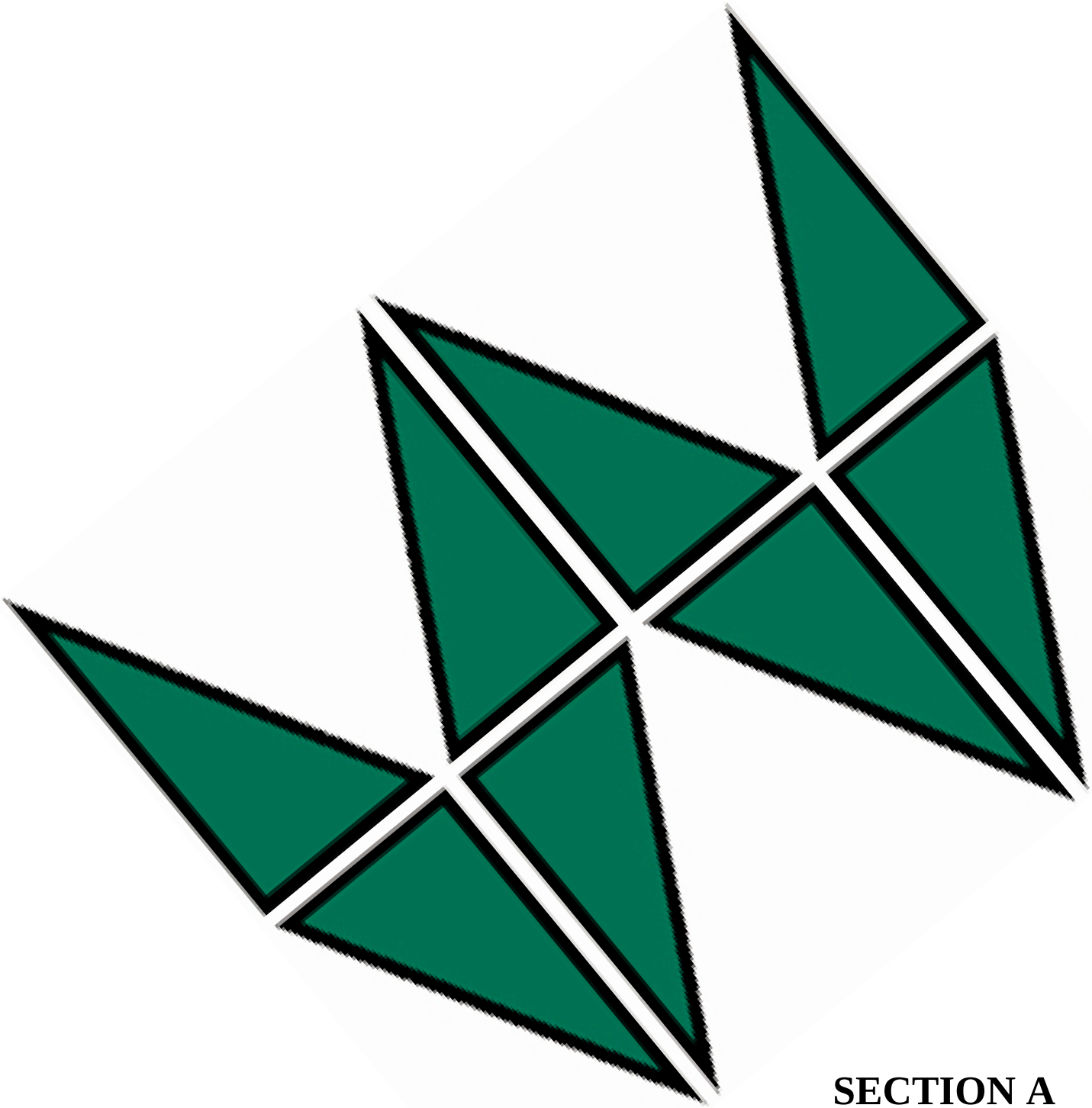


DRAINAGE BASIN MAP

(PROPOSED CONDITION)



SCALE 1"=100'



SECTION A

Basin A Hydrology (Existing):

Time of Concentration Calculation:

$$\mathbf{T_C = T_i + T_X}$$

where:

T_i = 8.7 min *(see Table 3-2, attached)*

The travel time, Tx, is the amount of time it takes the runoff to flow down the existing dirt road to the existing 24" CMP drainpipe. The travel time is calculated by dividing the length of the flow path by the velocity of runoff. The Q_{100} used for the velocity calculation is assumed and later checked for accuracy. The Q_{100} used for velocity calculation is also divided by 2 to average the amount runoff in the channel.

Travel Time for Basin A:

Channel Calculator

Given Input Data:
Shape ..... Trapezoidal
Solving for ..... Velocity
Flowrate ..... 2.8 cfs
Slope 0.13ft/ft
Manning's n 0.025

Computed Results:
Velocity ..... 7.2 fps

Velocity of runoff- 7.2 ft./sec (from above)

Length of Flow Path- 770ft (see Drainage Basin Map – Existing Condition, attached)

T_x = 770ft/7.2ft/sec = 107 sec
T_X = 1.8 min

T_C = 8.7 + 1.8

T_C = 10.5 min

Intensity Calculation:

$$\mathbf{I = 7.44\ P_6\ D^{-0.645}}$$ *(see Figure 3-1, attached)*

where:

P_6 = 3.2 in *(see Rainfall Isopluvial, Section E)*

D = T_C = 10.5 min *(from above)*

$$I = 7.44\ (3.2)\ (10.5)^{-0.645}$$

I = 5.2 in/hr

Runoff Coefficient (C Value):

Basin A in the existing condition is composed of natural terrain and portions of a dirt road. The "C" value is obtained from Table 3-1 of the County of San Diego Hydrology Manual (2003).

C = 0.30 *(see Table 3-1, attached)*

$\boxed{\mathbf{C_{weighted} = 0.30}}$

Flow Rate:

$$\mathbf{Q_{100} = C\ I\ A}$$

where:

C = 0.30 *(from above)*

I = 5.2 in/hr *(see Figure 3-1, attached)*

A = 3.6 AC *(see Drainage Basin Map – Existing Condition, attached)*

$Q_{100} = (0.30)(5.2)(3.6) = 5.6$

$\boxed{\mathbf{Q_{100} = 5.6\ CFS}}$

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.

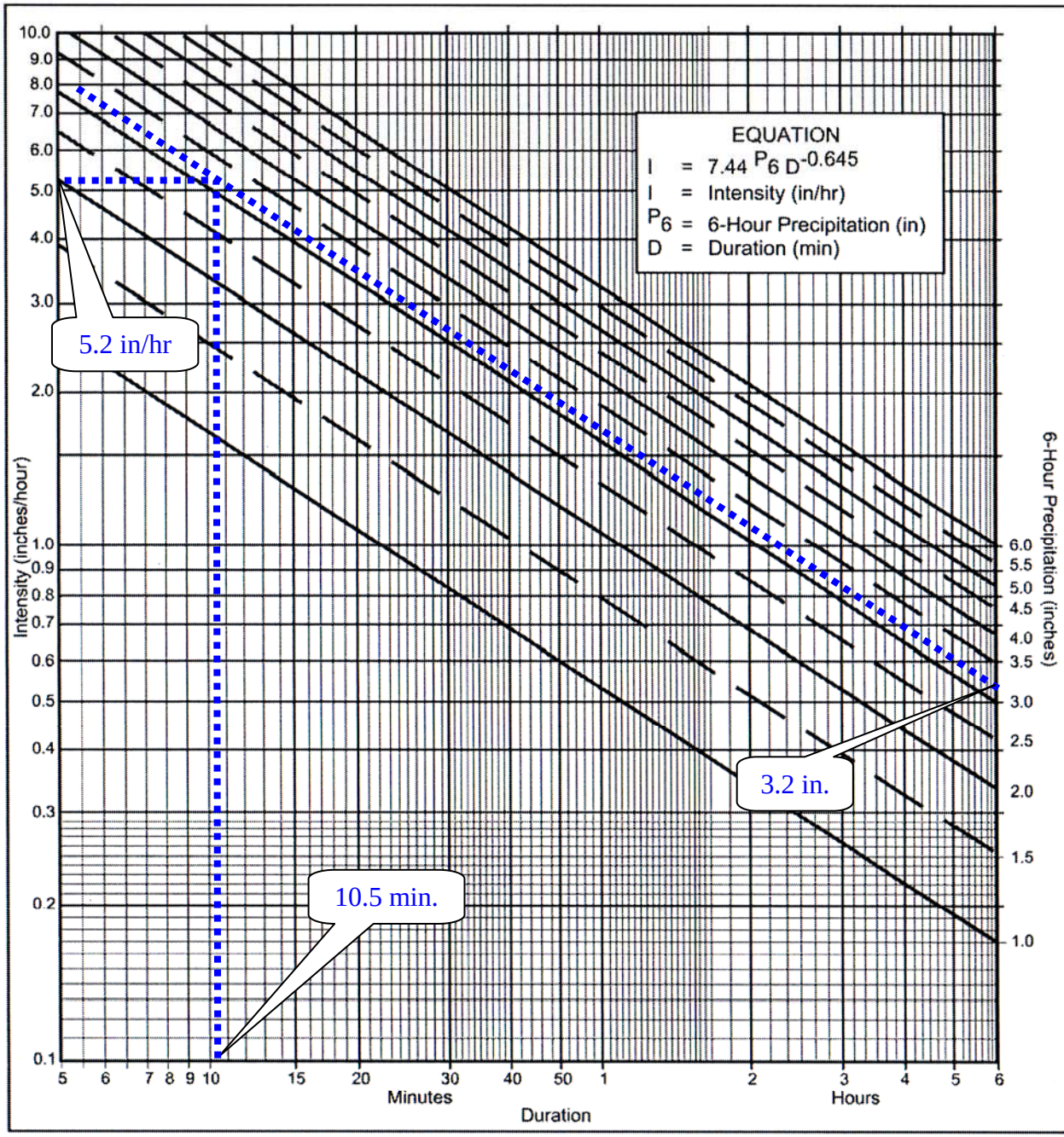
Table 3-2

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

Element*	DU/	.5%		1%		2%		3%		5%		10%	
	Acre	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

BASIN A - EXISTING



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 = 3.2 in., P_{24} = 7.1 , $\frac{P_6}{P_{24}}$ = 45 %(2)

(c) Adjusted $P_6^{(2)}$ = 3.2 in.

(d) t_x = 10.5 min.

(e) I = 5.2 in./hr.

I = 5.2in/hr

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

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
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

BASIN A - EXISTING

FIGURE

3-1

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

BASIN A – EXISTING
C = 0.30

Basin A Hydrology (Proposed):

Time of Concentration Calculation:

$$\mathbf{T_C = T_i + T_X}$$

where:

T_i = 8.7 min *(see Table 3-2, attached)*

The travel time, Tx, is the amount of time it takes the runoff to flow down the proposed paved road to the existing 24" CMP drainpipe. The travel time is calculated by dividing the length of the flow path by the velocity of runoff. The velocity is obtained from Figure 3-6 of the San Diego County Hydrology Manual. The Q_{100} used for the velocity calculation is assumed and later checked for accuracy. The Q_{100} used for velocity calculation is also divided by 2 to average the amount runoff in the channel.

Travel Time for Basin A:

Velocity of runoff- 7.1 ft./sec (see Figure 3-6, attached)
Length of Flow Path- 860ft (see Drainage Basin Map – Proposed Condition, attached)

T_x = 790ft/7.1ft/sec = 111 sec
T_X = 1.9 min

T_C = 8.7 + 1.9 = 10.6

T_C = 10.6 min

Intensity Calculation:

$$\mathbf{I = 7.44\ P_6\ D^{-0.645}}$$ *(see Figure 3-1, attached)*

where:

P_6 = 3.2 in *(see Rainfall Isopluvial, Section E)*

D = T_C = 10.6 min *(from above)*

$$I = 7.44\ (3.2)\ (10.6)^{-0.645}$$

I = 5.2 in/hr

Runoff Coefficient (C Value):

"C" values for the existing condition are derived from actual areas of existing and proposed surfaces and their corresponding "C" values from Table II and Table 3-1 of the County of San Diego Hydrology Manual (2003).

$$C_{weighted} = [(C_{PAVE} * A_{PAVE}) / A_{TOTAL}] + [(C_{NAT} * A_{NAT}) / A_{TOTAL}]$$

where:

C_{NAT} = 0.30 *(see Table 3-1, attached)*
C_{PAVE} = 0.90 *(see Table II, attached)*

A_{total} = 3.6 AC *(See Drainage Basin Map –Proposed Condition, attached)*

Natural Area (A_{NAT}) = 3.29 AC

Pavement Area (A_{PAVE}) = 0.31 AC

$C_{weighted}$ = [(0.90 * 0.31) / 3.6] + [(0.30 * 3.29) / 3.6] = 0.35

$C_{weighted}$ = 0.35

Flow Rate:

$$Q_{100} = C\ I\ A$$

where:

C = 0.35

I = 5.2 in/hr *(see Figure 3-1, attached)*

A = 3.6 AC *(see Drainage Basin Map – Proposed Condition, attached)*

Q_{100} = (0.35)(5.2)(3.6) = 6.6

Q_{100} = 6.6 CFS

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.

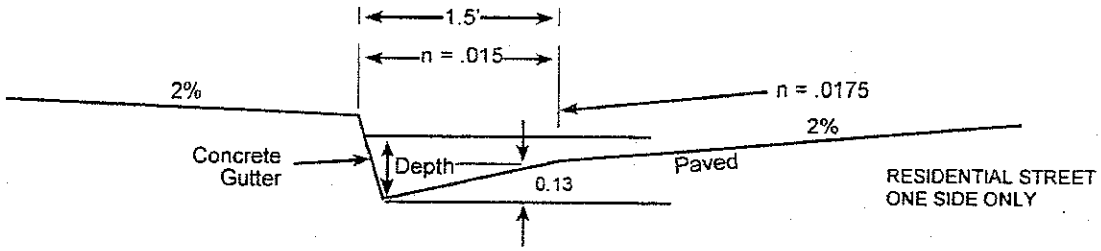
Table 3-2

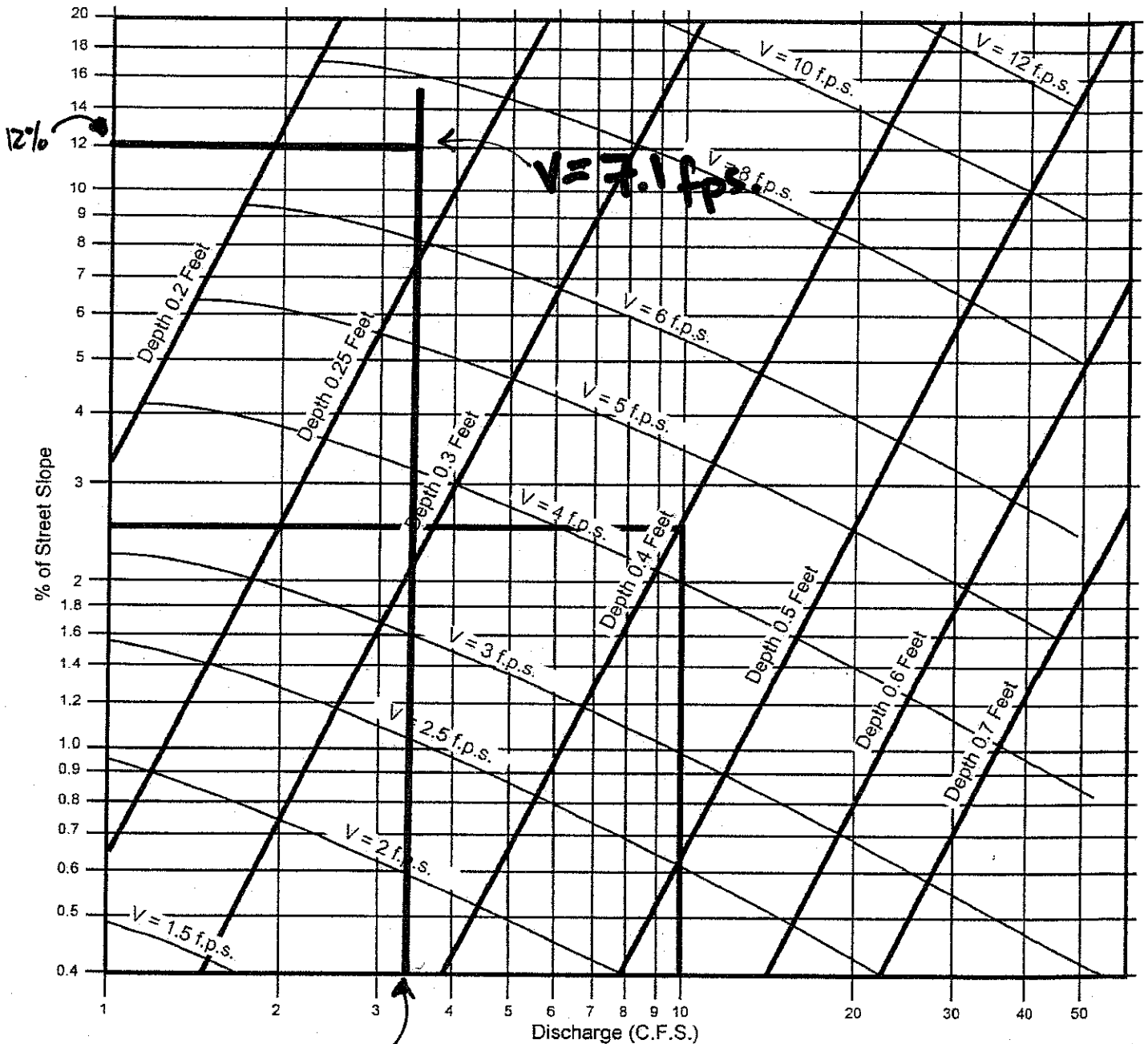
MAXIMUM OVERLAND FLOW LENGTH (L_M)
& INITIAL TIME OF CONCENTRATION (T_i)

Element*	DU/	.5%		1%		2%		3%		5%		10%	
	Acre	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

BASIN A - PROPOSED





$Q = 6.6\,cfs \Rightarrow \frac{Q}{2} = 3.3\,cfs$

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

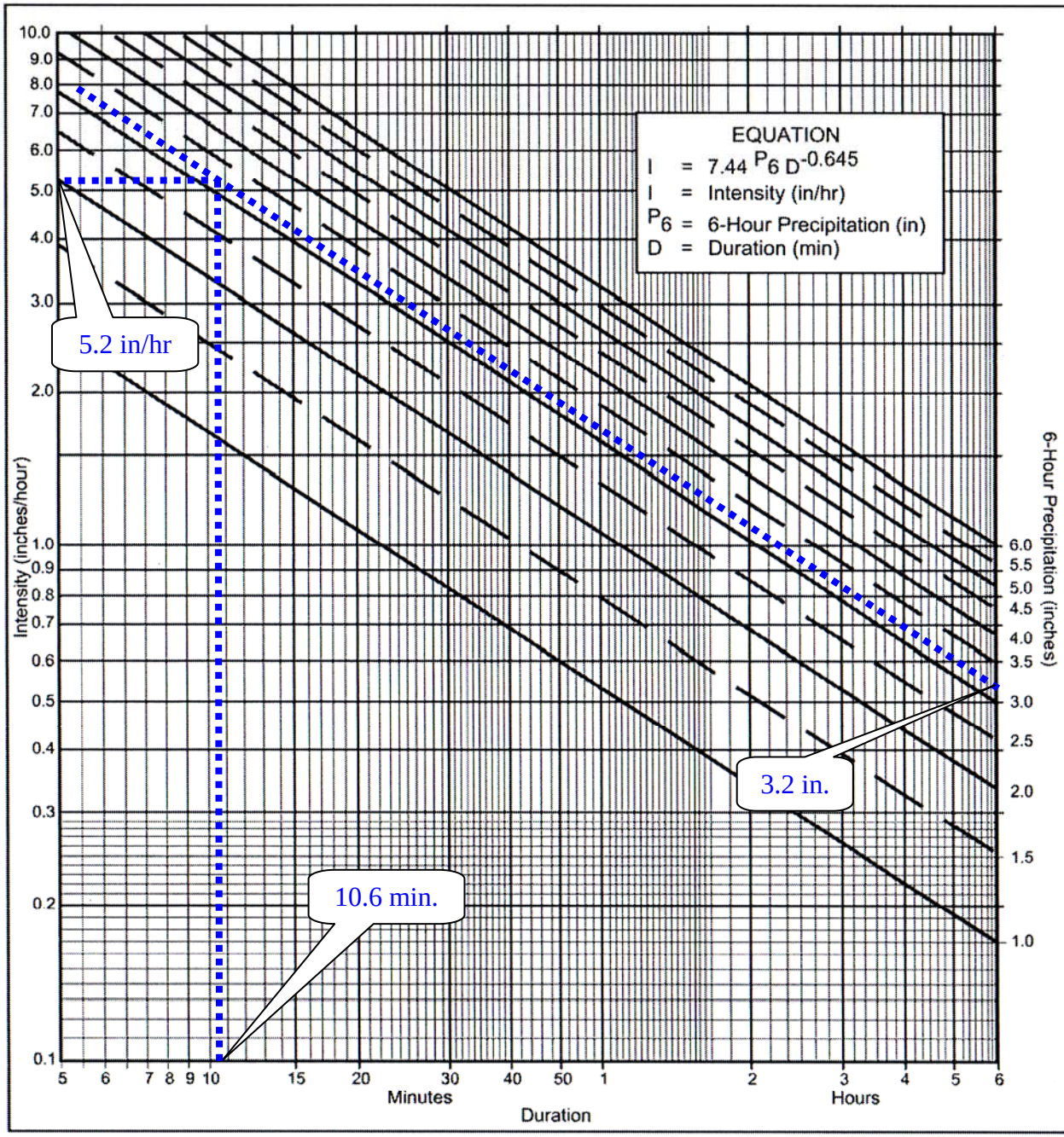
SOURCE: San Diego County Department of Special District Services Design Manual

FIGURE

Gutter and Roadway Discharge - Velocity Chart

3-6

BASIN A
PROPOSED



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 = 3.2 in., P_{24} = 7.1 , $\frac{P_6}{P_{24}}$ = 45 %(2)

(c) Adjusted $P_6^{(2)}$ = 3.2 in.

(d) t_x = 10.6 min.

(e) I = 5.2 in./hr.

I = 5.2in/hr

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

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
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

BASIN A - PROPOSED

FIGURE

3-1

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

BASIN A – PROPOSED
C = 0.30

TABLE II

Land Use/Type of Surface	Range of "C" Values
Business downtown	0.70 to 0.95
Business in neighborhoods	0.50 to 0.70
Single family	0.30 to 0.50
Multi-units, detached	0.40 to 0.60
Multi-units, attached	0.60 to 0.75
Suburban Residential	0.25 to 0.40
Apartment	0.50 to 0.70
Light Industrial	0.50 to 0.80
Heavy Industrial	0.60 to 0.90
Parks and Cemeteries	0.10 to 0.25
Playgrounds	0.20 to 0.35
Railroad yard	0.20 to 0.35
Unimproved land	0.10 to 0.30
Asphalt and Concrete	0.70 to 0.95 ← **USE 0.90**
Brick	0.70 to 0.85
Roofs	0.75 to 0.95
Sandy soil lawn, 2 percent slope	0.05 to 0.10
Sandy soil lawn, 2 to 7 percent slope	0.10 to 0.15
Sandy soil lawn, 7 percent slope	0.15 to 0.20
Heavy soil lawn, 2 percent slope	0.13 to 0.17
Heavy soil lawn, 2 to 7 percent slope	0.18 to 0.22
Heavy soil lawn, 7 percent slope	0.25 to 0.35

BASIN A-PROPOSED

SECTION B

Basin B Hydrology (Existing):

Time of Concentration Calculation:

$$\mathbf{T_C = T_i + T_X}$$

where:

T_i = 8.7 min *(see Table 3-2, attached)*

T_X = 1.4 min *(see Figure 3-4, attached)*

$T_C = 8.7 + 1.4$

$$\boxed{\mathbf{T_C = 10.1\ min}}$$

Intensity Calculation:

$$\mathbf{I = 7.44\ P_6\ D^{-0.645}}\ \textit{(see Figure 3-1, attached)}$$

where:

P_6 = 3.2 in *(see Rainfall Isopluvial, Section E)*

$D = T_C$ = 10.1 min *(from above)*

$$I = 7.44\ (\ 3.2\ )\ (\ 10.1\ )^{-0.645}$$

$$\boxed{\mathbf{I = 5.4\ in/hr}}$$

Runoff Coefficient (C Value):

"C" values for the existing condition are derived from actual areas of existing surfaces and corresponding "C" values from Table II and Table 3-1 of the County of San Diego Hydrology Manual (2003).

$$C_{weighted} = [(C_{PAVE} * A_{PAVE}) / A_{TOTAL}] + [(C_{NAT} * A_{NAT}) / A_{TOTAL}]$$

where:

C_{NAT} = 0.30 *(see Table 3-1, attached)*
C_{PAVE} = 0.90 *(see Table II, attached)*

A_{total} = 7.3 AC *(See Drainage Basin Map – Existing Condition, attached)*

Natural Area (A_{NAT}) = 7.15 AC

Pavement Area (A_{PAVE}) = 0.15 AC

$C_{weighted}$ = [(0.90 * 0.15) / 7.3] + [(0.30 * 7.15) / 7.3] = 0.31

$$\boxed{\mathbf{C_{weighted} = 0.31}}$$

Flow Rate:

$$\mathbf{Q_{100} = C\ I\ A}$$

where:

C = 0.31 *(from previous page)*

I = 5.4 in/hr *(see Figure 3-1, attached)*

A = 7.3 AC *(see Drainage Basin Map – Existing Condition, attached)*

$Q_{100} = (0.31)(5.4)(7.3) = 12.2$

$\boxed{\mathbf{Q_{100} = 12.2\ CFS}}$

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/	.5%		1%		2%		3%		5%		10%	
	Acre	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

BASIN B - EXISTING

L = 490'

ΔE = 2542
- 2168
174'

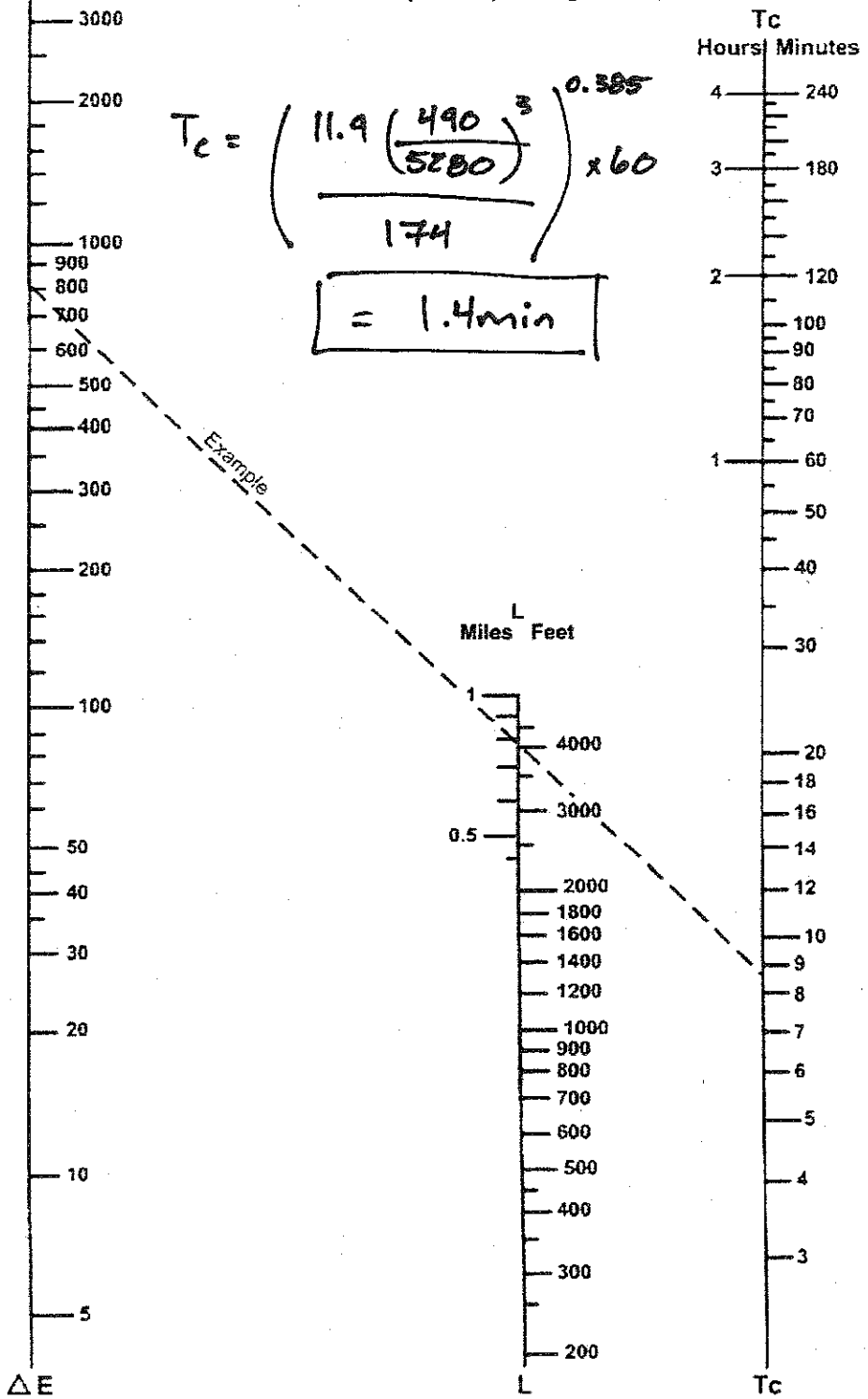
EQUATION

$$T_c = \left(\frac{11.9L^3}{\Delta E}\right)^{0.385}$$

Tc = Time of concentration (hours)
L = Watercourse Distance (miles)
ΔE = Change in elevation along effective slope line (See Figure 3-5) (feet)

$$T_c = \left(\frac{11.9\left(\frac{490}{5280}\right)^3}{174}\right)^{0.385} \times 60$$

$$\boxed{= 1.4\text{min}}$$

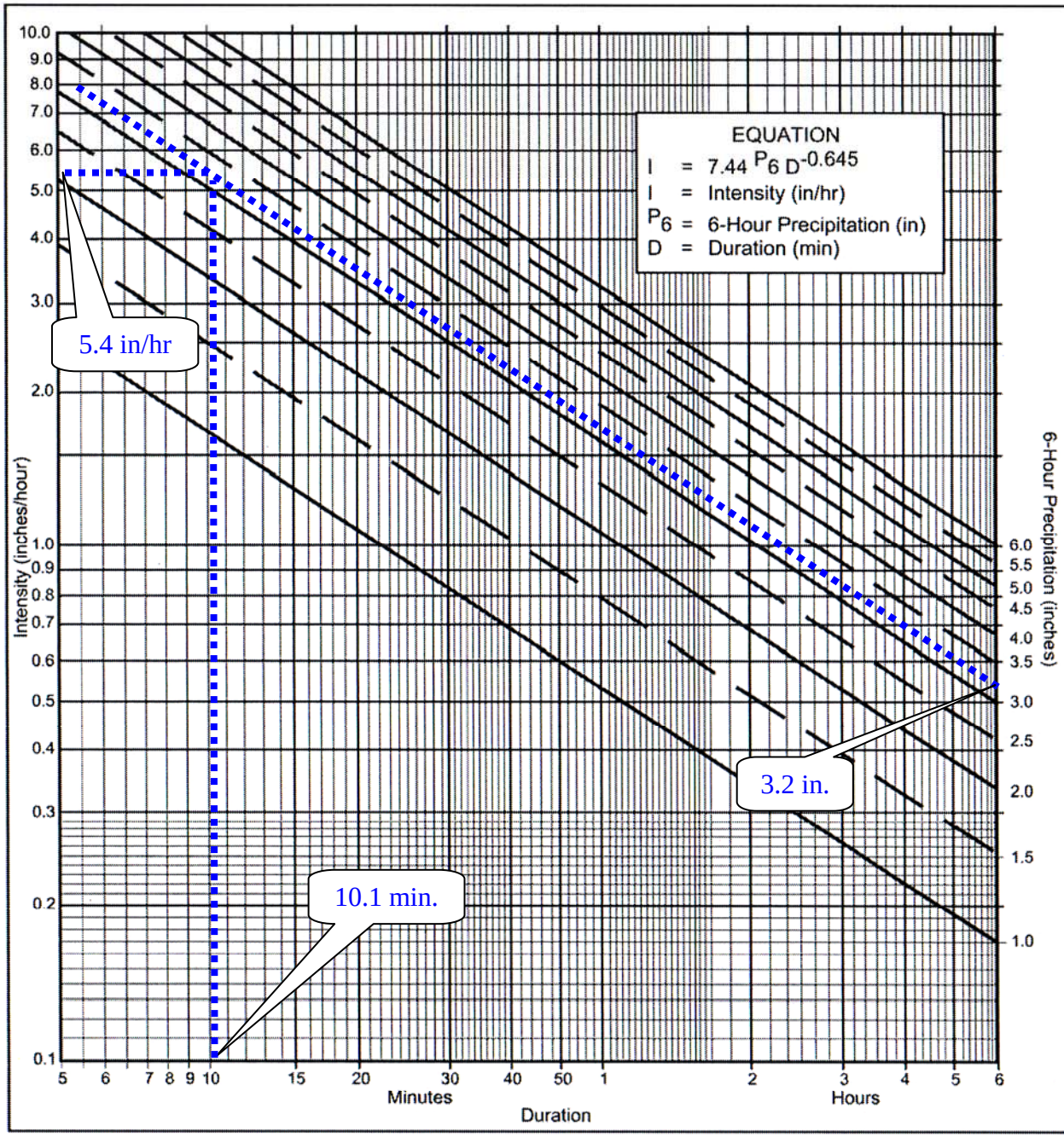


SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE 3-4

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

BASIN B
EXISTING



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 = 3.2 in., P_{24} = 7.1 , $\frac{P_6}{P_{24}}$ = 45 %(2)

(c) Adjusted $P_6^{(2)}$ = 3.2 in.

(d) t_x = 10.1 min.

(e) I = 5.4 in./hr.

I = 5.4in/hr

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

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
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

BASIN B - EXISTING

FIGURE

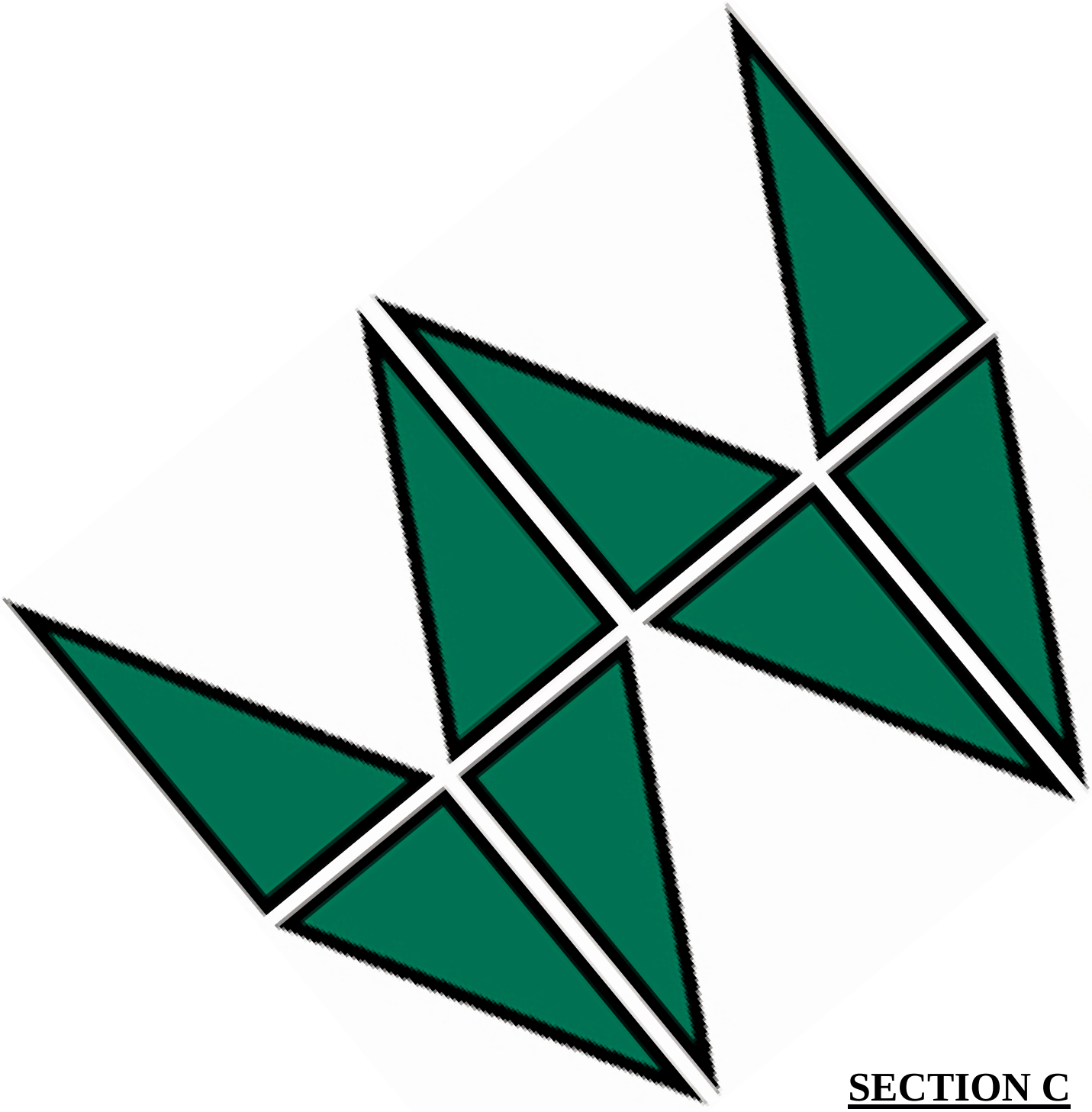
3-1

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

BASIN B – EXISTING
C = 0.30



SECTION C

TABLE II

Land Use/Type of Surface	Range of "C" Values
Business downtown	0.70 to 0.95
Business in neighborhoods	0.50 to 0.70
Single family	0.30 to 0.50
Multi-units, detached	0.40 to 0.60
Multi-units, attached	0.60 to 0.75
Suburban Residential	0.25 to 0.40
Apartment	0.50 to 0.70
Light Industrial	0.50 to 0.80
Heavy Industrial	0.60 to 0.90
Parks and Cemeteries	0.10 to 0.25
Playgrounds	0.20 to 0.35
Railroad yard	0.20 to 0.35
Unimproved land	0.10 to 0.30
Asphalt and Concrete	0.70 to 0.95 ← **USE 0.90**
Brick	0.70 to 0.85
Roofs	0.75 to 0.95
Sandy soil lawn, 2 percent slope	0.05 to 0.10
Sandy soil lawn, 2 to 7 percent slope	0.10 to 0.15
Sandy soil lawn, 7 percent slope	0.15 to 0.20
Heavy soil lawn, 2 percent slope	0.13 to 0.17
Heavy soil lawn, 2 to 7 percent slope	0.18 to 0.22
Heavy soil lawn, 7 percent slope	0.25 to 0.35

BASIN B -EXISTING

Basin B (Proposed):

Time of Concentration Calculation:

$$T_C = T_i + T_X$$

where:

T_i = 8.7 min *(see Table 3-2, attached)*

T_X = 1.4 min *(see Figure 3-4, attached)*

$T_C = 8.7 + 1.4$

$$\boxed{T_C = 10.1 \text{ min}}$$

Intensity Calculation:

$$I = 7.44\, P_6\, D^{-0.645}$$ *(see Figure 3-1, attached)*

where:

P_6 = 3.2 in *(see Rainfall Isopluvial, Section E)*

$D = T_C$ = 10.1 min *(from above)*

$$I = 7.44\,(3.2)\,(10.1)^{-0.645}$$

$$\boxed{I = 5.4 \text{ in/hr}}$$

Runoff Coefficient (C Value):

"C" values for the existing condition are derived from actual areas of existing and proposed surfaces and their corresponding "C" values from Table II and Table 3-1 of the County of San Diego Hydrology Manual (2003).

$$C_{weighted} = [(C_{PAVE} * A_{PAVE}) / A_{TOTAL}] + [(C_{NAT} * A_{NAT}) / A_{TOTAL}]$$

where:

C_{NAT} = 0.30 *(see Table 3-1, attached)*
C_{PAVE} = 0.90 *(see Table II, attached)*

A_{total} = 7.3 AC *(See Drainage Basin Map –Proposed Condition, attached)*

Natural Area (A_{NAT}) = 6.72 AC

Pavement Area (A_{PAVE}) = 0.58 AC

$C_{weighted} = [(0.90 * 0.58) / 7.3] + [(0.30 * 6.72) / 7.3] = 0.35$

$$\boxed{C_{weighted} = 0.35}$$

Flow Rate:

$$\mathbf{Q_{100} = C\ I\ A}$$

where:

C = 0.35

I = 5.4 in/hr *(see Figure 3-1, attached)*

A = 7.3 AC *(see Drainage Basin Map – Proposed Condition, attached)*

$$Q_{100} = (0.35)(5.4)(7.3) = 13.8$$

$$\boxed{\mathbf{Q_{100} = 13.8\ CFS}}$$

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/	.5%		1%		2%		3%		5%		10%	
	Acre	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

BASIN B - PROPOSED

L = 490'

ΔE = 2342
- 2168
174'

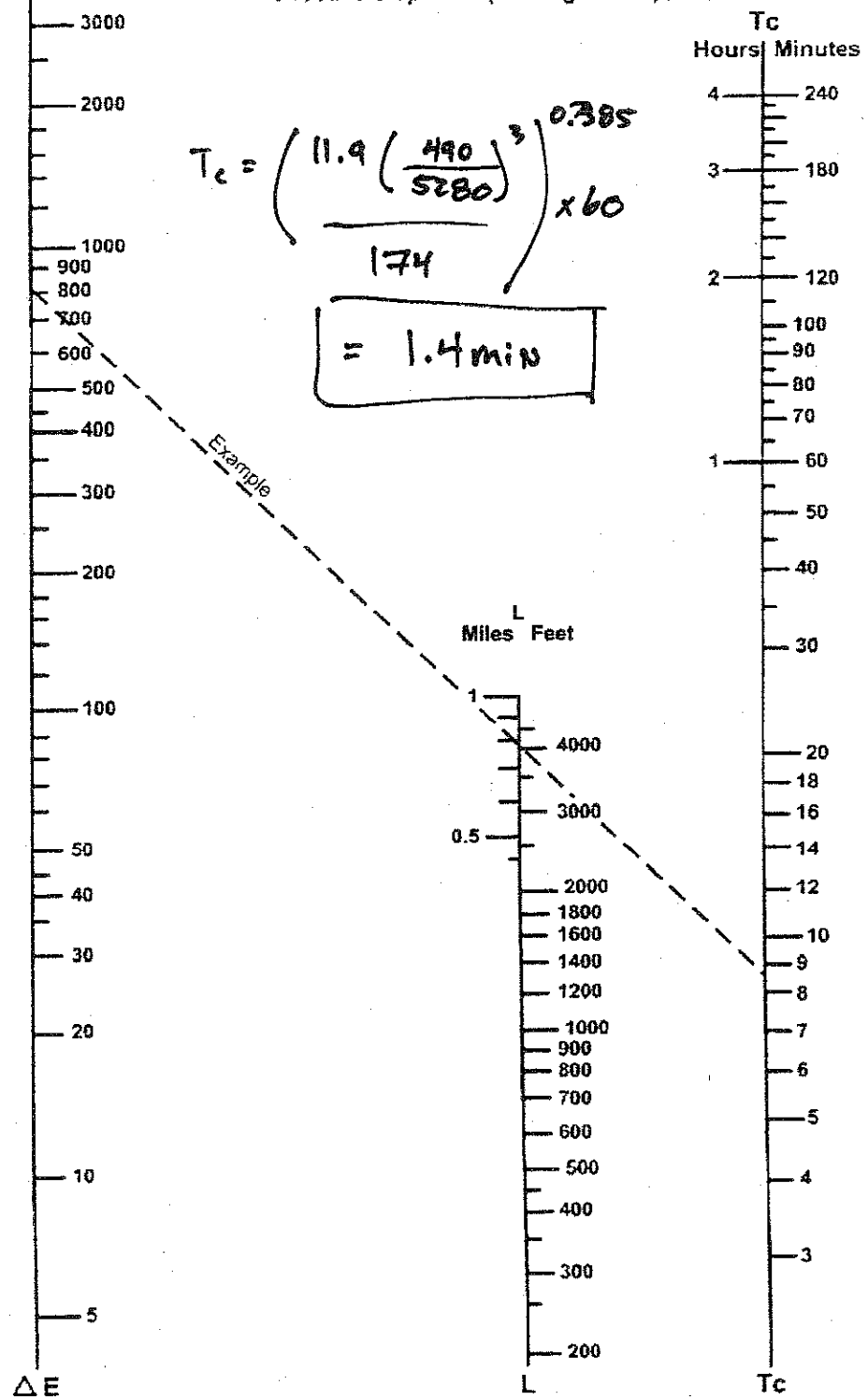
EQUATION

$$T_c = \left(\frac{11.9L^3}{\Delta E}\right)^{0.385}$$

Tc = Time of concentration (hours)
L = Watercourse Distance (miles)
ΔE = Change in elevation along effective slope line (See Figure 3-5) (feet)

$$T_c = \left(\frac{11.9\left(\frac{490}{5280}\right)^3}{174}\right)^{0.385} \times 60$$

$$\boxed{= 1.4 \text{ min}}$$

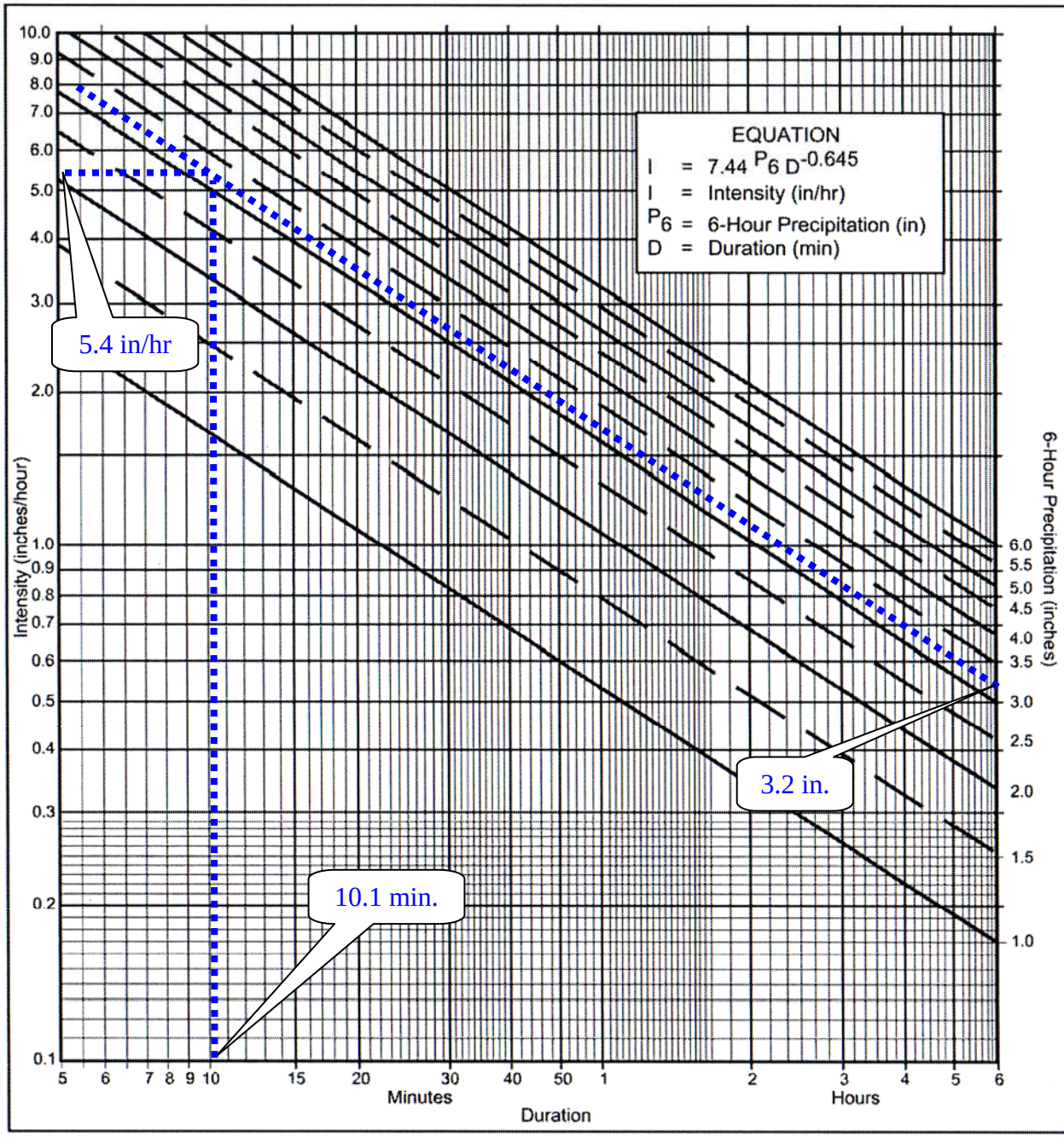


SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE 3-4

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

BASIN B
PROPOSED



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 = 3.2 in., P_{24} = 7.1 , $\frac{P_6}{P_{24}}$ = 45 %(2)

(c) Adjusted $P_6^{(2)}$ = 3.2 in.

(d) t_x = 10.1 min.

(e) I = 5.4 in./hr.

I = 5.4in/hr

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

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
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

BASIN B - PROPOSED

FIGURE

3-1

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

BASIN B – PROPOSED
C = 0.30

TABLE II

Land Use/Type of Surface	Range of "C" Values
Business downtown	0.70 to 0.95
Business in neighborhoods	0.50 to 0.70
Single family	0.30 to 0.50
Multi-units, detached	0.40 to 0.60
Multi-units, attached	0.60 to 0.75
Suburban Residential	0.25 to 0.40
Apartment	0.50 to 0.70
Light Industrial	0.50 to 0.80
Heavy Industrial	0.60 to 0.90
Parks and Cemeteries	0.10 to 0.25
Playgrounds	0.20 to 0.35
Railroad yard	0.20 to 0.35
Unimproved land	0.10 to 0.30
Asphalt and Concrete	0.70 to 0.95 ← USE 0.90
Brick	0.70 to 0.85
Roofs	0.75 to 0.95
Sandy soil lawn, 2 percent slope	0.05 to 0.10
Sandy soil lawn, 2 to 7 percent slope	0.10 to 0.15
Sandy soil lawn, 7 percent slope	0.15 to 0.20
Heavy soil lawn, 2 percent slope	0.13 to 0.17
Heavy soil lawn, 2 to 7 percent slope	0.18 to 0.22
Heavy soil lawn, 7 percent slope	0.25 to 0.35

BASIN B -PROPOSED

Basin C (Existing):

Time of Concentration Calculation:

$$\mathbf{T_C = T_i + T_X}$$

where:

T_i = 8.7 min *(see Table 3-2, attached)*

T_X = 3.1 min *(see Figure 3-4, attached)*

$$T_C = 8.7 + 3.1$$

$$\boxed{\mathbf{T_C = 11.8\ min}}$$

Intensity Calculation:

$$\mathbf{I = 7.44\ P_6\ D^{-0.645}}$$ *(see Figure 3-1, attached)*

where:

P_6 = 3.2 in *(see Rainfall Isopluvial, Section E)*

D = T_C = 11.8 min *(from above)*

$$I = 7.44\ (\ 3.2\ )\ (\ 11.8\ )^{-0.645}$$

$$\boxed{\mathbf{I = 4.8\ in/hr}}$$

Runoff Coefficient (C Value):

Basin C in the existing condition is composed of natural terrain and portions of a dirt road. The "C" value is obtained from Table 3-1 of the County of San Diego Hydrology Manual (2003).

C = 0.30 *(see Table 3-1, attached)*

$$\boxed{\mathbf{C_{weighted} = 0.30}}$$

Flow Rate:

$$Q_{100} = C\ I\ A$$

where:

C = 0.30

I = 4.8 in/hr *(see Figure 3-1 Basin A, attached)*

A = 12.5 AC *(see Drainage Basin Map – Existing Condition, attached)*

$$Q_{100} = (0.30)(4.8)(12.5) = 18.0$$

$$\boxed{\mathbf{Q_{100} = 18.0\ CFS}}$$

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/	.5%		1%		2%		3%		5%		10%	
	Acre	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

BASIN C - EXISTING

EQUATION

$$T_c = \left(\frac{11.9L^3}{\Delta E}\right)^{0.385}$$

T_c = Time of concentration (hours)

L = Watercourse Distance (miles)

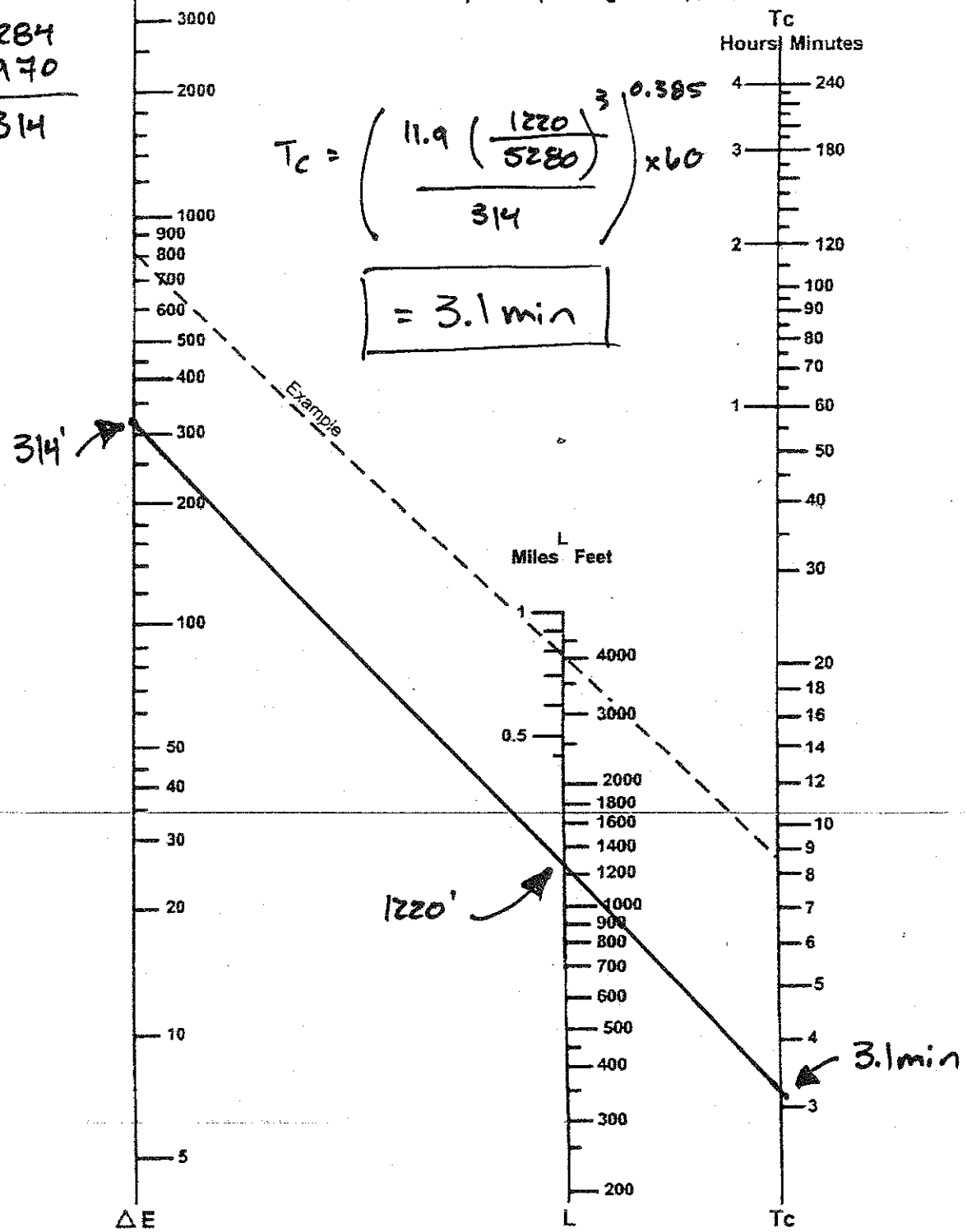
ΔE = Change in elevation along effective slope line (See Figure 3-5) (feet)

$L = 1220'$

$\Delta E = 2284 - 1970 = 314$

$$T_c = \left(\frac{11.9\left(\frac{1220}{5280}\right)^3}{314}\right)^{0.385} \times 60$$

$$\boxed{= 3.1 \text{ min}}$$



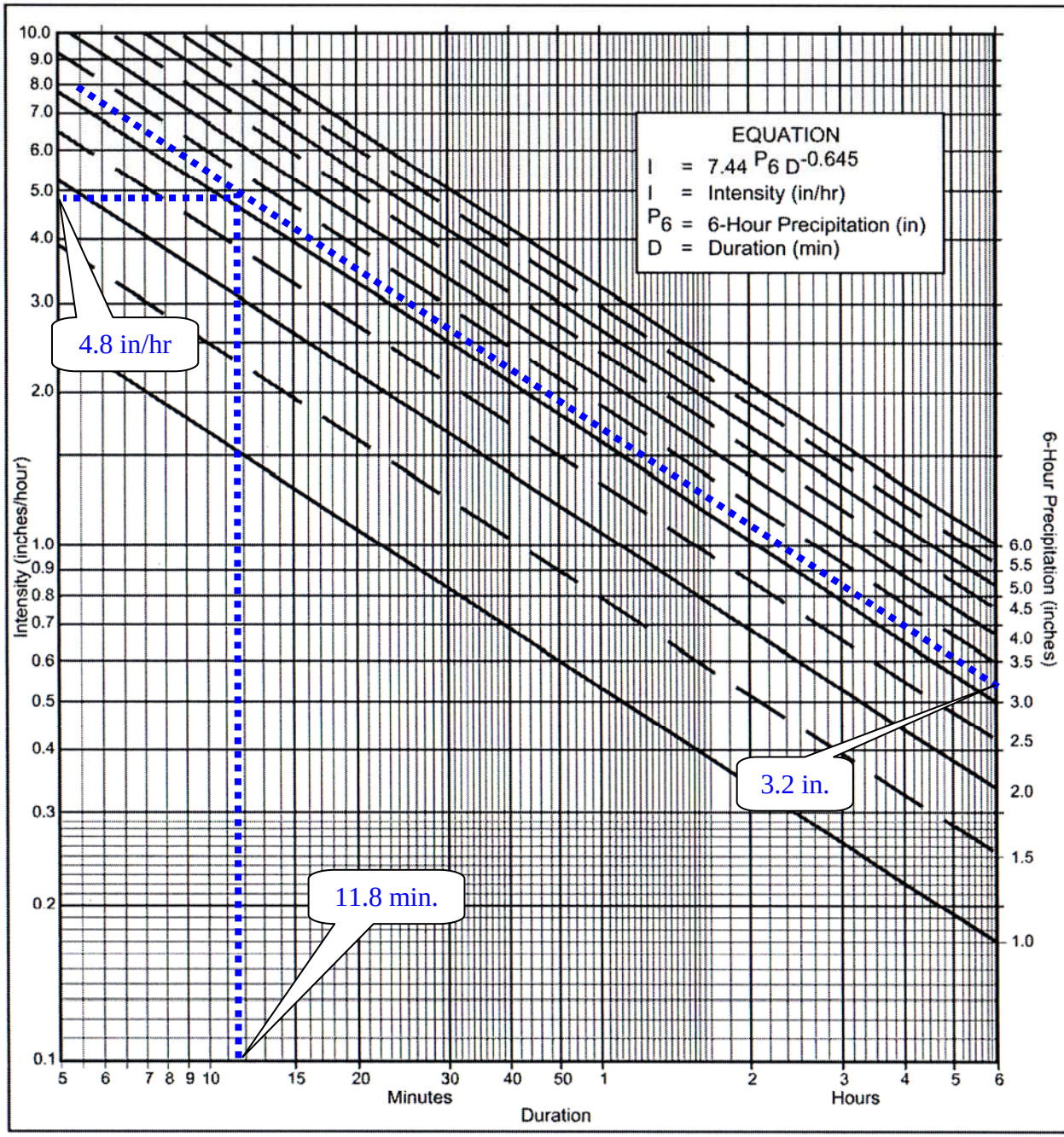
SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE

3-4

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

BASIN C
EXISTING



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 = 3.2 in., P_{24} = 7.1 , $\frac{P_6}{P_{24}}$ = 45 %(2)

(c) Adjusted $P_6^{(2)}$ = 3.2 in.

(d) t_x = 11.8 min.

(e) I = 4.8 in./hr.

I = 4.8in/hr

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

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
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

BASIN C - EXISTING

FIGURE

3-1

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

BASIN C – EXISTING
C = 0.30

Basin C (Proposed):

Time of Concentration Calculation:

$$\mathbf{T_C = T_i + T_X}$$

where:

T_i = 8.7 min *(see Table 3-2, attached)*

T_X = 3.1 min *(see Figure 3-4, attached)*

$$T_C = 8.7 + 3.1$$

$$\boxed{\mathbf{T_C = 11.8\ min}}$$

Intensity Calculation:

$$\mathbf{I = 7.44\ P_6\ D^{-0.645}}$$ *(see Figure 3-1, attached)*

where:

P_6 = 3.2 in *(see Rainfall Isopluvial, Section E)*

$D = T_C$ = 11.8 min *(from above)*

$$I = 7.44\ (\ 3.2\ )\ (\ 11.8\ )^{-0.645}$$

$$\boxed{I = 4.8\ in/h}$$

Runoff Coefficient (C Value):

"C" values for the existing condition are derived from actual areas of existing and proposed surfaces and their corresponding "C" values from Table II and Table 3-1 of the County of San Diego Hydrology Manual (2003).

$$C_{weighted} = [(C_{PAVE} * A_{PAVE}) / A_{TOTAL}] + [(C_{ROOF} * A_{ROOF}) / A_{TOTAL}] + [(C_{NAT} * A_{NAT}) / A_{TOTAL}]$$

where:

C_{NAT} = 0.30 *(see Table 3-1, attached)*
C_{ROOF} = 0.85 *(see Table II, attached)*
C_{PAVE} = 0.90 *(see Table II, attached)*

A_{total} = 12.5 AC *(See Drainage Basin Map –Proposed Condition, attached)*

Natural Area (A_{NAT}) = 12.2 AC

Pavement Area (A_{PAVE}) = 0.2 AC

Roof Area (A_{ROOF}) = 0.1 AC

$$C_{weighted} = [(0.90 * 0.2) / 12.5] + [(0.85 * 0.1) / 12.5] + [(0.30 * 12.2) / 12.5] = 0.31$$

$$\boxed{\mathbf{C_{weighted} = 0.31}}$$

Flow Rate:

$$\mathbf{Q_{100} = C\ I\ A}$$

where:

C = 0.31

I = 4.8 in/hr *(see Figure 3-1, attached)*

A = 12.5 AC *(see Drainage Basin Map – Proposed Condition, attached)*

$Q_{100} = (0.31)(4.8)(12.5) = 18.6$

$$\boxed{\mathbf{Q_{100} = 18.6\ CFS}}$$

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/	.5%		1%		2%		3%		5%		10%	
	Acre	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

BASIN C - PROPOSED

EQUATION

$$T_c = \left(\frac{11.9L^3}{\Delta E}\right)^{0.385}$$

T_c = Time of concentration (hours)

L = Watercourse Distance (miles)

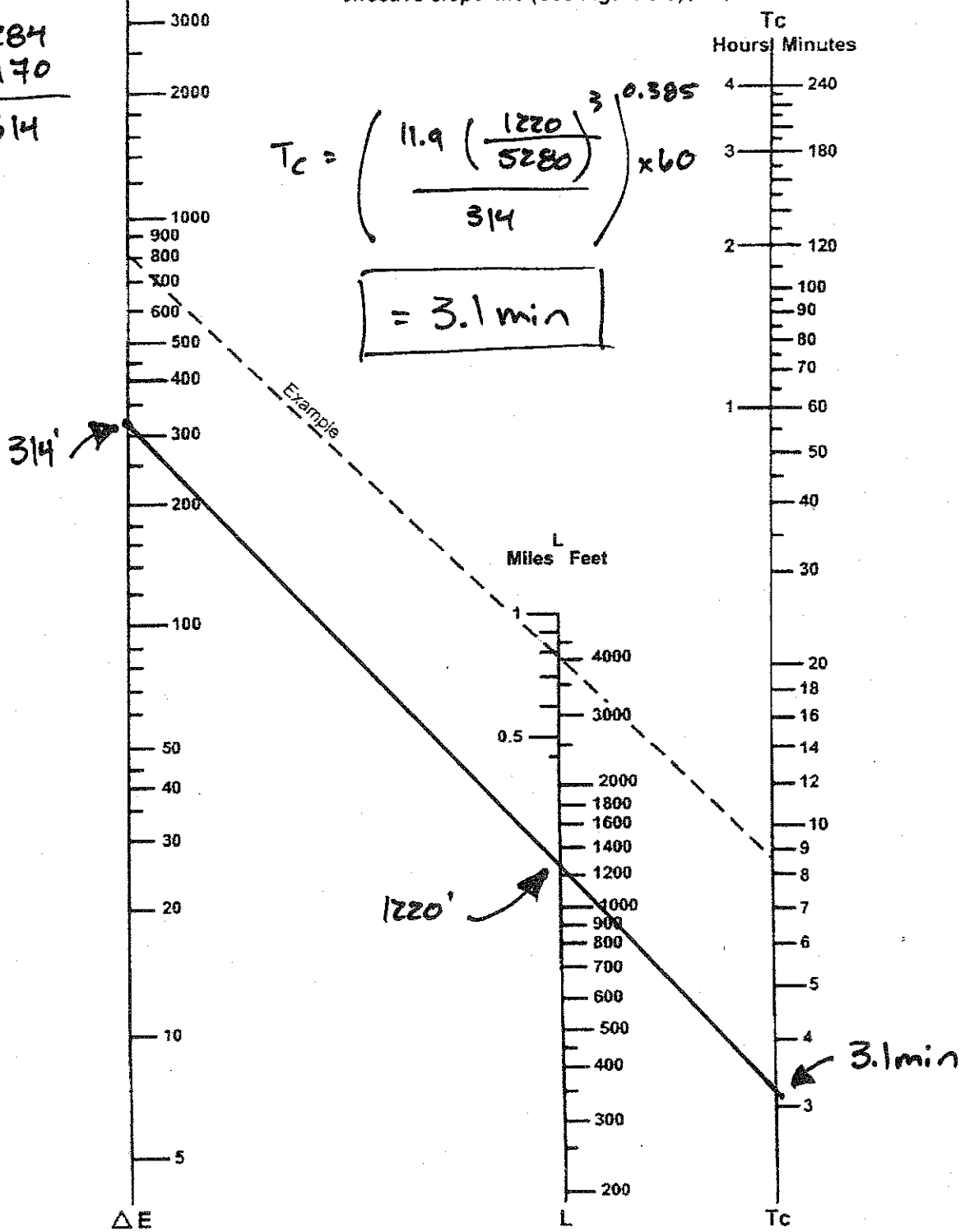
ΔE = Change in elevation along effective slope line (See Figure 3-5) (feet)

$L = 1220'$

$\Delta E = 2284 - 1970 = 314$

$$T_c = \left(\frac{11.9\left(\frac{1220}{5280}\right)^3}{314}\right)^{0.385} \times 60$$

$$\boxed{= 3.1 \text{ min}}$$



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

FIGURE

3-4

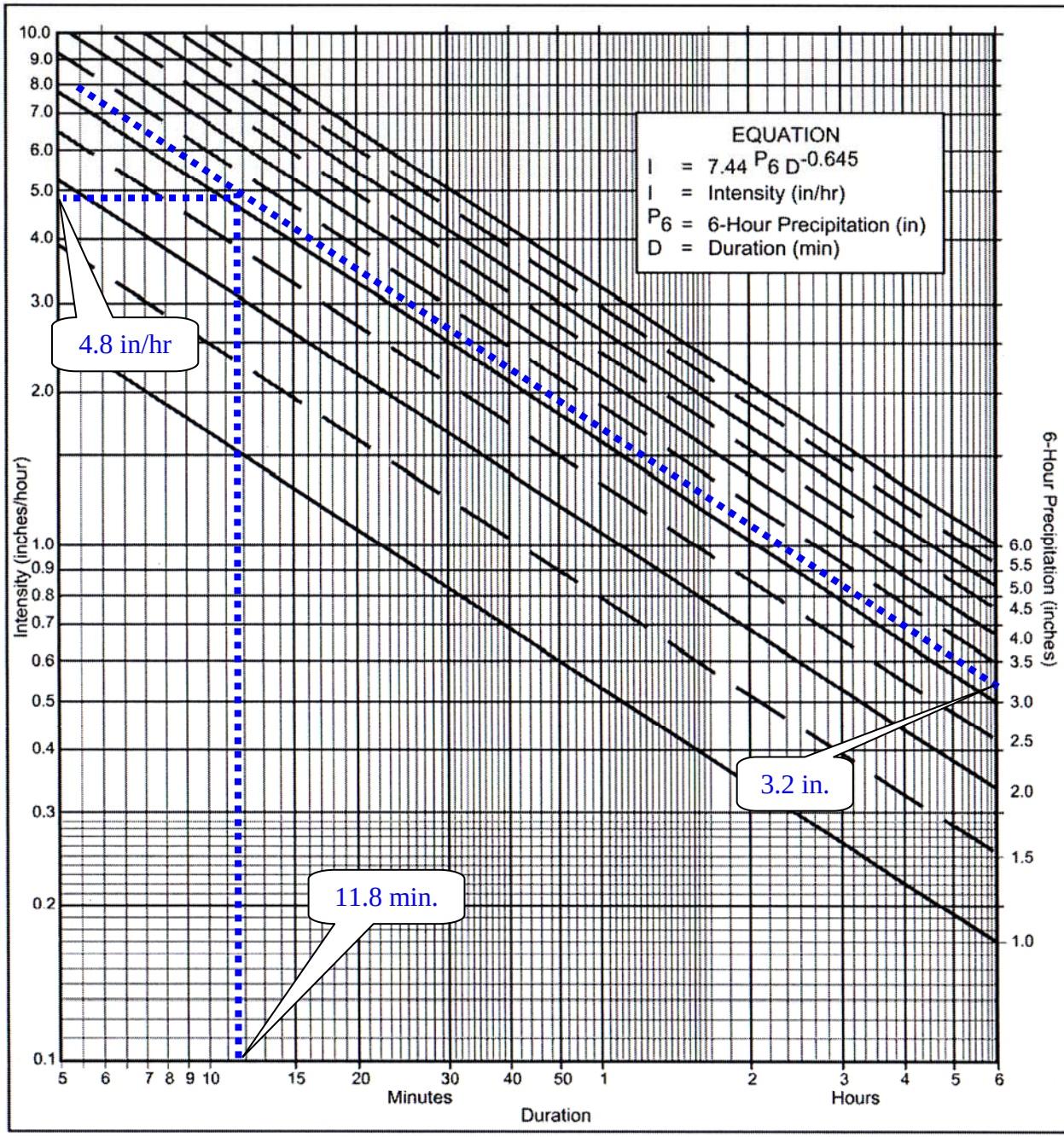
Nomograph for Determination of
Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds

BASIN C
PROPOSED

TABLE II

Land Use/Type of Surface	Range of "C" Values	
Business downtown	0.70 to 0.95	
Business in neighborhoods	0.50 to 0.70	
Single family	0.30 to 0.50	
Multi-units, detached	0.40 to 0.60	
Multi-units, attached	0.60 to 0.75	
Suburban Residential	0.25 to 0.40	
Apartment	0.50 to 0.70	
Light Industrial	0.50 to 0.80	
Heavy Industrial	0.60 to 0.90	
Parks and Cemeteries	0.10 to 0.25	
Playgrounds	0.20 to 0.35	
Railroad yard	0.20 to 0.35	
Unimproved land	0.10 to 0.30	
Asphalt and Concrete	0.70 to 0.95	**USE 0.90**
Brick	0.70 to 0.85	
Roofs	0.75 to 0.95	**USE 0.85**
Sandy soil lawn, 2 percent slope	0.05 to 0.10	
Sandy soil lawn, 2 to 7 percent slope	0.10 to 0.15	
Sandy soil lawn, 7 percent slope	0.15 to 0.20	
Heavy soil lawn, 2 percent slope	0.13 to 0.17	
Heavy soil lawn, 2 to 7 percent slope	0.18 to 0.22	
Heavy soil lawn, 7 percent slope	0.25 to 0.35	

BASIN C -PROPOSED



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 = 3.2 in., P_{24} = 7.1 , $\frac{P_6}{P_{24}}$ = 45 %(2)

(c) Adjusted $P_6^{(2)}$ = 3.2 in.

(d) t_x = 11.8 min.

(e) I = 4.8 in./hr.

I = 4.8in/hr

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

P6	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6
Duration	I	I	I	I	I	I	I	I	I	I	I
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

BASIN C - PROPOSED

FIGURE

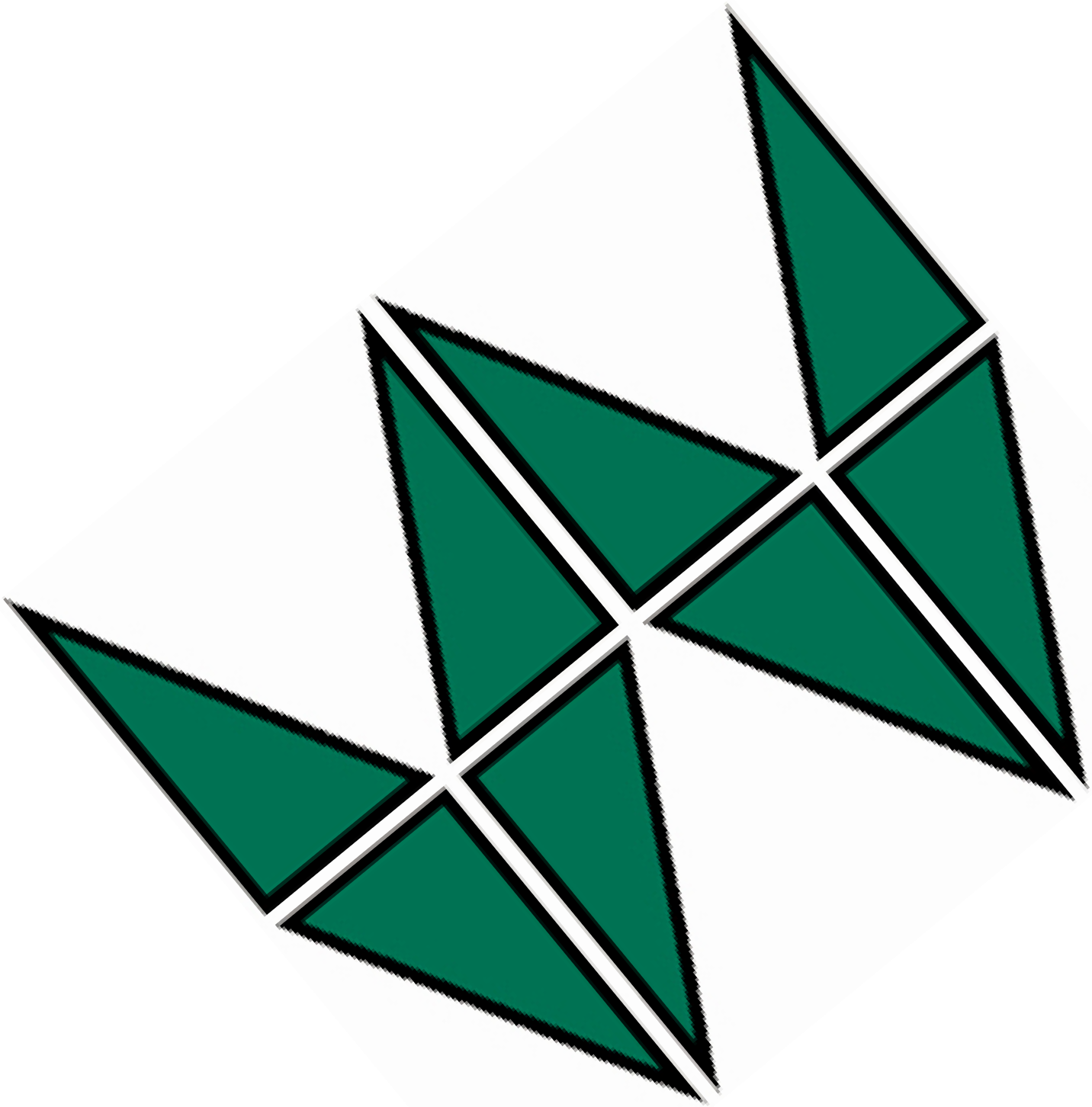
3-1

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

BASIN C – PROPOSED
C = 0.30



SECTION D

Basin A Hydraulics (Existing):

The following calculations pertain to the existing 24” CMP drainpipe.

Headwater:

HW/D = 0.65 *(see Chart 5 Basin A, attached)*

therefore:

HW = D(0.65)

where:

D = diameter of pipe = 24”

HW = (24”)(0.65) = 15.6” = 1.3’

There is approximately 6.1’ of available head from the flow line of the existing 24” drainpipe on the west side of the road to the top edge of the existing dirt road and therefore will be enough available head to handle the runoff produced from Basin A during a 100-year storm.

Pipe Capacity:

Manning Pipe Calculator

Given Input Data:

Shape ..... Circular
Diameter ..... 24 in
Flowrate ……..……... 5.6cfs *(see Section B)*
Slope ..... 0.10 ft/ft *(per field survey)*
Manning's n ..... 0.017 *(San Diego County Drainage Design Manual)*

Computed Results:

Depth ..... 6” in

Basin A Hydraulics (Proposed):

The following calculations pertain to the existing 24” CMP drainpipe.

Headwater:

HW/D = 0.68 *(see Chart 5 Basin A, attached)*

therefore:

HW = D(0.68)

where:

D = diameter of pipe = 24”

HW = (24”)(0.68) = 16.3” = 1.4’

There is approximately 6.6’ of available head from the flow line of the existing 24” drainpipe on the west side of the road to the top of the proposed AC dike on the east side of the road and therefore will be enough available head to handle the runoff produced from Basin A during a 100-year storm.

Pipe Capacity:

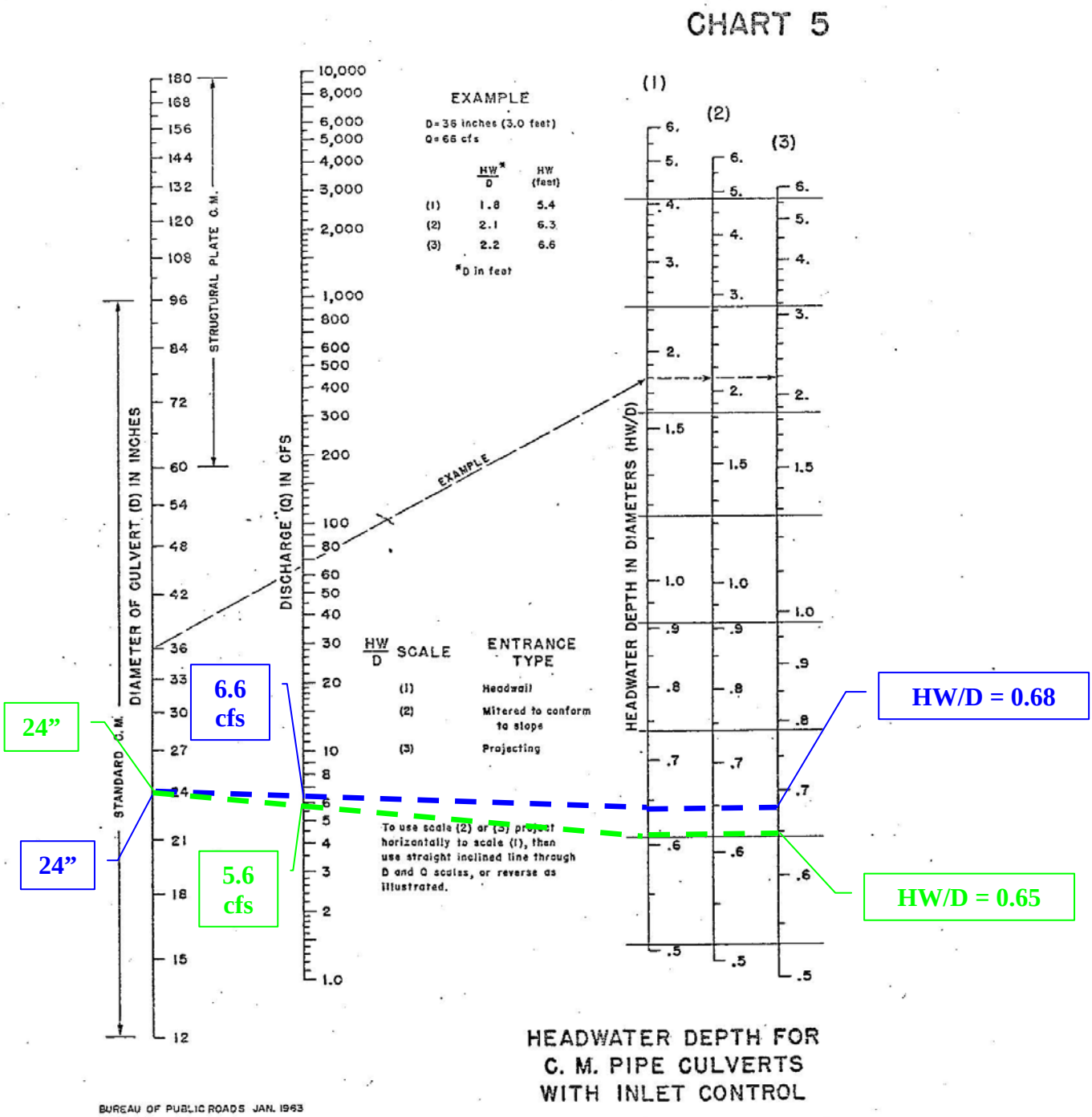
Manning Pipe Calculator

Given Input Data:

Shape ..... Circular
Diameter ..... 24 in
Flowrate ……..……... 6.6cfs *(see Section B)*
Slope ..... 0.10 ft/ft *(per field survey)*
Manning's n ..... 0.017 *(San Diego County Drainage Design Manual)*

Computed Results:

Depth ..... 6” in



HW/D = 0.68, therefore HW = (24”)(0.68) = 16.3” (PROPOSED)
HW/D = 0.65, therefore HW = (24”)(0.68) = 15.6” (EXISTING)

BASIN A

Basin A Hydraulics (Proposed):

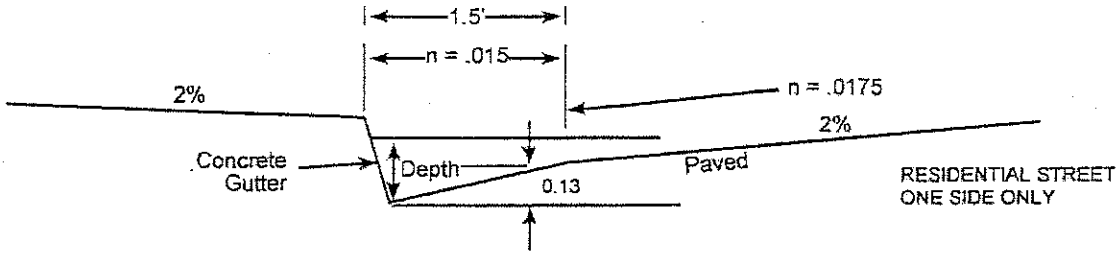
The following calculations pertain to the proposed AC dike. The Q_{100} used for the dike capacity is the Q_{100} from Basin A in the proposed condition. The depth of flow is obtained from Figure 3-6 of the San Diego County Hydrology Manual.

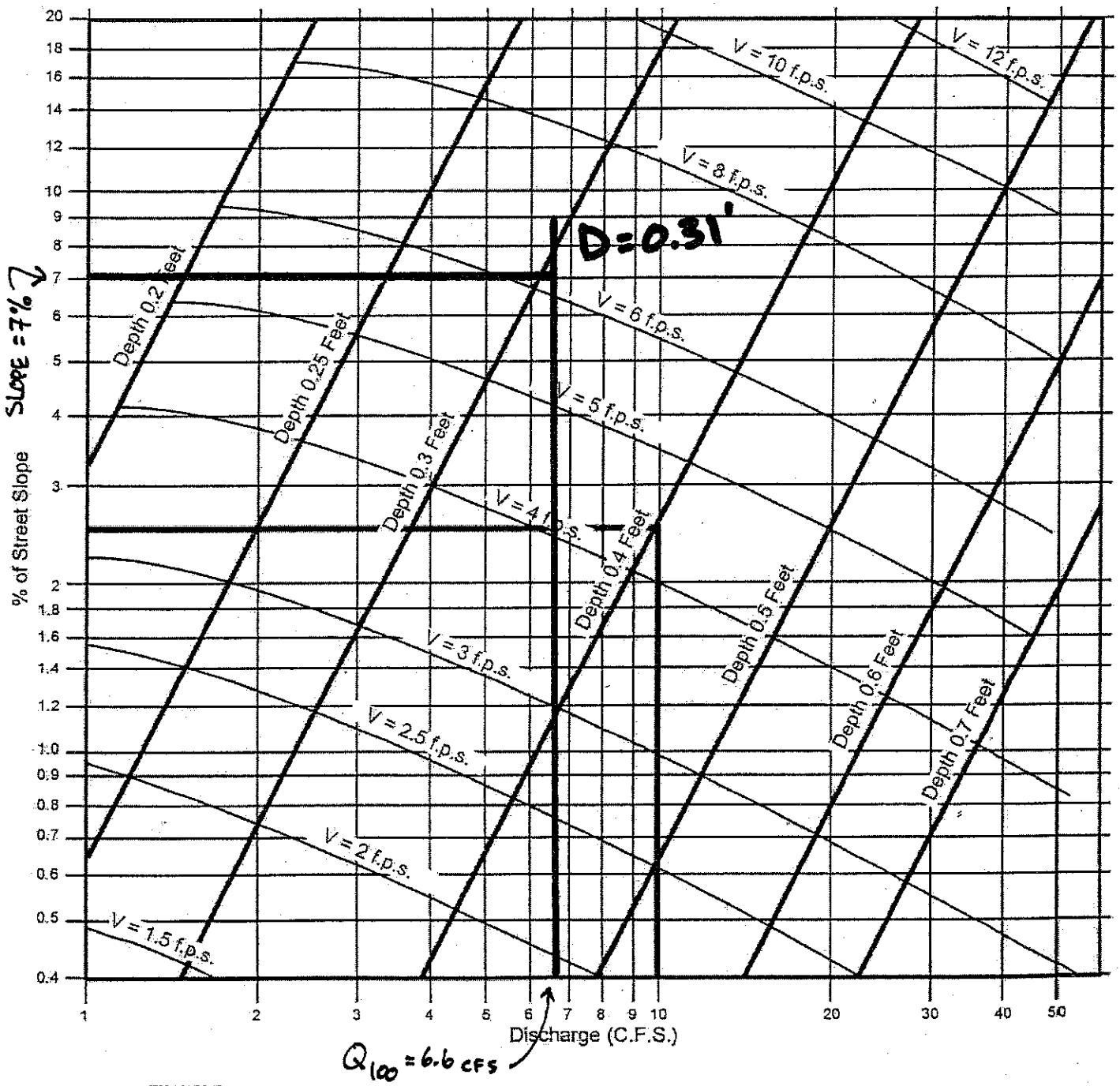
Q_{100} = 6.6 cfs *(from Section A)*
Slope = 7% *(from Preliminary Grading Plan, attached)*

Depth:

D = 0.31 ft *(see Figure 3-6 Basin A, attached)*

The depth of flow will be 0.31' during a 100-year storm. The proposed AC dike is 0.5' and is therefore adequate to handle the runoff produced from Basin A during a 100-year storm.





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

Gutter and Roadway Discharge - Velocity Chart

3-6

BASIN A

Basin B Hydraulics (Existing):

The following calculations pertain to the existing 24” CMP drainpipe.

Headwater:

HW/D = 1.02 *(see Chart 5 Basin B, attached)*

therefore:

HW = D(1.02)

where:

D = diameter of pipe = 24”

HW = (24”)(1.02) = 24.5” = 2.0’

There is approximately 21’ of available head from the flow line of the existing 24” drainpipe to the edge of Skyline Truck Trail and therefore will be enough head to handle the runoff from Basin B produced during a 100-year storm.

Pipe Capacity:

Manning Pipe Calculator

Given Input Data:

Shape ..... Circular
Diameter ..... 24 in
Flowrate ……..……... 12.2 cfs *(see Section A)*
Slope ..... 0.093 ft/ft *(per field survey)*
Manning's n ..... 0.017 *(San Diego County Drainage Design Manual)*

Computed Results:

Depth ..... 8 in

Basin B Hydraulics (Proposed):

The following calculations pertain to the existing 24” CMP drainpipe.

Headwater:

HW/D = 1.15 *(see Chart 5 Basin B, attached)*

therefore:

HW = D(1.15)

where:

D = diameter of pipe = 24”

HW = (24”)(1.15) = 27.6” = 2.3’

There is approximately 21’ of available head from the flow line of the existing 24” drainpipe to the edge of Skyline Truck Trail and therefore will be enough head to handle the runoff from Basin B produced during a 100-year storm.

Pipe Capacity:

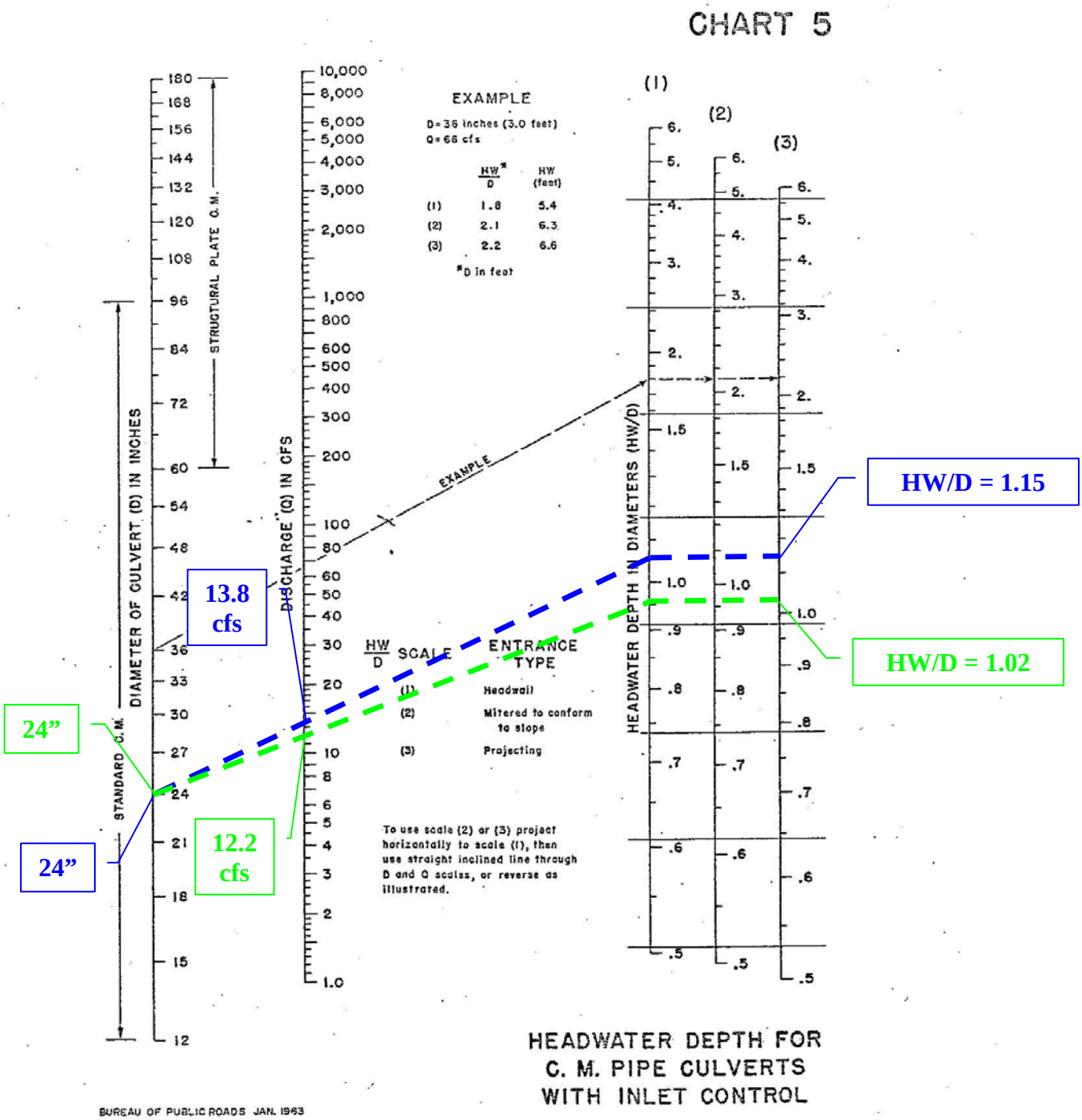
Manning Pipe Calculator

Given Input Data:

Shape ..... Circular
Diameter ..... 24 in
Flowrate ……..……... 13.8 cfs *(see Section B)*
Slope ..... 0.093 ft/ft *(per field survey)*
Manning's n ..... 0.017 *(San Diego County Drainage Design Manual)*

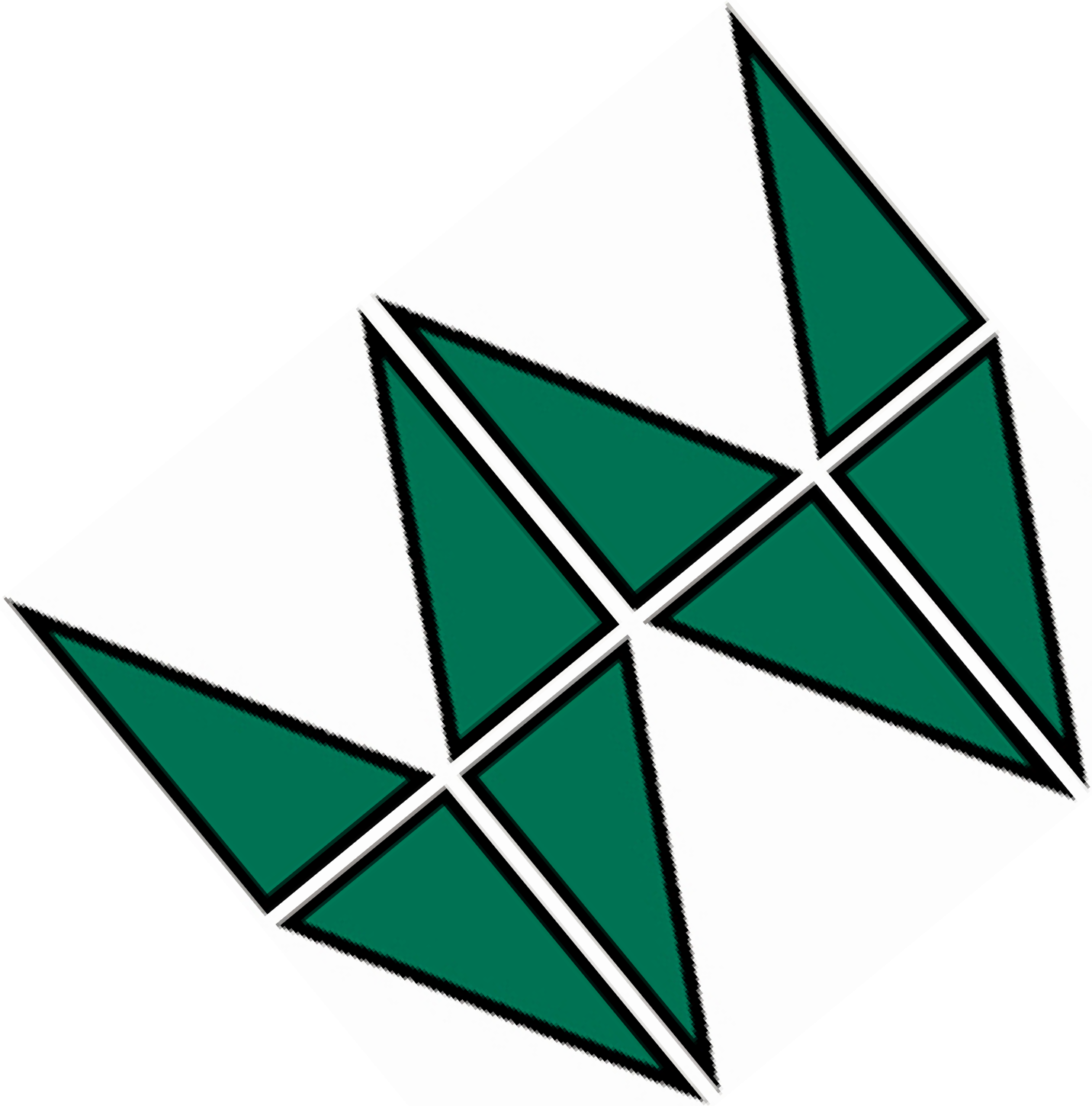
Computed Results:

Depth ..... 8 in

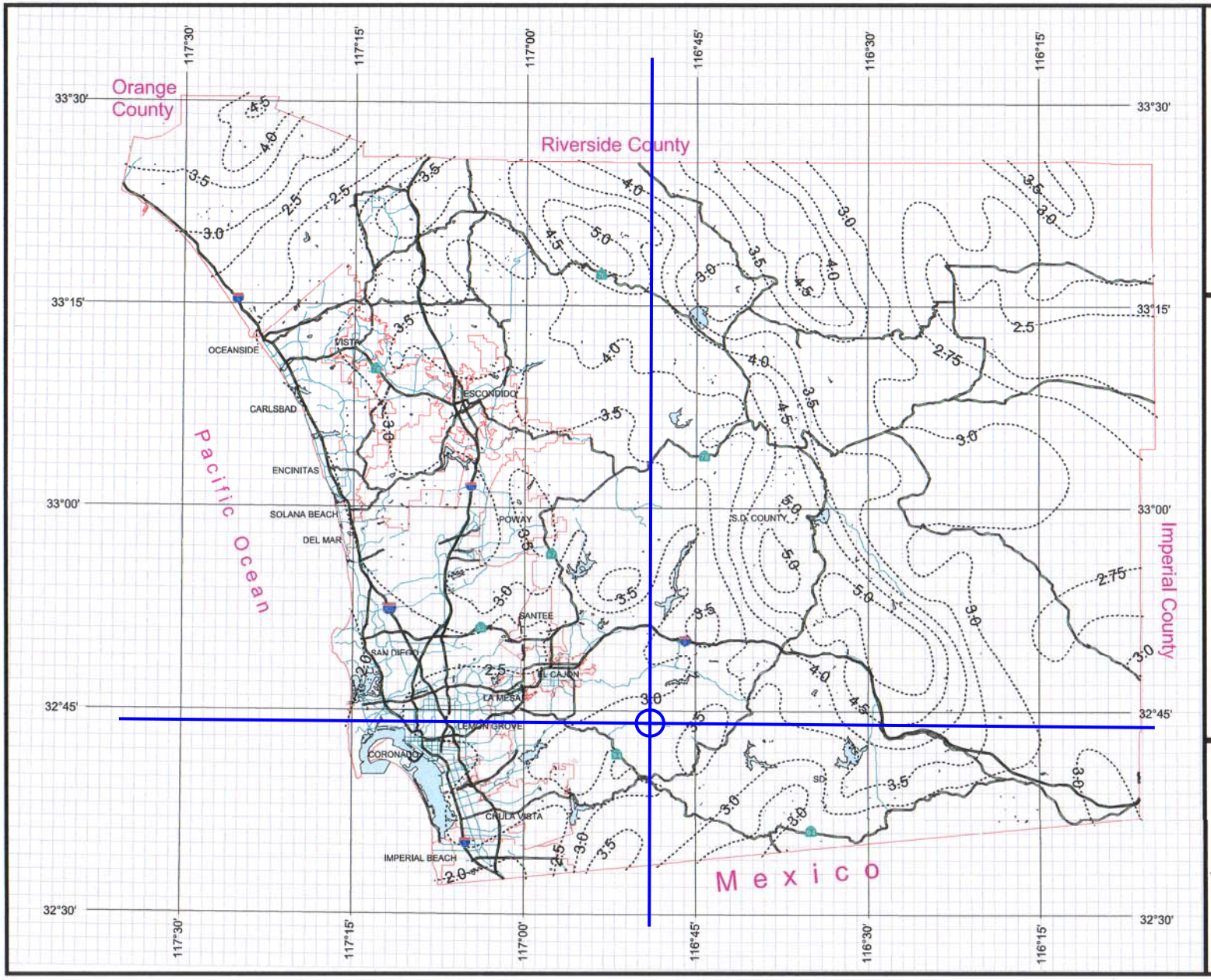


HW/D = 1.15, therefore HW = (24”)(1.15) = 27.6” (PROPOSED)
HW/D = 1.02, therefore HW = (24”)(0.68) = 24.5” (EXISTING)

BASIN B



SECTION E



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

Isopluvial (inches)

P_6=3.2in

DPW GIS

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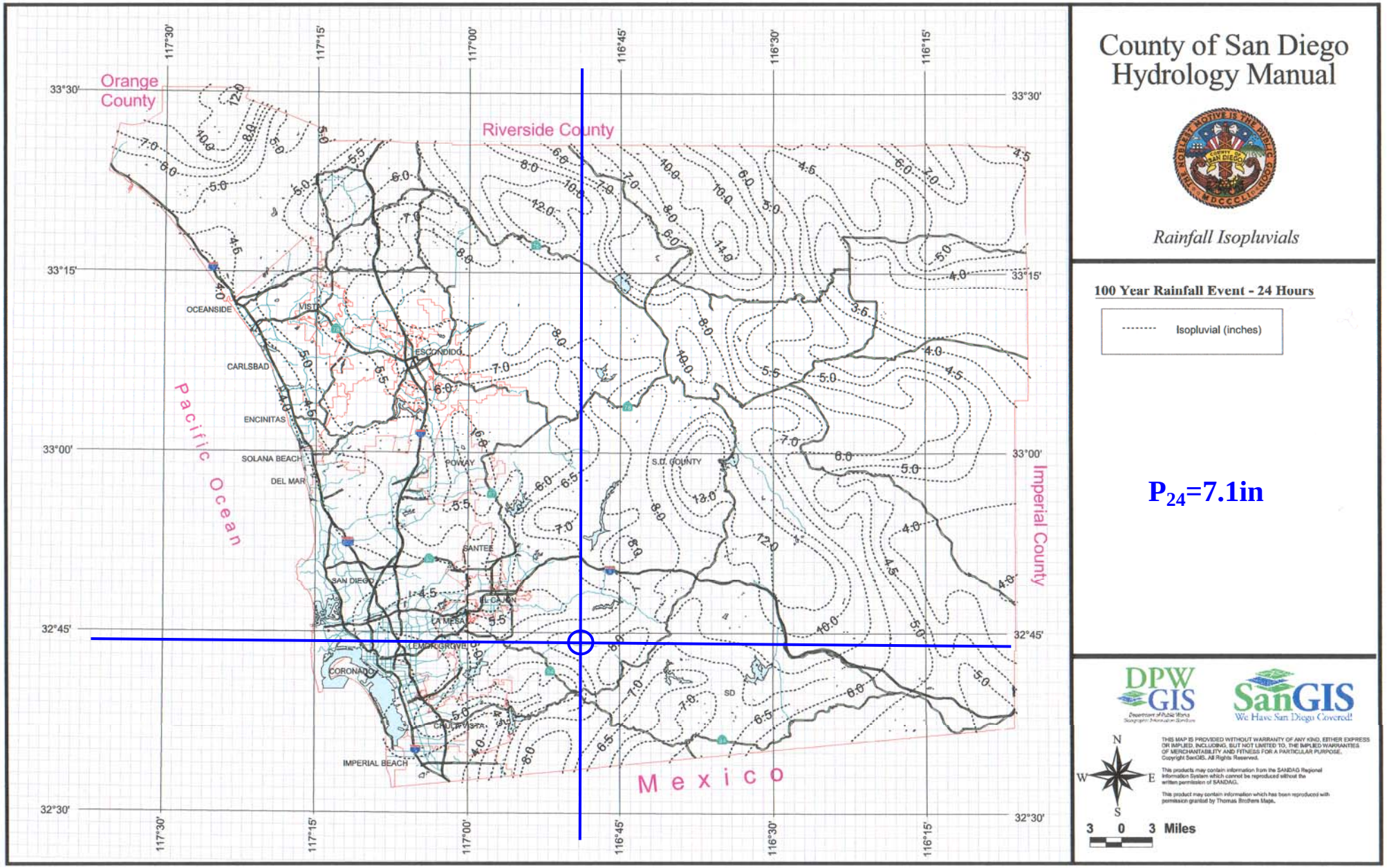
N W E S

3 0 3 Miles



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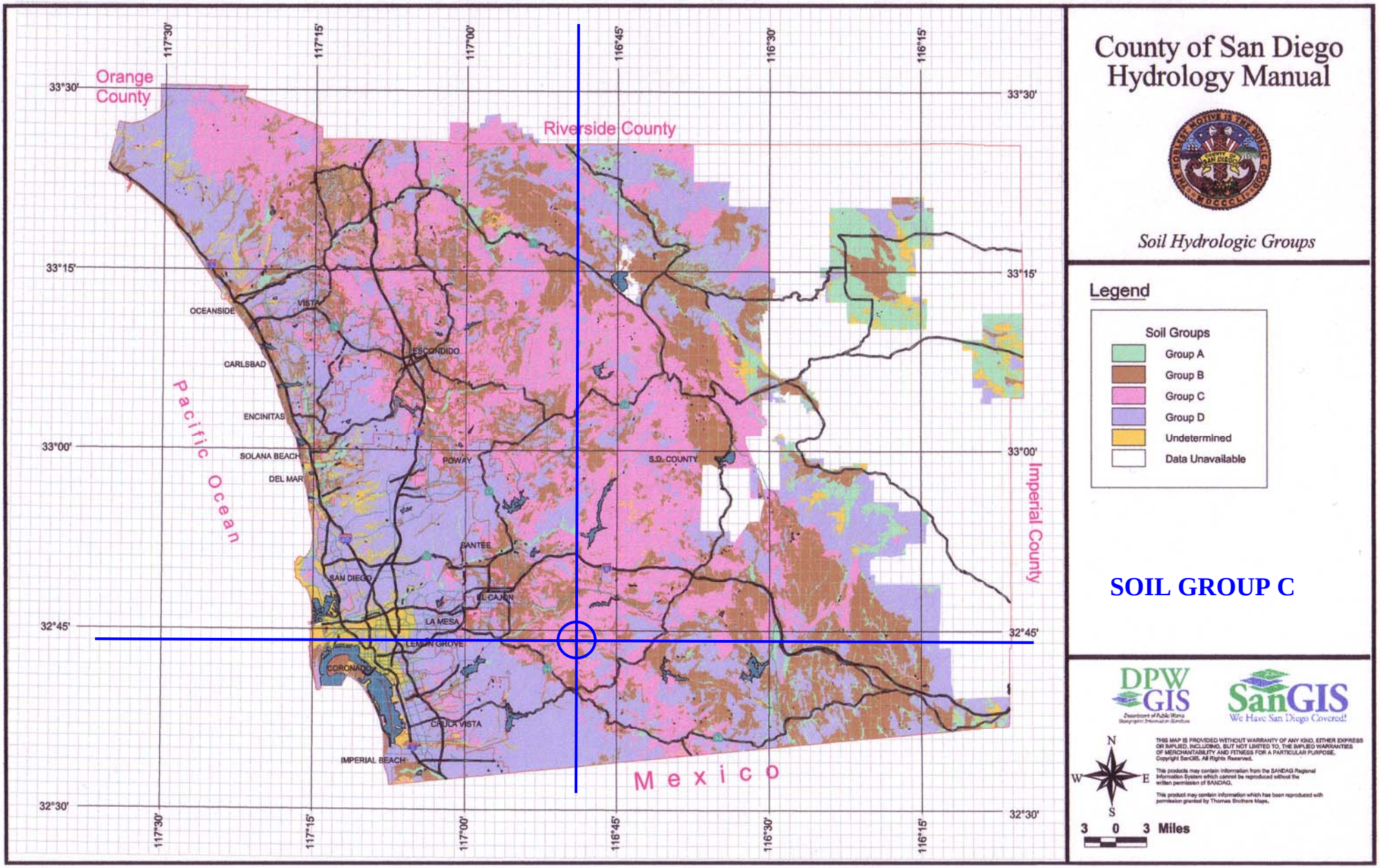

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