MASTER DRAINAGE PLAN
CITY OF RIVERSIDE
(Monroe Area)

FOR

THE RIVERSIDE COUNTY FLOOD CONTROL

AND

WATER CONSERVATION DISTRICT

KOEBIG & KOEBIG INC.
3242 West Eighth Street • Los Angeles 5, California
ENGINEERING ARCHITECTURE

R. D. SPENCER
CHAIRMAN OF THE BOARD

E. H. GRAHAM, JR.
PRESIDENT

R. J. THEROUX
EXECUTIVE VICE PRESIDENT

FRED DINGER, A.I.A.
CHIEF ARCHITECT

KOEBIG & KOEBIG, INC.
ENGINEERING · ARCHITECTURE
3242 WEST EIGHTH STREET
LOS ANGELES, CALIFORNIA 90005
PHONE 385-7021

L. H. NEWPORT
VICE PRESIDENT

M. J. SHELTON
VICE PRESIDENT

MARSHALL JONES
VICE PRESIDENT

D. M. HALL
DIRECTOR OF ENGINEERING

January 24, 1966

Re: Master Drainage Plan,
City of Riverside, Monroe Area

Mr. John W. Bryant
Chief Engineer
Riverside County Flood Control
and Water Conservation District
4600 Crestmore Avenue
Riverside, California

Dear Mr. Bryant:

We are pleased to submit our Master Drainage Plan for the Monroe Area within the City of Riverside. This report summarizes the most economical plan of the many alternatives studied.

One of the most important features is the inclusion of three retarding basins which substantially reduces the project cost. These basins could be developed as a joint recreation-flood control facility. Due to the rapid expansion and development within the area, land acquisition for such facilities becomes very important.

The estimated project cost of this Plan, based upon current prices, is $13,115,000. This total includes the construction as well as all incidental costs.

We wish to acknowledge the excellent cooperation afforded during the preparation of this report by your staff, City of Riverside and the local Soil Conservation Service.

Koebig & Koebig, Inc. appreciates the opportunity of performing this study. We are available for further discussions and meetings at your request.

Under separate cover we are submitting the following material to supplement this Report:

1. Volume I, Preliminary Plans & Profiles of Proposed Facilities.
2. Volume II, Hydrologic & Hydraulic Calculations.
3. Volume III, 200-scale Drainage Maps.

Very truly yours,

KOEBIG & KOEBIG, INC.

By R. D. Spencer
R. D. Spencer

MASTER DRAINAGE PLAN

CITY OF RIVERSIDE

(MONROE AREA)

For

The Riverside County Flood Control

and

Water Conservation District

KOEBIG & KOEBIG, INC.
Engineering - Architecture

TABLE OF CONTENTS

SECTION I - INTRODUCTION

SECTION II - HYDROLOGY

SECTION III - EXISTING DRAINAGE FACILITIES

SECTION IV - PROPOSED DRAINAGE FACILITIES

LIST OF TABLES

APPENDIX

LIST OF TABLES

LIST OF FIGURES

LIST OF MAPS

SECTION 1

INTRODUCTION

1. GENERAL

This master drainage study proposes the principal facilities of an ultimate storm drain system for an area within the westerly portion of the City of Riverside and generally referred to as the "Monroe Area." The drainage system will be composed of a combination of concrete lined channels, underground conduits, and retarding basins. This system will intercept surface runoff and convey it to the Santa Ana River, thereby protecting the area from damages and inconveniences caused by excess surface runoff. The existing drainage systems within the study area are integrated into the Master Drainage Plan, resulting in a balanced drainage system, which is capable of fulfilling the ultimate drainage requirements of the area.

Cost estimates for the construction of the recommended projects are based on current construction costs and must be adjusted annually, generally upward, to reflect changes in cost of construction, right of way, inspection, etc.

SECTION II

HYDROLOGY

1. GENERAL

The rational method of calculating storm runoff, as used by the Riverside County Flood Control and Water Conservation District, has been adopted for this report. The selection was made because of it being readily adaptable to the type of study being performed. Furthermore, the data available as to land use and soil type correlates satisfactorily to the runoff coefficient curves used by the District. Results obtained in this report should be highly reliable, and will reflect the requirements of a fully developed urban area.

2. DESIGN STORM FREQUENCY

The economical cost of a system, while providing an adequate service to a community, governs the criteria used in the basis of design. In this report, a 10-year storm frequency has been used as the basis, as this would provide a reasonable balance between flood damage cost and construction cost.

3. INTENSITY-DURATION CURVE

The intensity-duration curve as adapted from the United States Weather Bureau Technical Paper No. 24 is the basis of determining the rainfall intensity. The Riverside County Flood Control and Water Conservation District has studied a 25-year record of an automatic recording rain gage from the University of California, at Riverside, Citris Experiment Station. A statistical analysis of that data yielded an intensity-duration curve which is harmonious with the curve adopted from the United States Weather Bureau Technical Paper

No. 24. These curves also compare favorably with that used in the drainage master plan for the central portion of the City prepared by Koebig & Koebig, Inc. in May, 1961.

The 10-year intensity duration curve is shown in Figure 1 in the Appendix.

CLASSIFICATION OF SOILS

4. Recently, the Riverside office of the Soil Conservation Service has conducted a soil survey of the City of Riverside, including the study area. The various soil types were classified by the Soil Conservation Service into four basic groups on the basis of their hydrologic properties.

Group 1 - Soils having high infiltration rates even when thoroughly wetted, consisting chiefly of deep to excessively well drained sand and/or gravel.

Group 2 - Soils having moderate infiltration rates when thoroughly wetted, consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures.

Group 3 - Soils having slow infiltration rates when thoroughly wetted, consisting chiefly of soils with a layer that impedes the downward movement of water, or soils with moderately fine to fine texture.

Group 4 - Soils having very slow infiltration rates when thoroughly wetted, consisting chiefly of:

(a) Clay soils with a high swelling potential.

(b) Soils with a high permanent water table.

(c) Soils with clay pan or clay layer at or near the surface.

(d) Shallow soils over nearly impervious materials.

5. COEFFICIENT OF RUNOFF

Of various runoff coefficient curves being used by the Riverside County Flood Control and Water Conservation District for the appropriate soil type and land use, four charts were selected which approach very closely the hydrologic characteristics of the four basic soil groups as classified by the Soil Conservation Service. The local office of the Soil Conservation Service was consulted regarding the selection of the appropriate curves.

Figures 3 through 6 show the runoff coefficient curves corresponding to the four soil classifications.

6. CULTURAL CLASSIFICATION

The land use information for areas east of Van Buren Boulevard is based on the "Master Plan of Land Use and Circulation" prepared by the City of Riverside and adopted by the Riverside City Council on February 14, 1961 by Resolution No. 9046. Cultural classification for areas west of Van Buren Boulevard was determined from the "Master Plan Study - Arlanza-La Sierra Community" prepared by the Riverside City Planning Department.

The proposed land uses shown on these master plans were grouped into three classifications to correspond with the land use designation on Figures 3 through 6.

TABLE 1

CULTURAL CLASSIFICATION

Land Use Classification	Runoff Coefficient Curve	Symbol
Single Family Residential - Low Density & Agricultural	Agricultural	A
Single Family Residential - Medium Density	Single Family	S.F.
Multiple Family Residential - Low and Medium Density	Commercial	C
Office -	Commercial	C
Commercial -	Commercial	C
Industrial -	Commercial	C
School -	Commercial	C
Recreational - Public or Semi-Public	Agricultural	A
Airport -	Commercial	C
Other -	Single Family	S.F.

7. SOIL-CULTURAL CLASSIFICATION SYMBOLS

Throughout the remainder of this report, symbol designations will be used in lieu of the land and/or soil description. For example, an area in the Group 3 soil classification and zoned Single Family, Medium Density will be shown as "3-SF".

8. TIME OF CONCENTRATION

Determination of the time of concentration (tc) is an important element in runoff calculation, since it is the basis for obtaining the rainfall intensity. The initial time of concentration (ti) is the time required for surface runoff to flow from the farthest point of an initial sub-drainage area to the first concentration point. Fig. 2 in the Appendix was used for determining the initial time of concentration. The accumulation of time of flow from any given point to the next downstream concentration point is the time of concentration (tc) to that point or inlet.

The time of flow (tf) between successive points of concentration was determined by calculating the velocity for street flow, channel flow, or conduit flow.

9. HYDRAULIC CHARACTERISTICS OF STREETS

In order to determine velocities and depths of flow for runoff in streets, it was necessary to determine the theoretical hydraulic characteristics of the streets. Typical street cross sections were obtained from the City of Riverside for the various types of streets as adopted in their "Master Plan of Land Use and Circulation" map. Employing Manning's formula, curves were developed so that with a known Q and S the values of D (depth above gutter flow line) and A (the area of flow) could be determined. Figures 7, 8 and 9 in the

Appendix depict these characteristics. Figures 7 and 8 are for streets with the crown below the top of curb and were used as follows:

a. For flows confined to one-half of street, data was obtained from the lower curve segment.

b. For flows that are greater than one-half street capacity but not greater than the entire street capacity to crown, data was obtained from the vertical segment of the curve. This means that an inflow greater than one-half street capacity will flow over the crown to the other portion of the street.

c. For flows that are greater than the street capacity to the crown, data was obtained from the upper curve segment.

Figure 9 is for streets having the crown above the top of curb which confines the inflow to each side.

10. RUNOFF COMPUTATIONS

A brief resume is given to summarize the general procedure followed in making runoff computations. Table B in the Appendix is a typical hydrology computation sheet for summarizing these calculations. With the basic data as noted thereon with an asterisk, enter Figure 2 to determine the initial time of concentration of 10 minutes. The 10-minute intensity of 1.84 inches per hour is then obtained from Figure 1 or Table "C". Enter figure 5, runoff coefficients for 3-SF classification, with this intensity to determine the coefficient of runoff (C) equal to .82. The rational formula is employed to determine the peak rate of runoff from drainage area 1, Q=CIA, or 45.2 c.f.s. (cubic feet per second). Entering Figure 7 it is found that the flow is less than the allowable street capacity.

The resulting velocity as determined from the area obtained from Figure 7 gives a new time of concentration of 11 minutes for Area 2. Similar data is determined for Area 2 and the Q is added to that for Area 1 resulting in a total Q of 73.0 c.f.s. Figure 7 will show that for an average slope of 6 percent across Area 2 this Q is retained in the street provided there is an 8-inch curb, and that for an average slope of 1 percent across Area 3 the flow will be above an 8-inch curb, necessitating the initiation of an underground storm drain conduit. Calculations are made for successive concentration points.

The storm drain size utilized in the hydrologic analysis is determined in two steps. First the approximate size is determined by assuming that the average ground or street slope between control points is equal to the hydraulic friction slope. This value is shown in parentheses under column entitled "Slope" in Table B. The second step is to modify this slope to include hydraulic losses from curves, transitions, etc. This adjustment is accomplished by the use of Figure 10 in the Appendix, entitled " Relation of Friction Loss to Total Loss for Given Velocities in Conduits," and the storm drain is sized accordingly, using the Manning formula.

A further adjustment in the approximate conduit size was made utilizing the hydraulic gradient developed during preparation of Volume I "Prelimary Plans and Profiles of Proposed Storm Drains."

The runoff tributary to an intersection in which inlets are proposed has been approximated by adjusting the quantity of main line intersection inflow. The adjustment factor was the ratio between the runoff coefficients corresponding to the assumed time of concentration for the tributary areas and the main line time of concentration.

SECTION III

EXISTING DRAINAGE FACILITIES

1. GENERAL

The existing drainage facilities located within the boundaries outlined by this report are not capable of offering adequate protection from runoff generated by a rainfall having a 10-year frequency of occurrence. Rainfall of much lesser intensities will inundate various areas because of the lack of adequate drainage facilities. This condition will worsen as additional areas become developed and more runoff is generated.

The existing facilities are basically composed of four trunk lines and a series of lateral inlets. Hole Lake is the major point of disposal of runoff produced within the area. The trunk drains which comprise the existing system are: the Monroe Drain, The Hillside Drain, The Jackson-Arlington Drain, and The Bryant Park Outlet Channel. Map No. 1 entitled, "Existing and Proposed Storm Drain Facilities," enclosed at the back of this report, shows the location of these storm drains.

These major facilities have been investigated at length. However, there are small localized lines which have been reviewed and accepted as adequate if their drainage area is small and their carrying capacity appears adequate.

The drainage conveyed by the Hillside drain is directed into the Santa Ana River. The drainage conveyed by the other major trunk lines is discharged into Hole Lake. Hole Lake is privately owned and impounds water behind an earth fill dam. Excess inflow is passed over two concrete spillways and into the Santa Ana River.

The study area is protected from flash floods by two dams operated by the Riverside County Flood Control and Water Conservation District. Controlled outlet flows of 85 c.f.s. from Prenda Dam and 140 c.f.s. from the Woodcrest Dam are included in the analysis of the master plan.

2. CONDITION

A field investigation of the existing drainage facilities was conducted in order to determine their general condition. The open channel sections were inspected at grade. The closed conduits were inspected at manholes.

The Monroe Drain consists primarily of trapazoidal concrete lined channel. A portion of this channel has been covered with an apparently unreinforced arch top. The arch top appears at grade or above grade throughout most of its length.

The concrete lined channel portion of the Monroe Drain appeared in fair condition. However there are sections of this channel, located between Brunswick Avenue and California Avenue, in which the side has fractured and bulged out. The covered reach of the Monroe Channel, located between Magnolia Avenue and Dos Casas Place, is in poor condition. The arch top was found to be extremely deteriorated. Chemical action has decomposed the concrete at the soffit. The resulting disintegration has produced cracks and voids. The arch top section has little or no cover throughout its length, therefore a reduction in the effective thickness of the top slab presents a question of structural adequacy.

The Hillside Drain consisting of concrete conduit appears to be in good condition as does the Jackson-Arlington Drain which consists of concrete conduit and concrete

lined trapazoidal channel. The Bryant Park Outlet Channel between Cypress Avenue and Philbin Avenue is an earth ditch and is a maintenance problem.

3. CAPACITIES

The official records of the City of Riverside were utilized to determine the location, elevation and size of the existing storm drains. The capacities were then computed by employing Manning's formula.

An analysis of the Monroe Area indicates the importance of the Monroe Channel. It acts as the aortal trunk for most of the runoff generated in the area. Its existing capacity is limited to conveying runoff collected from uncontrolled areas northerly of Indiana Avenue and Easterly of the alignment of the drain.

With the exception of very minor reaches within the major trunk lines, the existing facilities are not capable of conveying the runoff generated by a ten-year storm.

The existing outlet facilities at Hole Lake consist of two spillways. If additional flows are channelized into the lake, as proposed,these spillways will not safely pass the design storm runoff through the lake.

SECTION IV

PROPOSED DRAINAGE FACILITIES

1. GENERAL

The immediate need for additional drainage facilities for the portion of the City of Riverside covered by this investigation is great and will continue to become more critical as the land becomes more fully developed.

In the development of this Master Drainage Plan, the existing drainage facilities were utilized to their maximum capacity or as dictated by the economics of constructing paralleling facilities. The alignments and points of disposal of the proposed lines resulted from investigating several alternate routes and methods of disposal. The systems shown are the most economical and feasible alignments. The location of the existing and proposed drains comprising this Master Drainage Plan are shown on Map No. 1. A preliminary plan and profile of each proposed storm drain is bound in Volume 1 as a supplement to this report.

When the construction of a storm drain is considered, its feasibility depends upon whether or not the estimated project cost is outweighed by the value of foreseeable damages and inconveniences which would result from the absence of that project.

As a basis for this report substantial damages and inconvenience were foreseen when the quantity of runoff in a street was greater than that which could be contained within the limits of the curbs, either existing or future. Storm drain conduits were initiated when this condition occurred.

The storm drain plans developed for this report are preliminary in nature and should only be used as an over-all guide for the ultimate construction plans. The construction plans will entail a complete investigation of existing utilities, localized drainage areas, detailed field survey, detailed hydraulic calculations and other factors.

Storm drains were initiated in undeveloped areas predicated on assumed street patterns and drainage areas. The size and location of the drainage facilities are based upon these runoff patterns. However, there is adequate flexibility within the assumed pattern so that minor alterations will not alter the considerations of the Master Drainage Plan.

Drainage facilities, either existing or future, which serve only a small localized area have not been shown in the Master Drainage Plan.

2. DRAINAGE SYSTEMS

The letter designation of the four drainage systems developed for the Master Drainage Plan are arbitrary and utilized only to simplify the description of the total study area.

System A

System A will intercept the runoff northerly of the Riverside Freeway and westerly of the existing Monroe drain and discharge this runoff into Hole Lake. The system is composed of concrete lined channel sections and concrete conduits. Its downstream alignment replaces an inadequate existing ditch. The invert is positioned vertically to facilitate lateral connections and minimize easement widths and utility relocations. The standing water surface elevation in Hole Lake must be lowered when this proposed

trunk is constructed. The transverse runoff is conveyed to the trunk line by means of a pattern of laterals. These laterals vary in diameter from 24-inch to 96-inch.

At California Avenue and Jackson Avenue the trunk intersects the existing Jackson Avenue storm drain, which outlets into the Monroe drain. The existing drain southerly of California Avenue is diverted into System A thereby relieving the burdened Monroe drain. That portion of the Jackson drain is paralleled by a proposed line, from California Avenue to Garfield Avenue, in order to convey greater runoff.

SYSTEM B

System B will intercept the runoff southerly of Indiana Avenue and convey this runoff a series of retarding basins. This system outlets into System C, which has a capacity limited to that of the existing Monroe drain.

Flow is conveyed to retarding basins by a series of concrete lined channel sections and concrete conduits. The retarding basins retain the bulk of a 24 hour storm runoff while discharging a controlled flow into System C, thereby preventing an overload in that system. It is not necessary that these retarding basins be utilized throughout the year solely as flood control facilities. They may be landscaped and transformed into park and playground areas.

SYSTEM C

System C serves the area northerly of Indiana Avenue, easterly of the existing Monroe drain and generally southerly of Arlington Avenue.

The majority of the existing drainage facilities located within the boundaries of this Master Drainage plan are integrated into this system. The existing Monroe drain is

the major facility and conveys flow into Hole Lake. A fraction of its flow is bypassed into System D. This diversion was necessitated by the limited capacity of the two existing box culverts located at the intersection of Arlington Avenue and Van Buren Boulevard. This diversion is proposed upstream of the culverts rather than construct additional facilities at the intersection as a preliminary investigation indicated many construction problems.

The Jefferson-Arlington drain discharges into the Monroe drain and is presently overloaded from its origin upstream to Magnolia Avenue. A proposed line relieves this condition at Magnolia Avenue by diverting flow away from the Jefferson line. Hydraulic balance is then achieved downstream of Magnolia Avenue by proposed paralleling facilities along reaches having insufficient capacity.

System D

System D intercepts runoff northerly of Arlington Avenue. The system is composed of concrete lined channel and concrete conduits. A line is proposed to parallel the existing Hillside Drain which is inadequate.

There are several lines in this system which are proposed in areas which are not presently developed. Street patterns have been assumed and drainage facilities serving these areas have been proposed. However, there is enough flexability in the assumed street pattern so that it may be varied during final design without altering the effect of the proposed drainage system.

The outlet facilities at Hole Lake dam must be modified in order to pass the design storm through the lake as well as lower the standing water surface. The lake water surface must be lowered to prevent standing water from backing up past Arlington Avenue. This condition would exist if the spillway crests remained at their present elevation and the proposed System A channel was constructed.

Various outlet works which would pass the design storm through the lake as well as lower the elevation of the standing water surface were studied. As a result of these studies, spillway modifications were found to be the most feasible. The eastern spillway and outlet structure should be widened to 35' and the crest established approximately 2 feet lower than that of the existing spillway. No modification is proposed to the western spillway.

3. COST ESTIMATE

Cost estimates for each of the existing lines are summarized in Table A in the Appendix. The unit costs are based on estimated current construction costs of the Riverside area. These estimates include the cost of the main line storm drain, appurtenances to the storm drain, retarding basins, modification to existing drainage facilities, and the estimated reconstruction of sanitary sewer and water facilities.

The unit cost per lineal foot of curb opening for inlets includes the cost of connection pipes and local depressions. The capacities of typical inlet openings have been studied and it has been assumed that one lineal foot of curb inlet opening will intercept approximately 0.6 cubic feet per second of surface runoff. This average value has been adopted for the Master Plan, although during detailed design, a great variance will occur from one point of interception to another.

The cost of sanitary sewer reconstruction was estimated by considering the location of existing sewers, probable location of other underground utilities, future development, and size and location of proposed storm drain.

There are many costs involved to complete the project cost proposed in the Master Drainage Plan other than those indicated in Table A such as the cost of administration, engineering, inspection, rights of way, utility relocation and incidentals. Table 2 summarizes the estimated total project costs.

TABLE 2

ESTIMATED PROJECT CONSTRUCTION COST

FOR

MASTER DRAINAGE PLAN

	A	B	C	D	TOTAL
Storm Drain & Appurtenances	$2,875,000	$3,933,000	$1,912,000	$1,683,000	$10,403,000
Admin. & Engr.	432,000	590,000	287,000	253,000	1,562,000
Right-of-Way	106,000	453,000	47,000	24,000	630,000
Contingencies	144,000	196,000	96,000	84,000	520,000
TOTALS	$3,557,000	$5,172,000	$2,342,000	$2,044,000	$13,115,000

TABLE A

PRELIMINARY COST ESTIMATE FOR STORM DRAINS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
LINE A				
Concrete Lined Channel	10,210	L.F.	$ 69.00	$ 704,900
Concrete Box Culvert	1,050	L.F.	118.00	123,800
96" R.C.P.	1,610	L.F.	89.00	142,290
69" R.C.P.	2,950	L.F.	51.00	150,450
48" R.C.P.	1,375	L.F.	32.00	44,000
Structures	1	Job		8,300
Catch Basins	1,020	L.F.	140.00	142,800
Sewer & Water Reconstruction	1	Job		11,460
TOTAL				$1,329,000
LINE A - 1				
96" R.C.P.	1,360	L.F.	$ 89.00	$ 121,040
75" R.C.P.	2,000	L.F.	60.00	120,000
60" R.C.P.	1,200	L.F.	46.00	55,200
57" R.C.P.	1,500 (976)	L.F.	43.00	64,500
42" R.C.P.	920	L.F.	28.00	25,760
27" R.C.P.	900	L.F.	18.00	16,200
Structures	1	Job		8,300
Catch Basins	800	L.F.	140.00	112,000
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 523,000
LINE A - 2				
57" R.C.P.	775	L.F.	$ 42.00	$ 32,600
36" R.C.P.	2,900	L.F.	23.00	66,700
Structures	1	Job		3,400
Catch Basins	195	L.F.	140.00	27,300
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 130,000

TABLE A - Cont'd.

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
LINE A - 3				
72" R.C.P.	1,350	L.F.	$ 60.00	$ 81,000
60" R.C.P.	900	L.F.	44.00	39,600
48" R.C.P.	1,160	L.F.	34.00	39,450
24" R.C.P.	650	L.F.	17.00	11,050
Structures	1	Job		4,600
Catch Basins	545	L.F.	140.00	76,300
Sewer & Water Reconstruction	1	Job		3,000
TOTAL				$ 255,000
LINE A - 4				
45" R.C.P.	1,325	L.F.	$ 32.00	$ 42,400
36" R.C.P.	900	L.F.	24.00	21,600
Structures	1	Job		2,400
Catch Basins	133	L.F.	140.00	18,600
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 85,000
LINE A - 5				
48" R.C.P.	1,050	L.F.	$ 32.00	$ 33,600
36" R.C.P.	1,000	L.F.	23.00	23,000
Structures	1	Job		2,000
Catch Basins	216	L.F.	140.00	30,400
Sewer & Water Reconstruction	1	Job		6,000
TOTAL				$ 95,000
LINE A - 6				
54" R.C.P.	1,350	L.F.	$ 36.00	$ 48,600
36" R.C.P.	975	L.F.	22.00	21,400
24" R.C.P.	750	L.F.	16.00	12,000
Structures	1	Job		3,000
Catch Basins	178	L.F.	140.00	25,000
Sewer & Water Reconstruction	1	Job		9,000
TOTAL				$ 119,000

TABLE A - Cont'd.

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
LINE A - 7				
45" R.C.P.	1,225	L.F.	$ 32.00	$ 39,200
36" R.C.P.	1,300	L.F.	24.00	31,200
Structures	1	Job		2,400
Catch Basins	145	L.F.	140.00	20,200
Sewer & Water Reconstruction	1	Job		3,000
TOTAL				$ 96,000
LINE A - 8				
51" R.C.P.	900	L.F.	$ 35.00	$ 31,500
Structures	1	Job		800
Catch Basins	55	L.F.	140.00	2,700
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 40,000
LINE A - 9				
45" R.C.P.	375	L.F.	$ 29.00	$ 10,900
36" R.C.P.	1,200	L.F.	28.00	33,600
Structures	1	Job		1,400
Catch Basins	151	L.F.	140.00	21,100
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 67,000
LINE A - 10				
36" R.C.P.	1,350	L.F.	$ 22.00	$ 29,700
30" R.C.P.	700	L.F.	18.00	12,600
Structures	1	Job		3,100
Catch Basins	169	L.F.	140.00	23,600
Sewer & Water Reconstruction	1	Job		1,000
TOTAL				$ 70,000

TABLE A - Cont'd.

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
LINE A - 11				
48" R.C.P.	1,350	L.F.	$ 32.00	$ 43,200
Structures	1	Job		1,800
Catch Basins	150	L.F.	140.00	21,000
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 66,000
LINE B				
Concrete Lined Channel	5,270	L.F.	$ 69.00	$ 363,600
Concrete Box Culvert	125	L.F.	126.00	15,750
81" R.C.P.	2,800	L.F.	67.00	187,600
57" R.C.P.	2,625	L.F.	41.00	107,625
45" R.C.P.	1,450	L.F.	30.00	43,500
Structures	1	Job		10,125
Catch Basins	740	L.F.	140.00	103,800
Sewer & Water Reconstruction	1	Job		9,000
TOTAL				$ 841,000
LINE B - 1				
36" R.C.P.	350	L.F.	$ 21.00	$ 7,350
Structures	1	Job		930
Catch Basins	33	L.F.	140.00	5,720
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 14,000
LINE B - 2				
96" R.C.P.	290	L.F.	$ 85.00	$ 24,650
57" R.C.P.	1,330	L.F.	42.00	55,860
42" R.C.P.	1,390	L.F.	28.00	38,920
33" R.C.P.	1,480	L.F.	21.00	31,080
Structures	1	Job		4,490
Catch Basins	435	L.F.	140.00	61,000
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 216,000

TABLE A - Cont'd.

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
LINE B - 3				
39" R.C.P.	1,325	L.F.	$ 25.00	$ 33,125
33" R.C.P.	1,400	L.F.	21.00	29,400
Structures	1	Job		2,175
Catch Basins	202	L.F.	140.00	28,300
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 93,000
LINE B - 4				
Concrete Lined Channel	1,660	L.F.	$ 60.00	$ 99,600
Concrete Box Culvert	80	L.F.	82.00	6,500
72" R.C.P.	165	L.F.	54.00	8,900
Structures	0	0	0	0
Catch Basins	0	0	0	0
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 115,000
LINE B - 5				
33" R.C.P.	1,200	L.F.	$ 21.00	$ 25,200
Structures	1	Job		1,000
Catch Basins	92	L.F.	140.00	12,800
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 39,000
LINE B - 6				
48" R.C.P.	1,450	L.F.	$ 32.00	$ 46,400
42" R.C.P.	2,550	L.F.	28.00	71,400
Structures	1	Job		4,200
Catch Basins	350	L.F.	140.00	49,000
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 171,000

TABLE A - Cont'd.

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
LINE B - 7				
114" R.C.P.	1,450	L.F.	$ 161.00	$ 233,450
108" R.C.P.	1,375	L.F.	109.00	149,875
96" R.C.P.	1,375	L.F.	85.00	116,875
54" R.C.P.	1,375	L.F.	37.00	50,875
39" R.C.P.	475	L.F.	24.00	11,400
Structures	1	Job		20,000
Catch Basins	650	L.F.	140.00	91,000
Sewer & Water Reconstruction	1	Job		5,525
TOTAL				$ 679,000
LINE B - 8				
39" R.C.P.	1,450	L.F.	$ 25.00	$ 36,250
Structures	1	Job		1,650
Catch Basins	158	L.F.	140.00	22,100
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 60,000
LINE B - 9				
66" R.C.P.	675	L.F.	$ 49.00	$ 33,075
63" R.C.P.	1,350	L.F.	46.00	62,100
54" R.C.P.	630	L.F.	37.00	23,310
33" R.C.P.	750	L.F.	20.00	15,000
Structures	1	Job		3,315
Catch Basins	344	L.F.	140.00	48,200
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 185,000

TABLE A - Cont'd.

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
LINE B - 10				
Concrete Lined Channel	10,575	L.F.	$ 35.00	$ 370,120
Concrete Box Culvert	25	L.F.	54.00	1,350
96" R.C.P.	100	L.F.	85.00	8,500
72" R.C.P.	50	L.F.	54.00	2,700
60" R.C.P.	50	L.F.	41.00	2,050
Structures	1	Job		49,680
Catch Basins	40	L.F.	140.00	5,600
Sewer & Water Reconstruction	1	Job		3,000
TOTAL				$ 443,000
LINE B - 11				
48" R.C.P.	1,500	L.F.	$ 40.00	$ 60,000
36" R.C.P.	2,475	L.F.	23.00	56,925
Structures	1	Job		4,275
Catch Basins	242	L.F.	140.00	33,800
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 155,000
LINE B - 12				
54" R.C.P.	1,125	L.F.	$ 39.00	$ 43,875
48" R.C.P.	2,125	L.F.	34.00	72,250
36" R.C.P.	1,025	L.F.	23.00	23,575
Structures	1	Job		4,300
Catch Basins	307	L.F.	140.00	43,000
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 187,000
LINE B - 13				
39" R.C.P.	1,650	L.F.	$ 25.00	$ 41,250
Structures	1	Job		1,750
Catch Basins	143	L.F.	140.00	20,000
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 63,000

TABLE A - Cont'd.

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
LINE B - 14				
33" R.C.P.	1,300	L.F.	$ 20.00	$ 26,000
30" R.C.P.	1,375	L.F.	18.00	24,750
24" R.C.P.	1,375	L.F.	16.00	22,000
Structures	1	Job		1,650
Catch Basins	133	L.F.	140.00	18,600
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 93,000
LINE B - 15				
48" R.C.P.	1,525	L.F.	$ 32.00	$ 48,800
30" R.C.P.	1,750	L.F.	18.00	31,500
Structures	1	Job		3,100
Catch Basins	83	L.F.	140.00	11,600
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 95,000
Retarding Basin No. 1	1	Job		$ 310,000
Retarding Basin No. 2	1	Job		122,000
Retarding Basin No. 3	1	Job		52,000
LINE C				
Concrete Lined Channel	3,150	L.F.	$ 124.00	$ 390,600
Structures	1	Job		15,400
Catch Basins	0	0	0	0
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 406,000
LINE C - 1				
Concrete Box Culvert	2,200	L.F.	$ 44.00	$ 96,800
45" R.C.P.	1,625	L.F.	30.00	48,750
Structures	1	Job		3,000
Catch Basins	132	L.F.	140.00	18,480
Sewer & Water Reconstruction	1	Job		5,970
TOTAL				$ 173,000

TABLE A - Cont'd.

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
LINE C - 2				
36" R.C.P.	500	L.F.	$ 22.00	$ 11,000
Structures	1	Job		200
Catch Basins	192	L.F.	140.00	26,800
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 38,000
LINE C - 3				
51" R.C.P.	1,100	L.F.	$ 33.00	$ 36,300
45" R.C.P.	1,700	L.F.	27.00	45,900
Structures	1	Job		4,400
Catch Basins	167	L.F.	140.00	23,400
Sewer & Water Reconstruction	1	Job		6,000
TOTAL				$ 116,000
LINE C - 4				
42" R.C.P.	1,630	L.F.	$ 26.00	$ 42,380
33" R.C.P.	1,287	L.F.	21.00	27,020
27" R.C.P.	1,000	L.F.	17.00	17,000
Structures	1	Job		5,100
Catch Basins	175	L.F.	140.00	24,500
Sewer & Water Reconstruction	1	Job		5,000
TOTAL				$ 121,000
LINE C - 5				
45" R.C.P.	1,000	L.F.	$ 28.00	$ 28,000
33" R.C.P.	1,050	L.F.	20.00	21,000
Structures	1	Job		2,600
Catch Basins	110	L.F.	140.00	15,400
Sewer & Water Reconstruction	1	Job		8,000
TOTAL				$ 75,000

TABLE A - Cont'd.

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
LINE C - 6				
Concrete Box Culvert	1,000	L.F.	$ 64.00	$ 64,000
78" R.C.P.	2,900	L.F.	64.00	185,600
72" R.C.P.	1,975	L.F.	54.00	106,650
66" R.C.P.	900	L.F.	48.00	43,200
Structures	1	Job		10,150
Catch Basins	303	L.F.	140.00	42,400
Sewer & Water Reconstruction	1	Job		18,000
TOTAL				$ 470,000
LINE C - 7				
39" R.C.P.	750	L.F.	$ 25.00	$ 18,750
33" R.C.P.	1,100	L.F.	21.00	23,100
Structures	1	Job		1,850
Catch Basins	145	L.F.	140.00	20,300
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 64,000
LINE C - 8				
36" R.C.P.	1,335	L.F.	$ 23.00	$ 30,705
Structures	1	Job		1,295
Catch Basins	145	L.F.	140.00	20,000
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 52,000
LINE C - 9				
42" R.C.P.	900	L.F.	$ 26.00	$ 23,400
30" R.C.P.	1,150	L.F.	18.00	20,700
Structures	1	Job		1,900
Catch Basins	250	L.F.	140.00	35,000
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 81,000

TABLE A - Cont'd.

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
LINE C - 10				
33" R.C.P.	1,550	L.F.	$ 20.00	$ 31,000
Structures	1	Job		1,400
Catch Basins	83	L.F.	140.00	11,600
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 44,000
LINE C - 11				
33" R.C.P.	1,250	L.F.	$ 21.00	$ 26,250
Structures	1	Job		1,150
Catch Basins	83	L.F.	140.00	11,600
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 39,000
LINE C - 12				
Concrete Box Culvert	720	L.F.	$ 50.00	$ 36,000
Structures	1	Job		3,000
Catch Basins	0	0	0	0
Sewer & Water Reconstruction	1	Job		3,000
TOTAL				$ 42,000
LINE C - 13				
54" R.C.P.	2,250	L.F.	$ 37.00	$ 83,250
48" R.C.P.	725	L.F.	32.00	23,200
Concrete Box Culvert	500	L.F.	44.00	22,000
Structures	1	Job		3,350
Catch Basins	30	L.F.	140.00	5,200
Sewer & Water Reconstruction	1	Job		3,000
TOTAL				$ 140,000

TABLE A - Cont'd.

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
LINE C - 14				
Concrete Box Culvert	600	L.F.	$ 78.00	$ 46,800
Structures	1	Job		4,200
Catch Basins	0	0	0	0
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 51,000
LINE D - 1				
Structures	1	Job		$ 2,500
Catch Basins	0	0	0	0
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 2,500
LINE D - 2				
42" R.C.P.	1,650	L.F.	$ 28.00	$ 46,200
Structures	1	Job		1,600
Catch Basins	165	L.F.	140.00	23,200
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 71,000
LINE D - 3				
Structures	1	Job		$ 2,500
Catch Basins	0	0	0	0
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 2,500
LINE D - 4				
Concrete Lined Channel	2,000	L.F.	$ 35.00	$ 70,000
Structures	1	Job		3,600
Catch Basins	260	L.F.	140.00	36,400
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 110,000

TABLE A - Cont'd.

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
LINE D - 5				
66" R.C.P.	1,375	L.F.	$ 52.00	$ 71,500
39" R.C.P.	1,275	L.F.	25.00	31,875
36" R.C.P.	2,125	L.F.	24.00	51,000
24" R.C.P.	925	L.F.	17.00	15,725
Structures	1	Job		5,800
Catch Basins	137	L.F.	140.00	19,100
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 195,000
LINE D - 6				
42" R.C.P.	1,362	L.F.	$ 28.00	$ 38,136
Structures	1	Job		864
Catch Basins	250	L.F.	140.00	35,000
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 74,000
LINE D - 7				
81" R.C.P.	1,780	L.F.	$ 69.00	$ 122,820
57" R.C.P.	1,050	L.F.	43.00	45,150
48" R.C.P.	1,700	L.F.	34.00	57,800
42" R.C.P.	1,350	L.F.	28.00	37,800
30" R.C.P.	425	L.F.	20.00	8,500
Structures	1	Job		5,930
Catch Basins	259	L.F.	140.00	32,000
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 310,000
LINE D - 8				
42" R.C.P.	675	L.F.	$ 28.00	$ 18,900
Structures	1	Job		1,200
Catch Basins	42	L.F.	140.00	5,900
Sewer & Water Reconstruction	1	Job		3,000
TOTAL				$ 29,000

TABLE A - Cont'd.

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST
LINE D - 9				
84" R.C.P.	950	L.F.	$ 73.00	$ 69,350
54" R.C.P.	700	L.F.	41.00	28,700
48" R.C.P.	1,400	L.F.	34.00	47,600
30" R.C.P.	1,225	L.F.	19.00	23,275
Structures	1	Job		4,675
Catch Basins	310	L.F.	140.00	43,400
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 218,000
LINE D - 10				
45" R.C.P.	1,625	L.F.	$ 30.00	$ 48,750
30" R.C.P.	825	L.F.	19.00	15,675
Structures	1	Job		7,875
Catch Basins	270	L.F.	140.00	37,700
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 110,000
LINE D - 11				
39" R.C.P.	480	L.F.	$ 24.00	$ 11,520
Structures	1	Job		1,860
Catch Basins	83	L.F.	140.00	11,620
Sewer & Water Reconstruction	0	0	0	0
TOTAL				$ 25,000
LINE D - 12				
84" R.C.P.	1,050	L.F.	$ 73.00	$ 76,650
81" R.C.P.	1,350	L.F.	71.00	95,850
78" R.C.P.	2,225	L.F.	65.00	144,625
63" R.C.P.	825	L.F.	47.00	38,775
57" R.C.P.	1,250	L.F.	41.00	51,250
36" R.C.P.	1,825	L.F.	23.00	41,975
Structures	1	Job		9,850
Catch Basins	450	L.F.	140.00	63,000
Sewer & Water Reconstruction	1	Job		3,000
TOTAL				$ 483,000
Hole Lake Spillway & Outlet Works Modification	1	Job		$ 50,000

KOEBIG & KOEBIG
LOS ANGELES

Sht. _____

TABLE B

HYDROLOGY CALCULATION SHEET

FREQUENCY _____
ISOHYETAL ZONE _____

DATE 4-10-65
CALC. BY J.V.
CHECKED BY P.P.

DRAINAGE AREA	Soil & Development *	A * Acres	I in/hr.	C	ΔQ CFS	ΣQ CFS	SLOPE *	SECTION	v FPS	L * FT.	T MIN.	ΣT MIN.	REMARKS
							.090			1000	10.0		
1	3-SF	30	1.84	.82	45.2	45.2	.060	36'St*	6.8	400	1.0	10.0	
2	3-SF	20	1.74	.80	27.8	73.0	.0092 .01	39" ø	8.7			11.0	

* Items to be determined prior to calculating runoff.

RIVERSIDE COUNTY FLOOD CONTROL
WATER CONSERVATION DISTRICT
INTENSITY-DURATION CURVE DATA
INCHES PER HOUR

5.0 Min. - 15.0 Min.

tc Min.	I	tc min.	I	tc min.	I	tc min.	I	tc min.	I
5.0	2.66	7.0	2.23	9.0	1.95	11.0	1.74	13.0	1.59
.1	2.63	.1	2.21	.1	1.94	.1	1.73	.1	1.59
.2	2.60	.2	2.19	.2	1.92	.2	1.72	.2	1.58
.3	2.57	.3	2.17	.3	1.91	.3	1.72	.3	1.57
.4	2.54	.4	2.15	.4	1.90	.4	1.71	.4	1.57
.5	2.53	.5	2.14	.5	1.89	.5	1.70	.5	1.56
.6	2.50	.6	2.12	.6	1.88	.6	1.69	.6	1.55
.7	2.48	.7	2.10	.7	1.87	.7	1.68	.7	1.54
.8	2.46	.8	2.08	.8	1.86	.8	1.67	.8	1.54
.9	2.44	.9	2.06	.9	1.85	.9	1.67	.9	1.53
6.0	2.42	8.0	2.07	10.0	1.84	12.0	1.66	14.0	1.53
.1	2.40	.1	2.04	.1	1.83	.1	1.65	.1	1.52
.2	2.38	.2	2.03	.2	1.82	.2	1.64	.2	1.52
.3	2.36	.3	2.02	.3	1.81	.3	1.63	.3	1.51
.4	2.34	.4	2.01	.4	1.80	.4	1.62	.4	1.51
.5	2.32	.5	2.00	.5	1.79	.5	1.62	.5	1.50
.6	2.30	.6	1.99	.6	1.78	.6	1.61	.6	1.50
.7	2.28	.7	1.98	.7	1.77	.7	1.61	.7	1.49
.8	2.26	.8	1.97	.8	1.76	.8	1.60	.8	1.48
.9	2.24	.9	1.96	.9	1.75	.9	1.60	.9	1.48
7.0	2.23	9.0	1.95	11.0	1.74	13.0	1.59	15.0	1.47

15.0 Min. - 25.0 Min.

15.0	1.47	17.0	1.38	19.0	1.30	21.0	1.23	23.0	1.17
.2	1.46	.2	1.37	.2	1.29	.2	1.23	.2	1.17
.4	1.45	.4	1.36	.4	1.28	.4	1.22	.4	1.16
.6	1.44	.6	1.35	.6	1.27	.6	1.22	.6	1.16
.8	1.43	.8	1.34	.8	1.26	.8	1.21	.8	1.15
16.0	1.42	18.0	1.34	20.0	1.26	22.0	1.20	24.0	1.14
.2	1.41	.2	1.33	.2	1.25	.2	1.20	.2	1.14
.4	1.40	.4	1.32	.4	1.25	.4	1.19	.4	1.13
.6	1.39	.6	1.31	.6	1.24	.6	1.19	.6	1.13
.8	1.38	.8	1.30	.8	1.24	.8	1.18	.8	1.12
17.0	1.38	19.0	1.30	21.0	1.23	23.0	1.17	25.0	1.12

25.0 Min. - 35.0 Min.

25.0	1.12	27.0	1.07	29.0	1.03	31.0	0.99	33.0	0.95
.5	1.11	.5	1.06	.5	1.02	.5		.5	
26.0	1.09	28.0	1.05	30.0	1.01	32.0	0.97	34.0	0.94
.5	1.08	.5	1.04	.5	1.00	.5		.5	
27.0	1.07	29.0	1.03	31.0	0.99	33.0	0.95	35.0	0.93

TABLE C

RIVERSIDE COUNTY FLOOD CONTROL
WATER CONSERVATION DISTRICT
INTENSITY-DURATION CURVE DATA
INCHES PER HOUR

35. Min. - 60. Min.

tc min.	I	tc min.	I	tc min.	I	tc min.	I	tc min.	I
35	0.93	40	0.86	45	0.81	50	0.76	55	0.73
36	0.91	41	0.85	46	0.80	51	0.76	56	0.72
37	0.90	42	0.84	47	0.79	52	0.75	57	0.71
38	0.89	43	0.83	48	0.78	53	0.74	58	0.71
39	0.87	44	0.82	49	0.77	54	0.74	59	0.70
40	0.86	45	0.81	50	0.76	55	0.73	60	0.69

60. Min. - 85. Min.

60	0.69	65	0.67	70	0.64	75	0.62	80	0.59
61	0.69	66	0.66	71	0.64	76	0.61	81	0.59
62	0.68	67	0.66	72	0.63	77	0.61	82	0.59
63	0.68	68	0.65	73	0.63	78	0.60	83	0.58
64	0.67	69	0.65	74	0.62	79	0.60	84	0.59
65	0.67	70	0.64	75	0.62	80	0.59	85	0.58

85. Min. - 100 Min.

85	0.58	90	0.56	95	0.54
86	0.57	91	0.56	96	0.54
87	0.57	92	0.55	97	0.54
88	0.57	93	0.55	98	0.53
89	0.56	94	0.55	89	0.53
90	0.56	95	0.54	100	0.53

TABLE C

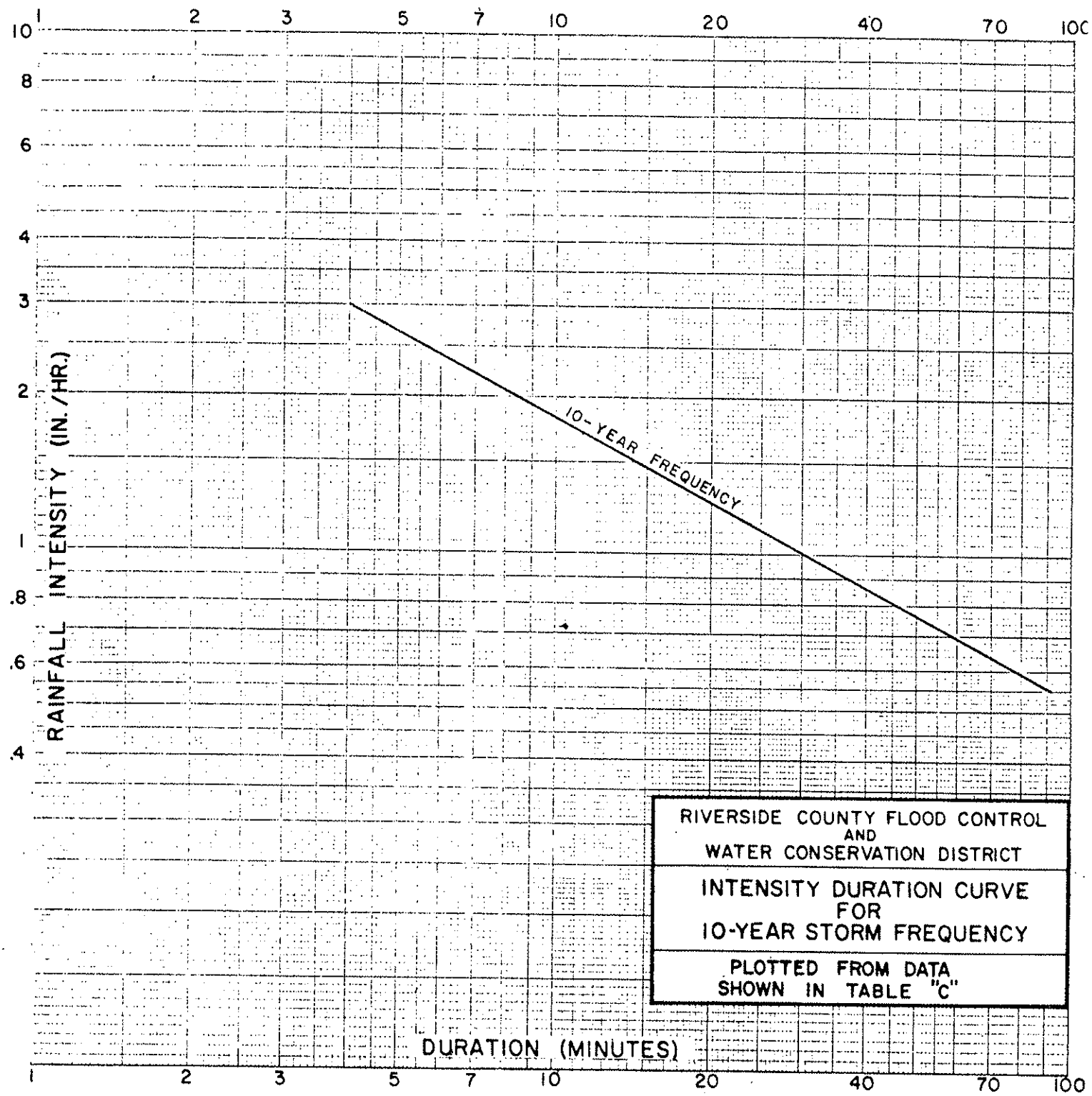
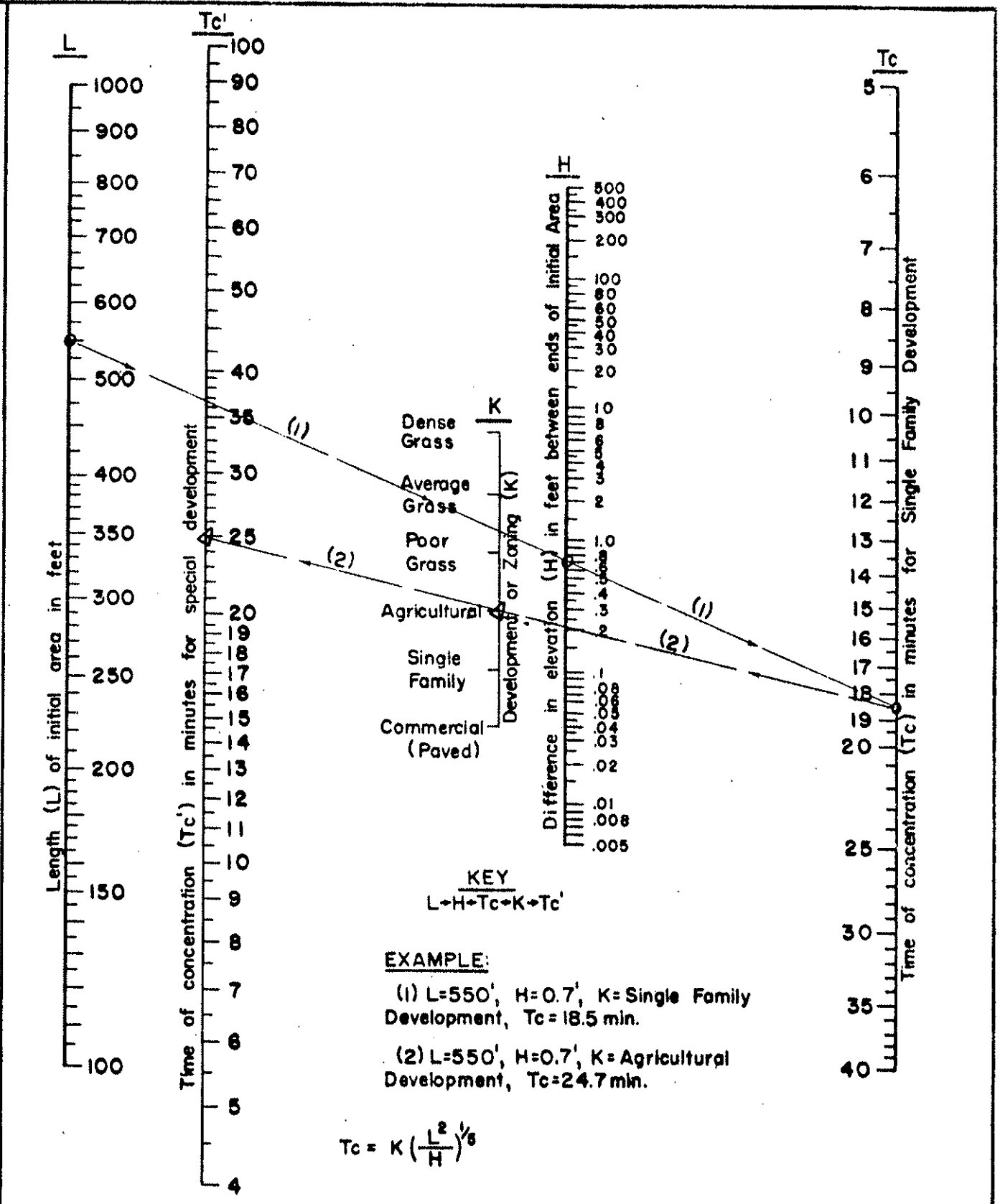

1
2
3
5
7
10
20
40
70
100
10
8
6
4
3
2
1
.8
.6
.4
RAINFALL INTENSITY (IN./HR.)
10-YEAR FREQUENCY
DURATION (MINUTES)
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
INTENSITY DURATION CURVE FOR 10-YEAR STORM FREQUENCY
PLOTTED FROM DATA SHOWN IN TABLE "C"

FIGURE 1

HYDROLOGY

Time Of Concentration For Initial Area

LIMITATIONS: Max. Length = 1000', Max. Area = 10 Acres



KEY

L→H→Tc→K→Tc'

EXAMPLE:

(1) L=550', H=0.7', K= Single Family Development, Tc = 18.5 min.

(2) L=550', H=0.7', K= Agricultural Development, Tc=24.7 min.

$$Tc = K\left(\frac{L^2}{H}\right)^{1/3}$$

FIGURE 2

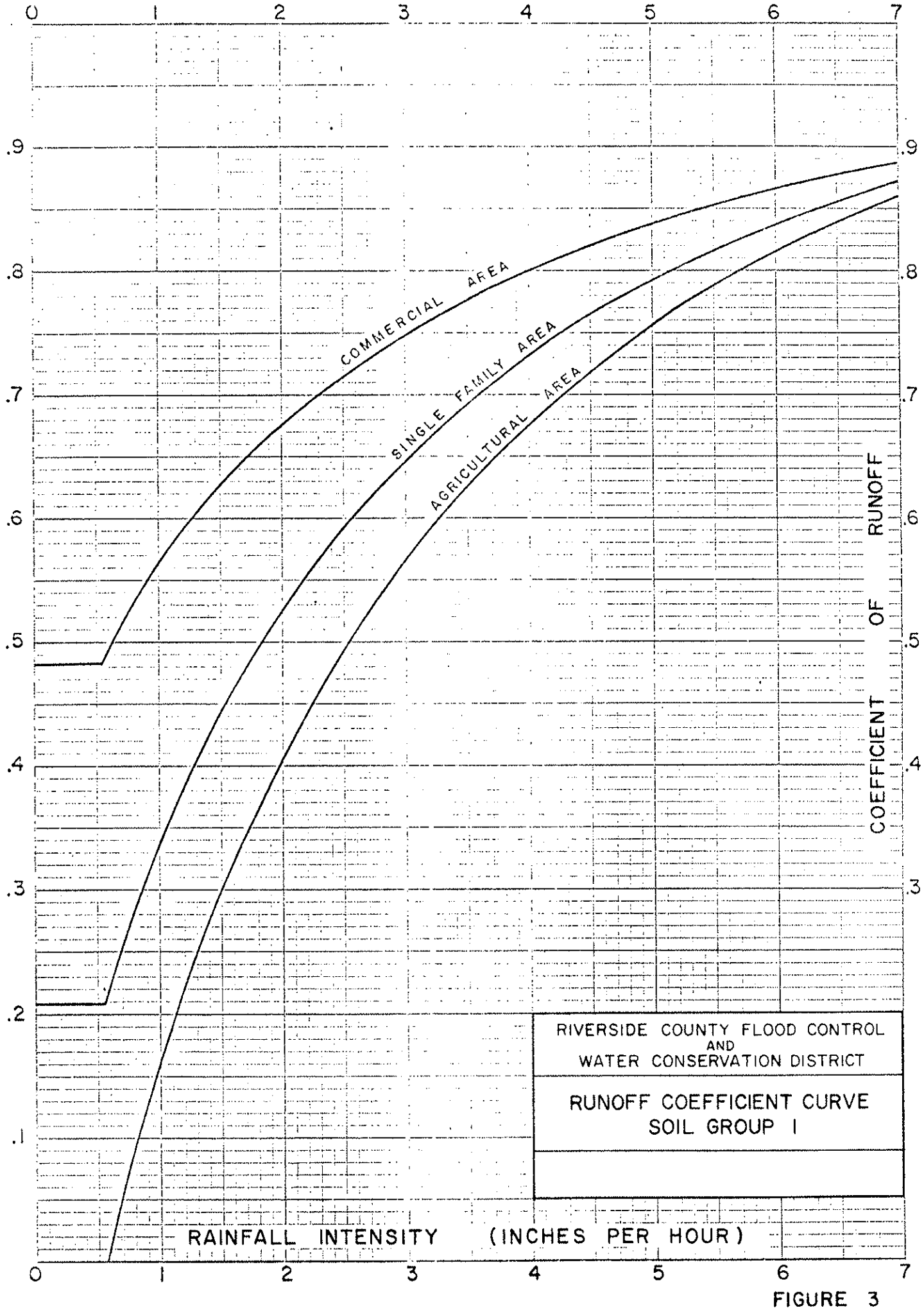

0
1
2
3
4
5
6
7
.9
.8
.7
.6
.5
.4
.3
.2
.1
COMMERCIAL AREA
SINGLE FAMILY AREA
AGRICULTURAL AREA
COEFFICIENT OF RUNOFF
RAINFALL INTENSITY (INCHES PER HOUR)
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
RUNOFF COEFFICIENT CURVE
SOIL GROUP I

FIGURE 3

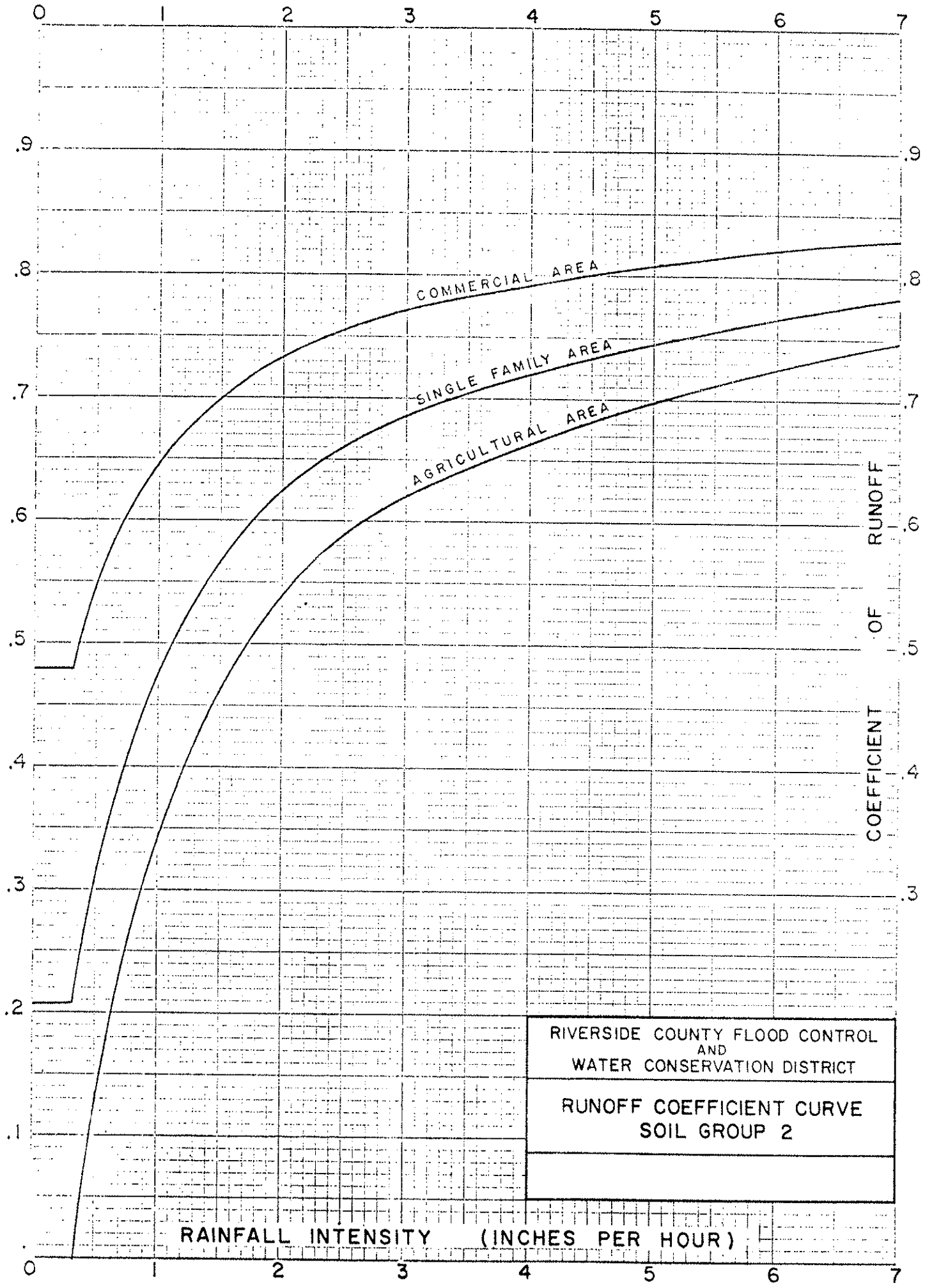

0
1
2
3
4
5
6
7
.9
.8
.7
.6
.5
.4
.3
.2
.1
COMMERCIAL AREA
SINGLE FAMILY AREA
AGRICULTURAL AREA
RUNOFF COEFFICIENT OF
RAINFALL INTENSITY (INCHES PER HOUR)
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
RUNOFF COEFFICIENT CURVE
SOIL GROUP 2

FIGURE 4

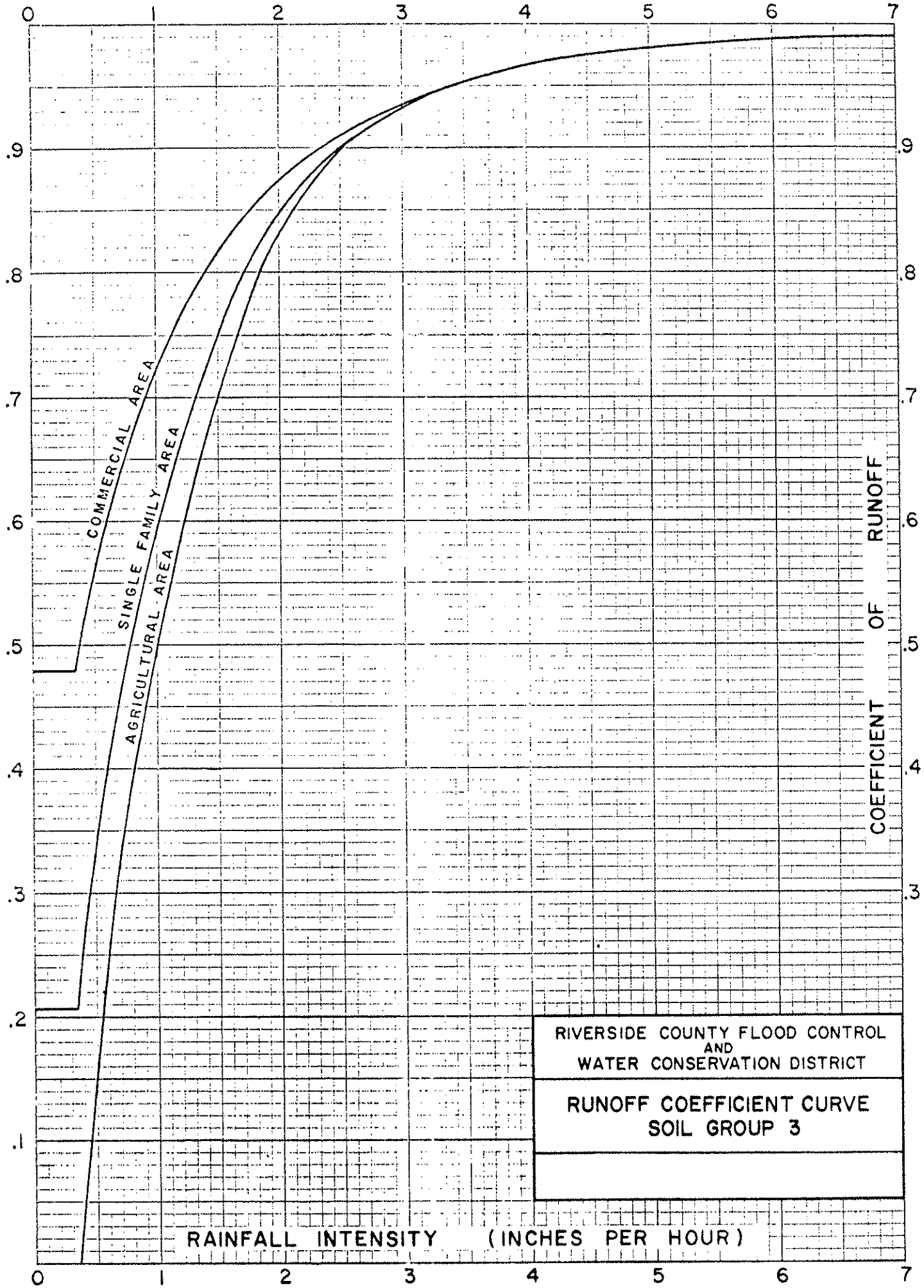

0
1
2
3
4
5
6
7
.9
.8
.7
.6
.5
.4
.3
.2
.1
COMMERCIAL AREA
SINGLE FAMILY AREA
AGRICULTURAL AREA
COEFFICIENT OF RUNOFF
RAINFALL INTENSITY (INCHES PER HOUR)
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
RUNOFF COEFFICIENT CURVE
SOIL GROUP 3

FIGURE 5

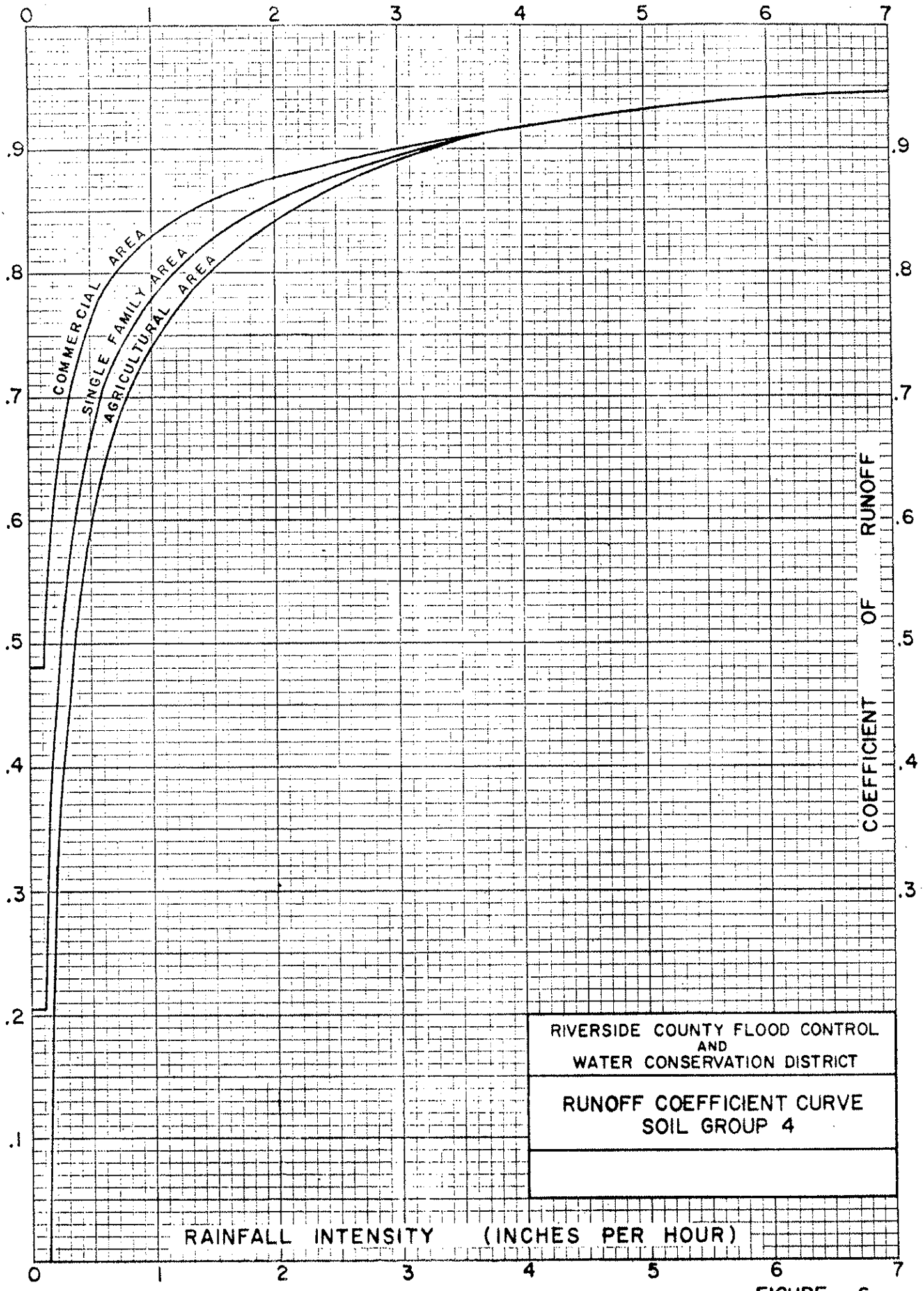

0
1
2
3
4
5
6
7
.9
.8
.7
.6
.5
.4
.3
.2
.1
COMMERCIAL AREA
SINGLE FAMILY AREA
AGRICULTURAL AREA
COEFFICIENT OF RUNOFF
RAINFALL INTENSITY (INCHES PER HOUR)
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
RUNOFF COEFFICIENT CURVE
SOIL GROUP 4

FIGURE 6

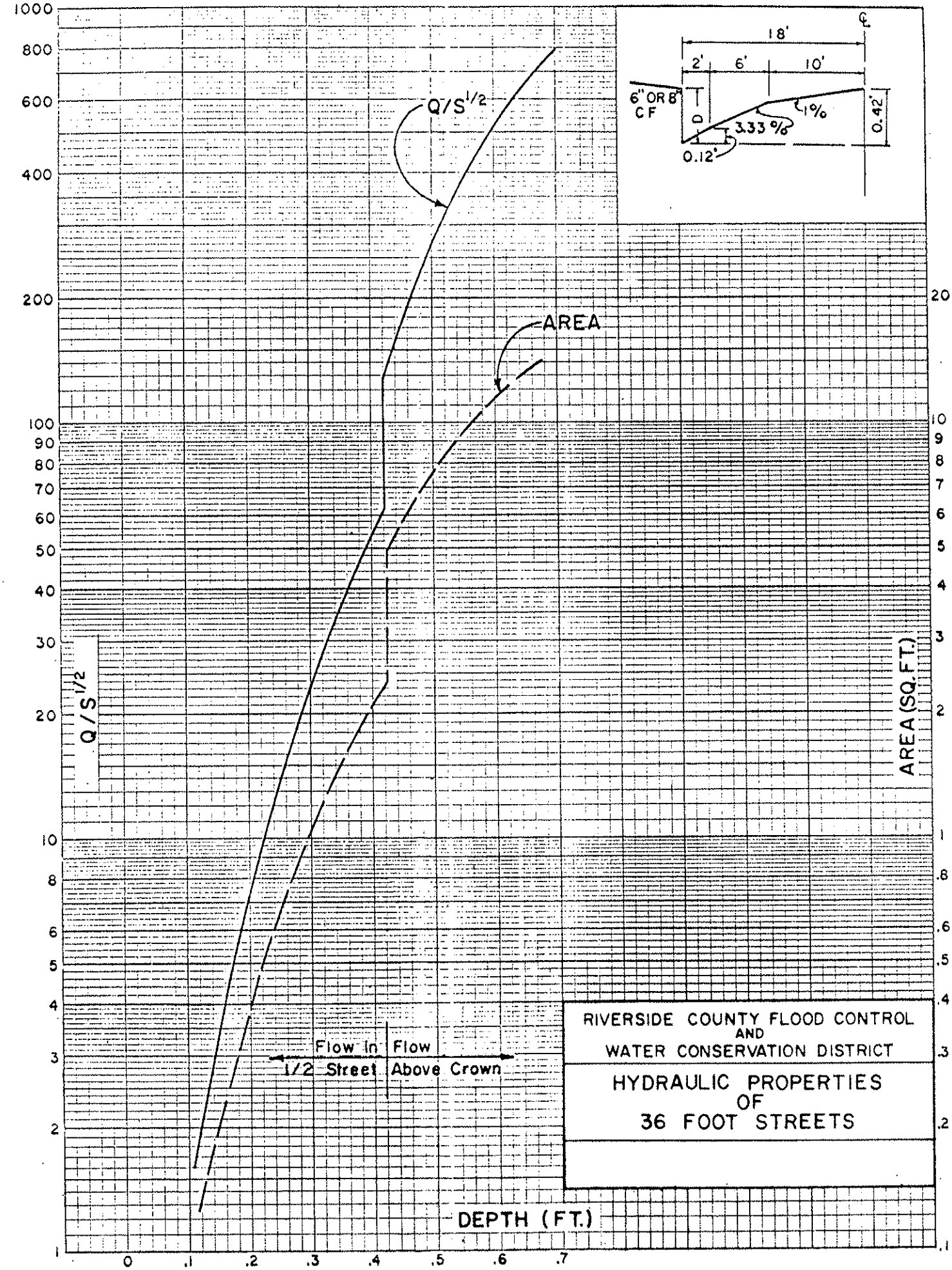

Q/S^1/2
AREA
18'
2'
6'
10'
6" OR 8" CF
D
1%
3.33 %
0.42'
0.12'
Q/S^1/2
AREA (SQ.FT.)
DEPTH (FT.)
Flow In Flow
1/2 Street Above Crown
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
HYDRAULIC PROPERTIES OF 36 FOOT STREETS

FIGURE 7

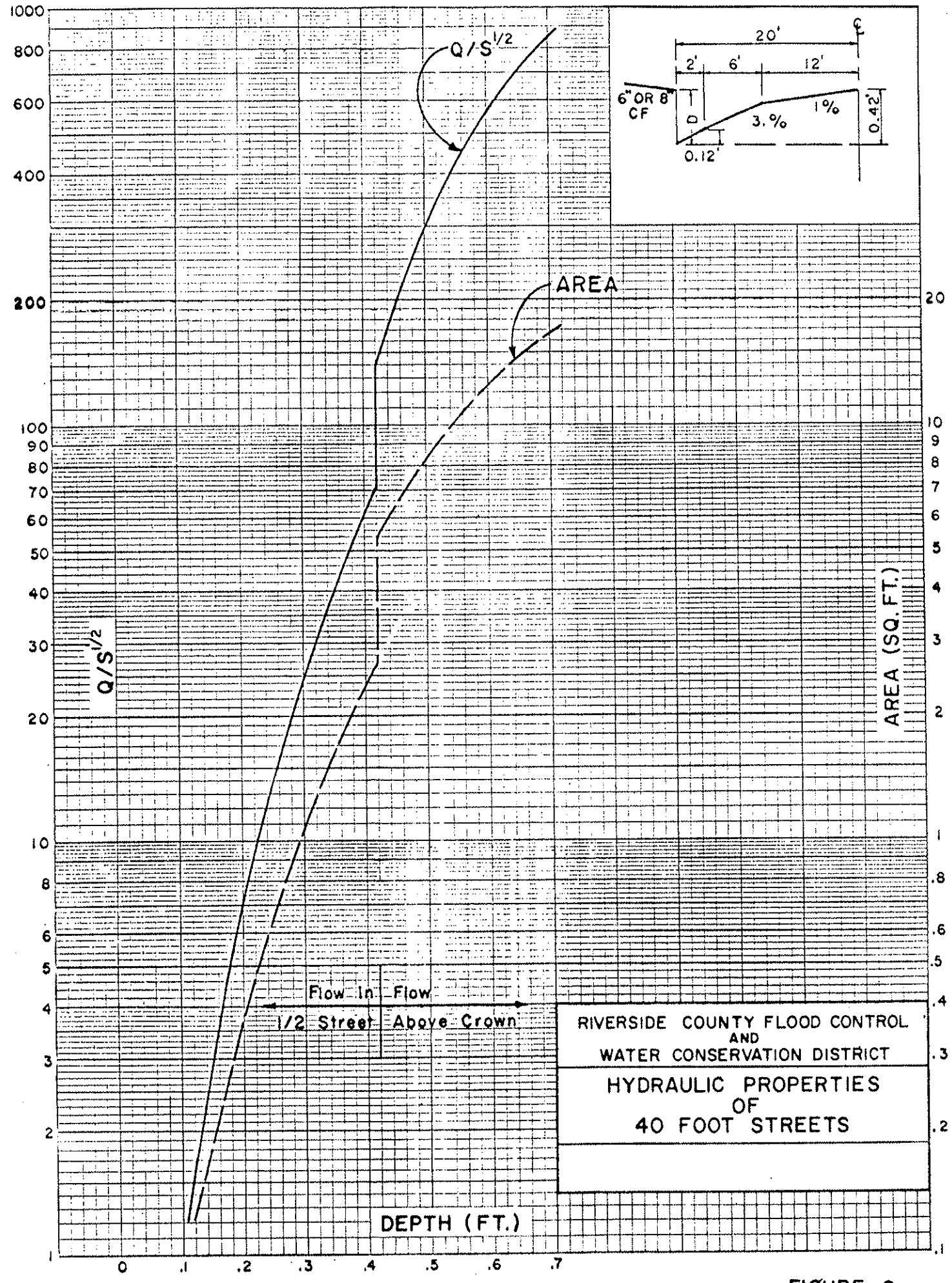
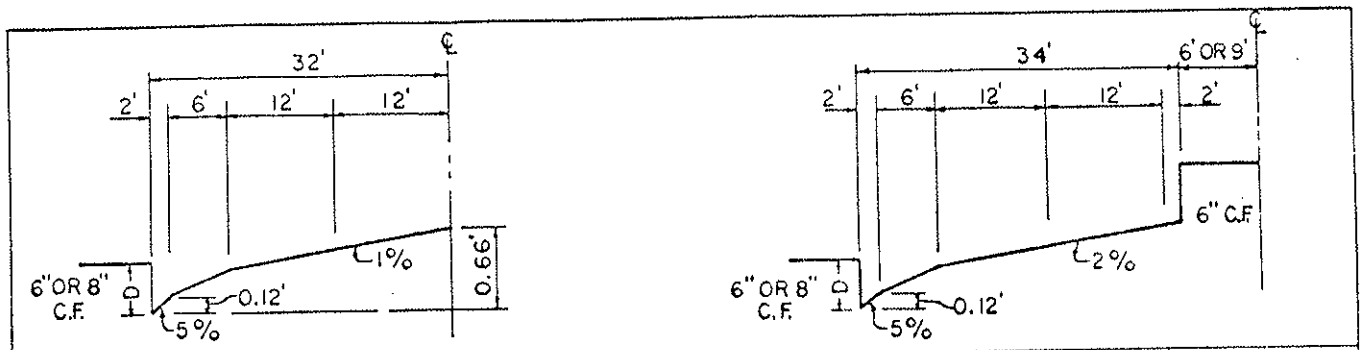
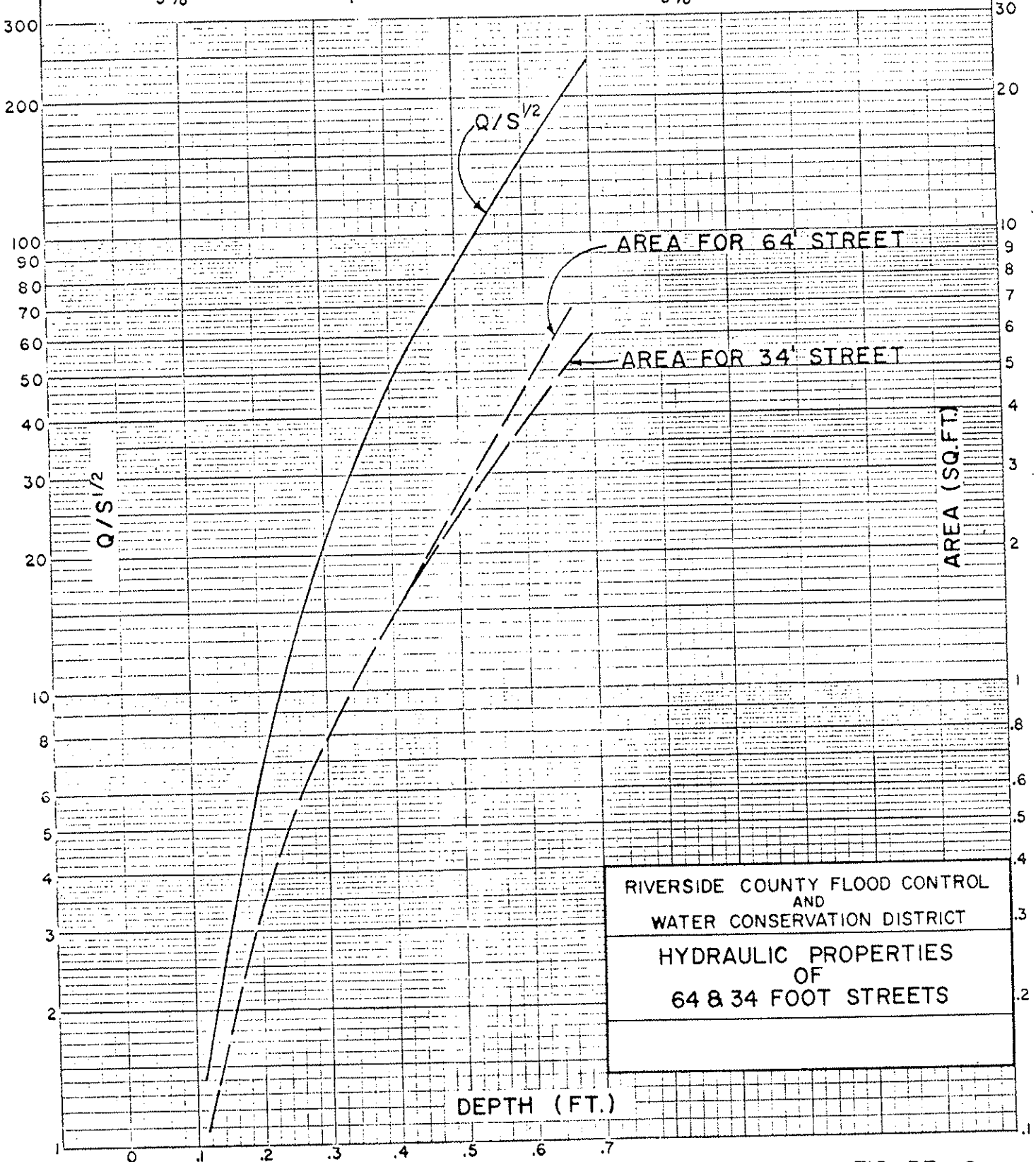

Q/S^1/2
AREA
20'
2'
6'
12'
6" OR 8" CF
D
3.%
1%
0.42'
0.12'
1000
800
600
400
200
100
90
80
70
60
50
40
30
20
10
8
6
5
4
3
2
1
0
.1
.2
.3
.4
.5
.6
.7
Q/S^1/2
AREA (SQ. FT.)
20
10
9
8
7
6
5
4
3
2
1
.8
.6
.5
.4
.3
.2
.1
Flow In 1/2 Street
Flow Above Crown
DEPTH (FT.)
RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT
HYDRAULIC PROPERTIES OF 40 FOOT STREETS

FIGURE 8

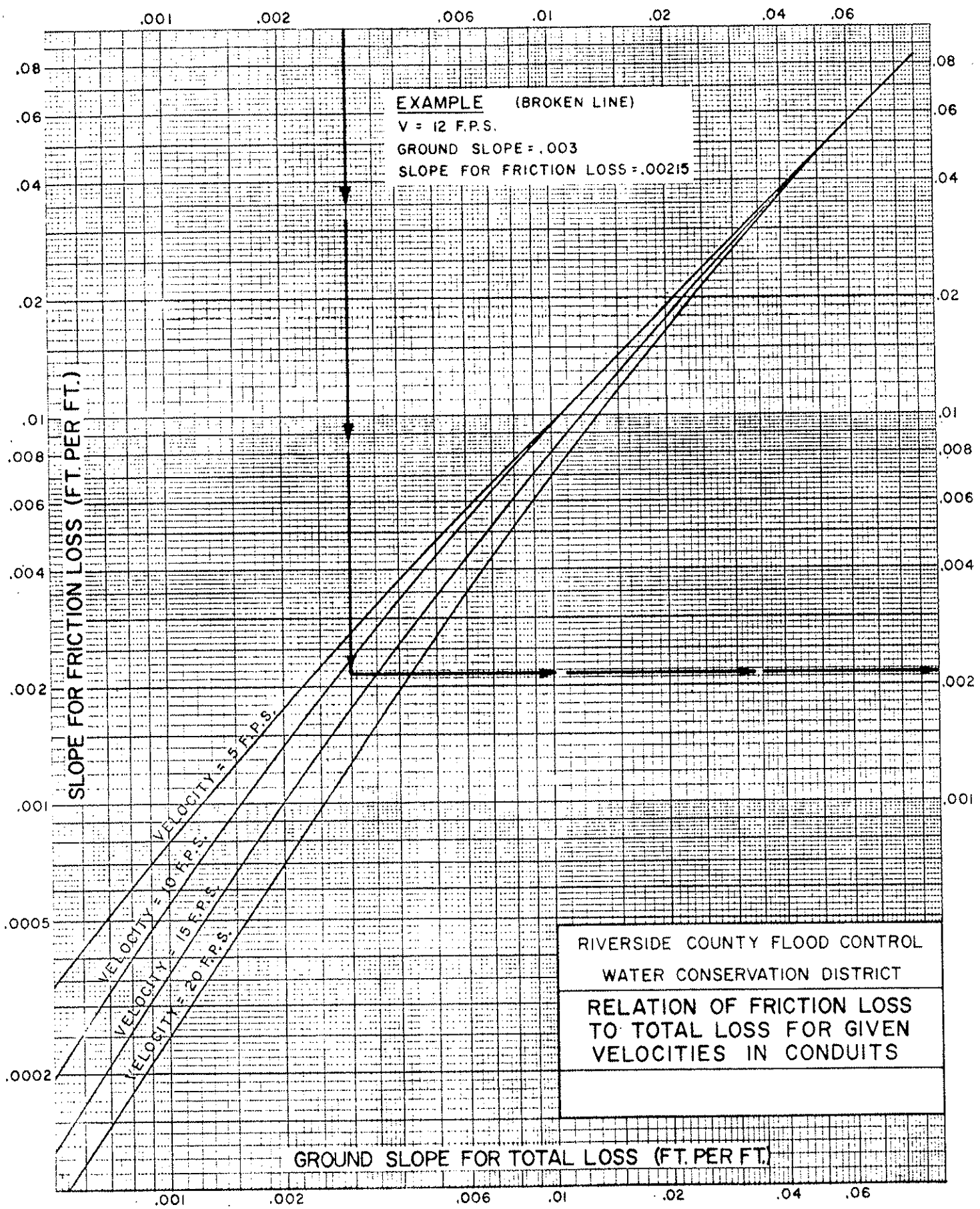




RIVERSIDE COUNTY FLOOD CONTROL AND WATER CONSERVATION DISTRICT

HYDRAULIC PROPERTIES OF 64 & 34 FOOT STREETS

FIGURE 9



RIVERSIDE COUNTY FLOOD CONTROL
WATER CONSERVATION DISTRICT

RELATION OF FRICTION LOSS TO TOTAL LOSS FOR GIVEN VELOCITIES IN CONDUITS

FIGURE 10