ABBEY DRAINAGE BASIN PLANNING STUDY

FOR

CANON CITY, COLORADO

PREPARED BY:

ASSOCIATED DESIGN PROFESSIONALS, INC.
1861 AUSTIN BLUFFS PARKWAY, SUITE 101
COLORADO SPRINGS, CO 80918

December 16, 1998
Job No. 960908

ADP
Associated Design Professionals, Inc.

ABBEY DRAINAGE BASIN
PLANNING STUDY
INTERIM IMPROVEMENTS

GENERAL

The overall cost to upgrade the drainage systems throughout the Abbey Drainage Basin is very significant. Where possible a stepped approach should be taken. The current City policy of purchasing land and constructing regional detention facilities is the most prudent idea. By constructing the detention facility first, storm runoff peaks will be reduced which will alleviate a portion of the downstream overloading on the existing drainage system. In conjunction with the proposed system improvements summarized in the Abbey Drainage Basin Planning Study, some interim improvements may be necessary until full improvements can be implemented.

INTERIM RECOMMENDATIONS

A 38 acre-foot detention facility is planned for the northern portion of the Abbey School property south of the Hydraulic Ditch. The detention facility will detain approximately 90% of the upstream storm flows, which will reduce the stream load downstream. As development occurs west and north of the Abbey, the proposed 8' x 4' box culvert crossing should be investigated to manage the increased flows that cross under U.S. Highway 50.

The structure at Central Avenue will require reconstruction to,

1. Reconstruct the drop at the upstream end of the pipe to allow a more smooth transition into the pipe, and
2. Remove the constriction at the downstream end of the pipe.

These improvements will increase the safety and capacity of this structure and will convey more of the upstream flows to the detention facility. The improvements listed will not destroy or inhibit any of the existing riparian habitat currently in the area.

Improvements should be made as development increases in the northern portion of the basin. For example, improvements should be made to the ponds as development increases in that area and the storm sewer along Raynolds Avenue should be considered as development occurs north of South Street.

The region east of the Abbey School that includes Bill Berry Motors and Wal-Mart currently has a drainage plan in effect to detain a portion of a major storm event. Therefore, the proposed storm sewer will only be needed in the future when this area fully develops.

The estimated probable cost for interim construction is as follows:

LOCATION	DESCRIPTION	COST
North Abbey property and Hydraulic Ditch	Detention facility	$464,000.00
Central Avenue and main channel	Structure improvements	$22,000.00
		$486,000.00

This cost does not include land or easement purchase costs and is based on 1998 dollars.

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

I. INTRODUCTION

A. Contract Authorization

The Abbey Drainage Basin Planning Study was authorized under the terms of an agreement between the City of Canon City and Associated Design Professionals, Inc. This study covers drainage development alternatives within the Abbey Drainage Basin.

B. Purpose and Scope of Work

The purpose of this study is to develop the most feasible drainage plans for the Abbey Drainage Basin. The detailed scope of services is as follows:

I. Abbey Drainage Basin as a whole

A. Review previous studies, maps and other available information.
B. Provide additional analysis and/or data that are critical to the project and not currently available, in order to accomplish II.

II. Conceptual Master Plan for Basin

A. Recommend improvements for the basin
B. Prioritize the improvements
C. Provide a planning level cost estimate for each improvement

C. Previous Drainage Reports

There have been two previous drainage studies performed within the Abbey Drainage Basin. The following is a summary of those reports:

"Preliminary Plan of a Storm Water Management Policy for the Four Major Drainage Basins located in the Northern Portions of Canon City, Colorado" by Great Divide Engineering and Surveying, 1986.

"Report on Storm Drainage Facilities for the City of Canon City, Colorado" by M & I, Inc., 1974.

D. Agency Jurisdictions

The City of Canon City has jurisdiction over the proposed drainage criteria and design requirements. Any proposed improvements or changes to the existing canals within the basins will need to be approved by one of the following canal boards:

- Fruitland Ditch
- Hydraulic Ditch
- Oil Creek Ditch

The US Army Corps of Engineers will have review approval for any work that disturbs existing wetland areas or for any modifications to the Arkansas River.

E. Drainage Criteria

The drainage criteria used in this study were obtained from the City of Canon City. Flow calculations are determined from the TR-20 Computer Program for Project Formulation Hydrology developed by the Soil Conservation Service. The charts used in determining input for the program are contained in the Appendix of this report.

F. Mapping

The Canon City, Colorado, 1:24,000 topographic quadrangle maps prepared by the U.S. Geological Survey was used as the basin map for this project. These maps use 20 feet contour intervals and was photo revised in 1976. The maps were used for the general purposes of basin boundary delineation and for the establishment of principal tributary regions and sub-basins within these regions. Recent road additions were added to the maps to reflect current conditions.

The mapping was supplemented with 2 ft contour, 100 ft scale mapping of a portion of the drainage basin. These maps were produced in 1979 by Ponderosa Engineering and used to better delineate the drainage in undeveloped areas.

G. Field Reconnaissance

Field reconnaissance of the basin was performed in order to supplement existing roadway and site development plans, and existing drainage reports. Culvert locations, sizes and depths were field checked and sub-basin flow patterns were analyzed. In addition, existing as well as potential problem areas were noted for a more in-depth evaluation.

Aerial photography, taken in March 1994, was utilized to identify current land uses and drainage patterns throughout the Abbey Drainage Basin.

H. Environmental Considerations

Environmentally sensitive areas currently exist in the Abbey Drainage Basin. The channel reach between Central Avenue and Elizabeth Street exhibits a well-vegetated riparian habitat with a broad channel base and stable side slopes. The five private ponds located in the northern reaches of the basin exhibit well-vegetated areas of native grasses with cattails in marshy areas. Any modifications to these areas will be designed in such a manner as to create no adverse affects on any wetland areas.

II. PROJECT DESCRIPTION

A. Basin Description and Location

The Abbey Drainage Basin encompasses the eastern portion of Canon City and a portion of El Paso County. It runs from the Orchard Avenue Basin on the west to the Fourmile Creek Drainage Basin on the east and the Arkansas River to the south. It is situated in Township 18S, Range 70W of the 6th PM, Fremont County, Colorado. The basin contains approximately 2.25 Square Miles. A majority of the lands are currently platted, but not yet developed.

The runoff from this basin flows in a southerly direction and crosses U.S. Highway 50 in culverts, which empties into roadside ditches. The topography varies from a mild slope of 1% in the lower portion of the basin to 3% to 6% in the central portion of the basin. The

vegetation consists primarily of native rangeland grasses with some trees and wetland vegetation along portions of the main channel.

B. Major Drainageways and Facilities

The upper channels in the Abbey Drainage Basin vary from broad swales with heavy vegetation to well-defined channels and roadside ditches with relatively sparse vegetation. There are three irrigation canals that traverse the basin from the west to east. The northern-most canal that crosses the central part of the basin is the Fruitland Ditch. The Hydraulic Ditch is located just south of Pear Avenue and is the largest ditch within the basin. It is approximately 12 feet wide with an average slope of about 0.1% and has a capacity of 96 cfs. The third canal is the Oil Creek Ditch and crosses the basin between U.S. Highway 50 and the Arkansas River. Although most basin run-off is currently tributary to these canals, their capacities are such that large storm flows will inundate the canals and allow water to overtop their banks.

The northern portion of the Abbey Drainage Basin traverses through a broad swale that has its origins in a developed area known as Park Center. This upper reach of the basin contains several small natural swales that combine into a single, broad swale as it nears High Street. The channel crosses under High Street through a 15" corrugated metal pipe (CMP) and continues flowing south through a series of small ponds. These small ponds are privately owned and are nestled in a small community of homes. Flows then continue south and pass under Elizabeth Street through a 72" CMP. Field inspection revealed that the inlet and outlet of this structure were eroded and is in need of repair. Flow from the Fruitland Ditch, which is partially enclosed upstream, passes under Elizabeth Street through a 24" CMP. Field inspection revealed that the Fruitland Ditch does not continue from this point to join with the Hydraulic Ditch as shown on the quadrangle map. Flows from the Fruitland Ditch and the main channel converge just south of Elizabeth Street in a well-defined channel with a bottom width of approximately 5-foot. This combined flow from approximately 325 acres continues southwesterly and passes though another 72" CMP located at Central Avenue. Field inspection revealed an unstable drop inlet and an outlet that constricts the flow exiting the culvert. This may create considerable problems with the 100-year flood event and will be addressed later on in the report. The flow continues south though a well-defined channel and crosses over the Hydraulic Ditch. In this area, the flow from the Hydraulic Ditch passes under the main channel through a siphon that replaces an older areal crossing.

A region of 240 acres to the west of the main channel stem and to the north of Central Avenue now combines with the main channel by means of a series of roadside ditches and the Hydraulic Ditch. Within this region, flows from an area of approximately 170 acres discharge across the Fruitland Ditch and continue south to the Hydraulic Ditch. The flows from this region intersect the Fruitland and Hydraulic Ditch and proceed into the neighboring sub-basins. The western portion of this area was previously included in a report for the Orchard Avenue Drainage Basin study that was conducted by Graef Anhalt Schloemer and Associates in November of 1994. This area of approximately 190 acres is included in this report in an effort to examine the flows normally flowing west along Pear Street. An attempt will be made to direct the flows back to the east and into the main channel to avoid confluence with the Hydraulic Ditch.

The total combined flow then continues south through an approximate area of 90 acres

consisting mostly of low-density housing. Flows then pass under U.S. Highway 50 through a 48" CMP just west of the Abbey. The flow then enters 2-36" CMP's under East Main Street. A 42" X 29" CMP carries the flow under the railroad and Rhodes Avenue to a roadside ditch with a bottom width of approximately 4 foot. Flows contained in the ditch pass over the Oil Creek Ditch and through a flume located near Ute Street and continue south to the Arkansas River.

The remaining portion of the basin encompasses an area of approximately 490 acres to the north, east, and south of the Abbey. Natural swales and roadside ditches drain an area of approximately 415 acres to the north and east of the Abbey and intersect U.S. Highway 50. Flow crosses under U.S. Highway 50 through 2-30" CMP's located just south of the Abbey and a 48" CMP located just south of the Bill Berry Motors car dealership. Along with the pipes mentioned previously, six 24" CMP's also carry water under U.S. Highway 50 and discharge into a series of roadside ditches that carry the flow east to Fourmile Creek. An area of approximately 75 acres between U.S. Highway 50 and the railroad drains south to the railroad and subsequently discharges into Fourmile Creek. The area south of the railroad of approximately 170 acres is drained by overland flow into roadside ditches. Flows from this area continue south to the Arkansas River.

The undersized culverts and lack of a defined storm system has added to the threat of frequent, shallow flooding to the residential neighborhoods north of U.S. Highway 50. The canals within the basin are quickly overwhelmed by most storm flows and subsequently deliver flows directly to the residential streets.

C. Existing Surface Water Improvements

The five private ponds located in the northern reaches of the basin are the only significant surface water impoundments within the Abbey Drainage Basin. The ponds are on average 4' deep and are well vegetated around their banks.

III. HYDROLOGIC EVALUATION

A. Basin Hydrology

The hydrologic model used to determine peak flows and volumes throughout Abbey Drainage Basin was the TR-20 Computer Program for Project Formulation Hydrology developed by the Soil Conservation Service.

The overall basin was divided into tributary basins and then into smaller sub-basins. The sub-basins and existing structures were numbered to designate different variables for data entry into TR-20. The sub-basins were chosen with respect to the natural topography, roadway crossings and development considerations.

Peak flows for the 100-year, 50-year and 25-year, 24-hour storms, were calculated and evaluated.

B. Time of Concentration

The time of concentration (Tc) used in the TR-20 calculations was determined by first calculating an initial overland flow time from the sub-basin boundary to the naturally occurring swales and channels. Then a travel time was calculated in these natural swales to the bottom of the sub-basins and added to the initial overland flow time to determine the overall time of concentration for existing conditions. For future developed conditions, the channel travel times were adjusted to reflect improved conditions and therefore a shorter time of concentration.

C. Rainfall

Rainfall amounts for the Abbey Basin were determined from the National Oceanic and Atmospheric Administration Atlas 2, Precipitation-Frequency Atlas of the Western United States, Volume III - Colorado, 1973.

Precipitation for the 100-year 50-year and 25-year, 24-hour storms were 3.40, 3.05 and 2.75 inches, respectively.

D. Land use

Existing land uses in the Abbey Drainage Basin were determined by examining current development plans supplemented with field reconnaissance. Currently most of the development is occurring in the eastern and southern portion of the basin with the western and northern areas remaining in their natural state.

Proposed land use for the area was determined through examination of current development plans and through discussions with Fremont County Planning Department officials and Canon City officials. For design purposes undeveloped areas were assumed to be fully developed using projected densities. The land use map is a composite of this land use information. There is not a time frame or date associated with this ultimate projected land use.

E. Soil Characteristics

The soils information contained in this report is derived from the "Soil Survey of Fremont County Area, Colorado", currently being completed by the USDA Soil Conservation Service. Of the 11 soils classifications found within the Abbey drainage basin, one belongs to Hydrologic Soil Group A/B, four belong to the Hydrologic Soil Group C, and six belong to the Hydrologic Soil Group D (see the Soils Map for location). The following is a table of the soils located within the basin:

TABLE 2
SOILS CLASSIFICATIONS

S.C.S Soils *Map Numbering*	*Soil Classification*	*Hydrologic* *Soil Group*
51	Kim	C
52	Kim	A/B
59	Limon	D
60	Limon	D
61	Limon	C
62	Limon	C
63	Limon	D
71	Midway	D
72	Midway	D
92	Riverwash	D
124	Wann	C

F. Runoff Curve Numbers

Runoff Curve Numbers (CN's) were determined for the basin by utilizing soils and land use information described in previous sections. Curve numbers for the undeveloped portions of the basin were prepared based on projected land densities with some agricultural land remaining in its existing rangeland conditions.

IV. HYDRAULIC DESIGN EVALUATION

A. Existing Structure Evaluation

Only the existing structures that transport flows out of major sub-basins have been examined in this report. These structures vary from a 15" CMP to 72" CMP. An allowable headwater of 6" below the edge of pavement was utilized to calculate maximum culvert capacities. The existing capacities of these structures were estimated primarily using inlet control analysis.

The analysis revealed that a portion of the existing structures throughout the basin are unable to effectively handle the existing 100 year, 24-hour storm without overflowing the roadways. An existing structure evaluation chart was developed to summarize these findings and is included at the end of this section.

B. Existing Drainageway Evaluation

As outlined in the Major Drainageway and Facilities section, most of the major drainageways within the Abbey Drainage Basin are natural, unimproved channels. In the upper reaches of the basin, the channels are typically wide, grassed swales with little or no signs of erosion. The existing capacities of major channel reaches within the basin were estimated using normal depth flow analysis.

C. Environmental Inventory

The significant environmentally sensitive areas within the Abbey Drainage Basin are the five private ponds and the channel reach as described in the Existing Surface Water Improvements Section.

V. ALTERNATE DRAINAGE SYSTEMS

A. Alternate Development Policies

The Alternative Drainage systems were developed in a cooperative effort with input from the City of Canon City, the Hydraulic Ditch Company, and the local residents. Several additional variations of the presented alternates were also examined but are not included in this report.

B. Alternate 1

This alternate investigates the existing flow conditions through the project area. It assumes that the Hydraulic Ditch is completely filled with storm flows from the north and allows flows to overtop the canal. A second assumption is that the privately owned stock ponds will breach and provide no upstream storage.

Based on these assumptions, approximately 831 cfs from 400 acres accumulates in the main channel at a point just north of the Hydraulic Ditch near Pear Street. Approximately 295 cfs from 130 acres accumulates from a region north of Central Avenue and also converges with the flows from the main channel. The western most region of the basin adjacent to the Orchard Avenue Drainage Basin contributes approximately 164 cfs from 60 acres and converges with the main channel. This total combined flow continues south near the western boundary of the Abbey School and intersects U.S. Highway 50 with a flow rate of 1016 cfs. The flows will continue south across U.S. Highway 50 and the railroad and eventually empty into the Arkansas River. The total flow amount that will reach the river would be 1,064 cfs.

C. Alternate 2

The assumptions presented in Alternate 1 were also considered in evaluating the suggested improvements for Alternative 2.

A 51 acre-foot detention facility has been conceived to intercept flows from the upper portion of the basin. The proposed location for the detention basin is in the northern portion of the Abbey property just south of the newly constructed Hydraulic Ditch siphon. The detention facility will retain the combined upstream flows of 867 cfs and release approximately 97 cfs downstream. An improved riprap channel reach is proposed north of the detention basin to Central Avenue. The existing 72" CMP at Central Avenue will require an improved drop inlet and the constriction at the outlet be corrected. Minimal improvements are expected for the reach between Central Avenue and Elizabeth Street. This channel reach is heavily vegetated with a well-established riparian habitat. Improvements made to the private ponds and channel upstream of Elizabeth Street will be addressed in alternate 3.

The channel south of the detention basin will require drop structures to attenuate the flows released from the detention basin. The drop structures will be constructed utilizing riprap

or gabion baskets with a maximum slope of 0.5% between each structure. The existing 48" CMP, 2-36" CMP, and 42" X 29" CMP that pass under Fremont Drive, U.S. Highway 50, and the Railroad Tracks respectively, will be replaced by a single 8' X 4' precast concrete box culvert. Flows passing through this box culvert will discharge into the roadside ditch that flows south along the west side of Rhodes Avenue. This ditch will require a riprap lining along its entire length to the Arkansas River. The total expected flow released to the river is 431 cfs.

The central area of the basin currently drains through a series of undersized 24" culverts that cross under U.S. Highway 50. There are 2-30" CMP's that handle the majority of the flows near the Abbey School and cross under U.S. Highway 50. These undersized pipes should be replaced with an 8' X 3' box culvert to handle the flow of 216 cfs from north of the Abbey School. The region west of Dozier Avenue of approximately 155 acres is currently drained by a single 24" RPC crossing under U.S. Highway 50. A 12' X 4' box culvert is proposed for this area to accommodate the developed flow of 356 cfs.

Roadside ditches and swales drain the upper reaches of the region north of Wal-Mart and the Bill Berry car dealership. The flows from approximately 165 acres are then concentrated and transported through a small drainage network that collects storm flows from the car dealership and Wal-Mart parking lots. An existing Type C inlet in conjunction with a 48" RCP is located between Fremont Drive and U.S. Highway 50 to collect surface runoff and is also connected to the drainage network. The developed flow of approximately 456 cfs will be conveyed under U.S. Highway 50 by means of a 14' X 4' box culvert replacing the existing 48" RCP.

A concrete drainage ditch is conceived to transport the flow east between U.S. Highway 50 and East Main Street and discharge directly into Fourmile Creek. The 4700-ft. ditch is comprised of a 1000-ft. section at 4 ft. in depth, a 2200-ft. section at 5 ft. in depth, and a 1500-ft. section at 6.5 ft. in depth. The ditch will have a base dimension of 10 ft. with side slopes of 3 to 1. A Type C inlet 5-ft. deep is presently located between East Main Street and U.S. Highway 50 and collects any surface runoff in the ditch. Alterations will need to be made at this location to continue the flow in the pipe, or possibly abandon the inlet.

After reviewing the drainage reports for Wal-Mart and examining the 2 ft. contour maps, it appears that the area in vicinity of Dozier Avenue may conceivably encounter shallow flooding and overtopping of U.S. Highway 50 if the existing pipes along U.S. Highway 50 are not upsized as previously described.

The area south of U.S. Highway 50 and north of the Denver and Rio Grande Railroad contributes 286 cfs from 102 acres directly to Fourmile Creek near the large Railroad Bridge at Grandview Street. Flows south of the railroad converge along Ute Street and delivers 286 cfs from 176 acres directly to the Arkansas River.

The estimated probable construction cost of Alternate 2 is $5,016,000. This cost does not include land or easement purchase costs and is based on 1998 dollars.

D. Alternate 3

This alternative contains the same detention alternatives as Alternate 2 as well as the same assumptions made in Alternate 1. The difference between Alternative 2 and

Alternative 3 is that now the private ponds have been upgraded to detain all or a portion of the 100 year storm event.

Based on the assumptions, approximately 810 cfs from 400 acres accumulates in the main channel at a point just north of the Hydraulic Ditch near Pear Street. Approximately 290 cfs from 130 acres accumulates along Raynolds Avenue from a region north of Central Avenue by means of an 8' X 3' box culvert. The western most region of the basin adjacent to the Orchard Avenue Drainage Basin contributes approximately 200 cfs from 60 acres through a 48" RCP under Central Avenue and a 400 ft. long 72" RCP along Pear Street. These three tributaries combine north of the siphon crossing at the Hydraulic Ditch and travel south to a 38 acre foot detention facility. The total combined flow of 810 cfs enters the detention facility and releases 91 cfs downstream. The southerly flows will continue beneath U.S. Highway 50 and the railroad through an 8' X 4' box culvert and eventually empty into the Arkansas River. The total flow amount that would reach the river would be 431 cfs.

Improvements to the ponds include the upsizing of the existing 24" CMP outlets to 48" RCP equipped with trash racks and vortex dissipaters. A 20' emergency overflow weir and spillway will be installed to direct flows downstream to prohibit any washouts of the embankments. The embankments may, in some cases, need to be raised to create adequate storage for the 100-year event.

A 4,700-ft. storm sewer between Fremont Drive and U.S. Highway 50 is proposed to carry storm flows of 1,027 cfs east to Fourmile Creek. It will consist of an 8' x 6' box culvert at 1000 ft., an 8' x 10' box culvert at 2200 ft. and an 8' x 16' box culvert at 1500 ft. The estimated probable construction cost the 4,700-ft. storm sewer is $3,168,000.00

Channel and pipe improvements are recommended for the area between the railroad and the Arkansas River. A 36" RCP is proposed at Ute Street with a 5' riprap channel along Ash Street to Grandview Street. A 54" RCP will cross under Grandview Street and a 6' riprap channel will transport flows downstream to the Arkansas River. The total expected flow from this area of 176 acres is 286 cfs.

The estimated probable construction cost of Alternate 3 is $6,766,000. This cost does not include land or easement purchase costs and is based on 1998 dollars.

E. Summary of Alternatives

Factors used to evaluate the three alternatives explained in this report were cost, constructability, citizen feedback, and city input. As a result of the meetings held with public and private individuals, Alternate 3 was selected as the preferred alternative. It was recommended that Alternate 3 be modified to include improvements of the existing structure at the intersection of Rhodes Avenue and the Oil Creek Ditch. It was also recommended that the storm sewer between Fremont Drive and U.S. Highway 50 be modified to transport flows to the Arkansas River through the existing overflow ditch for the Oil Creek Ditch located east of the campground and south of Bill Berry Motors. The land use map was also modified to depict more residential and commercial development in the vicinity around the Abbey School.

The existing structure at the intersection of the Oil Creek Ditch and Rhodes Avenue allows flows from the roadside ditch to enter the Oil Creek Ditch, or continue south to the Arkansas River. This structure must be upgraded to allow the flows from the north to effectively pass over the Oil Creek Ditch and to the Arkansas River during a major storm event. To improve this crossing, a 60" siphon along the Oil Creek Ditch is proposed to carry the flows under Rhodes Avenue. The siphon will be equipped with a trash rack and an overflow structure to divert flows back to the ditch along Rhodes Avenue in case of blockage of the siphon. The structure will allow flows from the roadside ditch to enter the Oil Creek Ditch, as does the existing structure.

The realignment of the storm sewer will involve crossing U.S. Highway 50 south of Bill Berry Motors with a single 16' X 8' box culvert. This culvert, along with the 8' X 4' box culvert near the Abbey School, will each be approximately 300 feet long and very costly to construct. The outflow ditch for the 8' X 16' box culvert will transport 991 cfs from the storm sewer south in an 8' riprap channel approximately 700 feet to the Arkansas River..

An overflow analysis was performed for the portion of the Hydraulic Ditch between the overflow structure at Phelps Avenue and upstream of the siphon near the intersection of Pear Street and Raynolds Avenue. The capacity of the ditch through this reach is approximately 134 cfs and the capacity of the siphon is approximately 137 cfs. The expected amount of flow that would reach the main channel if the ditch overtopped during a major storm event would be approximately 50 cfs. The existing weir structure in place upstream of the siphon would effectively handle this flow and direct it into the detention basin. This flow would not effect the size of the proposed detention basin as described in Alternate 3.

A similar analysis was performed at the intersection of the Oil Creek Ditch and Rhodes Avenue to determine the amount of flow that would be expected to enter the main channel. Upon approximation of the geometry and capacity of the Oil Creek Ditch, the expected amount of flow that would reach the main channel during a major storm event would be approximately 50 cfs. This extra flow would require that the riprap ditch between the Oil Creek Ditch and the Arkansas River be 6 inches deeper to handle this extra flow.

The estimated probable construction cost is $6,224,000. This cost does not include land or easement purchase costs and is based on 1998 dollars.

VI. PRELIMINARY DESIGN

A. General

Based on the results of the alternatives, the evaluation and comments from the public meetings and the City, the concepts from the chosen alternative were developed into preliminary designs. Each major system in the Abbey Drainage Basin is delineated on the conceptual plans contained in Appendix B with the associated costs for the facilities included in a summary table in the Economic Analysis section.

Although specific types of erosion protection and drop structures are delineated on the Preliminary Estimate of Probable Construction Costs, this does not preclude the use of other design materials or design schemes that will serve the intended purpose, as well as

or better than, those presented herein both hydraulically and environmentally. The designs presented in this study represent one method of stabilizing the channel. Other methods of stabilization are permitted as long as they meet with the approval of the Canon City Engineering Department and other affected agencies.

VII. WATER QUALITY

A. General

Concern regarding storm water quality has been growing through the past decade. Recently the Environmental Protection Agency (EPA) has been working on regulations for monitoring and the use of best management practices to control storm water. The actual design for any necessary control facilities will vary according to the type of pollutants present.

Pollutants enter storm water in many ways, among which are the following:

1. Pollutants are absorbed as the raindrops pass through the atmosphere.
2. Pollutants are washed off the paved and unpaved surfaces by storm water runoff.
3. Pollutants that have accumulated since the last storm in sewers, ditches, and channels are picked up by the storm water.

B. Treatments

Most of the pollutants expected to reach the main stem of the channel should be of the suspended solid variety. However, it may be necessary to sample and analyze the storm water to determine the exact control measures to implement.

Dry basins should be designed in areas where the main pollutants are suspended solids, which simply settle out in the basin when the channel velocity drops. However, if dissolved solids, nitrates and nitrites, and soluble phosphorus are present, a wet pond will need to be constructed to reduce these pollutants.

VIII. ECONOMIC ANALYSIS

A. General

The economic analysis of the channel improvements listed in this study was derived from current construction prices for materials and labor in the Canon City/Fremont County area. In addition, the 1997 edition of the Colorado Department of Highways "Cost Data" was utilized and updated for 1998 costs. Estimated probable construction costs were determined for each channel reach for the selected alternative utilizing the protection scheme delineated in the Alternate Drainage Systems section and on the Alternate Conceptual Plans located in Appendix B.

The following Table 9, Unit Construction Costs, lists the specific unit costs used in determining the estimated probable construction costs:

TABLE 9
UNIT CONSTRUCTION COSTS

Item Description	Unit	Estimated Unit Cost
Vortex Dissipator	EA	$1,500.00
Trash Rack	EA	$1,400.00
Gabion Baskets	CY	$85.00
Rip Rap	CY	$35.00
Heavy Rip Rap	CY	$45.00
Granular bedding materials	CY	$20.00
Reinforced concrete	CY	$265.00
Concrete channel lining	CY	$180.00
Structural backfill	CY	$8.00
Structural excavation	CY	$5.00
Unclassified excavation & embankment	CY	$2.50
Seeding (native)	Acre	$1000.00
36" RCP	LF	$60.00
48" RCP	LF	$75.00
54" RCP	LF	$90.00
60" RCP	LF	$120.00
66" RCP	LF	$150.00
72" RCP	LF	$170.00
42" CMP (pipe and installation)	LF	$60.00
54" CMP (pipe and installation)	LF	$70.00
8' X 3' Box culvert	LF	$250.00
8' X 4' Box culvert	LF	$260.00
8' X 5' Box culvert	LF	$300.00
8' X 6' Box culvert	LF	$400.00
8' X 10' Box culvert	LF	$575.00
8' X 16' Box culvert	LF	$650.00

NOTE: Pipe and culvert costs do not include utility relocation costs. Preliminary construction costs include a 20% factor for contingencies.

B. Preliminary Estimate of Probable Construction Costs

As previously stated, the proposed improvements are illustrated on the alternate conceptual plans that are included in Appendix B. Conceptual construction costs were estimated for each alternate based on the unit construction costs provided in this section and are also in Appendix B. Preliminary construction costs for the selected alternate are provided in Appendix C.

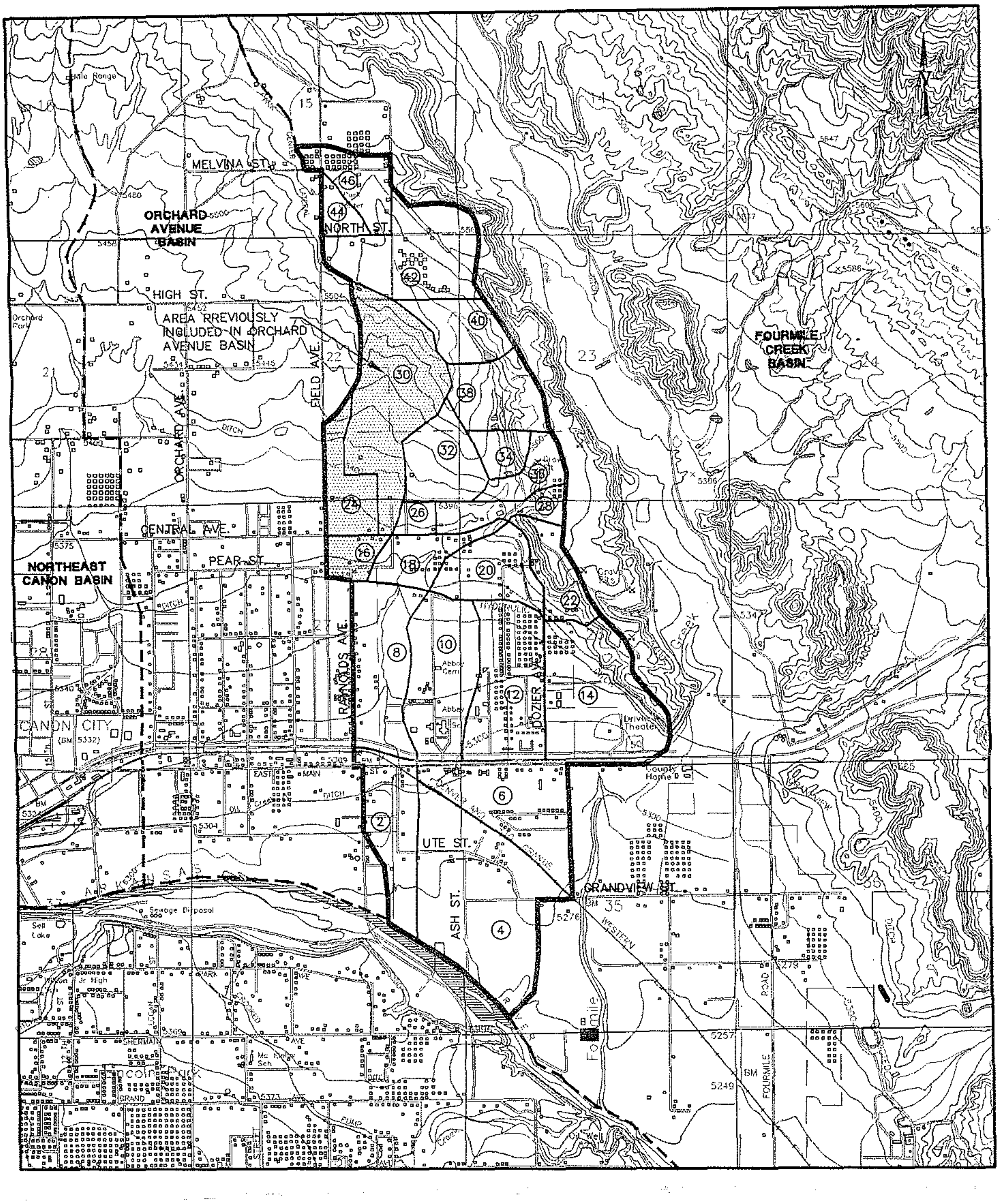


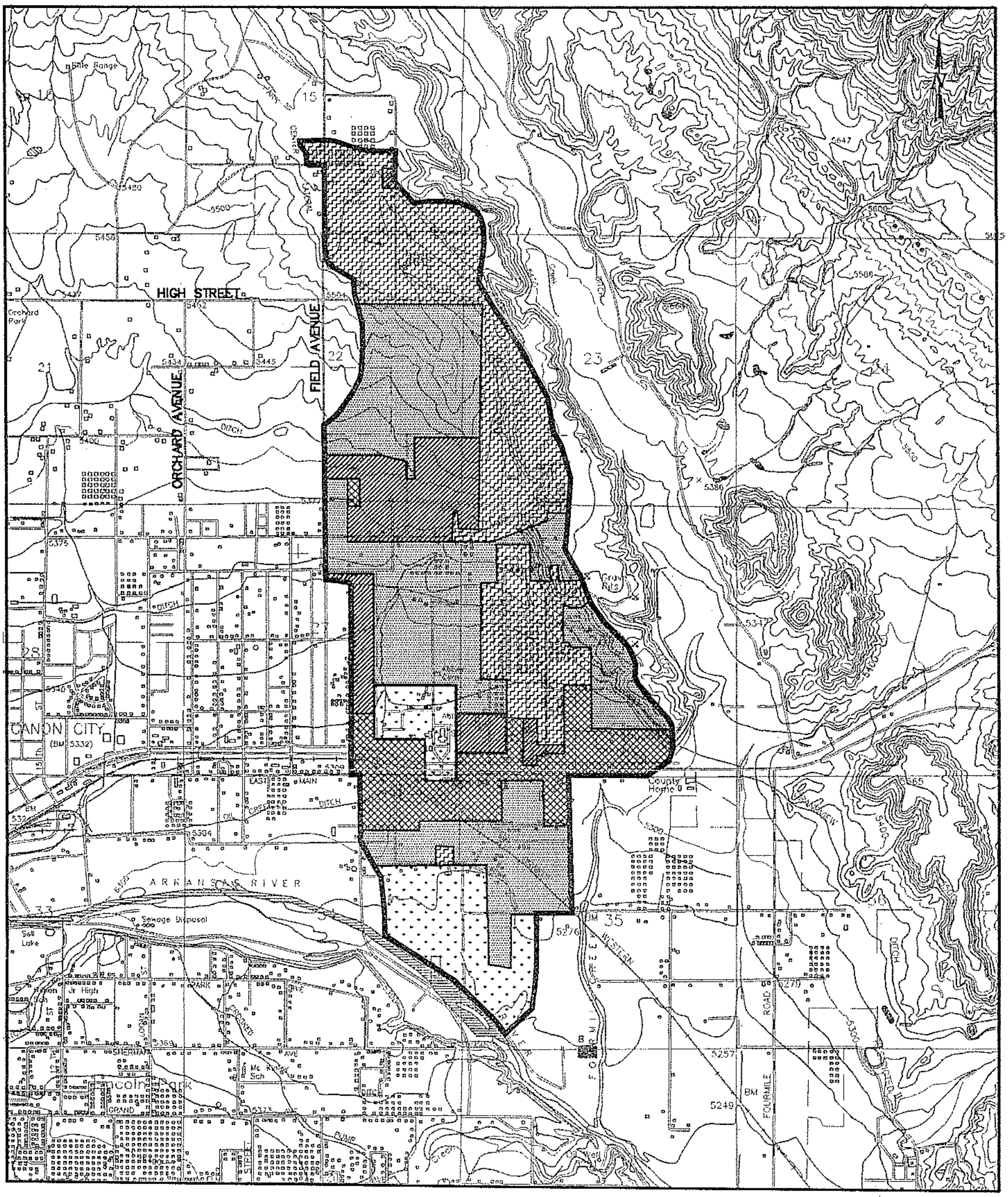
FIGURE 1	ABBEY DRAINAGE BASIN BASIN PLANNING STUDY CITY OF CANON CITY, COLORADO BASIN MAP

NO.	DATE	REVISION	BY

Associated Design Professionals, Inc.

PREPARED BY:

DATE: 6/10/98	DESIGNED BY JJW
JOB NO. 960908	PROJECT ENGINEER MAB
CAD FILE NO. ABBYBASN.DWG	PROJECT MANAGER MAB
DRAWN BY JJW	HORZ. 2000'
	VERT.



OPEN ESTATES > 1 AC LOTS

LOW DENSITY RESIDENCE < 6 DU/AC

MULTI FAMILY

AGRICULTURE

PARK

COMMERCIAL

FIGURE 2

ABBEY DRAINAGE BASIN

BASIN PLANNING STUDY

CITY OF CANON CITY, COLORADO

LAND USE MAP

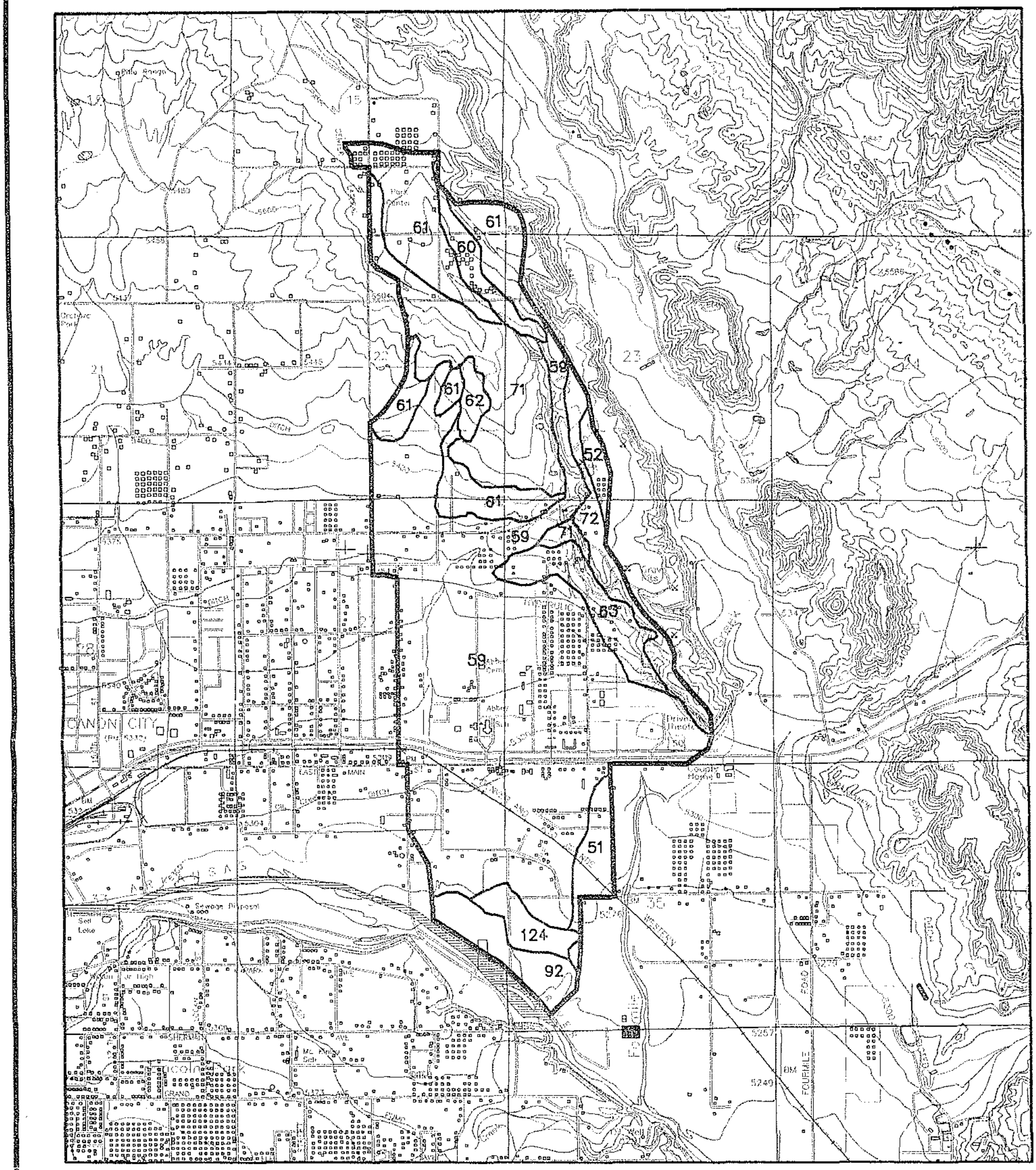
NO.	DATE	REVISION	BY
1	11/16/98	REVISE LAND USE NEAR ABBEY	JJW

1965 Ameritech Building Parkway
Suite 101
Colorado Springs, CO 80918
(719) 260-0887
FAX (719) 260-0941

ADP
Associated Design Professionals, Inc.

PREPARED BY:

DATE: 6/10/98	DESIGNED BY JJW
JOB NO. 960908	PROJECT ENGINEER MAB
CAD FILE NO. ABBYLAND.DWG	PROJECT MANAGER MAB
DRAWN BY JJW	HORZ. 2000'
	VERT.



SOIL NUMBER	HYDROLOGIC GROUP
51	C
52	A/B
59	D
60	D
61	C
62	C
63	D
71	D
72	D
92	D
124	C

FIGURE 8

ABBEY DRAINAGE BASIN

BASIN PLANNING STUDY

CITY OF CANON CITY, COLORADO

SOILS MAP

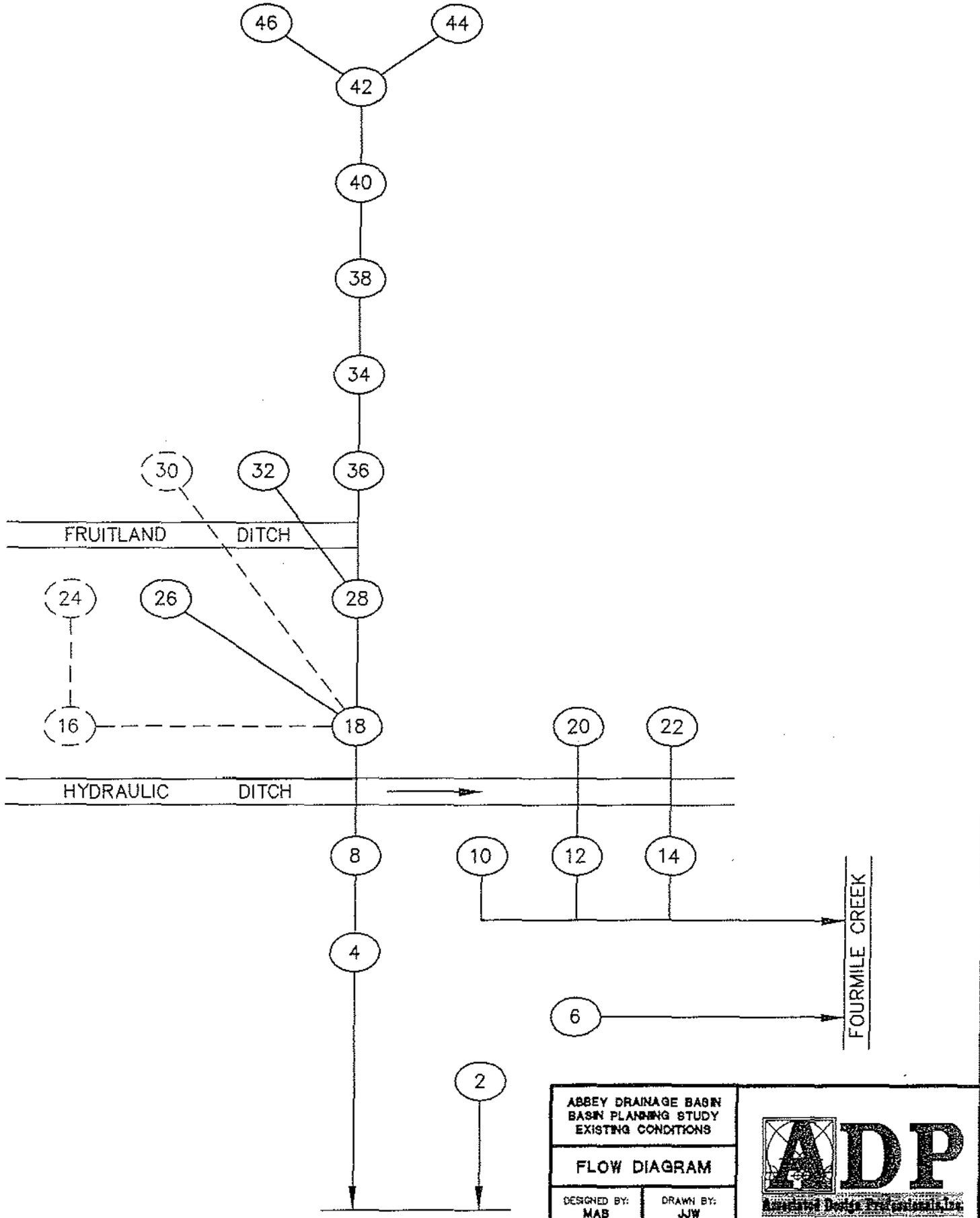
NO.	DATE	REVISION	BY

1941 Austin Bluffs Parkway
Colorado Springs, CO 80918
(719) 260-0887
fax (719) 260-1041

ADP Associated Design Professionals, Inc.

PREPARED BY:

DATE: 5/10/98	DESIGNED BY JJW
JOB NO. 960908	PROJECT ENGINEER MAB
CAD FILE NO. ABBYSOIL.DWG	PROJECT MANAGER MAB
DRAWN BY JJW	HORZ. 2000'
	VERT.

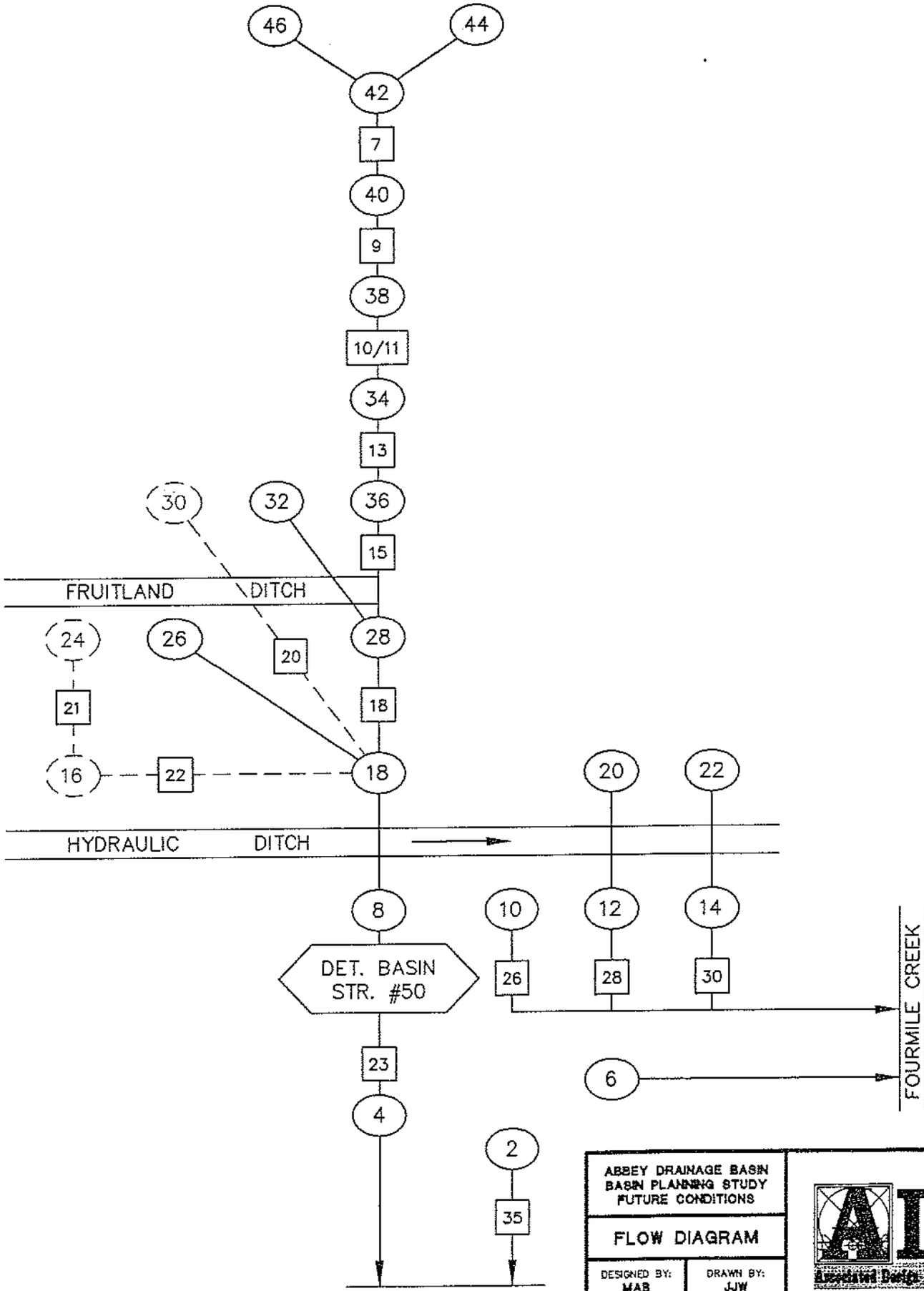


ABBEY DRAINAGE BASIN
BASIN PLANNING STUDY
EXISTING CONDITIONS

FLOW DIAGRAM

DESIGNED BY: MAB	DRAWN BY: JJW
CHECKED BY: MAB	DATE: 6/10/98
FILE NO: FLOW_DIA	JOB NO: 960908

ADP
Associated Design Professionals, Inc.
1861 Austin Bluffs Pkwy, Suite 101
Colorado Springs, CO 80918
(719) 266-5212
fax: (719) 266-5341



ABBEY DRAINAGE BASIN
BASIN PLANNING STUDY
FUTURE CONDITIONS

FLOW DIAGRAM

DESIGNED BY:	DRAWN BY:
MAB	JJW
CHECKED BY:	DATE:
MAB	6/10/98
FILE NO:	JOB NO:
P_FLOW_D	960906

ADP
Associated Design Professionals, Inc.
1861 Austin Bluffs Pkwy, Suite 101
Colorado Springs, CO 80918
(719) 266-5212
fax: (719) 266-5341

ABBEY BASIN
DEVELOPED CN CALCULATION (1 OF 2)

		LAND USE CURVE NUMBERS														SOIL TYPE %				
BASIN # W/ SOIL TYPE	AREA (ac.)	AGRI	%	ESTATE	%	SINGLE FAMILY	%	MULTI FAMILY	%	INDUST	%	COMM	%	PARK	%	A/B	C	D	DEV CN	BASIN # W/ SOIL TYPE
2D	175.80	84	30	84	5	87	25					95	5				30	70	84.2	2D
2C		79	20			83	15													2C
4D	68.38	84	30			87	20					95	50					100	90.1	4D
6D	102.08	84	5			87	25					95	40					100	90.0	6D
6C						83	20					94	10							6C
8	87.72	84	20			87	30	87	30			95	20						88.0	8
10	94.21	84	40			87	50	87	5			95	5					100	86.2	10
12	102.42			84	50	87	15	87	20			95	15					100	86.7	12
14	126.33			84	30	87	35	87	5			95	30					100	88.5	14
16	19.98					87	85	87	15									100	87.0	16
18	36.07			84	5	87	90	87	5									100	86.9	18
20	53.12			84	40	87	60											100	85.8	20
22	38.76			84	50	87	50											100	85.5	22
24D	40.57					87	40	87	40			95	10				15	85	87.4	24D
24C						83	10													24C
26D	11.12							87	40								75	25	88.8	26D
26C						83	5	83	60											26C
28D	31.35			84	20	87	20	87	10							10	40	50	81.3	28D
28C				79	20			83	20											28C
28A/B				60	10															28A/B
30D	128.90			84	10	87	50	87	20								20	80	85.9	30D
30C						83	20													30D

ABBEY BASIN
DEVELOPED CN CALCULATION (2 OF 2)

		LAND USE CURVE NUMBERS														SOIL TYPE %				
BASIN # W/ SOIL TYPE	AREA (ac.)	AGRI	%	ESTATE	%	SINGLE FAMILY	%	MULTI FAMILY	%	INDUST	%	COMM	%	PARK	%	A/B	C	D	DEV CN	BASIN # W/ SOIL TYPE
32D	52.05			84	5	87	25	87	55								15	85	85.9	32D
32C				79	10	83	5													32C
34D	19.74			84	100													100	84.0	34D
36D	26.12			84	60											30	10	60	76.3	36D
36C				79	10															36C
36A/B				60	30															36A/B
38D	55.36			84	70											30		70	82.5	38D
38A/B				79	30															38A/B
40D	42.74			84	30	87	60										10	90	85.5	40D
40C				79	5	83	5													40C
42D	101.85			84	40												60	40	81.0	42D
42C				79	60															42C
44D	16.23			84	40												60	40	81.0	44D
44C				79	60															44C
46C	40.67			79	100												100		79.0	46C

ABBEY BASIN

TIME OF CONCENTRATION AND CN CALCULATIONS

PROPOSED CONDITIONS

AREA DESIG	C_{10} (10 yr.)	L (ft)	Initial Tc_i Slope (%)	t_i (min)	L (ft)	Travel Time Slope (%)	V (fps)	T_t (min)	T_c (min)	T_c (hr)	EXIST CN	REV DEV CN	AREA DESIG
2	0.5	300	0.38	27.08	3200	0.38	4.81	11.10	38.18	0.64	84.3	84.2	2
4	0.7	300	0.95	13.67	2700	0.95	6.01	7.49	21.16	0.35	90.1	90.1	4
6	0.7	300	0.36	19.17	1100	0.36	4.91	3.74	22.91	0.38	90.7	89.95	6
8	0.7	300	1.76	11.29	2900	1.76	6.68	7.24	18.52	0.31	87.1	88	8
10	0.5	300	1.21	17.64	3200	1.21	6.83	7.81	25.45	0.42	86.6	86.2	10
12	0.5	300	1.50	16.79	2800	1.50	8.06	5.79	22.57	0.38	85.3	86.7	12
14	0.6	300	1.70	13.19	2200	1.70	6.05	6.06	19.24	0.32	85.8	88.5	14
16	0.5	300	1.33	16.80	500	1.33	4.34	1.92	18.72	0.31	87.0	87.0	16
18	0.5	300	2.22	14.75	900	2.22	6.06	2.47	17.22	0.29	86.9	86.9	18
20	0.5	300	2.80	14.30	1400	2.80	8.44	2.76	17.06	0.28	85.8	85.8	20
22	0.5	300	6.00	11.21	1000	6.00	8.94	1.86	13.07	0.22	85.5	85.5	22
24	0.6	300	1.95	12.47	2000	1.95	4.59	7.26	19.73	0.33	83.5	87.4	24
26	0.7	300	3.33	8.17	800	3.33	6.56	2.03	10.20	0.17	81.4	88.8	26
28	0.5	300	3.00	12.96	900	3.00	5.37	2.80	15.76	0.26	81.3	81.3	28
30	0.5	300	4.00	11.58	4500	4.00	5.52	13.59	25.17	0.42	84.0	85.9	30
32	0.6	300	4.30	9.96	1100	4.30	6.69	2.74	12.70	0.21	83.8	85.9	32
34	0.3	300	1.82	20.87	600	1.82	2.97	3.37	24.24	0.40	84.0	84.0	34
36	0.4	300	2.00	17.52	300	2.00	3.16	1.58	19.10	0.32	76.3	76.3	36
38	0.4	300	2.86	15.57	1000	2.86	4.38	3.80	19.37	0.32	76.5	82.5	38
40	0.5	300	1.54	17.34	1300	1.54	3.82	5.67	23.02	0.38	74.9	85.5	40
42	0.5	300	2.22	16.18	1450	2.22	5.38	4.49	20.67	0.34	82.5	81.0	42
44	0.5	300	2.22	16.18	800	2.22	3.97	3.36	19.54	0.33	81.5	81.0	44
46	0.5	300	3.08	14.52	1000	3.08	5.76	2.89	17.42	0.29	79.0	79.0	46

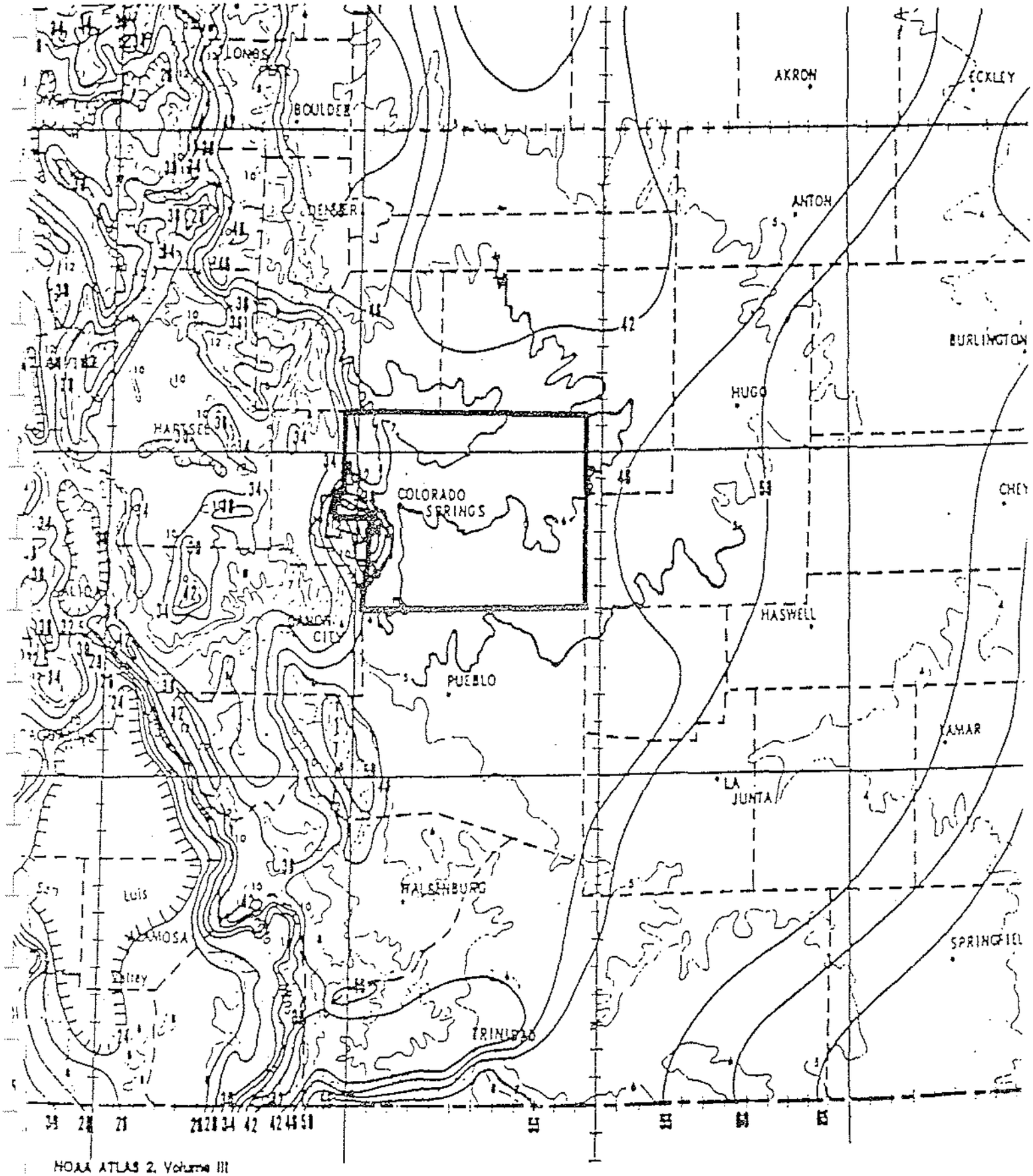
ABBEY BASIN
STRUCTURE EVALUATION

STR. #	LOCATION	UNDETAINED/DETAINED FLOWS 100 yr (cfs)	50 yr (cfs)	25 yr (cfs)	EXISTING CULVERT SIZE	CAPACITY (cfs)	PROPOSED CULVERT SIZE	COST ($)	REMARKS
7	HIGH ST.	296 / 276	241 / 226	196 / 189	15" CMP	10	2 - 60" RCP	13,000.00	LOCAL FLOWS
9	POND	130 / 108	98 / 90	73 / 77	24" CMP	26	48" RCP	3,900.00	LOCAL FLOWS
10	POND	108 / 95	82 / 81	62 / 69	24" CMP	26	48" RCP	3,900.00	LOCAL FLOWS
11	SOUTH ST./POND	107 / 90	82 / 75	61 / 66	24" CMP	26	48" RCP	3,900.00	LOCAL FLOWS
13	POND	99 / 84	74 / 74	52 / 63	24" CMP	26	48" RCP	3,900.00	LOCAL FLOWS
15	ELIZABETH ST.	98 / 85	73 / 74	51 / 63	72" CMP	240	SAME	N/A	LOCAL FLOWS
18	CENTRAL AVE.	244 / 230	202 / 202	168 / 169	72" CMP	240	SAME	N/A	LOCAL FLOWS
23	SH 50	984 / 281	826 / 241	695 / 207	48" CMP	110	8' X 4' BOX	1,100,000.00	LOCAL FLOWS
26	SH 50	220 / 222	185 / 188	157 / 159	24" CMP	26	8' X 6' BOX	480,000.00	STORM SEWER
28	SH 50	360 / 360	301 / 301	254 / 251	24" CMP	26	10' X 8' BOX	1,518,000.00	STORM SEWER
30	SH 50	454 / 458	387 / 390	331 / 333	48" CMP	110	16' X 8' BOX	1,170,000.00	STORM SEWER
50	DET. BASIN	825 / 91	693 / 78	585 / 66	N/A	90	36" RCP	5,400.00	DETAINED FLOWS

ABBEY BASIN
SUMMARY OF DISCHARGES

AREA	SUB-BASIN FLOWS 100 YR	50 YR	25 YR	ACCUMULATED FLOWS 100 YR	50 YR	25 YR	DETAINED FLOWS 100 YR	50 YR	25 YR	AREA
2	286	238	198							2
4	201	173	150	1060	886	743	431	368	314	4
6	286	246	212							6
8	263	227	196	1011	849	715	297	247	212	8
10	222	188	159							10
12	240	202	170	808	683	580	559	469	393	12
14	360	309	265	1026	867	736	978	823	693	14
16	54	46	39	163	139	118				16
18	98	85	72	825	693	585	810	693	585	18
20	139	120	102							20
22	109	92	78							22
24	109	93	79							24
26	37	32	27							26
28	71	59	49	112	94	76	255	213	178	28
30	262	249	210							30
32	148	126	107							32
34	42	35	29	104	78	57	89	75	64	34
36	43	34	28	98	73	51	85	74	63	36
38	123	102	85	126	105	87	128	106	88	38
40	101	85	72	207	164	130	191	153	122	40
42	204	168	138	296	245	196				42
44	33	27	22							44
46	80	65	53							46

APPENDIX A
Design Charts



NOAA ATLAS 2, Volume III

Prepared by U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Weather Service, Office of Hydrology

Prepared for U.S. Department of Agriculture,
Soil Conservation Service, Engineering Division

ISOPLUVIALS OF 100-YR 24-HR PRECIPITATK
IN TENTHS OF AN INCH

TABLE 5-5
RUNOFF CURVE NUMBERS
FOR HYDROLOGIC SOIL-COVER COMPLEXES
URBAN AND SUBURBAN CONDITIONS 1/
(For Antecedent Moisture Condition II)
(From: U.S. Department of Agriculture,
Soil Conservation Service, 1977)

NOTE: THIS TABLE TO BE USED FOR 24-HOUR STORM ONLY.

Land Use		Average % imperious 3/	Hydrologic Soil Group A	B	C	D
Open spaces, lawns, parks, golf courses, cemeteries, etc.						
	Good condition: grass cover on 75% or more of the area		39*	61	74	80
	Fair conditon: grass cover on 50% to 75% of the area		49*	69	79	84
Commercial and business areas (85% impervious)			89*	92	94	95
Industrial districts 72% impervious)			81*	88	91	93
Residential: 2/						
	Acres per Dwelling Unit					
	1/8 acre or less	65	77*	85	90	92
	1/4 acre	38	61*	75	83	87
	1/3 acre	30	57*	72	81	86
	1/2 acre	25	54*	70	80	85
	1 acre	20	51*	68	79	84
Paved parking lots, roofs, driveways, etc.			98	98	98	98
Streets and roads:						
	paved with curbs and storm sewers		98	98	98	98
	gravel		76*	85	89	91
	dirt		72*	82	87	89

1/ For a more detailed description of agricultural land use curve numbers, refer to in the National Engineering Handbook (U.S. Dept. of Agriculture, Soil Conservation Service, 1972).

2/ Curve numbers are computed assuming the runoff from the house and driveway is directed towards the street with a minimum of roof water directed to lawns where additional infiltration could occur.

3/ The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.

* Not to be used wherever overlot grading or filling is to occur.

TABLE 5-5
RUNOFF CURVE NUMBERS
FOR HYDROLOGIC SOIL-COVER COMPLEXES
URBAN AND SUBURBAN CONDITIONS 1/
(For Antecedent Moisture Condition II)
(From: U.S. Department of Agriculture, Soil Conservation Service, 1977)

NOTE: THIS TABLE TO BE USED FOR 24-HOUR STORM ONLY.

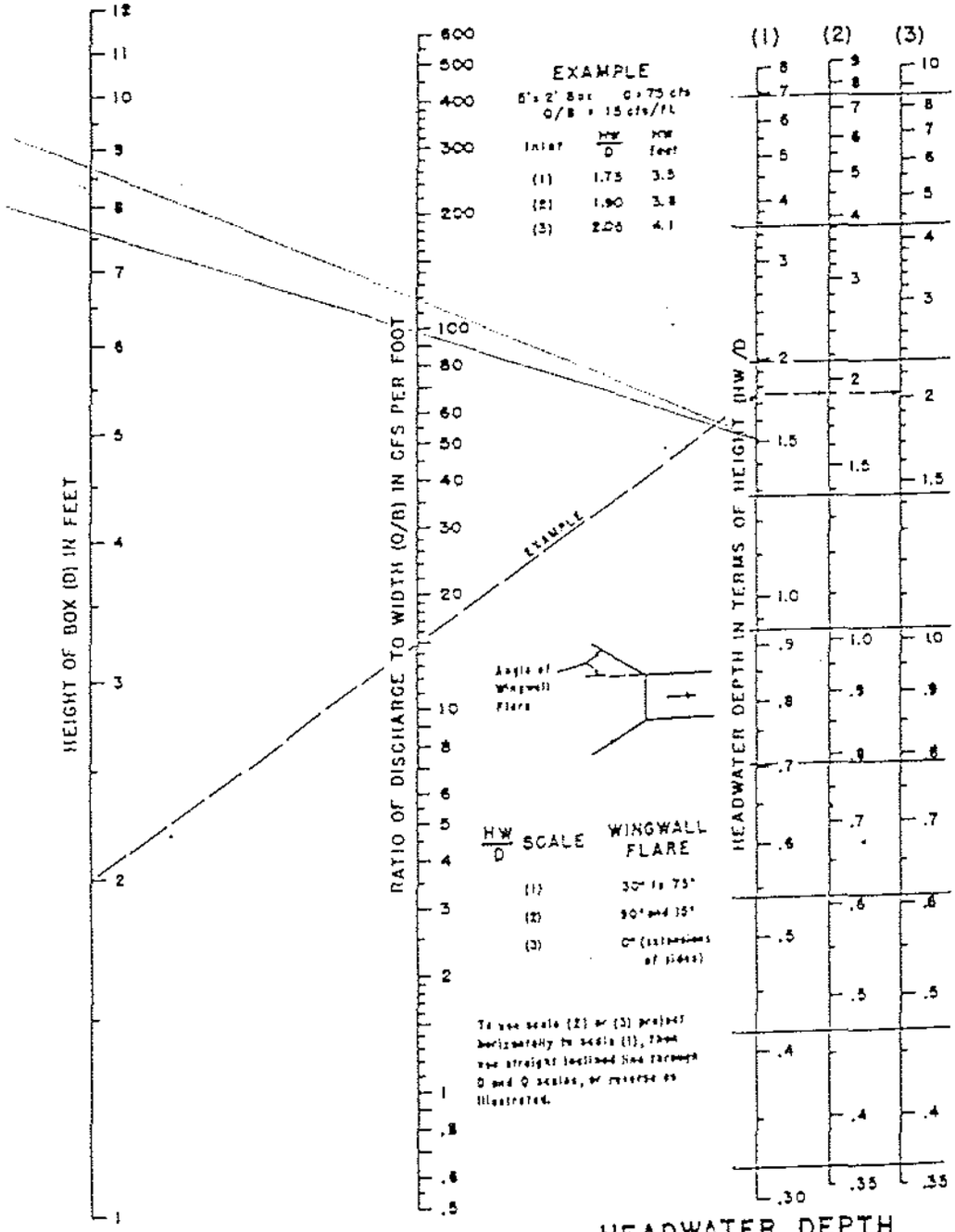
Land Use		Average % impervious 3/	Hydrologic Soil Group A	B	C	D
Open spaces, lawns, parks, golf courses, cemeteries, etc.						
	Good condition: grass cover on 75% or more of the area		39*	61	74	80
	Fair conditon: grass cover on 50% to 75% of the area		49*	69	79	84
Commercial and business areas (85% impervious)			89*	92	94	95
Industrial districts 72% impervious)			81*	88	91	93
Residential: 2/						
	Acres per Dwelling Unit					
	1/8 acre or less	65	77*	85	90	92
	1/4 acre	38	61*	75	83	87
	1/3 acre	30	57*	72	81	86
	1/2 acre	25	54*	70	80	85
	1 acre	20	51*	68	79	84
Paved parking lots, roofs, driveways, etc.			98	98	98	98
Streets and roads:						
	paved with curbs and storm sewers		98	98	98	98
	gravel		76*	85	89	91
	dirt		72*	82	87	89

1/ For a more detailed description of agricultural land use curve numbers, refer to in the National Engineering Handbook (U.S. Dept. of Agriculture, Soil Conservation Service, 1972).

2/ Curve numbers are computed assuming the runoff from the house and driveway is directed towards the street with a minimum of roof water directed to lawns where additional infiltration could occur.

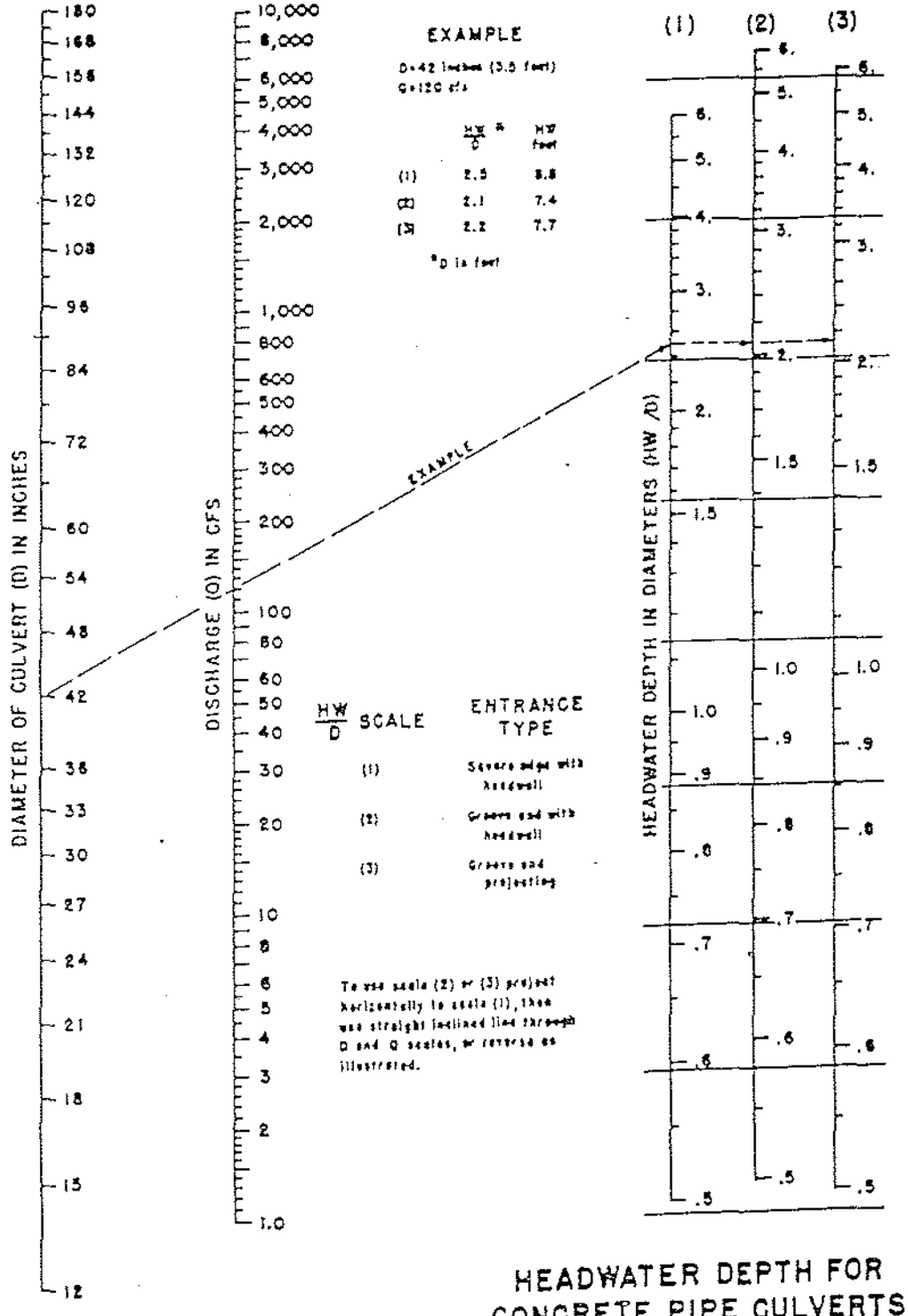
3/ The remaining pervious areas (lawn) are considered to be in good pasture condition for these curve numbers.

* Not to be used wherever overlot grading or filling is to occur.



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963

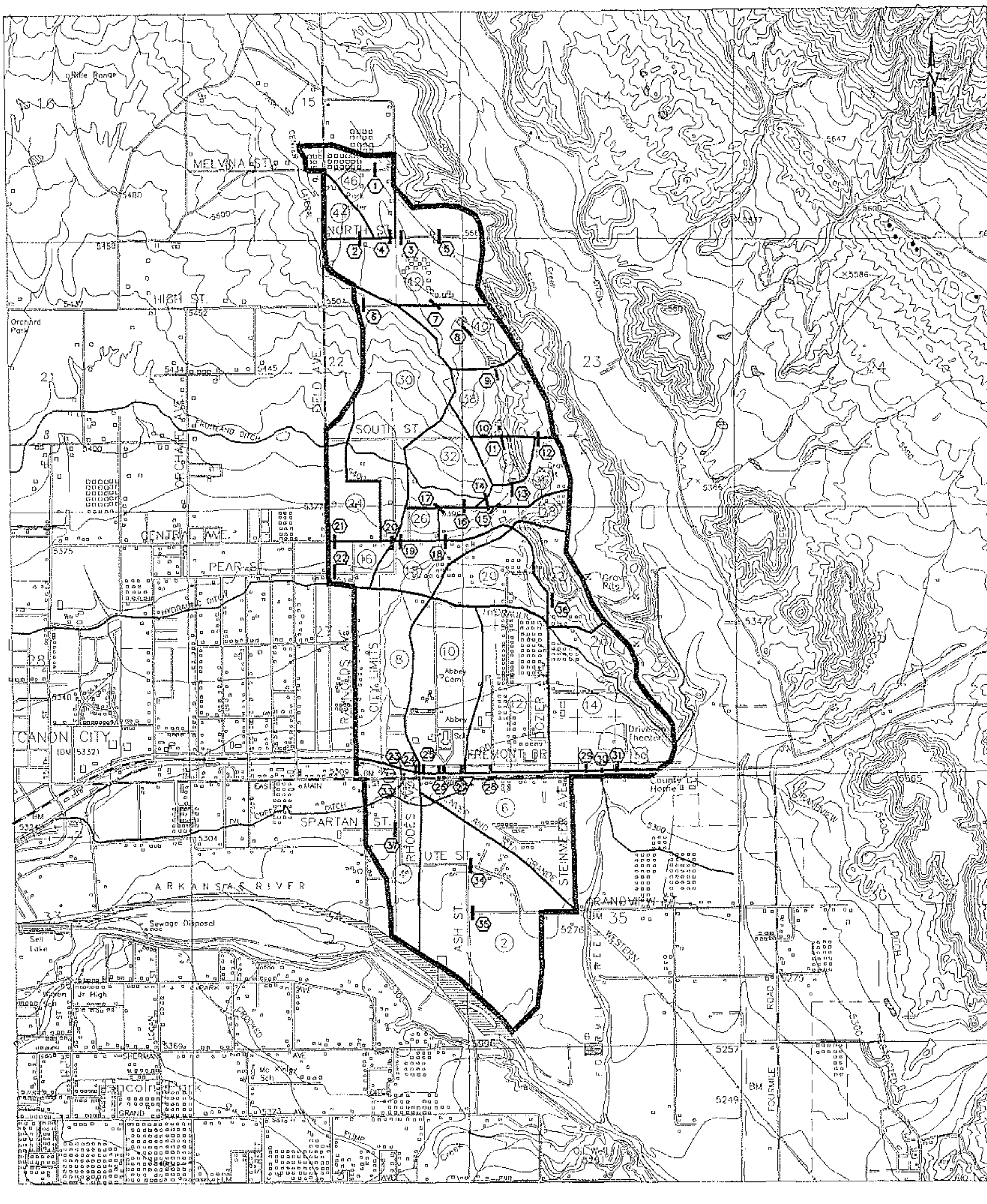


HEADWATER DEPTH FOR CONCRETE PIPE CULVERTS WITH INLET CONTROL

HEADWATER SCALES 2 & 3
REVISED MAY 1964

BUREAU OF PUBLIC ROADS JAN. 1963

APPENDIX B
Alternate Conceptual Plans



STRUCTURE NUMBER	STRUCTURE SIZE	STRUCTURE NUMBER	STRUCTURE SIZE	STRUCTURE NUMBER	STRUCTURE SIZE
1	21" X 15" CMP	12	24" CMP	(365) 25	24" CMP
2	18" CMP	13	24" CMP	(367) 26	2–30" CMP
3	18" CMP	14	24" CMP	(366) 27	24" CMP
4	30" CMP	15	72" CMP	(363) 28	24" CMP
5	30" CMP	16	18" CMP	(344) 29	24" CMP
6	18" CMP	17	18" ADS	(361) 30	48" CMP
7	15" CMP	18	72" CMP	(337) 31	24" CMP
8	15" STEEL PIPE	19	30" CMP	32	2–36" CMP
9	24" CMP	20	18" CMP	33	42" X 29" CMP
10	24" CMP	21	29" X 18" CMP	34	18" CMP
11	24" CMP	22	18" CMP	35	28" X 20" CMP
		23	48" CMP	36	18" CMP
		24	24" CMP	37	48" CMP SPARTAN
				38	" " UTE

SHEET 1 of 4

ABBEY DRAINAGE BASIN

BASIN PLANNING STUDY

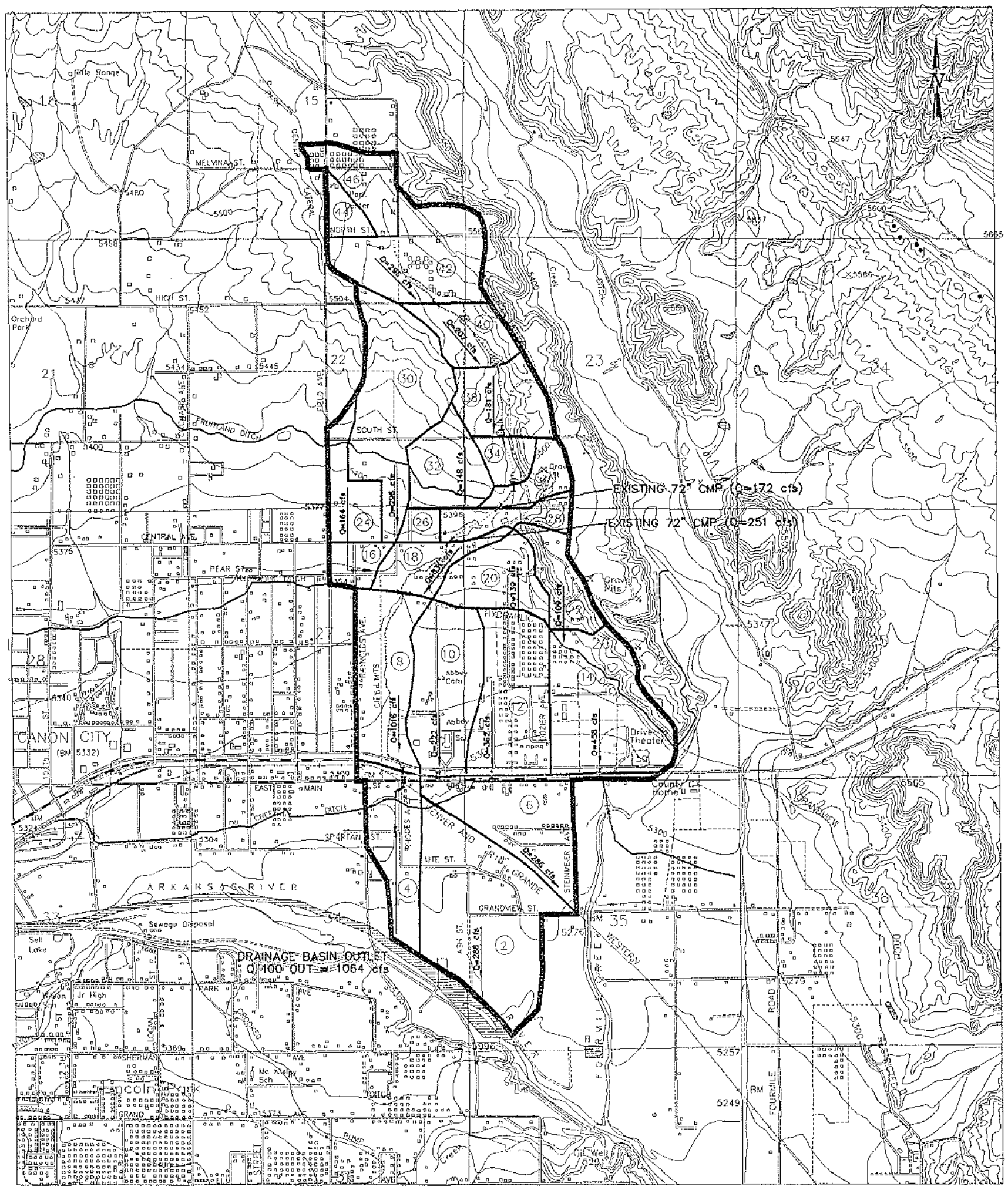
THE CITY OF CANON CITY, COLORADO

EXISTING STRUCTURES

NO.	DATE	REVISION	BY

PREPARED BY: ADP Associated Design Professionals, Inc.

DATE: 6/10/98
JOB NO. 960909
CAD FILE NO. ABBY_BIG.DWG
DRAWN BY JJW
DESIGNED BY JJW
PROJECT ENGINEER MAB
PROJECT MANAGER MAB
SCALE: HORZ. 1000'
VERT.



NO IMPROVEMENTS
BASIN AS IS

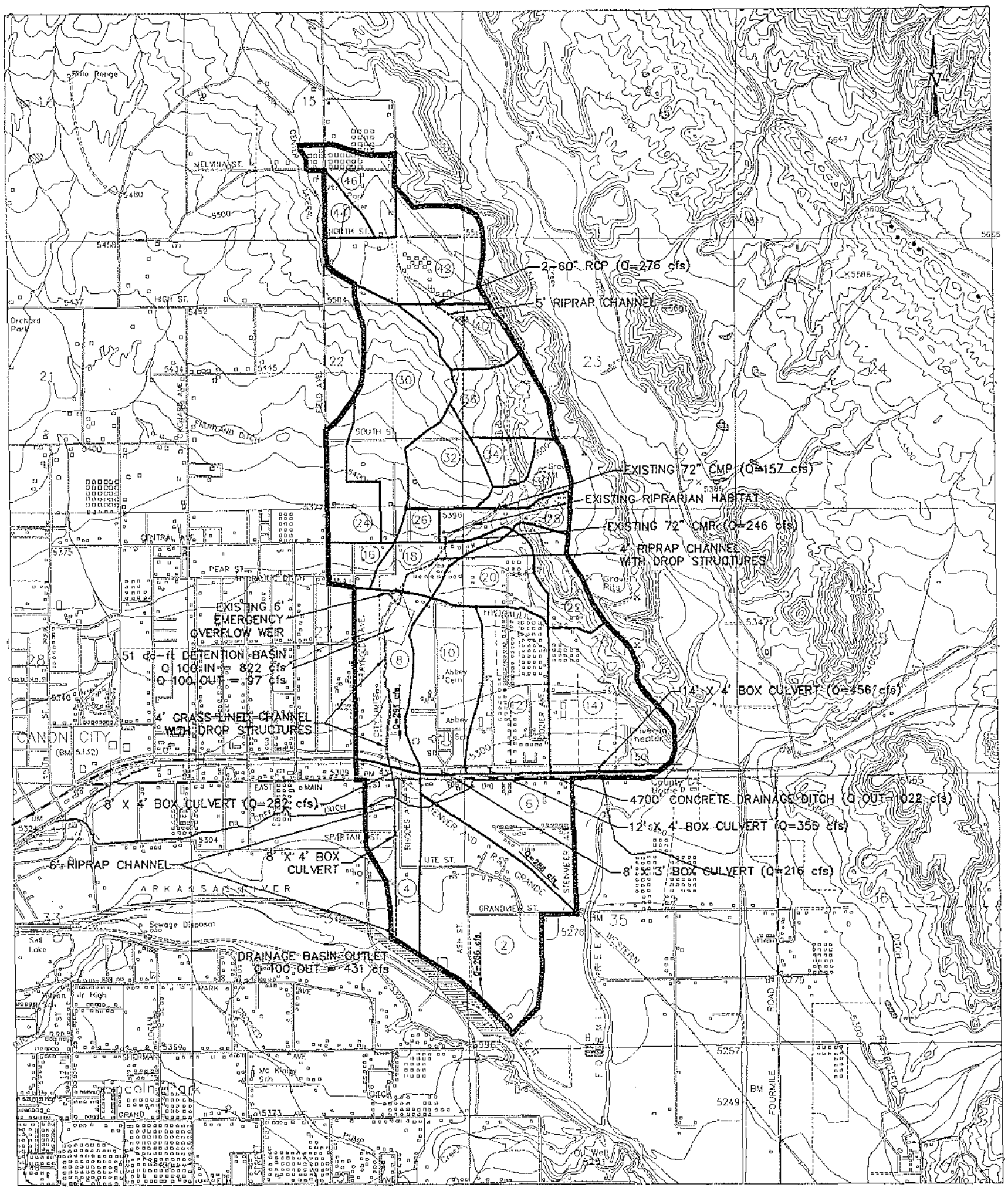
SHEET 2 of 4

ABBEY DRAINAGE BASIN
BASIN PLANNING STUDY
THE CITY OF CANON CITY, COLORADO
ALTERNATE 1

NO.	DATE	REVISION	BY

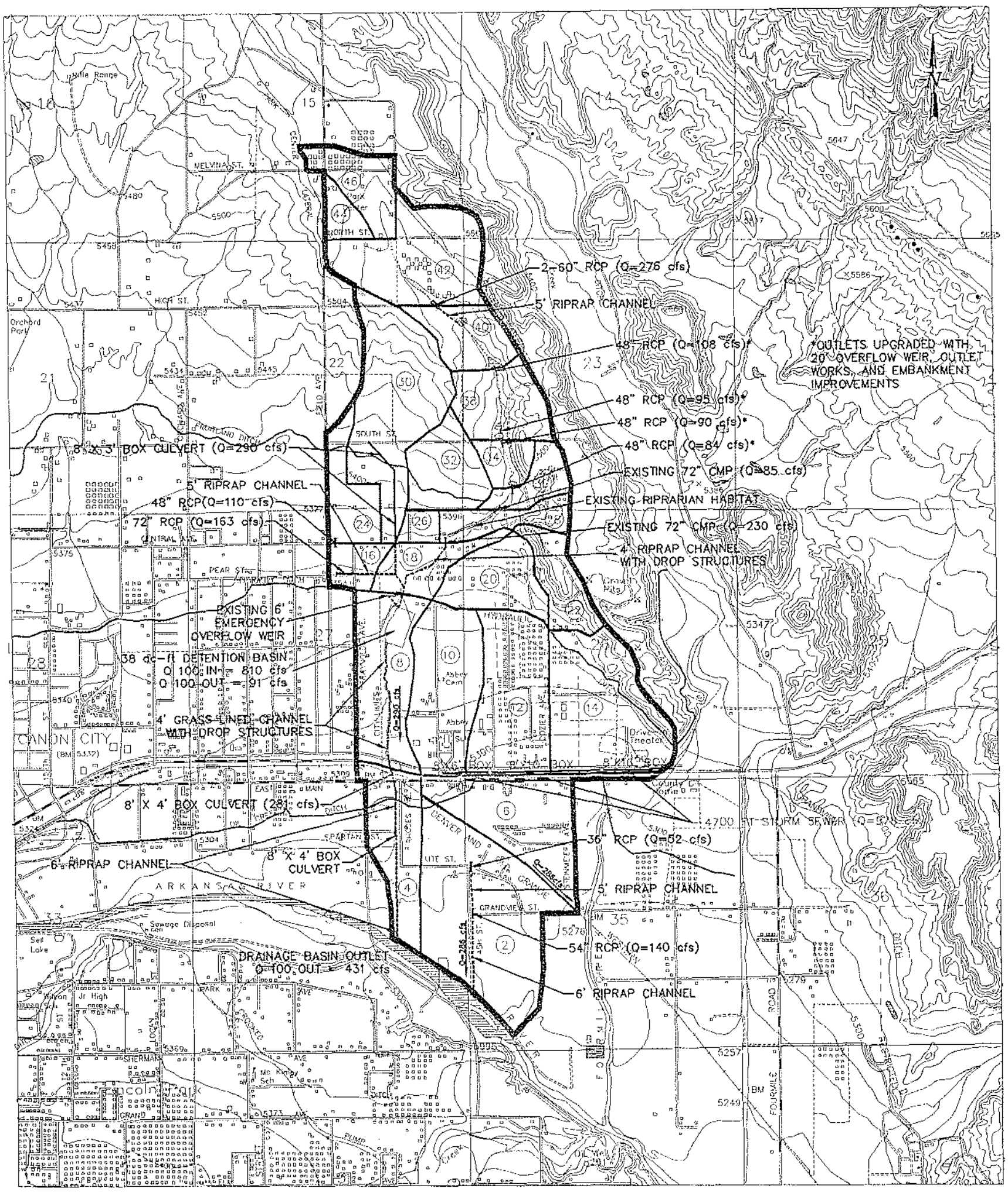
PREPARED BY:
Associated Design Professionals, Inc.

DATE: 6/10/96
DESIGNED BY: JJW
JOB NO.: 950905
PROJECT ENGINEER: MAB
CAD FILE NO.: AB_ALT_1.DWG
PROJECT MANAGER: MAB
DRAWN BY: JJW
SCALE: HORZ. N.T.S. VERT.



INSTALLATION OF DETENTION BASIN WITH NO UPSTREAM POND IMPROVEMENTS

SHEET 3 of 4	**ABBEY DRAINAGE BASIN** **BASIN PLANNING STUDY** **THE CITY OF CANON CITY, COLORADO** **ALTERNATE 2**	NO. / DATE / REVISION / BY	PREPARED BY: ADP Associated Design Professionals, Inc. 1861 Austin Bluffs Parkway, Suite 101, Colorado Springs, CO 80918 (719) 598-0441 FAX (719) 598-0541 DATE: 6/10/98 — DESIGNED BY: JJW JOB NO. 960005 — PROJECT ENGR: MAB CAD FILE NO. AB_ALT_2.DWG — PROJECT MANAGER: MAB DRAWN BY: JJW — SCALE: HORZ. N.T.S. VERT.



INSTALLATION OF DETENTION BASIN WITH UPSTREAM POND IMPROVEMENTS

SHEET 4 of 4

ABBEY DRAINAGE BASIN
BASIN PLANNING STUDY
THE CITY OF CANON CITY, COLORADO
ALTERNATE 3

NO.	DATE	REVISION	BY

1861 Austin Bluffs Parkway
Colorado Springs, CO 80918
(719) 598-0212
FAX (719) 598-0641

ADP
Associated Design Professionals, Inc.

PREPARED BY:

DATE: 6/10/98
DESIGNED BY: JJW
JOB NO. 950008
PROJECT ENGINEER: MAB
CAD FILE NO. AB_ALT_3.DWG
PROJECT MANAGER: MAB
DRAWN BY: JJW
SCALE: HORZ. N.T.S. VERT.

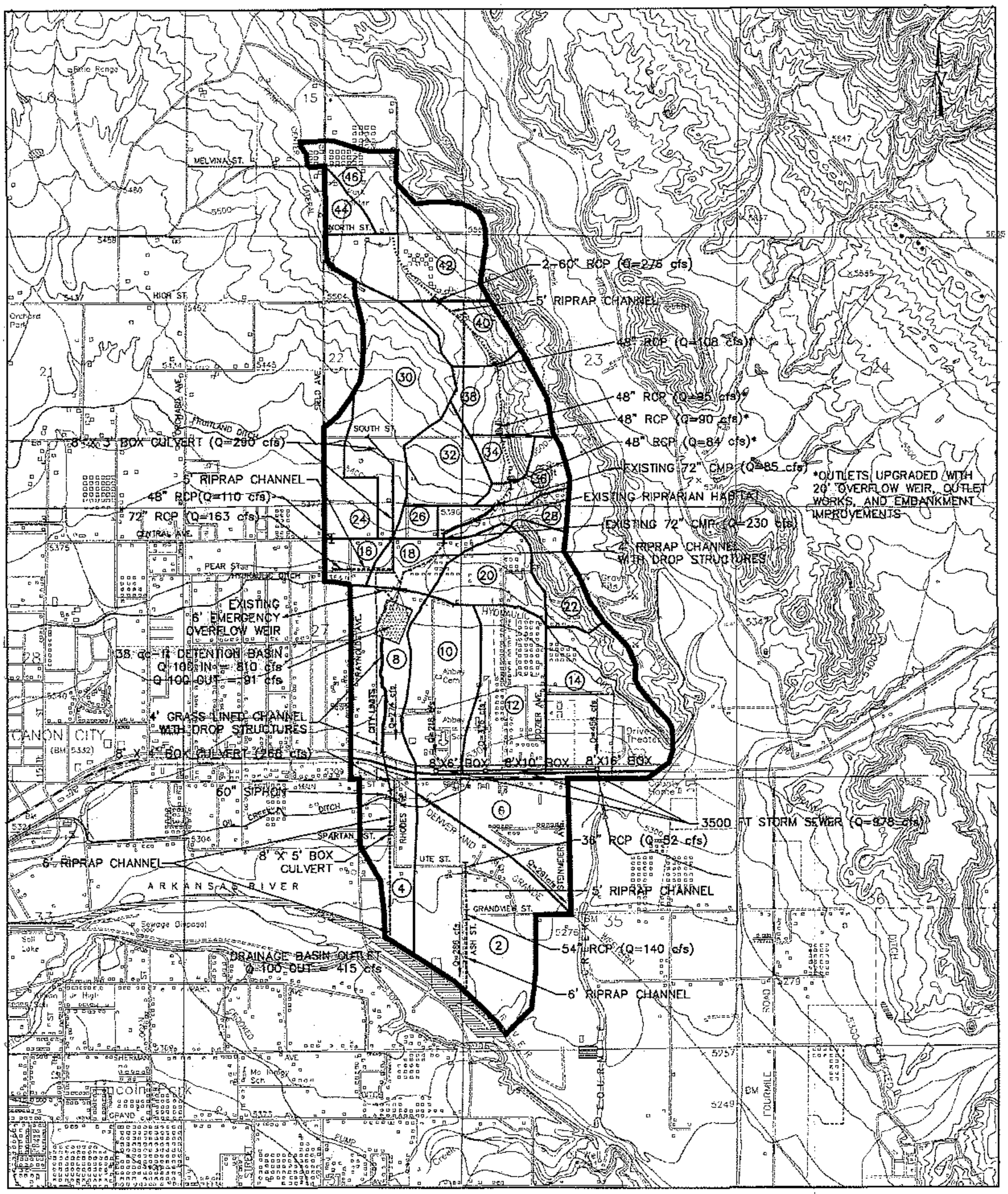
ABBEY BASIN DRAINAGE STUDY
ALTERNATIVE 2
INSTALLATION OF DETENTION BASIN WITH NO UPSTREAM POND IMPROVEMENTS

LOCATION	IMPROVEMENT DESCRIPTION	ESTIMATED PROBABLE CONSTRUCTION COST
ARKANSAS RIVER TO EAST MAIN ST.	6' RIPRAP CHANNEL - 3000' 8' X 4' BOX CULVERT - 30'	$302,000
EAST MAIN ST. TO FREMONT DR.	8' X 4' BOX CULVERT - 700' 7' X 3' BOX CULVERT - 100' 9' X 3' BOX CULVERT - 100' 9' X 4' BOX CULVERT - 100' 4700' CONCRETE DITCH	$4,162,000
FREMONT DR. TO HYDRAULIC DITCH	4' NATURAL CHANNEL - 3200' 51 AC-FT DETENTION BASIN 36" RCP OUTLET PIPE DROP STRUCTURES (≈ 4)	$620,000
HYDRAULIC DITCH TO CENTRAL AVE.	INLET/OUTLET IMPROVEMENTS 20' OVERFLOW WEIR U/S OF SIPHON 4' RIPRAP CHANNEL - 1800'	$247,000
CENTRAL AVE. TO ELIZABETH ST.	INLET/OUTLET IMPROVEMENTS	$7,000
ELIZABETH ST. TO SOUTH ST.	NO IMPROVEMENTS	$0
SOUTH ST. TO HIGH ST.	NO IMPROVEMENTS	$0
HIGH ST. TO NORTH ST.	2-54" CMP AT HIGH ST. - 50' EA.	$10,000
		TOTAL: $5,348,000

ABBEY BASIN DRAINAGE STUDY
ALTERNATIVE 3
INSTALLATION OF DETENTION BASIN WITH UPSTREAM POND IMPROVEMENTS

LOCATION	IMPROVEMENT DESCRIPTION	ESTIMATED PROBABLE CONSTRUCTION COST
ARKANSAS RIVER TO EAST MAIN ST.	5' RIPRAP CHANNEL - 1000' 6' RIPRAP CHANNEL - 4500' 8' X 4' BOX CULVERT - 30' 36" RCP - 54" RCP @ 30' EA.	$379,000
EAST MAIN ST. TO FREMONT DR.	8' X 4' BOX CULVERT - 700' 8' X 6' BOX CULVERT - 1000' 8' X 10' BOX CULVERT - 2200' 8' X 16' BOX CULVERT - 1500'	$4,178,000
FREMONT DR. TO HYDRAULIC DITCH	4' NATURAL CHANNEL - 3200' 38 AC-FT DETENTION BASIN 36" RCP OUTLET PIPE DROP STRUCTURES (≈ 4)	$474,000
HYDRAULIC DITCH TO CENTRAL AVE.	INLET/OUTLET IMPROVEMENTS 20' OVERFLOW WEIR U/S OF SIPHON 72" RCP - 550', 5' RIPRAP CHANNEL - 1800' 4' RIPRAP CHANNEL - 1800'	$506,000
CENTRAL AVE. TO ELIZABETH ST.	INLET/OUTLET IMPROVEMENTS	$12,000
ELIZABETH ST. TO SOUTH ST.	OUTLET WORKS @ 2 PONDS 8' X 3' BOX CULVERT - 2400'	$899,000
SOUTH ST. TO HIGH ST.	OUTLET WORKS @ 2 PONDS 5' RIPRAP CHANNEL - 1000'	$551,000
HIGH ST. TO NORTH ST.	2-54" CMP AT HIGH ST. - 50' EA.	$10,000
		TOTAL: $7,009,000

APPENDIX C
Preliminary Construction Costs



SHEET 1 of 1		**ABBEY DRAINAGE BASIN** **BASIN PLANNING STUDY** **THE CITY OF CANON CITY, COLORADO** **IMPROVEMENT RECOMMENDATIONS**	NO.	DATE	REVISION	BY	PREPARED BY: ADP	DATE: 12/10/93 JOB NO. 960606 CAD FILE NO. AB_ALT14.DWG DRAWN BY JJW	DESIGNED BY JJW PROJECT ENGINEER MAB PROJECT MANAGER MAB SCALE: HORZ. 1000' VERT.

ABBEY BASIN DRAINAGE STUDY
SUMMARY OF ALTERNATIVES

LOCATION	IMPROVEMENT DESCRIPTION	ESTIMATED PROBABLE CONSTRUCTION COST
ARKANSAS RIVER TO EAST MAIN ST.	5' RIPRAP CHANNEL - 1000' 5.5' RIPRAP CHANNEL - 200' 6' RIPRAP CHANNEL - 4300' 8' X 5' BOX CULVERT - 30' 36" RCP - 54" RCP @ 30' EA. 60" SIPHON - 100'	$630,000
EAST MAIN ST. TO FREMONT DR.	8' X 5' BOX CULVERT - 700' 8' X 6' BOX CULVERT - 1000' 8' X 10' BOX CULVERT - 2200' 8' X 16' BOX CULVERT - 300'	$3,385,000
FREMONT DR. TO HYDRAULIC DITCH	4' NATURAL CHANNEL - 3200' DROP STRUCTURES (≈ 4)	$10,000
DETENTION FACILITY	38 AC-FT DETENTION BASIN INCLUDING SEEDING 36" RCP OUTLET PIPE AND RIPRAP SPILLWAY	$464,000
HYDRAULIC DITCH TO CENTRAL AVE.	INLET/OUTLET IMPROVEMENTS 20' OVERFLOW WEIR U/S OF SIPHON 72" RCP - 550', 5' RIPRAP CHANNEL - 1800' 4' RIPRAP CHANNEL - 1800'	$506,000
CENTRAL AVE. TO ELIZABETH ST.	INLET/OUTLET IMPROVEMENTS	$22,000
ELIZABETH ST. TO SOUTH ST.	OUTLET WORKS @ 2 PONDS 8' X 3' BOX CULVERT - 2400'	$899,000
SOUTH ST. TO HIGH ST.	OUTLET WORKS @ 2 PONDS 5' RIPRAP CHANNEL - 1000'	$551,000
HIGH ST. TO NORTH ST.	2-54" CMP AT HIGH ST. - 50' EA.	$10,000
		TOTAL: $6,477,000