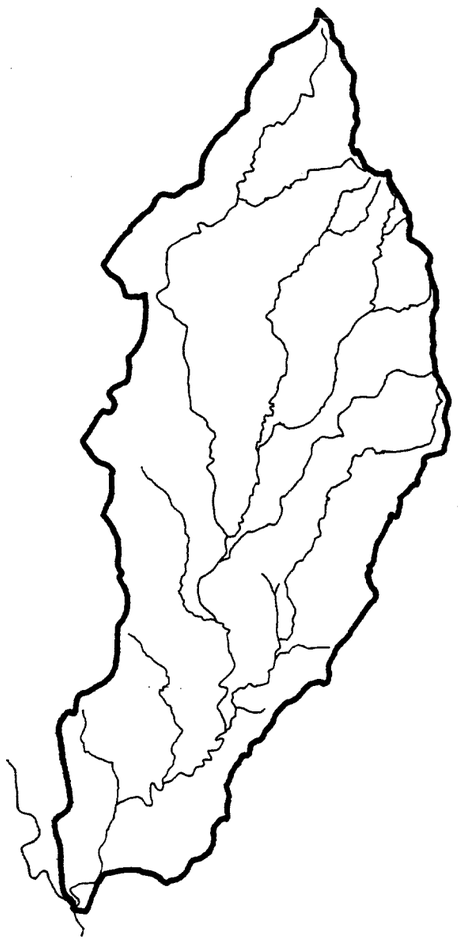
JIMMY CAMP CREEK
MASTER DRAINAGE PLANNING STUDY



FOR

THE CITY OF COLORADO SPRINGS

AND

EL PASO COUNTY, COLORADO

PRELIMINARY

Not reviewed by the City

JANUARY, 1987

WILSON & COMPANY
ENGINEERS

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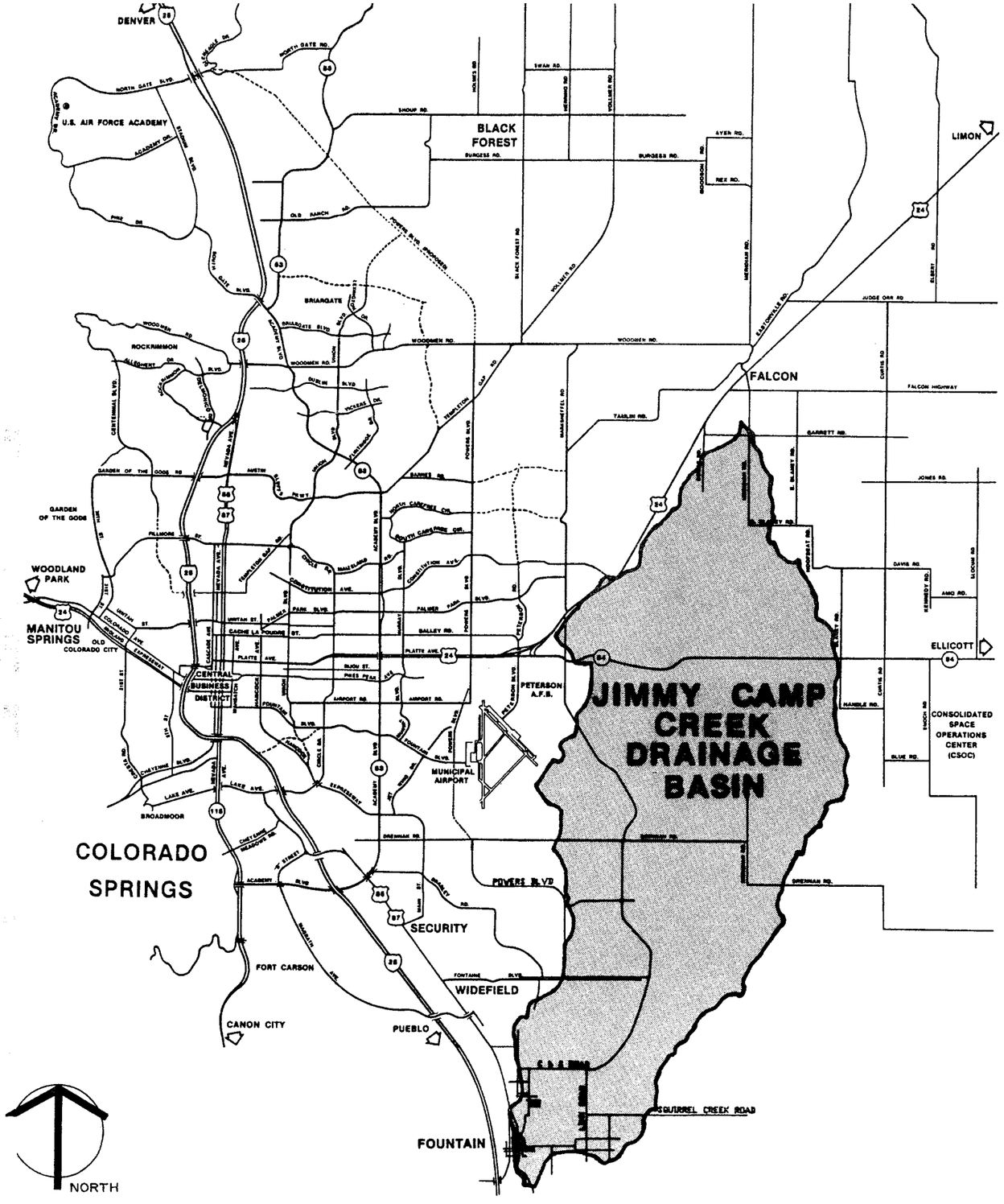


EXHIBIT NO. 1

VICINITY MAP

NO SCALE

INTRODUCTION

AUTHORIZATION

The Jimmy Camp Creek Master Drainage Planning study was authorized by Aries Properties, Inc., a Colorado corporation, and Colorado Centre Metropolitan District, a quasi-municipal corporation and political subdivision of the State of Colorado. The study was requested by the El Paso County Commissioners, and must be approved by the Colorado Springs/El Paso County Drainage Board, El Paso County Commissioners and the Colorado Springs City Council.

STUDY LOCATION

The Jimmy Camp Creek Drainage Basin lies east to southeast of the Colorado Springs metropolitan area, and drains toward the southwest into Fountain Creek just south of the City of Fountain. The sixty-seven (67) square mile basin is drained by several tributaries which flow into Jimmy Camp Creek and are examined in this study. These include: the Corral Tributary, the Strip Mine Tributary, the Franceville Tributary and the East Tributary.

STUDY OBJECTIVE & SCOPE

The purpose of the Jimmy Camp Creek Master Drainage Planning Study is to establish mitigation mechanisms for the additional stormwater runoff resulting from development within the drainage basin. Alternatives have been developed to reduce the impacts that these developments may have on historical hydrological events. The overall management scheme attempts to correlate the relevant parameters of the watershed. These parameters include:

1. Land Use and Density
2. Topographic Features
3. Soil Types
4. Ground Cover
5. Shape of Watershed
6. Slope of Watershed
7. Cost/Benefits
8. Environmental Impacts

The tasks included in this study consisted of the following items:

1. An initial project conference was organized to establish the project criteria and to establish lines of communication with the reviewing agencies.

2. Available existing data in the form of reports, maps and plans was analyzed to determine what could be used for the study and also to determine the need for additional information.

3. The work performed was coordinated with the El Paso County Land Use Department and the Department of Transportation, City of Colorado Springs Department of Public Works, the City of Fountain, the Soil Conservation Service and the Corps of Engineers.

4. Design parameters were developed and then reviewed with the appropriate governing agencies.

5. The capacity and adequacy of major existing channels and drainage structures in the Jimmy Camp Creek Basin were anaylzed.

6. Improvements to the natural storm drainage channels and existing structures were analyzed and recommended. Cost Estimates for said improvements were made.

7. The Master Planning Document is presented in four parts:

   A. Executive Summary

   B. Technical Section

      Background Information

      Basin Characteristics

      Elements of Hydrology

      Hydraulic Analysis

      Drainage Facility Analysis

      Economic Analysis

      Conclusions and Recommendations

   C. Drawings and Maps

   D. Technical Addendum
      (Separate Report)

EXECUTIVE SUMMARY

This is a summary of the results of the Jimmy Camp Creek Master Drainage Planning Study, in Colorado Springs and El Paso County, Colorado. The study covered all aspects of drainage planning throughout the basin. A number of drainage improvements alternatives were examined with the chosen alternative listed in the summary.

The final design flows used for sizing the drainage facilities and improvements in the basin were developed using the 100-year, 24-hour rainfall events in conjunction with fully developed conditions. These flows were then modeled through the proposed detention facilities, with the resultant flows then used for the design of the remainder of the improvements. The following information is a summary of the recommendations and subsequent costs of the proposed improvements.

A more detailed explanation of the items listed in this summary section can be found in the body of this report. The following is a description of where some of the items are located within the report:

Unit Costs - See Economic Analysis Section (Pg 64)

Channel Protection Costs - See Improvement Costs Section (Pg 64)

Explanation of Recommendations - See Conclusions and Reccomendations Section: (Pgs 67 to 78)

Definitions of Hydraulic Terms - See Glossary of Terms Section (Pgs 81 to 87)

Description of Channel Protection Types - See Drainage Concepts and Criteria Section (Pg 56)

TABLE NO 1

IMPROVEMENT COST SUMMARY

I. Major Channel Costs

Reach #1 Jimmy Camp Creek	$ 1,265,000
Reach #2 Jimmy Camp Creek	3,290,000
Reach #3 Jimmy Camp Creek	4,015,000
Reach #4 Jimmy Camp Creek	1,810,000
Reach #5 Jimmy Camp Creek	3,540,000
Reach #6 Corral Tributary	5,040,000
Reach #7 Corral Tributary	1,235,000
Reach #8 Strip Mine Tributary	2,210,000
Reach #9 Franceville Tributary	3,090,000
Reach #10 East Tributary	5,300,000
Marksheffel Tributary	440,000
Fontaine Tributary	1,570,000
TOTAL	**$32,775,000**

II. Minor Tributary Costs (Flows between 500 cfs and 3,000 cfs) See the Drainage Improvement Map for size and type of channels.

For drainage into:	COST
Jimmy Camp Creek	$ 10,138,000
Corral Tributary	5,107,000
Strip Mine Tributary	3,324,000
Franceville Tributary	544,000
East Tributary	4,316,000
Marksheffel Tributary	127,500
Fontaine Tributary	552,500
SUBTOTAL	**$24,109,000**
Colorado Centre*	$ 6,445,000
TOTAL	**$30,554,000**

III. Land Reimbursement Costs

Detention Facilities (257 ac.)	$ 1,285,000
Channel Buffer Zones (244 ac.)	1,220,000
TOTAL	**$ 2,505,000**

IV. Bridge Replacement Costs

Peaceful Valley Road	$ 629,200
Drennan Road	$ 338,800
TOTAL	**$ 968,000**

V. Minor Structures Costs

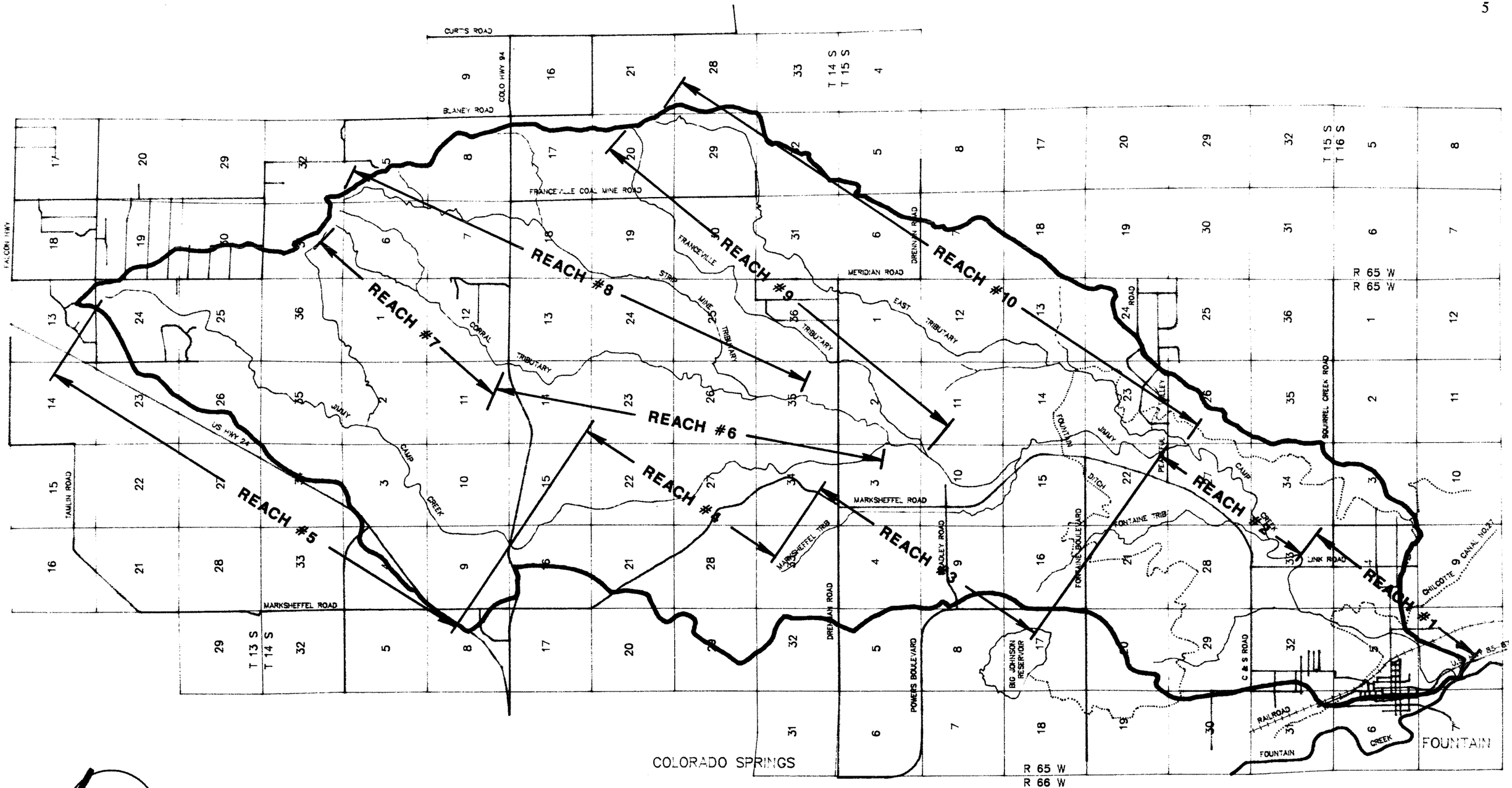
See Table No. 6 for information on location and size of proposed minor structures

Total Estimated Cost **$ 1,000,000**

TOTALS

I.	Major Channels	$ 32,775,000
II.	Minor Tributary	30,554,000
III.	Land Reimbursement	2,505,000
IV.	Bridge Replacement	968,000
V.	Minor Structures	1,000,000
		67,802,000
VI.	Contingency and Engineering (20%)	13,560,400
TOTAL BASIN IMPROVEMENT COSTS		**$81,362,400**

*Colorado Centre - Total Minor Tributary Improvement costs within the Colorado Centre Metropolitan District from the Master Drainage Study for Colorado Centre prepared by J.R. Engineering, Ltd. and the Phase I Business Park Study prepared by Kellogg Engineering, Inc.



MASTER DRAINAGE PLANNING STUDY
FOR JIMMY CAMP CREEK
REACH MAP

DESIGN	DRAWN	DATE:
		FILE NO. 85-832
		EXHIBIT NO. 2

WILSON & COMPANY
ENGINEERS

TABLE NO. 2A

JIMMY CAMP CREEK

Reach	From/To	Before Improvements				Recommendations	After Improvements				TotalCost
		$Q_{,cfs}$	$V_{,fps}$	$D_{,ft}$	$L_{,ft}$		Min $b_{,ft}$	$V_{,fps}$	$D_{,ft}$	$L_{,ft}$	
1	Fountain Creek to Old Pueblo Rd	21,000	11.5	6.1	810	1. No lining recommended. Remove abandoned reinforced concrete arch bridge.	250	---	---	---	75,000
	Old Pueblo Rd to D&RGW RR Bridge	21,000	11.5	6.1	4,320	1. Realign the channel from Old Pueblo Road upstream for 2,610 ft. to a point 430 ft. south of the D&RGW Bridge. Earthwork estimated at 212,000 c.y. 2. Recommend bank type 4 protection for realigned section.	250		6.5	3,040	985,000
	D&RGW RR Bridge to Iowa Ave.	21,200	11.3	6.2	2,465	1. Repair side slope failure and place 500 ft. of type 5 protection beginning 500 ft. upstream of the railroad bridge. 2. No additional major protection recommended.	250	---	---	---	145,000
	Iowa Ave. to Link Rd	21,200	12.9	6.3	9,980	1. Remove trees and brush from channel below Link Road bridge. 2. Correct localized erosion problems as required. 3. Recommend 100 ft. buffer zone in lieu of bank protection.	250	---	---	---	60,000
2	Link Rd. to STA 225+52 (Limit of Corps of Engineers' study)	21,500	11.5	7.8	5,010	1. Realign 1,700 ft. of stream section immediately upstream of Link Road. Earthwork estimated at 130,000 c.y. 2. Provide type 4 protection on side slopes along realigned section. 3. Remove trees and brush from the channel above Link Road bridge.	200	13.3	7.4	3,900	605,000
	STA 225+52 to Peaceful Valley Rd	20,500	13.2	7.0	12,540	1. Recommend 8,350 ft. of major realignment and profile correction (deepening). Earthwork estimated at 675,000 c.y. 2. Type 3 protection recommended for entire realigned reach.	200	12.3	7.6	8,350	2,685,000

(A line of dashes (---) denotes no change.)

TABLE NO. 2A CONT.

JIMMY CAMP CREEK (CONT)

Reach	From/To	Before Improvements Q,cfs	V,fps	D,ft	L,ft	Recommendations	After Improvements Min b,ft	V,fps	D,ft	L,ft	TotalCost
3	Peaceful Valley Rd. to Marksheffel Tributary	18,000	13.6	6.6	11,900	1. Recommend 9,400 ft. of major profile correction (deepening) and minor alignment correction. Earthwork estimated at 525,000 c.y. 2. Type 3 protection recommended for entire realigned reach.	200	13.1	6.2	9,400	2,485,000
	Marksheffel Tributary to Bradley Rd.	15,800	9.3	5.0	5,300	1. Recommend minor realignment at Marksheffel Tributary. Earthwork estimated at 30,000 c.y. 2. Type 2 protection recommended for a 3,400 ft. section of the westerly bank only.	200	---	---	4,900	160,000
	Bradley Rd. to STA 559+00	15,800	18.3	7.5	2,675	1. Provide type 4 side slope protection on the westerly bank for 2,200 ft. 2. Widen 1,300 ft. of channel. Earthwork estimated at 65,000 c.y. 3. Provide 1,200 LF of type 4 protection on easterly bank from Bradley Road bridge to beginning of type 5 protection. 4. Construct type 5 wall for 600 ft. on easterly bank.	200	14.3	5.2	---	600,000
	STA 559+00 to confluence of Corral Tributary	15,400	6.6	7.2	1,725	1. Construct type 5 wall for 800 ft. and backfill behind it to a 3:1 slope.	200	---	---	---	150,000
	Corral Tributary to Drennan Rd.	5,850	13.3	5.1	3,865	1. Recommend 900 ft. of channel realignment and minor widening of remainder. Earthwork estimated at 62,000 c.y. 2. Side slope protection type 3 recommended for 3,300 LF.	100	11.1	4.6	3,825	620,000
4	Drennan Rd. to STA 626+76	5,825	13.3	5.0	1,000	1. Widen existing channel to 100 ft. Earthwork estimated at 24,000 c.y.	100	9.0	6.0	---	175,000

(A line of dashes (---) denotes no change.)

TABLE NO. 2A CONT.

JIMMY CAMP CREEK (CONT)

Reach	From/To	Before Improvements Q,cfs	V,fps	D,ft	L,ft	Recommendations	After Improvements Min b,ft	V,fps	D,ft	L,ft	TotalCost
						2. Two 4-foot drop structures are recommended to reduce velocities before bridge. 3. Side slope protection type 2 recommended.					
	STA 626+76 to STA 663+66	5,630	15.0	6.0	3,690	1. Widen existing channel to 100 ft. Earthwork estimated at 15,000 c.y. 2. Side slope protection type 3 recommended.	100	12.2	4.2	3,690	615,000
4	STA 663+66 to Detention Facility JCC 1 (STA 720+36)	5,600	12.8	4.0	5,670	1. Recommend minor widening where needed and side slope regrading to 3:1 where existing slopes are steeper. 2. Recommend 100 ft. buffer zone in lieu of side slope protection. 3. Recommend reseeding of all side slopes.	100	---	---	---	35,000
	Detention Facility JCC 1 STA 720+36 to STA 732+36	In-6,010 Out-5,540			1,200	1. Construct a 175 ac. ft. facility w/50 ft. wide x 3 ft. deep low flow channel at So=0.5%. Earthwork estimated at 300,000 c.y. 2. Recommended 50' x 8' box culvert outlet structure at roadway. 3. Three 4-foot drop structures required at inlet of facility (100' wide).	50			---	670,000
	Detention Facility JCC 1 to STA 785+96	5,580	12.5	4.0	5,360	1. Recommend minor regrading of side slopes to minimum of 3:1. 2. Recommend 100 ft. buffer zone in lieu of side slope protection. 3. Recommend reseeding all side slopes.	100	---	---	---	30,000

(A line of dashes (---) denotes no change.)

TABLE NO. 2A CONT.

JIMMY CAMP CREEK (CONT)

Reach	From/To	Before Improvements Q,cfs	V,fps	D,ft	L,ft	Recommendations	After Improvements Min b,ft	V,fps	D,ft	L,ft	TotalCost
4	STA 785+96 to SR 94, (STA 863+67)	5,750	13.0	4.0	7,770	1. Recommend minor widening to 100 ft. minimum channel width. 2. Regrade side slopes to a minimum of 3:1 where existing slopes are steeper. 3. Provide type 4 protection at outside bends (3,000 linear ft.). 4. Recommend 100 ft. buffer zone in lieu of side slope protection. 5. Recommend reseeding all side slopes.	100	---	---	---	285,000
5	Detention Facility JCC 2 at SR 94	In 5,740 Out 5,280			1,500	1. Construct a 90 ac. ft. facility with 100 ft. wide channel at So = 0.5% along the eastern side of the basin. Earthwork estimated at 200,000 c.y. 2. Recommend a two stage soil cement in-channel weir 100 ft. upstream of the existing bridge. Weir dimensions; b=25 ft. from elevation 6,148 to 6,154 and b=150 ft. 3. Three 4-foot drop structures required at inlet of facility.	100			---	475,000
	Detention Facility JCC 2 to Detention Facility JCC 3	5,740	12.5	4.0	1,000	1. Regrade side slopes to a minimum of 3:1 where existing slopes are steeper. 2. Recommend 100 ft. buffer zone in lieu of side slope protection. 3. Recommend reseeding all side slopes.	100	---	---	---	10,000
	Detention Facility JCC 3	In 6,700 Out 4,740			1,000	1. Construct a 150 ac. ft. detention facility with a 50 ft. wide x 3 ft. deep low flow channel at So=0.5%. Earthwork estimated at 250,000 c.y. 2. Recommend 36'x8' box culvert outlet at roadway.	50			---	560,000

(A line of dashes (---) denotes no change.)

TABLE NO. 2A CONT.

JIMMY CAMP CREEK (CONT)

Reach	From/To	Before Improvements Q,cfs	V,fps	D,ft	L,ft	Recommendations	After Improvements Min b,ft	V,fps	D,ft	L,ft	TotalCost
						3. Three 4-foot drop structures required at inlet of facility.					
5	Detention Facility JCC 3, (STA 892+60) to Regional Park, (STA 950+70)	6,700	14.2	4.5	5,800	1. Recommend minor widening to 100 ft. minimum. 2. Regrade side slopes to a minimum of 3:1. 3. Provide type 4 protection on side slopes.	100	13.8	4.5	---	1,260,000
	Regional Park area (STA 950+70) to STA 1085+00	3,100 to 6,700	13.0 to 16.5	4.0 to 6.5	13,430	1. No work recommended within the park area.	50	---	---	---	----
	Regional Park, (STA 1085+00) to Power line easement, (STA 1109+00)	3,100	14.2	3.75	2,400	1. Recommend four 4-foot drop structures to reduce slope from 1.8% to 1.0%. 2. Recommend type 3 protection on side slopes.	50	11.5	4.5	---	450,000
	Power line easement, (STA 1109+00) to STA 1130+00	1,850	12.0	4.0	2,100	1. Widen and straighten channel where recommended. 2. Recommend type 3 protection on side slopes.	25	---	---	---	335,000
	STA 1130+00 to STA 1165+00	900	10.5	3.5	3,500	1. Widen and straighten channels where recommended. 2. Recommended type 3 protection on side slopes.	20	---	---	---	450,000

(A line of dashes (---) denotes no change.)

TABLE NO. 2B

CORRAL TRIBUTARY

Reach	From/To	Before Improvements Q, cfs	V, fps	D, ft	L, ft	Recommendations	After Improvements Min b, ft	V, fps	D, ft	L, ft	TotalCost
6	Confluence with JCC to Drennan Rd.	10,000	12.3	5.1	3,900	1. Install 500 LF of type 5 protection in existing highwall areas. 2. Regrade remainder of side slopes to 3:1. 3. Provide type 3 protection above concrete abutments of Drennan Road Bridge and 100 ft downstream of structure.	150	---	---	---	160,000
	Drennan Rd. to STA 68+60 (new confluence of Franceville Tributary)	10,200	18.0	8.3	2,960	1. Fill existing eroded area along Drennan Road. Earthwork estimated at 4,000 c.y. 2. Provide type 4 protection from Drennan road Bridge upstream for 550 LF. 3. Widen channel to minimum of 100 ft and realign to end of section. Earthwork estimated at 200,000 c.y. 4. Provide type 5 protection in widened section. 5. Construct three 4-foot grade control structures.	100	13.5	6.5	2,650	820,000
	New confluence of Franceville Tributary to new confluence of Strip Mine Tributary (STA 124+00)	6,500	15.3	7.0	5,540	1. Widen channel to minimum of 75 ft and realign 400 ft of channel. Earthwork estimated at 100,000 c.y. 2. Provide type 5 protection for entire section.	75	13.0	6.0	5,360	1,510,000
	STA 124+00 to Detention Facility COR 1 (STA 130+50)	3,400	13.5	6.0	550	1. Realign and lower channel downstream of detention facility to obtain So = 0.6%. 2. Widen channel to 50 ft.	50	10.0	5.5	530	60,000

(A line of dashes (---) denotes no change.)

TABLE NO. 2B

CORRAL TRIBUTARY (CONT.)

Reach	From/To	Before Improvements Q,cfs	V,fps	D,ft	L,ft	Recommendations	After Improvements Min b,ft	V,fps	D,ft	L,ft	TotalCost
						3. Regrade side slopes to 3:1. Total earthwork estimated at 12,000 c.y. 4. Provide type 2 protection on side slopes.					
	Detention Facility COR 1	In 4,820 Out 3,400				1. Construct a 170 ac. ft. detention facility w/25 ft wide x 3 ft deep low flow channel at So=0.5%. Earthwork estimated at 250,000 c.y. 2. Provide a 25' x 8' box culvert outlet at the roadway. 3. Two 4-ft grade control structures required at inlet of facility.	25				525,000
6	Detention Facility COR 1 to STA 187+50	4,820	10.0	5.9	3,750	1. Realign channel and widen to 75 ft. Earthwork estimated at 20,000 c.y. 2. Construct two 4-foot grade control structures to lower stream velocity. 3. Provide type 2 protection on side slopes.	75	9.4	6.0	2,650	290,000
	STA 187+50 to Detention Facility COR 2	4,600	11.1	4.5	6,300	1. Minor alignment corrections required. 2. Regrade areas of steep side slopes to 3:1. 3. Provide type 3 protection for side slopes.	75	---	---	---	1,035,000
	Detention Facility COR 2	In 5,300 Out 4,600				1. Construct a 100 ac.ft. detention facility w/50 ft wide x 3 ft deep low flow channel at So= 0.5%. Earthwork estimated at 260,000 c.y. 2. Construct a 10 ft high embankment with a 35' x 6' box culvert outlet and a 50 ft wide riprap weir emergency spillway. 3. Construct three 4-foot drop structures at the inlet of the facility.	50				620,000

(A line of dashes (---) denotes no change.)

TABLE NO. 2B

CORRAL TRIBUTARY (CONT.)

Reach	From/To	Before Improvements Q, cfs	V, fps	D, ft	L, ft	Recommendations	After Improvements Min b, ft	V, fps	D, ft	L, ft	TotalCost
6	Detention Facility COR 2 to SR 94	5,300	11.7	4.1	4,000	1. Regrade areas of steep side slopes to 3:1. 2. Provide buffer zone in lieu of protection. 3. Recommend reseeding all side slopes.	100	---	---	---	20,000
7	Detention Facility COR 3 at SR 94 STA 314+65	In 5,800 Out 3,930	---	---	---	1. Excavate area north of SR 94 to provide more storage capacity. Earthwork estimated at 30,000 c.y. 2. Utilize existing 36' x 6' box culvert under SR 94 as outlet.	50	---	---	---	60,000
	Detention facility COR 3, (STA 328+65) to STA 346+56	4,000	12.5	5.0	1,800	1. Realign channel and provide a 50 ft wide channel. Earthwork estimated at 10,000 c.y. 2. Construct four 4-foot drop structures in realignment area to lower velocity to below 10 fps. 3. Provide type 2 protection on side slopes.	50	9.8	6.2	1,400	220,000
	STA 346+56 to STA 394+36	2,100	10.6	3.5	4,780	1. Realign lower 1,500 LF of channel. 2. Widen and realign upper 2,100 LF of channel b = 50 ft. 3. Construct three 4-foot drop structures in realignment area. Earthwork; lower section - 25,000 c.y., upper section - 6,000 c.y. 4. Provide type 3 protection on side slopes.	50	10.0	3.7	3,600	560,000
	STA 394+36 to Corral Bluffs, (STA 427+36)	1,200	12.6	3.0	3,300	1. Construct min. 30' wide channel. Earthwork estimated at 20,000 c.y. 2. Provide type 3 protection on side slopes.	30	---	---	---	395,000

(A line of dashes (---) denotes no change.)

TABLE NO.2C

STIP MINE TRIBUTARY

Reach	From/To	Before Improvements Q,cfs	V,fps	D,ft	L,ft	Recommendations	After Improvements Min b,ft	V,fps	D,ft	L,ft	TotalCost
	Existing confluence with Corral Tributary to proposed diversion channel (STA 35+00)	3,300	n/a	n/a	2,800	1. This section of channel to be eliminated. Fill estimated at 70,000 c.y.				-0-	$105,000
	Proposed juncture with Corral Tributary to STA 35+00					1. Construct new channel to juncture with Corral Tributary, b=100'. Earthwork estimated at 25,000 c.y. 2. Recommend three 4-foot drop structures. 3. Provide type 2 protection for side slopes.	100	8.3	4.0	1,200	190,000
8	STA 35+00 to existing side channel	3,100	9.4	2.9	4,200	1. Realign 400 ft. of existing channel. Transition from existing 150 ft. wide channel to 100 ft. channel. (STA 77+00) Earthwork estimated at 40,000 c.y. 2. Widen remaining 3,600 LF of channel to b=150 ft. 3. Provide type 2 protection for side slopes. 4. Construct an embankment across side channel.	100	9.4	3.5	4,000	250,000
	STA 77+00 to Strip Mine Detention Facility SM 1 (STA 133+60)	3,250	9.0	2.5	5,660	1. Widen 700 ft. of the channel to 150 ft. wide. Earthwork estimated at 10,000 c.y. 2. Regrade side slopes to a minimum of 3:1 and reseed. 3. Provide 100 ft. buffer zone in lieu of protection.	150	---	---	---	75,000
	Detention Facility SM 1	In-5,000 Out-3,250				1. Excavate existing surface mining pits to provide a 100 ac. ft. side channel detention facility. Earthwork estimated at 150,000 c.y.					320,000

(A line of dashes (---) denotes no change.)

TABLE NO. 2C CONT.

STRIP MINE TRIBUTARY (CONT.

Reach	From/To	Before Improvements Q,cfs	V,fps	D,ft	L,ft	Recommendations	After Improvements Min b,ft	V,fps	D,ft	L,ft	TotalCost
						2. Construct a 150 ft. wide diversion structure into facility. 3. Construct a 50 ft. riprap lined weir outlet.					
	Detention Facility SM 1 to Detention Facility SM 2	4,500	7.8	1.6	7,920	1. Construct 300 ft. of channel to correct alignment. 2. Regrade side slopes to a minimum of 3:1. 3. Provide 100 ft. buffer zone in lieu of protection. 4. Recommend reseeding of all side slopes.	150	10.6	3.0	7,770	85,000
8	Detention Facility SM 2	In-3,400 Out-2,500				1. Construct a 60 ac. ft. facility with a 50 ft. wide x 3 ft. deep low flow channel. Earthwork estimated at 240,000 c.y. 2. Construct a 10 ft. high embankment with 30'x5' box culvert outlet and a 50 ft. wide riprap lined weir spillway. 3. Construct five 4-foot drop structures at the inlet to the facility.					625,000
	Detention Facility SM 2 to 600 ft. North of SR 94, (STA 240+50)	2,000	10.6	2.5	1,350	1. Regrade side slopes to minimum of 3:1 where required. 2. Provide type 3 protection on side slopes.	75	---	---	---	155,000
	STA 240+50 to Corral Bluffs, (STA 275+50)	1,300	10.6	2.75	3,500	1. Regrade side slopes where required to minimum of 3:1. 2. Provide type 3 protection on side slopes.	40	---	---	---	405,000

(A line of dashes (---) denotes no change.)

TABLE NO. 2D

FRANCEVILLE TRIBUTARY

Reach	From/To	Before Improvements				Recommendations	After Improvements				TotalCost
		Q,cfs	V,fps	D,ft	L,ft		Min b,ft	V,fps	D,ft	L,ft	
9	Confluence with Jimmy Camp Creek to STA 38+30	1,900	11.1	2.75	3,830	1. Regrade side slopes to 3:1 in steep areas. 2. Provide buffer zone in lieu of side slope protection. 3. Reseed all side slopes.	50	---	---	---	40,000
	STA 38+30 to STA 63+10	700	6.9	2.0	2,480	1. Construct 6 ft. wide concrete lined channel.	6	16	3.0	---	210,000
	STA 63+10 to STA 130+50	<500	---	---	---	1. No improvements specified	---	---	---	---	---
	New confluence with Corral Tributary to STA 130+50	2,950	n/a	n/a	n/a	1. Construct new 75 ft. wide channel with So=0.5% Earthwork estimated at 120,000 c.y. 2. Construct six 4-foot drop structures. 3. Provide type 2 protection.	75	7.8	4.5	4,750	630,000
	STA 130+50 to Detention Facility FR 1	2,850	11.6	4.0	4,400	1. Widen existing channel to 75 feet wide. Earthwork estimated at 90,000 c.y. 2. Provide type 3 protection for side slopes.	75	10.5	3.5	---	710,000
	Detention Facility FR1	In-4,980 Out-2,800			2,150	1. Construct a 100 ac. ft. facility with 25 ft. wide x 2 ft. deep low flow channel So=0.5%. Earthwork estimated at 100,000 c.y. 2. Construct a 10 ft. high embankment with 30'x5' box culvert outlet and a 50 ft. weir spillway.	25			---	250,000

(A line of dashes (---) denotes no change.)

TABLE NO. 2D

FRANCEVILLE TRIBUTARY

Reach	From/To	Before Improvements				Recommendations	After Improvements				TotalCost
		$Q_{,cfs}$	$V_{,fps}$	$D_{,ft}$	$L_{,ft}$		Min $b_{,ft}$	$V_{,fps}$	$D_{,ft}$	$L_{,ft}$	
9	Detention Facility to FR 1, (STA 256+80)	2,500	12.0	3.5	6,670	1. Construct 6,670 LF of new 50 ft. wide channel. Earthwork estimated at 90,000 c.y. 2. Recommend type 3 protection on side slopes.	50	11.6	3.75	---	1,000,000
	STA 256+80 to Franceville Rd	700	12.0	2.0	2,400	1. Realign existing channel to a minimum of 25 ft. wide. Earthwork estimated at 10,000 c.y. 2. Provide type 3 protection on side slopes.	25	12.1	2.0	2,150	250,000

(A line of dashes (---) denotes no change.)

TABLE NO. 2E

EAST TRIBUTARY

Reach	From/To	Before Improvements Q,cfs	V,fps	D,ft	L,ft	Recommendations	After Improvements Min b,ft	V,fps	D,ft	L,ft	TotalCost
10	Existing confluence with Jimmy Camp Creek to Retention Facility EA 1, (STA 21+10)	400	6.9	3.5	2,110	1. Improve channel to provide a minimum bottom width of 10 ft.	10	6.2	3.5	2,110	15,000
	Retention Facility EA 1	In-950 Out-400				1. Construct a 36" RCP drop outlet with a 20 ft. wide weir spillway. 2. Minor regrading of side slopes recommended. 3. Construct an in-channel diversion structure to divert overflow into the retention basin.					45,000
	New confluence with Jimmy Camp Creek to Retention Facility EA 1, (STA 46+62)	2,500				1. Construct new 75 ft. wide channel. Earthwork estimated at 55,000 c.y. 2. Provide type 2 protection on side slopes.	75	7.0	5.1	800	145,000
	STA 46+62 to Detention Facility EA 2 (STA 179+32)	4,050	11.3	5.8	13,270	1 Recommend widening and deepening of existing channel. Earthwork estimated at 225,000 c.y. 2. Provide type 2 protection.	75	9.4	6.0	13,000	1,400,000
	Dentention Facility EA 2	In-4,860 Out-3,400			700	1. Construct a 110 ac. ft. facility with a bottom slope of 0.5%. Earthwork estimated at 250,000 c.y. 2. Provide a 36'x8' box culvert outlet in the roadway embankment.				---	520,000

(A line of dashes (---) denotes no change.)

TABLE NO. 2E CONT.

EAST TRIBUTARY (CONT)

Reach	From/To	Before Improvements Q,cfs	V,fps	D,ft	L,ft	Recommendations	After Improvements Min b,ft	V,fps	D,ft	L,ft	TotalCost
						3. Construct three 4-foot drop structures at the inlets to the basin.					
	STA 186+32 to STA 248+22	2,000	4.0	1.5	6,190	1. Recommend widening and deepening of existing channel. Earthwork estimated at 125,000 c.y. 2. Provide type 2 protection for side slope.	75	8.1	2.9	6,190	450,000
	Detention Facility EA 3	In-3,600 Out-1,850				1. Construct a 120 ac. ft. facility with 25 ft. wide x 2 ft deep low flow channel at So=0.5%. Earthwork estimated at 200,000 c.y. 2. Provide a 20'x6' box culvert outlet in the roadway embankment. 3. Construct two 4-foot drop structures at the inlet.	25				435,000
10											
	Detention Facility EA 3 to Drennan Rd	3,600	11.3	5.2	4,600	1. Recommend widening and deepening of the existing channel from detention facility to STA 286+50. 2. Recommend realignment and widening of the channel from STA 286+50 to Drennan Rd. Earthwork estimated at 23,000 c.y. 3. Provide type 3 protection for side slopes.	75	10.9	4.0	4,250	660,000
	Drennan Rd to Meridian Rd	2,650	11.7	4.0	2,450	1. Recommend 600 LF of channel realignment and widening of of entire section. Earthwork estimated at 30,000 c.y. 2. Provide type 2 protection for side slopes.	75	9.4	3.5	2,000	200,000

(A line of dashes (---) denotes no change.)

TABLE NO. 2E CONT.

EAST TRIBUTARY (CONT)

Reach	From/To	Before Improvements Q,cfs	V,fps	D,ft	L,ft	Recommendations	After Improvements Min b,ft	V,fps	D,ft	L,ft	TotalCost
						3. Construct two 4-foot drop structures.					
	Meridian Rd to STA 370+74	2,500	11.3	3.9	3,790	1. Recommend widening and deepening of the existing channel. Earthwork estimated at 45,000 c.y. 2. Recommend type 3 side slope protection. 3. Provide four 4-foot drop structures.	75	9.7	3.4	3,690	640,000
10	STA 370+74 to Franceville Rd	1,950	11.9	3.0	5,190	1. Widen existing channel to a minimum of 50 ft. wide and realign 500 ft. of the existing channel. Earthwork estimated at 20,000 c.y. 2. Provide type 3 protection for side slopes.	50	10.3	2.6	4,690	545,000
	Franceville Rd to STA 448+64	1,150	10.9	2.0	2,100	1. Minor widening required to existing channel. Earthwork estimated at 10,000 c.y. 2. Provide type 3 protection on side slopes.	50	10.2	1.8	---	245,000

(A line of dashes (---) denotes no change.)

TABLE NO. 2F

MARKSHEFFEL TRIBUTARY

Reach	From/To	Before Improvements				Recommendations	After Improvements				TotalCost
		Q,cfs	V,fps	D,ft	L,ft		Min b,ft	V,fps	D,ft	L,ft	
MARKSHEFFEL	Detention Facility MRK1	In-3,670 Out-2,540	---	---	---	1. Construct improvement as outlined in plan approved by El Paso County 1/17/86.					See "Total in Economic Analysis section
	Detention Facility MRK1 to Drennan Rd	Varies	---	---	---	1. Existing or approved channel construction plans within Colorado Centre Metropolitan District.					
	Drennan Rd to to Detention Facility MRK2	860	5.0	1.0	400	1. Construct a 6-foot wide concrete lined channel with So=1.0%.	6	18.0	3.75	---	35,000
	Detention Facility MRK2	In-1,200 Out-860	---	---	---	1. Construct a 35 ac. ft. Detention Facility. Earthwork estimated at 60,000 c.y. 2. Construct a 10 ft high embankment with a 10 ft x 4 ft box culvert outlet and a 25 ft. weir spillway.					150,000
	Detention Facility MRK2 to City Limits	700	7.0	1.5	3,000	1. Construct a 6 ft wide wide concrete lined channel with So=1.5%.	6	18.3	3.25	---	255,000

(A line of dashes (---) denotes no change.)

TABLE NO. 2G

FONTAINE TRIBUTARY

Reach	From/To	Before Improvements Q,cfs	V,fps	D,ft	L,ft	Recommendations	After Improvements Min b,ft	V,fps	D,ft	L,ft	TotalCost
FONTAINE	Existing confluence with Jimmy Camp Creek to New Marksheffel crossing	3,550				1. Construct new 50 ft wide channel with So=0.4%. Earthwork estimated at 8,000 c.y. 2. Provide type 2 protection for side slopes.	50	9.3	6.0	800	75,000
	Marksheffel Rd to existing channel	3,550				1. Construct new 50 ft wide channel with So=0.4%. Earthwork estimated at 50,000 c.y. 2. Provide type 2 protection for side slopes.	50	9.3	6.0	2,300	260,000
	Existing channel connection to juncture with side channel from west	3,550	5.0	2.5	2,550	1. Widen and deepen the existing channel. Earthwork estimated at 35,000 c.y. 2. Provide type 2 protection for side slopes.	50	9.3	6.0	2,500	250,000
	Side channel	1,000	8.0	4.0	2,400	1. Construct a 40 ft wide channel with type 2 protection.	40	7.1	3.0		180,000
	Existing side channel to 5,500 ft upstream	2,500	10.6	5.5	5,500	1. Widen existing 30 ft channel to 50 ft. Earthwork estimated at 25,000 c.y. 2. Provide type 2 protection for side slopes.	50	9.5	4.5	5,200	380,000
	Previous location to Fontaine Rd	1,700	10.0	4.5	3,500	1. Widen existing 30 ft channel to 40 ft. Earthwork estimated at 6,000 c.y. 2. Provide type 2 protection for side slopes.	40	9.4	3.75	3,100	175,000
	Detention Facility FON1	In-3,700 Out-1,650				1. Construct a 90 ac. ft. Detention Facility. Earthwork estimated at 150,000 c.y. 2. Provide a 20 ft x 8 ft box culvert outlet.					250,000

(A line of dashes (---) denotes no change.)

BACKGROUND INFORMATION

PREVIOUS DRAINAGE STUDIES

The only comprehensive drainage study currently available is the "Flood Hazard Analyses for portions of Jimmy Camp Creek and adjoining tributaries" conducted by the U.S. Department of Agriculture Soil Conservation Service. The flows established in this report were obtained by using the methods described in the PO-2 technical note, which is a statistical method developed by the Soil Conservation Service. The study also determined the floodplain boundaries or limits by utilizing the HEC-2 hydrology/hydraulics program. The Army Corps of Engineers ran the HEC-2 Program for the Soil Conservation Service and established floodplain limits for the 100-year and 500-year storms. Both the SCS report and the Corps of Engineers Water Surface Profiles were concluded in October 1975.

Prior to the SCS study the Army Corps of Engineers produced a report entitled the "Flood Plain Information Study." This report mainly addressed the Fountain Creek flood hazard areas but it also included the Jimmy Camp Creek area from its confluence with Fountain Creek to 4.33 miles upstream. However, the SCS report focuses on the Jimmy Camp Creek Drainage Basin while in the Army Corps of Engineers study, the Jimmy Camp Creek Drainage basin was secondary. Since the Army Corps of Engineers study was completed in March of 1973, it proved to be extremely valuable to the SCS in preparing the October 1975 report because the flow information developed in the earlier report was used as a basis for their flows.

The aforementioned reports were prepared for the Pikes Peak Area Council of Governments and El Paso County, Colorado. To date, there have also been numerous private studies of areas within the Jimmy Camp Creek Drainage Basin. These were developed to analyze flood development patterns and flows within limited areas. This information is vitally important when trying to project future development patterns; i.e., establishing accurate criteria on where development should and should not occur.

These reports include the following:

"Preliminary Drainage Study for Colorado Centre Phase I Business Park," by Kellogg Engineering, Inc. 1985.

"Master Drainage Plan for Colorado Centre," by Gilbert, Meyer & Sams, Inc., 1985

"Revised Preliminary Master Drainage Study for Colorado Centre," by J.R. Engineering, LTD. 1986.

"Phase I Detention for Colorado Centre," by J.R. Engineering, LTD, 1985.

"Sunrise Ridge filing No. 6 Drainage Report," by Oliver E. Watts, P.E., L.S., 1985.

"Drainage Report for Wild Oaks Farms Subdivision No.1 filing No. 2," by Growth Technologies Corp., 1984.

"Master Plan Report for Fountain Center," by CEG & Associates, Inc., 1985.

"Preliminary Master Drainage and Floodplain Study for Banning-Lewis Ranch," by MSM/SP Group, 1981.

Although these reports serve a purpose in defining local conditions, they do not always convey a clear understanding of the overall effects of development on the entire basin.

EXISTING MAPPING

The U.S. Geological Survey has prepared 1:24,000 topographic quadrangle-maps with 20' contours for all of El Paso County which were photo revised in 1975. These were used for the general purposes of basin boundary delineation and for the establishment of principal tributary regions and subbasins within

these regions. The base maps used in the floodplain delineation are from aerial photographs provided by El Paso County. From these, SCS developed photomosaic contours at 2 and 4 ft. contours. These were included in their 1975 report depicting the 100-year and 500-year floodplain limits.

Other, more detailed maps, were available for specific areas within the basin. These more recent maps were used to check the accuracy of the older mapping as well as to better define the local conditions. Included in this category are a set of 1"=400' scale maps with 5 ft. contours of the Banning-Lewis Ranch developed by Delta Aerial Surveys, Inc. and Drexel, Barrell & Co. This mapping covers about 18 square miles of the Jimmy Camp Creek Drainage Basin. In addition another 7 square miles of the basin is covered by 1"=100' maps with 2 ft. contours of the Colorado Centre Development. These maps were prepared by Analytical Surveys, Inc. for L-P Associates, Inc. Another 1"=400' scale 2 ft. contour map was provided on the Aerospace Centre Development by ML Properties, Inc. This mapping covered about another 4-square miles of the basin, bringing the total coverage to about 50% of the entire area.

HISTORY OF THE AREA

The history of the area is both long and colorful. The Jimmy Camp Creek Region was once a stopping point along the Old Cherokee Trail. A spring which formed the headwaters of Jimmy Camp Creek was the only source of fresh water for many miles. The stream obtained its name during the early days of fur trading in the area when a trader named Jimmy Boyer would travel up the Arkansas and Fountain streams to set up a trading camp at the site of the spring. The area remained virtually untouched until after passage of the Homestead Act which provided free 160-acre parcels of land to anyone who would agree to farm the land. However, due to the semidesert conditions of the land, only the large ranches survived. It was not uncommon for these ranches to encompass 10,000 to 50,000 acres and extend beyond the horizon.

As travel in the area increased many small towns sprang up. Most of these small towns have vanished over the years and now, only a few old buildings remain. The towns which have survived were able to take advantage of the growth in Colorado Springs. The City of Fountain is just such a community. It was founded in 1859 south of Colorado Springs at the confluence of Fountain Creek and Jimmy Camp Creek. It survived by becoming a railhead shipping point for the area cattle ranches.

Although the Jimmy Camp Creek Basin area did not share in a rich abundance of the gold which brought prosperity to other western areas, large deposits of coal were found. The Franceville coal mine was opened in 1882 and was in production until it was closed in the summer of 1965 by floods. The coal was used primarily for domestic purposes although significant amounts were sold to the railroads and to gold reduction mills in Colorado City and Cripple Creek.

Today the area is still predominantly used as range land with a few areas of residential development scattered throughout the basin. However, the urbanization of the basin is increasing as time passes while the historic land uses continue to disappear.

BASIN CHARACTERISTICS

BASIN DESCRIPTION AND LOCATION

The Jimmy Camp Creek Drainage Basin is located eight miles southeast of downtown Colorado Springs in the central area of El Paso County. The basin measures 66.72 square miles (±), with the large majority being undeveloped range land. In addition to the primary channel of Jimmy Camp Creek, there are four primary tributaries: East, Franceville, Corral and Strip Mine, as well as other secondary tributaries such as: Marksheffel and Fontaine. (See overall map, Exhibit No. 3).

The runoff from Jimmy Camp Creek generally flows in a southerly direction, ultimately reaching Fountain Creek within the city limits of Fountain. The basin is roughly 17 miles in length and six miles in width. The principal tributaries are well defined although frequently dry in the upper reaches. As for the secondary channels and reaches, they are usually little more than natural valleys and swales.

Major east-west transportation corridors through the Jimmy Camp Creek region include State Highway 94, Drennan Road, and, to a lesser extent, Fontaine Boulevard. Marksheffel Boulevard, Franceville Mine Road and a portion of Drennan Road are the primary north-south thoroughfares; however, there is currently not a single road in this direction that stretches the entire length of the basin.

CLIMATE

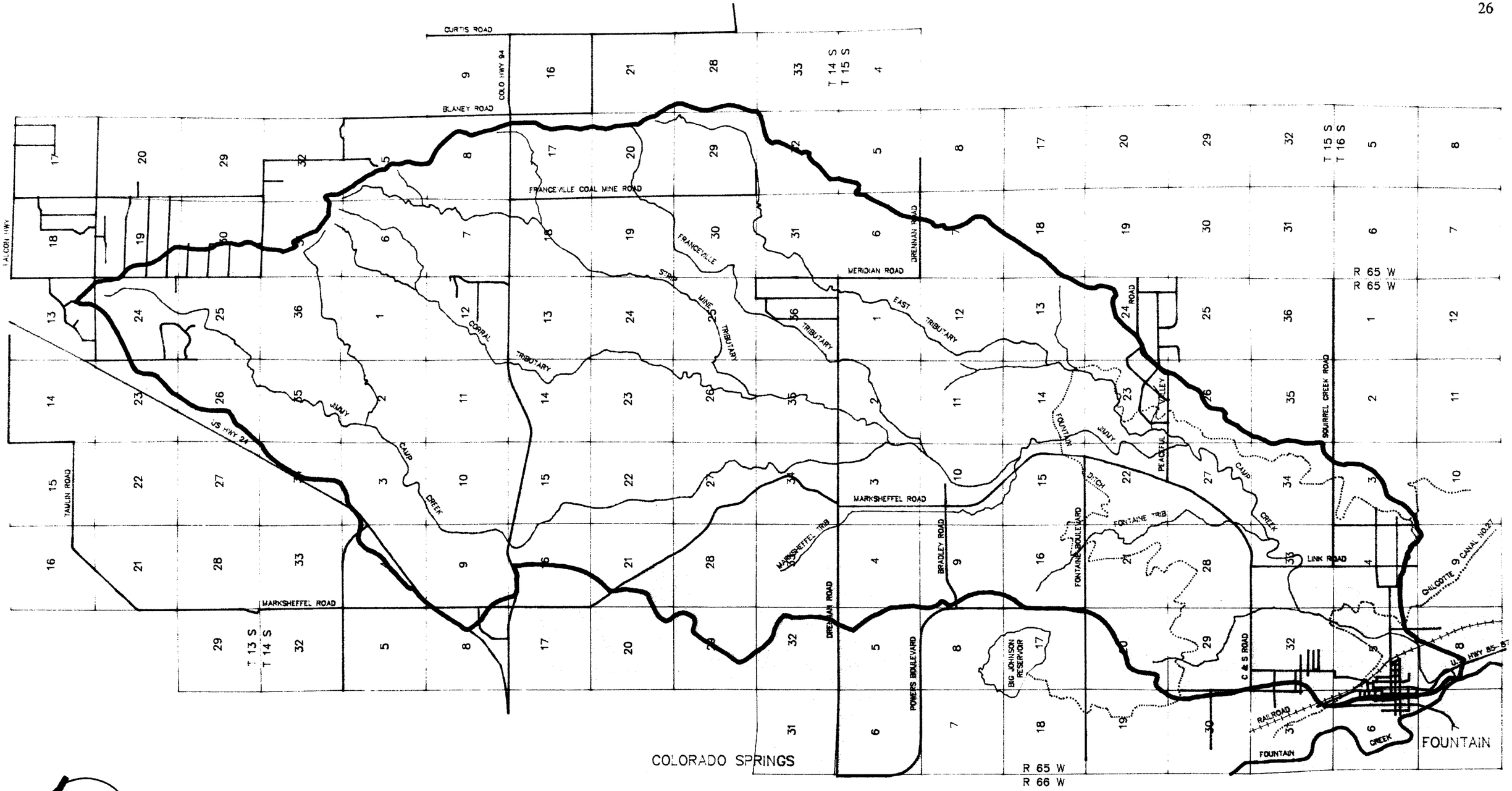
The Colorado Springs/Jimmy Camp Creek Area is classified as a semidesert region. This classification is given to a region which experiences an unusually high evapotranspiration rate relative to the amount of precipitation received. In some areas as much as 90% to 97% of the precipitation evaporates. Temperatures in this region vary as much as 80°F or more annually with an average annual day time temperature of 49°F. Summertime highs during the months of July and August average in the mid 80's, with daily lows around 55°F. In addition to being the warmest months of the year, July and August also have the highest precipitation. Precipitation amounts for these months average between 2 1/2 to 3 inches.

The winter months, specifically December and January, experience average daytime high readings below 45°F. Average normal daily lows during this period are in the 16°F - 18°F range. Frequently, though brief, cold periods occur where temperatures fall to -15°F. Precipitation amounts for the winter months generally are very low relative to the rest of the year, with monthly averages of 0.30 inches. Snowfall amounts range from 1.3 inches for May to 9.0 inches for the month of March. September and May are usually the first and last months of the snow season. September averages a monthly snowfall amount of 1.9 inches.

The annual average precipitation rate for the Jimmy Camp Creek Region is about 15.2 inches. Of this total, slightly more than 80 percent falls during the period from April through September. These figures are a product of the 1949-72 precipitation records which recorded values as high as 25.43 inches and as low as 8.59 inches.

SOILS AND GEOLOGY

The dominant soil in the Jimmy Camp Creek Drainage Basin is the Razor-Midway Group, characterized as being moderately deep and shallow with gently sloping to moderately steep slopes. These soils are well drained and are derived from calcareous shale. Within the Jimmy Camp Creek Tributary, the



MASTER DRAINAGE PLANNING STUDY
FOR JIMMY CAMP CREEK
OVERALL MAP

DESIGN	DRAWN	DATE

WILSON & COMPANY
ENGINEERS

FILE NO. 85-832

EXHIBIT NO. 3

Manzanola-Limon Group is also prevalent. This soil group is generally deep, nearly level to gently sloping, well drained and is formed of calcareous alluvium. In the extreme northerly portions of the basin, the Truckton-Blakeland-Bresser Group is found in nearly level to moderately steep slopes. Soils in this area are sandy, relatively deep and were formed out of the material weathered from Arkosic Sedimentary Rock.

The geological formations which surround the majority of the principal tributaries are the Pierre Shale, Niobrara Formation, Carlisle Shale, Greenhorn Limestone and Granerous Shale undivided complex. This formation is overlain by Piney Creek Alluvium in the primary channel reaches. To the north, the geological formations transition from Foot Hills Sandstone to the Laramie Formation with an increase in elevation. The Dawson Formation lies still further to the north and is found only in the higher elevations of the Jimmy Camp Creek Drainage Basin.

The alluvial deposits found, principally, in and around the main channel of Jimmy Camp Creek play an important role in recharging the groundwater supply. The material in this area is composed of sands and gravels with minor amounts of clay. As a result of this combination of porous materials, the permeability rate is relatively high. The Pierre Shale, and Niobrara Complex below the alluvial deposits provide the necessary barrier for aquiferous conditions to exist. This alluvial aquifer is large enough that it presently supplies municipal and irrigation water to the neighboring community of Fountain.

TOPOGRAPHY

The Jimmy Camp Creek Region is, for the most part, composed of numerous long, gently sloping hills with a fairly complex network of meandering valleys. South of State Highway 94 the slopes rarely exceed five percent. One exception to this occurs along the eastern boundary where the slopes may be nearly vertical at rock outcrops. In the east-central region of the basin, the abandoned strip pits of the Franceville Mines can be found on the mild slopes adjacent to the Strip Mine Tributary.

North of State Highway 94 the extremely rugged Corral Bluffs curve north and westwardly wrapping around from the east boundary, for about four miles. Directly south of this semicircular region of cliffs and rock outcroppings lies a relatively flat area with modest slopes ranging from 2 to 4 percent.

Further to the north and west of the Corral Bluffs the overall basin slopes remain fairly steep. Grades as much as 17 percent frequently occur although the valleys of the principal tributaries may be very flat, generally less than 1 percent. Between this area and the extreme northern basin boundary the terrain flattens out, with the variations becoming more gradual and quite similar in character to that of the land lying south of State Highway 94.

The predominantly sandy soils in the basin contribute to the relatively high incidence of erosion. This problem can be seen near many of the manmade structures such as bridges and bridge abutments and also in areas where the channels are relatively narrow and deep.

FLOOD HISTORY

The most damaging floods in the past occurred either in late May or early June. During this period, warm, very moist air masses from the Gulf of Mexico combine with cool, dry air from the north. The combination of these two very different air masses produce thunderstorms which may cause flooding. Snowmelt seldom contributes to flooding in Jimmy Camp Creek.

Based on past records, the most destructive flood in this basin took place on 17 June 1965. At a point four and one half miles above the confluence of Jimmy Camp Creek with Fountain Creek, the flow rate was estimated to be 124,000 cfs or 2,284 cfs/sq. mi., based on a 54.3 sq. mi. drainage area at that location. This was the largest known flood to have occurred in El Paso County. When the waters crested in Jimmy Camp Creek, waves as high as eight feet were recorded. Several lives were lost and property damage was well into the millions of dollars throughout the Colorado Springs area.

The factors which combined to produce a storm of such severe magnitude were somewhat unique in hydrologic terms. This particular flood was the result of a huge storm system which stalled over the Colorado Springs area for a period from June 13 through June 19. Since very few rainfall gauges existed within the Jimmy Camp Basin, the following rainfall amounts and intensities were recorded in nearby areas:

TABLE NO. 3

1965 Flood - Rainfall Information

Location	Date	Amount & Intensity
Peterson Air Force Base	June 14	4.5" in 24 hrs
Colorado Springs	June 15	1.98" in 3 hrs
Ayer Ranch	June 17	6.5" in 6 hrs
Fountain	June 17-18	5.25" in 24 hrs
Falcon	June 17	10.5"-12.5" in 10 hrs.

As can be seen from the above information, the various areas were subjected to several storms in succession which far exceeded the 100-year storm event.

The United States Weather Bureau has developed estimates of the probable maximum precipitation based upon the available data and current state of meteorological technology. This amount for the Jimmy Camp Creek Basin is approximately 22 inches of rainfall in a 6-hour period. By utilizing the Colorado Unit Hydrograph procedure and inserting the probable maximum rainfall for the area, a maximum probable peak flow of 162,800 cfs is computed. Comparing this value with the 1965 flow of 124,000 cfs it can be seen that the 1965 flood was approximately 75% of the maximum flood which can ever be expected to occur within the basin. In addition, when comparing the estimated flood amount of 124,000 cfs with the computed existing 100-year flow of 21,000 cfs it can be seen that the 1965 flood was almost 600% larger than the projected 100-year flood.

If future precipitation studies produce a radical change in rainfall amounts and intensities, then the present methods of storm prediction may have to be altered. For now, however, all indications are that the 1965 flood was an isolated event which has little probability of occurring again.

In addition to the 1965 flood, the following flood accounts have been recorded in the Jimmy Camp Creek Basin:

May 30, 1935

An undetermined amount of rainfall caused extensive damage to roads, bridges and agriculture in the area. The more extensive damage was recorded in the City of Colorado Springs.

July 18, 1972

Flooding along the Franceville Tributary, caused by approximately five inches of rainfall, inflicted approximately $100,000 in damages to roads and bridges downstream.

August 3, 1972

Flooding along Jimmy Camp Creek caused $50,000 in damages.

Even with the large magnitude of flows recorded in the Jimmy Camp Creek Basin, the resultant damage has been relatively minor when compared to some of the other areas of Colorado which have suffered heavy flooding. This has been due to the lack of development in the Jimmy Camp Creek Basin. As development occurs, more attention has to be paid to drainage considerations such that damage to real property can be minimized.

ELEMENTS OF HYDROLOGY

METHODS & CRITERIA

The analysis methodology used in this report was determined by a study conference which was held on January 8, 1986 and included representatives from the following organizations:

Wilson & Company

El Paso County Dept. of Transportation

City of Colorado Springs Department of Public Works

City of Fountain

Corps of Engineers

Soil Conservation Service

El Paso County Soil Conservation District

From this meeting it was determined that the TR-20 computer modeling method would be used to determine peak flows throughout the basin. The criteria set forth in the "Area Wide Runoff Determination Manual" was used to determine the design parameters in calculating peak flows. According to the present city/county criteria, peak flows for the 100-year and 5-year 24-hour storms, as well as the 100-year and 5-year 6-hour storms, must be calculated. The time of concentration (Tc) used in the TR-20 calculations was determined by using Fig III-6 from the aforementioned manual. It could also have been determined from the equation:

$$Tc = \left(\frac{11.9\,L^3}{H}\right)^{.385}$$

Where Tc = Time of concentration in hours
L = Longest flow length along the stream in miles
H = Elevation difference between the highest point and lowest point along the stream in feet

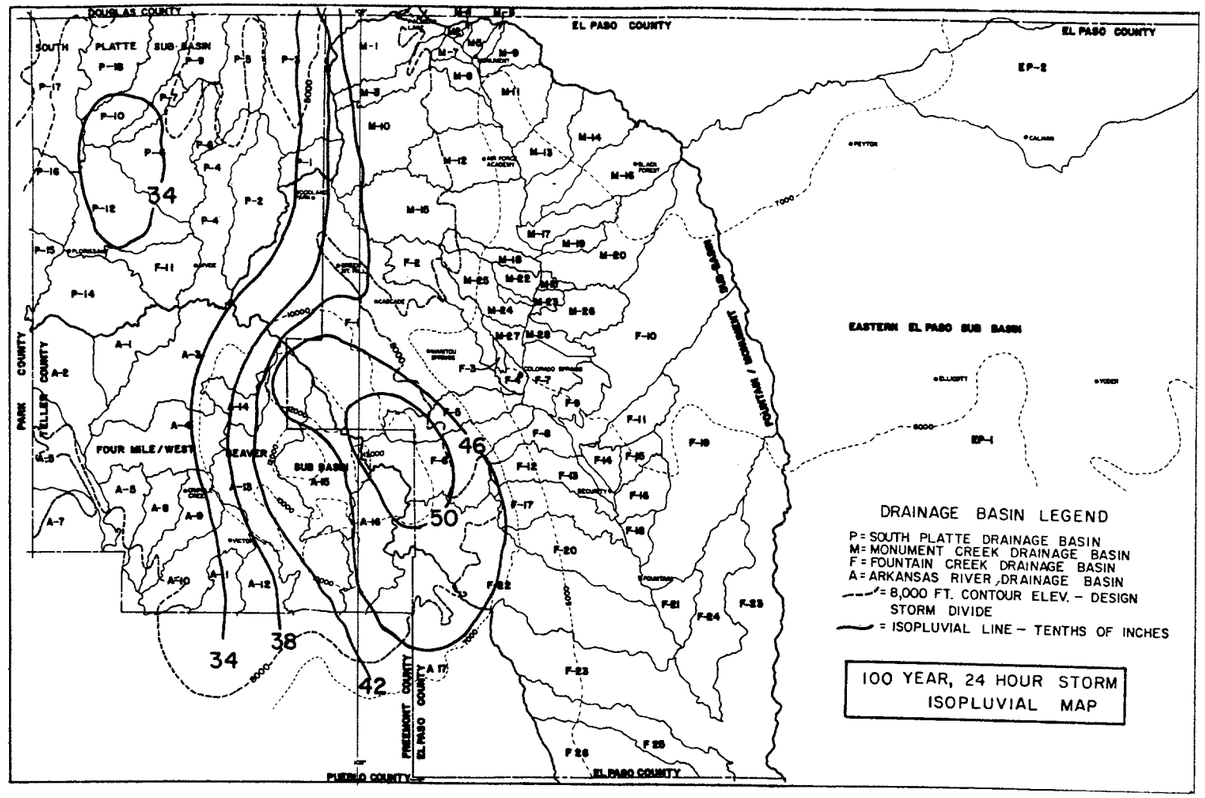
The basin was divided into tributary basins and then into smaller subbasins for which peak flows were calculated. (See the Basin Discharge Map in the back pocket of this report.) These subbasins were chosen with respect to their natural topography as well as to roadway crossings and confluence points. The peak flows for these subbasins were calculated for existing as well as fully developed conditions and then compared to the results listed in past reports. (See Sheets 18 and 19 of Appendix).

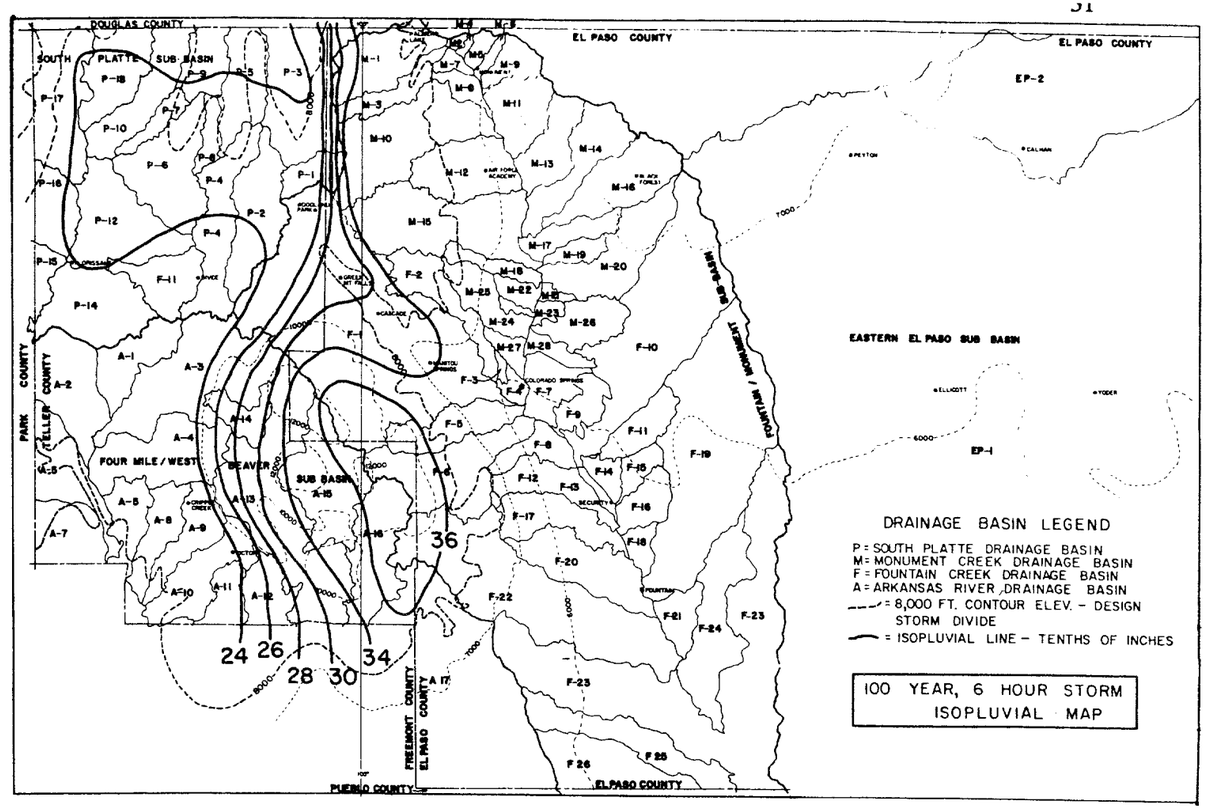
RAINFALL

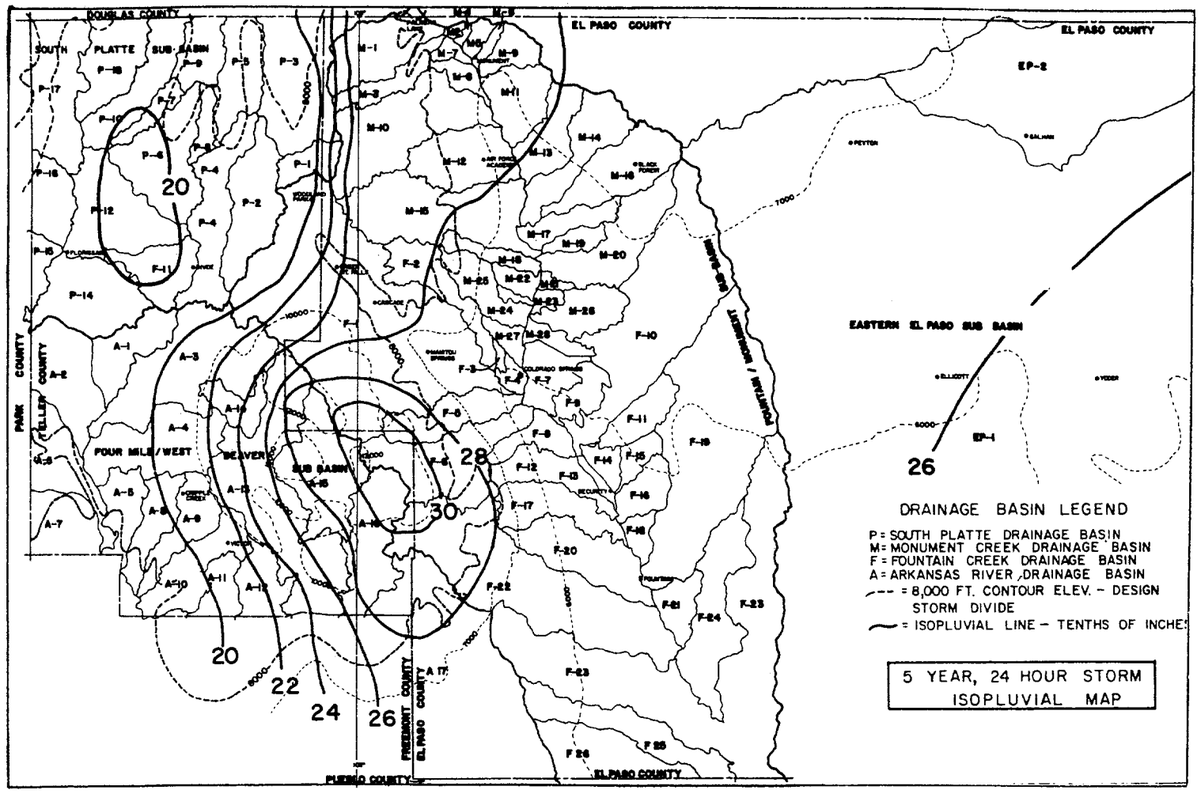
The rainfall intensities for the Jimmy Camp Creek Basin were determined from the "Areawide Urban Runoff Control Manual" (AURCM). These rainfall amounts used by AURCM were originally taken from the National Oceanic and Aeronautics Administration (NOAA) Technical Paper No. 20, which details the amounts of rainfall which can be expected to fall in any given region of the country.

Precipitation amounts for the 100-year, 24-hour and the 5-year, 24-hour storms were 4.6 inches and 2.7 inches, respectively. In addition, the precipitation amounts for the 100-year, 6-hour and 5-year, 6-hour storms were 3.0 inches and 2.1 inches, respectively. (See the Isopluvial Maps, Exhibit No.4).

According to the AURCM, when dealing with basins of the magnitude of Jimmy Camp Creek, a reductional factor may be utilized. This factor is graphically detailed in Exhibit No. 5, Ratios for Areal Adjustment of Point Rainfall. For areas of 50-square miles or larger a reduction of 5% is permitted. This reduces the 100-year rainfall amount from 4.6 inches to 4.37 inches and the 5-year rainfall from 2.7 inches to 2.57 inches.


DOUGLAS COUNTY
EL PASO COUNTY
SOUTH PLATTE SUB-BASIN
EASTERN EL PASO SUB BASIN
PARK COUNTY
TELLER COUNTY
FOUR MILE / WEST
BEAVER
SUB BASIN
A-15
FREMONT COUNTY
PUEBLO COUNTY
34
38
42
46
50
DRAINAGE BASIN LEGEND
P = SOUTH PLATTE DRAINAGE BASIN
M = MONUMENT CREEK DRAINAGE BASIN
F = FOUNTAIN CREEK DRAINAGE BASIN
A = ARKANSAS RIVER DRAINAGE BASIN
= 8,000 FT. CONTOUR ELEV. - DESIGN STORM DIVIDE
= ISOPLUVIAL LINE - TENTHS OF INCHES
100 YEAR, 24 HOUR STORM
ISOPLUVIAL MAP


DOUGLAS COUNTY
EL PASO COUNTY
SOUTH PLATTE SUB-BASIN
EASTERN EL PASO SUB BASIN
PARK COUNTY
TELLER COUNTY
FOUR MILE / WEST
BEAVER
SUB BASIN
A-15
FREMONT COUNTY
PUEBLO COUNTY
24
26
28
30
34
36
DRAINAGE BASIN LEGEND
P = SOUTH PLATTE DRAINAGE BASIN
M = MONUMENT CREEK DRAINAGE BASIN
F = FOUNTAIN CREEK DRAINAGE BASIN
A = ARKANSAS RIVER DRAINAGE BASIN
= 8,000 FT. CONTOUR ELEV. - DESIGN STORM DIVIDE
= ISOPLUVIAL LINE - TENTHS OF INCHES
100 YEAR, 6 HOUR STORM
ISOPLUVIAL MAP


DOUGLAS COUNTY
EL PASO COUNTY
SOUTH PLATTE SUB-BASIN
EASTERN EL PASO SUB BASIN
PARK COUNTY
TELLER COUNTY
FOUR MILE / WEST
BEAVER
SUB BASIN
A-15
FREMONT COUNTY
PUEBLO COUNTY
20
22
24
26
28
30
DRAINAGE BASIN LEGEND
P = SOUTH PLATTE DRAINAGE BASIN
M = MONUMENT CREEK DRAINAGE BASIN
F = FOUNTAIN CREEK DRAINAGE BASIN
A = ARKANSAS RIVER DRAINAGE BASIN
= 8,000 FT. CONTOUR ELEV. - DESIGN STORM DIVIDE
= ISOPLUVIAL LINE - TENTHS OF INCHES
5 YEAR, 24 HOUR STORM
ISOPLUVIAL MAP

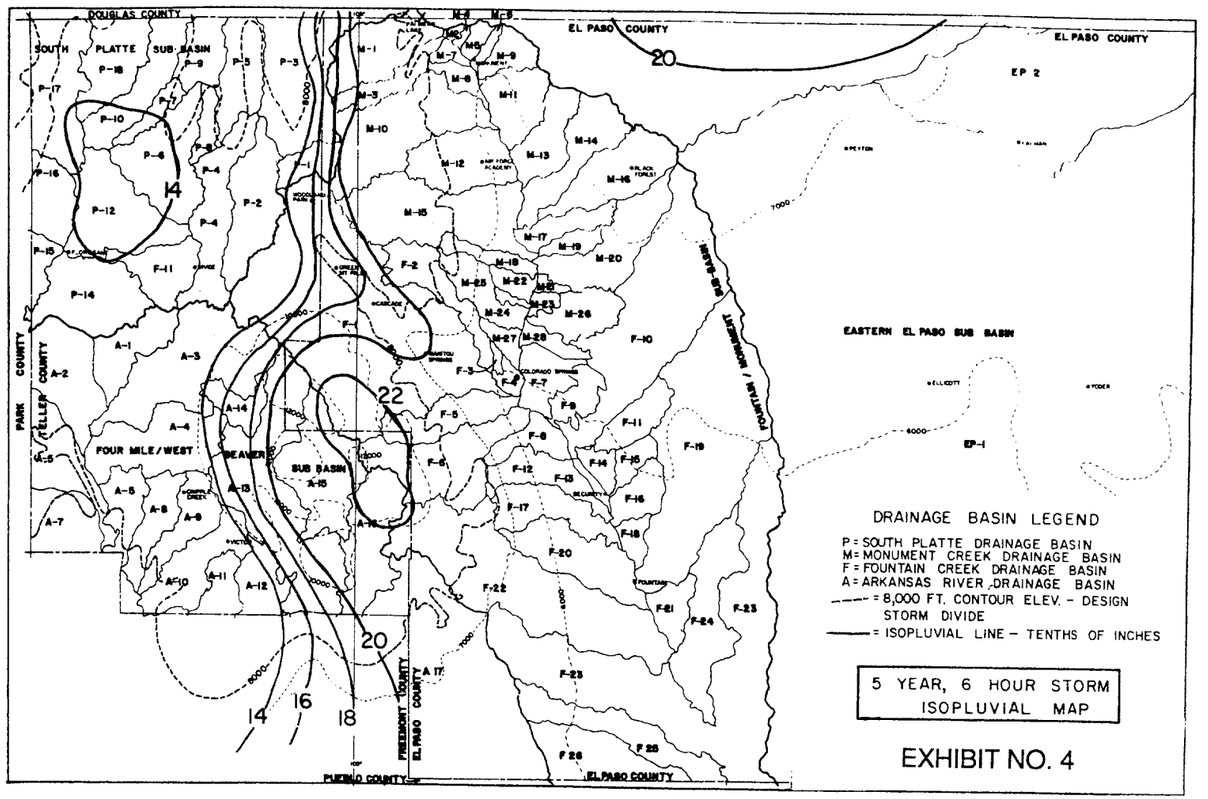
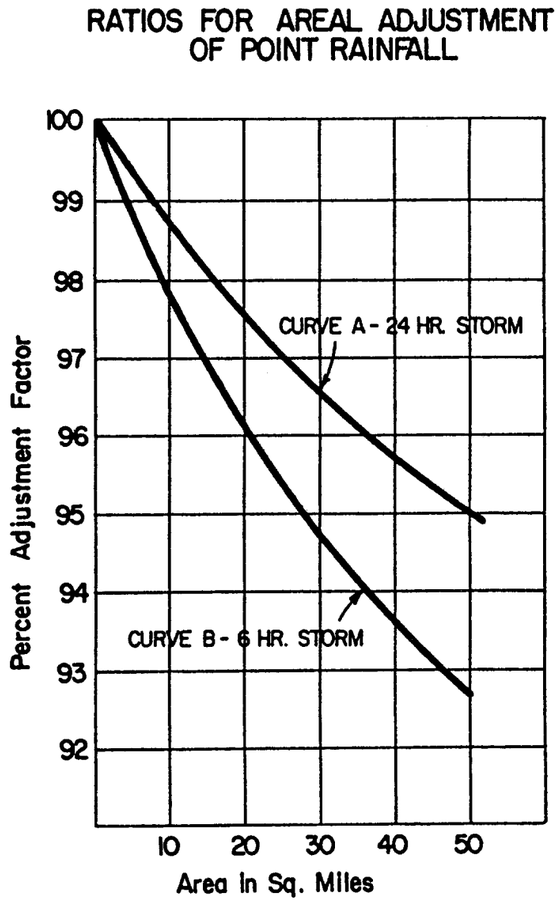

DOUGLAS COUNTY
EL PASO COUNTY
SOUTH PLATTE SUB-BASIN
EASTERN EL PASO SUB BASIN
PARK COUNTY
TELLER COUNTY
FOUR MILE / WEST
BEAVER
SUB BASIN
A-15
FREMONT COUNTY
PUEBLO COUNTY
14
16
18
20
22
DRAINAGE BASIN LEGEND
P = SOUTH PLATTE DRAINAGE BASIN
M = MONUMENT CREEK DRAINAGE BASIN
F = FOUNTAIN CREEK DRAINAGE BASIN
A = ARKANSAS RIVER DRAINAGE BASIN
= 8,000 FT. CONTOUR ELEV. - DESIGN STORM DIVIDE
= ISOPLUVIAL LINE - TENTHS OF INCHES
5 YEAR, 6 HOUR STORM
ISOPLUVIAL MAP

EXHIBIT NO. 4



NOTE: (1) CURVE 'A' IS APPLICABLE TO 24 HOUR STORMS THROUGHOUT COLORADO, ie. TYPE II AND IIA STORMS. (SOURCE: PROCEDURES FOR DETERMINING PEAK FLOWS IN COLORADO SUPPLEMENTING SCS TECHNICAL RELEASE 55.)

(2) CURVE 'B' IS APPLICABLE TO 6 HOUR STORMS. (SOURCE: PPACG DRAINAGE CRITERIA MANUAL 1976.)

EXHIBIT NO. 5

The Type IIA rainfall distribution curve used in this report was developed by the U.S. Department of Agriculture Soil Conservation Service. It was developed from NOAA data for typical precipitation amounts which occur east of the 8,000 foot elevation contour along the front range of the Rocky Mountains. (See Exhibit No. 6, Type IIA Rainlfall Distribution).

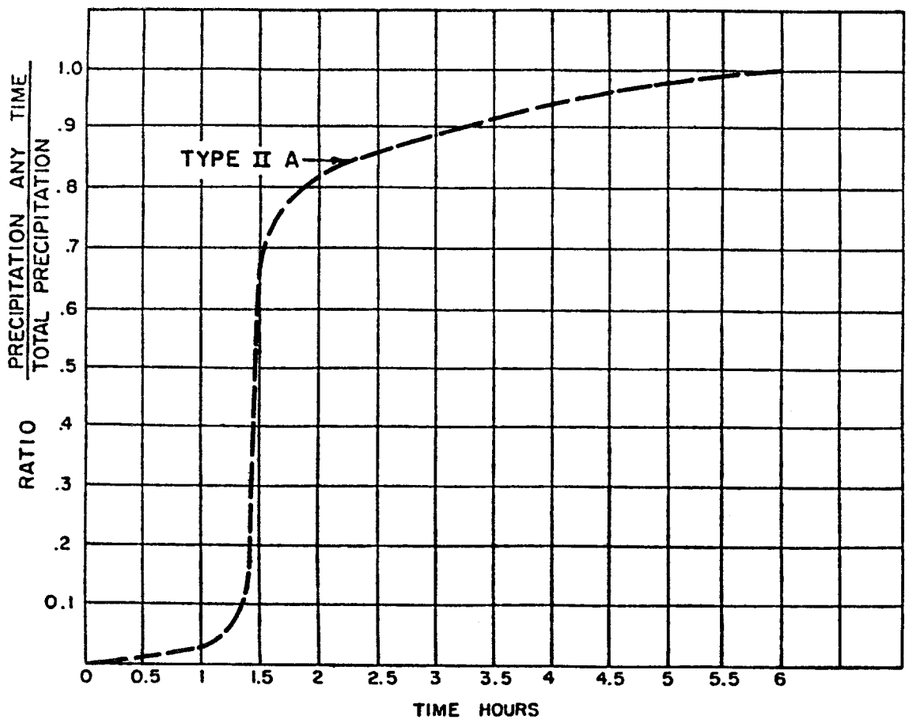
SOILS

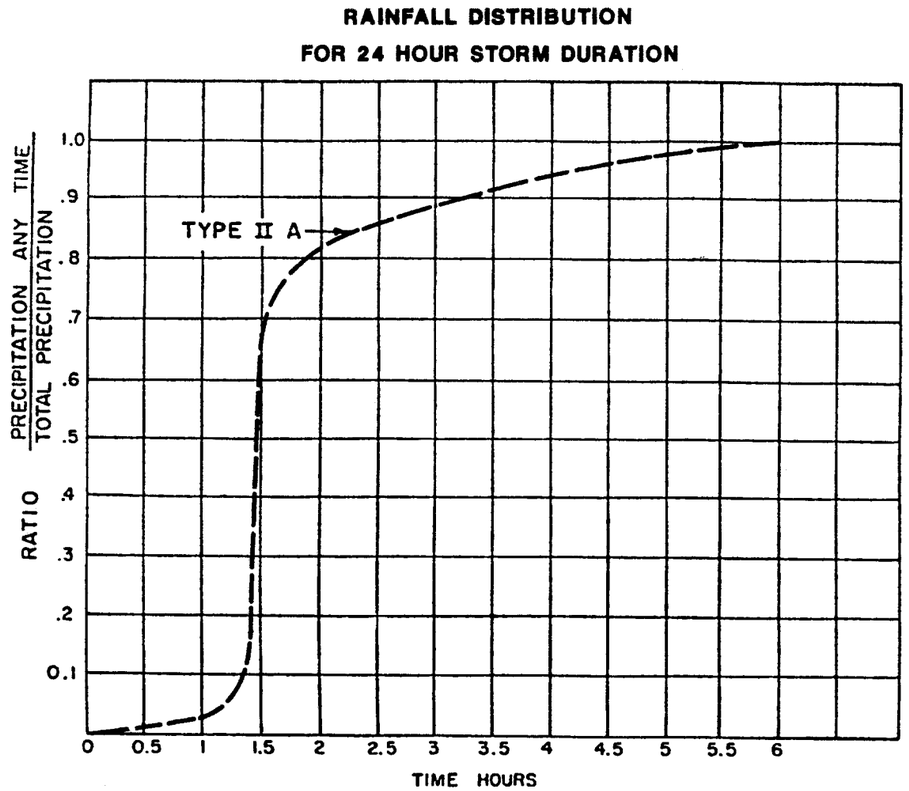
One of the integral parts in the determination of runoff discharges is determining the infiltration potential of the soils within the drainage basin. This determination was done by the Soil Conservation Service with the results of their soil survey published in the "Soil Survey of El Paso County Area, Colorado." This soil inventory was completed in 1981 and is the basis of the soil information used in this study.

The Soil Conservation Service has divided the different soils naturally found into four soil groups. Group A composed of very pervious sandy soils and Group D composed of very impervious soils. Soil Group B and Soil Group C fall between the two extremes. The subbasins were overlaid on the soils maps, and the acreage of each soil group was determined for each subbasin. The more pervious soils were found in and around the major channels, with the less pervious materials found in the upper reaches. Isolated pockets of nonhomogeneous materials can be found throughout the basins. See the Soils Map, Exhibit No. 7 for detailed locations of the soil groups in the Jimmy Camp Creek Basin.

LAND USE

Land uses in the Jimmy Camp Creek Basin were determined by examining current land use maps and studying current aerial photos. Although some





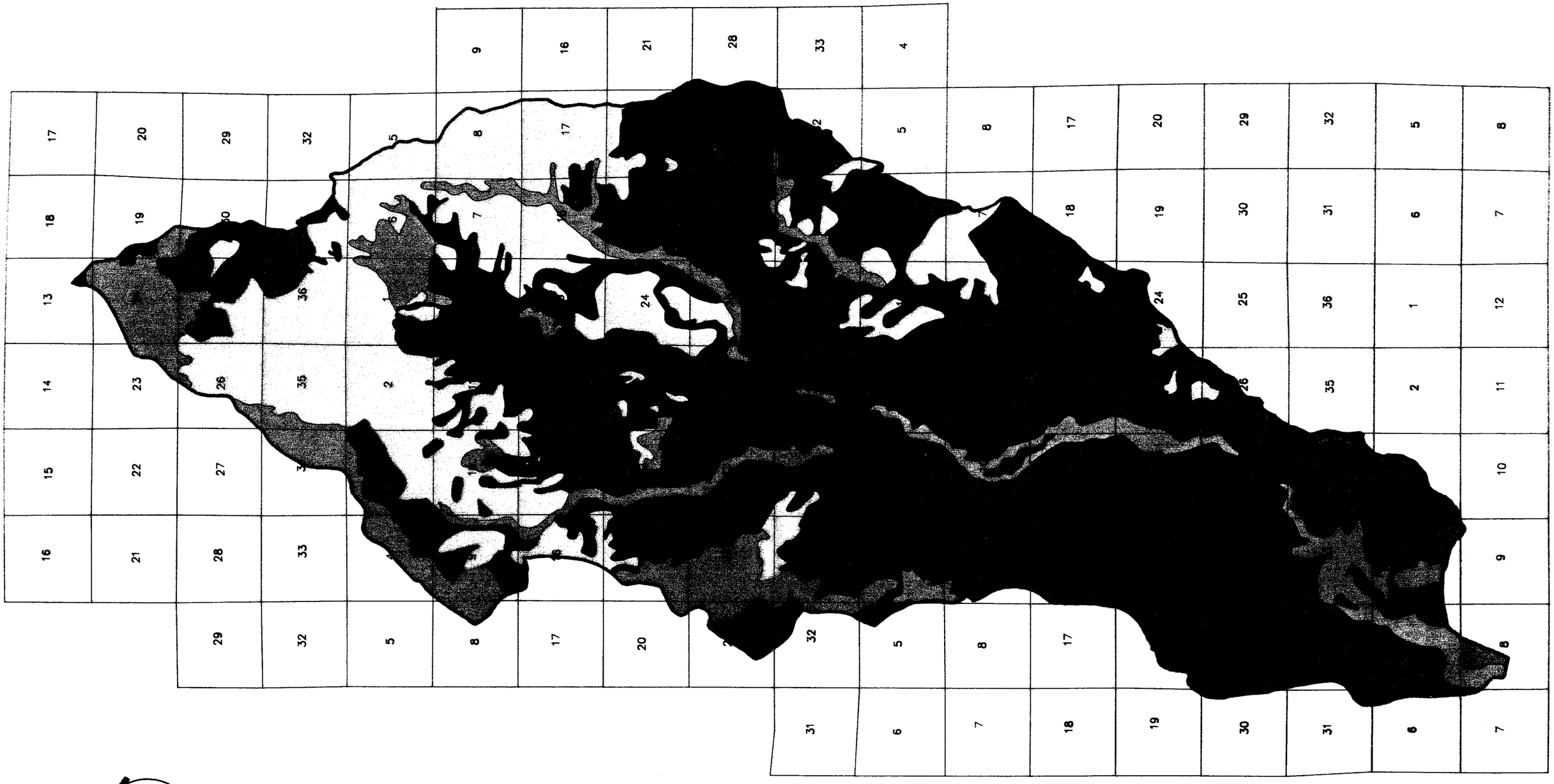
TYPE IIA 24 HOUR RAINFALL DISTRIBUTION

TIME (HRS.)	DISTRIBUTION OF TOTAL RAINFALL
0.0	0.000
2.0	0.010
3.0	0.020
4.0	0.030
4.5	0.050
5.0	0.060
5.5	0.100
6.0	0.700
6.5	0.750
7.0	0.780
7.5	0.800
8.0	0.820
8.5	0.830
9.0	0.840
9.5	0.850
10.0	0.860
11.0	0.870
12.0	0.890
14.0	0.915
16.00	0.940
20.00	0.980
24.00	1.000

TYPE IIA 6 HOUR RAINFALL DISTRIBUTION

TIME (HRS.)	DISTRIBUTION OF TOTAL RAINFALL
0.00	0.000
0.25	0.008
0.50	0.017
0.75	0.026
1.00	0.034
1.25	0.063
1.50	0.671
1.75	0.771
2.00	0.817
2.25	0.840
2.50	0.858
2.75	0.871
3.00	0.883
3.25	0.900
3.50	0.911
4.00	0.937
4.50	0.960
5.00	0.983
5.50	0.992
6.00	1.000

EXHIBIT NO. 6



MASTER DRAINAGE PLANNING STUDY
FOR JIMMY CAMP CREEK
SOILS MAP

DESIGN	DRAWN	DATE:
		FILE NO. 85-832
		EXHIBIT NO. 7

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residential development has occurred in the northern edge of the basin and in and around the City of Fountain, the predominant land use in the basin is agricultural or range land. According to the El Paso County Office of the Soil Conservation Service, most of the range land in the basin is in poor to fair condition. This characteristic means that there is very little absorption of storm runoff into the ground.

Future land use for the area was determined through discussions with local city and county planning officials as well as by obtaining projected land uses from the major developers currently developing property within the basin. In the areas not being developed currently, a land use mix was established in conjunction with the El Paso County Land Use Department. The Land Use Map, Exhibit No. 8 is a composite of the land use information for fully developed conditions within the basin. There is not a time frame or date associated with this projected land use.

From the soils and land use information obtained, hydrologic Curve Numbers (CN's) were computed and then utilized in the TR-20 computations. Table No. 4 is a list of the curve numbers used in the calculations:

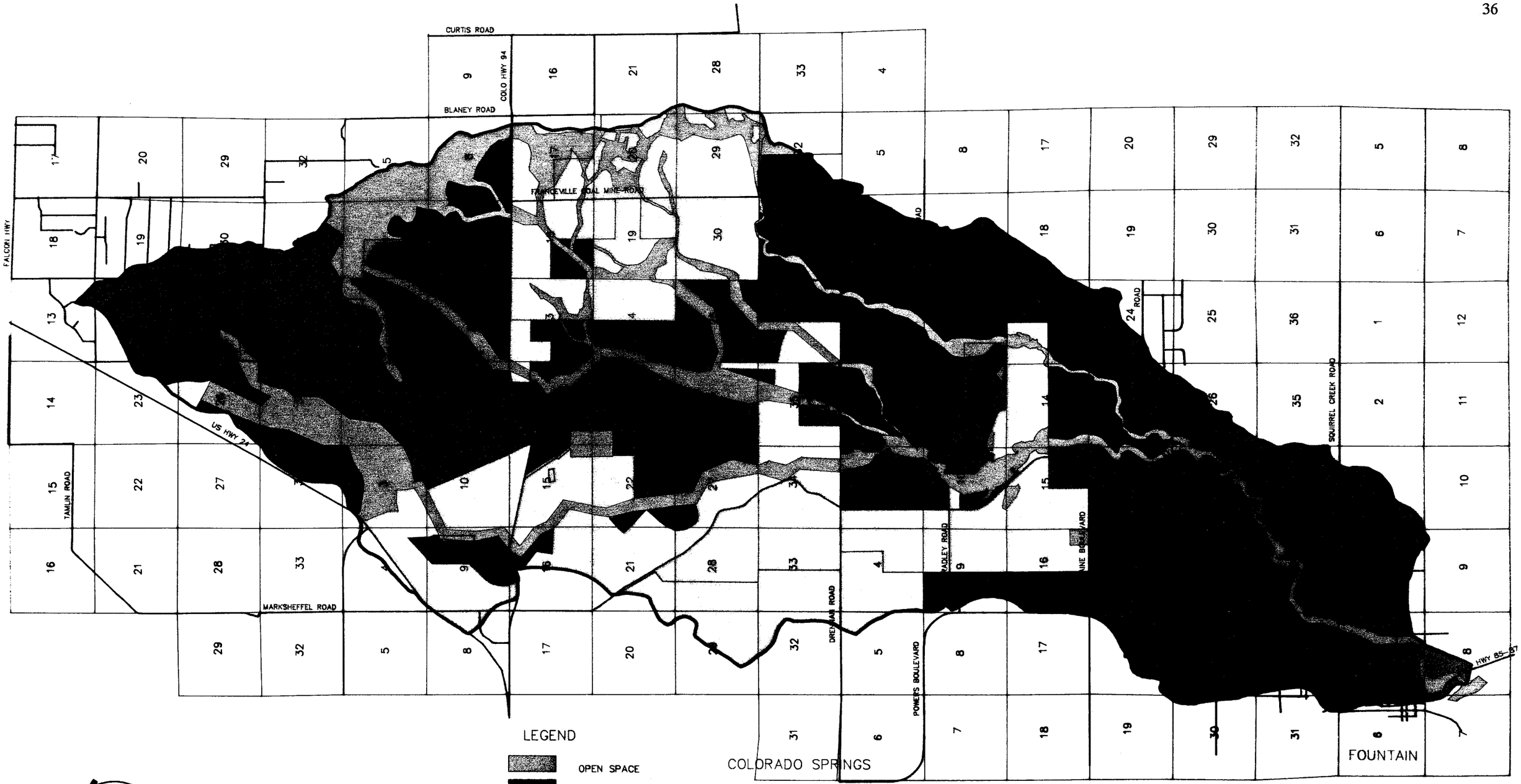
TABLE NO. 4

HYDROLOGIC CURVE NUMBERS
(CN's)

LAND USE DESCRIPTIONS & IMPERVIOUSNESS		HYDROLOGIC SOIL GROUP A	B	C	D
Residential @ 2 DU/AC	25% impervious	54	70	80	85
Residential @ 4 DU/AC	38% impervious	61	75	83	87
Residential @ 5 DU/AC	45% impervious	68	79	86	89
PUD	70% impervious	80	87	90	92
Commercial/Office/Industrial (Low Density)	72% impervious	81	88	91	93
Commercial/Office	85% impervious	89	92	94	95
Airport	36% impervious	65	78	85	88
Mixed Use		70	81	87	90
Residential - 4 DU/AC	47% of Area				
Commercial - 85% impervious	12% of Area				
Public Administration (72% impervious)	10% of Area				
Parks	11% of Area				
Streets	18% of Area				
Drainage (Open Space)	2% of Area				

HYDROLOGIC ALTERNATIVES

Based upon the development patterns within the basin and the associated increase in runoff, it became evident that channel improvements must be made such that historical flows would be confined to a defined channel and fully developed flows limited to historical peaks. Since the developed peak flows



LEGEND

- OPEN SPACE
- RESIDENTIAL 2DU/ACRE
- RESIDENTAL 4DU/ACRE
- RESIDENTIAL 5DU/ACRE
- RESIDENTIAL PUD
- MIXED USE
- MOBILE HOME PARK
- COMMERICAL
- AIRPORT

NORTH

SCALE 1" = 6000'

0 6000 12000

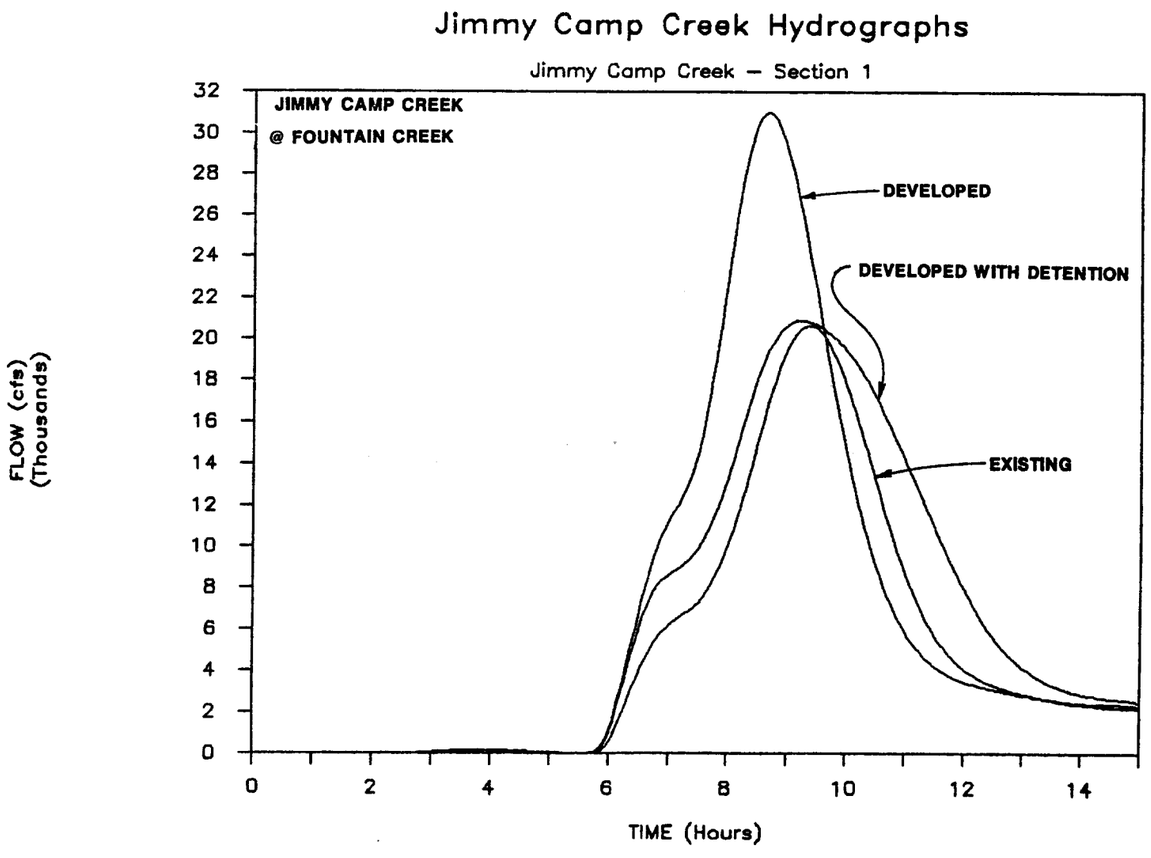
MASTER DRAINAGE PLANNING STUDY
FOR JIMMY CAMP CREEK
LAND USE MAP

DESIGN	DRAWN	DATE:
		FILE NO. 85-832
		EXHIBIT NO. 8

WILSON & COMPANY ENGINEERS

were computed to be over 50% higher than historical and some of the existing facilities were presently inadequate to handle the historic flows, it was determined that the best approach for the basin as a whole would be to provide regional detention facilities. In order for these regional facilities to be most effective, their location in the basin was examined and the middle and upper areas of the basin were found to be the most appropriate locations.

The detention modeling on the basin was done such that there would not be a net increase in peak flows in the lower reaches of the basin due to development. This modeling was accomplished by choosing sites along Jimmy Camp Creek and its major tributaries which would be readily adaptable to detention due to their existing physical characteristics. The basin discharge map (located in the back pocket) shows the location of the computed hydrographs for selected points throughout the basin. (See Exhibit No. 9 A through 9 O for the plot of the computed hydrographs.)



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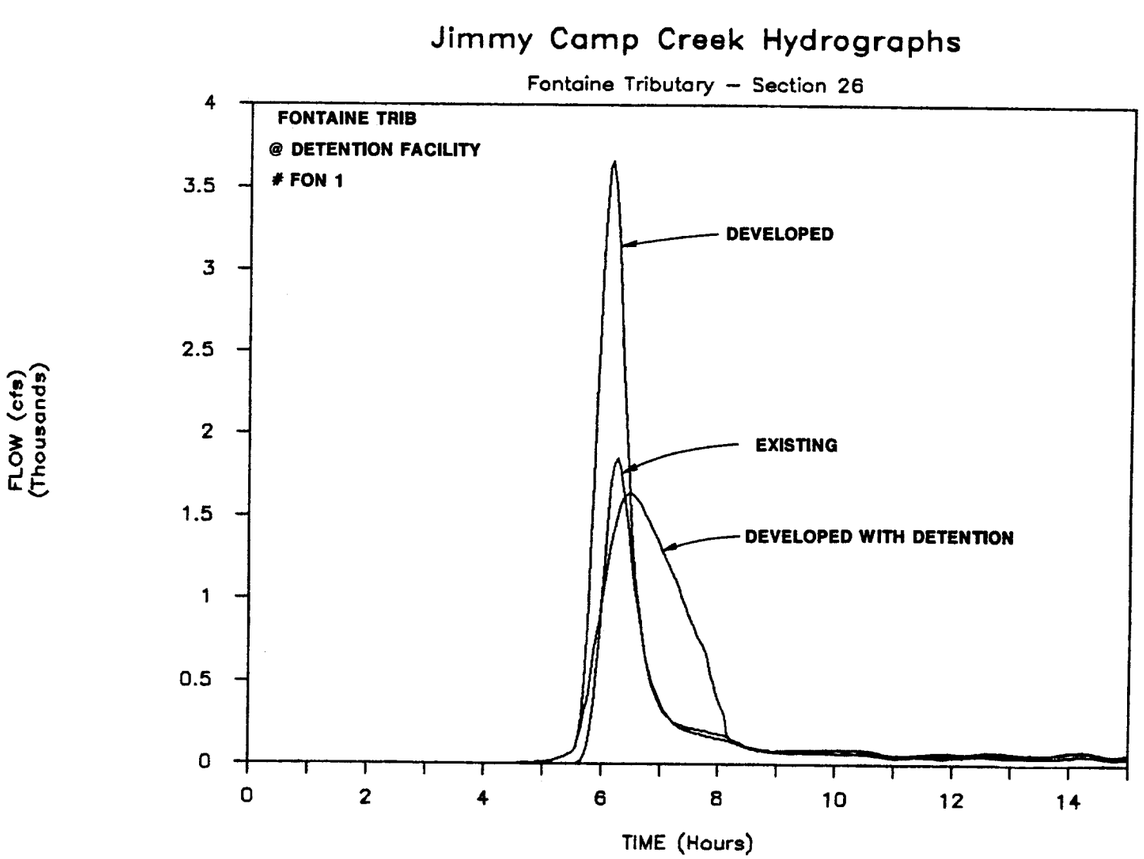

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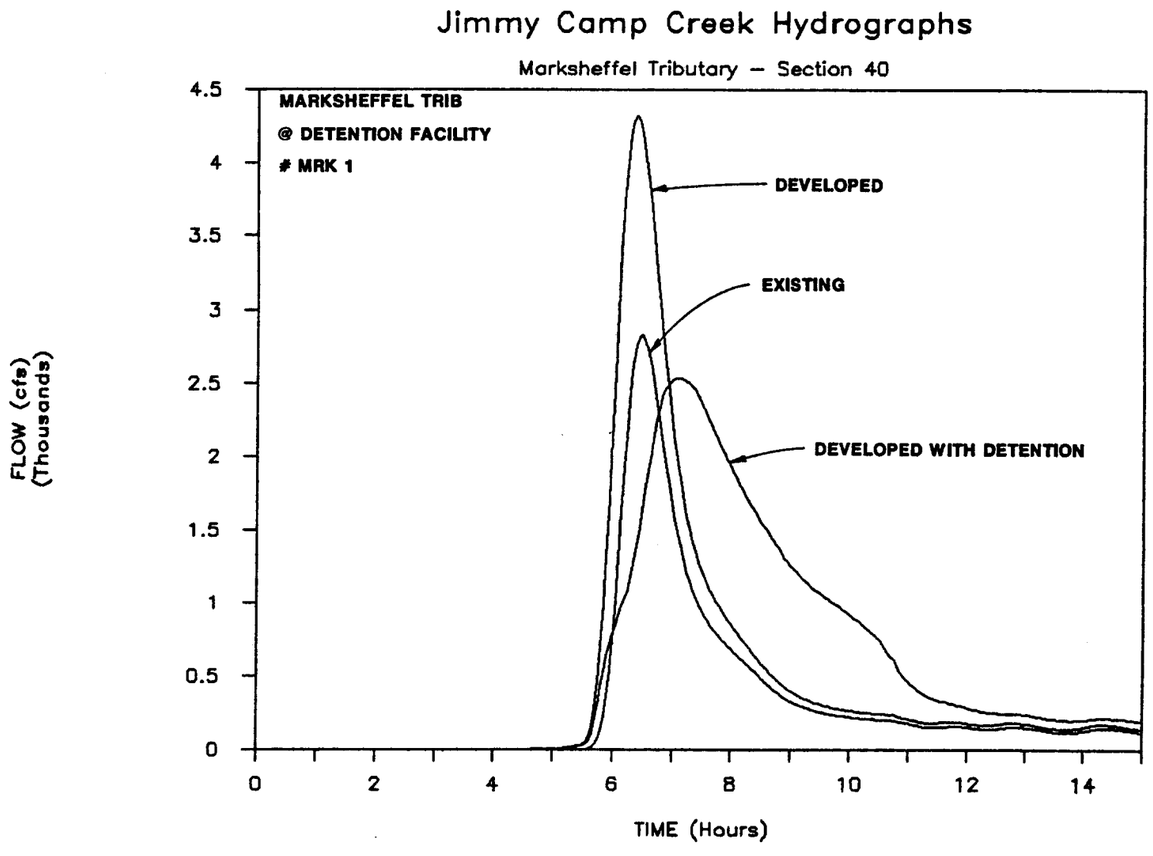

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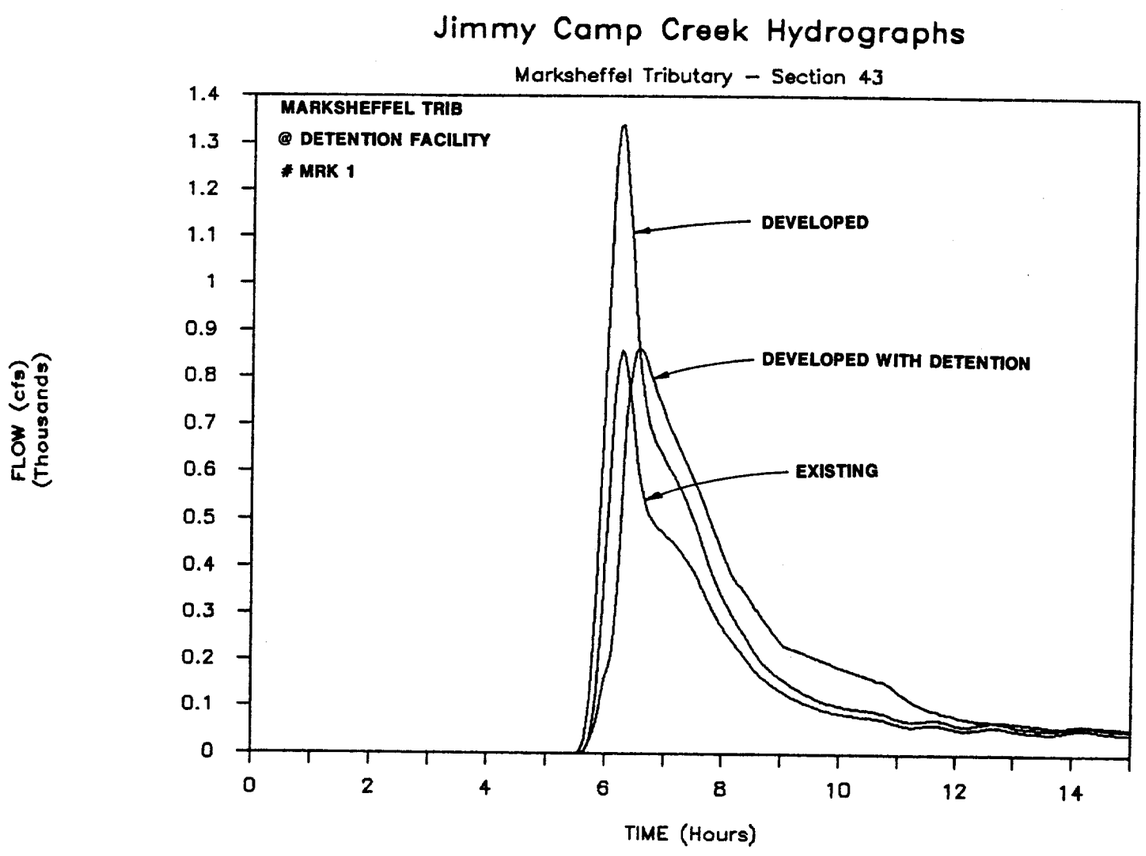

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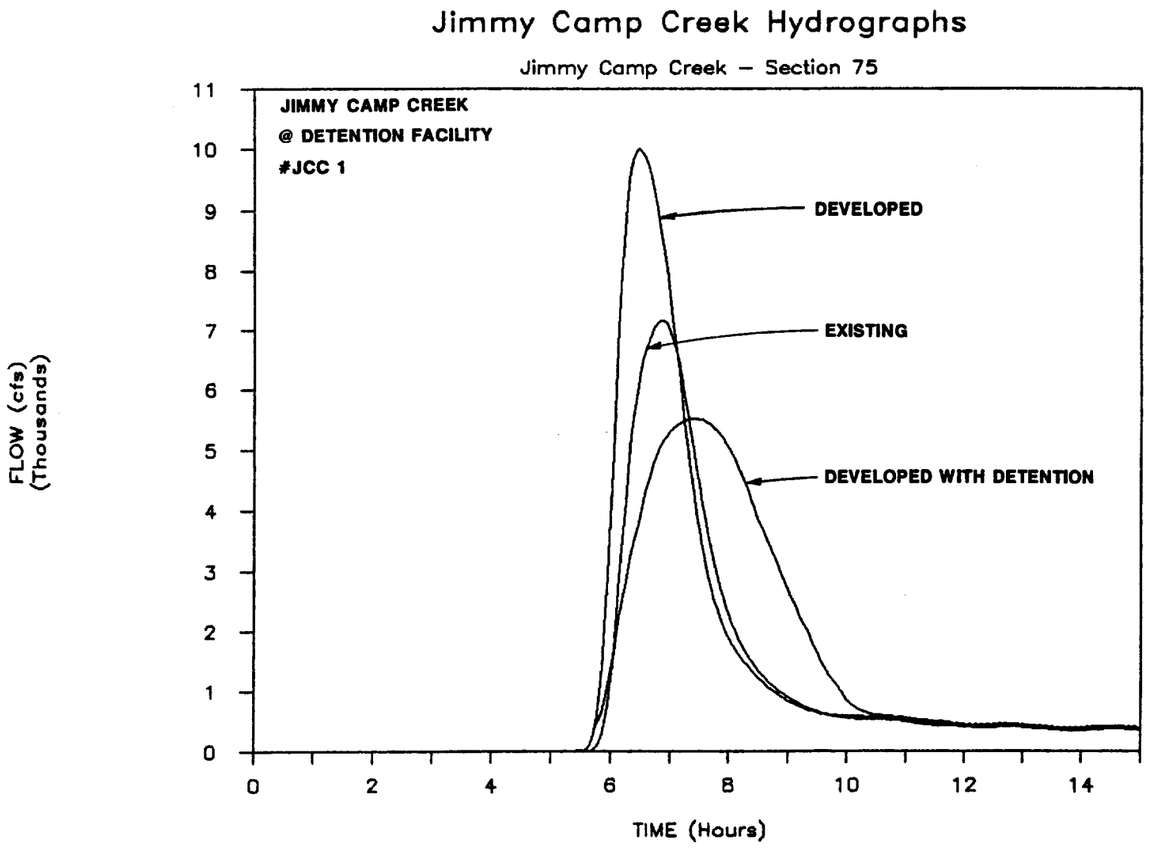

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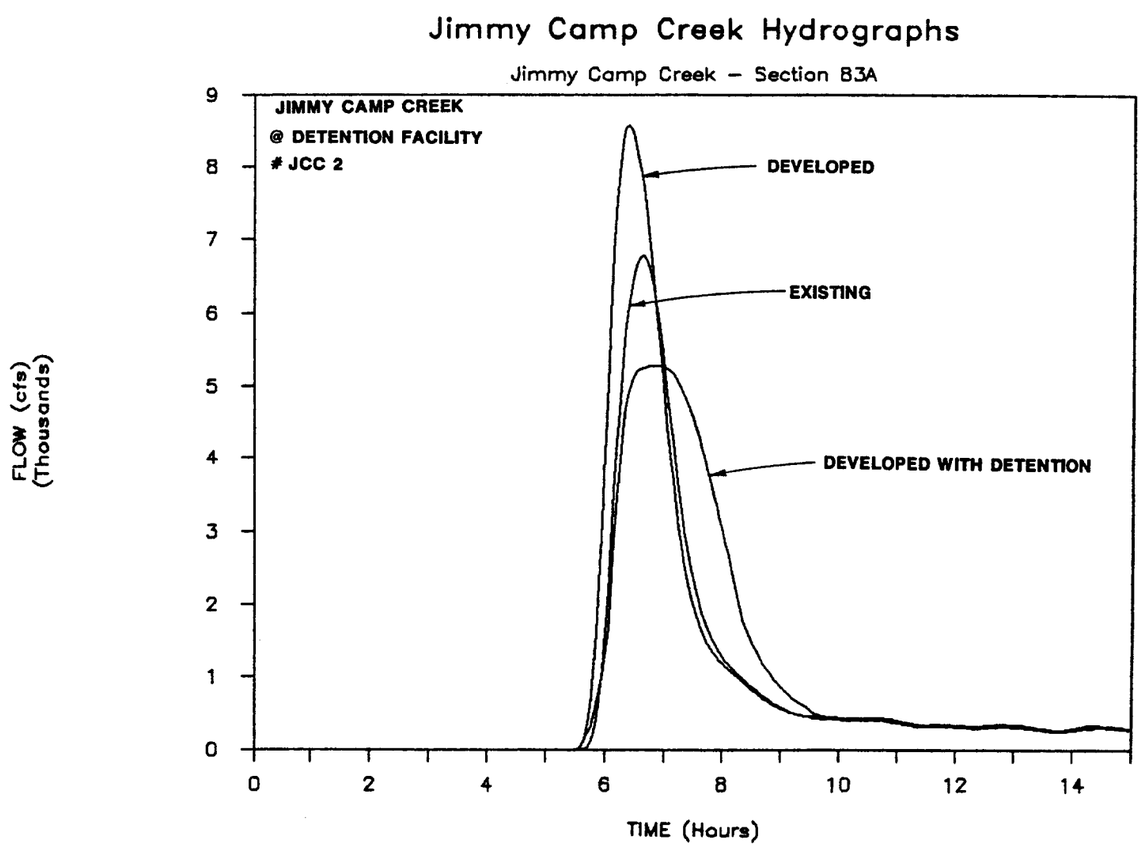

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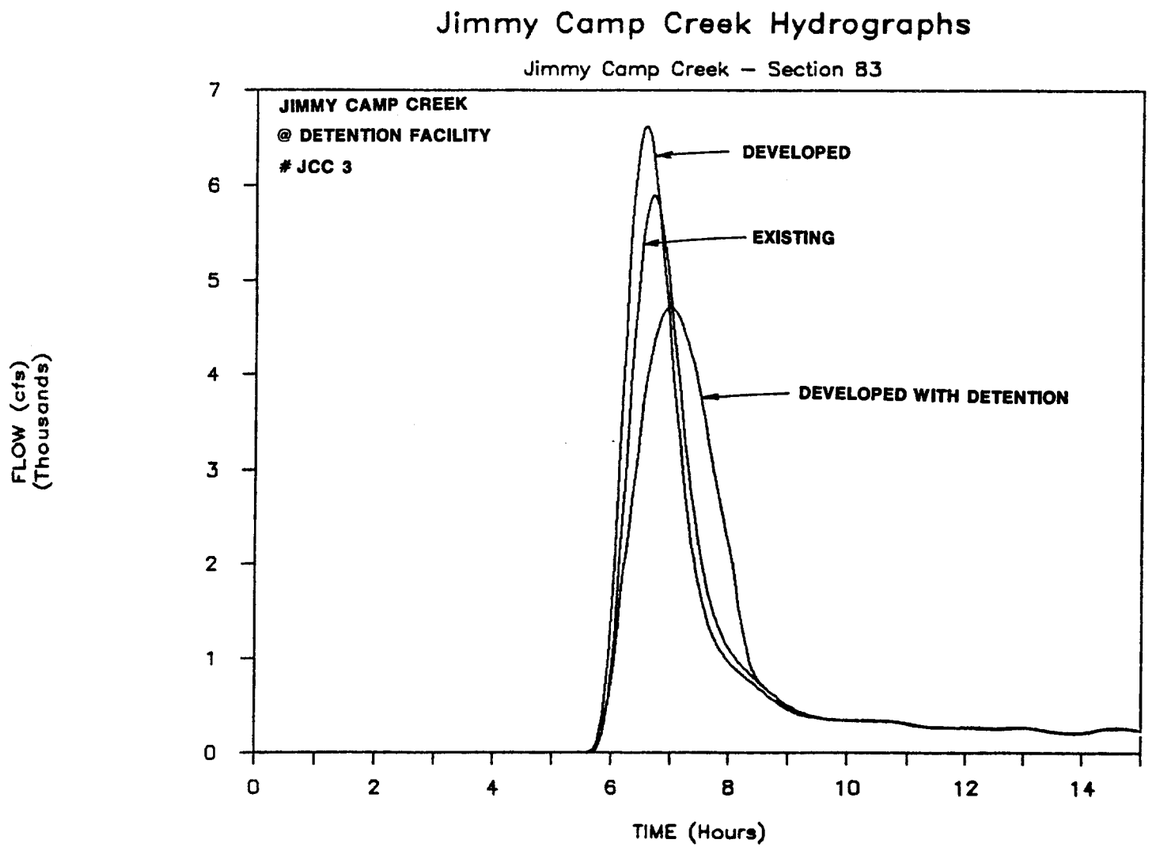

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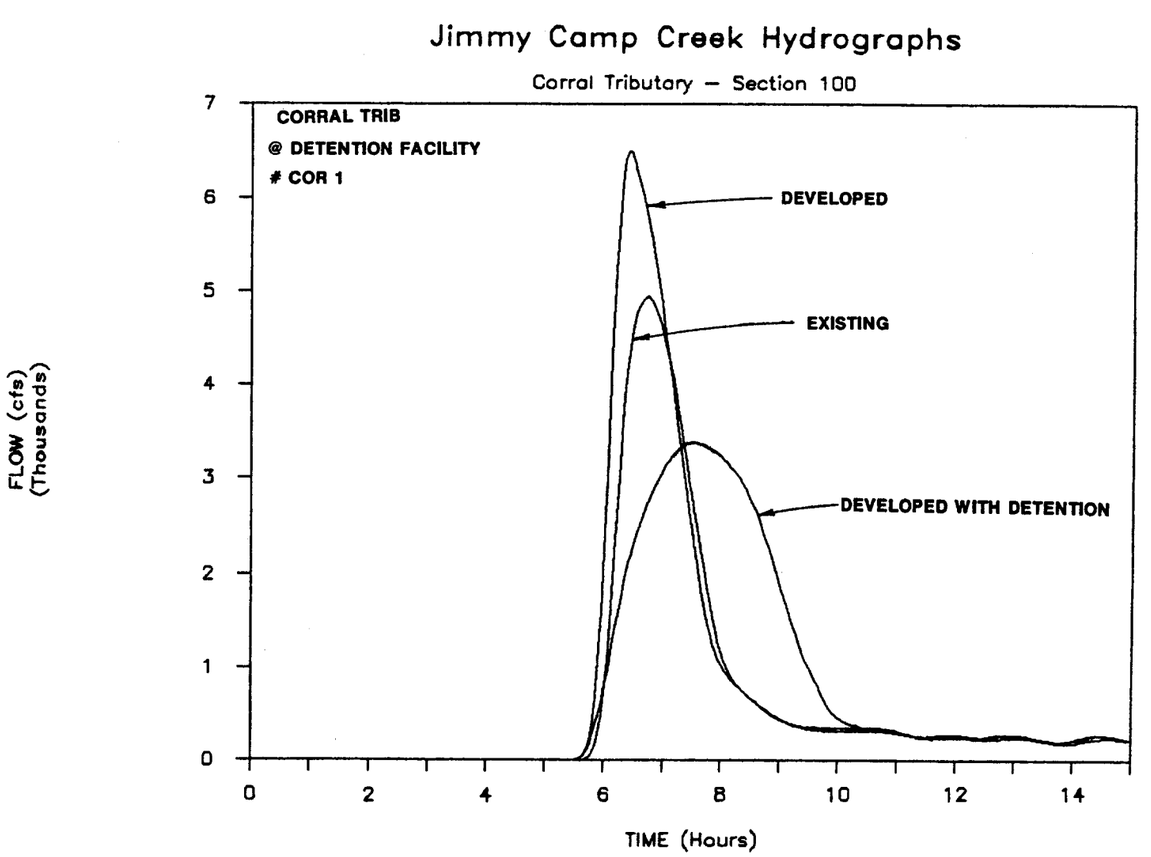

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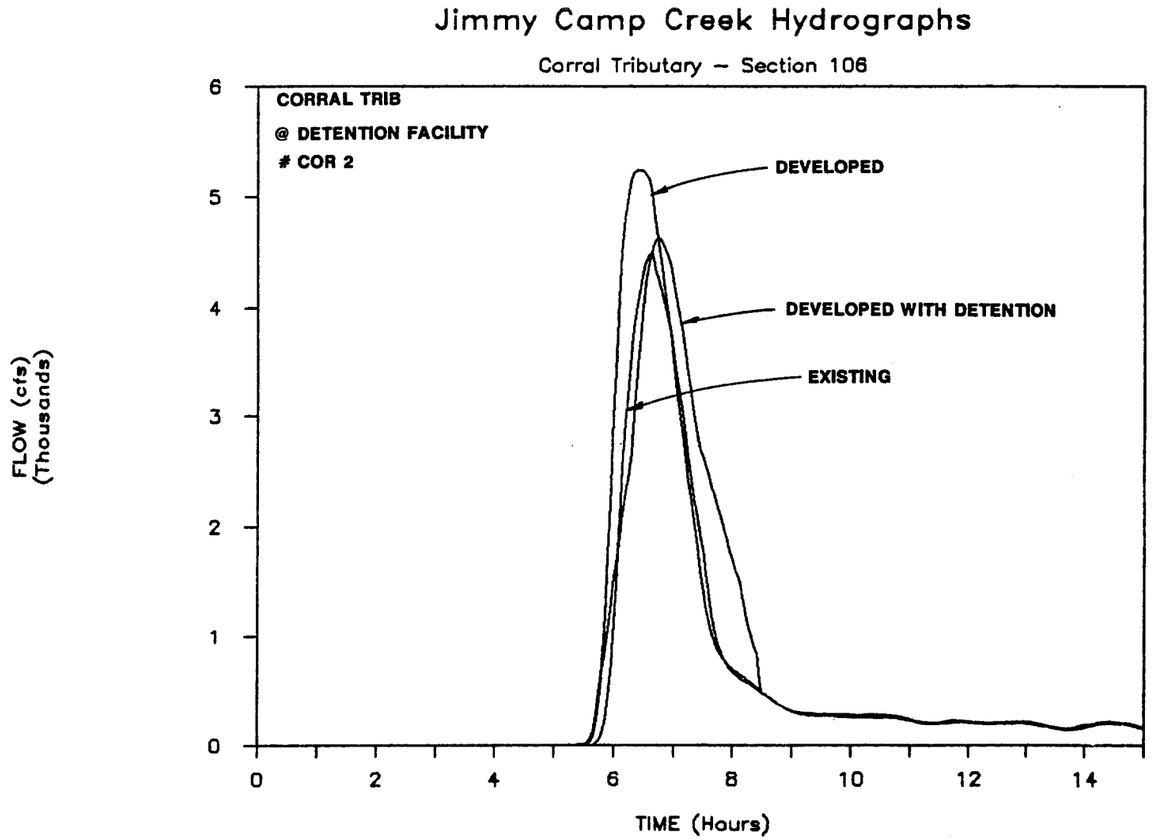

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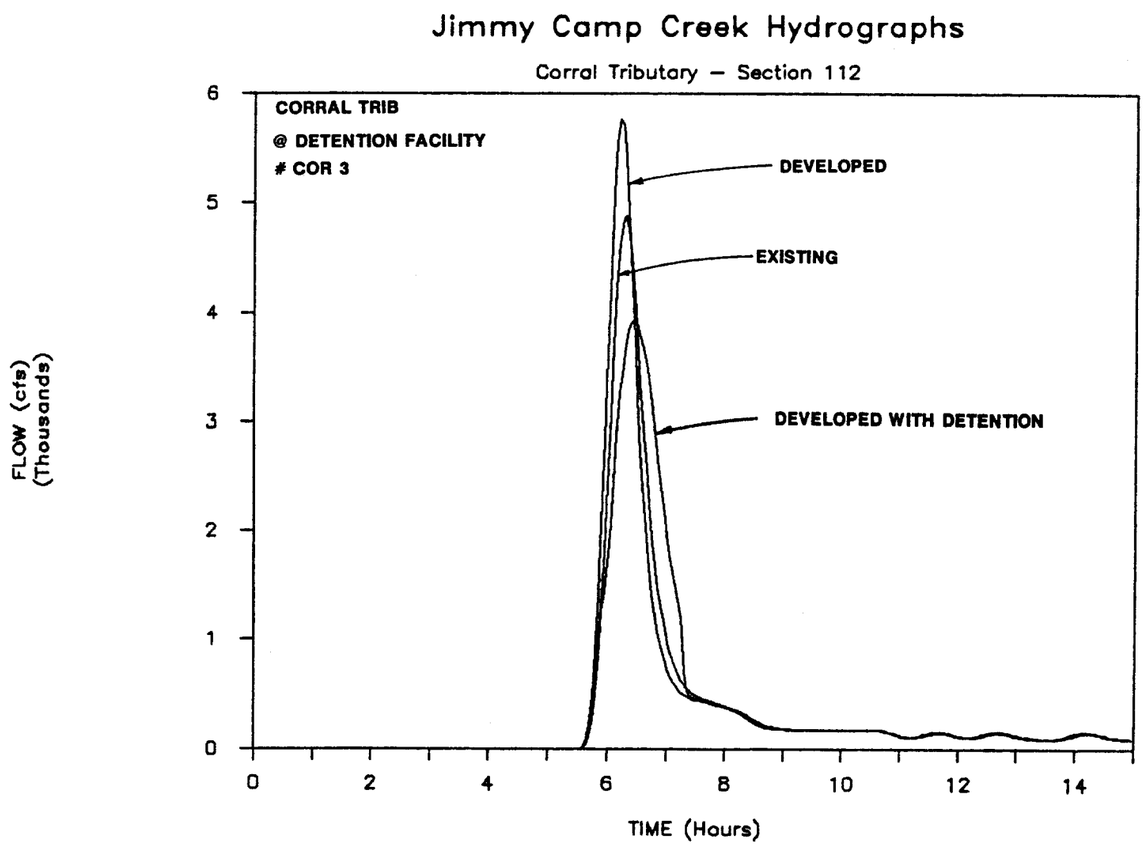

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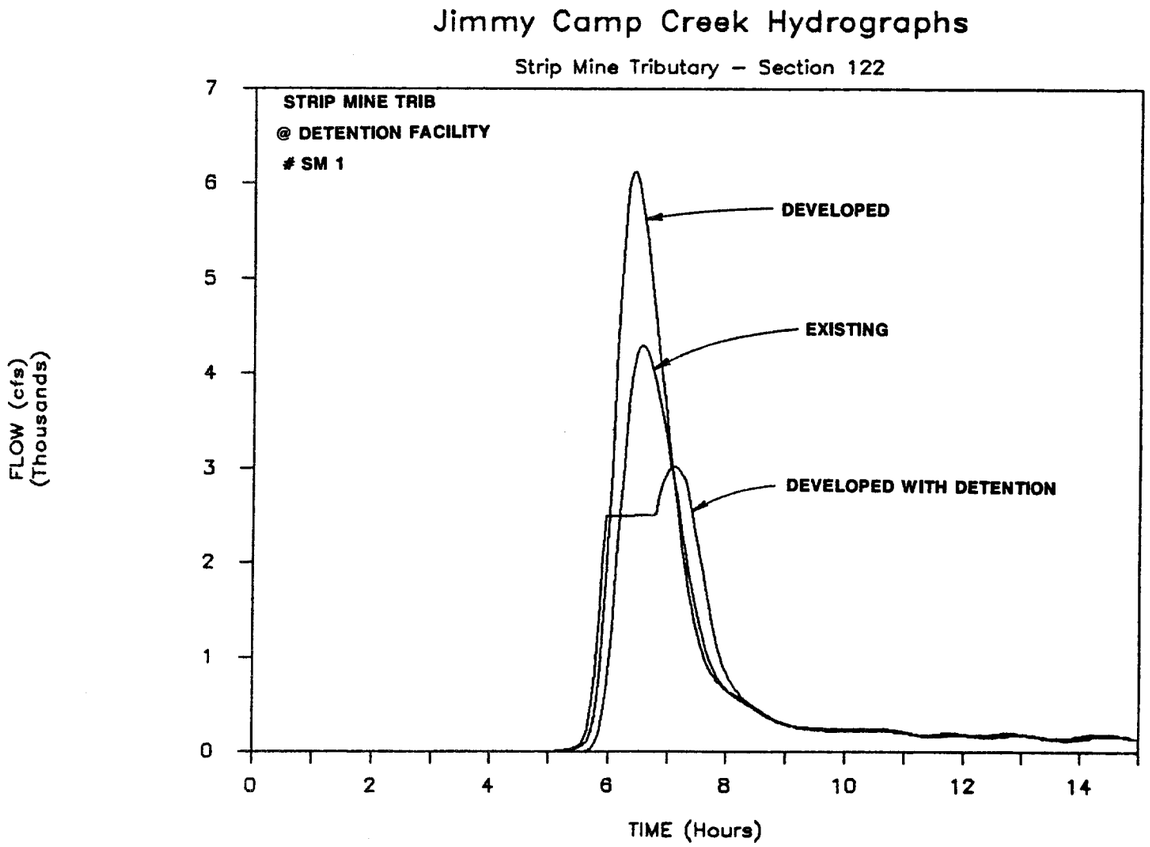

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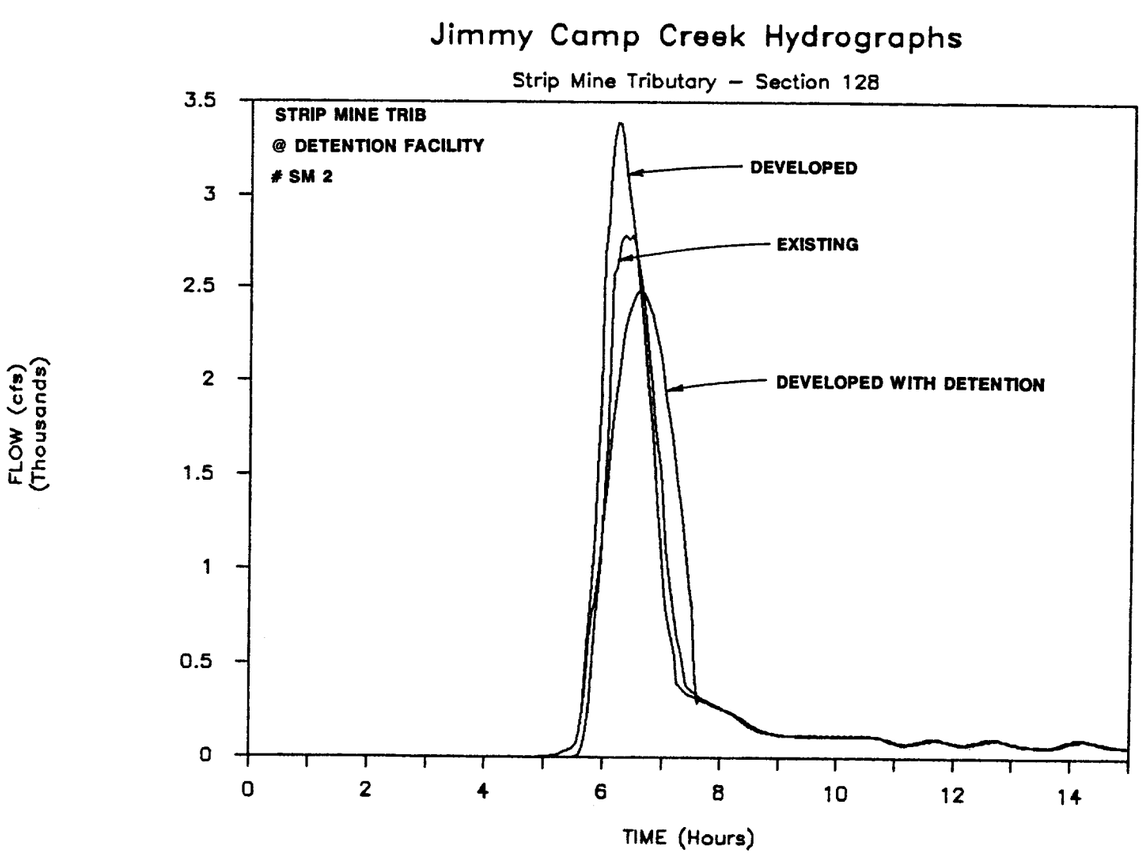

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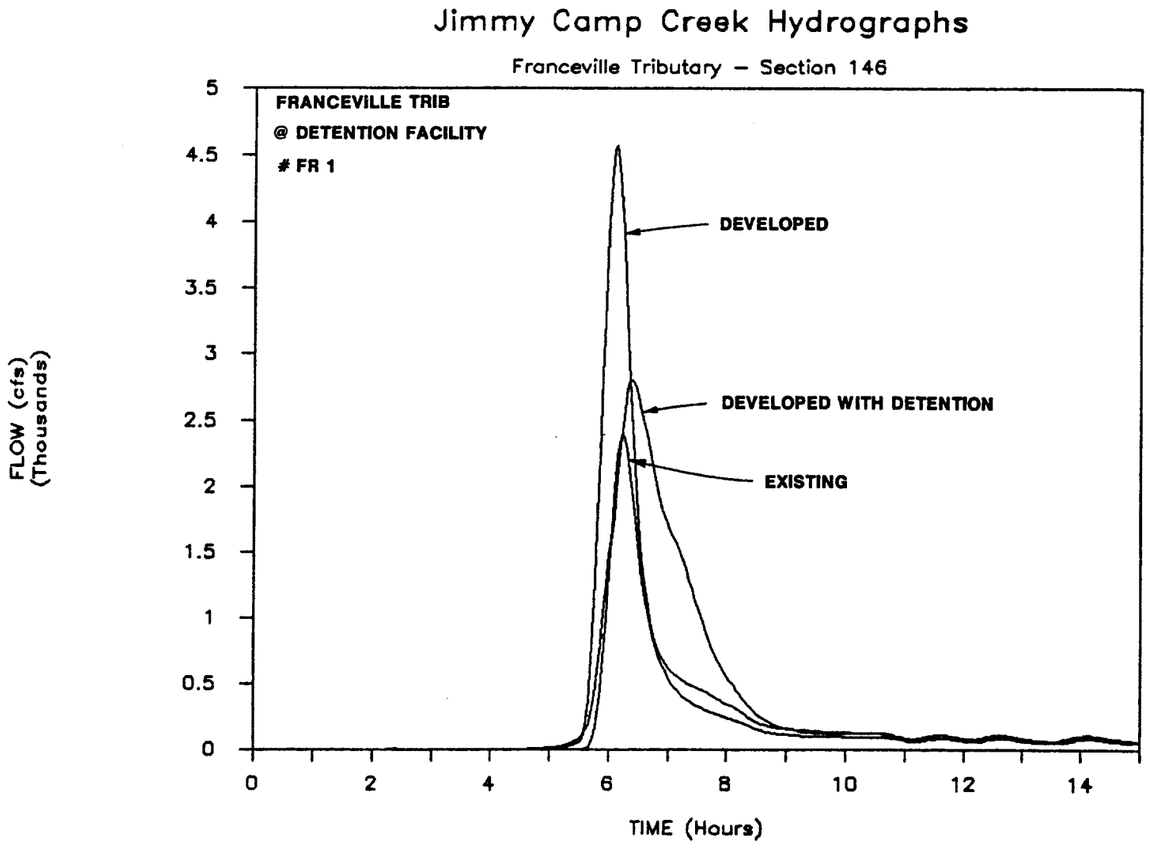

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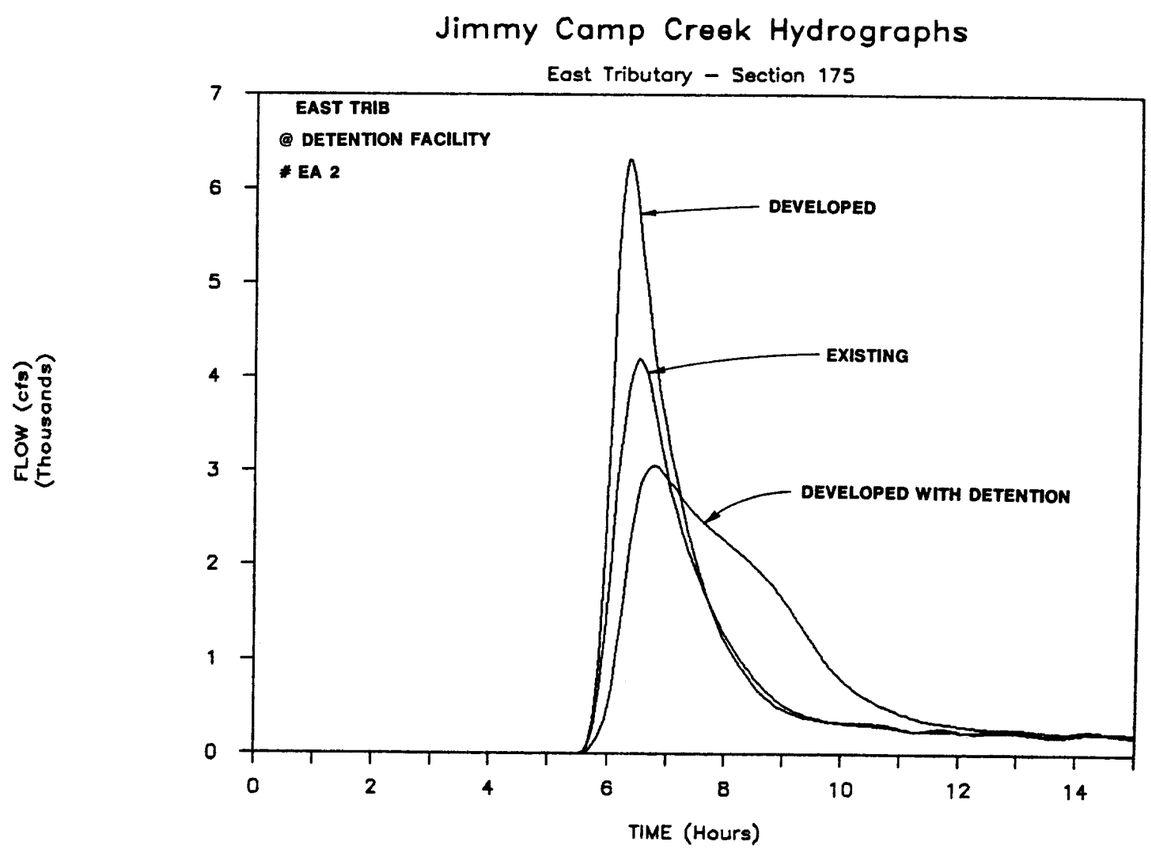

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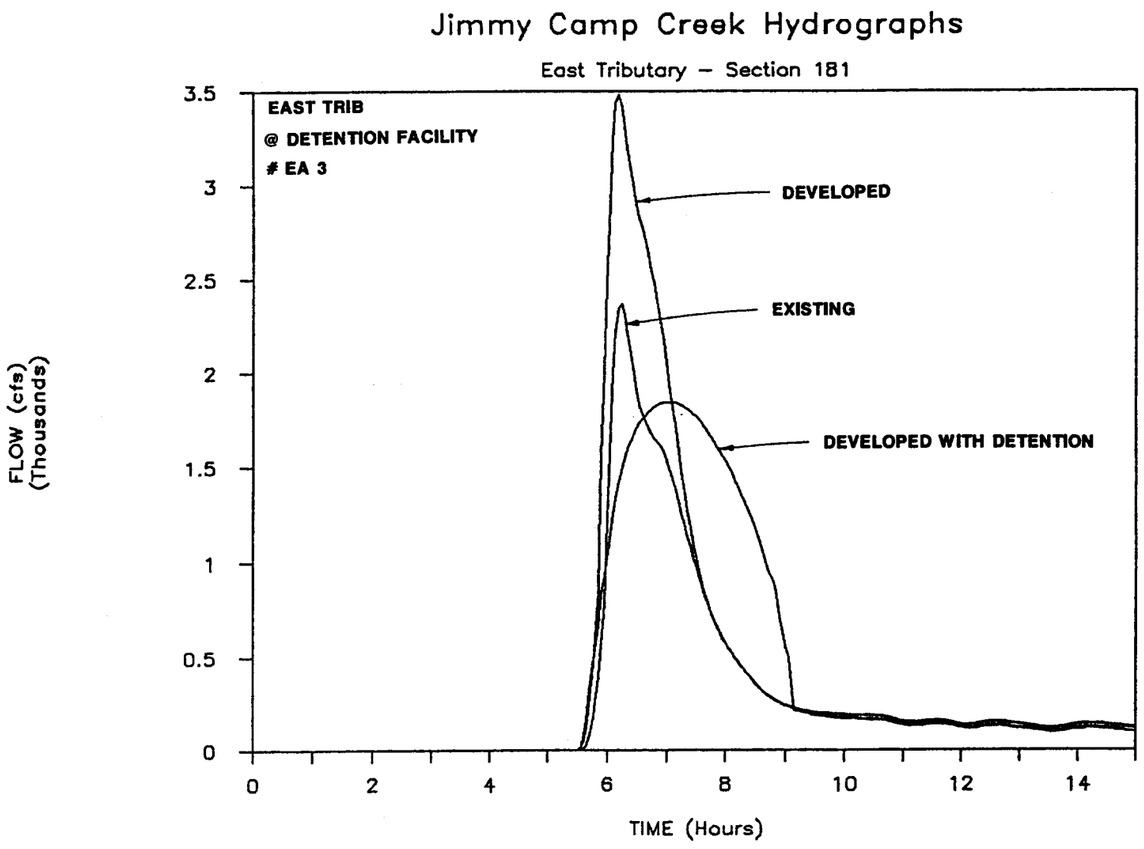

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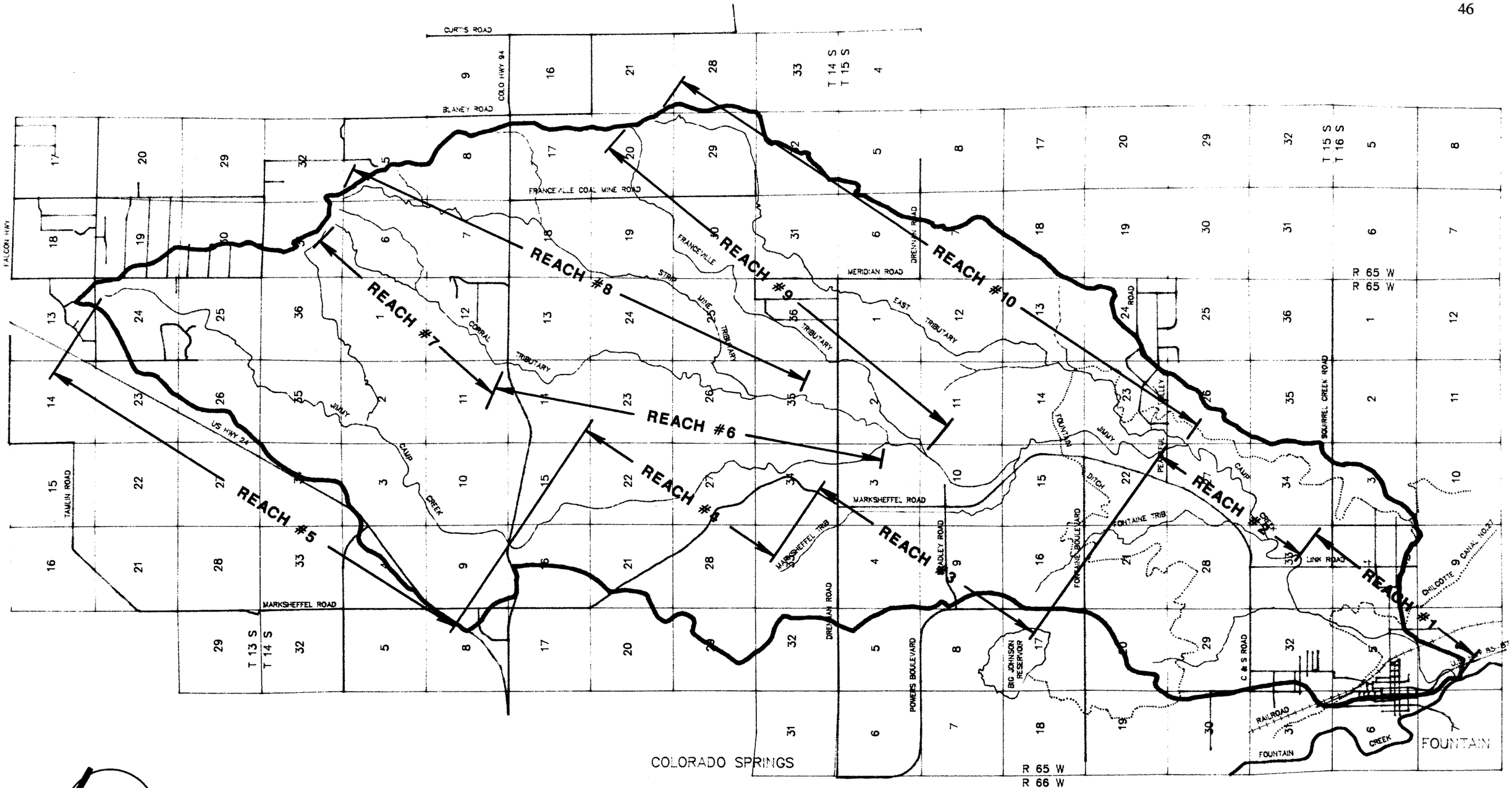

MASTER DRAINAGE PLANNING STUDY
FOR JIMMY CAMP CREEK
REACH MAP

DESIGN	DRAWN	DATE:
		FILE NO. 85-832
		EXHIBIT NO. 2

WILSON & COMPANY
ENGINEERS

HYDRAULIC ANALYSIS

METHODS & CRITERIA

The objective of the hydraulic analysis performed in this report was to study the existing drainage systems to determine their capacity for handling the historic runoff and increased runoff resulting from development within the basin. The problems were identified and alternative drainage solutions evaluated to correct the deficiencies. Existing structure plans were obtained where possible and field surveys were performed where no information was available. The existing structures and channel sections were modified where necessary to reflect existing improvements. Channel sections were obtained from mapping performed for Aries Properties, Inc. and Colorado Centre Metropolitan District as well as from the 1975 SCS Flood Hazard Analysis Report. The information from the report was field verified to check for changes due to scour or aggradation.

Based on the compiled Land Use Map, Exhibit No. 8, existing and developed flows were determined through the use of the SCS TR-20 program and compared to the flows obtained by the SCS in their 1975 report. (See Sheets 18 and 19 of Appendix). In addition, the U.S. Army Corps of Engineers HEC-2 "Water Surface Profile" program was used to check the corresponding water surface elevations along all main tributaries of the Jimmy Camp Creek Basin. The program data was used as a basis for determining the adequacy of existing structures as well as sizing future ones.

The HEC-2 criteria used in the computations assumed that roughness values in the channel varied from .025 to .045 while overbank areas varied from .030 to .080.

EXISTING CHANNEL CONDITIONS

Jimmy Camp Creek

Reach #1 - Fountain Creek to Link Road (STA 0+00 to STA 175+42)

The existing channel between the confluence with Fountain Creek to Link Road is a wide channel with channel widths varying from 200 to more than 400 ft. Channel bed slopes are mild, averaging .005 ft./ft. and the channel banks are from 5 to 12 ft. high. Trees and thin vegetative cover are typical in the sandy bed, and although some vegetation exists on the banks, erosion and bank failure are evident in some areas. For a 100-year storm event the TR-20 program produced a historic peak flow of 21,000 cfs for this reach with corresponding velocities of up to 13 fps. Although 100-year flows and velocities are high, the channel appears to be in a state of aggradation. This condition is probably due to the much lower stream velocities generated from smaller annual storms. (Output from TR-20 computer modeling is contained in the Technical Addendum of this report.)

Flows within this section of the channel are affected by two conditions: the first condition occurs within a few feet of Fountain Creek where an old abandoned concrete arch bridge restricts the flow going into Fountain Creek; the second condition is the severe alignment problem which exists between the railroad bridge and the Old Pueblo Road bridge. The stream alignment problem is caused by two 90° bends, one at the Old Pueblo Road bridge and the second approximately 1,500 ft. farther upstream.

Reach #2 - Link Road to Peaceful Valley Road (STA 175+42 to STA 350+93)

The portion of Jimmy Camp Creek from Link Road upstream to Peaceful Valley Road, with its pattern of meanders, is a typical example of a natural stream flowing through an alluvial valley. Existing channel widths vary from 150 to 200 ft. or more. Channel bed slopes average .005 ft./ft. and downstream of the confluence with East Tributary, the 100-year flow is 21,000 cfs.

At Peaceful Valley Road, the existing crossing consists of 4-43"x27" corrugated metal pipe arches designed to handle 160 cfs, after which the flow overtops the roadway. Also, the channel itself is very shallow with banks less than 2 ft. in height. Large flows and minimal in-channel capacity result in a very broad floodplain width in this area. Compounding the problem is the fact that East Tributary also crosses Peaceful Valley Road in the same vicinity before joining with Jimmy Camp Creek just south of the road.

In general, the predominant problem in this reach is the continuous meandering alignment and the trees and brush which have established themselves thoughout the meanders and around the Link Road bridge. The meanders and vegetation have combined to create a major siltation problem because of the drop in the stream velocity.

Reach #3 - Peaceful Valley Road to Drennan Road (STA 337+20 to STA 616+25)

Flows from Corral and Franceville Tributaries merge into Jimmy Camp Creek between Drennan Road and the proposed Bradley Road alignment. The 100-year flow at Bradley Road was determined to be 17,800 cfs which represents more than 75% of the total peak flow for the basin. For this reach, channel widths vary from 100 ft. to 600 ft. The extreme widths occur in an area where only one well-defined bank exists. Opposite the well-defined bank, the stream extends out over gently sloping terrain.

From Peaceful Valley Road upstream to the confluence with Corral Tributary, the bed slope gradually increases from .0064 to .009 ft./ft. Stream velocities range from 13 fps where the channel is 150 feet wide down to 2 fps where the flow expands across a wide section. This reach contains a broad range of problems from little or no channel depth to vertical channel sides over 30 ft. high. Proceeding north from Peaceful Valley Road where the existing channel banks are only a few feet high, the channel begins to develop some definition on the west bank while the east bank continues to vary. This situation continues until the stream reaches the proposed Bradley Road alignment. At this point, the channel narrows to approximately as little as 100 ft. in width. Because of the increased velocities caused by this flow restriction, severe erosion has produced a nearly vertical wall on the easterly bank. This situation continues for approximately 600 ft. before the channel again widens into a broad floodplain area. However, just upstream of the area, the westerly bank is 15 to 20 ft. high and nearly vertical due to undercutting followed by sloughing. Evidence of this severe erosion of the bank is typified by a steel caisson which is now freestanding at least 10 ft. from the westerly bank. The caisson was originally placed vertically through the channel bank and was used as a well point for the Cuchares Ranch irrigation system.

From the confluence with Corral Tributary upstream to Drennan Road, the channel width is about 100 ft., the bed slope nearly .01 ft./ft., and the 100-year flow in this section was determined to be about 6,800 cfs. This channel is in a relatively stable state except for some sharp curves and resulting headcutting just prior to the Corral confluence.

Reach #4 - Drennan Road to Highway 94 (STA 616+25 to STA 863+67)

Jimmy Camp Creek upstream of Drennan Road is characterized by a channel of very irregular widths due to the erosive soils which are typical of the basin. The bed slope averages .011 ft./ft. and the 100-year flow at Drennan Road is 6,800 cfs.The corresponding velocities average 13 fps and are well above any permissible velocity values for erosive soils.

The stream alignment through this reach is relatively straight, although a few minor meanders do occur. Also, evidence of old oxbows can be found along the stream. One existing oxbow is just east of Marsheffel Road, approximately 3,500 feet north of Drennan Road. At this point, a man-made embankment has been placed in the oxbow to form the westerly bank of Jimmy Camp Creek. Continuing upstream, numerous high banks are encountered; however, these vertical banks are generally in the 10 to 15 ft. high range and only extend for a short distance.

Reach #5 - Highway 94 to the Jimmy Camp Creek Basin Boundary (STA 863+67 to STA 1358+00)

Moving upstream from State Highway 94, Jimmy Camp Creek begins to gradually taper down in width to approximately 50 ft. toward the upper end of the reach. The slope increases to about .014 ft./ft. and the 100-year flow at State Highway 94 is 6,800 cfs. The storm flow in Jimmy Camp Creek develops very rapidly generating velocities of up to 15 fps in the more narrow channel sections. Bank erosion and failure are typical as the result of these extreme conditions. As the channel approaches the steeper portions of this reach it becomes more dramatic; sharp curves and steep channel banks become more prevalent. This more dramatic section continues until the channel approaches the upper section of the reach where a more gentle plateau exists. Also, the flow to the channel decreases in this area as the channel nears the basin boundary.

Corral Tributary

Reach #6 - From the Confluence with Jimmy Camp Creek Upstream to State Highway 94 (STA 0+00 to STA 314+65)

Beginning at the confluence with Jimmy Camp Creek and moving upstream toward Drennan Road, the channel gradually narrows in width from approximately 450 feet to 150 feet. The banks in this area also change from moderate slopes to nearly vertical walls as the stream approaches the Drennan Road bridge. The bed slope averages .008ft./ft. and for the 100-year event the discharge is 9,600 cfs.

Immediately north of Drennan Road and perpendicular to Corral Tributary, there exists a deep and narrow "finger" (erosion channel) which extends 1,000 ft. alongside Drennan Road to the east. It is evident, from this side erosion channel, that a portion of the flows from the Franceville Tributary have overtopped several small dikes and have been diverted to Corral Tributary instead of crossing underneath Drennan Road.

North of Drennan Road and upstream toward State Highway 94, Corral Tributary changes into a comparatively narrow channel (30'-75' wide) characterized by steep and nearly vertical side slopes. The channel alignment is comprised of a series of short radius curves which lend themselves to severe erosion of the outer banks. Closer to State Highway 94, the slope gradually increases to .01 ft./ft. and the alignment is straighter but still has isolated areas of severe curvature and bank erosion. Also in this reach, flows from Strip Mine Tributary enter Corral Tributary from a northeasterly direction, adding to the total flow in Corral Tributary.

Reach #7 - State Highway 94 Upstream to the Basin Boundary (STA 314+65 to STA 476+30)

North of State Highway 94 upstream toward the basin boundary, a severe meandering alignment is typical. The existing 100-year flow at State Highway 94 is 4,900 cfs and the bed slope in the upper reach increases to .019 ft./ft. As a result of the channel geometry, the flow velocity exceeds 14 fps. As the channel approaches the Corral Bluffs, the slope gradient increases even more resulting in nearly vertical drops from the plateau area above the bluffs.

Strip Mine Tributary

Reach #8 - From the Confluence with Corral Tributary Upstream to the Basin Boundary (STA 0+00 to STA 379+00)

Strip Mine Tributary enters Corral Tributary at a point approximately 1.0 mile north of Drennan Road from a northeasterly direction. Extending upstream of the confluence for about 4,000 ft., Strip Mine Tributary is characterized by sharp curves, narrow channel widths, and steep banks.Thence moving toward State Highway 94, the stream alignment changes to a more gentle horizontal curvature with broader channel widths averaging 150 ft. and bed slopes averaging .014 ft./ft. The maximum flow for a 100-year event is 4,300 cfs and occurs at a section downstream of the Franceville Mine strip pits.

There are a couple of existing overflow channels which extend out from the Strip Mine Tributary in a southerly direction. One is located approximately 2 miles north of Drennan Road and joins with Corral Tributary about 0.5 miles north of Drennan Road. The second one occurs about 2,500 ft. upstream from the first. The overflow channels account for the reduced main channel flow of 3,800 cfs at the Corral Tributary confluence.

Franceville Tributary

Reach #9 - From the Confluence with Jimmy Camp Creek Upstream to the Basin Boundary (STA 0+00 to STA 326+00)

The historical juncture of Franceville Tributary with Jimmy Camp Creek occurs a short distance downstream from the Corral Tributary confluence with Jimmy Camp Creek. It has been found from field observations that a large portion of the flows have been diverted over to the Corral Tributary as a result of the construction of Drennan Road. (See Corral Tributary Reach #6 discussion). From the TR-20 program output, it was determined that the contribution from Franceville drainage into Jimmy Camp Creek is approximately 2,500 cfs.

Upstream of the historical confluence, the tributary exhibits very poor definition in terms of cross-sectional shape and resembles a natural swale rather than a channel. Eventually the natural swale disappears and no visible evidence of a flow path can be found in the field.

Extending upstream from Drennan Road for about 4,000 ft., the Franceville Tributary is still poorly defined. Beginning at this point and extending for approximately 6,000 ft., a well-defined channel exists. From this point, the channel again becomes very poorly defined until it approaches the Franceville Mine Road.

Upstream toward Franceville Mine Road and then beyond, the channel slope increases from .015 ft./ft. to .032 ft./ft. The 100-year discharge at Franceville Mine Road is 400 cfs. In this area, the Franceville Tributary splits into a large number of hillside ditches which continue in an easterly direction toward the basin boundary.

East Tributary

Reach #10 - From the Confluence with Jimmy Camp Creek Upstream to the Basin Boundary (STA 0+00 to STA 541+00)

East Tributary flows into Jimmy Camp Creek at a point approximately 1,300 feet downstream from Peaceful Valley Road. At the confluence, the 100-year flow from the East Tributary drainage area was determined to be 4,400 cfs.

The stream crossing structure at Peaceful Valley Road consists of a 48" corrugated metal pipe which can only handle approximately 90 cfs.When the capacity is exceeded, stormwater overtops Peaceful Valley Road, further contributing to the flooding already caused by the Jimmy Camp Creek crossing 700 ft. to the west.

Approximately 400 ft. upstream of Peaceful Valley Road is an existing pond which has approximately 9 acres of surface area. During annual storms, the pond may act as a natural detention facility until the pond's capacity is exceeded and the flow proceeds over the emergency spillway.

Upstream, East Tributary is characterized by narrow channels measuring 25 to 50 ft. in width with minimal bank height until the channel cross section tapers into a swale approximately 1,500 ft. upstream from Peaceful Valley Road. Further upstream, about 0.3 mile south of Drennan Road, a defined channel begins. This narrow channel section continues upstream past Meridian Road before it widens into a channel 50 to 75 ft. in width. Continuing upstream, the channel goes through a series of curves before reaching the Franceville Mine Road. From this point on, the channel again begins to narrow as it approaches the steeper areas near the basin boundary. In general, most of East Tributary was found to have minimal flow capacity and for the 100-year event, flooding and uncontrolled overland flow would be typical.

The Marksheffel Tributary

The Marksheffel Tributary is a secondary tributary which flows into Jimmy Camp Creek approximately 4,000 ft. north of Fontaine Boulevard This tributary drains the western part of Colorado Centre in addition to a portion of the Colorado Springs Airport.

The existing channel is presently a natural meandering stream from its juncture with Jimmy Camp Creek to its crossing of Bradley Road. However, because of the development plans proposed for the Colorado Centre area, channel improvement plans have already been approved for this section of the reach. Included in these plans is the expansion of an existing pond into a regional detention facility.

The existing channel from Bradley Road north to Drennan Road is either already improved or scheduled for improvement within the next year. The design capacity of the existing improved channel has been estimated to

handle only developed flows from the Colorado Centre property, making it necessary to provide some type of detention upstream of Drennan Road in the future.

North of Drennan Road the channel disappears with flows spreading out over a wide, flat portion of the range land. The natural slope in this area averages about .016 ft./ft. As the stream approaches the proposed airport expansion area, the natural slope increases to approximately .045 ft./ft. Evidence of erosion exists along this entire reach. Once beyond the steep areas, the ground slope reduces to approximately .006 ft/.ft. This plateau area also contains natural detention and retention areas. Since natural detention areas presently exist in this area, it is recommended that they be incorporated into any future improvement schemes for the area.

Fontaine Tributary

The Fontaine Tributary is a secondary tributary which joins with Jimmy Camp Creek just upstream of the Link Road crossing. The existing channel presently flows along the east side of Marksheffel Road for approximately 2,500 ft. until it crosses the roadway through a 40"x26" corrugated steel pipe. The amount of flow from the Fontaine Tributary which actually uses this existing channel is minimal. From aerial photos and field reconnaissance it was determined that most of the estimated 3,100 cfs presently flows along the west side of Marksheffel Road through the open fields until it reaches the intersection of Link Road and C&S Road. Flooding has been recorded in this particular area after every moderate storm event.

Proceeding upstream from Marksheffel Road for about 3,500 ft., the tributary follows along a channel which is approximately 40 ft. in

width and has a bed slope of approximately .005 ft./ft. It does not have defined banks but instead spreads out to form a very wide flood area. Upstream from this point, a more defined channel exists. The channel narrows from 40 ft. wide to 30 ft. wide near Fontaine Boulevard where it divides into two channels just south of the roadway. North of Fontaine Boulevard a broad, low area exists before the channel extends to the end of the subbasin.

EROSION AND SEDIMENTATION

On-site evaluation of each channel's bed and bank materials indicated that the Jimmy Camp Creek Basin is typified by sandy, loamy soils. Soils of this type are non-cohesive and very erodible. The degree of erosion is mainly dependent upon stream velocity, soil gradation (size distribution), and the physical characteristics of the particles themselves. Except for some lower reaches, most of the channels in the basin support only sparse vegetation, further leading to erosion susceptibility. Due to the nature of the soil conditions, stabilization of the channel banks will be necessary to avoid excessive erosion and resulting lateral migration of the existing channel alignment. Lateral mitigation and erosion of the channels can occur even under the historical flow conditions.

In its current state, evidence of long term channel aggradation is present in the lower reaches of the basin. However, as housing and commercial development, landscaping, paving, etc., occurs, the supply of sediment into the channel reaches will decrease. This reduction of incoming sediment will cause the annual stream flows to pick up a greater percentage of bed material than before, promoting degradation. After development is complete, the stream will attempt to reach an equilibrium slope and it was qualitatively determined that the general result

would be a reduction of the existing channel bed slopes. The exact equilibrium slope that the channel will reach is, of course, dependent upon the specific soil size which comprises the length of the stream bed.

It should also be mentioned that urbanization normally increases the quantity of storm runoff through reduction in natural infiltration. However, the effects of increased runoff on sedimentation should be minimized through the proposed use of on-stream detention facilities within the basin. Without detention, the higher, developed flows would accelerate the degradation process.

ANALYSIS OF EXISTING STRUCTURES

Existing structures which have a proposed 100-year design flow greater than 500 cfs have been examined. These structures have been divided into two groups: the major structures are those located on the major channels tributary to Jimmy Camp Creek; the minor structures are those which drain the subtributaries of the main branches of Jimmy Camp Creek.

Examination of the existing major structures revealed that most were adequately sized to handle the 100-year design flow without being damaged. The criteria used to determine the adequacy of a bridge was that the design flow could pass through the bridge with a minimum of 2 ft. below the low chord elevation. In addition, the bridge width was required to be within 75% of the width of the approach channel. The existing structural condition of the bridges was not considered as part of this report. Table No. 5, Summary of Existing Major Structures, summarizes the hydraulic adequacy or inadequacy of the various major structures.

Evaluation of the minor structures revealed that most of them are inadequate to accommodate the design flows and will have to be replaced. Table No. 6, Inventory of Minor Structures, summarizes the necessary upgrades of minor structures.

TABLE NO. 5

SUMMARY OF EXISTING MAJOR STRUCTURES IN THE JIMMY CAMP CREEK DRAINAGE BASIN

STRUCTURE LOCATION	STRUCTURE TYPE	SIZE	BOTTOM OF STRUCTURE ELEVATION	100-YEAR SURFACE ELEVATION DEVELOPED	COMMENTS
Old Pueblo Rd. (Jimmy Camp Creek)	Prestressed Concrete and steel	180	5,507.5	5,493.2	Adequate
RR south of Iowa Ave. (Jimmy Camp Creek)	Steel truss	212	5,532.0	5,526.9	Adequate
Iowa Ave. (Jimmy Camp Creek)	Prestressed concreted	330	5,542.7	5,537.0	Adequate
Link Rd. (Jimmy Camp Creek)	Prestressed concrete	180	5,592.7	5,589.1	Adequate
Peaceful Valley Rd. (Jimmy Camp Creek)	Pipe arch culverts	4-42"x29"	5,665.3	5,677.3	Inadequate
Drennan Rd. (Jimmy Camp Creek)	Prestressed concrete and steel	58	5,870.6	5,869.4	Inadequate
Highway 94 (Jimmy Camp Creek)	Concrete	280	6,157.7	6,151.4	Adequate
Drennan Rd. (East Tributary)	Prestressed Concrete I-Girders	60	5,885.6	5,882.2	Adequate
Drennan Rd. (Corral Tributary)	Prestressed Concrete I-Girders	77	5,885.7	5,867.7	Adequate
Highway 94 (Corral Tributary)	Concrete Box Culvert	36'x10'	6,105.0	6,116.9	Adequate
Highway 94 (Strip Mine Tributary)	Concrete Box Culvert	24'x10'	6,202.9	6,206.8	Adequate
Franceville Mine (Strip Mine Tributary)	Prestressed Concrete	36'	6,218.75	6,216.5	Adequate