986

FILE PETE. FIELD

George Jury - City Engineer

HYDROLOGIC ENGINEERING STUDY

OF THE

PETERSON FIELD DRAINAGE BASIN

FOR THE

DEPARTMENT OF PUBLIC WORKS

COLORADO SPRINGS, COLORADO

november 1965

KARCICH & WEBER INC.

Engineers · Planners · Consultants

Colorado Springs, Colorado

Karcich & Weber, Inc.

ENGINEERS — PLANNERS — CONSULTANTS

P. O. Box 4291 2630 Airport Road
Colorado Springs, Colorado 80909

January 22, 1971

Mr. Dewitt Miller
Director of Public Works
Box 1575
Colorado Springs, Colorado

Dear Sir:

Transmitted herewith is the Addendum to the Engineering Study of the Peterson Field Drainage Basin.

This revision includes a study of runoff generated and channel improvements required for the entire basin.

It is recommended that further study be initiated to incorporate proposed improvement plans of Chandelle development, Pikes Peak Park East and drainage modifications made in Peterson Field.

We will be available to answer any questions you may have on this report.

Very truly yours,
KARCICH & WEBER, INC.

William P. Weber

DAM:jak

Addendum
Hydrologic Engineering Study
Peterson Field Drainage Study

PURPOSE:

This revision updates data related to overall drainage requirements of the Peterson Field Drainage Basin. Revised flow rates have been determined and required drainage structures resized and indicated in the same general locations as shown in the previous drainage report. The sizes of these drainage structures are based on flows generated by a one hour, two inch, fifty year frequency storm (same as original report). The synthetic hydrograph method as developed by the Soil Conservation Service and modified by the Bureau of Reclamation was used to determine revised flows in this study.

Both quantity flow rates and the sizes of drainage structures have been revised upwards due to consideration of a fully developed drainage basin and completely lined main channels and green belt sections. When considering concrete lined channel sections the velocity of flow is increased thus reducing the time of concentration and hence increasing flow rates. A summary of flow rates at selected points within the basin are given to provide a comparison of the effects of different types of channel sections: lined, unlined and lined sections with energy dissipators to keep flows at a non-scour velocity of 7 fps.

The size of the main channels and green belt sections have been determined by considering flows through concrete lined sections. The size of drainage facilities in subbasin areas (ouside main channel locations) will be highly dependent on final subdivision layout. It is therefore felt that design Q's based on a non-scour velocity of 7 fps throughout the subbasin area will yield reasonable flow rates for determining minor drainage facilities in these areas. The intent of this revision is to provide an overall determination of drainage generated in the area and a general method of routing the flow.

The following have been included to summarize and update findings of the Peterson Field Drainage Study.

1. Runoff Discharge-Summary of Subbasin Areas and Peak Q's.
2. Summary of Areas & Drainage Facilities Required.
3. Summary of Areas & Culvert Sizes Required at Channel Crossings.
4. Typical Channel Cross Sections.
5. Map of Drainage Basin with Subbasins and Provisions for Drainage.
6. Comparison of Channel Design Flow Rates.

RUNOFF DISCHARGE

SUMMARY OF SUBBASIN AREAS & PEAK Q'S

Area Designation Σ -Total Drainage Above Junction	Area$_2$ Miles	Peak Q 50 Year Storm CFS at Outlet of Basin Subdivided Conditions
8A1a1b1	0.301	244
8A1a1b2	0.073	78*
Σ 8A1a1b2	0.374	303
Σ8A1a1b	0.437	348
8A1a1a	0.240	228*
8A1a1c	0.153	141*
Σ8A1a1c	0.830	650
Σ8A1a1	0.955	744
8A1a2	0.100	98*
Σ8A1a2	1.055	810
Σ8A1a	1.534	1,113
8A1b	0.230	217*
8A1c	1.482	1,202
Σ8A1c	3.271	2,420
8A1d	0.228	271*
Σ8A1d	3.499	2,740
Σ8A1	4.329	3,050
8A2	0.475	288*
8A3	0.277	176*
8A4a	0.293	195*
8A4	0.154	97*
8A4 (includes 8A4a)	0.437	256*
Σ8A4	5.518	3,670
Σ8A	6.283	3,900
8B1	0.347	269
8B2	0.430	309
8B	1.017	731
8C	0.991	648
Σ8 (8C excluded) upper½	7.460	4,550
Σ8 (8C included) upper½	8.452	5,160
Σ8 (8C included)	8.613	5,170
7	0.165	167*
6	0.108	111*
Σ6	8.721	5,150
5	0.081	85*
4	0.060	54*
Σ4	8.781	5,130
3	0.048	43*
3 (includes 2)	0.049	45*
2	0.001	10*
1	0.139	6*

*Q determined by assuming V=7 fps throughout

SUMMARY

Drainage Channels - Subdivided Condition

Area Designation	Area, $Miles^2$	Qp CFS	S	Conc. Lined Chnl. L Feet	Conc. Lined Chnl. Size WxD	RCP L Feet	RCP Size Dia-in.	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
8A1a1b1	0.301	171	0.0232	6900	10x2			
		20	0.03			1000	24"	
		20	0.022			1800	24"	
*8A1a1b2	0.073	78	0.0266			1700	36"	
8A1a1b	0.437	303	0.01	1800	10x2.25			
*8A1a1a	0.240	228	0.0217			1600	54"	
		153				1600	42"	
		76				1600	36"	
*8A1a1c	0.153	141	0.020	4400	10x1.5			
8A1a1	0.955	650	0.0118	1700	10x3.5			
*8A1a2	0.100	98	0.0225			1350	36"	
		49				1350	30"	
8A1a	1.534	810	0.0075	4000	15x3.75			
		30	0.031			1300	24"	
		30	0.02			2000	30"	
		30	0.027			1500	30"	
8A1b	0.230	217	0.0204	4800	10x2			
8A1c	1.482	1202	0.014					

* Q Determined by Assuming Velocity of 7 fps throughout Subbasin

SUMMARY

Drainage Channels - Subdivided Condition

Area Designation	Area Miles^2	Qp CFS	S	Canal L Feet	Canal Size WxD	RCP L Feet	RCP Size Dia-in.	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
8A1c	0.093	119	0.025			1800	24"	
	0.344	310	0.0129			3100	42"	
						2000	24"	
						3000	36"	
	0.675	596	0.015			2000	60"	
	1.015	892	0.0175	1500	10x3.0			
						3500	36"	
	1.482	1202	0.010	1700	10x4.25			
				3300	10x5.00			
8A1d	0.228	208	0.0128					Assumed Natural Drainage as Existing
8A1	4.329	3050	0.0102	10,300	35x4.25			
8A2	0.475	238	0.0125	12,400	10x2			Ditch Sec. Unlined
8A3	0.277	131	0.0137	9100	10x2			"
8A4a	0.283	159	0.0115	9000	10x2			"
8A4	0.437	188	0.0127	9500	10x2			"
8A	6.283	3670	0.0125	8800	50x4			
8B1	0.347	269	0.0141	6400	10x2 or	2600	30"	
						2000	42"	
						1800	54"	
8B2	0.430	309	0.0151	6700	10x2 or	3200	42"	
						3500	54"	
8B	1.017	731	0.0143	4100	10x3.25			

*Q Determined by Assuming Velocity of 7 fps throughout Subbasin.

SUMMARY

Drainage Channels - Subdivided Condition

Area Designation	Area Miles^2	Qp CFS	S	Canal L Feet	Canal Size WxD	RCP L Feet	RCP Size Dia. in.	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
8C	0.991	648	0.0151					
8C	0.231	179	0.0148			3000	24"	
	0.336	253	0.0188	1600	10x1x5 or	1600	48"	
	0.408	301	0.0156	1600	10x1.75			
	0.700	489	0.0162	4000	10x2.0			
	0.991	648	0.0134	2800	10x2.75			
				2800	10x3.00			
8 (upper $\frac{1}{2}$ Area includes 8B)	7.46	4550	0.0145	2750	50x4.25			
8 (lower $\frac{1}{2}$ Area includes 8B & 8C)	8.613	5160	0.0145	2750	50x4.50			
*7	0.165	167	0.00295	1700	10x2			Existing Canal
*6	0.108	111	0.010	3000	10x1x5 or	3000	42"	
6 Main Chnl	8.721	5150	0.0109	2100	50x4.5			
*5	0.081	85	0.0187			1600	36"	
*4	0.060	54	0.0063	1600	10x2 or	1600	36"	
4 Main Chnl	8.781	5150	0.010	1000	50x4.5			
*3	0.048	45	0.014	2000	10x2 or	2000	30"	
*2	0.0065	10	0.01	500	10x2 or	500	18"	
*1	0.139	6	0.03	1000				Overland Flow to River

* Q Determined by Assuming Velocity of 7 fps throughout Subbasin.

SUMMARY

Culverts - Subdivided Condition

Revised January 22, 1971

Area Designation	Qp CFS	S	Approx. Length Feet	Existing Culverts	Alternates for Additional Culverts CMP Dia.	RCP Dia.	Box Culverts WxH	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
8A1a1b1	172	0.0232	300			1-42"		Under existing Rd.
8A1a1b1	244	0.0232	60			1-54"		Under anticipated Rd.
8A1a1c	70	0.020	60			1-36"		"
8A1a1a, 8A1a1c & 8A1a1b	650	0.010	100			1-66"	10x4.0	Under existing Rd.
8A1b	120	0.0204	60			1-42"		"
8A1a	810	0.0075	60				15x4.0	Under anticipated Rd.
8A1a	1100	0.02	60				15x4.25	Under existing Rd.
8A1d	120	0.015	330	2-30" RCP				Under runway
8A1c	800	0.0175	100				10x4.0	Existing Road
	900	0.010	100				10x5.0	"
	1200	0.010	100				10x6.0	"
	1200	0.010	100				10x6.0	"
	1200	0.010	100				10x6.0	"
8A1	2420	0.0102	60				4-9x4.3	Under existing Rd.
	2750	0.0102	140				4-9x4.5	Under Runway
	3000	0.0102	950	3-48" RCP			4-10x4.75	"
8A4	35	0.0127	200	1-30" RCP				"
	180		200	1-42" RCP		1-48"		"
	188		255	1-48" RCP				"

SUMMARY

Culverts - Subdivided Condition

Revised January 22, 1971

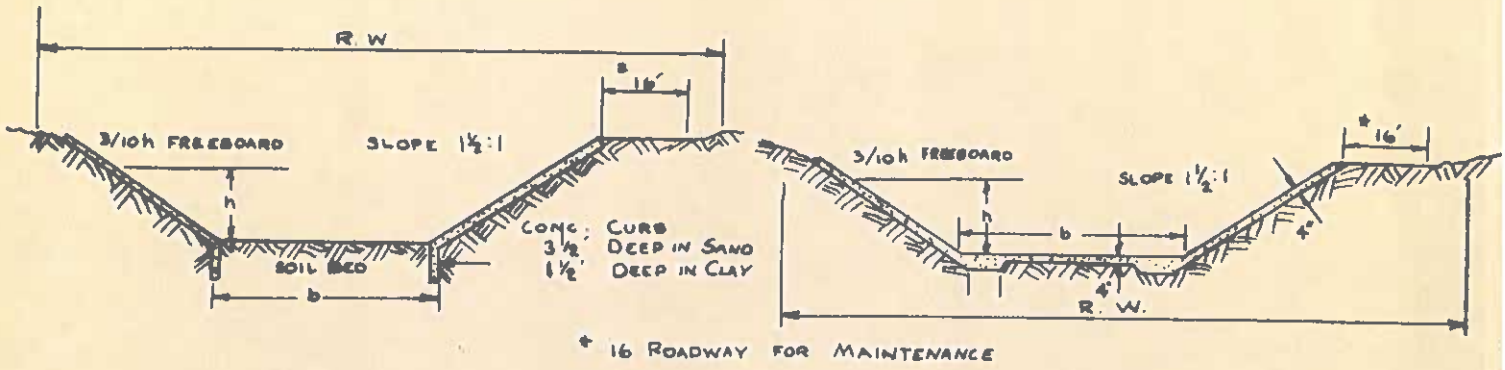
Area Designation	Qp CFS	S	Approx. Length Feet	Existing Culverts	Alternates for Additional Culverts: CMP Dia.	RCP Dia.	Box Culverts WxH	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
8A4a	159	0.0115	224	1-24" RCP		1-42"		Under runway
								"
8A3	131	0.00165	800	1-42" RCP				"
8A2	238	0.01	1150	1-60" RCP				"
			570	1-30" CMP				
8A	3700	0.0125	60				5-10x4.0	Under existing Rd.
8A	3700	0.0125	60				5-10x4.0	"
	3800	0.0125	60				5-10x4.0	"
	3900	0.0125	130				5-10x4.5	"
	3900	0.0125	130	1-72" CMP			5-10x4.5	Under highway
8B2	180	0.0151	60			1-48" (Req'd if open Chnl)		Under Anticipated Rd.
	180	0.0151	60			1-48" "		"
8B1	140	0.0141	60			1-42" "		"
8B1	140	0.0141	60			1-42" "		"
8B	680	0.0143	90			1-84"	1-10x4.0	Under Anticipated Road
	720	0.0143	150	1-18" CMP			1-10x4.0	Existing Road
8C	301	0.0156	150			1-60"		Under Anticipated Road
8C	489	0.0162	90			1-72"	1-10x3.0	"
8C	648	0.0123	150				1-10x4.5	"

SUMMARY

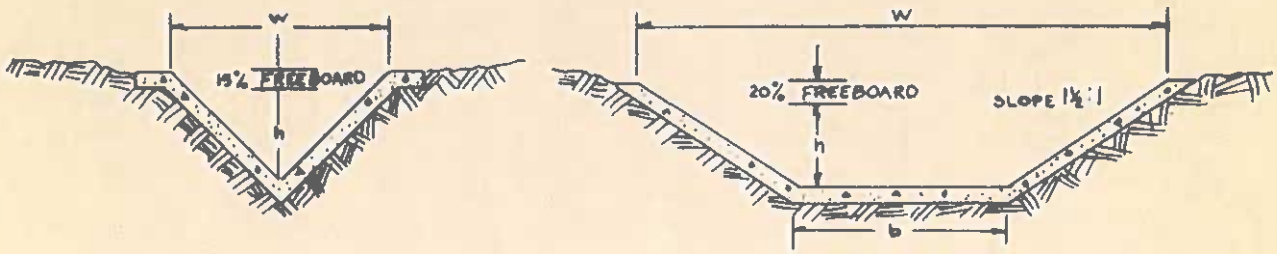
Culverts - Subdivided Condition

Revised January 22, 1971

Area Designation	Qp CFS	S	Approx. Length Feet	Existing Culverts	Alternates for Additional Culverts CMP Dia.	RCP Dia.	Box Culverts WxH	Remarks
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
8C	648	0.0134	150				1-10x4.5	Under highway
8	4530	0.0145	90				5-10x4.5	Under Colony Hills Circle
8	5160	0.0145	130				5-10x5.0	Under Acad. Blvd.
8	5160	0.0145	40				5-10x5.0	Under esisting Rd.
6	111	0.010	24	1-30" CMP		1-42"		"
	5150	0.0109	40				5-10x5.0	Drain under R.R. Drain toward Sand Creek
4	54	0.0167	36	1-54" CMP				Existing Road
4	5150	0.0063	80				5-10x5.0	Drain under RR & Hwy to Sand Ck.
		0.025	40	1-72" CMP				"

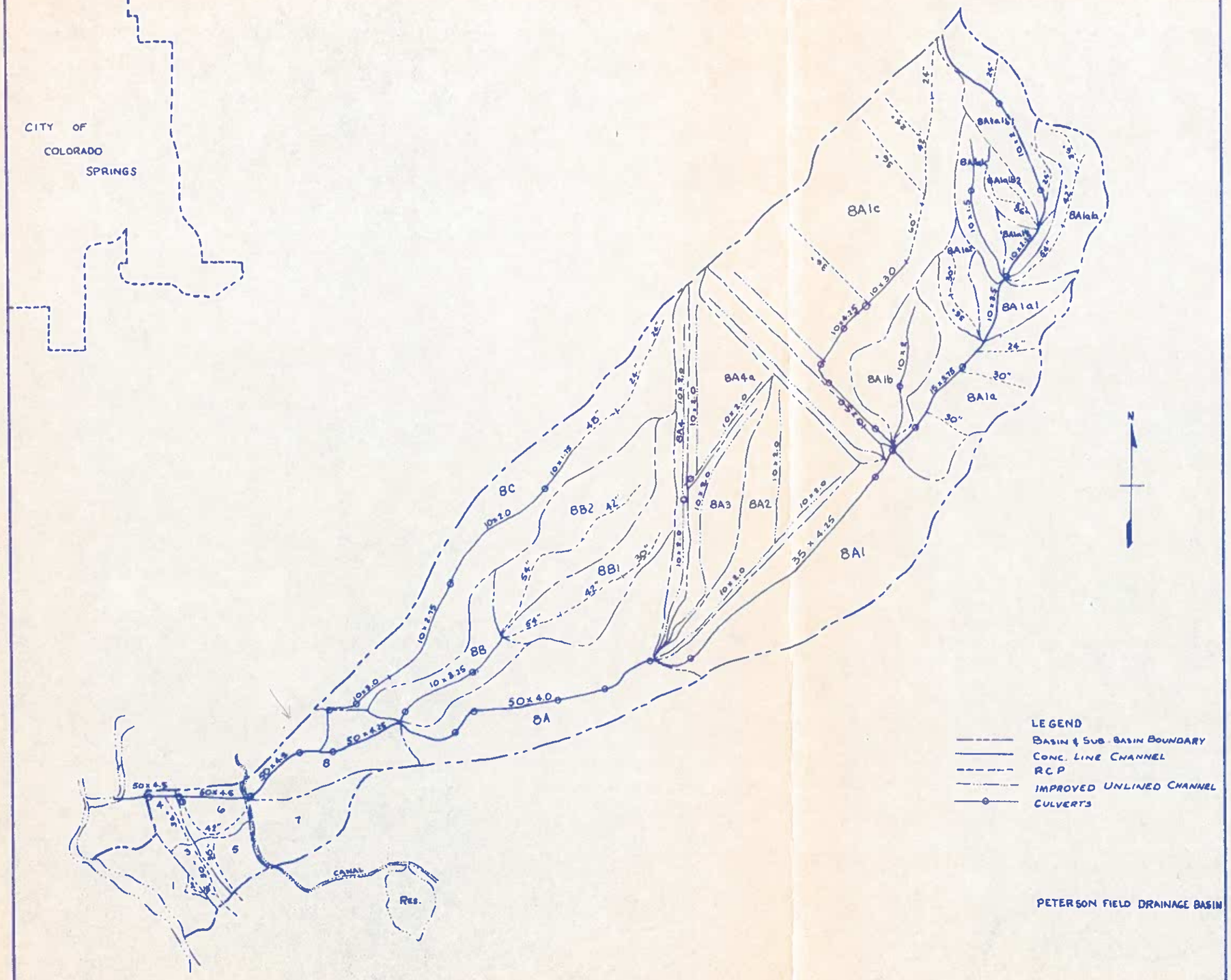


TYPICAL GREENBELT AND MAIN CHANNEL SECTION



TYPICAL RESIDENTIAL DITCH SECTION

CITY OF COLORADO SPRINGS



PETERSON FIELD DRAINAGE BASIN

Form D.O.H. 18

SU 0170(9) PE
US 0083(11) Const.
Hancock to Bradley Rd.

DEPARTMENT OF HIGHWAYS

DEPARTMENT OF HIGHWAYS
STATE OF COLORADO
4201 E. ARKANSAS AVE.
DENVER, COLORADO 80222

CHAS. E. SHUMATE
CHIEF ENGINEER

STATE OF COLORADO

September 20, 1971

Mr. George Jury
City Engineer
Post Office Box 1575
Colorado Springs, Colorado 80901

Dear Mr. Jury:

Thank you for the use of the Peterson Field Drainage Report by Karcich & Weber of Nov. 1965 and the revised report of Jan. 1971. The Q_{50} of 5160 cfs at Station 153+ on Academy Boulevard (S.H. 83) as predicted by Karcich & Weber, January 22, 1971, is close to our calculations using the Denver Regional Council of Governments' Unit Hydrograph Procedure.

The 50' bottom width concrete lined trapezoidal channel apparently being proposed will have supercritical flow (velocity of 27 fps) entering our structure. We are concerned about the flow disturbance as the water enters our structure.

To match the 50' bottom width channel, we are beginning the design on a 50' wide x 5' high multi-cell concrete box culvert at Station 153+. Any revision of your plans should be sent to us immediately.

Enclosed is the report of Nov. 1965 as you requested.

Very truly yours,

L. C. BOWER
Chief Engineer

By Tom M. Cox
Tom M. Cox
Staff Design Engineer

GCJ/acb
Enclosure
cc: H. W. Harris
John L. Pim
D. L. Vernon
R. S. Musgrave

P. S. Your stationery is attractive.

Karcich & Weber, Inc.

ENGINEERS – PLANNERS – CONSULTANTS

2630 AIRPORT ROAD
COLORADO SPRINGS, COLORADO

Director of Public Works
City of Colorado Springs
Colorado Springs, Colorado

Dear Sir:

Enclosed herewith is the Engineering Study of the Peterson Field Drainage Basin, authorized by the City Council of the City of Colorado Springs.

The report includes a study of the rainfall runoff characteristics, and channel improvements for the entire basin. It also includes a study of storm sewer requirements, developed basin hydrographs, and recommendations for required streets and grading in the basin. If desired, the study may be used as a "Master Drainage Plan" for the basin as it is developed in the future.

We have enjoyed preparing this study for the City and are available to answer any questions you may have in regards to it.

Yours truly,

KARCICH & WEBER, INC.

By : William P. Weber
William P. Weber
President

Fred Stepanich

HYDROLOGIC ENGINEERING STUDY

OF THE

PETERSON FIELD DRAINAGE BASIN

FOR THE

DEPARTMENT OF PUBLIC WORKS

COLORADO SPRINGS, COLORADO

CITY COUNCIL MEMBERS

Harry W. Hoth	Mayor
Harold Hawks	Vice-Mayor
W. H. Becker	Councilman
James K. Johnson	Councilman
Mrs. Betty F. Krouse	Councilwoman
Andrew Marshall Jr.	Councilman
Eugene Mc Cleary	Councilman
William S. Roe	Councilman
Carl H. Decker	Councilman

CITY ENGINEERING & PLANNING

John M. Biery	City Manager
Jerry Y. Weiss	City Engineer
Maury R. Pearce	Director of Public Works
Paul Griffith	Planning Engineer

ENGINEERING

Karcich & Weber, Inc. 2630 Airport Road Colorado Springs, Colorado	Consulting Engineers
Fred C. Stepanich	Consulting Hydrologic Engineer

NOVEMBER, 1965

INDEX

PAGE

I. DISCUSSION & RECOMMENDATIONS

A. SCOPE & PURPOSE:

It is the intent of this report to furnish the basis for an overall plan for placing storm sewers and drainage appurtenances in the Peterson Field Drainage Basin, as subdivisions are developed. It should be a part of the overall plan for storm water control in the Metropolitan Area around Colorado Springs.

The study does not establish the exact design of a storm sewer or drainage channel in any definite area, but, establishes the general location of required storm drainage structures and their required sizes. The report does establish those natural channels which must remain as water carrying channels. Since it is impossible to foresee development of subdivisions, storm sewers are placed in some locations to indicate their need and also for determining quantity estimates.

Existing channels should be reserved for drainage purposes, and encroachments on them must not be allowed. Natural channels that are blocked or diverted, will cause excessive flooding which in turn, necessitates the installation of large and expensive storm sewers and drainage works. If the natural channels are saved, at least part of these installations can be avoided.

Studies of undeveloped basins provide a basis for logical and relatively inexpensive overall storm drainage design. Thus adequate storm drainage structures may be constructed as subdivisions are developed, thereby minimizing costs and avoiding potential storm damage.

B. BASIN DESCRIPTION:

The Peterson Field Basin is approximately 9.36 square miles in area and lies Southeast of the City of Colorado Springs. It lies between Sand Creek Basin on the West and Jimmy Camp Creek Basin on the East. It is between Highway No. 24, on the North and Fountain Creek on the South at a point one mile North of

Security, Colorado.

The basin is drained by one undefined major channel which has many minor contributing branches. Except after a storm, the entire stream is dry.

Observation and discussions with people that are acquainted with the area indicate high flows in past years, and especially in the current year. Evidence of these flows can be seen in eroded banks and sand deposits. Relatively little soil conservation work has been done in this basin, and consequently, high flows of water have been frequent in recent years.

The basin has a rolling topography with some relatively flat areas around Peterson Field. The basin is pear-shaped, being one-half mile wide near the outfall at Fountain Creek and two miles wide at the Northern end. Because of the steep slopes water movement is fast. Existing grass helps to control erosion.

Most of the soil in the basin is deep brown with sandy subsoils of the Otis & Springer series, as indicated on the soil classification map in Section III. Clay lenses exist in areas which retard infiltration and increase the amount of runoff.

C. RAINFALL PATTERNS:

Average annual rainfall in the Peterson Field Basin is low, being about 14.49 " per year. The major portions of this annual rainfall are in May, June, July, and August as indicated by the graph in Section III. Both mountain type storms and plains type storms fall on this basin. The amount of actual moisture from snowfall is usually not high enough to lead to excessive runoff.

Storms of record in the basin fall into two categories.

1. Short, intense storms lasting up to two hours, and usually local in nature, and,
2. Long term storms lasting six hours or more, and being spread over a large area.

The long term storms last a relatively long period of time, allow high infiltration, produce a great volume of runoff, but have a relatively low flood peak.

The short duration storm produces less runoff water, but being intense, has a very high flood peak.

It was found through study that the 1 hour, 2 inch, 50 year frequency storm with a saturated soil condition produced the highest reasonable design peak flow. This storm was used in all computations. The hydrographs in the latter sections of this report can be used to change the design storm if desired, but for the purposes of this report, all data is given for this design storm.

D. RUNOFF PATTERNS:

In the absence of measured data, a synthetic hydrograph must be adapted to the soil conditions and topography of the Peterson Field Basin. Synthetic hydrographs were produced with the method developed by the Soil Conservation Service and modified by the Bureau of Reclamation.

The Peterson Field Basin was subdivided into 9 drainage sub-basins as shown in the drawings. Area No. 8 drainage sub-basin was divided into 22 minor basins. An outfall point was assigned to each sub and minor basin and a synthetic hydrograph constructed for these points. The hydrographs of each minor basin were combined to form hydrographs for the outfall point of each of the sub-basins.

All the hydrographs developed in this report are based on the assumption that the entire area has been developed into residential tracts except for the Peterson Field Runway area. The area presently is rolling hilly grasslands. Runoff peaks for this condition are much lower than for a fully developed condition.The study indicates that peak flows range from 0 percent higher in the Airport to 130 per cent higher for the fully subdivided condition than for the area in its present condition.

Since there is no sure way to predict growth of the City of Colorado Springs, it was assumed that the entire basin would be developed. This provides criteria for design of adequate drainage structures that will be large enough to handle the water produced if the entire basin becomes fully developed.

These hydrographs are all synthetic and some adjustments may be made when more accurate development conditions are known. Although the hydrographs are synthetic, the method is widely used and results have been favorable.

E. MAIN DRAINAGE CHANNELS:

The most economical method of removing flood runoff from a developed area is

to improve and use existing ditches or drainage channels. Initial cost is lower, the ditches are easier to maintain and clean that are pipes.

In developed areas, ditches are impractical because sufficient space usually has not been provided by the development for proper sized ditches or control works. However, in this basin, development is presently negligible and sufficient right-of-way for drainage can be made available at a reasonable cost.

Previous studies commissioned by the City of Colorado Springs have recommended a "Drainage Channel" drainage system in other areas. Peterson Field Drainage Basin is adaptable to this system, and therefore a "Drainage Channel" system is recommended.

The Drainage Channel system consists of strips of land reserved for drainage flow and for certain drainage structures. This land should be maintained as a ditch, should be planted in grass where possible and rip rapped on all curves and other areas where necessary to prevent erosion.

It is recommended that the "Drainage Channel" areas be seeded with blue grama grass at the rate of about 15 lbs. to the acre. Blue grama grass is economical and is drought resistant and will remain intact in the dry seasons. Seeding should be installed with a mulching in accordance with recommendations of the U. S. Soil Conservation Service. Other grasses that are suitable, such as crested wheat grass, blue stem and buffalo grass may be used in a mixture with the blue grama grass.

New subdivisions should be planned around these Drainage Channels so that there is no interference with runoff, and so that road crossings are held to a minimum. Bridges, culverts and pedestrian crossings will be required along the stream bed, but care should be taken that stream flow is neither impeded nor diverted.

In the Peterson Field basin the Drainage Channels follow the natural stream bed for the most part and do not interfere excessively with land fit for subdividing. The channels should be wide and shallow to reduce hazards, and to reduce water velocity, which in turn decreases requirements for channel stabilization. The required channel widths and depths are shown in tables at the end of this report.

Since actual water flow along these ditches would be periodic and not continuous,

these strips could be used as parks. Wide points might be used as playgrounds or parks, if desired, making use of the land during periods of no flow. Another advantage of the system is that it breaks up the monotony of continuously developed areas and it provides a desirable appearance.

F. INDIVIDUAL RECOMMENDATIONS FOR IMPROVEMENTS:

1. General

The following refers to the drainage drawings which indicate the recommended improvements. Drainage channels were provided for the larger drainage sub-areas. The individual smaller sub-basins were studied, using the minor basin hydrographs. Storm sewers were plotted in arbitrary locations, since it is impossible to determine future street layouts, to provide means for determining quantities and costs. The size of drainage channels and storm sewers are shown in the tables in the latter part of this report. The sizes of cross drainage culverts are also shown in a table in the latter part of this report. For the culverts, several alternates of CMP, RCP and box culverts are listed in each case. The alternate to be used should be determined in the final design of structures depending on costs and actual field requirements.

2. Street Design

Since street layout of any future subdivision cannot be determined, it is impossible to design street drainage requirements. Any subdivision in the basin should provide necessary street widths or storm sewers and inlets to accommodate the peak runoffs adequately. Design requirements for surface drainage or storm sewers and inlets should take in the consideration of existing slopes and peak flows within the individual sub-basins. Final Street design within a subdivision may alter our storm sewer design in any particular sub-basin, but these changes should be relatively minor in nature.

3. Broadview Subdivision

A plat of Broadview Subdivision is shown on the basin drainage map. The main drain channel of area No. 8 passes through the center of the subdivision. The most economical way to provide drainage is to establish a drainage channel area in the existing channel. Sewer drain pipes would be very large and expensive. Therefore, it is recommended that Broadview subdivision be re-subdivided to fit the proposed drainage channel.

4. Airfield Drainage

The study shows that the airfield should provide additional drainage structures to

adequately drain the airfield area. Evidence shows that some of the runways were flooded during storms that occurred in the current year. The additional drainage facilities shall minimize and reduce the danger of hazardous flooding. The additional drainage structures are for areas 8A4a, 8A1b and 3 structures in area 8A1. These structures are recommended, however, they are not included in the cost of the project.

5. Road Cross Drainage

In several cases existing roads should be built up and provided with culverts of sizes shown in the tables.

The Hancock Expressway should be provided with additional drainage culverts for areas No. 8A and No. 8C. The study and observation indicates that the existing drains are inadequate.

Area No. 8C presently drains along the north side of the Hancock Expressway to Sand Creek. The highway borrow area is adequate to carry about one-half of the design flow, but to prevent drainage into an adjoining basin, a drain culvert should be provided under the highway to drain all of the No. 8C peak into area No. 8. The size of drains are shown in the tables.

Area directly east and west of the Airport, show several anticipated highways. The highway locations are not definite, but drainage was provided for cost estimate purposes. The drain structure system will have to be modified to fit the final highway layout.

6. Area No. 8 Drainage

The outfall point of area No. 8 at Canal No. 4 receives approximately 80 per cent of the basin flow. The recommended outfall of area No. 8 is to provide a culvert under Canal No. 4 and drain area No. 8 into area No. 6 and then to Fountain Creek.

Widening of Canal No. 4 to drain surface flow into Big Johnson Reservoir was considered. This method is more expensive and also creates a bigger bottle neck for surface drainage in the adjoining drainage basin. The culvert under Canal No. 4 will necessitate large culverts under the railroads and roads of areas No. 4 and 6, but by this means will quickly dispose of surface drainage to Fountain Creek and minimize flooding and damage.

G. SUMMARY AND CONCLUSIONS:

Because of the steep slopes, and the intensity of storms in and around Colorado

Springs, storm runoff peaks are large. The most economical means to drain the area as quickly and effectively as possible is to make use of existing drain channels. That is, drainage channels should be provided by utilizing existing channels. Recommended sizes and locations for these areas are indicated in Section III H. These "Drainage Channels" should be seeded to grass as recommended to retard or prevent erosion. The size of Drainage Channel areas shown in the tables are for earth lined channels. If space is critical, concrete lined channels may be used in which case the bed width required is one-half the width for earth lined channels. Cross sections for both concrete and earth lined channels are shown in Section III F.

Drainage Channels should be wide and shallow to minimize channel erosion with depth of flow no greater than shown in the tables of Section III F. Channel erosion is basically a function of the specific weight of the fluid, slope of the channel and depth of flow. Because the channel slopes are steep, the depth of flow must be shallow.

Storm sewers are placed arbitrarily to provide means for determining quantities and costs. As the area is subdivided the locations of the storm sewers may be changed to fit the street layout. Sizes of storm sewers are given for vitrified clay pipe. Reinforced concrete pipe or corrugated metal pipe may be used if desired.

The subdivision streets should be planned to provide maximum advantage for the drainage pattern. The street gutters should be designed by applying existing slopes and the recommended design peak flows.

To drain Peterson Field quickly and efficiently, additional drainage should be provided. This will minimize the hazards of airfield flooding and incapacitating its use.

A study of this type should be made for each basin in the region in which subdividing can be expected. This way drainage channels can be preserved and building in hazardous areas can be avoided.

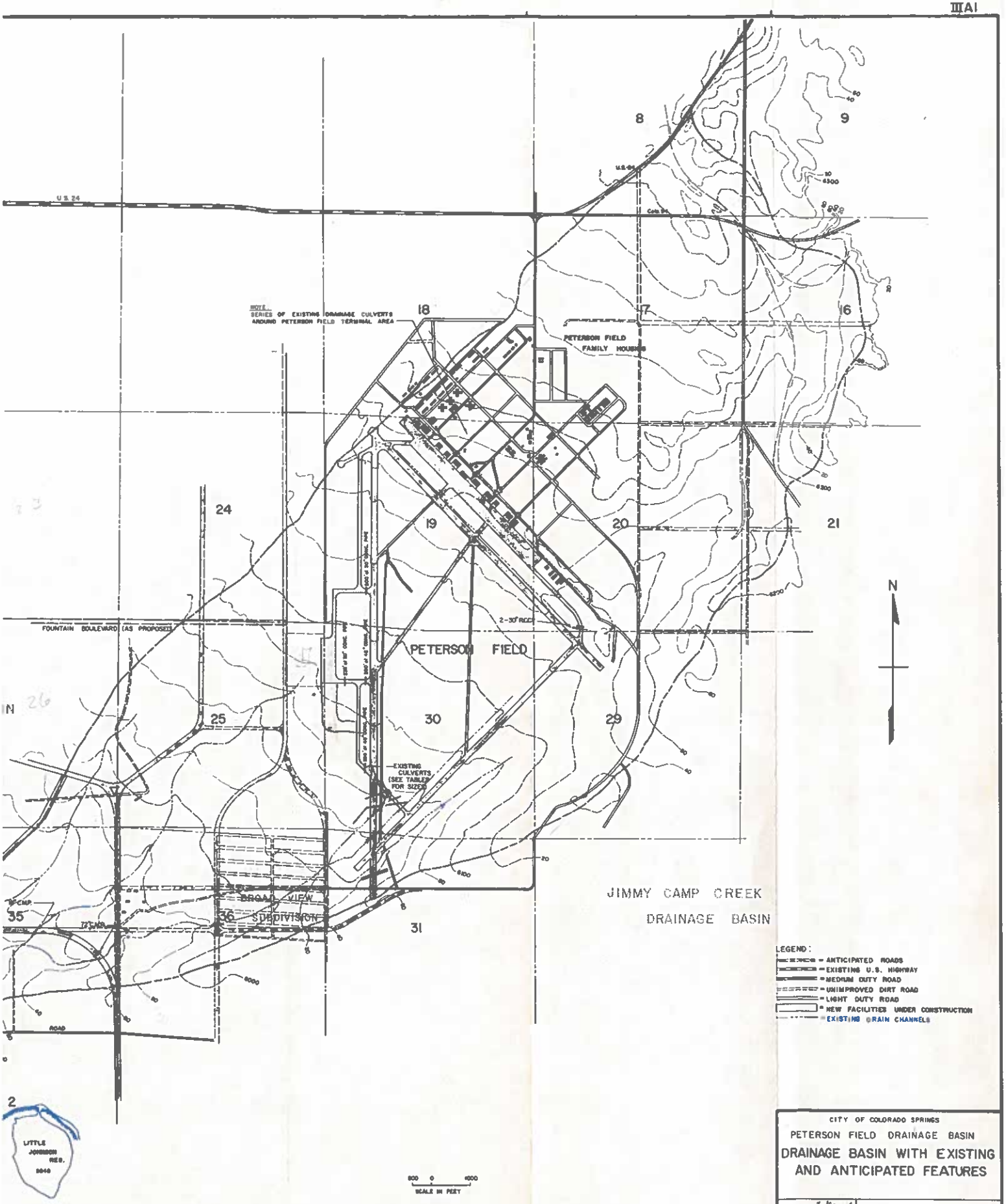
The recommended storm drainage can be provided as each subdivision is developed and thus eliminate expensive storm sewer installation after the area is developed.

It is recommended that the design features of this study be followed in general, making revisions as necessary, and that the cost be pro-rated among the subdivisions involved.

II BIBLIOGRAPHY

1. Chow, V. T., - "Open Channel Hydraulics" McGraw-Hill Book Company, 1959.
2. "Design of Small Dams", US Dept. of Interior, U. S. Bureau of Reclamation. 1960.
3. "Handbook of Drainage & Construction Products", Armco Drainage & Metal Products Inc., Lakeside Press - Chicago, Illinois, 1955.
4. King, H. W. & Brater, E. F., "Handbook of Hydraulics" McGraw-Hill Book Company Inc., 1963.
5. Lindsey, R. K. Kohler, M. A. & Paulhus, J. L. H., Hydrology for Engineers", McGraw-Hill Book Company, 1958.
6. "Local Climatological Data with Comparative Data for Colorado Springs", US Department of Commerce,Weather Bureau, 1964.
7. Rainfall Intensity-Duration Frequency Curves", Tech Paper No. 25, US Department of Commerce, 1955.

III TABLES AND DRAWINGS

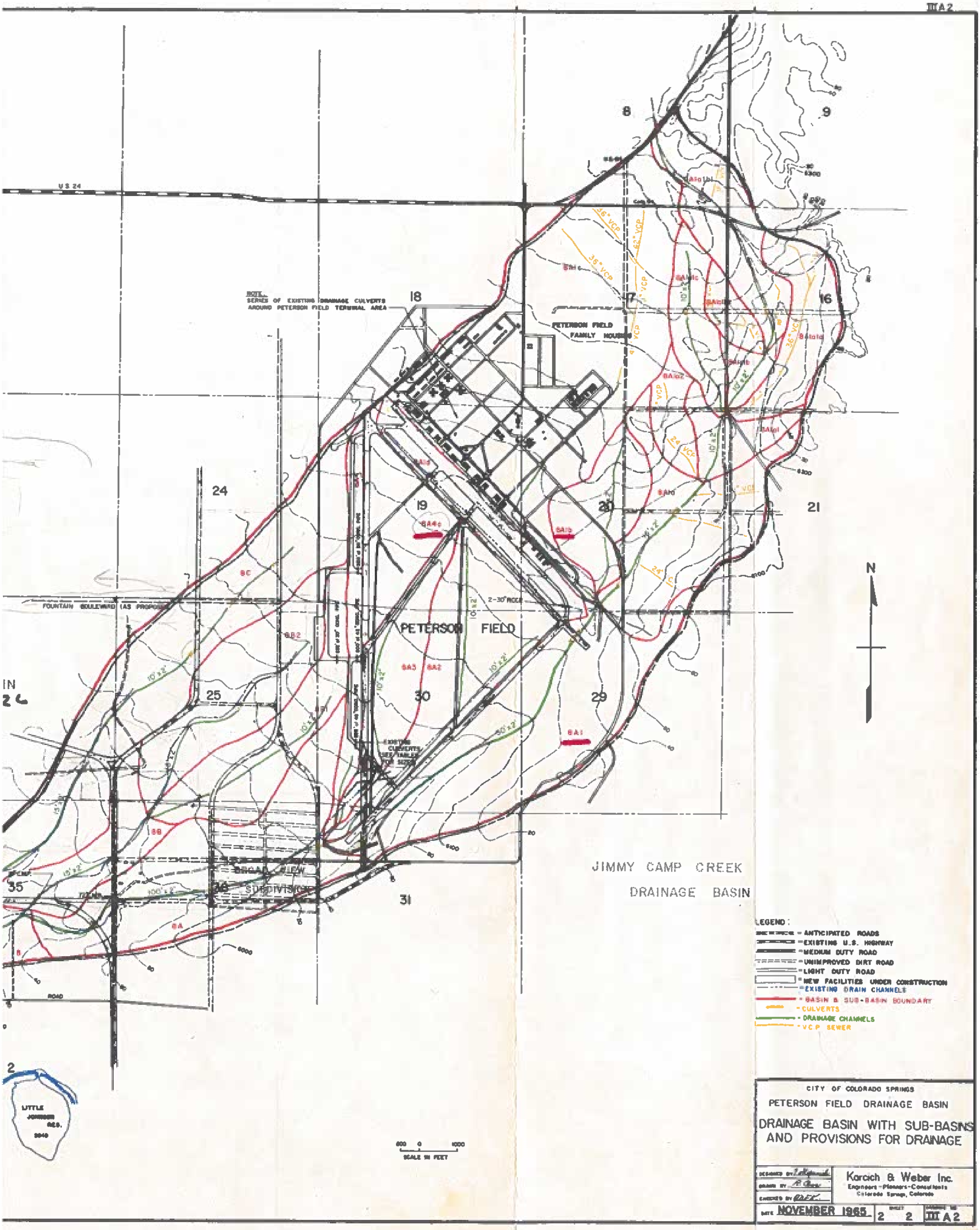


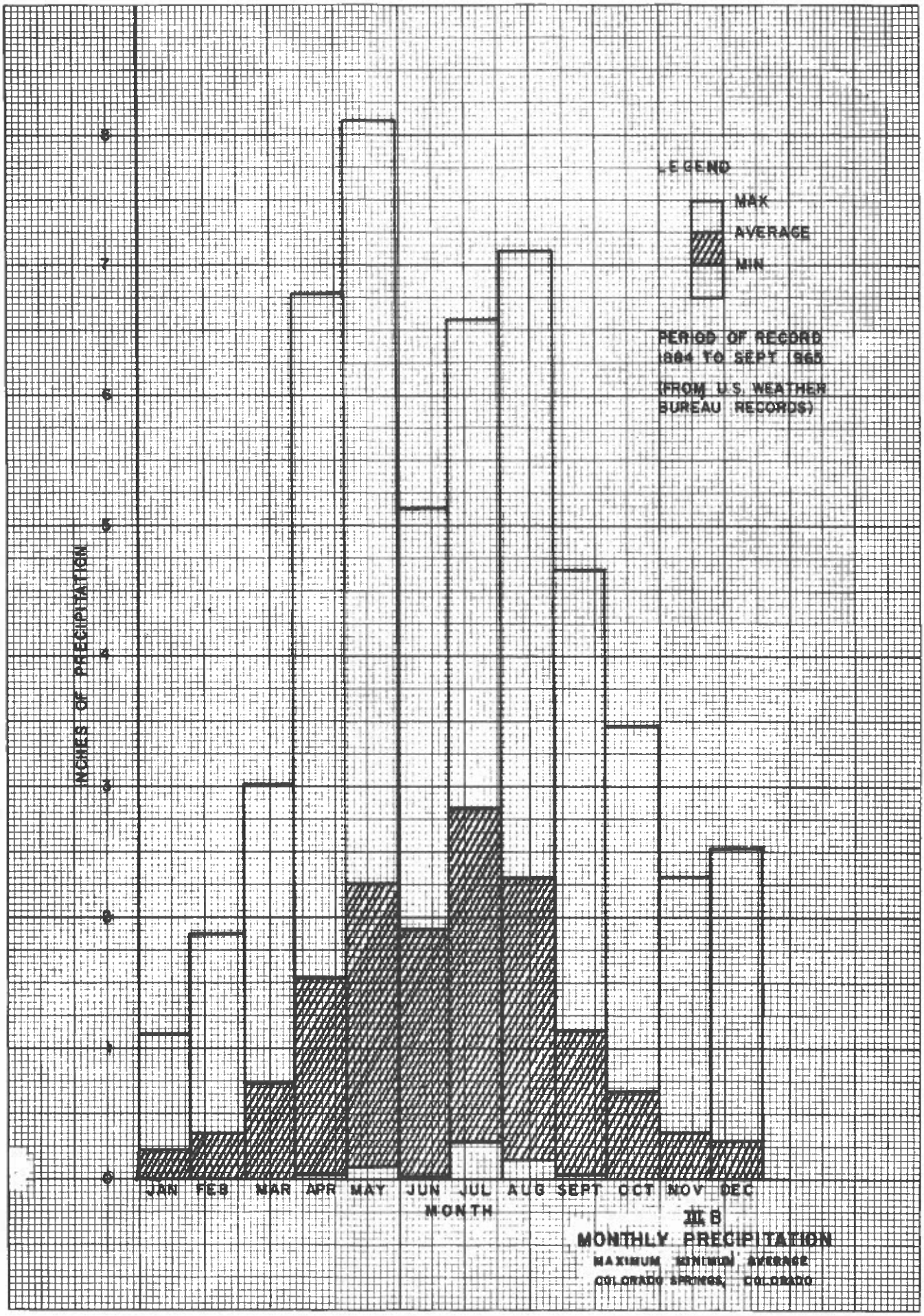
CITY OF COLORADO SPRINGS

PETERSON FIELD DRAINAGE BASIN

DRAINAGE BASIN WITH EXISTING AND ANTICIPATED FEATURES

DESIGNED BY J. Edgewood	Korcich & Weber Inc.
DRAWN BY R. Cox	Engineers—Planners—Consultants
CHECKED BY O.K.K.	Colorado Springs, Colorado
DATE NOVEMBER 1965	SHEET 1 of 2 — DRAWING NO. III A1


III A 2
U S 24
NOTE: SERIES OF EXISTING DRAINAGE CULVERTS AROUND PETERSON FIELD TERMINAL AREA
PETERSON FIELD FAMILY HOUSING
PETERSON FIELD
FOUNTAIN BOULEVARD (AS PROPOSED)
BROAD VIEW SUBDIVISION
EXISTING CULVERTS (SEE TABLES FOR SIZES)
JIMMY CAMP CREEK DRAINAGE BASIN
LITTLE JOHNSON RES.
N
8
9
16
17
18
19
20
21
24
25
29
30
31
35
36
36" VCP
42" VCP
24" VCP
10'x2'
2-30" RCCP
8A1
8A2
8A3
8B
8B2
8C
SCALE IN FEET
LEGEND:
= ANTICIPATED ROADS
= EXISTING U.S. HIGHWAY
= MEDIUM DUTY ROAD
= UNIMPROVED DIRT ROAD
= LIGHT DUTY ROAD
= NEW FACILITIES UNDER CONSTRUCTION
= EXISTING DRAIN CHANNELS
= BASIN & SUB-BASIN BOUNDARY
= CULVERTS
= DRAINAGE CHANNELS
= V.C.P. SEWER
CITY OF COLORADO SPRINGS
PETERSON FIELD DRAINAGE BASIN
DRAINAGE BASIN WITH SUB-BASINS AND PROVISIONS FOR DRAINAGE
Korcich & Weber Inc.
Engineers - Planners - Consultants
Colorado Springs, Colorado
DESIGNED BY
DRAWN BY
CHECKED BY
DATE NOVEMBER 1965
2
2
III A 2

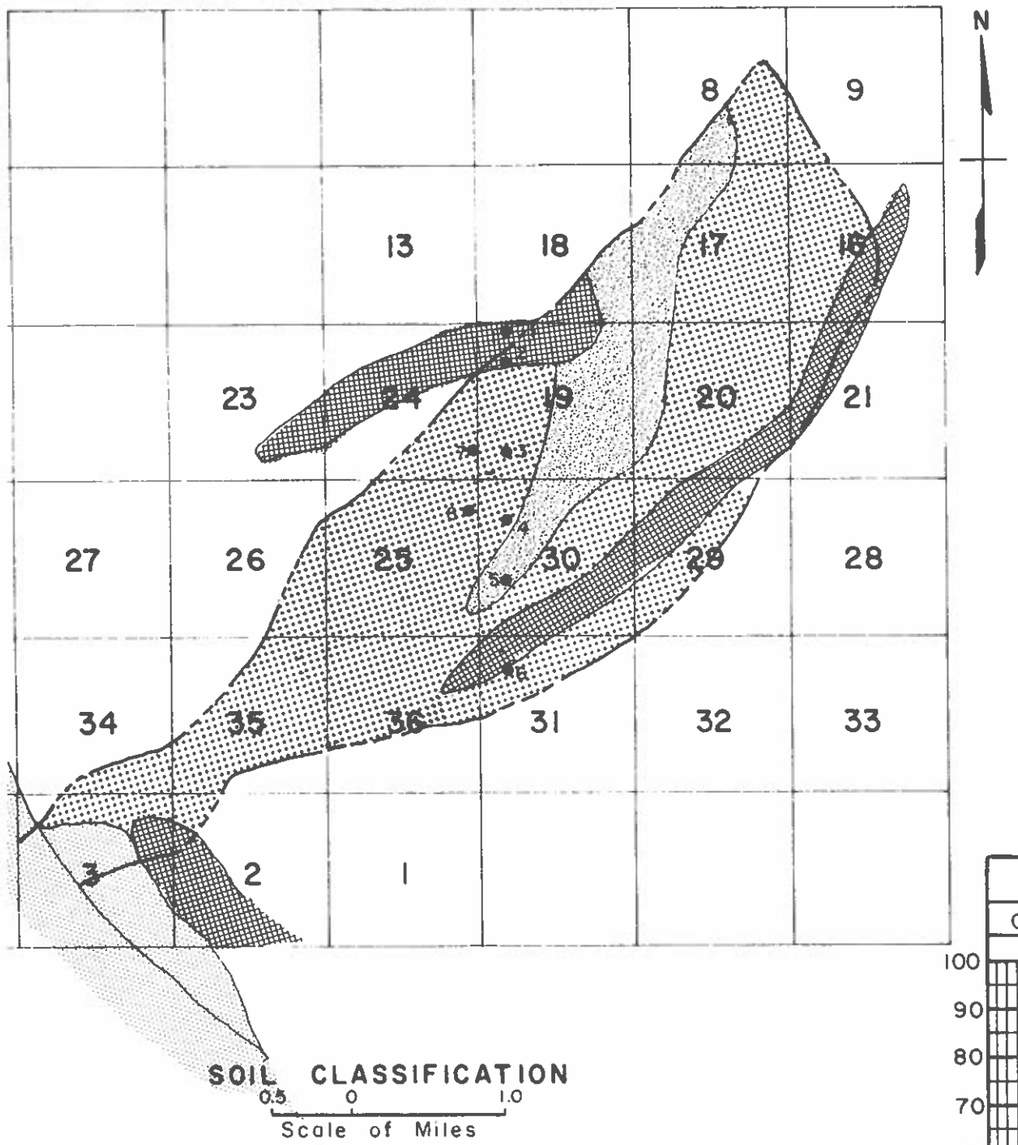


III B

MONTHLY PRECIPITATION

MAXIMUM MINIMUM AVERAGE

COLORADO SPRINGS, COLORADO



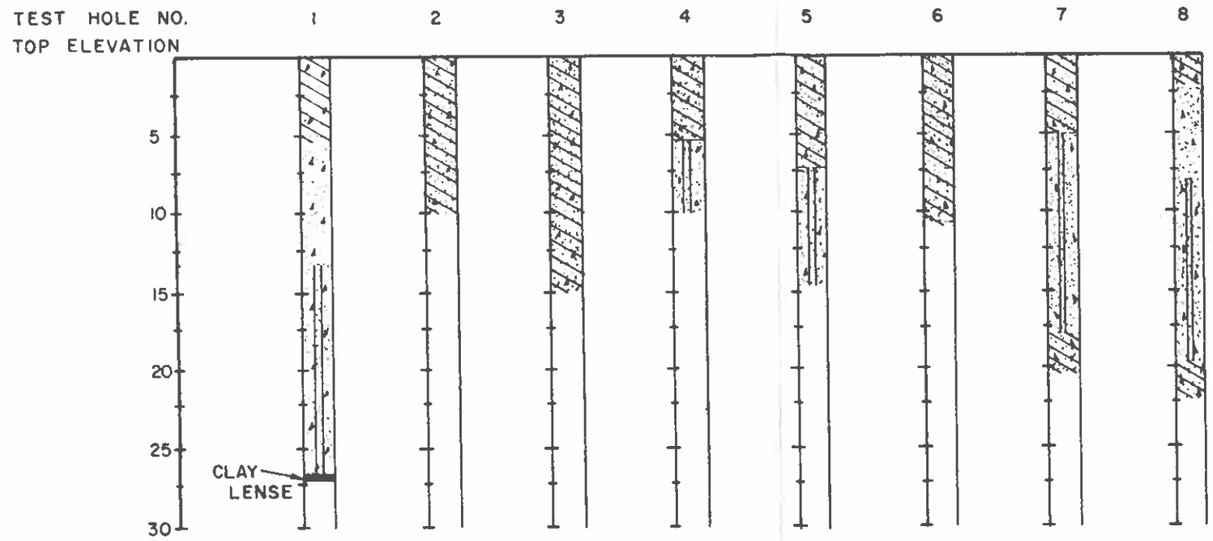
LASSIFICATION LEGEND

BROWN SOILS OF THE UPLAND WITH
Y SUBSOILS. OTIS AND SPRINGER SERIES.

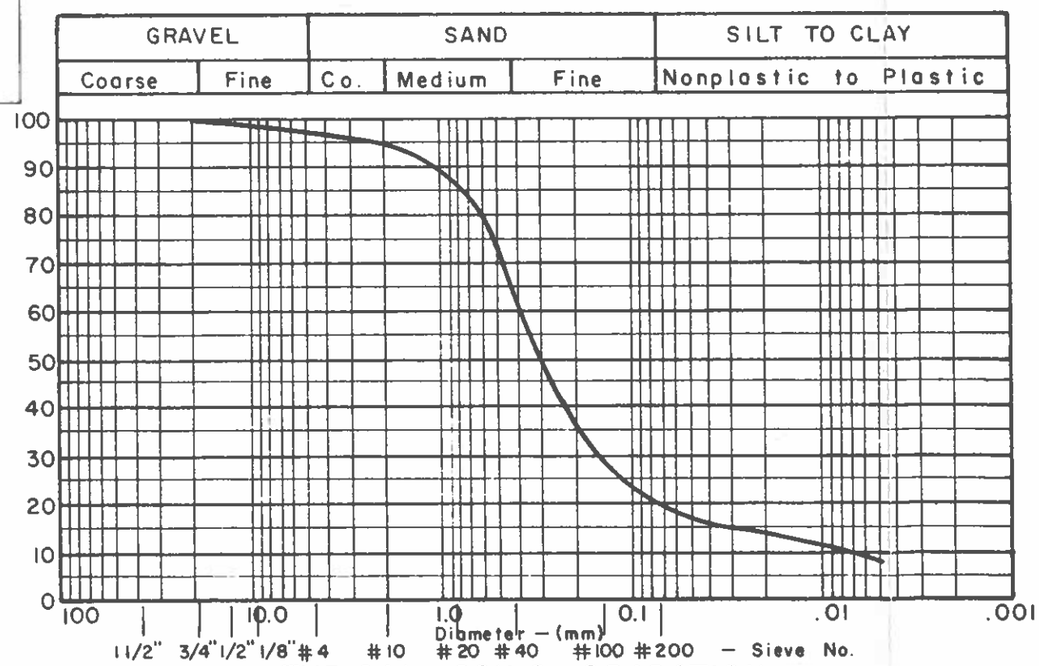
LOW OR MEDIUM DEPTH, DARK UPLAND SOILS
GRAVELLY SUBSOILS. FALCON SERIES

, DARK SOILS OF THE STREAM TERRACES
SANDY SUBSOILS. EASTONVILLE SERIES

E SANDS AND GRAVELS OF THE
T BOTTOMS, RIVERWASH



SOIL TEST HOLE PROFILES



TYPICAL SOILS GRADATION ANALYSIS

TEST HOLE SOIL LEGEND

SILTY SAND

COARSE SAND

STRATIFIED SAND

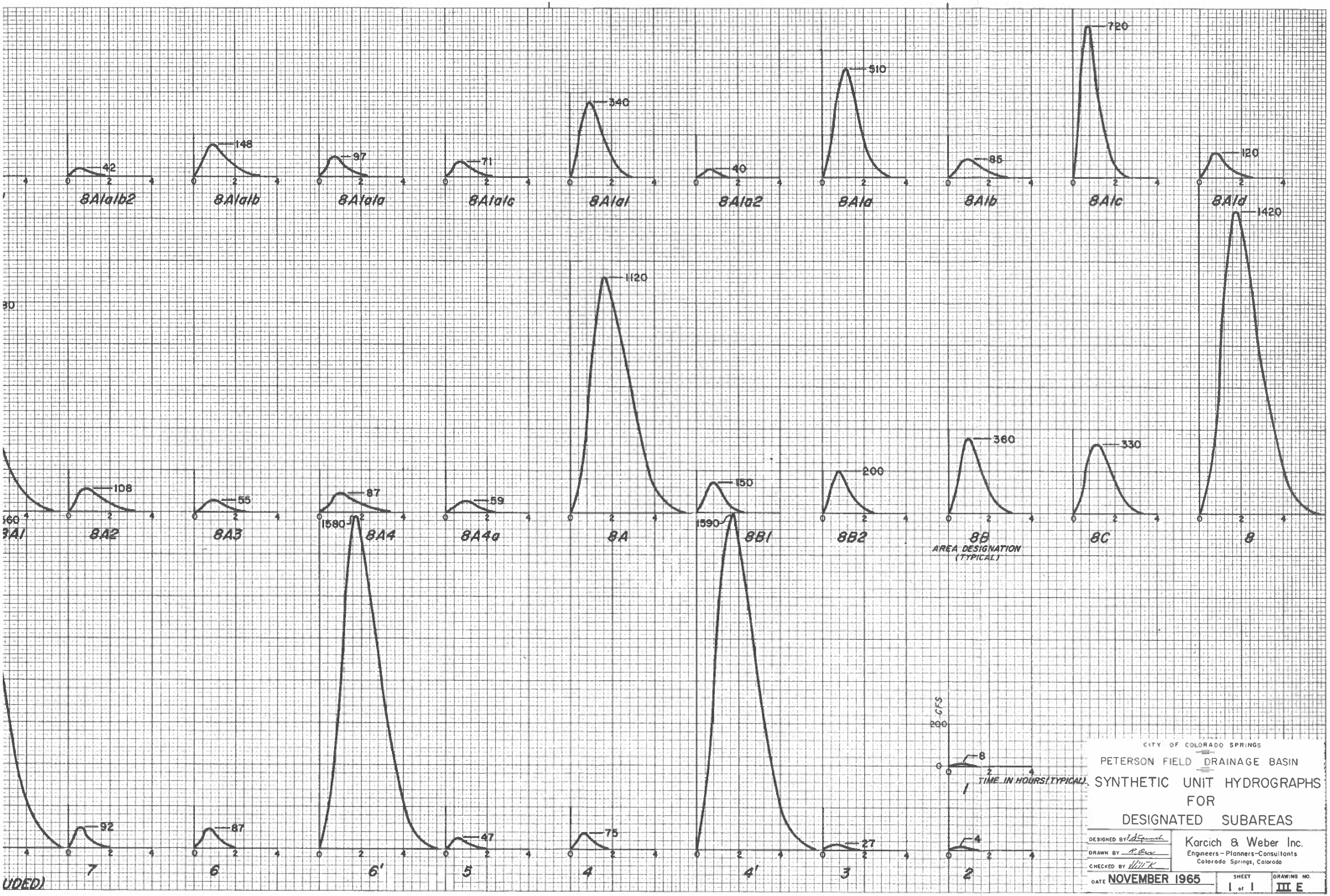
CITY OF COLORADO SPRINGS
PETERSON FIELD DRAINAGE BASIN
SOIL CLASSIFICATION

DESIGNED BY TCS	Karcich & Weber Inc. ENGINEERS-PLANNERS CONSULTANTS COLORADO SPRINGS, COLO.
DRAWN BY R.L.O.	
CHECKED BY MFK	
DATE NOVEMBER 1965	SHEET 1 OF 1 — DWG. NO. III C

III D - RUNOFF DISCHARGE

Comparison of Existing and Subdivided Conditions

Area Designation	Area Miles ^{2}	Peak Q 50 Year Storm CFS	
		Existing Conditions	Subdivided Conditions
8A1a1b1	0.298 .301	43	98 244
8A1a1b2	0.072	17	42 70
8A1a1b	0.433	64	148 348
8A1a1a	0.207	42	97 228
8A1a1c	0.147	30	71 141
8A1a1	0.915	148	340 744
8A1a2	0.110	16	40 98
8A1a	1.489	220	510
8A1b	0.236	35	85
8A1c	1.490	310	720
8A1d	0.228	120	120
8A1	4.308	420	980
8A2	0.480	81	108
8A3	0.254	42	55
8A4a	0.283	44	59
8A4	0.448	65	87 97
8A	6.225	560	1120
8B1	0.361	65	150
8B2	0.448	87	200
8B	1.023	156	360
8C	1.018	142	330
8 (8C Excluded)	7.594	610	1420
8 (8C Included)	8.612	670	1560
7	0.159	39	92
6	0.184	38	87
6	8.796	700	1580 5150
5	0.082	20	47
4	0.120	32	75
4	8.916	720	1590 5130
3	0.051	12	27
2	0.0065	2	4
1	0.142	4	8



CITY OF COLORADO SPRINGS

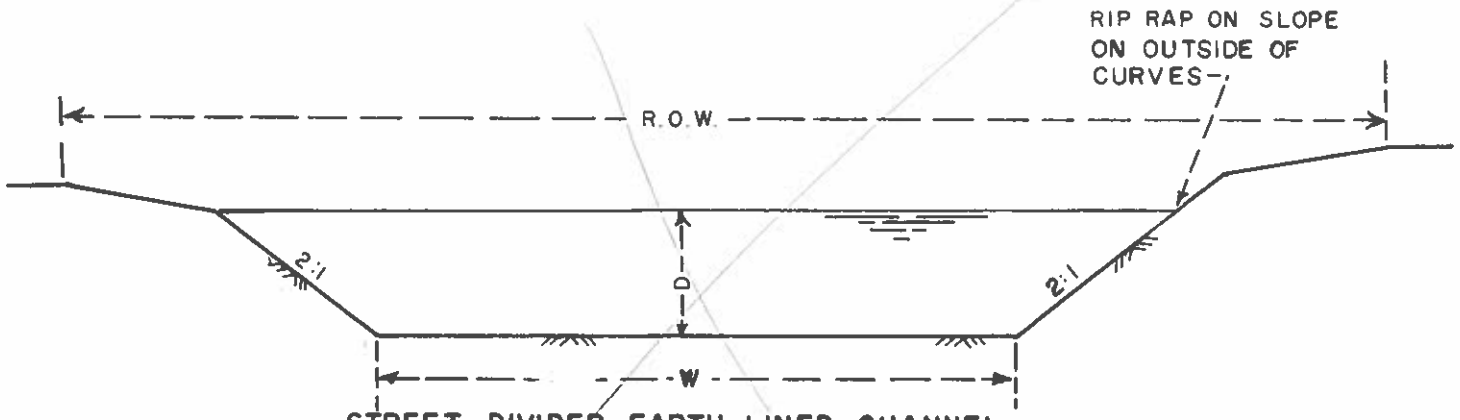
PETERSON FIELD DRAINAGE BASIN

SYNTHETIC UNIT HYDROGRAPHS FOR DESIGNATED SUBAREAS

DESIGNED BY T.J. [illegible]
DRAWN BY R. [illegible]
CHECKED BY [illegible]
DATE NOVEMBER 1965

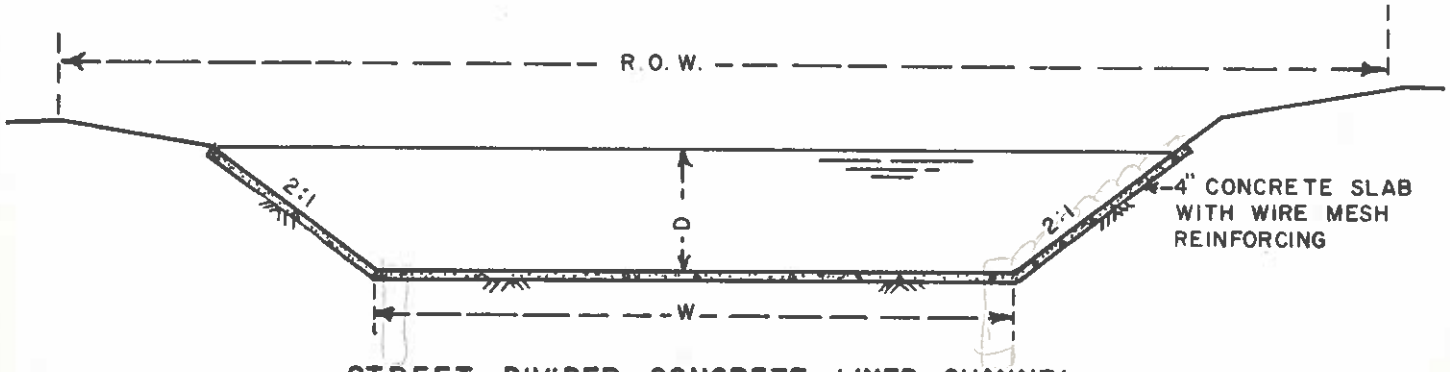
Karcich & Weber Inc.
Engineers – Planners – Consultants
Colorado Springs, Colorado

SHEET 1 of 1
DRAWING NO. III E

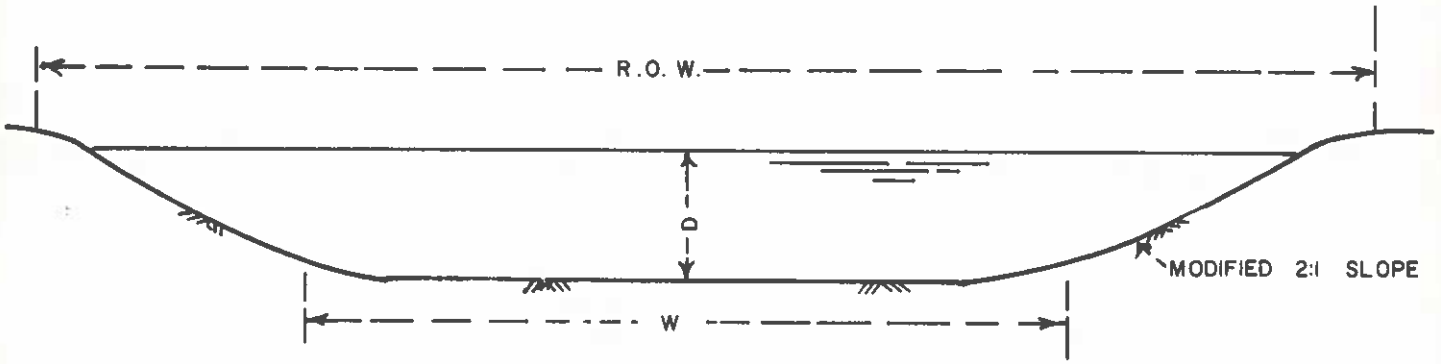


STREET DIVIDER EARTH LINED CHANNEL

BED WIDTH FOR CONCRETE LINED CHANNEL = 1/2 W FOR EARTH LINED CHANNEL

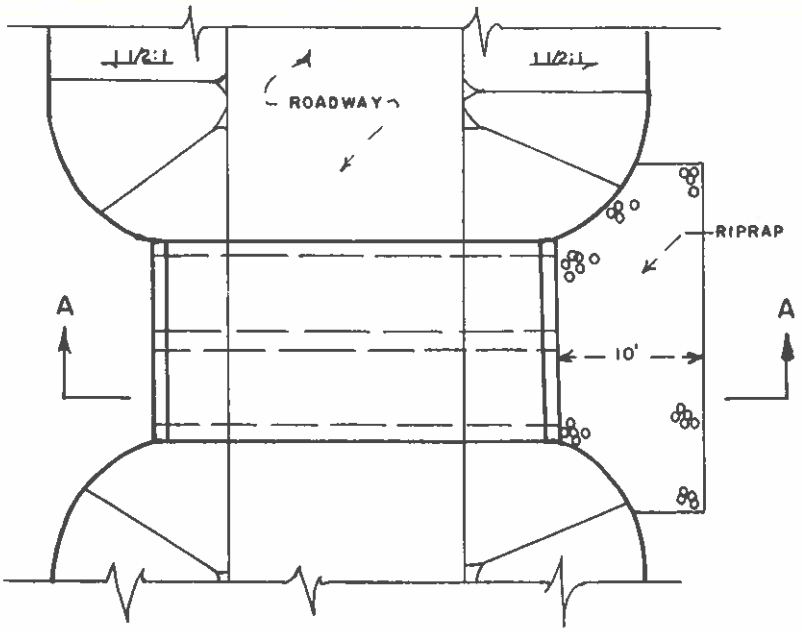


STREET DIVIDER CONCRETE LINED CHANNEL

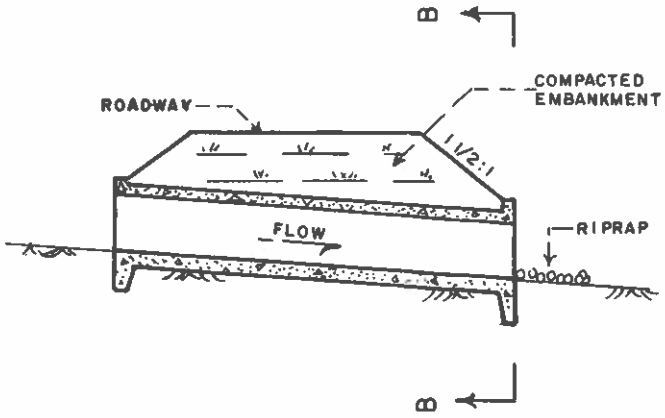


PARK STRIP CHANNEL

III F
CANAL CROSS SECTIONS

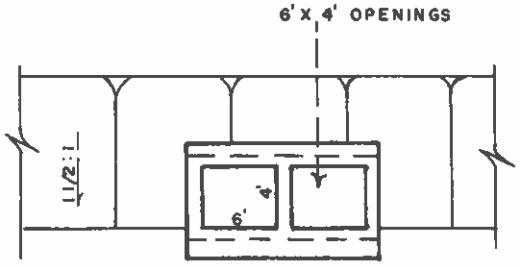


PLAN
(NO SCALE)



SECTION A-A

PROFILE



SECTION B-B

ELEVATION

TYPICAL BOX CULVERT

III G

BOX CULVERT SECTIONS

III H-1. TABLE OF DRAINAGE CHANNELS AND STORM SEWERS QUANTITIES AND COSTS.

Drainage channel areas are itemized by starting at the upper end of the drainage basin.

Drainage channels or sewers within a sub-area are listed by starting at the upper end of the sub-area and working toward the outfall point for the sub-area.

SUMMARY

III H 1-Drainage Channels – Subdivided Condition

Area Designation	Area Miles^2	Q CFS	S	Canal L Feet	Canal Size W x D	VCP L Feet	VCP Size W x D	Canal Cost	Sewer Cost
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
8A1a1b1	0.298	98	0.0232	6900	10 x 2			$4,250	
	-----	10	0.03	----	-----	1000	18"	------	$ 6,300
	-----	10	0.022	----	-----	1800	18"	------	11,700
8A1a1b2	0.072	42	0.0475	----	-----	1700	18"	------	11,000
8A1a1b	0.433	148	0.023	1800	10 x 2	----	--	1,120	------
8A1a1a	0.207	97	0.0127	----	-----	2000	30"	------	26,000
	-----	--	------	----	-----	2000	36"	------	32,000
	-----	--	------	----	-----	2000	42"	------	38,000
	-----	--	------	----	-----	2300	24"	------	21,000
8A1a1c	0.147	71	0.025	4400	10 x 2	----	--	2,750	------
8A1a1	0.915	340	0.0211	1700	10 x 2	----	--	1,050	------
8A1a2	0.110	40	0.0296	----	-----	900	24"	------	8,100
	-----	--	------	----	-----	1800	18"	------	11,700
8A1a	1.489	510	0.02	4000	15 x 2	----	--	3,900	------
	-----	30	0.031	----	-----	1300	18"	------	8,500
	-----	30	0.02	----	-----	2000	24"	------	18,000
	-----	30	0.027	----	-----	1500	24"	------	13,500
8A1b	0.236	85	0.0196	4800	10 x 2 or	1300	24"	2,670	11,800
	-----	--	------	----	-----	1500	30"	------	19,500
	-----	--	------	----	-----	2000	36"	------	32,000
8A1c	1.490	720	0.004	----	-----	----	--	------	------

SUMMARY

III H-1 Drainage Channels - Subdivided Condition

Area Designation (1)	Area Miles^2 (2)	Q CFS (3)	S (4)	Canal L Feet (5)	Canal Size W x D (6)	VCP L Feet (7)	VCP Size W x D (8)	Canal Cost (9)	Sewer Cost (10)
7	0..159	92	0.00295	1700	10 x 2	----	--	1,050	------
6	0.184	87	0.0069	2900	10 x 2	----	--	1,800	------
6	8.796	1580	0.057	2000	100 x 2	----	--	10,600	------
5	0.082	47	0.0187	1600	10 x 2	----	--	1,000	------
4	0.120	75	0.0095	2100	10 x 2	----	--	1,300	------
*4	8.916	1590	0.057	900	100 x 2	----	--	4,800	------
3	0.051	27	0.015	2100	10 x 2	----	--	1,300	------
2	0.0065	4	0.01	500	10 x 2	----	--	310	------
1	0.142	8	0.05	1000	10 x 2	----	--	620	------

SUMMARY

III H 1-Drainage Channels - Subdivided Condition

Area Designation (1)	Area Miles^2 (2)	Q CFS (3)	S (4)	Canal L Feet (5)	Canal Size W x D (6)	VCP L Feet (7)	VCP Size W x D (8)	Canal Cost (9)	Sewer Cost (10)
	-----	120	0.015	----	-----	1500	42"	------	28,500
	-----	80	0.008	----	-----	2000	36"	------	32,000
	-----	240	0.0135	----	-----	1500	48"	------	33,000
	-----	100	0.0085	----	-----	3000	48"	------	66,000
	-----	400	0.016	1700	10 x 2 or	1700	48"	1,050	37,500
8A1d	0.228	120	0.0091	----	-----	----	--	------	------
8A1	4.308	980	0.0137	10300	50 x 2	----	--	*27,800	------
8A2	0.480	108	0.012	4500	10 x 2			2,780	------
	-----	--	-----	7900	10 x 2	----	--	* 4,870	------
8A3	0.254	55	0.011	9100	10 x 2	----	--	* 5,620	------
8A4a	0.283	59	0.0072			----	--	------	------
8A4	0.448	87	0.0124	2500	10 x 2	----	--	------	------
8A	6.225	1120	0.0135	8800	100 x 2	----	--	46,500	------
8B1	0.361	150	-----	6700	10 x 2	----	--	4,140	------
8B2	0.448	200	0.135	3650	10 x 2	----	--	2,250	------
8B	1.023	360	0.176	10800	15 x 2	----	--	9,500	------
8C	1.018	330	0.0068	6700	10 x 2	----	--	4,140	------
	-----	--	-----	8000	15 x 2	----	--	7,000	------
8	8.612	330	0.0131	2000	15 x 2	----	--	1,760	------
	-----	1560	0.0131	5500	100 x 2	----	--	29,000	------

* Not included in total cost

III. H-2 . TABLES OF DRAINAGE CULVERT QUANTITIES AND COSTS

Culverts are itemized by starting at the upper end of the drainage basin. Culverts within a sub-area are listed by starting at the upper end of the sub-area and working toward the outfall point of the sub-area. Alternates of corrugated metal pipe, vitrified clay pipe and box culverts are given for each culvert. The type culvert to be used may be selected at the time of installation by considering costs and physical requirements.

SUMMARY

III H-2 Culverts - Subdivided Condition

Revised December 3, 1965

Area Designation (1)	Q CFS (2)	S (3)	Approx. Length Feet (4)	Existing Culverts (5)	Alternates for Additional Culverts CMP Dia. (6)	RCP Dia. (7)	Box Culverts W x H (8)	Remarks (9)	Cost (10)	Code Ref. for 1 to 500 Map (11)
8A1a1b1	50	0.0232	300		1-36"	1-30"			5,400	A
8A1a1b1	--	0.0232	60		1-36"	1-30"				
	--	------	---		or 2-30"	or 2-24"	1-4x4	Under anticipated road	1,800	B
8A1a1c	30	0.025	60		1-30"	1-24"				
	--	------	---		or 2-24"	or 2-18"		Under anticipated road	1,200	C
8A1a1c & 8A1a1b	220	0.018	230		2-48"	2-42"				
	--	------	---		----	----	2-4x4	Under road, build up road	14,600	D
8A1d	120	0.015	330	2-30"RCP	----	----				
8A1c	30	------	60		1-24"	1-24"			600	
8A1b	85	0.0196	60		1-42"	1-36"	1-4x4	Under road, build up road	1,200	E
8A1a	400	0.0171	60		1-66"	1-60"				
	--	------	---		or 2-60"	or 2-54"				
	--	------	---		or 3-54"	or 3-42"	1-6x4	Under anticipated road	5,400	F
8A1a	510	0.02	40		1-72"	1-60"				
	--	------	---		or 2-66"	or 2-54"				
	--	------	---		or 3-60"	or 3-48"	1-6x4	Under road, build up road	4,000	G
	25	0.02	---		1-24"	1-24"	1-4x4	Under road, build up road	400	H

(23)

SUMMARY

III H-2 Culverts - Subdivided Condition

Revised December 3, 1965

Area Designation (1)	Q CFS (2)	S (3)	Approx. Length Feet (4)	Existing Culverts (5)	Alternates for Additional Culverts			Remarks (9)	Cost (10)	Code Ref. for 1" = 500' Map (11)
					CMP Dia. (6)	RCP Dia. (7)	Box Culverts W x H (8)			
8A1	750	0.0137	40		1-96"	1-72"				
	--	------	---		or 2-78"	or 2-60"				
	--	------	---		or 3-60"	or 3-54"	1-4x4	Under road, build up road	4,650	J
	750	0.0137	140		1-96"	1-72"				
	--	------	---		or 2-78"	or 2-60"				
	--	------	---		or 3-60"	or 3-54"		Under runway	*16,200	K
	980	0.05	950	3-48"RCP	1-90"	1-78"				
	--	------	---		or 3-72"	or 2-72"				
	--	------	---		or 4-66"	or 3-66"		Under runway	*102,000	L
8A4	87	0.0124	130	2-30"RCP						
	--	------	---	1-42"RCP						
	--	------	---	1-48"RCP						
8A4a	59	0.0035	573	1-24"RCP	1-48"	1-42"				
	--	------	---		or 2-42"	or 2-36"				
	--	------	---		or 3-36"	or 3-30"			*23,000	M
8A3	55	0.00165	800	1-42"RCP						
8A2	108	0.01	1150	1-60"RCP						
	--	------	570	1-30"CMP						

*Not to be included in total cost

(24)

SUMMARY

III H-2 Culverts - Subdivided Condition

Revised December 3, 1965

Area Designation (1)	Q CFS (2)	S (3)	Approx. Length Feet (4)	Existing Culverts (5)	Alternates for Additional Culverts			Remarks (9)	Cost (10)	Code Ref. for 1" = 500' Map (11)
					CMP Dia. (6)	RCP Dia. (7)	Box Culverts W x H (8)			
8A	980	0.0135	60		1-108"	1-78"	2-6x4	Under road, build up road	9,700	N
	--	------	---		or 3-72"	or 2-72"				
	--	------	---		or 4-66"	or 3-66"				
8A	980	0.0135	60		1-108"	1-78"				
	--	------	---		or 3-72"	or 2-72"				
	--	------	---		or 4-66"	or 3-66"	2-6x4	Under road, build up road	9,700	O
	1050	0.0135	60		4-72"	4-66"				
	--	------	---		or 5-66"	or 5-60"				
	--	------	---		or 6-60"	or 6-54"	4-6x4		37,500	P
	1120	0.0135	130		4-72"	3-72"				
	--	------	---		or 6-66"	or 4-66"				
	--	------	---		or 8-60"	or 6-60"	5-6x4	Under road, build up road	39,000	Q
	1120	0.0135	130	1-72"CMP	4-66"	3-66"				
					or 6-60"	or 4-60"				
					or 8-42"	or 6-54"	5-6x4	Under highway	35,000	R
8B2	100	0.0152	60		1-48"	1-42"				
					or 2-42"	or 2-36"				
					or 3-36"	or 3-30"	1-4x4	Under anticipated road	2,150	S

(25)

SUMMARY

III H-2 Culverts - Subdivided Conditions

Revised December 3, 1965

Area Designation	Q CFS	S	Approx. Length Feet	Existing Culverts	Alternates for Additional Culverts			Remarks	Cost	Code Ref. for 1" = 500' Map
					CMP Dia.	RCP Dia.	Box Culverts W x H			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
8B2	150	0.0135	60		1-54"	1-48"				
	--	------	---		or 2-48"	or2-42"				
	--	------	---		or 3-42"	or3-36"			3,850	T
*8B2	150	0.0143	90		1-60"	1-54"				
	--	------	---		or 2-54"	or 2-48"				
	--	------	---		or 3-48"	or 3-42"		Under anticipated road	6,750	U
8B1	75	0.0130	60		1-42"	1-36"				
	--	------	---		or 2-36"	or 2-30"				
	--	------	---		or 3-30"	or 3-24"	1-4x4	Under anticipated road	2,150	V
8B1	90	0.0157	60		1-42"	1-36"				
	--	------	---		or 2-36"	or 2-30"				
	--	------	---		or 3-30"	or 3-24"			2,150	W
8B	320	0.0176	90		1-60"	1-54"				
	--	------	---		or 2-54"	or 2-48"				
	--	------	---		or 3-48"	or 3-42"			6,850	X
	360	0.0176	150	1-18"CMP	1-60"	1-54"				
	--	------	---		or 2-54"	or 2-48"				
	--	------	---		or 3-48"	or 3-42"	1-6x4		11,400	Y

* Item added due to anticipated road. J.S.

SUMMARY

III H-2 Culverts – Subdivided Conditions

Revised December 3, 1965

Area Designation (1)	Q CFS (2)	S (3)	Approx. Length Feet (4)	Existing Culverts (5)	Alternates for Additional Culverts			Remarks (9)	Cost (10)	Code Ref. for 1" = 500' Map (11)
					CMP Dia. (6)	RCP Dia. (7)	Box Culverts W x H (8)			
8C	75	0.0068	90		1-48"	1-42"				
	---	------	---		or 2-42"	or 2-36"				
	---	------	---		or 3-36"	or 3-30"		Under road	3,600	Z
8C	100	0.0068	150		1-54"	1-48"				
	---	------	---		or 2-48"	or 2-42"				
	---	------	---		or 3-42"	or 3-36"		Under Fountain Blvd.	9,600	AA
8C	100	0.0068	150		1-54"	1-48"				
	---	------	---		or 2-48"	or 2-42"		Under Road	9,600	BB
	---	------	---		or 3-42"	or 3-36"				
8C	240	0.0068	90		1-60"	1-54"				
	---	------	---		or 2-54"	or 2-48"				
	---	------	---		or 3-48"	or 3-42"		Under road	6,850	CC
*8C	275	0.0068	90		1-66"	1-60"				
	---	------	---		or 2-60"	or 2-54"				
	---	------	---		or 3-54"	or 3-48"		Under anticipated road	7,020	DD
8C	330	0.0068	150		1-66"	1-60"				
	---	------	---		or 2-60"	or 2-54"				
	---	------	---		or 3-54"	or 3-48"		Under highway	13,500	EE

(27)

* Item added due to anticipated road. J.S.

SUMMARY

III H-2 Culverts - Subdivided Condition

Revised December 3, 1965

Area Designation (1)	Q CFS (2)	S (3)	Approx. Length Feet (4)	Existing Culverts (5)	Alternates for Additional Culverts			Remarks (9)	Cost (10)	Code Ref. for 1"=500' Map (11)
					CMP Dia. (6)	RCP Dia. (7)	Box Culverts W x H (8)			
8C	330	0.0068	150		1-66"	1-60"				
	---	------	---		or 3-54"	or 2-54"				
	---	------	---		or 2-48"	or 3-42"		Under highway	13,500	FF
* 8	1300	0.0127	90		4-72"	3-72"				
	---	------	---		or 6-66"	or 4-66"				
	---	------	---		or 8-60"	or 6-60"		Under anticipated road	31,050	GG
8	1560	0.0131	130		4-96"	3-90"				
	---	------	---		or 5-90"	or 4-84"				
	---	------	---		or 6-84"	or 6-78"			43,000	HH
8	1560	0.0131	40		4-96"	3-90"				
	---	------	---		or 5-90"	or 4-84"				
	---	------	---		or 6-84"	or 6-78"	5-6x4		13,200	JJ
8	1560	0.01	80		2-108"	2-96"				
	---	------	---		or 3-78"	or 3-78"				
	---	------	---		or 6-60"	or 4-60"			14,000	KK
6	87	0.008	24	1-30"CMP	1-36"				430	
	1580	0.01	40		2-108"	2-96"				
	---	------	---		or 3-78"	or 3-78"				
	---	------	---		or 6-60"	or 4-60"	4-6x4	Drain toward SandCrk.	10,000	LL

(28)

* Item added due to anticipated road. J.S.

SUMMARY

III H-2 Culverts - Subdivided Conditions

Revised December 3, 1965

Area Designation	Q CFS	S	Approx. Length Feet	Existing Culverts	Alternates for Additional Culverts			Remarks	Cost	Code Ref. for 1" = 500' Map
					CMP	RCP	Box Culverts			
					Dia.	Dia.	W x H			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
4	---	0.0167	36	1-54"CMP						
	---	0.025	40	1-72"CMP						
4	1590	------	80		2-108"	2-96"				
	---	------	--		or 3-78"	or 3-78"		Drain under Rail Road &		
	---	------	--		or 6-60"	or 4-60"		Highway to Sand Creek	15,000	MM

(28a)

III H-3 SUMMARY

Grass Seeding of Drainage Channels

Area Designation (1)	Size Channel W x D Feet (2)	Length Channel Feet (3)	Width R.O.W Feet (4)	Area R.O.W. Acres (5)	Cost Grass Seeding (6)
8A1a1b1	10 x 2	6900	24	3.8	$570
8A1a1b	10 x 2	1800	24	1.0	150
8A1a1C	10 x 2	4400	24	2.4	360
8A1a1	10 x 2	1700	24	0.9	135
8A1a	15 x 2	4000	29	2.8	420
8A1b	10 x 2	4300	24	2.4	360
8A1C	10 x 2	1700	24	0.9	135
8A1	50 x 2	10300	64	15.2	2280
8A2	10 x 2	4500	24	2.5	375
	10 x 2	7900	24	4.3	645
8A3	10 x 2	9100	24	5.0	750
8A4	10 x 2	2500	24	1.4	210
8A	100 x 2	8800	114	23	3450
8B1	10 x 2	6700	24	3.7	550
8B2	10 x 2	3650	24	2.0	300
8B	15 x 2	10800	29	7.1	1060
8C	10 x 2	6700	24	3.8	570
	15 x 2	8000	29	0.5	75
8	15 x 2	2000	29	1.3	195
	100 x 2	5500	114	14.4	2160
7	10 x 2	1700	24	0.9	135
6	10 x 2	2900	24	1.6	240
6	100 x 2	2000	114	5.2	780
5	10 x 2	1600	24	0.9	135
4	10 x 2	2100	24	1.2	180
4	100 x 2	900	114	2.3	345
3	10 x 2	2100	24	1.2	180
2	10 x 2	500	24	0.3	45
1	10 x 2	1000	23	0.6	90

Revised December 3, 1965

III H-4 SUMMARY OF COST ESTIMATES

3558 Ac

Area of Peterson Field Drainage Basin	9.36 Mi^2
Area of Airport	3.78 Mi^2
Area (Drainage Basin - Airport)	5.56 Mi^2

COSTS

Drainage Channel Excavation	$ 234,930
Drainage Channel Grass Seeding	16,880
VCP Sewers	466,300
Culverts	395,800
TOTAL	$ 1,113,910
Plus 10 per cent Contingencies	111,390
	$ 1,225,300

UNIT COST - (Total Drainage Basin Area)

Cost/Mi^2 ($9.36Mi^2$)	$ 130,900.00
Cost/acre	$ 205/acre

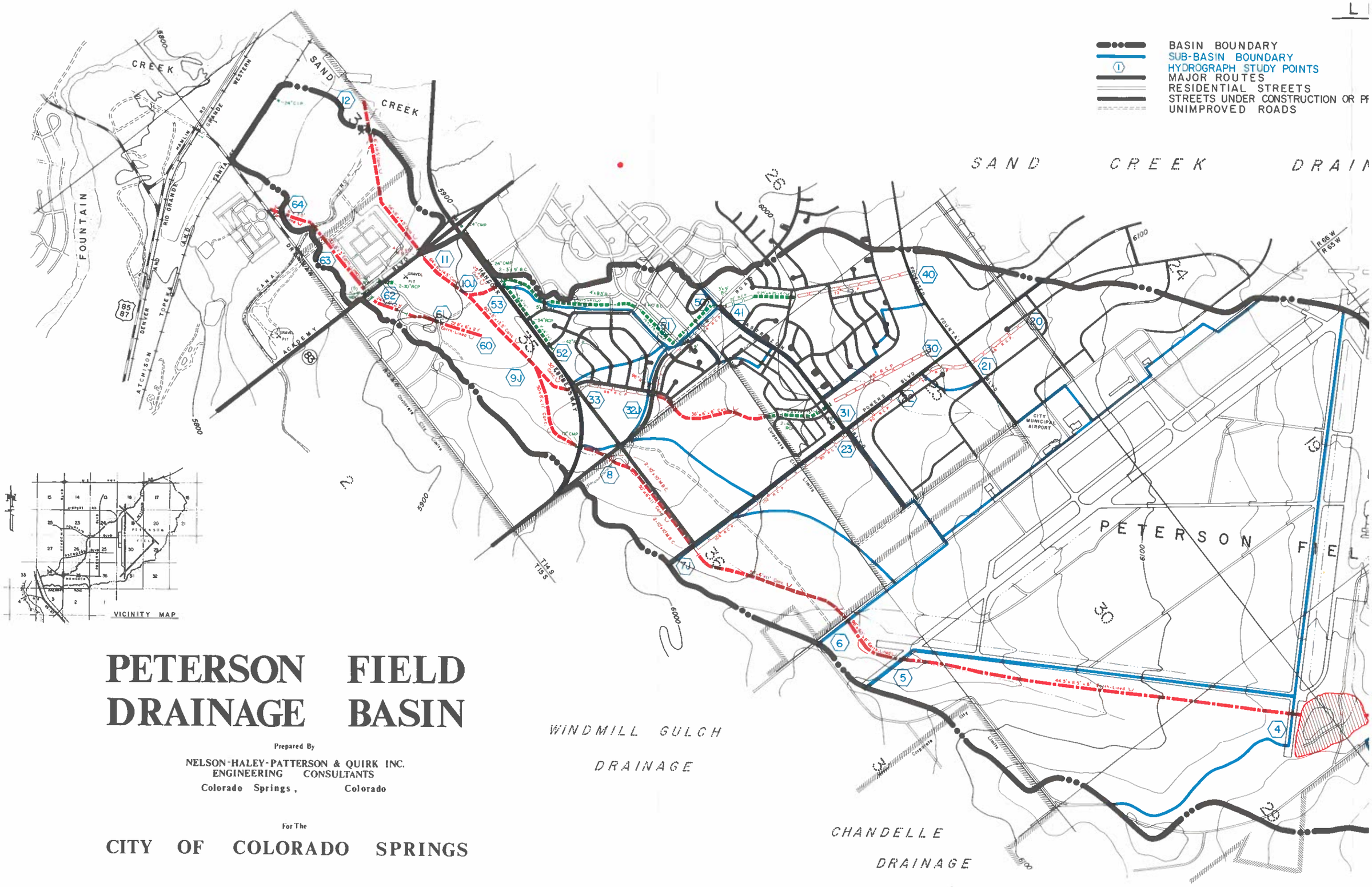
UNIT COST (Total Drainage Basin less Airport Area)

Cost/Mi^2 ($5.56Mi^2$)	$ 220,400.00
Cost/acre	$ 345/acre

PETERSON FIELD DRAINAGE BASIN

COMPARISON OF CHANNEL DESIGN FLOW RATES

Location on Channel Reach	Unlined Channel	V=7 fps Assumed (Energy Disipators Required in chnl)	Concrete lined section. (n =.014)
	cfs	cfs	cfs
8A1a1b (outlet of subbasin)	296	359	348
8A1a1 "	597	740	744
8A1a "	825	1,060	1,113
8A1c (only) "	855	1,145	1,202
8A1d " (inlet on Channdelle drainage report)	2,040	2,610	2,740
8A1 (outlet of subbasin) (outlet of Chandelle)	1,840	2,460	3,050
8A (outlet of subbasin)	2,245	2,842	3,900
8B (B Channel) "	575	723	
8C (C Channel)	496	633	648
Junction Channel 8A & 8B	2,610	3,300	4,530
Junction (design "Q" for Academy Blv) 8A+8B & 8C	2,850	3,560	5,160
8 (outlet of subbasin)	2,970	3,540	5,170
6 "	2,610	3,460	5,150
4 "	2,580	3,440	5,180
1 (outlet at River)	2,580	3,440	5,180



PETERSON FIELD DRAINAGE BASIN

Prepared By

NELSON-HALEY-PATTERSON & QUIRK INC.
ENGINEERING CONSULTANTS
Colorado Springs, Colorado

For The

CITY OF COLORADO SPRINGS

LEGEND

BASIN BOUNDARY
SUB-BASIN BOUNDARY
HYDROGRAPH STUDY POINTS
MAJOR ROUTES
RESIDENTIAL STREETS
STREETS UNDER CONSTRUCTION OR PROPOSED
UNIMPROVED ROADS

DRAINAGE IMPROVEMENTS

EXISTING		PROPOSED
	EARTH-LINED CHANNEL	
	CONCRETE-LINED CHANNEL	
	UNDERGROUND CHANNEL	
	CULVERT	
	PIPE	
	DETENTION POND	

(A) (B) (C)
5.5' x 75' x 4' (D)

SCALE IN FEET
20' CONTOUR INTERVALS

SAND CREEK DRAINAGE

PETERSON FIELD

CITY MUNICIPAL AIRPORT

DMILL GULCH DRAINAGE

CHANDELLE DRAINAGE

Van

LEGEND

- BASIN BOUNDARY
- SUB-BASIN BOUNDARY
- (1) HYDROGRAPH STUDY POINTS
- MAJOR ROUTES
- RESIDENTIAL STREETS
- STREETS UNDER CONSTRUCTION OR PROPOSED
- UNIMPROVED ROADS

DRAINAGE IMPROVEMENTS

EXISTING		PROPOSED
	EARTH-LINED CHANNEL	
	CONCRETE-LINED CHANNEL	
	UNDERGROUND CHANNEL	
	CULVERT	
	PIPE	
	DETENTION POND	

(A) (B) (C)
5.5' x 75' x 4' (D)

SCALE IN FEET
20' CONTOUR INTERVALS

SAND CREEK DRAINAGE

DMILL GULCH DRAINAGE

CHANDELLE DRAINAGE

PETERSON FIELD

CITY MUNICIPAL AIRPORT

VOID

LEGEND

BASIN BOUNDARY
SUB-BASIN BOUNDARY
(1) HYDROGRAPH STUDY POINTS
MAJOR ROUTES
RESIDENTIAL STREETS
STREETS UNDER CONSTRUCTION OR PROPOSED
UNIMPROVED ROADS

DRAINAGE IMPROVEMENTS

EXISTING		PROPOSED
	EARTH-LINED CHANNEL	
	CONCRETE-LINED CHANNEL	
	UNDERGROUND CHANNEL	
	CULVERT	
	PIPE	
	DETENTION POND	

(A) (B) (C)
15.5' x 7.5' x 4' (C)

SCALE IN FEET
20' CONTOUR INTERVALS

SAND CREEK DRAINAGE

PETERSON FIELD

DMILL GULCH DRAINAGE

CHANDELLE DRAINAGE

VOID