WALSH ENGINEERING
& SURVEYING, INC.

CEQA PRELIMINARY DRAINAGE STUDY

for

West Lilac Farms
TM 5276
Log No. 02-02-002

Lawrence W. Walsh 9/21/09

Lawrence W. Walsh, RCE 46316 Date

Revised August 7, 2009
Revised September 22, 2008
Revised March 9, 2007
Revised November 1, 2005
Revised May 25, 2005
Original May 24, 2004

Prepared for:
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(Walsh Engineering Job No 01246 - West Lilac)

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SECTION A

INTRODUCTION / SUMMARY

INTRODUCTION:

This Drainage Study is for the West Lilac Farms Tentative Map (TM 5276). The project site encompasses approximately 93 acres located westerly of Interstate 15 (I-15) and southerly of West Lilac Road between Via Ararat Drive and Aqueduct Road in the Community of Bonsall, County of San Diego. See the Vicinity Map attached. Land use for the 28-lot subdivision is rural-residential with a minimum lot size of 2.0 acres.

Existing Conditions:

In its existing condition, the site is characterized by rolling hills. Approximately 80 percent is primarily land uses of irrigated citrus and avocado groves with occasional orchard weeds. Several existing homes and grove areas surround the project. The two main roads, Via Ararat Drive and Aqueduct Road, parallel the westerly and easterly project boundaries, respectively.

Via Ararat Drive in its existing condition is approximately 20 feet wide. The surface of the road is paved with AC and is located on the easterly side of a 40-foot private road easement. In the proposed condition the road will be widened to 24-foot paved with 2-foot DG shoulder along the westerly edge of the road. The existing cross slopes of the road will be maintained.

Aqueduct Road in its existing condition is approximately 20 feet wide and is paved in the northerly section and DG in the southerly section. In the proposed condition the road will be widened to 24-foot paved with 2-foot DG shoulders along both sides of the road. The existing cross slopes of the road will also be maintained.

Proposed Conditions:

In the proposed condition, the site will retain its rolling hill character by aligning the road with the contour of the land and grading individual pads for each lot (i.e. no mass/contiguous grading). <u>The total disturbed area on-site due to the proposed building pads, driveways, roads and leach field areas is 34.3 acres in size. The total disturbed area off-site due to the proposed roads is 1.9 acres.</u>

Multiple access points are provided on-site through the use of cul-de-sacs, thereby reducing the lengths of the streets. On-site streets and off-site roads are designed to meet the County of San Diego’s minimum width criteria. The streets will have a paved width of 30-feet on a 34-feet graded width.

To the maximum extent practicable, the project is designed to drain impervious areas to the landscaped areas to promote pollutant removal and to reduce the intensity of the runoff prior to discharging thereby minimizing the directly connected impervious areas. The proposed single-family residences will also be setback from the impervious streets to provide opportunities to drain rooftops into landscaped areas.

Culverts are proposed for short reaches as road under-crossings and for the extension of existing pipes crossing Via Ararat Drive and Aqueduct Road. Rip rap energy dissipators will be located at all proposed outfalls of storm drain facilities to reduce runoff velocities.

Storm drain facilities and landscaping will not be located within proposed biological open space areas. The open space areas are to remain in the natural condition.

Stormwater:

Stormwater runoff from the north-half (approximately) of the project site drains in a northwesterly direction. Storm runoff from this portion of the site is collected in a well-defined, maturely vegetated swale off-site. The swale flows northwesterly approximately 1.5 miles to its confluence with the San Luis Rey River.

Stormwater runoff from the south-half (approximately) of the project site drains in a southwesterly direction. Storm runoff from this portion of the site is collected in a well-defined swale which flows southwesterly through the lower portion of the site. The swale continues off site to its confluence with Moosa Canyon approximately 1.5 miles southwesterly of the project boundary.

Moosa Canyon ultimately discharges to the San Luis Rey River approximately 2.5 miles westerly of the project boundary.

The 100-year floodplains limits of the San Luis Rey River and Moosa Canyon have been determined and are shown on the County of San Diego's floodplain maps. This project is not encumbered by the San Luis Rey River or Moosa Canyon floodplains.

The proposed project will not significantly alter the onsite or off-site drainage patterns and will not divert storm runoff from its ultimate receiving waters.

Appropriate BMPs will be utilized as soon as cuts or embankments, both on- and off-site, are completed, all slopes will be stabilized with a hydro-mulch mixture, or an equivalent protection measure to promote erosion and sediment control.

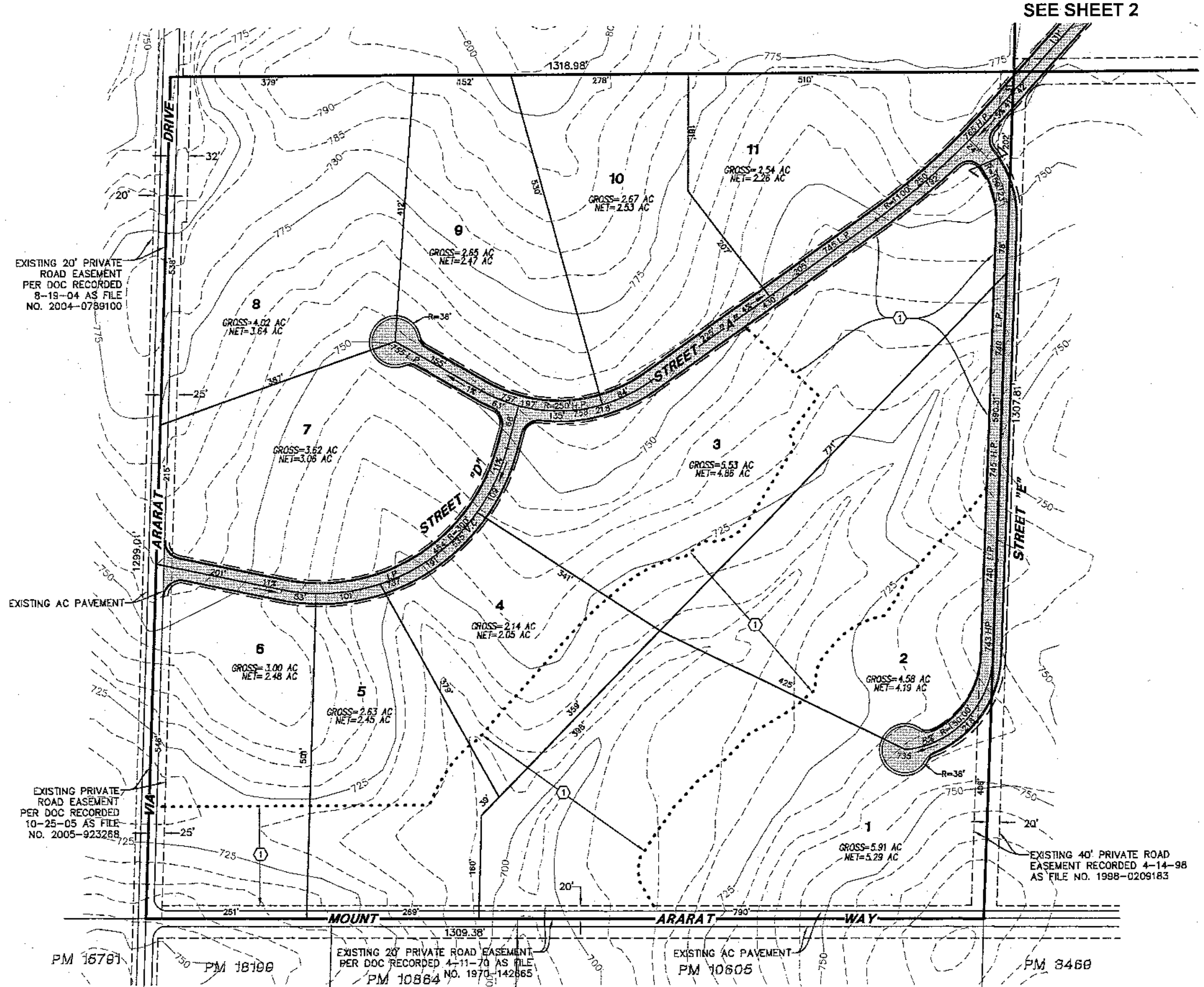
SUMMARY:

All hydrology calculations herein will be performed by using the Rational Method and follow procedures from the San Diego County Hydrology Manual (2003) for a 100-year storm.

The only disturbance of land on-site will be done on the streets and residential pads. Therefore, a significant portion of the existing orchards and vegetation will remain. Since the off-site access roads will be widened approximately 2 to 4 feet to meet the County of San Diego's minimum width, the disturbance is also minimal. Since the total disturbed area (stated above) is less than 50 acres, hydro-modification analysis is not required.

Roof drains on all homes to be constructed will deposit into landscaped areas and the runoff will be required to flow overland through the landscaping prior to entering the swales. Recognizing that pollutants from all onsite runoff from the lots will have been adequately filtered through the landscape and the natural swales, potential pollutants will be minimal. In addition,

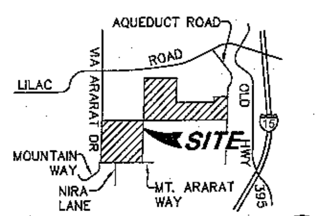
COUNTY OF SAN DIEGO TRACT 5276 RPL4



THIS DOES NOT CONSTITUTE APPROVAL OR DISAPPROVAL. Preliminary Information relating to this Tentative Map which is required for Department of Environmental Health processing has been submitted in satisfactory form.

County of San Diego
Department of Environmental Health

By ____________________ Date__________



VICINITY MAP

NO SCALE

THOMAS BRO MAP NO. 1048, G-7 & H-7 AND NO. 1068, G-1 & H-1

LEGAL DESCRIPTION

A PORTION OF SECTION 23, TOWNSHIP 10 SOUTH, RANGE 3 WEST, SAN BERNADINO MERIDIAN.

TENTATIVE MAP NOTES

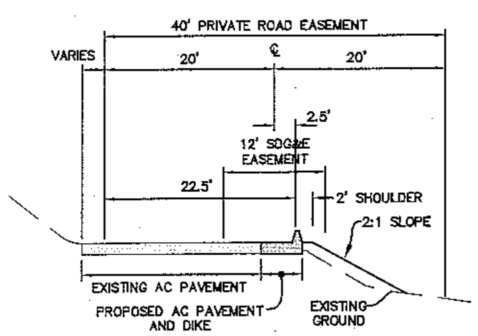
1. TAX ASSESSOR'S PARCEL NUMBER: 127-271-28 & 127-290-05
2. TOTAL NUMBER OF LOTS: 28
3. MINIMUM LOT SIZE: 2 ACRES
4. GENERAL PLAN REGIONAL CATEGORY: EDA
5. GENERAL PLAN LAND USE DESIGNATION: 19
6. COMMUNITY PLAN: BONSALL
7. SPECIAL ASSESSMENT ACT STATEMENT: WILL NOT OPPOSE AN ASSESSMENT DISTRICT
8. PARK LAND DEDICATION STATEMENT: WILL PAY IN-LIEU FEE.
9. STREET LIGHTS WILL BE PER COUNTY STANDARDS
10. SOLAR ACCESS STATEMENT: ALL PARCELS WITHIN THIS SUBDIVISION HAVE A MINIMUM OF 100 SQUARE FEET OF SOLAR ACCESS FOR EACH FUTURE DWELLING ALLOWED BY THIS SUBDIVISION AS REQUIRED BY SECTION 80.401(m) OF THE SUBDIVISION ORDINANCE.
11. TOPOGRAPHIC SOURCE: COUNTY 200 SCALE 410-1719 & 406-1719
12. DISTRICTS:
    SEWER: SEPTIC
    WATER: RAINBOW MUNICIPAL WATER DISTRICT
    FIRE: DEER SPRINGS FIRE PROTECTION DISTRICT
    SCHOOLS: FALLBROOK UNION HIGH SCHOOL DISTRICT AND BONSALL UNION ELEMENTARY SCHOOL DISTRICT
13. GRADING: SEE THE PRELIMINARY GRADING PLAN
14. ASSOCIATED PERMITS: NONE
15. EXISTING & PROPOSED ZONING:

USE REGULATIONS	A-70
ANIMAL REGULATIONS	W
DENSITY	0.50
LOT SIZE	2 AC
BUILDING TYPE	C
MAXIMUM FLOOR AREA	---
FLOOR AREA RATIO	---
HEIGHT	G
LOT COVERAGE	---
SETBACK	W
OPEN SPACE	---
SPECIAL AREA REGULATIONS	

16. TOTAL GROSS AREA = 92.77 AC
    TOTAL NET AREA = 82.13 AC
17. LOCATION AND STATUS OF EXISTING LEGAL ACCESS TO THE SUBJECT PROPERTY FROM A PUBLICLY MAINTAINED ROAD: PROPERTY HAS PRIVATE ROAD EASEMENTS OVER AQUEDUCT ROAD AND VIA ARARAT DRIVE TO WEST LILAC ROAD, A PUBLICLY MAINTAINED ROAD.

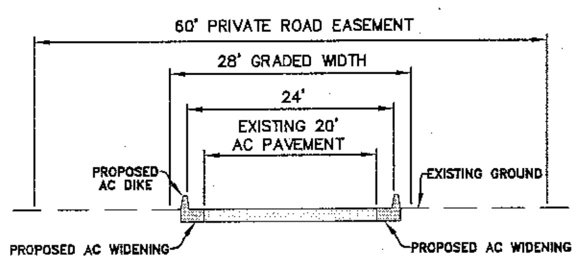
LEGEND

(1) PROPOSED LIMITED BUILDING ZONE EASEMENT



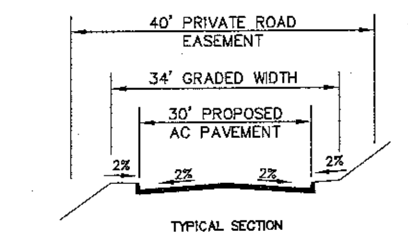
VIA ARARAT DRIVE

TYPICAL SECTION
NO SCALE



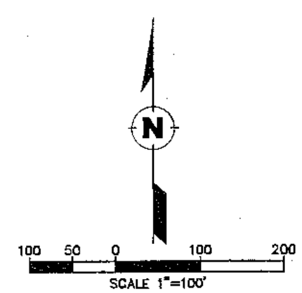
AQUADUCT ROAD

TYPICAL SECTION
NO SCALE



STREETS "A" - "E" (PRIVATE ROADS)

NO SCALE



REGISTERED PROFESSIONAL ENGINEER LAWRENCE W. WALSH No. C 46316 Exp. 12-31-10 CIVIL STATE OF CALIFORNIA

OWNER/SUBDIVIDER:

JAMES D. PARDEE, JR. DATE
WEST LILAC FARMS, LLC
267 STONECREEK COURT
WESTLAKE VILLAGE, CA 91361
1-805-373-5555

TENTATIVE MAP PREPARED BY:

LAWRENCE W. WALSH RCE 46316 DATE

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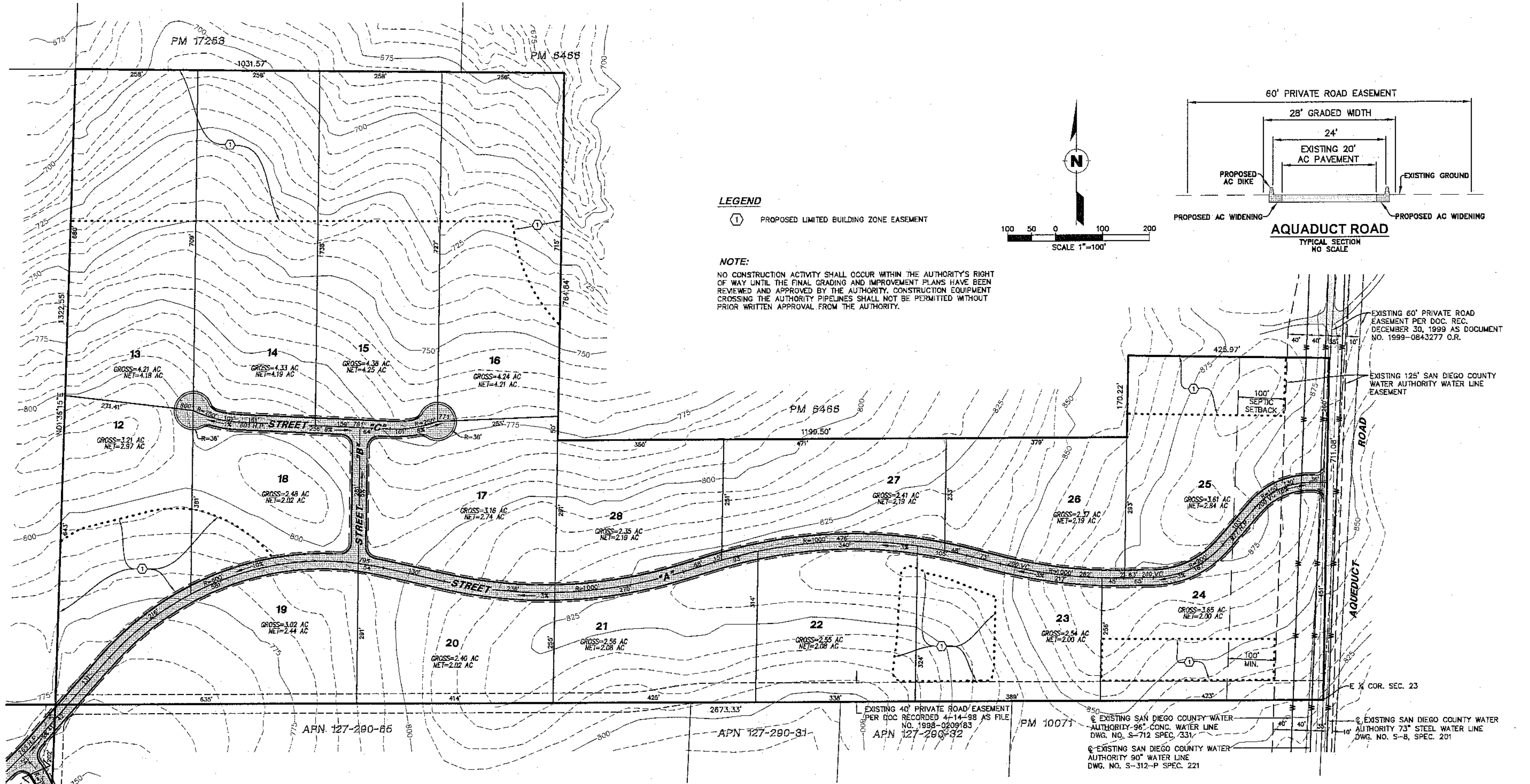
COUNTY OF SAN DIEGO TRACT 5276 RPL4



SEE SHEET 1

LEGEND

(1) PROPOSED LIMITED BUILDING ZONE EASEMENT

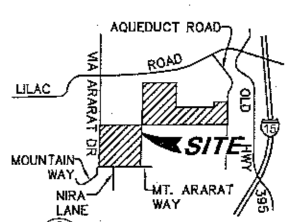
NOTE:

NO CONSTRUCTION ACTIVITY SHALL OCCUR WITHIN THE AUTHORITY'S RIGHT OF WAY UNTIL THE FINAL GRADING AND IMPROVEMENT PLANS HAVE BEEN REVIEWED AND APPROVED BY THE AUTHORITY. CONSTRUCTION EQUIPMENT CROSSING THE AUTHORITY PIPELINES SHALL NOT BE PERMITTED WITHOUT PRIOR WRITTEN APPROVAL FROM THE AUTHORITY.

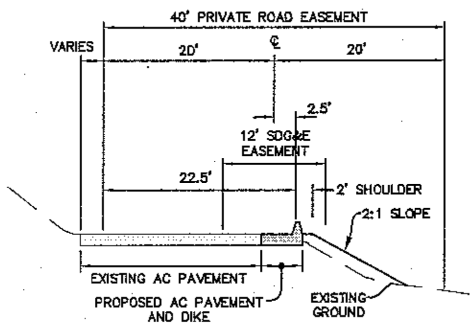
N
100 50 0 100 200
SCALE 1"=100'

60' PRIVATE ROAD EASEMENT
28' GRADED WIDTH
24'
EXISTING 20' AC PAVEMENT
PROPOSED AC DIKE
EXISTING GROUND
PROPOSED AC WIDENING
PROPOSED AC WIDENING

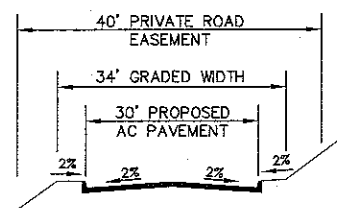
AQUADUCT ROAD
TYPICAL SECTION
NO SCALE



VICINITY MAP
NO SCALE
THOMAS BRO MAP NO. 1048, G-7 & H-7
AND NO. 1088, G-1 & H-1



VIA ARARAT DRIVE
TYPICAL SECTION
NO SCALE



TYPICAL SECTION
STREETS "A" - "E" (PRIVATE ROADS)
NO SCALE

REGISTERED PROFESSIONAL ENGINEER
LAWRENCE W. WALSH
No. C 48316
Exp. 12-31-10
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STATE OF CALIFORNIA

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OWNER/SUBDIVIDER:

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SECTION B

ON-SITE HYDROLOGY

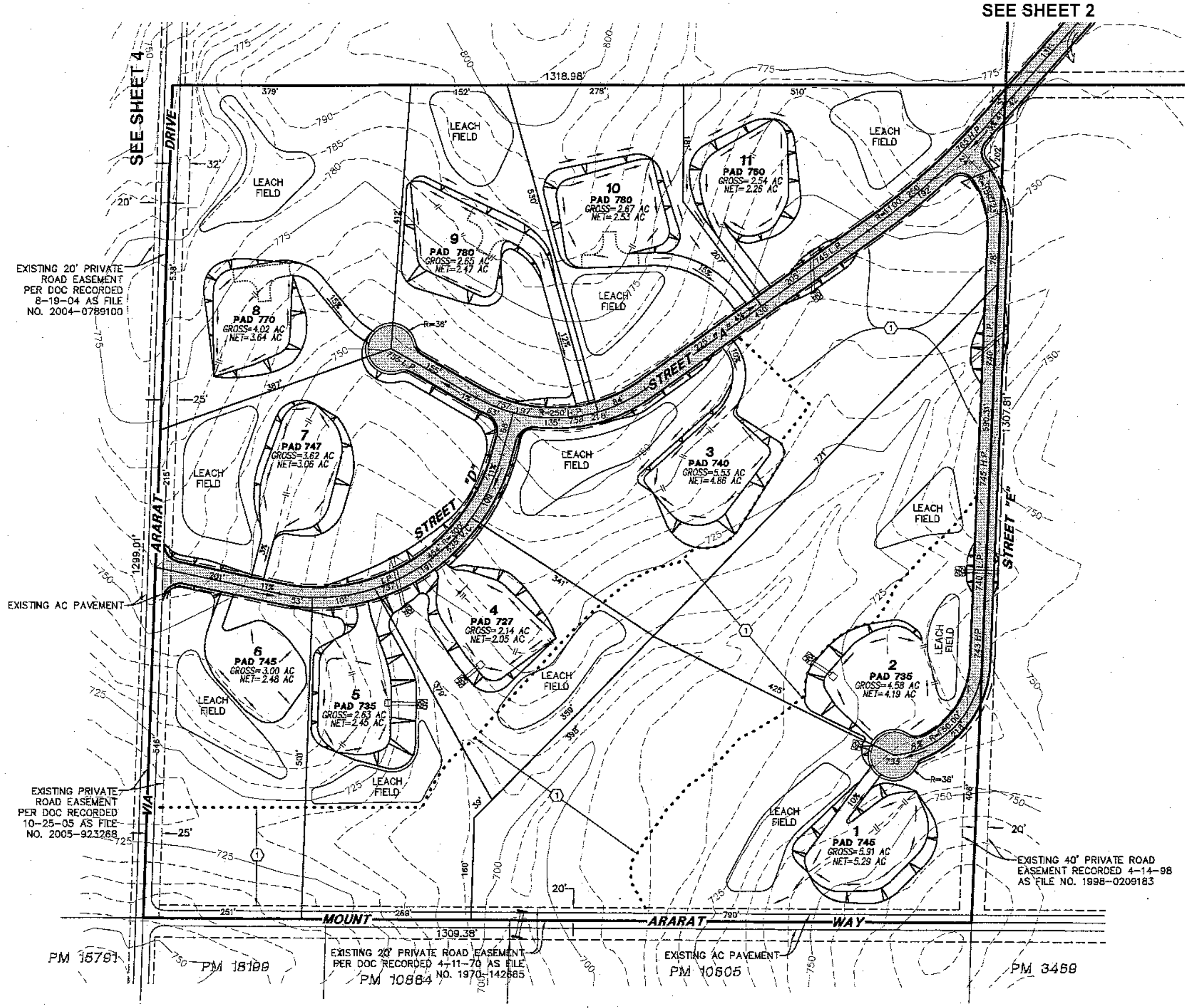
ON-SITE

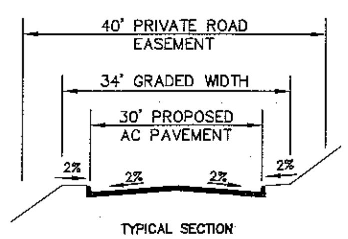
This portion of the drainage covers on-site hydrology for the existing and proposed conditions. The Preliminary Grading Plan (sheets 1 & 2 of 4) is attached. The methodology used to prepare this portion of the study is presented followed by hydrology calculations for the existing and proposed conditions.

Looking north along an existing dirt/asphalt road near the southeast corner of the southwestern portion of the project. The project is located on the left hand side of the road and in the background in the upper right hand corner.

PRELIMINARY GRADING PLAN
FOR TM 5276 RPL4

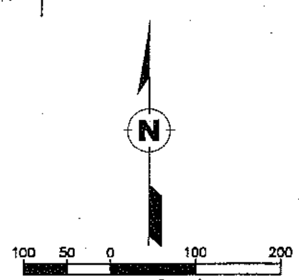
SEE SHEET 2



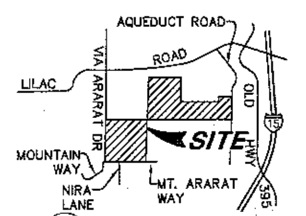


STREETS "A" - "E" (PRIVATE ROADS)

NO SCALE



SCALE 1"=100'



VICINITY MAP

NO SCALE

THOMAS BRO MAP NO. 1048, G-7 & H-7
AND NO. 1068, G-1 & H-1

LEGEND

⟨1⟩ PROPOSED LIMITED BUILDING ZONE EASEMENT

NOTE:

ALL EASEMENTS OF 20' IN WIDTH OR GREATER ARE SHOWN ON THIS PLAN.

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 A VALID GRADING PERMIT BEFORE COMMENCING SUCH ACTIVITY.

CUT=FILL= 33,000 C.Y. ± SHEET 1 ONLY (PLUS MINOR ROAD GRADING). THIS QUANTITY IS BASED ON 3,000 C.Y. PER LOT AVERAGE. ALL CUT & FILL SLOPES TO BE 2:1 RATIO.

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PREPARED BY:

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PRELIMINARY GRADING PLAN FOR TM 5276 RPL4

NOTE:
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NOTE:
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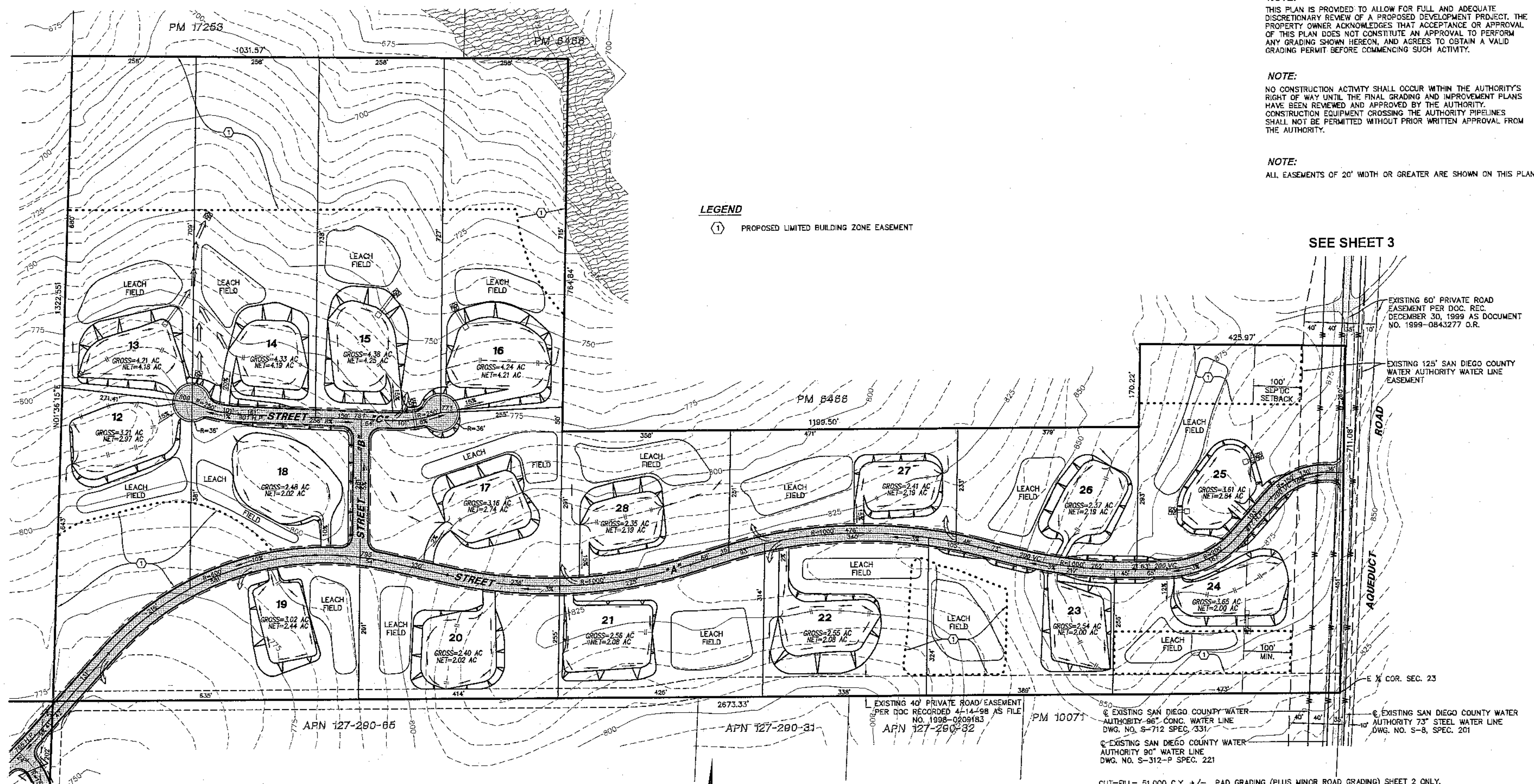
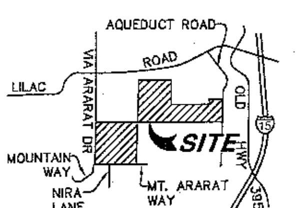
LEGEND
(1) PROPOSED LIMITED BUILDING ZONE EASEMENT

SEE SHEET 3

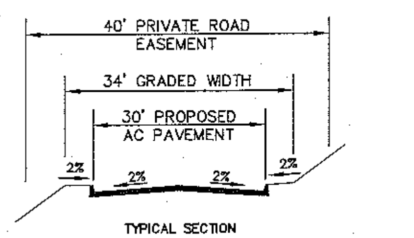


CUT=FILL= 51,000 C.Y. +/- PAD GRADING (PLUS MINOR ROAD GRADING) SHEET 2 ONLY.
THIS QUANTITY IS BASED ON 3,000C.Y. PER LOT AVERAGE. ALL CUT & FILL SLOPES TO BE 2:1 RATIO.

SEE SHEET 1



VICINITY MAP
NO SCALE
THOMAS BRO MAP NO. 1048, G-7 & H-7 AND NO. 1068, G-1 & H-1



TYPICAL SECTION
STREETS "A" - "E" (PRIVATE ROADS)
NO SCALE

OWNER/SUBDIVIDER:
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METHODOLOGY

The methododology we utilized to calculate the peak rates of runoff for this project was based upon the Rational Method (RM) described in the County of San Diego's Hydrology Manual dated June 2003 (Manual) for a 100-year storm event. The RM is formula used to determine the maximum runoff rate from a given rainfall event. The RM formula estimates the peak rate of runoff at any location in a watershed as a function of the drainage area (A), runoff coefficient (C), and rainfall intensity (I) for a duration equal to the time of concentration (Tc). The RM formula is expressed as follows and the calculations are shown below:

Q = C I A, where:

Q = peak discharge, in cubic feet per second (cfs)

C = runoff coefficient, Ratio of the runoff to the total rainfall (no units)

I = average rainfall intensity for a duration equal to the Tc for the area, in inches per hour (Note: If the computed Tc is less than 5 minutes, 5 minutes was used for computing the peak discharge, Q)

A = drainage area contributing to the design location, in acres

Runoff Coefficient:

Runoff coefficients (C) are based on land use and soil type. Runoff coefficient values given by Table 3-1 of the Manual are categorized by land use and soil type. Soil Types can be gathered from the Soil Type Map in the Manual or the County's Hydrologic Soils Group Map.

Existing Condition:

The runoff coefficient selected for the existing condition was reflective of the agricultural development of the land as shown on Drainage Map No.1 – Existing Conditions, and soil types B, C, and D as shown on the County's Hydrologic Soils Group Map (attached). See also photographs attached.

Table 3-1 does not have a specific runoff coefficient titled "Agricultural". Therefore, the runoff coefficient was calculated based upon the percentage of impervious area using the formula in Section 3.1.2 "Runoff Coefficient" of the Manual as follows:

C = 0.90 x (% impervious) + Cp x (1 - % impervious)

Where: Cp = Pervious Coefficient Runoff Value for the soil type (shown in Table 3-1 as Undisturbed Natural Terrain/Permanent Open Space, 0% Impervious).

The existing condition is definitely not undisturbed or natural. Therefore, the runoff coefficient for the existing condition is quite conservative as it relates to comparing existing condition peak runoff to proposed condition peak runoff, i.e. the true existing condition peak runoff will most likely be higher than calculated herein.

Proposed Condition:

The runoff coefficient for the proposed condition was calculated the same way as the existing condition. Typical proposed impervious areas for the basins are roads, driveways, roofs, walkways, patios, etc.

Typical impervious areas for the building pad are tabulated below:

All Basins	Type of Surface (typical)	Area Range (SF)	Area Selected (SF)
Impervious Areas	Roofs	3,000 - 7,000	5,000
	Driveway	2,400 - 3,000	2,700
	Walkway/Patio	1,500 - 2,500	2,000
	Miscellaneous Hardscape (Extra)	1,500 - 2,500	2,000
		Total Impervious Area per Building Pad =	11,700

The runoff coefficient for Basin 2 (as an example) is calculated below:

Basin 2	Basin Area	Area Soil Type B	Area Soil Type C	Area Soil Type D	Cp	# of Pads	Length of Road	Impervious Area	% Impervious	C
Existing	16.8	0	5.9	10.9	0.33	0.5	800	18650	0.025	**0.35**
Proposed	16.8	0	5.9	10.9	0.33	3	60	36900	0.050	**0.36**

Areas of Soil Types per Basin from Drainage Map No. 1 & 2
Cp is weighted per the Soil Types and areas
Impervious area per Pad is 11,700 SF (**see discussion above)**
Road width is 16 feet wide for existing and 30 feet wide for proposed

Time of Concentration:

The Time of Concentration (Tc) is defined by the Manual as the time required for runoff to flow from the most remote part of the drainage area to the point of interest. The Tc is composed of two parts: initial time of concentration (Ti) and travel time (Tt). The Ti is the time required for runoff to travel across the surface of the most remote subarea in the study, or “initial subarea.” The Tt is the time required for the runoff to flow in a watercourse (e.g., swale, channel, gutter, pipe) or series of watercourses from the initial subarea to the concentration point. For the RM, the Tc at any point within the drainage area is given by:

Tc = Ti + Tt

Existing Condition:

The initial time of concentration for the existing condition is reflective of the hills and ridge lines which have a relatively steep area near the drainage divides. The initial times of concentration used for the existing condition were based upon the land being in an undisturbed/natural condition even though the existing condition is definitely not undisturbed or natural. Therefore, the initial times of concentration are conservative. The travel time is reflective of the change in elevation and the length of the flow path between the position at the end of the initial subarea, determined by its maximum length according to Table 3-2 of the Manual, and the concentration point as shown on the Drainage Map No.1.

Proposed Condition:

The initial time of concentration for the proposed condition incorporates the pad area as the initial subarea because on each basin a building pad is located at the most remote location in the basin. The land use type is interrelated to a Low Density Residential – 1 dwelling unit per acre or less (LDR 1). However, the actual land use density for this project is 28 dwelling units per 93 acres or 0.3 dwelling units per acre. Therefore, the initial time is conservative for the proposed condition because the proposed density is actually less than the density of that on Table 3-2. The travel time is reflective of the change in elevation and the length of the flow path from the most remote building pad to the basin outlet or concentration point as shown on the Drainage Map No.1.

Rainfall Intensity:

The rainfall intensity (I) is the rainfall in inches per hour (in/hr) for a duration equal to the T_c for a selected storm frequency. Once a particular storm frequency has been selected for design and a T_c calculated for the drainage area, the rainfall intensity can be determined from the Intensity-Duration Design Chart (Figure 3-1). The 6-hour storm rainfall amount (P_6) and the 24-hour storm rainfall amount (P_{24}) for the selected storm frequency are also needed for calculation of I. P_6 and P_{24} can be read from the isopluvial maps provided in Appendix B of the Manual. An Intensity-Duration Design Chart applicable to all areas within San Diego County is provided as Figure 3-1. Intensity can be calculated using the following equation:

$$I = 7.44\, P_6\, D^{-0.645}$$

where:
P_6 = adjusted 6-hour storm rainfall amount
D = duration in minutes (use T_c)

Example Calculations (Rational Method):

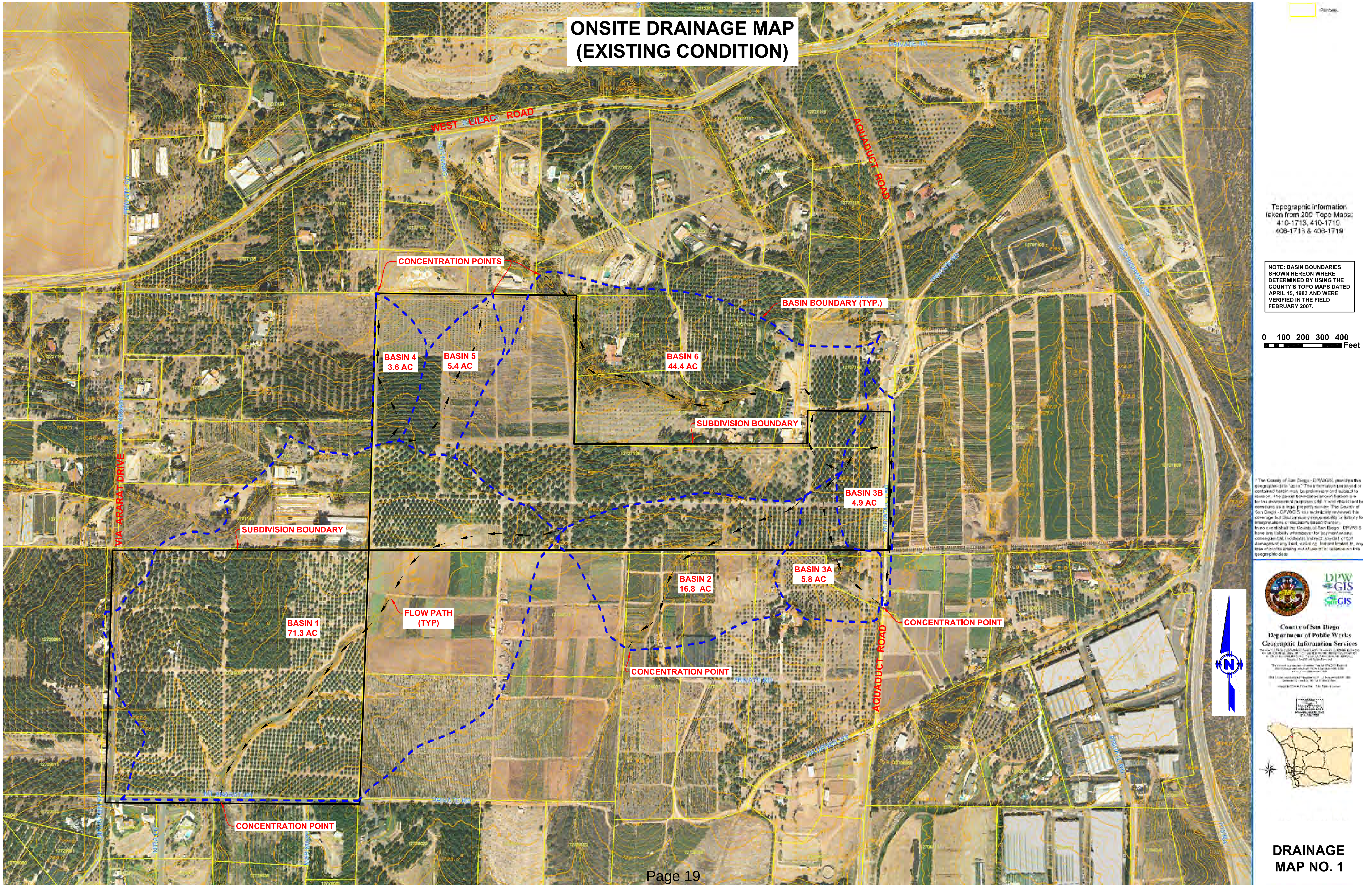
Basin 2	**Runoff Coefficient**	**Time of Concentration**			**Intensity**	**Area**	**Discharge (Q)**
	C	Ti (min)	Tt (min)	Tc (min)	I (in/hr)	(acres)	(cfs)
Existing	0.35	6.9	4.28	11.2	5.5	16.8	**32.0**
Proposed	0.36	11.5	3.9	15.4	4.5	16.8	**27.1**

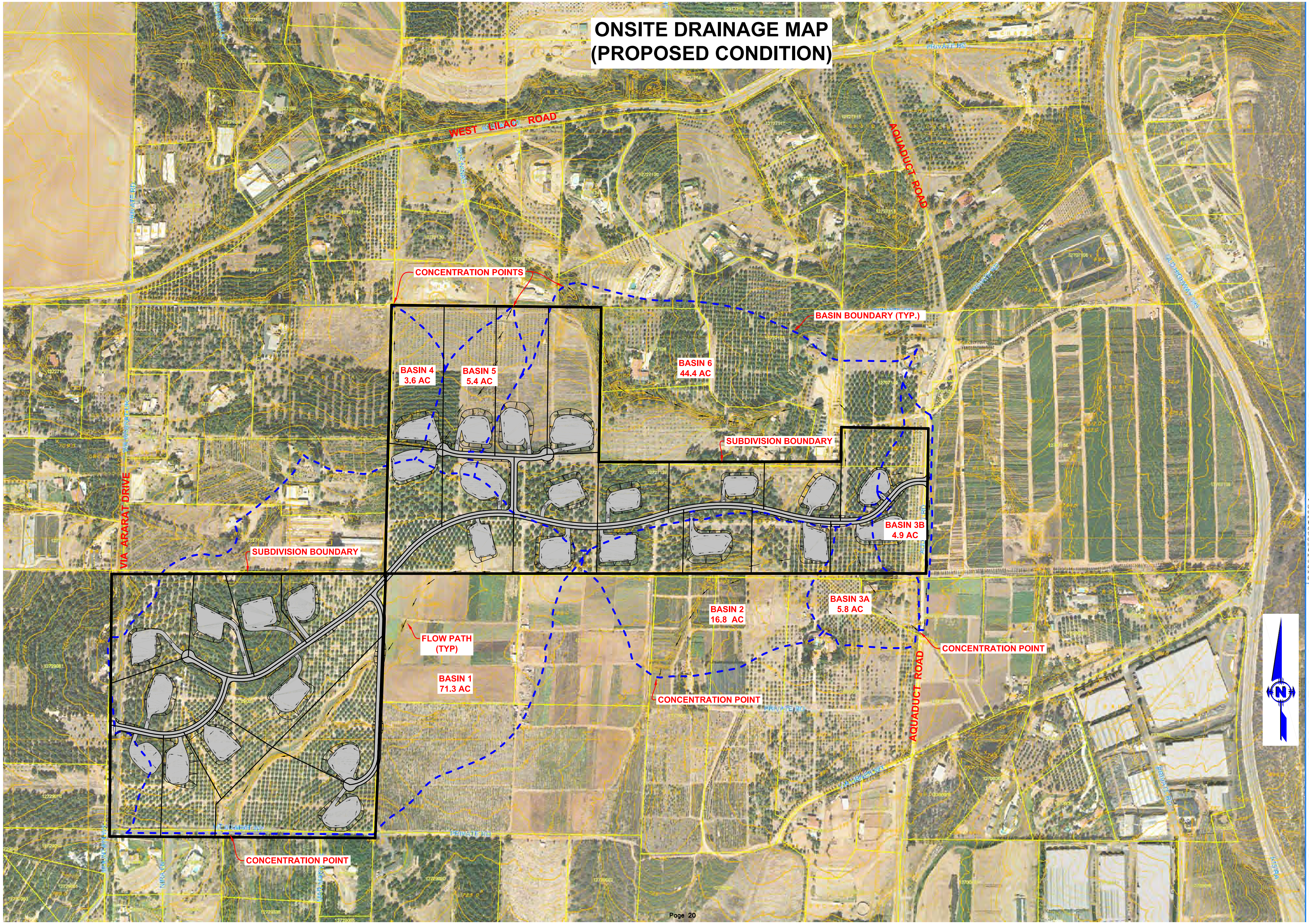
Assumptions/Conditions:
Based upon Q = C I A
Runoff Coefficient per Table 3-1 for Low Density Residential, 1.0 dwelling units per acre or less, Soil Type "D"
Ti per Table 3-2 for Low Density Residential, 1.0 dwelling units per acre or less at 10% for existing and 1% for proposed
Tt per equation on Figure 3-4, Existing: E = 123 feet, L = 1170 feet, Proposed: E = 98 feet, L = 990 feet
Intensity per equation on Figure 3-2 where P6 = 3.5 inches
Area per Drainage Map No. 1 & 2

Conclusions/Recommendations:

As a result, the peak rate of runoff in the proposed condition is less than the existing condition. This is the case for all basins even though the runoff coefficient in the proposed condition increased. The increase in the time of concentration in the proposed condition more than compensates for the increased runoff coefficient due to the proposed development.

In analyzing the existing condition versus the proposed condition, the assumption is the runoff coefficient for all undeveloped areas (those not covered by pads, driveways or roads) will be the same in the existing and proposed condition. This is based upon the valid assumption that a significant number of buyers will sustain the remaining trees. On the balance of the lots where trees will be removed, the assumption is that the area will be re-landscaped to a runoff coefficient equal to or less than the existing runoff coefficient.


ONSITE DRAINAGE MAP
(EXISTING CONDITION)
WEST LILAC ROAD
AQUADUCT ROAD
VIA ARARAT DRIVE
CONCENTRATION POINTS
BASIN BOUNDARY (TYP.)
BASIN 4
3.6 AC
BASIN 5
5.4 AC
BASIN 6
44.4 AC
SUBDIVISION BOUNDARY
BASIN 3B
4.9 AC
SUBDIVISION BOUNDARY
BASIN 3A
5.8 AC
BASIN 2
16.8 AC
CONCENTRATION POINT
FLOW PATH
(TYP)
BASIN 1
71.3 AC
CONCENTRATION POINT
CONCENTRATION POINT
Topographic information taken from 200' Topo Maps: 410-1713, 410-1719, 406-1713 & 406-1719
NOTE: BASIN BOUNDARIES SHOWN HEREON WHERE DETERMINED BY USING THE COUNTY'S TOPO MAPS DATED APRIL 15, 1983 AND WERE VERIFIED IN THE FIELD FEBRUARY 2007.
0 100 200 300 400
Feet
DPW GIS
County of San Diego
Department of Public Works
Geographic Information Services
DRAINAGE
MAP NO. 1

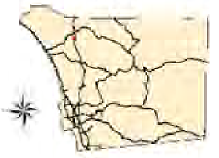


Topographic information taken from 200' Topo Maps; 410-1713, 410-1719 406-1713 & 406-1719

NOTE: BASIN BOUNDARIES SHOWN HEREON WERE DETERMINED BY USING THE COUNTY'S TOPO MAPS DATED APRIL 15, 1983 AND WERE VERIFIED IN THE FIELD FEBRUARY 2007.

0 100 200 300 400 Feet

County of San Diego
Department of Public Works
Geographic Information Services



DRAINAGE MAP NO. 2

Summary of Input Data and Rational Method Calculations for TM 5276 RPL3

Existing Condition:

Basin	Runoff Coefficent									Time of Concentration								Intensity	Area	Discharge
	Area Soil Type "B"	Area Soil Type "C"	Area Soil Type "D"	Cp	# of Pads	Length of Road	Imper-vious Area	% Imper-vious	C	Element	Initial Slope	Ti	Up-stream Elevation	Down-stream Elevation	Length	Tt_1	Tc	I	A	Q_{100}
	(acres)	(acres)	(acres)			(ft)	(acres)			(DU/Acre)	(%)	(min)	(ft)	(ft)	(ft)	(min)	(min)	(in/hr)	(acres)	(cfs)
1	29.8	7.0	34.5	0.30	6.0	1600	2.1	0.029	**0.32**	Natural	10	6.9	819	697.5	2320	9.5	16.4	**4.3**	**71.3**	**98.0**
2	0.0	5.9	10.9	0.33	0.5	800	0.4	0.025	**0.35**	Natural	10	6.9	870	747	1170	4.3	11.2	**5.5**	**16.8**	**32.0**
3A	0.0	5.8	0.0	0.30	1.5	400	0.5	0.095	**0.36**	Natural	10	6.9	879	802	700	2.8	9.7	**6.0**	**5.8**	**12.4**
3B	1.7	3.2	0.0	0.28	0.0	250	0.1	0.019	**0.29**	Natural	10	6.9	883	801	900	3.7	10.6	**5.7**	**4.9**	**8.2**
4	0.3	3.3	0.0	0.30	0.0	800	0.3	0.082	**0.35**	Natural	10	6.9	808	682	700	2.3	9.2	**6.2**	**3.6**	**7.7**
5	0.0	4.1	1.3	0.31	0.0	0	0.0	0.000	**0.31**	Natural	10	6.9	807	681	880	3.1	10.0	**5.9**	**5.4**	**10.0**
6	0.1	30.6	13.7	0.32	6.0	1500	2.2	0.049	**0.34**	Natural	10	6.9	895	653	1930	5.9	12.8	**5.0**	**44.4**	**76.8**

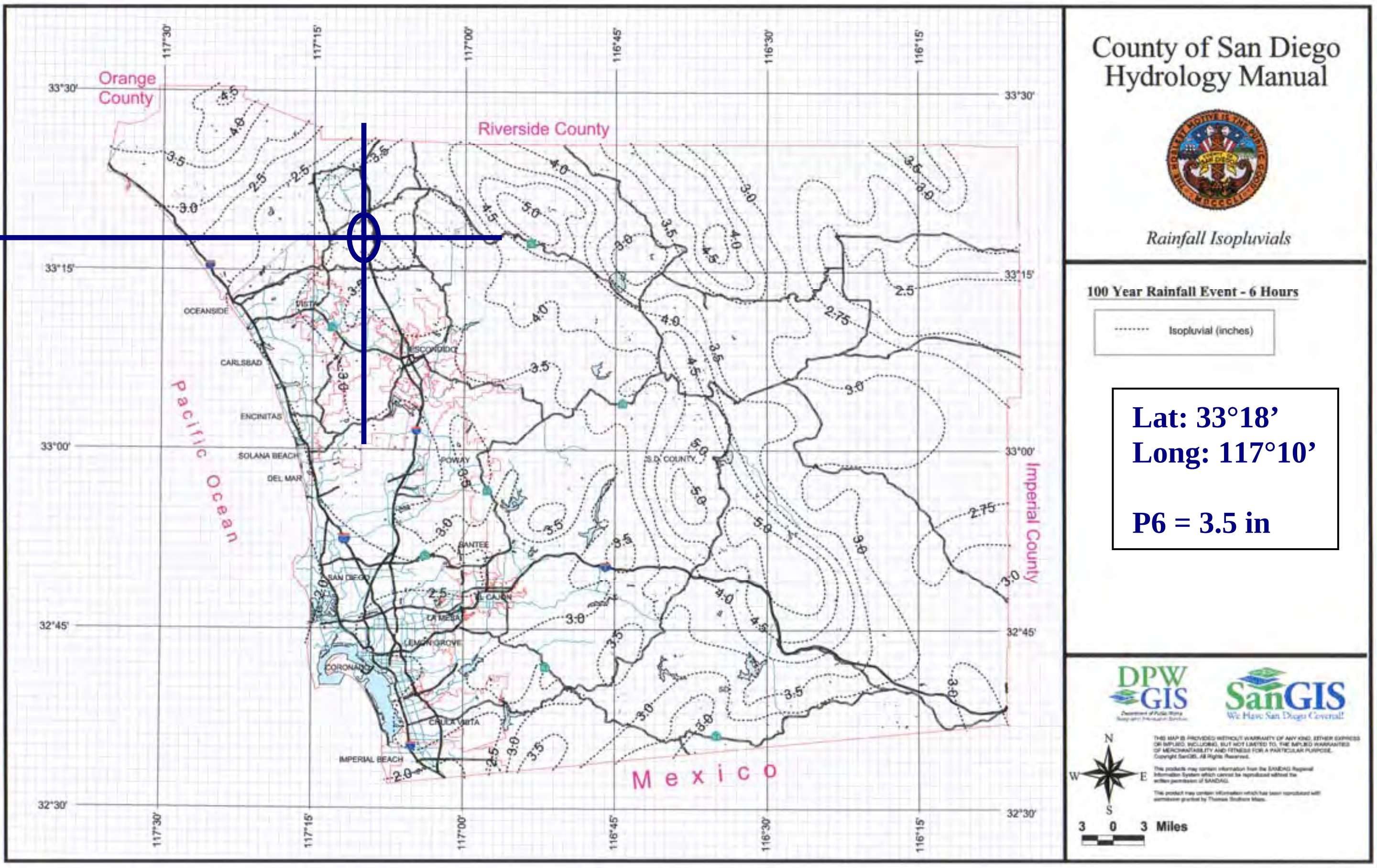
Proposed Condition:

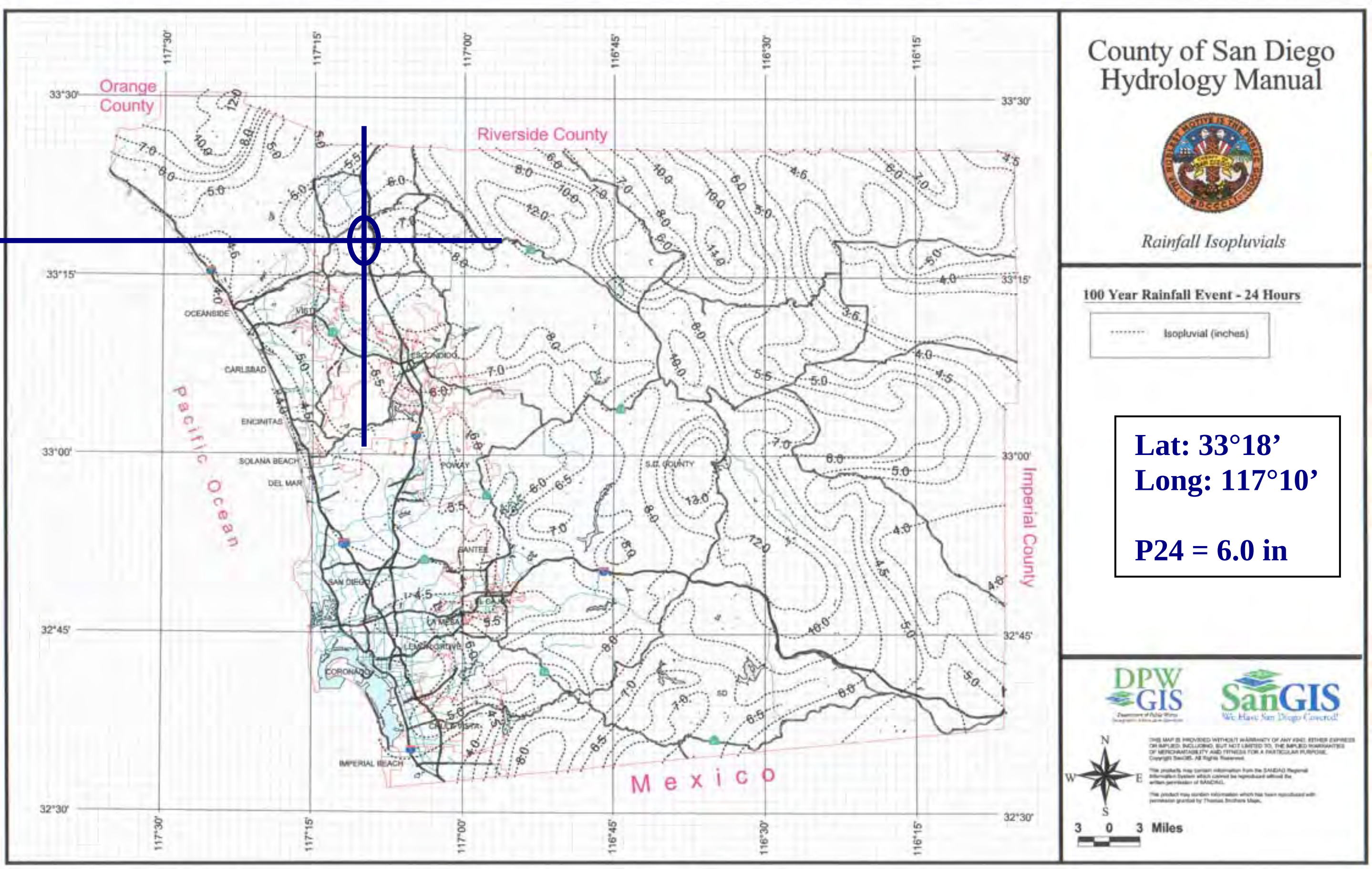
Basin	Runoff Coefficent									Time of Concentration								Intensity	Area	Discharge
	Area Soil Type "B"	Area Soil Type "C"	Area Soil Type "D"	Cp weighted	# of Pads	Length of Road	Imper-vious Area	% Imper-vious	C	Element	Initial Slope	Ti	Up-stream Elevation	Down-stream Elevation	Length	Tt_1	Tc	I	A	Q_{100}
	(acres)	(acres)	(acres)			(ft)	(acres)			(DU/Acre)	(%)	(min)	(ft)	(ft)	(ft)	(min)	(min)	(in/hr)	(acres)	(cfs)
1	29.8	7.0	34.5	0.30	13.75	3620	6.2	0.087	**0.36**	LDR-1	1	11.5	813	697.5	2250	9.3	20.8	**3.7**	**71.3**	**93.0**
2	0.0	5.9	10.9	0.33	3	60	0.8	0.050	**0.36**	LDR-1	1	11.5	845	747	990	3.9	15.4	**4.5**	**16.8**	**27.1**
3A	0.0	5.8	0.0	0.30	0.5	175	0.3	0.044	**0.33**	LDR-1	1	11.5	883	802	650	2.6	14.1	**4.7**	**5.8**	**9.0**
3B	1.7	3.2	0.0	0.28	1.25	340	0.6	0.116	**0.35**	LDR-1	1	11.5	883	801	920	3.8	15.3	**4.5**	**4.9**	**7.8**
4	0.3	3.3	0.0	0.30	1	0	0.3	0.075	**0.34**	LDR-1	1	11.5	795	682	650	2.2	13.7	**4.8**	**3.6**	**5.9**
5	0.0	4.1	1.3	0.31	2	230	0.7	0.129	**0.39**	LDR-1	1	11.5	780	681	750	2.8	14.3	**4.7**	**5.4**	**9.8**
6	0.1	30.6	13.7	0.32	6.5	2040	3.2	0.071	**0.36**	LDR-1	1	11.5	883	653	1960	6.1	17.6	**4.1**	**44.4**	**64.9**

where,
Q = C * I * A
C = 0.9 x (% Impervious) + C_P x (1 - % Impervious)
C_P values per Table 3-1 (attached)
Soil Type Areas per Soil Type Map
Impervious area per pad = 11,700 ft^2
Road width = 12' (existing), 30' (proposed)
A = Basin areas per Drainage Map 1 & 2 (attached)

Tc = Ti + Tt
Ti = values per Table 3-2 (attached)
Tt = values per formula on Figure 3-4 and 3-6 (attached)
Elevations, Lengths and Drainage Systems per Drainage Maps
Intensity per Formula on Figure 3-1 (attached)
P6 = 3.5 in 100-year per isopluvial charts (attached)
# of Pads used in the existing were based upon equivelent values per the proposed condition

Only one quarter the length of Aquaduct Road for Basin #B was counted as impervious since it is a dirt road


County of San Diego
Hydrology Manual
Rainfall Isopluvials
100 Year Rainfall Event - 6 Hours
Isopluvial (inches)
Lat: 33°18’
Long: 117°10’
P6 = 3.5 in
Orange County
Riverside County
Imperial County
Pacific Ocean
Mexico
DPW GIS
SanGIS
3 0 3 Miles


County of San Diego
Hydrology Manual
Rainfall Isopluvials
100 Year Rainfall Event - 24 Hours
Isopluvial (inches)
Lat: 33°18’
Long: 117°10’
P24 = 6.0 in
Orange County
Riverside County
Imperial County
Pacific Ocean
Mexico
DPW GIS
SanGIS
3 0 3 Miles

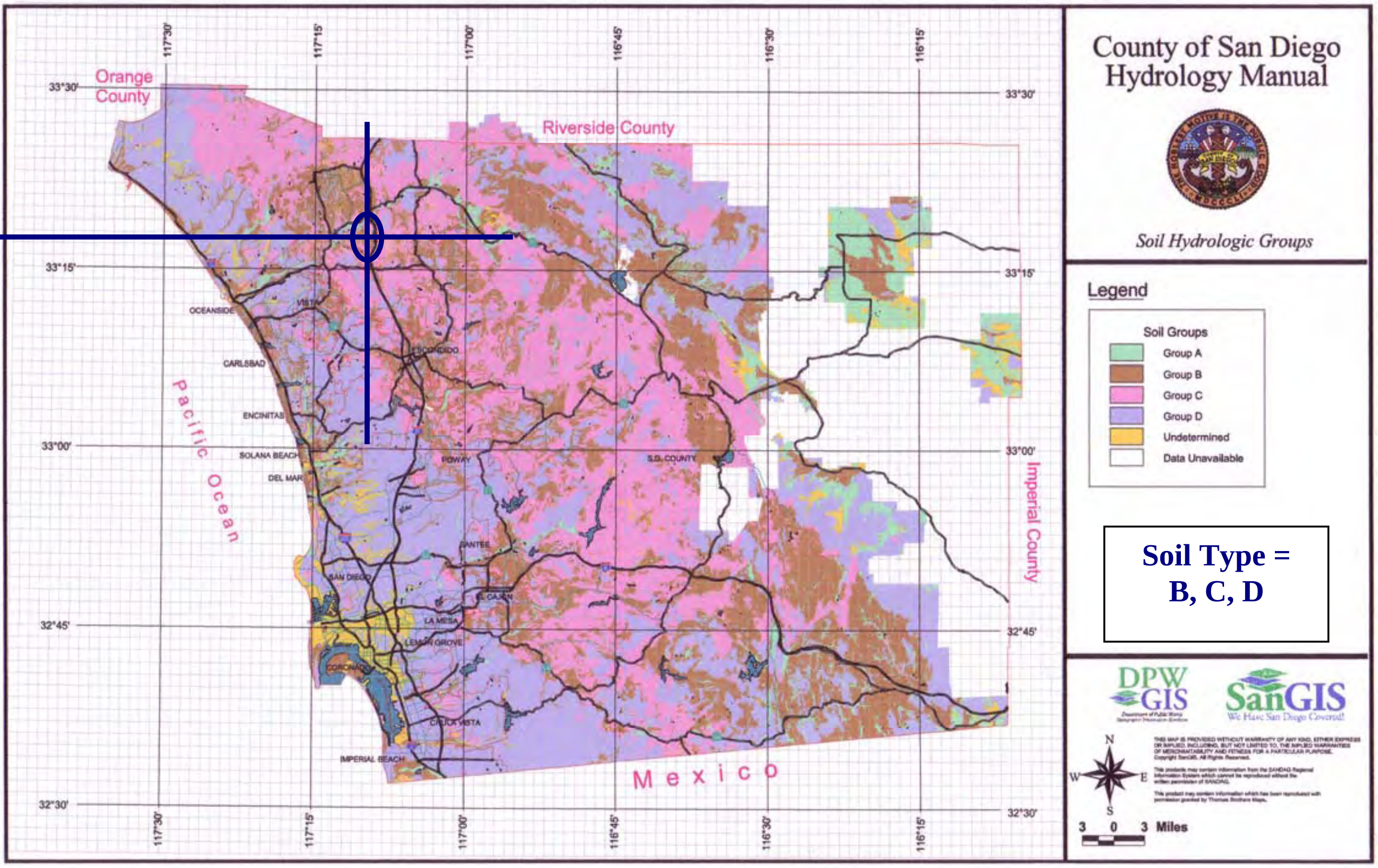


Table 3-1
RUNOFF COEFFICIENTS FOR URBAN AREAS

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

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

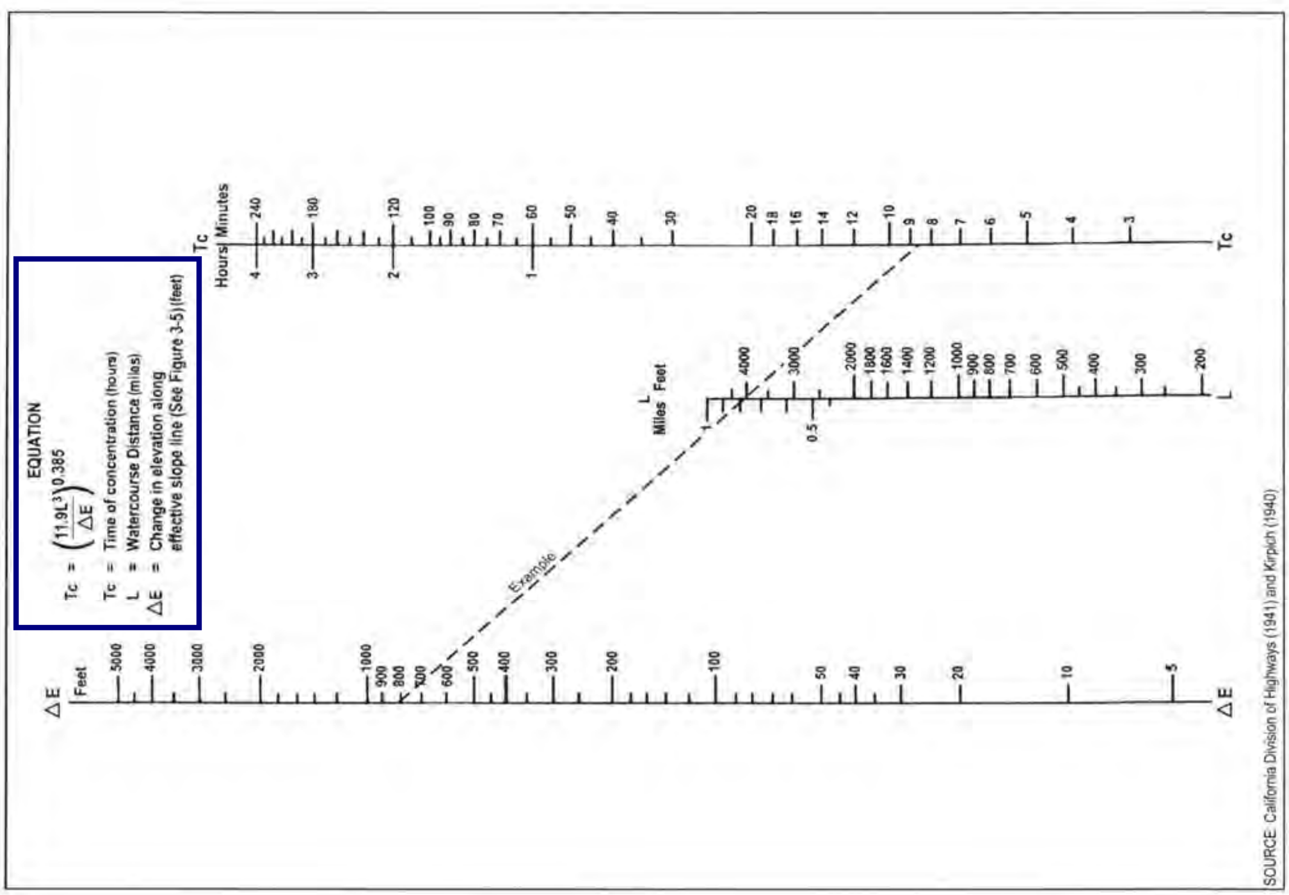
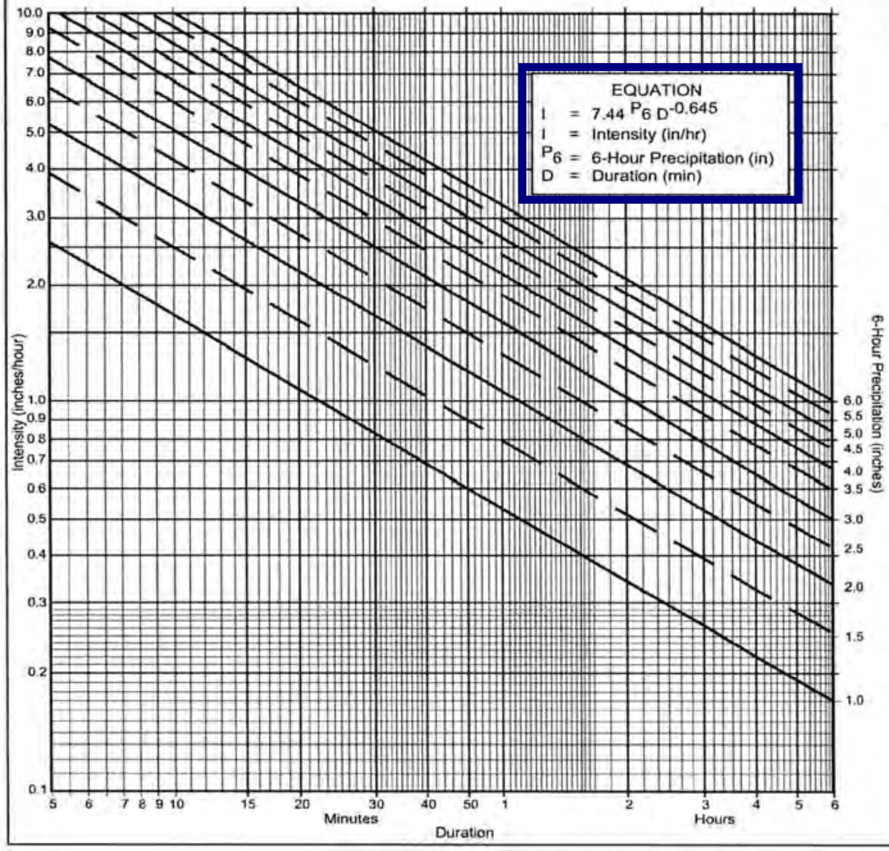


FIGURE 3-4

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



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 = 3.5 in., P_{24} = 6.0, $\frac{P_6}{P_{24}}$ = 58 %(2)

(c) Adjusted P_6(2) = 3.5 in.

(d) t_x = *** min. *** - See Calculation Summary

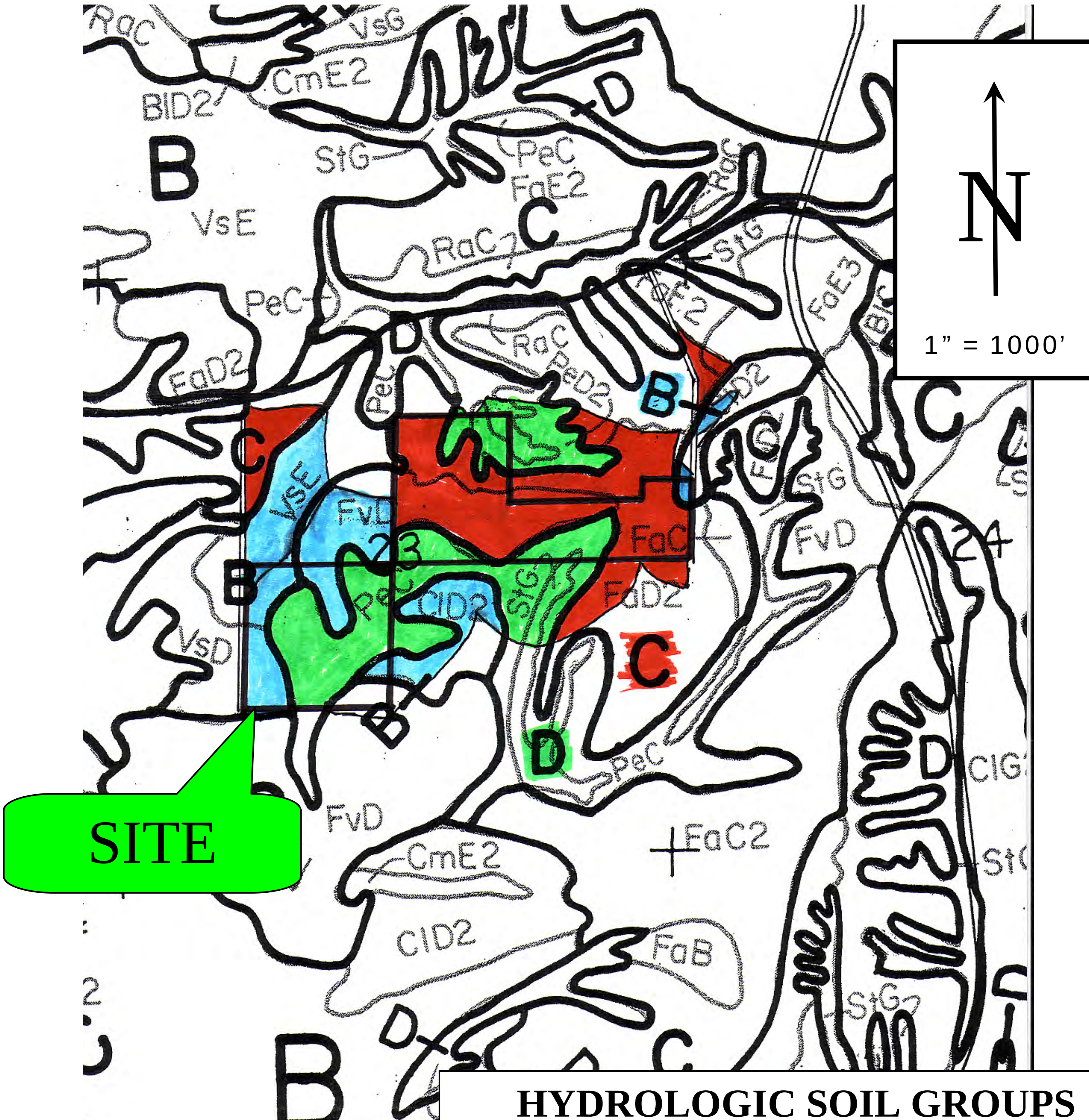
(e) I = *** in./hr. *** - See Calculation Summary

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

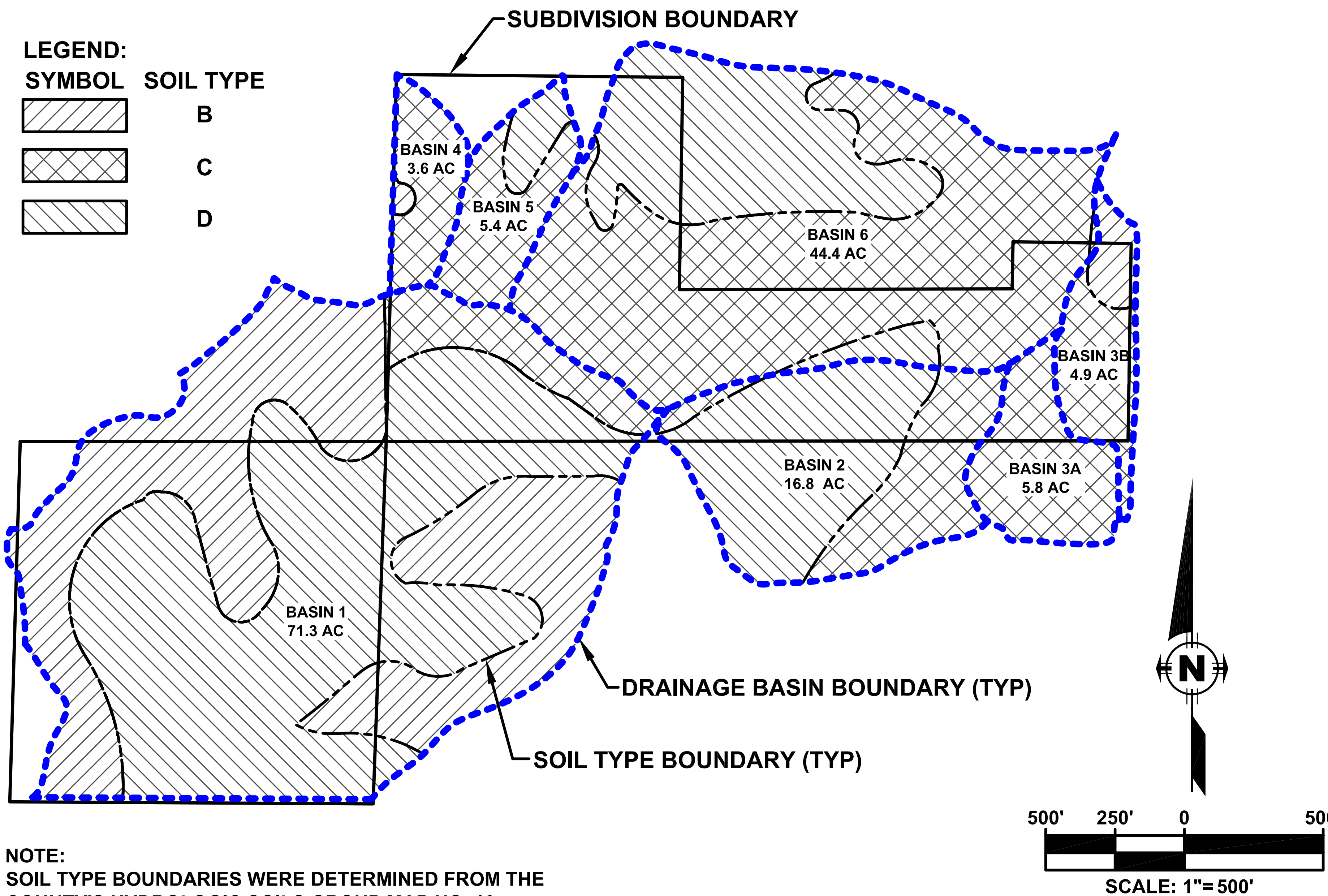
Intensity-Duration Design Chart - Template

FIGURE **3-1**



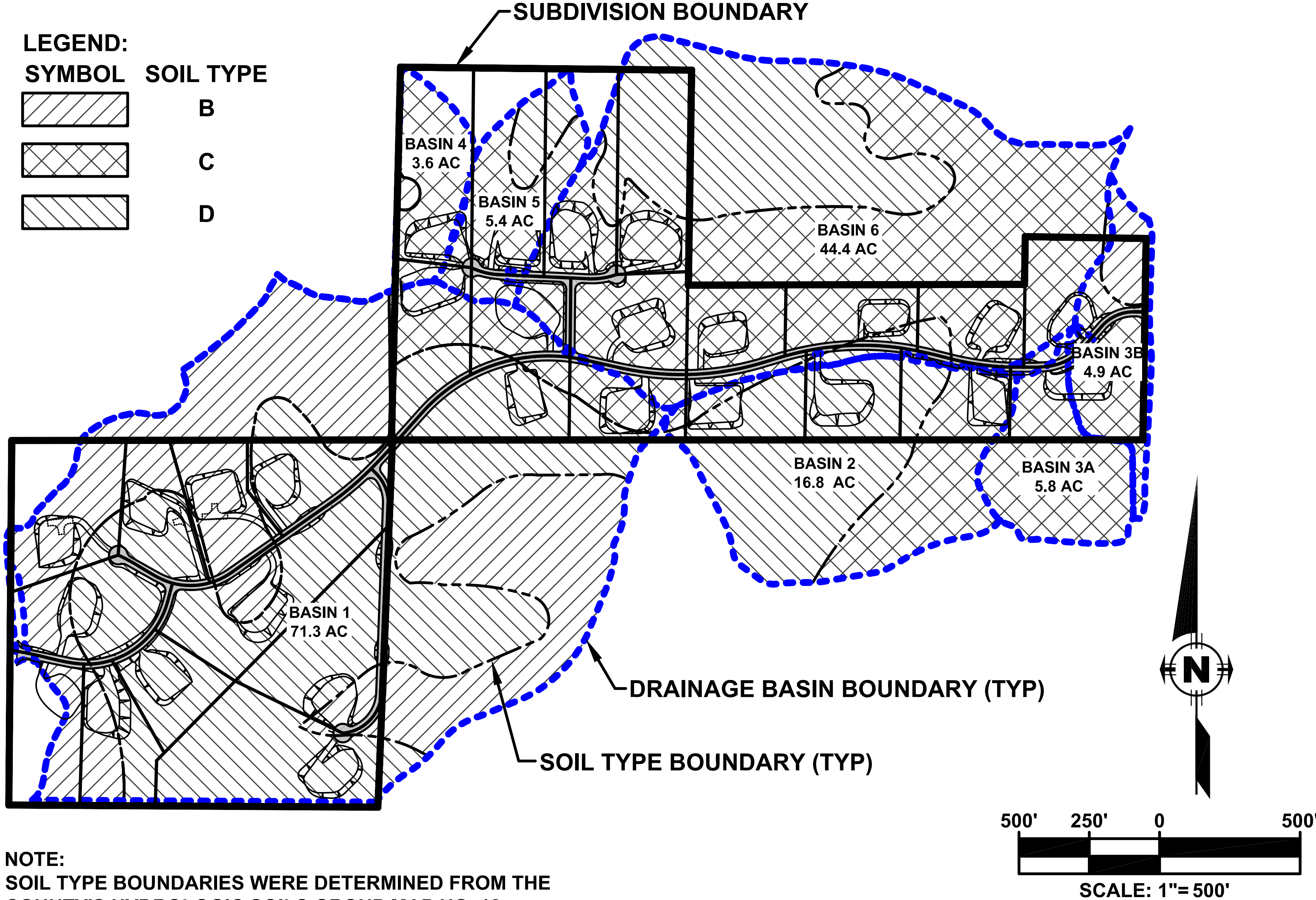
HYDROLOGIC SOIL GROUPS
Runoff Potential
Sheet No: 12
Sheet Name: Bonsall

SOIL'S MAP
EXISTING CONDITION



NOTE:
SOIL TYPE BOUNDARIES WERE DETERMINED FROM THE COUNTY'S HYDROLOGIC SOILS GROUP MAP NO. 12.

SOIL'S MAP
PROPOSED CONDITION



NOTE:
SOIL TYPE BOUNDARIES WERE DETERMINED FROM THE COUNTY'S HYDROLOGIC SOILS GROUP MAP NO. 12.

SECTION C

OFF-SITE HYDROLOGY

INTRODUCTION

This portion of the drainage study is for the offsite improvements of Tentative Map, TM 5276. It focuses on the existing and proposed improvements of Aqueduct Road and Via Ararat Drive.

In the existing condition, Aqueduct Road runs along the easterly side of TM 5276 northerly to West Lilac Road. The road is approximately 20 feet wide and is paved in the northerly section and DG in the southerly section. In the proposed condition the road will be widened to 24-foot paved with 2-foot DG shoulders along both sides of the road. The existing cross slopes of the road will be maintained.

In the existing condition, Via Ararat Drive is approximately 20 feet wide. The surface of the road is paved with AC and is located on the easterly side of a 40-foot private road easement. In the proposed condition the road will be widened to 24-foot paved with 2-foot DG shoulder along the westerly edge of the road. The existing cross slopes of the road will be maintained.

In conclusion, there will be a slight increase in flowrate due to the widening of the existing roads. Since the project is not proposing new roads, the existing drainage patterns of the area will not be altered. Therefore, the proposed widening of the roads will not cause erosion to the existing swales. Finally, since the existing drainage patterns will stay the same, there will be no people or structures in risk of loss, injury or death resulting from flooding.

Summary of Input Data and Rational Method Calculations for TM 5276 RPL3

Existing Condition:

	Basin	Area	Runoff Coefficent	Drainage System	Time of Concentration									Intensity (100-yr)	Velocity (At Concentration Point)	% Increase	Discharge	% Increase
	#	A	C		Element	Initial Slope	Ti	Upstream Elevation	Downstream Elevation	Length	Tt_1	Tt_2	Tc	I	V_{100}	V_{100}	Q_{100}	Q_{100}
		(acres)			(DU/Acre)	(%)	(min)	(ft)	(ft)	(ft)	(min)	(min)	(min)	(in/hr)	(ft/s)		(cfs)	
VIA ARARAT DRIVE	7	2.9	0.32	Pad, Street Flow, 12" RCP, Natural Swale	LDR-1	1	11.5	815	733	540	2.0	0.0	13.5	4.8	5.4	-	4.5	-
	8	0.7	0.32	Pad, Street Flow, 12" RCP, Natural Swale	LDR-1	1	11.5	815	732	500	1.9	0.0	13.4	4.9	1.4	-	1.1	-
	9	1.6	0.32	Pad, Street Flow, AC Driveway, Natural Swale	LDR-1	1	11.5	815	722	570	2.1	0.0	13.6	4.8	3.8	-	2.5	-
	10	1.0	0.33	Agriculture, Pad, 12" HDPE, Natural Swale	LDR-1	10	6.4	767	698	500	2.0	0.0	8.4	6.6	2.8	-	2.2	-
	11	14.4	0.336	Pad, Sheet Flow, Street Flow, AC Spillway, Natural Swale	LDR-1	1	11.5	815	705	800	2.9	1.8	16.2	4.3	6.1	-	20.9	-
	12	0.2	0.36	Agriculture, Street Flow	LDR-1	10	6.4	693	683	50	0.3	0.5	7.2	7.3	3.8	-	0.5	-
	13	0.8	0.36	Pad, Street Flow, 12" HDPE, Natural Swale	LDR-1	3	9.5	750	685	620	2.6	0.0	12.1	5.2	1.9	-	1.5	-
AQUEDUCT ROAD	14	0.47	0.36	Agriculture, Street Flow	LDR-1	8	6.4	873	860	190	1.2	0.0	7.6	7.0	3.8	-	1.2	-
	15	0.60	0.36	Agriculture, Street Flow	LDR-1	3	9.5	885	858	620	3.7	0.0	13.2	4.9	3.7	-	1.1	-
	16	0.80	0.73	Pad, Street Flow	LDR-1	10	11.5	887	874	170	1.1	0.4	13.0	5.0	2.7	-	2.9	-
	17	3.7	0.65	Pad, Street Flow	LDR-1	10	6.4	860	840	140	0.7	2.6	9.7	6.0	7.5	-	14.4	-
	18	0.1	0.95	Street Flow	LDR-1	10	6.4	N/A	N/A	N/A	0.0	1.6	8.0	6.8	6.1	-	0.6	-

Proposed Condition:

VIA ARARAT DRIVE	7	2.95	0.33	Pad, Street Flow, 12" RCP, Natural Swale	LDR-1	1	11.5	815	733	540	2.0	0.0	13.5	4.8	5.4	0	4.7	5
	8	0.7	0.32	Pad, Street Flow, 12" RCP, Natural Swale	LDR-1	1	11.5	815	732	500	1.9	0.0	13.4	4.9	1.4	0	1.1	0
	9	1.62	0.33	Pad, Street Flow, AC Driveway, Natural Swale	LDR-1	1	11.5	815	722	570	2.1	0.0	13.6	4.8	3.8	0	2.6	4
	10	1.0	0.33	Agriculture, Pad, 12" HDPE, Natural Swale	LDR-1	10	6.4	767	698	500	2.0	0.0	8.4	6.6	2.8	0	2.2	0
	11	14.47	0.339	Pad, Sheet Flow, Street Flow, AC Spillway, Natural Swale	LDR-1	1	11.5	815	705	800	2.9	1.8	16.2	4.3	6.2	2	21.2	1
	12	0.21	0.39	Agriculture, Street Flow	LDR-1	10	6.4	693	683	50	0.3	0.5	7.2	7.3	3.8	0	0.6	14
	13	0.8	0.36	Pad, Street Flow, 12" HDPE, Natural Swale	LDR-1	3	9.5	750	685	620	2.6	0.0	12.1	5.2	1.9	0	1.5	0
AQUEDUCT ROAD	14	0.45	0.46	Agriculture, Street Flow	LDR-1	8	6.4	873	860	190	1.2	0.0	7.6	7.0	3.9	3	1.5	22
	15	0.62	0.46	Agriculture, Street Flow	LDR-1	8	9.5	884	874	160	1.1	2.4	13.0	5.0	3.8	3	1.4	33
	16	0.83	0.74	Pad, Street Flow	LDR-1	10	11.5	887	874	170	1.1	0.4	13.0	5.0	2.7	0	3.1	5
	17	3.82	0.66	Pad, Street Flow	LDR-1	10	6.4	860	840	140	0.7	2.6	9.7	6.0	7.6	1	15.1	5
	18	0.13	0.95	Street Flow	LDR-1	10	6.4	N/A	N/A	N/A	0.0	1.6	8.0	6.8	6.2	2	0.8	30

where,

$Q = C * I * A$

C values - see Hydrology Calculations

Elevations, Lengths and Drainage Systems per Drainage Maps

Ti = values per Table 3-2 (attached)

T_t = values per Formula on Figures 3-4 and 3-6 attached

V = Q / A or values per Figure 3-6 attached

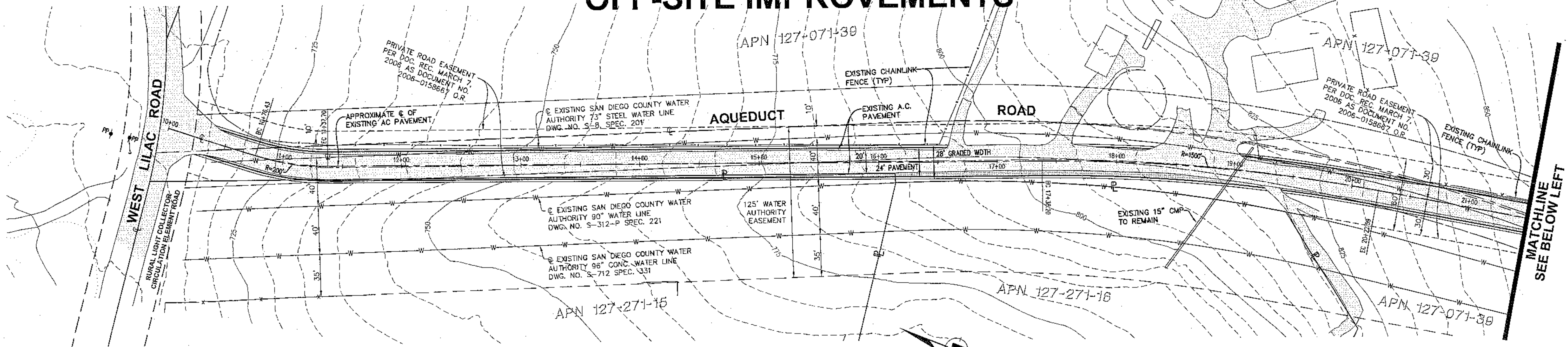
A = Basin areas per Drainage Map 1 & 2 (attached)

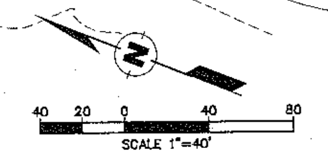
$Tc = Ti + Tt$; $Tt = Tt_1 + Tt_2$

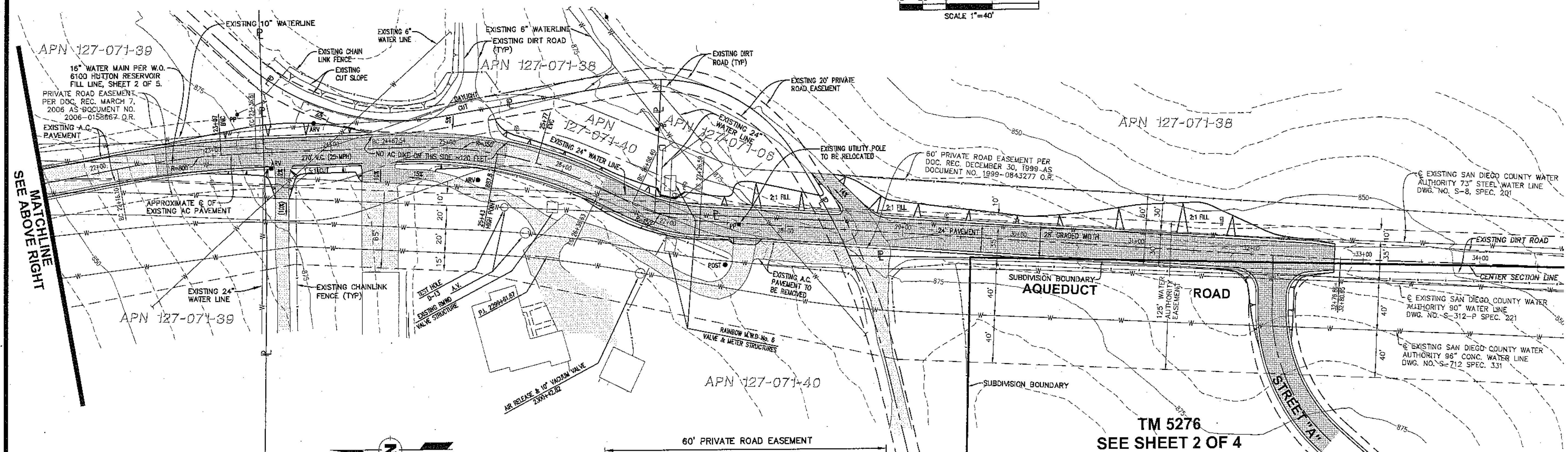
P6 = 3.5 in per isopluvial charts (attached)

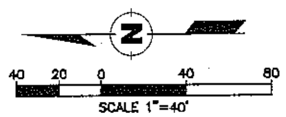
Intensity per Formula on Figure 3-1 (attached)

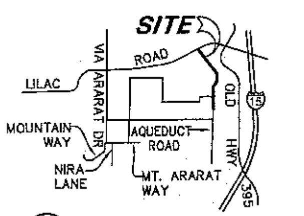
PRELIMINARY GRADING PLAN FOR TM 5276 RPL4
OFF-SITE IMPROVEMENTS







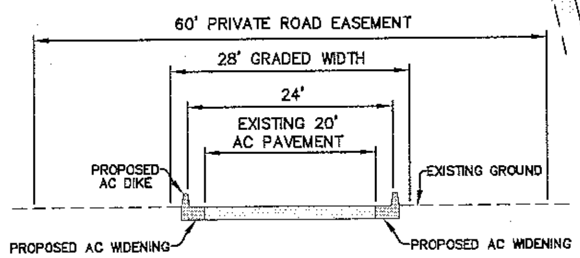




VICINITY MAP

NO SCALE
THOMAS BRO MAP NO. 1048, G-7 & H-7
AND NO. 1068, G-1 & H-1

NOTE:
THE EXISTING CROSS SLOPE VARIES BETWEEN A NORMAL CROWN AND A CONTINUOUS SLOPE TO ONE SIDE OR THE OTHER ALONG THE ENTIRE LENGTH OF THE ROAD. IN ORDER NOT TO DIVERT DRAINAGE, THE EXISTING CROSS SLOPE WILL BE MAINTAINED IN AREAS WHERE WIDENING IS PROPOSED.



AQUADUCT ROAD
TYPICAL SECTION
NO SCALE

PREPARED BY:

LAWRENCE W. WALSH RCE 46316 DATE

Walsh Engineering & Surveying, Inc.
607 Aldwych Road, El Cajon, CA 92020
(619) 588-6747 (619) 732-1232 Fax

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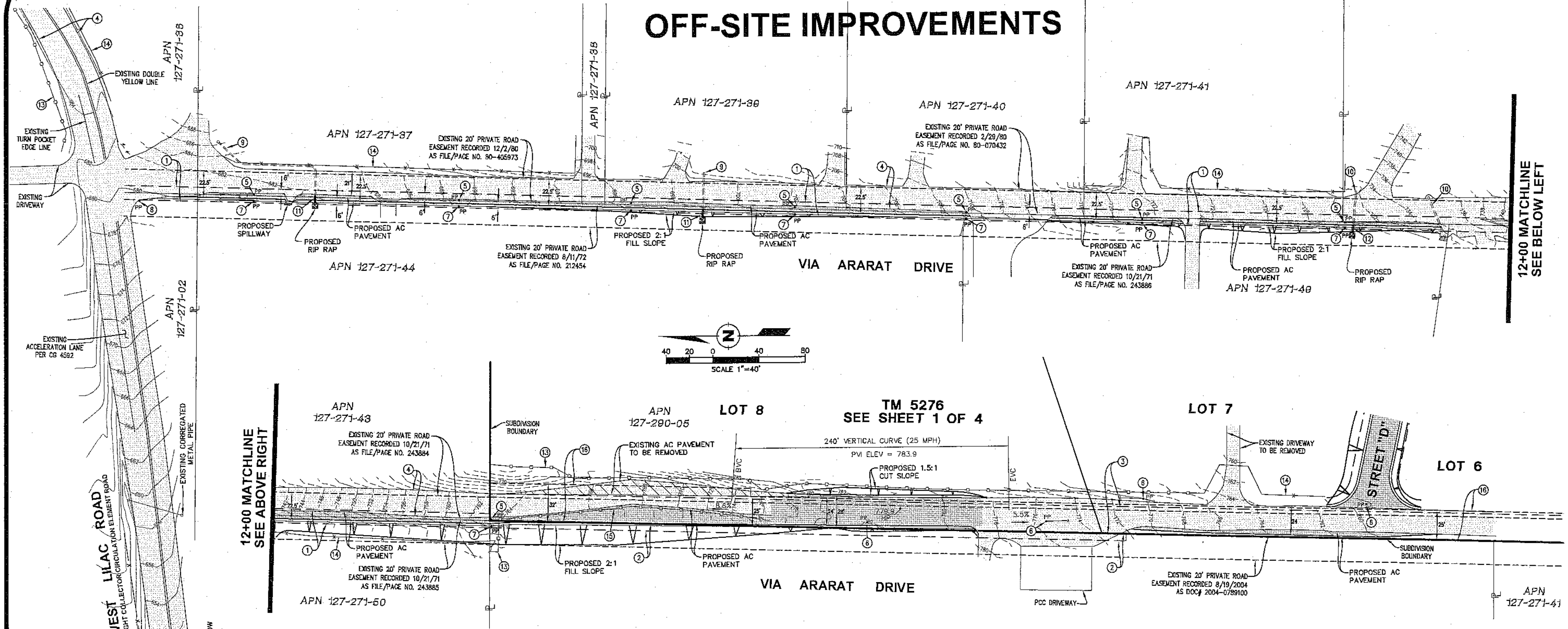
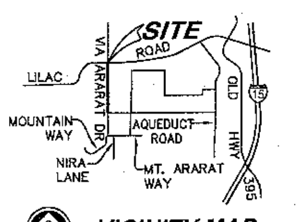
PRELIMINARY GRADING PLAN FOR TM 5276 RPL4
OFF-SITE IMPROVEMENTS

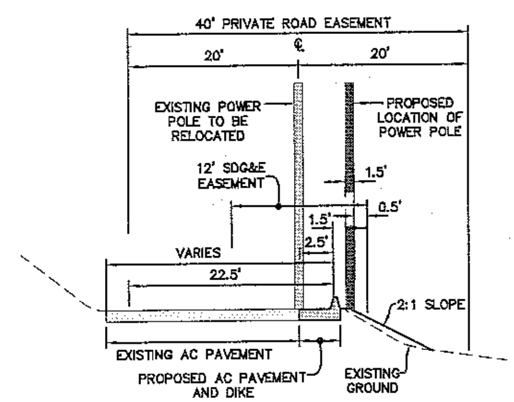


LEGEND:

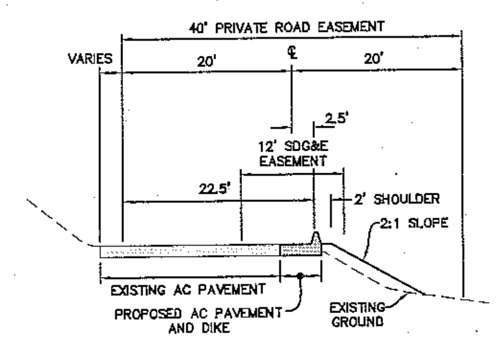
1. EXISTING 12' SDG&E EASEMENT
2. EXISTING 6' SDG&E EASEMENT
3. EXISTING 23' SDG&E EASEMENT
4. EXISTING AC PAVEMENT
5. EXISTING POWER POLE TO BE RELOCATED
6. EXISTING POWER POLE TO BE REMOVED AND UTILITY LINES TO BE UNDERGROUNDED
7. PROPOSED LOCATION OF POWER POLE
8. EXISTING POWER POLE TO REMAIN
9. EXISTING 12" HDPE TO REMAIN
10. EXISTING 12" RCP TO REMAIN
11. PROPOSED 6"~12" HDPE AT 1% MIN.
12. PROPOSED 6"~12" RCP AT 1% MIN.
13. EXISTING WOOD FENCE TO REMAIN
14. EXISTING CHAINLINK FENCE TO REMAIN
15. EXISTING WOOD FENCE TO BE RELOCATED TO NEW EDGE OF PAVEMENT
16. EXISTING PRIVATE ROAD EASEMENT RECORDED OCTOBER 25, 2005 AS FILE NO. 2005-923268



VICINITY MAP
NO SCALE
THOMAS BRO MAP NO. 1048, G-7 & H-7 AND NO. 1068, G-1 & H-1



VIA ARARAT DRIVE
TYPICAL SECTION
AT THE EIGHT OFFSITE POWER POLE LOCATIONS
NO SCALE



VIA ARARAT DRIVE
TYPICAL SECTION
IN BETWEEN POWER POLES
NO SCALE

NOTE:
THE EXISTING CROSS SLOPE VARIES BETWEEN A NORMAL CROWN AND A CONTINUOUS SLOPE TO ONE SIDE OR THE OTHER ALONG THE ENTIRE LENGTH OF THE ROAD. IN ORDER NOT TO DIVERT DRAINAGE, THE EXISTING CROSS SLOPE WILL BE MAINTAINED IN AREAS WHERE WIDENING IS PROPOSED.

OWNER/SUBDIVIDER:
JAMES D. PARDEE, JR.
WEST LILAC FARMS II, LLC
267 STONECREEK COURT
WESTLAKE VILLAGE, CA 91361
1-805-373-5555

REGISTERED PROFESSIONAL ENGINEER LAWRENCE W. WALSH No. C 48316 Exp. 12-31-10 CIVIL STATE OF CALIFORNIA

PREPARED BY:

LAWRENCE W. WALSH RCE 48316 DATE

Walsh Engineering & Surveying, Inc.
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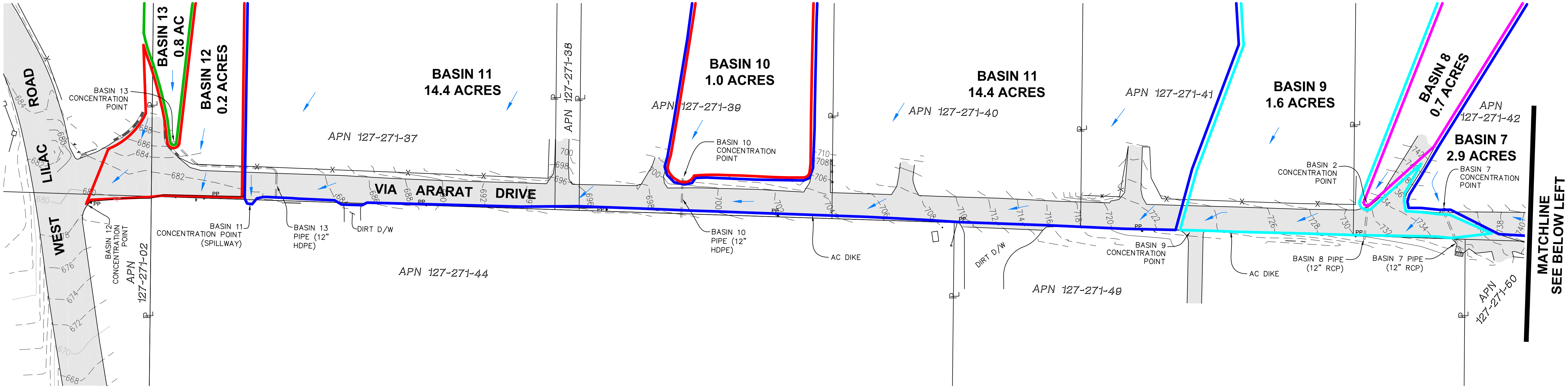
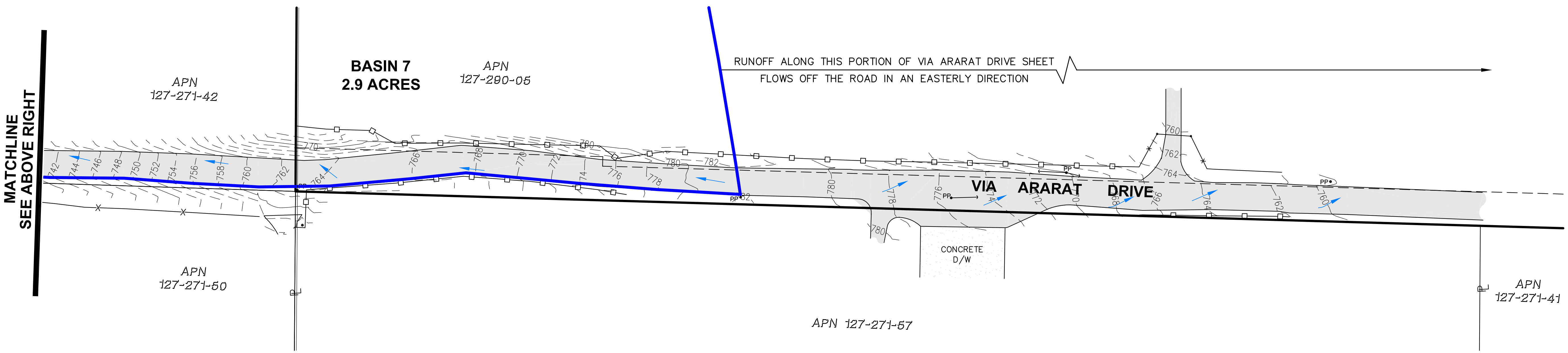
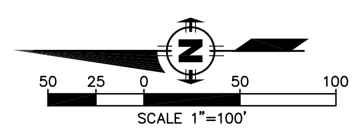
VIA ARARAT DRIVE

DRAINAGE MAP FOR VIA ARARAT DRIVE
(EXISTING CONDITION)







NOTE:
SEE SHEET 2 OF 2 FOR A 200-SCALE DRAINAGE MAP.

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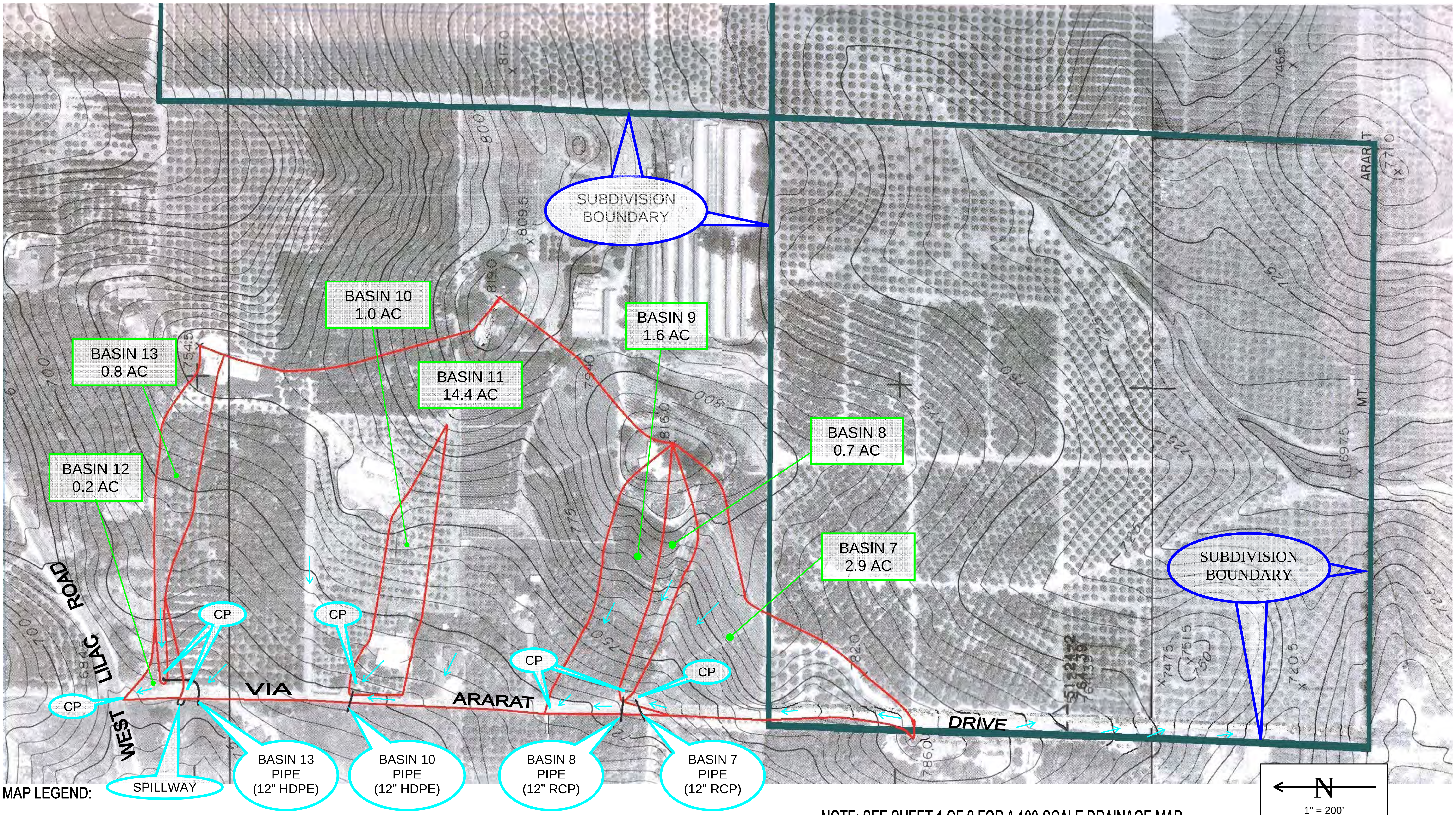
DRAINAGE MAP FOR VIA ARARAT DRIVE
(EXISTING CONDITIONS)



N
1" = 200'
SAN DIEGO
COUNTY TOPO
410-1719 & 406-1719

MAP LEGEND:

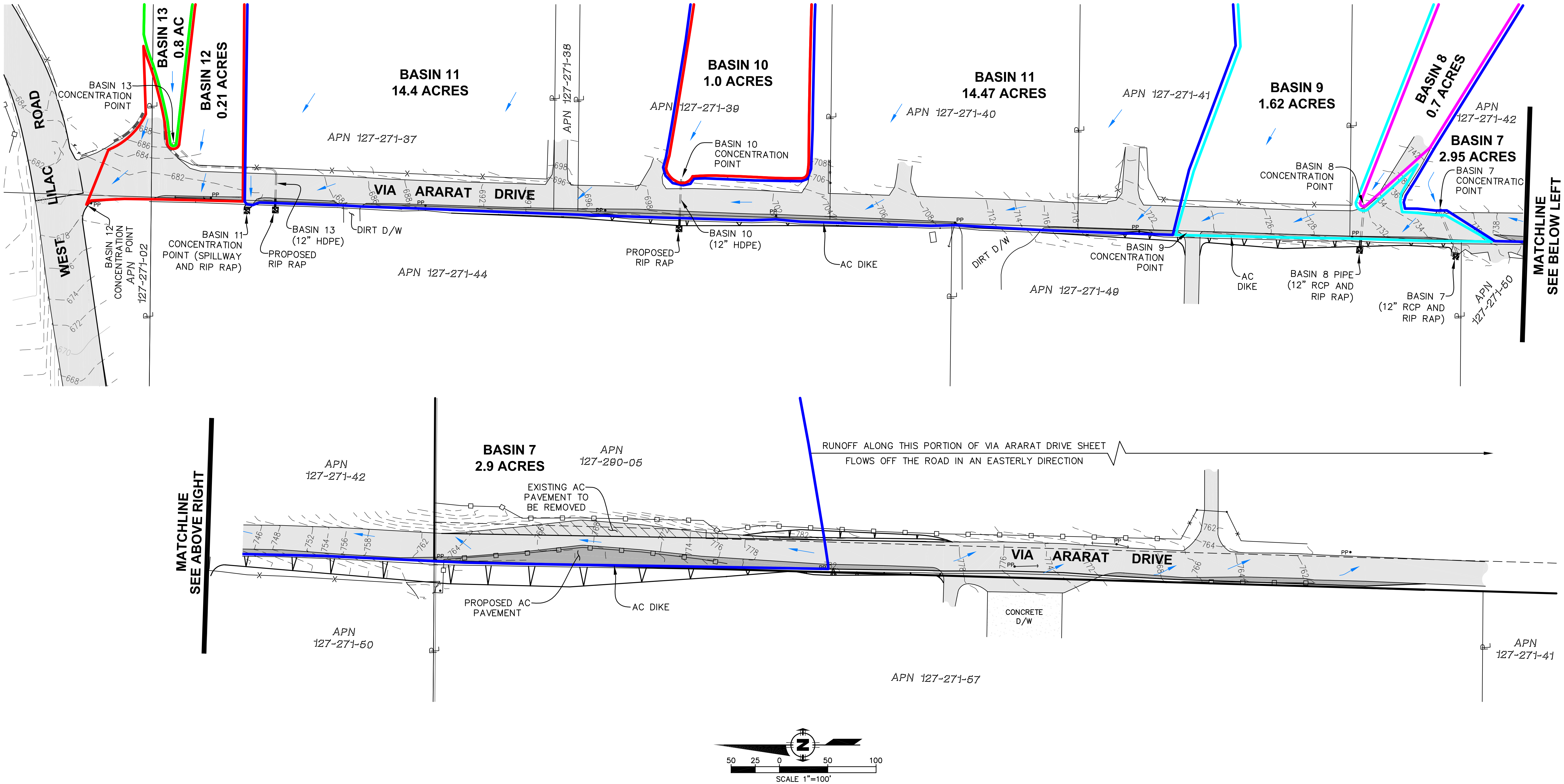
CONCENTRATION POINT CP

BASIN BOUNDARIES

FLOW DIRECTON

NOTE: SEE SHEET 1 OF 2 FOR A 100-SCALE DRAINAGE MAP

DRAINAGE MAP FOR VIA ARARAT DRIVE (PROPOSED CONDITION)



BASIN 7
VIA ARARAT DRIVE

VIA ARARAT DRIVE

Basin 7 Hydrology (Existing Condition)

	Q_{100}	=	CIA			Rational Method
C-Value:						
	$\mathbf{C_{SOIL\ B}}$	**=**	**0.32**			(see Table 3-1, Appendix)
Intensity Calculations:						
	I	=	$7.44\ P_6\ T_C^{-0.645}$			(see Figure 3-1 on the following pages)
Where						
	T_C	=	$T_i + T_t$			
And:						
	T_i	=	11.5	minutes		(see Table 3-2 on following pages).
	T_t	=	2.0	minutes		(see Figure 3-4 on following pages).
Then:						
	T_C	=	11.5 + 2.0	=	13.5	minutes
Also,						
	P_6	=	3.5	inches		(see Rainfall Isopluvial, Appendix)
	I	=	$7.44\ (3.5)\ (13.5)^{-0.645}$			(also see Figure 3-1 on following pages)
Then						
	I	**=**	**4.8**	**in/hr**		
Area:						
	A	**=**	**2.9**	**acres**		(see Drainage Maps attached)
Flow Rate:						
	Q_{100}	=	CIA			Rational Method
	Q_{100}	=	0.32 * 4.8 * 2.9			
Then						
	$\mathbf{Q_{100}}$	**=**	**4.5**	**cfs**		

<u>Basin 7 Hydrology (Proposed Condition)</u>

The purpose for the calculations below is to account for the additional paving due to the widening of Via Ararat Drive.

$Q_{100} = C_{Weighted}\ I\ A$ Rational Method

Updated Area:

$A_{total} = A_{Exist} + A_{Asph}$

Where:

Existing Area (A_{Exist}) = 2.9 acres (see Drainage Maps attached)

New Pavement Area (A_{Asph}) = 0.05 acres (see Preliminary Grading Plan, Appendix)

Then

$\mathbf{A_{total} = 2.9 + 0.05 = 2.95}$ **acres**

C-Value:

$C_{Weighted} = [(C_{SOIL\ B} * A_{Exist}) / A_{total}] + [(C_{Asph} * A_{Asph}) / A_{total}]$

Where:

New Pavement (C_{Asph}) = 0.95 (see Table II, Appendix)

Then:

$C_{Weighted} = [(0.32)\ (2.9) / 2.95] + [(0.95)\ (0.05) / 2.95]$

$\mathbf{C_{Weighted} = 0.33}$

Flow Rate:

$Q_{100} = C_{Weighted}\ I\ A$ Rational Method

$Q_{100} = 0.33 * 4.8 * 2.95$

Then

$\boxed{\mathbf{Q_{100} = 4.7\ cfs}}$

<u>Basin 7 Comparison</u>

Q_{100} Existing = 4.5 cfs

Q_{100} Proposed = 4.7 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/ 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

BASIN 7
(VIA ARARAT)

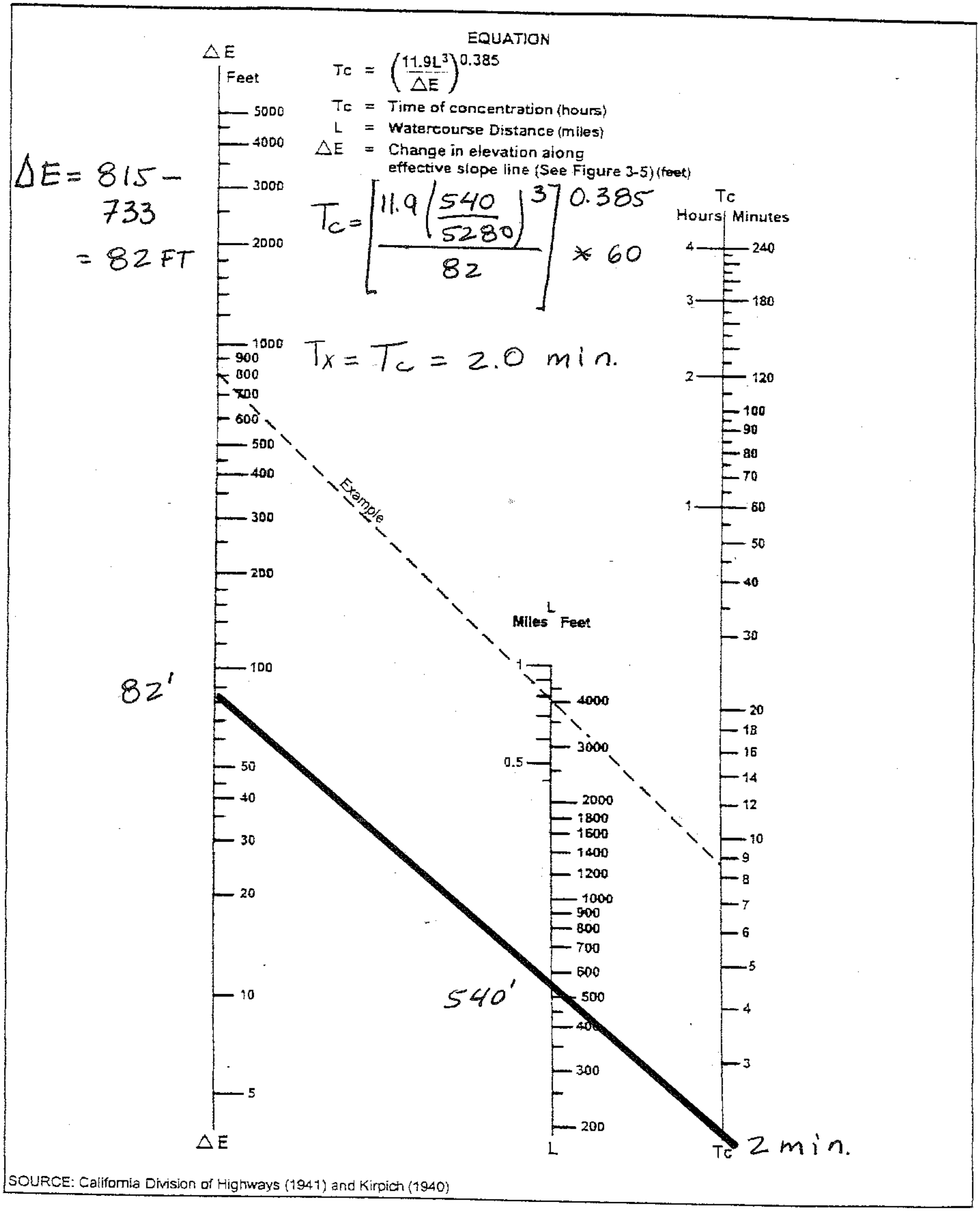
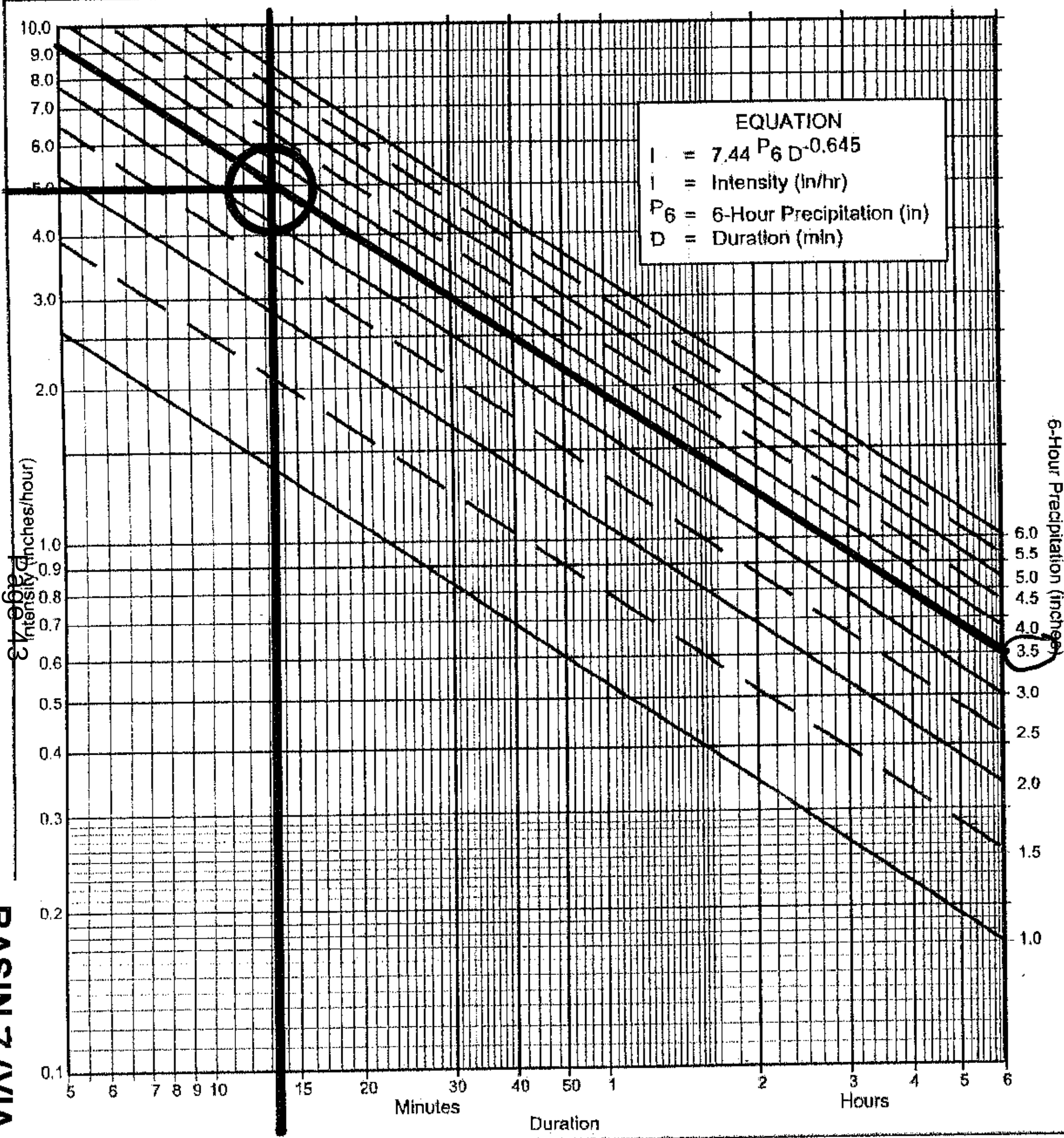


FIGURE **3-4**

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

BASIN 7
(VIA ARARAT)



4.8 in/hr

13.5 minutes

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 = 3.5 in., P_{24} = 6.0, $\frac{P_6}{P_{24}}$ = 58 %(2)

(c) Adjusted $P_6^{(2)}$ = 3.5 in.

(d) t_x = 13.5 min.

(e) I = 4.8 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

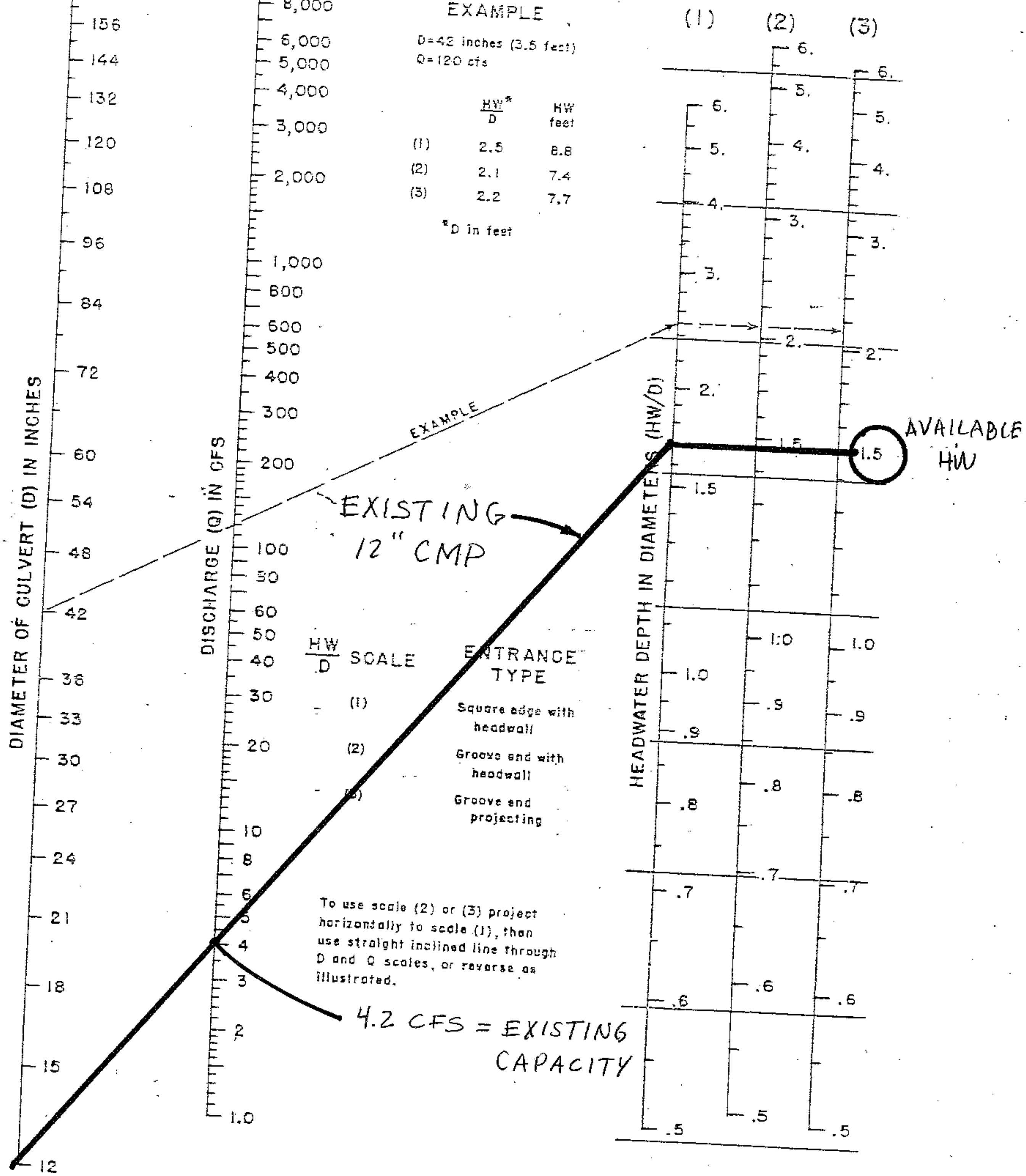
BASIN 7 (VIA ARARAT)

Basin 7 Hydraulics (Proposed Condition)

The flow from Basin 7 is directed towards an existing 12" RCP that crosses under Via Ararat Drive, see the picture below. The capacity of said pipe 12" RCP with a headwater depth of 1.5 feet is 4.2 cfs per the following Inlet Control Chart. However, the peak discharge is 4.7 cfs. Therefore, 0.5 cfs will bypass the 12" RCP in the 100-year storm and flow into Basin 9.

The flow velocity in the culvert will remain the same as in the existing condition. The flow velocity is ($V = Q_{100} / A = 4.2 \text{ cfs} / 0.78 \text{ ft}^2$) 5.4 ft/sec. Therefore, from Table 200-1.6.1(A) in the Appendix, the rock size for the outlet will be No. 3 Backing Class rip rap, 0.5' thick.

CHART 2



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

HEADWATER SCALES 2&3 REVISED MAY 1964

4.7 − 4.2 = 0.5 cfs that will bypass the pipe in a 100-yr storm

BASIN 7 (VIA ARARAT)

BASIN 8
VIA ARARAT DRIVE

Basin 8 Hydrology (Existing Condition)

Q_{100}	=	CIA			Rational Method

C-Value:

$C_{SOIL\ B}$	**=**	**0.32**			(see Table 3-1, Appendix)

Intensity Calculations:

$I = 7.44\ P_6\ T_C^{-0.645}$ (see Figure 3-1 on the following pages)

Where

$T_C = T_i + T_t$

And:

T_i	=	11.5	minutes		(see Table 3-2 on following pages).
T_t	=	1.9	minutes		(see Figure 3-4 on following pages).

Then:

T_C	=	11.5 + 2.1	=	13.4	minutes

Also,

P_6	=	3.5	inches		(see Rainfall Isopluvial, Appendix)

$I = 7.44\ (3.5)\ (13.4)^{-0.645}$ (also see Figure 3-1 on following pages)

Then

I	**=**	**4.9**	**in/hr**

Area:

A	**=**	**0.7**	**acres**	(see Drainage Maps attached)

Flow Rate:

Q_{100}	=	CIA	Rational Method

$Q_{100} = 0.32 * 4.9 * 0.7$

Then

$$\boxed{\mathbf{Q_{100} = 1.1\ cfs}}$$

Basin 8 Hydrology (Proposed Condition)

The flow rate for Basin 8 does not change from the existing conditions since the Basin is not on Via Ararat Drive and therefore remains unchanged (see Drainage Maps attached).

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.

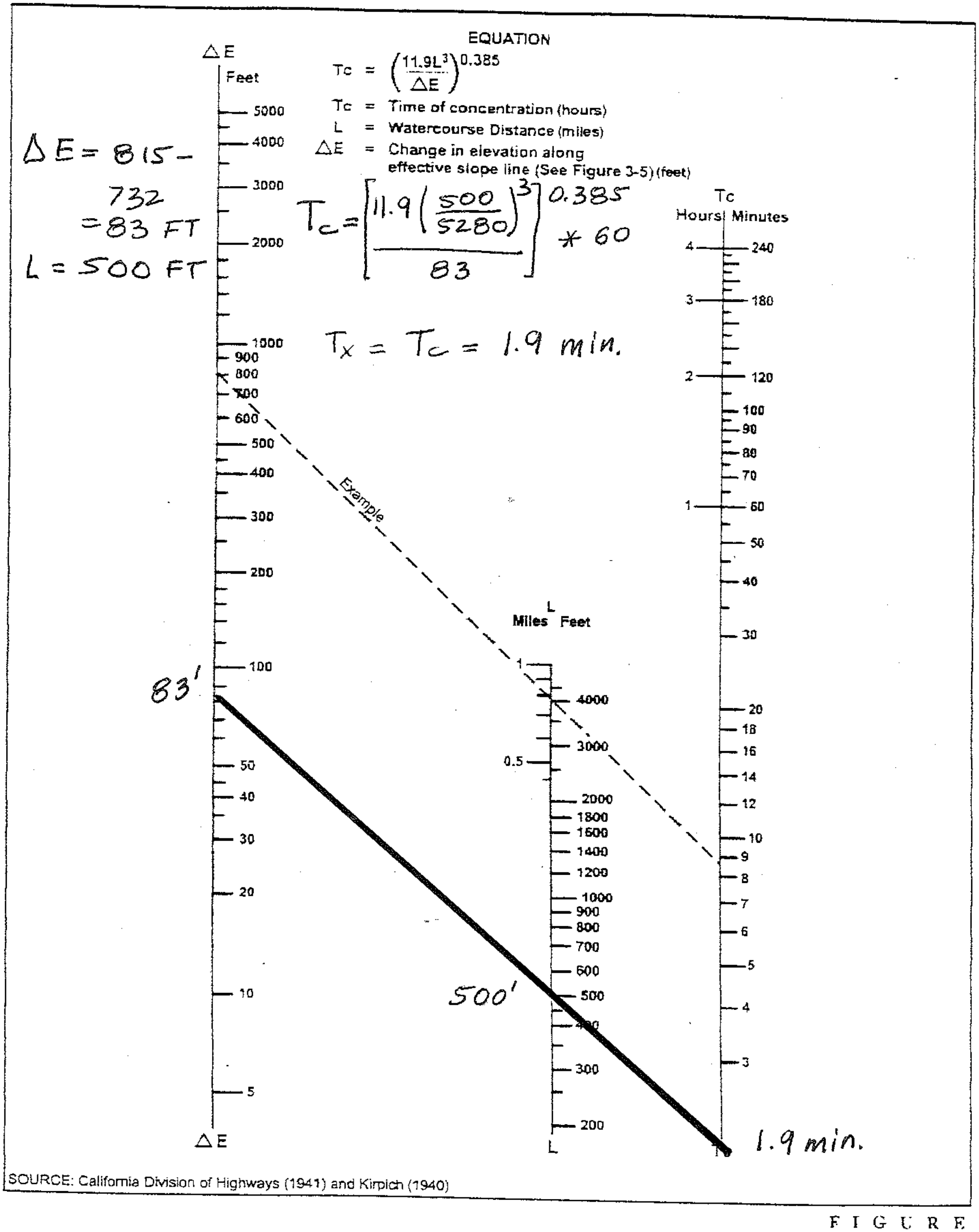
Table 3-2

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	[illegible]	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

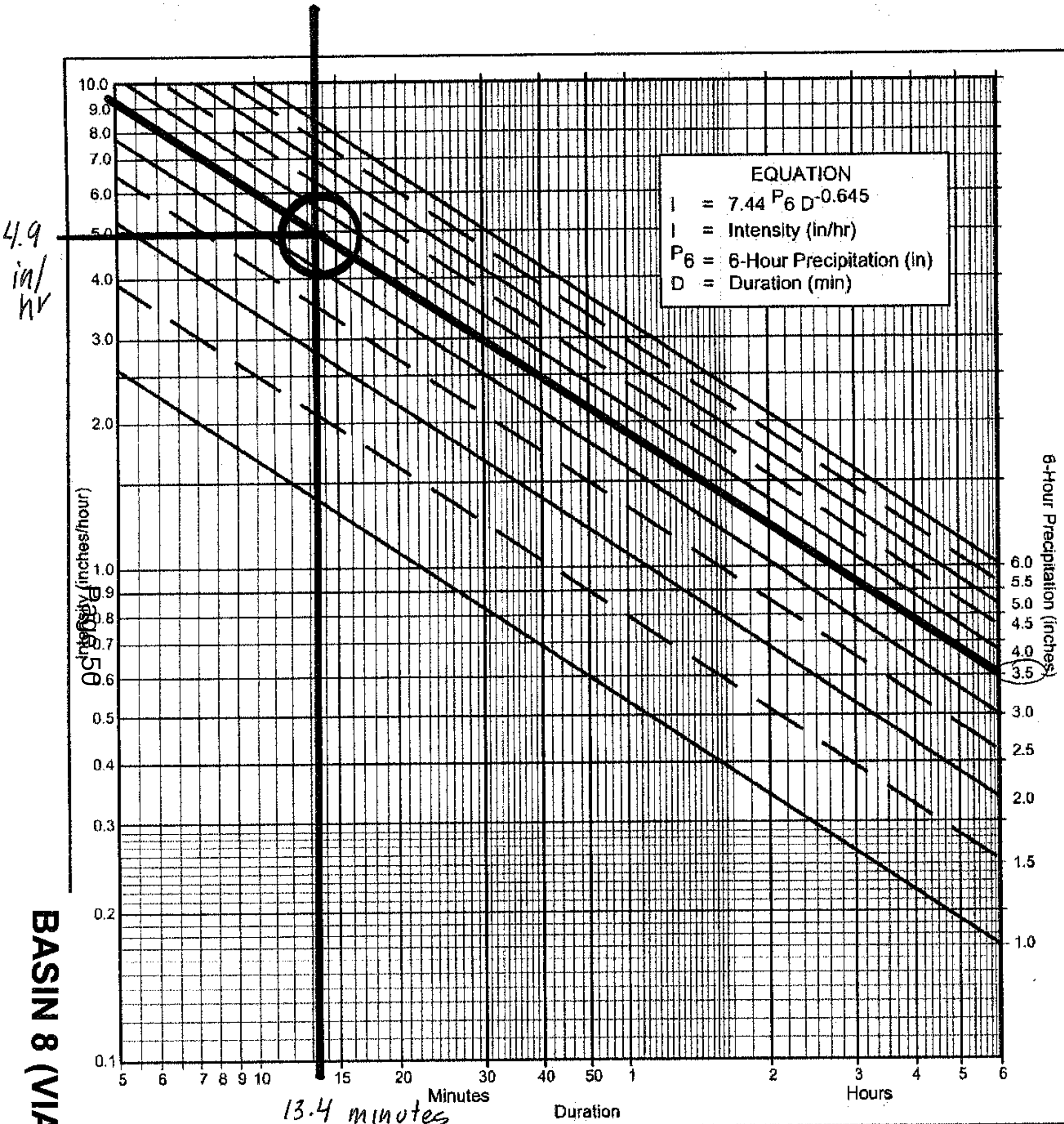
BASIN 8
(VIA ARARAT)



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

FIGURE 3-4

BASIN 8 (VIA ARARAT)



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 = 3.5 in., P_{24} = 6.0, $\frac{P_6}{P_{24}}$ = 58 %(2)

(c) Adjusted $P_6^{(2)}$ = 3.5 in.

(d) t_x = 13.4 min.

(e) I = 4.9 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

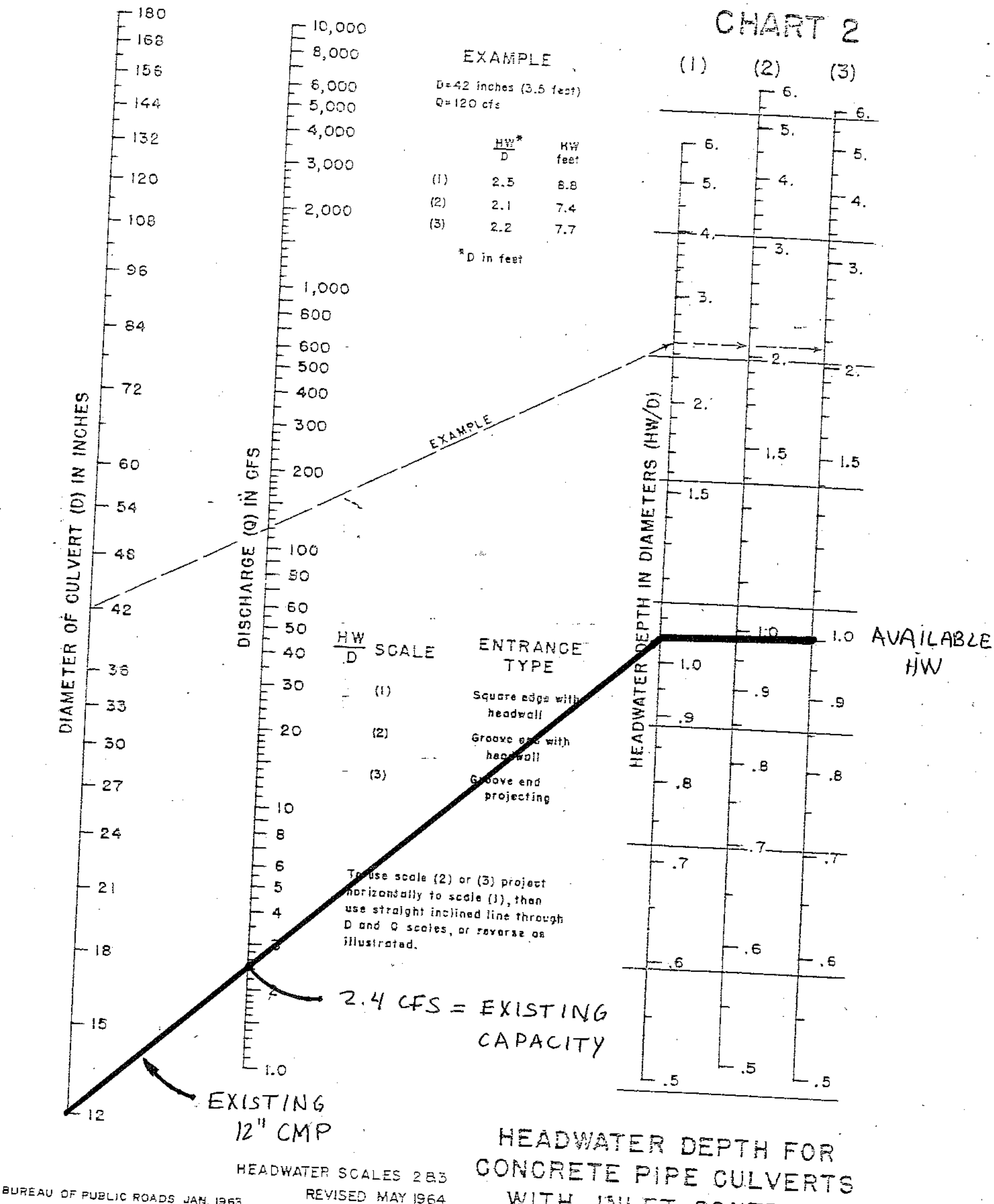
FIGURE **3-1**

BASIN 8 (VIA ARARAT)

Basin 8 Hydraulics (Proposed Condition)

The flow from Basin 8 is directed towards an existing 12" RCP that crosses under Via Ararat Drive, see the picture below. The capacity of said pipe 12" RCP with a headwater depth of 1' is 2.4 cfs per the following Inlet Control Chart. The peak discharge is 1.1 cfs. Therefore, the existing 12" RCP is adequate in the 100-year storm.

The culvert has a flow velocity ($V = Q_{100} / A = 1.1 \text{ cfs} / 0.78 \text{ ft}^2$) of 1.4 ft/s. Therefore, from Table 200-1.6.1(A) in the Appendix, the rock size for the outlet will be No. 3 Backing Class rip rap, 0.5' thick.



HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

5-22

EXISTING CAPACITY = 2.4 CFS

EXISTING Q_{PEAK} = 1.1 CFS

$2.4 > 1.1$ ∴ EXISTING PIPE IS ADEQUATE

BASIN 8
(VIA ARARAT)

BASIN 9
VIA ARARAT DRIVE

<u>Basin 9 Hydrology (Existing Condition)</u>

Q_{100} = CIA   Rational Method

C-Value:

$C_{SOIL\ B}$ = 0.32   (see Table 3-1, Appendix)

Intensity Calculations:

I = $7.44\ P_6\ T_C^{-0.645}$ (see Figure 3-1 on the following pages)

Where

T_C = $T_i + T_t$

And:

T_i = 11.5 minutes   (see Table 3-2 on following pages).
T_t = 2.1 minutes   (see Figure 3-4 on following pages).

Then:

T_C = 11.5 + 2.1 = 13.6 minutes

Also,

P_6 = 3.5 inches   (see Rainfall Isopluvial, Appendix)

I = $7.44\ (3.5)\ (13.6)^{-0.645}$ (also see Figure 3-1 on following pages)

Then

I = 4.8 in/hr

Area:

A = 1.6 acres   (see Drainage Maps attached)

Flow Rate:

Q_{100} = CIA   Rational Method

Q_{100} = 0.32 (4.8) (1.6)

Then

$\boxed{\mathbf{Q_{100} = 2.5\ cfs}}$

Basin 9 Hydrology (Proposed Condition):

The purpose for the calculations below is to account for the additional paving due to the widening of Via Ararat Drive.

Q_{100} = $C_{weighted}$ I A Rational Method

Updated Area:

A_{total} = $A_{Exist} + A_{Asph}$

Where:

New Pavement Area (A_{Asph}) = 0.02 acres (see Preliminary Grading Plan, Appendix)

Then

A_{total} = 1.6 + 0.02 = 1.62 acres

C-Value:

$C_{Weighted}$ = $[(C_{SOIL\ B} * A_{Exist}) / A_{total}] + [(C_{Asph} * A_{Asph}) / A_{total}]$

Where:

New Pavement (C_{Asph}) = 0.95 (see Table II, Appendix)

$C_{Weighted}$ = [(0.32) (1.6) / 1.62] + [(0.95) (0.02) / 1.62]

Then

$C_{Weighted}$ = 0.33

Intensity:

I = 4.8 in/hr

Flow Rate:

Q_{100} = $C_{weighted}$ I A Rational Method

Q_{100} = 0.33 * 4.8 * 1.62

Then

$\boxed{Q_{100} = 2.6 \text{ cfs}}$

<u>Basin 9 Comparison</u>

Q_{100} Existing = 2.5 cfs

Q_{100} Proposed = 2.6 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.

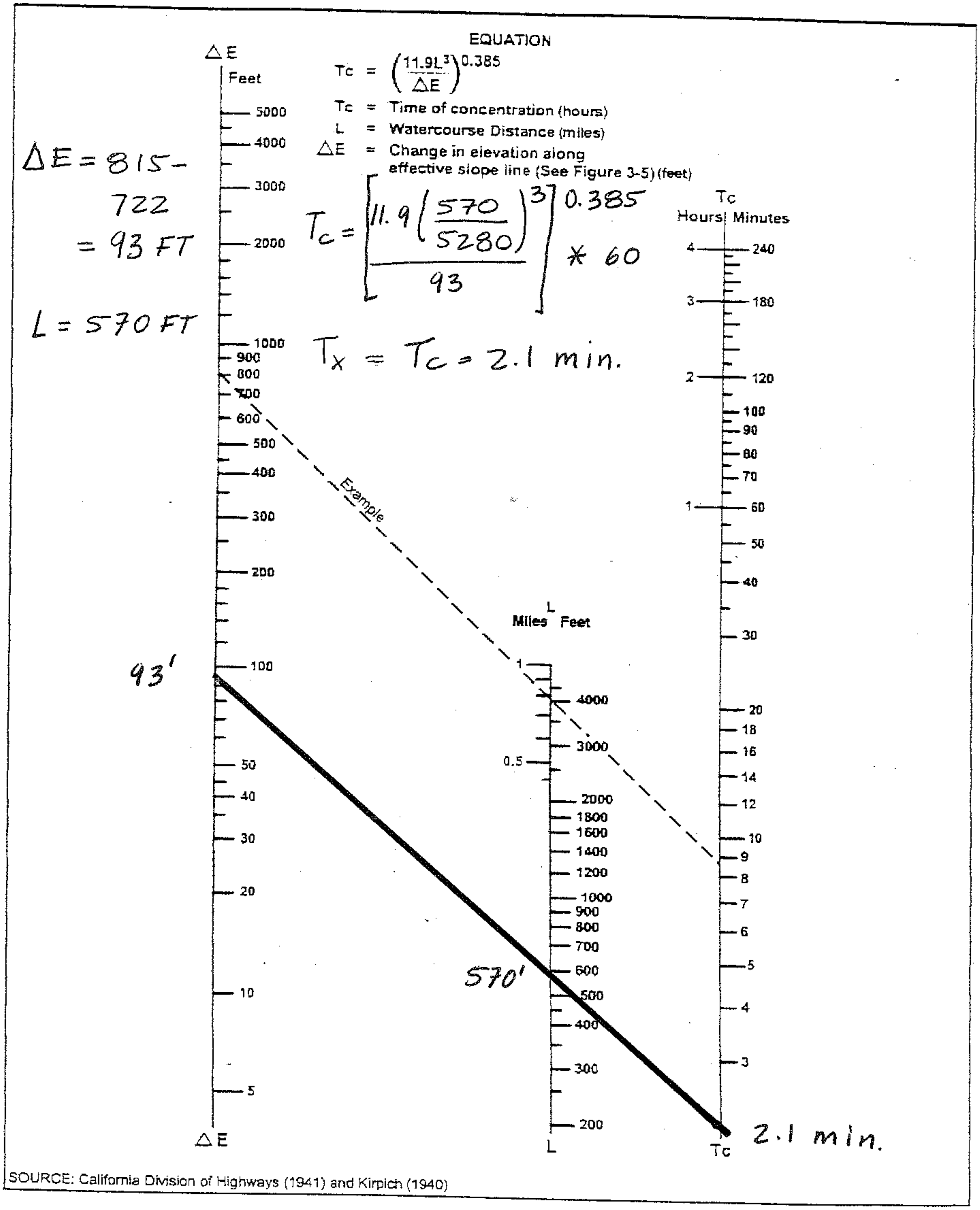
Table 3-2

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

Element*	DU/ 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	[illegible]	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

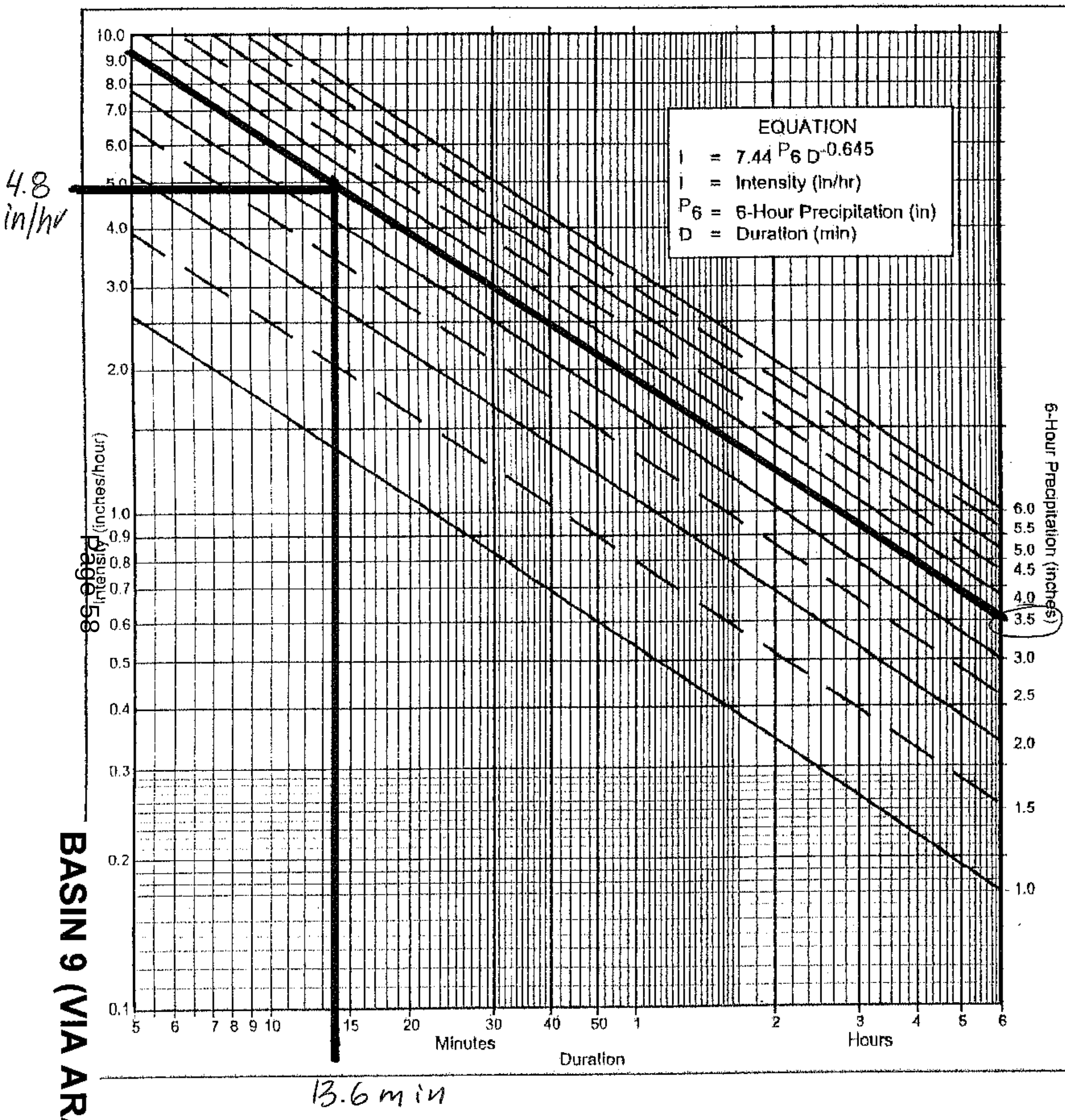
BASIN 9
(VIA ARARAT)



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

FIGURE **3-4**

BASIN 9
(VIA ARARAT)



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 = 3.5 in., P_{24} = 6.0, $\frac{P_6}{P_{24}}$ = 58 %(2)

(c) Adjusted $P_6^{(2)}$ = 3.5 in.

(d) t_x = 13.6 min.

(e) I = 4.8 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

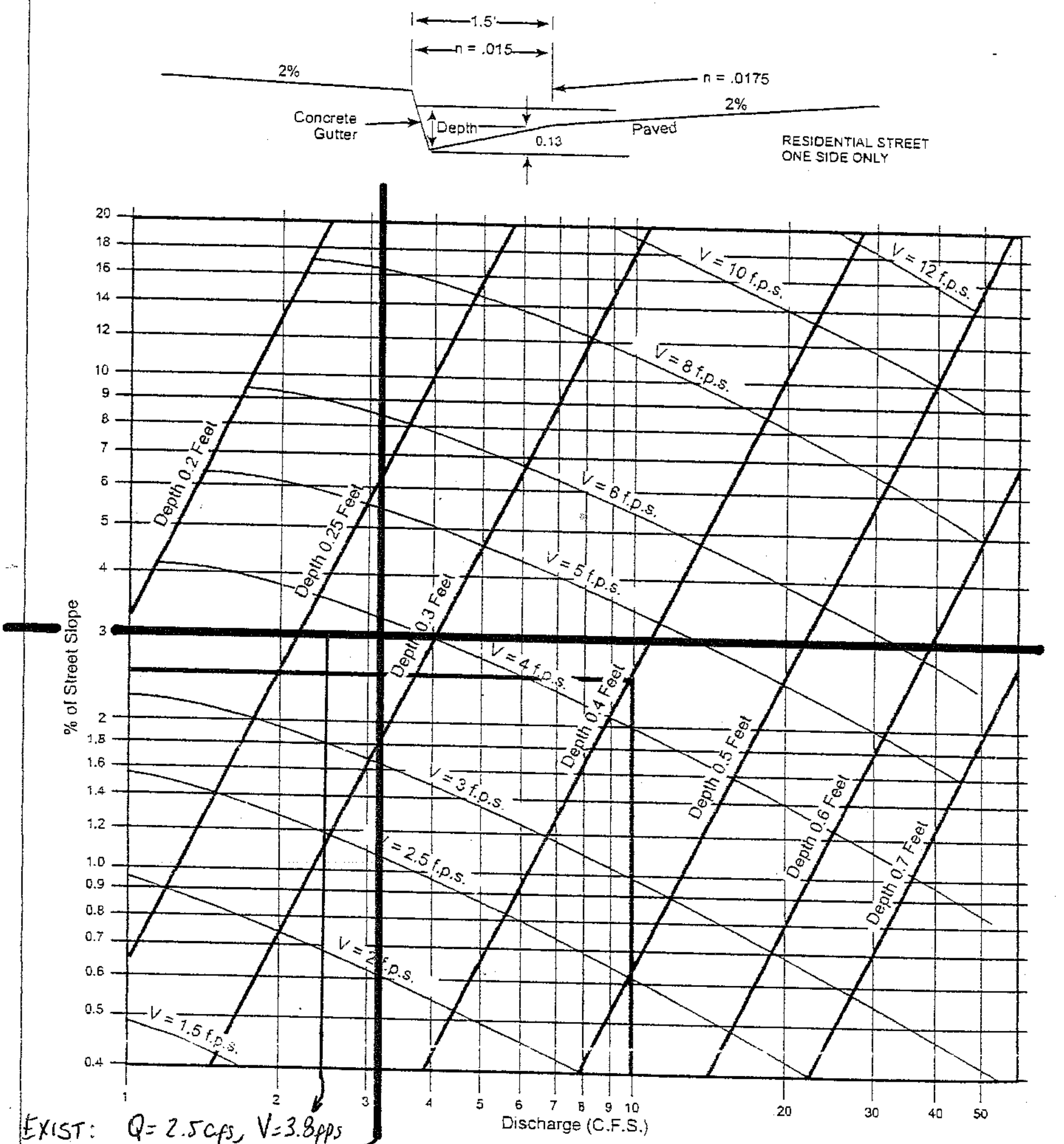
FIGURE **3-1**

BASIN 9 (VIA ARARAT)

Basin 9 Hydraulics (Proposed Condition)

In the existing condition, the storm water from this basin sheet flows across Via Ararat Drive to the westerly side of the road. There is a 6-inch AC dike along the west side of the road that directs the runoff into a driveway (see the picture below) for property of APN 127-271-49. The runoff then sheet flows off the northerly edge of the driveway and continues in a northerly direction. See the contours on the 200-scale Drainage Map in the Appendix.

From Figure 3-6, located on the following page, a depth of 0.27 feet is obtained in the gutter. Therefore, a 6-inch dike "Type A" G-5 per RSDs is adequate to handle a 100-year storm.



EXIST: Q= 2.5 cfs, V=3.8 fps

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

2.6 + 0.5 = 3.1 CFS (PROPOSED)

OVERFLOW FROM BASIN 7

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

Gutter and Roadway Discharge - Velocity Chart

FIGURE **3-6**

V = 3.8 f.p.s.

D = 0.27 ft

BASIN 9 (VIA ARARAT)

BASIN 10
VIA ARARAT DRIVE

Basin 10 Hydrology (Existing Condition)

$Q_{100} = C_{weighted}\ I\ A$ — Rational Method

C-Value:

$C_{Weighted} = [(C_{SOIL\ B} * \%_{SOIL\ B}) / 100] + [(C_{SOIL\ C} * \%_{SOIL\ C}) / 100]$

Where:

$C_{SOIL\ B}$ = 0.32 (see Table 3-1, Appendix)

$C_{SOIL\ C}$ = 0.36 (see Table 3-1, Appendix)

Percentage of Soil Type "B" ($\%_{SOIL\ B}$) = 70 % of Basin Area (see Hydrologic Soil Groups, Appendix)

Percentage of Soil Type "C" ($\%_{SOIL\ C}$) = 30 % of Basin Area (see Hydrologic Soil Groups, Appendix)

Then

$C_{Weighted} = [(0.32)\ (70) / 100] + [(0.36)\ (30) / 100]$

$\mathbf{C_{Weighted} = 0.33}$

Intensity Calculations:

$I = 7.44\ P_6\ T_C^{-0.645}$ (see Figure 3-1 on the following pages)

Where

$T_C = T_i + T_t$

And:

T_i = 6.4 minutes (see Table 3-2 on following pages).

T_t = 2.0 minutes (see Figure 3-4 on following pages).

Then:

T_C = 6.4 + 2.0 = 8.4 minutes

Also,

P_6 = 3.5 inches (see Rainfall Isopluvial, Appendix)

Then

$I = 7.44\ (3.5)\ (8.4)^{-0.645}$ (also see Figure 3-1 on following pages)

Therefore:

I = 6.6 in/hr

Area:

A = 1.0 acres (see Drainage Maps attached)

Flow Rate:

$Q_{100} = C_{weighted}\ I\ A$ — Rational Method

$Q_{100} = 0.33 * 6.6 * 1.0$

Then

$\boxed{\mathbf{Q_{100} = 2.2\ cfs}}$

Basin 10 Hydrology (Proposed Condition)

The flow rate for Basin 10 does not change from the existing conditions since the Basin is not on Via Ararat Drive and therefore remains unchanged (see Drainage Maps attached).

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.

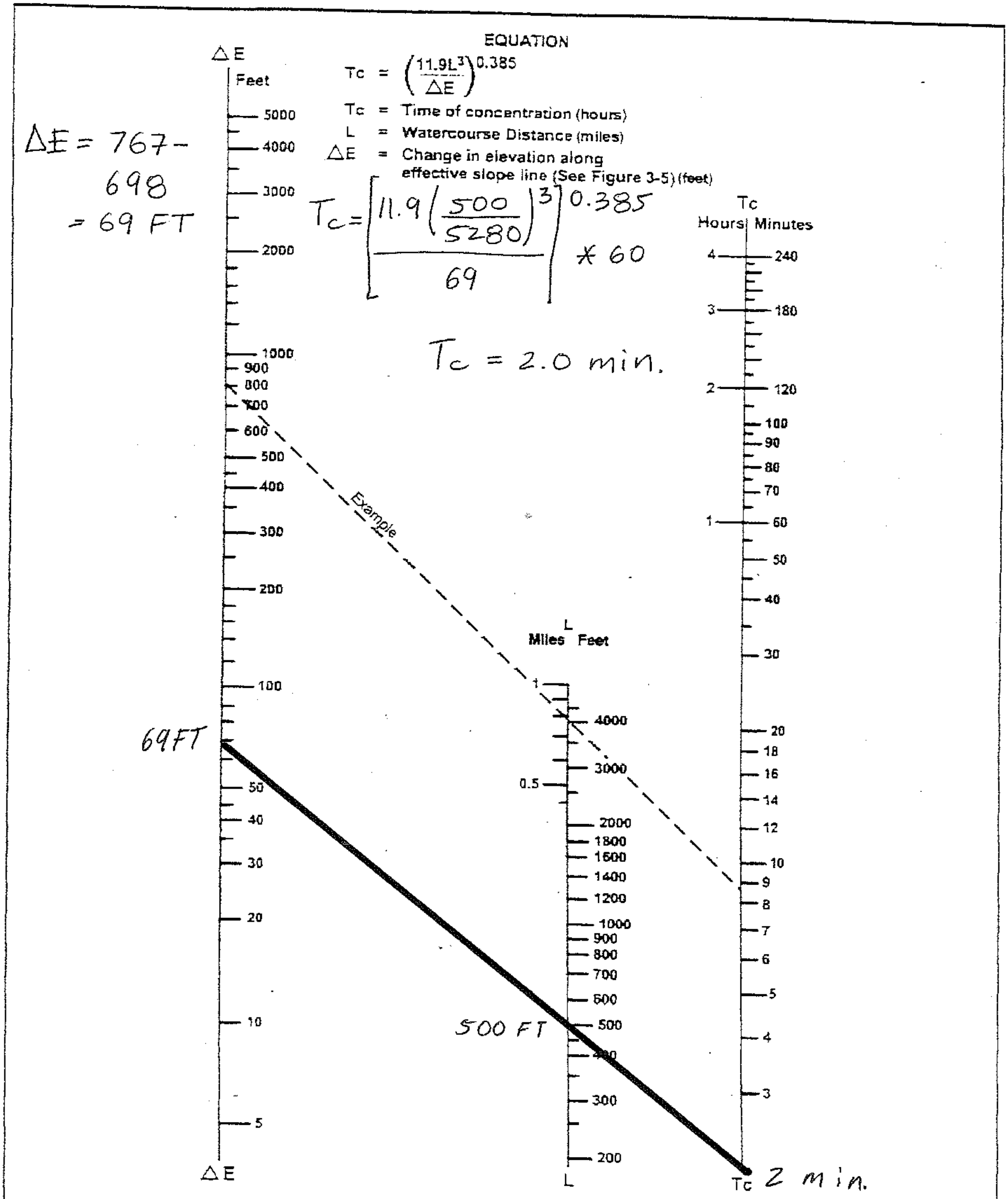
Table 3-2

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	[illegible]
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	[illegible]
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 10
(VIA ARARAT)

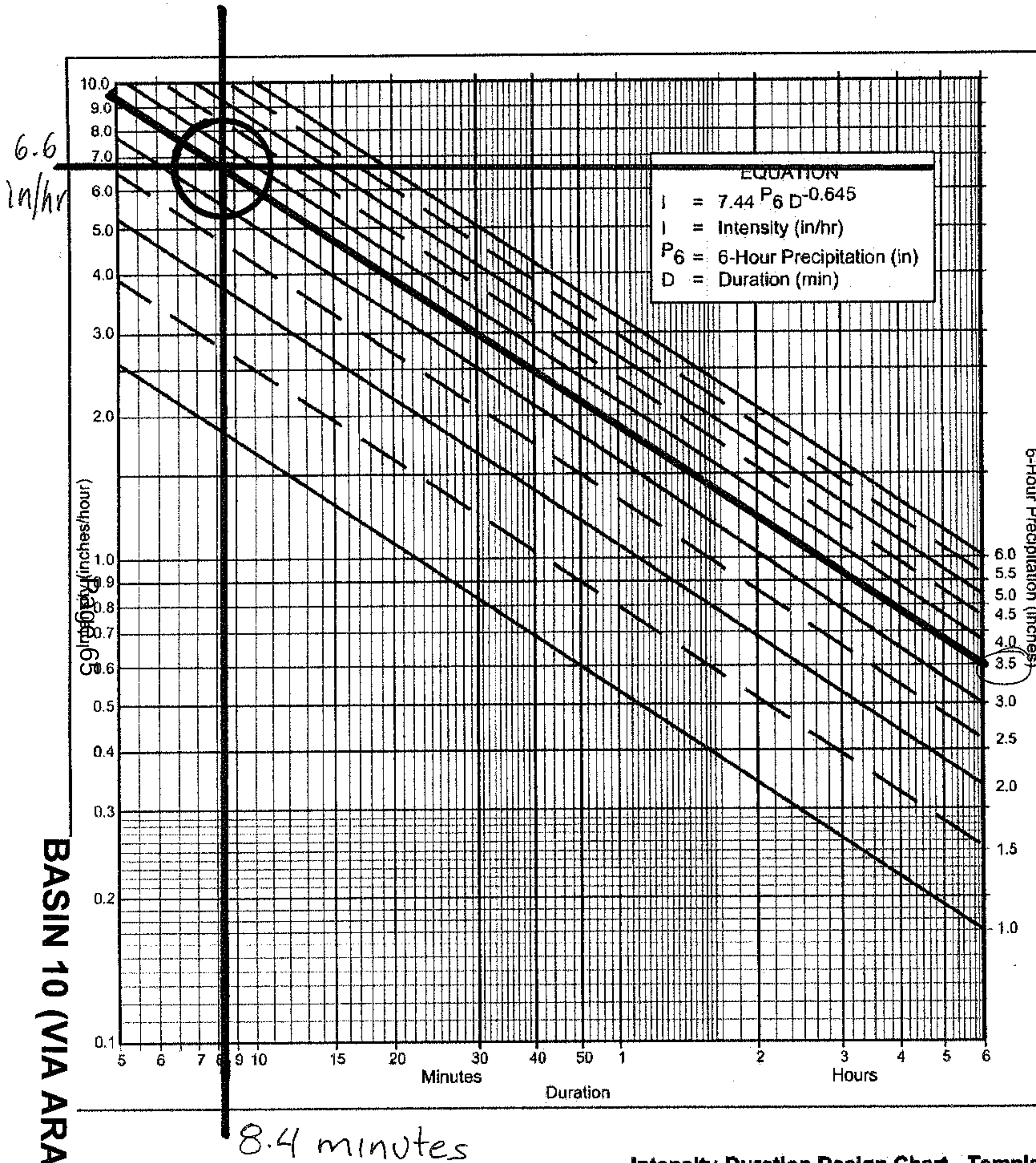


SOURCE: California Division of Highways (1941) and Kirpich (1940)

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

FIGURE **3-4**

BASIN 10 (VIA ARARAT)



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 = 3.5 in., P_{24} = 6.0, $\frac{P_6}{P_{24}}$ = 58 %(2)

(c) Adjusted P_6(2) = 3.5 in.

(d) t_x = 8.4 min.

(e) I = 6.6 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

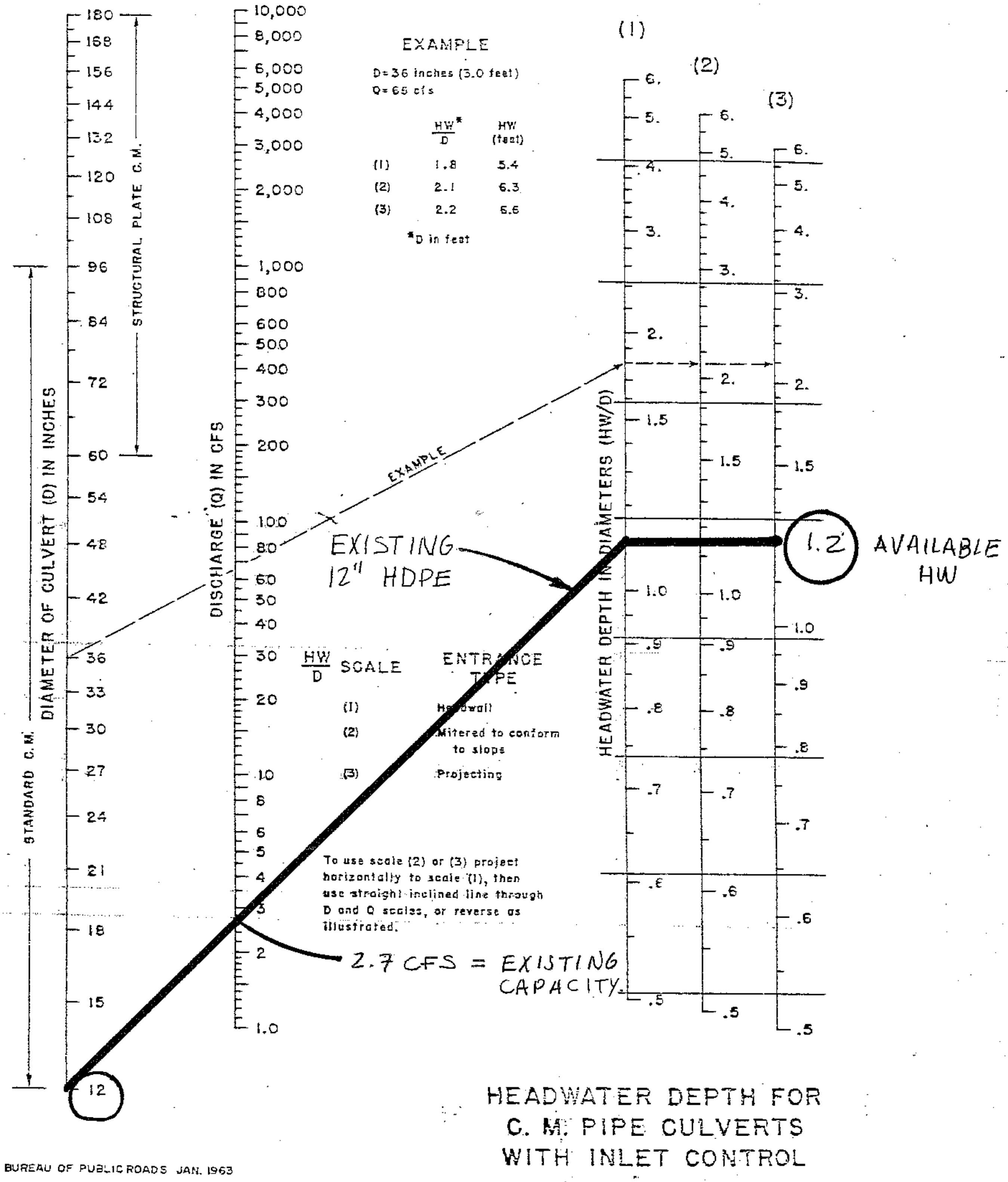
BASIN 10 (VIA ARARAT)

Basin 10 Hydraulics (Proposed Condition)

The flow from Basin 10 is directed towards an existing 12" HDPE that crosses under Via Ararat Drive, see the 100-scale Drainage Map attached. The capacity of said 12" HDPE with a headwater depth of 1.2' is 2.7 cfs per the following Inlet Control Chart. The peak discharge is 2.2 cfs. Therefore, the existing 12" HDPE is adequate in the 100-year storm.

The culvert has a flow velocity ($V = Q_{100} / A = 2.2$ cfs / 0.78 ft^2) of 2.8 ft/s. Therefore, from Table 200-1.6.1(A) in the Appendix, the rock size for the outlet will be No. 3 Backing Class rip rap, 0.5' thick.

CHART 5



HEADWATER DEPTH FOR C. M. PIPE CULVERTS WITH INLET CONTROL

5-25

EXISTING PEAK DISCHARGE = 2.2 CFS

2.7 > 2.2 ∴ PIPE IS ADEQUATE FOR A 100-YR STORM

BASIN 10 (VIA ARARAT)

BASIN 11
VIA ARARAT DRIVE

Basin 11 Hydrology (Existing Condition)

Q_{100} = $C_{weighted}$ I A — Rational Method

C-Value:

$C_{Weighted}$ = $[(C_{SOIL\ B} * \%_{SOIL\ B}) / 100] + [(C_{SOIL\ C} * \%_{SOIL\ C}) / 100]$

Where:

$C_{SOIL\ B}$	=	0.32	(see Table 3-1, Appendix)
$C_{SOIL\ C}$	=	0.36	(see Table 3-1, Appendix)
Percentage of Soil Type "B" ($\%_{SOIL\ B}$)	=	60 % of Basin Area	(see Hydrologic Soil Groups, Appendix)
Percentage of Soil Type "C" ($\%_{SOIL\ C}$)	=	40 % of Basin Area	(see Hydrologic Soil Groups, Appendix)

$C_{Weighted}$ = [(0.32) (60) / 100] + [(0.36) (40) / 100]

Then

$C_{Weighted}$ = 0.336

Intensity Calculations:

I = $7.44\ P_6\ T_C^{-0.645}$ (see Figure 3-1 on the following pages)

Where

$T_C = T_i + T_{t1} + T_{t2}$

And:

T_i	=	11.5	minutes	(see Table 3-2 on following pages).
T_{t1}	=	2.9	minutes	(see Figure 3-4 on following pages).

T_{t2} is the time it takes the runoff to travel along the gutter flow line. The time it takes the water to travel from the initial point of the gutter flow to the concentration point is calculated using the velocity and the distance traveled. The velocity is calculated using Figure 3-6 of the San Diego hydrology manual and the distance traveled is obtained from the Drainage Map. The Q_{100} used for Figure 3-6 is assumed and then divided by two to average the amount of runoff in the gutter. This assumption is later checked for accuracy. See below for the calculation:

T_{t2} = Distance Traveled / Velocity

Where:

Velocity (V)	=	4.8	fps	(see Figure 3-6 on following pages)
Distance Traveled	=	520	feet	(see Drainage Maps, Appendix)

Then:

T_{t2} = 520 / 4.8 = 108.3 seconds = 1.8 minutes

Therefore:

T_C = 11.5 + 2.9 + 1.8 = 16.2 minutes

Also,

P_6 = 3.5 inches (see Rainfall Isopluvial, Appendix)

Now:

I = $7.44\ (3.5)\ (16.2)^{-0.645}$ (also see Figure 3-1 on following pages)

Then:

I = 4.3 in/hr

Area:

A = 14.4 acres (see Drainage Maps attached)

Basin 11 cont…

Flow Rate:

Q_{100} = $C_{weighted}$ I A   Rational Method

Q_{100} = 0.336 * 4.3 * 14.4

Then

$\boxed{\mathbf{Q_{100} = 20.9 \quad cfs}}$

* The assumption for the Q_{100} for the velocity calculation is found to be correct with accepatable tolerance.

Basin 11 Hydrology (Proposed Condition):

The purpose for the calculations below is to account for the additional paving due to the widening of Via Ararat Drive.

Q_{100} = $C_{weighted}$ I A   Rational Method

Updated Area:

A_{total} = A_{Exist} + A_{Asph}

Where:

New Pavement Area (A_{Asph}) = 0.07 acres   (see Preliminary Grading Plan, Appendix)

Then

$\mathbf{A_{total}}$ = **14.4 + 0.07 = 14.47 acres**

C-Value:

$C_{Weighted}$ = $[(C_{SOIL\ B} * \%_{SOIL\ B})/100] + [(C_{SOIL\ C} * \%_{SOIL\ C})/100] + [(C_{Asph} * A_{Asph})/A_{total}]$

Where:

New Pavement (C_{Asph}) = 0.95   (see Table II, Appendix)

Then:

$C_{Weighted}$ = [(0.32) (60) / 100] + [(0.36) (40) / 100] + [(0.95) (0.07) / 14.47]

$\mathbf{C_{Weighted}}$ = **0.339**

Intensity:

I = 4.3 in/hr

Flow Rate:

Q_{100} = CIA   Rational Method

Q_{100} = 0.339 * 4.3 * 14.47

Then

$\boxed{\mathbf{Q_{100} = 21.2 \quad cfs}}$

<u>**Basin 11 Comparison**</u>

Q_{100} Existing	=	20.9	cfs
Q_{100} Proposed	=	21.2	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.

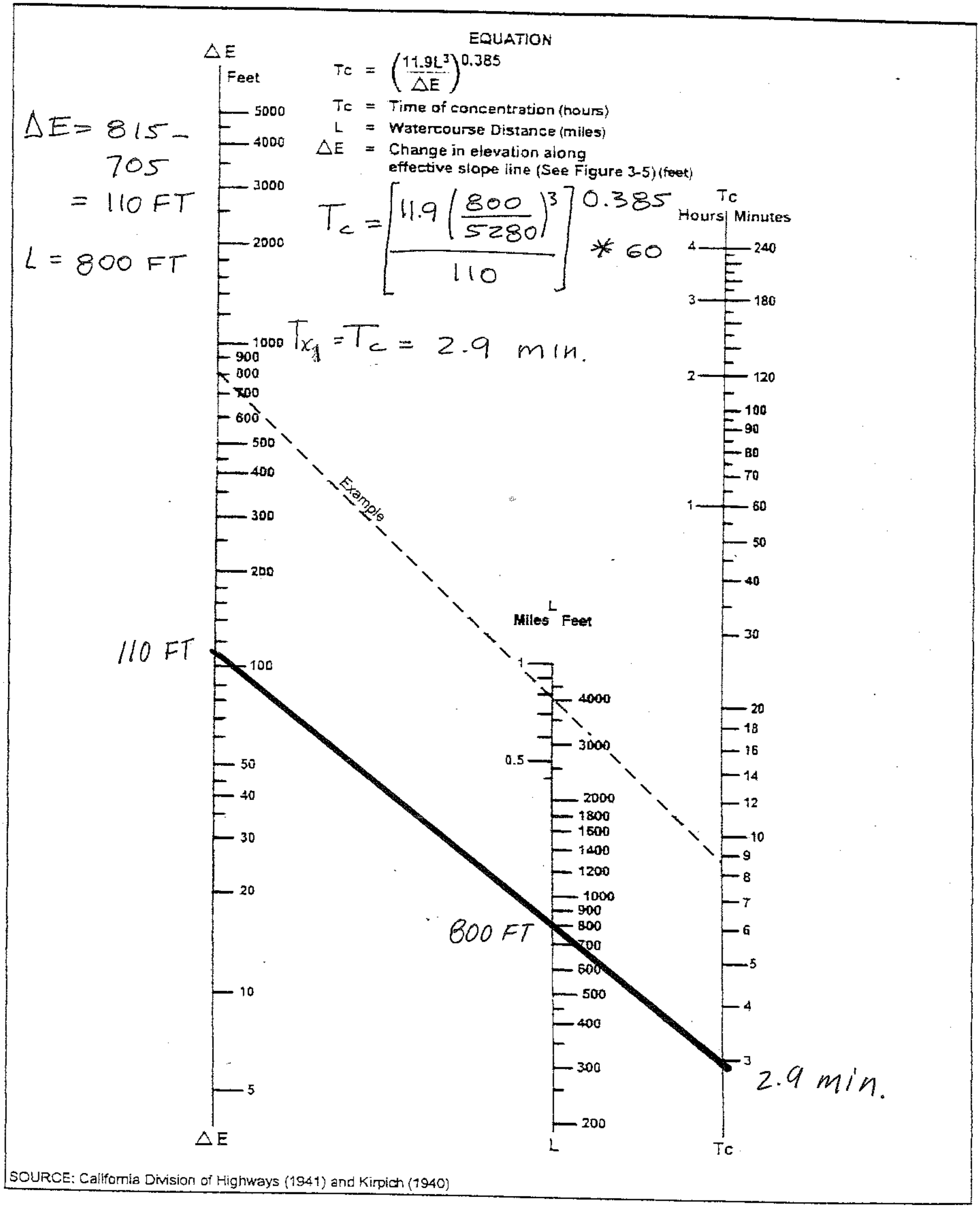
Table 3-2

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

Element*	DU/ 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	[illegible]	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

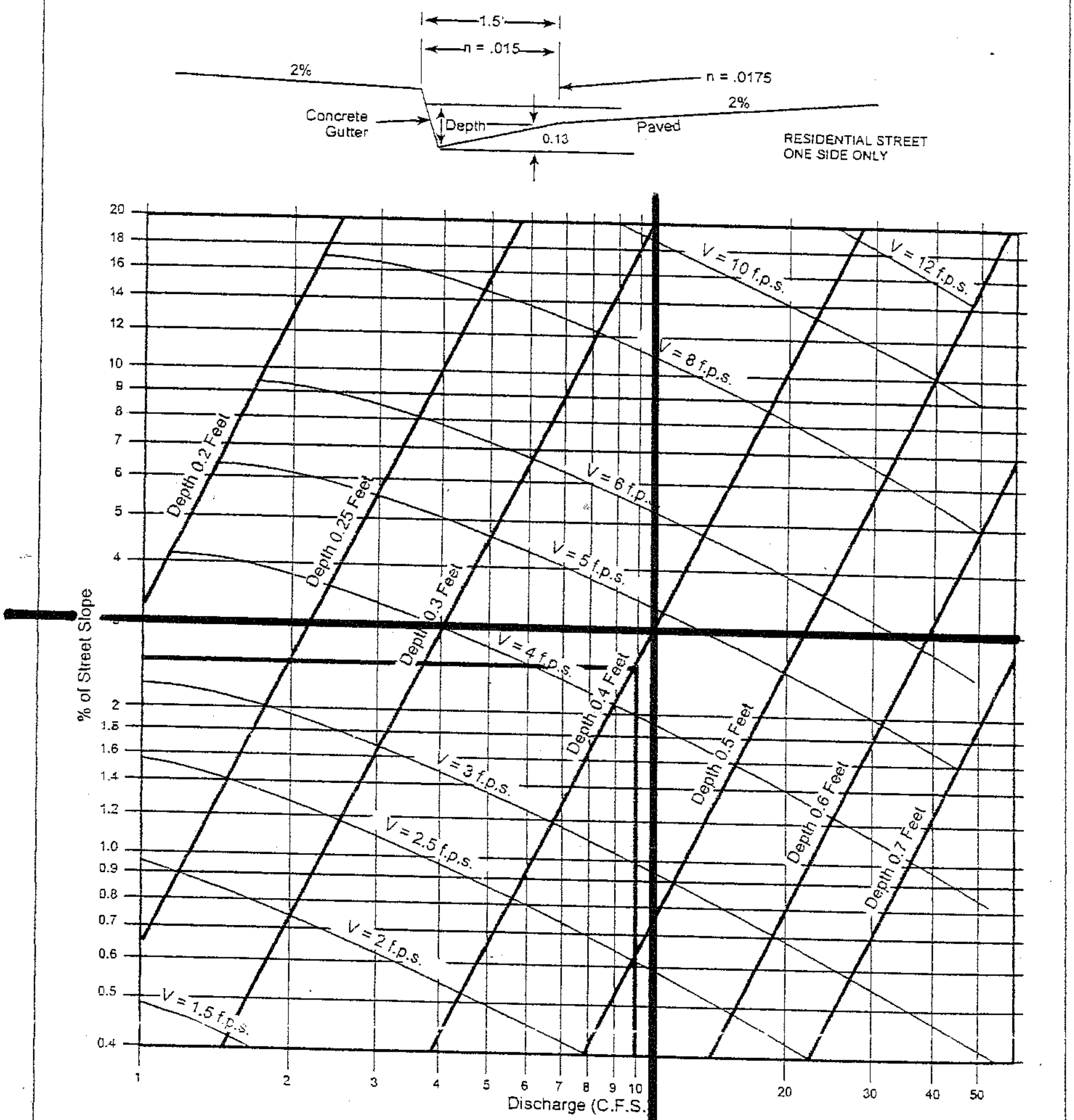
BASIN 11
(VIA ARARAT)



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

FIGURE
3-4

BASIN 11
(VIA ARARAT)



EXAMPLE:

Given: Q = 10 S = 2.5%

Chart gives: Depth = 0.4, Velocity = 4.4 f.p.s.

$\frac{Q}{2} = 10.5$ CFS

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

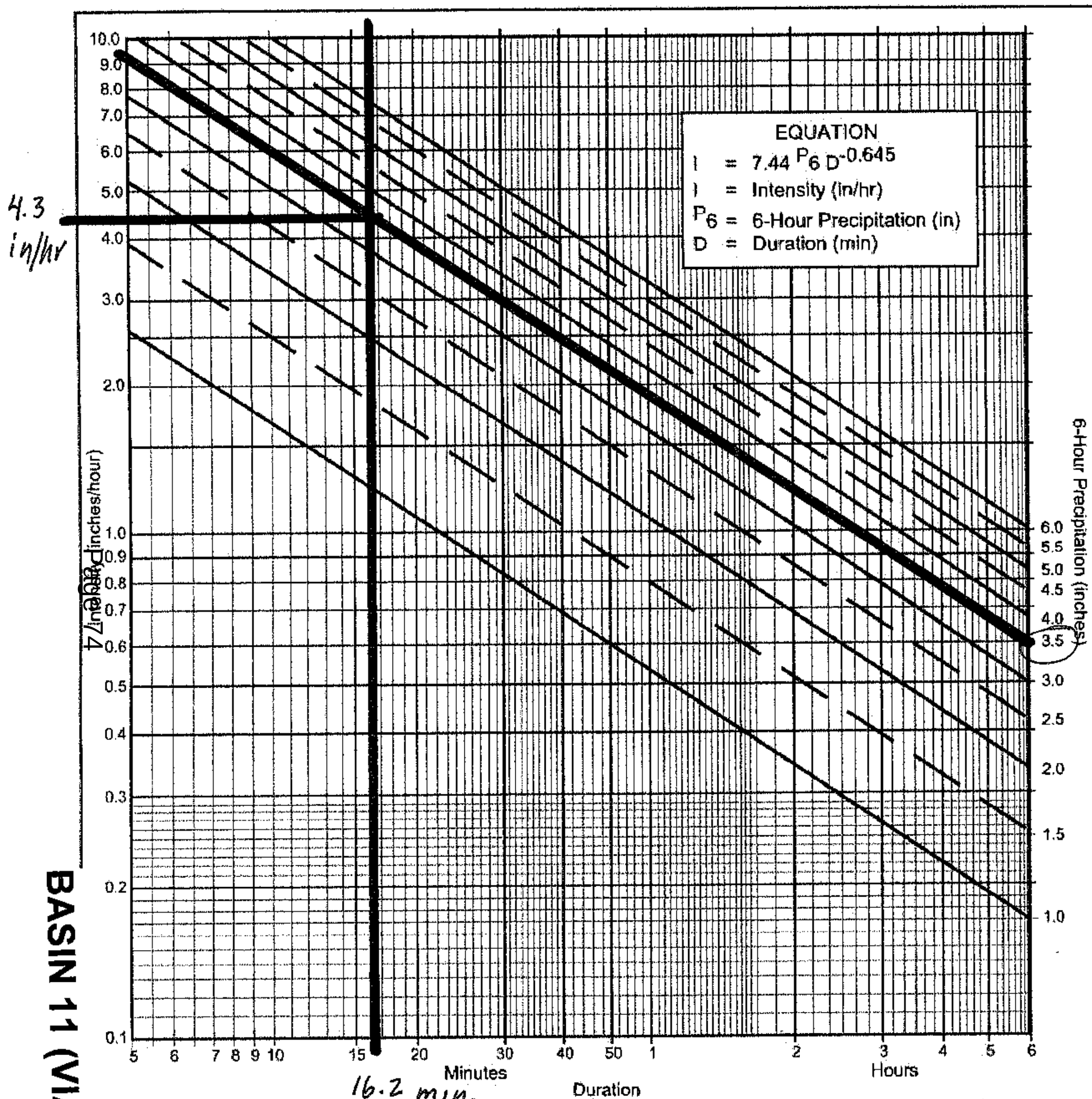
Gutter and Roadway Discharge - Velocity Chart

FIGURE

3-6

V = 4.8 f.p.s

BASIN 11 (VIA ARARAT)



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 = 3.5 in., P_{24} = 6.0, $\frac{P_6}{P_{24}}$ = 58 %(2)

(c) Adjusted $P_6^{(2)}$ = 3.5 in.

(d) t_x = 16.2 min.

(e) I = 4.3 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

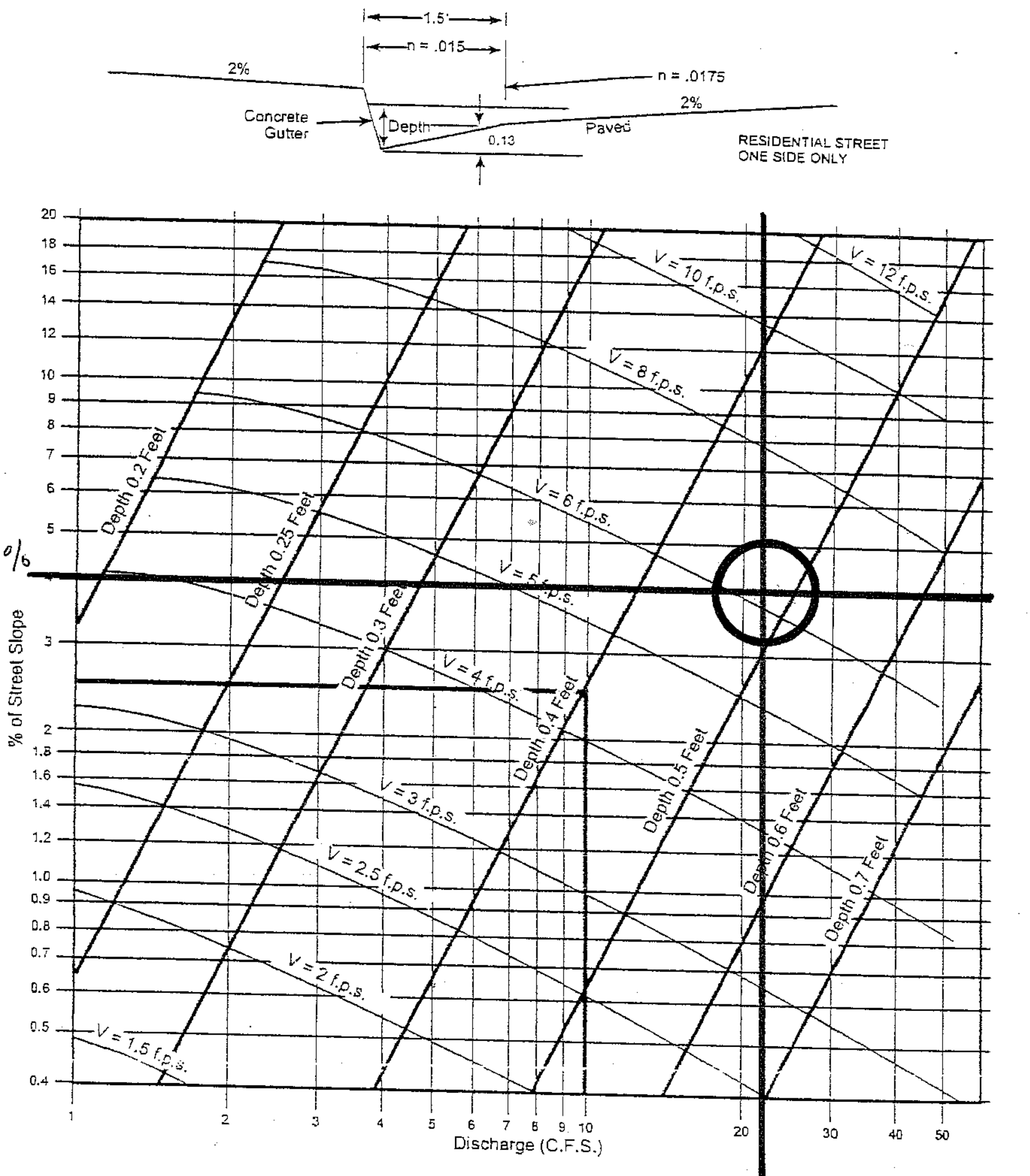
BASIN 11 (VIA ARARAT)

Basin 11 Hydraulics (Proposed Condition)

In the existing condition, the storm water flows along the westerly side of Via Ararat Drive, see the picture below. There is a 6-inch AC dike along this side of the road that directs the runoff into a spillway located north of the driveway for the property of APN 127-271-44, see the 200-scale Drainage Map attached.

From Figure 3-6, located on the following page, a depth of 0.48 feet is obtained. Therefore, an 8-inch AC dike “Type B” G-5 per RSDs is proposed to handle a 100-year storm.

Also from Figure 3-6, the gutter flow velocity is 6.2 ft/s. Therefore, from Table 200-1.6.1(A) in the Appendix, the rock size for the outlet will be No. 2 Backing Class rip rap, 1.0’ thick.



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

21.2 CFS (PROPOSED)

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

Gutter and Roadway Discharge - Velocity Chart

FIGURE **3-6**

PROPOSED { Q = 21.2 cfs, V = 6.2 fps, D = 0.48 ft }

EXIST. { Q = 20.9, V = 6.1 fps, D = 0.47 ft }

BASIN 11 (VIA ARARAT)

BASIN 12
VIA ARARAT DRIVE

Basin 12 Hydrology (Existing Condition)

Q_{100} = CIA Rational Method

C-Value:

$C_{SOIL\ C}$ = 0.36 (see Table 3-1, Appendix)

Intensity Calculations:

I = $7.44\ P_6\ T_C^{-0.645}$ (see Figure 3-1 on the following pages)

Where

$T_C = T_i + T_{t1} + T_{t2}$

And:

T_i = 6.4 minutes (see Table 3-2 on following pages).
T_{t1} = 0.3 minutes (see Figure 3-4 on following pages).

T_{t2} is the time it takes the runoff to travel along the gutter flow line. The time it takes the water to travel from the initial point of the gutter flow to the concentration point is calculated using the velocity and the distance traveled. The velocity is calculated using Figure 3-6 of the San Diego hydrology manual and the distance traveled is obtained from the Drainage Map. The Q_{100} used for Figure 3-6 is assumed and then divided by two to average the amount of runoff in the gutter. This assumption is later checked for accuracy. See below for the calculation:

T_{t2} = Distance Traveled / Velocity

Where:

Velocity (V) = 3.5 fps (see Figure 3-6 on following pages)

Distance Traveled = 100 feet (see Drainage Maps attached)

Then:

T_{t2} = 100 / 3 = 29 seconds = 0.5 minutes

Therefore:

T_C = 6.4 + 0.3 + 0.5 = 7.2 minutes

Also,

P_6 = 3.5 inches (see Rainfall Isopluvial, Appendix)

Now:

I = $7.44\ (3.5)\ (7.2)^{-0.645}$ (also see Figure 3-1 on following pages)

Then

I = 7.3 in/hr

Area:

A = 0.2 acres (see Drainage Maps attached)

Flow Rate:

Q_{100} = CIA Rational Method

Q_{100} = 0.36 * 7.3 * 0.2

Then

$\boxed{\mathbf{Q_{100} = 0.5\ cfs}}$

* The assumption for the Q_{100} for the velocity calculation is found to be correct with accepatable tolerance.

Basin 12 Hydrology (Proposed Condition):

The purpose for the calculations below is to account for the additional paving due to the widening of Via Ararat Drive.

$Q_{100} = C_{weighted}\ I\ A$ Rational Method

Updated Area:

$A_{total} = A_{Exist} + A_{Asph}$

Where:

New Pavement Area (A_{Asph}) = 0.01 acres (see Preliminary Grading Plan, Appendix)

Then

$\mathbf{A_{total} = 0.2 + 0.01 = 0.21}$ **acres**

C-Value:

$C_{Weighted} = [(C_{Exist} * A_{Exist}) / A_{total}] + [(C_{Asph} * A_{Asph}) / A_{total}]$

Where:

New Pavement (C_{Asph}) = 0.95 (see Table II, Appendix)

$C_{Weighted} = [(0.36)(0.2) / 0.21] + [(0.95)(0.01) / 0.21]$

Then:

$\mathbf{C_{Weighted} = 0.39}$

Intensity:

I = 7.3 in/hr

Flow Rate:

$Q_{100} = C_{weighted}\ I\ A$ Rational Method

$Q_{100} = 0.39 * 7.3 * 0.21$

Then

$\boxed{\mathbf{Q_{100} = 0.6\ cfs}}$

<u>**Basin 12 Comparison**</u>

Q_{100} Existing = 0.5 cfs
Q_{100} Proposed = 0.6 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.

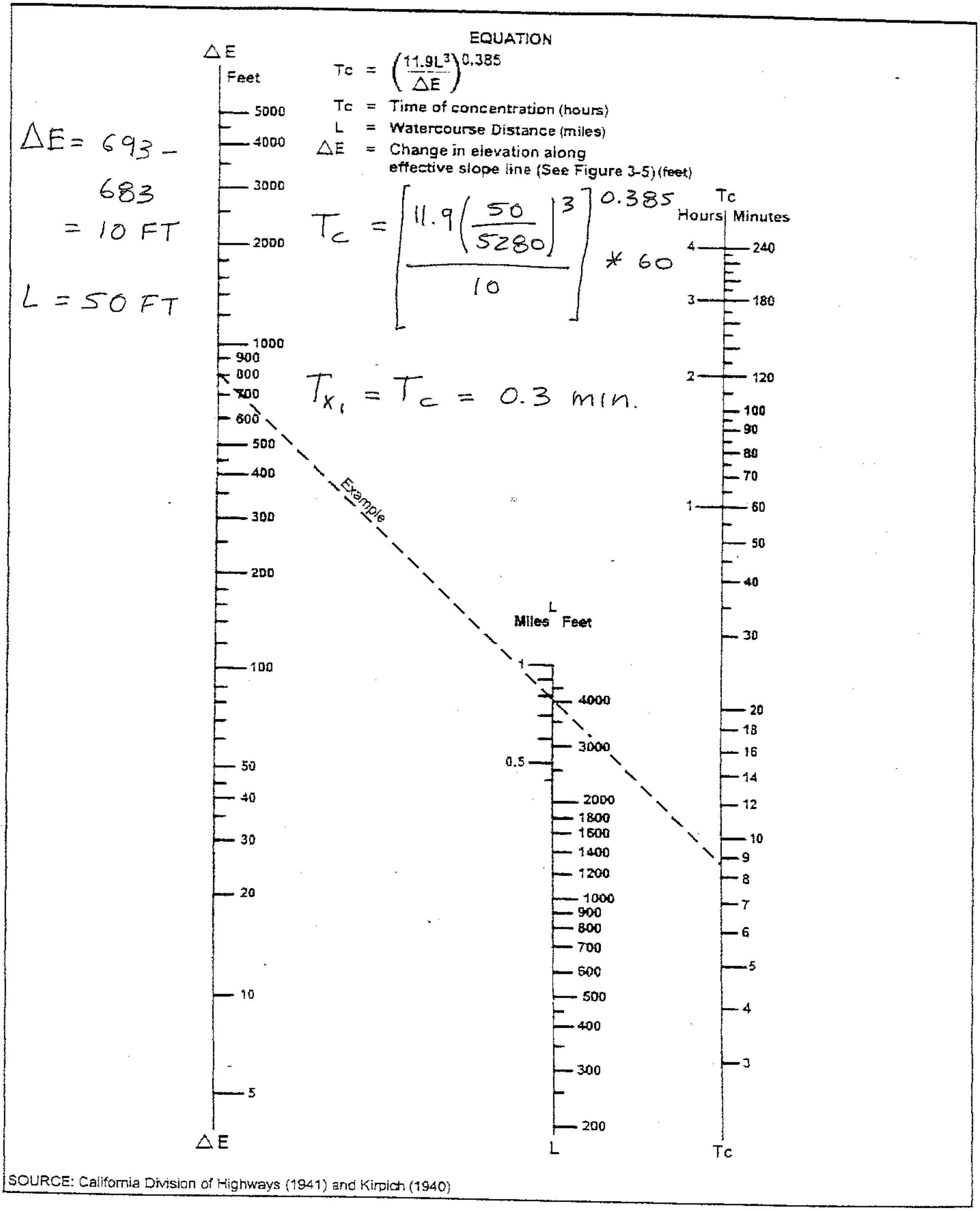
Table 3-2

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

Element*	DU/ 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

BASIN 12
(VIA ARARAT)



EQUATION

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

Tc = Time of concentration (hours)

L = Watercourse Distance (miles)

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

$\Delta E = 693 - 683 = 10$ FT

$L = 50$ FT

$$T_c = \left[\frac{11.9\left(\frac{50}{5280}\right)^3}{10}\right]^{0.385} * 60$$

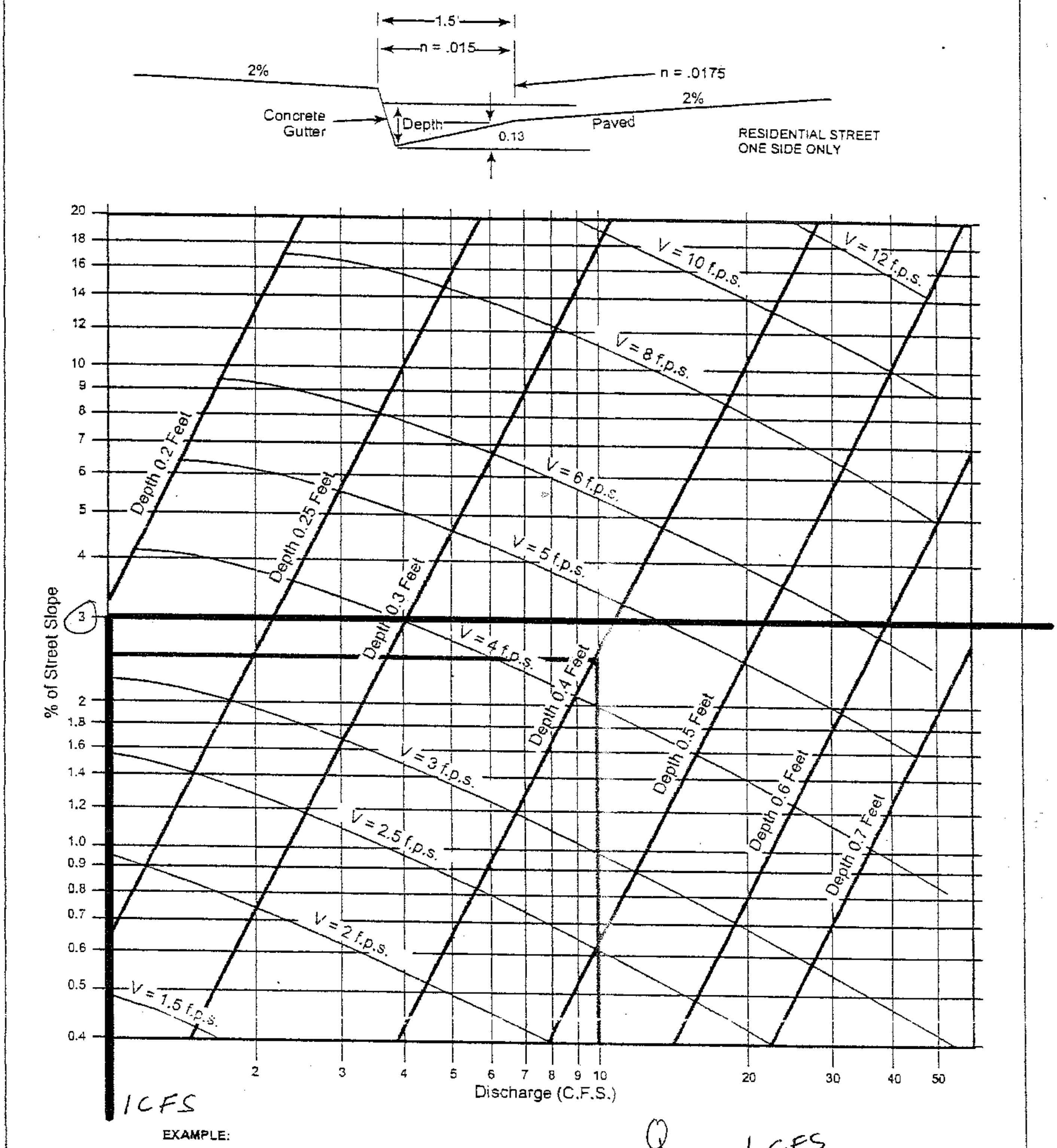
$T_{x_1} = T_c = 0.3$ min.

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

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

FIGURE 3-4

BASIN 12 (VIA ARARAT)



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

$\frac{Q}{2} = 1$ CFS
(Q assumed = 2CFS)

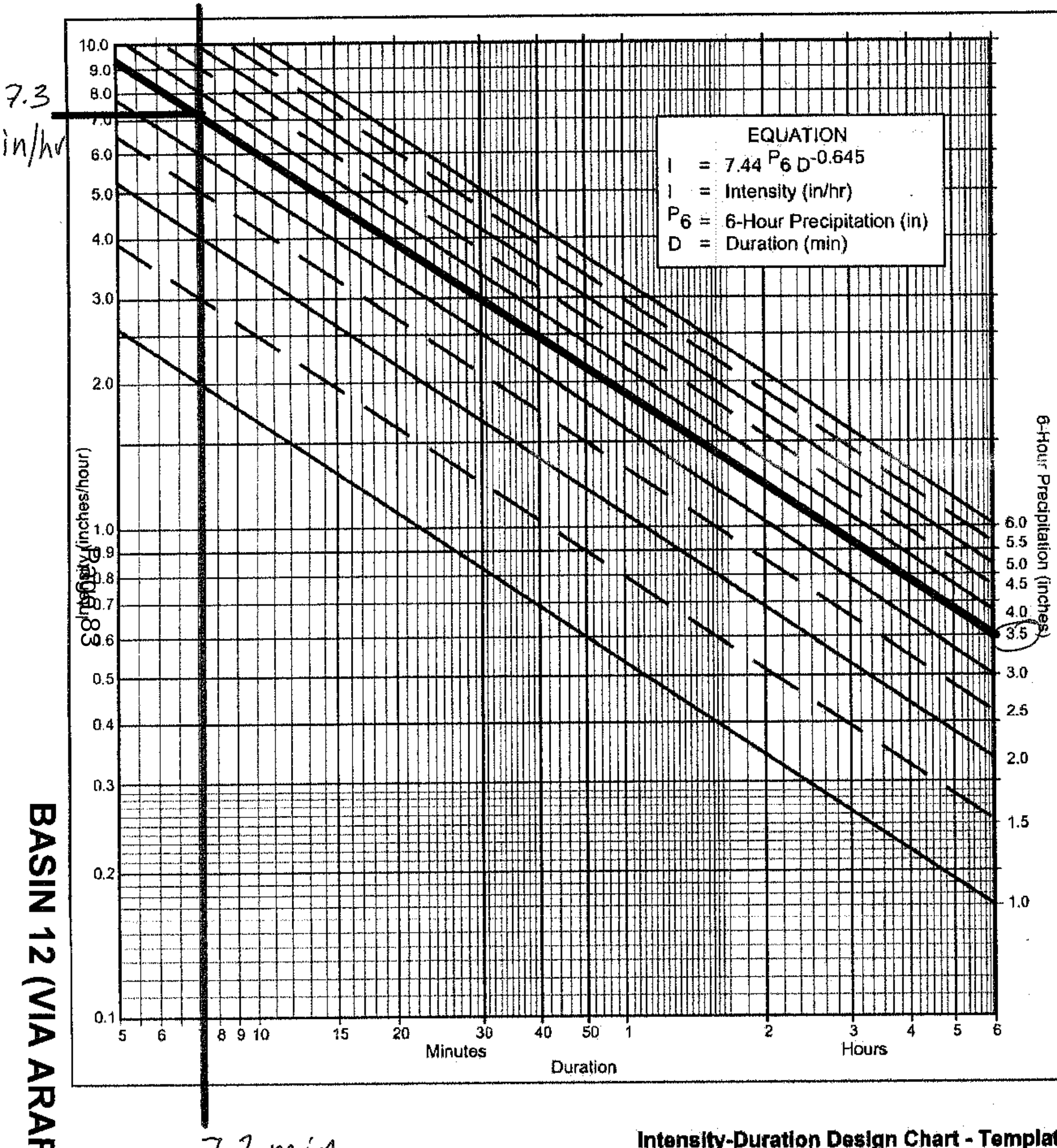
SOURCE: San Diego County Department of Special District Services Design Manual

FIGURE 3-6

Gutter and Roadway Discharge - Velocity Chart

V = 3.5 fps

BASIN 12 (VIA ARARAT)



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 = 3.5 in., P_{24} = 6.0, $\frac{P_6}{P_{24}}$ = 58 %(2)

(c) Adjusted $P_6^{(2)}$ = 3.5 in.

(d) t_x = 7.2 min.

(e) I = 7.3 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

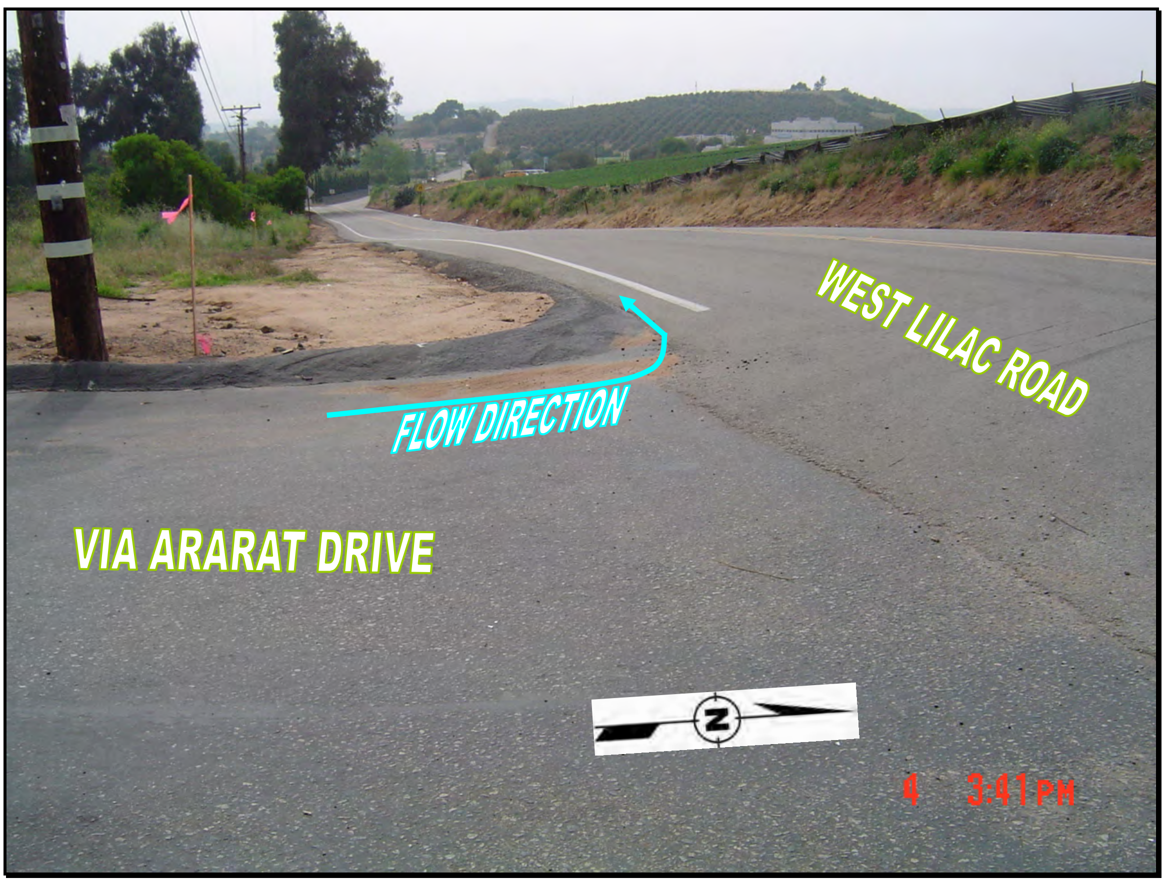
3-1

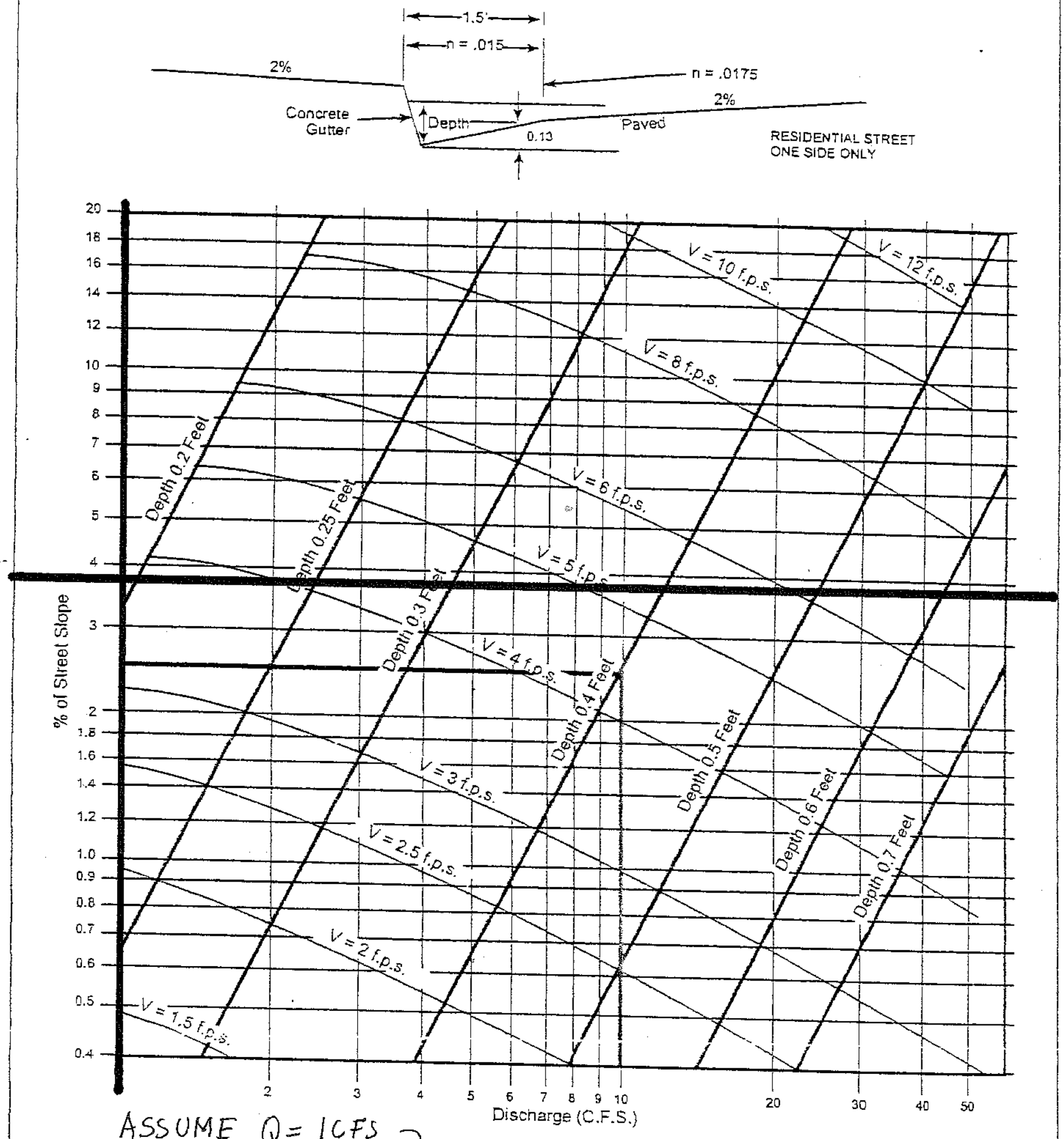
BASIN 12 (VIA ARARAT)

Basin 12 Hydraulics (Proposed Condition)

In the existing condition, the storm water from this basin sheet flows across Via Ararat Drive to the westerly side of the road. There is a 6-inch AC dike along this side of the road that directs the runoff to West Lilac Road, see the picture below.

From Figure 3-6, located on the following page, a depth of less than 0.2 feet is obtained in the gutter. Therefore, a 6-inch dike "Type A" G-5 per RSDs is adequate to handle a 100-year storm.





ASSUME Q = 1CFS → Q_{PEAK} = 0.6, 1 > 0.6

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

ASSUMPTION IS OK.

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

PROPOSED:
Q = 0.6 cfs
V = 3.8 f.p.s
D < 0.2 FT

Gutter and Roadway Discharge - Velocity Chart

EXISTING:
Q = 0.5 cfs
V = 3.8 f.p.s.
D < 0.2 ft

FIGURE 3-6

BASIN 12 (VIA ARARAT)

BASIN 13
VIA ARARAT DRIVE

Basin 13 Hydrology (Existing Condition)

Q_{100} = CIA   Rational Method

C-Value:

$\mathbf{C_{SOIL\ C}}$ **= 0.36**   (see Table 3-1, Appendix)

Intensity Calculations:

$I = 7.44\ P_6\ T_C^{-0.645}$ (see Figure 3-1 on the following pages)

Where

$T_C = T_i + T_t$

And:

T_i = 9.5 minutes   (see Table 3-2 on following pages).

T_t = 2.6 minutes   (see Figure 3-4 on following pages).

Then:

T_C = 9.5 + 2.6 = 12.1 minutes

Also,

P_6 = 3.5 inches   (see Rainfall Isopluvial, Appendix)

Now:

$I = 7.44\ (3.5)\ (12.1)^{-0.645}$ (also see Figure 3-1 on following pages)

Then

I = 5.2 in/hr

Area:

A = 0.8 acres   (see Drainage Maps attached)

Flow Rate:

Q_{100} = CIA   Rational Method

Q_{100} = 0.36 * 5.2 * 0.8

Then

$\boxed{\mathbf{Q_{100} = 1.5\ cfs}}$

Basin 13 Hydrology (Proposed Condition)

The flow rate for Basin 13 does not change from the existing conditions since the Basin is not on Via Ararat Drive and therefore remains unchanged (see Drainage Map attached).

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.

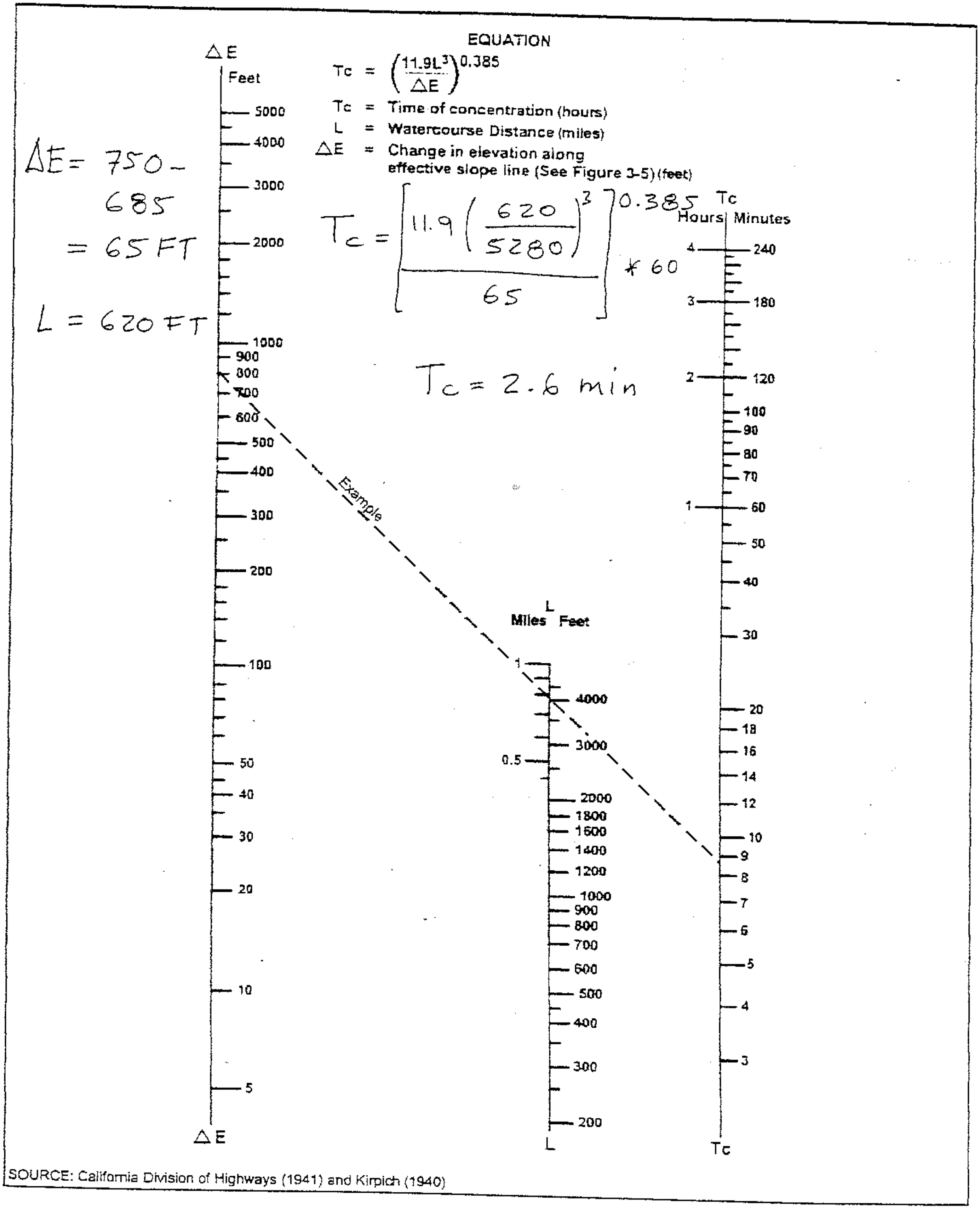
Table 3-2

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 13
(VIA ARARAT)

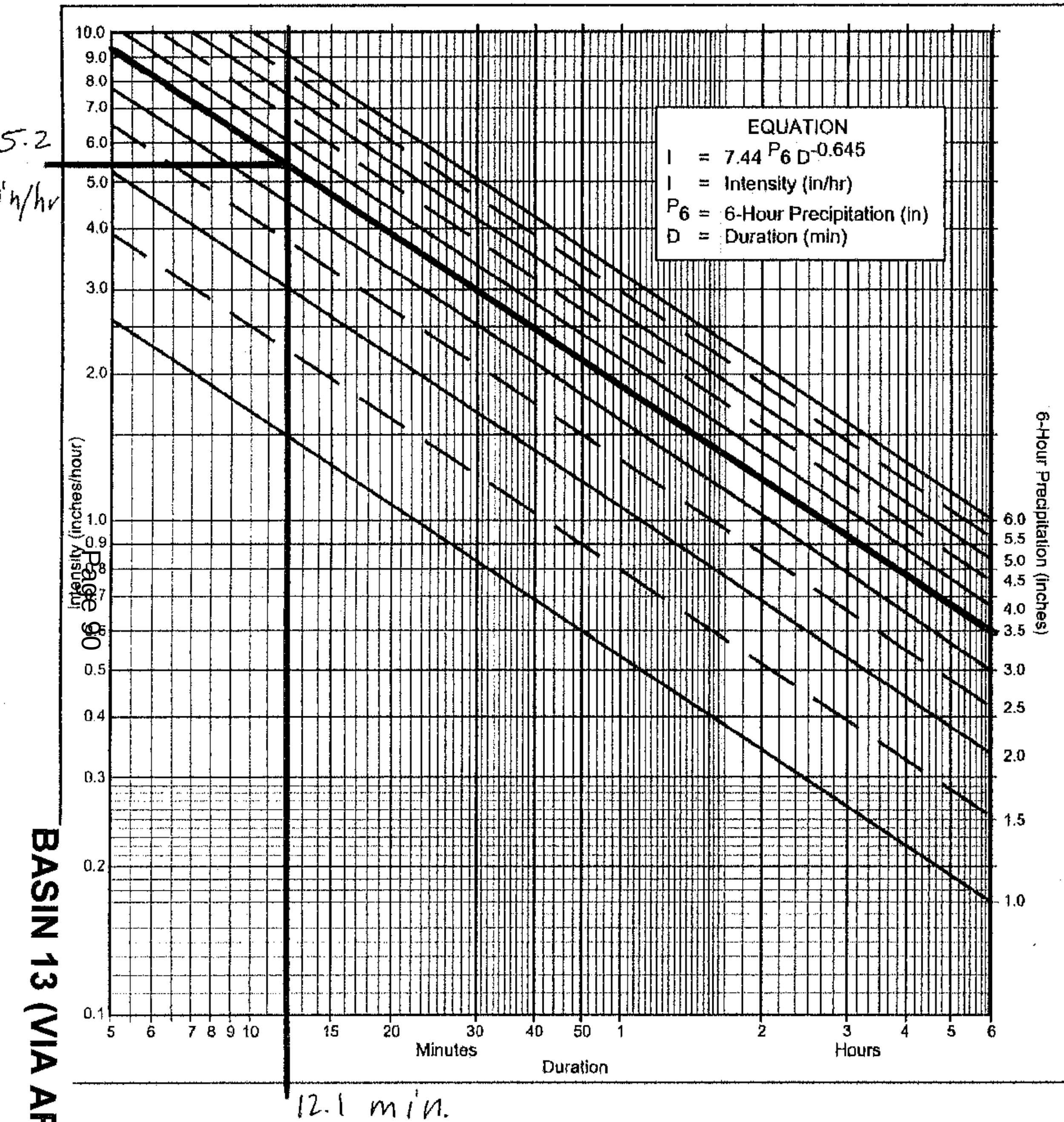


Nomograph for Determination of
Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds

FIGURE
3-4

BASIN 13
(VIA ARARAT)

BASIN 13 (VIA ARARAT)



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 = 3.5 in., P_{24} = 6.0, $\frac{P_6}{P_{24}}$ = 58 %(2)

(c) Adjusted $P_6^{(2)}$ = 3.5 in.

(d) t_x = 12.1 min.

(e) I = 5.2 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

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

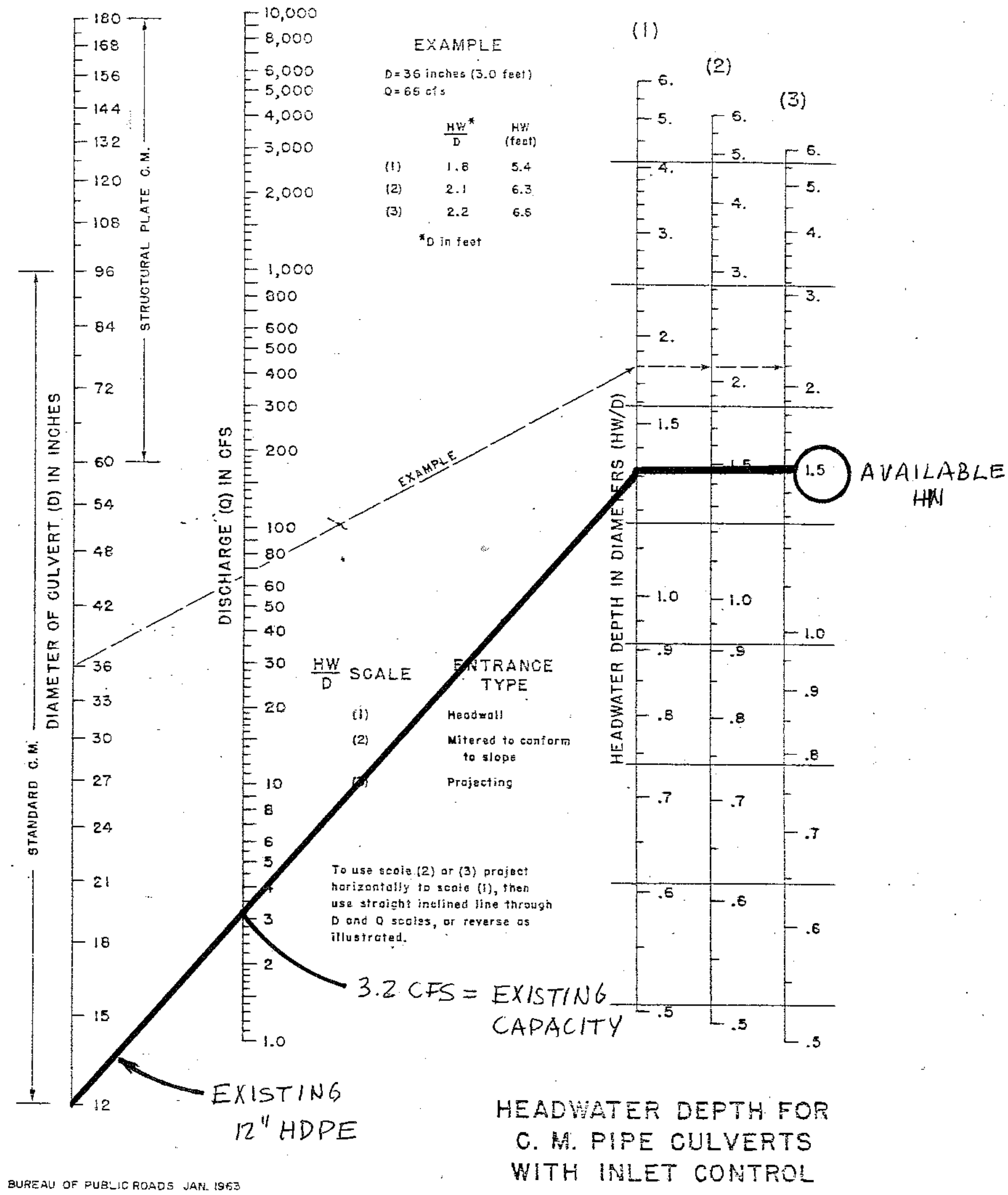
BASIN 15
(AQUEDUCT ROAD)

Basin 13 Hydraulics (Proposed Condition)

The flow from Basin 13 is directed towards an existing 12” HDPE that crosses under Via Ararat Drive, see the picture below. The capacity of said 12” HDPE with a headwater depth of 1.5’ is 3.2 cfs per the following Inlet Control Chart. The peak discharge is 1.5 cfs. Therefore, the existing 12” HDPE is adequate in the 100-year storm.

The culvert has a flow velocity ($V = Q_{100}$ / A = 1.5 cfs / 0.78 ft^2) of 1.9 ft/s. Therefore, from Table 200-1.6.1(A) in the Appendix, the rock size for the outlet will be No. 3 Backing Class rip rap, 0.5’ thick.

CHART 5



EXISTING CAPACITY = 3.2 CFS

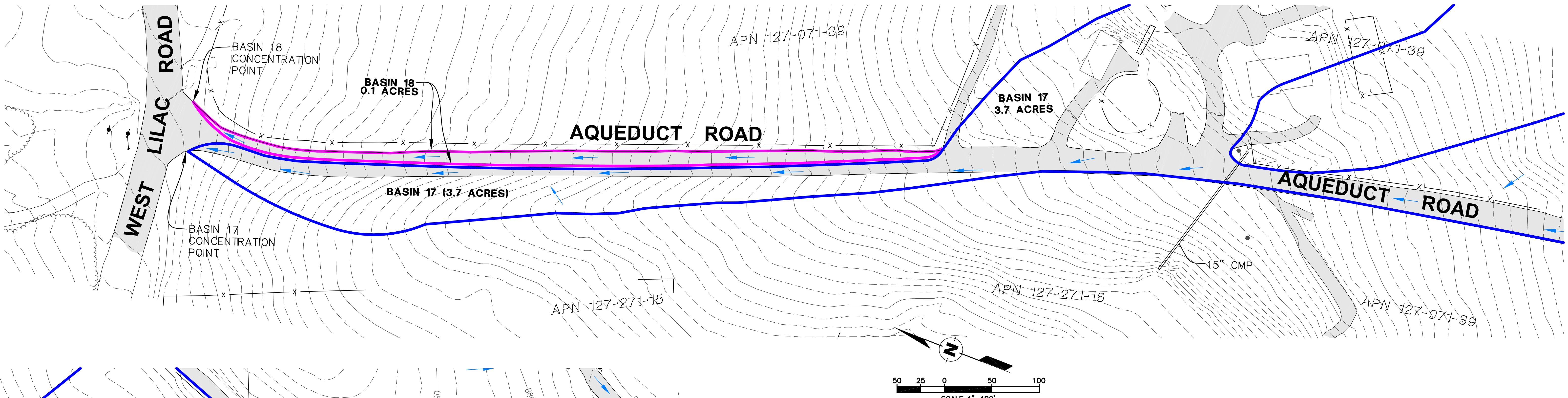
EXISTING Q_{PEAK} = 1.5 CFS

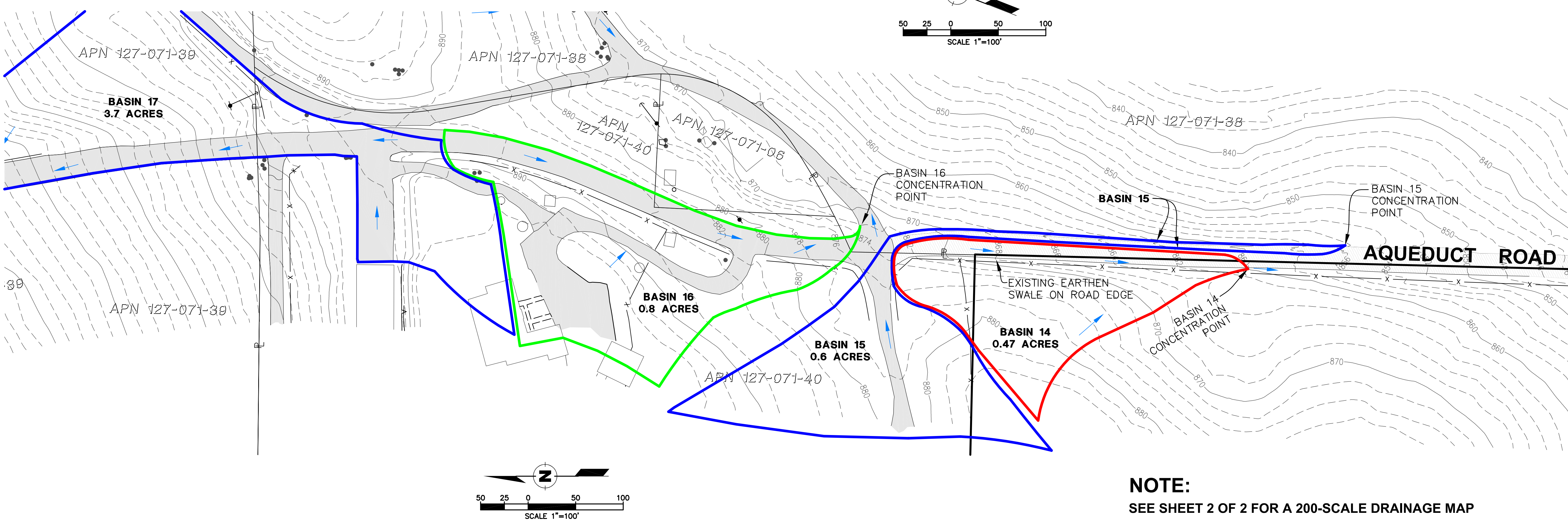
$\boxed{3.2 > 1.5}$ ∴ EXISTING PIPE IS ADEQUATE.

BASIN 13 (VIA ARARAT)

AQUEDUCT ROAD

DRAINAGE MAP FOR AQUEDUCT ROAD (EXISTING CONDITIONS)

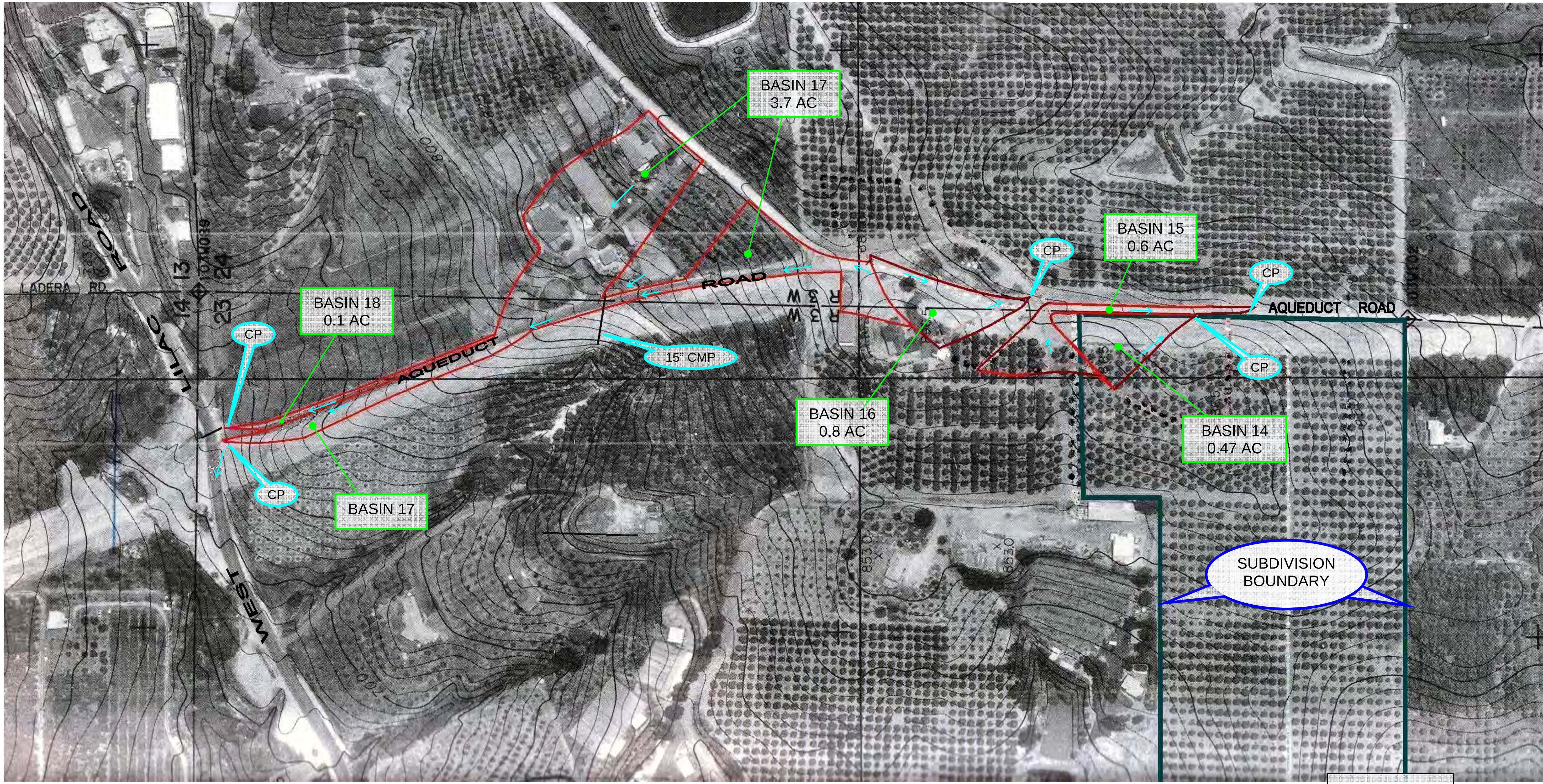




NOTE:

SEE SHEET 2 OF 2 FOR A 200-SCALE DRAINAGE MAP

DRAINAGE MAP FOR AQUEDUCT ROAD
(EXISTING CONDITIONS)



MAP LEGEND:

CONCENTRATION POINT CP

BASIN BOUNDARIES

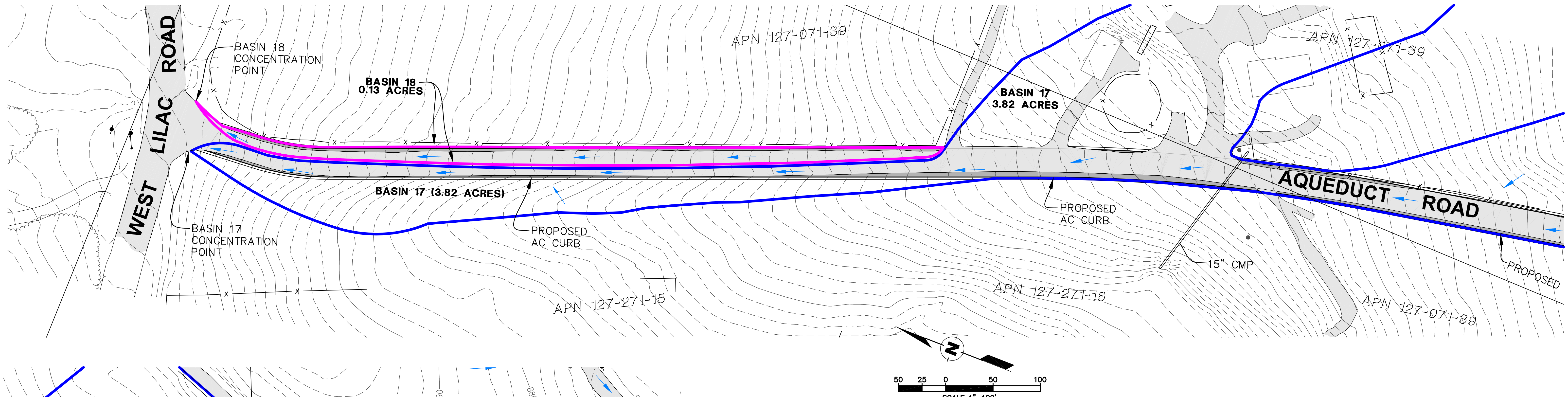
FLOW DIRECTION

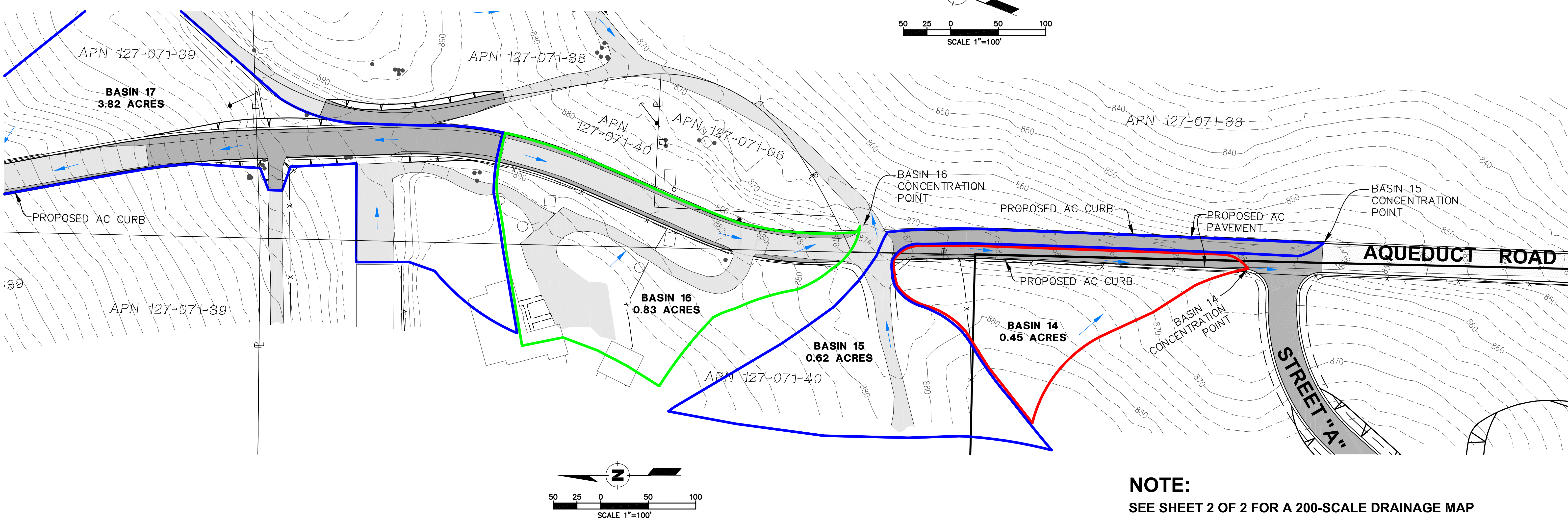
NOTE: SEE SHEET 1 OF 2 FOR A 100-SCALE DRAINAGE MAP

N

1" = 200'
SAN DIEGO
COUNTY TOPO
410-1719

DRAINAGE MAP FOR AQUEDUCT ROAD (PROPOSED CONDITIONS)





NOTE:

SEE SHEET 2 OF 2 FOR A 200-SCALE DRAINAGE MAP

BASIN 14
AQUEDUCT ROAD

AQUEDUCT ROAD

<u>Basin 14 Hydrology (Existing Condition)</u>

Q_{100} = CIA — Rational Method

C-Value:

$C_{SOIL\ C}$ = 0.36 — (see Table 3-1, Appendix)

Intensity Calculations:

I = $7.44\ P_6\ T_C^{-0.645}$ — (see Figure 3-1 on the following pages)

Where:

T_C = $T_i + T_t$

And:

T_i = 6.4 minutes — (see Table 3-2 on following pages).

T_t = 1.2 minutes — (see Figure 3-4 on following pages).

Then:

T_C = 6.4 + 1.2 = 7.6 minutes

Also:

P_6 = 3.5 inches — (see Rainfall Isopluvial, Appendix)

Now:

I = $7.44\ (3.5)\ (7.6)^{-0.645}$ — (also see Figure 3-1 on following pages)

Then:

I = 7.0 in/hr

Area:

A = 0.47 acres — (see Drainage Maps attached)

Flow Rate:

Q_{100} = CIA — Rational Method

Q_{100} = 0.36 * 7.0 * 0.47

Then

$\boxed{\mathbf{Q_{100} = 1.2\ cfs}}$

Basin 14 Hydrology (Proposed Condition)

The purpose for the calculations below is to account for the additional paving due to the widening of Aqueduct Road.

Q_{100} = $C_{weighted}$ I A   Rational Method

Updated Area:

$A_{total} = A_{SOIL\ C} + A_{Asph}$

Where:

$A_{SOIL\ C}$ = 0.37 acres

New Pavement Area (A_{Asph}) = 0.08 acres   (see Preliminary Grading Plan, Appendix)

Then

A_{total} = 0.37 + 0.08 = 0.45 acres   (see Drainage Maps attached)

C-Value:

$C_{Weighted} = [(C_{SOIL\ C} * A_{SOIL\ C}) / A_{total}] + [(C_{Asph} * A_{Asph}) / A_{total}]$

Where:

$C_{SOIL\ C}$ = 0.36   (see Table 3-1, Appendix)

New Pavement (C_{Asph}) = 0.95   (see Table II, Appendix)

Then:

$C_{Weighted} = [(0.36)(0.37) / 0.45] + [(0.95)(0.08) / 0.45]$

$C_{Weighted}$ = 0.46

Intensity Calculations:

I = 7.0 in/hr

Flow Rate:

Q_{100} = CIA   Rational Method

$Q_{100} = 0.46 * 7.0 * 0.45$

Then

$\boxed{Q_{100} = 1.5 \text{ cfs}}$

Basin 14 Comparison

Q_{100} Existing = 1.2 cfs

Q_{100} Proposed = 1.5 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 14
(AQUEDUCT ROAD)**

EQUATION

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

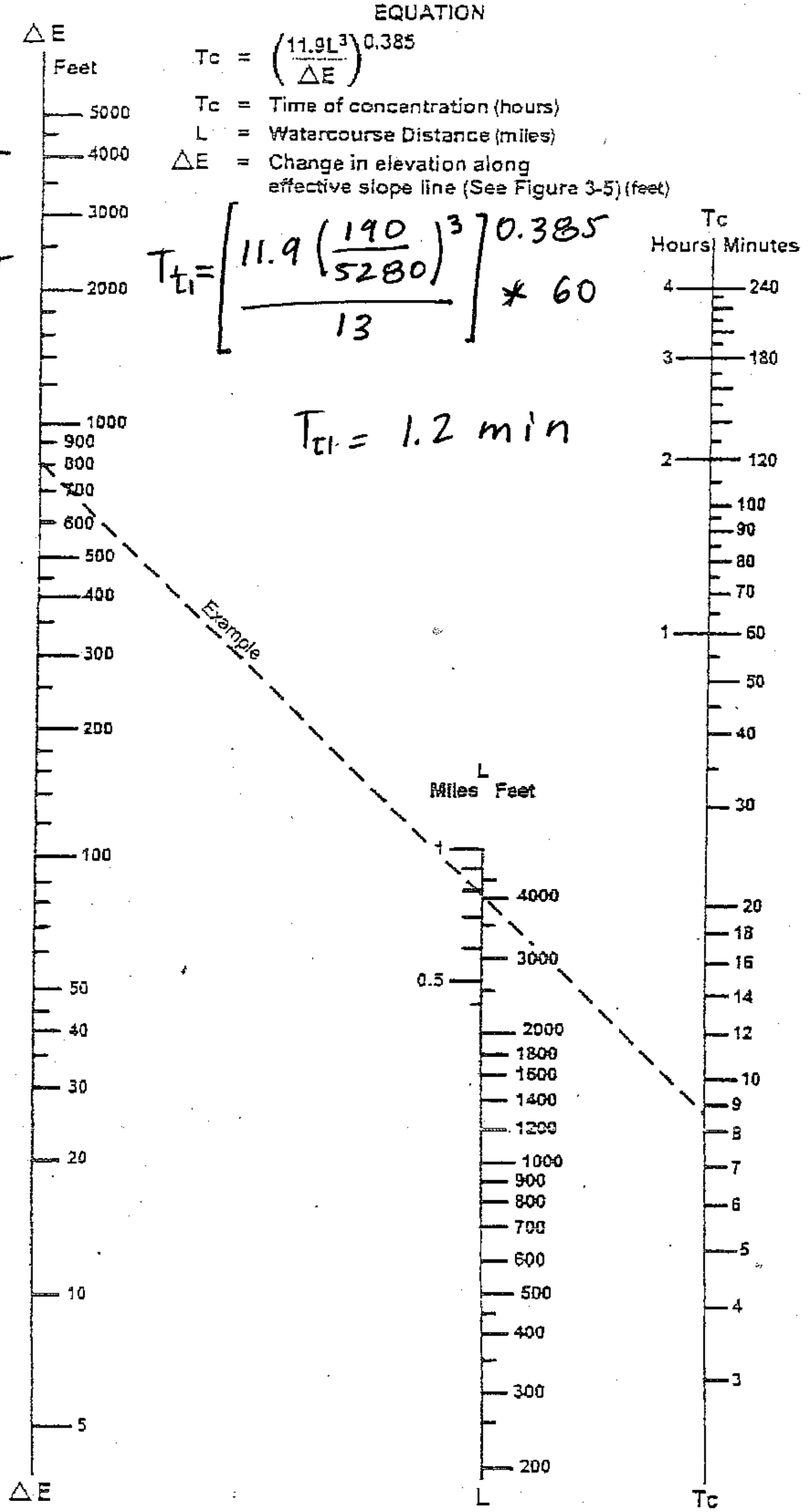
T_c = Time of concentration (hours)
L = Watercourse Distance (miles)
ΔE = Change in elevation along effective slope line (See Figure 3-5) (feet)

$\Delta E = 873 - 860 = 13$ FT

$L = 190$

$$T_{t_1} = \left[\frac{11.9\left(\frac{190}{5280}\right)^3}{13}\right]^{0.385} * 60$$

$T_{t1} = 1.2$ min



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

FIGURE 3-4

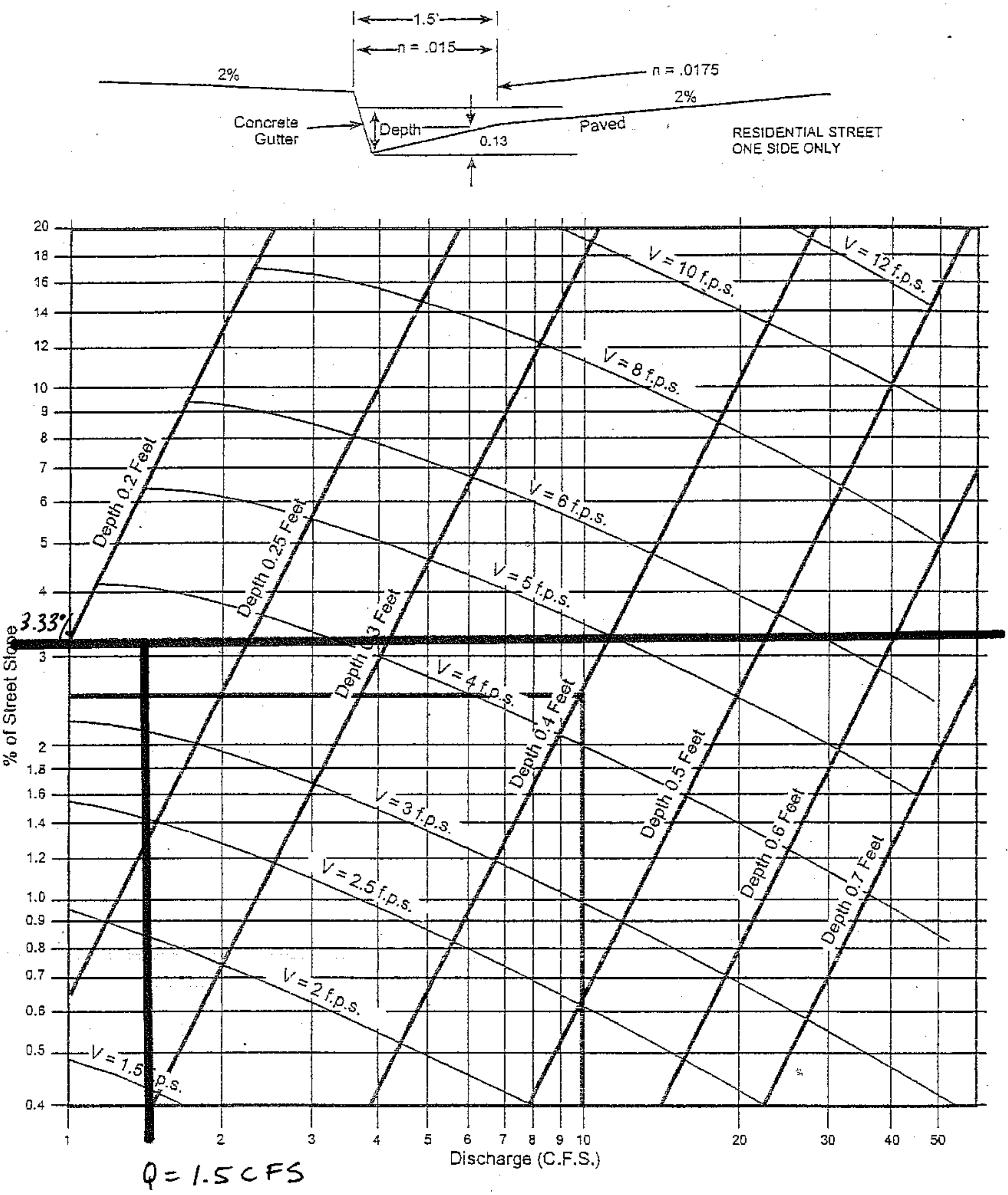
Nomograph for Determination of
Time of Concentration (Tc) or Travel Time (Tt) for Natural Watersheds

BASIN 14
(AQUEDUCT ROAD)

Basin 14 Hydraulics (Proposed Condition)

In the existing condition, the storm water from this basin sheet flows southerly along the westerly edge of the dirt road (Aqueduct Road). See the picture below and the 100-scale Drainage Map.

From Figure 3-6, located on the following page, a depth of 0.22 feet is obtained from the westerly edge of the road. Therefore, a 6-inch dike "Type A" G-5 per RSDs is adequate to handle 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

3-6

Gutter and Roadway Discharge - Velocity Chart

V = 3.6 fps
D = 0.22 ft

BASIN 14
(AQUEDUCT ROAD)

BASIN 15
AQUEDUCT ROAD

Basin 15 Hydrology (Existing Condition)

	Q_{100}	=	CIA			Rational Method
C-Value:						
	$\mathbf{C_{SOIL\ C}}$	**=**	**0.36**			(see Table 3-1, Appendix)
Intensity Calculations:						
	I	=	$7.44\ P_6\ T_C^{-0.645}$			(see Figure 3-1, Appendix)
Where						
	T_C	=	$T_i + T_t$			
And:						
	T_i	=	9.5	minutes		(see Table 3-2 on following pages).
	T_t	=	3.7	minutes		(see Figure 3-4 on following pages).
Then:						
	T_C	=	9.5 + 3.7	=	13.2	minutes
Also,						
	P_6	=	3.5	inches		(see Rainfall Isopluvial, Appendix)
	I	=	$7.44\ (3.5)\ (13.2)^{-0.645}$			
Then						
	I	**=**	**4.9**	**in/hr**		(also see Figure 3-1 on following pages)
Area:						
	A	**=**	**0.60**	**acres**		
Flow Rate:						
	Q_{100}	=	CIA			Rational Method
	Q_{100}	=	0.36 * 4.9 * 0.60			
Then						
	$\mathbf{Q_{100}}$	**=**	**1.1**	**cfs**		

Basin 15 Hydrology (Proposed Condition)

The purpose for the calculations below is to account for the additional paving due to the widening of Aqueduct Road.

Q_{100} = $C_{weighted}$ I A   Rational Method

Updated Area:

A_{total} = $A_{SOIL\ C} + A_{Asph}$

Where:

$A_{SOIL\ C}$ = 0.52 acres

New Pavement Area (A_{Asph}) = 0.10 acres (see Preliminary Grading Plan, Appendix)

Then

A_{total} = 0.52 + 0.10 = 0.62 acres (see Drainage Maps attached)

C-Value:

$C_{Weighted}$ = $[(C_{SOIL\ C} * A_{SOIL\ C}) / A_{total}] + [(C_{Asph} * A_{Asph}) / A_{total}]$

Where:

$C_{SOIL\ C}$ = 0.36 (see Table 3-1, Appendix)

New Pavement (C_{Asph}) = 0.95 (see Table II, Appendix)

Then:

$C_{Weighted}$ = [(0.36) (0.52) / 0.62] + [(0.95) (0.10) / 0.62]

$C_{Weighted}$ = 0.46

Intensity Calculations:

I = $7.44\ P_6\ T_C^{-0.645}$ (see Figure 3-1, Appendix)

Where

T_C = $T_i + T_{t1} + T_{t2}$

And:

T_i = 9.5 minutes (see Table 3-2 on following pages).

T_{t1} = 1.1 minutes (see Figure 3-4 on following pages).

T_{t2} is the time it takes the runoff to travel along the gutter flow line. The time it takes the water to travel from the initial point of the gutter flow to the concentration point is calculated using the velocity and the distance traveled. The velocity is calculated using Figure 3-6 of the San Diego hydrology manual and the distance traveled is obtained from the Drainage Map. The Q_{100} used for Figure 3-6 is assumed and then divided by two to average the amount of runoff in the gutter. This assumption is later checked for accuracy. See below for the calculation:

T_{t2} = Distance Traveled / Velocity

Where:

Velocity (V) = 3.5 fps (see Figure 3-6 on following pages)

Distance Traveled = 510 feet (see Drainage Maps attached)

Then:

T_{t2} = 510 / 3.5 = 146 seconds = 2.4 minutes

Therefore:

T_C = 9.5 + 1.1 + 2.4 = 13.0 minutes

Also,

P_6 = 3.5 inches (see Rainfall Isopluvial, Appendix)

Basin 15 cont…

now

$I = 7.44\ (3.5)\ (13.0)^{-0.645}$ (also see Figure 3-1 on following pages)

Then

$I = 5.0$ in/hr

Flow Rate:

$Q_{100} = CIA$ Rational Method

$Q_{100} = 0.46 * 5.0 * 0.8$

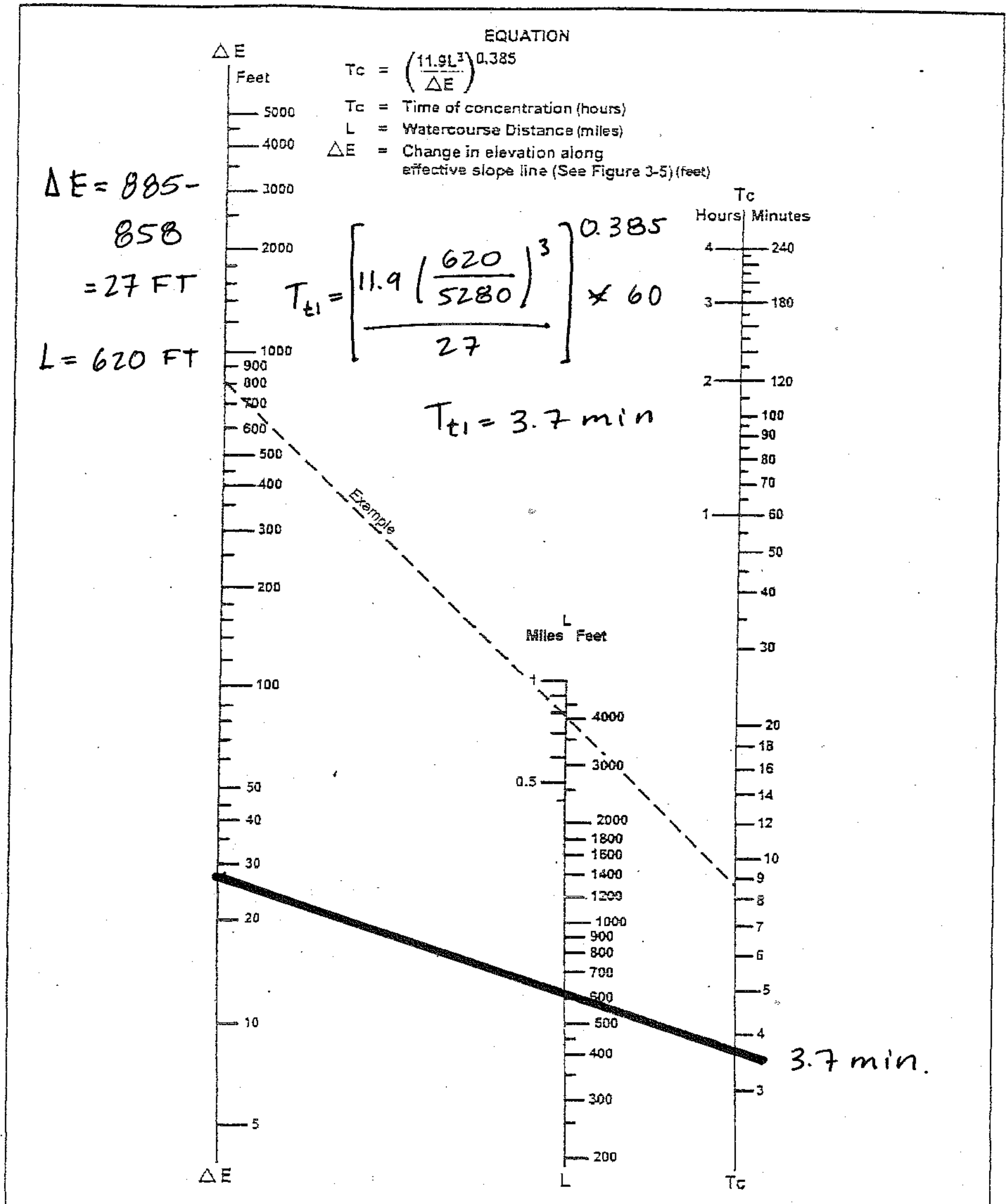
Then

$\boxed{\mathbf{Q_{100} = 1.4 \text{ cfs}}}$

* The assumption for the Q_{100} for the velocity calculation is found to be correct with accepatable tolerance.

<u>Basin 15 Comparison</u>

Q_{100} Existing	=	1.1	cfs
Q_{100} Proposed	=	1.4	cfs

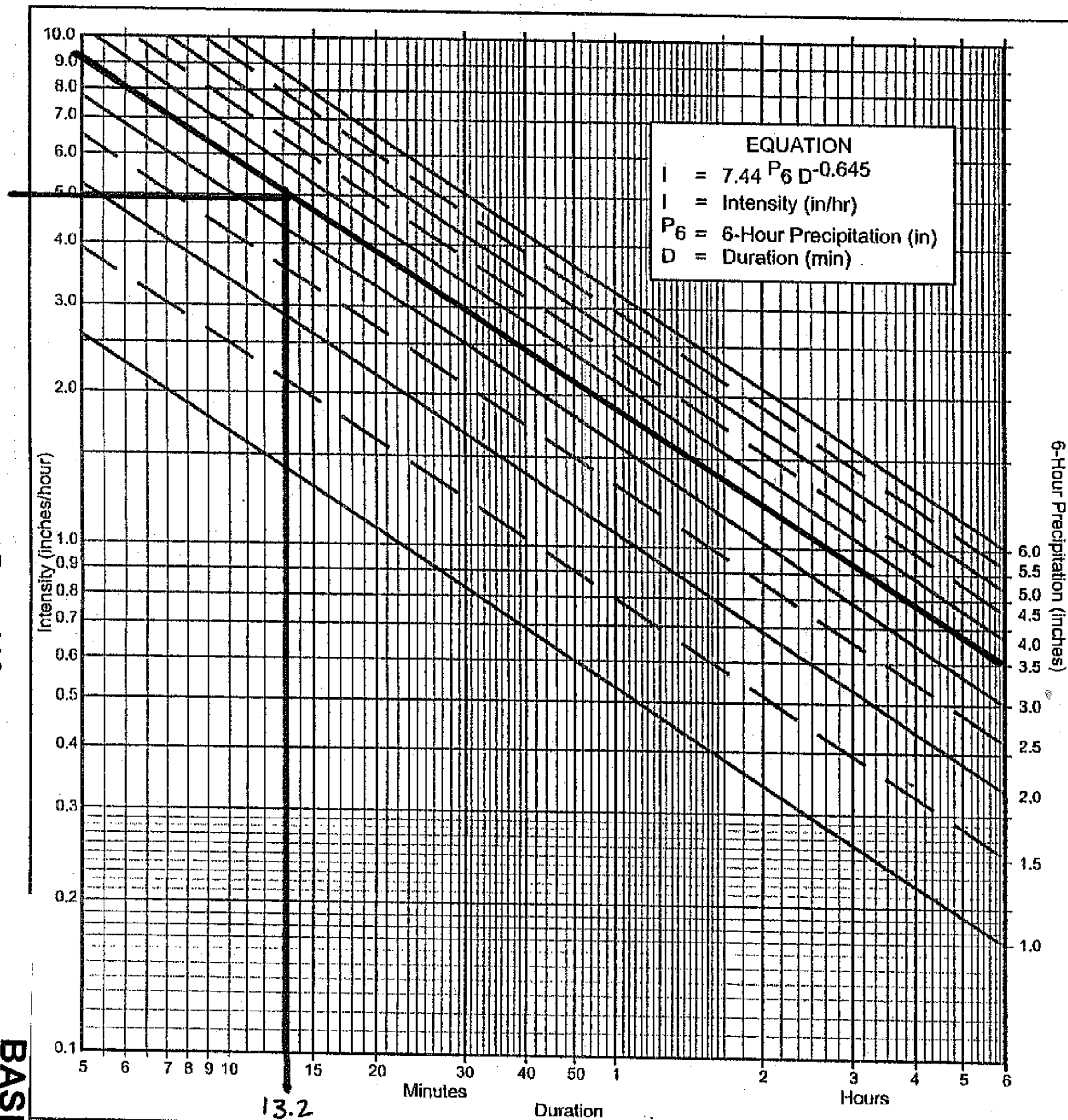


SOURCE: California Division of Highways (1941) and Kirpich (1940)

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

FIGURE
3-4

BASIN 15
Existing Condition
(AQUEDUCT ROAD)



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 = 3.5 in., P_{24} = 6.0 $\frac{P_6}{P_{24}}$ = 58 %(2)

(c) Adjusted $P_6^{(2)}$ = 3.5 in.

(d) t_x = 13.2 min. = 9.5 + 3.7

(e) I = 4.9 in./hr.

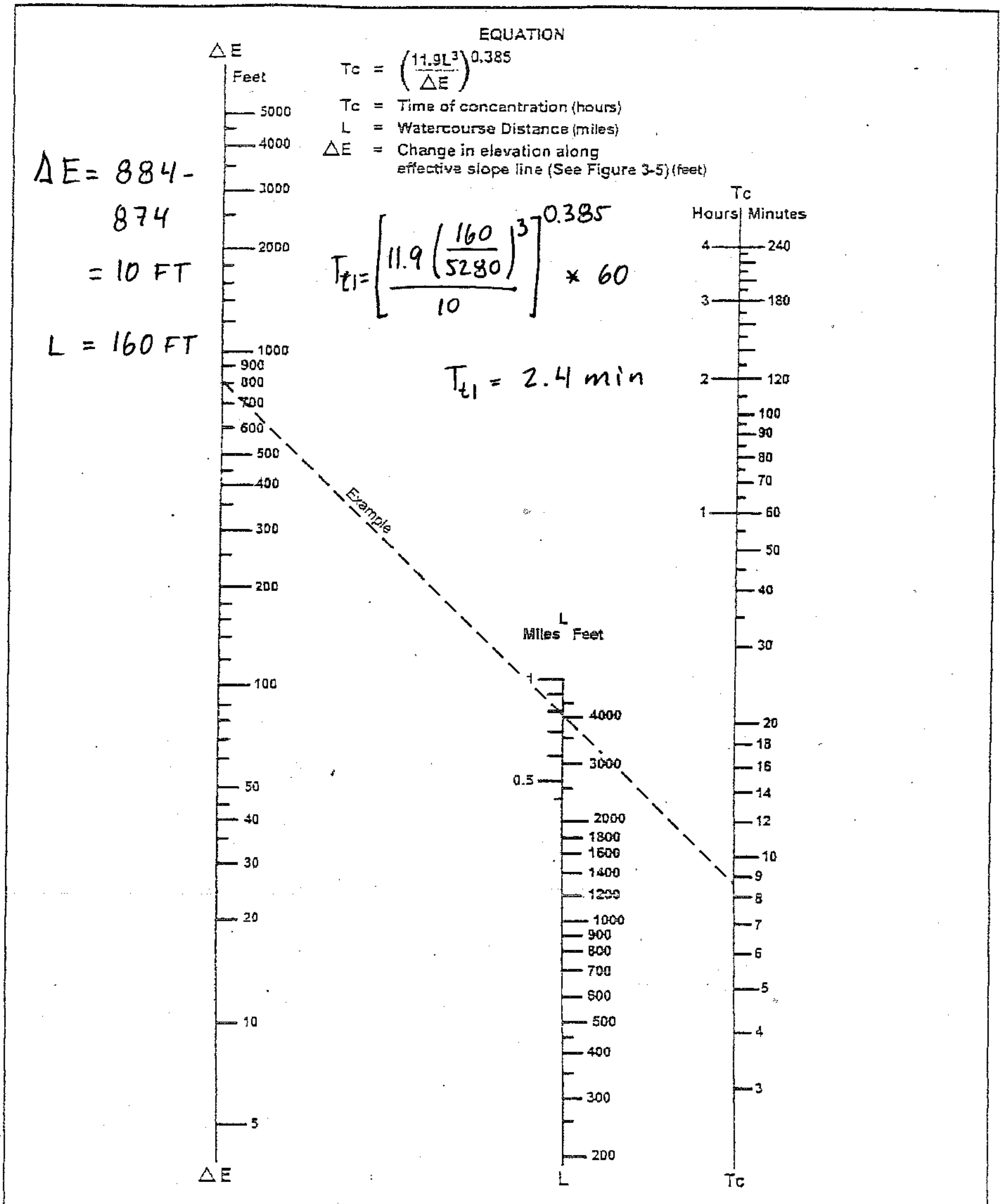
Note: This chart replaces the Intensity-Duration-Frequency curves used since 1965.

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**

BASIN 15
Existing Condition
(AQUEDUCT ROAD)



$\Delta E = 884 - 874 = 10$ FT

$L = 160$ FT

$$T_{t1} = \left[\frac{11.9\left(\frac{160}{5280}\right)^3}{10}\right]^{0.385} \times 60$$

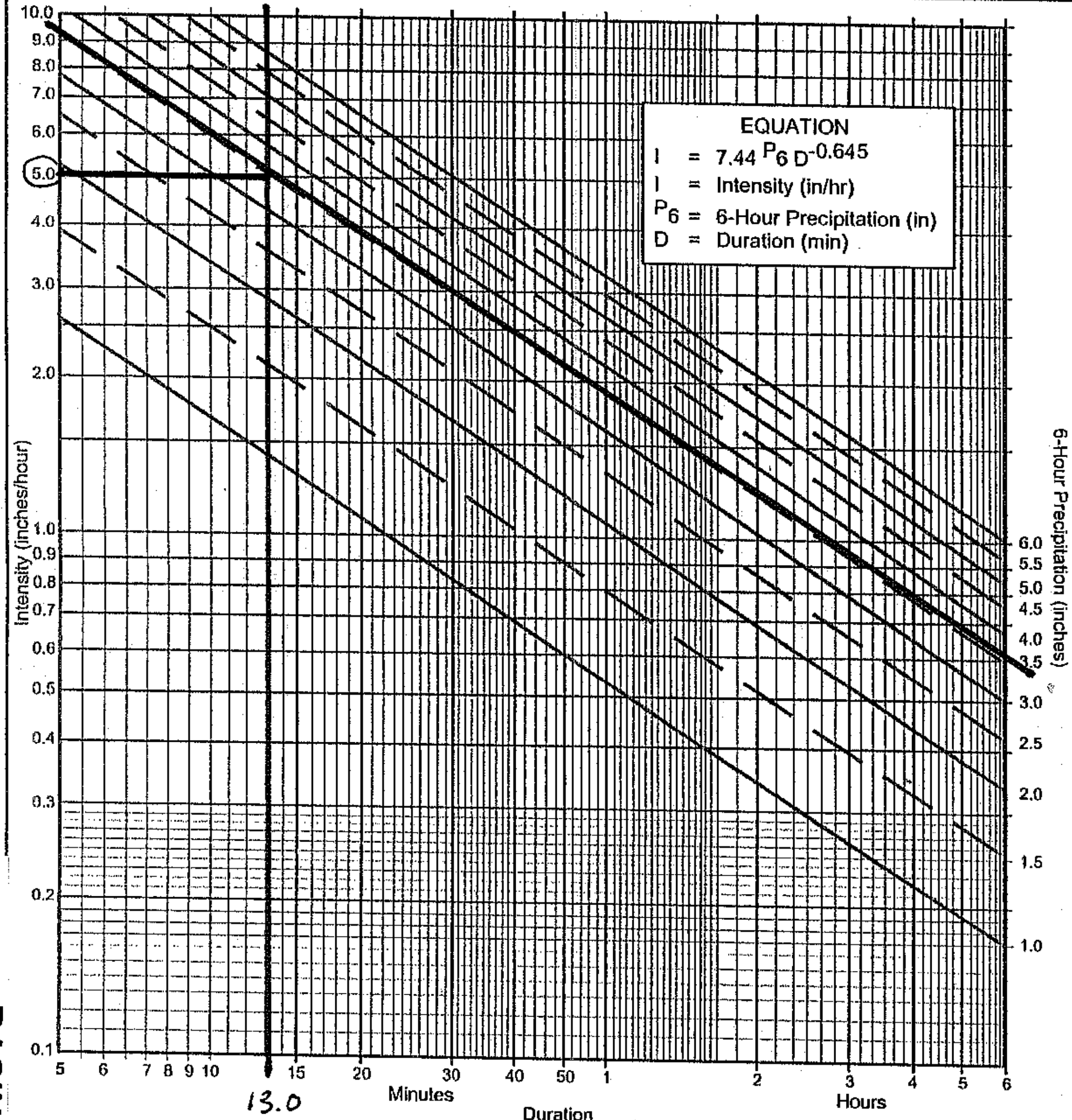
$T_{t1} = 2.4$ min

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

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

FIGURE **3-4**

BASIN 15
Proposed Condition
(AQUEDUCT ROAD)



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 = 3.5 in., P_{24} = 6.0, $\frac{P_6}{P_{24}}$ = 58 %(2)

(c) Adjusted $P_6^{(2)}$ = 3.5 in.

(d) t_x = 13.0 min. = 9.5 + 1.1 + 2.4

(e) I = 5.0 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

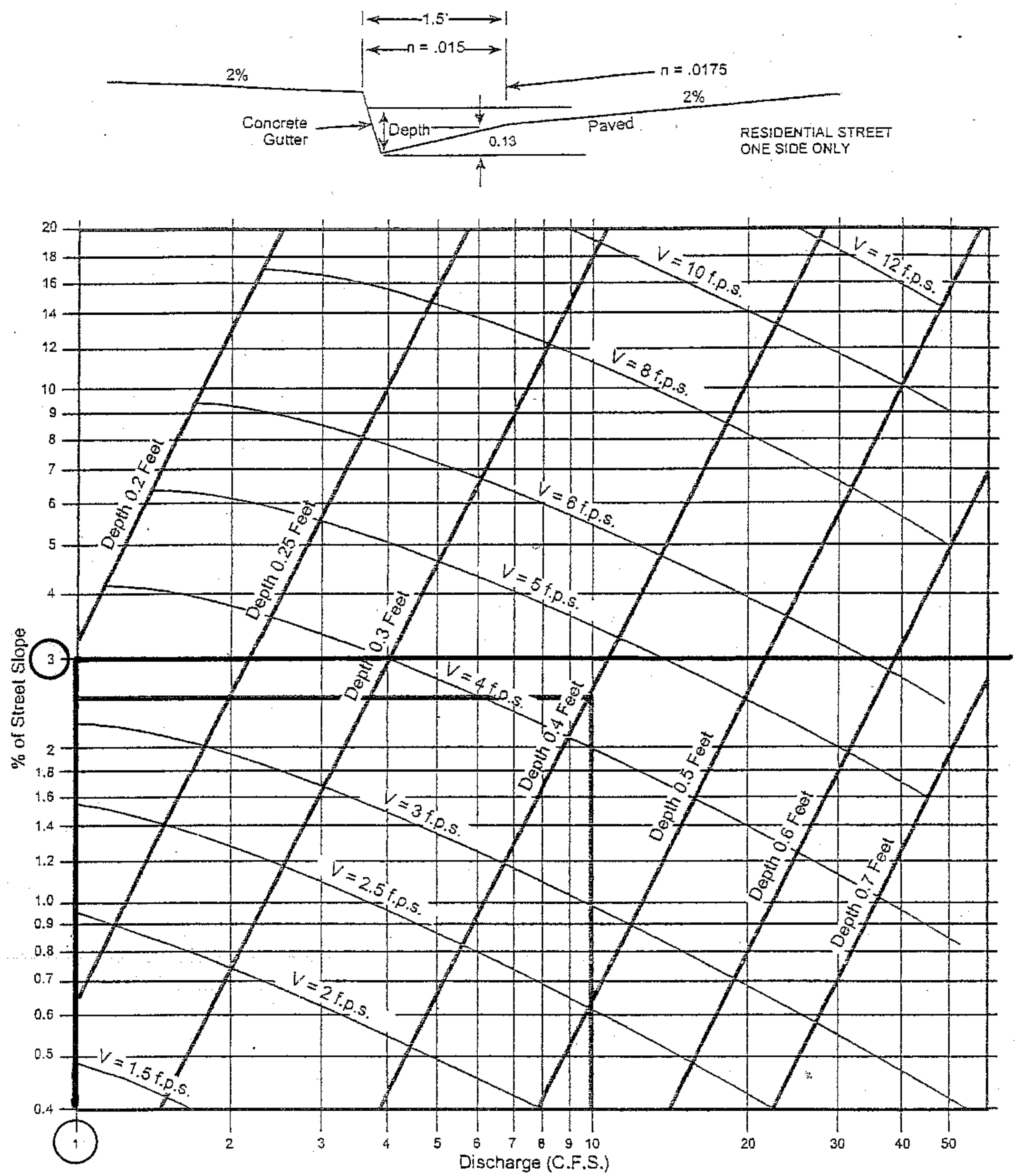
FIGURE **3-1**

BASIN 15
Proposed Condition
(AQUEDUCT ROAD)

Basin 15 Hydraulics (Proposed Condition)

In the existing condition, the storm water from this basin sheet flows southerly in the easterly edge of the dirt road (Aqueduct Road), see the picture below and the 100-scale Drainage Map attached.

From Figure 3-6, located on the following page, a depth of 0.21 feet is obtained from the easterly edge of the road. Therefore, a 6-inch dike “Type A” G-5 per RSDs is adequate to handle a 100-year storm.



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

$$\frac{Q}{2} = \frac{1.4}{2} < 1 \text{ CFS.}$$

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

FIGURE

3-6

Gutter and Roadway Discharge - Velocity Chart

V = 3.5 f.p.s.

D = 0.27

BASIN 15
(AQUEDUCT ROAD)

Basin 16 Hydrology (Existing Condition)

Q_{100} = $C_{weighted}$ I A   Rational Method

Area:

A_{total} = $A_{Nat} + A_{Exist\ Asph}$

Where:

Natural Area (A_{Nat}) = 0.25 acres (see Drainage Maps attached)

Asphalt and Roof area ($A_{Exist\ Asph}$) 0.55 acres (see Drainage Maps attached)

A_{total} = 0.25 + 0.55 = 0.8 acres

C-Value:

$C_{Weighted}$ = $[(C_{Nat} * A_{Nat} / A_{total}] + [(C_{Exist\ Asph} * A_{Exist\ Asph}) / A_{total}]$

Where:

C_{Nat} = 0.25 (see Table 3-1, Appendix)

$C_{Exist\ Asph}$ = 0.95 (see Table II, Appendix)

$C_{Weighted}$ = [(0.25) (0.25) / 0.8] + [(0.95) (0.55) / 0.8]

$C_{Weighted}$ = 0.73

Intensity Calculations:

I = $7.44\ P_6\ T_C^{-0.645}$ (see Figure 3-1, Appendix)

Where

T_C = $T_i + T_{t1} + T_{t2}$

And:

T_i = 11.5 minutes (see Table 3-2 on following pages).

T_{t1} = 1.1 minutes (see Figure 3-4 on following pages).

T_{t2} is the time it takes the runoff to travel along the gutter flow line. The time it takes the water to travel from the initial point of the gutter flow to the concentration point is calculated using the velocity and the distance traveled. The velocity is calculated using Figure 3-6 of the San Diego hydrology manual and the distance traveled is obtained from the Drainage Map. The Q_{100} used for Figure 3-6 is assumed and then divided by two to average the amount of runoff in the gutter. This assumption is later checked for accuracy. See below for the calculation:

T_{t2} = Distance Traveled / Velocity

Where:

Velocity (V) = 5.4 fps (see Figure 3-6-1 on following pages)

Distance Traveled = 140 feet (see Drainage Maps attached)

Then:

T_{t2} = 140 / 5.4 = 26 seconds = 0.4 minutes

Therefore:

T_C = 11.5 + 1.1 + 0.4 = 13.0 minutes

Also,

P_6 = 3.5 inches (see Rainfall Isopluvial, Appendix)

now

I = $7.44\ (3.5)\ (13.0)^{-0.645}$ (also see Figure 3-1 on following pages)

Then:

I = 5.0 in/hr

BASIN 16
AQUEDUCT ROAD

Basin 16 cont…

Flow Rate:

$Q_{100} = C_{weighted}\ I\ A$ Rational Method

$Q_{100} = 0.73 * 5.0 * 0.8$

Then

$\boxed{\mathbf{Q_{100} = 2.9\ cfs}}$

* The assumption for the Q_{100} for the velocity calculation is found to be correct with accepatable tolerance.

<u>Basin 16 Hydrology (Proposed Condition)</u>

The purpose for the calculations below is to account for the additional paving due to the widening of Aqueduct Road.

$Q_{100} = C_{weighted}\ I\ A$ Rational Method

Updated Area:

$A_{total} = A_{Nat} + A_{Exist\ Asph} + A_{New\ Asph}$

Where:

Natural Area (A_{Nat})	=	0.25	acres	(see Drainage Maps attached)
Asphalt and Roof area ($A_{Exist\ Asph}$)		0.55	acres	(see Drainage Maps attached)
New Pavement Area ($A_{New\ Asph}$)	=	0.03	acres	(see Preliminary Grading Plan, Appendix)

$\mathbf{A_{total} = 0.25 + 0.55 + 0.03 = 0.83}$ **acres**

C-Value:

$C_{Weighted} = [(C_{Nat} * A_{Nat} / A_{total}] + [(C_{Asph} * A_{Asph}) / A_{total}]$

Where:

C_{Nat}	=	0.25	(see Table 3-1, Appendix)
C_{Asph}	=	0.95	(see Table II, Appendix)

$C_{Weighted} = [(0.25) (0.25) / 0.83] + [(0.95) (0.58) / 0.83]$

$\mathbf{C_{Weighted} = 0.74}$

Intensity:

I = 5.0 in/hr (also see Figure 3-1 on following pages)

Flow Rate:

$Q_{100} = CIA$ Rational Method

$Q_{100} = 0.74 * 5.0 * 0.83$

Then

$\boxed{\mathbf{Q_{100} = 3.1\ cfs}}$

<u>Basin 16 Comparison</u>

Q_{100} Existing	=	2.9	cfs
Q_{100} Proposed	=	3.1	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.

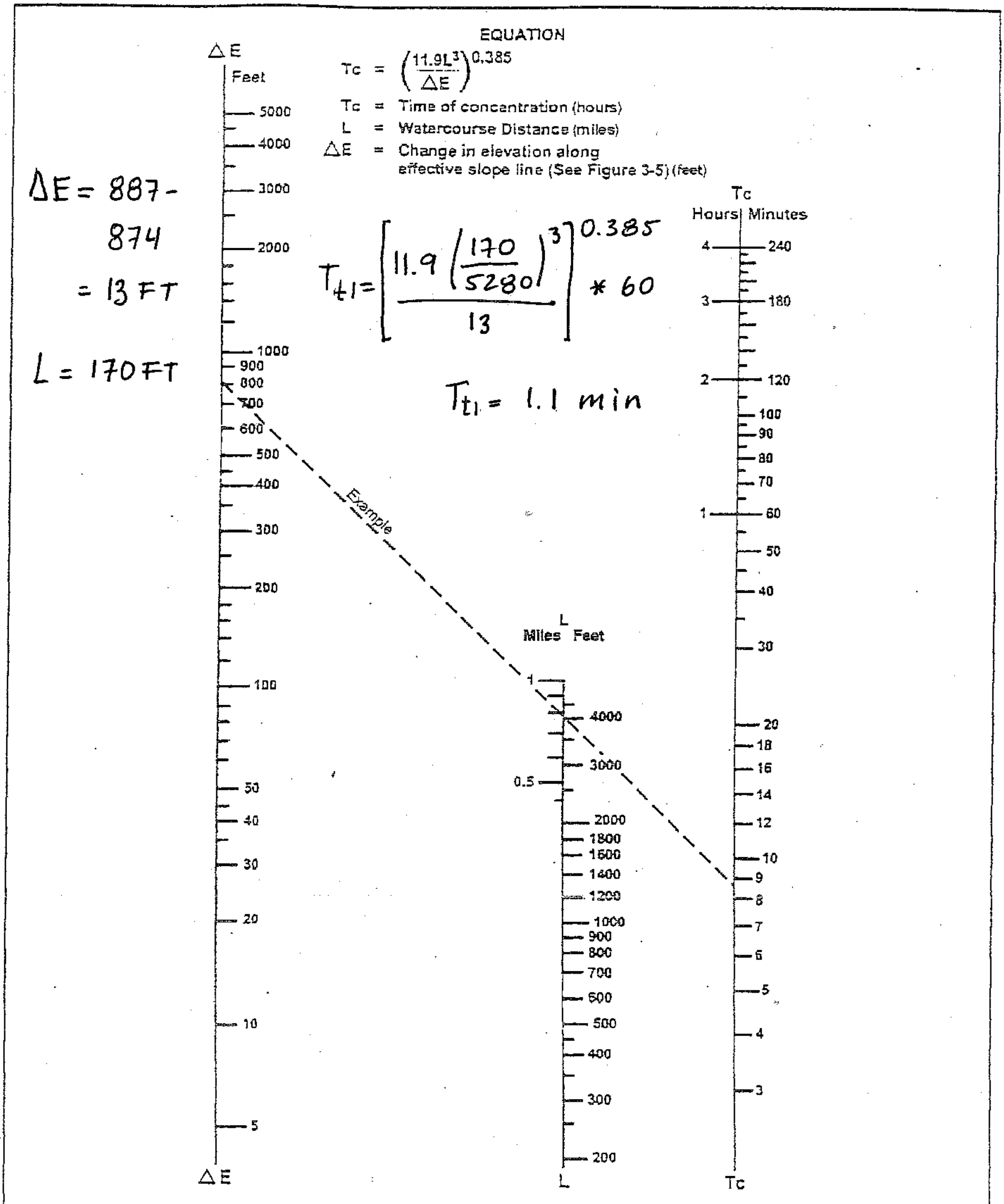
Table 3-2

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

Element*	DU/ 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

**BASIN 16
(AQUEDUCT ROAD)**

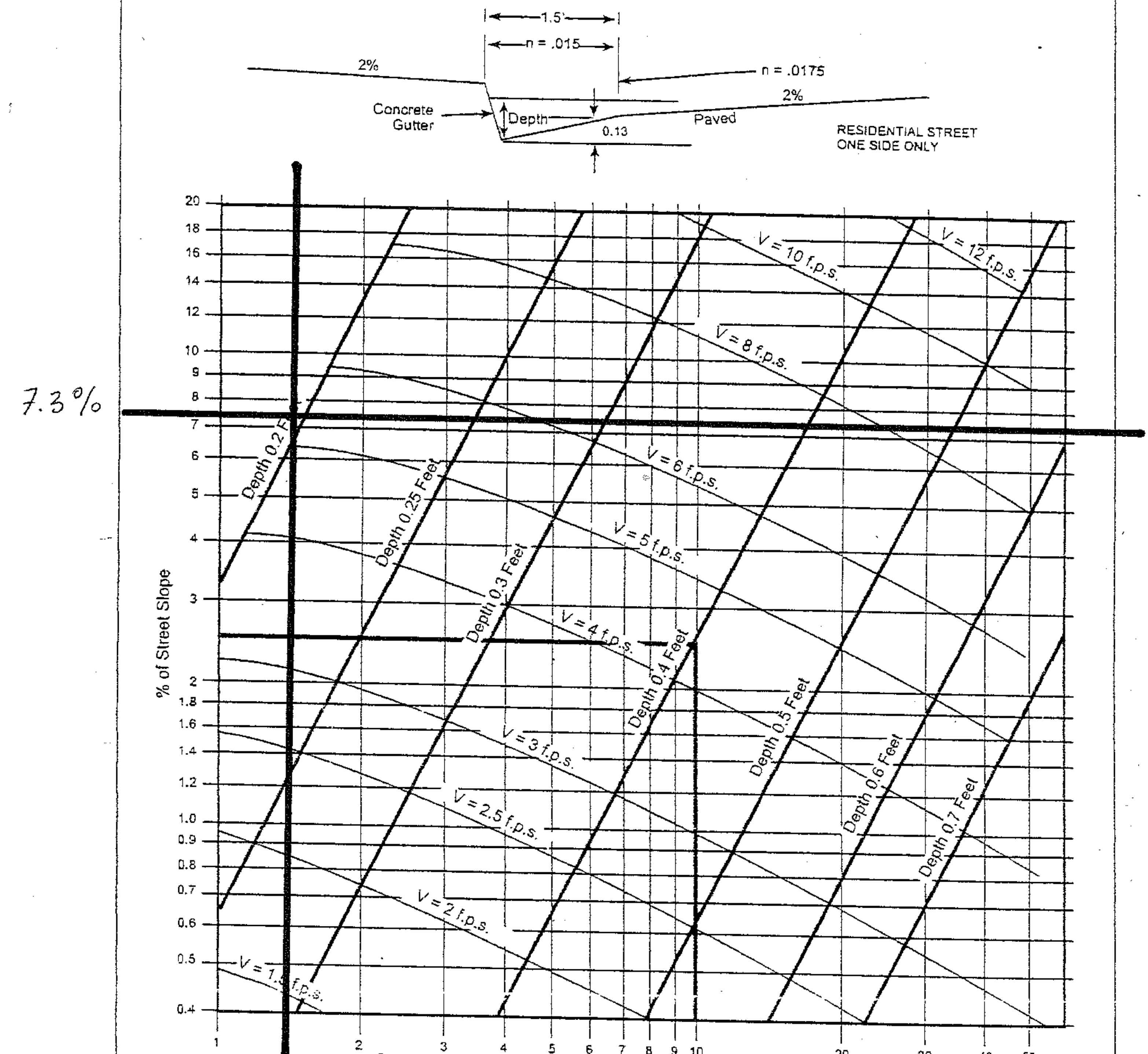


SOURCE: California Division of Highways (1941) and Kirpich (1940)

FIGURE 3-4

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

**BASIN 16
(AQUEDUCT ROAD)**



$\frac{Q}{2} = 1.5$ 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

Gutter and Roadway Discharge - Velocity Chart

FIGURE

3-6-1

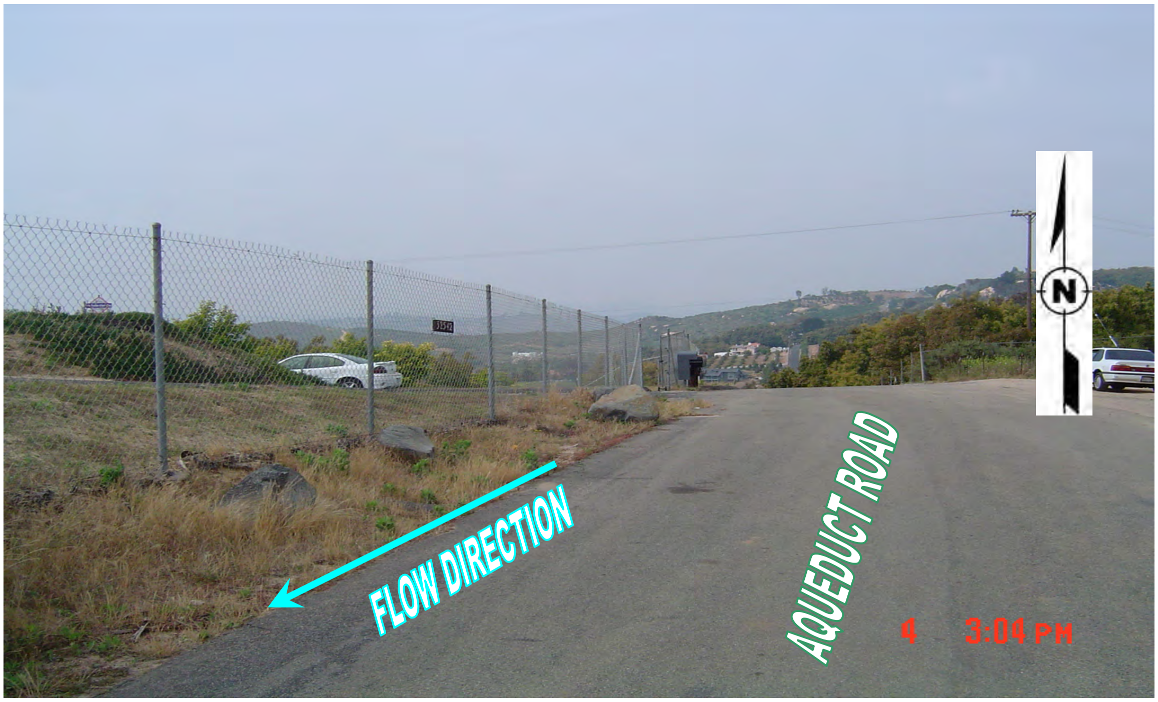
V = 5.4 ft/s

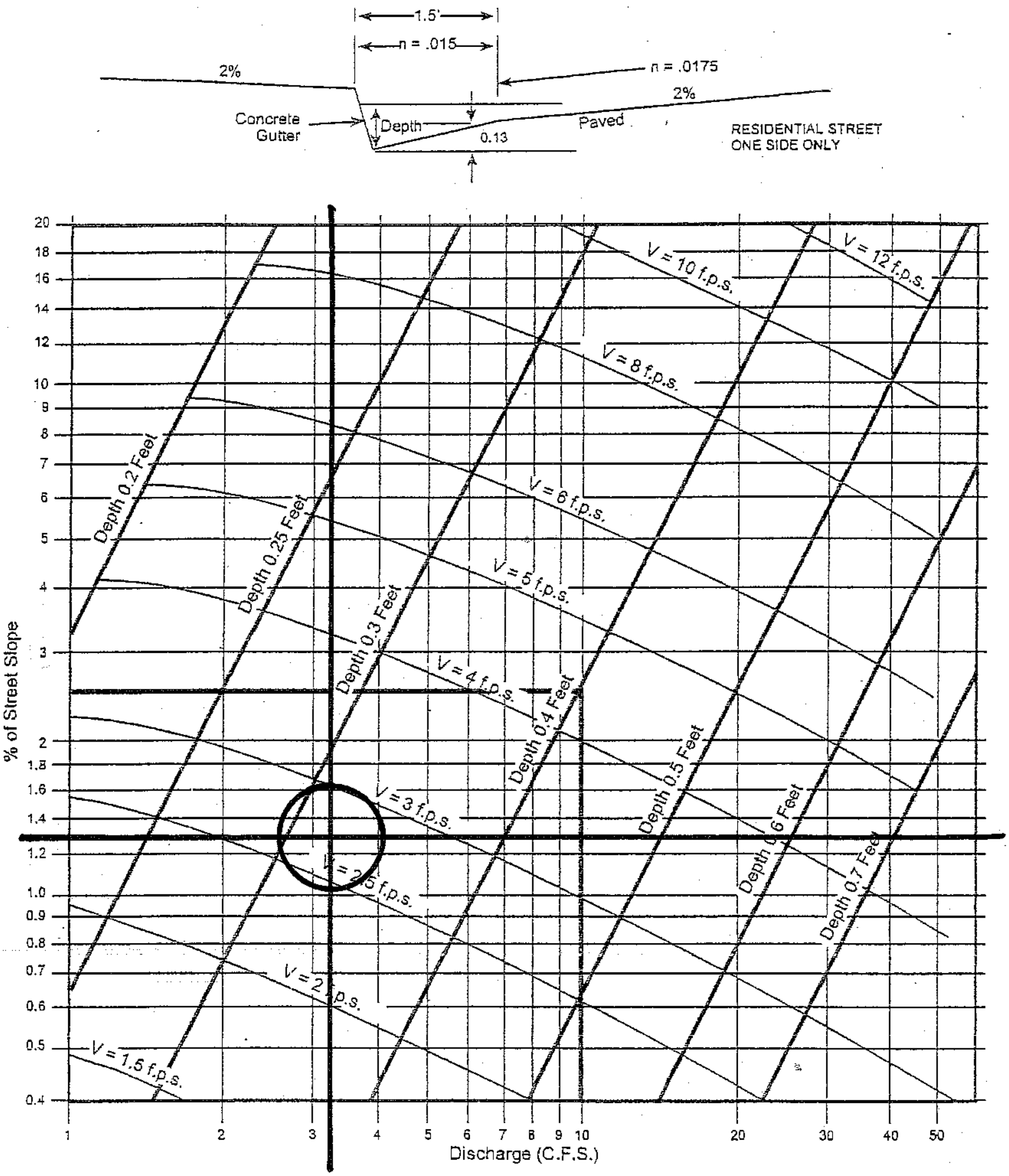
BASIN 16 (AQUEDUCT ROAD)

Basin 16 Hydraulics (Proposed Condition)

In the existing condition, the storm water from this basin sheet flows southerly on the westerly edge of Aqueduct Road, see the picture below. The runoff then sheet flows across to the easterly edge of the road and continues in an easterly direction. See the 100-scale Drainage Map attached.

From Figure 3-6-2, located on the following page, a depth of 0.32 feet is obtained in the westerly edge of the road. Therefore, a 6-inch dike "Type A" G-5 per RSDs is adequate to handle a 100-year storm.





3.1 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
3-6-2

Gutter and Roadway Discharge - Velocity Chart

V = 2.7 fps
D = 0.32 ft

BASIN 16
(AQUEDUCT ROAD)

BASIN 17
AQUEDUCT ROAD

Basin 17 Hydrology (Existing Condition)

$Q_{100} = C_{weighted}\ I\ A$ Rational Method

Area:

$A_{total} = A_{Nat} + A_{Exist\ Asph}$

Where:

Natural Area (A_{Nat}) = 1.7 acres (see Drainage Maps attached)

Asphalt and Roof area ($A_{Exist\ Asph}$) 2.0 acres (see Drainage Maps attached)

$A_{total} = 1.7 + 2.0 = 3.7$ acres

C-Value:

$C_{Weighted} = [(C_{Nat} * A_{Nat} / A_{total}] + [(C_{Exist\ Asph} * A_{Exist\ Asph}) / A_{total}]$

Where:

C_{Nat} = 0.30 (see Table 3-1, Appendix)

$C_{Exist\ Asph}$ = 0.95 (see Table II, Appendix)

$C_{Weighted} = [(0.30)(1.7) / 3.7] + [(0.95)(2.0) / 3.7]$

$\mathbf{C_{Weighted} = 0.65}$

Intensity Calculations:

$I = 7.44\ P_6\ T_C^{-0.645}$ (see Figure 3-1, Appendix)

Where

$T_C = T_i + T_{t1} + T_{t2}$

And:

T_i = 6.4 minutes (see Table 3-2 on following pages).

T_{t1} = 0.7 minutes (see Figure 3-4 on following pages).

T_{t2} is the time it takes the runoff to travel along the gutter flow line. The time it takes the water to travel from the initial point of the gutter flow to the concentration point is calculated using the velocity and the distance traveled. The velocity is calculated using Figure 3-6 of the San Diego hydrology manual and the distance traveled is obtained from the Drainage Map. The Q_{100} used for Figure 3-6 is assumed and then divided by two to average the amount of runoff in the gutter. This assumption is later checked for accuracy. See below for the calculation:

T_{t2} = Distance Traveled / Velocity

Where:

Velocity (V) = 6.8 fps (see Figure 3-6-1 on following pages)

Distance Traveled = 1080 feet (see Drainage Maps attached)

Then:

$T_{t2} = 1080 / 6.8 = 159$ seconds = 2.6 minutes

Therefore:

$T_C = 6.4 + 0.7 + 2.6 = 9.7$ minutes

Also,

P_6 = 3.5 inches (see Rainfall Isopluvial, Appendix)

Now:

$I = 7.44\ (3.5)\ (9.7)^{-0.645}$ (also see Figure 3-1 on following pages)

Then:

I = 6.0 in/hr

Basin 17 cont…

Flow Rate:

Q_{100} = CIA   Rational Method

Q_{100} = 0.65 * 6.0 * 3.7

Then

$\boxed{\mathbf{Q_{100} = 14.4\ cfs}}$

* The assumption for the Q_{100} for the velocity calculation is found to be correct with accepatable tolerance.

<u>Basin 17 Hydrology (Proposed Condition)</u>

The purpose for the calculations below is to account for the additional paving due to the widening of Aqueduct Road.

Q_{100} = $C_{weighted}$ I A

Updated Area:

A_{total} = A_{Nat} + $A_{Exist\ Asph}$ + $A_{New\ Asph}$

Where:

Natural Area (A_{Nat})	=	1.7	acres	(see Drainage Maps attached)
Asphalt and Roof area ($A_{Exist\ Asph}$)		2.0	acres	(see Drainage Maps attached)
New Pavement Area (A_{Asph})	=	0.12	acres	(see Preliminary Grading Plan, Appendix)

Then

A_{total} = 1.7 + 2.0 + 0.12 = 3.82 acres

C-Value:

$C_{Weighted}$ = $[(C_{Nat} * A_{Nat}) / A_{total}] + [(C_{Asph} * A_{Asph}) / A_{total}]$

Where:

C_{Nat}	=	0.30	(see Table 3-1, Appendix)
New Pavement (C_{Asph})	=	0.95	(see Table II, Appendix)

Then:

$C_{Weighted}$ = [(0.30) (1.7) / 3.82] + [(0.95) (2.12) / 3.82]

$C_{Weighted}$ = 0.66

Intensity:

I = 6.0 in/hr   (also see Figure 3-1 on following pages)

Flow Rate:

Q_{100} = CIA   Rational Method

Q_{100} = 0.66 * 6.0 * 3.82

Then

$\boxed{\mathbf{Q_{100} = 15.1\ cfs}}$

<u>Basin 17 Comparison</u>

Q_{100} Existing	=	14.4	cfs
Q_{100} Proposed	=	15.1	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/ 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	[illegible]
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 17 (AQUEDUCT ROAD)

EQUATION

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

Tc = Time of concentration (hours)

L = Watercourse Distance (miles)

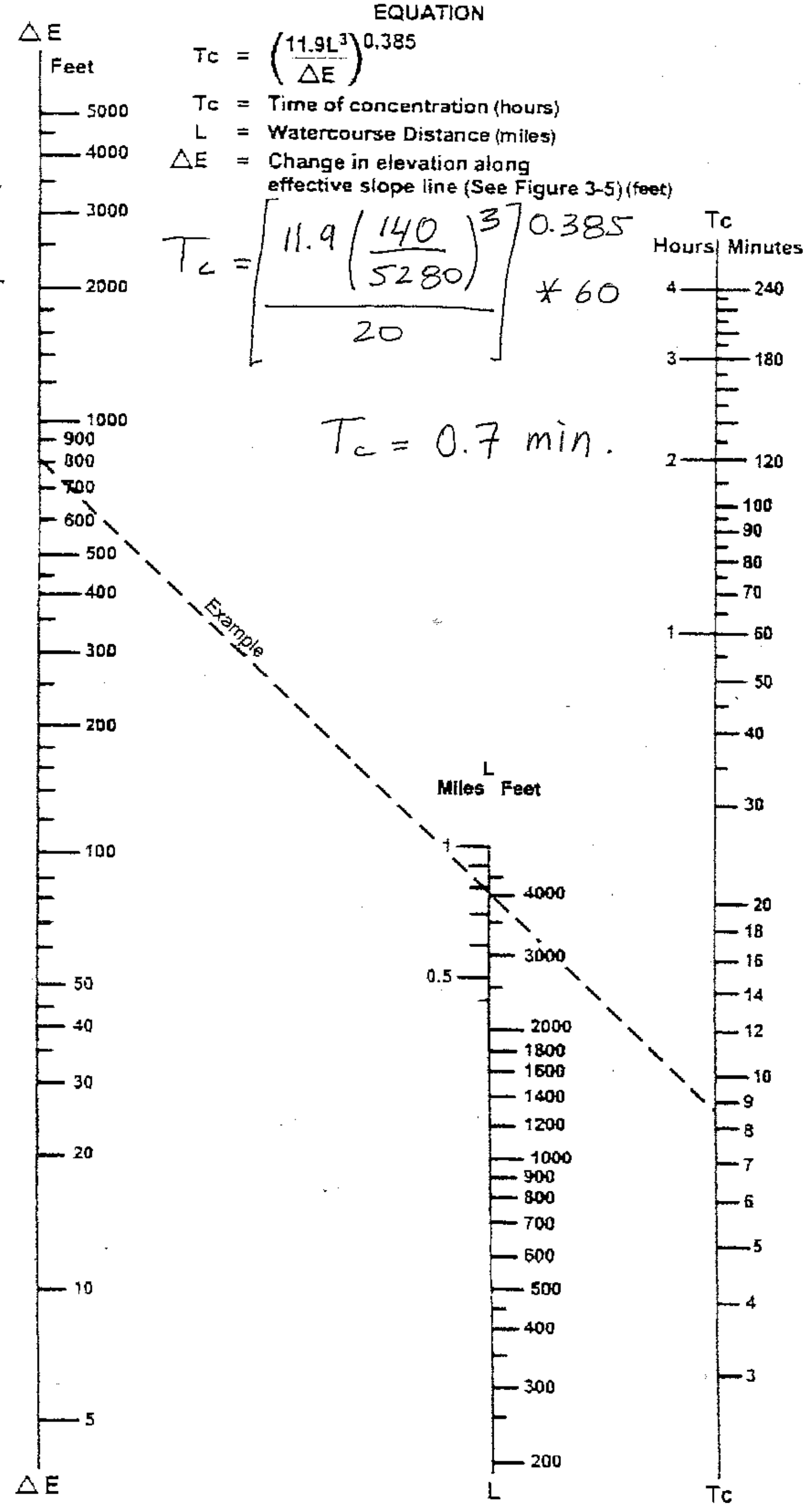
ΔE = Change in elevation along effective slope line (See Figure 3-5) (feet)

$\Delta E = 860 - 840 = 20\text{FT}$

$L = 140\text{ FT}$

$$T_c = \left[\frac{11.9\left(\frac{140}{5280}\right)^3}{20}\right]^{0.385} * 60$$

$T_c = 0.7$ min.

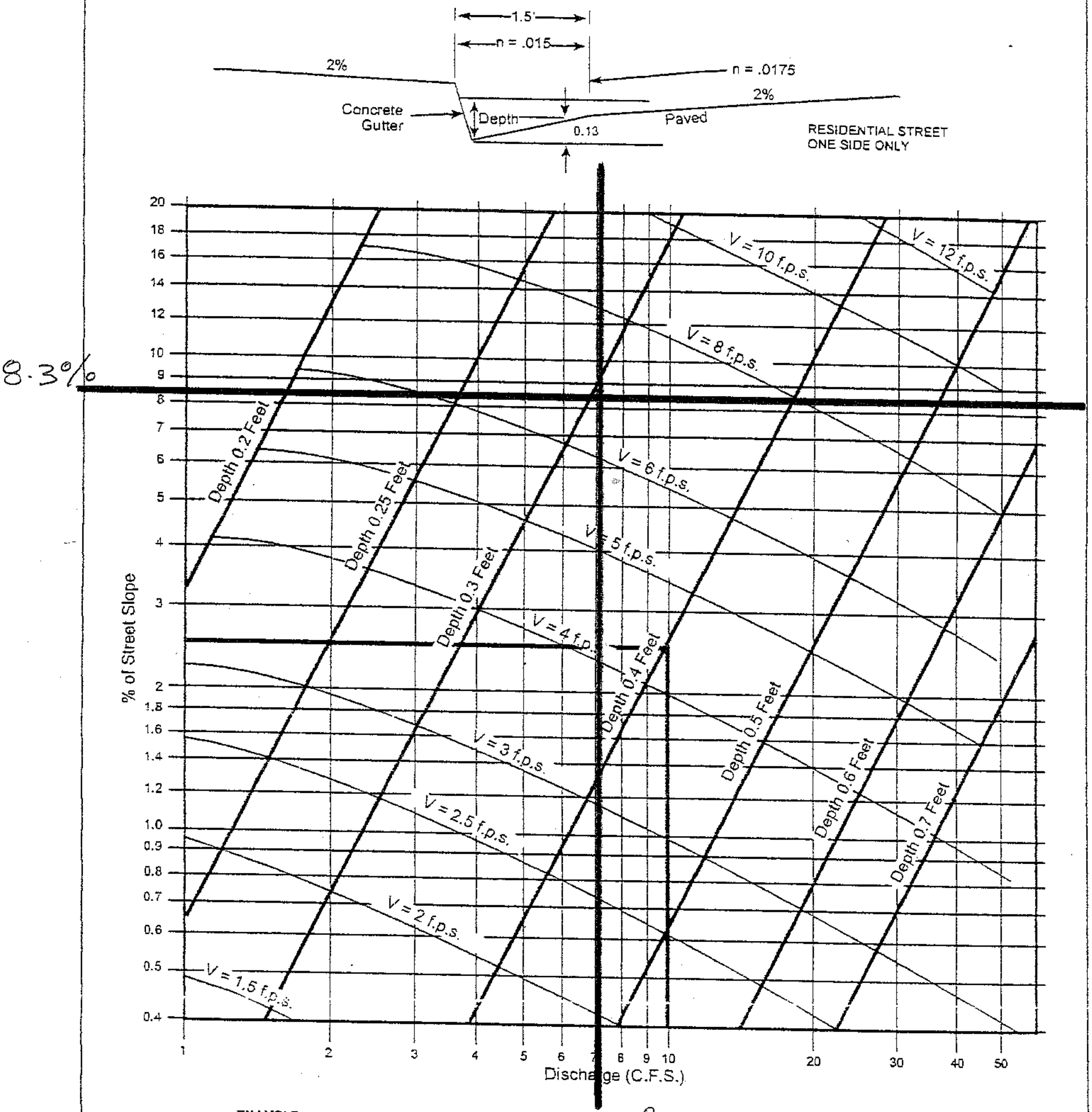


SOURCE: California Division of Highways (1941) and Kirpich (1940)

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

FIGURE 3-4

BASIN 17 (AQUEDUCT ROAD)



$\frac{Q}{2} = 7$ CFS

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

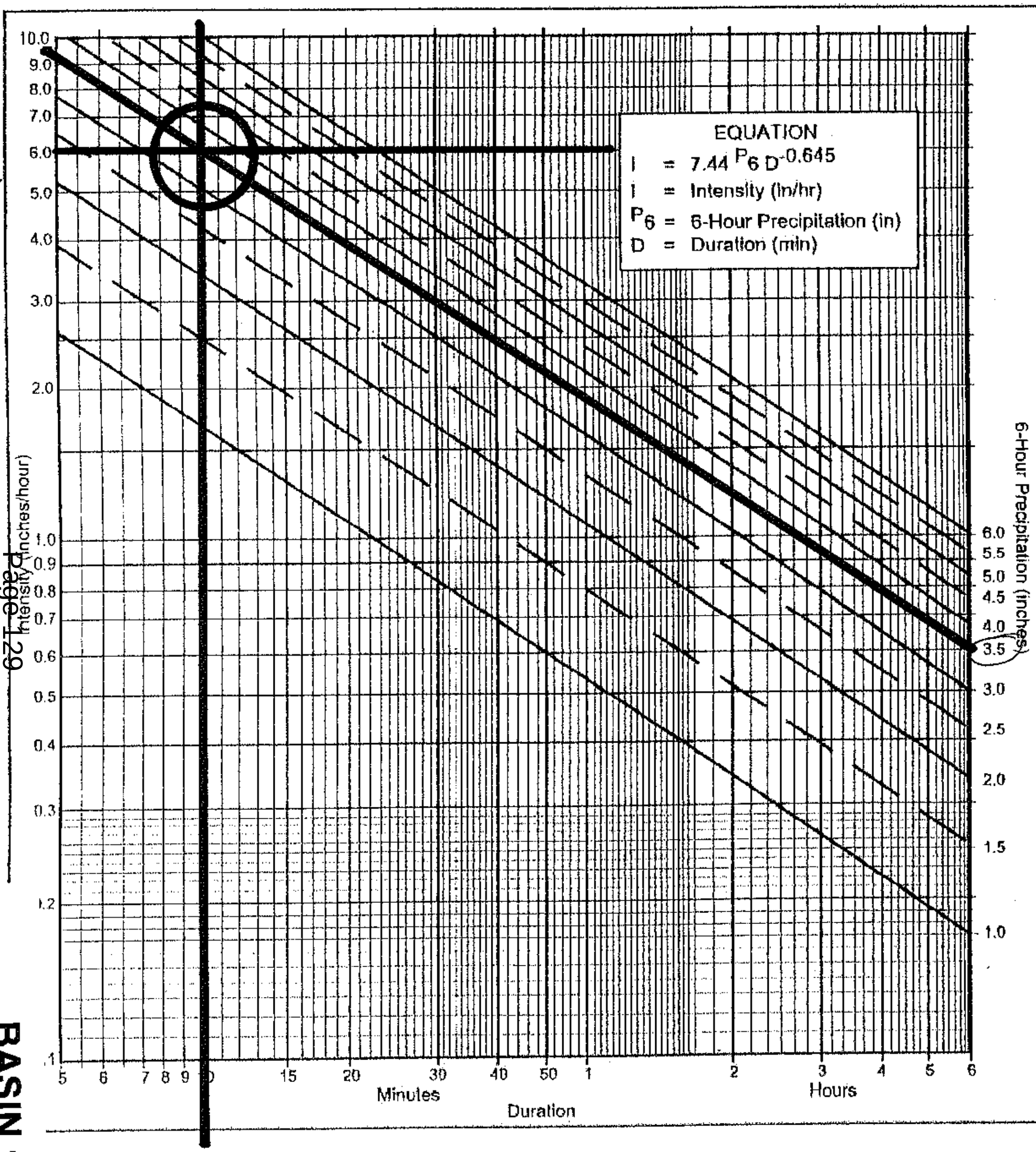
SOURCE: San Diego County Department of Special District Services Design Manual

FIGURE **3-6-1**

Gutter and Roadway Discharge - Velocity Chart

V = 6.8 ft/s

BASIN 17 (AQUEDUCT ROAD)



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 = 3.5 in., P_{24} = 6.0, $\frac{P_6}{P_{24}}$ = 58 %(2)

(c) Adjusted $P_6^{(2)}$ = 3.5 in.

(d) t_x = 9.7 min.

(e) I = 6.0 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

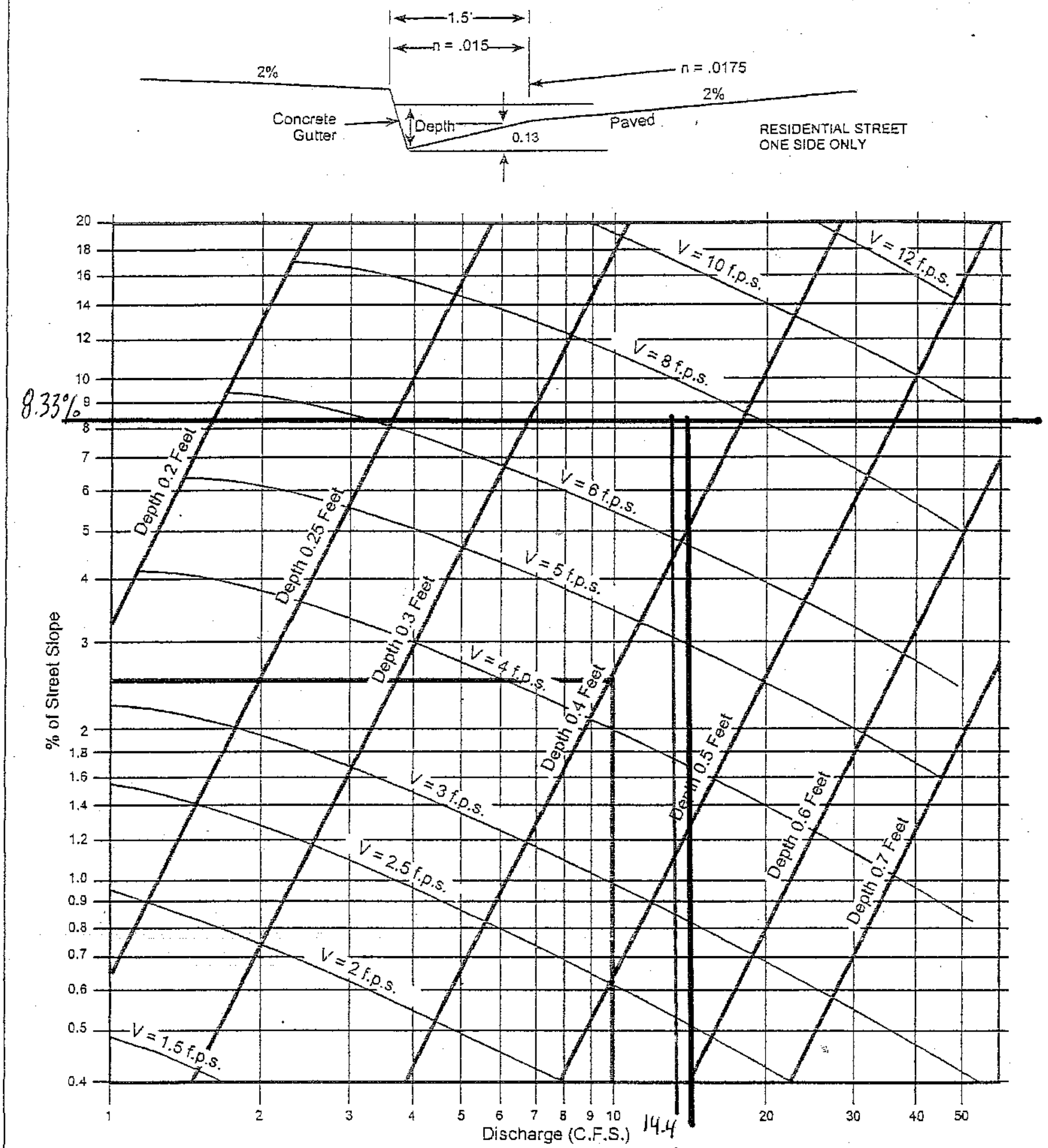
FIGURE **3-1**

BASIN 17 (AQUEDUCT ROAD)

Basin 17 Hydraulics (Proposed Condition)

In the existing condition, the storm water from this basin sheet flows across Aqueduct Road to the westerly side of the road. There is a 6-inch AC dike along this side of the road that directs the runoff to West Lilac Road. See the picture below and the 100-scale Drainage Map attached.

From Figure 3-6-2, located on the following page, a depth of 0.38 feet is obtained. Therefore, a 6-inch AC dike "Type A" G-5 per RSDs is proposed to handle 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

3-6-2

Gutter and Roadway Discharge - Velocity Chart

PROPOSED { Q = 15.1 cfs, V = 7.6 fps, D = 0.38 ft

EXISTING { Q = 14.4, V = 7.5 fps, D = 0.37 ft

BASIN 17
(AQUEDUCT ROAD)

BASIN 18
AQUEDUCT ROAD

Basin 18 Hydrology (Existing Condition)

Q_{100} = CIA — Rational Method

C-Value:

C_{Asph} = 0.95 — (see Table II, Appendix)

Area:

$A_{Exist\ Asph}$ = 0.1 acres — (see Drainage Maps attached)

Intensity Calculations:

$I = 7.44\ P_6\ T_C^{-0.645}$ — (see Figure 3-1, Appendix)

Where

$T_C = T_i + T_t$

And:

T_i = 6.4 minutes — (see Table 3-2 on following pages).

T_t is the time it takes the runoff to travel along the gutter flow line. The time it takes the water to travel from the initial point of the gutter flow to the concentration point is calculated using the velocity and the distance traveled. The velocity is calculated using Figure 3-6 of the San Diego hydrology manual and the distance traveled is obtained from the Drainage Map. The Q_{100} used for Figure 3-6 is assumed and then divided by two to average the amount of runoff in the gutter. This assumption is later checked for accuracy. See below for the calculation:

T_t = Distance Traveled / Velocity

Where:

Velocity (V) = 5.6 fps — (see Figure 3-6-1 on following pages)

Distance Traveled = 540 feet — (see Drainage Maps attached)

Then:

T_t = 540 / 5.6 = 96 seconds = 1.6 minutes

Therefore:

T_C = 6.4 + 1.6 = 8.0 minutes

Also,

P_6 = 3.5 inches — (see Rainfall Isopluvial, Appendix)

Now:

$I = 7.44\ (3.5)\ (8.0)^{-0.645}$

Then:

I = 6.8 in/hr — (also see Figure 3-1 on following pages)

Flow Rate:

Q_{100} = CIA — Rational Method

Q_{100} = 0.95 * 6.8 * 0.1

Then

$\boxed{\mathbf{Q_{100} = 0.6\ cfs}}$

* The assumption for the Q_{100} for the velocity calculation is found to be correct with accepatable tolerance.

Basin 18 Hydrology (Proposed Condition):

The purpose for the calculations below is to account for the additional paving due to the widening of Aqueduct Road.

Q_{100} = CIA

Updated Area:

$A_{total} = A_{Exist\ Asph} + A_{Asph}$

Where:

New Pavement Area ($A_{New\ Asph}$) = 0.03 acres (see Preliminary Grading Plan, Appendix)

Then

A_{total} = 0.1 +0.03 = 0.13 acres

C-Value:

C_{Asph} = 0.95 (see Table II, Appendix)

Intensity:

I = 6.8 in/hr (also see Figure 3-1 on following pages)

Flow Rate:

Q_{100} = CIA Rational Method

Q_{100} = 0.95 * 6.8 * 0.13

Then

Q_{100} = 0.8 cfs

<u>**Basin 18 Comparison**</u>

Q_{100} Existing	=	0.6	cfs
Q_{100} Proposed	=	0.8	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.

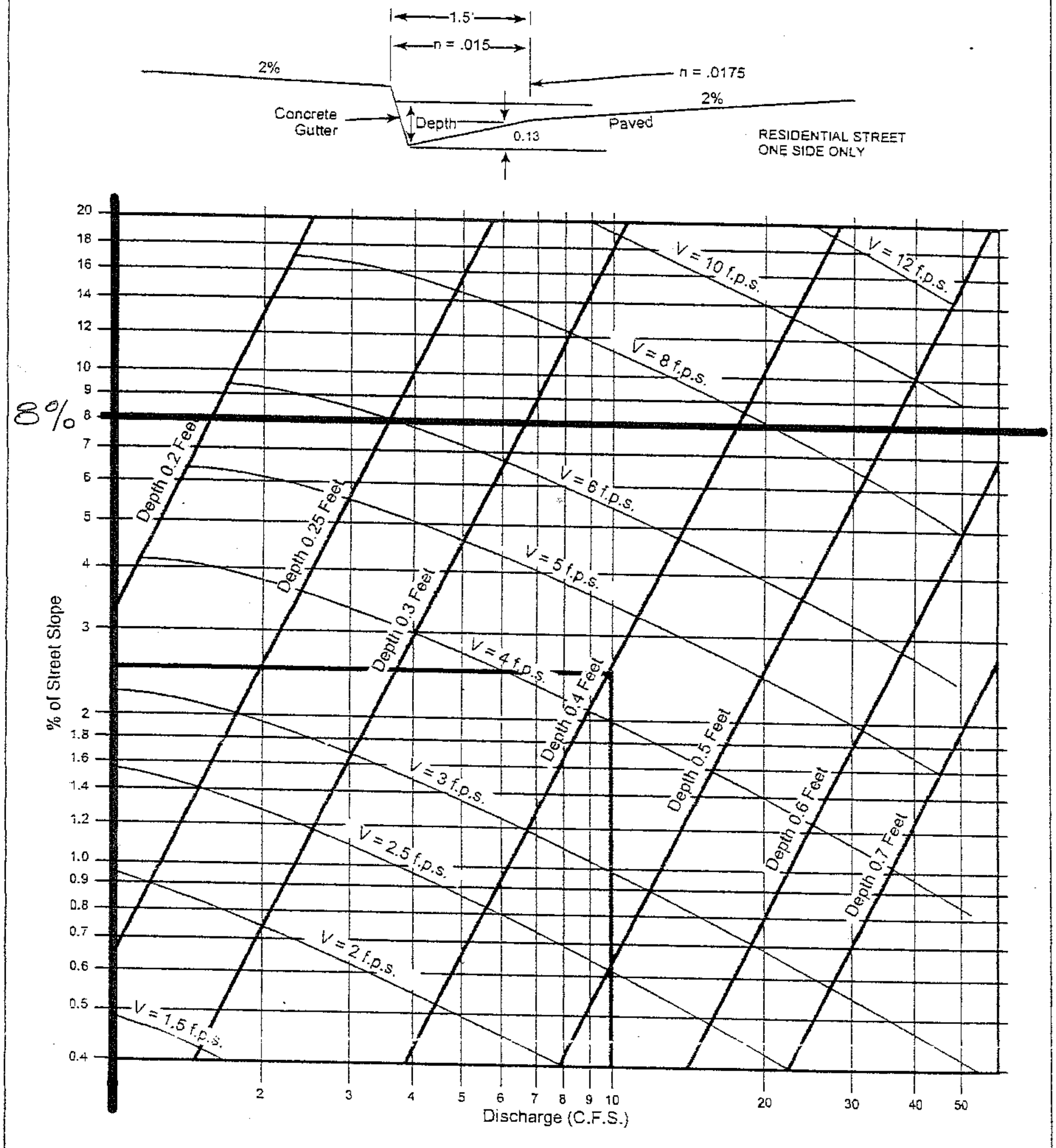
Table 3-2

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

Element*	DU/ 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

BASIN 18
(AQUEDUCT ROAD)



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

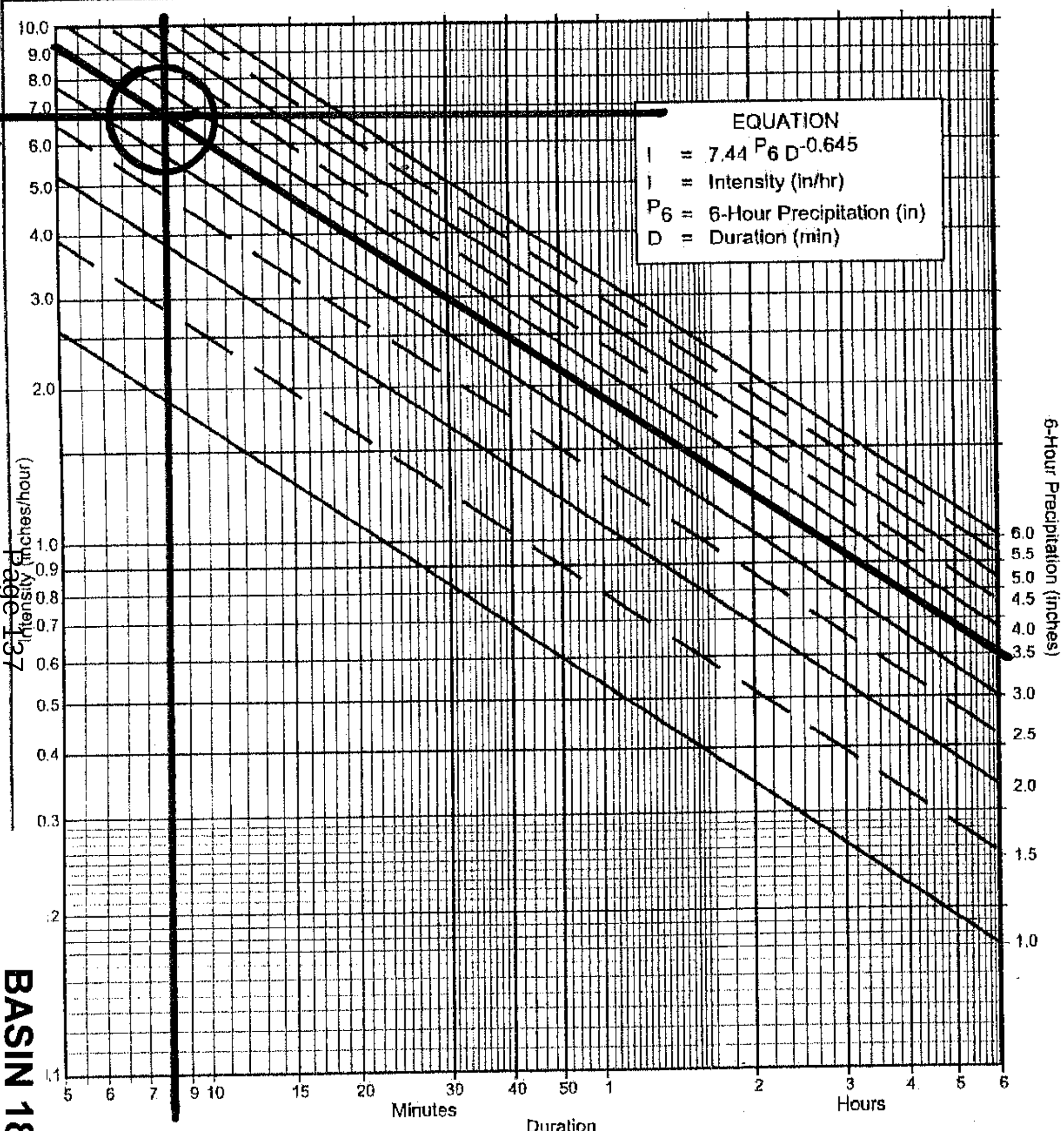
FIGURE

Gutter and Roadway Discharge - Velocity Chart

3-6-1

V = 5.6 ft/s

BASIN 18
(AQUEDUCT ROAD)



6.8 in/hr

8.0 min

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 = 3.5 in., P_{24} = 6.0 $\frac{P_6}{P_{24}}$ = 58 %(2)

(c) Adjusted $P_6^{(2)}$ = 3.5 in.

(d) t_x = 8.0 min.

(e) I = 6.8 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

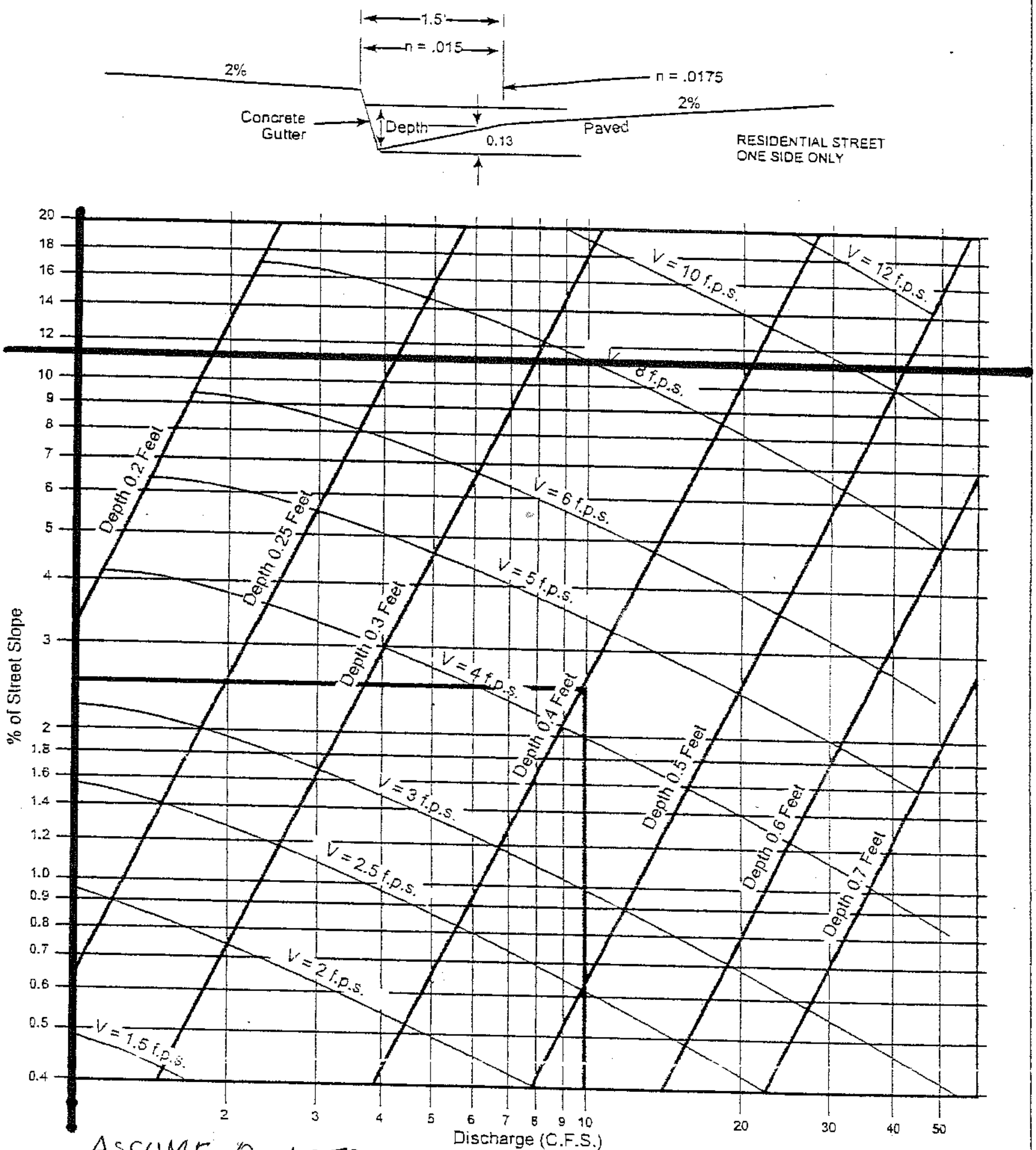
3-1

BASIN 18
(AQUEDUCT ROAD)

Basin 18 Hydraulics (Proposed Condition)

In the existing condition, the storm water from this basin sheet flows down the easterly side of the road towards West Lilac road. See the picture below and the 100-scale Drainage Map attached.

From Figure 3-6-2, located on the following page, a depth of less than 0.2 feet is obtained. Therefore, a 6-inch AC dike "Type A" G-5 per RSDs is proposed to handle a 100-year storm.



ASSUME Q = 1 CFS → Q_{PEAK} = 0.8, 1.0 > 0.8

EXAMPLE:

Given: Q = 10 S = 2.5%

Chart gives: Depth = 0.4, Velocity = 4.4 f.p.s.

ASSUMPTION IS OK

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

FIGURE

3-6-2

Gutter and Roadway Discharge - Velocity Chart

PROPOSED { Q = 0.8 cfs, V ≅ 6.2 f.p.s, D < 0.2 ft

EXIST. { Q = 0.6 cfs, V = 6.1 fps, D < 0.2 ft

BASIN 18
(AQUEDUCT ROAD)

APPENDIX

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

ALL BASINS
(EXIST & PROP.)

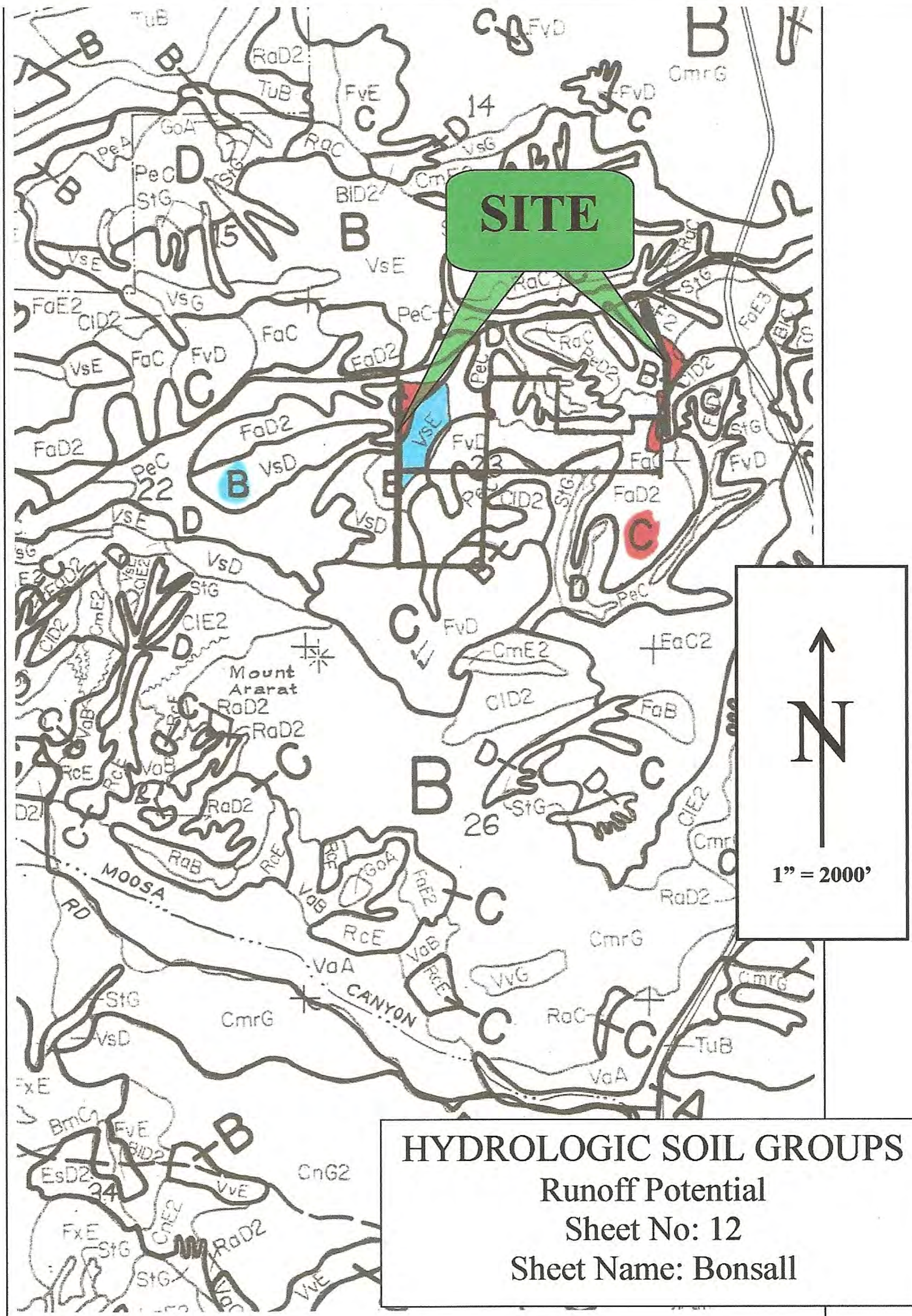
Table II

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
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

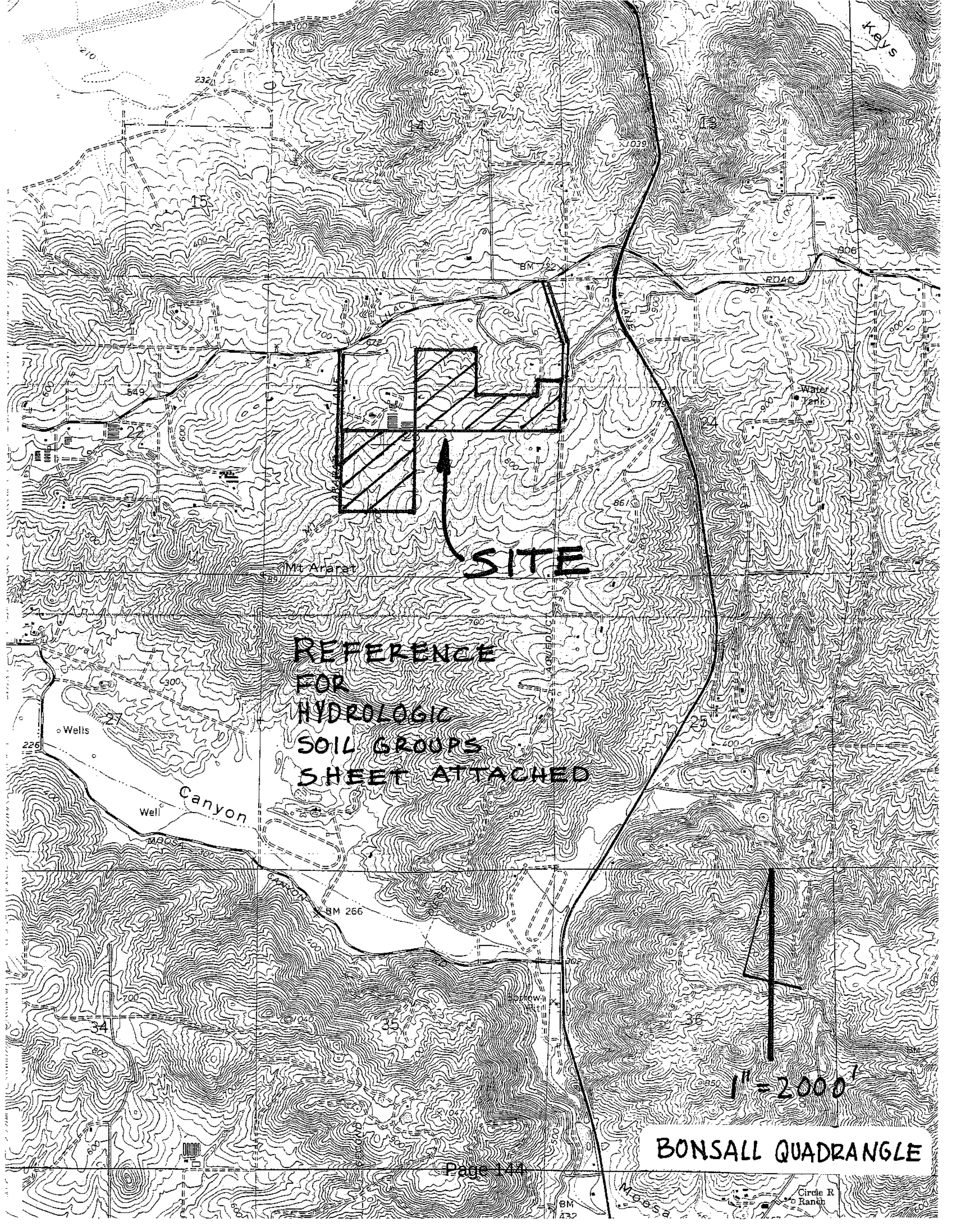
III. SAN DIEGO COUNTY LAND USE ELEMENTS

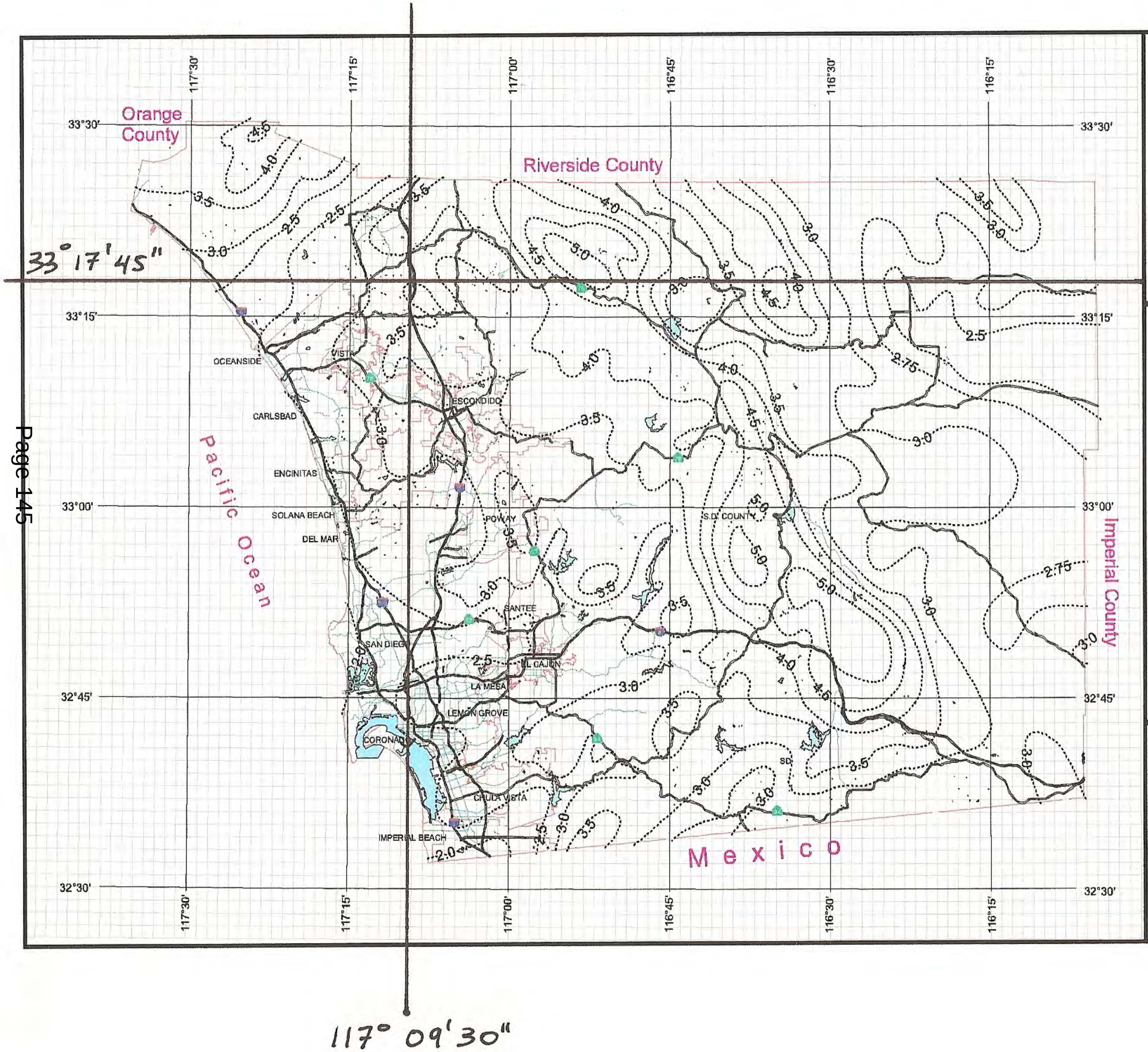
There are 28 different types Land Use Elements within the County of San Diego General Plan. Of the 28 Land Uses, 15 have densities of one or more dwelling units per acre and are listed in Table III with respect to their Land Use Element Number. The effective percent impervious is based on discussions with the Planning Department, evaluation of typical land use patterns, amount of roofs, driveways, parking surfaces, etc. that are direct/indirect connection to the storm system and the Soil Conservation Service (SCS) criteria in the County Hydrology Manual.

ALL BASINS (EXIST & PROP)



HYDROLOGIC SOIL GROUPS
Runoff Potential
Sheet No: 12
Sheet Name: Bonsall


SITE
REFERENCE
FOR
HYDROLOGIC
SOIL GROUPS
SHEET ATTACHED
1" = 2000'
BONSALL QUADRANGLE
Mt Ararat
Canyon
Wells
Well
Water Tank
ROAD
Keys
BM 266
Borrow Pit
Circle R Ranch
Moosa



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 6 Hours

....	Isopluvial (inches)

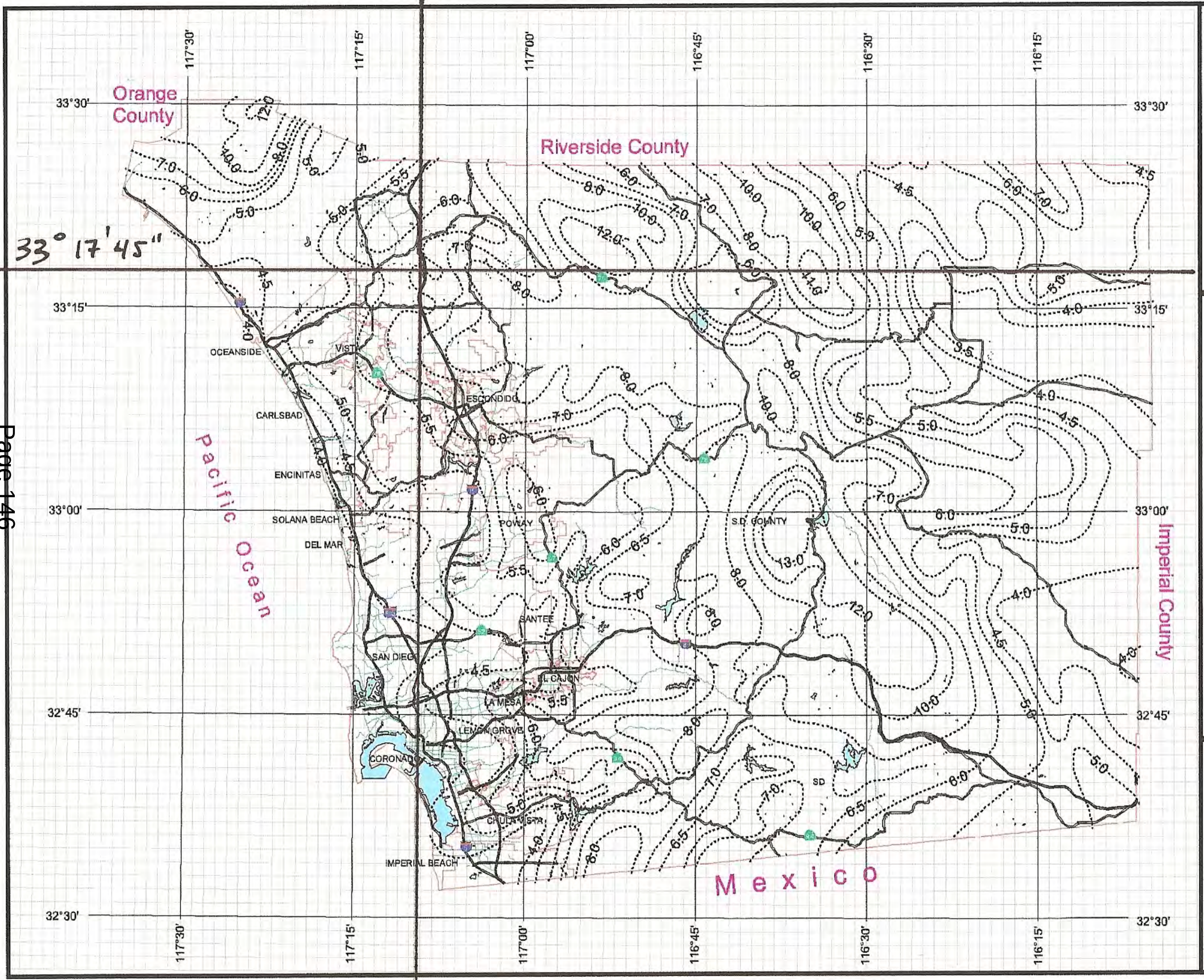
3.5 inches

DPW GIS
Department of Public Works
Geographic Information Services

SanGIS
We Have San Diego Covered!

N W E S

3 0 3 Miles



County of San Diego Hydrology Manual

Rainfall Isopluvials

100 Year Rainfall Event - 24 Hours

Isopluvial (inches)

6.0 inches

DPW GIS

SanGIS We Have San Diego Covered!

3 0 3 Miles

Values of n to Be Used with the Manning Equation

Surface	Best	Good	Fair	Bad
Uncoated cast-iron pipe	0.012	0.013	0.014	0.015
Coated cast-iron pipe	0.011	0.012*	0.013*	
Commercial wrought-iron pipe, black	0.012	0.013	0.014	0.015
Commercial wrought-iron pipe, galvanized	0.013	0.014	0.015	0.017
Smooth brass and glass pipe	0.009	0.010	0.011	0.013
Smooth lockbar and welded "OD" pipe	0.010	0.011*	0.013*	
Riveted and spiral steel pipe	0.013	0.015*	0.017*	
Vitrified sewer pipe	0.010 / 0.011	0.013*	0.015	0.017
Common clay drainage tile	0.011	0.012*	0.014*	0.017
Glazed brickwork	0.011	0.012	0.013*	0.015
Brick in cement mortar; brick sewers	0.012	0.013	0.015*	0.017
Neat cement surfaces	0.010	0.011	0.012	0.013
Cement mortar surfaces	0.011	0.012	0.013*	0.015
Concrete pipe	0.012	0.013	0.015*	0.016
Wood stave pipe	0.010	0.011	0.012	0.013
Plank Flumes:				
Planed	0.010	0.012*	0.013	0.014
Unplaned	0.011	0.013*	0.014	0.015
With battens	0.012	0.015*	0.016	
Concrete-lined channels	0.012	0.014*	0.016*	0.018
Cement-rubble surface	0.017	0.020	0.025	0.030
Dry-rubble surface	0.025	0.030	0.033	0.035
Dressed-ashlar surface	0.013	0.014	0.015	0.017
Semicircular metal flumes, smooth	0.011	0.012	0.013	0.015
Semicircular metal flumes, corrugated	0.0225	0.025	0.0275	0.030
Canals and Ditches:				
Earth, straight and uniform	0.017	0.020	0.0225*	0.025
Rock cuts, smooth and uniform	0.025	0.030	0.033*	0.035
Rock cuts, jagged and irregular	0.035	0.040	0.045	
Winding sluggish canals	0.0225	0.025*	0.0275	0.030
Dredged earth channels	0.025	0.0275*	0.030	0.033
Canals with rough stony beds, weeds on earth banks	0.025	0.030	0.035*	0.040
Earth bottom, rubble sides	0.028	0.030*	0.033*	0.035
Natural Stream Channels:				
(1) Clean, straight bank, full stage, no rifts or deep pools	0.025	0.0275	0.030	0.033
(2) Same as (1), but some weeds and stones	0.030	0.033	0.035*	0.040
(3) Winding, some pools and shoals, clean	0.033	0.035	0.040	0.045
(4) Same as (3), lower stages, more ineffective slope and sections	0.040	0.045	0.050	0.055
(5) Same as (3), some weeds and stones	0.035	0.040	0.045	0.050
(6) Same as (4), stony sections	0.045	0.050	0.055	0.060
(7) Sluggish river reaches, rather weedy or with very deep pools	0.050	0.060	0.070	0.080
(8) Very weedy reaches	0.075	0.100	0.125	0.150

* Values commonly used in designing.

Table 7-14. Values of K' for Circular Channels in the Formula

$$Q = \frac{K'}{n} d^{8/3} s^{1/2}$$

D = depth of water d = diameter of channel

$\frac{D}{d}$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0		.00007	.00031	.00074	.00138	.00222	.00328	.00455	.00604	.00775
.1	.00967	.0118	.0142	.0167	.0195	.0225	.0257	.0291	.0327	.0366
.2	.0406	.0448	.0492	.0537	.0585	.0634	.0686	.0738	.0793	.0849
.3	.0907	.0966	.1027	.1089	.1153	.1218	.1284	.1352	.1420	.1490
.4	.1561	.1633	.1705	.1779	.1854	.1929	.2005	.2082	.2160	.2238
.5	.232	.239	.247	.255	.263	.271	.279	.287	.295	.303
.6	.311	.319	.327	.335	.343	.350	.358	.366	.373	.380
.7	.388	.395	.402	.409	.416	.422	.429	.435	.441	.447
.8	.453	.458	.463	.468	.473	.477	.481	.485	.488	.491
.9	.494	.496	.497	.498	.498	.498	.496	.494	.489	.483
1.0	.463									

Table 7-4. For Determining the Area a of the Cross Section of a Circular Conduit Flowing Part Full

Let $\frac{\text{depth of water}}{\text{diameter of channel}} = \frac{D}{d}$ and C_a = the tabulated value. Then $a = C_a d^2$.

$\frac{D}{d}$	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
.0	.0000	.0013	.0037	.0069	.0105	.0147	.0192	.0242	.0294	.0350
.1	.0409	.0470	.0534	.0600	.0668	.0739	.0811	.0885	.0961	.1039
.2	.1118	.1199	.1281	.1365	.1449	.1535	.1623	.1711	.1800	.1890
.3	.1982	.2074	.2167	.2260	.2355	.2450	.2546	.2642	.2739	.2836
.4	.2934	.3032	.3130	.3229	.3328	.3428	.3527	.3627	.3727	.3827
.5	.393	.403	.413	.423	.433	.443	.453	.462	.472	.482
.6	.492	.502	.512	.521	.531	.540	.550	.559	.569	.578
.7	.587	.596	.605	.614	.623	.632	.640	.649	.657	.666
.8	.674	.681	.689	.697	.704	.712	.719	.725	.732	.738
.9	.745	.750	.756	.761	.766	.771	.775	.779	.782	.784

200-1.6.1 Selection of Riprap and Filter Blanket Material

Table 200-1.6.1(A)

Vel. Ft/Sec (1)	Rock Class (2)	Riprap Thickness "T"	Filter Blanket (3) Upper Layer(s)			
			Opt.1 Sec. 200 (4)	Opt.2 Sec.400 (4)	Opt.3 (5)	Lower Layer (6)
6-7	No. 3 Backing	.6	3/16"	[illegible]	D.G.	—
7-8	No. 2 Backing	1.0	1/4"	B3	D.G.	—
8-9.5	Facing	1.4	3/8"	—	D.G.	—
9.5-11	Light	2.0	1/2"	—	3/4" 1-1/2" P.B.	—
11-13	1/4 TON	2.7	3/4"	—	3/4" 1-1/2" P.B.	SAND
13-15	1/2 TON	3.4	1"	—	3/4" 1-1/2" P.B.	SAND
15-17	1 TON	4.3	1-1/2"	—	TYPE B	SAND
17-20	2 TON	5.4	2"	—	TYPE B	SAND