FINAL DRAINAGE REPORT AND DRAINAGE PLAN

FOR

COTTONWOOD CREEK THROUGH

NOR'WOOD DEVELOPMENT

PREPARED BY:

K L H ENGINEERING CONSULTANTS, INC.
206-208 Sutton Lane
Colorado Springs, CO 80907
J.N.: KLH 83 527 00

September, 1983
Revised March, 1984
Revised July, 1984

I. INTRODUCTION:

Report Overview: This report addresses the drainage improvements of the main Cottonwood Creek channel through Sections 10 and 11, Township 13 South, Range 66 West of the 6th P.M., adjacent to Nor'wood Development. The study covers the area from Woodmen Road to the East line of Deliverance Subdivision, on both sides of the channel. General site location map and vicinity map are found in Figures 1 and 2 respectively.

In general, the report identifies a floodway management scheme for a specific reach of Cottonwood Creek; delineates location, size and design criteria for channel improvements; and examines some of the overall effects on adjacent development.

Existing Basin Studies: A minimum of four seperate drainage studies for the entire Cottonwood Creek Drainage Basin have been performed. Although the results and purposes for which the studies were authorized vary, the flood plain information utilized in this report was generated by the U.S. Army Corps of Engineers, Albuquerque District, in September, 1976, and is titled "Flood Plain Information Study for Cottonwood Creek". The report serves as a basis for flood plain management decisions, and also provides technical data on maximum flood depths.

Drainage Board Comments: At the regular meeting of the Colorado Springs Drainage Board on November 18, 1982, the concept of a flood plain development program for Cottonwood Creek adjacent to Nor'wood Development was presented for discussion. The concept is, in effect, an amendment to the Cottonwood Creek Master Drainage Plan, and thus required Board action. The Board concluded that such a program is a viable alternate to an improved channel, and voted to approve the concept. This report establishes the final flood plain development plan.

II. REPORT SCOPE:

General: The purpose of this report is to present the results of an investigation concerning the Cottonwood Creek drainageway through the Nor'wood area. The purpose of the investigation was to examine the present condition of the channel, to determine future impact on the channel as a result of proposed upstream development, and to recommend facilities or structures required to control any possible adverse impact resulting during a flood.

Flood Plain Planning: Implementation of flood planning objectives takes the form of structural flood control measures, including levees, dikes, slope armoring and drainage related structures. A drainage and flood control plan has been developed for the Nor'wood area, and will be implemented to mitigate existing and anticipated future stormwater-related problems according to the objectives stated above.

Report Limitations: It should be remembered that drainage planning is a dynamic process. When previously unrecognized problems, flexibilities and constraints arise, they should be integrated into the stormwater management plan. Similiarly, when the surrounding masterplan or development plan is changed, the stormwater management plan should again be modified to reflect these changes.

III. EXISTING FACILITIES:

Downstream Facilities: Immediately downstream from the study area and adjacent to both the Deliverance Subdivision Filing No. 2 and Woodland Hills Village Filing No. 1, the main Cottonwood Creek drainage way has been channelized to carry the 100 year event. The cross-section is depicted in Figure 3, and consists of a 130 to 150 foot wide natural bottom trapezoidal channel, with 1 1/2 foot horizontal to 1 foot vertical crushed rock, rip-rap sideslopes. This section extends westward to the Union Boulevard bridge.

Tributary Areas and Facilities: The areas tributary to the study corridor are classified either as on-site or off-site in nature. On-site areas include all platted or planned components of the Nor'wood Masterplan areas. Off-site areas are generally upstream of the study corridor, currently consisting of mostly unimproved rangeland and low density development.

The drainage facilities associated with the on-site areas have not yet been designed or constructed for the most part, but will consist of storm sewers and lined open channels in accordance with the City of Colorado Springs drainage criteria. These structures will enter the main Cottonwood Channel at selected locations (probably near predevelopment runoff routes), and should be received by erosion resistent outlet structures. The locations of anticipated on-site facilities are shown on the proposed channel facilities mapping.

A FEMA map amendment adjacent to Woodland Hills Village has been processed which modifies the flood fringe in this specific location. Merrick and Company proposes filling or otherwise flood-proofing the area immediately North of Cottonwood Creek, and East of the existing development. These "old" and "new" flood plain limits are shown on the main exhibits.

Another on-site facility which will have an impact on flood plain delineation is the Rangewood Drive bridge. The hydraulics of the structure are considered in the hydraulic analysis of the entire stream, with the resulting impact "minimal" at best.

The off-site (upstream) drainage facilities consist of unimproved channels with culvert crossings of roadways. At Woodmen Road, a steel bridge spans the channel. Otherwise, improvements are minimal.

IV. PROJECT PARAMETERS

Baseline Data: In order to formulate sound stormwater management recommendations, fundamental information was collected and assembled. The various data is summarized below:

1. Base Mapping - Topographic mapping (1"=100'), with 2-foot contour interval, was obtained in 1982. On the four main exhibits contained herein, the Corps floodplain and the anticipated adjacent development (per the approved masterplan) have been superimposed on the base mapping, along with the geometric image of platted elements.

2. Vegetation - Aerial photographs and site investigations reveal a certain amount of vegetation is presented along the main channel in the form of deciduous trees and brush. Vegetation characteristics are important in evaluating both the flow capacity of the stream (i.e. restrictions or debris) and the landscape planning aspects.

3. Historic Data - Historic data is useful as an aid to floodplain delineation. Aerial photographs from 1937, 1947, 1966 and 1982 were examined to compare topographic, vegetative and channel configurations over time. The watercourses and flood plain developed through periodic inundations are the primary areas of consideration in drainage basin and flood plain management. In review of this information, it is concluded that the Corps 100-year flood plain represents a maximum water surface inundation zone that has not been exceeded in the past 45+ years. Further, aside from a few exceptions, the channel vegetation has increased in the less frequently used portions of the floodway. The recommended levels of channel vegetation are summarized in the proposed channel facilities section.

4. Design Flows - The proposed channel improvements have been sized according to the Federal Emergency Management Agency (FEMA) 100-year flow rates and velocities. This data was extracted from information supplied by both Camp Dresser & McKee (Engineering Contractor for the FEMA study) and documented in the Lincoln-DeVore "Engineering Study of Cottonwood Creek Drainage Basin, 1979". The existing condition flow rate is assumed to be 9,200 c.f.s.

   The future condition flow rate of 17,900 c.f.s. (which varies to 16,500 c.f.s. at Woodmen Road) was derived from flow data contained in the U.S. Army Corps of Engineers publication "Flood Plain Information Study for Cottonwood Creek - 1976". Stream stationing for KLH's report is based on the Corps' study mapping, but only fair correlation can be made between topographic information and the profiles.

5. Criteria for Channel Improvements - A majority of the channel improvements consist of naturally sandy streambeds and slope armored banks. Bank protection requirements have been established utilizing the results of a HEC-2 computer analysis and the FEMA flow data (9,200 c.f.s.). A second run of the HEC-2 program was made using the Corps' flow data (17,900 c.f.s.) to establish building siting criteria adjacent to the main floodway. This was necessary because of the extensive changes to the channel and overbank areas since the Corps' study was completed in 1976.

Cross-sectional data for the stream is based upon newly defined boundaries as described later in this report, and as shown on the facilities maps enclosed. Roughness coefficients used in the analysis ranged from 0.025 to 0.032 in the channel, and 0.045 to 0.060 along the overbanks (natural areas).

Results of the HEC-2 runs are contained in Appendix A. A good correlation in water surface profiles was achieved between the analysis summarized herein and the analysis contained in the Woodland Hills Recreation Center Drainage Report (Simons, Li & Associates, Inc. - April, 1984.) Flood Profiles based upon these results are included in Appendix B.

The bank protection proposed consists of dumped rip-rap placed in accordance with City of Colorado Springs specifications. Sizing and height on the armoring is based upon the FEMA main stream velocity and depth. Freeboard is to be provided as follows:

$$\frac{\text{Depth of Flow}}{4} \quad \text{or 1' minimum}$$

Rock sizing is based upon Equation 5-4 (as revised 5/1/84) in the "Urban Storm Drainage Criteria Manual" published by the Urban Drainage and Flood Control District, Denver, Colorado, including latest revisions. Gradation of the rock is shown in Figure 4, with limits of specific rock sizes shown in the facilities mapping.

Comparing the sizing criteria currently utilized by The City of Colorado Springs, the Urban Storm Drainage Criteria Manual methodology is more conservative or comparable up to a main stream average velocity of 18 feet per second (f.p.s.). Above this velocity the two sizing methods vary. The velocities computed in this study are less than 18 f.p.s. and thus rip-rap designs meet or exceed current City design criteria.

6. Soils and Geology - The Cottonwood Creek drainage basin geology is discussed in detail in the Lincoln DeVore "Engineering Study of Cottonwood Creek Drainage Basin", 1979. Briefly, the soils within the Nor'wood area consist of weakly cemented sandstones, some relatively competent sandstones, and some wind blown sands. The eastern portion of the study corridor contains the competent sandstones, characterized by cliff formations and vertical slopes. The western portion of the study corridor represents the alluvium deposits of sands, some gravel, and silts. In both areas, the "sandy" channel bottom is the result of upstream erosion and consequential channel aggregation. Although suspended sediment concentrations are not known, it is evident from field investigations that the sandbars, channel meandering and overall channel character will remain unchanged until upstream areas are either developed or modified.

7. Colorado Springs Park and Recreation Department Involvement - In September, 1982, the Colorado Springs Park and Recreation Department completed a concept plan for the Nor'wood Park Site which is along the Southerly Cottonwood Creek Drainageway between Deliverance Subdivision and Rangewood Drive. The plan includes softball fields, natural areas, soccer fields, and other park amenities. Some of the facilities are located in the 100 year flood plain, and modification of the flood fringe is anticipated upon development. These elements are depicted on the facilities mapping. The impact of the park is discussed in the following section of the report.

V. PROPOSED CHANNEL FACILITIES

General: Some of the aspects to be addressed by this section include drainage improvement locations, types and sizes; timetables for construction; incorporation of visual/recreational amenities; and general facilities requirements. The plan provides an outline for full channel development according to the flood plain management concepts discussed earlier.

Structural Components: The structural components of the drainage system are depicted on the main exhibits at the end of the report, and include rip-rap sideslopes, outlet structures, stream re-channelization work, and selected clearing. The general concept is a natural channel with some clearing and erosion control work.

Dumped rip-rap is to be utilized to protect erosion-prone slopes and slopes adjacent to "new" development in the flood plain fringes. The sideslopes shall be shaped to no steeper than 1 1/2 horizontal to 1 vertical (1 1/2 to 1). The suggested sideslopes are 2 to 1. Natural sideslopes meandering is encorporated in this design, and can be an important visual asset when the top of the slope varies with the natural contours.

To be effective in erosion protection, the rip-rap layer must be placed on either a graded filter material or engineering fabric to prevent piping erosion. Either method is acceptable. The engineering fabric is shown in Figure 4, and is preferred because of installation ease and long term durability.

Three (3) access points into the streambed from the maintenance road have been shown on the proposed channel facilities mapping and detailed in Figure 5. Final location of each shall be determined at the time of final design or construction. The roadway accesses will allow maintenance traffic to service the slope armoring and will provide main channel bed access. The ramps will also service the recreational activities of the park/trail system.

Channel cleaning and selective brush clearing is proposed near the Nor'wood Park overlook at approximately Stations 185+00 to 200+00. The main low-flow channel is currently restricted to the South side of the drainageway, and utilizes only a small waterway area. This situation has become more definitive over time as the Northern part of the drainageway gradually built-up with sand, and foliage growth promoted the Southern route. It is suggested that selective clearing of low-profile brush and trees be undertaken to assure a clean floodway. Trees over 2-inches in diameter shall be left since floodwater should have minimal impact on them. The clearing will prevent concentration of flows that can produce scouring velocities and destructive conditions downstream. A typical cross-section is shown in Figure 6.

The final major structural component in the proposed drainage plan are the outfall structures from the on-site Nor'wood or Woodland Hills drainage systems. As we stated before, the extent and precise nature of these structures is unknown at this time, but generally will consist of outlets from storm drain pipes and open channels. Several outlet structures are shown in Figure 7, with the final design to be predicated on the side conditions and stormwater conveyance.

Construction Schedule: While keeping with the overall goals of the flood plain masterplan, the construction of facilities is to be completed in several phases. The phasing as shown on the plans is a design designation only, and is not necessarily a construction sequence.

Phase I

Phase I work includes all major protection facilities designed for the 100-year storm event. The individual sections of work are generally described below.

A. Slope armoring along the South side of the channel at the West end of the Nor'wood Park Site. This section will tie in the Deliverance Subdivision project with the natural areas of the proposed park site, including an outfall structure from the concrete ditch between Deliverance Subdivision and Greenbriar Park Subdivision Filing No. 1.

The major portion of Phase I-A work is the construction of a levee and maintenance roadway in the West half of the park site along the South stream bank. Beginning at the West end of the park site and matching into the existing rip-rap bank in Deliverance, slope protection is to be placed along the levee face Eastward to the overlook/dam. Some low level flooding in the most Westerly tip of the natural park site is anticipated during high flows because of backwater through the culverts under the levee. The limits of inundation are shown on the facilities mapping. Velocities will be small and no damage from this action is anticipated.

The levee shall extend from the existing Deliverance slope protection to the East until termination of the nose of the existing dam/overlook, where Phase I-G begins. Figure 8 details the height and slope features of the levee. This slope protection provided will be for the 100-year storm event, and sized for the velocities anticipated.

B. Slope armoring along the North side of the channel from the Eastern edge of an existing rip-rapped slope to the Eastern boundary line for the Woodland Hills Recreation Center site. A drainage report covering this portion of the stream has been submitted by Simons, Li & Associates, Inc. in April, 1984. Therefore, all bank improvement designs are detailed in that study. As was stated earlier, close correlation is evident between the FEMA water surface profiles in that report and the profiles in this report.

Phase I-B terminates at the Western edge of the Phase I-C facilities, and will tie-in the improved channel downstream with the Woodland Hills Filing No. 6 improvements. Schedule of actual construction will be tied to the development of the Woodland Hills Recreation Center site.

C. Slope armoring of the North bank of Cottonwood Creek adjacent to Woodland Hills Filing No. 6. A portion of the bank protection must be upsized to counteract possibly locally high velocities where the floodway is directed into the existing bank. The work to be included under this phase is some re-shaping of the bank slopes to smooth eroded areas. Schedule of construction shall be immediate to avoid additional bank erosion.

D. Slope armoring of the inlet and outlet approaches to the Rangewood Drive crossing. This work shall take place when the actual structure(s) are built, and when specific limits of protection have been determined.

E. Slope armoring of the Northern channel slopes adjacent to Dysan Subdivision Filing No. 1 located immediately East of Rangewood Drive. The protection works will be required Northeastward to the East line of the subdivision. Construction of these facilities shall be completed per the Channelization schedules established by Nor'wood Development.

F. Slope armoring of slopes East of the Rangewood Drive Crossing along the Southeast side of the channel. This work is limited to natural runoff points where they enter the Cottonwood Creek drainageway, and where severe erosion is evident. The scope of this phase could change significantly as platting of the adjacent land is completed. Therefore, construction of major stream facilities is not suggested in the immediate future until development schemes are finalized, and final on-site drainage facilities have been designed.

G. Slope armoring of the South bank of Cottonwood Creek adjacent to the East one-half of the Nor'wood Park. Some filling into the flood plain is anticipated to accommodate ball fields and other recreational facilities. The 100 year slope armoring proposed extends from the park overlook to the Rangewood Drive Crossing. This item also includes the 48-inch diameter storm drain from existing subdivisions to the South, and extends to the main floodway.

Phase II

Phase II work shall be completed when park improvements are made. The individual locations of work are described below.

A. Channel construction near the Nor'wood Park overlook as discussed earlier. This work includes removal of some low profile vegetation and trees and is also dependent on the proposed park development schedule, which is unknown at this time.

B. Special consideration must be given to several low-profile pedestrian bridge crossings proposed by the Parks Department. Potential structure wash-out and minor clogging is anticipated during major storm events. Each structure will have to be evaluated to determine impact on the drainage characteristics of the channel. The location and design of these bridges shall be reviewed by the City Engineer and Department of Public Works prior to construction.

FACILITIES COST ESTIMATE: A preliminary cost estimate of drainage facilities required at this time in Cottonwood Creek adjacent to Nor'wood Development is given below. The costs have been broken down into the construction phases outlined earlier.

Phase I-A

Clearing and Grubbing	2,500	L.F.	@ $ 2./L.F.	= $	5,000.
Concrete Drop Structure	1	Each	@ $3000./Ea.	= $	3,000.
Slope Shaping & Earthwork	300	L.F.	@ $ 2./L.F.	= $	600.
Rip-Rap (including fabric)	3,280	C.Y.	@ $ 35./C.Y.	= $	114,800.
Levee Construction	15,000	C.Y.	@ $ 6./C.Y.	= $	90,000.
24" R.C.P. Storm Drain	320	L.F.	@ $ 35./L.F.	= $	11,200.
36" R.C.P. Storm Drain	100	L.F.	@ $ 60./L.F.	= $	6,000.
54" R.C.P. Storm Drain	590	L.F.	@ $ 94./L.F.	= $	55,460.
4" PVC Storm Drain	225	L.F.	@ $ 8./L.F.	= $	1,800.
Flapgates (36")	2	Each	@ $ 500./Ea.	= $	1,000.
Manholes	4	Each	@ $1000./Ea.	= $	4,000.
Access Structure	1	Each	@ $7000./Ea.	= $	7,000.
Maintenance Road	2,500	L.F.	@ $ 3./L.F.	= $	7,500.
		TOTAL PHASE I-A		= $	307,360.

Phase I-B

See Simons, Li & Associates, Inc. Drainage Report for the Woodland Hills Recreation Center.

Phase I-C

Slope Shaping & Earthwork	860	L.F.	@ $ 2./L.F.	= $	1,720.
Rip-Rap (including fabric)	2,010	C.Y.	@ $ 35./C.Y.	= $	70,350.
Re-build Pipe Outfall	1	Each	@ $5000./Ea.	= $	5,000.
		TOTAL PHASE I-C		= $	77,070.

Phase I-D

Slope Shaping & Earthwork	1,090	L.F.	@ $ 2./L.F.	= $	2,180.
Rip-Rap (including fabric)	1,050	C.Y.	@ $ 35./C.Y.	= $	36,750.
		TOTAL PHASE I-D		= $	38,930.

Phase I-E

Slope Shaping & Earthwork	2,800	L.F.	@ $ 2./L.F.	= $	5,600.
Rip-Rap (including fabric)	6,678	C.Y.	@ $ 35./C.Y.	= $	233,730.
Access Structure	1	Each	@ $7000./Ea.	= $	7,000.
Maintenance Road	1,115	L.F.	@ $ 3./L.F.	= $	3,345.
		TOTAL PHASE I-E		= $	249,675.

Phase I-G

Clearing and Grubbing	1,940	L.F.	@ $ 2./L.F.	= $	3,880.
Slope Shaping & Earthwork	1,940	L.F.	@ $ 2./L.F.	= $	3,880.
Rip-Rap (including fabric)	2,950	C.Y.	@ $ 35./C.Y.	= $	103,250.
48" R.C.P. Storm Drain	525	L.F.	@ $ 74./L.F.	= $	38,850.
Manholes	2	Each	@ $1000./Ea.	= $	2,000.
Access Structure	1	Each	@ $7000./Ea.	= $	7,000.
Maintenance Road	2,050	L.F.	@ $ 3./L.F.	= $	6,150.
		TOTAL PHASE I-G		= $	165,010.
		TOTAL PHASE I		= $	838,045

FACILITIES COST ESTIMATE (CON'T)

Phase II-A

Earthwork & Channel Cleaning	1,500 L.F. @ $ 5./L.F.	= $	7,500.
	TOTAL PHASE II-A	= $	7,500.
	TOTAL PHASE II	= $	7,500.
	TOTAL	= $	845,545.

VI. DRAINAGE REPORT STATEMENTS

Engineer's Statement:

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the City for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by the negligent acts, errors or omissions on my part in preparing this report.

Name

THOMAS C. LITTLE REGISTERED 10929 PROFESSIONAL ENGINEER STATE OF COLORADO Seal

Developer's Statement:

The developer has read and will comply with all of the requirements specified in this drainage report.

Nor'wood Development Corporation
Business Name
By:
Title: Pres
Address: P.O. Box 552
Manitou Springs, CO 80829

City of Colorado Springs:

Filed in accordance with Section 15-3-906 of the Code of the City of Colorado Springs, 1980, as amended.

City Engineer

1/22/85
Date

Conditions:

VII. FIGURES

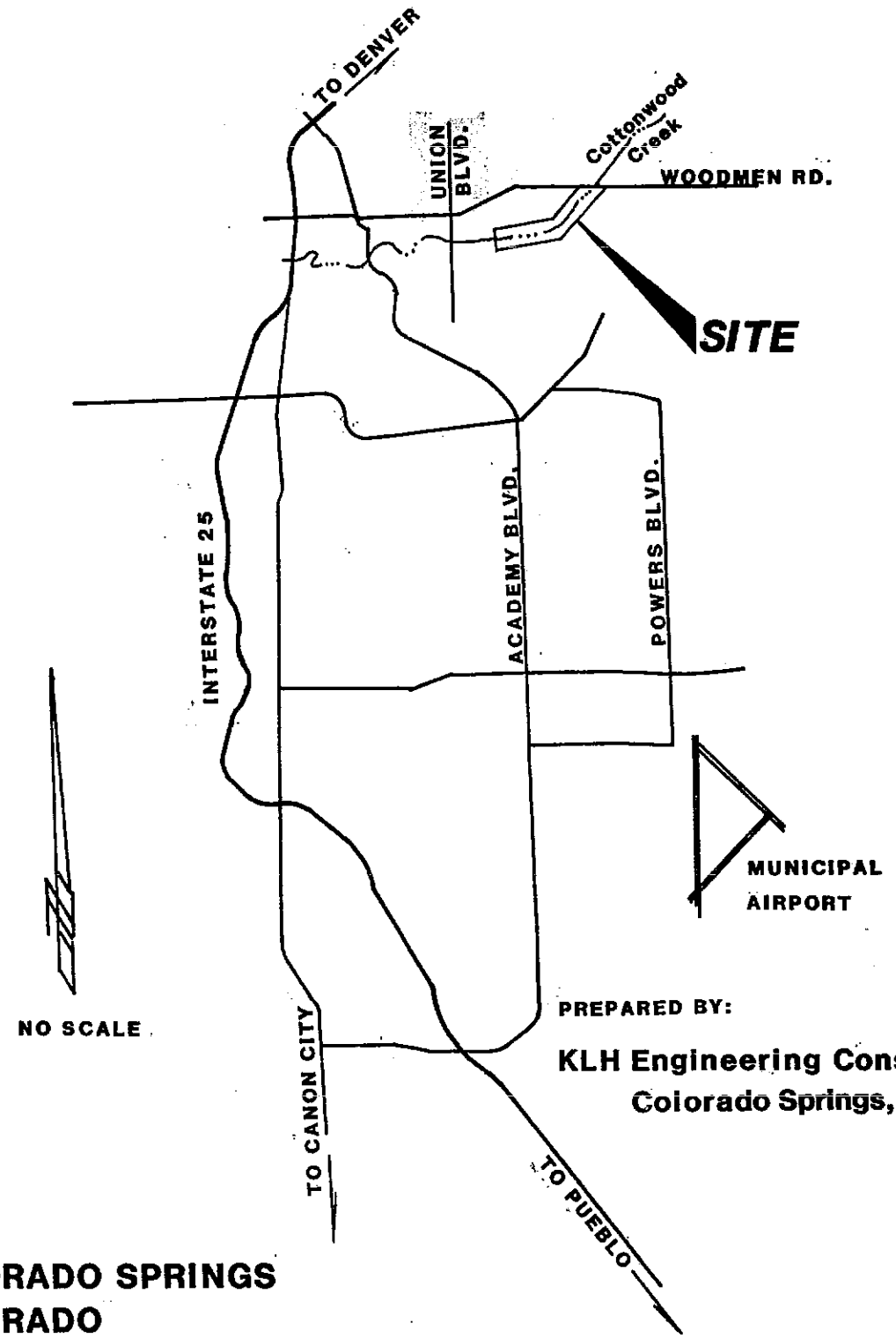
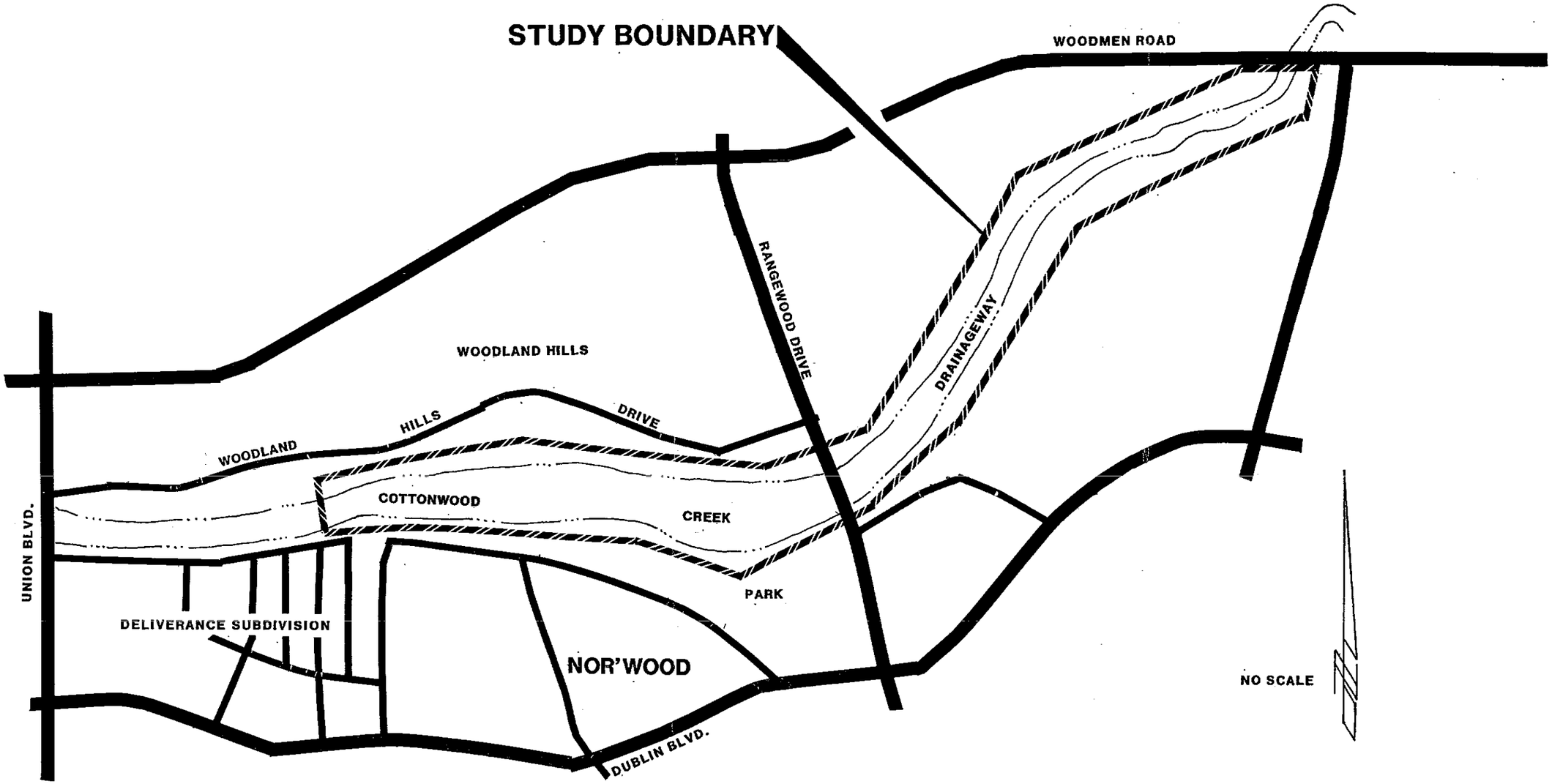


FIGURE 1 – LOCATION MAP



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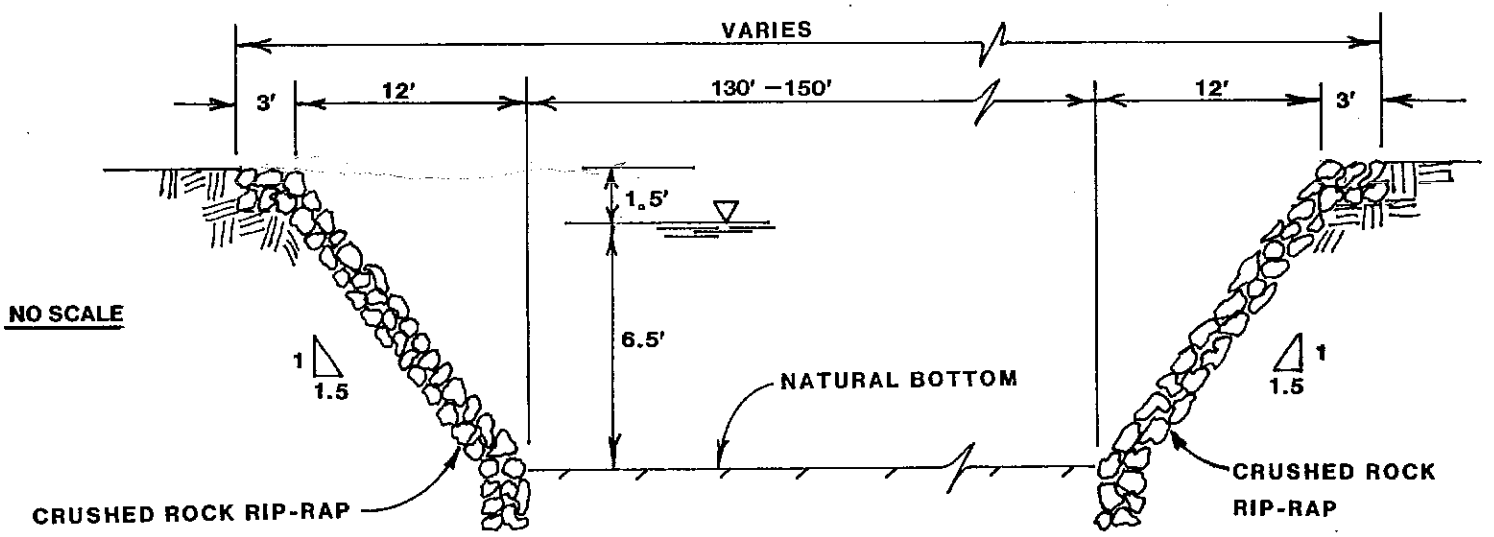
Colorado Springs, Co

FIGURE 2—VICINITY MAP



TYPICAL CROSS–SECTION, EXISTING CHANNEL

WEST OF NOR'WOOD

EXISTING IMPROVED CHANNEL
LOOKING UPSTREAM (EAST)
FROM UNION BLVD.

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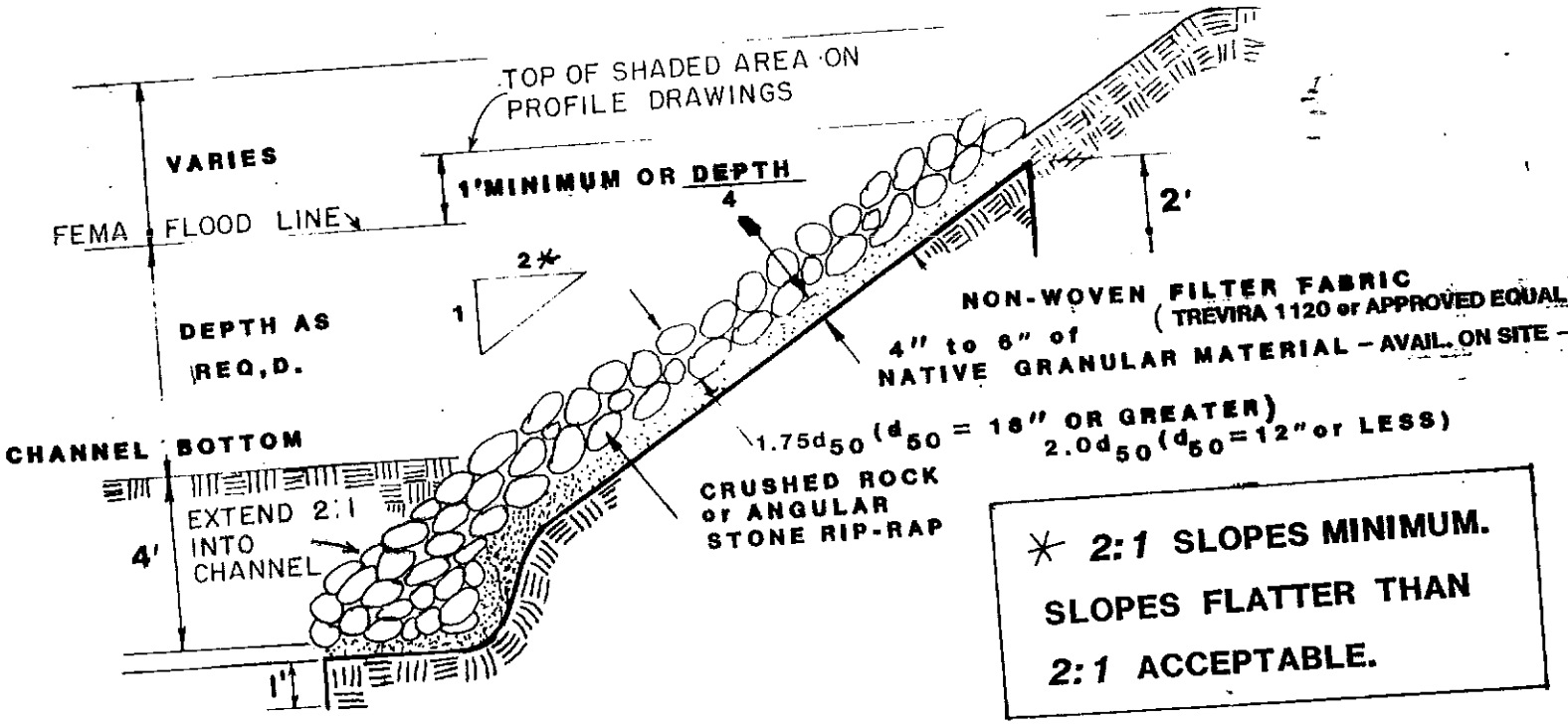
Colorado Springs, Co

FIGURE 3–DOWNSTREAM IMPROVED CHANNEL



NOTES

1. Stone size and stone graduation shall be provided as follows:

	% smaller than given size by weight	Intermediate Rock Dimension (Inches)
d_{50} = 12"	70 - 100	21
	50 - 70	18
	35 - 70	12
	2 - 10	4
d_{50} = 18"	100	30
	50 - 70	24
	35 - 50	18
	2 - 10	6
d_{50} = 24"	100	42
	50 - 70	33
	35 - 50	24
	2 - 10	9

2. Use 4-6 inches of native granular material on top of geotextile material for impact protection.
3. Geotextiles shall be overlapped at least 1.0 foot longitudinally (along the channel), with the upstream fabric being placed on the downstream fabric at the lap.

FIGURE 4 –– TYPICAL RIP–RAP SECTION

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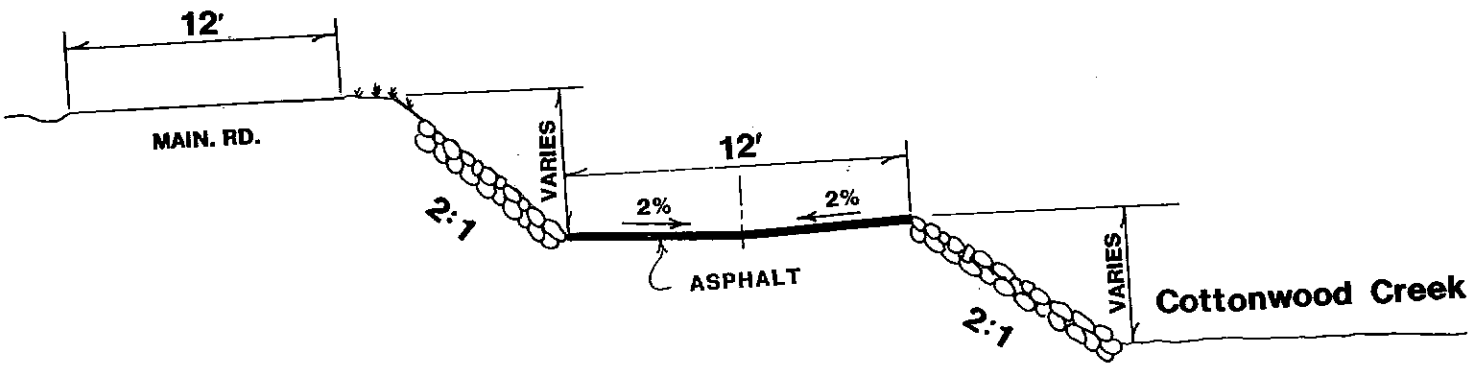

SECTION A-A

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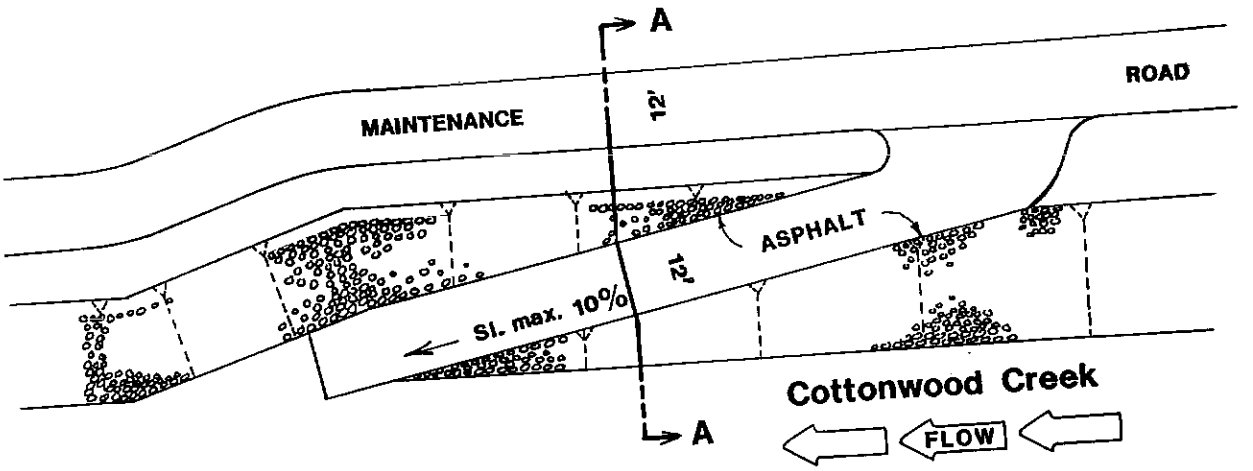


PLAN VIEW

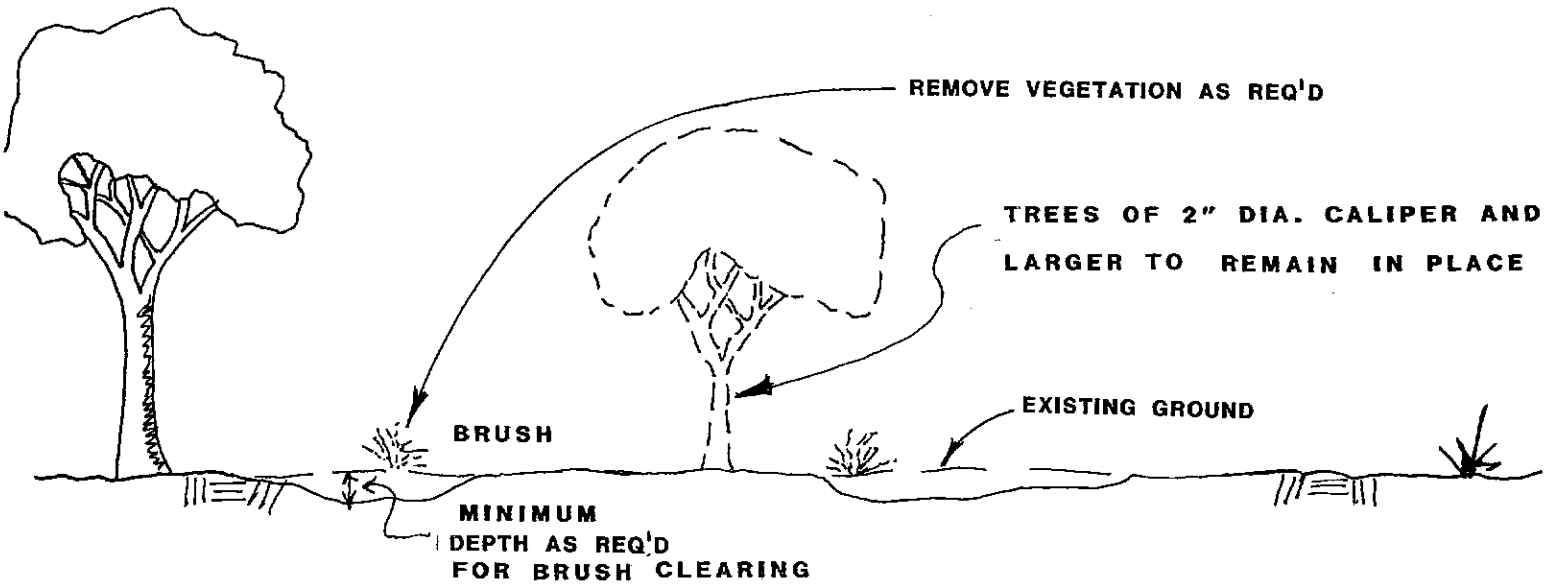
NTS

prepared by:

KLH Engineering Consultants, Inc.

Colorado Springs, Co

FIGURE 5 – TYPICAL CREEK ACCESS



TYPICAL SECTION

NTS

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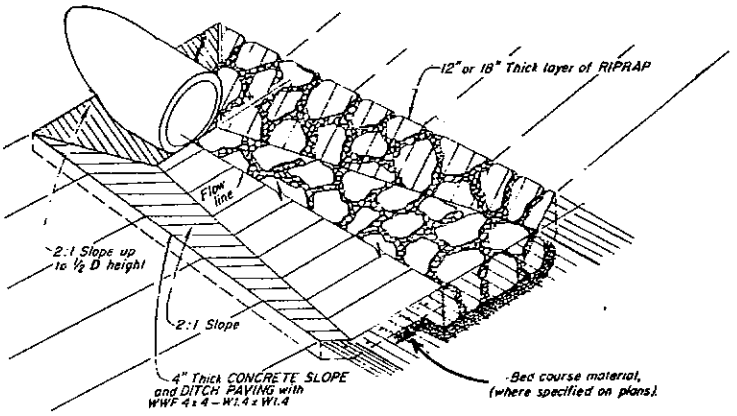
Colorado Springs , Co

FIGURE 6—TYPICAL CHANNEL CLEANING DETAIL

NOTE

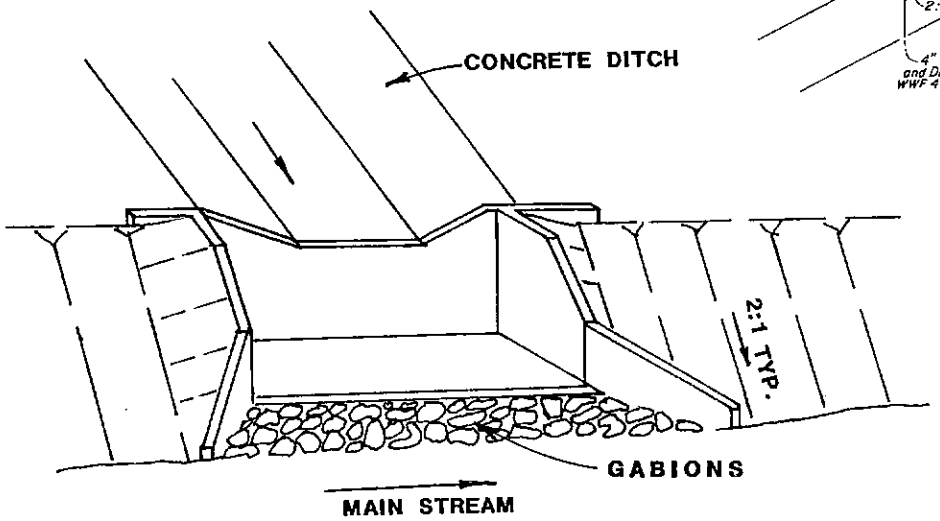
THESE STRUCTURES DO NOT COMPRISE DESIGNS FOR CONSTRUCTION. DETAILS SHALL BE COMPLETED ON A SITE BY SITE BASIS .



COLO. DIVISION OF HIGHWAYS
STANDARD M-601-L

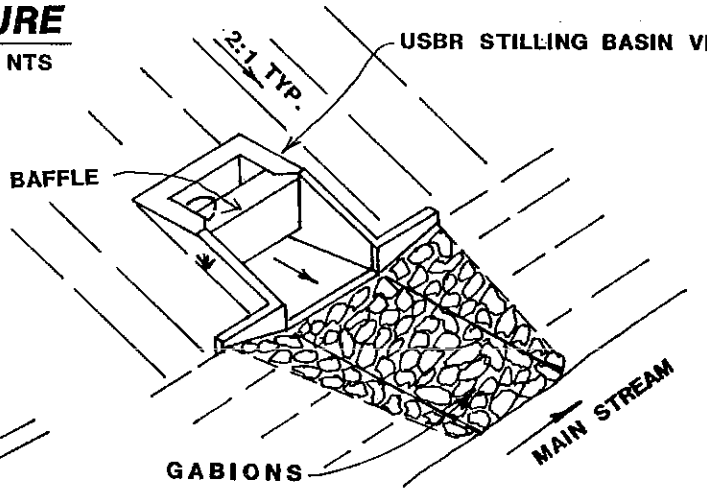
PIPE OUTLET

NTS



OPEN CHANNEL DROP STRUCTURE

NTS



PIPE OUTLET

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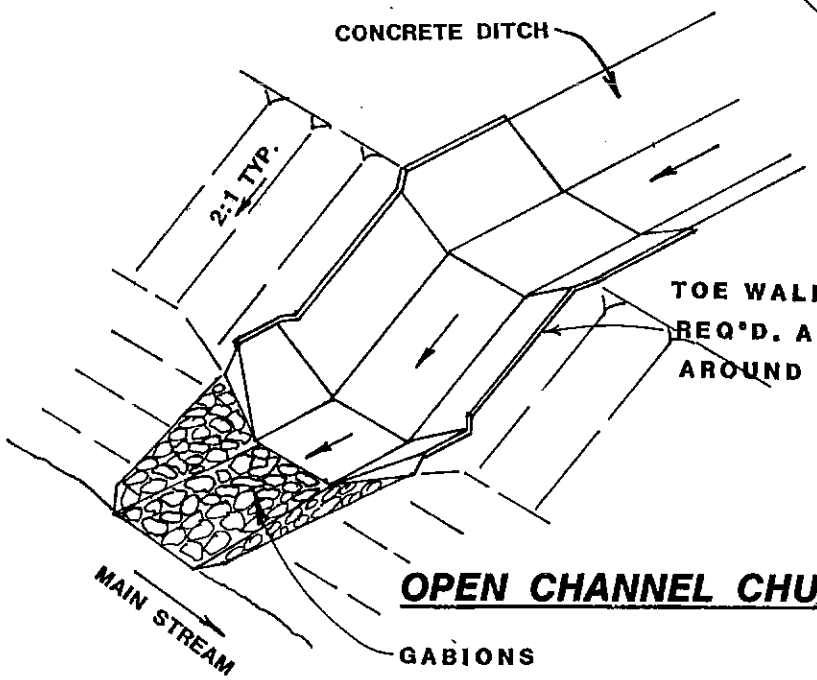

OPEN CHANNEL CHUTE

NTS

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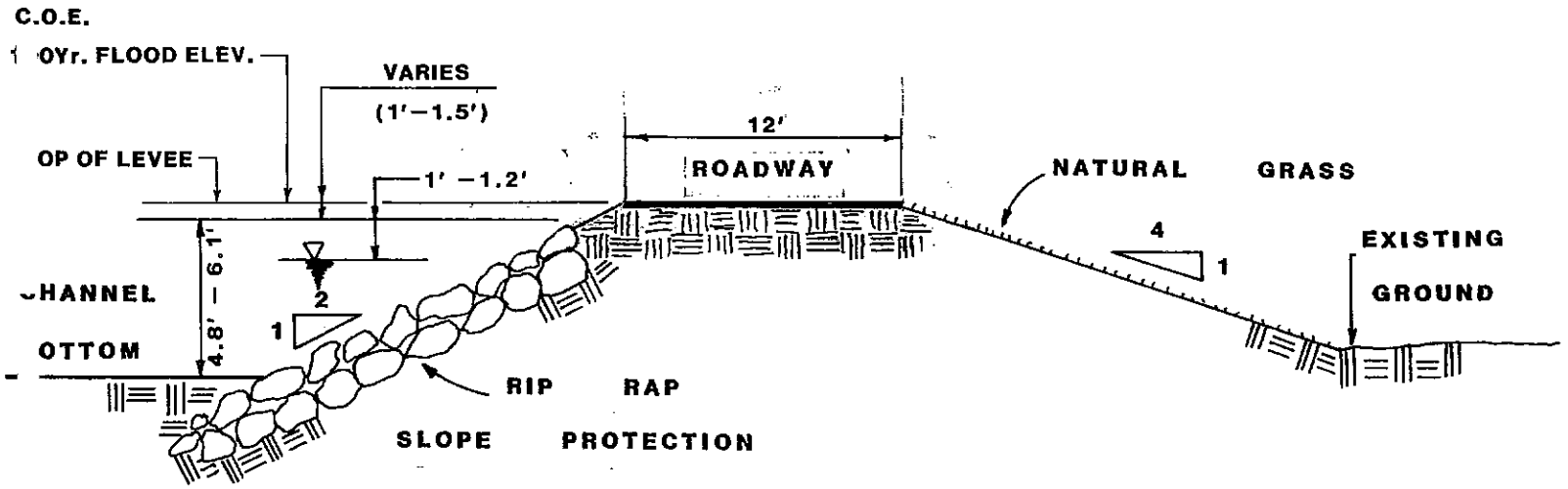
Colorado Springs,Co

FIGURE 7—ALTERNATE OUTLET STRUCTURES



TYPICAL SECTION

NTS

NOTES:

1. SUBGRADE FOR ALL LEVEES SHALL BE STRIPPED OF ALL VEGETATION.
2. COMPACTION OF LEVEE MATERIALS SHALL BE TO 95% MODIFIED PROCTOR DENSITY.
3. NATURAL STREAM MATERIALS ARE ACCEPTABLE LEVEE FILLS, PROVIDED THEY ARE CLEAN, UNIFORM, AND CONTAIN NO GRASS, TREES OR ROOTS.

FIGURE 8—TYPICAL LEVEE DETAIL

PREPARED BY **KLH ENGINEERING CONSULTANTS INC.**

APPENDIX A

Summary Printouts

HEC-2 Hydraulic Analysis

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0R65YI.2  1243.0  5610.8  1243.1  5611.8  1343.1


   @S
  * Batch queue "SYS$BATCH" Joblim=4, Baserri=3, Swap

   CURR  3692 SIMONS11      RHEC2      Pri=4 21-JUN-1984 09:40
    VAX/VMS V3.6     Processes on 21-JUN-1984 09:41:40.31     Uptime  6 12:58:14
      Pid     Process Name      UIC   State Pri Dir. I/O      CPU      Page flts Ph.Mem
   00710015 _JOB3692         001,004 COM     3         4 00:00:00.20         55    91 B
$ @S
  * Batch queue "SYS$BATCH" Joblim=4, Baserri=3, Swap

   CURR  3692 SIMONS11      RHEC2      Pri=4 21-JUN-1984 09:40
    VAX/VMS V3.6     Processes on 21-JUN-1984 09:42:17.85     Uptime  6 12:58:51
      Pid     Process Name      UIC   State Pri Dir. I/O      CPU      Page flts Ph.Mem
   00710015 _JOB3692         320,003 COM     3       104 00:00:12.20       5952   200 B
$
Batch Job 3692 RHEC2 completed on 21-JUN-1984 09:42
$ TYPE COTTON.OUT
$ SET NOVERIFY
  21-JUN-1984 09:41:49
%SYSTEM-W-IVDEVNAM, invalid device name
$ ASSIGN DUMMY SYS$PRINT
$ ASSIGN DIANE.DAT INPUT
$ REN RHEC2.LOG COTTON.OUT
$ RUN ISLALIB:HEC2
```

COTTONWOOD CREEK HYDRAULIC ANALYSIS THROUGH NORWOOD
JUNE 21, 1984
15% BLOCKAGE ASSOMED @ RANGEWOOD.

```
**********************************************************
*                                                        *
*  WATER SURFACE PROFILES                                *
*  VERSION OF NOVEMBER 1976                              *
*  UPDATED MAY 1984                                      *
*                                                        *
*  RUN DATE 21-JUN-84  TIME 09:41:53                     *
*                                                        *
**********************************************************

**********************************************
*  U.S. ARMY CORPS OF ENGINEERS              *
*  THE HYDROLOGIC ENGINEERING CENTER         *
*  609 SECOND STREET, SUITE D                *
*  DAVIS, CALIFORNIA 95616                   *
*  (916) 440-2105 (FTS) 448-2105             *
**********************************************
```

```
X     X  XXXXXXX  XXXXX          XXXXX
X     X  X       X     X        X     X
X     X  X       X              X     X
XXXXXXX  XXXX    X              XXXXX
X     X  X       X              X     X
X     X  X       X     X        X     X
X     X  X        XXXXX          XXXXX
```

THIS RUN EXECUTED 21-JUN-84 09:41:54

```
**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY   1984
  ERROR CORR -  01;02;03;04;05;06
  MODIFICATION -  50;51;52;53;54;55
**************************************************
```

Q=9200

```
T1  SIMONS, LI AND ASSOCIATES
T2  KLH & NORWOOD DEVELOPMENT
T3  COTTONWOOD CREEK, COLORADO SPRINGS
```

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	-10.	2.	0.	0.	0.000000	0.00	0.0	0.	6526.900	0.000

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	1.000	0.000	-1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	QLOSS	BANK ELEV	
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT	
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA	
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST	

```
*PROF 1

CCHV=  0.100 CEHV=  0.300
*SECNO 1.000
3720 CRITICAL DEPTH ASSUMED
     1.00      4.55   6526.95   6526.95   6526.90   6529.08      2.13      0.00      0.00   6522.40
     9200.     430.    8697.       83.       61.      728.       14.        0.        0.    6522.40
```

```
      0.00        7.01       11.93       6.07      0.000      0.032      0.034      0.000    6522.40    1503.04
  0.008741        310.        310.        310.          0          4          0       0.00     192.95    1695.99

*SECNO 2.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=     6539.00 ELREA=     6539.00

      2.00        3.40    6535.30    6535.30      0.00    6537.77       2.47       3.97       0.10    6538.00
      9200.          0.      9200.         0.        0.       730.         0.         8.         2.    6538.00
      0.01        0.00      12.60       0.00     0.000      0.032      0.000      0.000    6529.90    1154.72
  0.008943        430.        450.        460.        20          8          0       0.00     147.86    1302.58

*SECNO 3.000

3301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=     6541.00 ELREA=     6541.00

      3.00        4.08    6539.38    6539.38      0.00    6541.26       1.89       2.53       0.06    6541.00
      9200.          0.      9200.         0.        0.       835.         0.        13.         3.    6541.00
      0.02        0.00      11.02       0.00     0.000      0.032      0.000      0.000    6535.30    1196.90
  0.009831        270.        270.        270.         7         15          0       0.00     223.85    1420.75

*SECNO 4.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

21-JUN-84   09:41:53                                                                          PAGE     3

   SECNO      DEPTH      CWSEL      CRIWS      WSELK      EG         HV         HL         OLOSS      BANK ELEV
   Q          QLOB       QCH        QROB       ALOB       ACH        AROB       VOL        TWA        LEFT/RIGHT
   TIME       VLOB       VCH        VROB       XNL        XNCH       XNR        WTN        ELMIN      SSTA
   SLOPE      XLOBL      XLCH       XLOBR      ITRIAL     IDG        ICONT      CORAR      TOPWID     ENDST

3195 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA=     6554.00 ELREA=     6554.00
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```
     4.00      4.88   6549.49   6549.48      0.00   6551.65      2.17      4.62      0.08   6554.00
     9200.        0.      9200.        0.        0.       779.        0.        22.        5.   6554.00
      0.03      0.00     11.82      0.00     0.000     0.032     0.000     0.000   6541.60   1181.04
 0.009434      180.       180.       180.        20        11         0      0.00    181.91   1362.96

CCHV=   0.100 CEHV=   0.300
*SECNO 5.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE;ELLEA=     6570.00 ELREA=     6573.00

     5.00      4.31   6563.51   6563.51      0.00   6565.24      1.73      7.70      0.04   6570.00
     9200.        0.      9200.        0.        0.       873.        0.        41.       10.   6573.00
      0.05      0.00     10.54      0.00     0.000     0.025     0.000     0.000   6559.20   1482.97
 0.006172      1020.      1020.      1020.        15        11         0      0.00    255.92   1738.89

*SECNO 6.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
     6.00      4.57   6570.37   6570.37      0.00   6572.02      1.65      3.81      0.01   6580.00
     9200.        0.      4334.      4866.        0.       323.       766.        54.       14.   6566.00
      0.07      0.00     13.43      6.36     0.000     0.025     0.045     0.000   6565.80   1055.60
 0.007393       565.       565.       565.        20         8         0      0.00    305.26   1360.85

*SECNO 7.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
     7.00      3.78   6583.78   6583.78      0.00   6585.09      1.32      9.71      0.03   6585.80
     9200.        0.      1784.      7416.        0.       140.       912.        76.       22.   6581.00
      0.10      0.00     12.75      8.13     0.000     0.025     0.045     0.000   6580.00   1173.26
 0.016263       920.       920.       920.        14        15         0      0.00    425.56   1598.82

*SECNO 7.500
7185 MINIMUM SPECIFIC ENERGY


21-JUN-84   09:41:53                                                                    PAGE     4

  SECNO     DEPTH     CWSEL     CRIWS     WSELK      EG        HV        HL       OLOSS     BANK ELEV
    Q       QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA      LEFT/RIGHT
   TIME     VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN      SSTA
  SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID     ENDST
```

3720 CRITICAL DEPTH ASSUMED

7.50	4.04	6591.64	6591.64	0.00	6593.31	1.67	4.43	0.11	6594.00
9200.	0.	9200.	0.	0.	886.	0.	87.	25.	6600.00
0.11	0.00	10.38	0.00	0.000	0.025	0.000	0.000	6587.60	1069.38
0.006242	465.	465.	465.	3	8	0	0.00	268.86	1338.24

*SECNO 8.000

3265 DIVIDED FLOW

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

8.00	5.76	6595.56	6595.56	0.00	6598.97	3.41	1.26	0.52	6610.80
9200.	0.	9200.	0.	0.	621.	0.	90.	26.	6610.80
0.12	0.00	14.82	0.00	0.000	0.025	0.000	0.000	6588.80	1100.07
0.009002	169.	169.	169.	20	14	0	0.00	91.99	1243.03

SPECIAL BRIDGE

5227 DOWNSTREAM ELEV IS 6591.93 ,NOT 6595.56 HYDRAULIC JUMP OCCURS DOWNSTREAM (IF LOW FLOW CONTROLS)

SB XK	XKOR	COFQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
1.05	1.25	2.63	0.00	142.90	51.00	962.00	0.00	6591.20	6588.80

*SECNO 8.100

3301 HV CHANGED MORE THAN HVINS

CLASS B LOW FLOW

3420 BRIDGE W.S.= 6596.78 BRIDGE VELOCITY= 14.77 CALCULATED CHANNEL AREA= 513.

EGPRS	EGLWC	H3	QWEIR	QLOW	BAREA	TRAPEZOID AREA	ELLC	ELTRD
6597.34	6603.20	0.00	0.	9200.	962.	965.	6601.70	6610.80

8.10	10.66	6601.86	0.00	0.00	6603.20	1.35	4.23	0.00	6610.80
9200.	0.	9200.	0.	0.	988.	0.	92.	26.	6610.80
0.12	0.00	9.31	0.00	0.000	0.025	0.000	0.000	6591.20	1100.05
0.003448	148.	148.	148.	0	0	0	0.00	143.01	1243.05

SECNO DEPTH CWSEL CRIWS WSELK EG IHV HL OLOSS BANK ELEV

```
      TIME      QLOB      QCH       QROB      XNL       XNCH      XNR       WTN       ELMIN     SSTA
     SLOPE      XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWID    ENDST

CCHV=   0.100 CEHV=   0.300
*SECNO 9.000

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
      9.00      5.03   6605.03   6605.03      0.00   6606.92      1.90      2.29      0.16   6602.00
    9200.      1694.     7506.        0.      430.      621.        0.       105.       29.   6611.00
      0.13      3.94     12.09      0.00     0.000     0.025     0.000     0.000   6600.00   1179.27
 0.005630       528.      528.       528.        20        14         0      0.00    280.79   1460.05

*SECNO 10.000
3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
     10.00      5.20   6615.00   6615.00      0.00   6616.92      1.92      3.60      0.01   6610.20
    9200.      3213.     3987.        0.      674.      149.        0.       120.       33.   6616.00
      0.15      4.76     13.34      0.00     0.000     0.025     0.000     0.000   6609.80   1144.66
 0.006410       600.      600.       600.        20         8         0      0.00    283.92   1428.58

CCHV=   0.100 CEHV=   0.300
*SECNO 11.000

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
     11.00      6.28   6632.28   6632.28      0.00   6634.81      2.53      6.16      0.18   6636.00
    9200.        0.     9200.        0.        0.      720.        0.       142.       38.   6632.00
      0.17      0.00     12.77      0.65     0.000     0.025     0.045     0.000   6626.00   1177.69
 0.005483      1040.     1040.      1040.        20        11         0      0.00    146.72   1324.41

*SECNO 12.000

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
```

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

12.00	9.14	6647.44	6647.44	0.00	6651.16	3.72	4.85	0.36	6650.00
9200.	0.	9200.	0.	0.	594.	0.	156.	40.	6650.00
0.19	0.00	15.48	0.00	0.000	0.025	0.000	0.000	6638.30	1191.86
0.005075	920.	920.	920.	20	11	0	0.00	80.08	1271.93

THIS RUN EXECUTED 21-JUN-84 09:42:07

```
**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY   1984
  ERROR CORR -  01,02,03,04,05,06
  MODIFICATION -  50,51,52,53,54,55
**************************************************
```

Q = 17900

```
T1
T2
T3       Q=17900
```

J1	ICHECK	INQ	NINV	IDIR	STRT	METRIC	HVINS	Q	WSEL	FQ
	-10.	3.	0.	0.	0.000000	0.00	0.0	0.	6529.300	0.000

J2	NPROF	IPLOT	PRFVS	XSECV	XSECH	FN	ALLDC	IBW	CHNIM	ITRACE
	15.000	0.000	-1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	BETA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IBC	ICONT	CORAR	TOPWID	ENDST

*PROF 2

CCHV= 0.100 CEHV= 0.300

*SECNO 1.000

3720 CRITICAL DEPTH ASSUMED

1.00	6.99	6529.39	6529.39	6529.30	6532.55	3.16	0.00	0.00	6522.40
17900.	1247.	16413.	240.	145.	1119.	22.	0.	0.	6522.40
0.00	8.62	14.67	7.47	0.000	0.032	0.034	0.000	6522.40	1488.61
0.007469	310.	310.	310.	0	4	0	0.00	210.59	1699.20

*SECNO 2.000

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

2.00	8.32	6538.22	6538.22	0.00	6541.79	3.57	3.39	0.12	6538.00
17900.	0.	17895.	5.	0.	1181.	6.	13.	2.	6538.00
0.01	0.88	15.16	-0.88	0.000	0.032	0.034	0.000	6529.90	1147.36
0.007635	430.	450.	460.	20	12	0	0.00	214.29	1361.65

*SECNO 3.000

3301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3.00	6.98	6542.28	6542.28	0.00	6543.88	1.60	1.54	0.20	6541.00
17900.	272.	16016.	1612.	66.	1500.	199.	23.	5.	6541.00
0.02	4.14	10.68	3.23	0.000	0.032	0.034	0.000	6535.30	1153.92
0.004423	270.	270.	270.	3	15	0	0.00	728.31	1882.23

*SECNO 4.000

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA= 6551.00 ELREA= 6554.00

SECNO / Q / TIME / SLOPE	DEPTH / QLOB / VLOB / XLOBL	CWSEL / QCH / VCH / XLCH	CRIWS / QROB / VROB / XLOBR	WSELK / ALOB / XNL / ITRIAL	EG / ACH / XNCH / IDC	HV / AROB / XNR / ICONT	HL / VOL / WTN / CORAR	OLOSS / IWA / ELMIN / TOPWID	BANK ELEV LEFT/RIGHT / SSTA / ENDST
4.00	7.32	6551.92	6551.92	0.00	6555.18	3.26	2.84	0.50	6564.00
17900.	0.	17900.	0.	0.	1235.	0.	41.	10.	6554.00
0.03	0.00	14.50	0.00	0.000	0.035	0.000	0.000	6544.60	1178.14
0.008292	480.	480.	480.	20	8	0	0.00	191.68	1367.84

CCHV= 0.100 CEHV= 0.300

*SECNO 5.000

3301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE,ELLEA= 6570.00 ELREA= 6573.00

5.00	5.96	6565.16	6565.16	0.00	6567.66	2.50	6.87	0.08	6570.00
16500.	0.	16500.	0.	0.	1301.	0.	71.	16.	6573.00
0.05	0.00	12.68	0.00	0.000	0.025	0.000	0.000	6559.20	1479.68
0.005498	1020.	1020.	1020.	17	15	0	0.00	264.79	1744.47

*SECNO 6.000

3695 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

6.00	6.14	6571.94	6571.94	0.00	6574.32	2.38	3.61	0.01	6580.00
16500.	0.	7177.	9323.	0.	441.	1131.	89.	19.	6566.00
0.06	0.00	16.26	8.24	0.000	0.025	0.045	0.000	6565.80	1053.05
0.007503	565.	565.	565.	20	8	0	0.00	311.42	1364.47

*SECNO 7.000

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

7.00	5.02	6585.02	6585.02	0.00	6586.93	1.91	9.18	0.05	6585.80
16500.	0.	3431.	13069.	0.	221.	1365.	123.	27.	6581.00
0.08	0.00	15.53	9.57	0.000	0.025	0.045	0.000	6580.00	1170.64
0.016923	920.	920.	920.	16	15	0	0.00	431.42	1602.06

*SECNO 7.500

7185 MINIMUM SPECIFIC ENERGY

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XECH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

3720 CRITICAL DEPTH ASSUMED

7.50	5.65	6593.25	6593.25	0.00	6595.65	2.40	3.85	0.15	6594.00
16500.	0.	16500.	0.	0.	1328.	0.	138.	31.	6600.00
0.09	0.00	12.12	0.00	0.000	0.025	0.000	0.000	6587.60	1064.34
0.005489	465.	465.	465.	3	8	0	0.00	279.07	1343.41

*SECNO 8.000

3265 DIVIDED FLOW

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

8.00	9.98	6598.78	6598.78	0.00	6603.81	5.02	1.21	0.79	6610.80
16500.	0.	16500.	0.	0.	917.	0.	143.	32.	6610.80
0.10	0.00	17.99	0.00	0.000	0.025	0.000	0.000	6588.80	1100.05
0.009787	169.	169.	169.	20	14	0	0.00	92.18	1243.05

SPECIAL BRIDGE

5227 DOWNSTREAM ELEV IS 6593.42 ,NOT 6598.78 HYDRAULIC JUMP OCCURS DOWNSTREAM (IF LOW FLOW CONTROLS)

SB	XK	XKOR	COFQ	RDLEN	BWC	BWP	BAREA	SS	ELCHU	ELCHD
	1.05	1.25	2.63	0.00	142.90	51.00	962.00	0.00	6591.20	6588.80

*SECNO 8.100

PRESS FLOW BECAUSE EGLWC OF 6608.37 EXCEEDS 1.5 DEPTH

3301 HV CHANGED MORE THAN HVINS

PRESSURE FLOW

EGPRS	EGLWC	H3	QWEIR	QPR	BAREA	TRAPEZOID AREA	ELLC	ELTRD
6604.49	6608.37	0.00	0.	16500.	962.	965.	6601.70	6610.80

3685 20 TRIALS ATTEMPTED WSEL,CWSEL

SECNO / Q / TIME / SLOPE	DEPTH / QLOB / VLOB / XLOBL	CWSEL / QCH / VCH / XLCH	CRIWS / QROB / VROB / XLOBR	WSELK / ALOB / XNL / ITRIAL	EG / ACH / XNCH / IDC	HV / AROB / XNR / ICONT	HL / VOL / WTN / CONAR	CLOSS / TWA / ELMIN / TOPWID	BANK ELEV LEFT/RIGHT / SSTA / ENDST
3710 WSEL ASSUMED BASED ON MIN DIFF									
3693 PROBABLE MINIMUM SPECIFIC ENERGY									
8.10	11.30	6602.50	6601.05	0.00	6606.12	3.62	1.33	-1.33	6610.80
16500.	0.	16500.	0.	0.	1080.	0.	146.	32.	6610.80
0.10	0.00	15.28	0.00	0.000	0.025	0.000	0.000	6591.20	1100.04
0.008299	148.	148.	148.	20	8	0	0.00	143.02	1243.06
CCHV= 0.100 CEHV= 0.300									
*SECNO 9.000									
3301 HV CHANGED MORE THAN HVINS									
9.00	7.03	6607.03	0.00	0.00	6609.56	2.53	3.33	0.11	6602.00
16500.	3678.	12822.	0.	721.	902.	0.	162.	35.	6611.00
0.11	5.10	14.22	0.00	0.000	0.025	0.000	0.000	6600.00	1173.92
0.004942	528.	528.	528.	2	0	0	0.00	290.14	1464.06
*SECNO 10.000									
3685 20 TRIALS ATTEMPTED WSEL,CWSEL									
3693 PROBABLE MINIMUM SPECIFIC ENERGY									
3720 CRITICAL DEPTH ASSUMED									
10.00	7.06	6616.86	6616.86	0.00	6619.60	2.74	3.33	0.06	6610.20
16500.	6299.	10181.	21.	1034.	628.	19.	185.	39.	6616.00
0.13	6.09	16.21	1.12	0.000	0.025	0.060	0.000	6609.80	1136.60
0.006269	600.	600.	600.	20	5	0	0.00	337.42	1474.03
CCHV= 0.100 CEHV= 0.300									
*SECNO 11.000									
3265 DIVIDED FLOW									
3301 HV CHANGED MORE THAN HVINS									
3685 20 TRIALS ATTEMPTED WSEL,CWSEL									
3693 PROBABLE MINIMUM SPECIFIC ENERGY									
3720 CRITICAL DEPTH ASSUMED									
11.00	8.94	6634.94	6634.94	0.00	6638.24	3.30	5.35	0.17	6636.00
16500.	72.	16323.	105.	38.	1113.	38.	219.	* 46.	6632.00
0.15	1.92	14.41	2.79	0.000	0.025	0.045	0.000	6626.00	1039.55

0.004299 1040. 1040. 1040. 20 11 0 0.00 224.21 1347.72

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS	BANK ELEV
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA	LEFT/RIGHT
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN	SSTA
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWID	ENDST

*SECNO 12.000

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL;CWSEL
3695 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

12.00	12.86	6651.16	6651.16	0.00	6656.24	5.08	4.05	0.53	6650.00
16500.	7.	16488.	5.	5.	911.	3.	242.	49.	6650.00
0.16	1.53	18.09	1.52	0.000	0.025	0.045	0.000	6638.30	1178.87
0.004514	920.	920.	920.	20	11	0	0.00	101.48	1280.34

THIS RUN EXECUTED 21-JUN-84 09:42:15

****
HEC2 RELEASE DATED NOV 76 UPDATED MAY 1984
ERROR CORR - 01,02,03,04,05,06
MODIFICATION - 50,51,52,53,54,55
****

NOTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

ONWOOD CREEK, COLORADO S

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
*	1.000	0.00	0.00	0.00	6522.40	9200.00	6526.95	6526.95	6529.08	87.41	11.93	803.39	984.00

*	1.000	0.00	0.00	0.00	6522.40	17900.00	6529.39	6529.39	6532.55	74.69	14.67	1295.37	2071.22
*	2.000	450.00	0.00	0.00	6529.90	9200.00	6535.60	6535.30	6537.77	89.43	12.60	730.07	972.86
*	2.000	450.00	0.00	0.00	6529.90	17900.00	6538.22	6538.22	6541.79	76.35	15.16	1186.58	2048.59
*	3.000	270.00	0.00	0.00	6535.60	9200.00	6539.38	6539.38	6541.26	98.31	11.02	834.80	927.88
*	3.000	270.00	0.00	0.00	6535.30	17900.00	6542.28	6542.28	6543.88	44.23	10.68	2064.69	2691.57
*	4.000	480.00	0.00	0.00	6544.60	9200.00	6549.48	6549.48	6551.65	94.34	11.82	778.57	947.18
*	4.000	480.00	0.00	0.00	6544.60	17900.00	6551.92	6551.92	6555.18	82.92	14.50	1234.79	1965.78
*	5.000	1020.00	0.00	0.00	6559.20	9200.00	6563.51	6563.51	6565.24	61.72	10.54	872.71	1171.07
*	5.000	1020.00	0.00	0.00	6559.20	16500.00	6565.16	6565.16	6567.66	54.98	12.68	1301.50	2225.27
*	6.000	565.00	0.00	0.00	6565.80	9200.00	6570.37	6570.37	6572.02	73.93	13.43	1088.21	1069.97
*	6.000	565.00	0.00	0.00	6565.80	16500.00	6571.94	6571.94	6574.32	75.03	16.26	1572.55	1904.88
*	7.000	920.00	0.00	0.00	6580.00	9200.00	6583.78	6583.78	6585.09	162.63	12.75	1052.30	721.42
*	7.000	920.00	0.00	0.00	6580.00	16500.00	6585.02	6585.02	6586.93	139.23	15.53	1585.95	1398.35
*	7.500	465.00	0.00	0.00	6587.60	9200.00	6591.64	6591.64	6593.31	62.42	10.38	886.34	1164.43
*	7.500	465.00	0.00	0.00	6587.60	16500.00	6593.25	6593.25	6595.65	54.89	12.42	1328.41	2227.08
*	8.000	169.00	0.00	0.00	6588.80	9200.00	6595.56	6595.56	6598.97	90.02	14.82	620.72	969.67
*	8.000	169.00	0.00	0.00	6588.80	16500.00	6598.78	6598.78	6603.81	97.87	17.99	917.28	1667.87
*	8.100	148.00	6610.80	6601.70	6591.20	9200.00	6601.86	0.00	6606.20	34.48	9.31	987.82	1566.88
*	8.100	148.00	6610.80	6601.70	6591.20	16500.00	6602.50	6601.05	6606.12	82.99	15.28	1080.01	1811.26
*	9.000	528.00	0.00	0.00	6600.00	9200.00	6605.04	6605.03	6606.92	56.30	12.09	1050.77	1226.17
	9.000	528.00	0.00	0.00	6600.00	16500.00	6607.03	0.00	6609.56	49.42	14.22	1622.92	2347.10

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA	.01K
*	10.000	600.00	0.00	0.00	6609.80	9200.00	6615.00	6615.00	6616.92	64.10	13.34	1123.14	1149.13
*	10.000	600.00	0.00	0.00	6609.80	16500.00	6616.86	6616.86	6619.60	62.69	16.21	1680.51	2083.90
*	11.000	1040.00	0.00	0.00	6626.00	9200.00	6632.28	6632.28	6634.81	54.83	12.77	720.64	1242.50
*	11.000	1040.00	0.00	0.00	6626.00	16500.00	6634.94	6634.94	6638.24	42.99	14.67	1188.33	2516.57
*	12.000	920.00	0.00	0.00	6638.30	9200.00	6647.44	6647.44	6651.16	50.75	15.48	594.38	1291.37
*	12.000	920.00	0.00	0.00	6638.30	16500.00	6651.16	6651.16	6656.24	45.14	18.09	919.26	2455.90

ONWOOD CREEK, COLORADO S

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	1.000	9200.00	6526.95	0.00	0.00	0.05	192.95	0.00
*	1.000	17900.00	6529.39	2.44	0.00	0.09	210.59	0.00
*	2.000	9200.00	6535.30	0.00	8.35	0.00	107.86	450.00
*	2.000	17900.00	6538.22	2.92	8.83	0.00	214.29	450.00
*	3.000	9200.00	6539.38	0.00	4.07	0.00	223.85	270.00
*	3.000	17900.00	6542.28	2.90	4.06	0.00	728.31	270.00
*	4.000	9200.00	6549.48	0.00	10.10	0.00	181.91	480.00
*	4.000	17900.00	6551.92	2.44	9.64	0.00	191.68	480.00
*	5.000	9200.00	6563.51	0.00	14.04	0.00	255.92	1020.00
*	5.000	16500.00	6565.16	1.65	13.24	0.00	264.79	1020.00
*	6.000	9200.00	6570.37	0.00	6.86	0.00	305.26	565.00
*	6.000	16500.00	6571.94	1.57	6.78	0.00	311.42	565.00
*	7.000	9200.00	6583.78	0.00	13.41	0.00	425.56	920.00
*	7.000	16500.00	6585.02	1.25	13.08	0.00	431.42	920.00
*	7.500	9200.00	6591.64	0.00	7.86	0.00	268.86	465.00
*	7.500	16500.00	6593.25	1.61	8.23	0.00	279.07	465.00
*	8.000	9200.00	6595.56	0.00	3.92	0.00	91.99	169.00
*	8.000	16500.00	6598.78	3.22	5.53	0.00	92.18	169.00
*	8.100	9200.00	6601.86	0.00	6.29	0.00	143.01	148.00
*	8.100	16500.00	6602.50	0.64	3.72	0.00	143.02	148.00
*	9.000	9200.00	6605.03	0.00	3.17	0.00	280.79	528.00
	9.000	16500.00	6607.03	2.00	4.53	0.00	290.14	528.00
*	10.000	9200.00	6615.00	0.00	9.98	0.00	283.92	600.00
*	10.000	16500.00	6616.86	1.86	9.83	0.00	337.42	600.00
*	11.000	9200.00	6632.28	0.00	17.27	0.00	146.72	1040.00
*	11.000	16500.00	6634.94	2.66	18.08	0.00	224.21	1040.00
*	12.000	9200.00	6647.44	0.00	15.17	0.00	80.08	920.00
*	12.000	16500.00	6651.16	3.72	16.22	0.00	101.48	920.00

SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO= 1.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 1.000 PROFILE= 2 CRITICAL DEPTH ASSUMED

CAUTION SECNO= 2.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 2.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 2.000 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 2.000 PROFILE= 2 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 2.000 PROFILE= 2 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 3.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 3.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 3.000 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 3.000 PROFILE= 2 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 4.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 4.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 4.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 4.000 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 4.000 PROFILE= 2 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 4.000 PROFILE= 2 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 5.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 5.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 5.000 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 5.000 PROFILE= 2 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 6.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 6.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 6.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 6.000 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 6.000 PROFILE= 2 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 6.000 PROFILE= 2 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 7.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 7.000 PROFILE= 1 MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 7.000 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 7.000 PROFILE= 2 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 7.500 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 7.500 PROFILE= 1 MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 7.500 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 7.500 PROFILE= 2 MINIMUM SPECIFIC ENERGY

CAUTION SECNO= 8.000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 8.000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 8.000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 8.000 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 8.000 PROFILE= 2 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 8.000 PROFILE= 2 20 TRIALS ATTEMPTED TO BALANCE WSEL

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CAUTION  SECNO=     8.100  PROFILE= 1  HYDRAULIC JUMP D.S.
CAUTION  SECNO=     8.100  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=     8.100  PROFILE= 2  WSEL ASSUMED BASED ON MIN DIFF
CAUTION  SECNO=     8.100  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=     8.100  PROFILE= 2  HYDRAULIC JUMP D.S.

CAUTION  SECNO=     9.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=     9.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=     9.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=    10.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=    10.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=    10.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=    10.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=    10.000  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=    10.000  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=    11.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=    11.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=    11.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=    11.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=    11.000  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=    11.000  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION  SECNO=    12.000  PROFILE= 1  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=    12.000  PROFILE= 1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=    12.000  PROFILE= 1  20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION  SECNO=    12.000  PROFILE= 2  CRITICAL DEPTH ASSUMED
CAUTION  SECNO=    12.000  PROFILE= 2  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION  SECNO=    12.000  PROFILE= 2  20 TRIALS ATTEMPTED TO BALANCE WSEL
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**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED MAY   1984
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THIS RUN EXECUTED 21-JUN-84 09:42:19

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   ERROR CORR -  01;02;03;04;05;06
   MODIFICATION -  50;51;52;53;54;55
*****************************************************


FORTRAN STOP
  SIMONS11     Job terminated at 21-JUN-1984 09:42:21.47

  Accounting information:
  Buffered I/O count:              85      Peak working set size:    200
  Direct I/O count:               119      Peak page file size:      625
  Page faults:                   6194      Mounted volumes:            0
  Elapsed CPU time:      0 00:00:12.96     Elapsed time:      0 00:01:21.49
$ TYPE DIANE.DAT
```

```
T1   SIMONS, LI AND ASSOCIATES
T2   KLK & NORWOOD DEVELOPMENT
T3   COTTONWOOD CREEK, COLORADO SPRINGS
J1   -10.      2.0                                                                  6526.9
JD     1.       0.       -1.       0.       0.       0.       0.       0.
NC   .034     .034     .032       .1       .3
QT        2  9200.0  17900.0
X1     1.0       11.   1530.    1690.     310.     310.     310.
GR  6530.    1000.    6540.    1420.    6530.    1480.    6522.4    1540.    6522.4    1690.
GR  6530.    1700.    6530.    1723.    6541.3    1750.    6530.    2140.    6540.    2400
GR  6560.    2600.
X1     2.0       14   1150.0   1310.0     430      460      450
X3    10.0
GR6550.0    1000.0   6548.0   1032.0   6546.0   1058.0   6544.0   1097.0   6542.0   1112.0
GR6540.0    1126.0   6538.0   1150.0   6530.0   1164.0   6530.0   1170.0   6529.9   1187.0
GR6529.9    1256.0   6530.0   1288.0   6538.0   1310.0   6539.8   1732.0      0.0      0.0
X1     4.0       14   1193.0   1424.0    270.0    270.0    270.0
X3    10.0
GR6560.0    1000.0   6550.0   1092.0   6548.0   1111.0   6546.0   1144.0   6540.0   1160.0
GR6541.0    1193.0   6536.0   1205.0   6535.3   1249.0   6535.5   1314.0   6535.5   1413.0
GR6541.0    1424.0   6541.1   1791.0   6542.0   1850.0   6541.0   2080.0
X1     4.0       12   1172.0   1372.0    480.0    480.0    480.0
X3    10.0
X4     3.0   6550.0    823.0   6550.0   1000.0   6550.0   1714.0
GR6560.0     805.0   6548.0   1080.0   6547.0   1137.0   6544.0   1155.0   6554.0   1172.0
GR6546.0    1189.0   6544.6   1205.0   6544.6   1280.0   6546.0   1356.0   6554.0   1372.0
GR6552.0    1520.0   6555.0   2050.0      0.0      0.0      0.0      0.0      0.0      0.0
QT        2  9200.0  16500.0
NC   .045     .045     .025       .1       .3
X1     5.0       22   1470.0   1771.0   1020.0   1020.0   1020.0
X3    10.0
GR6568.0    1000.0   6567.0   1065.0   6560.0   1079.0   6560.0   1135.0   6559.0   1287.0
GR6560.0    1362.0   6560.2   1435.0   6560.0   1438.0   6570.0   1458.0   6570.0   1470.0
GR6560.0    1490.0   6560.4   1529.0   6560.0   1575.0   6559.9   1606.0   6560.0   1639.0
GR6560.2    1658.0   6560.0   1675.0   6559.2   1717.0   6560.0   1727.0   6573.0   1771.0
GR6573.5    1930.0   6573.0   2025.0      0.0      0.0      0.0      0.0      0.0      0.0
X1     6.0       11   1040.0   1130.0    565.0    565.0    565.0
GR6584.0    1000.0   6584.0   1022.0   6580.0   1040.0   6565.8   1063.0   6565.8   1124.0
GR6566.0    1130.0   6568.0   1355.0   6570.0   1360.0   6580.0   1383.0   6584.0   1396.0
GR6588.0    1420.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
X1     7.0       15   1169.0   1267.0    920.0    920.0    920.0
GR6591.6    1000.0   6590.0   1032.0   6588.0   1038.0   6586.2   1048.0   6585.8   1169.0
GR6588.0    1177.0   6581.0   1237.0   6580.3   1409.0   6582.0   1422.0   6582.5   1460.0
GR6582.0    1511.0   6581.5   1561.0   6580.0   1589.0   6590.0   1615.0   6592.0   1720.0
X1     7.5       12   1062.0   1365.0    465.0    465.0    465.0
GR6603.5    1000.0   6602.0   1023.0   6600.0   1032.0   6598.0   1046.0   6596.0   1052.0
GR6594.0    1062.0   6587.6   1082.0   6587.6   1190.0   6588.0   1224.0   6590.0   1333.0
GR6600.0    1365.0   6602.0   1465.0      0.0      0.0      0.0      0.0      0.0      0.0
X1     8.0       18   1100.0   1243.1    169.0    169.0    169.0
GR6611.8    1000.0   6610.8   1100.0   6588.8   1100.1   6588.8   1123.0   6601.1   1123.1
GR6601.1    1140.0   6588.8   1140.1   6588.8   1163.0   6601.1   1163.1   6601.1   1180.0
GR6588.8    1180.1   6588.8   1203.0   6601.1   1203.1   6601.1   1220.0   6588.8   1220.1
GR6588.8    1243.0   6610.8   1243.1   6611.8   1343.1
SB   1.05     1.25     2.63      0.0    142.9     51.0    962.0      0.0   6591.2   6588.8
X1     9.1       18   1100.0   1243.1    148.0    148.0    148.0      0.0      0.0      0.0
X2     0.0      0.0      1.0   6601.7   6610.8
GR6611.8    1000.0   6610.8   1100.0   6591.2   1100.1   6591.2   1123.0   6601.7   1123.1
GR6601.7    1140.0   6591.2   1140.1   6591.2   1163.0   6601.7   1163.1   6601.7   1180.0
GR6591.2    1180.1   6591.2   1203.0   6601.7   1203.1   6601.7   1220.0   6591.2   1220.1
```

```
GR6591.2   1243.0   6610.8   1243.1   6611.8   1343.1
ET    4.0  1100.0   6610.8   6610.8   1100.0   6610.8   6601.7   1243.1   6610.8   6601.7
ET1243.1   6610.8   6610.8
NC   .060    .060     .025       .1       .3
X1    9.0      16   1322.0   1472.0    528.0    528.0    528.0
GR6630.0   1000.0   6620.0   1124.0   6616.0   1145.0   6610.0   1166.0   6604.0   1182.0
GR6602.0   1195.0   6601.2   1212.0   6602.0   1240.0   6602.0   1322.0   6600.0   1345.0
GR6600.0   1390.0   6600.2   1413.0   6601.0   1452.0   6611.0   1472.0   6612.0   1511.0
GR6614.0   1572.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
X1   10.0      11   1334.0   1431.0    600.0    600.0    600.0
GR6640.0   1000.0   6632.0   1074.0   6630.0   1082.0   6620.0   1123.0   6614.0   1149.0
GR6612.0   1175.0   6610.2   1334.0   6610.0   1345.0   6609.8   1416.0   6616.0   1431.0
GR6618.0   1531.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
NC   .045    .045     .025       .1       .3
X1   11.0      16   1169.0   1322.0   1040.0   1040.0   1040.0
GR6640.0   1000.0   6638.0   1012.0   6636.0   1030.0   6634.0   1048.0   6634.0   1080.0
GR6636.0   1096.0   6636.0   1130.0   6636.0   1150.0   6636.0   1169.0   6630.0   1193.0
GR6628.0   1195.0   6626.0   1245.0   6626.0   1298.0   6632.0   1322.0   6640.0   1392.0
GR6650.0   1434.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
X1   12.0      11   1187.0   1275.0    920.0    920.0    920.0
GR6658.0   1000.0   6656.0   1026.0   6654.0   1088.0   6652.0   1173.0   6650.0   1187.0
GR6640.0   1206.0   6638.3   1213.0   6638.4   1258.0   6640.0   1263.0   6650.0   1275.0
GR6660.0   1321.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0      0.0
EJ
T1
T2
T3        Q=17900
J1   -10.     3.0      0.0      0.0      0.0      0.0      0.0      0.0   6529.3
J2    15.     0.0      -1.


ER
$ LOG
J SIMONS11     logged out at 21-JUN-1984 09:49:19.79
```

RIP RAP SIZING

USING $\frac{V\ S^{0.17}}{d_{50}^{.5}\ (S_s-1)^{.66}} = 4.5$

FROM URBAN STORM DRAINAGE CRITERIA MANUAL

WHERE V = MAIN CHANNEL VELOCITY IN F.P.S.
S = LONGITUDINAL CHANNEL SLOPE
S_s = SPECIFIC GRAVITY OF ROCK (S_s MIN = 2.6)
d_{50} = ROCK SIZE IN FEET FOR WHICH 50 % OF THE RIPRAP BY WEIGHT IS SMALLER.

SECTION (2)

V = 12.6 F.P.S.
S = 0.0190
S_s = 2.60

d_{50} = 1.10' OR 13.1"
RQRD d_{50} = 18"

SECTION (3)

V = 11.0 FPS
S = 0.0202
S_s = 2.60

d_{50} = 0.85 OR 10.2"
RQRD d_{50} = 12"

SECTION (4)

V = 11.8 FPS
S = .0165
S_s = 2.60

d_{50} = 0.92' OR 11.0"
RQRD d_{50} = 12"

SECTION (5)

V = 10.5
S = .0132
S_s = 2.60

d_{50} = 0.67' OR 8.1"
RQRD d_{50} = 9"

USE d_{50} = 12"

RIP RAP SIZING

SECTION (6)
V = 13.4 FPS
S = .0131
S_S = 2.60
d_{50} = 1.09 OR 13.1"
RQRD d_{50} = 18"

SECTION (7)
V = 12.8 FPS
S = .0138
S_S = 2.60
d_{50} = 1.01' OR 12.2"
RQRD d_{50} = 12"

SECTION (7.5)
V = 10.4
S = .0102
S_S = 2.60
d_{50} = 0.60 OR 7.2"
RQRD d_{50} = 9"

SECTION (8) TO SECTION (8.1) — RANGEWOOD DRIVE BRIDGE

SECTION (9)
V = 12.11 FPS
S = .0166
S_S = 2.60
d_{50} = 0.97 OR 11.6"
RQRD d_{50} = 12"

SECTION (10)
V = 13.3 FPS
S = .0159
S_S = 2.60
d_{50} = 1.15 OR 13.8"
RQRD d_{50} = 18"

SECTION (11)
V = 12.8 FPS
S = .0142
S_S = 2.60
d_{50} = 1.02 OR 12.3"
RQRD d_{50} = 18"

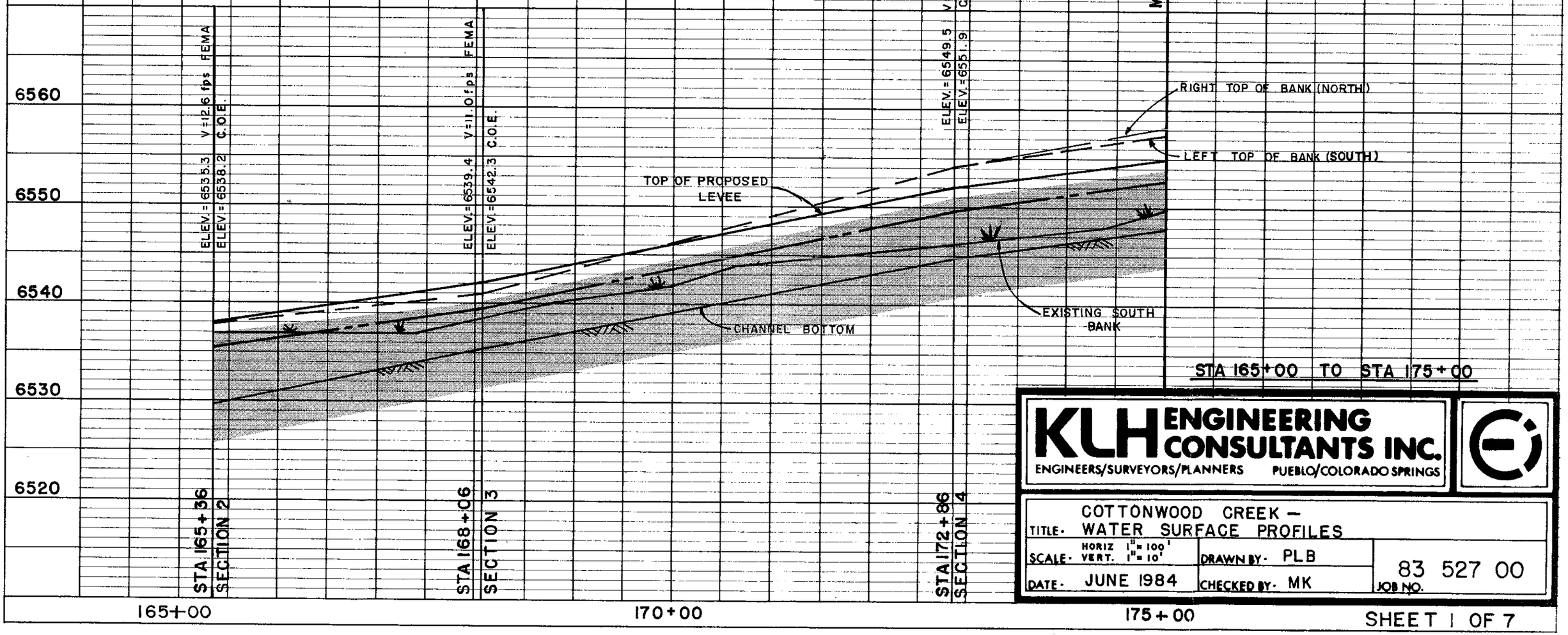
SECTION (12)
V = 15.5 FPS
S = .0138
S_S = 2.60
d_{50} = 1.49 OR 17.8"
RQRD d_{50} = 18"

APPENDIX B

Flood Profiles

FLOW DATA

- FEMA DISCHARGE PROFILE (Q_{100} = 9200 cfs)
- C.O.E. DISCHARGE PROFILE (Q_{100} = 17900 cfs)
- DENOTES RIP RAP PROTECTION (SEE PLAN SHEETS FOR SIZING)



STA 165+00 TO STA 175+00

KLH ENGINEERING CONSULTANTS INC.
ENGINEERS/SURVEYORS/PLANNERS PUEBLO/COLORADO SPRINGS

TITLE: COTTONWOOD CREEK — WATER SURFACE PROFILES		
SCALE: HORIZ 1"= 100' VERT. 1"= 10'	DRAWN BY: PLB	83 527 00 JOB NO.
DATE: JUNE 1984	CHECKED BY: MK	

MATCH LINE 175+00

MATCH LINE 185+00

ELEV.= 6563.5 V = 10.5 fps FEMA

ELEV.= 6565.2 C.O.E.

6590

6580

6570

6560

6550

6045

LEFT TOP OF BANK (SOUTH)

RIGHT TOP OF BANK (NORTH)

TOP OF PROPOSED LEVEE

CHANNEL BOTTOM

EXISTING SOUTH BANK

C.O.E Q_{100} = 17900 cfs

C.O.E Q_{100} = 16500 cfs

STA 183+06 SECTION 5

175+00

180+00

185+00

FLOW DATA

FEMA DISCHARGE PROFILE (Q_{100} = 9200 cfs)

C.O.E. DISCHARGE PROFILE (Q_{100} = 16500 cfs)

DENOTES RIP RAP PROTECTION (SEE PLAN SHEETS FOR SIZING)

STA 175+00 TO STA. 185+00

KLH ENGINEERING CONSULTANTS INC.

ENGINEERS/SURVEYORS/PLANNERS PUEBLO/COLORADO SPRINGS

TITLE: COTTONWOOD CREEK — WATER SURFACE PROFILES

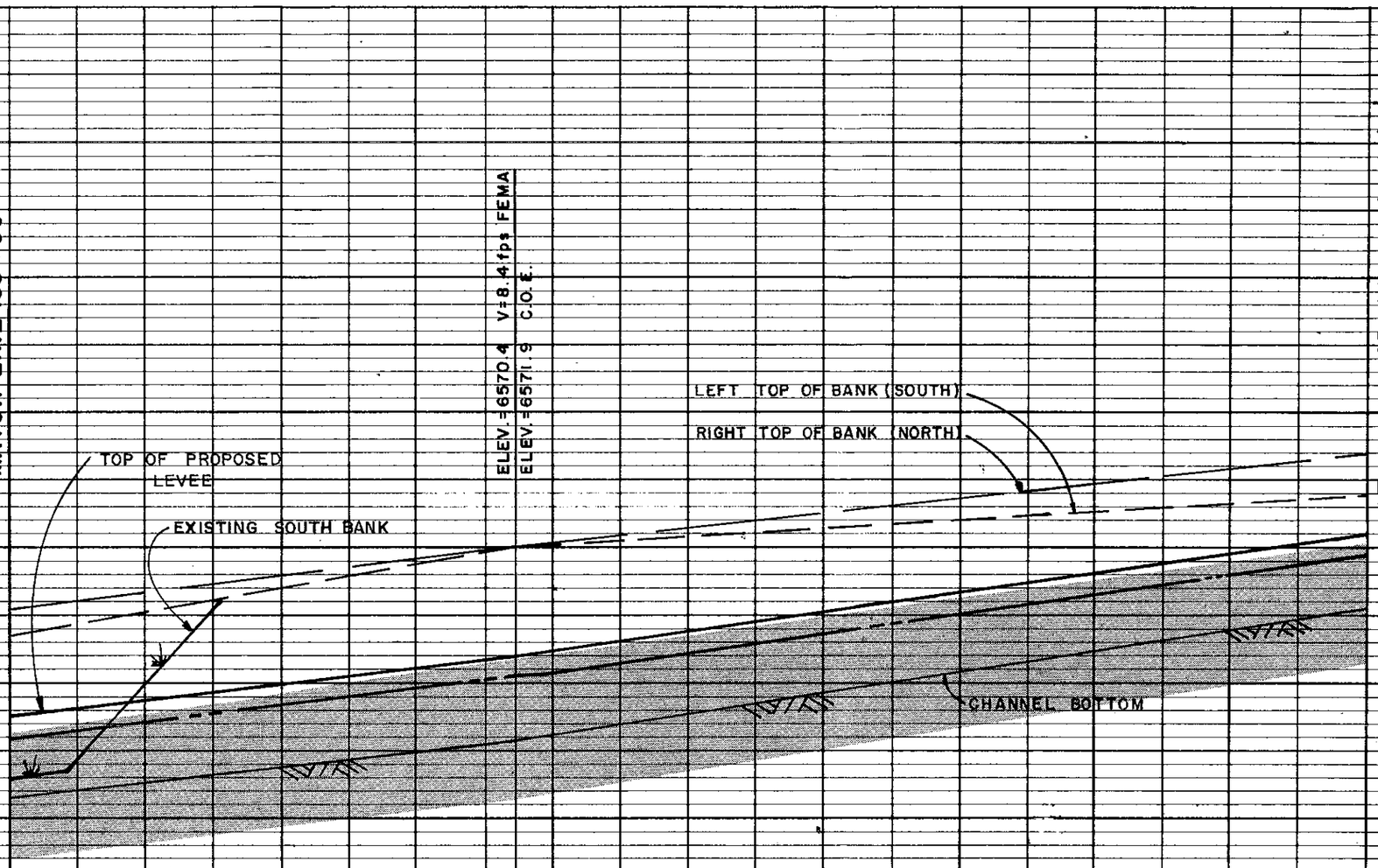
SCALE: HORIZ 1"= 100' VERT. 1"= 10'

DRAWN BY: PLB

DATE: JUNE 1984

CHECKED BY: MK

JOB NO. 83 527 00



FLOW DATA

- - - - FEMA DISCHARGE PROFILE (Q_{100} = 9200 cfs)

——— C.O.E DISCHARGE PROFILE (Q_{100} = 16500 cfs)

DENOTES RIP RAP PROTECTION (SEE PLAN SHEETS FOR SIZING)

STA 185+00 TO 195+00

KLH ENGINEERING CONSULTANTS INC.
ENGINEERS/SURVEYORS/PLANNERS PUEBLO/COLORADO SPRINGS

TITLE: COTTONWOOD CREEK — WATER SURFACE PROFILES

SCALE: HORIZ 1"=100' VERT. 1"=10'

DRAWN BY: PLB

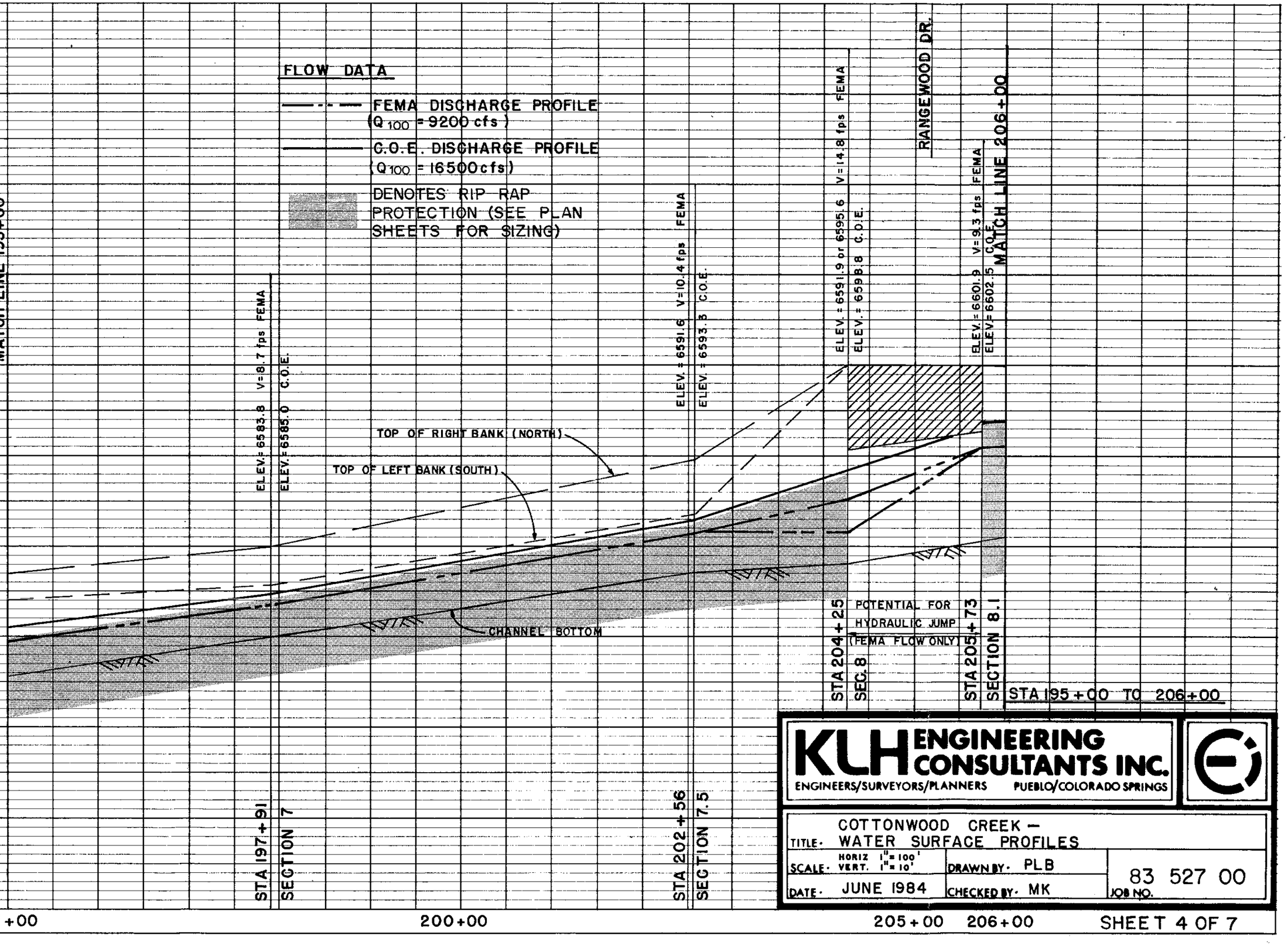
DATE: JUNE 1984

CHECKED BY: MK

JOB NO. 83 527 00

FLOW DATA

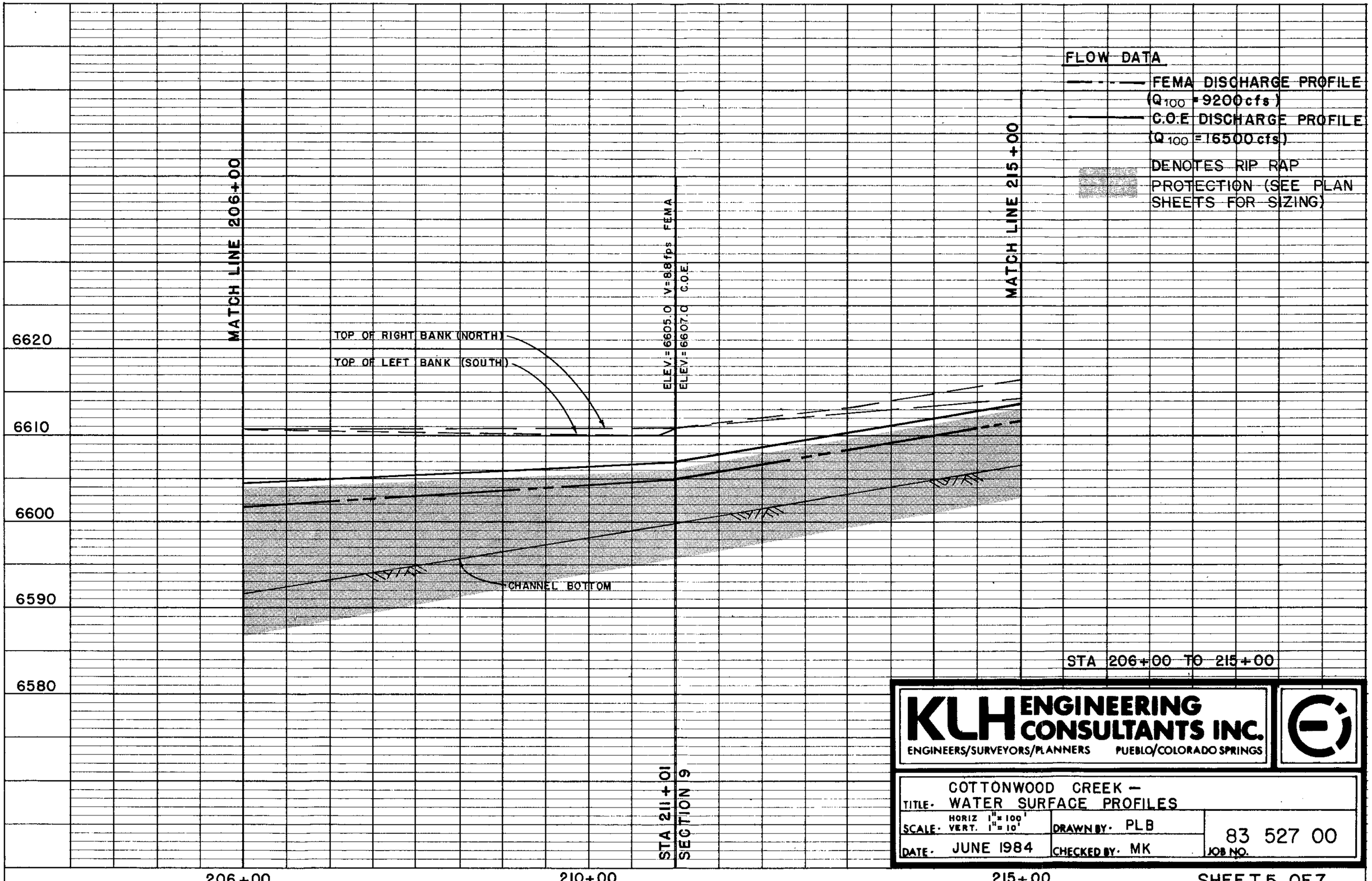
- FEMA DISCHARGE PROFILE (Q_{100} = 9200 cfs)
- C.O.E. DISCHARGE PROFILE (Q_{100} = 16500 cfs)
- DENOTES RIP RAP PROTECTION (SEE PLAN SHEETS FOR SIZING)



STA 195+00 TO 206+00

KLH ENGINEERING CONSULTANTS INC.
ENGINEERS/SURVEYORS/PLANNERS PUEBLO/COLORADO SPRINGS

TITLE: COTTONWOOD CREEK — WATER SURFACE PROFILES			
SCALE: HORIZ 1"=100' VERT. 1"=10'		DRAWN BY: PLB	83 527 00
DATE: JUNE 1984		CHECKED BY: MK	JOB NO.



STA 206+00 TO 215+00

KLH ENGINEERING CONSULTANTS INC.
ENGINEERS/SURVEYORS/PLANNERS PUEBLO/COLORADO SPRINGS

TITLE: COTTONWOOD CREEK — WATER SURFACE PROFILES

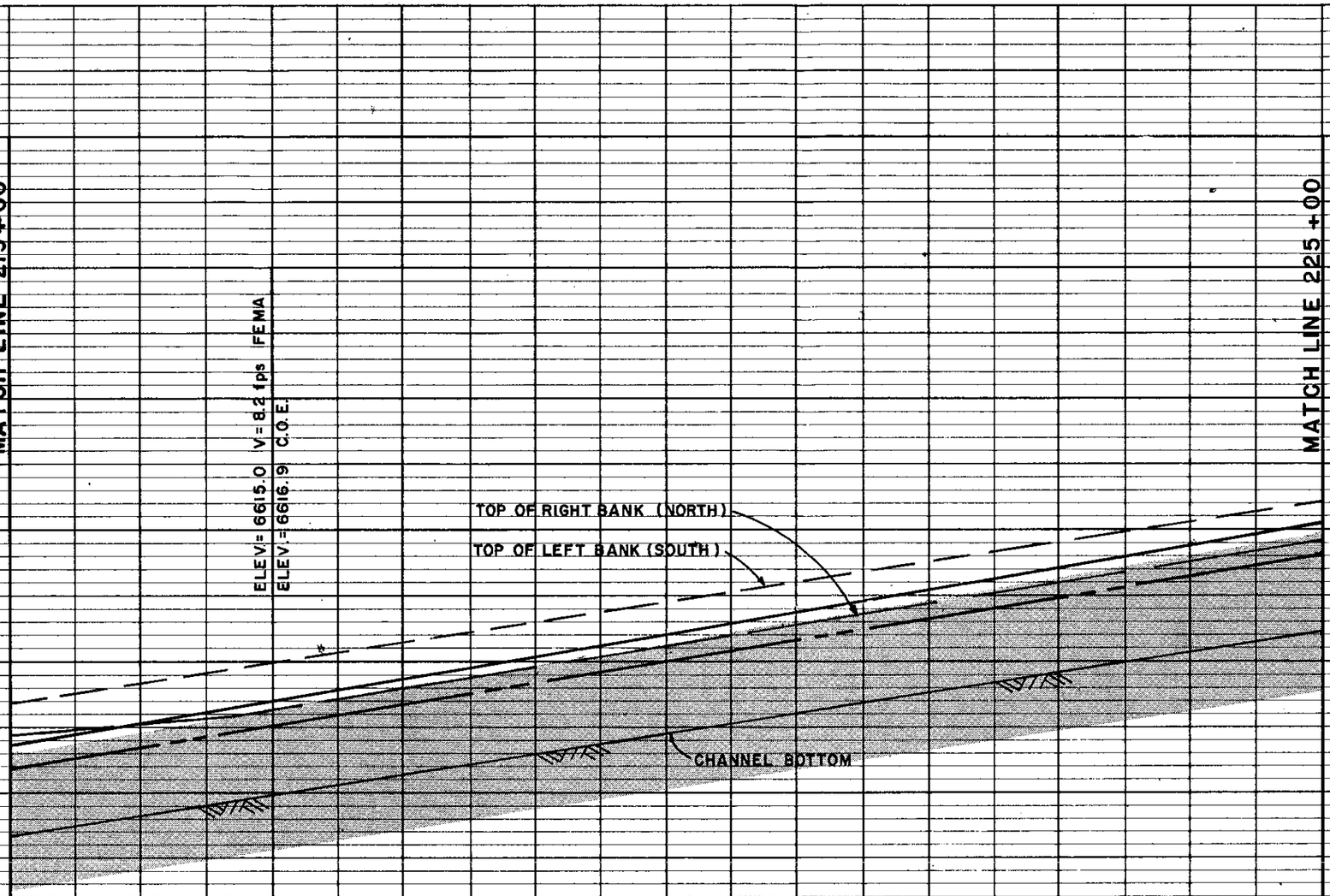
SCALE: HORIZ 1"=100' VERT. 1"=10'

DRAWN BY: PLB

DATE: JUNE 1984

CHECKED BY: MK

JOB NO. 83 527 00



FLOW DATA

- - - - FEMA DISCHARGE PROFILE (Q_{100} = 9200 cfs)

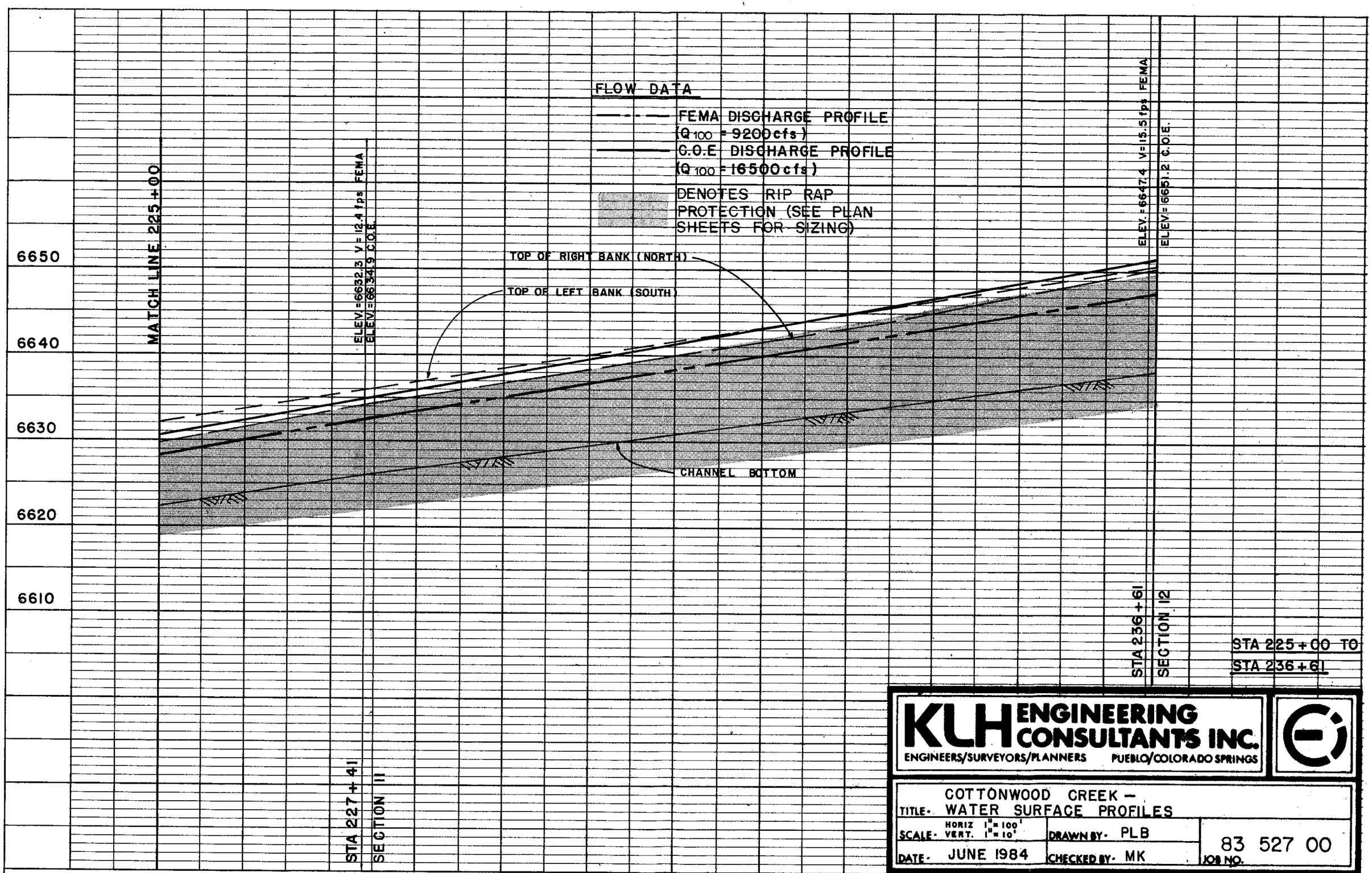
——— C.O.E. DISCHARGE PROFILE (Q_{100} = 16500 cfs)

DENOTES RIP RAP PROTECTION (SEE PLAN SHEETS FOR SIZING)

STA 215+00 TO 225+00

KLH ENGINEERING CONSULTANTS INC.
ENGINEERS/SURVEYORS/PLANNERS PUEBLO/COLORADO SPRINGS

TITLE: COTTONWOOD CREEK — WATER SURFACE PROFILES			
SCALE: HORIZ 1"=100' VERT. 1"=10'	DRAWN BY: PLB	JOB NO. 83 527 00	
DATE: JUNE 1984	CHECKED BY: MK		



STA 225+00 TO
STA 236+61

KLH ENGINEERING CONSULTANTS INC.
ENGINEERS/SURVEYORS/PLANNERS PUEBLO/COLORADO SPRINGS

TITLE: COTTONWOOD CREEK — WATER SURFACE PROFILES
SCALE: HORIZ 1"=100' VERT. 1"=10'
DRAWN BY: PLB
DATE: JUNE 1984
CHECKED BY: MK
JOB NO. 83 527 00

SHEET 7 OF 7