Resolution No. 63-81

A RESOLUTION ESTABLISHING BEAR CREEK DRAINAGE BASIN AND ARTERIAL ROADWAY BRIDGE FEES FOR 1981

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF COLORADO SPRINGS:

Section 1. That Bear Creek Drainage Basin and arterial roadway bridge fees for 1981, as recommended by the City of Colorado Springs Drainage Board at their March 20th, 1981 meeting, are established for 1981 as follows:

Bear Creek Drainage Basin Fee - $1,000 per acre

Bear Creek Arterial Roadway Bridge Fee - $ 94.00 per acre

Dated at Colorado Springs, Colorado this 10th day of March, 1981.

Mayor

ATTEST:

City Clerk

3/5/81

CITY OF COLORADO SPRINGS

DEPARTMENT OF PUBLIC WORKS
ADMINISTRATION (719) 578-6660
30 S. NEVADA SUITE 402 P.O. BOX 1575
COLORADO SPRINGS, COLORADO 80901-1575

December 20, 1988

TO WHOM IT MAY CONCERN:

The City of Colorado Springs Council at the December 13, 1988 meeting approved the drainage basin and bridge fees as follows:

CODE	BASIN NAME	1988 DRAINAGE FEE/ACRE	1988 BRIDGE FEE/ACRE	% OF INCREASE	1989 DRAINAGE FEE/ACRE	1989 BRIDGE FEE/ACRE
	SAND CREEK	$5445.00	$454.00	2%	$5554.00	$463.00
	SPRING CREEK	4196.00		2%	4280.00	
3	TEMPLETON GAP	2767.00	30.00	2%	2822.00	31.00
	DOUGLAS CREEK	4883.00	112.00	2%	4981.00	114.00
	19TH STREET	1593.00		2%	1625.00	
6	POPES BLUFF	1620.00	276.00	2%	1652.00	282.00
7	CAMP CREEK	898.00		2%	916.00	
	PETERSON FIELD	4102.00	237.00	2%	4184.00	242.00
9	SOUTH ROCKRIMMON	1902.00		2%	1940.00	
0	PULPIT ROCK	2681.00		2%	2735.00	
	DRY CREEK	2306.00		2%	2352.00	
	NORTH ROCKRIMMON	2433.00		2%	2482.00	
3	COTTONWOOD CREEK	3562.00	216.00	2%	3633.00	220.00
	MISCELLANEOUS	3278.00		2%	3341.00[1]	
	MESA	4231.00		2%	4316.00	
6	21ST STREET	2433.00		2%	2482.00	
7	BEAR CREEK	1566.00	146.00	2%	1597.00	149.00
	SOUTHWEST AREA	5297.00		2%	5403.00	
9	WINDMILL GULCH	4843.00	133.00	2%	4940.00	136.00
20	BLK. SQUIRREL CREEK	5172.00	714.00	2%	5275.00	728.00
	MONUMENT BRANCH	3918.00		1%	3974.00[2]	
	MIDDLE TRIBUTARY	2994.00		1%	3026.00[3]	

[1] Miscellaneous fee is computed as a simple average of all studied basins.

[2] Monument Branch basin fee has two components, the construction cost fee of $3812.00 per/acre and the detention pond land cost fee[4] of $162.00 per/acre.

[3] Middle Tributary basin fee has two components, the constructon cost fee of $2821.00 per/acre and the detention pond cost fee[4] of $205.00 per/acre.

[4] The detention pond land cost component of the basin fee is determined based upon the 1989 park land dedication fee of $14,000.00 per/acre.

THE FEE CHANGE IS EFFECTIVE JANUARY 1, 1989

Sincerly,

Gary R. Haynes
City Engineer

cc:DeWitt Miller, Director of Public Works

Lincoln DeVore
1000 West Fillmore St.
Colorado Springs, Colorado 80907
(303) 632-3593
Home Office

December 16, 1980

Director of Public Works and
Drainage Board of the City of Colorado Springs
101 West Costilla Street
Colorado Springs, Colorado

Re: ENGINEERING STUDY

of

BEAR CREEK DRAINAGE BASIN

COLORADO SPRINGS, COLORADO

Gentlemen:

Enclosed herewith is the report concerning the engineering study of the Bear Creek Drainage Basin, authorized by the City Council of the City of Colorado Springs, the Colorado Springs Drainage Board, and the Public Works Department of the City of Colorado Springs.

This study includes an overview of basin geology, rainfall/runoff characteristics, hydrologic history and of the channel improvements existing in the basin. Additions to existing drainage improvements are recommended in this study, together with rating and some upgrading of the existing structures.

The study may be used as a master guide for drainage improvements within the basin. The included recommendations should be used as a guide, not as an inflexible design.

Respectfully submitted,

LINCOLN-DeVORE TESTING LAB., INC.

By: George D. Morris, P. E.
By: Kathryn A. Phillips
Civil Engineer

GDM/ss

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Pueblo, Colo 81001
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Rock Springs, Wyo 82901
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SCOPE AND GENERAL REQUIREMENTS OF THE STUDY:

The Bear Creek Drainage Basin was previously studied in 1972, by R. Keith Hook & Associates. Some studies have been made for individual, relatively small areas, but no other major drainage or "flood plain" plan could be found for any major portion of the basin.

Although construction has continued in the area since 1972, the basic street pattern of existing developed areas is the same in 1980 as it was then. This is due to the fact that the major subdivision developments were planned and constructed by one development company. The location and establishment of Bear Creek County Park aided in this by removing a large amount of developable land from the basin. It has been assumed that the park will be maintained, thus keeping this large area clear of development of runoff increasing units.

New developments are being proposed at this time, however. These are mostly on the upper alluvial fan, above the "Skyway" subdivisions, eventually extending to the Gold Camp Road. Individual tracts have already been developed in this area. The City encouraged policy of "infilling" will eventually complete development of the lower areas not within the bounds of the park.

It is desirable to update drainage basin studies periodically to keep pace with changes in development type and changes of street and drainage patterns within an individual basin. This report is intended to furnish the basis for the overall plan for placing new, and replacing old, drainage structures within the basin at the time of development.

To date, the major subdivisions in the area have developed in a planned manner. The more or less individually developed tracts in the upper basin have developed in a more random manner along a series of roads. These roads have been modified to fit the topography, but in general, can be described as a rough grid system. Such a system cannot be universally applied on this type of topography, and changes in this system are inevitable when areas become more completely planned. For this reason, some proposed streets have been shown in this report. These have been placed in the best locations to aid in draining the area and will probably change to some degree upon site specific planning.

Although slopes are generally steep throughout the area remaining to be developed, some systems of runoff retention can be used and have been proposed. Such systems cannot be large retention reservoirs, since proper sites simply do not exist in the area. Smaller systems, designed only to retard the flow to a degree must be used, from a practical point of view. Such a system is proposed herein at those points at which this system is workable.

With a partial retardation system and complete use of existing ditches in the area, the use of long underground storm sewers can be greatly reduced. Certain storm sewer systems must be constructed to direct water and protect existing structures and streets. For the most part, however, required sewer systems have been minimized. Those studies of basins which have been commissioned by the City in the past have provided the basis for an overall storm sewer system. This study proposes such a basis while reducing major structures to a minimum.

This study is designed to compute the probable runoff flow at points throughout the basin, as determined by the presently existing City of Colorado Springs rainfall/runoff criteria. In this respect, the flows of the previous report have been changed to be consistant with the higher rainfall values now being used.

In addition, existing drainage structures throughout the basin were evaluated with regard to the existing runoff rates. Changes in or replacement of existing structures were to be recommended if such change is required. The study was conducted in two parts. The upper basin, generally in the National Forest, was studied only to the extent of determining the major stream flow and any existing constrictions in the channel. The lower basin, partially developable, was to be studied in detail.

The adequacy of existing drainage structures and drainageways is determined in this study. Recommendations for general improvements and changes required to ensure safe disposal of runoff are presented. The very steep grades of much of the area has restricted the use of larger retention structures, so a proposal for small, retarding designs is presented. Lining material for various ditches is recommended, considering both the velocity of flows and the fact that most of the ditch system passes through park areas.

The intent of a study of this type cannot be to establish precise locations, sizes or details of design for storm sewers, ditches, culverts and other appurtenances. This can be done at points of major structures along the main channel, but is not practical in areas which may develop differently than assumed. It is intended to establish the need, general location and probable size of required systems. The major channels have been formed by nature and exist as the main stream of Bear Creek and various "gullies" across the fan. This part of the system can be predicted with relative ease simply due to the fact that it already exists and has not been blocked, for the most part.

BASIN DESCRIPTION:

The Bear Creek Basin contains approximately 10.8 square miles and lies generally southwest of central metropolitan Colorado Springs. The Bear Creek Drainage Basin consists of four major sub-basins, all of which are collected directly into Bear Creek at various points. Each of these four major sub-basins has been further sub-divided into several smaller sub-basins. The boundaries between these basins are not clearly defined at all points and the boundaries are crossed by culverts at a number of points.

Except for a small portion of the southwest corner of the basin which lies in Teller County, the entire Bear Creek Basin lies within El Paso County. The eastern third of the basin is partially in the City of Colorado Springs, while the western two-thirds of the basin is almost entirely within the Pike National Forest. The majority of the southern basin boundary is defined by the ridges separating it from the North Cheyenne Creek Basin, and the eastern portion of the southern boundary is defined by the rolling hills separating it from this portion of the Cheyenne Creek Basin. The northwest corner of the basin is defined by the ridges separating it from the south Ruxton Creek and Willow Creek Basins, while the remainder of the northern basin boundary is defined by the ridges to the west and rolling hills to the east, separating it from the Sutherland Creek and Fountain Creek drainage basins. The eastern boundary is, of course, Fountain Creek, which serves as the outfall.

The topography of the basin is steep and rough in the upper portions and more rolling in the east. The upper basin is relatively narrow with steep side drainage to the creek. The central eastern portion of the basin is also relatively narrow, but the side drainage is less steep due to the fact that the area consists of an alluvial fan. The far eastern portion of the basin can only be described as a series of rolling hills with channels that are barely definable in some areas.

Existing development in the far eastern portion of the basin has not changed the overall direction of drainage flow in any significant way. Some culverts in the area have acted to alter the direction of street flows at specific points, but this is, for the most part, relatively insignificant. The hills around the major streams are sufficiently steep that flow direction can be altered only with the greatest difficulty. Drainage throughout the basin is basically dendritic and uncomplicated. The flow is generally collected in the main stream via a number of small tributaries and flows directly into Fountain Creek. Nearly all the tributaries are normally "intermittent" streams and do not carry much water, except after storms or during the snowmelt period.

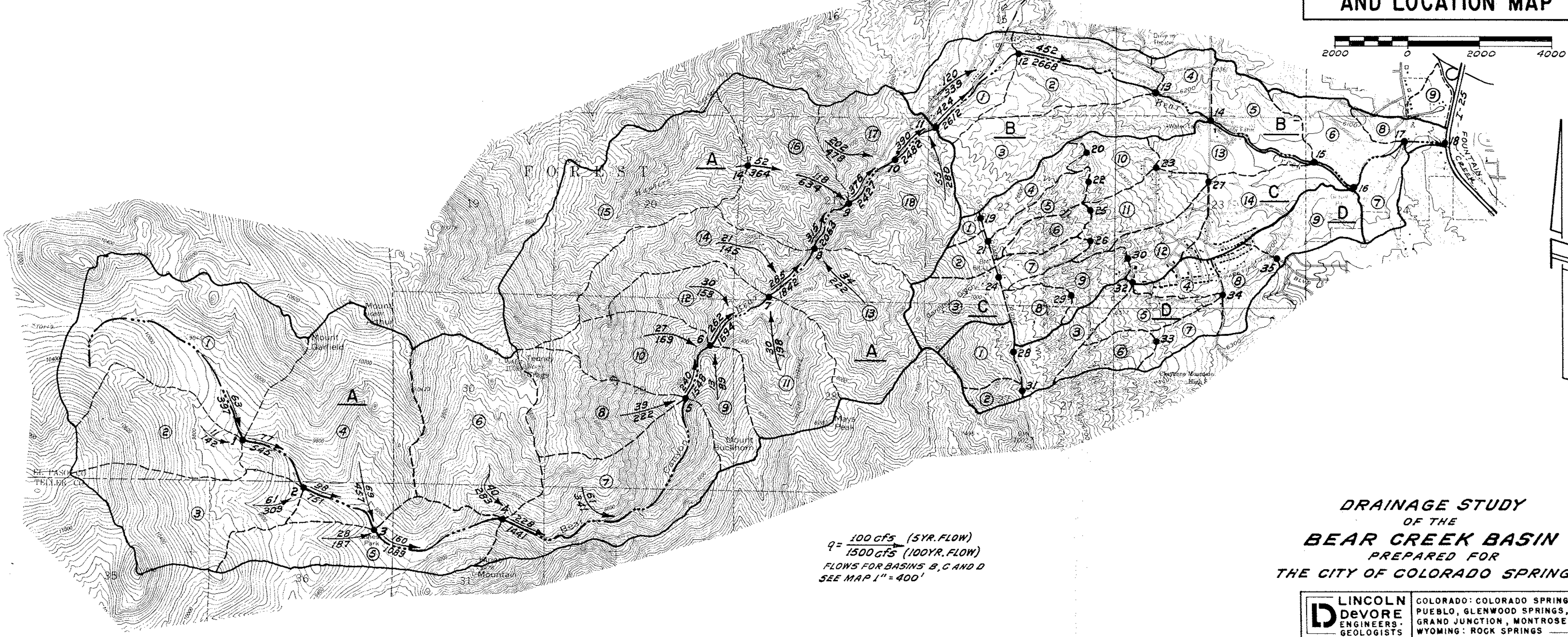
The existing development within the basin has been of two distinct types. A large area along Bear Creek and the northern boundary has developed as a county park. The existence of this park reduces the possibilities for future development which would cause increases in water runoff. An exception to this is the presence of the rodeo stadium on a portion of this park. It must be assumed that eventually a significant portion of this site will be paved. This would, of course, increase runoff in this area.

The second existing development type is that of a large single family residential area (1/3 acre or less) on the lower portions of the alluvial fan east of the Front Range. This was constructed with some regard for drainage, but with little in the way of storm sewer or ditch systems. Real flooding has been minimal in the area since the subdivisions were constructed. Runoff quantities have been increased, however, and some of the streets are presently overloaded, or nearly so, by the 5 year rainfall.

Only one large area is available for future development. This consists of the upper portion of the alluvial fan, between the existing "Skyway" Subdivisions on the east, west, across the Gold Camp Road to the National Forest boundary. This entire area is quite steep and special sub-division designs will be necessary in order to develop it. Great care must be used to detain runoff, preventing major erosion and damage to "downstream" improvements, both existing and proposed. Some of the area is so steep that development will be very difficult. For this reason, the area has been divided into an area of 1/2 to 1 acre tracts, and an area of 1 to 2 acre tracts. It appears that practical considerations will force development into these categories, considering average land use possible.

In addition, a few areas can be developed into residential units of 1/3 to 1/2 acre sites. In gneral, these are not sufficiently large to have significant effects on overall flow, but have been considered in the proposals

BASIN BOUNDARY MAP AND LOCATION MAP



DRAINAGE STUDY
OF THE
BEAR CREEK BASIN
PREPARED FOR
THE CITY OF COLORADO SPRINGS

LINCOLN DeVORE ENGINEERS-GEOLOGISTS	COLORADO: COLORADO SPRINGS, PUEBLO, GLENWOOD SPRINGS, GRAND JUNCTION, MONTROSE, WYOMING: ROCK SPRINGS	
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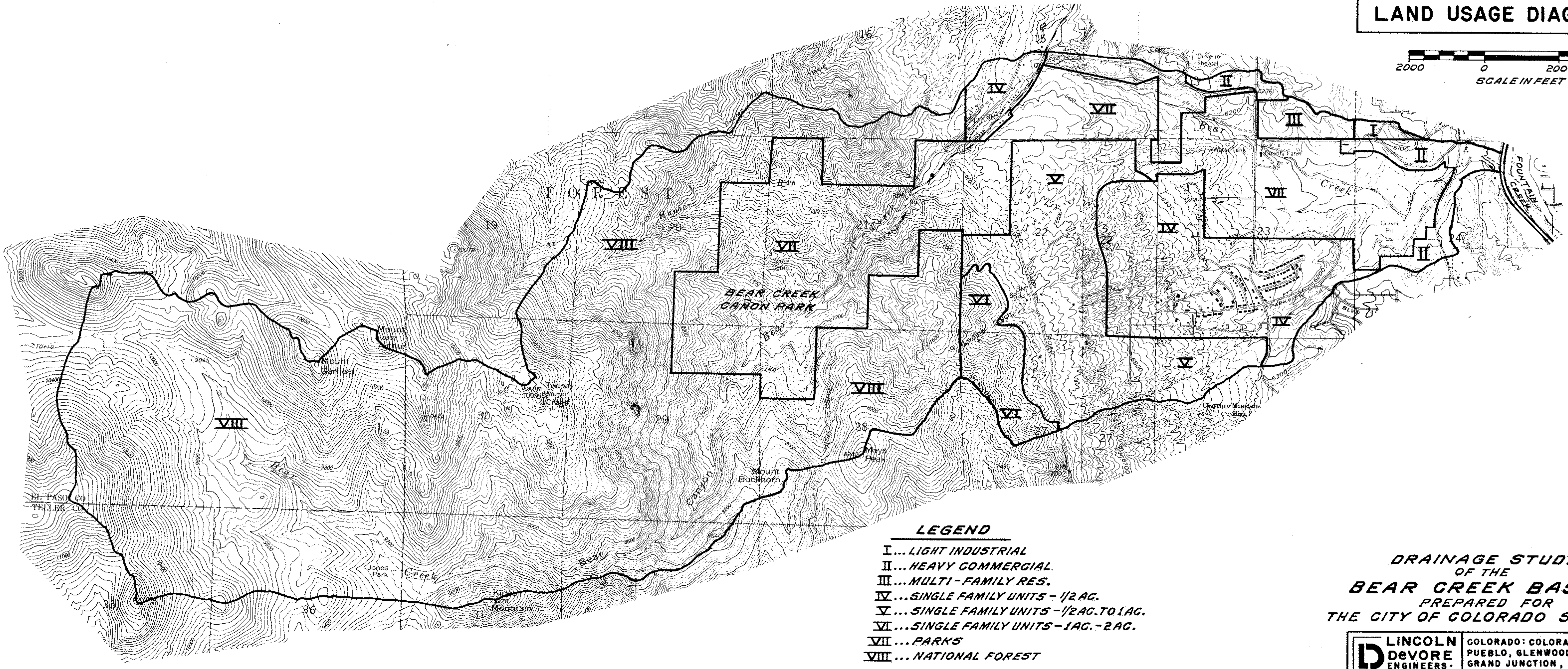
LAND USAGE DIAGRAM

2000 0 2000 4000
SCALE IN FEET



LEGEND

I ... *LIGHT INDUSTRIAL*
II ... *HEAVY COMMERCIAL*
III ... *MULTI-FAMILY RES.*
IV ... *SINGLE FAMILY UNITS - 1/2 AC.*
V ... *SINGLE FAMILY UNITS - 1/2 AC. TO 1 AC.*
VI ... *SINGLE FAMILY UNITS - 1 AC. - 2 AC.*
VII ... *PARKS*
VIII ... *NATIONAL FOREST*

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contained herein. For all practical purposes, the Old Bear Creek Canyon Subdivision can be enlarged to a degree, but this would be the furthest subdivision west within the basin. West of this, is the National Forest and Bear Creek Canyon Park control development.

Rather minor commercial areas exist within the basin. These are concentrated along 8th St. and 21st St., outside of the park area. Although runoff will be high from these areas, they are small and in the lower portions of the basin. As a result, they have little effect on drainage appurtenances.

BASIN GEOLOGY, SOILS, AND WATER TABLE:

With the exception of the strip of land along the Ute Pass Fault, basin geology of the Bear Creek Basin is not complicated. For the most part, the basin to the east of the fault is underlain by the Pierre Shale Formation. The major portion of the basin to the west of the fault is underlain by the Pikes Peak Granite, with a small portion of Subbasins A-6 and A-7, underlain by the Mt. Rosa Granite and the Fayalite Granite. Along a narrow band paralleling the Ute Pass Fault, there are outcropings of the Niobrara Formation, the Carlisle Shale, Greenhorn Limestone, Graneros Shale, the Dakota Sandstone and Purgatoire Formation, the Morrison Formation, the Lykins Formation, and the Lyons Sandstone. We direct you to the Surficial Geology Map for a better understanding of this outcrop.

The Pierre Shale has been described as a dark gray to black, thinly bedded, marine shale of high density. Some of the beds are known to be highly bentonitic, and hence, highly expansive. However, most of the shales only have a moderate swell potential. The Pierre Shale is found on the surface of the ground over a fairly large area of the eastern portion of the basin. This shale weathers easily upon exposure to air and water, but even when highly weathered, is resistant to infiltration and increases the runoff from any given rainfall to a considerable degree. The Pierre Shale has a hydrologic "D" classification.

A large area of the shale just east of the Fault is overlain by an alluvial fan deposit. This material is derived from the Pikes Peak Granite and from various older alluvial deposits in the higher portions of the basin. This alluvial fan has a high infiltration rate, and hence, low runoff. The alluvial fan, although underlain by the Pierre Shale, has a hydrologic "A" to "A/B" classification. To the east of this, scattered portions of the Pierre Shale are overlain by alluvial deposits of variable thickness. These deposits include the Rocky Flats Alluvium, the Piney Creek Alluvium, and the Verdos Alluvium. Nearly all of these materials consist of fine grained, silty sands or clayey sands. These areas of alluvial cover have a hydrologic "B" or "C" classification depending on the depth of the deposit.

To the west of the Ute Pass Fault, the area is predominately Pikes Peak Granite, either in a solid state or in a decomposed gravel condition, with alluvial deposits only along Bear Creek and some larger tributaries. This granite is moderate reddish-orange and coarse grained. Joints are prominent in the granite. Pikes Peak Granite weathers mostly by mechanical means and this disintegration usually starts along the joints and gradually invades the blocks, which are commonly weathered to a depth of 15 feet or more. Although the slopes are very steep in this portion of the basin, infiltration is relatively high, therefore, runoff is generally low to moderate. This area has an overall hydrologic "B" classification with scattered areas of "A" and "C" classifications.

The Ute Pass Fault, located approximately at the base of the mountains, was formed during the Laramide Orogeny. The local complex folding, faulting, and steeply tilted and sometimes overturned strata found in this area is dramatic evidence of this mountain building episode. Studies done on the Ute Pass Fault conclude that evidence of Quaternary Fault movement is not definitive, although certain circumstantial evidence indicates two possible episodes of activity during the Quaternary. Evidence suggest that major fault movements and related earthquakes have not occurred on the fault zone during the last 200,000 years, however, the Ute Pass Fault is designated as a potentially active fault. Any activity along this fault could not compare in magnitude and frequency with areas such as California, but both small and moderate shocks can occur.

The sequence of shales, limestones, siltstones and sandstones that constitute the several formations easterly of the fault zone have predominately a hydrologic "C" classification, however, in areas of alluvial deposits, there is a hydrologic "B" classification. There is also an area easterly of the fault zone mapped as a landslide. This landslide area has a hydrologic "A" classification.

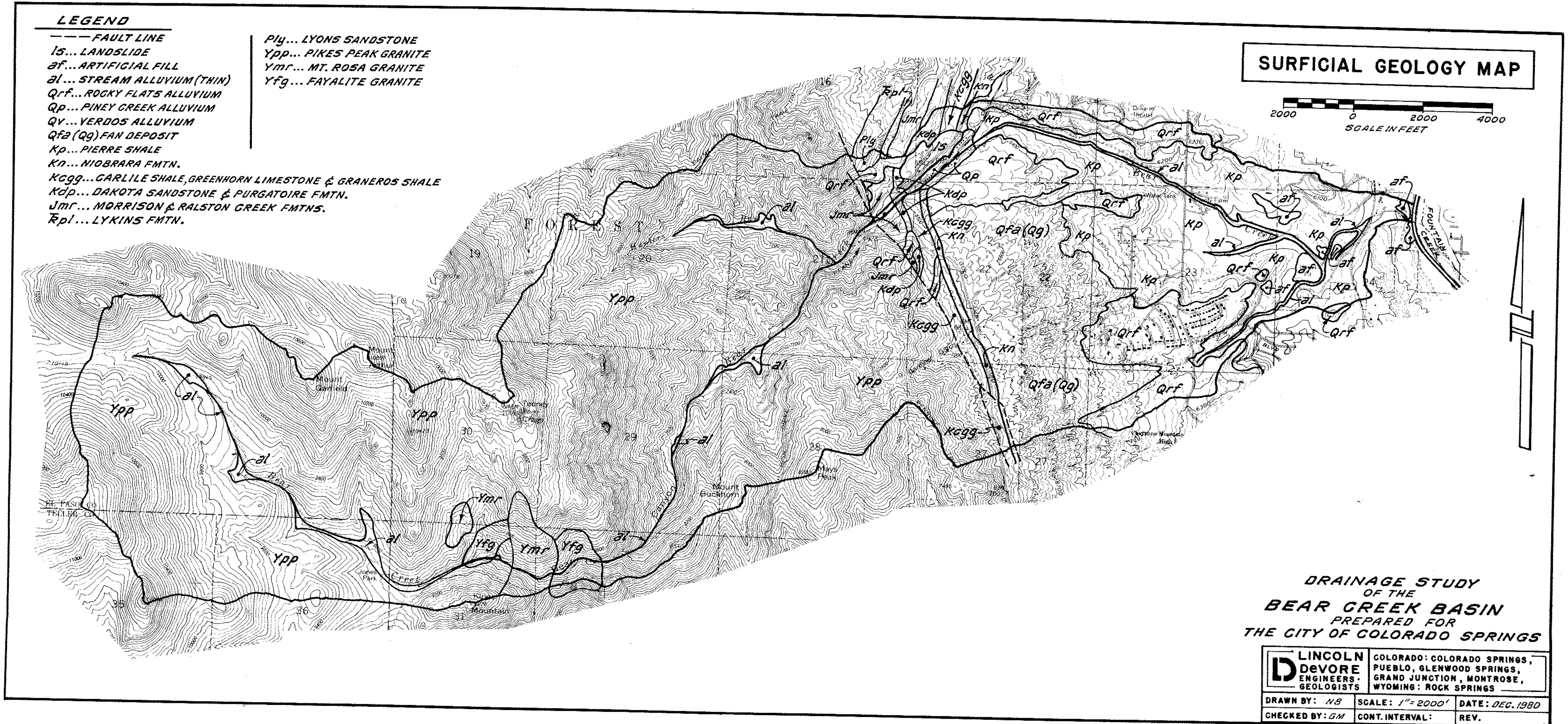
As the streambeds are closely controlled by the geologic features in this area, the underground water table is also so controlled. The only points which contain major free water below the surface of the ground are in areas of alluvium immediately along the line of Bear Creek. Some areas which have relatively flat topography near the creek may tend to be slightly swampy, but the majority of the basin consists of relatively hard, dry soils with very little underground free water.

Since the alluvial fan between the fault area and the lower subdivisions is composed of sands and gravels with high infiltration, it has a tendency to act as a flow retarding area (sponge). Rainfall must be extremely high for this area to produce large amounts of water. In general, the water will infiltrate the fan, forming a relatively temporary water table, releasing this water slowly at various points within the "Skyway" group of subdivisions. Springs have been common along the eastern edge of the alluvial fan for well over 100 years. This water table and the springs, tend to be transient, however, and appear to be completely dependent on the annual rainfall.

The effect of the fault zone on runoff from the west is indirect and only partially understood. It is known that the fault tends to trap subsurface water from the Pikes Peak Granite in an area of North Cheyenne Creek immediately south of this basin. When properly tapped, it tends to produce relatively large amounts of water. If this is true in the Bear Creek Basin, the effect would be to remove the possibility of a "permanent" water table in the alluvial fan to the east. The rather extreme dependence of the fan on seasonal weather for production of a stable water table would indicate that some blockage of normal seepage is created by the presence of the fault area.

An area of soils immediately north of point 16 is of interest due to its storage and erosive capability in a location near a required backwater area. This is the area of the Portland Mill's tailings pond, placed over the native Pierre Shale at the turn of the century. This soil classifies as a very fine grained sand of extremely uniform grain size.

Due to its grain size characteristics, the deposit is very permeable and of low slope stability. Structures placed in this area will require careful design. When the backwater area is filled with storm water during the 100 year storm, slope instability will be a problem. Any ditches or structures in this area must be cleaned after major storms due to the bank instability.


LEGEND
FAULT LINE
ls... LANDSLIDE
af... ARTIFICIAL FILL
al... STREAM ALLUVIUM (THIN)
Qrf... ROCKY FLATS ALLUVIUM
Qp... PINEY CREEK ALLUVIUM
Qv... VERDOS ALLUVIUM
Qfa (Qg) FAN DEPOSIT
Kp... PIERRE SHALE
Kn... NIOBRARA FMTN.
Kcgg... CARLILE SHALE, GREENHORN LIMESTONE & GRANEROS SHALE
Kdp... DAKOTA SANDSTONE & PURGATOIRE FMTN.
Jmr... MORRISON & RALSTON CREEK FMTNS.
₽pl... LYKINS FMTN.
Ply... LYONS SANDSTONE
Ypp... PIKES PEAK GRANITE
Ymr... MT. ROSA GRANITE
Yfg... FAYALITE GRANITE
SURFICIAL GEOLOGY MAP
2000 0 2000 4000
SCALE IN FEET
Mount Arthur
Mount Garfield
Mount Buckhorn
Mays Peak
Kineo Mountain
Jones Park
Bear Creek
Fountain Creek
EL PASO CO
TELLER CO
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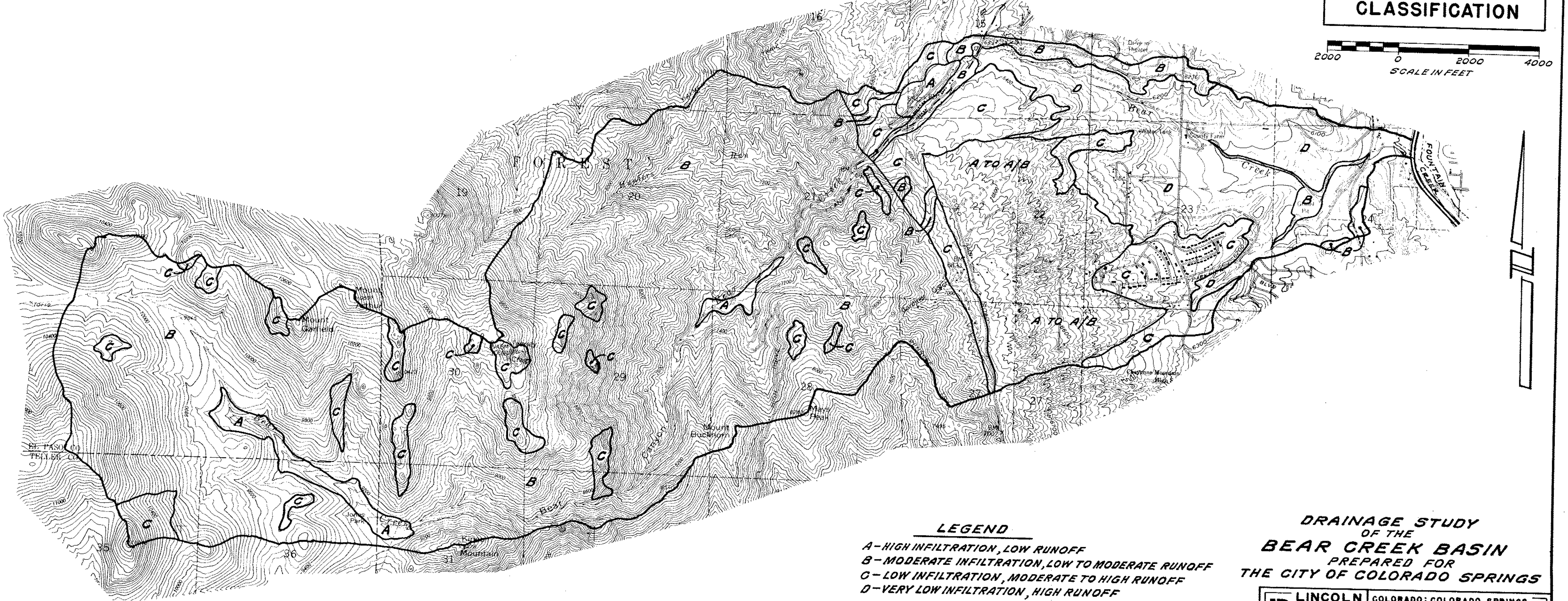
HYDROLOGIC SOILS CLASSIFICATION



LEGEND

A - HIGH INFILTRATION, LOW RUNOFF
B - MODERATE INFILTRATION, LOW TO MODERATE RUNOFF
C - LOW INFILTRATION, MODERATE TO HIGH RUNOFF
D - VERY LOW INFILTRATION, HIGH RUNOFF

DRAINAGE STUDY OF THE BEAR CREEK BASIN PREPARED FOR THE CITY OF COLORADO SPRINGS

LINCOLN DeVORE ENGINEERS-GEOLOGISTS
COLORADO: COLORADO SPRINGS, PUEBLO, GLENWOOD SPRINGS, GRAND JUNCTION, MONTROSE, WYOMING: ROCK SPRINGS

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RAINFALL AND RUNOFF PATTERNS:

The average annual precipitation within the Bear Creek drainage basin is a bit higher than that for other portions of Colorado Springs. This is due to its higher elevation and the fact that it is slightly to the south of the "rain shadow" created by the higher portions of the Pikes Peak Massive. Total average annual precipitation is believed to be approximately 15.8 inches (40.13 cm) although only unofficial records exist. The central weather bureau station is at Peterson Field, approximately 10 miles east of the central basin area. About 45% of this precipitation falls in the form of snow, with greater amounts of snow falling on the higher mountain slopes.

Snowmelt does not produce the highest peak flow in this basin, or in any of the other mountain type basins, for that matter. The snowmelt runoff from Bear Creek was rated, but primarily for use as a base flow for the usually higher spring rain storms. Snowfall can be expected in the basin in any month except that the probability is quite low for June, July and August.

Slightly over half of the annual precipitation within the basin occurs in May, June, July and August. The major rainstorms are generally of two types: 1) the slow, 3 to 4 day "upslope" condition which can produce high precipitation, but over a longer period of time; and, 2) the intense, summer thunderstorm of high intensity but of short duration.

Of these two storm types, the long term, upslope type storm generally produces large total quantities of water, but relatively low peak flows. The most damaging function of this type of storm is to increase the antecedent moisture condition of the soils in the basin. A properly timed, intense thunderstorm can then produce very high peak flows.

The second type normal to the area is a high intensity, short duration thunderstorm. This will produce the highest peak flow in runoff under most conditions of antecedent moisture, although the total quantity of water may not be great. If such a storm is assumed to take place over the entire basin, the runoff flow is greatest. The Type IIA storm has been developed to simulate this condition of high runoff flow and has been used in essentially its present form since 1975 by the City of Colorado Springs. Its principal use is the determination of flood flow, for design purposes, within larger area channels. The so called Type IIA storm was developed by the NOAA and the SCS to simulate such thunderstorms east of the mountain front in the western United States. This storm is one of six hour duration, with a one hour burst of rainfall during the second hour. In its effect, it is not greatly different from the one hour thunderstorm used locally until 1972.

The Type IIA storm cannot be easily categorized, due to the intense, one hour burst of rainfall. It is listed as a 6 hour duration, 3.5" total rainfall, storm. It could just as easily be categorized as a one hour duration, 2.12" intensity storm with a one hour duration, .07" intensity rain preceding it and a varying intensity (from .02" to 1.3") rainfall following the one hour burst for a period of 4 hours.

In any event, the total rainfall for a storm of this type, given by the NOAA and by the City of Colorado Springs is as follows:

	5 year frequency	100 year frequency
1. NOAA	1.88"	3.55"
2. City of Colorado Springs	2.10"	3.50"

The Bear Creek drainage basin is approximately 10.8 square miles in area, which is not so large that the storm could not cover the entire basin. The area is so close to the 10 square mile norm used by most hydrologic methods, that no reduction in the rainfall should be used in calculation. Such storms move generally from west to east, tending to reinforce the peak flow in the main channel. Several storm patterns were considered and it was determined that the maximum peak runoff would be produced if the storm were centered between points 6 and 7 (on Bear Creek) at the time of its rainfall "burst".

Conversely, experience has indicated that those drainage basins originating in the foothills of the Front Range near Colorado Springs do not have as high peak flows as those basins originating on the high plains to the east. Rainfall patterns of major storms, plotted from the information available, are shown on a map of the area. The two largest flood producing storms, together with other major, but somewhat smaller storms indicate a pattern of storm activity in a band, six to eight miles wide, over and across eastern Colorado Springs. The approximate axis of this band is shown on the map and appears to be roughly parallel with the mountain front.

With a few exceptions, rainfall near the mountains can be high, but has not reached the extremes noted in the storms to the east. The exception to this appears to be the Cheyenne Mountain Thrust. Partly for orographic reasons, some higher intensity storms have centered over the Cheyenne Creek and Turkey Creek Basins, producing relatively high runoff. Only one major storm, producing high runoff, is recorded over the Bear Creek Basin. Unfortunately, records of this are all unofficial and very "sketchy". Damage did occur in the Bear Creek Canyon and County Farm areas, however, together with some damage at the Portland Mill site. Insofar as is known, no measured runoff data exists within the basin.

The most notable recent storms close to the mountain front include the 1965 Monument-Palmer Lake storm, the 1967 Ivywild-Broadmoor area storm, the 1967 and 1978 Mesa area storms, the 1978 north Colorado Springs storm and the 1979 Manitou storm. All of these storms caused damage and some street flooding. Only the Monument-Palmer Lake storm caused major flooding, however.

The City of Colorado Springs drainage criterion requires computation of both the 5 year frequency storm and of the 100 year frequency storm. Until the runoff from the 100 year storm reaches 500 cfs, drainage appurtenances must be designed for the 5 year frequency runoff. When the runoff exceeds 500 cfs, drainage appurtenances must be designed for the 100 year frequency runoff.

Within this basin, the runoff exceeds 500 cfs only in the major channels. Appurtenances in these channels have been sized to permit passage of the 100 year frequency flows. In all cases of subdivisions and developed areas, either existing or proposed, the drainage appurtenances have been sized for the 5 year runoff.

For the purposes of this report, the City of Colorado Springs, criteria for rainfall and runoff have been followed for calculations. The runoff was computed by the modified SCS methods for Colorado and checked by the HEC-1 program, based on Snyder's coefficients. The antecedent soils moisture conditions was taken as normal (Type II) and the storm was centered between points 6 and 7.

The runoff in the upper basin was computed taking the variable soil conditions into account as well as bare rock areas and bank storage areas along the main channel. The effect of Jones Park was also noted. For the most part, this upper basin runoff was considered as entering Bear Creek and moving to point 10. No "local" problems were considered, since the upper basin is nearly all within the bounds of the Pike National Forest and no significant development is anticipated.

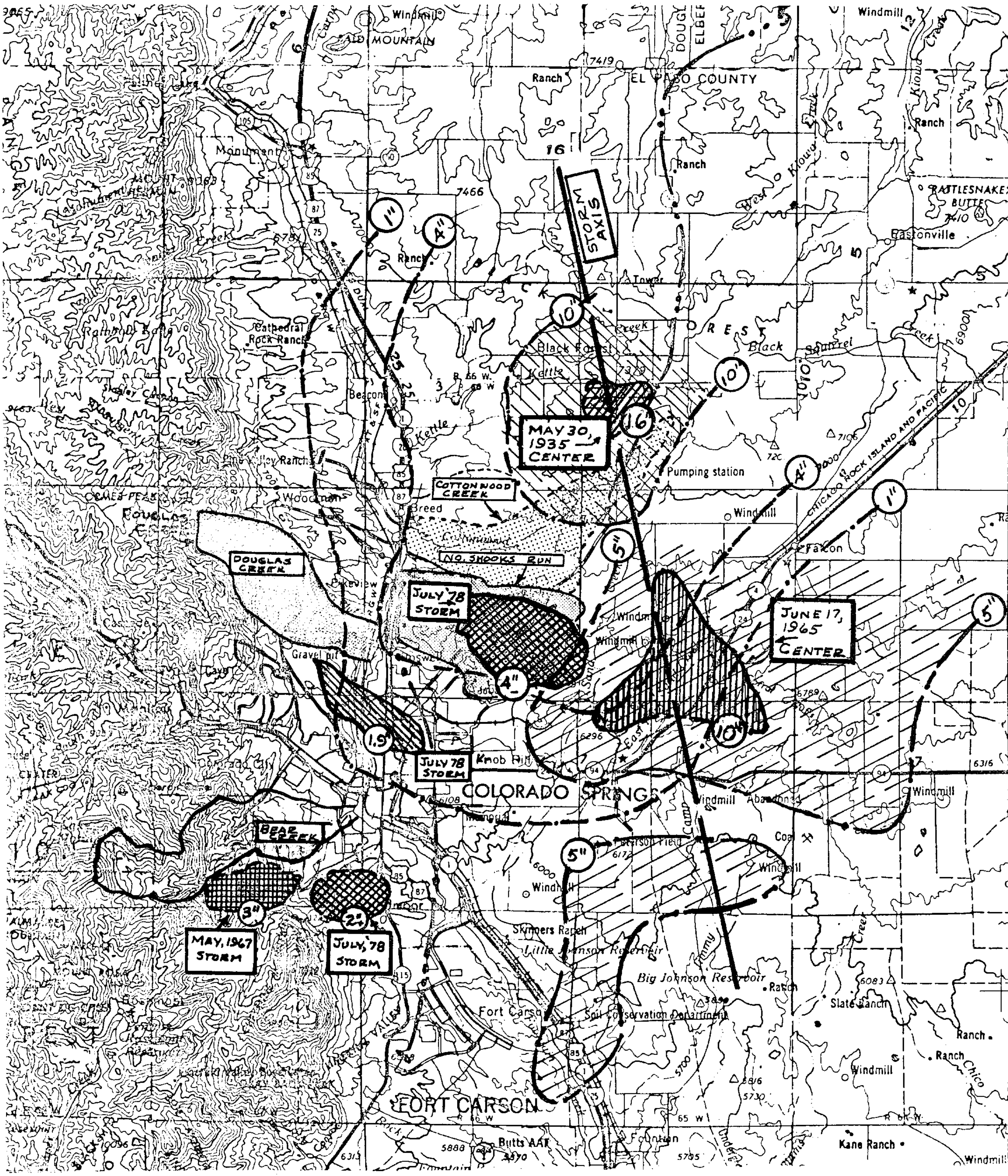
From the point of crossing the Gold Camp Road (approximately at point 10), however, local problems were noted and considered together with local flows. From this point (10) to the east, the land is considered developable and its use may change--with the probable exception of the County Park. Local peak flows in this area are not necessarily related to the peak flow in Bear Creek due to the effects of time on the hydrographs. Local peak flows were therefore used to calculate local drainage conditions. The total peak flow along Bear Creek and the south (Parkview) channel were used to calculate required structures along these channels.

Typical runoff hydrographs were computed and plotted for stream points 11, 14, 17 and 18. These points correspond respectively with the creek crossings at Gold Camp Road, 21st St., 8th St., and Highway I-25. Hydrographs are not included in this report, but were computed for a number of small retarding structures recommended for the upper alluvial fan area just east of Gold Camp Road.

These retarding structures have been planned for a proposed subdivision in this area. Defacto retarding structures already exist along Gold Camp Road which reduce 5 year frequency flows considerably. This system was elected for use in the upper fan areas. This system must consist of small structures due to the general topography. Large scale retention structures are not feasible. The runoff pattern and drainage systems in this area were calculated based on this time retardation system.

The entire basin was divided into 4 major internal basins and an outfall point assigned for each. These major internal basins were then divided into a total of 50 local sub-basins. These basins were selected on the basis of topography and on the basis of existing man-made physical features. In this manner, the best picture of the runoff pattern can be developed. Peak runoff flow was determined for each desired frequency of rainfall and for each sub-basin. These peak flows were routed through the appropriate major channels to their intersection with Bear Creek. The Bear Creek Channel was routed from the upper end of the upper basin to its point of outfall in Fountain Creek. Routing was accomplished by hand calculator, taking stream flow time into consideration, and was checked by the HEC-1 major drainage program on a computer.

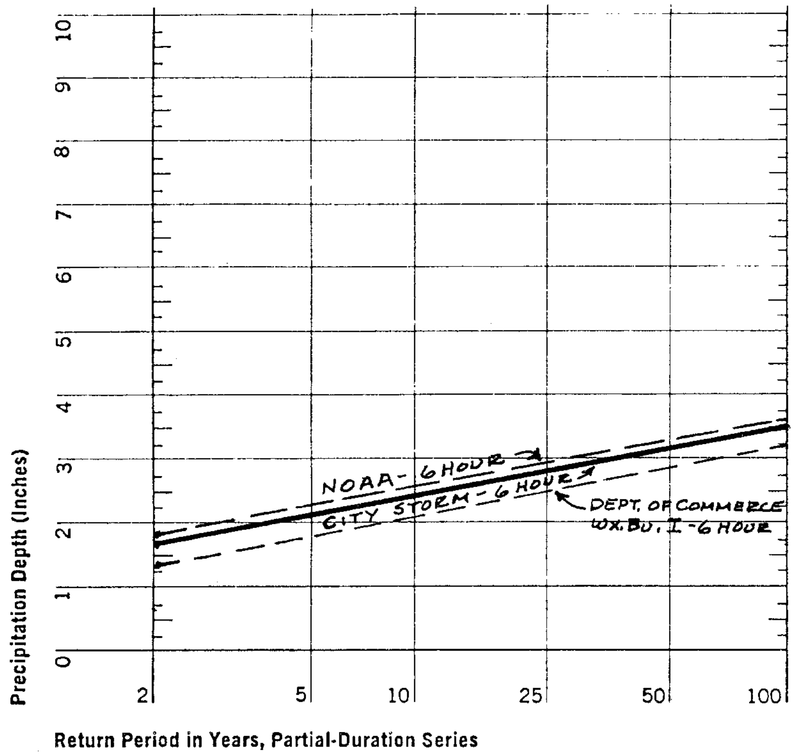
These computations indicate that at the present time, flooding within the developed portion of the basin will be rare and relatively minor. To prevent future problems after further development, however, some changes and additions will be required within the basin.

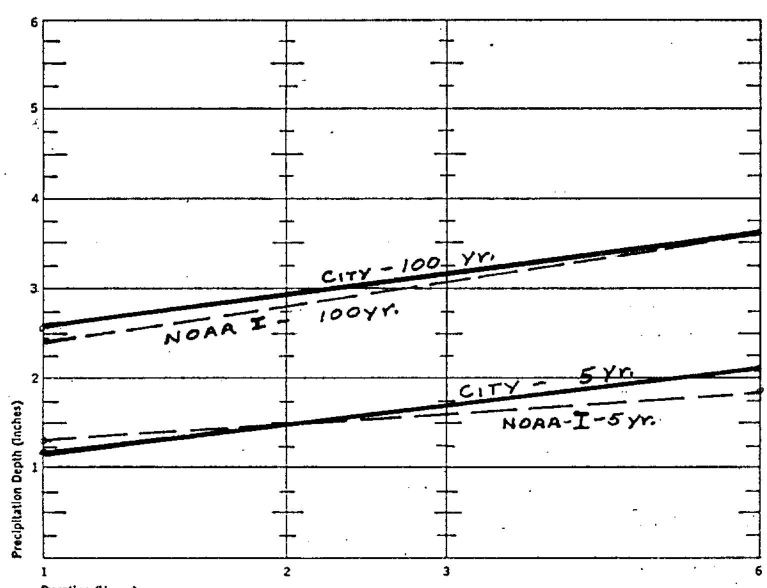


LOCATION OF MAJOR STORM CENTERS
HISTORICAL MAJOR STORMS • UNOFFICIAL

LINCOLN DeVORE ENGINEERS · GEOLOGISTS

COLORADO: COLORADO SPRINGS, PUEBLO, GLENWOOD SPRINGS, GRAND JUNCTION, MONTROSE, WYOMING: ROCK SPRINGS



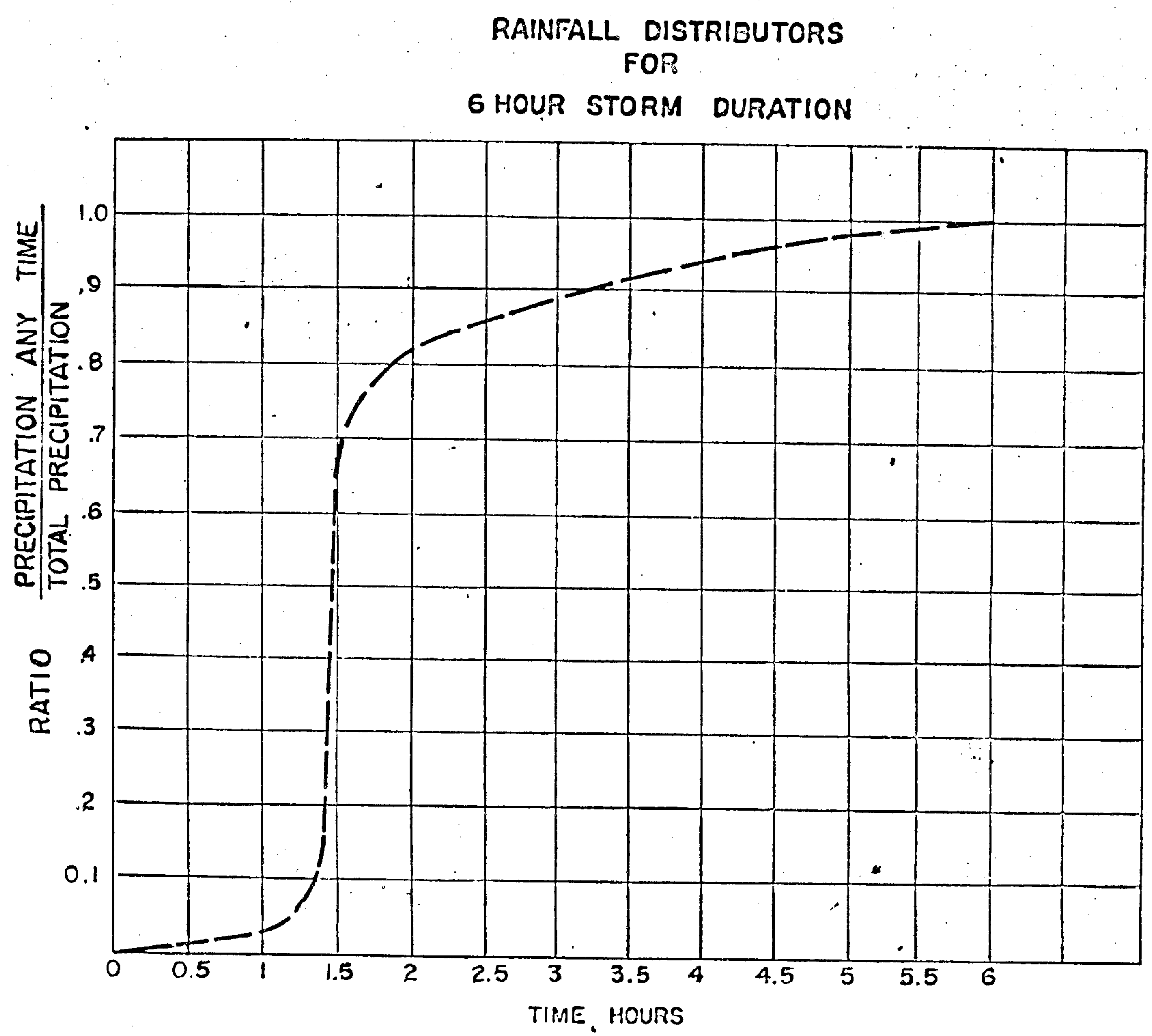


RAINFALL DURATION & FREQUENCY

GENERAL STORM - SOUTHWEST COLORADO SPRINGS

LINCOLN DeVORE
ENGINEERS - GEOLOGISTS

COLORADO: COLORADO SPRINGS, PUEBLO, GLENWOOD SPRINGS, GRAND JUNCTION, MONTROSE, WYOMING: ROCK SPRINGS



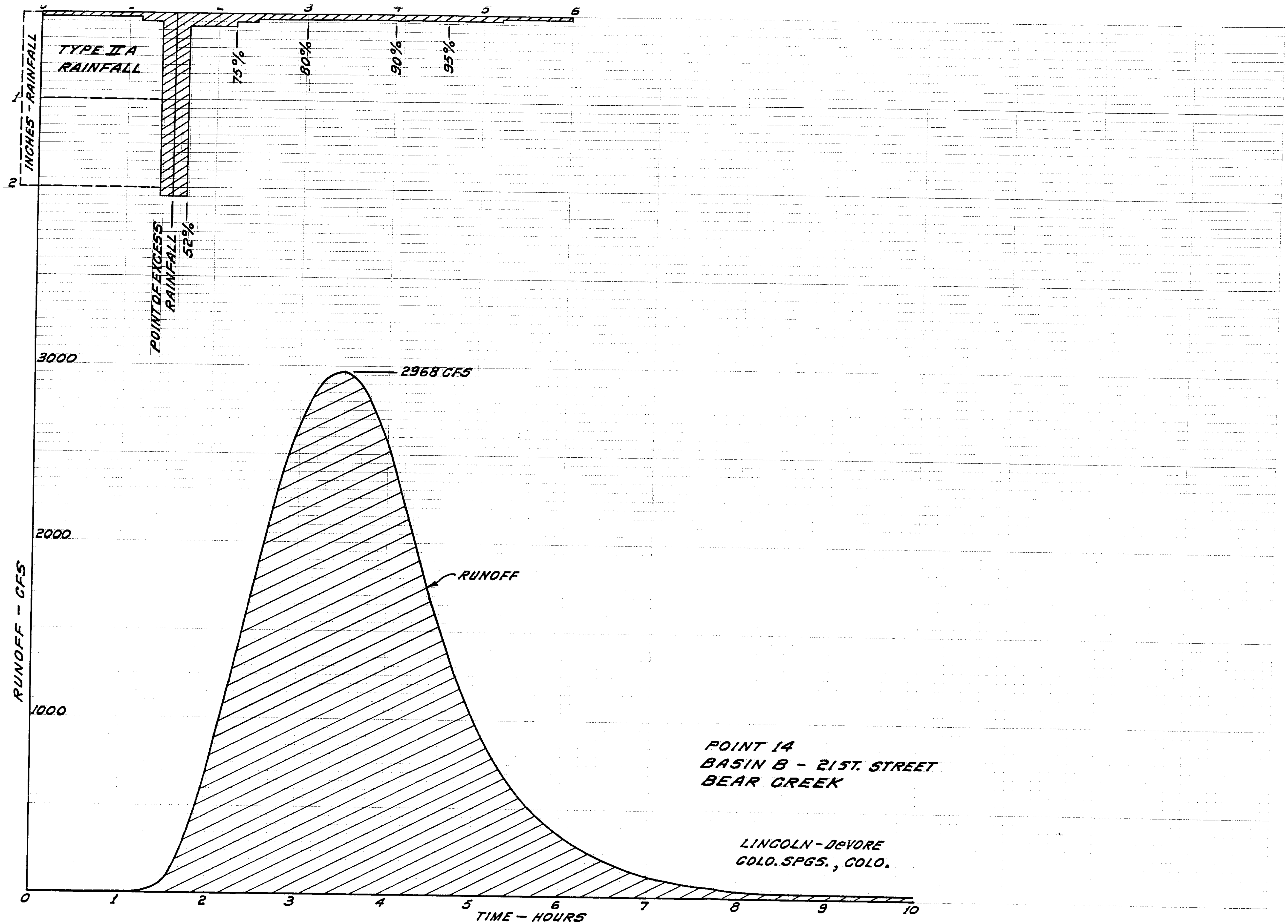
THUNDERSTORM - ADAPTED TO 6 HOUR CONFIGURATION BY NOAA & SCS FOR WESTERN STATES.

TYPE IIA STORM MASS CURVE

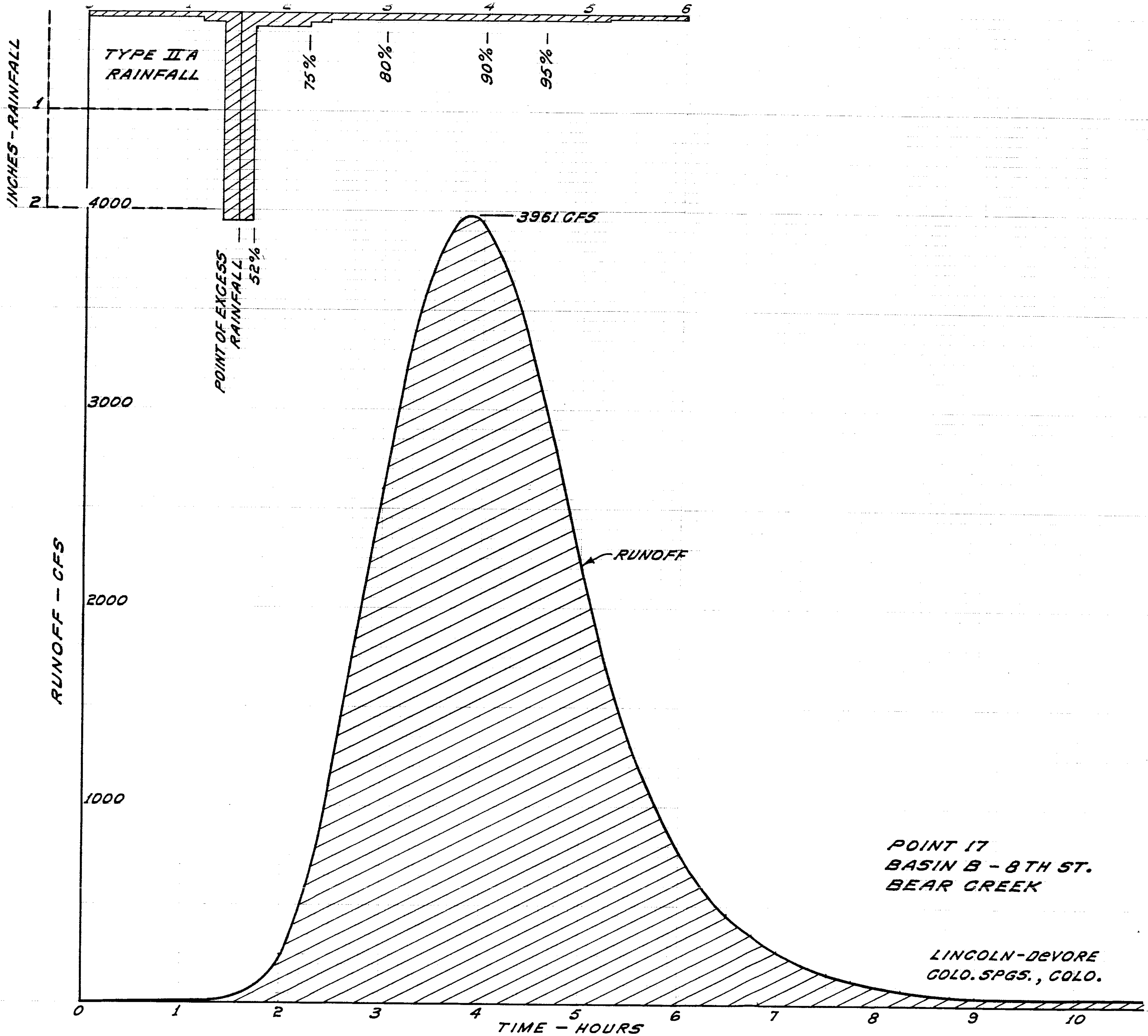
CITY OF COLORADO SPRINGS & PPACG

LINCOLN DeVORE ENGINEERS-GEOLOGISTS

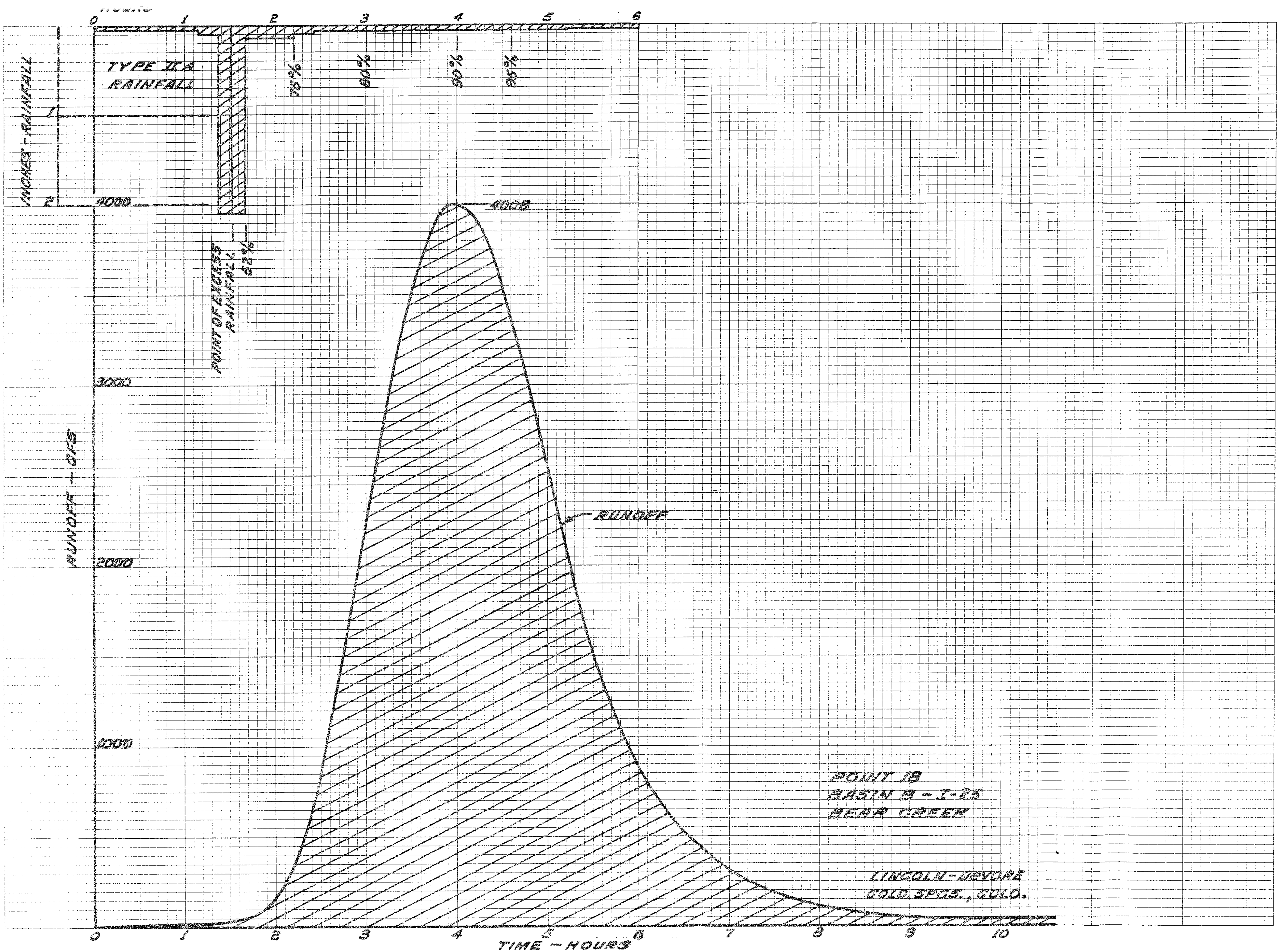
COLORADO: COLORADO SPRINGS, PUEBLO, GLENWOOD SPRINGS, GRAND JUNCTION, MONTROSE, WYOMING: ROCK SPRINGS



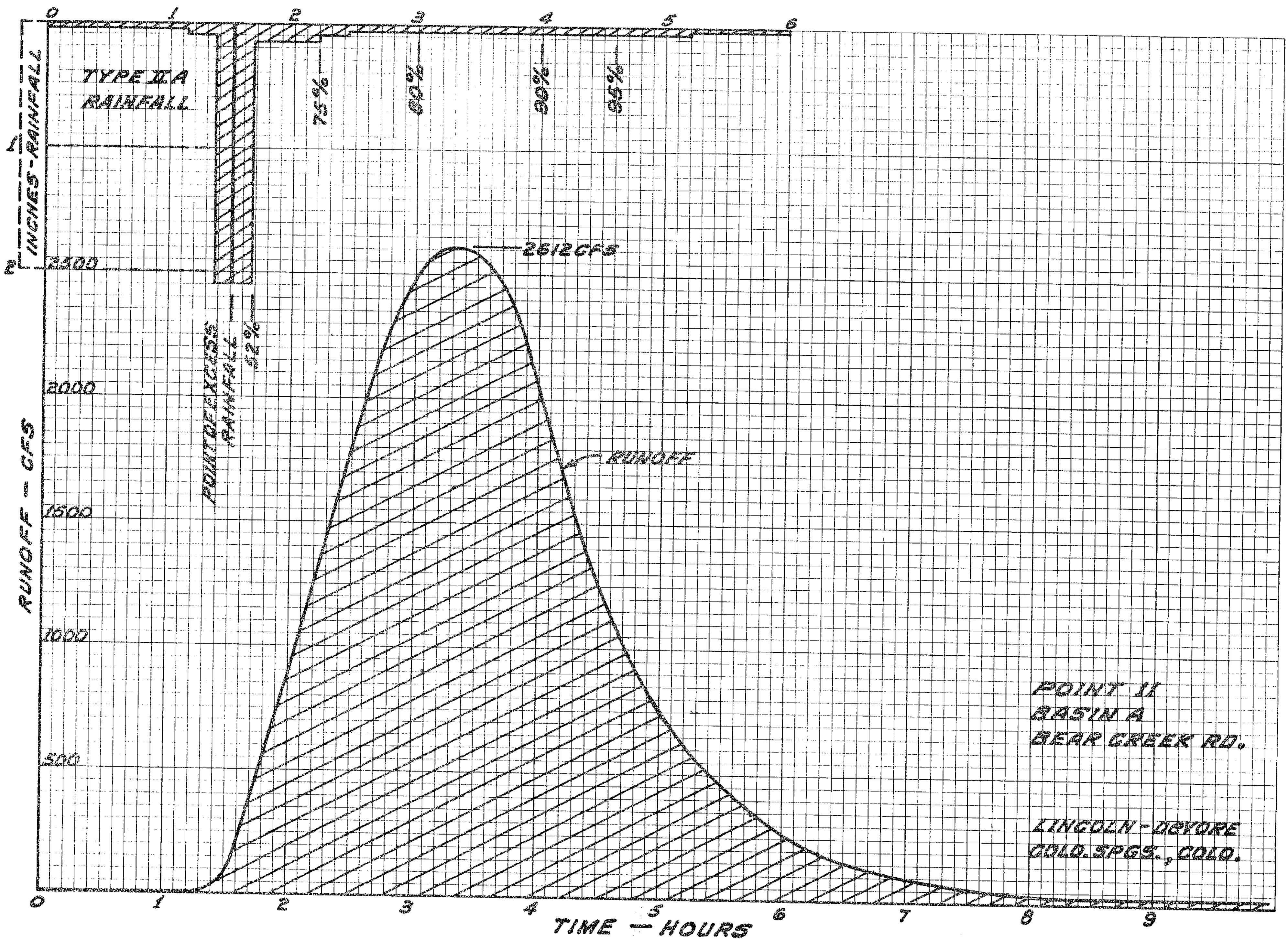
TYPE II A
RAINFALL
INCHES - RAINFALL
2
75%
80%
90%
95%
POINT OF EXCESS RAINFALL
52%
0
1
2
3
4
5
6
3000
2000
1000
2968 CFS
RUNOFF
RUNOFF - CFS
0
1
2
3
4
5
6
7
8
9
10
TIME — HOURS
POINT 14
BASIN B - 21ST. STREET
BEAR CREEK
LINCOLN - DeVORE
COLO. SPGS., COLO.



TYPE II A RAINFALL
INCHES - RAINFALL
1
2
75%
80%
90%
95%
4000
3961 CFS
POINT OF EXCESS RAINFALL
52%
3000
2000
1000
RUNOFF - CFS
RUNOFF
0
1
2
3
4
5
6
7
8
9
10
TIME - HOURS
POINT 17
BASIN B - 8TH ST.
BEAR CREEK
LINCOLN-DeVORE
COLO. SPGS., COLO.



HOURS
0 1 2 3 4 5 6
TYPE II A RAINFALL
INCHES - RAINFALL
1
2
75%
80%
90%
95%
POINT OF EXCESS RAINFALL
62%
4000
4028
3000
RUNOFF - CFS
RUNOFF
2000
1000
POINT 19
BASIN B - I - 23
BEAR CREEK
LINCOLN-DEVORE
COLO. SPGS., COLO.
0 1 2 3 4 5 6 7 8 9 10
TIME - HOURS


TYPE II A
RAINFALL
INCHES - RAINFALL
75%
80%
90%
95%
2612 CFS
POINT OF EXCESS RAINFALL
52%
RUNOFF
RUNOFF - CFS
2500
2000
1500
1000
500
TIME - HOURS
POINT 11
BASIN A
BEAR CREEK RD.
LINCOLN - DEVORE
COLO. SPGS., COLO.

EXISTING DRAINAGE STRUCTURES:

Most of the upper basin, Basin A, is undeveloped and in several areas is inaccessible, hence, there are very few existing drainage structures. The only drainage structures in Basin A are in the lower portions along the High Drive, and they consist mainly of small to medium sized culverts beneath the road. On the whole, these small structures are sized properly but many are partially or fully plugged. There should be periodic maintenance done to keep these culverts functional. There is, however, one area where the pipes are undersized. The main drainage "gulley" of Sub-basin A-11 crosses High Drive in three places before entering Bear Creek at point 7. The three existing pipes should be re-sized to handle the 100 year flow across there.

There are four minor box culverts along the High Drive, all of which are undersized. The first is a reinforced concrete box at point 7; the second is a reinforced concrete box just upstream of point 8; the third is a reinforced concrete box at point 8; and the fourth is a reinforced concrete box just upstream of point 9. Improving the inlet conditions of these structures was considered, but it was finally determined that they would need to be replaced with adequately sized structures. There is also one major structure on the High Drive/Gold Camp Rd, in Basin A, located a short distance upstream of point 10. This structure is adequately sized for the flow at this point. However, the inlet conditions need to be improved.

In this upper basin, water flow is in natural channels throughout. A few minor changes have been made in the natural channel at the box culverts and other structures, but these changes are all minimal.

In the lower, more closely studied, portions of the basin, the main channel of Bear Creek is either entirely in or is bounding Basin B. This basin contains a number of structures, both major and minor, and of varying age. Downstream from the major structure on the High Drive/Gold Camp Road mentioned above, the first major bridge structure on Bear Creek is a double reinforced concrete box under 21st St. (point 14). The second major bridge structure is a double corregated metal pipe located where Bear Creek crosses 8th St. (point 17). The third and final major bridge structure is a double reinforced concrete box at Interstate 25 (point 18). The open area of these boxs and culverts is adequate in all three cases, however, the entry conditions at the structures crossing 21st St. and 8th St. must be improved. A back water area is required behind the 8th St. culverts, and should be preserved.

The only other major drainage structure in Basin B is a recently built 10 foot concrete drop structure at point 17A. The channel is lined for approximately 635 feet above the drop structure. This channel and drop structure are adequately sized, but the lined channel should be continued to point 18, the basin outfall.

There are also several minor structures in Basin B. On Bear Creek, between points 11 and 12, there are two, three-span timber bridges. These bridges are privately owned, however, they would wash out if the 100 year flood were to pass through these points. There is also an undersized corregated metal pipe at point 17 that is, again, private. There is only one existing structure on Bear Creek Canyon Road. It is an oversized masonry box with a corregated metal cap. This structure is above Point 12, and is apparently quite old. There are two corregated metal pipes above point 17 on West Rio Grande and a corregated metal pipe on Gold Camp Road in the upper part of Sub-basin B-3, all three of which are sized appropriately. However, inlet conditions should be improved.

The remaining structures in Basin B are all either undersized, or are insufficient. These would consist of three corregated metal pipes on Bear Creek near point 13; two corregated metal pipes on Gold Camp Road in Sub-basin B-5, one of which is totally buried; and a catch basin and two corregated metal pipes in the vicinity of Penrose Stadium.

Basin C has very few existing drainage structures and several of these are serving no apparent purpose. There is a 6 inch concrete pipe in sub-basin C-12 just off Hercules, five 5 inch x 6 foot curb openings spaced along 21st St. near points 27 and 14; and a reinforced concrete box and corregated metal pipe on Orion which are all basically useless, but can be left in place since they cause no damage. There is a properly sized corregated metal pipe near point 14 on 21st St. and one farther south on 21st that is not of adequate capacity to carry the computed flow by itself. South of point 27 on 21st St. there are three corregated pipes in a row, the southernmost one being undersized.

Basin D, like Basin C, has very few existing drainage structures, most of which are either useless or undersized. This would include a grate and corregated metal pipe at point 34, and two catch basins and two corregated metal pipes near point 35. In Sub-basin D-5 along Taurus, there are three corrugated metal pipes, and on Sirius, below point 35, there is a reinforced concrete pipe, all of which are sized properly. There is also a curb opening, approximately 17 inches x 54 feet at point 34 that is adequate to carry the calculated flow.

Probably the most undersized pipe structure of any importance in Sub-basin D is the 36 inch rebar CMP placed along the primary drainage channel in Sub-basin D under Parkview Dr. A pending proposal to replace this 36 inch culvert with a 3 unit, 3 x 6 RCB should be approved and constructed at the earliest possible time.

In addition to a number of undersized culverts in this area, it was noted that entry boxes and street grates were all of low capacity. It would be surprising if the pipes ever reach their limited capacity, considering these entries.

The numerous small culverts and the major drainage structures in Bear Creek Basin have been plotted as closely as possible on the attached maps, and are also listed in Appendix D and E together with the proposed changes. As in so many basins in the area, the lack of overall drainage structure planning is painfully obvious. With the exception of the major culverts and bridges along Bear Creek itself, any intense point rainfall in this area is capable of overloading any drainage system in the developed areas and occasional local flooding can be expected--possibly with minor damage. If development is to continue, the drainage within these areas must be improved to reduce potential damage.

The major channels have been left in the location and general condition in which they existed when developed. As a result, the channels are winding in places, allowing bend erosion and incomplete capacity. At some points the channels are wide and poorly defined. At others, the channels are narrow and deeply incized. The resulting flow is relatively turbulent--at least during higher runoff periods. This is disruptive, since it forces the use of deeper channels than necessary and larger riprap and structures than would be required by smoother flow. Insofar as possible, this study recommends smoothing the flow in all major channels.

MAIN CHANNEL - DRAINAGEWAYS

For the most part, the primary drainageway channels in the four basins are well defined, have been in existence for many years and are presently being used as outfall points for smaller drainage systems. It is desirable that this system be maintained in future design. This will be the most economical way of removing water from the subdivided areas and it would appear that all major bridges already exist. This system has been continued by this study, with all major channels being designed to carry the 100-year frequency flow as defined by the City of Colorado Springs.

Very little change has been recommended for the main channel in the upper basin, Basin A, since it is all National Forest land and will probably never be developed. Even though the road would be covered from point 9 to point 11 if a 100-year flood should pass through, no construction is felt necessary at this time and the channel should remain natural. It is, however, recommended that approximately 350 feet of the natural stream above point 7 in Sub-basin A-11 be fully lined with riprap. This channel would require a 5-foot bottom and approximately a 2-1/2 foot depth.

In the interest of economics, almost all of the remainder of the main channel (from point 11 to point 17 has been sized from point to point to minimize costs inasfar as possible. The main channel requirements were found to vary from a bottom width of 43 feet, a depth of 4 feet and a right-of-way of 65 feet between points 11 and 12, to a bottom width of 75 feet, a depth of 4 feet and a right-of-way of 100 feet for the stretch above point 15. The upper portion of the main channel needs riprap on just the sides, but the remainder of the length will need full riprap. We direct your attention to Appendix C for a full listing of the required sections.

As previously discussed, the main channel past point 17 has already been fully lined to point 17A. The remainder of this channel, from point 17A to point 18, must also be fully lined, however, heavy riprap will be adequate. Without lining this section, erosion would become a major problem. This channel would require a bottom width of 30 feet, a depth of 7.5 feet and a right-of-way of 65 feet.

Besides the recommendations for the main channel of Bear Creek, there are also several tributary channels in Basins B, C, and D that will require some construction or lining. Again, there is a full detailed list of these channels and the recommended changes in Appendix C.

There is a natural "gully" or channel in Sub-Basin B-3 above point 13 that, if a 100-year storm were to pass, would be carrying a sizable amount of water. At the present time, no construction is warrented; however, should this area ever be developed, approximately 2100 feet of this channel would require full riprap. This channel would require a bottom width of 8 feet, a total depth of 4 feet and a total right-of-way of 36 feet.

The existing channel between point 23 and its entry into Bear Creek, just above point 14, is inadequate. There presently exists a riprap ditch from point 23 for approximately 800 feet which then becomes an earth ditch for the remaining length. This channel needs to be rebuilt as a fully lined riprap ditch. This channel would require a bottom width of 12 feet and a depth of 4.5 feet for 800 feet and then a bottom width of 20 feet and a depth of 5 feet for the remaining length.

The channel extending from point 27 to point 15 is a special problem. Presently, there is no defined channel, just a very shallow swale and the flow is primarily sheetflow. Even though this channel is in Bear Creek Park, a riprap lined channel should be constructed. In general, the existing swale would be followed. This type of channel would be constructed with a bottom width of 32 feet, an average depth of 3 feet and a total right-of-way of 55 feet.

Because of the proposed development along the channel between point 34 and point 35, a concrete lined ditch will be required. For approximately two-thirds the length from point 34, the channel channel will require a bottom width of 8 feet, a depth of 4 feet and a total right-of-way of 40 feet. The remaining distance would require a bottom width of 15 feet, a depth of 4 feet and a right-of-way of 48 feet.

From point 35 to point 16, where the channel enters Bear Creek, it is proposed that the channel be fully lined with riprap. In its present condition, the flow essentially becomes sheetflow approximately half way through the reach. This channel would require a bottom width of 63 feet, a depth of 3 feet and a total right-of-way of 85 feet.

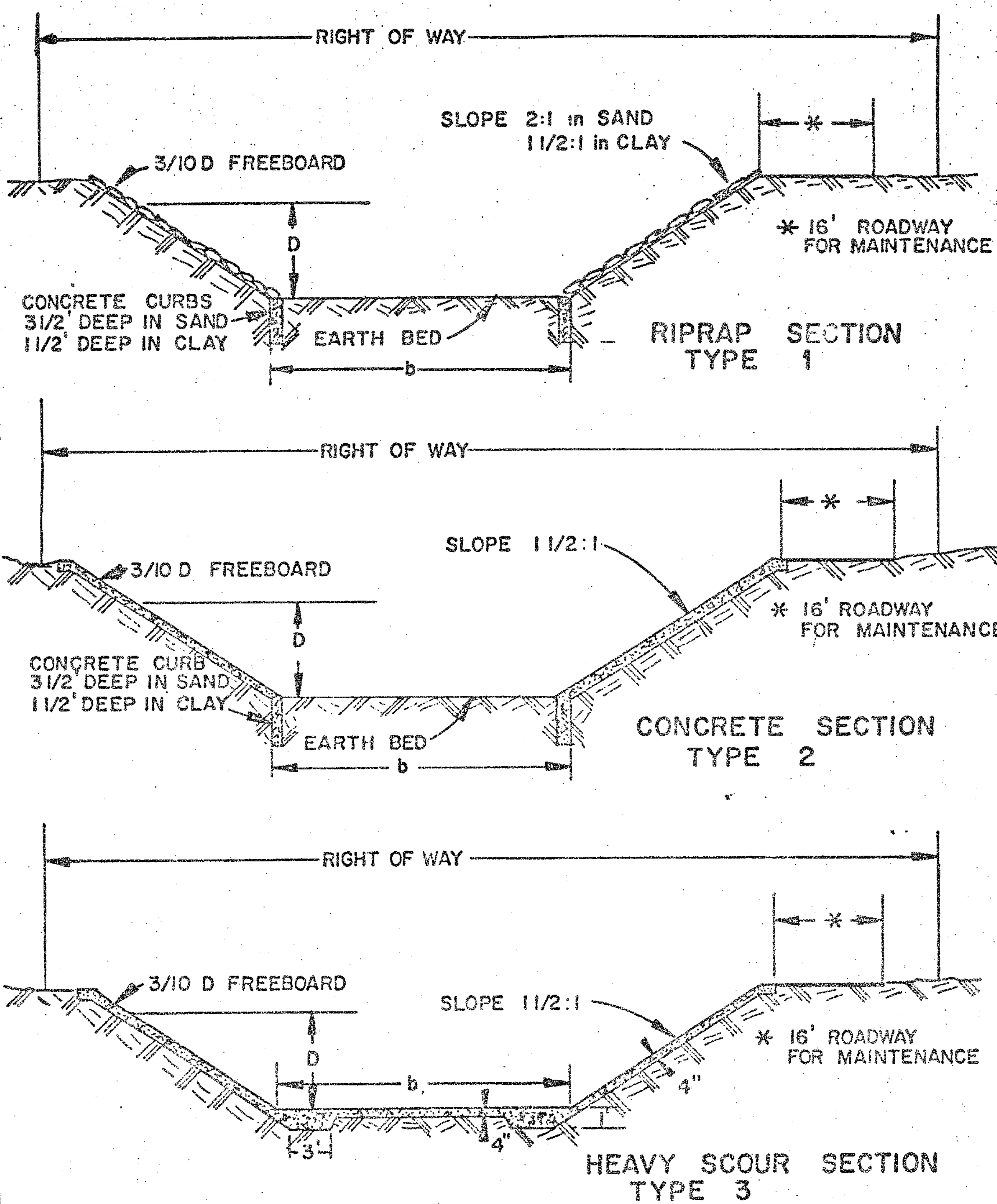
There is an area above this southern channel, just discussed, that would need to be fully lined with riprap only if and when the area is developed. This section of channel is in Sub-basin D-7 above point 34 and extends up to near point 33. This channel would require a bottom width of 6 feet, a depth of 3 feet and a total right-of-way of 34 feet.

All of the channels discussed in this section will require either riprap or paving where they pass through any of the lower basins. With the exception of the section of channel between points 34 and 35, the riprap system has been recommended for all channels, providing that the size of riprap is large enough to resist the full flood tractive forces.

Riprap in the area of the Portland Mill tailings, primarily along the ditch between points 16 and 17, must be carefully placed to help support the tailings deposit. This material is potentially unstable on slopes and, when saturated, will require support. In addition, this section of the Bear Creek channel must be used to store backwater during the 100-year frequency runoff. This storage will raise the water level to a potential elevation of 2 feet above the top of the major structure under 8th Street. This backwater will allow saturation of the tailings materials, increasing the potential instability. This riprap section must be specially designed to fit the soil types in the old mill dump area. Special riprap, probably including some concrete slope protection, will be required at the proposed bridge at the new crossing of Lower Gold Camp Road. This protection for the old tailings must also take the required backwater from the 8th Street culverts into account. Under no circumstances should the proposed bridge structure be weakened by side erosion.

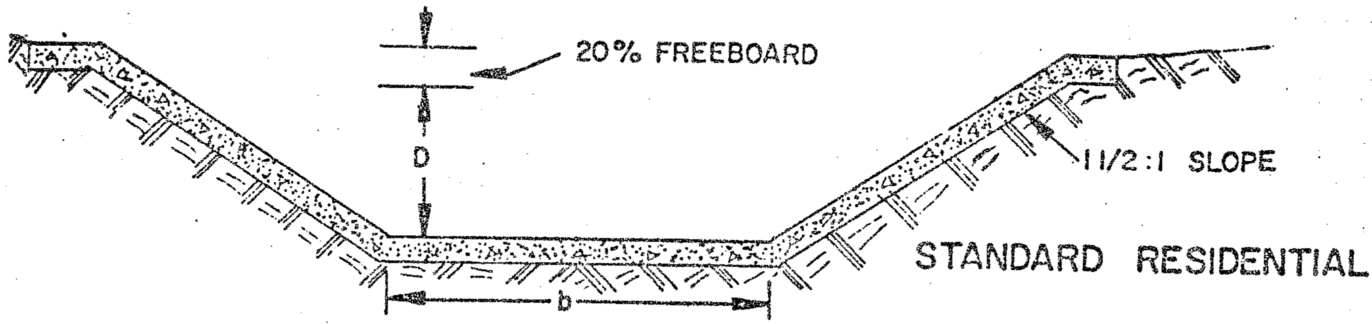
All bridges and concrete boxes along drainageways must have inlet and outlet paved adjacent channels and scour protection lips at points which use earth bottom channels. Since a few ditches may be in easements from necessity in the future, precautions against placing fences across the ditches are required. Placing any fence, particularly of the chainlink variety, across a drainageway is a dangerous practice, cannot be recommended and should not be allowed.

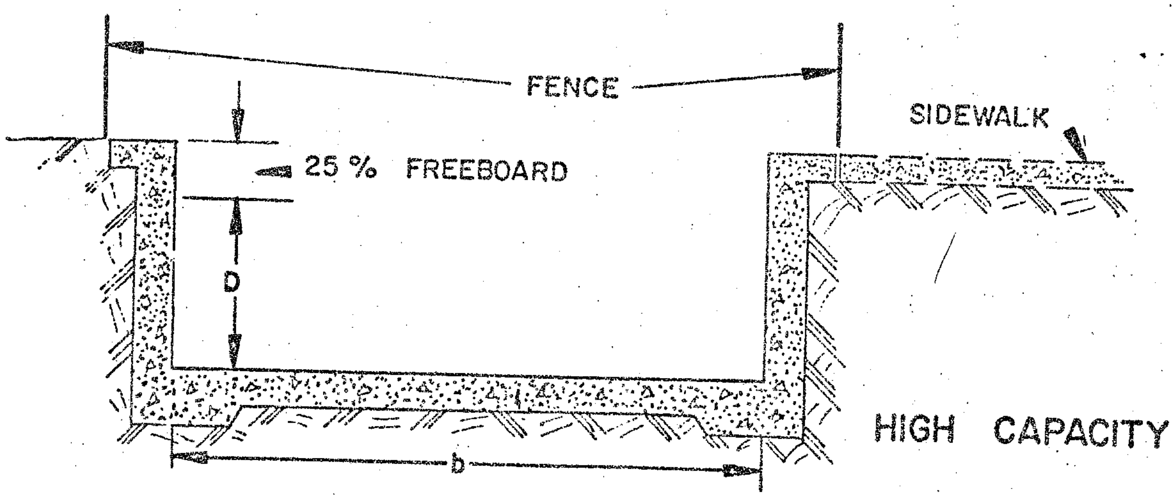
All proposed concrete boxes over major drainageways should be designed to carry the 100-year frequency flow, as defined herein, with an overflow section capable of carrying potential excess over this amount. Such overflow sections must be reasonably clean to allow water flow without damage to the structure.



TYPICAL GREENBELT DITCH SECTIONS

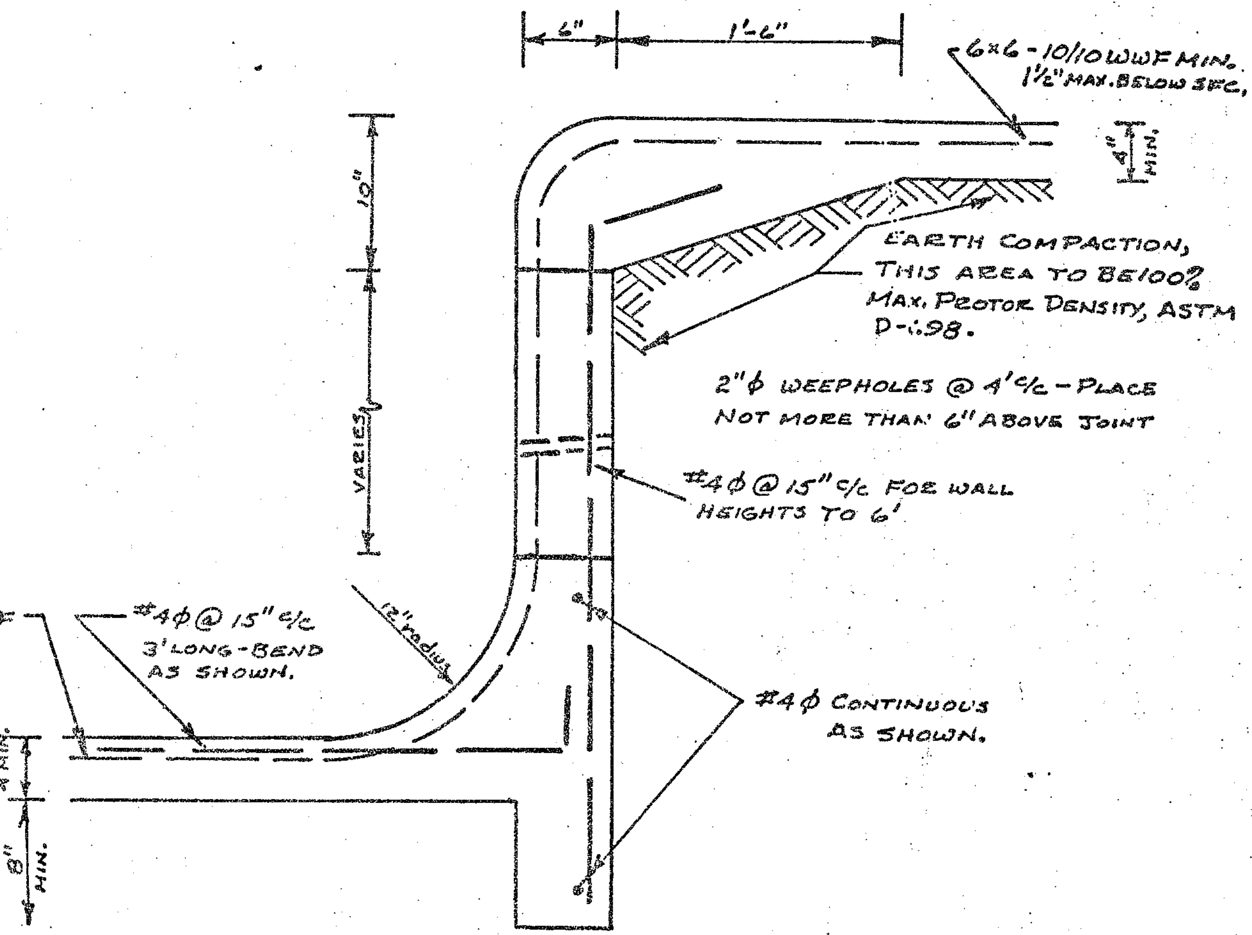
THE LINCOLN DeVORE TESTING LABORATORY





TYPICAL RESIDENTIAL DITCH SECTIONS

THE LINCOLN DeVORE
TESTING LABORATORY



CONCRETE: 3000 psi @ 28 DAYS
MAX. SLUMP - 3"

WOOD FLOAT FINISH ONLY.

REMOVE LAITANCE, IMMEDIATELY.

SCALE ~ 1" = 1'-0"

TYPICAL GRADE CONTROL STEP GREENBELT OR MAJOR PAVED CHANNEL	THE LINCOLN-DeVORE TESTING LABORATORY COLORADO: Colorado Springs, Pueblo, Glenwood Springs, Montrose, Gunnison. WYOMING: Rock Springs

INDIVIDUAL IMPROVEMENTS--STORM SEWER & DITCHES:

Attention is directed to Appendices C, D, E & F, which list existing drainage structures within the basin and the required improvements or additions to the drainage system. A set of maps is also attached to this report, showing existing and recommended drainage structures. The lists and maps taken together, comprise the recommendations for drainage improvements within the Bear Creek drainage basin.

After sizing the major channels within the basin, the individual basins were studied both separately and in flow line groups to individual outlets. Both the predicted 5 year runoff and the predicted 100 year runoff were studied to determine the probable size of storm appurtenances required. In developed areas, the water flow of runoff was compared with the street capacity existing. The distribution of streets was also noted to determine the probable natural routing. The street capacity deemed allowable was taken in accordance with the City chart of allowable street runoff, corrected for slope between curbs. The City chart is not directly applicable to the streets within the basin in some cases, since the construction standards for these streets do not invariably meet city standards.

In the upper portions of the existing subdivision, runoff is sometimes spread over a number of streets. The quantity of runoff at any given point in these circumstances can be kept relatively low and no further drainage improvements are necessary. In this basin, however, the more common condition within the subdivision consist of a series of flow lines converging onto a single street, thereby overloading that street. That this condition has indeed occurred is shown by mute testimony of new, and higher curbs at points along these streets.

The already developed areas are at, and on, the base of a large alluvial fan along the mountain front. As is typical of such fans, the drainage has been collected in a number of varied sized gullies, most of which predate the development. The smaller gullies are of greatest significance, since they were partially or completely blocked by construction of the subdivision streets. As a result, streets tend to collect the runoff of several gullies, collecting the water and transmitting it to the collector street of the group. In some cases, the streets were designed to carry this flow. In most cases, however, they were not so designed and will require storm sewer assistance.

The City drainage criterion for runoff design can be paraphrased as: All drainage structures in areas in which the 100 year frequency flow is projected as greater than 500 cfs, will be designed for this 100 year frequency flow. Where the 100 year frequency projection is for less than 500 cfs, all structures will be designed for the 5 year frequency flow. According to this criterion, practically all of the major drainageways must be designed for the 100 year frequency flow. These channels consist of the main channel of Bear Creek, the major gully in Sub-basin D, and a channel east of 21st St. through the county park.

For all practical purposes, all developed areas, both existing and in the future, require drainage design for the 5 year runoff only. The alluvial fan has the unfortunate capability of concentrating flows into street systems. However, it is also formed from A & A/B type soils, limiting the total possible runoff. As a result, the potential flow in areas which are, or can be, subdivided seldom exceeds the 500 cfs limit.

Those areas which are not as yet developed are relatively steep and limit the type of development which can be planned. Several gullies, primarily Gardiner Gulch and the extension of the main Sub-basin D gully must be maintained in a reasonably free flow condition. Other gullies may be re-routed or combined.

Gold Camp Road is, at the present time, acting as a minor dam. Runoff from the west is stopped or diverted along the west side of the road. A number of small basins have been formed over the years which generally contain minor storm runoff. The areas are relatively small, however, and are not capable of holding the full 5 year runoff, much less the 100 year runoff. There is not adequate area to completely increase the size of the holding basins, due to the steep slopes and to the presence of some existing buildings.

Due to this, the effect of simply retarding flows was investigated. Such a system, as envisioned, would require that each holding area be deepened and enlarged, insofar as possible. A culvert would be required beneath the roads to allow some flow, while retarding peak flows. The important point here is not to stop the water completely, but to retard the peak flow time so that a downstream high peak can be avoided. Five small retarding ponds are proposed for use, together with a small diversion from Gardiner Gulch to the first major gully to the north. This will change peak flows to the east and into the subdivided area.

Since retardation cannot be complete for a number of practical reasons, further retardation will be required in the proposed subdivisions east of the Gold Camp Road. One proposed subdivision has been designed with such a retarding system, although it will require some enlargement. Another small retarding system is proposed for parts of Sub-basin D.

The major flow through existing subdivisions will enter Orion Dr. through points 20 and 22. This will (and does) include some flow diverted from Gardiner Gulch. This flow is such that a storm sewer system is required on Orion from its intersection with Pluto Dr. to its outfall at the county park boundary.

Flow at this point is now being carried by a partially built, inadequately sized ditch into the park area. To prevent the flooding of the park and overloading an existing culvert at 21st St., it has been recommended that the park ditch be enlarged and completed north to Bear Creek just upstream from point 14 on the map.

In addition, it was found that the south extension of Orion and Andromeda require only small relief, since the streets are not badly overloaded. However, the park area and 21st St. would become badly overloaded near point 27, if all entering flow were allowed to reach this point. To relieve 21st St. at this point, a storm sewer is proposed, starting on Andromeda and running north on Orion to the major outfall near point 23. This will relieve the necessity of a major structure across 21st St.

Two small storm sewers are recommended on Scorpio Dr. & Hercules Dr., west of 21st St. In addition, these streets should be either completely curbed and paved, or larger side ditches should be constructed to increase the flow capability of these streets. Other areas of the existing subdivision in Sub-basin C are such that relatively simple improvement of the streets as drainageways--completion of curb and gutter, etc.--will be adequate.

A major storm sewer system will be required in Sub-basin D, even with the small retarding system proposed for this area. A storm sewer is proposed along Parkview Blvd., starting at its intersection with Hercules and running to 21st St. At this point, the sewer should turn south along 21st St. to its outlet with the channel--or major outfall from this sub-basin.

A second storm sewer system will be required to protect some already existing buildings along Constellation. This could be constructed in a number of ways. The least expensive, however, appears to be to extend from a retarding system in an undeveloped area to 21st St., then north to the point of discharge in the main channel of Sub-basin D. Constellation itself was designed as a drainage channel and will hold the expected runoff. Improved catchment basins will be required to prevent problems on 21st St., however.

A small storm sewer system has been proposed on Hercules Dr. This will cross the sub-basin boundaries, moving a small amount of water from Sub-basin C to Sub-basin D. The need for this storm sewer system appears to be primarily due to the flat "mesa top" type of topography. The area is small and does not generate large amounts of water. Being relatively flat, however, the water tends to overload Hercules Dr. The outfall for this system will be to an existing 42 inch pipe under Sirius Place, then into the Sub-basin D drainage channel.

Considering the location of Bear Creek, the location of the Sub-basin D channel and the fact that much of the east portion of the basin is a county park, almost no drainage systems will be required. The major channels must, of coarse, be lined. Riprap is proposed for the park area. The small amount of commercial property along 8th St. will require some improvement of existing structures, but no major storm sewer facilities.

In general, any storm sewer or ditch system entering major drainageways must be paved so that erosion does not damage the point of entry. Such pipes and ditches should also be angled with the major channel flow to allow as smooth a merger as possible. Bridges or boxes placed along channels should be constructed with dropout boxes or drains from the streets above to the channel below. These should be surface design boxes for efficiency, and should be carried into the main channel at an angle with flow.

For the purposes of this report, reinforced concrete pipe has been used throughout to calculate sizes. A few exceptions, such as replacement of existing pipe sections have been noted, but concrete pipe has been used for computations. The City standard curb inlet, D-10R, as revised, has been used for size computations and cost analysis in this report. At some points, a high velocity inlet might be more efficient.

It is noted that inlet problems can be quite difficult to solve. Inlets and drop out structures should be designed for each specific site, with characteristics to fit the conditions of the site. Therefore, although a specific number and size of inlets have been shown on the plan, this data should not be used without site specific investigation. This study is a plan, not a design, and should not be substituted for a site specific design.

SPECIFIC PROBLEM AREAS:

A number of problem areas exist in the basin, primarily related to older development of roads and streets in the area. Although these have been discussed in other sections of this study, an enumeration of these problems will be made herein for convenience in planning construction.

Although all of the recommended systems and structures are believed needed to properly control drainage within the subdivision, some are needed more urgently than others. Although the time table could be changed, and even reversed, by changes in proposed subdivisions, the most urgently needed drainage structures appear to be the following:

1. Enlargement and reconstruction of the concrete and riprap ditch extending essentially from point 23 to point 14 in the county park west of 21st St. This will provide a needed outlet for major subdivision drainage which presently has no good outlet.

2. Construction of the storm sewer extending west on Orion from the outfall ditch in (1) above. The reason for this is given above.

3. Enlarging and deepening the small retarding areas west of Gold Camp Road and installation of the required culverts. These areas are located at or near points 19, 21, 24, 28 & 31. This will at least retard flow through the existing subdivisions.

4. Enlargement and reconstruction of the underized culvert beneath Parkview Blvd. at point 35. This has been proposed as part of a proposed subdivision. This is needed with or without the proposed subdivision, but will become essential if the subdivision is approved.

5. The riprapped main channel between points 17A (drop structure) and point 18 (outfall) is required to prevent major erossion problems and slope stability problems in this area. Since this is the outfall for the entire system, such problems cannot be tolerated here.

6. Enlargement of the concrete boxes in upper Bear Creek Canyon to prevent flooding of the Canyon Road. At the same time, some of the undersized, plugged culverts should be replaced with silt traps placed at entries.

All other recommended systems will become necessary as development proceeds in presently undeveloped land around the existing subdivision. Basically, the order of requirement would depend entirely on which tracts are proposed for development.

Riprapping of the main Bear Creek Channel should proceed through the developed portion of the park first. For example, the channel between points 15 and 16 is too small by far for the 100 year flow. It is barely adequate for the 5 year flow. The channel has been encroached upon by construction for the equestrian center in this area. It should be enlarged. In addition, deposits of unstable tailings are found in this general area and should be protected. A heavy riprap bend will be required here.

A second point which will eventually require some protection is the bend in Bear Creek near point 12. The Solar Trails complex here is low lying and could sustain some damage with the 100 year runoff event.

The large culverts throughout the basin are adequately sized. Except for the addition of some drop-out type structures from the roads above, no major additions or construction will be required. The major exception to this is the Parkview Blvd. culvert, listed as item #5 in this section.

The retarding system proposed for the areas near Gold Camp Road is not completely adequate to prevent higher flow down the fan in itself. The system must be extended through the proposed subdivisions east of the road as they are constructed. Due to the steep slopes, no individual unit can be very large. A number of smaller units will be needed as shown in the proposed plan for Skyway Heights. Those required elsewhere have been shown on the plan.

SUMMARY:

This basin is fairly typical of foothills basins west of Colorado Springs. The lower portions of the basin have been at least partially developed while the upper basin is in the National Forest and cannot be changed to affect drainage. This basin is more fortunate than most in that a great deal of the basin is County Park, requiring little improvement.

The major stream beds are mostly natural condition beds and should be selectively riprapped. Some portions of these natural-bed streams will require protection to prevent loss of the channel or of surrounding structures. The stream bed is predominately clay with a relatively small underflow, so that the bed is reasonably stable. The banks, however, are not stable.

At this time, development of the remaining land within the basin is feasible if the area is eventually annexed into the City. The supply of potable water will control the development in this area to a great extent. Even with adequate water service, the slopes of the available land for development are so steep that "city sized" lots are very improbable. The potential development is believed to average lot sizes of 1/2 acre to 2 acres and up. The total additional runoff caused by the potential development will not be as large as in most other basins.

With this estimate, the various structures recommended by this study fit the runoff computed by use of the rainfall/runoff methods described herein. No major overflow was allowed for the applicable storm, other than the amounts allowed in streets by the City flow criterion. Street flow in undeveloped areas is difficult to assess since the street pattern is incompletely known. Although the basic street pattern developed in this study will probably be approximately followed in basic pattern, changes will undoubtedly be made.

The specific recommendations made by this study are fully outlined in the Appendix and on the attached maps. As stated, exact locations of the structures may vary and must not be taken as exact. Differences in street location and planning will fix these locations and such changes in detail must be allowed if they are reasonable. The general outline should be followed, however.

Gradients on the fan are steep and ditches must be designed with a relatively large number of velocity checks. The gradient of the major channels are much less steep so that velocity checks will not be required to any extent.

Concrete in contact with the soils in the lower basin should be made using Type II Cement, due to the sulfate content of the clays. Higher on the fans, the soils do not have a high sulfate content and Type I Cement may be used. Air entrainment should be used in all exposed concrete.

Where structures are not properly sized as existing, they may be removed and replaced with properly sized structures, or a new structure could be added so that the sum of the two is properly sized. All structures, particularly along the major channels should have the capacity, and should be designed, to carry the full design flow smoothly. Turbulence should be kept to a minimum.

The general recommendation of this study is that the storm drainage structures of all types shown herein be constructed approximately as shown. For planning purposes, this study has included areas both inside and outside the present City limits.

BEAR CREEK DRAINAGE BASIN

COST ANALYSIS

Studied Basin:

National Forest	4500.3 Acres
County Owned Parks	463.9 Acres
City Owned Parks	216.8 Acres
Unplatted Existing Streets	53.5 Acres
Existing Subdivisions	510.9 Acres
Remaining Private Land in Basin (Less Bear Creek Canyon & Section 16 in Forest)	1001.6 Acres
Remaining Private Land within City Limits (Note: City Limits in dispute at present time)	828.0 Acres

Summary of Costs:

I. Developer

(C) Ditches & Stream Lining (includes retard system)	310,352.00
(E) Major Culverts	367,990.00
(F) Storm Sewer Systems	228,855.00
Sub-Total	907,197.00
Engineering (10%)	90,720.00
Contingency (5%)	45,360.00
Total Developer Basin Cost	1,043,277.00

Developer Drainage Fee: $\frac{1,043,277.00}{216.8 + 828.0}$ = 998.54 use 1,000.00

The City Park Dept. is responsible for drainage fees of 216.8 acres x $1,000/acre = $216,800.

II. (D)

Bridges (Construction & Renovate)	130,560.00
Engineering (10%)	13,056.00
Contingency (5%)	6,528.00
Total Developer Bridge Cost (direct)	150,144.00

Total Developer Bridge Fees: $\frac{150,144.00}{216.8 + 53.5 + 510.9 + 828.0}$ = 93.30 use 94.00

The City's arterial bridge construction responsibility is $70,656.00 (per Ordinance 74-9)

The City's contribution to the arterial bridge fund is (216.8 + 53.5 + 510.9 acres) x $94.00/acre = 781.2 acres x $94.00/acre= $73,432.80 (per Ordinance 74-9)

III. Other Basin Cost (direct)	
(C) Ditches & Stream Lining	151,799.00
(D) Misc. Bridge Repair-drop boxes	71,740.00
(E) Major Culverts	224,800.00
(F) Storm Sewer Systems	590,290.00
Subtotal, Other Basin Cost	1,038,629.00
Engineering (10%)	103,863.00
Contingency (5%)	51,931.00
Total-Other Basin Cost	1,194,423.00

BEAR CREEK DRAINAGE BASIN

COST ANALYSIS--SPECIAL ITEM

It has been noted in this study that a large percentage of the lower portion of the Bear Creek Drainage Basin consists of Park land. The City of Colorado Springs owned portions of this "open space", and related costs have been included on the first page of this cost analysis, under the heading "Other Basin Cost".

A total of 463.9 acres has been deeded to the El Paso County Park and Recreation District and named the Bear Creek County Park. The main channel of Bear Creek lies within the park boundary from approximately point 12 to approximately point 15, as defined in this study.

As noted in this study, some channel improvement will be required within the park area to prevent damage to the park and contiguous streets. One of these improvements is listed among those most urgently needed. The remainder can be made as future development requires. In any event, the Park and Recreation District should budget the required money to improve drainage facilities within the park boundaries. The Drainage Board and staff of the City of Colorado Springs should inform the County Park and Recreation District of the needs outlined in this study so that the District can be aware of the need for these improvements.

The required work is shown on 3 sheets of Appendix C, and on sheet 2 (of 4) of Appendix E. This consists of 1/2 the cost of placing one culvert on Gold Camp Road (Rio Grande), riprap protective cover on the channel of Bear

Creek within the park boundary, construction of a channel from 21st St. to Bear Creek (point 27 to 15 on the study map) and reconstruction of a riprapped channel from Orion Dr. to Bear Creek (points 23 to 14 on the study map).

Summary of costs of work in Bear Creek Park:

(C)	Ditches & Stream Lining	$527,174.00
(E)	Major Culverts	2,840.00
		$530.014.00
	Engineering (10%)	53,001.00
	Contingency (5%)	26,501.00
		$609.516.00

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Sub Basin	AREA		Slope 1/1	Av. Exist. CN	Av. Pot. CN	Tc hrs.	Tpo hrs.	FLOW - cfs		Tb hrs.
	Ac.	Sq.Mi.						5 Yr.	100 Yr.	
A 1	466	.729		61	61	.275	1.67	63	397	4.45
2	235	.367		56	56	.234	1.64	11	142	4.38
3	262	.410		64	64	.201	1.62	61	309	4.33
4	481	.751		60	60	.148	1.59	69	457	4.24
5	251	.391		60	60	.308	1.68	28	187	4.50
6	352	.549		59	59	.205	1.62	40	283	4.33
7	349	.545		62	62	.232	1.64	61	341	4.38
8	185	.288		62	62	.115	1.56	39	222	4.19
9	94	.147		59	59	.117	1.57	13	89	4.19
10	158	.247		61	61	.129	1.58	27	169	4.21
11	203	.317		60	60	.133	1.58	30	198	4.22
12	113	.177		64	64	.122	1.57	30	153	4.20
13	240	.374		60	60	.173	1.60	34	222	4.28
14	199	.311		59	59	.278	1.67	21	145	4.45
15	454	.710		59	59	.212	1.63	52	364	4.35
16	256	.400		64	64	.138	1.58	67	338	4.23
17	126	.197		84	84	.103	1.56	202	478	4.17
18	226	.354		63	63	.122	1.57	55	280	4.20
Subtotal A	4650	7.266			Av. 61.2					

HYDROLOGIC DATA SHEET 1 OF 3
APPENDIX A
INDIVIDUAL BASIN RUNOFF

LINCOLN DeVORE ENGINEERS · GEOLOGISTS

COLORADO: COLORADO SPRINGS, PUEBLO, GLENWOOD SPRINGS, GRAND JUNCTION, MONTROSE, WYOMING: ROCK SPRINGS

Sub Basin	AREA Ac.	AREA Sq.Mi.	Slope 1/1	Av. Exist. CN	Av. Pot. CN	Tc hrs.	Tpo hrs.	FLOW - cfs 5 Yr.	FLOW - cfs 100 Yr.	Tb hrs.
B 1	128	.200		72.7	77.5	.147	1.59	120	339	4.24
2	163	.255		78.7	78.7	.168	1.60	163	444	4.27
3	218	.340		63.9	72.6	.228	1.60	125	401	4.37
4	51	.080		76.2	85.0	.091	1.56	89	208	4.15
5	65	.102		81.7	88.5	.154	1.59	127	270	4.25
6	103	.161		85.9	89.5	.172	1.60	206	432	4.28
7	66	.104		80.8	92.9	.115	1.57	180	349	4.19
8	45	.070		84.5	95.0	.089	1.55	145	269	4.15
9	29	.046		85.6	92.5	.179	1.61	69	134	4.29
9A	29	.046		85.6	92.5					
Subtotal B	868	1.356		Av. 75.7	Av. 81.8					
C 1	18	.028		68.7	72.0	.066	1.54	13	42	4.11
2	27	.043		69.9	76.4	.077	1.55	27	78	4.13
3	88	.137		69.5	73.0	.058	1.54	67	214	4.10
4	55	.086		53.5	60.9	.164	1.60	9	56	4.27
5	46	.072		51.0	61.3	.169	1.60	8	48	4.28
6	40	.062		49.5	59.8	.121	1.57	6	40	4.20
7	35	.054		50.0	58.3	.175	1.61	3	28	4.28
8	51	.080		52.8	59.8	.077	1.55	8	54	4.13
9	60	.093		52.1	60.4	.159	1.60	9	58	4.26
10	85	.133		90.7	91.8	.096	1.56	220	438	4.16
11	101	.157		72.5	77.5	.210	1.63	59	190	4.34
12	66	.102		85.0	87.0	.131	1.58	122	269	4.22
13	85	.132		82.4	83.8	.291	1.68	101	240	4.47
14	135	.210		85.0	86.0	.267	1.66	187	426	4.43

HYDROLOGIC DATA SHEET 2 OF 3
APPENDIX A
INDIVIDUAL BASIN RUNOFF

Sub Basin	AREA Ac.	Sq.Mi.	Slope 1/1	Av. Exist. CN	Av. Pot. CN	Tc hrs.	Tpo hrs.	FLOW - cfs 5 Yr.	100 Yr.	Tb hrs.
Subtotal C	679	1.060		Av. 62.6	68.5					
D 1	70	.109		70.1	73.5	.053	1.53	56	175	4.09
2	23	.036		67.1	71.5	.054	1.53	16	52	4.09
3	81	.126		53.0	60.2	.194	1.62	11	73	4.32
4	42	.066		88.0	89.6	.085	1.55	99	206	4.14
5	56	.087		56.3	67.0	.233	1.64	19	75	4.32
6	45	.070		54.8	66.5	.136	1.58	16	69	4.22
7	56	.087		73.8	82.1	.141	1.59	74	184	4.23
8	60	.093		89.5	89.5	.109	1.57	133	278	4.18
9	88	.137		78.1	79.2	.214	1.63	85	228	4.35
Subtotal D	521	.812		Av. 69.9	75.1					
TOTAL	6898	10.78		Av. 64.9	Av. 66.5					

HYDROLOGIC DATA SHEET 3 OF 3
APPENDIX A
INDIVIDUAL BASIN RUNOFF

LINCOLN DeVORE ENGINEERS · GEOLOGISTS

COLORADO: COLORADO SPRINGS, PUEBLO, GLENWOOD SPRINGS, GRAND JUNCTION, MONTROSE, WYOMING: ROCK SPRINGS

Sub Basin	Pt.	AREA Ac.	AREA Sq.Mi.	Slope 1/1	Av. Exist. CN	Av. Pot. CN	Tc hrs.	Tpo hrs.	FLOW - cfs 5 Yr.	FLOW - cfs 100 Yr.	Tb hrs.
A 1,2	1	701	1.10	.1054	59.4		.261	1.66	77	545	4.43
3	2	964	1.51	.1054	60.6		.324	1.69	98	751	4.51
4	3	1445	2.26	.1039	60.4		.379	1.73	160	1089	4.62
5,6	4	2047	3.20	.1069	61.0		.495	1.80	228	1441	4.81
7,8	5	2580	4.03	.1563	60.5		.653	1.89	240	1548	5.05
9,10	6	2832	4.42	.1515	60.5		.687	1.91	262	1694	5.10
11,12	7	3148	4.92	.0971	60.5		.727	1.94	285	1842	5.18
13,14	8	3587	5.60	.0682	60.4		.783	1.97	315	2063	5.26
15,16	9	4297	6.71	.1364	60.5		.813	1.99	376	2427	5.31
17,18	10	4473	6.99	.0765	60.8		.860	2.02	390	2482	5.39
17,18	11	4650	7.27	.0610	61.2		.889	2.03	424	2612	5.42
B 1	12	4778	7.47	.0447	61.5	61.6	.975	2.09	452	2668	5.57
2	13	4941	7.72	.0345	62.1	62.2	1.082	2.15	494	2724	5.74
3,4	14	5210	8.14	.0356	62.3	62.9	1.096	2.16	579	2968	5.76
West 5	15	5275	8.24	.0249	62.5	63.2	1.214	2.23	596	2999	5.95
Add C (Out)	15	6338	9.90	---	63.7	65.0	1.214	2.23	768	3602	5.95
West											
Add D Out	16	6683	10.44	.0184	64.2	65.7	1.253	2.25	862	3897	6.01
6,7	17	6853	10.71	.0273	64.8	66.3	1.311	2.29	919	3961	6.11
8,8A	18	6898	10.78	.0200 (Step)	64.9	66.5	1.344	2.31	983	4008	6.16

HYDROLOGIC DATA SHEET 1 OF 3
APPENDIX B
ACCUMULATIVE RUNOFF
Main Stream

LINCOLN DeVORE ENGINEERS · GEOLOGISTS

COLORADO: COLORADO SPRINGS, PUEBLO, GLENWOOD SPRINGS, GRAND JUNCTION, MONTROSE, WYOMING: ROCK SPRINGS

Sub Basin	Pt	AREA Ac.	Sq.Mi.	Slope 1/1	Av. Exist. CN	Av. Pot. CN	Tc hrs.	Tpo hrs.	FLOW - cfs 5 Yr.	100 Yr.	Tb hrs.
C 1	19	18	.028	---	68.7	72.0	.065	1.54	12	42	4.11
4	20	73	.113	.1170	57.2	63.3	.176	1.61	17	85	4.30
2	21	27	.043	---	69.9	76.4	.070	1.54	26	78	4.12
5	22	73	.115	.1236	64.2	66.9	.178	1.60	26	107	4.29
10 in	23	231	.361	.0743	69.8	75.0	.251	1.65	153	464	4.33
3	24	88	.137	---	69.5	73.0	.101	1.56	67	214	4.17
7	26	122	.191	.1175	64.0	68.8	.192	1.62	51	195	4.31
6	25	39	.062	---	50.0	59.8	.132	1.58	6	40	4.22
11 Split to	23	--	----	ST.&SS	---	----	.288	1.68	70	136	4.47
11 Split to	27	262	.410	.0633	65.2	70.8	.346	1.71	38	241	4.56
13 Out	23	--	---	---	----	---	----	1.66	223	600	4.38
8	29	51	.080	----	52.8	59.8	.091	1.55	8	54	4.15
9	30	111	.173	.0939	52.4	60.1	.174	1.60	16	104	4.28
12	27	176	.276	.0733	64.5	70.1	.298	1.68	72	258	4.49
11-12 Out	27	With	Sewer	to North	---	---	.346	1.70	109	498	4.54
14 in.	15	573	.896	.0323	69.6	74.2	.456	1.77	278	857	4.73

HYDROLOGIC DATA SHEET 2 OF 3
APPENDIX B
ACCUMULATIVE RUNOFF

LINCOLN DeVORE ENGINEERS · GEOLOGISTS
COLORADO: COLORADO SPRINGS, PUEBLO, GLENWOOD SPRINGS, GRAND JUNCTION, MONTROSE, WYOMING: ROCK SPRINGS

Sub Basin	Pt.	AREA Ac.	AREA Sq.Mi.	Slope 1/1	Av. Exist. CN	Av. Pot. CN	Tc hrs.	Tpo hrs.	FLOW - cfs 5 Yr.	FLOW - cfs 100 Yr.	Tb hrs.
D 1	28	70	.109	----	70.1	73.5	.075	1.55	56	175	4.13
2	31	23	.036	-----	67.1	71.5	.063	1.54	15	52	4.11
3	32	174	.271	.1037	61.8	67.1	.223	1.63	59	239	4.36
4	34	216	.337	.0660	67.0	71.6	.318	1.69	100	333	4.51
6	33	45	.070	----	54.8	66.5	.141	1.58	16	69	4.23
7	34	101	.157	.0632	66.5	72.0	.244	1.65	64	206	4.40
5	34	56	.087	.0828	56.3	67.0	.233	1.64	19	78	4.38
D Out	34	372	.581	----	66.5	72.0	.318	1.69	178	586	4.52
8	35	432	.675	.0569	69.7	74.4	.375	1.73	232	714	4.62
9	16	520	.812	.0475	71.1	75.2	.472	1.78	269	804	4.76

HYDROLOGIC DATA SHEET 3 OF 3
APPENDIX B
ACCUMULATIVE RUNOFF

LINCOLN DeVORE ENGINEERS · GEOLOGISTS
COLORADO: COLORADO SPRINGS, PUEBLO, GLENWOOD SPRINGS, GRAND JUNCTION, MONTROSE, WYOMING: ROCK SPRINGS

Sub Basin	LOCATION			EXISTING					REQUIRED (full devel.)					Notes & Est. Cost $
	From	To	Length of Run	Bottom Width b-ft.	Top Width	Total Depth d-ft.	R/W ft.	cpy. flow cfs	Flow-cfs 5 Yr.	Flow-cfs 100 Yr.	Bottom Width b-ft	Depth d-ft	R/W ft	
A	1	2	2230	Nat. Stream	16	3.9'	N/A	843	98	751	OK	See	Exist.	
	2	3	1910	"	40	6.2	N/A	1287	160	1089	"	"	"	
	3	4	4440	"	23.5	5.2	N/A	1746	228	1441	"	"	"	
	4	5	7680	"	20	6.2	N/A	2271	240	1548	"	"	"	
	5	6	1650	"	36	4.9	N/A	2509	262	1694	"	"	"	
	6	7	1750	"	39	5.7	N/A	2297	285	1842	"	"	"	At road near 7.
	7	8	2200	"	45	6.2	N/A	3166	315	2063	"	"	"	Riprap at boxes see culvert sheets
	8	9	1540	"	34	7.1	N/A	3460	335	2103	"	"	"	" " " Riprap Oposite Ent of Hunters Run
														700 cy.yd=$6650
	14	9	3220		16	2.7	N/A	768	118	634	"	"	"	
														Note: 100 yr.storm will cover Rd.from pt.9 + pt.11.
	9	10	1960		37	8.2	N/A	3782	376	2427				Riprap at boxes see culvert sheets
	10	11	1150		40	8.4	N/A	3480	390	2482				
A-11	Above High Drive	Near 7	350	Nat. Stream	10	2	N/A	48	24	162	5	2.5	N/A	Riprap-full 190cy- $2470
B-3	2100 Ab. 13	13	(1050 priv) 2100	Nat ditch	Av. 16	4	N/A	511	125	401	8	4	36	Riprap-full 1970 cy-$23640

HYDROLOGIC DATA SHEET 1 OF 3

APPENDIX C DITCH & STREAM INVENTORY

LINCOLN DeVORE ENGINEERS · GEOLOGISTS

COLORADO: COLORADO SPRINGS, PUEBLO, GLENWOOD SPRINGS, GRAND JUNCTION, MONTROSE, WYOMING: ROCK SPRINGS

Sub Basin	LOCATION From	LOCATION To	Length of Run	EXISTING Av. Bottom Width b-ft.	EXISTING Av. Top Width Ft.	EXISTING Total Depth d-ft.	EXISTING R/W ft.	EXISTING cpy. flow cfs	REQUIRED (full devel.) Flow-cfs 5 Yr.	REQUIRED (full devel.) Flow-cfs 100 Yr.	REQUIRED Bottom Width b-ft	REQUIRED Depth d-ft	REQUIRED R/W ft	Notes & Est. Cost $
B	11	12	3288	Nat. Stream	79 O.B.	3.7	N/A	1510 OB	424	2612	43	4	65	Riprap sides to Solar Ex. 1800 cy $22,500
	12	13	4028	"	118 O.B.	4.2	N/A	2700 OB	452	2668	54	4	80	Riprap full-12A t East 12370cy- $142,255
	13	14	1685	"	104 OB	4.7	N/A	2980 OB	579	2968	55	4	80	Riprap full-full length 5350 cy $64,200
	14	14A	1750	"	90 OB	5.5	N/A	3032 OB	596	2999	68	4	95	Riprap full-full length 6600 cy $79,200
	14A	15	1425	"	130 OB	4.8	N/A	3048 OB	596	2999	75	4	100	Riprap full-full length 5850 cy- $70,200
	15	16	1415	"	42 OB	12	N/A	2427 OB	768	3602	25	8.5	75	Riprap full-full length 3950 cy- $47,400
	16	17	2125	"	56 OB	8.2	N/A	3970 OB	862	3897	40	6	80	Riprap full-full length 7000 cy- $80,500
	17	17A	680	10'	35	9	60	5280	919	3961	--	--	65	Existing conc. Channel & drop structure
	17A	18	490	30	70	7.5	75	5335	919	3961	--	--	90	Riprap full-full length 2300 cy- $27,600
C	--	23	150	1	8	3	12	420	223	600	4	4	12	Rebuild Conc. Ditch 55cy-150' $10,450
	23	23A	800	Riprap 8	ditch 20	3	N/A	188	223	600	12	4.5	N/A	Rebuild Park ditch R.R. 990 cy- $13,860
	23A	14	1010	Earth 6	ditch 14	1.5	N/A	103	223	600	20	4.5	N/A	Rebuild Park ditch R.R. 1640 cy - $22,960
C	27	15	3155	Sheet overland	flow-		N/A	---	109	498	32	3	N/A	Build park ditch R.R. 6100 cy- $79,300

HYDROLOGIC DATA

APPENDIX C DITCH & STREAM INVENTORY

LINCOLN DeVORE ENGINEERS · GEOLOGISTS
COLORADO: COLORADO SPRINGS, PUEBLO, GLENWOOD SPRINGS, GRAND JUNCTION, MONTROSE, WYOMING: ROCK SPRINGS

Sub Basin	LOCATION From	To	Length of Run	EXISTING Bottom Width b-ft.	Top Width	Total Depth d-ft.	R/W ft.	cpy. flow cfs	REQUIRED (full devel.) Flow-cfs 5 Yr.	100 Yr.	Bottom Width b-ft	Depth d-ft	R/W ft	Notes & Est. Cost $
D	Near 33	Rd. above 34	1630	Nat. 15	Stream Channel 50 OB	4	N/A	1252	64	206	6	3	z=2 34	Riprap full & full length. 960 cy-$13,440
	34	34A	1170	Nat. 8	Stream 32 OB	5	N/A	1130	178	586	8	4	z=2 40	Conc. ditch-full length 380 cy-1170' $76,000
	34A	35	600	Nat. 16	Stream 40	5	N/A	1632	232	714	15	4	z=2 48	Conc. ditch-full length 250 cy-600' $51,000
	35	16	2925	Alluv. 2	fan from ditch-fill 138	2	N/A	931	269	804	63	3	z=1 85	Riprap full & full length- 9750 cy $136,500
														1825' CBCP
	Near 35	Stream	520	Nat.	Gulley			188	42	94	2	2-1/2	z=1-1/2 20	Conc.ditch-full length,96 cy
														$19,200

HYDROLOGIC DATA

SHEET 3 OF 3

APPENDIX C DITCH & STREAM INVENTORY

LINCOLN DeVORE ENGINEERS · GEOLOGISTS

COLORADO: COLORADO SPRINGS, PUEBLO, GLENWOOD SPRINGS, GRAND JUNCTION, MONTROSE, WYOMING: ROCK SPRINGS

LOCATION			EXISTING			REQUIRED		
Sub Basin	Near Point	Street	Type of Structure	Flow-cfs 5 Yr.	Flow-cfs 100 Yr.	Equiv.Type Structure	Comment	Est. Cost
B 5	14	21st Street	2-6x10 RCB	579	2968	Improve entry RCB-OK	2 drop boxes req'd.Equiv. D10R-12'	$5,150
B 6	17	Lower Gold Camp Road	2-8x14 RCB	919	3961	100'- 2-8x14 RCB	100' wing & apron 440 cy+ exc.	$121,500
B 6	17	8th Street	2-13'ØM/P CMP	919	3961	Improve entry Allow 750' Back water area	2 drop boxes required-Equiv. D-10R-12'	$5,150
B 8	17A	None	10' Drop Str. & Energy Dis.	930	3970	Size O.K.	No Const. Required.	----
B 8	18	I-25	2-14x10 RCB	983	4008	Size O.K.	No Const. Required	----
D 8	35	Parkview Blvd.	2-5' Drop C.B. 36" CMP	232	714	3-3x6 RCB	100' wingwalls & apron-280 cy maj.exc.	$70,500

HYDROLOGIC DATA - SHEET 1 OF 1
APPENDIX D.
MAJOR BRIDGE INVENTORY

LINCOLN DeVORE ENGINEERS · GEOLOGISTS

COLORADO: COLORADO SPRINGS, PUEBLO, GLENWOOD SPRINGS, GRAND JUNCTION, MONTROSE, WYOMING: ROCK SPRINGS

LOCATION			EXISTING			REQUIRED		
Sub Basin	Near Point	Street	Type of Structure	Flow-cfs 5 Yr.	Flow-cfs 100 Yr.	Equiv. Type Structure	Comment	Est. Cost
A 11	above 7 --	High Drive	18" ø CMP	1	4	Size OK	No const. req'd.	---
A 11	--	High Drive	2-15"ø CMP	1	2	Size OK Both plugged	Unplug-add silt basins-22cy rock	$ 450
A 11	--	High Drive	2-15"ø CMP	1	2	Size OK	No const. req'd	---
A 11	--	High Drive	18" ø CMP	<1	1	Size OK	No const. req'd	---
A 11	--	High Drive	15" ø RCP	1	2	Size OK	No const. req'd	---
A 11	--	High Drive	21" ø CMP	1	3	Size OK Pipe plugged	Clean-add silt basin-16cy rock	$ 380
A 11	--	High Drive	24" ø CMP	17	116	36" ø CMP - 60'	Headwall with silt basin-20cy	$ 6,920
A 11	--	High Drive	33" ø RCP	18	118	Size OK Pipe plugged	Clean-add silt basin-18cy-rock	$ 400
A 11	--	High Drive	15" ø CMP	<1	1	Size OK	No const. req'd	---
A 11	--	High Drive	33" ø RCP	24	162	Size OK Headwall Rep.	Riprap entry & exit-23cy-rock	$ 450
A 11	7	High Drive	11'x4.7' RCB-7'x4.7'	285	1842	10'x4.5' RCB -36'	Headwall & apron total-106cy conc.	$27,800
A 14	near 7	Bear Cr. Can.	24" ø CMP	21	145	30" CMP-70'	Add silt basin 16 cy rock	$ 2,730
A 14	bet. 7-8	Bear Cr. Can.	18" ø CMP	1	2	Size OK	Silt basin exists No const. req'd	---
A 14	near 8	Bear Cr. Can.	9'x3.5' 8'x2.5' RCB	310	2048	2-11'x3' RCB-36'	Headwall & apron tot.184cy conc.	$44,600
A 14	8	Bear Cr. Can.	9'x3.5'RCB	315	2063	2-10'x3.5' RCB-36'	Headwall & apron tot.188cy conc.	$46,000
A 16	8	Bear Cr. Can.	30" ø CMP	13	67	Size OK	No const. req'd	---
A 16	8	Bear Cr. Can.	21" ø CMP	2	12	Size OK	No const. req'd	---
A 16	9	Bear Cr. Can.	9'x4' RCB	376	2427	2-9'x4' RCB -36'	Headwall & apron tot.146cy conc.	$36,200
A 18	9	Bear Cr. Can.	2-18"ø CMP	1	4	Size OK	No const. req'd	---
A 18	9	Bear Cr. Can.	24" ø CMP	9	46	Size OK	Silt basin exists No const. req'd	---
A 17	10	Bear Cr. Can.	2-8'x10' /RCB	390	2482	Size OK	Improve inlet 24cy rock	$ 480
A 17	10	Gold Camp	24" ø CMP	42	102	36" ø RCP	Headwall & 65'-long 4cy conc.	$ 3,985
A 17	10	Bear Cr. Can.	18" ø CMP	7	20	Size OK	Clean-add silt basin-4cy rock	$ 180
A 17	11	Bear Cr. Can.	24" ø CMP	37	91	36" ø RCP	Headwall & 65'-long 4cy conc., 8cy rock	$ 4,125

LOCATION			EXISTING			REQUIRED		
Sub Basin	Near Point	Street	Type of Structure	Flow-cfs 5 Yr.	Flow-cfs 100 Yr.	Equiv. Type Structure	Comment	Est. Cost
A-17	11	Gold Camp	None	21	48	27" Ø RCP	Headwall 4cy con. - 60'	$ 2,520
A-17	11	Bear Cr. Can.	36" Ø CMP	9	20	Size OK	Clean - add silt basin-6cy rock	$ 180
A-18	11	Abandoned	2-30"ØCMP	424	2612	Useless	Remove	---
B-1	11	Bear Cr. Can.	None	4	13	24"ØRCP	Headwall & silt basin-4cy conc. 65'	$ 2,260
B-1	11	Bear Cr. Can.	None	21	52	24"ØRCP	Headwall & silt basin-4cy conc. 65'	$ 2,260
B-1	11	Bear Creek	2-3 span, 6' x6' wood bldg.	431	2630	will wash out private-no rep.	No const. req'd	---
B-1	12	Bear Cr. Can.	None	21	58	24" Ø RCP	Headwall & silt basin-4cy conc. 65'	$ 2,260
B-1	12	Gold Camp Rd.	None	12	35	24" Ø RCP	Headwall & silt basin-4cy conc. 65'	$ 2,260
B-1	12	Bear Cr. Can.	None	22	60	27" Ø RCP	Headwall & silt basin-5cy conc. 80'	$ 3,250
B-1	12	Bear Cr. Can.	54"x30" masonry box	6	18	Size OK	No const. req'd	---
B-2	13	Bear Creek	36" x 58" CMP	494	2724	3-4' x 10' RCB	Wing & apron 174cy-40'	$43,400
B-2	13	Bear Creek	2-24"ØCMP	494	2724	3-4' x 10' RCB	Wing & apron 174cy-40'	$43,400
B-3	19	Gold Camp Rd.	18" Ø CMP	6	20	Pipe size OK	No const. req'd	---
B-5	14+	Gold Camp Rd.	24" Ø CMP	58	204	42" Ø RCP	Headwall & silt basin 80'-4cy conc.-5cy rk.	$ 5,680
B-6	16	Stadium parking lot	CB&18"CMP	31	64	Add-150' 30" CMP	1-D10R-6' (add) or equiv.	$ 6,810
B-6	16	Stadium/ring road	18" CMP	55	123	48" RCP	Headwall 50'-4cy conc.	$ 4,550
B-6	17	Gold Camp Rd.	8'x3' open CB 19"x26" CMP	15	32	110'-27" CMP	Replace CB 1-D10R-6'	$ 4,860
B-6	17	Parking lot to ditch	24" CMP	19	40	70'-30" CMP	Questionable (private pipe)	$ 2,450
B-8	17	Gold Camp Rd.	18" Ø CB 18"x29" CMP	12	26	110' Pipe size OK	Replace CB 1-D10R-6'	$ 1,560

HYDROLOGIC DATA - SHEET 2 OF 4
APPENDIX E.
MAJOR CULVERT INVENTORY

LINCOLN DeVORE ENGINEERS · GEOLOGISTS

COLORADO: COLORADO SPRINGS, PUEBLO, GLENWOOD SPRINGS, GRAND JUNCTION, MONTROSE, WYOMING: ROCK SPRINGS

LOCATION			EXISTING			REQUIRED		
Sub Basin	Near Point	Street	Type of Structure	Flow-cfs 5 Yr.	100 Yr.	Equiv. Type Structure	Comment	Est. Cost
C-1	19	Gold Camp Rd.	None	13	42	18" Ø RCP	60' headwall + 1/3 AC. silt basin - 24cy-RK	$ 4,280
C-2	20	Gold Camp Rd.	None	27	78	24" Ø RCP	60' headwall + ½ AC s.b.-48cy rock	$ 5,820
C-13	14	21st Street	42" CMP	39	98	Pipe size OK	No const. req'd	---
C-13	14	21st Street	5"x6' curb opening	39	98	No change	No const. req'd	---
C-3	24	Gold Camp Rd.	None	67 (normal)	214	18"ØRCP(5 yr)	70'-excavate 6' 2/3 acre-4950cy	$ 8,750
C-3	24	Gold Camp Rd.	None	26 (choked)	130	24"ØRCP(100 yr)	70'- riprap-73 cy	$ 2,940
C-7	24	Vista Grande	None	29	140	18"ØRCP(5 yr) 24"ØRCP(100 yr)	70' ea.-riprap-56cy ½ac.-12'road-4200cy	$13,200
C-7	26		None	32	152	18"ØRCP(85) 24"ØRCP(8100)	90'ea.-riprap-60cy 1AC-8'rd.min.-5800cy	$21,800
C-7	26	Pegasus Dr.	None	35	162	24"ØRCP(85) 30"ØRCP(8100)	130'ea.-riprap-130cy 1AC-8'rd.min.-5200 cy	$26,400
C-11	26	Andromeda	None	38	170	36"ØRCP	90' riprap-70cy ½AC-7'rd.min.-4000cy	$14,700
C-12	above 27	Hercules Pl.	6"Ø curb pipe	<1	2	Adequate	No const. req'd	---
C-6	25		None	5	38	24"ØRCP	100' riprap -50cy	$ 3,200
C-8	29	Constellation	None	8	54	24"ØRCP	100'-headwall-4cy riprap-6cy	$ 3,300
C-9	29	Pegasus	None	3	20	18"ØRCP(85) 18"ØRCP(8100)	130'ea. riprap-58cy 1/3AC-8'rd.-2600 cy	$13,200
C-9	30		None	5	28	18"ØRCP(85) 18"ØRCP(8100)	80'ea. riprap-64cy 1/3AC-8'rd.-2700cy	$11,900
C-9	29	Pegasus	None	9	61	24"ØRCP(85) 24"ØRCP(8100)	100'ea.-riprap-60cy 1/3AC-8'rd.-2500cy	$13,600
C-9	29		None	10	63	42"ØRCP	60'riprap-22cy	$ 4,010
C-12	30	Orion	18"x24"box 12"ØCMP	22	51	replace with storm drain	See S.S.inventory	---
C-12	27	21st Street	3-5'x6'curb op. 36"ØCMP	109	498	Add- 3-36"ØRCP	90' ea.-headwalls 12cy conc.	$15,630
C-14	above 27	21st Street	18" CMP	11	26	Replace- 24"ØRCP	140' headwall/ apron-6cy	$ 4,540
C-14	above 27	21st Street	24" CMP	7	18	Pipe size OK	No const. req'd	---
C-14	above 27	21st Street	18" CMP	2	6	Pipe size OK	No const. req'd	---

HYDROLOGIC DATA - SHEET 3 OF 4
APPENDIX E.
MAJOR CULVERT INVENTORY

LINCOLN DeVORE ENGINEERS · GEOLOGISTS

COLORADO: COLORADO SPRINGS, PUEBLO, GLENWOOD SPRINGS, GRAND JUNCTION, MONTROSE, WYOMING: ROCK SPRINGS

LOCATION			EXISTING			REQUIRED		
Sub Basin	Near Point	Street	Type of Structure	Flow-cfs 5 Yr.	Flow-cfs 100 Yr.	Equiv. Type Structure	Comment	Est. Cost
D-1	28	Gold Camp Rd.	None	(normal) 56	175	24"ØRCP (85)	½A-8' nt.rd.-3850cy 90'	$10,720
D-1	28	Gold Camp Rd.	None	(choked) 25	82	24"ØRCP(8100)	90' ea. riprap-83cy	$ 3,570
D-3	28	Constellation Pl.	None	45	158	24" RCP	160'riprap-90cy 1D10R-6'-½AC 8'rd.-4100cy	$17,600
D-2	31	Gold Camp Rd.	None	(choked) 15	45	18"ØRCP(85) 18"ØRCP(8100)	90'ea.-riprap-50cy,1-DR-10-6' 1/3AC-7'rd-2700cy	$14,750
D-3	32	Pegasus	None	48	169	27"ØRCP	85' 1-D10R-6' riprap-8cy	$ 4,250
D-3	32	Constellation	None	50	176	30"ØRCP	85' 1-D10R-6' riprap-10cy	$ 4,700
D-5	32	Taurus	2-24"ØCMP	4	15	Pipe size ok	No const. req'd	---
D-5	32	Taurus	25"x44" CMP	4	15	Pipe size OK	No const. req'd	---
D-5	33	Taurus (ext.)	None	6	25	24"ØRCP	80'riprap-5cy 1-D10R-6'-1/3AC 7'rd.-2100cy	$10,150
D-5	33	No street	None	8	33	27"ØRCP	80'riprap-6cy 1-D10R-6'	$ 4,060
D-6	33	Pegasus (ext)	None	2	7	18"ØRCP	70'-1-D10R-6' riprap-4cy	$ 2,800
D-6	33	No street	None	6	27	24"ØRCP	70'-1-D10R-6' riprap-6cy	$ 3,320
D-6	33	No street	None	4	19	18"ØRCP	70'-1-D10R-6' riprap-4cy	$ 2,890
D-6	33	Taurus (ext.)	None	16	69	27"ØRCP	70'-1-D10R-6' 1/3AC-1600cy-10cy rk.	$ 8,250
D-7	33	No street	None	25	93	24"ØRCP	70'-1-D10R-6'-1/3 AC-2000cy-10cy rk.	$ 9,400
D-7	34	No street	None	58	196	see S.S. Inv. 30"ØRCP	2-D10R-6'-21cy rock-½AC-3500cy	$17,420
D-8	34	Constellation	None	7	15	24"ØRCP	55' riprap-4cy	$ 1,370
D-8	34	@ 21st St.	24"x36"open 12"ØCMP	100	333	Useless	Remove, replace with SS, see inv.	---
D-9	35	Sirius Dr.	D10R-15, D10R5 42"ØRCP	13	36	Pipe size OK see S.S.inv.	Use with S.S.	---
D-8	34	Sirius (ext)	None	4	10	18" RCP	25' riprap-4cy	$ 520
D-8	34	Sirius (ext)	None	19	41	24" RCP	25' riprap-6cy	$ 700
D-8	34	Sirius (ext)	None	6	13	18" RCP	25' riprap-4cy	$ 520
D-8	35	Sirius (ext)	None	6	14	18" RCP	25' riprap-4cy	$ 520
D-9	35	Prop. Sirius CR.	None	42	94	42"RCP	75' riprap-4cy	$ 8,450

LOCATION			EXISTING				FLOW-cfs		REQUIRED (full devel.)				
Sub Basin	Near Point	Street	Pipe	Length ft.	CB	Outlet Struct.	5 Yr.	100 Yr.	Pipe	Length ft.	CB Equiv. D-10R	Outlet Structure	Notes & Est. Cost $
B-6	15	Lower Gold Camp Rd.	None	---	None	-----	39	80	30"RCP	580	1-10' 1-8'		$24,290
B-6	15	Lower Gold Camp Rd.	None	---	None	-----	42	89	36"RCP	500	4-8'		$32,060
B-6	17	Lower Gold Camp Rd.	None	---	None	-----	60	126	48"RCP	620	2-8'		$50,280
B-6	17	Lower Gold Camp Rd.	None	---	None	-----	72	151	54"RCP	560	4-8' 2 MH	Bear Creek	$58,960
B-6	17	Lower Gold Camp Rd.	None	---	None	-----	--	---	24"RCP	540	Inlet Pipe		$12,960
B-7	17	8th St.	None	---	None	-----	97	192	42"RCP	410	1-10' 2-8'	Bear Creek	$30,890
B-7	17	8th St.	None	---	None	-----	--	---	24"RCP	260	2-2x2 Grates. Inlet		$ 9,140

HYDROLOGIC DATA
APPENDIX F

SHEET 1 OF 4

STORM SEWER INVENTORY

LINCOLN DeVORE ENGINEERS - GEOLOGISTS

COLORADO: COLORADO SPRINGS, PUEBLO, GLENWOOD SPRINGS, GRAND JUNCTION, MONTROSE, WYOMING: ROCK SPRINGS

LOCATION			EXISTING				FLOW-cfs		REQUIRED (full devel.)				
Sub Basin	Near Point	Street	Pipe	Length ft.	CB	Outlet Struct.	5 Yr.	100 Yr.	Pipe	Length ft.	CB Equiv. D-10R	Outlet Structure	Notes & Est. Cost $
C 10	23	Orion	None		None		48	161	24"RCP	260	3-6'		$10,920
C 10	23	Rigel	None		None		54	169	24"RCP	550	1-8' 3-6'		$19,300
C 10	23	Orion	None		None		102	282	30"RCP	300	2-6' 2-8'		$16,450
C 10	23	Orion	None		None		138	386	36"RCP	660	2-6'		$35,460
C 10	23	Orion	12"CMP	75	18"x24" Grate	Nat. Ditch	153	464	42"RCP	340	2-6' 1-8' 1MH	Conc.entry to Park ditch	$25,750
C 10	23	orion	None		None		--	--	18"RCP	720	(Inlet pipe)		$12,960
C 11	23	Andromeda	None		None		31	99	24"RCP	620	3-6' 1-8' 1-10'		$23,550
C 11	23	Orion	None		None		33	104	24"RCP	310	1-6'		$ 7,800
C 11	23	Orion	None		None		52	113	27"RCP	650	3-6'		$24,140
C 11	23	Orion	None		None		60	124	30"RCP	300	1-6'		$12,060
C 11	23	Orion	12"CMP		18"x24" Grate		70	136	36"RCP	370	3-6'	Conc.entry to part ditch	$22,810
C 11	23	Orion	None		None		--	--	18"RCP	560	(Inlet pipe)		$10,080
C 12	30	Scorpio	None		None		58	128	24"RCP	580	4-8' 2-6'	Open to Nat. Gulley-Park	$23,060
C 12	30	Scorpio	None		None		--	---	18"RCP	226	(Inlet Pipe)		$ 4,070

HYDROLOGIC DATA

APPENDIX F

SHEET 2 OF 4

STORM SEWER INVENTORY

LINCOLN DeVORE ENGINEERS · GEOLOGISTS

COLORADO: COLORADO SPRINGS, PUEBLO, GLENWOOD SPRINGS, GRAND JUNCTION, MONTROSE, WYOMING: ROCK SPRINGS

LOCATION			EXISTING				FLOW-cfs		REQUIRED (full devel.)				
Sub Basin	Near Point	Street	Pipe	Length ft.	CB	Outlet Struct.	5 Yr.	100 Yr.	Pipe	Length ft.	CB Equiv. D-10R	Outlet Structure	Notes & Est. Cost $
C 12	30	Hercules	None		None		31	68	24"RCP	370	2-8' 1-6'		$14,220
C 12	30	Orion	12"CMP	65'	18"x24 Grate	"Nat.Gully to Park	37	78	30"RCP	240	2-8' 1-6'	Open to Nat. Gully-park	$13,340
C 12	30	Orion	None		None		--	--	18"RCP	230	(Inlet pipe)		$ 4,140
D 4	32	Parkview	None		None		68	261	24"RCP	1080	1-8' 3-6'		$32,640
D 4	32	Parkview	None		None		81	290	27"RCP	660	4-6'		$26,050
D 4	34	Parkview	None		None		93	317	30"RCP	715	7-6'		$36,230
D 4	34	21st St.	None		None		100	333	30"RCP	440	1-6' 1 MH	48"RCP from D-5	$17,460
D 4	34	Parkview	None		None		---	---	18"RCP	608	(Inlet pipe)		$10,945
D 5	34	Constel-lation	12"CMP	75'	24x36" Grate	Basin D ditch	24	89	24"RCP	680	2-10' 2-8'		$24,300
D 5	34	Constel-lation	None		None		32	99	36"RCP	290			$14,210
D 5	34	21st St.	None		None		125	406	48"RCP	150	1-6'	Basin D ditch to Bear Creek	$12,810
D 5	34	Constel-lation	None		None		---	--	18"RCP	115	(Inlet pipe)		$ 2,070

LOCATION			EXISTING				FLOW-cfs		REQUIRED (full devel.)				
Sub Basin	Near Point	Street	Pipe	Length ft.	CB	Outlet Struct.	5 Yr.	100 Yr.	Pipe	Length ft.	CB Equiv. D-10R	Outlet Structure	Notes & Est. Cost $
D 7	34	Sundown Ext.	None		None		55	184	30"RCP	380	2-6' 1 entry		$16,720
D 7	34	Subd. Bndry	None		None		64	206	36"RCP	330	1-8'		$18,060
D 8	34	21st St.	None		None		78	238	36"RCP	410	1-6' 1-8'		$23,540
D 8	34	21st St.	None		None		82	248	48"RCP	50	1-8' 2 MH	Basin D ditch to bear creek	$ 6,240
D 8	34	21st St.	None		None	--	---		18"RCP	255	(Inlet pipe)		$ 4,590
D 9	35	Hercules	None		None		21	47	27"RCP	1450	3-8' 4-6'		$55,800
D 9	35	Sirius	None		None		24	56	36"RCP	240	1-6'	Into exist. 42"ØRCP	$13,320
D 9	35	Hercules	42"RCP	60	1-D10R-15' 1-D10R-5'	Nat. Ditch	37	92	18"RCP	304	(Inlet pipe)		$ 5,470

HYDROLOGIC DATA

APPENDIX F

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