

RIVERSIDE COUNTY FLOOD CONTROL AND
WATER CONSERVATION DISTRICT

RIVERSIDE, CALIFORNIA

REPORT ON
MASTER DRAINAGE PLAN
FOR
THE CITY OF RIVERSIDE
(UNIVERSITY AREA)
ZONE ONE

JULY 1967

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CHIEF ENGINEER

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S U M M A R Y

During the past few years residential, commercial and industrial development in the University Area of the city of Riverside has increased at a rapid rate. This development has caused increased storm runoff which in turn is creating serious drainage and flood control problems and public inconvenience.

A Master Drainage Plan is presented in this report which provides an economically feasible solution to the drainage problems in the University Area of the city of Riverside. The plan consists of a retention basin and a network of open channels and underground storm drains that would intercept storm waters in overloaded streets and convey them safely through developed areas to adequate outlet channels. The University Wash and Springbrook Wash channels will serve as the outlets for all the proposed drains set forth in this plan.

A high degree of protection will be provided when the recommended improvements are constructed. These facilities will minimize storm damage and will eliminate most of the public inconvenience that now occurs during periods of normal rainfall. The total estimated cost of the plan is \$4,020,000.

I N T R O D U C T I O N

General Statement - The Riverside County Flood Control and Water Conservation District, in cooperation with the City of Riverside, is developing a Master Drainage Plan for the entire city. This plan, which is part of an overall plan, considers the northeasterly section of the city, commonly referred to as the University Area. Separate reports providing a Master Drainage Plan for the Central, La Sierra, and Monroe Areas of the city were completed in May 1961, July 1965, and January 1966, respectively, and have been adopted by the City Council.

This report provides a Master Drainage Plan for the University Area. The plan consists of a retention basin that will intercept and retard flood flows from the Box Springs Mountains and a network of underground storm drains, open channels and inlets which intercept surface runoff from the developed urban areas, thus reducing storm water damage and inconvenience to the public.

Purpose - The purpose of this report is to investigate and evaluate the drainage problems within the University Area and to develop an economically feasible Master Drainage Plan. Such a plan will provide adequate protection to the area and will serve as a guide in programming a storm drain construction program in the city. The plan will also influence land development and street design in this area.

Scope - The general drainage boundaries of the area covered by this plan are Springbrook Wash on the north, the Santa Ana River on the west, the Box Springs Mountains on the east and U. S. Highway 60 on the south. The extent of the studies establishing the Master Plan include:

1. Determination of the amounts and points of concentration of storm runoff in the area.
2. Preparation of a drainage map showing all of the subdrainage areas tributary to each system of drains.
3. Routing studies to determine the height of dam and reservoir area required for the proposed retention basin.
4. Location and size of all existing and proposed underground storm drains, open channels and inlets which will be required for ultimate development of the plan.
5. Investigation of alternative routes and methods of control to insure the most economical and feasible plan of control.
6. Preparation of preliminary design plans and supporting cost estimates.

Description of Problem - The University Area, so named because the University of California is located within the watershed, is situated partly on an alluvial fan at the base of the Box Springs Mountains and partly within the historic flood plain of the Santa Ana River. All but the westerly portion of the watershed around the Riverside Freeway was in agricultural use prior to 1950. Since that time, and especially with the development of the University of California, there has been a significant change to an urban land use. Most of the watershed will eventually be developed into single family residences; however, there are two planned industrial areas within the watershed and several multifamily and commercial developments. The area around the University of California has experienced intense residential and commercial development in recent years. The area west of the Riverside Freeway is developed in residential and commercial uses. The Industrial Park in the vicinity of Chicago and Spruce Street is well developed. The Hunter Industrial Park in the vicinity of Iowa Avenue and Columbia Avenue, while containing 3 major plants, is still relatively undeveloped.

The watershed comprises an area of 5,920 acres or 9.25 square miles. The rugged, steep and barren Box Springs Mountains form the eastern boundary of the watershed and are the source of significant quantities of storm runoff. The watershed slopes from east to west on moderately steep slopes, from the base of the mountains to Springbrook Wash.

The general slope of the land between Orange Street and the Santa Ana River is to the southwest and on a fairly flat gradient.

Storm runoff from the Box Springs Mountains concentrates at the mouths of the canyons and debouches out on the alluvial fan causing property damage and interruptions to the flow of traffic and other community activities. The development that has taken place in the watershed has created additional flooding problems because of increased runoff caused by the addition of roofs and paved streets. The existing street system cannot carry the runoff that is now generated in the developed areas let alone runoff from the mountains. Additional development in the future will make the flooding problem even more critical.

There are two major streams that drain this watershed. University Wash is an unimproved natural wash that drains the watershed area south of Palmyrita Avenue and east of the Riverside Freeway. Springbrook Wash drains primarily the west slope of the Box Springs Mountains in the Pigeon Pass area and the portion of the watershed between the Riverside Freeway and the Santa Ana River. University Wash is tributary to Springbrook Wash just upstream from Evans Lake in Fairmount Park.

Both of these streams presently have capacity only for storm runoff from minor storms. In many instances the channels have been encroached upon by property owners or partially

blocked with inadequate culverts. The improvement of these two stream channels therefore becomes a necessary and integral part of any drainage plan for the area as they are the only outlet for various storm drains proposed in this plan.

The U. S. Army Corps of Engineers has completed a study of the University Wash and Springbrook Wash flooding problems and have found that improvement of these channels is economically feasible. The improvements proposed by the Corps of Engineers will be an integral part of the drainage system that will be constructed in the area in the future. With the completion of the channel improvements the proposed system of storm drains can function as designed as all lines will have an adequate outlet.

D I S C U S S I O N

General - As has been previously stated, with the increased development taking place in the University Area, the street system cannot contain the storm runoff. Therefore, in order to reduce damage and public inconvenience, some means of controlling excess storm runoff must be provided. The Master Drainage Plan presented herein provides an economical method of collecting storm runoff in a flood retention basin and a system of underground storm drains, and open channels which would discharge into the University Wash and Springbrook Wash channels. The plan provides a high degree of protection throughout the area and utilizes the street system to the greatest extent possible.

Criteria - The criteria used in the development of this Master Plan was that retention basins would be designed to control a 100-year frequency storm discharge and underground drain lines or open channels draining urban areas would be designed to control a 10-year frequency storm discharge. The University Wash and Springbrook Wash channels which will be constructed by the U. S. Corps of Engineers, will control a 100-year frequency flood. Retention basins would be used to control runoff from the mountainous portions of the watershed when the cost for retention storage was less than the cost to provide a larger storm drain for the unregulated peak discharges. Open channels would be provided when the

discharge is large and the construction and right of way costs for the channel proved to be less than the costs of an underground storm drain.

The storm drain network proposed in this report was developed on the basis of providing a drain when:

- (a) Street flow reaches the top of the curb level.
- (b) Diversion from an overloaded existing drain is necessary.
- (c) Economic considerations dictated a diversion from the normal path of storm flows.
- (d) Relief for a major street intersection is needed.

Generally all underground storm drains are to be located within either existing or proposed future street right of way. In some instances underground drains will be located in easements across private property. The alignments of all drains and channels were based on hydraulic efficiency and economics. Any major departures from the proposed alignments will require a reevaluation of the design of the system.

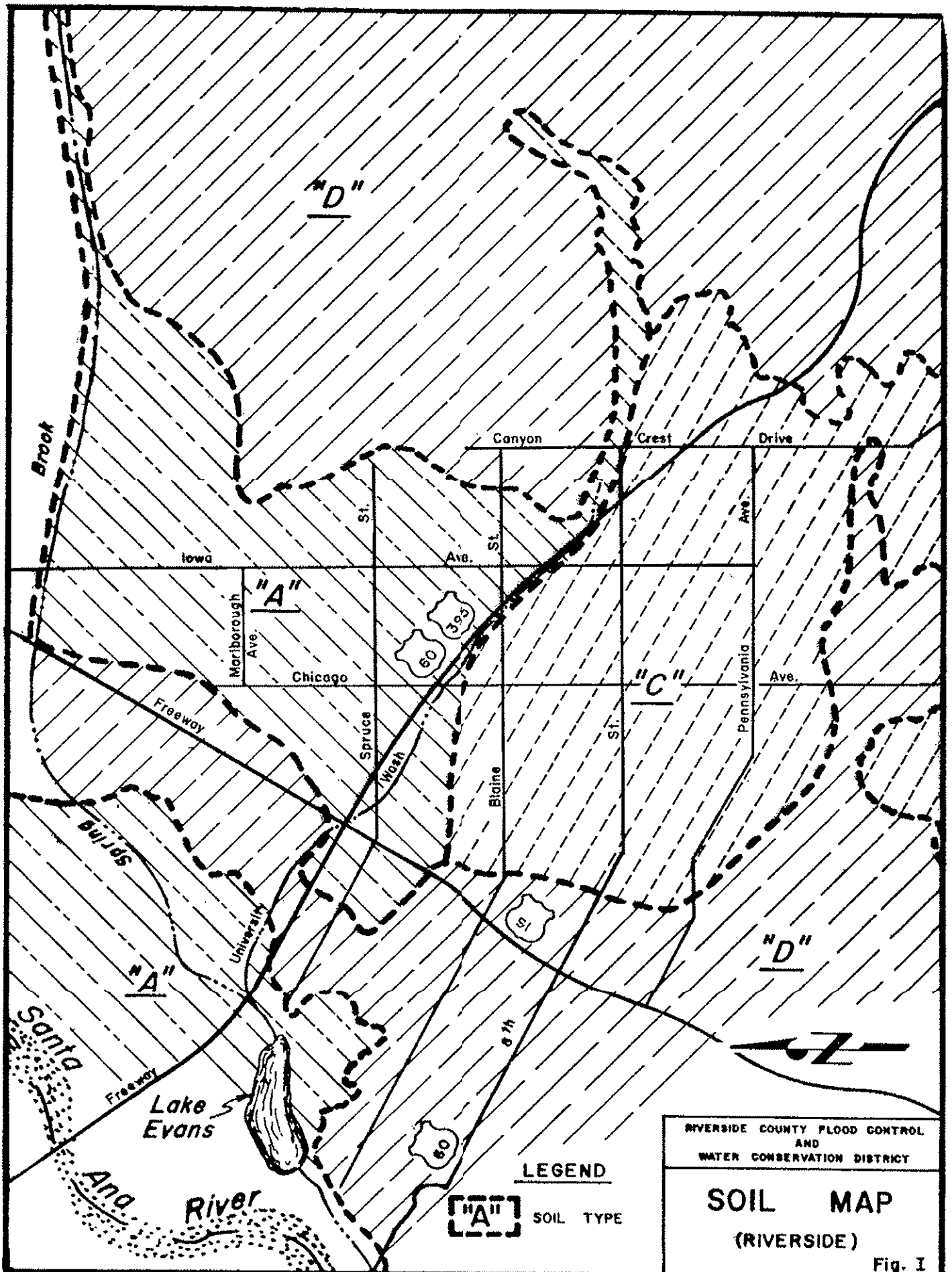
Hydrology - The hydrology for the plan was developed by two methods; namely, the modified rational method and the synthetic unit hydrograph method.

The modified rational method was used to determine the 10-year frequency design discharge generated within the watershed. All street systems were rated for these flows and all drain lines were sized according to these discharges. The basic equation for the rational method is $Q=CIA$: where Q is the quantity of flow in cubic feet per second; C is a runoff coefficient based on soil type, slope of land, type of development and intensity of rainfall; I is the intensity of rainfall in inches per hour; and A is the size of contributing area in acres.

A soil map depicting the various soil classifications in the watershed was prepared and is included in the report as Figure 1. The U. S. Soil Conservation Service classifies soils into four hydrologic groupings. The grouping or classification signifies the relative permeability of the soil, with group A being the most permeable soil and group D the least permeable soil. The University area watershed contains groups A, C and D soil types. These soil types were verified with the Riverside office of the U. S. Soil Conservation Service. Runoff coefficient (C) curves for each of the three soil groups is included in the report as Figures II through IV.

Rainfall intensity-duration-frequency curves for the city of Riverside were developed from a statistical analysis of the rainfall record from the Citrus Experiment Station recording rain gage. A 25-year period of record was studied and the results obtained compared favorably with data derived from U. S. Weather Bureau Technical Bulletin No. 24. Table I of this report is a tabulation of rainfall intensity-duration data for a 10-year frequency event.

The hydrology for the retention basin design was derived by the synthetic unit hydrograph method. A 100-year intensity, six-hour storm was centered over the contributing drainage area and a hydrograph of the discharge in cubic feet per second versus time in minutes was determined. The total volume of runoff in acre-feet, which is the amount of runoff that is to be stored in the basin, was also determined by computing the area under the hydrograph curve. A design hydrograph for the Blain Street Retention Basin is included in the report as Figure V.



RIVERSIDE COUNTY FLOOD CONTROL
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SOIL MAP
(RIVERSIDE)

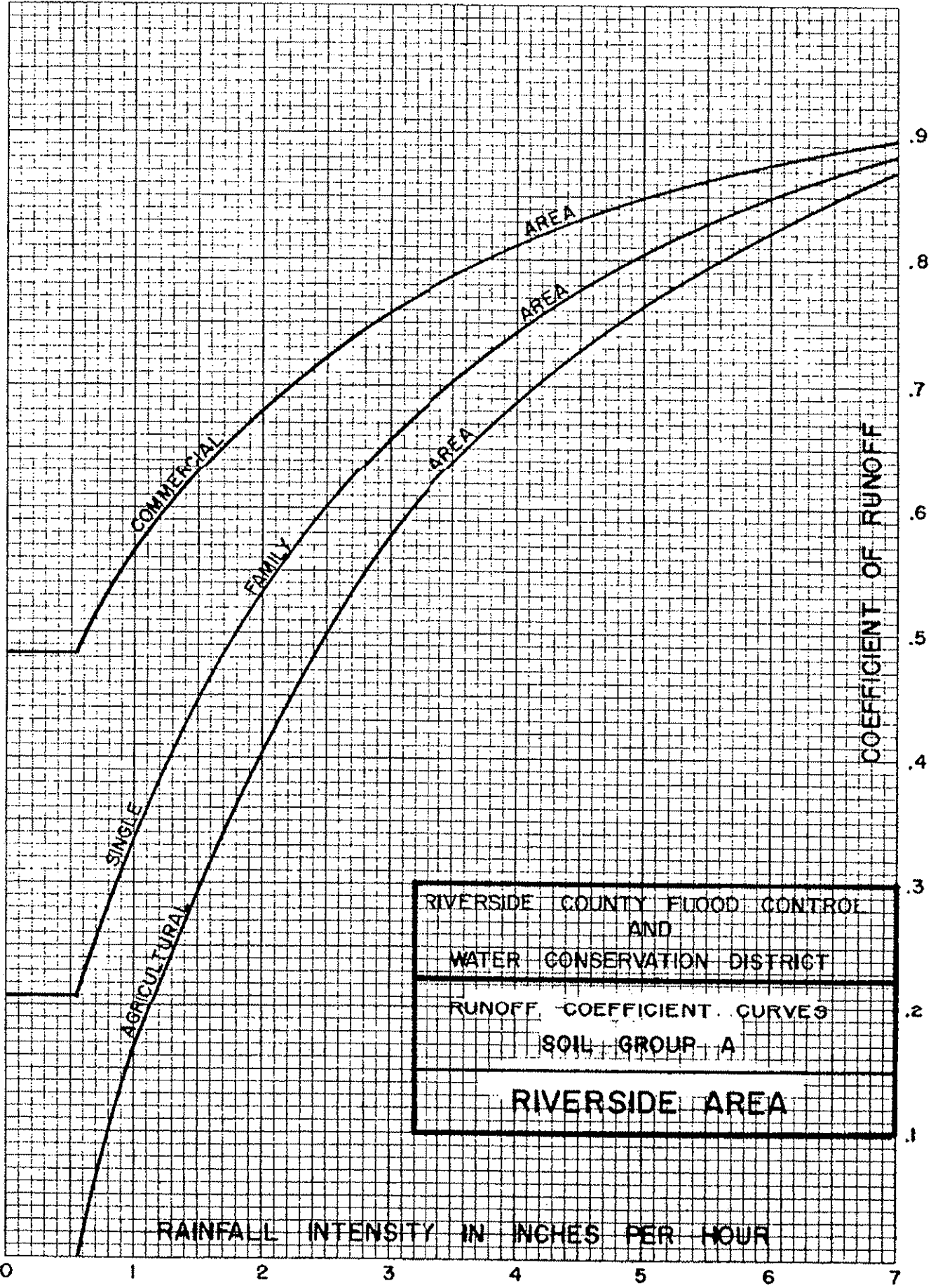
Fig. I

EUG. SIETZ, D.
MADE IN U. S. A.

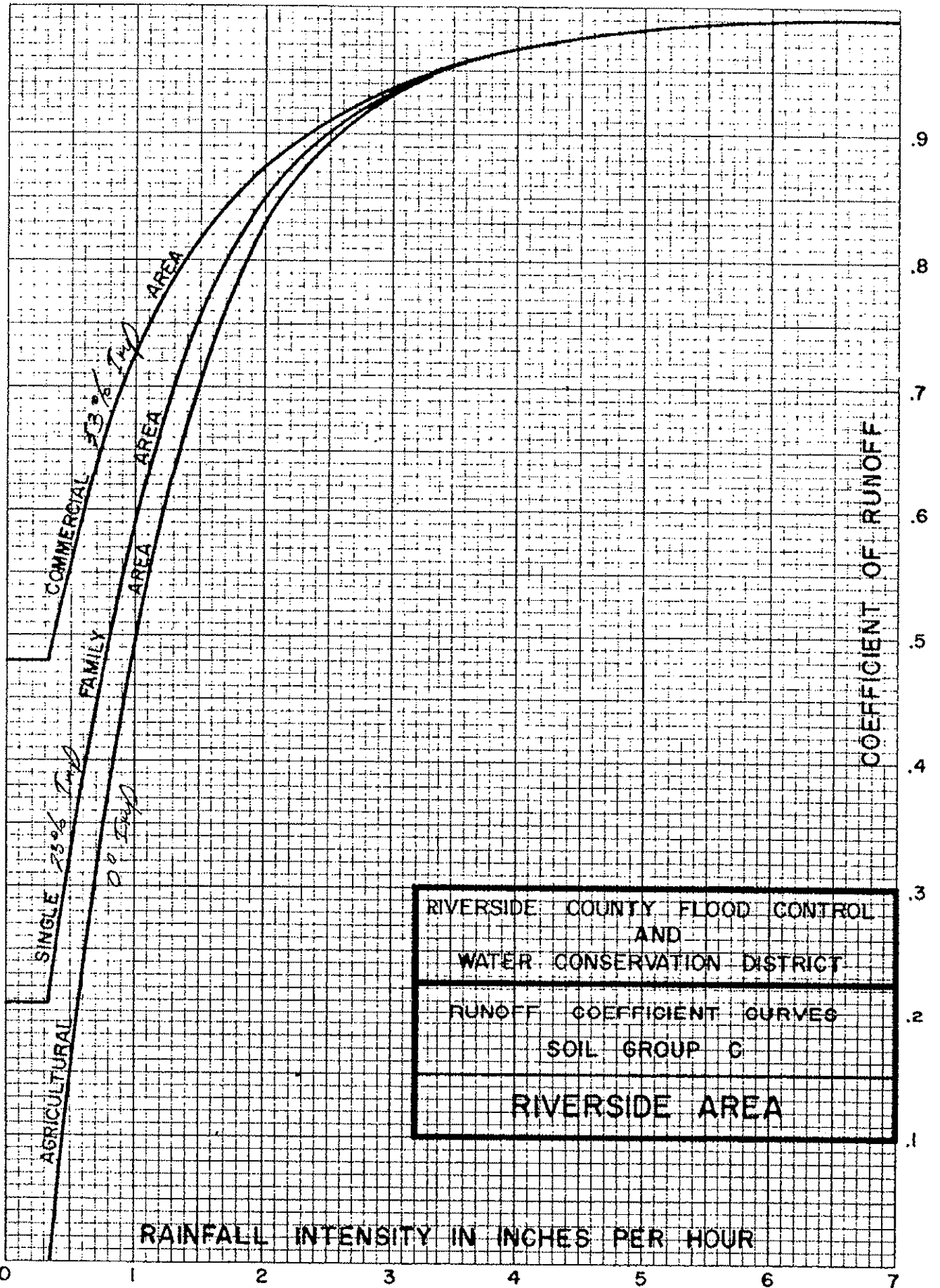
PAP

10 X 10 PER INCH

D. 3.



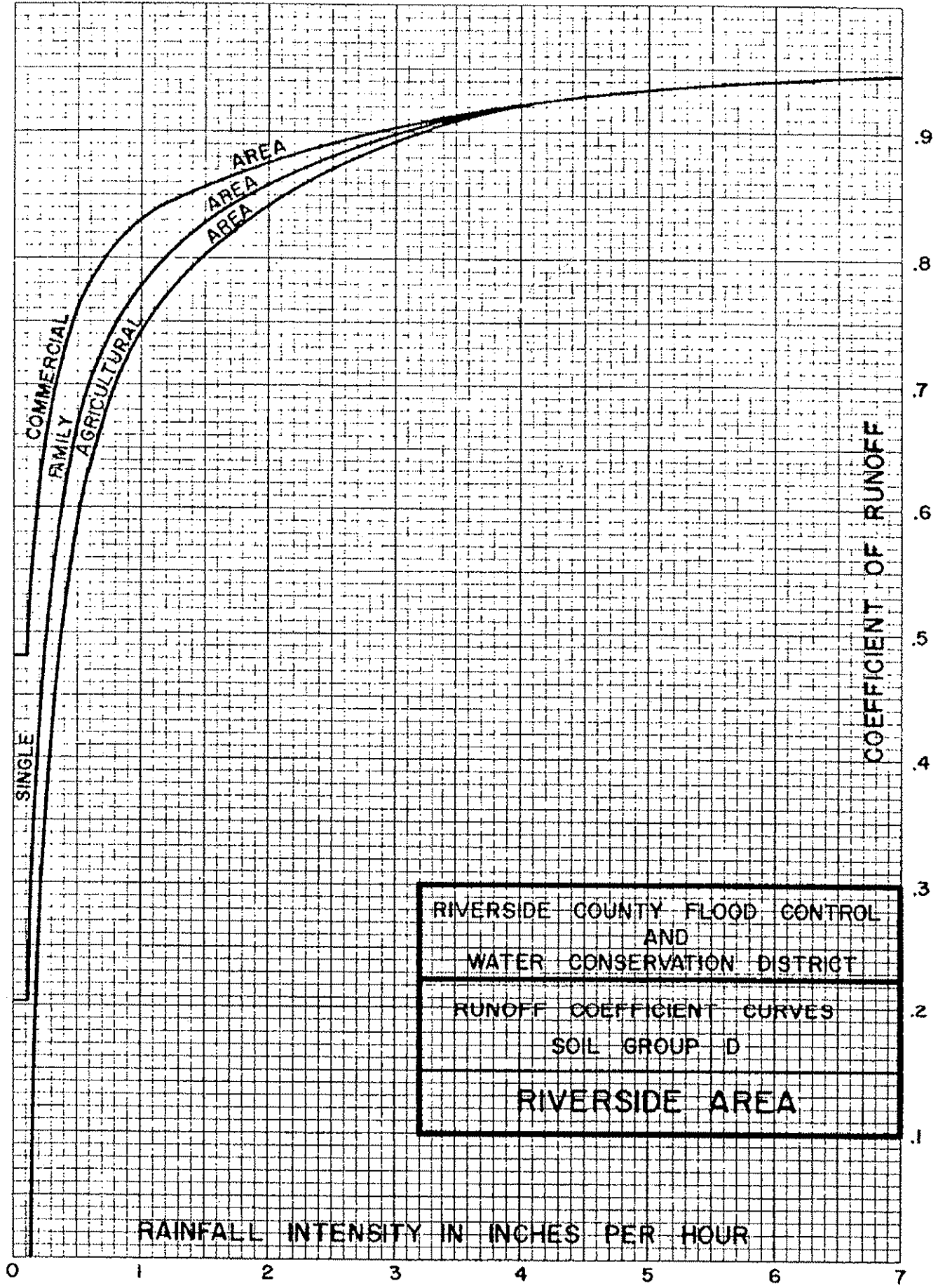
RIVERSIDE COUNTY FLOOD CONTROL
AND
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RUNOFF COEFFICIENT CURVES
SOIL GROUP A
RIVERSIDE AREA



RIVERSIDE COUNTY FLOOD CONTROL
AND
WATER CONSERVATION DISTRICT
RUNOFF COEFFICIENT CURVES
SOIL GROUP C
RIVERSIDE AREA

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MADE IN U. S. A.

NO. 3 SQUARE DIXIE MAN ENGRAVED PAPER
10 X 10 PER INCH



RIVERSIDE COUNTY FLOOD CONTROL
AND
WATER CONSERVATION DISTRICT
RUNOFF COEFFICIENT CURVES
SOIL GROUP D
RIVERSIDE AREA

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

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.

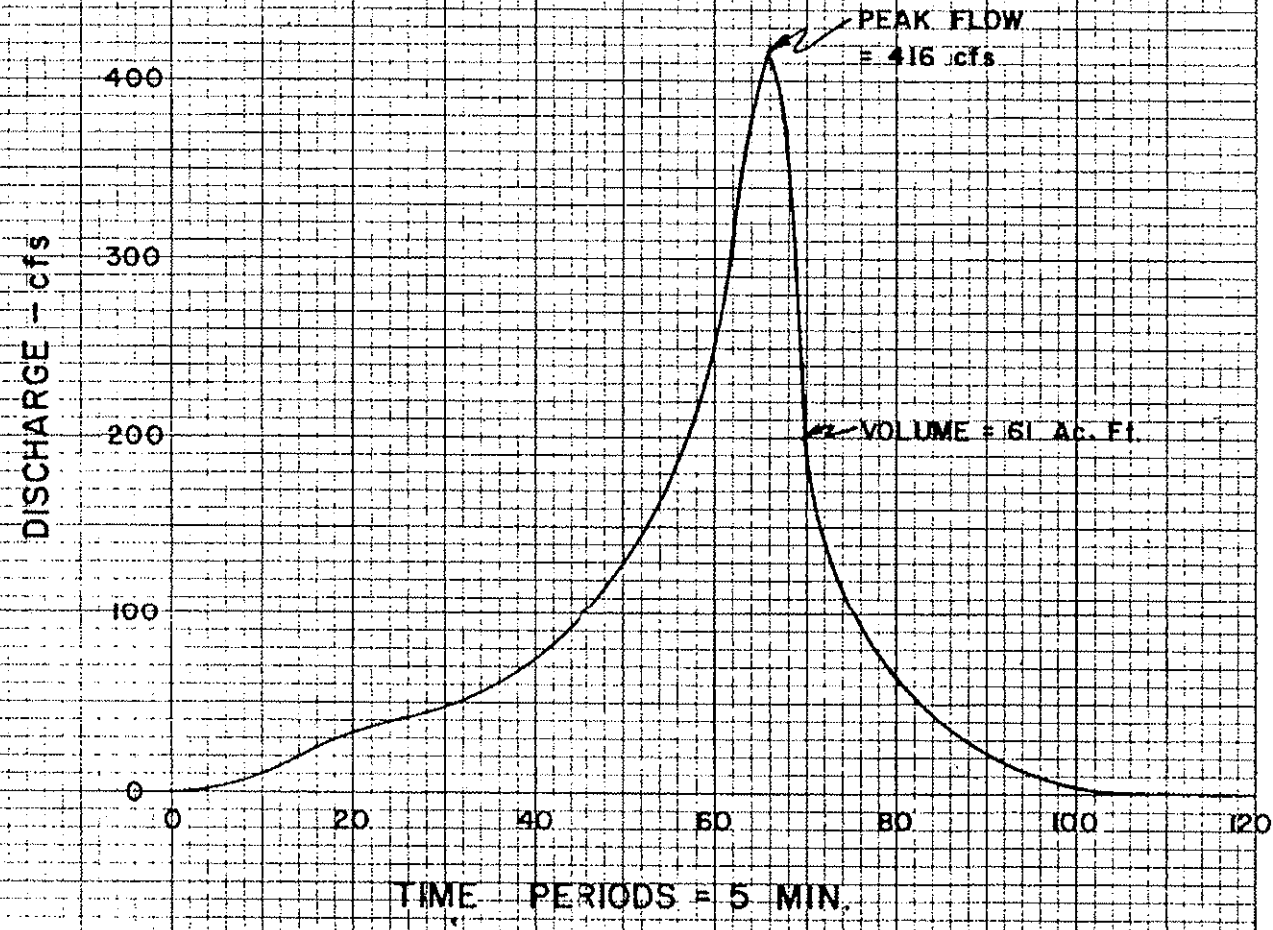
60	0.69	65	0.67	70	0.64	75	0.62	80	0.59
61	0.69	66	0.66	71	0.64	76	0.61	81	0.59
62	0.68	67	0.66	72	0.63	77	0.61	82	0.59
63	0.68	68	0.65	73	0.63	78	0.60	83	0.58
64	0.67	69	0.65	74	0.62	79	0.60	84	0.59
65	0.67	70	0.64	75	0.62	80	0.59	85	0.58

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

RIVERSIDE COUNTY FLOOD CONTROL
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100 YR. FREQUENCY HYDROGRAPH
5 HR. STORM
BLAINE ST. RETENTION BASIN
DRAINAGE AREA \approx .51 SQ. MI.
MAY 1967, D.T.S.



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Maps and Plates - A map depicting the drainage plan and a composite drainage map is included in the report. Preliminary plan and profile drawings indicating pertinent details for each drainage facility are also included in this report.

Existing Lines - Several existing storm drains and open channels are located within the University Area watershed. These lines have been constructed in the past by the City, the Division of Highways or private interests. Those lines that are utilized directly by the plan were assigned line numbers. The channels constructed by the Division of Highways and located within State-owned right of way were not assigned numbers. A brief description of the existing lines which are an integral part of the Master Plan follows:

Line 1 - The existing section of line 1 between Canyon Crest Drive and Valencia Street is a 72-inch diameter pipeline that relieves a flooding problem at the University of California.

Line 1-B - Line 1-B is a lateral to line 1 and drains a large area south and east of the University. This line is a 48-inch diameter pipe and was constructed by the University at the same time as line 1.

Line 1-C - Line 1-C is an existing 39-inch pipeline that conveys runoff generated on the University property and

from line 2 through the athletic fields to University Wash downstream from Canyon Crest Drive.

Line 1-D - Line 1-D is a small line that conveys runoff from the University athletic area to University Wash downstream from Canyon Crest Drive.

Line 1-E - Line 1-E is located in Canyon Crest Drive through the University and south of line 1. It serves to drain University property and outlets in line 1.

Line 2 - Line 2 is an existing underground drain and open channel that serves a residential area near Watkins Drive and Valencia Street. The line extends from the A.T. & S.F. Railroad at Mt. Vernon Avenue to a well-defined natural watercourse at Valencia Street. The line consists of an unimproved wash between Mt. Vernon Avenue and the railroad, a concrete lined channel between the railroad and Watkins Drive and an underground conduit from Watkins Drive to the outlet. The line discharges in a natural watercourse located within the University of California property.

Line 3-A - Line 3-A is an existing underground drain that drains the area around the elementary school near Highlander and Sugarloaf Drives. The line extends along the easterly side of the school grounds from Massachusetts Avenue to Highlander Street; thence southwesterly to confluence with line 3.

Line 8-A - Line 8-A is an existing underground drain that relieves the intersection at Palmyrita and Iowa Avenues. The drain extends from Iowa Avenue westerly to the A.T. & S.F. Railroad and the confluence with line 8.

Line 8-D - Line 8-D is a system of underground drains that relieves the area along the west side of the Riverside Freeway near Columbia Avenue. This drain was constructed by the State Division of Highways, and extends from Columbia Avenue southerly in freeway right of way to the confluence with line 8-E.

Line 11 - Line 11 is an existing line that drains a residential area located north of Strong Street and east of Main Street. The line begins at the intersection of Post and Sutter Streets and continues in a southwesterly direction through a subdivision until reaching the intersection of Main and Strong Streets where the line proceeds west in Strong Street to Springbrook Wash.

Line 11-A - This line is a lateral to line 11. It intercepts flows from University Wash at Orange Street, proceeds through the Fremont School property to Main Street, then north in Main Street to line 11. The section of line 11 through the school will be abandoned with the construction of the University Wash Channel.

Recommended Improvements

Line 1 - Line 1 serves the developed area between the base of the Box Springs Mountains and the University of California. This line will tie into the existing section of line 1 passing through the University of California. This line is an underground drain in Big Springs Road beginning at Valencia Drive and extending easterly to Goodrich Drive.

The large unimproved wash located between Canyon Crest Drive and the Gage Canal is on University of California property. Any improvement of this wash or development of the property should be the responsibility of the University of California. A preliminary plan and profile drawing of line 1 is shown on Plate 3. The estimated construction cost is \$68,640.

Line 1-A - Line 1-A relieves the intersection of Watkins Drive and Broadbent Road. The line is an underground drain that extends northerly in Watkins Drive from Broadbent Drive to join line 1 at Big Springs Road. A preliminary plan and profile drawing of the drain is shown on Plate 4. The estimated construction cost is \$22,280.

Line 3 - Line 3 serves the developed area along Blaine Street between Mt. Vernon Avenue and the shopping center. The line is an underground drain extending from the Blaine

Street Retention Basin westerly in Blaine Street to Watkins Drive and the A.T. & S.F. Railroad. The line crosses under the railroad and turns northwesterly parallel with the A.T. & S.F. Railroad and the future extension of Watkins Drive to line 5 at Spruce Street. The section of line between Blaine and Spruce Streets is planned as an open channel and is to be located between Watkins Drive and the railroad. Preliminary plan and profile drawings of the line are shown on Plates 5 through 8. The estimated construction cost is \$161,440.

Blaine Street Retention Basin and Diversion Dike - The Blaine Street Retention Basin is located 600 feet north of Blaine Street between Valencia Street and Mt. Vernon Avenue. The basin is designed to intercept and control 100-year peak flows from a 324-acre watershed. This basin will make it possible to significantly reduce the size of drainage facilities downstream.

The basin will be formed by an earth fill dam having a crest length of approximately 1,000 feet, a maximum height of 35 feet and a storage capacity for about 60 acre-feet. The outlet will be an ungated 30-inch diameter pipe that will discharge into line 3. The spillway will discharge into the natural watercourse downstream from the dam.

In order to obtain the maximum benefit from the retention basin, it is proposed to divert runoff from a 115-acre

watershed that normally drains into Spruce Street. A dike located about 1500 feet upstream from the retention basin will divert all flows into the basin. The dike is about 100 feet long and 5 feet high. Because of the diversion it will be necessary to obtain a flooding easement between the dike and the retention basin. Preliminary plan and profile drawings of the retention basin and dike are shown on plates 9 and 10. The estimated construction cost is \$50,000.

Line 4 - Line 4 is an underground drain that is designed to relieve a major intersection at Iowa Avenue and Blaine Street. The drain begins in Blaine Street approximately 1350 feet east of Iowa Avenue and extends westerly in Blaine Street to the confluence with an existing State Highway channel located on the north side of U. S. Highway 60. The State Highway channel in turn discharges directly into the University Wash channel. A preliminary plan and profile drawing of line 4 is shown on plate 11. The estimated construction cost is \$64,180.

Line 5 - Line 5 is a major underground drain that serves the central portion of the watershed and relieves an important arterial street from flooding. The line extends westerly in Spruce Street from Flanders Road to the University Wash channel. Line 5 is also the outlet for line 3 flows.

Preliminary plan and profile drawings of this drain are shown on Plates 12 through 16. The estimated construction cost is \$503,080.

Line 5-A - Line 5-A drains Massachusetts Avenue near Rustin Avenue. This line is an underground drain that extends westerly in Massachusetts Avenue to Iowa Avenue; thence north in Iowa Avenue to line 5 in Spruce Street. Preliminary plan and profile drawings of this drain are shown on Plates 17 and 18. The estimated construction cost is \$74,510.

Line 5-B - Line 5-B is an underground drain designed to relieve a drainage problem along Atlanta Street at the Southern Pacific Railroad. The line begins at the railroad and extends southerly in Atlanta Street to the confluence with line 5. A preliminary plan and profile drawing of the drain is shown on Plate 19. The estimated construction cost is \$8,480.

Line 6 - Line 6 serves a major industrial area in the northeast portion of the watershed and will relieve a major east-west street from flooding. The line is an underground drain in Columbia Avenue that begins about 500 feet west of Serpentine Road and continues westerly in Columbia Avenue to the confluence with line 8 at the Santa Fe Railroad. Preliminary plan and profile drawings are shown on Plates 20 through 23. The estimated construction cost is \$394,710.

Line 6-A - Line 6-A relieves the intersection at California and Marlborough Avenues. The line is an underground drain that extends northerly in California Avenue from the intersection of California and Marlborough Avenues to line 6 at Columbia Avenue. A preliminary plan and profile drawing of the drain is shown on plate 24. The estimated construction cost is \$62,350.

Line 6-B - Line 6-B is an underground drain designed to drain Iowa Avenue between Marlborough and Columbia Avenues. The line begins at the intersection of Iowa and Marlborough Avenues and extends north in Iowa Avenue to line 6 in Columbia Avenue. Approximately 650 feet of this drain is existing with about 650 feet remaining to be constructed. A preliminary plan and profile drawing of the drain is shown on Plate 25. The estimated construction cost is \$25,980.

Line 7 - Line 7 serves the northeasterly section of the drainage area. The line is an underground drain that is designed to intercept flows along the foothills and convey them safely to an adequate outlet. The line proceeds northerly in a future extension of Mt. Vernon Avenue from the foothills to the intersection of Palmyrita and Mt. Vernon Avenues; thence westerly in Palmyrita Avenue to California Avenue; thence northerly in California Avenue to Springbrook Wash. It should be noted that this line is discharging outside of the watershed boundary. This is not, however, a diversion

as the flows now follow this direction in a borrow ditch along California Avenue. Preliminary plan and profile drawings are shown on Plates 26 through 29. The estimated construction cost is \$273,500.

Line 8 - Line 8 is a major line that serves as the outlet for all flows originating in the east-central or industrial section of the watershed. The line is partially an underground drain and partially open channel, depending upon availability of right of way. The line begins at Palmyrita Avenue and the Santa Fe Railroad and extends southerly along the east side of the railroad to Thornton Street; thence northwesterly in Thornton Street to the Riverside Freeway. After crossing under the Riverside Freeway and La Cadena Drive the line follows a natural watercourse, joining the University Wash channel just upstream from Orange Street. Preliminary plan and profile drawings are shown on Plates 30 through 33. The estimated construction cost is \$454,000.

Line 8-B - Line 8-B relieves the intersection at Chicago Avenue and Thornton Street. The line is an underground drain that extends from Chicago Avenue westerly in Thornton Street to the confluence with line 8. A preliminary plan and profile drawing is shown on Plate 34. The estimated construction cost is \$21,140.

Line 8-C - Line 8-C is an underground drain designed to relieve a sump area along Spring Garden Street near West

La Cadena Drive. The line begins at the low point in Spring Garden Street and extends about 600 feet southerly to West La Cadena Drive and the confluence with line 8-E. A preliminary plan and profile drawing is shown on Plate 35. The estimated construction cost is \$11,170.

Line 8-E - Line 8-E is an underground drain designed to relieve a drainage problem in the vicinity of Columbia Avenue and East La Cadena Drive. The line begins in Columbia Avenue and extends southwesterly in East La Cadena Drive to an existing culvert under the Riverside Freeway between Milton and Blenheim Streets; thence southwesterly in West La Cadena Drive to line 8. Preliminary plan and profile drawings are shown on plates 35 and 36. The estimated construction cost is \$73,970.

Line 9 - Line 9 serves the northwestern portion of the watershed. It is designed to intercept flows crossing the Riverside Freeway near Chase Road and convey them in an underground drain to a grassed swale type channel located within the Springbrook Golf Course west of Orange Street. The flows would discharge into the proposed Springbrook Wash channel located along the west side of the golf course. Preliminary plan and profile drawings of the drain are shown on plates 37 through 39. The estimated construction cost is \$78,490.

Line 9-A - Line 9-A is an underground drain that conveys flows from a culvert crossing the Riverside Freeway near Palmyrita Avenue about 700 feet westerly to confluence with line 9. Approximately 350 feet of the drain is existing with the remainder to be constructed. A preliminary plan and profile drawing of the drain is shown on Plate 39. The estimated construction cost is \$9,300.

Line 9-B - Line 9-B is an underground drain designed to relieve a drainage problem along Orange Street near Chase Road. The drain begins at the intersection of Chase Road and Camp Street and extends northwesterly to Orange Street; thence southwesterly in Orange Street to the confluence with line 9. A preliminary plan and profile drawing of the drain is shown on Plate 40. The estimated construction cost is \$108,770.

Line 10 - Line 10 is an underground drain designed to relieve a drainage problem along Orange Street and Columbia Avenue west of Orange Street. The line begins near the intersection of Orange and Post Streets and extends northeasterly in Orange Street to Columbia Avenue; thence northwesterly in Columbia Avenue to the confluence with the proposed Springbrook Wash channel. This drain will replace an existing inadequate line located in Columbia Avenue and will also provide relief for line 11 which is presently overloaded. Preliminary plan and profile drawings of the drain are shown on Plates 41 and 42. The estimated construction cost is \$185,340.

Line 12 - Line 12 is an underground drain designed to relieve flooding along Main Street. The drain begins at the intersection of Spruce and Lime Streets and extends northerly in Lime Street to Russell Street; thence northwesterly in Russell Street to Main Street; thence northeasterly in Main Street, discharging into an existing State Highway channel. A preliminary plan and profile drawing of the drain is shown on Plate 43. The estimated construction cost is \$44,900.

Line 12-A - Line 12-A is an underground drain designed to drain Spruce Street between Main Street and Orange Street. The line begins near the intersection of Orange and Spruce Streets and extends westerly in Spruce to Main Street; thence northwesterly to the confluence with line 12. Approximately 1800 feet of this line is existing. The purpose of the extension of this line is to eliminate flooding at the intersection of Spruce and Main Streets. A preliminary plan and profile drawing is shown on Plate 44. The estimated construction cost is \$9,820.

Line 13 - Line 13 is an underground drain that serves an industrial area along the A.T. & S.F. Railroad near Spruce Street and Kansas Avenue. The drain begins approximately 700 feet southwest of Kansas Avenue and extends northeasterly, parallel with the railroad to confluence with the proposed University Wash channel. This line will intercept flows that normally cross the Gage Canal and Riverside Freeway and flow

into Spruce Street at Mulberry Street. This alignment will be less costly than enlarging and extending line 12 upstream. A preliminary plan and profile drawing is shown on Plate 45. The estimated construction cost is \$47,590.

Line 14 - Line 14 is an underground drain designed to relieve a major north-south arterial street in the northwest section of the city. The drain begins in Main Street at a point approximately 1300 feet north of Alamo Street and extends southerly to Alamo Street; thence westerly in an easement to the proposed Springbrook Wash channel. A preliminary plan and profile drawing is shown on Plate 46. The estimated construction cost is \$49,290.

Line 14-A - Line 14-A is an underground drain that begins in Alamo Street at a low point located about 1000 feet west of Main Street. The drain extends easterly in Alamo Street to the confluence with line 14 at Main Street. A preliminary plan and profile drawing is shown on Plate 47. The estimated construction cost is \$32,700.

Line 15 - Line 15 is an underground drain designed to intercept flows from a low area along Columbia Avenue approximately 1600 feet west of the proposed Springbrook Wash channel. The drain extends easterly in Columbia Avenue to the proposed Springbrook Wash channel. A preliminary plan and profile drawing is shown on Plate 48. The estimated construction cost is \$51,560.

Line 16 - Line 16 is an underground drain designed to intercept flows in a low area along Strong Street located approximately 1600 feet west of the proposed Springbrook Wash channel. The drain begins at the low point in Strong Street and extends westerly to Rivera Street; thence southerly to Market Street; and thence southeasterly in Market Street to a natural wash at the Fairmount Park Golf Course. Preliminary plan and profile drawings of the drain are shown on Plates 49 and 50. The estimated construction cost is \$96,940.

Inlets - Inlets and their proper location are perhaps the most important and integral part of any flood control and drainage system. Inlets provide the means of intercepting uncontrolled flows in the streets or watercourses and directing them into the channels and storm drains. Most of the inlets to be used in this plan will be the curb opening type catch basins or modifications thereof. Field investigations have been made in order to generally establish the locations of the proposed inlets and to locate existing inlets which are to be utilized in the proposed system. Table II lists the location of existing and proposed catch basins and the approximate length of curb opening required to intercept the storm runoff.

TABLE II
PROPOSED INLETS FOR MASTER DRAINAGE PLAN

Line	Drainage Area No.	Location	Proposed Inlets - Feet		
			Total	Existing	Proposed
1	P.*22	Big Springs @ Goodrich	37	0	37
1	P. 22	Big Springs @ Mt. Vernon	47	0	47
1	25	Big Springs @ Watkins	46	0	46
1	26	Big Springs @ Valencia	8	0	8
1-A	21, 24	Watkins @ Broadbent	58	0	58
1-A	23	Watkins @ Big Springs	9	0	9
3	9, 10	Blaine @ Valencia	45	0	45
3	12	Blaine @ Duranga	15	0	15
3	11,13,14	Blaine @ Flanders	158	0	158
4	37, P.40	Blaine @ 700 E. of Iowa	67	0	67
4	P. 40	Blaine @ Iowa	32	7	25
4	42	Blaine @ Freeway	65	65	0
5	P. 16	Spruce @ Flanders	114	0	114
5	P. 16	Spruce @ Sugarloaf	17	0	17

P.* Denotes part of drainage area.

TABLE II
PROPOSED INLETS FOR MASTER DRAINAGE PLAN

Line	Drainage Area No.	Location	Proposed Inlets - Feet		
			Total	Existing	Proposed
5	17	Spruce @ Watkins(proposed)	99	14	85
5	47	Spruce @ Iowa	43	0	43
5	48	Spruce @ Atlanta	17	0	17
5	49	Spruce @ Chicago	18	0	18
5	P.*50	Spruce @ Freeway	3	3	0
5	P. 50	Spruce @ University Wash	15	0	15
5-A	38, P.39	Massachusetts @ Rustin	48	0	48
5-A	P. 39	Massachusetts @ Iowa	22	0	22
5-B	55A	Atlanta @ Railroad	12	0	12
6	52	Columbia Between Calif. & End	302	0	302
6	59	Columbia @ Railroad	11	0	11
6	62	Columbia @ Iowa	38	20	18
6	65	Columbia @ Railroad	22	4	18
6-A	52-A	Marlborough @ California	111	0	111

P.* Denotes part of drainage area.

TABLE II
PROPOSED INLETS FOR MASTER DRAINAGE PLAN

Line	Drainage Area No.	Location	Proposed Inlets - Feet		
			Total	Existing	Proposed
6-A	P.* 52	California @ Columbia	29	0	29
6-B	53, 63	Iowa Between Marlborough & Columbia	57	10	47
6-B	54	Iowa @ Marlborough	40	0	40
7	P. 51	Future @ Upstream End	77	0	77
7	P. 51	Palmyrita @ Mt. Vernon	61	0	61
7	P. 51	Palmyrita @ California	90	0	90
7	P. 51	California @ Prospect	9	0	9
8	60, 64	Palmyrita @ Railroad	21	0	21
8	55,57,66	Marlborough @ Railroad	81	0	81
8	106, 57A	Thornton @ Railroad	27	0	27
8	71,104	Thornton @ Freeway	49	0	49
8-B	56	Thornton @ Chicago	23	0	23
8-C	P. 73	Spring Garden near La Cadena	8	0	8
8-E	P. 69	Columbia @ E.La Cadena Dr.	30	6	24
8-E	P.69,70	La Cadena @ Milton	17	9	8

P.* Denotes part of drainage area.

TABLE II
PROPOSED INLETS FOR MASTER DRAINAGE PLAN

Line	Drainage Area No.	Location	Proposed Inlets - Feet		
			Total	Existing	Proposed
8-E	P.* 73	West La Cadena @ 8-E	3	3	0
8-E	P. 73	Line 8-E @ Knoll Way	5	5	0
8-E	P. 73	Line 8-E @ Strong Street	6	0	6
9	67, P.68	Line 9 @ E. La Cadena	46	10	36
9	P. 76	Line 9 @ W. La Cadena	3	3	0
9	P. 76	Line 9 @ Orange	34	0	34
9-A	P. 68	Line 9-A @ E. La Cadena	20	10	10
9-A	P. 76	Line 9-A @ W. La Cadena	12	12	0
9-B	77	Chase between Orange & Kemp	80	0	80
10	82	Orange @ Post	72	8	64
10	75, 81	Orange @ Columbia	53	16	37
10	79, P.80,83	Columbia between Kearny & Main	65	9	56
10	P. 80	Columbia @ University Cha.	14	0	14
12	108, P.109	Spruce @ Lime	46	0	46
12	102	Russell @ Orange	19	3	16

P.* Denotes part of drainage area.

TABLE II
PROPOSED INLETS FOR MASTER DRAINAGE PLAN

Line	Drainage Area No.	Location	Proposed Inlets - Feet		
			Total	Existing	Proposed
12	97	Main @ Freeway	92	92	0
12-A	101	Spruce @ Orange	17	6	11
13	P. 109	Railroad @ 700' S.Kansas	26	0	26
13	P. 109	Kansas @ Railroad	11	0	11
13	P. 109	Spruce @ Railroad	6	0	6
14	P. 110	Main @ 1300' N.Alamo	41	0	41
14-A	P. 110,112	Alamo @ 100' W. Main	35	0	35
15	P. 114	Columbia @ 1700' W. Springbrook	51	0	51
15	P. 114	Columbia @ Springbrook	13	0	13
16	P. 116	Strong @ 500' E. of Rivera	53	0	53
16	P. 116	Rivera @ Market	37	0	37
16	P. 116	Market @ Freeway	47	6	41

P.* Denotes part of drainage area.

Alternative Studies - Alternative studies were made of the alignment of several proposed open channels and underground storm drains as well as retention basin sites. Studies were also made of open channels versus underground drains for portions of lines 3, 8 and 9, and comparisons of vertical wall and trapezoidal sections for open channels. Consideration was also given to a concrete lined channel in lieu of the diversion dike and flooding easement in connection with the Blaine Street Retention Basin. It was determined that the alignments, types of construction and sites proposed in this plan are the most economical and provide the most efficient system of collection and disposal of storm waters.

Estimated Cost - The estimated cost of each line and the retention basin is tabulated in Table III. Unit prices used in determining costs are based on present (July 1967) price levels. The project costs for each line which includes engineering, contingencies and right of way costs, are summarized in Table IV.

TABLE III
PRELIMINARY CONSTRUCTION COST ESTIMATE

<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total</u>
<u>Line 1</u>				
42" R.C.P.	L.F.	520	\$ 26.00	\$13,520
33" R.C.P.	L.F.	850	19.50	16,580
30" R.C.P.	L.F.	780	18.25	14,240
Catch Basins	L.F.	135	140.00	18,900
Manholes	Ea.	9	600.00	<u>5,400</u>
			Total	\$68,640
 <u>Line 1-A</u>				
30" R.C.P.	L.F.	650	\$ 18.00	\$11,700
Catch Basins	L.F.	67	140.00	9,380
Manholes	Ea.	2	600.00	<u>1,200</u>
			Total	\$22,280

TABLE III
PRELIMINARY CONSTRUCTION COST ESTIMATE

<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total</u>
<u>Line 3</u>				
51" R.C.P.	L.F.	440	\$ 36.25	\$ 15,950
48" R.C.P.	L.F.	500	30.50	15,250
33" R.C.P.	L.F.	250	20.00	5,000
30" R.C.P.	L.F.	2,800	18.00	50,400
Channel Concrete	S.F.	49,300	.40	19,720
Cutoff Wall conc.	L.F.	5,600	1.50	8,400
Excavation	C.Y.	3,000	1.00	3,000
Catch Basins	L.F.	218	140.00	30,520
Manholes	Ea.	8	600.00	4,800
Fencing	L.F.	5,600	1.50	<u>8,400</u>
			Total	\$161,440

Blaine Street Retention Basin and Diversion Dike

Embankment, Spillway, etc.	L.S.	-----	\$ -----	<u>\$ 50,000</u>
			Total	\$ 50,000

Line 4

39" R.C.P.	L.F.	720	\$ 23.75	\$ 17,100
36" R.C.P.	L.F.	1,360	22.50	30,600
Catch Basins	L.F.	92	140.00	12,880
Manholes	Ea.	6	600.00	<u>3,600</u>
			Total	\$ 64,180

TABLE III

PRELIMINARY CONSTRUCTION COST ESTIMATE

<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total</u>
<u>Line 5</u>				
75" R.C.P.	L.F.	3,500	\$ 59.00	\$206,500
66" R.C.P.	L.F.	2,500	49.75	124,380
63" R.C.P.	L.F.	700	45.00	31,500
39" R.C.P.	L.F.	1,800	24.75	44,550
36" R.C.P.	L.F.	1,300	22.50	29,250
33" R.C.P.	L.F.	320	19.50	6,240
Catch Basins	L.F.	309	140.00	43,260
Manholes	Ea.	29	600.00	<u>17,400</u>
			Total	\$503,080
<u>Line 5-A</u>				
42" R.C.P.	L.F.	1,320	\$ 27.25	\$ 35,970
30" R.C.P.	L.F.	1,330	18.00	23,940
Catch Basins	L.F.	70	140.00	9,800
Manholes	Ea.	8	600.00	<u>4,800</u>
			Total	\$ 74,510
<u>Line 5-B</u>				
24" R.C.P.	L.F.	400	\$ 15.50	\$ 6,200
Catch Basins	L.F.	12	140.00	1,680
Manholes	Ea.	1	600.00	<u>600</u>
			Total	\$ 8,480

TABLE III
PRELIMINARY CONSTRUCTION COST ESTIMATE

<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total</u>
<u>Line 6</u>				
78" R.C.P.	L.F.	1,710	\$ 61.25	\$104,740
69" R.C.P.	L.F.	1,680	51.50	86,520
63" R.C.P.	L.F.	990	45.00	44,550
51" R.C.P.	L.F.	1,630	34.50	56,240
33" R.C.P.	L.F.	2,000	20.00	40,000
Catch Basins	L.F.	349	140.00	48,860
Manholes	Ea.	23	600.00	<u>13,800</u>
			Total	\$394,710
<u>Line 6-A</u>				
51" R.C.P.	L.F.	1,000	\$ 33.75	\$ 33,750
36" R.C.P.	L.F.	300	22.00	6,600
Catch Basins	L.F.	140	140.00	19,600
Manholes	Ea.	4	600.00	<u>2,400</u>
			Total	\$ 62,350
<u>Line 6-B</u>				
30" R.C.P.	L.F.	700	\$ 18.00	\$ 12,600
Catch Basins	L.F.	87	140.00	12,180
Manholes	Ea.	2	600.00	<u>1,200</u>
			Total	\$ 25,980

TABLE III

PRELIMINARY CONSTRUCTION COST ESTIMATE

<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total</u>
<u>Line 7</u>				
54" R.C.P.	L.F.	1,580	\$ 40.50	\$ 63,990
48" R.C.P.	L.F.	420	32.00	13,440
45" R.C.P.	L.F.	2,230	29.50	65,790
39" R.C.P.	L.F.	2,780	24.25	67,420
30" R.C.P.	L.F.	870	18.25	15,880
Catch Basins	L.F.	237	140.00	33,180
Manholes	Ea.	23	600.00	<u>13,800</u>
			Total	\$273,500
<u>Line 8</u>				
84" R.C.P.	L.F.	780	\$ 70.00	\$ 54,600
81" R.C.P.	L.F.	1,414	66.25	93,680
42" R.C.P.	L.F.	1,610	27.25	43,870
Channel Concrete	C.Y.	3,150	60.00	189,000
Excavation	C.Y.	23,280	1.00	23,280
Catch Basins	L.F.	178	140.00	24,920
Manholes	Ea.	11	600.00	6,600
Fencing	L.F.	8,700	1.50	13,050
10 x 5 R.C.B.	L.S.	-----	-----	<u>5,000</u>
			Total	\$454,000

TABLE III
PRELIMINARY CONSTRUCTION COST ESTIMATE

<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total</u>
<u>Line 8-B</u>				
24" R.C.P.	L.F.	1,040	\$ 15.50	\$ 16,120
Catch Basins	L.F.	23	140.00	3,220
Manholes	Ea.	3	600.00	<u>1,800</u>
		Total		\$ 21,140
<u>Line 8-C</u>				
21" R.C.P.	L.F.	630	\$ 15.00	\$ 9,450
Catch Basins	L.F.	8	140.00	1,120
Manholes	Ea.	1	600.00	<u>600</u>
				\$ 11,170
<u>Line 8-E</u>				
39" R.C.P.	L.F.	1,500	\$ 27.50	\$ 41,250
30" R.C.P.	L.F.	1,310	17.25	22,600
Catch Basins	L.F.	38	140.00	5,320
Manholes	Ea.	8	600.00	<u>4,800</u>
		Total		\$ 73,970

TABLE III
PRELIMINARY CONSTRUCTION COST ESTIMATE

<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total</u>
<u>Line 9</u>				
36" R.C.P.	L.F.	820	\$ 21.50	\$ 17,630
33" R.C.P.	L.F.	500	19.50	9,750
30" R.C.P.	L.F.	980	18.00	17,640
Channel Concrete	S.F.	5,450	.40	2,180
Cutoff Wall Conc.	L.F.	700	1.50	1,050
Excavation	C.Y.	8,640	1.00	8,640
Catch Basins	L.F.	70	140.00	9,800
Manholes	Ea.	7	600.00	4,200
Grouted Riprap	C.Y.	381	20.00	<u>7,600</u>
			Total	\$ 78,490
<u>Line 9-A</u>				
30" R.C.P.	L.F.	400	\$ 18.25	\$ 7,300
Catch Basins	L.F.	10	140.00	1,400
Manholes	Ea.	1	600.00	<u>600</u>
			Total	\$ 9,300
<u>Line 9-B</u>				
48" R.C.P.	L.F.	1,330	\$ 30.50	\$ 40,570
33" R.C.P.	L.F.	280	19.50	54,600
Catch Basins	L.F.	80	140.00	11,200
Manholes	Ea.	4	600.00	<u>2,400</u>
			Total	\$108,770

TABLE III
PRELIMINARY CONSTRUCTION COST ESTIMATE

<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total</u>
<u>Line 10</u>				
72" R.C.P.	L.F.	370	\$ 53.75	\$ 19,890
69" R.C.P.	L.F.	1,130	51.50	58,200
60" R.C.P.	L.F.	830	42.25	35,070
48" R.C.P.	L.F.	1,320	32.00	42,240
Catch Basins	L.F.	171	140.00	23,940
Manholes	Ea.	10	600.00	<u>6,000</u>
		Total		\$185,340
<u>Line 12</u>				
36" R.C.P.	L.F.	650	\$ 21.50	\$ 13,980
30" R.C.P.	L.F.	1,090	18.75	20,440
Catch Basins	L.F.	62	140.00	8,680
Manholes	Ea.	3	600.00	<u>1,800</u>
		Total		\$ 44,900
<u>Line 12-A</u>				
24" R.C.P.	L.F.	480	\$ 16.00	\$ 7,680
Catch Basins	L.F.	11	140.00	1,540
Manholes	Ea.	1	600.00	<u>600</u>
		Total		\$ 9,820

TABLE III
PRELIMINARY CONSTRUCTION COST ESTIMATE

<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total</u>
<u>Line 12</u>				
36" R.C.P.	L.F.	650	\$ 21.50	\$ 13,980
30" R.C.P.	L.F.	1,090	18.75	20,440
Catch Basins	L.F.	62	140.00	8,680
Manholes	Ea.	3	600.00	<u>1,800</u>
		Total		\$ 44,900
<u>Line 12-A</u>				
24" R.C.P.	L.F.	480	\$ 16.00	\$ 7,680
Catch Basins	L.F.	11	140.00	1,540
Manholes	Ea.	1	600.00	<u>600</u>
		Total		\$ 9,820
<u>Line 13</u>				
39" R.C.P.	L.F.	660	\$ 24.75	\$ 16,340
36" R.C.P.	L.F.	350	22.50	7,880
33" R.C.P.	L.F.	700	20.50	14,350
Catch Basins	L.F.	43	140.00	6,020
Manholes	Ea.	5	600.00	<u>3,000</u>
		Total		\$ 47,590

TABLE III
PRELIMINARY CONSTRUCTION COST ESTIMATE

<u>Description</u>	<u>Unit</u>	<u>Quantity</u>	<u>Unit Price</u>	<u>Total</u>
<u>Line 14</u>				
42" R.C.P.	L.F.	510	\$ 27.25	\$ 13,900
33" R.C.P.	L.F.	1,300	20.50	26,650
Catch Basins	L.F.	41	140.00	5,740
Manholes	Ea.	5	600.00	<u>3,000</u>
		Total		\$ 49,290
<u>Line 14-A</u>				
42" R.C.P.	L.F.	1,000	\$ 26.00	\$ 26,000
Catch Basins	L.F.	35	140.00	4,900
Manholes	Ea.	3	600.00	<u>1,800</u>
		Total		\$ 32,700
<u>Line 15</u>				
39" R.C.P.	L.F.	1,600	\$ 24.75	\$ 39,600
Catch Basins	L.F.	64	140.00	8,960
Manholes	Ea.	5	600.00	<u>3,000</u>
		Total		\$ 51,560
<u>Line 16</u>				
51" R.C.P.	L.F.	1,700	\$ 33.00	\$ 56,100
39" R.C.P.	L.F.	900	23.00	20,700
Catch Basins	L.F.	131	140.00	18,340
Manholes	Ea.	3	600.00	<u>1,800</u>
		Total		\$ 96,940

TABLE IV

ESTIMATED PROJECT COST
FOR UNIVERSITY AREA

MASTER DRAINAGE PLAN

Item	Line 1	Line 3 Includes Blaine St. Retention Basin	Line 4	Line 5	Line 6	Line 7	Line 8
Storm Drain & Appurtenances	\$ 90,920	\$211,440	\$ 64,180	\$586,070	\$483,040	\$273,500	\$560,280
Right of Way	- 0 -	84,500	- 0 -	- 0 -	- 0 -	5,700	45,500
Engineering & Administration @ 18%	16,370	38,060	11,550	105,490	86,950	49,230	100,850
Contingencies @ 12%	10,910	25,370	7,700	70,330	57,960	32,820	67,230
Total	\$118,200	\$359,370	\$ 83,430	\$761,890	\$627,950	\$361,250	\$773,860

TABLE IV

ESTIMATED PROJECT COST
FOR UNIVERSITY AREA

MASTER DRAINAGE PLAN

Item	Line 9	Line 10	Line 12	Line 13	Line 14	Line 15	Line 16
Storm Drain & Appurtenances	\$196,560	\$185,340	\$ 54,720	\$ 47,590	\$ 81,990	\$ 51,560	\$ 96,940
Right of Way	5,000	- 0 -	- 0 -	- 0 -	- 0 -	- 0 -	- 0 -
Engineering & Administration @ 18%	35,380	33,360	9,850	8,570	14,760	9,280	17,450
Contingencies @ 12%	23,590	22,240	6,570	5,710	9,840	6,190	11,630
Total	\$260,530	\$240,940	\$ 71,140	\$ 61,870	\$106,590	\$ 67,030	\$126,020

C O N C L U S I O N S

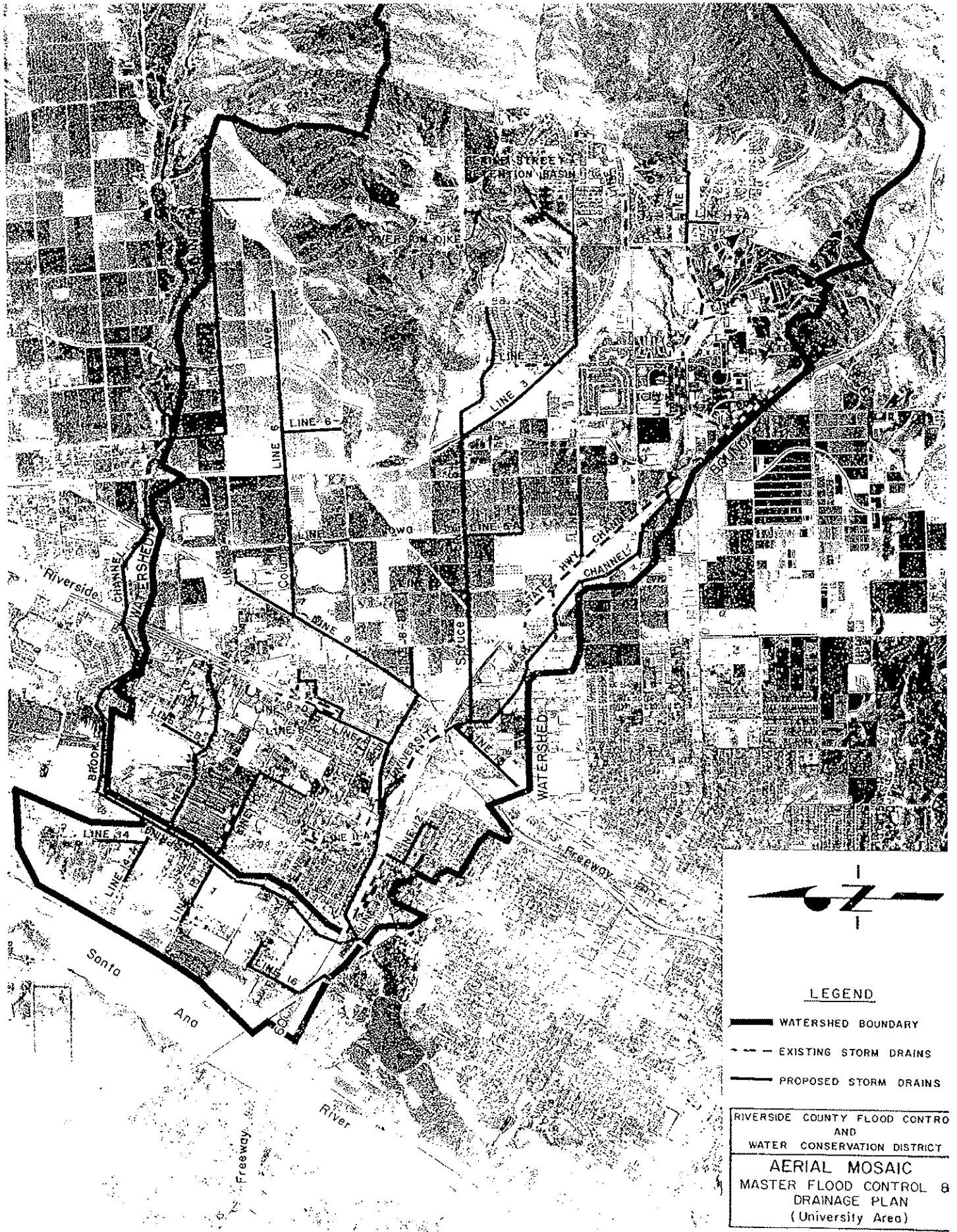
Based on the studies and investigations made for this report, it is concluded that:


1. The University area of the city of Riverside is experiencing serious drainage problems due to the rapid urbanization and development of the watershed and due to the lack of an adequate drainage system in the area.
2. A retention basin and a system of underground drains and open channels will be required to control and convey storm runoff safely through developed areas to adequate points for disposal of said storm runoff.
3. The Master Drainage Plan proposed in this report is economically feasible.
4. The total cost of the proposed improvements, including right of way, is estimated to be \$4,020,000.

R E C O M M E N D A T I O N S

It is recommended that:

1. The Master Drainage Plan as set forth herein be adopted by the City of Riverside as part of the overall master plan for the city.
2. The Master Drainage Plan as set forth herein be used as a guide to all future developments and that such developments be required to conform to the plan insofar as it is possible to do so.
3. The right of way required for the proposed plan be protected from encroachment whenever possible.




LEGEND
 ——— WATERSHED BOUNDARY
 - - - EXISTING STORM DRAINS
 ——— PROPOSED STORM DRAINS

RIVERSIDE COUNTY FLOOD CONTROL
 AND
 WATER CONSERVATION DISTRICT
AERIAL MOSAIC
MASTER FLOOD CONTROL &
DRAINAGE PLAN
 (University Area)