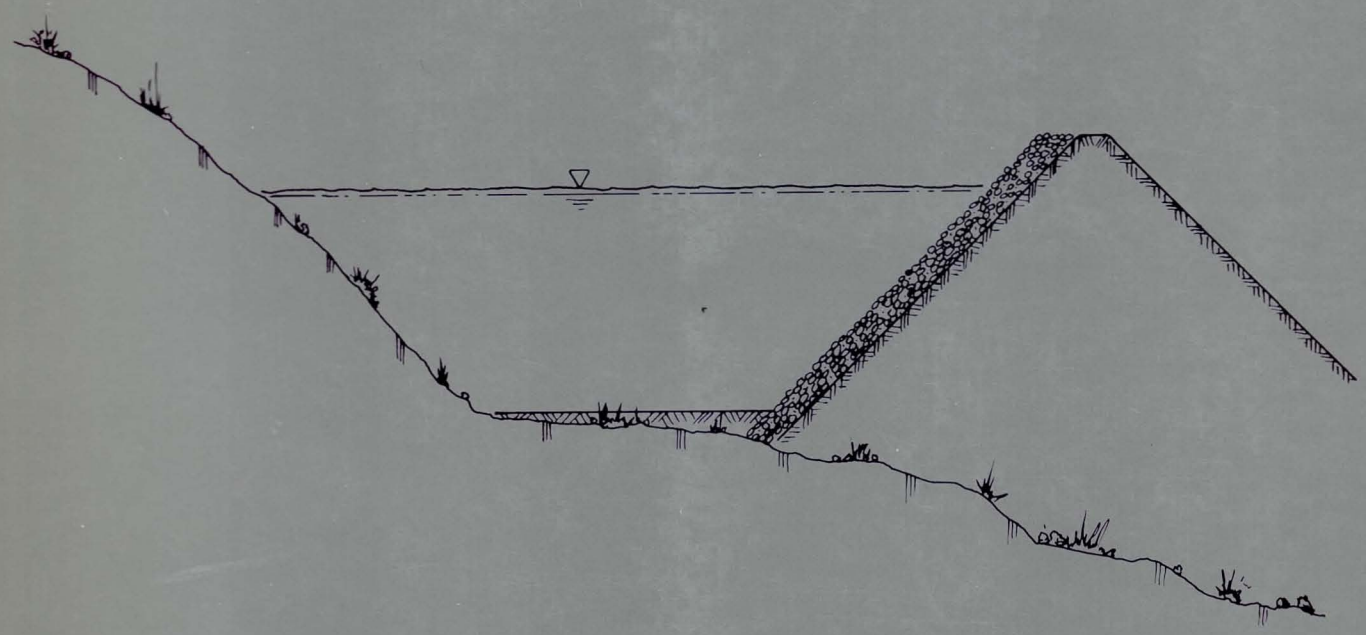
KNOCHEL BROTHERS LANDFILL SITE

CAVE CREEK WASH
Channel Modifications and Dike Design

Part 1

(See plans for part 2)



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August 1989

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FOR SUBMITTAL TO:

THE FLOOD CONTROL DISTRICT
OF
MARICOPA COUNTY

AUGUST, 1989

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EXECUTIVE SUMMARY

The purpose of this report is to present the details of a dike and channel modification design, which is capable of effectively diverting and conveying the 100-year storm event discharge for Cave Creek around a landfill site. The hydraulic conditions and moveable bed analysis associated with the design proposal are also included.

A main requirement of the design is that the hydraulic conditions upstream and downstream of the landfill site must not deviate significantly from those of existing conditions. Existing conditions are those established and accepted hydraulic conditions to which any channel modifications are compared when determining the effects of the modifications on the flow conditions. Existing conditions for this site were established in 1979-80.

A previously-proposed dike and channel configuration was approved in 1988 by the Flood Control District of Maricopa County. Having been approved, the hydraulic conditions associated with this dike and channel configuration are also used for comparative purposes with the hydraulic conditions of the newly-proposed dike and channel configuration.

The newly-proposed dike and channel configuration efficiently guides the 100-year storm runoff around the landfill site and provides dike embankment protection. The hydraulic conditions and floodplain limits compare favorably with those of the previously-proposed conditions and the existing conditions.

The hydraulic conditions of the 100-year flood associated with the newly-proposed channel are within allowable limits as defined by accepted practice and utilized by the Flood Control District of Maricopa County.

The dike embankment protection includes sufficient toedown depth and freeboard height to provide protection should the bed adjustments, as determined in the moveable bed analysis, occur. The freeboard height meets the dike design requirement of the Federal Emergency Management Agency.

I. INTRODUCTION

Development Engineering, Inc., has been retained by Knochel Brothers, Inc. to develop a channel modification and dike design capable of effectively diverting and conveying the 100- year storm event discharge for Cave Creek around a landfill site.

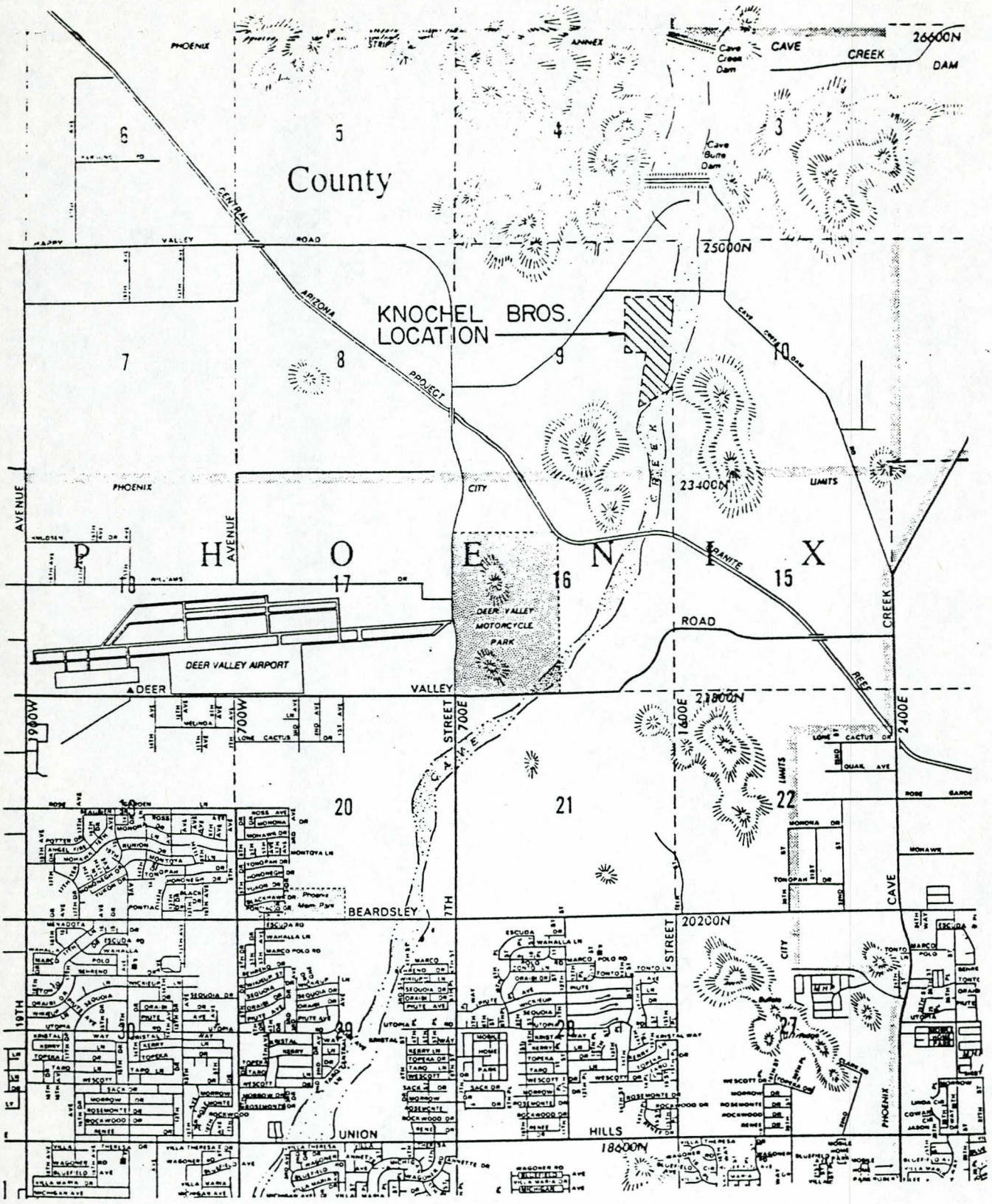
The landfill site is adjacent to a one-half mile reach of Cave Creek Wash with the upstream portion of the boundary located approximately one-half mile downstream of Cave Buttes Dam (see Figure 1). Deer Valley Creek joins Cave Creek from the east at approximately the midpoint of the landfill site (See Figure 2).

Because the landfill site is being removed from the 100-year floodplain, the dike design must meet the requirements of the Federal Emergency Management Agency (FEMA).

The land occupied by the landfill operation is owned by the Arizona State Land Department and is leased to Knochel Brothers, Inc.

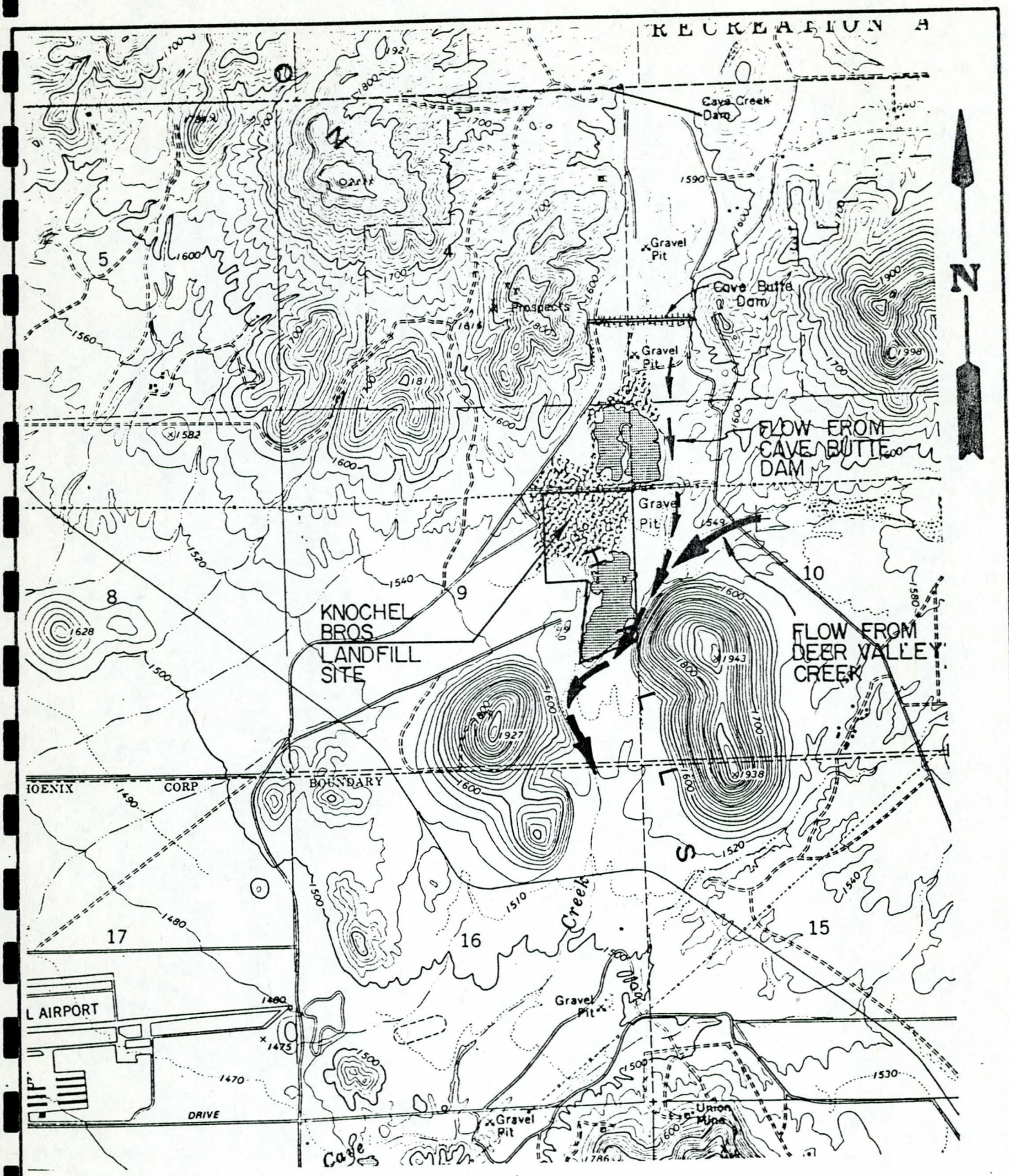
A channel improvement and dike design completed by another consultant has been previously approved by the Flood Control District of Maricopa County.

Presented herein is the new channel/dike alternative which is more hydraulically efficient and meets the design criteria as



KNOCHEL BROTHERS INC., LANDFILL LOCATION MAP

FIGURE 1



KNOCHEL BROTHERS INC., LANDFILL LOCATION MAP

FIGURE **2**

established by the Flood Control District of Maricopa County. A main requirement of the design is that the hydraulic conditions upstream and downstream of the landfill site must not deviate significantly from existing conditions. Per the request of the Flood Control District of Maricopa County, any alterations to the floodplain limits caused by the dike and channel modifications, are delineated herein.

A moveable-bed analysis was conducted to determine the total effects of the design event flood and the long-term bed adjustment. The dike embankment protection includes sufficient toedown depth and freeboard height to provide protection should the projected bed adjustments occur. The freeboard height meets the dike design requirements of FEMA.

II. HYDROLOGY

The 100-year discharge value for Cave Creek, below the confluence with Deer Valley Creek, as determined by the Corps of Engineers, is 5400 cfs.[1] A misprint in the Corps of Engineers' report indicates the discharge above the confluence is 5,000 cfs. This is actually the approximate discharge of Deer Valley Creek into Cave Creek. Development Engineering, Inc., by agreement with the Flood Control District of Maricopa County, utilized a flow value of 420 cfs, as the outflow discharge from Cave Buttes Dam (100-year flow value above the confluence).

III. EXISTING CONDITIONS

Existing conditions are those established and accepted hydraulic conditions to which any channel modifications are compared when determining the effects of the modifications on the flow conditions. The hydraulics of the stream, upstream and downstream of the modifications, cannot be significantly different from those of existing conditions. The existing conditions as defined by the Flood Control District of Maricopa

[1] "Hydrology Part 2, Gila River Basin, Phoenix, Arizona and Vicinity (including New River)", Design Memorandum Number 2, U. S. Army Corps of Engineers, Table 1, page 31 and plate 44.

County were those topographic conditions present in 1979-1980. However, it is important to note that the previous dike proposal, which has been approved, also represents viable conditions for comparison purposes. (See section entitled "Previously-Proposed Conditions for details).

A hydraulic analysis of existing conditions on Cave Creek Wash, using the Corps of Engineers' HEC-2 Water Surface Profile Program, was completed in 1980 by Cella, Barr, Evans and Associates for use by the City of Phoenix. At that time, Cave Buttes Dam was not in existence. The 100-year discharges which were utilized are 4000 cfs below the Deer Valley Creek confluence and 500 cfs above the confluence. Plate 1 shows the floodplain and floodway limits for these discharges and the HEC-2 cross-section locations.

Development Engineering, Inc., verified the reliability of their computer model by duplicating Cella, Barr, Evans' HEC-2 results for the floodplain and floodway, using the old 100-year discharge values. Appendix "A" presents the model verification data.

It was necessary for Development Engineering, Inc., to establish new floodplain and floodway limits for the existing conditions since the 100-year discharge values are now 5400 cfs below the Deer Valley confluence and 420 cfs above the conflu-

ence. Appendix "B" presents the results of the HEC-2 analysis using these discharges. Plate 2 shows the comparison of floodway and floodplain limits before and after the construction of Cave Buttes Dam. It is important to note that the floodway limits for the 5400 cfs model are within the floodway limits for the 4000 cfs model. The reason for this is that in the 5400 cfs model, the floodway encroachments are located such that the water surface elevation is nearly one foot above the floodplain water surface elevation, while in the 4000 cfs model, this is not the case.

The results of the 5400 cfs model of existing conditions are used for comparisons with the HEC-2 output for the modified channel. The Flood Control District of Maricopa County requested that cross-sections 10.74 and 11.39 be used as the locations where the hydraulics for the dike and channel modifications, relative to the existing conditions, were to be similar downstream and upstream, respectively.

The topographic mapping used in the HEC-2 analysis of existing conditions was developed using the National Geodetic Vertical Datum of 1929.

The 1979-80 existing conditions were established before the landfill operation began and included several large gravel pits. The flow was predominantly north to south with relatively wide topwidths, shallow depths, and low velocities. The land contours

rise sharply at the upstream end of the landfill site. The HEC-2 analysis shows that the water surface elevation rises more than 20 feet in 1200 feet of this upstream portion of the reach. Approximately 500 feet downstream of the landfill site, the flow is naturally constricted and sharply redirected by the presence of a volcanic butte. Here, the channel is very narrow, the flow is relatively deep, and velocity is relatively high under flood conditions.

IV. PREVIOUSLY-PROPOSED CONDITIONS

In 1988, a dike design alternative was proposed for the Knochel Brothers, Inc. landfill site. That previously-proposed dike alignment produced hydraulic conditions and floodplain limits that were comparatively similar to the hydraulic conditions and floodplain limits of existing conditions. The plans were, therefore, approved by the Flood Control District of Maricopa County. Having been approved, the hydraulic results for the previously-proposed conditions, along with the hydraulic results for the existing conditions, were used for comparisons with the hydraulic results for the newly-proposed dike.

A HEC-2 model of the previously-proposed conditions was developed using the approved dike plans. The previously-proposed dike plans are shown on topographic maps developed by Kenney Aerial Mapping Company. Based on the information available, this mapping is on the same vertical datum as the mapping used for the

HEC-2 analysis of existing conditions. The Kenney Aerial maps include cross-sections 10.82 to 11.12. Because the cross-section locations upstream of that point are not shown on the maps, cross-sections 14 to 28 were developed and encoded into the HEC-2 model. The model utilized the 5400 cfs discharge below the Deer Valley Creek confluence and the 420 cfs discharge above the confluence. This model was developed because the information available for the previously-proposed dike was not completely satisfactory and it also provided a means for comparing the hydraulic results of the previously-proposed dike and the newly-proposed dike. The HEC-2 input and output for the previously-proposed conditions can be found in Appendix "C".

The previously-proposed dike was aligned to direct the flow from north to south along the east edge of the landfill site, then to the southwest around the downstream portions of the property where the flow joined the existing channel. Plate 3 shows the previously-proposed dike alignment and HEC-2 cross-section locations, and the floodplain associated with this alternative. For comparative purposes, it also shows the floodplain limits for existing conditions.

The previously-proposed dike features an 8:1 side slope with a 2-foot thick bank protection of dumped riprap with a mean diameter of eight inches. A channel bottom approximately 120 feet wide with a constant invert elevation of 1526 was specified. A

relatively large amount of fill material was required because much of the topography along the channel alignment falls below that elevation.

V. NEWLY-PROPOSED CONDITIONS

The newly-proposed channel and dike configuration efficiently routes the 100-year storm runoff (5400 cfs) around the Knochel Brothers, Inc. landfill site and provides for adequate dike embankment protection. The floodplain limits compare favorably with those of the previously-proposed conditions and the existing conditions.

Like the previously-proposed dike, the newly-proposed dike will direct the flow from north to south along the east edge of the landfill site, then the channel curves to the southwest downstream of the property and joins the existing channel. The newly-proposed channel and dike configuration features a channel bottom width of 85 feet, except where boundary restrictions along the east edge of the site require a wider channel. At the downstream portion of the landfill location, the channel will widen as the dike follows the boundary of the property leased to Knochel Brothers, Inc. The channel excavation extends from cross-section 3 to cross-section 7. The dike side slope will be 2.2:1 from cross-section 1 to cross-section 4. The side slope transitions between cross-sections 4 and 5. From cross-section 5

to the upstream end of the dike, the side slope will be 2:1. The land side-slope will be 2:1. The topwidth will be a minimum of 6 feet not including riprap thickness. The embankment opposite the dike will remain unaltered. The newly-proposed dike and channel configuration are shown on Plate 4.

The newly-proposed dike and channel modifications were analyzed using HEC-2. Cross-section 10.68 for existing conditions is used as the downstream starting point with a known water surface elevation determined in the prior analysis of existing conditions. Cross-section 10.74 for existing conditions was also included since it is the location where the hydraulics downstream of the newly-proposed channel must be very close to the hydraulics of existing conditions. Upstream of that point, the new dike and channel were included beginning at cross-section 1. The channel extends upstream to cross-section 11, a distance of 1,640 feet. Cross-sections 12 to 28 include the topography upstream of the channel and to the east of the landfill site. Cross-section 28 is the upstream point where the hydraulic results are compared to those of existing conditions and the previously-proposed conditions. The HEC-2 cross-section locations for the newly-proposed conditions are shown on Plate 4.

The HEC-2 model includes a Mannings' roughness value (n) of 0.040 for the channel where modifications are proposed. This is the same n-value that was used for the channel in the analysis of

the previously-proposed conditions. The bed and bank material will consist mainly of sand and gravel interspersed with some cobbles and a few boulders. In the other areas, where the topography remains untouched, the n-value is set at 0.045 for the main channel. This is the same n-value that was used for the main channel in the analysis of existing conditions. Here, bed material is similar to that of the modified channel, but also includes a small amount of vegetation. All overbank areas have moderate vegetative cover and an n-value of 0.050. This n-value for the overbanks was also used in the analyses of existing conditions and previously-proposed conditions.

Contraction and expansion coefficients were set at 0.1 and 0.3, respectively. These are the same values that were used in the analyses of existing conditions and previously-proposed conditions.

The discharge value of 5400 cfs is utilized upstream through cross-section 19. At cross-section 20, the discharge drops to 420 cfs and depths are lower. However, the dike will need to extend up to cross-section 22. The natural topography is sufficiently high to contain the flow upstream of that point.

The HEC-2 input and output for the newly-proposed conditions can be found in Appendix "D".

Plate 5 shows the floodplain limits for the newly-proposed conditions relative to the floodplain limits for the existing conditions and the previously-proposed conditions.

The dike will be protected with a three-foot thick layer of dumped riprap having a mean diameter of 1.25 feet and a maximum diameter of 3.0 feet. This provides a calculated safety factor of 1.5 using the stability analysis method.[1] The Corps of Engineers' method for determining the required riprap protection was also used.[2] The results of that method verified that the proposed riprap will provide adequate protection for the dike embankment. Calculations can be found in Appendix "E".

To take into account the possibility of scour and other unaccountable factors, the riprap protection will need to extend above the computed water surface and below the channel bed. The dike's freeboard height will be 3.0 feet above the 100-year water surface elevation, except at cross-sections 9 to 16 where

[1] "Sediment Transport Technology", Simons and Senturk, 1977, p.418-426.

[2] "Hydraulic Design of Flood Control Channels", Engineering Manual 1110-2-1601, U. S. Army Corps of Engineers, 1 July 1970, p.39-42.

4.0 feet of freeboard will be required due to the flow constriction and impingement on the flow direction.[1] The freeboard height will prevent the dike from being over-topped and meets the requirements of the Federal Emergency Management Agency. The freeboard height takes into account the height of dunes, general aggradation, and the superelevation occurring where the dike impinges on the flow direction. Riprap bank protection will extend to the top of the dike. The required toedown depth will vary from three feet to 7 feet, which takes into account antidune depths, bend scour, contraction scour, general scour, and long-term degradation; providing a minimum safety factor of 1.3. The toedown depth must be at least 3 feet to match the maximum riprap diameter.

Bank protection is warranted only up to cross-section 17, upstream of the channel flow contraction, where the hydraulic impacts are less significant. Table 1 lists the recommended toedown depth and freeboard height of the bank protection at each cross-section. Figure 3 shows the details of the riprap bank protection.

In the sediment transport analysis, the reaches were selected so as to include cross-sections with similar hydraulic

[1] "National Flood Insurance Program and Related Regulations," Federal Emergency Management Agency, Section 65-10, October 1, 1986.

TABLE 1

RIP-RAP BANK PROTECTION
Recommended Dimensions
Toedown Depth and Freeboard Height

CROSS-SECTION	TOE-DOWN DEPTH, FT.	FREEBOARD HEIGHT, FT.
1	4.0	3.0
2	4.0	3.0
3	4.0	3.0
4	4.0	3.0
5	4.0	3.0
6	4.0	3.0
7	4.7	3.0
8	5.6	3.0
9	5.9	4.0
10	7.0	4.0
11	7.0	4.0
12	7.0	4.0
13	5.5	4.0
14	4.0	4.0
15	4.0	4.0
16	4.0	4.0
17	3.0	3.0

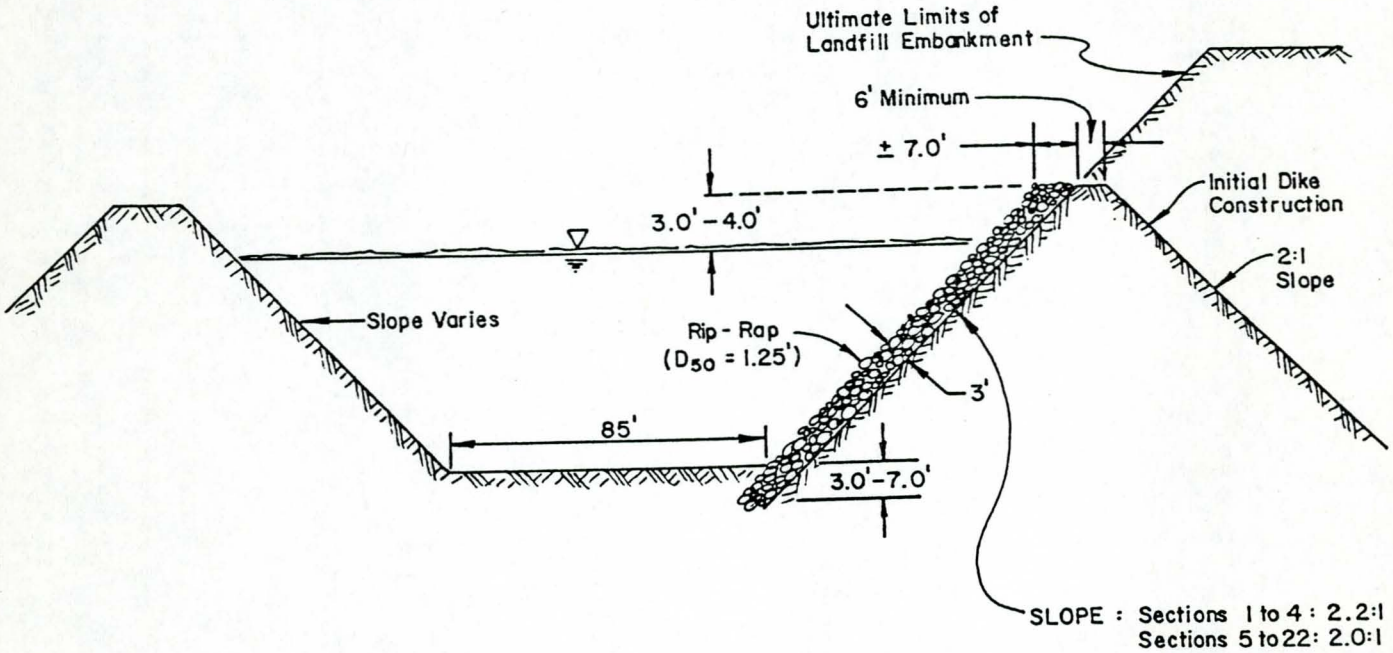


FIGURE	KNOCHEL BROS. - LANDFILL SITE		
	RIP-RAP BANK PROTECTION		
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characteristics. Reach 1 includes cross-sections 18 and 19, reach 2 includes cross-secitons 13 to 17, reach 3 includes cross-sections 9 to 12, reach 4 includes cross-sections 5 to 8, and reach 5 includes cross-sections 2 to 4. The sediment transport analysis does not include the cross-sections with a peak flow of 420 cfs.

The general scour and long term degradation/aggradation depths were calculated using the Meyer-Peter, Muller bed-material transport equation. Cross-section 10.74 was used as the pivot point for the equilibrium slope because of the restricted flow area and high velocity which prevents aggradation and the presence of bedrock which provides geologic stability. Reach 1 was determined to be the sediment supply reach because of the stable hydraulic conditions present there. The 10-year flow event was selected as the dominant discharge in determining the long-term changes to the bed. This value was unavailable, however, so the value was estimated to be approximately 3000 cfs.

The flow conditions are relatively wide and shallow in reach 1, as compared to the other reaches. At the 10-year flow rate, the entire stream bed in reach 1 will be impacted by the hydraulic conditions and will, therefore, be contributing to the sediment supply.

The presence of bedrock underlying the surface of the embankment opposite the dike will prevent any lateral migration in the channel bed.

VI. RESULTS

The hydraulic conditions of the newly-proposed dike and channel configuration compare favorably with the hydraulic conditions associated with the previously-proposed conditions and the existing conditions. The hydraulic conditions of the 100-year flood are within allowable limits such that there should be relatively little impact on the newly-proposed channel. The only effects of the dike on the geometry of the creek will be seen in the form of adjustments to the stream bed due to degradation and aggradation.

The flow conditions for the existing conditions, previously-proposed conditions and newly-proposed conditions, are very similar at the downstream point of comparison, cross-section 10.74.

At the upstream location in the reach, the flow conditions for the newly-proposed conditions are nearly identical to the flow conditions for the previously-proposed conditions. The flow conditions for the newly-proposed conditions and the previously-proposed conditions are different from, and actually more favorable to, the flow conditions for the existing conditions at this upstream point of comparison. This is due to the manner in which the upstream flow conditions were modeled in the Cella, Barr & Evans HEC-2 Analyses of Existing Conditions. A roadway running east and west along the north edge of the landfill site presents a barrier to flow, except for a single channel passing

through the roadway just to the east of the landfill site. The HEC-2 models for the previously-proposed conditions and the newly-proposed conditions include this flow channel. The HEC-2 analysis of existing conditions by Cella, Barr & Evans does not include the channel and therefore the stormwater is modeled as flowing over the top of the roadway. Because of this difference, the flow conditions for the previously-proposed analysis are used for comparisons with the newly-proposed conditions in this portion of the reach.

The water surface elevation for the newly-proposed conditions and the previously-proposed conditions is nearly nine feet lower at cross-section 28 than the water surface elevation at cross-section 11.39 for the existing conditions. However, if the flow path for the existing conditions is shifted to the channel passing through the roadway, the hydraulic conditions are nearly identical to those of the newly-proposed conditions and the previously-proposed conditions. Plate 6 shows the HEC-2 Cross-section locations for the analysis of existing conditions with the upstream flow modifications. The HEC-2 input and output from this analysis can be found in Appendix "F".

The hydraulics of the 100-year flood should have relatively little impact on the bed and banks of the newly-proposed channel. The calculated maximum velocity of 5.97 ft/sec is within the

Corps of Engineers' allowable limits for unprotected channels consisting of fine gravel[1]. The depth of flow generally ranges from 8.5 to 9 feet. The topwidth varies from 140 to 220 feet with an average of approximately 150 feet.

Table 2 includes the hydraulic data for existing conditions, previously-proposed conditions, and newly-proposed conditions. Comparative plots of the water surfaces and invert elevations, velocities, and depths for each of the conditions are shown in Figures 4, 5 and 6.

Scouring of the stream bed will occur in areas where the available flow area is reduced or in those locations where the dike impinges on the direction of the flow. Bend scour will lower the channel bed along the toe of the dike from 2.6 feet to 3.2 feet at cross-sections 10 to 16 due to the flow impingement. Contraction scour will lower the stream bed by as much as 0.4 feet in reach 3 where the available flow area is smaller and the velocity and shear stress are higher than in reach 2, immediately upstream. General scour will occur in reach 3, because the sediment transport capacity is higher than in reach 2. This will lower the bed elevation by approximately 0.7 feet.

[1] "Hydraulic Design of Flood Control Channels", Engineering Manual 1110-2-1601, U. S. Corps of Engineers, 1 July 1970, p.36.

TABLE 2
HYDRAULIC RESULTS
FLOODPLAIN

EXISTING CONDITIONS

DISTANCE	CROSS-SECTION	WSEL	VELOCITY	DEPTH	TOPWIDTH	INVERT
0	10.74	1528.41	7.43	7.41	188.75	1521
426	10.82	1531.08	4.34	7.58	415.49	1523.5
1267	10.98	1531.85	1.62	7.85	580.79	1524
2164	11.15	1532.11	2.47	10.11	355.96	1522
3434	11.39	1555.12	6.80	3.32	524.91	1551.8

PREVIOUSLY-PROPOSED CONDITIONS

DISTANCE	CROSS-SECTION	WSEL	VELOCITY	DEPTH	TOPWIDTH	INVERT
0	10.74	1528.41	7.43	7.41	188.75	1521
426	10.82	1530.03	3.01	6.03	327.31	1524
691	10.88	1530.26	6.40	4.26	248.59	1526
1187	10.97	1532.14	5.53	6.14	200.64	1526
1615	11.04	1533.12	5.82	9.12	175.42	1524
2003	11.12	1533.98	3.73	9.98	219.95	1524
2165	14	1534.22	1.60	10.12	419.01	1524.1
2265	15	1534.24	1.26	10.24	422.00	1524
2365	16	1534.25	1.34	10.25	470.00	1524
2465	17	1534.26	1.10	11.36	590.00	1522.9
2565	18	1534.27	1.37	8.27	590.00	1526
2665	19	1534.28	1.60	7.18	570.00	1527.1
2765	20	1534.33	.19	6.33	450.00	1528
2865	21	1534.33	.40	4.33	335.48	1530
2965	22	1534.33	.78	2.33	258.10	1532
3065	23	1534.48	3.76	1.14	231.09	1533.33
3165	24	1536.67	3.04	.67	203.36	1536
3265	25	1538.62	4.07	.62	175.00	1538
3365	26	1540.90	4.04	.90	115.45	1540
3465	27	1543.33	5.82	1.33	68.57	1542
3565	28	1546.24	6.79	2.24	44.00	1544

TABLE 2 (CONT.)

NEWLY-PROPOSED CONDITIONS

DISTANCE	CROSS-SECTION	WSEL	VELOCITY	DEPTH	TOPWIDTH	INVERT
0	10.74	1528.35	7.76	7.35	165.35	1521
233	1	1529.72	3.70	9.62	253.08	1520.1
326	2	1529.87	3.36	9.37	273.00	1520.5
379	3	1529.89	3.05	9.19	219.84	1520.7
729	4	1529.89	5.94	8.19	136.79	1521.7
1049	5	1530.61	5.52	8.31	150.52	1522.3
1187	6	1530.88	5.66	8.28	145.12	1522.6
1316	7	1531.07	5.97	8.27	133.72	1522.8
1471	8	1531.46	5.49	8.46	142.44	1523
1520	9	1531.65	4.81	8.55	162.47	1523.1
1712	10	1531.93	4.81	8.43	189.85	1523.5
1873	11	1532.19	4.74	8.39	189.28	1523.8
1965	12	1532.37	4.52	8.37	191.75	1524
2065	13	1532.66	2.87	9.66	245.33	1523
2165	14	1532.77	2.02	8.67	355.33	1524.1
2265	15	1532.82	1.47	8.82	422.00	1524
2365	16	1532.83	1.60	8.83	470.00	1524
2465	17	1532.86	1.33	9.96	590.00	1522.9
2565	18	1532.86	1.73	6.86	582.90	1526
2665	19	1532.88	2.09	5.78	560.98	1527.1
2765	20	1532.98	.26	4.98	426.09	1528
2865	21	1532.98	.68	2.98	318.06	1530
2965	22	1533.00	1.96	1.00	227.31	1532
3065	23	1534.46	3.88	1.13	231.00	1533.33
3165	24	1536.70	3.00	.70	203.38	1536
3265	25	1538.61	4.13	.61	175.00	1538
3365	26	1540.91	4.00	.91	115.46	1540
3465	27	1543.33	5.83	1.33	68.55	1542
3565	28	1546.24	6.79	2.24	44.01	1544

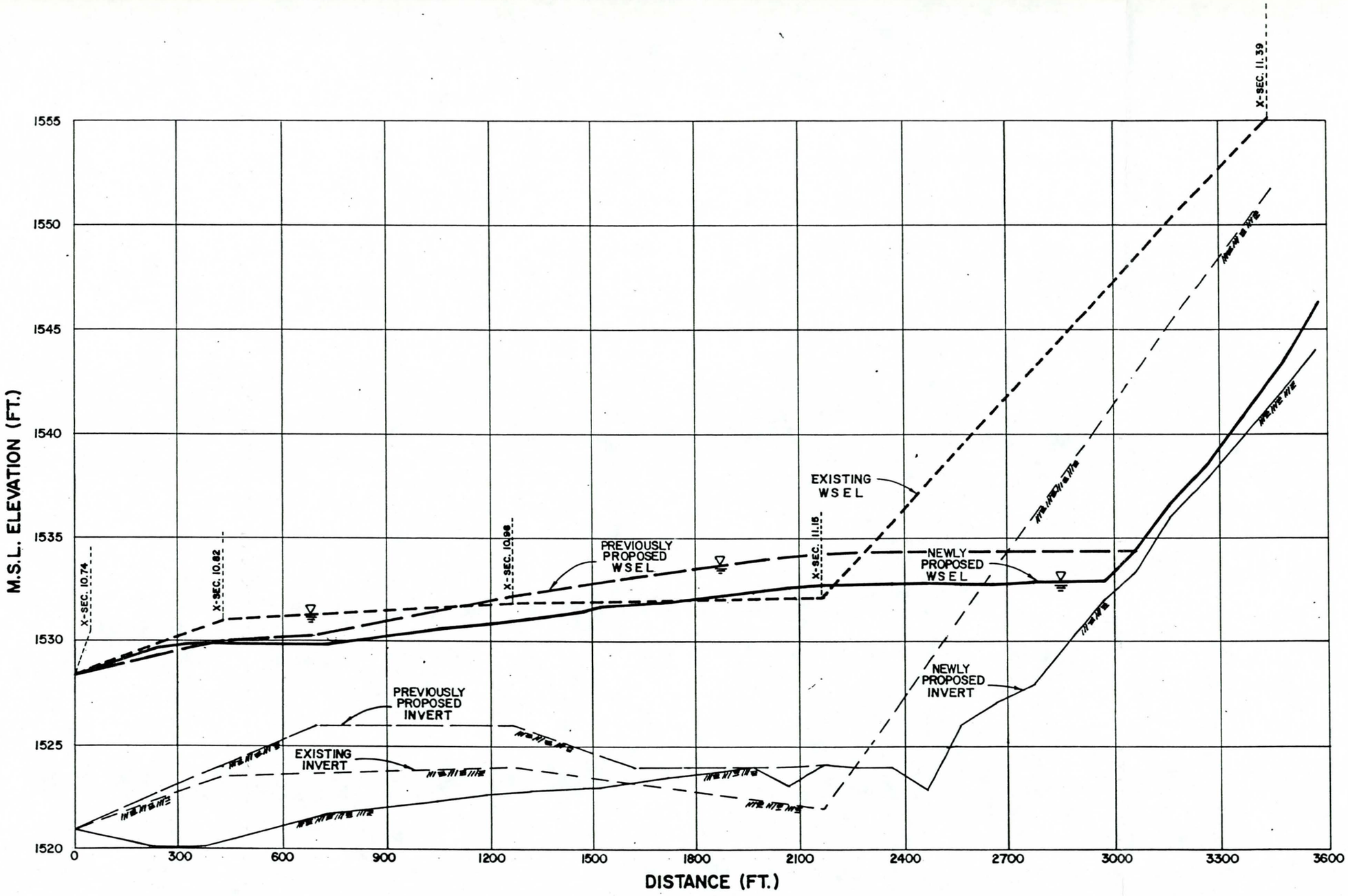

FIGURE	KNOCHEL BROS. - LANDFILL SITE
4	WATER SURFACE ELEVATIONS
SCALE NOTED	Development Engineering
JOB NO. 1740	4400 North 12th Street, Suite 300 Phoenix, Arizona 85014 (602) 264-6775 / (602) 240-0000
DATE	SHEET OF

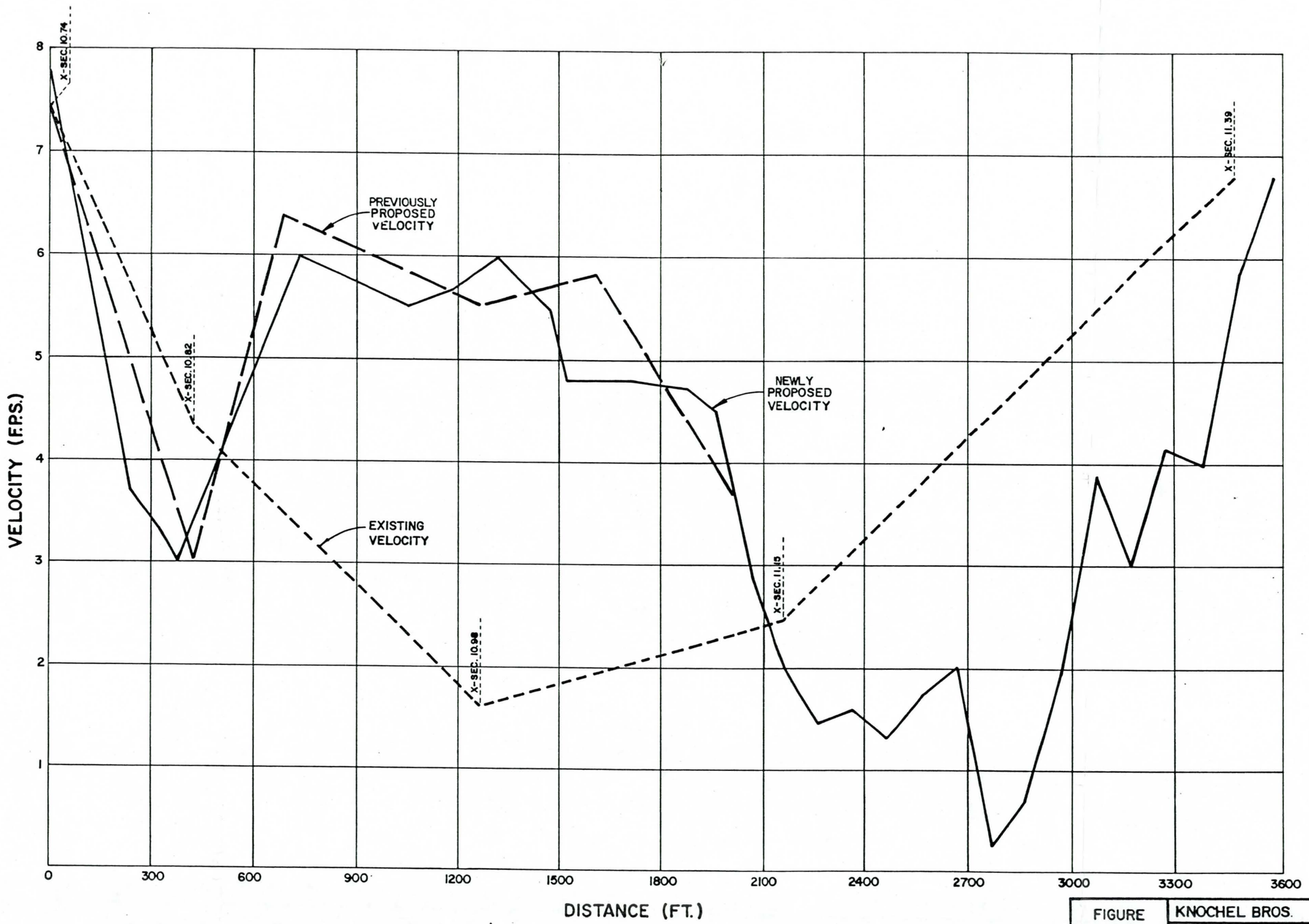

FIGURE	KNOCHEL BROS. - LANDFILL SITE
5	VELOCITIES
SCALE NOTED	Development Engineering
JOB NO. 1740	
DATE	
DESIGN MN / DRAWN RS / CHECK MN	SHEET OF

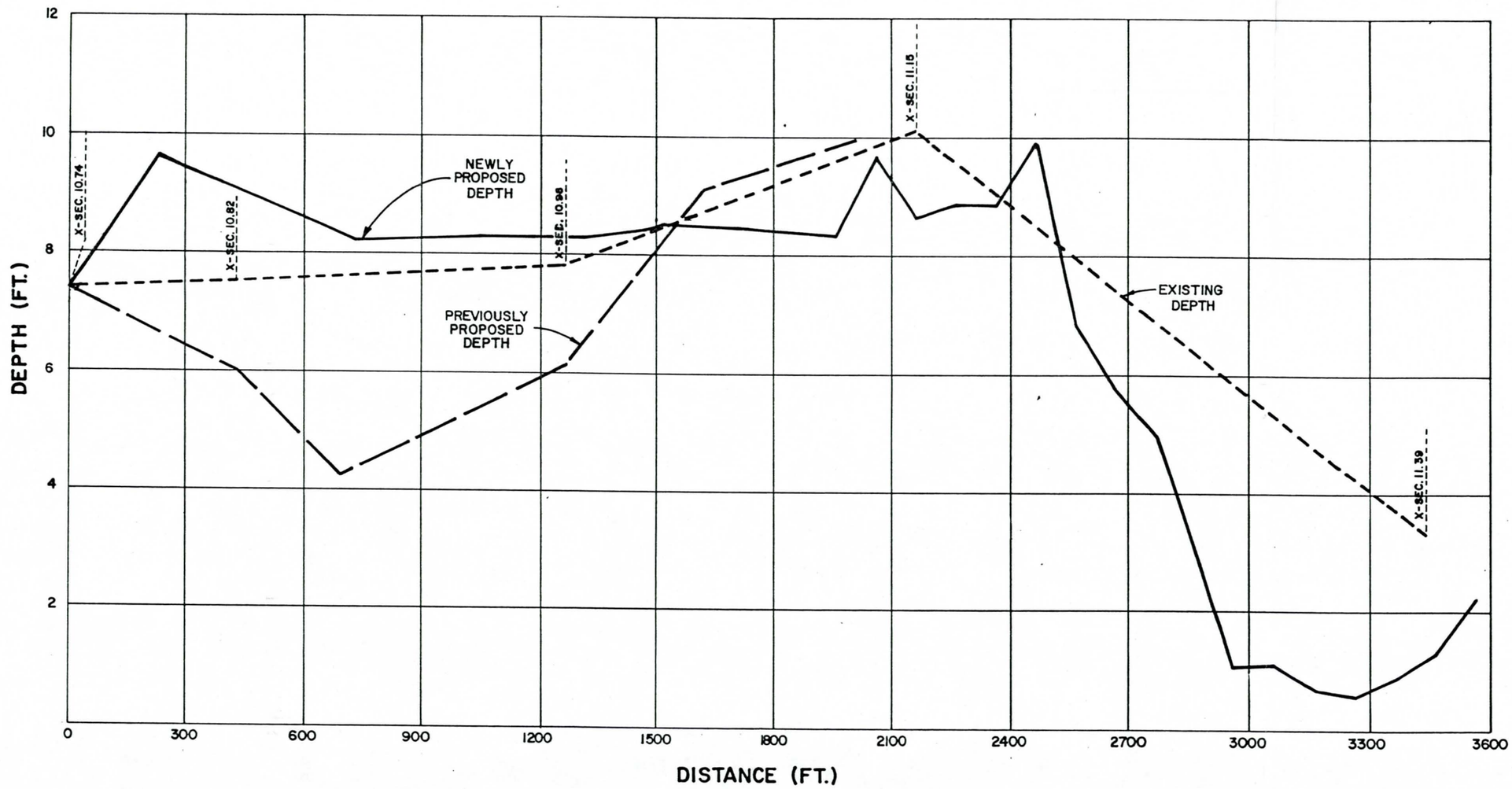

FIGURE	KNOCHEL BROS. - LANDFILL SITE
6	DEPTHS

SCALE: NOTED
JOB NO. 1740
DATE

Development Engineering
4455 North 16th Street, Suite 200
Phoenix, Arizona 85014
(602) 264-6775 / (602) 240-5565

DESIGN
DRAWN
CHECK
SHEET OF

The long-term effects of the flow on the channel bed will be minor. The maximum amount of degradation will be 0.8 feet at the upstream end of reach 3.

The potential for armoring of the stream bed exists in each of the reaches. In the area where the dike impinges on the flow direction, the total scour depth calculated extended well below the scour depth required to establish an armor layer. This was due to the bend scour depths that were projected. Because the total of the individually calculated scour depths were unrealistic and were below the calculated armor layer in this area, the recommended toedown depth was adjusted to reflect the sum of the depth required to establish an armor layer and the bend scour depth. This was based on the fact that the bend scour calculations take into account the secondary currents associated with the change in flow direction, while the armor layer calculations do not. A safety factor of 1.3 has been included.

At the upstream portion of the study reach, there is a much steeper slope than at any other downstream location. However, there was no analysis conducted on the headcutting potential in this area because the contours represent existing topography and are upstream of the effects of the dike and channelization.

In every instance, the freeboard height required by FEMA at each cross-section location was greater than the freeboard height

required due to the dune formation, aggradation, and superelevation of flow.

Calculations of aggradation and degradation depths used in the determination of freeboard and toedown dimensions can be found in Appendix "G".

The dike slope stability calculations show that the dike is stable at a 2:1 slope (see Appendix "H" for calculations).

A flow net of seepage through the dike shows that the flow will not surface at the landside of the dike so that piping failure is precluded (see Appendix "H" for calculations).

The existing site soils are graded so that they provide a natural filter precluding significant material migration. Therefore, a synthetic filter fabric does not appear necessary (see Appendix "H").

APPENDIX "A"

HEC-2 Input and Output for Existing Conditions at 4000 cfs (Floodplain and Floodway)

```
1 ELLA,BARR,EVANS AND ASSOCIATES
2CAVE CK WASH FLOOD INSURANCE STUDY
3       DEER VALLEY TO DAM OUTLET
1    -10       2                                                  1466.75
2      1                -1
C 0.045   0.045    0.04      .1       .3
T      1    5400
1    9.2      26    9944   10266
R   1486    9840    1480    9852    1478    9860  1476.4    9880    1476    9944
R   1447    9960    1472    9964    1470    9968    1462    9980    1460    9990
R  459.5   10000    1460   10018  1461.4   10020    1464   10021    1466   10026
R   1470   10036    1472   10040    1474   10106    1470   10116    1464   10128
R  1462.8  10150    1464   10168    1466   10196    1470   10220    1480   10266
R   1490   10290
C   0.05    0.05   0.045     0.3     0.5
1    9.3      13    9840   10056     900     340     528
R   1480    9840    1468    9840    1468    9880    1468    9900    1468    9950
R   1468   10005    1466   10030    1467   10040    1470   10048    1476   10056
R   1478   10170    1478   10295    1480   10310
T      1    5000
1   9.32      16    9880   10070     125      80     100
R  1482.8   9700    1480    9880    1472    9930    1470    9931    1468   10016
R   1468   10048    1470   10053    1480   10068    1482   10070    1484   10085
R   1486   10120  1487.9   10155    1486   10180    1484   10190    1482   10225
R   1484   10260
C                     0.1     0.3
1   9.33      16    9900   10075      30      40      40
R   1482    9410    1480    9530    1480    9820    1478    9845    1476    9870
R   1474    9900    1472    9925    1470    9955  1468.3   10045    1470   10050
R   1472   10075    1474   10095    1476   10120    1478   10138    1480   10175
R   1490   10400
1   9.34      12    9950   10072      40      50      55
R   1482    9440    1480    9560    1480    9675    1480    9840    1480    9950
R   1470    9975    1468    9980    1468   10010    1470   10042    1482   10072
R   1488   10090    1490   10120
C                     0.3     0.5
1   9.44      15    9400    9860     100     510     528
R   1485    9190    1482    9230    1480    9235    1480    9400  1478.9    9480
R   1478    9600    1476    9794    1474    9800    1476    9810    1478    9837
R   1480    9848    1481    9851    1482    9854    1483    9857    1484    9860
C                     0.1     0.3
1    9.6      17    9060    9600     620     800     800
R   1488    8825    1486    8830    1484    8835  1483.2    8837    1482    8840
R   1482    8975  1483.7    9060    1482    9105  1481.4    9220    1480    9370
R  1479.9   9460    1480    9570    1484    9600    1484    9700    1486    9800
R   1488    9920  1491.2    9980
1    9.8      13    9315    9786    1100     930    1085
R   1504    9150    1494    9210    1492    9290    1490    9315    1488    9360
R   1488    9430  1487.3    9610    1488    9650    1490    9785    1492    9786
R   1494    9890    1498    9893    1498    9960
1   9.86      10    9400    9805     350     280     300
R   1500    9295    1494    9345    1492    9400    1490    9420    1488    9425
R   1488    9475    1490    9795    1498    9805    1500    9895    1502    9900
1   9.97      14    9460    9655     640     550     540
R   1506    9204    1496    9210    1494    9215    1492    9225    1494    9275
R   1494    9460    1492    9461    1492    9505  1492.4    9555    1494    9654
R   1496    9655    1498    9656    1500    9685    1502    9700
1  10.04      13    9665    9955     360     280     360
R   1510    9612    1510    9650    1510 A-1 9665    1498    9685    1496    9735
```

```
C                                0.3       0.5
1 10.05        8     9840    10040       460       400       430
R 1504      9840     1500     9860      1498      9890      1498     10010      1500     10020
R 1502     10028   1503.6    10040      1504     10360
C                                0.1       0.3
1 10.1        13     9942    10030       270       270       270
R1 08.5     9910     1508     9942      1504      9947      1502      9950      1500      9954
R 1498      9957   1497.3     9975      1498     10000      1500     10020      1502     10025
R 1504     10030     1506    10070      1507     10190
C                                0.3       0.5
1 10.14       22     9963    10038       230       210       212
R 1520      9460     1516     9490      1516      9584      1514      9590      1512      9700
R 1510      9765     1508     9830      1508      9900      1510      9905      1510      9930
R 1508      9935     1509     9963      1500    9963.1      1500   10037.9      1509     10038
R 1508     10055     1508    10115      1510     10130      1510     10200      1512     10230
R 1514     10270     1514    10430
C                                0.1       0.3
110.145        9     9963    10038        10        10        10
R 1520      9460     1516     9490      1516      9580      1515      9590      1515      9963
R1 05.9   9963.1   1505.9  10037.9      1515     10038      1514     10460
110.165       11     9963    10038       105       105       105
R 1520      9520     1516     9530      1515      9570      1515      9963    1505.9      9963
R1 05.9    10038     1515    10038      1515     10140      1516     10180      1518     10190
R 1520     10250
C                                0.3       0.5
1 0.18        19     9900    10096        90        70        85
R 1530      9520     1520     9580      1518      9590      1518      9672      1516      9710
R 1514      9740     1514     9900      1508      9930      1506      9958      1506     10002
R 1508     10040     1508    10075      1510     10080      1514     10096      1516     10160
R 1518     10180     1520    10210      1522     10260    1523.5     10370
C                                0.1       0.3
T    1      4000
1 0.25        22     9845    10185       320       400       370
R1521.4     8840     1520     9145      1518      9180      1516      9210      1516      9375
R 1514      9470     1514     9540      1512      9555      1512      9620    1511.6      9700
R 1512      9790   1513.6     9845      1512      9900      1510      9948    1506.7      9975
R 1508      9994     1510    10040      1511     10048    1511.1     10185      1512     10328
R 1520     10332     1530    10343
1 10.4        23     9970    10054       800       650       790
R 1518      9740     1518     9750      1518      9760      1518      9780      1518      9800
R 1514      9810     1516     9825      1514      9850      1516      9863      1518      9952
R 1518      9970     1516     9980      1512      9986    1511.5      9990      1512     10004
R 1514     10048   1515.4    10054      1516     10230      1516     10400      1514     10410
R 1514     10435     1520    10445      1530     10458
1 10.55       15     9956    10024       800       800       790
R 1524      9800   1523.8     9830    1523.7      9860    1523.5      9880    1523.2      9956
R 1522      9966     1520     9974      1518      9986      1516      9992    1515.5     10000
R 1516     10010     1518    10018      1520     10024      1522     10136      1530     10155
1 10.68       10     9705    10032       620       680       686
R 528.5     9615     1528     9705      1526      9800      1524      9850      1522      9880
R 1520      9990   1519.7    10000      1520     10014      1530     10032      1540     10042
1 10.74       15     9840    10032       155       350       317
R 529.5     9740   1528.5     9840      1528      9850      1526      9870      1524      9970
R 1522      9982     1521    10010      1522     10018      1524     10020      1526     10028
R 1530     10032     1532    10056      1534     10105      1534     10320      1540     10400
1 10.82       23     9825    10163       385       375       422
R 1532      9680     1530     9825      1528      9840      1526      9870      1524      9878
R1523.5     9885     1524     9895      1526      9915      1528      9928      1530      9935
R 528.3     9960     1528     9985      1526     10000      1528     10005    1529.7     10080
R 1528     10115     1526    10116      1524     10125      1526     10158      1530     10160
R 1532     10163     1534    10175      1536     10200
1 10.98        7     9530    10140       980       870       845
R 1544      9530     1524     9553      1526      9560      1526     10098      1524     10103
R 1530     10118     1536    10140
T    1      500
```

R	1524	10010	1528	10020	1524	10070	1524	10150	1528	10165
R	1526	10190	1528	10216	1540	10230				
1	11.39	15	9700	10800	1270	1270	1270			
R	1560	9700	1556	9770	1554	9970	1552	10000	1554	10120
R	1556	10280	1558	10370	1558	10550	1551.8	10560	1551.8	10585
R	1560	10600	1554	10630	1552	10640	1554	10710	1556	10800

J

R

```
*****************************************************
*  WATER SURFACE PROFILES                           *
*  VERSION OF SEPTEMBER 1988                        *
*                                                   *
*                                                   *
*  RUN DATE      3/30/89    TIME    10:23:45        *
*****************************************************
```

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

END OF BANNER

FPLN 4000 - CUT

~~FCDFLPLN CUT~~

Existing Conditions

Q = 4000 cfs (in project area)

Floodplain

3/30/89 10:23:45

```
*****************************************************
 HEC2 RELEASE DATED SEPT 88

*****************************************************

T1CELLA,BARR,EVANS AND ASSOCIATES
T2CAVE CK WASH FLOOD INSURANCE STUDY
T3      DEER VALLEY TO DAM OUTLET
J1  ICHECK    INQ      NINV     IDIR     STRT     METRIC   HVINS    Q
    -10       2
J2  NPROF     IPLOT    PRFVS    XSECV    XSECH    FN       ALLDC    IBW
    1                  -1
```

3/30/89 10:23:45

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

*PAGE OF 1

CCHV= .100 CEHV= .300
*SECNO 9.200

3235 DIVIDED FLOW

9.20	19.75	1466.75	.00	1466.75	1467.90	1.15	.00	.0
5400.	0.	5400.	0.	0.	627.	0.	0.	0
.00	.00	8.61	.00	.000	.040	.000	.000	1447.0
.010235	0.	0.	0.	0	0	0	.00	147.0

CCHV= .300 CEHV= .500
*SECNO 9.300

9.30	5.73	1471.73	.00	.00	1472.41	.68	4.37	.1
5400.	0.	5400.	0.	0.	814.	0.	9.	2
.02	.00	6.63	.00	.000	.045	.000	.000	1466.0
.006838	900.	528.	340.	3	0	0	.00	210.3

*SECNO 9.320

3301 HV CHANGED MORE THAN HVINS

7235 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

9.32	4.48	1472.48	1472.48	.00	1474.29	1.81	1.07	.5
5000.	0.	5000.	0.	0.	463.	0.	10.	3
.02	.00	10.80	.00	.000	.045	.000	.000	1468.0
.020110	125.	100.	80.	3	15	0	.00	129.6

CCHV= .100 CEHV= .300
*SECNO 9.330

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

9.33	5.72	1474.02	.00	.00	1474.90	.88	.52	.0
5000.	0.	4942.	58.	0.	655.	20.	11.	3
.03	.03	7.55	2.86	.050	.045	.050	.000	1468.3
.009035	30.	40.	40.	4	0	0	.00	195.6

3/30/89 10:23:45

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

*SECNO 9.340

3301 HV CHANGED MORE THAN HVINS

3655 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

9.34	6.00	1474.00	1474.00	.00	1476.37	2.36	.69	.4
5000.	0.	5000.	0.	0.	405.	0.	11.	3
.03	.00	12.34	.00	.000	.045	.000	.000	1468.0
.018508	40.	55.	50.	20	8	0	.00	87.0

CEHV= .300 CEHV= .500
*SECNO 9.440

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

9.44	6.54	1480.54	.00	.00	1480.79	.24	3.78	.6
5000.	110.	4890.	0.	90.	1228.	0.	21.	6
.06	1.22	3.98	.00	.050	.045	.000	.000	1474.0
.003822	100.	528.	510.	4	0	0	.00	615.9

CEHV= .100 CEHV= .300
*SECNO 9.600

3355 DIVIDED FLOW

9.60	3.45	1483.35	.00	.00	1483.53	.17	2.73	.0
5000.	429.	4571.	0.	229.	1330.	0.	47.	18
.13	1.87	3.44	.00	.050	.045	.000	.000	1479.9
.003144	620.	800.	800.	5	0	0	.00	731.1

*SECNO 9.800

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

9.80	2.59	1489.89	1489.69	.00	1490.52	.64	6.86	.1
5000.	0.	5000.	0.	0.	779.	0.	76.	33
.18	.00	6.41	.00	.000	.045	.000	.000	1487.3
.018620	1100.	1085.	930.	11	19	0	.00	458.8

3/30/89 10:23:45

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

*SECNO 9.860

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

9.86	4.18	1492.18	.00	.00	1492.42	.24	1.85	.0
5000.	0.	5000.	0.	0.	1268.	0.	83.	36
.20	.33	3.94	.00	.050	.045	.000	.000	1488.0
.003048	350.	300.	280.	3	0	0	.00	402.6

*SECNO 9.970

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

9.97	3.11	1495.11	.00	.00	1495.78	.68	3.24	.1
5000.	1552.	3448.	0.	330.	471.	0.	97.	41
.22	4.70	7.31	.00	.050	.045	.000	.000	1492.0
.015260	640.	540.	550.	3	0	0	.00	442.2

*SECNO 10.040

10.04	4.65	1499.65	.00	.00	1500.59	.93	4.73	.0
5000.	0.	5000.	0.	0.	645.	0.	103.	44
.24	.00	7.76	.00	.000	.045	.000	.000	1495.0
.011417	360.	360.	280.	3	0	0	.00	196.8

CHV= .300 CEHV= .500
*SECNO 10.050

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.05	5.15	1503.15	.00	.00	1503.71	.56	3.01	.1
5000.	0.	5000.	0.	0.	832.	0.	110.	46
.26	.00	6.01	.00	.000	.045	.000	.000	1498.0
.004735	460.	430.	400.	3	0	0	.00	192.4

CHV= .100 CEHV= .300
*SECNO 10.100

3301 HV CHANGED MORE THAN HVINS

3/30/89 10:23:45

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.10	6.85	1504.15	.00	.00	1506.19	2.05	2.04	.4
5000.	0.	5000.	0.	0.	436.	0.	114.	47
.26	.00	11.48	.62	.000	.045	.050	.000	1497.3
.013854	270.	270.	270.	3	0	0	.00	86.2

CCHV= .300 CEHV= .500
*SECNO 10.140

3301 HV CHANGED MORE THAN HVINS

10.14	7.13	1507.13	.00	.00	1508.49	1.36	2.09	.2
5000.	0.	5000.	0.	0.	534.	0.	116.	47
.27	.00	9.36	.00	.000	.045	.000	.000	1500.0
.007385	230.	212.	210.	3	0	0	.00	74.9

CCHV= .100 CEHV= .300
*SECNO 10.145

3301 HV CHANGED MORE THAN HVINS

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

10.15	5.17	1511.07	1511.07	.00	1513.66	2.59	.12	.3
5000.	0.	5000.	0.	0.	387.	0.	116.	47
.27	.00	12.92	.00	.000	.045	.000	.000	1505.9
.020344	10.	10.	10.	20	15	0	.00	74.9

*SECNO 10.165

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.16	7.78	1513.68	.00	.00	1514.82	1.14	1.01	.1
5000.	0.	5000.	0.	0.	584.	0.	117.	47
.27	.00	8.57	.00	.000	.045	.000	.000	1505.9
.005607	105.	105.	105.	2	0	0	.00	75.0

3/30/89 10:23:45

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

CHV= .300 CEHV= .500
SECNO 10.180

301 HV CHANGED MORE THAN HVINS

302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.18	9.07	1515.07	.00	.00	1515.26	.18	.15	.2
5000.	159.	4830.	10.	180.	1381.	18.	120.	48
.28	.89	3.50	.57	.050	.045	.050	.000	1506.0
.00839	90.	85.	70.	2	0	0	.00	406.3

CHV= .100 CEHV= .300
SECNO 10.250

302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.25	8.70	1515.40	.00	.00	1515.43	.02	.15	.0
4000.	1090.	2302.	608.	1155.	1626.	553.	140.	53
.36	.94	1.42	1.10	.050	.045	.050	.000	1506.7
.000229	320.	370.	400.	2	0	0	.00	926.0

SECNO 10.400

65 DIVIDED FLOW

01 HV CHANGED MORE THAN HVINS

85 20 TRIALS ATTEMPTED WSEL,CWSEL
93 PROBABLE MINIMUM SPECIFIC ENERGY
20 CRITICAL DEPTH ASSUMED

10.40	5.21	1516.71	1516.71	.00	1517.34	.62	.53	.1
4000.	442.	2225.	1333.	111.	282.	390.	176.	66
.40	3.98	7.88	3.42	.050	.045	.050	.000	1511.5
.01 0452	800.	790.	650.	20	16	0	.00	554.5

ECNO 10.550

10.55	7.95	1523.45	.00	.00	1524.25	.79	6.86	.0
4000.	5.	2724.	1271.	8.	337.	277.	189.	73
.43	.64	8.08	4.58	.050	.045	.050	.000	1515.5
007264	800.	790.	800.	4	0	0	.00	247.6

3/30/89 10:23:45

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

*SECNO 10.680

3[illegible]01 HV CHANGED MORE THAN HVINS

3[illegible]02 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.68	6.91	1526.61	.00	.00	1526.85	.24	2.55	.0
4000.	0.	4000.	0.	0.	1018.	0.	202.	77
.48	.00	3.93	.00	.000	.045	.000	.000	1519.7
.002259	620.	686.	680.	3	0	0	.00	255.2

*SECNO 10.740

3[illegible]01 HV CHANGED MORE THAN HVINS

3[illegible]02 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.74	6.54	1527.54	.00	.00	1528.31	.77	1.30	.1
4000.	0.	4000.	0.	0.	569.	0.	207.	79
.49	.00	7.03	.00	.000	.045	.000	.000	1521.0
.009545	155.	317.	350.	2	0	0	.00	174.9

*SECNO 10.820

3[illegible]01 HV CHANGED MORE THAN HVINS

3[illegible]02 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.82	6.90	1530.40	.00	.00	1530.64	.25	2.29	.0
4000.	3.	3997.	0.	6.	1001.	0.	215.	81
.52	.60	3.99	.00	.050	.045	.000	.000	1523.5
.003484	385.	422.	375.	3	0	0	.00	364.2

*SECNO 10.980

3[illegible]02 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3/30/89 10:23:45

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI
10.98	7.09	1531.09	.00	.00	1531.11	.03	.45	.0
4000.	0.	4000.	0.	0.	2901.	0.	253.	90
.69	.00	1.38	.00	.000	.045	.000	.000	1524.0
.000205	980.	845.	870.	4	0	0	.00	577.1

*SECNO 11.150

3[illegible]02 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

11.15	9.21	1531.21	.00	.00	1531.21	.00	.09	.0
500.	0.	500.	0.	0.	1702.	0.	300.	100
1.54	.00	.29	.00	.000	.045	.000	.000	1522.0
.000010	970.	897.	840.	2	0	0	.00	353.5

*SECNO 11.390

3[illegible]65 DIVIDED FLOW

3[illegible]85 20 TRIALS ATTEMPTED WSEL,CWSEL
3[illegible]93 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

11.39	1.31	1553.11	1553.11	.00	1553.45	.34	.05	.1
500.	0.	500.	0.	0.	107.	0.	327.	107
1.61	.00	4.69	.00	.000	.045	.000	.000	1551.8
.034050	1270.	1270.	1270.	20	17	0	.00	157.2

3/30/89 10:23:45

****
HEC2 RELEASE DATED SEPT 88

****

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

DEER VALLEY TO DAM OUTLE

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIW
	9.200	.00	.00	.00	1447.00	5400.00	1466.75	-
	9.300	528.00	.00	.00	1466.00	5400.00	1471.73	-
*	9.320	100.00	.00	.00	1468.00	5000.00	1472.48	1472.
*	9.330	40.00	.00	.00	1468.30	5000.00	1474.02	-
*	9.340	55.00	.00	.00	1468.00	5000.00	1474.00	1474.
*	9.440	528.00	.00	.00	1474.00	5000.00	1480.54	-
	9.600	800.00	.00	.00	1479.90	5000.00	1483.35	-
*	9.800	1085.00	.00	.00	1487.30	5000.00	1489.89	1489.
*	9.860	300.00	.00	.00	1488.00	5000.00	1492.18	-
*	9.970	540.00	.00	.00	1492.00	5000.00	1495.11	-
	10.040	360.00	.00	.00	1495.00	5000.00	1499.65	-
*	10.050	430.00	.00	.00	1498.00	5000.00	1503.15	-
*	10.100	270.00	.00	.00	1497.30	5000.00	1504.15	-
	10.140	212.00	.00	.00	1500.00	5000.00	1507.13	-
*	10.145	10.00	.00	.00	1505.90	5000.00	1511.07	1511.
*	10.165	105.00	.00	.00	1505.90	5000.00	1513.68	-
*	10.180	85.00	.00	.00	1506.00	5000.00	1515.07	-

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	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIW
*	10.250	370.00	.00	.00	1506.70	4000.00	1515.40	-
*	10.400	790.00	.00	.00	1511.50	4000.00	1516.71	1516.
	10.550	790.00 2582'	.00	.00	1515.50	4000.00	1523.45	-
300 *	10.680	686.00	.00	.00	1519.70	4000.00	1526.61	-
*	10.740	317.00	.00	.00	1521.00	4000.00	1527.54	-
*	10.820	422.00	.00	.00	1523.50	4000.00	1530.40	-
*	10.980	845.00	.00	.00	1524.00	4000.00	1531.09	-
*	11.150	897.00	.00	.00	1522.00	500.00	1531.21	-
*	11.390	1270.00	.00	.00	1551.80	500.00	1553.11	1553.

Slope 10.25 to 10.74 = 0.0055 ft/ft
10.25 to 10.52 = 0.0056 ft/ft

3/30/89 10:23:45

DEER VALLEY TO DAM OUTLE

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	9.200	5400.00	1466.75	.00	.00	.00	147.06	.
	9.300	5400.00	1471.73	.00	4.98	.00	210.31	528.
*	9.320	5000.00	1472.48	.00	.74	.00	129.69	100.
*	9.330	5000.00	1474.02	.00	1.55	.00	195.61	40.
*	9.340	5000.00	1474.00	.00	-.02	.00	87.01	55.
*	9.440	5000.00	1480.54	.00	6.54	.00	615.99	528.
	9.600	5000.00	1483.35	.00	2.81	.00	731.17	800.
*	9.800	5000.00	1489.89	.00	6.53	.00	458.85	1085.
*	9.860	5000.00	1492.18	.00	2.29	.00	402.63	300.
*	9.970	5000.00	1495.11	.00	2.93	.00	442.29	540.
	10.040	5000.00	1499.65	.00	4.55	.00	196.89	360.
*	10.050	5000.00	1503.15	.00	3.50	.00	192.43	430.
*	10.100	5000.00	1504.15	.00	1.00	.00	86.20	270.
	10.140	5000.00	1507.13	.00	2.98	.00	74.96	212.
*	10.145	5000.00	1511.07	.00	3.94	.00	74.91	10.
*	10.165	5000.00	1513.68	.00	2.61	.00	75.00	105.
*	10.180	5000.00	1515.07	.00	1.39	.00	406.37	85.
*	10.250	4000.00	1515.40	.00	.33	.00	926.03	370.
*	10.400	4000.00	1516.71	.00	1.31	.00	554.52	790.
	10.550	4000.00	1523.45	.00	6.74	.00	247.61	790.
*	10.680	4000.00	1526.61	.00	3.16	.00	255.22	686.
*	10.740	4000.00	1527.54	.00	.93	.00	174.99	317.
*	10.820	4000.00	1530.40	.00	2.86	.00	364.27	422.
*	10.980	4000.00	1531.09	.00	.69	.00	577.13	845.

3/30/89 10:23:45

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	11.150	500.00	1531.21	.00	.13	.00	353.55	897.
*	11.390	500.00	1553.11	.00	21.90	.00	157.26	1270.

3/30/89 10:23:45

SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO=	9.320	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	9.320	PROFILE=	1	MINIMUM SPECIFIC ENERGY
WARNING SECNO=	9.330	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION SECNO=	9.340	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	9.340	PROFILE=	1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=	9.340	PROFILE=	1	20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING SECNO=	9.440	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	9.800	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	9.860	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	9.970	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.050	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.100	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION SECNO=	10.145	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	10.145	PROFILE=	1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=	10.145	PROFILE=	1	20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING SECNO=	10.165	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.180	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.250	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION SECNO=	10.400	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	10.400	PROFILE=	1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=	10.400	PROFILE=	1	20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING SECNO=	10.680	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.740	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.820	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.980	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	11.150	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION SECNO=	11.390	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	11.390	PROFILE=	1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=	11.390	PROFILE=	1	20 TRIALS ATTEMPTED TO BALANCE WSEL

FWAY4000.DAT
Existing Conditions
Floodway
Q=4000 cfs

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1CELLA,BARR,EVANS AND ASSOCIATES
2CIVE CK WASH FLOOD INSURANCE STUDY
3       DEER VALLEY TO DAM OUTLET                                                    1466.75
1   -10       2
2     1                -1
C  0.045    0.045    0.04      .1       .3
T     1     5400                                                                    9949    10200
T            9.1
1   9.2       26     9944    10266
R  1486     9840     1480     9852     1478     9860   1476.4     9880     1476     9944
R  1447     9960     1472     9964     1470     9968     1462     9980     1460     9990
R 1459.5   10000     1460    10018   1461.4    10020     1464    10021     1466    10026
R  1470    10036     1472    10040     1474    10106     1470    10116     1464    10128
R 1462.8   10150     1464    10168     1466    10196     1470    10220     1480    10266
R  1490    10290
C  0.05     0.05    0.045      0.3      0.5                                          9840    10049
T            9.1
1   9.3       13     9840    10056      900      340      528
R  1480     9840     1468     9840     1468     9880     1468     9900     1468     9950
R  1468    10005     1466    10030     1467    10040     1470    10048     1476    10056
R  1478    10170     1478    10295     1480    10310
T     1     5000                                                                    9927    10056
T            9.1
1  9.32       16     9880    10070      125       80      100
R 482.8     9700     1480     9880     1472     9930     1470     9931     1468    10016
R  1468    10048     1470    10053     1480    10068     1482    10070     1484    10085
R  1486    10120   1487.9    10155     1486    10180     1484    10190     1482    10225
R  1484    10260
C                            0.1      0.3                                          9900    10095
T            9.1
1  9.33       16     9900    10075       30       40       40
R  1482     9410     1480     9530     1480     9820     1478     9845     1476     9870
R  1474     9900     1472     9925     1470     9955   1468.3    10045     1470    10050
R  1472    10075     1474    10095     1476    10120     1478    10138     1480    10175
R  1490    10400                                                                    9965    10052
T            9.1
1  9.34       12     9950    10072       40       50       55
R  1482     9440     1480     9560     1480     9675     1480     9840     1480     9950
R  1470     9975     1468     9980     1468    10010     1470    10042     1482    10072
R  1488    10090     1490    10120
C                            0.3      0.5                                          9620     9830
T            9.1
1  9.44       15     9400     9860      100      510      528
R  1485     9190     1482     9230     1480     9235     1480     9400   1478.9     9480
R  1478     9600     1476     9794     1474     9800     1476     9810     1478     9837
R  1480     9848     1481     9851     1482     9854     1483     9857     1484     9860
C                            0.1      0.3                                          9280     9560
T            9.1
1   9.6       17     9060     9600      620      800      800
R  1488     8825     1486     8830     1484     8835   1483.2     8837     1482     8840
R  1482     8975   1483.7     9060     1482     9105   1481.4     9220     1480     9370
R 1479.9    9460     1480     9570     1484     9600     1484     9700     1486     9800
R  1488     9920   1491.2     9980                                                 9495     9700
T            9.1
1   9.8       13     9315     9786     1100      930     1085
R  1504     9150     1494     9210     1492     9290     1490     9315     1488     9360
R  1488     9430   1487.3     9610     1488     9650     1490     9785     1492     9786
R  1494     9890     1498     9893     1498     9960                                 9425     9650
T            9.1
```

R	1488	9475	1490	9795	1498	9805	1500	9895	1502	9900
T		9.1							9480	9610
	9.97	14	9460	9655	640	550	540			
R	1506	9204	1496	9210	1494	9215	1492	9225	1494	9275
R	1494	9460	1492	9461	1492	9505	1492.4	9555	1494	9654
	1496	9655	1498	9656	1500	9685	1502	9700		
		9.1							9685	9870
1	10.04	13	9665	9955	360	280	360			
	1510	9612	1510	9650	1510	9665	1498	9685	1496	9735
	1496	9810	1495	9830	1496	9850	1498	9875	1500	9880
R	1502	9905	1504	9918	1505	9955				
C				0.3	0.5					
		9.1							9880	10017
T	10.05	8	9840	10040	460	400	430			
R	1504	9840	1500	9860	1498	9890	1498	10010	1500	10020
	1502	10028	1503.6	10040	1504	10360				
				0.1	0.3					
T		9.1							9947	10033
	10.1	13	9942	10030	270	270	270			
	1508.5	9910	1508	9942	1504	9947	1502	9950	1500	9954
R	1498	9957	1497.3	9975	1498	10000	1500	10020	1502	10025
	1504	10030	1506	10070	1507	10190				
				0.3	0.5					
T		9.1							9963	10038
1	10.14	22	9963	10038	230	210	212			
	1520	9460	1516	9490	1516	9584	1514	9590	1512	9700
R	1510	9765	1508	9830	1508	9900	1510	9905	1510	9930
R	1508	9935	1509	9963	1500	9963.1	1500	10037.9	1509	10038
	1508	10055	1508	10115	1510	10130	1510	10200	1512	10230
	1514	10270	1514	10430						
C				0.1	0.3					
		9.1							9963	10038
	10.145	9	9963	10038	10	10	10			
R	1520	9460	1516	9490	1516	9580	1515	9590	1515	9963
R	1505.9	9963.1	1505.9	10037.9	1515	10038	1514	10460		
		9.1							9963	10038
T	10.165	11	9963	10038	105	105	105			
R	1520	9520	1516	9530	1515	9570	1515	9963	1505.9	9963
	1505.9	10038	1515	10038	1515	10140	1516	10180	1518	10190
	1520	10250								
C				0.3	0.5					
		9.1							9950	10050
	10.18	19	9900	10096	90	70	85			
R	1530	9520	1520	9580	1518	9590	1518	9672	1516	9710
R	1514	9740	1514	9900	1508	9930	1506	9958	1506	10002
	1508	10040	1508	10075	1510	10080	1514	10096	1516	10160
R	1518	10180	1520	10210	1522	10260	1523.5	10370		
C				0.1	0.3					
		9.1							9930	10080
	1	4000								
1	10.25	22	9845	10185	320	400	370			
	1521.4	8840	1520	9145	1518	9180	1516	9210	1516	9375
	1514	9470	1514	9540	1512	9555	1512	9620	1511.6	9700
R	1512	9790	1513.6	9845	1512	9900	1510	9948	1506.7	9975
R	1508	9994	1510	10040	1511	10048	1511.1	10185	1512	10328
	1520	10332	1530	10343						
T		9.1							9970	10150
1	10.4	23	9970	10054	800	650	790			
	1518	9740	1518	9750	1518	9760	1518	9780	1518	9800
	1514	9810	1516	9825	1514	9850	1516	9863	1518	9952
R	1518	9970	1516	9980	1512	9986	1511.5	9990	1512	10004
	1514	10048	1515.4	10054	1516	10230	1516	10400	1514	10410
	1514	10435	1520	10445	1530	10458				
T		9.1							9935	10080

R	1522	9966	1520	9974	1518	9986	1516	9992	1515.5	10000
R	1516	10010	1518	10018	1520	10024	1522	10136	1530	10155
		9.1							9860	10025
T	10.68	10	9705	10032	620	680	686			
R	1528.5	9615	1528	9705	1526	9800	1524	9850	1522	9880
	1520	9990	1519.7	10000	1520	10014	1530	10032	1540	10042
		9.1							9900	10029
T	10.74	15	9840	10032	155	350	317			
	1529.5	9740	1528.5	9840	1528	9850	1526	9870	1524	9970
	1522	9982	1521	10010	1522	10018	1524	10020	1526	10028
R	1530	10032	1532	10056	1534	10105	1534	10320	1540	10400
		9.1							9850	10100
	10.82	23	9825	10163	385	375	422			
R	1532	9680	1530	9825	1528	9840	1526	9870	1524	9878
R	1523.5	9885	1524	9895	1526	9915	1528	9928	1530	9935
	1528.3	9960	1528	9985	1526	10000	1528	10005	1529.7	10080
R	1528	10115	1526	10116	1524	10125	1526	10158	1530	10160
R	1532	10163	1534	10175	1536	10200				
		9.1							9620	10100
	10.98	7	9530	10140	980	870	845			
R	1544	9530	1524	9553	1526	9560	1526	10098	1524	10103
	1530	10118	1536	10140						
	1	500								
T		9.1							9866	10219
T	11.15	13	9850	10230	970	840	897			
	1542	9850	1530	9868	1528	9945	1526	9990	1522	10000
R	1524	10010	1528	10020	1524	10070	1524	10150	1528	10165
R	1526	10190	1528	10216	1540	10230				
		9.1							9982	10680
T	11.39	15	9700	10800	1270	1270	1270			
R	1560	9700	1556	9770	1554	9970	1552	10000	1554	10120
	1556	10280	1558	10370	1558	10550	1551.8	10560	1551.8	10585
	1560	10600	1554	10630	1552	10640	1554	10710	1556	10800
J										
R										

```
*****************************************************
*  WATER SURFACE PROFILES                           *
*  VERSION OF SEPTEMBER 1988                        *
*                                                   *
*                                                   *
*  RUN DATE      3/30/89    TIME    11:53:49        *
*****************************************************
```

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

END OF BANNER

FWAY4000_OUT

Existing Conditions

Q = 4000 cfs (in project area)

Floodway

```
3/30/89        11:53:49


*****************************************************
HEC2 RELEASE DATED SEPT 88

*****************************************************


T1CELLA,BARR,EVANS AND ASSOCIATES
T2AVE CK WASH FLOOD INSURANCE STUDY
T3      DEER VALLEY TO DAM OUTLET

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q

    -10       2

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW

    1                   -1
```

```
  3/30/89        11:53:49

  SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS
  Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA
  TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN
  SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWI

*PROF 1

CCHV=      .100 CEHV=      .300
*SECNO 9.200

3265 DIVIDED FLOW

3470 ENCROACHMENT STATIONS=      9949.0    10200.0  TYPE=       1  TARGET=       251
     9.20     19.75  1466.75       .00       .00  1467.90     1.15       .00        .0
   5400.        0.    5400.        0.        0.     627.       0.        0.         0
     .00       .00     8.61       .00      .000     .040      .000      .000    1447.0
  .010204       0.       0.        0.         0        0         0       .00     146.5

CCHV=      .300 CEHV=      .500
*SECNO 9.300

3470 ENCROACHMENT STATIONS=      9840.0    10049.0  TYPE=       1  TARGET=       209
     9.30      5.73  1471.73       .00       .00  1472.41      .69      4.37        .1
   5400.        0.    5400.        0.        0.     813.       0.        9.         2
     .02       .00     6.64       .00      .000     .045      .000      .000    1466.0
  .006853     900.     528.      340.         3        0         0       .00     209.0

*SECNO 9.320

3001 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
3120 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS=      9927.0    10056.0  TYPE=       1  TARGET=       129
     9.32      4.47  1472.47  1472.47       .00  1474.29     1.82      1.07        .5
   5000.        0.    5000.        0.        0.     462.       0.       10.         3
     .02       .00    10.83       .00      .000     .045      .000      .000    1468.0
 .020175     125.     100.       80.         3       15         0       .00     128.9

CCHV=      .100 CEHV=      .300
*SECNO 9.330
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 3/30/89        11:53:49

 SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS
 Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA
 TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN
 SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWI


3301 HV CHANGED MORE THAN HVINS


3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE


3470 ENCROACHMENT STATIONS=      9900.0    10095.0  TYPE=       1  TARGET=       195
   9.33      5.73   1474.03       .00       .00   1474.90      .87       .52        .0
  5000.        0.     4941.       59.        0.      655.      21.       11.         3
    .03       .00      7.54      2.86      .000      .045     .050      .000    1468.3
 009005       30.       40.       40.         4         0        0       .00     195.0


*SECNO 9.340

3301 HV CHANGED MORE THAN HVINS

3485 20 TRIALS ATTEMPTED WSEL,CWSEL
3493 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS=      9965.0    10052.0  TYPE=       1  TARGET=        87
   9.34      6.00   1474.00   1474.00       .00   1476.37     2.37       .69        .4
  5000.        0.     5000.        0.        0.      405.       0.       11.         3
    .03       .00     12.35       .00      .000      .045     .000      .000    1468.0
 018553       40.       55.       50.        20         8        0       .00      86.9


CEHV=      .300 CEHV=      .500
*SECNO 9.440

3301 HV CHANGED MORE THAN HVINS


3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE


3470 ENCROACHMENT STATIONS=      9620.0     9830.0  TYPE=       1  TARGET=       210
   9.44      6.86   1480.86       .00       .00   1481.38      .52      4.45        .5
  5000.        0.     5000.        0.        0.      868.       0.       19.         5
    .05       .00      5.76       .00      .000      .045     .000      .000    1474.0
 004800      100.      528.      510.         2         0        0       .00     210.0
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 3/30/89        11:53:49

 SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS
 Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA
 TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN
 SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWI

CCHV=      .100 CEHV=      .300
*SECNO 9.600

3470 ENCROACHMENT STATIONS=      9280.0     9560.0  TYPE=       1  TARGET=       280
    9.60      4.19  1484.09       .00       .00  1484.40      .31      3.00        .0
   5000.        0.     5000.        0.        0.     1116.       0.       37.         9
     .10       .00      4.48       .00      .000      .045     .000      .000    1479.9
 .003013      620.      800.      800.         5         0        0       .00     280.0

*SECNO 9.800

3301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
3320 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS=      9495.0     9700.0  TYPE=       1  TARGET=       205
    9.80      3.09  1490.39   1490.39       .00  1491.72     1.33      6.98        .3
   5000.        0.     5000.        0.        0.      541.       0.       58.        15
     .14       .00      9.25       .00      .000      .045     .000      .000    1487.3
 .022144     1100.     1085.      930.        11        15        0       .00     205.0

*SECNO 9.860

3301 HV CHANGED MORE THAN HVINS

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS=      9425.0     9650.0  TYPE=       1  TARGET=       225
    9.86      5.21  1493.21       .00       .00  1493.54      .33      1.72        .1
   5000.        0.     5000.        0.        0.     1077.       0.       64.        17
     .15       .00      4.64       .00      .000      .045     .000      .000    1488.0
 .002583      350.      300.      280.         4         0        0       .00     225.0

*SECNO 9.970

3301 HV CHANGED MORE THAN HVINS
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 3/30/89        11:53:49

 SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS
 Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA
 TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN
 SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWI

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3710 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS=      9480.0     9610.0  TYPE=       1  TARGET=       130
   9.97      4.00   1496.00   1496.00       .00   1497.81     1.81      3.06       .4
  5000.        0.     5000.        0.        0.      464.       0.       73.       19
    .17       .00     10.79       .00      .000      .045      .000      .000   1492.0
 .020952     640.      540.      550.        20        15         0       .00    130.0

*SECNO 10.040

3301 HV CHANGED MORE THAN HVINS

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS=      9685.0     9870.0  TYPE=       1  TARGET=       185
  10.04      5.62   1500.62       .00       .00   1501.22      .59      3.29       .1
  5000.        0.     5000.        0.        0.      810.       0.       78.       20
    .18       .00      6.18       .00      .000      .045      .000      .000   1495.0
 .005090     360.      360.      280.         4         0         0       .00    185.0

CCHV=      .300 CEHV=      .500
*SECNO 10.050

3470 ENCROACHMENT STATIONS=      9880.0    10017.0  TYPE=       1  TARGET=       137
  10.05      4.97   1502.97       .00       .00   1503.83      .86      2.48       .1
  5000.        0.     5000.        0.        0.      672.       0.       86.       22
    .20       .00      7.44       .00      .000      .045      .000      .000   1498.0
 .006563     460.      430.      400.         4         0         0       .00    137.0

CCHV=      .100 CEHV=      .300
*SECNO 10.100

3301 HV CHANGED MORE THAN HVINS

3470 ENCROACHMENT STATIONS=      9947.0    10033.0  TYPE=       1  TARGET=        86
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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI
10.10	7.28	1504.58	.00	.00	1506.32	1.75	2.23	.2
5000.	0.	4997.	3.	0.	471.	2.	89.	22
.21	.00	10.61	1.78	.000	.045	.050	.000	1497.3
.010727	270.	270.	270.	2	0	0	.00	86.0

CCHV= .300 CEHV= .500
*SECNO 10.140

3470 ENCROACHMENT STATIONS= 9963.0 10038.0 TYPE= 1 TARGET= 75

10.14	6.94	1506.94	.00	.00	1508.37	1.43	1.95	.0
5000.	0.	5000.	0.	0.	520.	0.	92.	23
.21	.00	9.61	.00	.000	.045	.000	.000	1500.0
.008012	230.	212.	210.	2	0	0	.00	74.9

CCHV= .100 CEHV= .300
*SECNO 10.145

3301 HV CHANGED MORE THAN HVINS

3335 20 TRIALS ATTEMPTED WSEL,CWSEL
3393 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS= 9963.0 10038.0 TYPE= 1 TARGET= 75

10.15	5.16	1511.06	1511.06	.00	1513.66	2.60	.12	.3
5000.	0.	5000.	0.	0.	386.	0.	92.	23
.21	.00	12.95	.37	.000	.045	.050	.000	1505.9
.018826	10.	10.	10.	20	15	0	.00	74.9

*SECNO 10.165

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS= 9963.0 10038.0 TYPE= 1 TARGET= 75

10.16	7.76	1513.66	.00	.00	1514.80	1.15	.99	.1
5000.	0.	5000.	0.	0.	582.	0.	93.	23
.22	.00	8.59	.00	.000	.045	.000	.000	1505.9
.005658	105.	105.	105.	2	0	0	.00	75.0

3/30/89 11:53:49

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

```
CCHV=      .300 CEHV=      .500
*SECNO 10.180

3301 HV CHANGED MORE THAN HVINS

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS=      9950.0    10050.0  TYPE=       1  TARGET=       100
   10.18      8.69  1514.69       .00       .00  1515.28      .59       .31        .1
   5000.        0.    5000.        0.        0.     808.       0.       94.        23
     .22       .00     6.19       .00      .000     .045     .000      .000    1506.0
 .002602       90.      85.       70.         2        0        0       .00     100.0

CCHV=      .100 CEHV=      .300
*SECNO 10.250

3470 ENCROACHMENT STATIONS=      9930.0    10080.0  TYPE=       1  TARGET=       150
   10.25      9.07  1515.77       .00       .00  1516.04      .27       .73        .0
   4000.        0.    4000.        0.        0.     963.       0.      102.        24
     .24       .00     4.15       .00      .000     .045     .000      .000    1506.7
 .001445      320.     370.      400.         2        0        0       .00     150.0

*SECNO 10.400

3301 HV CHANGED MORE THAN HVINS

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS=      9970.0    10150.0  TYPE=       1  TARGET=       180
   10.40      6.13  1517.63       .00       .00  1518.59      .97      2.34        .2
   4000.        0.    3063.      937.        0.     355.     198.      115.        27
     .27       .00     8.62      4.74      .000     .045     .050      .000    1511.5
 .009934      800.     790.      650.         3        0        0       .00     178.1

*SECNO 10.550
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3/30/89 11:53:49

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

3470 ENCROACHMENT STATIONS= 9935.0 10080.0 TYPE= 1 TARGET= 145

10.55	8.44	1523.94	.00	.00	1524.79	.84	6.18	.0
4000.	27.	2970.	1003.	15.	371.	193.	126.	30
.30	1.83	8.01	5.20	.050	.045	.050	.000	1515.5
.006293	800.	790.	800.	4	0	0	.00	145.0

*SECNO 10.680

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS= 9860.0 10025.0 TYPE= 1 TARGET= 165

10.68	6.99	1526.69	.00	.00	1526.99	.31	2.15	.0
4000.	0.	3892.	108.	0.	870.	40.	137.	32
.35	.00	4.47	2.70	.000	.045	.050	.000	1519.7
.001877	620.	686.	680.	4	0	0	.00	165.0

*SECNO 10.740

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS= 9900.0 10029.0 TYPE= 1 TARGET= 129

10.74	6.36	1527.36	.00	.00	1528.44	1.08	1.21	.2
4000.	0.	4000.	0.	0.	479.	0.	142.	34
.36	.00	8.36	.00	.000	.045	.000	.000	1521.0
.011626	155.	317.	350.	2	0	0	.00	129.0

*SECNO 10.820

3301 HV CHANGED MORE THAN HVINS

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS=			9850.0	10100.0	TYPE=	1	TARGET=	250
10.82	7.49	1530.99	.00	.00	1531.35	.36	2.83	.0
4000.	0.	4000.	0.	0.	836.	0.	149.	35
.38	.00	4.78	.00	.000	.045	.000	.000	1523.5
.004364	385.	422.	375.	4	0	0	.00	250.0

*SECNO 10.980

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS=			9620.0	10100.0	TYPE=	1	TARGET=	480
10.98	6.58	1531.78	.00	.00	1531.82	.03	.44	.0
4000.	0.	4000.	0.	0.	2777.	0.	184.	42
.54	.00	1.44	.00	.000	.045	.000	.000	1525.2
.000190	980.	845.	870.	4	0	0	.00	480.0

*SECNO 11.150

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS=			9866.0	10219.0	TYPE=	1	TARGET=	353
11.15	9.89	1531.89	.00	.00	1531.90	.00	.08	.0
500.	0.	472.	28.	0.	1808.	135.	232.	51
1.51	.00	.26	.21	.000	.045	.050	.000	1522.0
.000006	970.	897.	840.	2	0	0	.00	353.0

*SECNO 11.390

3265 DIVIDED FLOW

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
3820 CRITICAL DEPTH ASSUMED

3/30/89 11:53:49

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

3470 ENCROACHMENT STATIONS=			9982.0	10680.0	TYPE=	1	TARGET=	698
11.39	1.32	1553.12	1553.12	.00	1553.46	.34	.03	.1
500.	0.	419.	81.	0.	87.	22.	262.	58
1.58	.00	4.84	3.69	.000	.045	.050	.000	1551.8
033278	1270.	1270.	1270.	20	17	0	.00	158.7

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****
HEC2 RELEASE DATED SEPT 88

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

DEER VALLEY TO DAM OUTLE

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIW
	9.200	.00	.00	.00	1447.00	5400.00	1466.75	-
	9.300	528.00	.00	.00	1466.00	5400.00	1471.73	-
*	9.320	100.00	.00	.00	1468.00	5000.00	1472.47	1472.
*	9.330	40.00	.00	.00	1468.30	5000.00	1474.03	-
*	9.340	55.00	.00	.00	1468.00	5000.00	1474.00	1474.
*	9.440	528.00	.00	.00	1474.00	5000.00	1480.86	-
	9.600	800.00	.00	.00	1479.90	5000.00	1484.09	-
*	9.800	1085.00	.00	.00	1487.30	5000.00	1490.39	1490.
*	9.860	300.00	.00	.00	1488.00	5000.00	1493.21	-
*	9.970	540.00	.00	.00	1492.00	5000.00	1496.00	1496.
*	10.040	360.00	.00	.00	1495.00	5000.00	1500.62	-
	10.050	430.00	.00	.00	1498.00	5000.00	1502.97	-
	10.100	270.00	.00	.00	1497.30	5000.00	1504.58	-
	10.140	212.00	.00	.00	1500.00	5000.00	1506.94	-
*	10.145	10.00	.00	.00	1505.90	5000.00	1511.06	1511.
*	10.165	105.00	.00	.00	1505.90	5000.00	1513.66	-
*	10.180	85.00	.00	.00	1506.00	5000.00	1514.69	-

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	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIW
	10.250	370.00	.00	.00	1506.70	4000.00	1515.77	-
*	10.400	790.00	.00	.00	1511.50	4000.00	1517.63	-
	10.550	790.00	.00	.00	1515.50	4000.00	1523.94	-
*	10.680	686.00	.00	.00	1519.70	4000.00	1526.69	-
*	10.740	317.00	.00	.00	1521.00	4000.00	1527.36	-
*	10.820	422.00	.00	.00	1523.50	4000.00	1530.99	-
*	10.980	845.00	.00	.00	1525.20	4000.00	1531.78	-
*	11.150	897.00	.00	.00	1522.00	500.00	1531.89	-
*	11.390	1270.00	.00	.00	1551.80	500.00	1553.12	1553.

3/30/89 11:53:49

DEER VALLEY TO DAM OUTLE

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	9.200	5400.00	1466.75	.00	.00	.00	146.56	.
	9.300	5400.00	1471.73	.00	4.98	.00	209.00	528.
*	9.320	5000.00	1472.47	.00	.74	.00	128.93	100.
*	9.330	5000.00	1474.03	.00	1.56	.00	195.00	40.
*	9.340	5000.00	1474.00	.00	-.03	.00	86.99	55.
*	9.440	5000.00	1480.86	.00	6.86	.00	210.00	528.
	9.600	5000.00	1484.09	.00	3.23	.00	280.00	800.
*	9.800	5000.00	1490.39	.00	6.30	.00	205.00	1085.
*	9.860	5000.00	1493.21	.00	2.82	.00	225.00	300.
*	9.970	5000.00	1496.00	.00	2.79	.00	130.00	540.
*	10.040	5000.00	1500.62	.00	4.63	.00	185.00	360.
	10.050	5000.00	1502.97	.00	2.34	.00	137.00	430.
	10.100	5000.00	1504.58	.00	1.61	.00	86.00	270.
	10.140	5000.00	1506.94	.00	2.36	.00	74.95	212.
*	10.145	5000.00	1511.06	.00	4.12	.00	74.91	10.
*	10.165	5000.00	1513.66	.00	2.59	.00	75.00	105.
*	10.180	5000.00	1514.69	.00	1.03	.00	100.00	85.
	10.250	4000.00	1515.77	.00	1.08	.00	150.00	370.
*	10.400	4000.00	1517.63	.00	1.85	.00	178.13	790.
	10.550	4000.00	1523.94	.00	6.32	.00	145.00	790.
*	10.680	4000.00	1526.69	.00	2.74	.00	165.00	686.
*	10.740	4000.00	1527.36	.00	.67	.00	129.00	317.
*	10.820	4000.00	1530.99	.00	3.63	.00	250.00	422.
*	10.980	4000.00	1531.78	.00	.79	.00	480.00	845.

3/30/89 11:53:49

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	11.150	500.00	1531.89	.00	.11	.00	353.00	897.
*	11.390	500.00	1553.12	.00	21.23	.00	158.71	1270.

3/30/89 11:53:49

SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION	SECNO=	9.320	PROFILE= 1	CRITICAL DEPTH ASSUMED
CAUTION	SECNO=	9.320	PROFILE= 1	MINIMUM SPECIFIC ENERGY
WARNING	SECNO=	9.330	PROFILE= 1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION	SECNO=	9.340	PROFILE= 1	CRITICAL DEPTH ASSUMED
CAUTION	SECNO=	9.340	PROFILE= 1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION	SECNO=	9.340	PROFILE= 1	20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING	SECNO=	9.440	PROFILE= 1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION	SECNO=	9.800	PROFILE= 1	CRITICAL DEPTH ASSUMED
CAUTION	SECNO=	9.800	PROFILE= 1	MINIMUM SPECIFIC ENERGY
WARNING	SECNO=	9.860	PROFILE= 1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION	SECNO=	9.970	PROFILE= 1	CRITICAL DEPTH ASSUMED
CAUTION	SECNO=	9.970	PROFILE= 1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION	SECNO=	9.970	PROFILE= 1	20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING	SECNO=	10.040	PROFILE= 1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION	SECNO=	10.145	PROFILE= 1	CRITICAL DEPTH ASSUMED
CAUTION	SECNO=	10.145	PROFILE= 1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION	SECNO=	10.145	PROFILE= 1	20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING	SECNO=	10.165	PROFILE= 1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING	SECNO=	10.180	PROFILE= 1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING	SECNO=	10.400	PROFILE= 1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING	SECNO=	10.680	PROFILE= 1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING	SECNO=	10.740	PROFILE= 1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING	SECNO=	10.820	PROFILE= 1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING	SECNO=	10.980	PROFILE= 1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING	SECNO=	11.150	PROFILE= 1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION	SECNO=	11.390	PROFILE= 1	CRITICAL DEPTH ASSUMED
CAUTION	SECNO=	11.390	PROFILE= 1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION	SECNO=	11.390	PROFILE= 1	20 TRIALS ATTEMPTED TO BALANCE WSEL

APPENDIX "B"

HEC-2 Input and Output for Existing Conditions at 5400 cfs (Floodplain and Floodway)

FPLN5400.DAT

Existing Conditions
Floodplain
Q = 5400 cfs

```
1CELLA,BARR,EVANS AND ASSOCIATES
2CAVE CK WASH FLOOD INSURANCE STUDY
3       DEER VALLEY TO DAM OUTLET                                                    1466.75
    -10       2
      1              -1
C 0.045   0.045    0.04      .1      .3
      1    5400
    9.2      26    9944   10266
R  1486    9840    1480    9852    1478    9860  1476.4    9880    1476    9944
R  1447    9960    1472    9964    1470    9968    1462    9980    1460    9990
R 1459.5  10000    1460   10018  1461.4   10020    1464   10021    1466   10026
R  1470   10036    1472   10040    1474   10106    1470   10116    1464   10128
R1462.8   10150    1464   10168    1466   10196    1470   10220    1480   10266
R  1490   10290
C  0.05    0.05   0.045     0.3     0.5
1   9.3      13    9840   10056     900     340     528
R  1480    9840    1468    9840    1468    9880    1468    9900    1468    9950
R  1468   10005    1466   10030    1467   10040    1470   10048    1476   10056
R  1478   10170    1478   10295    1480   10310
1   9.32     16    9880   10070     125      80     100
R 1482.8   9700    1480    9880    1472    9930    1470    9931    1468   10016
R  1468   10048    1470   10053    1480   10068    1482   10070    1484   10085
R  1486   10120  1487.9   10155    1486   10180    1484   10190    1482   10225
R  1484   10260
C                         0.1     0.3
1   9.33     16    9900   10075      30      40      40
R  1482    9410    1480    9530    1480    9820    1478    9845    1476    9870
R  1474    9900    1472    9925    1470    9955  1468.3   10045    1470   10050
R  1472   10075    1474   10095    1476   10120    1478   10138    1480   10175
R  1490   10400
    9.34     12    9950   10072      40      50      55
R  1482    9440    1480    9560    1480    9675    1480    9840    1480    9950
R  1470    9975    1468    9980    1468   10010    1470   10042    1482   10072
R  1488   10090    1490   10120
C                         0.3     0.5
1   9.44     15    9400    9860     100     510     528
R  1485    9190    1482    9230    1480    9235    1480    9400  1478.9    9480
R  1478    9600    1476    9794    1474    9800    1476    9810    1478    9837
R  1480    9848    1481    9851    1482    9854    1483    9857    1484    9860
                          0.1     0.3
    9.6      17    9060    9600     620     800     800
R  1488    8825    1486    8830    1484    8835  1483.2    8837    1482    8840
R  1482    8975  1483.7    9060    1482    9105  1481.4    9220    1480    9370
R 1479.9   9460    1480    9570    1484    9600    1484    9700    1486    9800
R  1488    9920  1491.2    9980
1   9.8      13    9315    9786    1100     930    1085
R  1504    9150    1494    9210    1492    9290    1490    9315    1488    9360
R  1488    9430  1487.3    9610    1488    9650    1490    9785    1492    9786
R  1494    9890    1498    9893    1498    9960
    9.86     10    9400    9805     350     280     300
R  1500    9295    1494    9345    1492    9400    1490    9420    1488    9425
R  1488    9475    1490    9795    1498    9805    1500    9895    1502    9900
1   9.97     14    9460    9655     640     550     540
R  1506    9204    1496    9210    1494    9215    1492    9225    1494    9275
R  1494    9460    1492    9461    1492    9505  1492.4    9555    1494    9654
R  1496    9655    1498    9656    1500    9685    1502    9700
   10.04     13    9665    9955     360     280     360
R  1510    9612    1510    9650    1510    9665    1498    9685    1496    9735
R  1496    9810    1495    9830    1496 B-1 9850    1498    9875    1500    9880
```

1 10.05	8	9840	10040	[illegible]	[illegible]	[illegible]			
R 1504	9840	1500	9860	1498	9890	1498	10010	1500	10020
R 1502	10028	1503.6	10040	1504	10360				
C			0.1	0.3					
1 10.1	13	9942	10030	270	270	270			
R 1508.5	9910	1508	9942	1504	9947	1502	9950	1500	9954
R 1498	9957	1497.3	9975	1498	10000	1500	10020	1502	10025
R 1504	10030	1506	10070	1507	10190				
C			0.3	0.5					
1 10.14	22	9963	10038	230	210	212			
R 1520	9460	1516	9490	1516	9584	1514	9590	1512	9700
R 1510	9765	1508	9830	1508	9900	1510	9905	1510	9930
R 1508	9935	1509	9963	1500	9963.1	1500	10037.9	1509	10038
R 1508	10055	1508	10115	1510	10130	1510	10200	1512	10230
R 1514	10270	1514	10430						
C			0.1	0.3					
1 10.145	9	9963	10038	10	10	10			
R 1520	9460	1516	9490	1516	9580	1515	9590	1515	9963
R 1505.9	9963.1	1505.9	10037.9	1515	10038	1514	10460		
1 0.165	11	9963	10038	105	105	105			
R 1520	9520	1516	9530	1515	9570	1515	9963	1505.9	9963
R 1505.9	10038	1515	10038	1515	10140	1516	10180	1518	10190
R 1520	10250								
C			0.3	0.5					
1 10.18	19	9900	10096	90	70	85			
R 1530	9520	1520	9580	1518	9590	1518	9672	1516	9710
R 1514	9740	1514	9900	1508	9930	1506	9958	1506	10002
R 1508	10040	1508	10075	1510	10080	1514	10096	1516	10160
R 1518	10180	1520	10210	1522	10260	1523.5	10370		
C			0.1	0.3					
1 10.25	22	9845	10185	320	400	370			
R 1521.4	8840	1520	9145	1518	9180	1516	9210	1516	9375
R 1514	9470	1514	9540	1512	9555	1512	9620	1511.6	9700
R 1512	9790	1513.6	9845	1512	9900	1510	9948	1506.7	9975
R 1508	9994	1510	10040	1511	10048	1511.1	10185	1512	10328
R 1520	10332	1530	10343						
1 10.4	23	9970	10054	800	650	790			
R 1518	9740	1518	9750	1518	9760	1518	9780	1518	9800
R 1514	9810	1516	9825	1514	9850	1516	9863	1518	9952
R 1518	9970	1516	9980	1512	9986	1511.5	9990	1512	10004
R 1514	10048	1515.4	10054	1516	10230	1516	10400	1514	10410
R 1514	10435	1520	10445	1530	10458				
1 10.55	15	9956	10024	800	800	790			
R 1524	9800	1523.8	9830	1523.7	9860	1523.5	9880	1523.2	9956
R 1522	9966	1520	9974	1518	9986	1516	9992	1515.5	10000
R 1516	10010	1518	10018	1520	10024	1522	10136	1530	10155
1 10.68	10	9705	10032	620	680	686			
R1528.5	9615	1528	9705	1526	9800	1524	9850	1522	9880
R 1520	9990	1519.7	10000	1520	10014	1530	10032	1540	10042
1 10.74	15	9840	10032	155	350	317			
R1529.5	9740	1528.5	9840	1528	9850	1526	9870	1524	9970
R 1522	9982	1521	10010	1522	10018	1524	10020	1526	10028
R 1530	10032	1532	10056	1534	10105	1534	10320	1540	10400
1 10.82	23	9825	10163	385	375	422			
R 1532	9680	1530	9825	1528	9840	1526	9870	1524	9878
R 1523.5	9885	1524	9895	1526	9915	1528	9928	1530	9935
R1528.3	9960	1528	9985	1526	10000	1528	10005	1529.7	10080
R 1528	10115	1526	10116	1524	10125	1526	10158	1530	10160
R 1532	10163	1534	10175	1536	10200				
1 10.98	7	9530	10140	980	870	845			
R 1544	9530	1524	9553	1526	9560	1526	10098	1524	10103
R 1530	10118	1536	10140						
1	420								
1 11.15	13	9850	10230	970	B-2 840	897			

R	1524	10010	1528	10040	1524	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
R	1526	10190	1528	10216	1540	10230				
	11.39	15	9700	10800	1270	1270	1270			
	1560	9700	1556	9770	1554	9970	1552	10000	1554	10120
R	1556	10280	1558	10370	1558	10550	1551.8	10560	1551.8	10585
	1560	10600	1554	10630	1552	10640	1554	10710	1556	10800
R										

FPLN5400.OUT

Existing Conditions

Q = 5400 / 420 cfs

Floodplain

```
*******************************************************
*  WATER SURFACE PROFILES                             *
*  VERSION OF SEPTEMBER 1988                          *
*                                                     *
*                                                     *
*  RUN DATE      1/ 1/80    TIME     1:51:36          *
*******************************************************
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```
X      X  XXXXXXX   XXXXX
X      X  X         X      X
X      X  X         X
XXXXXXX   XXXX      X           XXXXX
X      X  X         X
X      X  X         X      X
X      X  XXXXXXX   XXXXX
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END OF BANNER

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1/ 1/80        1:51:36


*****************************************************
 HEC2 RELEASE DATED SEPT 88

*****************************************************


T1CELLA,BARR,EVANS AND ASSOCIATES
T2CAVE CK WASH FLOOD INSURANCE STUDY
T3      DEER VALLEY TO DAM OUTLET

J1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q

    -10        2

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW

     1                  -1
```

1/ 1/80 1:51:36

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

*PROF 1

CCHV= .100 CEHV= .300
SECNO 9.200

3265 DIVIDED FLOW

9.20	19.75	1466.75	.00	1466.75	1467.90	1.15	.00	.0
5400.	0.	5400.	0.	0.	627.	0.	0.	0
.00	.00	8.61	.00	.000	.040	.000	.000	1447.0
.010235	0.	0.	0.	0	0	0	.00	147.0

CHV= .300 CEHV= .500
*SECNO 9.300

9.30	5.73	1471.73	.00	.00	1472.41	.68	4.37	.1
5400.	0.	5400.	0.	0.	814.	0.	9.	2
.02	.00	6.63	.00	.000	.045	.000	.000	1466.0
.006838	900.	528.	340.	3	0	0	.00	210.3

*SECNO 9.320

301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
720 CRITICAL DEPTH ASSUMED

9.32	4.68	1472.68	1472.68	.00	1474.57	1.89	1.09	.6
5400.	0.	5400.	0.	0.	489.	0.	10.	3
.02	.00	11.04	.00	.000	.045	.000	.000	1468.0
.019830	125.	100.	80.	3	15	0	.00	131.2

CHV= .100 CEHV= .300
*SECNO 9.330

301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

9.33	5.98	1474.28	.00	.00	1475.16	.89	.49	.1
5400.	0.	5318.	82.	1.	699.	26.	11.	3
.03	.72	7.61	3.15	.050	.045	.050	.000	1468.3
.008416	30.	40.	40.	4	0	0	.00	202.5

1/ 1/80 1:51:36

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

*SECNO 9.340

3301 HV CHANGED MORE THAN HVINS

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

9.34	6.27	1474.27	1474.27	.00	1476.73	2.46	.66	.4
5400.	0.	5400.	0.	0.	429.	0.	12.	3
.03	.00	12.59	.00	.000	.045	.000	.000	1468.0
.018259	40.	55.	50.	20	8	0	.00	88.3

CCHV= .300 CEHV= .500
*SECNO 9.440

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

9.44	6.72	1480.72	.00	.00	1480.96	.24	3.56	.6
5400.	170.	5230.	0.	120.	1308.	0.	22.	6
.06	1.42	4.00	.00	.050	.045	.000	.000	1474.0
.003547	100.	528.	510.	4	0	0	.00	616.9

CCHV= .100 CEHV= .300
*SECNO 9.600

3265 DIVIDED FLOW

9.60	3.55	1483.45	.00	.00	1483.63	.18	2.66	.0
5400.	493.	4907.	0.	249.	1382.	0.	50.	18
.13	1.98	3.55	.00	.050	.045	.000	.000	1479.9
.003215	620.	800.	800.	5	0	0	.00	739.7

*SECNO 9.800

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

9.80	2.70	1490.00	1489.78	.00	1490.65	.65	6.88	.1
5400.	0.	5400.	0.	0.	835.	0.	80.	33
.18	.00	6.47	.00	.000	.045	.000	.000	1487.3
.017816	1100.	1085.	930.	12	19	0	.00	469.5

1/ 1/80 1:51:36

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

*SECNO 9.860

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

9.86	4.30	1492.30	.00	.00	1492.56	.26	1.87	.0
5400.	1.	5399.	0.	1.	1316.	0.	88.	36
.20	.47	4.10	.00	.050	.045	.000	.000	1488.0
.003145	350.	300.	280.	3	0	0	.00	406.0

*SECNO 9.970

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

9.97	3.24	1495.24	.00	.00	1495.92	.68	3.23	.1
5400.	1751.	3649.	0.	365.	499.	0.	102.	42
.22	4.79	7.31	.00	.050	.045	.000	.000	1492.0
.014182	640.	540.	550.	3	0	0	.00	442.7

*SECNO 10.040

10.04	4.74	1499.74	.00	.00	1500.77	1.04	4.75	.1
5400.	0.	5400.	0.	0.	661.	0.	108.	44
.23	.00	8.17	.00	.000	.045	.000	.000	1495.0
.012290	360.	360.	280.	3	0	0	.00	197.2

CCHV= .300 CEHV= .500
*SECNO 10.050

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.05	5.40	1503.40	.00	.00	1503.99	.59	3.08	.1
5400.	0.	5400.	0.	0.	880.	0.	116.	46
.25	.00	6.14	.00	.000	.045	.000	.000	1498.0
.004680	460.	430.	400.	3	0	0	.00	195.5

CCHV= .100 CEHV= .300
*SECNO 10.100

3301 HV CHANGED MORE THAN HVINS

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 1/ 1/80        1:51:36

 SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS
 Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA
 TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN
 SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWI


302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

   10.10      7.00  1504.30       .00       .00  1506.55      2.25      2.07        .5
   5400.        0.    5399.        1.        0.     448.        1.      120.        47
     .26       .00    12.04      1.03      .000      .045      .050      .000    1497.3
 .014719      270.     270.      270.         3         0         0       .00      89.4


CCHV=      .300 CEHV=      .500
*SECNO 10.140

301 HV CHANGED MORE THAN HVINS


302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

   10.14      7.50  1507.50       .00       .00  1508.94      1.43      2.14        .2
   5400.        0.    5400.        0.        0.     562.        0.      122.        48
     .26       .00     9.61       .00      .000      .045      .000      .000    1500.0
 .007350      230.     212.      210.         3         0         0       .00      74.9


CCHV=      .100 CEHV=      .300
*SECNO 10.145

3301 HV CHANGED MORE THAN HVINS

685 20 TRIALS ATTEMPTED WSEL,CWSEL
693 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED
   10.15      5.44  1511.34  1511.34       .00  1514.07      2.73       .11        .3
   5400.        0.    5400.        0.        0.     407.        0.      122.        48
     .26       .00    13.26       .00      .000      .045      .000      .000    1505.9
 .020178       10.      10.       10.        20        15         0       .00      74.9


*SECNO 10.165

301 HV CHANGED MORE THAN HVINS
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1/ 1/80 1:51:36

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.16	8.13	1514.03	.00	.00	1515.24	1.22	1.02	.1
5400.	0.	5400.	0.	0.	610.	0.	123.	48
.27	.00	8.86	.00	.000	.045	.000	.000	1505.9
.005713	105.	105.	105.	2	0	0	.00	75.0

CCHV= .300 CEHV= .500
*SECNO 10.180

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.18	9.52	1515.52	.00	.00	1515.69	.18	.14	.3
5400.	275.	5100.	25.	260.	1469.	37.	126.	48
.27	1.06	3.47	.68	.050	.045	.050	.000	1506.0
.000762	90.	85.	70.	2	0	0	.00	427.3

CCHV= .100 CEHV= .300
*SECNO 10.250

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.25	9.14	1515.84	.00	.00	1515.87	.04	.16	.0
5400.	1554.	3021.	825.	1352.	1774.	616.	148.	54
.34	1.15	1.70	1.34	.050	.045	.050	.000	1506.7
.000294	320.	370.	400.	2	0	0	.00	946.9

*SECNO 10.400

3265 DIVIDED FLOW

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY

1/ 1/80 1:51:36

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

3720 CRITICAL DEPTH ASSUMED

10.40	5.44	1516.94	1516.94	.00	1517.74	.80	.67	.2
5400.	630.	2739.	2032.	134.	300.	479.	189.	67
.37	4.71	9.12	4.24	.050	.045	.050	.000	1511.5
.013127	800.	790.	650.	20	14	0	.00	566.9

*SECNO 10.550

3280 CROSS SECTION 10.55 EXTENDED .19 FEET

10.55	8.69	1524.19	.00	.00	1525.04	.85	7.28	.0
5400.	187.	3309.	1905.	97.	387.	363.	205.	75
.40	1.92	8.54	5.25	.050	.045	.050	.000	1515.5
.006756	800.	790.	800.	5	0	0	.00	341.2

*SECNO 10.680

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.68	7.76	1527.46	.00	.00	1527.75	.29	2.66	.0
5400.	0.	5400.	0.	0.	1252.	0.	222.	80
.45	.00	4.31	.00	.000	.045	.000	.000	1519.7
.002526	620.	686.	680.	3	0	0	.00	297.0

*SECNO 10.740

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.74	7.41	1528.41	.00	.00	1529.27	.86	1.34	.1
5400.	0.	5400.	0.	0.	727.	0.	229.	82
.46	.00	7.43	.00	.000	.045	.000	.000	1521.0
.008533	155.	317.	350.	2	0	0	.00	188.7

1/ 1/80 1:51:36

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

*SECNO 10.820

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.82	7.58	1531.08	.00	.00	1531.37	.29	2.05	.0
5400.	47.	5353.	0.	43.	1234.	0.	239.	85
.49	1.11	4.34	.00	.050	.045	.000	.000	1523.5
.003129	385.	422.	375.	2	0	0	.00	415.4

*SECNO 10.980

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.98	7.85	1531.85	.00	.00	1531.89	.04	.49	.0
5400.	0.	5400.	0.	0.	3341.	0.	283.	94
.63	.00	1.62	.00	.000	.045	.000	.000	1524.0
.000235	980.	845.	870.	4	0	0	.00	580.7

*SECNO 11.150

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

11.15	9.99	1531.99	.00	.00	1531.99	.00	.10	.0
420.	0.	420.	0.	0.	1978.	0.	338.	104
1.81	.00	.21	.00	.000	.045	.000	.000	1522.0
.000004	970.	897.	840.	2	0	0	.00	355.6

*SECNO 11.390

3265 DIVIDED FLOW

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

11.39	1.22	1553.02	1553.02	.00	1553.34	.32	.02	.1
420.	0.	420.	0.	0.	93.	0.	368.	111
1.88	.00	4.53	.00	.000	.045	.000	.000	1551.8
.034822	1270.	1270.	1270.	20	17	0	.00	146.3

1/ 1/80 1:51:36

****
HEC2 RELEASE DATED SEPT 88

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

DEER VALLEY TO DAM OUTLE

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIW
	9.200	.00	.00	.00	1447.00	5400.00	1466.75	.
	9.300	528.00	.00	.00	1466.00	5400.00	1471.73	.
*	9.320	100.00	.00	.00	1468.00	5400.00	1472.68	1472.
*	9.330	40.00	.00	.00	1468.30	5400.00	1474.28	.
*	9.340	55.00	.00	.00	1468.00	5400.00	1474.27	1474.
*	9.440	528.00	.00	.00	1474.00	5400.00	1480.72	.
	9.600	800.00	.00	.00	1479.90	5400.00	1483.45	.
*	9.800	1085.00	.00	.00	1487.30	5400.00	1490.00	1489.
*	9.860	300.00	.00	.00	1488.00	5400.00	1492.30	.
*	9.970	540.00	.00	.00	1492.00	5400.00	1495.24	.
	10.040	360.00	.00	.00	1495.00	5400.00	1499.74	.
*	10.050	430.00	.00	.00	1498.00	5400.00	1503.40	.
*	10.100	270.00	.00	.00	1497.30	5400.00	1504.30	.
*	10.140	212.00	.00	.00	1500.00	5400.00	1507.50	.
*	10.145	10.00	.00	.00	1505.90	5400.00	1511.34	1511.
*	10.165	105.00	.00	.00	1505.90	5400.00	1514.03	.
*	10.180	85.00	.00	.00	1506.00	5400.00	1515.52	.

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	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIW
*	10.250	370.00	.00	.00	1506.70	5400.00	1515.84	.
*	10.400	790.00	.00	.00	1511.50	5400.00	1516.94	1516.
	10.550	790.00	.00	.00	1515.50	5400.00	1524.19	.
*	10.680	686.00	.00	.00	1519.70	5400.00	1527.46	.
*	10.740	317.00	.00	.00	1521.00	5400.00	1528.41	.
*	10.820	422.00	.00	.00	1523.50	5400.00	1531.08	.
*	10.980	845.00	.00	.00	1524.00	5400.00	1531.85	.
*	11.150	897.00	.00	.00	1522.00	420.00	1531.99	.
*	11.390	1270.00	.00	.00	1551.80	420.00	1553.02	1553.

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EER VALLEY TO DAM OUTLE

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	9.200	5400.00	1466.75	.00	.00	.00	147.06	.
	9.300	5400.00	1471.73	.00	4.98	.00	210.31	528.
	9.320	5400.00	1472.68	.00	.95	.00	131.25	100.
*	9.330	5400.00	1474.28	.00	1.60	.00	202.55	40.
*	9.340	5400.00	1474.27	.00	-.00	.00	88.36	55.
	9.440	5400.00	1480.72	.00	6.45	.00	616.97	528.
	9.600	5400.00	1483.45	.00	2.73	.00	739.71	800.
	9.800	5400.00	1490.00	.00	6.55	.00	469.59	1085.
*	9.860	5400.00	1492.30	.00	2.30	.00	406.07	300.
*	9.970	5400.00	1495.24	.00	2.94	.00	442.71	540.
	10.040	5400.00	1499.74	.00	4.49	.00	197.23	360.
*	10.050	5400.00	1503.40	.00	3.67	.00	195.52	430.
*	10.100	5400.00	1504.30	.00	.90	.00	89.47	270.
*	10.140	5400.00	1507.50	.00	3.20	.00	74.97	212.
*	10.145	5400.00	1511.34	.00	3.84	.00	74.92	10.
*	10.165	5400.00	1514.03	.00	2.69	.00	75.00	105.
*	10.180	5400.00	1515.52	.00	1.49	.00	427.37	85.
*	10.250	5400.00	1515.84	.00	.32	.00	946.99	370.
*	10.400	5400.00	1516.94	.00	1.11	.00	566.95	790.
	10.550	5400.00	1524.19	.00	7.25	.00	341.20	790.
*	10.680	5400.00	1527.46	.00	3.27	.00	297.05	686.
*	10.740	5400.00	1528.41	.00	.95	.00	188.75	317.
*	10.820	5400.00	1531.08	.00	2.67	.00	415.49	422.
*	10.980	5400.00	1531.85	.00	.76	.00	580.79	845.

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	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	11.150	420.00	1531.99	.00	.14	.00	355.63	897.
	11.390	420.00	1553.02	.00	21.03	.00	146.38	1270.

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SUMMARY OF ERRORS AND SPECIAL NOTES

```
CAUTION SECNO=      9.320  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      9.320  PROFILE=  1  MINIMUM SPECIFIC ENERGY

WARNING SECNO=      9.330  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

CAUTION SECNO=      9.340  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=      9.340  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=      9.340  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO=      9.440  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

WARNING SECNO=      9.800  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

WARNING SECNO=      9.860  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

WARNING SECNO=      9.970  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

WARNING SECNO=     10.050  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

WARNING SECNO=     10.100  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

WARNING SECNO=     10.140  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

CAUTION SECNO=     10.145  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     10.145  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=     10.145  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO=     10.165  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

WARNING SECNO=     10.180  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

WARNING SECNO=     10.250  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

CAUTION SECNO=     10.400  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     10.400  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=     10.400  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO=     10.680  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

WARNING SECNO=     10.740  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

WARNING SECNO=     10.820  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

WARNING SECNO=     10.980  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

WARNING SECNO=     11.150  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

CAUTION SECNO=     11.390  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     11.390  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=     11.390  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL
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Existing Conditions

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1CELLA,BARR,EVANS AND ASSOCIATES
CAVE CK WASH FLOOD INSURANCE STUDY
      DEER VALLEY TO DAM OUTLET
1   -10       2                                                   1466.75
      1              -1
  0.045   0.045    0.04      .1      .3
T     1    5400
             9.1                                                   9949    10200
    9.2      26    9944   10266
R  1486    9840    1480    9852    1478    9860  1476.4    9880    1476    9944
R  1447    9960    1472    9964    1470    9968    1462    9980    1460    9990
R1459.5   10000    1460   10018  1461.4   10020    1464   10021    1466   10026
R  1470   10036    1472   10040    1474   10106    1470   10116    1464   10128
R1462.8   10150    1464   10168    1466   10196    1470   10220    1480   10266
R  1490   10290
  0.05     0.05   0.045     0.3     0.5
T            9.1                                                    9840    10049
    9.3      13    9840   10056     900     340     528
R  1480    9840    1468    9840    1468    9880    1468    9900    1468    9950
R  1468   10005    1466   10030    1467   10040    1470   10048    1476   10056
R  1478   10170    1478   10295    1480   10310
             9.1                                                    9927    10056
   9.32      16    9880   10070     125      80     100
R1482.8    9700    1480    9880    1472    9930    1470    9931    1468   10016
R  1468   10048    1470   10053    1480   10068    1482   10070    1484   10085
R  1486   10120  1487.9   10155    1486   10180    1484   10190    1482   10225
R  1484   10260
C                          0.1     0.3
             9.1                                                    9900    10095
   9.33      16    9900   10075      30      40      40
R  1482    9410    1480    9530    1480    9820    1478    9845    1476    9870
R  1474    9900    1472    9925    1470    9955  1468.3   10045    1470   10050
R  1472   10075    1474   10095    1476   10120    1478   10138    1480   10175
R  1490   10400
T            9.1                                                    9965    10052
   9.34      12    9950   10072      40      50      55
R  1482    9440    1480    9560    1480    9675    1480    9840    1480    9950
R  1470    9975    1468    9980    1468   10010    1470   10042    1482   10072
R  1488   10090    1490   10120
C                          0.3     0.5
T            9.1                                                    9620     9830
   9.44      15    9400    9860     100     510     528
R  1485    9190    1482    9230    1480    9235    1480    9400  1478.9    9480
R  1478    9600    1476    9794    1474    9800    1476    9810    1478    9837
R  1480    9848    1481    9851    1482    9854    1483    9857    1484    9860
C                          0.1     0.3
T            9.1                                                    9280    9560
   9.6      17    9060    9600     620     800     800
R  1488    8825    1486    8830    1484    8835  1483.2    8837    1482    8840
R  1482    8975  1483.7    9060    1482    9105  1481.4    9220    1480    9370
R1479.9    9460    1480    9570    1484    9600    1484    9700    1486    9800
R  1488    9920  1491.2    9980
T            9.1                                                    9495    9700
   9.8      13    9315    9786    1100     930    1085
R  1504    9150    1494    9210    1492    9290    1490    9315    1488    9360
R  1488    9430  1487.3    9610    1488    9650    1490    9785    1492    9786
R  1494    9890    1498    9893    1498    9960
T            9.1                                                    9425    9650
   9.86      10    9400    9805     350     280     300
R  1500    9295    1494    9345    1492    9400    1490    9420    1488    9425
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1  9.97      14    9460    9655     640     550     540
R  1506    9204    1496    9210    1494    9215    1492    9225    1494    9275
R  1494    9460    1492    9461    1492    9505  1492.4    9555    1494    9654
R  1496    9655    1498    9656    1500    9685    1502    9700
T            9.1                                                   9685    9870
1 10.04      13    9665    9955     360     280     360
R  1510    9612    1510    9650    1510    9665    1498    9685    1496    9735
R  1496    9810    1495    9830    1496    9850    1498    9875    1500    9880
R  1502    9905    1504    9918    1505    9955
C                          0.3     0.5
T            9.1                                                   9880   10017
1 10.05       8    9840   10040     460     400     430
R  1504    9840    1500    9860    1498    9890    1498   10010    1500   10020
R  1502   10028  1503.6   10040    1504   10360
C                          0.1     0.3
T            9.1                                                   9947   10033
1  10.1      13    9942   10030     270     270     270
R1508.5    9910    1508    9942    1504    9947    1502    9950    1500    9954
R  1498    9957  1497.3    9975    1498   10000    1500   10020    1502   10025
R  1504   10030    1506   10070    1507   10190
C                          0.3     0.5
T            9.1                                                   9963   10038
1 10.14      22    9963   10038     230     210     212
R  1520    9460    1516    9490    1516    9584    1514    9590    1512    9700
R  1510    9765    1508    9830    1508    9900    1510    9905    1510    9930
R  1508    9935    1509    9963    1500  9963.1    1500 10037.9    1509   10038
R  1508   10055    1508   10115    1510   10130    1510   10200    1512   10230
R  1514   10270    1514   10430
C                          0.1     0.3
T            9.1                                                   9963   10038
110.145       9    9963   10038      10      10      10
R  1520    9460    1516    9490    1516    9580    1515    9590    1515    9963
R1505.9  9963.1  1505.9 10037.9    1515   10038    1514   10460
T            9.1                                                   9963   10038
110.165      11    9963   10038     105     105     105
R  1520    9520    1516    9530    1515    9570    1515    9963  1505.9    9963
R1505.9   10038    1515   10038    1515   10140    1516   10180    1518   10190
R  1520   10250
C                          0.3     0.5
T            9.1                                                   9950   10050
1 10.18      19    9900   10096      90      70      85
R  1530    9520    1520    9580    1518    9590    1518    9672    1516    9710
R  1514    9740    1514    9900    1508    9930    1506    9958    1506   10002
R  1508   10040    1508   10075    1510   10080    1514   10096    1516   10160
R  1518   10180    1520   10210    1522   10260  1523.5   10370
C                          0.1     0.3
T            9.1                                                   9930   10080
1 10.25      22    9845   10185     320     400     370
R1521.4    8840    1520    9145    1518    9180    1516    9210    1516    9375
R  1514    9470    1514    9540    1512    9555    1512    9620  1511.6    9700
R  1512    9790  1513.6    9845    1512    9900    1510    9948  1506.7    9975
R  1508    9994    1510   10040    1511   10048  1511.1   10185    1512   10328
R  1520   10332    1530   10343
T            9.1                                                   9970   10150
1  10.4      23    9970   10054     800     650     790
R  1518    9740    1518    9750    1518    9760    1518    9780    1518    9800
R  1514    9810    1516    9825    1514    9850    1516    9863    1518    9952
R  1518    9970    1516    9980    1512    9986  1511.5    9990    1512   10004
R  1514   10048  1515.4   10054    1516   10230    1516   10400    1514   10410
R  1514   10435    1520   10445    1530   10458
T            9.1                                                   9957   10058
1 10.55      15    9956   10024     800     800     790
R  1524    9800  1523.8    9830  1523.7    9860  1523.5    9880  1523.2    9956
R  1522    9966    1520    9974    1518    9986    1516    9992  1515.5   10000
```

T		9.1							9902	10042
1	10.68	10	9705	10032	620	680	686			
R	1528.5	9615	1528	9705	1526	9800	1524	9850	1522	9880
R	1520	9990	1519.7	10000	1520	10014	1530	10032	1540	10042
T		9.1							9866	10004
1	10.74	15	9840	10032	155	350	317			
R	1529.5	9740	1528.5	9840	1528	9850	1526	9870	1524	9970
R	1522	9982	1521	10010	1522	10018	1524	10020	1526	10028
R	1530	10032	1532	10056	1534	10105	1534	10320	1540	10400
T		9.1							9860	10090
1	10.82	23	9825	10163	385	375	422			
R	1532	9680	1530	9825	1528	9840	1526	9870	1524	9878
R	1523.5	9885	1524	9895	1526	9915	1528	9928	1530	9935
R	1528.3	9960	1528	9985	1526	10000	1528	10005	1529.7	10080
R	1528	10115	1526	10116	1524	10125	1526	10158	1530	10160
R	1532	10163	1534	10175	1536	10200				
T		9.1							9567	10102
1	10.98	7	9530	10140	980	870	845			
R	1544	9530	1524	9553	1526	9560	1526	10098	1524	10103
R	1530	10118	1536	10140						
T	1	420								
T		9.1							9940	10165
1	11.15	13	9850	10230	970	840	897			
R	1542	9850	1530	9868	1528	9945	1526	9990	1522	10000
R	1524	10010	1528	10020	1524	10070	1524	10150	1528	10165
R	1526	10190	1528	10216	1540	10230				
T		9.1							10062	10600
1	11.39	15	9700	10800	1270	1270	1270			
R	1560	9700	1556	9770	1554	9970	1552	10000	1554	10120
R	1556	10280	1558	10370	1558	10550	1551.8	10560	1551.8	10585
R	1560	10600	1554	10630	1552	10640	1554	10710	1556	10800
J										

FWAY5400.OUT

Existing Conditions

Q = 5400 / 420 cfs

Floodway

```
*****************************************************
  WATER SURFACE PROFILES                            *
  VERSION OF SEPTEMBER 1988                         *
*                                                   *
*                                                   *
  RUN DATE      1/ 1/80   TIME    2:12:15           *
*****************************************************
```

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

END OF BANNER

1/ 1/80 2:12:15

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	11.150	420.00	1532.96	.00	.11	.00	225.00	897.
	11.390	420.00	1553.80	.00	20.84	.00	78.10	1270.

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 1/ 1/80        2:12:15


*****************************************************
HEC2 RELEASE DATED SEPT 88

*****************************************************

1CELLA,BARR,EVANS AND ASSOCIATES
2CAVE CK WASH FLOOD INSURANCE STUDY
T3       DEER VALLEY TO DAM OUTLET
1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q

    -10       2

2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW

     1                 -1
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 1/ 1/80        2:12:15

  SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS
  Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA
  TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN
  SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWI

*PROF 1


CCHV=      .100 CEHV=      .300
*SECNO 9.200

3265 DIVIDED FLOW

3470 ENCROACHMENT STATIONS=      9949.0    10200.0  TYPE=       1  TARGET=       251
     9.20     19.75  1466.75      .00       .00  1467.90     1.15      .00        .0
    5400.        0.    5400.       0.        0.     627.       0.       0.         0
      .00       .00     8.61      .00      .000     .040     .000     .000    1447.0
  .010204        0.       0.       0.         0        0        0      .00     146.5


CCHV=      .300 CEHV=      .500
*SECNO 9.300

3470 ENCROACHMENT STATIONS=      9840.0    10049.0  TYPE=       1  TARGET=       209
     9.30      5.73  1471.73      .00       .00  1472.41      .69     4.37        .1
    5400.        0.    5400.       0.        0.     813.       0.       9.         2
      .02       .00     6.64      .00      .000     .045     .000     .000    1466.0
  .006853      900.     528.     340.         3        0        0      .00     209.0


*SECNO 9.320

301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS=      9927.0    10056.0  TYPE=       1  TARGET=       129
     9.32      4.66  1472.66  1472.66       .00  1474.57     1.92     1.09        .6
    5400.        0.    5400.       0.        0.     486.       0.      10.         3
      .02       .00    11.11      .00      .000     .045     .000     .000    1468.0
  .019926      125.     100.      80.         3       15        0      .00     129.0


CCHV=      .100 CEHV=      .300
*SECNO 9.330
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 1/ 1/80.        2:12:15

 SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS
 Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA
 TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN
 SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWI


3301 HV CHANGED MORE THAN HVINS


3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE


3470 ENCROACHMENT STATIONS=      9900.0    10095.0  TYPE=       1  TARGET=       195
     9.33      5.99  1474.29      .00       .00  1475.17     .88       .49        .1
    5400.        0.    5319.      81.        0.     700.     26.       11.         3
      .03       .00     7.59     3.17      .000      .045    .050      .000    1468.3
  .008371       30.      40.      40.         4         0       0       .00     195.0


*SECNO 9.340

3301 HV CHANGED MORE THAN HVINS

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

3470 ENCROACHMENT STATIONS=      9965.0    10052.0  TYPE=       1  TARGET=        87
     9.34      6.24  1474.24  1474.24       .00  1476.74    2.49       .66        .4
    5400.        0.    5400.       0.        0.     426.      0.       12.         3
      .03       .00    12.67      .00      .000      .045    .000      .000    1468.0
  .018381       40.      55.      50.        20         8       0       .00      87.0


CHV=      .300 CEHV=      .500
*SECNO 9.440

3301 HV CHANGED MORE THAN HVINS


3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE


3470 ENCROACHMENT STATIONS=      9620.0     9830.0  TYPE=       1  TARGET=       210
     9.44      7.12  1481.12      .00       .00  1481.65     .53      4.33        .5
    5400.        0.    5400.       0.        0.     920.      0.       20.         5
      .05       .00     5.87      .00      .000      .045    .000      .000    1474.0
  .004618      100.     528.     510.         2         0       0       .00     210.0
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 1/ 1/80        2:12:15

  SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS
  Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA
  TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN
  SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWI

CCHV=      .100 CEHV=      .300
*SECNO 9.600

3470 ENCROACHMENT STATIONS=      9280.0     9560.0  TYPE=       1  TARGET=       280
     9.60      4.38  1484.28      .00       .00  1484.61      .33      2.94       .0
    5400.        0.    5400.       0.        0.    1172.       0.       39.        9
      .10       .00     4.61      .00      .000     .045     .000      .000   1479.9
  .002997      620.     800.     800.         5        0        0       .00    280.0

*SECNO 9.800

3301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
7720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS=      9495.0     9700.0  TYPE=       1  TARGET=       205
     9.80      3.23  1490.53  1490.53       .00  1491.93     1.40      6.92       .3
    5400.        0.    5400.       0.        0.     569.       0.       61.       15
      .13       .00     9.48      .00      .000     .045     .000      .000   1487.3
  .021760     1100.    1085.     930.        11       15        0       .00    205.0

*SECNO 9.860

3301 HV CHANGED MORE THAN HVINS

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS=      9425.0     9650.0  TYPE=       1  TARGET=       225
     9.86      5.41  1493.41      .00       .00  1493.77      .36      1.74       .1
    5400.        0.    5400.       0.        0.    1123.       0.       66.       17
      .15       .00     4.81      .00      .000     .045     .000      .000   1488.0
  .002631      350.     300.     280.         4        0        0       .00    225.0

*SECNO 9.970

3301 HV CHANGED MORE THAN HVINS
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 1/ 1/80        2:12:15

  SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS
  Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA
  TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN
  SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWI

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
693 PROBABLE MINIMUM SPECIFIC ENERGY
720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS=      9480.0     9610.0  TYPE=       1  TARGET=       130
     9.97      4.19  1496.19  1496.19       .00  1498.09      1.90      3.09       .4
    5400.        0.    5400.       0.        0.     488.        0.       76.       19
      .16       .00    11.07       .00      .000     .045      .000      .000   1492.0
  .020680      640.     540.     550.        20       15         0       .00    130.0

*SECNO 10.040

3301 HV CHANGED MORE THAN HVINS

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

470 ENCROACHMENT STATIONS=      9685.0     9870.0  TYPE=       1  TARGET=       185
    10.04      5.84  1500.84       .00       .00  1501.47       .62      3.25       .1
    5400.        0.    5400.       0.        0.     852.        0.       82.       20
      .18       .00     6.34       .00      .000     .045      .000      .000   1495.0
  .005032      360.     360.     280.         3        0         0       .00    185.0

CHV=      .300 CEHV=      .500
*SECNO 10.050

470 ENCROACHMENT STATIONS=      9880.0    10017.0  TYPE=       1  TARGET=       137
    10.05      5.18  1503.18       .00       .00  1504.10       .92      2.48       .1
    5400.        0.    5400.       0.        0.     701.        0.       90.       22
      .19       .00     7.70       .00      .000     .045      .000      .000   1498.0
  .006688      460.     430.     400.         4        0         0       .00    137.0

CHV=      .100 CEHV=      .300
*SECNO 10.100

301 HV CHANGED MORE THAN HVINS

470 ENCROACHMENT STATIONS=      9947.0    10033.0  TYPE=       1  TARGET=        86
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 1/ 1/80        2:12:15

  SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS
  Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA
  TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN
  SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWI

   10.10      7.49  1504.79       .00       .00  1506.68      1.89      2.29        .2
   5400.        0.     5395.        5.        0.     488.        2.       93.        22
     .20       .00     11.05      2.19      .000      .045      .050      .000    1497.3
 .011117      270.      270.      270.         2         0         0       .00      86.0

CCHV=      .300 CEHV=      .500
*SECNO 10.140

3470 ENCROACHMENT STATIONS=      9963.0   10038.0  TYPE=       1  TARGET=         75
   10.14      7.26  1507.26       .00       .00  1508.79      1.53      2.00        .1
   5400.        0.     5400.        0.        0.     544.        0.       96.        23
     .21       .00      9.93       .00      .000      .045      .000      .000    1500.0
 .008136      230.      212.      210.         3         0         0       .00      74.9

CCHV=      .100 CEHV=      .300
*SECNO 10.145

3301 HV CHANGED MORE THAN HVINS

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

3470 ENCROACHMENT STATIONS=      9963.0   10038.0  TYPE=       1  TARGET=         75
   10.15      5.43  1511.33  1511.33       .00  1514.07      2.74       .12        .3
   5400.        0.     5400.        0.        0.     406.        0.       96.        23
     .21       .00     13.29       .39      .000      .045      .050      .000    1505.9
 .018614       10.       10.       10.        20        15         0       .00      74.9

*SECNO 10.165

3301 HV CHANGED MORE THAN HVINS

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS=      9963.0   10038.0  TYPE=       1  TARGET=         75
   10.16      8.10  1514.00       .00       .00  1515.22      1.22      1.00        .1
   5400.        0.     5400.        0.        0.     608.        0.       97.        23
     .21       .00      8.88       .00      .000      .045      .000      .000    1505.9
 .005763      105.      105.      105.         2         0         0       .00      75.0
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 1/ 1/80        2:12:15

  SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS
  Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA
  TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN
  SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWI

CCHV=      .300 CEHV=      .500
*SECNO 10.180

3301 HV CHANGED MORE THAN HVINS

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS=      9950.0    10050.0  TYPE=       1  TARGET=       100
    10.18      9.09  1515.09      .00       .00  1515.72      .63       .32        .1
    5400.        0.    5400.       0.        0.     849.       0.       99.        23
      .21       .00     6.36      .00      .000     .045     .000      .000    1506.0
  .002604       90.      85.      70.         2        0        0       .00     100.0

CCHV=      .100 CEHV=      .300
*SECNO 10.250

3470 ENCROACHMENT STATIONS=      9930.0    10080.0  TYPE=       1  TARGET=       150
    10.25      9.48  1516.18      .00       .00  1516.61      .43       .87        .0
    5400.        0.    5400.       0.        0.    1025.       0.      106.        24
      .23       .00     5.27      .00      .000     .045     .000      .000    1506.7
  .002155      320.     370.     400.         2        0        0       .00     150.0

*SECNO 10.400

3301 HV CHANGED MORE THAN HVINS

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS=      9970.0    10150.0  TYPE=       1  TARGET=       180
    10.40      7.16  1518.66      .00       .00  1519.60      .94      2.83        .1
    5400.        0.    3791.    1609.        0.     442.     297.      122.        27
      .26       .00     8.59     5.42      .000     .045     .050      .000    1511.5
  .007666      800.     790.     650.         3        0        0       .00     180.0

*SECNO 10.550
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1/ 1/80 2:12:15

SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

3301 HV CHANGED MORE THAN HVINS

3470 ENCROACHMENT STATIONS=			9957.0	10058.0	TYPE=	1	TARGET=	101
10.55	9.26	1524.76	.00	.00	1526.22	1.46	6.47	.1
5400.	0.	4347.	1053.	0.	425.	152.	134.	30
.28	.00	10.24	6.95	.000	.045	.050	.000	1515.5
.008702	800.	790.	800.	3	0	0	.00	101.0

*SECNO 10.680

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS=			9902.0	10042.0	TYPE=	1	TARGET=	140
10.68	8.76	1528.46	.00	.00	1528.98	.52	2.67	.0
5400.	0.	5185.	215.	0.	881.	64.	146.	31
.32	.00	5.89	3.33	.000	.045	.050	.000	1519.7
.002200	620.	686.	680.	3	0	0	.00	127.2

*SECNO 10.740

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS=			9866.0	10004.0	TYPE=	1	TARGET=	138
10.74	8.11	1529.32	.00	.00	1530.27	.95	1.16	.1
5400.	0.	5400.	0.	0.	691.	0.	152.	32
.33	.00	7.81	.00	.000	.045	.000	.000	1521.2
.007243	155.	317.	350.	2	0	0	.00	138.0

*SECNO 10.820

3301 HV CHANGED MORE THAN HVINS

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 1/ 1/80        2:12:15

  SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS
  Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA
  TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN
  SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWI


470 ENCROACHMENT STATIONS=      9860.0    10090.0  TYPE=       1  TARGET=       230
   10.82      8.54  1532.04      .00       .00  1532.48      .44      2.15        .0
   5400.        0.    5400.       0.        0.    1015.       0.      160.        34
     .35       .00     5.32      .00      .000     .045     .000      .000    1523.5
 .003791      385.     422.     375.         2        0        0       .00     230.0

SECNO 10.980

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS=      9567.0    10102.0  TYPE=       1  TARGET=       535
   10.98      8.45  1532.85      .00       .00  1532.89      .03       .37        .0
   5400.        0.    5400.       0.        0.    3672.       0.      206.        42
     .51       .00     1.47      .00      .000     .045     .000      .000    1524.4
 .000158      980.     845.     870.         3        0        0       .00     535.0

*SECNO 11.150

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

470 ENCROACHMENT STATIONS=      9940.0    10165.0  TYPE=       1  TARGET=       225
   11.15     10.96  1532.96      .00       .00  1532.96      .00       .07        .0
    420.        0.     420.       0.        0.    1721.       0.      261.        49
    1.53       .00      .24      .00      .000     .045     .000      .000    1522.0
 .000004      970.     897.     840.         2        0        0       .00     225.0

SECNO 11.390

265 DIVIDED FLOW

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

3470 ENCROACHMENT STATIONS=     10062.0    10600.0  TYPE=       1  TARGET=       538
   11.39      2.00  1553.80  1553.80       .00  1554.29      .49       .02        .1
    420.        0.     420.       0.        0.      75.       0.      287.        54
    1.59       .00     5.62      .00      .000     .045     .000      .000    1551.8
 .031631     1270.    1270.    1270.        20       25        0       .00      78.1
```

1/ 1/80 2:12:15

****
HEC2 RELEASE DATED SEPT 88

****

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

DEER VALLEY TO DAM OUTLE

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIW
	9.200	.00	.00	.00	1447.00	5400.00	1466.75	.
	9.300	528.00	.00	.00	1466.00	5400.00	1471.73	.
	9.320	100.00	.00	.00	1468.00	5400.00	1472.66	1472.
*	9.330	40.00	.00	.00	1468.30	5400.00	1474.29	.
	9.340	55.00	.00	.00	1468.00	5400.00	1474.24	1474.
*	9.440	528.00	.00	.00	1474.00	5400.00	1481.12	.
	9.600	800.00	.00	.00	1479.90	5400.00	1484.28	.
	9.800	1085.00	.00	.00	1487.30	5400.00	1490.53	1490.
*	9.860	300.00	.00	.00	1488.00	5400.00	1493.41	.
	9.970	540.00	.00	.00	1492.00	5400.00	1496.19	1496.
*	10.040	360.00	.00	.00	1495.00	5400.00	1500.84	.
	10.050	430.00	.00	.00	1498.00	5400.00	1503.18	.
	10.100	270.00	.00	.00	1497.30	5400.00	1504.79	.
	10.140	212.00	.00	.00	1500.00	5400.00	1507.26	.
	10.145	10.00	.00	.00	1505.90	5400.00	1511.33	1511.
*	10.165	105.00	.00	.00	1505.90	5400.00	1514.00	.
	10.180	85.00	.00	.00	1506.00	5400.00	1515.09	.

1/ 1/80 2:12:15

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIW
10.250	370.00	.00	.00	1506.70	5400.00	1516.18	.
10.400	790.00	.00	.00	1511.50	5400.00	1518.66	.
10.550	790.00	.00	.00	1515.50	5400.00	1524.76	.
10.680	686.00	.00	.00	1519.70	5400.00	1528.46	.
* 10.740	317.00	.00	.00	1521.21	5400.00	1529.32	.
10.820	422.00	.00	.00	1523.50	5400.00	1532.04	.
10.980	845.00	.00	.00	1524.40	5400.00	1532.85	.
* 11.150	897.00	.00	.00	1522.00	420.00	1532.96	.
11.390	1270.00	.00	.00	1551.80	420.00	1553.80	1553.

1/ 1/80 2:12:15

EER VALLEY TO DAM OUTLE

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	9.200	5400.00	1466.75	.00	.00	.00	146.56	.
	9.300	5400.00	1471.73	.00	4.98	.00	209.00	528.
	9.320	5400.00	1472.66	.00	.93	.00	129.00	100.
*	9.330	5400.00	1474.29	.00	1.63	.00	195.00	40.
*	9.340	5400.00	1474.24	.00	-.04	.00	87.00	55.
	9.440	5400.00	1481.12	.00	6.87	.00	210.00	528.
	9.600	5400.00	1484.28	.00	3.17	.00	280.00	800.
	9.800	5400.00	1490.53	.00	6.25	.00	205.00	1085.
*	9.860	5400.00	1493.41	.00	2.88	.00	225.00	300.
	9.970	5400.00	1496.19	.00	2.78	.00	130.00	540.
	10.040	5400.00	1500.84	.00	4.66	.00	185.00	360.
	10.050	5400.00	1503.18	.00	2.33	.00	137.00	430.
	10.100	5400.00	1504.79	.00	1.61	.00	86.00	270.
	10.140	5400.00	1507.26	.00	2.48	.00	74.96	212.
	10.145	5400.00	1511.33	.00	4.07	.00	74.92	10.
	10.165	5400.00	1514.00	.00	2.67	.00	75.00	105.
*	10.180	5400.00	1515.09	.00	1.09	.00	100.00	85.
	10.250	5400.00	1516.18	.00	1.09	.00	150.00	370.
*	10.400	5400.00	1518.66	.00	2.48	.00	180.00	790.
	10.550	5400.00	1524.76	.00	6.10	.00	101.00	790.
*	10.680	5400.00	1528.46	.00	3.70	.00	127.23	686.
*	10.740	5400.00	1529.32	.00	.87	.00	138.00	317.
	10.820	5400.00	1532.04	.00	2.71	.00	230.00	422.
*	10.980	5400.00	1532.85	.00	.82	.00	535.00	845.

1/ 1/80 2:12:15

SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO=	9.320	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	9.320	PROFILE=	1	MINIMUM SPECIFIC ENERGY
WARNING SECNO=	9.330	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION SECNO=	9.340	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	9.340	PROFILE=	1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=	9.340	PROFILE=	1	20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING SECNO=	9.440	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION SECNO=	9.800	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	9.800	PROFILE=	1	MINIMUM SPECIFIC ENERGY
WARNING SECNO=	9.860	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION SECNO=	9.970	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	9.970	PROFILE=	1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=	9.970	PROFILE=	1	20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING SECNO=	10.040	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION SECNO=	10.145	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	10.145	PROFILE=	1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=	10.145	PROFILE=	1	20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING SECNO=	10.165	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.180	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.400	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.680	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.740	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.980	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	11.150	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION SECNO=	11.390	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	11.390	PROFILE=	1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=	11.390	PROFILE=	1	20 TRIALS ATTEMPTED TO BALANCE WSEL

APPENDIX "C"

HEC-2 Input and Output for

Previously-Proposed Conditions

at 5400 cfs

Previously - Proposed Conditions

Q = 5400 cfs

```
1CELLA,BARR,EVANS AND ASSOCIATES
2[redacted]VE CK WASH FLOOD INSURANCE STUDY
3[redacted]     DEER VALLEY TO DAM OUTLET
1    -10       3                                                  5400 1466.75
2      1              -1
C[redacted].045   0.045    0.04      .1      .3
T             9.1                                                          9949    10200
1    9.2      26    9944   10266
R[redacted]1486   9840    1480    9852    1478    9860  1476.4    9880    1476     9944
R[redacted]1447   9960    1472    9964    1470    9968    1462    9980    1460     9990
R1459.5  10000    1460   10018  1461.4   10020    1464   10021    1466    10026
R[redacted]1470  10036    1472   10040    1474   10106    1470   10116    1464    10128
R[redacted]62.8  10150    1464   10168    1466   10196    1470   10220    1480    10266
R   1490  10290
C[redacted]0.05   0.05   0.045     0.3     0.5
T[redacted]           9.1                                                          9840    10049
1    9.3      13    9840   10056     900     340     528
R[redacted]1480   9840    1468    9840    1468    9880    1468    9900    1468     9950
R[redacted]1468  10005    1466   10030    1467   10040    1470   10048    1476    10056
R[redacted]1478  10170    1478   10295    1480   10310
T             9.1                                                          9927    10056
1[redacted]9.32   16    9880   10070     125      80     100
R[redacted]82.8   9700    1480    9880    1472    9930    1470    9931    1468    10016
R   1468  10048    1470   10053    1480   10068    1482   10070    1484    10085
R[redacted]1486  10120  1487.9   10155    1486   10180    1484   10190    1482    10225
R[redacted]1484  10260
C                             0.1     0.3
T             9.1                                                          9900    10095
1[redacted]9.33   16    9900   10075      30      40      40
R[redacted]1482   9410    1480    9530    1480    9820    1478    9845    1476     9870
R[redacted]1474   9900    1472    9925    1470    9955  1468.3   10045    1470    10050
R[redacted]1472  10075    1474   10095    1476   10120    1478   10138    1480    10175
R[redacted]1490  10400
T             9.1                                                          9965    10052
1[redacted]9.34   12    9950   10072      40      50      55
R[redacted]1482   9440    1480    9560    1480    9675    1480    9840    1480     9950
R[redacted]1470   9975    1468    9980    1468   10010    1470   10042    1482    10072
R[redacted]1488  10090    1490   10120
C[redacted]                           0.3     0.5
T[redacted]           9.1                                                          9620     9830
1[redacted]9.44   15    9400    9860     100     510     528
R[redacted]1485   9190    1482    9230    1480    9235    1480    9400  1478.9     9480
R[redacted]1478   9600    1476    9794    1474    9800    1476    9810    1478     9837
R   1480  9848    1481    9851    1482    9854    1483    9857    1484     9860
C[redacted]                           0.1     0.3
T[redacted]           9.1                                                          9280     9560
1[redacted]9.6    17    9060    9600     620     800     800
R[redacted]1488   8825    1486    8830    1484    8835  1483.2    8837    1482     8840
R[redacted]1482   8975  1483.7    9060    1482    9105  1481.4    9220    1480     9370
R1479.9   9460    1480    9570    1484    9600    1484    9700    1486     9800
R[redacted]1488   9920  1491.2    9980
T[redacted]           9.1                                                          9495     9700
1[redacted]9.8    13    9315    9786    1100     930    1085
R[redacted]1504   9150    1494    9210    1492    9290    1490    9315    1488     9360
R[redacted]1488   9430  1487.3    9610    1488    9650    1490    9785    1492     9786
R[redacted]1494   9890    1498    9893    1498    9960
T[redacted]           9.1                                                          9425     9650
1[redacted]9.86   10    9400    9805     350     280     300
R[redacted]1500   9295    1494    9345    1492    9400    1490    9420    1488     9425
R[redacted]1488   9475    1490    9795    1498    9805    1500    9895    1502     9900
T[redacted]           9.1                                                          9480     9610
1[redacted]9.97   14    9460    9655     640     550     540
R[redacted]1506   9204    1496    9210    1494    9215    1492    9225    1494     9275
R[redacted]1494   9460    1492    9461    1492    9505  1492.4    9555    1494     9654
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T          9.1                                                   9685    9870
1 10.04     13    9665    9955     360     280     360
R  1510   9612    1510    9650    1510    9665    1498    9685    1496    9735
R  1496   9810    1495    9830    1496    9850    1498    9875    1500    9880
R  1502   9905    1504    9918    1505    9955
C                         0.3     0.5
T          9.1                                                   9880   10017
1 10.05      8    9840   10040     460     400     430
R  1504   9840    1500    9860    1498    9890    1498   10010    1500   10020
R  1502  10028  1503.6   10040    1504   10360
C                         0.1     0.3
T          9.1                                                   9947   10033
1  10.1     13    9942   10030     270     270     270
R1508.5   9910    1508    9942    1504    9947    1502    9950    1500    9954
R  1498   9957  1497.3    9975    1498   10000    1500   10020    1502   10025
R  1504  10030    1506   10070    1507   10190
C                         0.3     0.5
T          9.1                                                   9963   10038
1 10.14     22    9963   10038     230     210     212
R  1520   9460    1516    9490    1516    9584    1514    9590    1512    9700
R  1510   9765    1508    9830    1508    9900    1510    9905    1510    9930
R  1508   9935    1509    9963    1500  9963.1    1500 10037.9    1509   10038
R  1508  10055    1508   10115    1510   10130    1510   10200    1512   10230
R  1514  10270    1514   10430
C                         0.1     0.3
T          9.1                                                   9963   10038
110.145     9    9963   10038      10      10      10
R  1520   9460    1516    9490    1516    9580    1515    9590    1515    9963
R505.9  9963.1   1505.9 10037.9    1515   10038    1514   10460
T          9.1                                                   9963   10038
110.165    11    9963   10038     105     105     105
R  1520   9520    1516    9530    1515    9570    1515    9963  1505.9    9963
R505.9   10038    1515   10038    1515   10140    1516   10180    1518   10190
R  1520  10250
C                         0.3     0.5
T          9.1                                                   9950   10050
1 10.18     19    9900   10096      90      70      85
R  1530   9520    1520    9580    1518    9590    1518    9672    1516    9710
R  1514   9740    1514    9900    1508    9930    1506    9958    1506   10002
R  1508  10040    1508   10075    1510   10080    1514   10096    1516   10160
R  1518  10180    1520   10210    1522   10260  1523.5   10370
C                         0.1     0.3
T          9.1                                                   9930   10080
1 10.25     22    9845   10185     320     400     370
R521.4   8840    1520    9145    1518    9180    1516    9210    1516    9375
R  1514   9470    1514    9540    1512    9555    1512    9620  1511.6    9700
R  1512   9790  1513.6    9845    1512    9900    1510    9948  1506.7    9975
R  1508   9994    1510   10040    1511   10048  1511.1   10185    1512   10328
R  1520  10332    1530   10343
T          9.1                                                   9970   10150
1  10.4     23    9970   10054     800     650     790
R  1518   9740    1518    9750    1518    9760    1518    9780    1518    9800
R  1514   9810    1516    9825    1514    9850    1516    9863    1518    9952
R  1518   9970    1516    9980    1512    9986  1511.5    9990    1512   10004
R  1514  10048  1515.4   10054    1516   10230    1516   10400    1514   10410
R  1514  10435    1520   10445    1530   10458
T          9.1                                                   9957   10058
1 10.55     15    9956   10024     800     800     790
R  1524   9800  1523.8    9830  1523.7    9860  1523.5    9880  1523.2    9956
R  1522   9966    1520    9974    1518    9986    1516    9992  1515.5   10000
R  1516  10010    1518   10018    1520   10024    1522   10136    1530   10155
T          9.1                                                   9902   10042
1 10.68     10    9705   10032     620     680     686
R1528.5   9615    1528    9705    1526    9800    1524    9850    1522    9880
```

1	10.74	15	9840	10032	155	350	317		
R	1529.5	9740	1528.5	9840	1528	9850	1526	9870	1524	9970
R	1522	9982	1521	10010	1522	10018	1524	10020	1526	10028
R	1530	10032	1532	10056	1534	10105	1534	10320	1540	10400
1	10.82	9	1059	1407	385	375	422		
R	530.7	1000	1530	1059	1528	1071	1526	1096	1524	1105
R	1524	1377	1530	1384	1532	1391	1534	1407	
C	0.040	0.040	0.040						
1	10.88	7	1000	1473	250	607	320		
R	1534	1000	1532	1051	1530	1142	1528	1167	1526	1185
R	1526	1344	1542	1473					
1	10.97	11	1000	1407	525	315	445		
R	1550	1000	1540	1018	1538	1023	1536	1031	1534	1039
R	1534	1082	1532	1133	1530	1145	1526	1158	1526	1282
R	1542	1407							
1	11.04	18	1167	1440	390	360	375		
3	10								
R	1560	1000	1540	1028	1536	1042	1536	1080	1534	1120
R	1532	1123	1530	1131	1530	1150	1534	1158	1534	1167
R	1532	1184	1530	1196	1528	1203	1526	1219	1524	1245
R	1526	1267	1526	1291	1544	1440			
C	0.045	0.040	0.040						
1	11.12	14	1233	1593	355	395	380		
R	1540	1000	1538	1010	1536	1050	1536	1071	1536	1108
R	1538	1121	1538	1233	1534	1292	1530	1325	1528	1332
R	1526	1350	1524	1412	1524	1445	1546	1593	
C	0.05	0.05	0.045						
1	14	9	1085	1788	150	110	162		
3				1290					
R	1550	1000	1540	1015	1538	1023	1536	1042	1534	1085
R	1526	1208	1524.9	1471	1524.1	1628	1544.1	1788	
1	15	10	1078	1858	45	106	100		
3				1270		1692			
R	1550	1000	1540	1020	1538	1029	1536	1048	1534	1078
R	1524	1172	1524	1220	1524	1684	1525	1698	1545	1858
1	16	19	1070	1925	15	113	100		
3				1260		1730			
R	1550	1000	1540	1018	1538	1028	1536	1046	1534	1070
R	1524	1156	1523	1186	1524	1214	1526	1363	1526	1403
R	1524	1491	1524	1544	1528	1567	1528	1608	1526	1627
R	1526	1733	1528	1752	1529	1765	1549	1925	
1	17	25	1140	2107	225	94	100		
3				1295		1885			
R	1550	1000	1540	1026	1540	1047	1538	1058	1536	1140
R	1532	1168	1530	1197	1528	1203	1526	1220	1525.1	1262
R	1526	1314	1527.6	1329	1526	1391	1526	1569	1528	1587
R	1528	1616	1526	1622	1524	1641	1522.9	1680	1524	1698
R	1526	1705	1526	1920	1528	1937	1529	1947	1549	2107
1	18	24	1000	2315	310	108	100		
3				1480		2070			
R	1540	1000	1534	1047	1534	1107	1532	1150	1530	1160
R	1528	1273	1528	1296	1529.9	1335	1528	1372	1526	1440
R	1532	1452	1534	1470	1532	1500	1526	1520	1528	1667
R	1530	1671	1530	1686	1526	1694	1526	1766	1528	1876
R	1528	2127	1530	2140	1530	2155	1550	2315	
1	19	20	1000	2168	410	75	100		
3				1330		1900			
R	1544	1000	1540	1030	1538	1037	1534	1079	1534	1140
R	1532	1160	1528	1180	1527.1	1401	1528	1548	1532	1559
R	1533.7	1572	1532	1578	1528	1586	1528	1773	1530	1857
R	1532	1915	1532	1950	1530	1975	1530	2008	1550	2168
T	1	420	420						
1	20	17	1000	2048	140	66	100		
3				1320		1770			
R	1546	1000	1536	1024	1524	1048	1534	1128	1536	1194

```
R  1532   1888   1552   2048
1    21     22   1000   2048    280     30    100
3                       1395           1760
R  1550   1000   1544   1020   1542   1046   1540   1088   1538   1097
R  1536   1119   1534   1123   1530   1170 1529.3   1248   1530   1311
R  1532   1468   1532   1492   1530   1557   1530   1570   1532   1618
R  1536   1649   1534   1669   1530   1683   1530   1720   1532   1782
R  1532   1888   1552   2048
1    22     14   1000   1982     70     98    100
3                       1365           1675
R  1550   1000   1534   1087   1534   1191   1532   1212   1532   1551
R  1534   1585   1536   1610   1536   1621   1534   1645   1532   1656
R  1532   1736   1534   1799   1534   1822   1554   1982
1    23     21   1000   1966    105    105    100
3                       1385           1645
R  1550   1000   1538   1082   1536   1114   1534   1167   1536   1247
R  1536   1285   1534   1311   1534   1357   1536   1369 1537.2   1385
R  1536   1394   1534   1399   1534   1620   1536   1623   1536   1633
R  1534   1638   1532   1659   1532   1772   1538   1798   1539   1806
R  1559   1966
1    24     15   1000   1905    160    134    100
3                       1355
R  1550   1000   1540   1057   1536   1091   1536   1211   1540   1231
R  1540   1251   1536   1278   1536   1557   1538   1561   1540   1578
R  1542   1590   1544   1653   1546   1727   1546   1745   1566   1905
1    25     13   1000   1680     20    178    100
3                       1345           1520
R  1550   1000   1540   1037   1536   1062   1536   1186   1538   1280
R  1538   1500   1540   1570   1542   1587   1542   1631   1550   1680
R1550.4   1720   1550   1758   1570   1918
1    26     16   1000   1619    100     80    100
3                       1395
R  1552   1000   1538   1078   1536   1100   1536   1208   1538   1288
R  1540   1316   1540   1510   1542   1511   1544   1540   1546   1575
R  1548   1592   1550   1600   1552   1619   1552   1722   1551   1765
R  1571   1925
1    27     12   1000   1542     60     47    100
3                       1330
R  1552   1000   1546   1048   1544   1070   1544   1091   1546   1132
R  1546   1382   1542   1390   1542   1430   1544   1469   1548   1482
R  1550   1542   1550   1750
1    28     15   1000   1308    110     17    100
3                       1090           1265
R  1560   1000   1558   1025   1556   1044   1554   1075   1548   1114
R  1546   1130   1544   1140   1544   1152   1548   1188   1548   1214
R  1550   1308   1552   1398   1552   1412   1550   1443   1550   1493
J

R
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*****************************************************
*  WATER SURFACE PROFILES                           *
*  VERSION OF SEPTEMBER 1988                        *
*                                                   *
*                                                   *
*  RUN DATE      5/17/89    TIME    18:12: 7         *
*****************************************************
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X     X  XXXXXXX   XXXXX
X     X  X        X     X
X     X  X        X
XXXXXXX  XXXX     X          XXXXX
X     X  X        X
X     X  X        X     X
X     X  XXXXXXX   XXXXX
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END OF BANNER

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6/17/89        18:12: 7


*****************************************************
 HEC2 RELEASE DATED SEPT 88

*****************************************************

1CELLA,BARR,EVANS AND ASSOCIATES
2CIVE CK WASH FLOOD INSURANCE STUDY
3       DEER VALLEY TO DAM OUTLET
J1  ICHECK    INQ      NINV     IDIR     STRT     METRIC   HVINS    Q
                                                                    5400
    -10       3
J2  NPROF     IPLOT    PRFVS    XSECV    XSECH    FN       ALLDC    IBW
    1                  -1
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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

*PROF 1

CCHV= .100 CEHV= .300
*SECNO 9.200

3265 DIVIDED FLOW

9.20	19.75	1466.75	.00	1466.75	1467.90	1.15	.00	.0
5400.	0.	5400.	0.	0.	627.	0.	0.	0
.00	.00	8.61	.00	.000	.040	.000	.000	1447.0
.010235	0.	0.	0.	0	0	0	.00	147.0

CCHV= .300 CEHV= .500
*SECNO 9.300

9.30	5.73	1471.73	.00	.00	1472.41	.68	4.37	.1
5400.	0.	5400.	0.	0.	814.	0.	9.	2
.02	.00	6.63	.00	.000	.045	.000	.000	1466.0
.006838	900.	528.	340.	3	0	0	.00	210.3

*SECNO 9.320

3301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

9.32	4.68	1472.68	1472.68	.00	1474.57	1.89	1.09	.6
5400.	0.	5400.	0.	0.	489.	0.	10.	3
.02	.00	11.04	.00	.000	.045	.000	.000	1468.0
.019830	125.	100.	80.	3	15	0	.00	131.2

CCHV= .100 CEHV= .300
*SECNO 9.330

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

9.33	5.98	1474.28	.00	.00	1475.16	.89	.49	.1
5400.	0.	5318.	82.	1.	699.	26.	11.	3
.03	.72	7.61	3.15	.050	.045	.050	.000	1468.3
.008416	30.	40.	40.	4	0	0	.00	202.5

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

*SECNO 9.340

3301 HV CHANGED MORE THAN HVINS

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

9.34	6.27	1474.27	1474.27	.00	1476.73	2.46	.66	.4
5400.	0.	5400.	0.	0.	429.	0.	12.	3
.03	.00	12.59	.00	.000	.045	.000	.000	1468.0
.018259	40.	55.	50.	20	8	0	.00	88.3

CCHV= .300 CEHV= .500
*SECNO 9.440

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

9.44	6.72	1480.72	.00	.00	1480.96	.24	3.56	.6
5400.	170.	5230.	0.	120.	1308.	0.	22.	6
.06	1.42	4.00	.00	.050	.045	.000	.000	1474.0
.003547	100.	528.	510.	4	0	0	.00	616.9

CCHV= .100 CEHV= .300
*SECNO 9.600

3265 DIVIDED FLOW

9.60	3.55	1483.45	.00	.00	1483.63	.18	2.66	.0
5400.	493.	4907.	0.	249.	1382.	0.	50.	18
.13	1.98	3.55	.00	.050	.045	.000	.000	1479.9
.003215	620.	800.	800.	5	0	0	.00	739.7

*SECNO 9.800

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

9.80	2.70	1490.00	1489.78	.00	1490.65	.65	6.88	.1
5400.	0.	5400.	0.	0.	835.	0.	80.	33
.18	.00	6.47	.00	.000	.045	.000	.000	1487.3
.017816	1100.	1085.	930.	12	19	0	.00	469.5

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ECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
LOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

SECNO 9.860

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

9.86	4.30	1492.30	.00	.00	1492.56	.26	1.87	.0
5400.	1.	5399.	0.	1.	1316.	0.	88.	36
.20	.47	4.10	.00	.050	.045	.000	.000	1488.0
003145	350.	300.	280.	3	0	0	.00	406.0

*SECNO 9.970

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

9.97	3.24	1495.24	.00	.00	1495.92	.68	3.23	.1
5400.	1751.	3649.	0.	365.	499.	0.	102.	42
.22	4.79	7.31	.00	.050	.045	.000	.000	1492.0
014182	640.	540.	550.	3	0	0	.00	442.7

*SECNO 10.040

10.04	4.74	1499.74	.00	.00	1500.77	1.04	4.75	.1
5400.	0.	5400.	0.	0.	661.	0.	108.	44
.23	.00	8.17	.00	.000	.045	.000	.000	1495.0
012290	360.	360.	280.	3	0	0	.00	197.2

CCHV= .300 CEHV= .500
*SECNO 10.050

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.05	5.40	1503.40	.00	.00	1503.99	.59	3.08	.1
5400.	0.	5400.	0.	0.	880.	0.	116.	46
.25	.00	6.14	.00	.000	.045	.000	.000	1498.0
004680	460.	430.	400.	3	0	0	.00	195.5

CCHV= .100 CEHV= .300
*SECNO 10.100

3301 HV CHANGED MORE THAN HVINS

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.10	7.00	1504.30	.00	.00	1506.55	2.25	2.07	.5
5400.	0.	5399.	1.	0.	448.	1.	120.	47
.26	.00	12.04	1.03	.000	.045	.050	.000	1497.3
.014719	270.	270.	270.	3	0	0	.00	89.4

CCHV= .300 CEHV= .500
*SECNO 10.140

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.14	7.50	1507.50	.00	.00	1508.94	1.43	2.14	.2
5400.	0.	5400.	0.	0.	562.	0.	122.	48
.26	.00	9.61	.00	.000	.045	.000	.000	1500.0
.007350	230.	212.	210.	3	0	0	.00	74.9

CCHV= .100 CEHV= .300
*SECNO 10.145

3301 HV CHANGED MORE THAN HVINS

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

10.15	5.44	1511.34	1511.34	.00	1514.07	2.73	.11	.3
5400.	0.	5400.	0.	0.	407.	0.	122.	48
.26	.00	13.26	.00	.000	.045	.000	.000	1505.9
.020178	10.	10.	10.	20	15	0	.00	74.9

*SECNO 10.165

3301 HV CHANGED MORE THAN HVINS

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SECNO      DEPTH      CWSEL      CRIWS      WSELK      EG         HV         HL         OLOSS
Q          QLOB       QCH        QROB       ALOB       ACH        AROB       VOL        TWA
TIME       VLOB       VCH        VROB       XNL        XNCH       XNR        WTN        ELMIN
SLOPE      XLOBL      XLCH       XLOBR      ITRIAL     IDC        ICONT      CORAR      TOPWI


3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

  10.16      8.13  1514.03       .00       .00  1515.24      1.22      1.02        .1
  5400.        0.    5400.        0.        0.     610.        0.      123.        48
    .27       .00     8.86       .00      .000     .045      .000      .000    1505.9
 .005713     105.     105.      105.         2        0         0       .00      75.0


CCHV=      .300 CEHV=      .500
*SECNO 10.180

3301 HV CHANGED MORE THAN HVINS


3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

  10.18      9.52  1515.52       .00       .00  1515.69       .18       .14        .3
  5400.      275.    5100.       25.      260.    1469.       37.      126.        48
    .27      1.06     3.47       .68      .050     .045      .050      .000    1506.0
 .000762      90.      85.       70.         2        0         0       .00     427.3


CCHV=      .100 CEHV=      .300
*SECNO 10.250

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

  10.25      9.14  1515.84       .00       .00  1515.87       .04       .16        .0
  5400.     1554.    3021.      825.     1352.    1774.      616.      148.        54
    .34      1.15     1.70      1.34      .050     .045      .050      .000    1506.7
 .000294     320.     370.      400.         2        0         0       .00     946.9


*SECNO 10.400

3265 DIVIDED FLOW


3301 HV CHANGED MORE THAN HVINS

3385 20 TRIALS ATTEMPTED WSEL,CWSEL
3693 PROBABLE MINIMUM SPECIFIC ENERGY
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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

3720 CRITICAL DEPTH ASSUMED

10.40	5.44	1516.94	1516.94	.00	1517.74	.80	.67	.2
5400.	630.	2739.	2032.	134.	300.	479.	189.	67
.37	4.71	9.12	4.24	.050	.045	.050	.000	1511.5
013127	800.	790.	650.	20	14	0	.00	566.9

*SECNO 10.550

3[illegible]0 CROSS SECTION 10.55 EXTENDED .19 FEET

10.55	8.69	1524.19	.00	.00	1525.04	.85	7.28	.0
5400.	187.	3309.	1905.	97.	387.	363.	205.	75
.40	1.92	8.54	5.25	.050	.045	.050	.000	1515.5
.006756	800.	790.	800.	5	0	0	.00	341.2

*SECNO 10.680

3[illegible]1 HV CHANGED MORE THAN HVINS

3[illegible]2 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.68	7.76	1527.46	.00	.00	1527.75	.29	2.66	.0
5400.	0.	5400.	0.	0.	1252.	0.	222.	80
.45	.00	4.31	.00	.000	.045	.000	.000	1519.7
.002526	620.	686.	680.	3	0	0	.00	297.0

*SECNO 10.740

3[illegible]1 HV CHANGED MORE THAN HVINS

3[illegible]2 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.74	7.41	1528.41	.00	.00	1529.27	.86	1.34	.1
5400.	0.	5400.	0.	0.	727.	0.	229.	82
.46	.00	7.43	.00	.000	.045	.000	.000	1521.0
.008533	155.	317.	350.	2	0	0	.00	188.7

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

*SECNO 10.820

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.82	6.03	1530.03	.00	.00	1530.18	.14	.84	.0
5400.	0.	5400.	0.	0.	1794.	0.	241.	84
.50	.01	3.01	.00	.050	.045	.000	.000	1524.0
000862	385.	422.	375.	2	0	0	.00	327.3

*SECNO 10.880

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.88	4.26	1530.26	.00	.00	1530.90	.64	.58	.1
5400.	0.	5400.	0.	0.	844.	0.	251.	86
.51	.00	6.40	.00	.000	.040	.000	.000	1526.0
005823	250.	320.	607.	3	0	0	.00	248.5

*SECNO 10.970

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.97	6.14	1532.14	.00	.00	1532.62	.47	1.70	.0
5400.	0.	5400.	0.	0.	977.	0.	260.	89
.53	.00	5.53	.00	.000	.040	.000	.000	1526.0
002702	525.	445.	315.	3	0	0	.00	200.6

*SECNO 11.040

3495 OVERBANK AREA ASSUMED NON-EFFECTIVE, ELLEA= 1534.00 ELREA= 1544.0

11.04	9.12	1533.12	.00	.00	1533.64	.53	1.01	.0
5400.	0.	5400.	0.	0.	928.	0.	268.	90
.55	.00	5.82	.00	.000	.040	.000	.000	1524.0
002690	390.	375.	360.	3	0	0	.00	175.4

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

*SECNO 11.120

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

11.12	9.98	1533.98	.00	.00	1534.20	.22	.52	.0
5400.	0.	5400.	0.	0.	1447.	0.	279.	92
.58	.00	3.73	.00	.000	.040	.000	.000	1524.0
.000826	355.	380.	395.	2	0	0	.00	219.9

*SECNO 14.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS= 1290.0 1788.0 TYPE= 1 TARGET= -1290

14.00	10.12	1534.22	.00	.00	1534.25	.04	.04	.0
5400.	0.	2590.	2810.	0.	1619.	1937.	287.	93
.61	.00	1.60	1.45	.000	.045	.050	.000	1524.1
.000134	150.	162.	110.	0	0	0	.00	419.0

*SECNO 15.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS= 1270.0 1692.0 TYPE= 1 TARGET= 422

15.00	10.24	1534.24	.00	.00	1534.26	.02	.01	.0
5400.	0.	5347.	53.	0.	4243.	80.	296.	94
.63	.00	1.26	.67	.000	.045	.050	.000	1524.0
.000068	45.	100.	106.	1	0	0	.00	422.0

*SECNO 16.000

3470 ENCROACHMENT STATIONS= 1260.0 1730.0 TYPE= 1 TARGET= 470

16.00	10.25	1534.25	.00	.00	1534.27	.03	.01	.0
5400.	0.	5400.	0.	0.	4040.	0.	306.	95
.65	.00	1.34	.00	.000	.045	.000	.000	1524.0
.000098	15.	100.	113.	0	0	0	.00	470.0

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SECNO     DEPTH     CWSEL     CRIWS     WSELK     EG        HV        HL        OLOSS
Q         QLOB      QCH       QROB      ALOB      ACH       AROB      VOL       TWA
TIME      VLOB      VCH       VROB      XNL       XNCH      XNR       WTN       ELMIN
SLOPE     XLOBL     XLCH      XLOBR     ITRIAL    IDC       ICONT     CORAR     TOPWI

*SECNO 17.000

3470 ENCROACHMENT STATIONS=      1295.0     1885.0  TYPE=      1  TARGET=      590
   17.00     11.36  1534.26      .00        .00  1534.28     .02       .01       .0
   5400.        0.    5400.       0.         0.    4902.      0.      316.       96
     .68       .00     1.10      .00       .000     .045    .000      .000   1522.9
 .000069      225.     100.      94.          0        0       0       .00    590.0

*SECNO 18.000

3470 ENCROACHMENT STATIONS=      1480.0     2070.0  TYPE=      1  TARGET=      590
   18.00      8.27  1534.27      .00        .00  1534.29     .03       .01       .0
   5400.        0.    5400.       0.         0.    3954.      0.      326.       98
     .70       .00     1.37      .00       .000     .045    .000      .000   1526.0
 .000138      310.     100.     108.          1        0       0       .00    590.0

*SECNO 19.000

3470 ENCROACHMENT STATIONS=      1330.0     1900.0  TYPE=      1  TARGET=      570
   19.00      7.18  1534.28      .00        .00  1534.32     .04       .02       .0
   5400.        0.    5400.       0.         0.    3368.      0.      334.       99
     .71       .00     1.60      .00       .000     .045    .000      .000   1527.1
 .000227      410.     100.      75.          1        0       0       .00    570.0

*SECNO 20.000

3302 WARNING:  CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS=      1320.0     1770.0  TYPE=      1  TARGET=      450
   20.00      6.33  1534.33      .00        .00  1534.33     .00       .01       .0
    420.        0.     420.       0.         0.    2171.      0.      341.      100
     .86       .00      .19      .00       .000     .045    .000      .000   1528.0
 .000004      140.     100.      66.          2        0       0       .00    450.0

*SECNO 21.000

3235 DIVIDED FLOW
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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

3202 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS=			1395.0	1760.0	TYPE=	1	TARGET=	365
21.00	4.33	1534.33	.00	.00	1534.33	.00	.00	.0
420.	0.	420.	0.	0.	1057.	0.	344.	101
.93	.00	.40	.00	.000	.045	.000	.000	1530.0
.000032	280.	100.	30.	1	0	0	.00	335.4

*SECNO 22.000

3265 DIVIDED FLOW

3202 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS=			1365.0	1675.0	TYPE=	1	TARGET=	310
22.00	2.33	1534.33	.00	.00	1534.34	.01	.01	.0
420.	0.	420.	0.	0.	539.	0.	346.	102
.96	.00	.78	.00	.000	.045	.000	.000	1532.0
.000214	70.	100.	98.	0	0	0	.00	258.1

*SECNO 23.000

3265 DIVIDED FLOW

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

3470 ENCROACHMENT STATIONS=			1385.0	1645.0	TYPE=	1	TARGET=	260
23.00	1.14	1534.48	1534.48	.00	1534.70	.22	.07	.0
420.	0.	420.	0.	0.	112.	0.	347.	102
.97	.00	3.76	.00	.000	.045	.000	.000	1533.3
.034595	105.	100.	105.	20	9	0	.00	231.0

*SECNO 24.000

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS=			1355.0	1905.0	TYPE=	1	TARGET=	-1355
24.00	.67	1536.67	.00	.00	1536.82	.14	2.11	.0
420.	0.	420.	0.	0.	138.	0.	347.	103
.98	.00	3.04	.00	.000	.045	.000	.000	1536.0
014236	160.	100.	134.	5	0	0	.00	203.3

*SECNO 25.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS=			1345.0	1520.0	TYPE=	1	TARGET=	175
25.00	.62	1538.62	.00	.00	1538.87	.26	2.02	.0
420.	0.	420.	0.	0.	103.	0.	348.	103
.99	.00	4.07	.00	.000	.045	.000	.000	1538.0
030969	20.	100.	178.	3	0	0	.00	175.0

*SECNO 26.000

3470 ENCROACHMENT STATIONS=			1395.0	1925.0	TYPE=	1	TARGET=	-1395
26.00	.90	1540.90	.00	.00	1541.15	.25	2.28	.0
420.	0.	420.	0.	0.	104.	0.	348.	104
.99	.00	4.04	.00	.000	.045	.000	.000	1540.0
.017497	100.	100.	80.	4	0	0	.00	115.4

*SECNO 27.000
7185 MINIMUM SPECIFIC ENERGY
3120 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS=			1330.0	1750.0	TYPE=	1	TARGET=	-1330
27.00	1.33	1543.33	1543.33	.00	1543.86	.53	2.23	.0
420.	0.	420.	0.	0.	72.	0.	348.	104
1.00	.00	5.82	.00	.000	.045	.000	.000	1542.0
.029270	60.	100.	47.	8	11	0	.00	68.5

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

```
*SECNO 28.000
7135 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS=      1090.0     1265.0  TYPE=       1  TARGET=       175
  28.00      2.24   1546.24   1546.24       .00   1546.95      .72      2.81        .0
   420.        0.      420.        0.        0.       62.       0.      348.       104
   1.00       .00      6.79       .00      .000      .045     .000      .000    1544.0
 027072      110.      100.       17.         3        14         0       .00      44.0
```

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****
HEC2 RELEASE DATED SEPT 88

****

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

DEER VALLEY TO DAM OUTLE

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIW
	9.200	.00	.00	.00	1447.00	5400.00	1466.75	-
	9.300	528.00	.00	.00	1466.00	5400.00	1471.73	-
*	9.320	100.00	.00	.00	1468.00	5400.00	1472.68	1472.
*	9.330	40.00	.00	.00	1468.30	5400.00	1474.28	-
*	9.340	55.00	.00	.00	1468.00	5400.00	1474.27	1474.
*	9.440	528.00	.00	.00	1474.00	5400.00	1480.72	-
	9.600	800.00	.00	.00	1479.90	5400.00	1483.45	-
*	9.800	1085.00	.00	.00	1487.30	5400.00	1490.00	1489.
*	9.860	300.00	.00	.00	1488.00	5400.00	1492.30	-
*	9.970	540.00	.00	.00	1492.00	5400.00	1495.24	-
	10.040	360.00	.00	.00	1495.00	5400.00	1499.74	-
*	10.050	430.00	.00	.00	1498.00	5400.00	1503.40	-
*	10.100	270.00	.00	.00	1497.30	5400.00	1504.30	-
*	10.140	212.00	.00	.00	1500.00	5400.00	1507.50	-
*	10.145	10.00	.00	.00	1505.90	5400.00	1511.34	1511.
*	10.165	105.00	.00	.00	1505.90	5400.00	1514.03	-
*	10.180	85.00	.00	.00	1506.00	5400.00	1515.52	-

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	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIW
*	10.250	370.00	.00	.00	1506.70	5400.00	1515.84	.
*	10.400	790.00	.00	.00	1511.50	5400.00	1516.94	1516.
	10.550	790.00	.00	.00	1515.50	5400.00	1524.19	.
*	10.680	686.00	.00	.00	1519.70	5400.00	1527.46	.
*	10.740	317.00	.00	.00	1521.00	5400.00	1528.41	.
*	10.820	422.00	.00	.00	1524.00	5400.00	1530.03	.
*	10.880	320.00	.00	.00	1526.00	5400.00	1530.26	.
*	10.970	445.00	.00	.00	1526.00	5400.00	1532.14	.
	11.040	375.00	.00	.00	1524.00	5400.00	1533.12	.
*	11.120	380.00	.00	.00	1524.00	5400.00	1533.98	.
*	14.000	162.00	.00	.00	1524.10	5400.00	1534.22	.
*	15.000	100.00	.00	.00	1524.00	5400.00	1534.24	.
	16.000	100.00	.00	.00	1524.00	5400.00	1534.25	.
	17.000	100.00	.00	.00	1522.90	5400.00	1534.26	.
	18.000	100.00	.00	.00	1526.00	5400.00	1534.27	.
	19.000	100.00	.00	.00	1527.10	5400.00	1534.28	.
*	20.000	100.00	.00	.00	1528.00	420.00	1534.33	.
*	21.000	100.00	.00	.00	1530.00	420.00	1534.33	.
*	22.000	100.00	.00	.00	1532.00	420.00	1534.33	.
*	23.000	100.00	.00	.00	1533.33	420.00	1534.48	1534.
*	24.000	100.00	.00	.00	1536.00	420.00	1536.67	.
*	25.000	100.00	.00	.00	1538.00	420.00	1538.62	.
	26.000	100.00	.00	.00	1540.00	420.00	1540.90	.
*	27.000	100.00	.00	.00	1542.00	420.00	1543.33	1543.
*	28.000	100.00	.00	.00	1544.00	420.00	1546.24	1546.

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DEER VALLEY TO DAM OUTLE

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	9.200	5400.00	1466.75	.00	.00	.00	147.06	-
	9.300	5400.00	1471.73	.00	4.98	.00	210.31	528.
*	9.320	5400.00	1472.68	.00	.95	.00	131.25	100.
*	9.330	5400.00	1474.28	.00	1.60	.00	202.55	40.
*	9.340	5400.00	1474.27	.00	-.00	.00	88.36	55.
*	9.440	5400.00	1480.72	.00	6.45	.00	616.97	528.
	9.600	5400.00	1483.45	.00	2.73	.00	739.71	800.
*	9.800	5400.00	1490.00	.00	6.55	.00	469.59	1085.
*	9.860	5400.00	1492.30	.00	2.30	.00	406.07	300.
*	9.970	5400.00	1495.24	.00	2.94	.00	442.71	540.
	10.040	5400.00	1499.74	.00	4.49	.00	197.23	360.
*	10.050	5400.00	1503.40	.00	3.67	.00	195.52	430.
*	10.100	5400.00	1504.30	.00	.90	.00	89.47	270.
*	10.140	5400.00	1507.50	.00	3.20	.00	74.97	212.
*	10.145	5400.00	1511.34	.00	3.84	.00	74.92	10.
*	10.165	5400.00	1514.03	.00	2.69	.00	75.00	105.
*	10.180	5400.00	1515.52	.00	1.49	.00	427.37	85.
*	10.250	5400.00	1515.84	.00	.32	.00	946.99	370.
*	10.400	5400.00	1516.94	.00	1.11	.00	566.95	790.
	10.550	5400.00	1524.19	.00	7.25	.00	341.20	790.
*	10.680	5400.00	1527.46	.00	3.27	.00	297.05	686.
*	10.740	5400.00	1528.41	.00	.95	.00	188.75	317.
*	10.820	5400.00	1530.03	.00	1.63	.00	327.31	422.
*	10.880	5400.00	1530.26	.00	.23	.00	248.59	320.

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SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
10.970	5400.00	1532.14	.00	1.88	.00	200.64	445.
11.040	5400.00	1533.12	.00	.97	.00	175.42	375.
11.120	5400.00	1533.98	.00	.86	.00	219.95	380.
14.000	5400.00	1534.22	.00	.24	.00	419.01	162.
15.000	5400.00	1534.24	.00	.02	.00	422.00	100.
16.000	5400.00	1534.25	.00	.01	.00	470.00	100.
17.000	5400.00	1534.26	.00	.02	.00	590.00	100.
18.000	5400.00	1534.27	.00	.00	.00	590.00	100.
19.000	5400.00	1534.28	.00	.01	.00	570.00	100.
20.000	420.00	1534.33	.00	.05	.00	450.00	100.
* 21.000	420.00	1534.33	.00	.00	.00	335.48	100.
* 22.000	420.00	1534.33	.00	.00	.00	258.10	100.
* 23.000	420.00	1534.48	.00	.15	.00	231.09	100.
* 24.000	420.00	1536.67	.00	2.20	.00	203.36	100.
* 25.000	420.00	1538.62	.00	1.94	.00	175.00	100.
26.000	420.00	1540.90	.00	2.29	.00	115.45	100.
* 27.000	420.00	1543.33	.00	2.43	.00	68.57	100.
* 28.000	420.00	1546.24	.00	2.91	.00	44.00	100.

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SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO=	9.320	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	9.320	PROFILE=	1	MINIMUM SPECIFIC ENERGY
WARNING SECNO=	9.330	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION SECNO=	9.340	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	9.340	PROFILE=	1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=	9.340	PROFILE=	1	20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING SECNO=	9.440	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	9.800	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	9.860	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	9.970	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.050	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.100	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.140	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION SECNO=	10.145	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	10.145	PROFILE=	1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=	10.145	PROFILE=	1	20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING SECNO=	10.165	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.180	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.250	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION SECNO=	10.400	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	10.400	PROFILE=	1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=	10.400	PROFILE=	1	20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING SECNO=	10.680	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.740	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.820	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.880	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.970	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	11.120	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	14.000	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

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WARNING SECNO=     15.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

WARNING SECNO=     20.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

WARNING SECNO=     21.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

WARNING SECNO=     22.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

CAUTION SECNO=     23.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     23.000  PROFILE=  1  PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=     23.000  PROFILE=  1  20 TRIALS ATTEMPTED TO BALANCE WSEL

WARNING SECNO=     24.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

WARNING SECNO=     25.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

CAUTION SECNO=     27.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     27.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=     28.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     28.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY
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APPENDIX "D"

HEC-2 Input and Output for Newly-

Proposed Conditions at 5400 cfs

Newly- Proposed Conditions

Q = 5400 cfs

```
DEVELOPMENT ENGINEERING      PROJECT 1740      JULY 1989
PROPOSED DIKE ON CAVE CREEK   EXISTING CONDITIONS DOWNSTREAM - FLOODPLAIN
KNOCHEL BROS. LANDFILL SITE      Q = 5400 CFS     BOTTOM WIDTH = 85 FT
  -10       2       0       0       0       0       0    5400 1527.46       0
   -1       0      -1       0       0       0      -1       0       0       0
 0.050   0.050   0.045      .1      .3
 10.68      10    9705   10032       0       0       0
1528.5    9615    1528    9705    1526    9800    1524    9850    1522    9880
  1520    9990  1519.7   10000    1520   10014    1530   10032    1540   10042
  1.74      15    9840   10032     155     350     317
                          9865
1529.5    9740  1528.5    9840    1528    9850    1526    9870    1524    9970
  1522    9982    1521   10010    1522   10018    1524   10020    1526   10028
  1530   10032    1532   10056    1534   10105    1534   10320    1540   10400
 0.050   0.050   0.040
     1       5    1115  1353.0     214     277     233
                          1070
1530.0    1000  1528.2    1115  1520.1    1145  1522.4    1272  1534.0  1353.0
     2       6    1057  1315.0      98      83      93
                          1042              1315
1530.0    1000  1529.0    1057  1520.5    1095  1522.1    1150  1522.1    1275
1528.0  1315.0
     3       5    1000  1235.8      51      57      53
1531.9    1000  1520.7  1042.2  1520.7    1086  1520.7  1207.2  1533.7  1235.8
     4       6    1041  1192.2     350     347     350
1532.0    1000  1531.0    1041  1521.7  1081.2  1521.7    1097  1521.7  1166.2
1534.7  1192.2
     5       6    1000  1167.5     325     312     320
1535.8     975  1531.9    1000  1522.3  1056.5  1522.3    1079  1522.3  1141.5
1535.3  1167.5
     6       5    1000  1166.2     159     142     155
1533.1    1000 1522.60  1055.2 1522.60    1060 1522.60  1140.2  1535.6  1166.2
     7       5    1000  1153.8     121     101     112
1533.8    1000  1522.8  1042.8  1522.8    1050  1522.8  1127.8  1535.8  1153.8
     8       5    1000  1159.7     168     140     155
1533.4    1000  1523.0  1043.7  1523.0    1079  1523.0  1133.7  1536.0  1159.7
     9       5    1000  1188.1      53      43      49
1534.8    1000  1523.1  1062.1  1523.1    1098  1523.1  1162.1  1536.1  1188.1
    10       7    1000  1217.2     200     198     192
1535.8    1000  1530.5    1025  1531.2    1059  1523.5  1086.2  1523.5    1130
1523.5  1191.2  1536.5  1217.2
    11       7    1000  1228.0     155     163     161
1530.9    1000  1529.6    1038  1527.6    1091  1523.8    1120  1523.9    1142
1523.9    1202  1536.9  1228.0
  0.05    0.05   0.045
    12      19    1207    1522      60      91      92
                          1305
  1550    1000    1540    1014    1538    1021    1536    1055    1535    1070
  1538    1080    1538    1102    1536    1115    1538    1128    1538    1207
  1536    1237    1534    1270    1530    1300    1530    1319    1526    1366
  1524    1411    1524    1458    1525    1482    1545    1522
    13      11    1150    1601      75     100     100
                          1335
  1550    1000    1540    1019    1538    1028    1536    1058    1534    1150
  1532    1215    1526    1300  1525.3    1370    1524    1532    1523    1561
  1543    1601
    14       9    1085    1668      55     105     100
                          1290
  1550    1000    1540    1015    1538    1023    1536    1042    1534    1085
  1526    1208  1524.9    1471  1524.1    1628  1544.1    1668
    15      10    1078    1738      45     106     100
```

1550	1000	1540	1020	1538	1029	1538	1048	1534	1078
1524	1172	1524	1220	1524	1684	1525	1698	1545	1738
16	19	1070	1805	15	113	100			
			1260		1730				
1550	1000	1540	1018	1538	1028	1536	1046	1534	1070
1524	1156	1523	1186	1524	1214	1526	1363	1526	1403
1524	1491	1524	1544	1528	1567	1528	1608	1526	1627
1526	1733	1528	1752	1529	1765	1549	1805		
17	25	1140	1987	225	94	100			
			1295		1885				
1550	1000	1540	1026	1540	1047	1538	1058	1536	1140
1532	1168	1530	1197	1528	1203	1526	1220	1525.1	1262
1526	1314	1527.6	1329	1526	1391	1526	1569	1528	1587
1528	1616	1526	1622	1524	1641	1522.9	1680	1524	1698
1526	1705	1526	1920	1528	1937	1529	1947	1549	1987
18	24	1000	2195	310	108	100			
			1480		2070				
1540	1000	1534	1047	1534	1107	1532	1150	1530	1160
1528	1273	1528	1296	1529.9	1335	1528	1372	1526	1440
1532	1452	1534	1470	1532	1500	1526	1520	1528	1667
1530	1671	1530	1686	1526	1694	1526	1766	1528	1876
1528	2127	1530	2140	1530	2155	1550	2195		
19	20	1000	2048	410	75	100			
			1330		1900				
1544	1000	1540	1030	1538	1037	1534	1079	1534	1140
1532	1160	1528	1180	1527.1	1401	1528	1548	1532	1559
1533.7	1572	1532	1578	1528	1586	1528	1773	1530	1857
1532	1915	1532	1950	1530	1975	1530	2008	1550	2048
1	420								
20	17	1000	1928	140	66	100			
			1320		1770				
1546	1000	1536	1034	1534	1048	1534	1128	1536	1194
1536	1216	1530	1260	1528	1314	1528	1411	1534	1428
1534	1447	1530	1455	1528.3	1655	1530	1700	1532	1784
1532	1888	1552	1928						
21	22	1000	1928	280	30	100			
			1395		1760				
1550	1000	1544	1020	1542	1046	1540	1088	1538	1097
1536	1119	1534	1123	1530	1170	1529.3	1248	1530	1311
1532	1468	1532	1492	1530	1557	1530	1570	1532	1618
1536	1649	1534	1669	1530	1683	1530	1720	1532	1782
1532	1888	1552	1928						
22	14	1000	1862	70	98	100			
			1365		1675				
1550	1000	1534	1087	1534	1191	1532	1212	1532	1551
1534	1585	1536	1610	1536	1621	1534	1645	1532	1656
1532	1736	1534	1799	1534	1822	1554	1862		
23	21	1000	1846	105	105	100			
			1385		1645				
1550	1000	1538	1082	1536	1114	1534	1167	1536	1247
1536	1285	1534	1311	1534	1357	1536	1369	1537.2	1385
1536	1394	1534	1399	1534	1620	1536	1623	1536	1633
1534	1638	1532	1659	1532	1772	1538	1798	1539	1806
1559	1846								
24	15	1000	1785	160	134	100			
			1355						
1550	1000	1540	1057	1536	1091	1536	1211	1540	1231
1540	1251	1536	1278	1536	1557	1538	1561	1540	1578
1542	1590	1544	1653	1546	1727	1546	1745	1566	1785
25	13	1000	1680	20	178	100			
			1345		1520				
1550	1000	1540	1037	1536	1062	1536	1186	1538	1280
1538	1500	1540	1570	1542	1587	1542	1631	1550	1680
1550.4	1720	1550	1758	1570	1798				
26	16	1000	1619	100	80	100			

1552	1000	1538	1078	1538	1160	1538	1208	1538	1255
1540	1316	1540	1510	1542	1511	1544	1540	1546	1575
1548	1592	1550	1600	1552	1619	1552	1722	1551	1765
1571	1805								
27	12	1000	1542	60	47	100			
			1330						
1552	1000	1546	1048	1544	1070	1544	1091	1546	1132
1546	1382	1542	1390	1542	1430	1544	1469	1548	1482
1550	1542	1550	1750						
28	15	1000	1308	110	17	100			
			1090		1265				
1560	1000	1558	1025	1556	1044	1554	1075	1548	1114
1546	1130	1544	1140	1544	1152	1548	1188	1548	1214
1550	1308	1552	1398	1552	1412	1550	1443	1550	1493

```
*****************************************************
 WATER SURFACE PROFILES                              *
VERSION OF SEPTEMBER 1988                            *
                                                     *
                                                     *
RUN DATE      7/ 5/89    TIME    17:51:24            *
*****************************************************
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```
X      X  XXXXXXX   XXXXX
X      X  X         X     X
X      X  X         X
XXXXXXX   XXXX      X          XXXXX
X      X  X         X
X      X  X         X     X
X      X  XXXXXXX   XXXXX
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ND OF BANNER

7/ 5/89 17:51:24

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*****************************************************
HEC2 RELEASE DATED SEPT 88

*****************************************************

1   DEVELOPMENT ENGINEERING      PROJECT 1740      JULY 1989
2   PROPOSED DIKE ON CAVE CREEK   EXISTING CONDITIONS DOWNSTREAM - FLOODPLAIN
3   KNOCHEL BROS. LANDFILL SITE      Q = 5400 CFS     BOTTOM WIDTH = 85 FT

1  ICHECK    INQ       NINV      IDIR      STRT      METRIC    HVINS     Q

   -10       2         0         0         0         0         0         5400

2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW

   -1        0         -1        0         0         0         -1        0
```

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

PROF 1

R TICAL DEPTH TO BE CALCULATED AT ALL CROSS SECTIONS

C V= .100 CEHV= .300

SECNO 10.680

10.68	7.76	1527.46	1524.40	1527.46	1527.75	.29	.00	.0
5400.	0.	5400.	0.	0.	1251.	0.	0.	0
.00	.00	4.32	.00	.000	.045	.000	.000	1519.7
002534	0.	0.	0.	0	13	0	.00	296.7

SECNO 10.740

3 1 HV CHANGED MORE THAN HVINS

3 2 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

4 0 ENCROACHMENT STATIONS= 9865.0 10400.0 TYPE= 1 TARGET= -9865

10.74	7.35	1528.35	1527.29	.00	1529.28	.93	1.34	.1
5400.	0.	5400.	0.	0.	696.	0.	7.	2
.01	.00	7.76	.00	.000	.045	.000	.000	1521.0
008387	155.	317.	350.	2	15	0	.00	165.3

S CNO 1.000

3 1 HV CHANGED MORE THAN HVINS

302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

470 ENCROACHMENT STATIONS= 1070.0 1353.0 TYPE= 1 TARGET= -1070

1.00	9.62	1529.72	1524.88	.00	1529.93	.22	.58	.0
5400.	55.	617.	4728.	52.	167.	1262.	14.	3
.03	1.05	3.70	3.75	.050	.040	.050	.000	1520.1
001051	214.	233.	277.	2	14	0	.00	253.0

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

SECNO 2.000
280 CROSS SECTION 2.00 EXTENDED 1.87 FEET

470 ENCROACHMENT STATIONS= 1042.0 1315.0 TYPE= 1 TARGET= 273

2.00	9.37	1529.87	1524.83	.00	1530.01	.14	.07	.0
5400.	6.	2235.	3159.	11.	666.	1163.	17.	3
.04	.58	3.36	2.71	.050	.040	.050	.000	1520.5
000601	98.	93.	83.	2	18	0	.00	273.0

SECNO 3.000

3.00	9.19	1529.89	1523.84	.00	1530.03	.14	.03	.0
5400.	0.	5400.	0.	0.	1768.	0.	19.	4
.04	.00	3.05	.00	.000	.040	.000	.000	1520.7
000427	51.	53.	57.	2	17	0	.00	219.8

SECNO 4.000

302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

4.00	8.19	1529.89	1526.41	.00	1530.44	.55	.28	.1
5400.	0.	5400.	0.	0.	908.	0.	30.	5
.06	.00	5.94	.00	.000	.040	.000	.000	1521.7
002109	350.	350.	347.	2	8	0	.00	136.7

SECNO 5.000

5.00	8.31	1530.61	1526.93	.00	1531.08	.47	.63	.0
5400.	0.	5400.	0.	0.	978.	0.	37.	6
.08	.00	5.52	.00	.000	.040	.000	.000	1522.3
001862	325.	320.	312.	2	11	0	.00	150.5

SECNO 6.000

6.00	8.28	1530.88	1527.26	.00	1531.38	.50	.29	.0
5400.	0.	5400.	0.	0.	953.	0.	40.	7
.08	.00	5.66	.00	.000	.040	.000	.000	1522.6
001938	159.	155.	142.	2	11	0	.00	145.1

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI
SECNO 7.000								
7.00	8.27	1531.07	1527.52	.00	1531.62	.55	.22	.0
5400.	0.	5400.	0.	0.	904.	0.	43.	7
.09	.00	5.97	.00	.000	.040	.000	.000	1522.8
.002079	121.	112.	101.	2	11	0	.00	133.7
SECNO 8.000								
8.00	8.46	1531.46	1527.55	.00	1531.92	.47	.29	.0
5400.	0.	5400.	0.	0.	983.	0.	46.	8
.10	.00	5.49	.00	.000	.040	.000	.000	1523.0
.001712	168.	155.	140.	2	11	0	.00	142.4
SECNO 9.000								
9.00	8.55	1531.65	1527.34	.00	1532.01	.36	.07	.0
5400.	0.	5400.	0.	0.	1122.	0.	47.	8
.10	.00	4.81	.00	.000	.040	.000	.000	1523.1
.001306	53.	49.	43.	2	8	0	.00	162.4
SECNO 10.000								
10.00	8.43	1531.93	1527.68	.00	1532.29	.36	.28	.0
5400.	0.	5400.	0.	0.	1124.	0.	52.	9
.11	.00	4.81	.00	.000	.040	.000	.000	1523.5
.001599	200.	192.	198.	1	11	0	.00	189.8
SECNO 11.000								
11.00	8.39	1532.19	1528.63	.00	1532.54	.35	.25	.0
5400.	0.	5400.	0.	0.	1139.	0.	56.	9
.12	.00	4.74	.00	.000	.040	.000	.000	1523.8
.001515	155.	161.	163.	2	11	0	.00	189.2
SECNO 12.000								
470 ENCROACHMENT STATIONS=		1305.0	1522.0	TYPE=	1	TARGET=		-1305
12.00	8.37	1532.37	1528.51	.00	1532.69	.31	.14	.0
5400.	0.	4354.	1046.	0.	964.	243.	59.	10
.13	.00	4.52	4.30	.000	.045	.050	.000	1524.0
.001642	60.	92.	91.	2	11	0	.00	191.7

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

SECNO 13.000

302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

470 ENCROACHMENT STATIONS=			1335.0	1601.0	TYPE=	1	TARGET=	-1335
13.00	9.66	1532.66	1527.20	.00	1532.79	.12	.08	.0
5400.	0.	4455.	945.	0.	1550.	359.	62.	10
.14	.00	2.87	2.63	.000	.045	.050	.000	1523.0
.000508	75.	100.	100.	2	8	0	.00	245.3

SECNO 14.000

470 ENCROACHMENT STATIONS=			1290.0	1668.0	TYPE=	1	TARGET=	-1290
14.00	8.67	1532.77	1526.91	.00	1532.83	.06	.04	.0
5400.	0.	2731.	2669.	0.	1355.	1372.	68.	11
.15	.00	2.02	1.95	.000	.045	.050	.000	1524.1
.000268	55.	100.	105.	1	17	0	.00	355.3

SECNO 15.000

302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

470 ENCROACHMENT STATIONS=			1270.0	1692.0	TYPE=	1	TARGET=	422
15.00	8.82	1532.82	1525.72	.00	1532.85	.03	.02	.0
5400.	0.	5344.	56.	0.	3647.	68.	75.	12
.17	.00	1.47	.82	.000	.045	.050	.000	1524.0
.000111	45.	100.	106.	1	21	0	.00	422.0

SECNO 16.000

470 ENCROACHMENT STATIONS=			1260.0	1730.0	TYPE=	1	TARGET=	470
16.00	8.83	1532.83	1527.09	.00	1532.87	.04	.01	.0
5400.	0.	5400.	0.	0.	3375.	0.	83.	13
.19	.00	1.60	.00	.000	.045	.000	.000	1524.0
.000177	15.	100.	113.	0	19	0	.00	470.0

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
IME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

SECNO 17.000

47 ENCROACHMENT STATIONS=			1295.0	1885.0	TYPE=	1	TARGET=	590
17.00	9.96	1532.86	1527.26	.00	1532.88	.03	.01	.0
5400.	0.	5400.	0.	0.	4070.	0.	92.	14
.21	.00	1.33	.00	.000	.045	.000	.000	1522.9
.00127	225.	100.	94.	0	9	0	.00	590.0

SECNO 18.000

302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

470 ENCROACHMENT STATIONS=			1480.0	2070.0	TYPE=	1	TARGET=	590
18.00	6.86	1532.86	1528.68	.00	1532.91	.05	.02	.0
5400.	0.	5400.	0.	0.	3123.	0.	100.	15
.22	.00	1.73	.00	.000	.045	.000	.000	1526.0
.00297	310.	100.	108.	2	14	0	.00	582.9

SECNO 19.000

265 DIVIDED FLOW

47 ENCROACHMENT STATIONS=			1330.0	1900.0	TYPE=	1	TARGET=	570
19.00	5.78	1532.88	1529.43	.00	1532.95	.07	.04	.0
5400.	0.	5400.	0.	0.	2580.	0.	107.	17
.24	.00	2.09	.00	.000	.045	.000	.000	1527.1
.000536	410.	100.	75.	1	22	0	.00	560.9

SECNO 20.000

26 DIVIDED FLOW

30 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

47 ENCROACHMENT STATIONS=			1320.0	1770.0	TYPE=	1	TARGET=	450
20.00	4.98	1532.98	1528.84	.00	1532.99	.00	.03	.0
420.	0.	420.	0.	0.	1588.	0.	111.	18
.34	.00	.26	.00	.000	.045	.000	.000	1528.0
.00011	140.	100.	66.	2	17	0	.00	426.0

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
IME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

SECNO 21.000

26 DIVIDED FLOW

30 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

47 ENCROACHMENT STATIONS=			1395.0	1760.0	TYPE=	1	TARGET=	365
21.00	2.98	1532.98	1530.96	.00	1532.99	.01	.00	.0
420.	0.	420.	0.	0.	615.	0.	114.	19
.38	.00	.68	.00	.000	.045	.000	.000	1530.0
.00180	280.	100.	30.	2	21	0	.00	318.0

SECNO 22.000

265 DIVIDED FLOW

302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

470 ENCROACHMENT STATIONS=			1365.0	1675.0	TYPE=	1	TARGET=	310
22.00	1.00	1533.00	1532.50	.00	1533.05	.06	.05	.0
420.	0.	420.	0.	0.	214.	0.	115.	19
.40	.00	1.96	.00	.000	.045	.000	.000	1532.0
.003855	70.	100.	98.	0	20	0	.00	227.3

SECNO 23.000

26 DIVIDED FLOW

185 MINIMUM SPECIFIC ENERGY
72 CRITICAL DEPTH ASSUMED

470 ENCROACHMENT STATIONS=			1385.0	1645.0	TYPE=	1	TARGET=	260
23.00	1.13	1534.46	1534.46	.00	1534.70	.23	.89	.0
420.	0.	420.	0.	0.	108.	0.	115.	20
.40	.00	3.88	.00	.000	.045	.000	.000	1533.3
.038210	105.	100.	105.	0	8	0	.00	231.0

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

SECNO 24.000

302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

470 ENCROACHMENT STATIONS=			1355.0	1785.0	TYPE=	1	TARGET=	-1355
24.00	.70	1536.70	1536.51	.00	1536.84	.14	2.13	.0
420.	0.	420.	0.	0.	140.	0.	116.	20
.41	.00	3.00	.00	.000	.045	.000	.000	1536.0
.013586	160.	100.	134.	6	14	0	.00	203.3

SECNO 25.000

302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

470 ENCROACHMENT STATIONS=			1345.0	1520.0	TYPE=	1	TARGET=	175
25.00	.61	1538.61	1538.60	.00	1538.88	.26	2.00	.0
420.	0.	420.	0.	0.	102.	0.	116.	21
.42	.00	4.13	.00	.000	.045	.000	.000	1538.0
.032419	20.	100.	178.	3	11	0	.00	175.0

SECNO 26.000

470 ENCROACHMENT STATIONS=			1395.0	1805.0	TYPE=	1	TARGET=	-1395
26.00	.91	1540.91	1540.74	.00	1541.16	.25	2.28	.0
420.	0.	420.	0.	0.	105.	0.	116.	21
.43	.00	4.00	.00	.000	.045	.000	.000	1540.0
.016898	100.	100.	80.	4	11	0	.00	115.4

SECNO 27.000
185 MINIMUM SPECIFIC ENERGY
720 CRITICAL DEPTH ASSUMED

470 ENCROACHMENT STATIONS=			1330.0	1750.0	TYPE=	1	TARGET=	-1330
27.00	1.33	1543.33	1543.33	.00	1543.86	.53	2.18	.0
420.	0.	420.	0.	0.	72.	0.	116.	21
.43	.00	5.83	.00	.000	.045	.000	.000	1542.0
.029319	60.	100.	47.	0	11	0	.00	68.5

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

SECNO 28.000
'185 MINIMUM SPECIFIC ENERGY
:72 CRITICAL DEPTH ASSUMED

:470 ENCROACHMENT STATIONS= 1090.0 1265.0 TYPE= 1 TARGET= 175

28.00	2.24	1546.24	1546.24	.00	1546.95	.71	2.82	.0
420.	0.	420.	0.	0.	62.	0.	116.	21
.44	.00	6.79	.00	.000	.045	.000	.000	1544.0
27066	110.	100.	17.	0	14	0	.00	44.0

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HEC2 RELEASE DATED SEPT 88

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OTE- ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY

HEL BROS. LANDFILL SITE

UMMARY PRINTOUT TABLE 150

SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIW
10.680	.00	.00	.00	1519.70	5400.00	1527.46	1524.
10.740	317.00	.00	.00	1521.00	5400.00	1528.35	1527.
1.000	233.00	.00	.00	1520.10	5400.00	1529.72	1524.
2.000	93.00	.00	.00	1520.50	5400.00	1529.87	1524.
3.000	53.00	.00	.00	1520.70	5400.00	1529.89	1523.
4.000	350.00	.00	.00	1521.70	5400.00	1529.89	1526.
5.000	320.00	.00	.00	1522.30	5400.00	1530.61	1526.
6.000	155.00	.00	.00	1522.60	5400.00	1530.88	1527.
7.000	112.00	.00	.00	1522.80	5400.00	1531.07	1527.
8.000	155.00	.00	.00	1523.00	5400.00	1531.46	1527.
9.000	49.00	.00	.00	1523.10	5400.00	1531.65	1527.
10.000	192.00	.00	.00	1523.50	5400.00	1531.93	1527.
11.000	161.00	.00	.00	1523.80	5400.00	1532.19	1528.
12.000	92.00	.00	.00	1524.00	5400.00	1532.37	1528.
13.000	100.00	.00	.00	1523.00	5400.00	1532.66	1527.
14.000	100.00	.00	.00	1524.10	5400.00	1532.77	1526.
15.000	100.00	.00	.00	1524.00	5400.00	1532.82	1525.

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SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIW
16.000	100.00	.00	.00	1524.00	5400.00	1532.83	1527.
17.000	100.00	.00	.00	1522.90	5400.00	1532.86	1527.
18.000	100.00	.00	.00	1526.00	5400.00	1532.86	1528.
19.000	100.00	.00	.00	1527.10	5400.00	1532.88	1529.
20.000	100.00	.00	.00	1528.00	420.00	1532.98	1528.
21.000	100.00	.00	.00	1530.00	420.00	1532.98	1530.
22.000	100.00	.00	.00	1532.00	420.00	1533.00	1532.
23.000	100.00	.00	.00	1533.33	420.00	1534.46	1534.
24.000	100.00	.00	.00	1536.00	420.00	1536.70	1536.
25.000	100.00	.00	.00	1538.00	420.00	1538.61	1538.
26.000	100.00	.00	.00	1540.00	420.00	1540.91	1540.
27.000	100.00	.00	.00	1542.00	420.00	1543.33	1543.
28.000	100.00	.00	.00	1544.00	420.00	1546.24	1546.

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HEL BROS. LANDFILL SITE

UMMARY PRINTOUT TABLE 150

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
10.680	5400.00	1527.46	.00	.00	.00	296.78	.
10.740	5400.00	1528.35	.00	.89	.00	165.35	317.
1.000	5400.00	1529.72	.00	1.37	.00	253.08	233.
2.000	5400.00	1529.87	.00	.15	.00	273.00	93.
3.000	5400.00	1529.89	.00	.02	.00	219.84	53.
4.000	5400.00	1529.89	.00	.00	.00	136.79	350.
5.000	5400.00	1530.61	.00	.72	.00	150.52	320.
6.000	5400.00	1530.88	.00	.28	.00	145.12	155.
7.000	5400.00	1531.07	.00	.19	.00	133.72	112.
8.000	5400.00	1531.46	.00	.38	.00	142.44	155.
9.000	5400.00	1531.65	.00	.19	.00	162.47	49.
10.000	5400.00	1531.93	.00	.28	.00	189.85	192.
11.000	5400.00	1532.19	.00	.26	.00	189.28	161.
12.000	5400.00	1532.37	.00	.19	.00	191.75	92.
13.000	5400.00	1532.66	.00	.29	.00	245.33	100.
14.000	5400.00	1532.77	.00	.11	.00	355.33	100.
15.000	5400.00	1532.82	.00	.05	.00	422.00	100.
16.000	5400.00	1532.83	.00	.01	.00	470.00	100.
17.000	5400.00	1532.86	.00	.03	.00	590.00	100.
18.000	5400.00	1532.86	.00	.01	.00	582.90	100.
19.000	5400.00	1532.88	.00	.02	.00	560.98	100.
20.000	420.00	1532.98	.00	.10	.00	426.09	100.
21.000	420.00	1532.98	.00	-.00	.00	318.06	100.
22.000	420.00	1533.00	.00	.01	.00	227.31	100.

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SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
23.000	420.00	1534.46	.00	1.47	.00	231.00	100.
24.000	420.00	1536.70	.00	2.24	.00	203.38	100.
25.000	420.00	1538.61	.00	1.91	.00	175.00	100.
26.000	420.00	1540.91	.00	2.30	.00	115.46	100.
27.000	420.00	1543.33	.00	2.42	.00	68.55	100.
28.000	420.00	1546.24	.00	2.91	.00	44.01	100.

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SUMMARY OF ERRORS AND SPECIAL NOTES

ARNING SECNO=	10.740	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
ARNING SECNO=	1.000	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
ARNING SECNO=	4.000	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
ARNING SECNO=	13.000	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
ARNING SECNO=	15.000	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
ARNING SECNO=	18.000	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
ARNING SECNO=	20.000	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
ARNING SECNO=	21.000	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
ARNING SECNO=	22.000	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
ION SECNO=	23.000	PROFILE=	1	CRITICAL DEPTH ASSUMED
ION SECNO=	23.000	PROFILE=	1	MINIMUM SPECIFIC ENERGY
ARNING SECNO=	24.000	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
ARNING SECNO=	25.000	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
ION SECNO=	27.000	PROFILE=	1	CRITICAL DEPTH ASSUMED
ION SECNO=	27.000	PROFILE=	1	MINIMUM SPECIFIC ENERGY
ION SECNO=	28.000	PROFILE=	1	CRITICAL DEPTH ASSUMED
ION SECNO=	28.000	PROFILE=	1	MINIMUM SPECIFIC ENERGY

APPENDIX "E"

Riprap Design Calculations

* STABILITY ANALYSIS

RIP RAP DESIGN

9/1/89

B.C.

I) CROSS SECTION 1 - 3

- Q = 5400 cfs
- n = 0.04
- AVERAGE BANK SIDE SLOPE OPPOSITE DIKE = 4.2:1
- MAXIMUM ENERGY GRADE LINE SLOPE = 0.0019 FT/FT (HEC-2 RESULTS ASSUMING 2.2:1 SIDE S
- BED SLOPE = 0.0030 FT/FT
- MAXIMUM VELOCITY = 5.7 FT/S (HEC 2 RESULTS - ASSUMING 2.2:1 SIDE SLOPE)
- MAXIMUM DEPTH = 9.0 FT
- CHANNEL BOTTOM WIDTH = 85 FT
- HYDRAULIC RADIUS

$$R = \left[Vn / 1.486 (S_e)^{1/2} \right]^{1.5}$$

$$= \left[(5.7)(.04) / 1.486 (.0019)^{1/2} \right]^{1.5} = 6.6 \text{ FT}$$

- UTILIZING DIKE SIDE SLOPE = 2.2:1

CALCULATIONS FOR CRITICAL SHEAR (3 METHODS)

A) 1) $\tau_1 = \gamma R S_E$ - (SHEAR EQUATION)

$V = \frac{1.486}{n} R^{2/3} S^{1/2}$ - (MANNING EQUATION) WHERE

γ = SPECIFIC WEIGHT OF WATER

R = HYDRAULIC RADIUS

S_e = ENERGY GRADE LINE UTIL MANNING EQUATION

2) $S_E = \left(\frac{Vn}{1.486 R^{2/3}} \right)^2$

COMBINING EQUATIONS 1 + 2 THE FOLLOWING EQUATION FOR SHEAR IS OBTAINED

$$\tau_1 = \gamma R \left(\frac{Vn}{1.486 R^{2/3}} \right)^2$$

$$\tau_1 = (62.4)(6.6)\left(\frac{5.7(.04)}{1.486 (6.6)^{2/3}} \right)^2 = 0.78 \text{ LBS/FT}^2$$

B) $\tau_2 = \gamma R S_E$ - (SHEAR EQUATION)

WHERE γ = SPECIFIC WEIGHT OF WATER

R = HYDRAULIC RADIUS

S_e = ENERGY GRADE LINE UTILIZ

HEC 2 PRINTOUT

$$\frac{\left(\frac{V_2^2}{2g} + Z_1 \right) - \left(\frac{V_1^2}{2g} + Z_2 \right)}{L_{1-2}}$$

* SEDIMENT TRANSPORT TECHNOLOGY, "SIMONS + SENTURK" 1976 P 418 - 426

I) CROSS SECTION 1-3 (CONTINUED)

B) $\tau_2 = (62.4)(6.6)\left[\frac{(3.05)^2}{2g} + 29.89\right] - \left[\frac{(3.7)^2}{2g} + 29.72\right]$

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$\tau_2 = 0.29 \text{ LBS/FT}^2$

C) $\tau_3 = \frac{1}{8}\rho f V^2$ (SHEAR EQUATION)

WHERE ρ = DENSITY OF WATER
f = FRICTION FACTOR
V = VELOCITY
Fr = FROUDE NUMBER

$Fr = V/\sqrt{gR} = 5.7/\sqrt{(32.2)(6.6)} = 0.39$

$f = 8g/(1.486/n\ R^{1/6})^2 = \frac{(8)(32.2)}{\left(\frac{1.486}{.04}(6.06)^{1/6}\right)^2} = 0.10$

OR

$f = \frac{8\,S_E}{Fr^2} = \frac{8(.0019)}{.15} = 0.10$

$\tau_3 = \frac{1}{8}(1.94)(0.10)(5.7)^2 = 0.79 \text{ LBS/FT}^2$

USE $\tau = 0.79 \text{ LBS/FT}^2$ ←

D_{50} SIZE AVAILABLE = 1.25 FT
SPECIFIC GRAVITY (S_g) = 2.74
θ = 24.4 (2.2:1 SIDE SLOPE) -

ANGLE OF REPOSE ϕ, OBTAINED FROM FIG 7.16 ON P. 44 OF "SEDIMENT TRANSPORT TECHNOLOGY," BY SIMONS & SENTU ASSUMING THE ROCK WOULD BE ROUNDED (WORST CASE)

$n = 21\tau/[(S_g - 1)\gamma D_{50}]$ EQUATION 7.59 ON P. 425 OF "SEDIMENT TRANSPORT TECHNOLOGY."

$\beta = \tan^{-1}[(n \tan\phi)/(2 \sin\theta)]$ EQUATION 7.61 ON P 425 OF "SEDIMENT TRANSPORT TECHNOLOGY

B

I) CROSS SECTION 1-3 (CONTINUED)

$$n' = n\left[\left(1+\sin\beta\right)/2\right]$$

EQUATION 7.62 ON P. 425 OF "SEDIMENT TRANSPORT TECHNOLOGY

$$S.F. = \cos\theta \tan\phi \Big/ \left[n' \tan\phi + \sin\theta \cos\beta\right]$$

EQUATION 7.57 ON PAGE 425 OF "SEDIMENT TRANSPORT TECHNOLOGY

D50 (FT)	TAN ϕ (DEG)	n	β (DEG)	n'	S.F	REMARKS
1.25	.83	.12	6.9	.06	1.64	GOOD - CONSERVATIVE

II) CROSS SECTION 4-12

- Q = 5400 cfs
- n = 0.04
- AVERAGE BANK SLOPE OPPOSITE DIKE - 5.0:1
- MAXIMUM ENERGY GRADE LINE SLOPE = 0.0020 FT/FT
- BED SLOPE = 0.0018 FT/FT
- MAXIMUM VELOCITY = 5.84 FT/S
- MAXIMUM DEPTH = 8.6 FT.
- CHANNEL BOTTOM WIDTH = 85 FT.
- HYDRAULIC RADIUS

$$R = \left[(5.84)(.04) \Big/ (1.486)(0.002)^{1/2}\right]^{1.5} = 6.59 \text{ FT}$$

- UTILIZING DIKE SIDE SLOPE = 2:1

CALCULATIONS FOR CRITICAL SHEAR (3 METHODS)

A) $\tau_1 = \gamma R \left(\frac{Vn}{1.486\, R^{2/3}}\right)^2$

$$\tau_1 = (62.4)(6.59)\left(\frac{(5.84)(0.04)}{(1.486)(6.59)^{2/3}}\right)^2 = 0.82 \text{ LBS/FT}^2$$

B
PJ

II) CROSS SECTION 4-12 (CONTINUED)

B) $\tau_2 = \gamma R S_E$

$$\tau_2 = (62.4)(6.59)\left[\frac{\left(\frac{(4.59)^2}{2g} + 32.37\right) - \left(\frac{(5.94)^2}{2g} + 29.89\right)}{1236}\right]$$

$$\tau_2 = 0.75 \text{ LBS/FT}^2$$

c) $\tau_3 = \frac{1}{8} \rho f V^2$

$$Fr = V/\sqrt{gR} = 5.84/\sqrt{(32.2)(6.59)} = 0.40$$

$$f = \frac{8 S_E}{Fr^2} = \frac{8(.002)}{.16} = 0.10$$

OR

$$f = \frac{8g}{\left(\frac{1.486}{n} R^{1/6}\right)^2} = \frac{8(32.2)}{\left(\frac{1.486}{.04}(6.59)^{1/6}\right)^2} = 0.10$$

$$\tau_3 = \frac{1}{8}(1.94)(.10)(5.84)^2 = 0.83 \text{ LBS/FT}^2$$

USE $\tau = 0.83$ LBS/FT^2 ←

D50 SIZE AVAILABLE = 1.25 FT
SPECIFIC GRAVITY (SG) = 2.75
$\Theta = 26.6°$

D_{50} (FT)	ϕ (DEG)	TAN ϕ	n	β (DEG)	n'	S.F	REMARKS
.25	40	.83	.12	6.9	.07	1.48	CLOSE

USING D_{50} = 1.25 FT $D_{100} = 2D_{50} = 2.5$ FT
$D_{20} = 0.5 D_{50} = 0.625$ FT

OBTAINED FROM P. 447 OF "SEDIMENT TRANSPORT TECHNOLOGY"
THICKNESS OF RIP RAP SHOULD BE LARGE ENOUGH TO
ACCOMMODATE THE LARGEST STONES (IF WELL-GRADED WITH NO VOIDS) - P. 448 PU

GRADATION ESTIMATE

DIAM, FT	% PASSING
3	100
2	80
1.5	65
1	45
0.75	30
0.50	20

Project 1740

M.N.
4-25-89

Corps of Engineers
Design Criteria For Stone Weight*

Available $D_{50} = 1.25$ ft.

Specific Gravity = 2.74

Cross-Sections 2 to 4 – Velocity = 5.7 fps $\quad S_e = 0.0019$ ft/ft

$$R = \left[(V)(n) \Big/ (1.486)(S_e)^{1/2} \right]^{1.5} = \left[(5.7)(.04) \Big/ (1.486)(.0019)^{1/2} \right]^{1.5}$$

$$= 6.60 \text{ ft.}$$

$$\bar{\tau}_o = \gamma R S_e = (62.4)(6.60)(0.0019)$$

$$= 0.78 \text{ lb/ft}^2$$

$$\tau = a(\gamma_s - \gamma) D_{50} = 0.04(2.74 - 1)(62.4)(1.25)$$

$$= 5.43 \text{ lb/ft}^2$$

$\phi = 24.4°$ (2.2:1 side slope)

$\theta = 40°$

$$\tau' = \tau \left(1 - \frac{\sin^2 \phi}{\sin^2 \theta} \right)^{0.5} = 5.43 \left(1 - \frac{\sin^2 24.4}{\sin^2 40} \right)^{0.5}$$

$$= 4.16 \text{ lb/ft}^2$$ ← shear that riprapped dike bank will withstand.

Using 5.7 as an estimate for $\bar{V}$:

$$\tau_o = \gamma \bar{V}^2 \Big/ \left(32.6 \log_{10} \frac{12.2 y}{D_{50}} \right)^2 \qquad \text{Depth} = y = 9.03 \text{ ft.}$$

$$= (62.4)(5.7)^2 \Big/ \left(32.6 \log_{10} \frac{12.2(9.03)}{1.25} \right)^2$$

$$= 0.50 \text{ lb/ft}^2$$ ← est. of local boundary shear

Actual boundary shear value will be higher, but the average local velocity would have to be 16.4 fps to match the riprap design shear, which is not possible. The hydraulics for the other cross-sections are similar with a dike side slope of 2:1.

⟹ **Riprap is ok**

* "Hydraulic Design of Flood Control Channels," Corps of Engineers, Engineering Manual EM 1110-2-1601, 1 July 1970, p. 39-42.

APPENDIX "F"

HEC-2 Input and Output for Existing Conditions at 5400 cfs with Upstream Flow Modifications

Existing Conditions
Modified Flow Path
Q = 5400 cfs

CORREXIS.*
Flow thru low flow channel

```
1CELLA,BARR,EVANS AND ASSOCIATES                    EXISTING CONDITIONS
2 AVE CK WASH FLOOD INSURANCE STUDY              FLOW CONDITIONS UPSTREAM WERE
3       DEER VALLEY TO DAM OUTLET                       MODIFIED - MAY 1989
1    -10       2                                                   1466.75
2      1                -1
C  0.045   0.045    0.04      .1      .3
T      1    5400
1    9.2      26    9944   10266
R   1486    9840    1480    9852    1478    9860  1476.4    9880    1476    9944
R   1447    9960    1472    9964    1470    9968    1462    9980    1460    9990
R1459.5   10000    1460   10018  1461.4   10020    1464   10021    1466   10026
R   1470   10036    1472   10040    1474   10106    1470   10116    1464   10128
R1462.8   10150    1464   10168    1466   10196    1470   10220    1480   10266
R   1490   10290
C   0.05    0.05   0.045     0.3     0.5
1    9.3      13    9840   10056     900     340     528
R   1480    9840    1468    9840    1468    9880    1468    9900    1468    9950
R   1468   10005    1466   10030    1467   10040    1470   10048    1476   10056
R   1478   10170    1478   10295    1480   10310
1   9.32      16    9880   10070     125      80     100
R1482.8    9700    1480    9880    1472    9930    1470    9931    1468   10016
R   1468   10048    1470   10053    1480   10068    1482   10070    1484   10085
R   1486   10120  1487.9   10155    1486   10180    1484   10190    1482   10225
R   1484   10260
C                     0.1     0.3
1   9.33      16    9900   10075      30      40      40
R   1482    9410    1480    9530    1480    9820    1478    9845    1476    9870
R   1474    9900    1472    9925    1470    9955  1468.3   10045    1470   10050
R   1472   10075    1474   10095    1476   10120    1478   10138    1480   10175
R   1490   10400
1   9.34      12    9950   10072      40      50      55
R   1482    9440    1480    9560    1480    9675    1480    9840    1480    9950
R   1470    9975    1468    9980    1468   10010    1470   10042    1482   10072
R   1488   10090    1490   10120
C                     0.3     0.5
1   9.44      15    9400    9860     100     510     528
R   1485    9190    1482    9230    1480    9235    1480    9400  1478.9    9480
R   1478    9600    1476    9794    1474    9800    1476    9810    1478    9837
R   1480    9848    1481    9851    1482    9854    1483    9857    1484    9860
C                     0.1     0.3
1    9.6      17    9060    9600     620     800     800
R   1488    8825    1486    8830    1484    8835  1483.2    8837    1482    8840
R   1482    8975  1483.7    9060    1482    9105  1481.4    9220    1480    9370
R1479.9    9460    1480    9570    1484    9600    1484    9700    1486    9800
R   1488    9920  1491.2    9980
1    9.8      13    9315    9786    1100     930    1085
R   1504    9150    1494    9210    1492    9290    1490    9315    1488    9360
R   1488    9430  1487.3    9610    1488    9650    1490    9785    1492    9786
R   1494    9890    1498    9893    1498    9960
1   9.86      10    9400    9805     350     280     300
R   1500    9295    1494    9345    1492    9400    1490    9420    1488    9425
R   1488    9475    1490    9795    1498    9805    1500    9895    1502    9900
1   9.97      14    9460    9655     640     550     540
R   1506    9204    1496    9210    1494    9215    1492    9225    1494    9275
R   1494    9460    1492    9461    1492    9505  1492.4    9555    1494    9654
R   1496    9655    1498    9656    1500    9685    1502    9700
1  10.04      13    9665    9955     360     280     360
R   1510    9612    1510    9650    1510    9665    1498    9685    1496    9735
R   1496    9810    1495    9830    1496    9850    1498    9875    1500    9880
R   1502    9905    1504    9918    1505    9955
```

R	1504	9840	1500	9860	1498	9890	1498	10010	1500	10020
R	1502	10028	1503.6	10040	1504	10360				
C				0.1	0.3					
1	10.1	13	9942	10030	270	270	270			
R	1508.5	9910	1508	9942	1504	9947	1502	9950	1500	9954
R	1498	9957	1497.3	9975	1498	10000	1500	10020	1502	10025
R	1504	10030	1506	10070	1507	10190				
C				0.3	0.5					
1	10.14	22	9963	10038	230	210	212			
R	1520	9460	1516	9490	1516	9584	1514	9590	1512	9700
R	1510	9765	1508	9830	1508	9900	1510	9905	1510	9930
R	1508	9935	1509	9963	1500	9963.1	1500	10037.9	1509	10038
R	1508	10055	1508	10115	1510	10130	1510	10200	1512	10230
R	1514	10270	1514	10430						
C				0.1	0.3					
1	10.145	9	9963	10038	10	10	10			
R	1520	9460	1516	9490	1516	9580	1515	9590	1515	9963
R	1505.9	9963.1	1505.9	10037.9	1515	10038	1514	10460		
1	10.165	11	9963	10038	105	105	105			
R	1520	9520	1516	9530	1515	9570	1515	9963	1505.9	9963
R	1505.9	10038	1515	10038	1515	10140	1516	10180	1518	10190
R	1520	10250								
C				0.3	0.5					
1	10.18	19	9900	10096	90	70	85			
R	1530	9520	1520	9580	1518	9590	1518	9672	1516	9710
R	1514	9740	1514	9900	1508	9930	1506	9958	1506	10002
R	1508	10040	1508	10075	1510	10080	1514	10096	1516	10160
R	1518	10180	1520	10210	1522	10260	1523.5	10370		
C				0.1	0.3					
1	10.25	22	9845	10185	320	400	370			
R	1521.4	8840	1520	9145	1518	9180	1516	9210	1516	9375
R	1514	9470	1514	9540	1512	9555	1512	9620	1511.6	9700
R	1512	9790	1513.6	9845	1512	9900	1510	9948	1506.7	9975
R	1508	9994	1510	10040	1511	10048	1511.1	10185	1512	10328
R	1520	10332	1530	10343						
1	10.4	23	9970	10054	800	650	790			
R	1518	9740	1518	9750	1518	9760	1518	9780	1518	9800
R	1514	9810	1516	9825	1514	9850	1516	9863	1518	9952
R	1518	9970	1516	9980	1512	9986	1511.5	9990	1512	10004
R	1514	10048	1515.4	10054	1516	10230	1516	10400	1514	10410
R	1514	10435	1520	10445	1530	10458				
1	10.55	15	9956	10024	800	800	790			
R	1524	9800	1523.8	9830	1523.7	9860	1523.5	9880	1523.2	9956
R	1522	9966	1520	9974	1518	9986	1516	9992	1515.5	10000
R	1516	10010	1518	10018	1520	10024	1522	10136	1530	10155
1	10.68	10	9705	10032	620	680	686			
R	1528.5	9615	1528	9705	1526	9800	1524	9850	1522	9880
R	1520	9990	1519.7	10000	1520	10014	1530	10032	1540	10042
1	10.74	15	9840	10032	155	350	317			
R	1529.5	9740	1528.5	9840	1528	9850	1526	9870	1524	9970
R	1522	9982	1521	10010	1522	10018	1524	10020	1526	10028
R	1530	10032	1532	10056	1534	10105	1534	10320	1540	10400
1	10.82	23	9825	10163	385	375	422			
R	1532	9680	1530	9825	1528	9840	1526	9870	1524	9878
R	1523.5	9885	1524	9895	1526	9915	1528	9928	1530	9935
R	1528.3	9960	1528	9985	1526	10000	1528	10005	1529.7	10080
R	1528	10115	1526	10116	1524	10125	1526	10158	1530	10160
R	1532	10163	1534	10175	1536	10200				
1	10.98	7	9530	10140	980	870	845			
R	1544	9530	1524	9553	1526	9560	1526	10098	1524	10103
R	1530	10118	1536	10140						
1	21	27	1195	1890	360	720	580			
3				1284	1540	1832	1540			
R	1540	1000	1536	1014	1536	1052	1532	1066	1532	1076

R	1520	1555	1524	1570	1524	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
R	1520.7	1792	1522	1827	1522	1855	1524	1868	1538	1890
R	1538	2039	1540	2050						
T	1	420								
1	22	14	1000	1862	1280	680	960			
3				1365		1675				
R	1550	1000	1534	1087	1534	1191	1532	1212	1532	1551
R	1534	1585	1536	1610	1536	1621	1534	1645	1532	1656
R	1532	1736	1534	1799	1534	1822	1554	1862		
1	23	21	1000	1846	105	105	100			
3				1385		1645				
R	1550	1000	1538	1082	1536	1114	1534	1167	1536	1247
R	1536	1285	1534	1311	1534	1357	1536	1369	1537.2	1385
R	1536	1394	1534	1399	1534	1620	1536	1623	1536	1633
R	1534	1638	1532	1659	1532	1772	1538	1798	1539	1806
R	1559	1846								
1	24	15	1000	1785	160	134	100			
3				1355						
R	1550	1000	1540	1057	1536	1091	1536	1211	1540	1231
R	1540	1251	1536	1278	1536	1557	1538	1561	1540	1578
R	1542	1590	1544	1653	1546	1727	1546	1745	1566	1785
1	25	13	1000	1680	20	178	100			
3				1345		1520				
R	1550	1000	1540	1037	1536	1062	1536	1186	1538	1280
R	1538	1500	1540	1570	1542	1587	1542	1631	1550	1680
R	550.4	1720	1550	1758	1570	1798				
1	26	16	1000	1619	100	80	100			
3				1395						
R	1552	1000	1538	1078	1536	1100	1536	1208	1538	1288
R	1540	1316	1540	1510	1542	1511	1544	1540	1546	1575
R	1548	1592	1550	1600	1552	1619	1552	1722	1551	1765
R	1571	1805								
1	27	12	1000	1542	60	47	100			
3				1330						
R	1552	1000	1546	1048	1544	1070	1544	1091	1546	1132
R	1546	1382	1542	1390	1542	1430	1544	1469	1548	1482
R	1550	1542	1550	1750						
1	28	15	1000	1308	110	17	100			
3				1090		1265				
R	1560	1000	1558	1025	1556	1044	1554	1075	1548	1114
R	1546	1130	1544	1140	1544	1152	1548	1188	1548	1214
R	1550	1308	1552	1398	1552	1412	1550	1443	1550	1493
J										

R

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**************************************************
*  WATER SURFACE PROFILES                        *
*  VERSION OF SEPTEMBER 1988                     *
*                                                *
*                                                *
*  RUN DATE      5/23/89    TIME     9:49:28      *
**************************************************
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X     X  XXXXXXX   XXXXX
X     X  X        X     X
X     X  X        X
XXXXXXX  XXXX     X          XXXXX
X     X  X        X
X     X  X        X     X
X     X  XXXXXXX   XXXXX
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END OF BANNER

5/23/89 9:49:28

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*****************************************************
HEC2 RELEASE DATED SEPT 88

*****************************************************

T1CELLA,BARR,EVANS AND ASSOCIATES                    EXISTING CONDITIONS
T2CAVE CK WASH FLOOD INSURANCE STUDY            FLOW CONDITIONS UPSTREAM WERE
T3     DEER VALLEY TO DAM OUTLET                     MODIFIED - MAY 1989

J1  ICHECK    INQ      NINV     IDIR     STRT     METRIC   HVINS    Q

    -10       2

J2  NPROF     IPLOT    PRFVS    XSECV    XSECH    FN       ALLDC    IBW

    1                  -1
```

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

*PROF 1

CCHV= .100 CEHV= .300
*SECNO 9.200

3265 DIVIDED FLOW

9.20	19.75	1466.75	.00	1466.75	1467.90	1.15	.00	.0
5400.	0.	5400.	0.	0.	627.	0.	0.	0
.00	.00	8.61	.00	.000	.040	.000	.000	1447.0
010235	0.	0.	0.	0	0	0	.00	147.0

CCHV= .300 CEHV= .500
*SECNO 9.300

9.30	5.73	1471.73	.00	.00	1472.41	.68	4.37	.1
5400.	0.	5400.	0.	0.	814.	0.	9.	2
.02	.00	6.63	.00	.000	.045	.000	.000	1466.0
.006838	900.	528.	340.	3	0	0	.00	210.3

*SECNO 9.320

3301 HV CHANGED MORE THAN HVINS

7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

9.32	4.68	1472.68	1472.68	.00	1474.57	1.89	1.09	.6
5400.	0.	5400.	0.	0.	489.	0.	10.	3
.02	.00	11.04	.00	.000	.045	.000	.000	1468.0
019830	125.	100.	80.	3	15	0	.00	131.2

CCHV= .100 CEHV= .300
*SECNO 9.330

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

9.33	5.98	1474.28	.00	.00	1475.16	.89	.49	.1
5400.	0.	5318.	82.	1.	699.	26.	11.	3
.03	.72	7.61	3.15	.050	.045	.050	.000	1468.3
.008416	30.	40.	40.	4	0	0	.00	202.5

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

*SECNO 9.340

3301 HV CHANGED MORE THAN HVINS

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

9.34	6.27	1474.27	1474.27	.00	1476.73	2.46	.66	.4
5400.	0.	5400.	0.	0.	429.	0.	12.	3
.03	.00	12.59	.00	.000	.045	.000	.000	1468.0
.018259	40.	55.	50.	20	8	0	.00	88.3

CCHV= .300 CEHV= .500
*SECNO 9.440

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

9.44	6.72	1480.72	.00	.00	1480.96	.24	3.56	.6
5400.	170.	5230.	0.	120.	1308.	0.	22.	6
.06	1.42	4.00	.00	.050	.045	.000	.000	1474.0
.003547	100.	528.	510.	4	0	0	.00	616.9

CCHV= .100 CEHV= .300
*SECNO 9.600

3265 DIVIDED FLOW

9.60	3.55	1483.45	.00	.00	1483.63	.18	2.66	.0
5400.	493.	4907.	0.	249.	1382.	0.	50.	18
.13	1.98	3.55	.00	.050	.045	.000	.000	1479.9
.003215	620.	800.	800.	5	0	0	.00	739.7

*SECNO 9.800

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

9.80	2.70	1490.00	1489.78	.00	1490.65	.65	6.88	.1
5400.	0.	5400.	0.	0.	835.	0.	80.	33
.18	.00	6.47	.00	.000	.045	.000	.000	1487.3
.017816	1100.	1085.	930.	12	19	0	.00	469.5

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

*SECNO 9.860

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

9.86	4.30	1492.30	.00	.00	1492.56	.26	1.87	.0
5400.	1.	5399.	0.	1.	1316.	0.	88.	36
.20	.47	4.10	.00	.050	.045	.000	.000	1488.0
.003145	350.	300.	280.	3	0	0	.00	406.0

*SECNO 9.970

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

9.97	3.24	1495.24	.00	.00	1495.92	.68	3.23	.1
5400.	1751.	3649.	0.	365.	499.	0.	102.	42
.22	4.79	7.31	.00	.050	.045	.000	.000	1492.0
.014182	640.	540.	550.	3	0	0	.00	442.7

*SECNO 10.040

10.04	4.74	1499.74	.00	.00	1500.77	1.04	4.75	.1
5400.	0.	5400.	0.	0.	661.	0.	108.	44
.23	.00	8.17	.00	.000	.045	.000	.000	1495.0
.012290	360.	360.	280.	3	0	0	.00	197.2

CCHV= .300 CEHV= .500
*SECNO 10.050

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.05	5.40	1503.40	.00	.00	1503.99	.59	3.08	.1
5400.	0.	5400.	0.	0.	880.	0.	116.	46
.25	.00	6.14	.00	.000	.045	.000	.000	1498.0
.004680	460.	430.	400.	3	0	0	.00	195.5

CCHV= .100 CEHV= .300
*SECNO 10.100

3301 HV CHANGED MORE THAN HVINS

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.10	7.00	1504.30	.00	.00	1506.55	2.25	2.07	.5
5400.	0.	5399.	1.	0.	448.	1.	120.	47
.26	.00	12.04	1.03	.000	.045	.050	.000	1497.3
.014719	270.	270.	270.	3	0	0	.00	89.4

CCHV= .300 CEHV= .500
*SECNO 10.140

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.14	7.50	1507.50	.00	.00	1508.94	1.43	2.14	.2
5400.	0.	5400.	0.	0.	562.	0.	122.	48
.26	.00	9.61	.00	.000	.045	.000	.000	1500.0
.007350	230.	212.	210.	3	0	0	.00	74.9

CCHV= .100 CEHV= .300
*SECNO 10.145

3301 HV CHANGED MORE THAN HVINS

3605 20 TRIALS ATTEMPTED WSEL,CWSEL
3603 PROBABLE MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

10.15	5.44	1511.34	1511.34	.00	1514.07	2.73	.11	.3
5400.	0.	5400.	0.	0.	407.	0.	122.	48
.26	.00	13.26	.00	.000	.045	.000	.000	1505.9
.020178	10.	10.	10.	20	15	0	.00	74.9

*SECNO 10.165

3301 HV CHANGED MORE THAN HVINS

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.16	8.13	1514.03	.00	.00	1515.24	1.22	1.02	.1
5400.	0.	5400.	0.	0.	610.	0.	123.	48
.27	.00	8.86	.00	.000	.045	.000	.000	1505.9
.005713	105.	105.	105.	2	0	0	.00	75.0

CEHV= .300 CEHV= .500
*SECNO 10.180

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.18	9.52	1515.52	.00	.00	1515.69	.18	.14	.3
5400.	275.	5100.	25.	260.	1469.	37.	126.	48
.27	1.06	3.47	.68	.050	.045	.050	.000	1506.0
.000762	90.	85.	70.	2	0	0	.00	427.3

CEHV= .100 CEHV= .300
*SECNO 10.250

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.25	9.14	1515.84	.00	.00	1515.87	.04	.16	.0
5400.	1554.	3021.	825.	1352.	1774.	616.	148.	54
.34	1.15	1.70	1.34	.050	.045	.050	.000	1506.7
.000294	320.	370.	400.	2	0	0	.00	946.9

*SECNO 10.400

3365 DIVIDED FLOW

3301 HV CHANGED MORE THAN HVINS

3685 20 TRIALS ATTEMPTED WSEL,CWSEL
3393 PROBABLE MINIMUM SPECIFIC ENERGY

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
IME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
LOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

372 CRITICAL DEPTH ASSUMED

10.40	5.44	1516.94	1516.94	.00	1517.74	.80	.67	.2
5400.	630.	2739.	2032.	134.	300.	479.	189.	67
.37	4.71	9.12	4.24	.050	.045	.050	.000	1511.5
.013127	800.	790.	650.	20	14	0	.00	566.9

*SECNO 10.550

3280 CROSS SECTION 10.55 EXTENDED .19 FEET

10.55	8.69	1524.19	.00	.00	1525.04	.85	7.28	.0
5400.	187.	3309.	1905.	97.	387.	363.	205.	75
.40	1.92	8.54	5.25	.050	.045	.050	.000	1515.5
006756	800.	790.	800.	5	0	0	.00	341.2

*SECNO 10.680

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.68	7.76	1527.46	.00	.00	1527.75	.29	2.66	.0
5400.	0.	5400.	0.	0.	1252.	0.	222.	80
.45	.00	4.31	.00	.000	.045	.000	.000	1519.7
002526	620.	686.	680.	3	0	0	.00	297.0

*SECNO 10.740

3301 HV CHANGED MORE THAN HVINS

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.74	7.41	1528.41	.00	.00	1529.27	.86	1.34	.1
5400.	0.	5400.	0.	0.	727.	0.	229.	82
.46	.00	7.43	.00	.000	.045	.000	.000	1521.0
008533	155.	317.	350.	2	0	0	.00	188.7

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

*SECNO 10.820

3311 HV CHANGED MORE THAN HVINS

3312 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.82	7.58	1531.08	.00	.00	1531.37	.29	2.05	.0
5400.	47.	5353.	0.	43.	1234.	0.	239.	85
.49	1.11	4.34	.00	.050	.045	.000	.000	1523.5
.003129	385.	422.	375.	2	0	0	.00	415.4

*SECNO 10.980

3312 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

10.98	7.85	1531.85	.00	.00	1531.89	.04	.49	.0
5400.	0.	5400.	0.	0.	3341.	0.	283.	94
.63	.00	1.62	.00	.000	.045	.000	.000	1524.0
.000235	980.	845.	870.	4	0	0	.00	580.7

*SECNO 21.000

3312 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS= 1284.0 1832.0 TYPE= 1 TARGET= 548
ELENCL= 1540.00 ELENCR= 1540.00

21.00	11.92	1531.92	.00	.00	1531.94	.02	.05	.0
5400.	0.	5400.	0.	0.	5396.	0.	342.	102
.79	.00	1.00	.00	.000	.045	.000	.000	1520.0
.000045	360.	580.	720.	2	0	0	.00	548.0

*SECNO 22.000

3665 DIVIDED FLOW

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

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

3470 ENCROACHMENT STATIONS= 1365.0 1675.0 TYPE= 1 TARGET= 310

22.00	.50	1532.50	1532.50	.00	1532.75	.25	.05	.0
420.	0.	420.	0.	0.	105.	0.	402.	110
.86	.00	3.99	.00	.000	.045	.000	.000	1532.0
.038288	1280.	960.	680.	20	26	0	.00	216.2

*SECNO 23.000

3255 DIVIDED FLOW

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS= 1385.0 1645.0 TYPE= 1 TARGET= 260

23.00	1.32	1534.65	.00	.00	1534.77	.12	2.01	.0
420.	0.	420.	0.	0.	152.	0.	402.	111
.87	.00	2.76	.00	.000	.045	.000	.000	1533.3
.012357	105.	100.	105.	7	0	0	.00	232.2

*SECNO 24.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS= 1355.0 1785.0 TYPE= 1 TARGET= -1355

24.00	.52	1536.52	1536.51	.00	1536.77	.25	1.96	.0
420.	0.	420.	0.	0.	105.	0.	403.	111
.88	.00	4.00	.00	.000	.045	.000	.000	1536.0
.035618	160.	100.	134.	8	18	0	.00	203.0

*SECNO 25.000

3302 WARNING: CONVEYANCE CHANGE OUTSIDE OF ACCEPTABLE RANGE

3470 ENCROACHMENT STATIONS= 1345.0 1520.0 TYPE= 1 TARGET= 175

25.00	.78	1538.78	.00	.00	1538.94	.16	2.16	.0
420.	0.	420.	0.	0.	129.	0.	403.	112
.89	.00	3.24	.00	.000	.045	.000	.000	1538.0
.014524	20.	100.	178.	4	0	0	.00	175.0

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SECNO	DEPTH	CWSEL	CRIWS	WSELK	EG	HV	HL	OLOSS
Q	QLOB	QCH	QROB	ALOB	ACH	AROB	VOL	TWA
TIME	VLOB	VCH	VROB	XNL	XNCH	XNR	WTN	ELMIN
SLOPE	XLOBL	XLCH	XLOBR	ITRIAL	IDC	ICONT	CORAR	TOPWI

*SECNO 26.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS=			1395.0	1805.0	TYPE=	1	TARGET=	-1395
26.00	.75	1540.75	1540.75	.00	1541.12	.37	2.10	.0
420.	0.	420.	0.	0.	86.	0.	403.	112
.89	.00	4.89	.00	.000	.045	.000	.000	1540.0
.033034	100.	100.	80.	3	8	0	.00	115.3

*SECNO 27.000

3470 ENCROACHMENT STATIONS=			1330.0	1750.0	TYPE=	1	TARGET=	-1330
27.00	1.43	1543.43	.00	.00	1543.87	.45	2.73	.0
420.	0.	420.	0.	0.	78.	0.	403.	112
.90	.00	5.35	.00	.000	.045	.000	.000	1542.0
.022968	60.	100.	47.	3	0	0	.00	70.5

*SECNO 28.000
7185 MINIMUM SPECIFIC ENERGY
3720 CRITICAL DEPTH ASSUMED

3470 ENCROACHMENT STATIONS=			1090.0	1265.0	TYPE=	1	TARGET=	175
28.00	2.23	1546.23	1546.23	.00	1546.95	.72	2.49	.0
420.	0.	420.	0.	0.	62.	0.	404.	112
.90	.00	6.79	.00	.000	.045	.000	.000	1544.0
.027152	110.	100.	17.	3	14	0	.00	43.9

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****
HEC2 RELEASE DATED SEPT 88

****

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

DEER VALLEY TO DAM OUTLE

SUMMARY PRINTOUT TABLE 150

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIW
	9.200	.00	.00	.00	1447.00	5400.00	1466.75	-
	9.300	528.00	.00	.00	1466.00	5400.00	1471.73	-
*	9.320	100.00	.00	.00	1468.00	5400.00	1472.68	1472.
*	9.330	40.00	.00	.00	1468.30	5400.00	1474.28	-
*	9.340	55.00	.00	.00	1468.00	5400.00	1474.27	1474.
*	9.440	528.00	.00	.00	1474.00	5400.00	1480.72	-
	9.600	800.00	.00	.00	1479.90	5400.00	1483.45	-
*	9.800	1085.00	.00	.00	1487.30	5400.00	1490.00	1489.
*	9.860	300.00	.00	.00	1488.00	5400.00	1492.30	-
*	9.970	540.00	.00	.00	1492.00	5400.00	1495.24	-
	10.040	360.00	.00	.00	1495.00	5400.00	1499.74	-
*	10.050	430.00	.00	.00	1498.00	5400.00	1503.40	-
*	10.100	270.00	.00	.00	1497.30	5400.00	1504.30	-
*	10.140	212.00	.00	.00	1500.00	5400.00	1507.50	-
*	10.145	10.00	.00	.00	1505.90	5400.00	1511.34	1511.
*	10.165	105.00	.00	.00	1505.90	5400.00	1514.03	-
*	10.180	85.00	.00	.00	1506.00	5400.00	1515.52	-

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	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIW
*	10.250	370.00	.00	.00	1506.70	5400.00	1515.84	-
*	10.400	790.00	.00	.00	1511.50	5400.00	1516.94	1516.
	10.550	790.00	.00	.00	1515.50	5400.00	1524.19	-
*	10.680	686.00	.00	.00	1519.70	5400.00	1527.46	-
*	10.740	317.00	.00	.00	1521.00	5400.00	1528.41	-
*	10.820	422.00	.00	.00	1523.50	5400.00	1531.08	-
*	10.980	845.00	.00	.00	1524.00	5400.00	1531.85	-
*	21.000	580.00	.00	.00	1520.00	5400.00	1531.92	-
*	22.000	960.00	.00	.00	1532.00	420.00	1532.50	1532.
*	23.000	100.00	.00	.00	1533.33	420.00	1534.65	-
*	24.000	100.00	.00	.00	1536.00	420.00	1536.52	1536.
*	25.000	100.00	.00	.00	1538.00	420.00	1538.78	-
*	26.000	100.00	.00	.00	1540.00	420.00	1540.75	1540.
	27.000	100.00	.00	.00	1542.00	420.00	1543.43	-
*	28.000	100.00	.00	.00	1544.00	420.00	1546.23	1546.

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DEER VALLEY TO DAM OUTLE

SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	9.200	5400.00	1466.75	.00	.00	.00	147.06	-
	9.300	5400.00	1471.73	.00	4.98	.00	210.31	528.
*	9.320	5400.00	1472.68	.00	.95	.00	131.25	100.
*	9.330	5400.00	1474.28	.00	1.60	.00	202.55	40.
*	9.340	5400.00	1474.27	.00	-.00	.00	88.36	55.
*	9.440	5400.00	1480.72	.00	6.45	.00	616.97	528.
	9.600	5400.00	1483.45	.00	2.73	.00	739.71	800.
*	9.800	5400.00	1490.00	.00	6.55	.00	469.59	1085.
*	9.860	5400.00	1492.30	.00	2.30	.00	406.07	300.
*	9.970	5400.00	1495.24	.00	2.94	.00	442.71	540.
	10.040	5400.00	1499.74	.00	4.49	.00	197.23	360.
*	10.050	5400.00	1503.40	.00	3.67	.00	195.52	430.
*	10.100	5400.00	1504.30	.00	.90	.00	89.47	270.
*	10.140	5400.00	1507.50	.00	3.20	.00	74.97	212.
*	10.145	5400.00	1511.34	.00	3.84	.00	74.92	10.
*	10.165	5400.00	1514.03	.00	2.69	.00	75.00	105.
*	10.180	5400.00	1515.52	.00	1.49	.00	427.37	85.
*	10.250	5400.00	1515.84	.00	.32	.00	946.99	370.
*	10.400	5400.00	1516.94	.00	1.11	.00	566.95	790.
	10.550	5400.00	1524.19	.00	7.25	.00	341.20	790.
*	10.680	5400.00	1527.46	.00	3.27	.00	297.05	686.
*	10.740	5400.00	1528.41	.00	.95	.00	188.75	317.
*	10.820	5400.00	1531.08	.00	2.67	.00	415.49	422.
*	10.980	5400.00	1531.85	.00	.76	.00	580.79	845.

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	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
*	21.000	5400.00	1531.92	.00	.08	.00	548.00	580.
*	22.000	420.00	1532.50	.00	.58	.00	216.25	960.
*	23.000	420.00	1534.65	.00	2.15	.00	232.24	100.
*	24.000	420.00	1536.52	.00	1.87	.00	203.04	100.
*	25.000	420.00	1538.78	.00	2.26	.00	175.00	100.
*	26.000	420.00	1540.75	.00	1.97	.00	115.37	100.
	27.000	420.00	1543.43	.00	2.68	.00	70.52	100.
*	28.000	420.00	1546.23	.00	2.81	.00	43.98	100.

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SUMMARY OF ERRORS AND SPECIAL NOTES

CAUTION SECNO=	9.320	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	9.320	PROFILE=	1	MINIMUM SPECIFIC ENERGY
WARNING SECNO=	9.330	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION SECNO=	9.340	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	9.340	PROFILE=	1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=	9.340	PROFILE=	1	20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING SECNO=	9.440	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	9.800	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	9.860	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	9.970	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.050	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.100	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.140	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION SECNO=	10.145	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	10.145	PROFILE=	1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=	10.145	PROFILE=	1	20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING SECNO=	10.165	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.180	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.250	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION SECNO=	10.400	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	10.400	PROFILE=	1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=	10.400	PROFILE=	1	20 TRIALS ATTEMPTED TO BALANCE WSEL
WARNING SECNO=	10.680	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.740	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.820	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	10.980	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
WARNING SECNO=	21.000	PROFILE=	1	CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN
CAUTION SECNO=	22.000	PROFILE=	1	CRITICAL DEPTH ASSUMED
CAUTION SECNO=	22.000	PROFILE=	1	PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO=	22.000	PROFILE=	1	20 TRIALS ATTEMPTED TO BALANCE WSEL

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WARNING SECNO=     23.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

WARNING SECNO=     24.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

WARNING SECNO=     25.000  PROFILE=  1  CONVEYANCE CHANGE OUTSIDE ACCEPTABLE RAN

CAUTION SECNO=     26.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     26.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY

CAUTION SECNO=     28.000  PROFILE=  1  CRITICAL DEPTH ASSUMED
CAUTION SECNO=     28.000  PROFILE=  1  MINIMUM SPECIFIC ENERGY
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APPENDIX "G"

Freeboard and Toedown Dimension Calculations

Moveable - Bed Analysis

Contents

	Pages
1. Armor Layer Calculations	2-3
2. General Scour Calculations (using 4 reaches)	4-37
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ARMER LAYER CALCULATIONS

A) CROSS-SECTION 1-3

$\tau_b = 0.79$ (FROM STABILITY ANALYSIS PAGE E-2)

CRITICAL PARTICLE SIZE

$D_c = \tau_c / (\gamma_s - \gamma)(.047)$

$D_c = (0.79) / (2.74 - 1)(62.4)(.047) = .15 \text{ FT} = 1.9 \text{ IN}$

THIS CORRESPONDS TO D_{85} PARTICLE SIZE

$\Delta Z_a = (2)(1.9)\left(\frac{1}{.15} - 1\right) = 21.5 \text{ IN} = 1.8 \text{ FT}$

B) CROSS SECTION 4-12

$\tau_b = 0.83 \text{ LBS/FT}^2$ (FROM STABILITY ANALYSIS PAGE E-4)

CRITICAL PARTICLE SIZE

$D_c = \tau_c / (\gamma_s - \gamma)(.047)$

$D_c = (0.83) / (2.74 - 1)(.047)(62.4) = 0.16 \text{ FT} = 1.9 \text{ IN}$

THIS CORRESPONDS TO A D_{85} PARTICLE SIZE

$\Delta Z_a = (2)(1.9)\left(\frac{1}{.15} - 1\right) = 21.5 \text{ IN} = 1.8 \text{ FT}$

C) CROSS SECTION 13-17

CRITICAL BOUNDARY SHEAR STRESS

$R_{100} = 3.5$

1) $\tau_1 = \gamma R \left(\frac{Vn}{1.486 R^{2/3}}\right)^2$

$\tau_1 = (62.4)(3.5)\left(\frac{(2.87)(0.04)}{1.486 (3.5)^{2/3}}\right)^2 = 0.25 \text{ LBS/FT}^2$

c) CROSS SECTION 13-17 (CONT)

2) $\tau_2 = \gamma R S_E$

$$\tau_2 = (62.4)(3.5)\left[\frac{\left((1.33)^2/2g + 32.86\right) - \left((2.87)^2/2g + 32.66\right)}{400}\right]$$

$\tau_2 = .05$ LBS/FT^2

3) $\tau_3 = \frac{1}{8}\rho f v^2 =$

$F_r = V/\sqrt{gR} = 2.87/\sqrt{(32.2)(7.9)} = 0.18$

$f = 8(S_E)/F_r^2 = 8(.0002)/(.18)^2 = .06$

$\tau_3 = \frac{1}{8}(1.94)(.06)(2.8)^2 = .11$

SO USE $\tau_0 = 0.25$ LBS/FT^2

CRITICAL PARTICLE SIZE

$D_c = \tau/(\gamma_s - \gamma)(.047)$

$D_c = (.25)/(2.74-1)(.047)(62.4) = .05$ FT $\cong 0.6$ IN

THIS CORRESPONDS TO D_{70} PARTICLE SIZE

$\Delta Z_a = (2)(.6)\left(\frac{1}{.3} - 1\right) = 2.8$ IN $= 0.25$ FT

General Scour Calculations
Hydrograph

$Q_p = 5400$ cfs
Storm Duration = 6 hrs.

Furthest flow length = 12,000 ft.
Slope = $(1650 - 1540)/12{,}000 = 0.0092$ ft/ft

Time of Concentration $= \dfrac{0.04593\,L^{0.77}}{S^{0.385}} = \dfrac{0.04593\,(12{,}000)^{0.77}}{(.0092)^{0.385}}$

= 66 min.
= 1 hr.

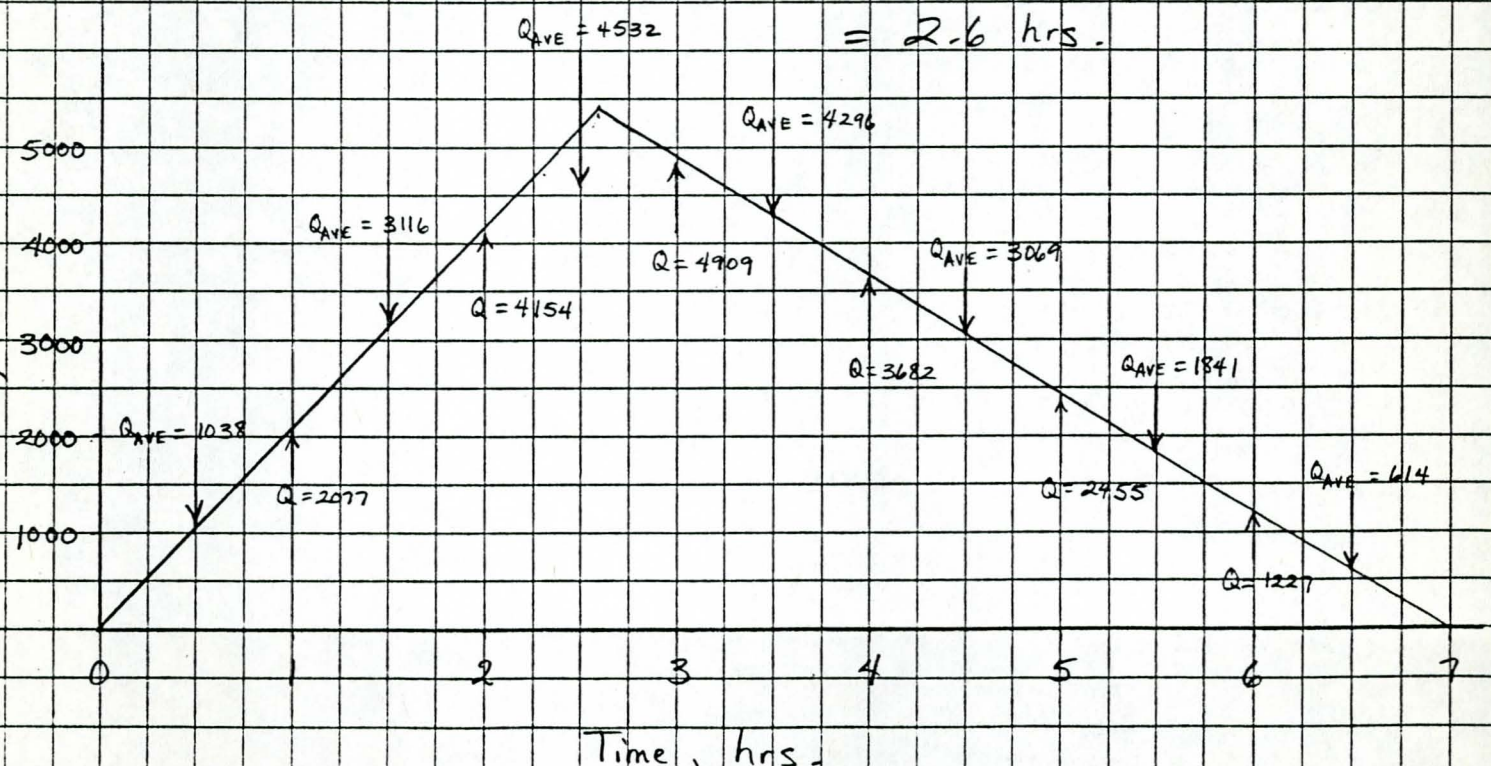
Time base of hydrograph = 6 hr + 1 hr = 7 hr.

Drainage area = 1250 acres = 1.95 mi^2

Time to peak (Snyder method) $= C_t\,(L_{ca}\,L)^{0.3}$

$= (1.9)\left(\dfrac{7000}{5280} \times \dfrac{12000}{5280}\right)^{0.3}$

= 2.6 hrs.



General Scour Calculations

Discretized Hydrograph – 100-yr. Flood

Time, hrs.	Q, cfs
0 - 1	1038
1 - 2	3116
2 - 3	4532
3 - 4	4296
4 - 5	3069
5 - 6	1841
6 - 7	614

Meyer-Peter, Muller Equation[1]

$$q_b = \frac{12.85}{\sqrt{\rho}\ \gamma_s}\left(\tau_o - \tau_c\right)^{1.5}, \quad \text{where}$$

q_b = bed-load transport rate, cfs/ft

τ_o = tractive force (boundary shear stress)

τ_c = critical tractive force

ρ = density of water

γ_s = specific weight of dry sediment

[1] "Engineering Analysis of Fluvial Systems, A Short Course," Arizona Department of Transportation, July 1986, p. 5.51.

PAGE NO. 6/77

General Scour Calculations
Using 4 reaches

PREPARED BY: M.N.
DATE: 7-7-89

Q = 1038 cfs

Reach 1

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
18	.045	3.20	324	303.1	11164	1.07	1.07	.008644
19	.045	2.73	380	434	11460	0.87	0.87	.008204
Averages:	.045	2.97	352	368.6		0.97	0.97	.008644 (max.)

Reach 2

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
13	.045	1.48	688	235.2	45683	2.85	2.93	.000576
14	.045	1.06	936	345.1	57073	2.51	2.71	.000331
15	.045	0.67	1552	422.0	120916	3.62	3.68	.000074
16	.045	1.07	973	424.3	55385	2.26	2.29	.000351
17	.045	0.99	1053	557.6	52810	1.87	1.89	.000386
Averages:	.045	1.05	1040	396.8		2.62	2.70	.000516 (max.)

Reach 3

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
9	.04	2.48	419	127.0	34284	3.27	3.30	.000917
10	.04	2.59	400	124.3	32191	3.19	3.22	.001040
11	.04	3.22	322	114.2	23800	2.81	2.82	.001962
12	.045	2.98	353	137.0	21514	2.51	2.58	.002328
Averages:	.041	2.82	374	125.6		2.95	2.98	.002328 (max)

General Scour Calculations
Using 4 reaches

B.9.

PREPARED BY: M.N.
DATE: 7-7-89

Reach 4

XSEC	n	vel	area	topwidth	K	R	hydr. dep.	S_E
2	.04	2.27	508	136.8	42207	3.34	3.71	.000605
3	.04	2.02	513	115.5	50920	4.37	4.44	.000416
4	.04	2.45	424	112.1	37816	3.72	3.78	.000753
5	.04	2.61	398	116.2	33304	3.38	3.43	.000971
6	.04	2.76	376	112.6	30983	3.30	3.34	.001122
7	.04	2.91	357	106.9	29409	3.30	3.34	.001246
8	.04	2.75	378	113.1	31108	3.30	3.34	.001113
Averages:	.04	2.54	422	116.2		3.53	3.63	.001246 (max)

Q = 3116 cfs

Reach 1

XSEC	n	vel	area	topwidth	K	R	hydr. dep.	S_E
18	.045	1.63	1911	565.8	141306	3.35	3.38	.000486
19	.045	2.18	1430	525.3	91568	2.70	2.72	.001158
Averages:	.045	1.91	1671	545.6		3.03	3.05	.001158 (max)

Reach 2

XSEC	n	vel	area	topwidth	K	R	hydr. dep.	S_E
13	.045	2.24	1404	241.2	145925	5.58	5.82	.000456
14	.045	1.58	1986	351.1	196439	5.18	5.66	.000252
15	.045	1.11	2822	422.0	325175	6.52	6.69	.000092
16	.045	1.31	2379	470.0	227995	4.94	5.06	.000143
17	.045	1.11	2819	590.0	261000	4.69	4.78	.000456
Averages:	.045	1.47	2282	414.9		5.38	5.60	.000456 (max)

General Scour Calculations
Using 4 reaches

B.C.
PREPARED BY M.N.
DATE 7-7-89

Reach 3

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
9	.04	3.79	822	148.4	94683	5.46	5.54	.001083
10	.04	3.95	788	140.5	91399	5.52	5.61	.001162
11	.04	4.09	762	178.3	74059	4.23	4.27	.001770
12	.045	3.77	823	187.7	71773	4.29	4.38	.001885
Averages =	.041	3.90	799	163.7		4.88	4.95	.001885 (max)

Reach 4

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
2	.04	4.04	741	152.1	90341	5.15	4.87	.001190
3	.04	3.91	798	129.4	98312	6.04	6.17	.001004
4	.04	4.30	725	128.1	84579	5.56	5.66	.001357
5	.04	4.21	740	137.5	83637	5.31	5.38	.001388
6	.04	4.36	714	132.6	80646	5.30	5.38	.001493
7	.04	4.58	680	123.4	77798	5.40	5.51	.001604
8	.04	4.28	728	130.9	83913	5.47	5.56	.001379
Averages:	.04	4.24	732	133.4		5.58	5.50	.001604 (max)

Q = 4532 cfs

Reach 1

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
18	.045	1.65	2748	573.2	256017	2.82	4.79	.000313
19	.045	2.04	2220	553.8	183351	3.31	4.01	.000611
Averages:	.045	1.85	2484	563.5		3.07	4.40	.000611 (max)

General Scour Calculations
Using 4 reaches

PREPARED BY M.N.
DATE 7-7-89

Reach 2

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
13	.045	2.62	1756	244.1	209519	6.87	7.19	.000468
14	.045	1.84	2502	354.1	286614	6.46	7.07	.000250
15	.045	1.33	3444	422.0	451615	7.91	8.16	.000101
16	.045	1.48	3071	470.0	347502	6.34	6.53	.000170
17	.045	1.23	3688	590.0	407209	6.11	6.25	.000124
Averages:	.045	1.70	2892	416.0		6.74	7.04	.000468 (max)

Reach 3

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
9	.04	4.38	1035	158.5	132771	6.42	6.53	.001165
10	.04	4.46	1015	186.0	115668	5.37	5.46	.001535
11	.04	4.40	1029	186.1	118508	5.46	5.53	.001462
12	.045	4.17	1094	190.6	113691	5.58	5.74	.001589
Averages:	.041	4.35	1043	180.3		5.71	5.82	.001589 (max)

Reach 4

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
2	.04	4.87	1009	168.1	119080	5.66	6.00	.001449
3	.04	4.82	940	135.8	125025	6.77	6.92	.001314
4	.04	5.14	882	135.6	112606	6.37	6.50	.001620
5	.04	4.91	923	147.6	115035	6.14	6.25	.001552
6	.04	5.07	894	142.1	111780	6.17	6.29	.001644
7	.04	5.35	847	131.2	107516	6.32	6.46	.001777
8	.04	4.98	911	139.3	116748	6.41	6.54	.001507
Averages:	.04	5.02	915	142.8		6.26	6.42	.001777 (max)

General Scour Calculations using 4 reaches

PREPARED BY M.N.
DATE 7-7-89

Q = 4296 cfs

Reach 1

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
18	.045	1.64	2626	570.0	238351	4.56	4.61	.000325
19	.045	2.05	2097	551.3	167426	3.76	3.80	.000658
Averages:	.045	1.85	2362	560.7		4.16	4.21	.000658 (max)

Reach 2

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
13	.045	2.56	1702	243.6	199337	6.68	6.99	.000464
14	.045	1.80	2424	353.6	272340	6.28	6.86	.000249
15	.045	1.29	3350	422.0	431508	7.70	7.94	.000099
16	.045	1.45	2966	470.0	328182	6.13	6.31	.000171
17	.045	1.21	3557	590.0	383329	5.90	6.03	.000126
Averages:	.045	1.66	2800	415.8		6.54	6.83	.000464 (max)

Reach 3

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
9	.04	4.29	1001	156.9	126473	6.27	6.38	.001153
10	.04	4.41	975	181.5	109910	5.29	5.37	.001528
11	.04	4.35	989	185.0	111359	5.28	5.35	.001487
12	.045	4.10	1054	190.1	106929	5.38	5.54	.001614
Averages:	.041	4.29	1005	178.4		5.56	5.66	.001614 (max)

General Scour Calculations using 4 reaches

PREPARED BY: M.N.
DATE: 7-7-89

Reach 4

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
2	.04	4.74	982	158.2	114007	5.52	6.21	.001418
3	.04	4.68	918	134.9	120877	6.67	6.81	.001262
4	.04	5.02	856	134.4	107932	6.25	6.37	.001583
5	.04	4.81	894	146.0	109838	6.01	6.12	.001529
6	.04	4.96	866	140.7	106758	6.04	6.15	.001618
7	.04	5.24	820	130.0	102606	6.18	6.31	.001752
8	.04	4.87	882	138.0	111344	6.26	6.39	.001488
Averages:	.04	4.90	888	140.3		6.13	6.34	.001752 (max)

Q = 3069 cfs

Reach 1

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
18	.045	1.63	1888	565.7	138455	3.31	3.34	.000491
19	.045	2.19	1404	523.6	88943	2.66	2.68	.001191
Averages:	.045	1.91	1646	544.7		2.99	3.01	.001191 (max)

Reach 2

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
13	.045	2.22	1392	241.1	143856	5.54	5.77	.000455
14	.045	1.57	1967	351.0	193523	5.14	5.60	.000251
15	.045	1.10	2801	422.0	321038	6.47	6.64	.000091
16	.045	1.30	2355	470.0	224155	4.89	5.01	.000187
17	.045	1.10	2789	590.0	256356	4.64	4.73	.000143
Averages:	.045	1.46	2261	414.8		5.34	5.55	.000455 (max)

General Scour Calculations
Using 4 reaches

PREPARED BY M.N.
DATE 7-7-89

Reach 3

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
9	.04	3.77	814	148.0	93409	5.43	5.50	.001079
10	.04	3.93	781	140.2	90148	5.48	5.57	.001159
11	.04	4.08	753	178.0	72658	4.19	4.23	.001784
12	.045	3.75	813	187.6	70442	4.25	4.33	.001898
Averages:	.041	3.88	790	163.5		4.84	4.91	.001898 (max)

Reach 4

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
2	.04	4.00	834	151.8	89388	4.90	5.49	.001178
3	.04	3.87	792	129.2	97387	6.02	6.13	.000993
4	.04	4.26	720	127.8	83636	5.53	5.63	.001346
5	.04	4.18	734	137.1	82583	5.27	5.35	.001381
6	.04	4.34	708	132.3	79602	5.26	5.35	.001486
7	.04	4.55	674	123.2	76791	5.37	5.47	.001597
8	.04	4.25	721	130.6	82804	5.44	5.52	.001374
Averages:	.04	4.21	740	133.1		5.40	5.56	.001597 (max)

Q = 18411 cfs

Reach 1

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
18	.045	1.82	1011	541.8	50449	1.86	1.87	.001332
19	.045	2.71	680	465.2	28804	1.45	1.46	.004085
Averages:	.045	2.27	846	503.5		1.66	1.67	.0004085 (max)

B.a

General Scour Calculations
Using 4 reaches

PREPARED BY: M.N.
DATE: 7-7-89

Reach 2

XSEC	n	vel	area	topwidth	K	R	hydr. dep.	S_E
13	.045	1.83	1017	238.0	86371	4.12	4.27	.000454
14	.045	1.31	1416	347.9	112801	3.75	4.07	.000266
15	.045	0.87	2135	422.0	204982	4.96	5.06	.000081
16	.045	1.14	1611	470.0	119563	3.37	3.43	.000237
17	.045	0.99	1856	590.0	130508	3.11	3.15	.000199
Averages:	.045	1.23	1607	413.6		3.86	4.00	.000454 (max)

Reach 3

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
9	.04	3.07	599	137.0	59042	4.32	4.37	.000972
10	.04	3.21	573	131.8	56251	4.30	4.35	.001071
11	.04	3.71	496	145.0	41600	3.39	3.42	.001958
12	.045	3.35	553	155.9	41935	3.48	3.55	.001927
Averages:	.041	3.36	555	142.4		3.87	3.92	.001958 (max)

Reach 4

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
2	.04	3.05	664	144.1	63293	4.11	4.61	.000846
3	.04	2.85	645	122.2	71870	5.19	5.28	.000656
4	.04	3.28	562	119.7	57936	4.62	4.70	.001010
5	.04	3.34	551	126.2	54285	4.32	4.37	.001150
6	.04	3.49	527	122.0	51474	4.26	4.32	.001279
7	.04	3.66	503	114.7	49484	4.31	4.39	.001384
8	.04	3.44	535	121.4	52916	4.34	4.41	.001210
Averages:	.04	3.30	570	124.3		4.45	4.58	.001384 (max)

General Scour Calculations

Using 4 reaches

B.C.

PREPARED BY: M.N.

DATE: 7-7-89

Q = 614 cfs

Reach 1

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
18	.045	4.66	132	201.2	3280	0.65	0.66	.035052
19	.045	2.02	305	425.8	8033	0.71	0.72	.005843
Averages:	.045	3.34	219	313.5		0.68	0.69	.035052 (max)

Reach 2

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
13	.045	1.52	471	233.3	24582	1.99	2.02	.000624
14	.045	1.07	616	343.2	28809	1.69	1.79	.000454
15	.045	0.53	1161	422.0	74656	2.72	2.75	.000068
16	.045	1.05	584	410.1	24289	1.41	1.42	.000639
17	.045	1.07	576	509.8	20561	1.12	1.13	.000892
Averages:	.045	1.05	682	383.7		1.79	1.82	.000892 (max)

Reach 3

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
9	.04	2.10	292	119.5	19635	2.44	2.44	.000977
10	.04	2.22	277	118.7	18024	2.32	2.33	.001160
11	.04	2.84	216	104.8	12938	2.05	2.06	.002251
12	.04	2.73	230	124.1	11238	1.80	1.85	.002983
Averages:	.04	2.47	254	116.8		2.15	2.17	.002983 (max)

General Scour Calculations

Using 4 reaches

Reach 4

XSEC	n	vel.	area	topwidth	K	R	hydr. dep.	S_E
2	.04	1.83	377	130.2	26621	2.62	2.90	.000531
3	.04	1.53	401	109.6	35068	3.61	3.66	.000306
4	.04	1.97	312	105.7	23644	2.91	2.95	.000674
5	.04	2.19	281	108.0	19634	2.58	2.60	.000977
6	.04	2.33	263	105.1	17945	2.49	2.50	.001170
7	.04	2.45	251	100.9	16971	2.46	2.49	.001308
8	.04	2.31	266	106.7	18010	2.46	2.49	.001162
Averages:	.04	2.09	307	109.5		2.73	2.80	.001308 (max)

Q = 1038 cfs

Reach 1

$$\tau_o = \tfrac{1}{8}\rho f V^2$$
$$= \tfrac{1}{8}(1.94)(.25)(2.97)^2$$
$$= 0.53 \text{ lb/ft}^2$$

$$f = (8)(S_E)/F_r^2 = 8(.008644)/.28$$
$$= 0.25$$

$$F_r = V/\sqrt{gR} = 2.97/\sqrt{(32.2)(.97)}$$
$$= 0.53$$

Reach 2

$$\tau_o = \tfrac{1}{8}(1.94)(.32)(1.05)^2$$
$$= 0.09 \text{ lb/ft}^2$$

$$f = 8(.000516)/.01$$
$$= 0.32$$

$$F_r = 1.05/\sqrt{(32.2)(2.62)}$$
$$= 0.11$$

Reach 3

$$\tau_o = \tfrac{1}{8}(1.94)(.23)(2.82)^2$$
$$= 0.44 \text{ lb/ft}^2$$

$$f = 8(.002328)/.08$$
$$= 0.23$$

$$F_r = 2.82/\sqrt{(32.2)(2.95)}$$
$$= 0.29$$

General Scour Calculations
Using 4 reaches

PREPARED BY	M.N.
DATE	7-7-89

Reach 4

$\tau_o = \frac{1}{8}(1.94)(.17)(2.54)^2$
$= 0.27 \ lb/ft^2$

$f = 8(.001246)/.06$
$= 0.17$

$F_r = 2.54/\sqrt{(32.2)(3.53)}$
$= 0.24$

Q = 3116 cfs

Reach 1

$\tau_o = \frac{1}{8}(1.94)(.23)(1.91)^2$
$= 0.20 \ lb/ft^2$

$f = 8(.001158)/.04$
$= 0.23$

$F_r = 1.91/\sqrt{(32.2)(5.03)}$
$= 0.19$

Reach 2

$\tau_o = \frac{1}{8}(1.94)(.36)(1.47)^2$
$= 0.19 \ lb/ft^2$

$f = 8(.000456)/.01$
$= 0.36$

$F_r = 1.47/\sqrt{(32.2)(5.38)}$
$= 0.11$

Reach 3

$\tau_o = \frac{1}{8}(1.94)(.15)(3.90)^2$
$= 0.55 \ lb/ft^2$

$f = 8(.001885)/.10$
$= 0.15$

$F_r = 3.90/\sqrt{(32.2)(4.88)}$
$= 0.31$

Reach 4

$\tau_o = \frac{1}{8}(1.94)(.13)(4.24)^2$
$= 0.57 \ lb/ft^2$

$f = 8(.001604)/.10$
$= 0.13$

$F_r = 4.24/\sqrt{(32.2)(5.58)}$
$= 0.32$

General Scour Calculations
Using 4 reaches

Q = 4532 cfs

Reach 1

$\tau_o = \frac{1}{8}(1.94)(.16)(1.85)^2$
$= 0.13\ lb/ft^2$

$f = 8(.000611)/.03$
$= 0.16$

$F_r = 1.85/\sqrt{(32.2)(3.07)}$
$= 0.19$

Reach 2

$\tau_o = \frac{1}{8}(1.94)(.37)(1.70)^2$
$= 0.26\ lb/ft^2$

$f = 8(.000468)/.01$
$= 0.37$

$F_r = 1.70/\sqrt{(32.2)(6.74)}$
$= 0.12$

Reach 3

$\tau_o = \frac{1}{8}(1.94)(.13)(4.35)^2$
$= 0.60\ lb/ft^2$

$f = 8(.001589)/.10$
$= 0.13$

$F_r = 4.35/\sqrt{(32.2)(5.71)}$
$= 0.32$

Reach 4

$\tau_o = \frac{1}{8}(1.94)(.11)(5.02)^2$
$= 0.67\ lb/ft^2$

$f = 8(.001777)/.13$
$= 0.11$

$F_r = 5.02/\sqrt{(32.2)(6.26)}$
$= 0.35$

General Scour Calculations using 4 reaches

PREPARED BY M.N.
DATE 7-7-89

Q = 4296 cfs

Reach 1

$\tau_o = \frac{1}{8}(1.94)(.18)(1.85)^2$
$= 0.15\ lb/ft^2$

$f = 8(.000658)/.03$
$= 0.18$

$F_r = 1.85/\sqrt{(32.2)(4.16)}$
$= 0.16$

Reach 2

$\tau_o = \frac{1}{8}(1.94)(0.37)(1.66)^2$
$= 0.25\ lb/ft^2$

$f = 8(.000464)/.01$
$= 0.37$

$F_r = 1.66/\sqrt{(32.2)(6.54)}$
$= 0.11$

Reach 3

$\tau_o = \frac{1}{8}(1.94)(0.13)(4.29)^2$
$= 0.58\ lb/ft^2$

$f = 8(.001614)/.10$
$= 0.13$

$F_r = 4.29/\sqrt{(32.2)(5.56)}$
$= 0.32$

Reach 4

$\tau_o = \frac{1}{8}(1.94)(0.12)(4.90)^2$
$= 0.70\ lb/ft^2$

$f = 8(.001752)/.12$
$= 0.12$

$F_r = 4.90/\sqrt{(32.2)(6.34)}$
$= 0.34$

General Scour Calculations
Using 4 reaches

B.9

PREPARED BY	M.N.
DATE	7-7-89

Q = 3069 cfs

Reach 1

$\tau_o = \frac{1}{8}(1.94)(.24)(1.91)^2$
$= 0.21\ lb/ft^2$

$f = 8(.001191)/.04$
$= 0.24$

$F_r = 1.91/\sqrt{(32.2)(2.99)}$
$= 0.19$

Reach 2

$\tau_o = \frac{1}{8}(1.94)(.36)(1.46)^2$
$= 0.19\ lb/ft^2$

$f = 8(.000455)/.01$
$= 0.36$

$F_r = 1.46/\sqrt{(32.2)(5.34)}$
$= 0.11$

Reach 3

$\tau_o = \frac{1}{8}(1.94)(.15)(3.88)^2$
$= 0.55\ lb/ft^2$

$f = 8(.001898)/.10$
$= .15$

$F_r = 3.88/\sqrt{(32.2)(4.84)}$
$= 0.31$

Reach 4

$\tau_o = \frac{1}{8}(1.94)(.13)(4.21)^2$
$= 0.56\ lb/ft^2$

$f = 8(.001597)/.10$
$= 0.13$

$F_r = 4.21/\sqrt{(32.2)(5.40)}$
$= 0.32$

General Scour Calculations
Using 4 reaches

PREPARED BY	M.N.
DATE	7-7-89

Q = 1841 cfs

Reach 1

$\tau_o = \frac{1}{8}(1.94)(0.33)(2.27)^2$
$= 0.41\ lb/ft^2$

$f = 8(.004085)/.10$
$= 0.33$

$F_r = 2.27/\sqrt{(32.2)(1.66)}$
$= 0.31$

Reach 2

$\tau_o = \frac{1}{8}(1.94)(0.36)(1.23)^2$
$= 0.13\ lb/ft^2$

$f = 8(.000454)/.01$
$= 0.36$

$F_r = 1.23/\sqrt{(32.2)(3.86)}$
$= 0.11$

Reach 3

$\tau_o = \frac{1}{8}(1.94)(0.17)(3.36)^2$
$= 0.47\ lb/ft^2$

$f = 8(.001958)/.09$
$= 0.17$

$F_r = 3.36/\sqrt{(32.2)(3.87)}$
$= 0.30$

Reach 4

$\tau_o = \frac{1}{8}(1.94)(0.14)(3.30)^2$
$= 0.37\ lb/ft^2$

$f = 8(.001384)/.08$
$= 0.14$

$F_r = 3.30/\sqrt{(32.2)(4.45)}$
$= 0.28$

General Scour Calculations

Using 4 reaches

PREPARED BY	B.G. M.N.
DATE	7-7-89

$Q = 614$ cfs

Reach 1

$\tau_o = \frac{1}{8}(1.94)(.55)(3.34)^2$
$= 1.49$ lb/ft^2

$f = 8(.035052)/.51$
$= 0.55$

$F_r = 3.34/\sqrt{(32.2)(.68)}$
$= 0.71$

Reach 2

$\tau_o = \frac{1}{8}(1.94)(0.36)(1.05)^2$
$= 0.10$ lb/ft^2

$f = 8(.000892)/.02$
$= 0.36$

$F_r = 1.05/\sqrt{(32.2)(1.79)}$
$= 0.14$

Reach 3

$\tau_o = \frac{1}{8}(1.94)(0.27)(2.47)^2$
$= 0.40$ lb/ft^2

$f = 8(.002983)/.09$
$= 0.27$

$F_r = 2.47/\sqrt{(32.2)(2.15)}$
$= 0.30$

Reach 4

$\tau_o = \frac{1}{8}(1.94)(0.21)(2.09)^2$
$= 0.22$ lb/ft^2

$f = 8(.001308)/.05$
$= 0.21$

$F_r = 2.09/\sqrt{(32.2)(2.73)}$
$= 0.22$

General Scour Calculations using 4 reaches

$D_{25} = 0.00312$ ft.

$D_{50} = 0.00984$ ft.

$D_{75} = 0.08333$ ft.

For $D_c = D_{25}$, $\tau_c = (.047)(.00312)(1.74)(62.4)$
$= 0.02$ lb/ft^2

For $D_c = D_{50}$, $\tau_c = (.047)(.00984)(1.74)(62.4)$
$= 0.05$ lb/ft^2

For $D_c = D_{75}$, $\tau_c = (.047)(.08333)(1.74)(62.4)$
$= 0.42$ lb/ft^2

<u>Q = 1038 cfs</u>

Reach 1

$$q_{b25} = \left(\frac{12.85}{\sqrt{1.94}\,(2.74)(62.4)}\right)(.53 - .02)^{1.5}$$
$$= (.054)(.53 - .02)^{1.5}$$
$$= 0.020 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.53 - .05)^{1.5}$$
$$= 0.018 \text{ cfs/ft}$$

$$q_{b75} = (.054)(.53 - .42)^{1.5}$$
$$= 0.002 \text{ cfs/ft}$$

Total $q_b = (.020)(.333) + (.018)(.333) + (.002)(.333)$
$= 0.013$ cfs/ft

General Scour Calculations using 4 reaches

Reach 2

$$q_{b25} = (.054)(.09 - .02)^{1.5}$$
$$= 0.001 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.09 - .05)^{1.5}$$
$$= 0 \text{ cfs/ft}$$

$$q_{b75} = 0 \text{ cfs/ft}$$

Total $q_b = 0$ cfs/ft

Reach 3

$$q_{b25} = (.054)(.44 - .02)^{1.5}$$
$$= 0.015 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.44 - .05)^{1.5}$$
$$= 0.013 \text{ cfs/ft}$$

$$q_{b75} = (.054)(.44 - .42)^{1.5}$$
$$= 0 \text{ cfs/ft}$$

Total $q_b = (.015)(.333) + (.013)(.333)$
$= 0.009$ cfs/ft

General Scour Calculations
Using 4 reaches

Reach 4

$$q_{b25} = (.054)(.27 - .02)^{1.5}$$
$$= 0.007 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.27 - .05)^{1.5}$$
$$= 0.006 \text{ cfs/ft}$$

$$q_{b75} = 0 \text{ cfs/ft}$$

$$\text{Total } q_b = (.007)(.333) + (.006)(.333)$$
$$= 0.004 \text{ cfs/ft}$$

Q = 3116 cfs

Reach 1

$$q_{b25} = (.054)(.20 - .02)^{1.5}$$
$$= 0.004 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.20 - .05)^{1.5}$$
$$= 0.003 \text{ cfs/ft}$$

$$q_{b75} = 0 \text{ cfs/ft.}$$

$$\text{Total } q_b = (.004)(.333) + (.003)(.333)$$
$$= 0.002 \text{ cfs/ft}$$

General Scour Calculations
Using 4 reaches

Reach 2

$$q_{b25} = (.054)(.19 - .02)^{1.5}$$
$$= 0.004 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.19 - .05)^{1.5}$$
$$= 0.003 \text{ cfs/ft}$$

$$q_{b75} = 0 \text{ cfs/ft}$$

$$\text{Total } q_b = (.004)(.333) + (.003)(.333)$$
$$= 0.002 \text{ cfs/ft}$$

Reach 3

$$q_{b25} = (.054)(.55 - .02)^{1.5}$$
$$= 0.021 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.55 - .05)^{1.5}$$
$$= 0.019 \text{ cfs/ft}$$

$$q_{b75} = (.054)(.55 - .42)^{1.5}$$
$$= 0.003 \text{ cfs/ft}$$

$$\text{Total } q_b = (.021)(.333) + (.019)(.333) + (.003)(.333)$$
$$= 0.014 \text{ cfs/ft}$$

General Scour Calculations using 4 reaches

Reach 4

$$q_{b25} = (0.054)(.57 - .02)^{1.5}$$
$$= 0.022 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.57 - .05)^{1.5}$$
$$= 0.020 \text{ cfs/ft}$$

$$q_{b75} = (.054)(.57 - .42)^{1.5}$$
$$= 0.003 \text{ cfs/ft}$$

$$\text{Total } q_b = (.022)(.333) + (.020)(.333) + (.003)(.333)$$
$$= 0.015 \text{ cfs/ft}$$

Q = 4532 cfs

Reach 1

$$q_{b25} = (.054)(.13 - .02)^{1.5}$$
$$= 0.002 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.13 - .05)^{1.5}$$
$$= 0.001 \text{ cfs/ft}$$

$$q_{b75} = 0 \text{ cfs/ft}$$

$$\text{Total } q_b = (.002)(.333) + (.001)(.333)$$
$$= 0.001 \text{ cfs/ft}$$

General Scour Calculations using 4 reaches

Reach 2

$$q_{b25} = (.054)(.26 - .02)^{1.5}$$
$$= 0.006 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.26 - .05)^{1.5}$$
$$= 0.005 \text{ cfs/ft}$$

$$q_{b75} = 0 \text{ cfs/ft}$$

$$\text{Total } q_b = (.006)(.333) + (.005)(.333)$$
$$= 0.004 \text{ cfs/ft}$$

Reach 3

$$q_{b25} = (.054)(.60 - .02)^{1.5}$$
$$= 0.024 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.60 - .05)^{1.5}$$
$$= 0.022 \text{ cfs/ft}$$

$$q_{b75} = (.054)(.60 - .42)^{1.5}$$
$$= 0.004 \text{ cfs/ft}$$

$$\text{Total } q_b = (.024)(.333) + (.022)(.333) + (.004)(.333)$$
$$= 0.017 \text{ cfs/ft}$$

General Scour Calculations
Using 4 reaches

Reach 4

$q_{b25} = (.054)(.67 - .02)^{1.5}$
$= 0.028$ cfs/ft

$q_{b50} = (.054)(.67 - .05)^{1.5}$
$= 0.026$ cfs/ft

$q_{b75} = (.054)(.67 - .42)^{1.5}$
$= 0.007$ cfs/ft

Total $q_b = (.028)(.333) + (.026)(.333) + (.007)(.333)$
$= 0.020$ cfs/ft

Q = 4296 cfs

Reach 1

$q_{b25} = (.054)(.15 - .02)^{1.5}$
$= 0.003$ cfs/ft

$q_{b50} = (.054)(.15 - .05)^{1.5}$
$= 0.002$ cfs/ft

$q_{b75} = 0$ cfs/ft

Total $q_b = (.003)(.333) + (.002)(.333)$
$= 0.002$ cfs/ft

General Scour Calculations
Using 4 reaches

Reach 2

$q_{b25} = (.054)(.25 - .02)^{1.5}$
$= 0.006$ cfs/ft

$q_{b50} = (.054)(.25 - .05)^{1.5}$
$= 0.005$ cfs/ft

$q_{b75} = 0$ cfs/ft

Total $q_b = (.006)(.333) + (.005)(.333)$
$= 0.004$ cfs/ft

Reach 3

$q_{b25} = (.054)(.58 - .02)^{1.5}$
$= 0.023$ cfs/ft

$q_{b50} = (.054)(.58 - .05)^{1.5}$
$= 0.021$ cfs/ft

$q_{b75} = (.054)(.58 - .42)^{1.5}$
$= 0.003$ cfs/ft

Total $q_b = (.023)(.333) + (.021)(.333) + (.003)(.333)$
$= 0.016$ cfs/ft

General Scour Calculations
Using 4 reaches

Reach 4

$$q_{b25} = (.054)(.70 - .02)^{1.5}$$
$$= 0.030 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.70 - .05)^{1.5}$$
$$= 0.028 \text{ cfs/ft}$$

$$q_{b75} = (.054)(.70 - .42)^{1.5}$$
$$= 0.008 \text{ cfs/ft}$$

$$\text{Total } q_b = (.030)(.333) + (.028)(.333) + (.008)(.333)$$
$$= 0.022 \text{ cfs/ft}$$

Q = 3069 cfs

Reach 1

$$q_{b25} = (.054)(.21 - .02)^{1.5}$$
$$= 0.004 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.21 - .05)^{1.5}$$
$$= 0.003 \text{ cfs/ft}$$

$$q_{b75} = 0 \text{ cfs/ft}$$

$$\text{Total } q_b = (.004)(.333) + (.003)(.333)$$
$$= 0.002 \text{ cfs/ft}$$

General Scour Calculations using 4 reaches

B.a.
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DATE 7-10-89

Reach 2

$q_{b25} = (.054)(.19 - .02)^{1.5}$
$= 0.004$ cfs/ft

$q_{b50} = (.054)(.19 - .05)^{1.5}$
$= 0.003$ cfs/ft

$q_{b75} = 0$ cfs/ft

Total $q_b = (.004)(.333) + (.003)(.333)$
$= 0.002$ cfs/ft

Reach 3

$q_{b25} = (.054)(.55 - .02)^{1.5}$
$= 0.021$ cfs/ft

$q_{b50} = (.054)(.55 - .05)^{1.5}$
$= 0.019$ cfs/ft

$q_{b75} = (.054)(.55 - .42)^{1.5} = 0.003$ cfs/ft

Total $q_b = (.021)(.333) + (.019)(.333) + (.003)(.333)$
$= 0.014$ cfs/ft.

General Scour Calculations
Using 4 reaches

PREPARED BY	M.N.
DATE	7-10-89

B.a.

Reach 4

$q_{b25} = (.054)(.56 - .02)^{1.5}$
$= 0.021$ cfs/ft

$q_{b50} = (.054)(.56 - .05)^{1.5}$
$= 0.020$ cfs/ft

$q_{b75} = (.054)(.56 - .42)^{1.5}$
$= 0.003$ cfs/ft

Total $q_b = (.021)(.333) + (.020)(.333) + (.003)(.333)$
$= 0.015$ cfs/ft

Q = 1841 cfs

Reach 1

$q_{b25} = (.054)(.41 - .02)^{1.5}$
$= 0.013$ cfs/ft

$q_{b50} = (.054)(.41 - .05)^{1.5}$
$= 0.012$ cfs/ft

$q_{b75} = 0$ cfs/ft

Total $q_b = (.013)(.333) + (.012)(.333)$
$= 0.008$ cfs/ft

General Scour Calculations
Using 4 reaches

Reach 2

$$q_{b25} = (.054)(.13 - .02)^{1.5}$$
$$= 0.002 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.13 - .05)^{1.5}$$
$$= 0.001 \text{ cfs/ft}$$

$$q_{b75} = 0 \text{ cfs/ft}$$

$$\text{Total } q_b = (.002)(.333) + (.001)(.333)$$
$$= 0.001 \text{ cfs/ft}$$

Reach 3

$$q_{b25} = (.054)(.47 - .02)^{1.5}$$
$$= 0.016 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.47 - .05)^{1.5}$$
$$= 0.015 \text{ cfs/ft}$$

$$q_{b75} = (.054)(.47 - .42)^{1.5}$$
$$= 0.001 \text{ cfs/ft}$$

$$\text{Total } q_b = (.016)(.333) + (.015)(.333) + (.001)(.333)$$
$$= 0.011 \text{ cfs/ft}$$

General Scour Calculations
Using 4 reaches

Reach 4

$q_{b25} = (.054)(.37 - .02)^{1.5}$
$= 0.011$ cfs/ft

$q_{b50} = (.054)(.37 - .05)^{1.5}$
$= 0.010$ cfs/ft

$q_{b75} = 0$ cfs/ft

Total $q_b = (.011)(.333) + (.010)(.333)$
$= 0.007$ cfs/ft

Q = 614 cfs

Reach 1

$q_{b25} = (.054)(1.49 - .02)^{1.5}$
$= 0.096$ cfs/ft

$q_{b50} = (.054)(1.49 - .05)^{1.5}$
$= 0.093$ cfs/ft

$q_{b75} = (.054)(1.49 - .42)^{1.5}$
$= 0.060$ cfs/ft

Total $q_b = (.096)(.333) + (.093)(.333) + (.060)(.333)$
$= 0.083$ cfs/ft

General Scour Calculations
Using 4 reaches

B.a.
PREPARED BY M.N.
DATE 7-10-89

Reach 2

$$q_{b25} = (.054)(.10 - .02)^{1.5}$$
$$= 0.001 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.10 - .05)^{1.5}$$
$$= 0.001 \text{ cfs/ft}$$

$$q_{b75} = 0 \text{ cfs/ft}$$

$$\text{Total } q_b = (.001)(.333) + (.001)(.333)$$
$$= 0.001 \text{ cfs/ft}$$

Reach 3

$$q_{b25} = (.054)(.40 - .02)^{1.5}$$
$$= 0.013 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.40 - .05)^{1.5}$$
$$= 0.011 \text{ cfs/ft}$$

$$q_{b75} = 0 \text{ cfs/ft}$$

$$\text{Total } q_b = (.013)(.333) + (.011)(.333)$$
$$= 0.008 \text{ cfs/ft}$$

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General Scour Calculations using 4 reaches

B.Q.

PREPARED BY: M.N.

DATE: 7-10-89

Reach 4

$$q_{b25} = (.054)(.22 - .02)^{1.5}$$
$$= 0.005 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.22 - .05)^{1.5}$$
$$= 0.004 \text{ cfs/ft}$$

$$q_{b75} = 0 \text{ cfs/ft}$$

$$\text{Total } q_b = (.005)(.333) + (.004)(.333)$$
$$= 0.003 \text{ cfs/ft}$$

Time (hrs)	Q (cfs)	Q_s (cfs) Reach 1	Δ	Reach 2	Δ	Reach 3	Δ	Reach 4
1	1038	4.79		0		1.13		0.46
			+4.79		-1.13		+0.67	
2	3116	1.09		0.83		2.29		2.00
			+0.26		-1.46		+0.29	
3	4532	0.56		1.66		3.07		2.86
			-1.10		-1.41		+0.21	
4	4296	1.12		1.66		2.85		3.09
			-0.54		-1.19		-0.24	
5	3069	1.09		0.83		2.29		2.00
			+0.26		-1.46		+0.29	
6	1841	4.03		0.41		1.57		0.87
			+3.62		-1.16		+0.70	
7	614	26.02		0.38		0.93		0.53
			+25.64		-0.55		+0.60	

General Scour Calculations
Using 4 reaches

FIELD NOTES BY M.N.
DATE 7-10-89

Reach	Q (cfs)	ΔQ_s (cfs)	Δt (hr)	Length (ft)	Width (ft)	Vertical Movement (ft) Unbulked	Vertical Movement (ft) Bulked (n=0.4)	Cumulative Δ Elev. (ft)
2	1038	+4.79	1	500	396.8	+0.09	+0.14	+0.14
3	1038	-1.13	1	494	125.6	-0.07	-0.11	-0.11
4	1038	+0.67	1	1238	116.2	+0.02	+0.03	+0.03
2	3116	+0.26	1	500	414.9	+0.005	+0.01	+0.15
3	3116	-1.46	1	494	163.7	-0.06	-0.11	-0.22
4	3116	+0.29	1	1238	133.4	+0.01	+0.01	+0.04
2	4532	-1.10	1	500	416.0	-0.02	-0.03	+0.12
3	4532	-1.41	1	494	180.3	-0.06	-0.09	-0.31
4	4532	+0.21	1	1238	142.8	+0.004	+0.01	+0.05
2	4296	-0.54	1	500	415.8	-0.01	-0.02	+0.10
3	4296	-1.19	1	494	178.4	-0.05	-0.08	-0.39
4	4296	-0.24	1	1238	140.3	-0.005	-0.01	+0.04
2	3069	+0.26	1	500	414.8	+0.005	+0.01	+0.11
3	3069	-1.46	1	494	163.5	-0.07	-0.11	-0.50
4	3069	+0.29	1	1238	133.1	+0.01	+0.01	+0.05
2	1841	+3.62	1	500	413.6	+0.06	+0.11	+0.22
3	1841	-1.16	1	494	142.4	-0.06	-0.10	-0.60
4	1841	+0.70	1	1238	124.3	+0.02	+0.03	+0.08
2	614	+25.64	1	500	383.7	+0.48	+0.80	+1.02
3	614	-0.55	1	494	116.8	-0.03	-0.06	-0.66
4	614	+0.60	1	1238	109.5	+0.02	+0.03	+0.11

General Scour Totals:

Reach 2 : 1.02 ft. of aggradation
Reach 3 : 0.66 ft. of degradation
Reach 4 : 0.11 ft. of aggradation

General Scour Calculations
Using 3 reaches

Reach 3 - cross-sections 2 to 12
(to be compared to previous calculations for reaches 3 and 4)

Average hydraulic values:

Q = 1038 cfs

Vel.	Area	Topwidth	R	S_E
2.64	404	119.6	3.32	.002328 (max)

Q = 3116 cfs

Vel.	Area	Topwidth	R	S_E
4.12	756	144.4	5.32	.001885 (max)

Q = 4532 cfs

Vel.	Area	Topwidth	R	S_E
4.78	962	156.4	6.06	.001779 (max)

Q = 4296 cfs

Vel.	Area	Topwidth	R	S_E
4.68	931	154.2	5.92	.001752 (max)

Q = 3069 cfs

Vel.	Area	Topwidth	R	S_E
4.09	759	144.2	5.19	.001898 (max)

Q = 1841 cfs

Vel.	Area	Topwidth	R	S_E
3.31	5.64	130.9	4.24	.001958 (max)

General Scour Calculations
Using 3 reaches

D.G.
PREPARED BY M.N.
DATE 7-10-89

Q = 614 cfs

Vel.	Area	Topwidth	R	S_E
2.23	288	112.1	2.52	.002983 (max)

Q = 1038 cfs

$\tau_o = \frac{1}{8}(1.94)(.27)(2.64)^2$
$= 0.46 \ lb/ft^2$

$f = 8(.002328)/.07$
$= 0.27$

$F_r = 2.64/\sqrt{(32.2)(3.32)}$
$= 0.26$

Q = 3116 cfs

$\tau_o = \frac{1}{8}(1.94)(.15)(4.12)^2$
$= 0.62 \ lb/ft^2$

$f = 8(.001885)/.10$
$= 0.15$

$F_r = 4.12/\sqrt{(32.2)(5.32)}$
$= 0.31$

Q = 4532 cfs

$\tau_o = \frac{1}{8}(1.94)(.12)(4.78)^2$
$= 0.66 \ lb/ft^2$

$f = 8(.001770)/.12$
$= 0.12$

$F_r = 4.78/\sqrt{(32.2)(6.06)}$

Q = 4296 cfs

$\tau_o = \frac{1}{8}(1.94)(.13)(4.68)^2$
$= 0.69 \ lb/ft^2$

$f = 8(.001752)/.11$
$= 0.13$

$F_r = 4.68/\sqrt{(32.2)(5.92)}$
$= 0.34$

General Scour Calculations
Using 3 reaches

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$Q = 3069$ cfs

$\tau_o = 1/8(1.94)(.15)(4.09)^2$
$= 0.61$ lb/ft^2

$f = 8(.001898)/.10$
$= 0.15$

$F_r = 4.09/\sqrt{(32.2)(5.19)}$
$= 0.32$

$Q = 1841$ cfs

$\tau_o = 1/8(1.94)(.20)(3.31)^2$
$= 0.53$ lb/ft^2

$f = 8(.001958)/.08$
$= 0.20$

$F_r = 3.31/\sqrt{(32.2)(4.24)}$
$= 0.28$

$Q = 614$ cfs

$\tau_o = 1/8(1.94)(.40)(2.23)^2$
$= 0.48$ lb/ft^2

$f = 8(.002983)/.06$
$= 0.40$

$F_r = 2.23/\sqrt{(32.2)(2.52)}$
$= 0.25$

$Q = 1038$ cfs

$q_{b25} = (.054)(.46-.02)^{1.5} = 0.016$ cfs/ft

$q_{b50} = (.054)(.46-.05)^{1.5} = 0.014$ cfs/ft

$q_{b75} = (.054)(.46-.42)^{1.5} = 0$ cfs/ft

Total $q_b = (.016)(.333) + (.014)(.333)$
$= 0.010$ cfs/ft

General Scour Calculations
Using 3 reaches

DATE 7-10-89

Q = 3116 cfs

$q_{b25} = (.054)(.62 - .02)^{1.5} = 0.025$ cfs/ft

$q_{b50} = (.054)(.62 - .05)^{1.5} = 0.023$ cfs/ft

$q_{b75} = (.054)(.62 - .42)^{1.5} = 0.005$ cfs/ft

Total $q_b = (.025)(.333) + (.023)(.333) + (.005)(.333)$
$= 0.018$ cfs/ft

Q = 4532 cfs

$q_{b25} = (.054)(.66 - .02)^{1.5} = 0.028$ cfs/ft

$q_{b50} = (.054)(.66 - .05)^{1.5} = 0.026$ cfs/ft

$q_{b75} = (.054)(.66 - .42)^{1.5} = 0.006$ cfs/ft

Total $q_b = (.028)(.333) + (.026)(.333) + (.006)(.333)$
$= 0.020$ cfs/ft

Q = 4296 cfs

$q_{b25} = (.054)(.69 - .02)^{1.5} = 0.030$ cfs/ft

$q_{b50} = (.054)(.69 - .05)^{1.5} = 0.028$ cfs/ft

$q_{b75} = (.054)(.69 - .42)^{1.5} = 0.008$ cfs/ft

Total $q_b = (.030)(.333) + (.028)(.333) + (.008)(.333)$
$= 0.022$ cfs/ft

General Scour Calculations
Using 3 reaches

PREPARED BY M.N.
DATE 7-10-89

Q = 3069 cfs

$q_{b25} = (.054)(.61 - .02)^{1.5} = 0.025$ cfs/ft

$q_{b50} = (.054)(.61 - .05)^{1.5} = 0.023$ cfs/ft

$q_{b75} = (.054)(.61 - .42)^{1.5} = 0.005$ cfs/ft

Total $q_b = (.025)(.333) + (.023)(.333) + (.005)(.333)$
$= 0.018$ cfs/ft

Q = 1841 cfs

$q_{b25} = (.054)(.53 - .02)^{1.5} = 0.020$ cfs/ft

$q_{b50} = (.054)(.53 - .05)^{1.5} = 0.018$ cfs/ft

$q_{b75} = (.054)(.53 - .42)^{1.5} = 0.002$ cfs/ft

Total $q_b = (.020)(.333) + (.018)(.333) + (.002)(.333)$
$= 0.013$ cfs/ft

Q = 614 cfs

$q_{b25} = (.054)(.48 - .02)^{1.5} = 0.017$ cfs/ft

$q_{b50} = (.054)(.48 - .05)^{1.5} = 0.015$ cfs/ft

$q_{b75} = (.054)(.48 - .42)^{1.5} = 0.001$ cfs/ft

Total $q_b = (.017)(.333) + (.015)(.333) + (.001)(.333)$
$= 0.011$ cfs/ft

General Scour Calculations using 3 reaches

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Time (hrs)	Q (cfs)	Q_s (cfs) Reach 2	Δ	Reach 3
1	1038	0		1.20
			-1.20	
2	3116	0.83		2.06
			-1.23	
3	4532	1.66		3.13
			-1.47	
4	4296	1.66		3.39
			-1.73	
5	3069	0.83		2.60
			-1.77	
6	1841	0.41		1.70
			-1.29	
7	614	0.38		1.23
			-0.85	

Reach 3 Degradation

Q (cfs)	ΔQ_s (cfs)	Δt (hr)	Length (ft)	Width (ft)	Vertical Movement (ft) Unbulked	Bulked (n=.04)	Cumulative Δ Elev. (ft)
1038	-1.20	1	1732	119.6	-0.02	-0.03	-0.03
3116	-1.23	1	1732	144.4	-0.02	-0.03	-0.06
4532	-1.47	1	1732	156.4	-0.02	-0.03	-0.09
4296	-1.73	1	1732	154.2	-0.02	-0.04	-0.13
3069	-1.77	1	1732	144.2	-0.03	-0.04	-0.17
1841	-1.29	1	1732	130.9	-0.02	-0.03	-0.20
614	-0.85	1	1732	112.1	-0.02	-0.03	-0.23

Reach 3 length: (cross-sections 2 to 12) = 1732 ft (cross-sections 9 to 12) = 494 ft.

Ratio = 1732/494 = 3.5

Reach 3 scour: (cross-sections 2 to 12): 0.23 ft. (cross-sections 9 to 12) = 0.66 ft.

Ratio = 0.66/0.23 = 2.9

executive

(over)

General Scour Calculations
Using 3 reaches

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→ Cross-sections 9 to 12 represent a more accurate reach length for determining the scour. Aggradation actually occurs in cross-sections 2 to 8. The order of magnitude of the scour depths calculated for cross-sections 9 to 12 is still very low, so these results should provide a high enough level of accuracy.

General Scour Calculations
Using 5 reaches

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Reach 4 - cross-sections 5 to 8
Reach 5 - Cross-sections 2 to 4
(to be compared to the results for reach 4 using cross-sections 2 to 8)

Average hydraulic values:

Q = 1038 cfs

Reach 4

Vel.	Area	Topwidth	R	S_E
2.76	377	112.2	3.32	.001246 (max)

Reach 5

Vel.	Area	Topwidth	R	S_E
2.25	482	121.5	3.81	.000753 (max)

Q = 3116 cfs

Reach 4

Vel.	Area	Topwidth	R	S_E
4.36	716	131.1	5.37	.001604 (max)

Reach 5

Vel.	Area	Topwidth	R	S_E
4.08	755	136.5	5.85	.001357 (max)

General Scour Calculations
Using 5 reaches

Q = 4532 cfs

Reach 4

Vel.	Area	Topwidth	R	S_E
5.08	894	140.1	6.26	.001777 (max)

Reach 5

Vel.	Area	Topwidth	R	S_E
4.94	944	146.5	6.27	.001620 (max)

Q = 4296 cfs

Reach 4

Vel.	Area	Topwidth	R	S_E
4.97	866	138.7	6.12	.001752 (max)

Reach 5

Vel.	Area	Topwidth	R	S_E
4.81	919	142.5	6.15	.001583 (max)

Q = 3069 cfs

Reach 4

Vel.	Area	Topwidth	R	S_E
4.33	709	130.8	5.36	.001597 (max)

Reach 5

Vel.	Area	Topwidth	R	S_E
4.04	782	136.3	5.48	.001346 (max)

General Scour Calculations
Using 5 reaches

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Q = 1841 cfs

Reach 4

Vel.	Area	Topwidth	R	S_E
3.48	529	121.1	4.31	.001384 (max)

Reach 5

Vel.	Area	Topwidth	R	S_E
3.06	624	128.7	4.64	.001010 (max)

Q = 614 cfs

Reach 4

Vel.	Area	Topwidth	R	S_E
2.32	265	105.2	2.50	.001308 (max)

Reach 5

Vel.	Area	Topwidth	R	S_E
1.77	363	115.2	3.05	.000674 (max)

Q = 1038 cfs

Reach 4

$$\tau_o = \tfrac{1}{8}(1.94)(.14)(2.76)^2 = 0.26 \ \text{lb/ft}^2$$

$$f = 8(.001246)/.07 = 0.14$$

$$F_r = 2.76/\sqrt{(32.2)(3.32)} = 0.27$$

General Scour Calculations
Using 5 reaches

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DATE 7-10-89

Reach 5

$\tau_o = 1/8\,(1.94)(.15)(2.25)^2$
$= 0.18\ lb/ft^2$

$f = 8(.000753)/.04$
$= 0.15$

$F_r = 2.25/\sqrt{(32.2)(3.81)}$
$= 0.20$

Q = 3116 cfs

Reach 4

$\tau_o = 1/8\,(1.94)(.12)(4.36)^2$
$= 0.55\ lb/ft^2$

$f = 8(.001604)/.11$
$= 0.12$

$F_r = 4.36/\sqrt{(32.2)(5.37)}$
$= 0.33$

Reach 5

$\tau_o = 1/8\,(1.94)(.12)(4.08)^2$
$= 0.48\ lb/ft^2$

$f = 8(.001357)/.09$
$= 0.12$

$F_r = 4.08/\sqrt{(32.2)(5.85)}$
$= 0.30$

Q = 4532 cfs

Reach 4

$\tau_o = 1/8\,(1.94)(.11)(5.08)^2$
$= 0.69\ lb/ft^2$

$f = 8(.001777)/.13$
$= .11$

$F_r = 5.08/\sqrt{(32.2)(6.26)}$
$= 0.36$

Reach 5

$\tau_o = 1/8\,(1.94)(.11)(4.94)^2$
$= 0.65\ lb/ft^2$

$f = 8(.001620)/.12$
$= 0.11$

$F_r = 4.94/\sqrt{(32.2)(6.27)}$
$= 0.35$

General Scour Calculations
Using 5 reaches

Q = 4296 cfs

Reach 4

$\tau_o = \frac{1}{8}(1.94)(.11)(4.97)^2$
$= 0.65\ lb/ft^2$

$f = 8(.001752)/.13$
$= 0.11$

$F_r = 4.97/\sqrt{(32.2)(6.12)}$
$= 0.35$

Reach 5

$\tau_o = \frac{1}{8}(1.94)(.11)(4.81)^2$
$= 0.62\ lb/ft^2$

$f = 8(.001583)/.12$
$= 0.11$

$F_r = 4.81/\sqrt{(32.2)(6.15)}$
$= 0.34$

Q = 3069 cfs

Reach 4

$\tau_o = \frac{1}{8}(1.94)(.12)(4.33)^2$
$= 0.55\ lb/ft^2$

$f = 8(.001597)/.11$
$= 0.12$

$F_r = 4.33/\sqrt{(32.2)(5.36)}$
$= 0.33$

Reach 5

$\tau_o = \frac{1}{8}(1.94)(.12)(4.04)^2$
$= 0.48\ lb/ft^2$

$f = 8(.001346)/.09$
$= 0.12$

$F_r = 4.04/\sqrt{(32.2)(5.48)}$
$= 0.30$

General Scour Calculations Using 5 reaches

Q = 1841 cfs

Reach 4

$\tau_o = \frac{1}{8}(1.94)(.12)(3.48)^2$
$= 0.35 \ lb/ft^2$

$f = 8(.001384)/.09$
$= 0.12$

$F_r = 3.48/\sqrt{(32.2)(4.31)}$
$= 0.30$

Reach 5

$\tau_o = \frac{1}{8}(1.94)(.13)(3.06)^2$
$= 0.30 \ lb/ft^2$

$f = 8(.001010)/.06$
$= 0.13$

$F_r = 3.06/\sqrt{(32.2)(4.64)}$
$= 0.25$

Q = 614 cfs

Reach 4

$\tau_o = \frac{1}{8}(1.94)(.15)(2.32)^2$
$= 0.20 \ lb/ft^2$

$f = 8(.001308)/.07$
$= 0.15$

$F_r = 2.32/\sqrt{(32.2)(2.50)}$
$= 0.26$

Reach 5

$\tau_o = \frac{1}{8}(1.94)(.18)(1.77)^2$
$= 0.14 \ lb/ft^2$

$f = 8(.000674)/.03$
$= 0.18$

$F_r = 1.77/\sqrt{(32.2)(3.05)}$
$= 0.18$

General Scour Calculations using 5 reaches

PREPARED BY M. N.
DATE 7-10-89

$Q = 1038$ cfs

Reach 4

$q_{b25} = (.054)(.26 - .02)^{1.5} = 0.006$ cfs/ft

$q_{b50} = (.054)(.26 - .05)^{1.5} = 0.005$ cfs/ft

$q_{b75} = 0$ cfs/ft

Total $q_b = (.006)(.333) + (.005)(.333)$
$= 0.004$ cfs/ft

Reach 5

$q_{b25} = (.054)(.18 - .02)^{1.5} = 0.004$ cfs/ft

$q_{b50} = (.054)(.18 - .05)^{1.5} = 0.003$ cfs/ft

$q_{b75} = 0$ cfs/ft

Total $q_b = 0.002$ cfs/ft

General Scour Calculations
Using 5 reaches

$Q = 3116$ cfs

Reach 4

$q_{b25} = (.054)(.55 - .02)^{1.5} = 0.021$ cfs/ft

$q_{b50} = (.054)(.55 - .05)^{1.5} = 0.019$ cfs/ft

$q_{b75} = (.054)(.55 - .42)^{1.5} = 0.003$ cfs/ft

Total $q_b = (.021)(.333) + (.019)(.333) + (.003)(.333)$
$= 0.014$ cfs/ft

Reach 5

$q_{b25} = (.054)(.48 - .02)^{1.5} = 0.017$ cfs/ft

$q_{b50} = (.054)(.48 - .05)^{1.5} = 0.015$ cfs/ft

$q_{b75} = (.054)(.48 - .42)^{1.5} = 0.001$ cfs/ft

Total $q_b = (.017)(.333) + (.015)(.333) + (.001)(.333)$
$= 0.011$ cfs/ft

General Scour Calculations
Using 5 reaches

$Q = 4532$ cfs

Reach 4

$$q_{b25} = (.054)(.69 - .02)^{1.5} = 0.030 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.69 - .05)^{1.5} = 0.028 \text{ cfs/ft}$$

$$q_{b75} = (.054)(.69 - .42)^{1.5} = 0.008 \text{ cfs/ft}$$

$$\text{Total } q_b = (.030)(.333) + (.028)(.333) + (.008)(.333)$$
$$= 0.022 \text{ cfs/ft}$$

Reach 5

$$q_{b25} = (.054)(.65 - .02)^{1.5} = 0.027 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.65 - .05)^{1.5} = 0.025 \text{ cfs/ft}$$

$$q_{b75} = (.054)(.65 - .42)^{1.5} = 0.006 \text{ cfs/ft}$$

$$\text{Total } q_b = (.027)(.333) + (.025)(.333) + (.006)(.333)$$
$$= 0.019 \text{ cfs/ft}$$

General Scour Calculations using 5 reaches

PREPARED BY B.A. M.N.
DATE 7-10-89

$Q = 4296$ cfs

Reach 4

$q_{b25} = (.054)(.65 - .02)^{1.5} = 0.027$ cfs/ft

$q_{b50} = (.054)(.65 - .05)^{1.5} = 0.025$ cfs/ft

$q_{b75} = (.054)(.65 - .42)^{1.5} = 0.006$ cfs/ft

Total $q_b = (.027)(.333) + (.025)(.333) + (.006)(.333)$
$= 0.019$ cfs/ft

Reach 5

$q_{b25} = (.054)(.62 - .02)^{1.5} = 0.025$ cfs/ft

$q_{b50} = (.054)(.62 - .05)^{1.5} = 0.023$ cfs/ft

$q_{b75} = (.054)(.62 - .42)^{1.5} = 0.005$ cfs/ft

Total $q_b = (.025)(.333) + (.023)(.333) + (.005)(.333)$
$= 0.018$ cfs/ft

General Scour Calculations
Using 5 reaches

$Q = 3069$ cfs

Reach 4

$q_{b25} = (.054)(.55 - .02)^{1.5} = 0.021$ cfs/ft

$q_{b50} = (.054)(.55 - .05)^{1.5} = 0.019$ cfs/ft

$q_{b75} = (.054)(.55 - .42)^{1.5} = 0.003$ cfs/ft

Total $q_b = (.021)(.333) + (.019)(.333) + (.003)(.333)$
$= 0.014$ cfs/ft

Reach 5

$q_{b25} = (.054)(.48 - .02)^{1.5} = 0.017$ cfs/ft

$q_{b50} = (.054)(.48 - .05)^{1.5} = 0.015$ cfs/ft

$q_{b75} = (.054)(.48 - .42)^{1.5} = 0.001$ cfs/ft

Total $q_b = (.017)(.333) + (.015)(.333) + (.001)(.333)$
$= 0.011$ cfs/ft

General Scour Calculations
Using 5 reaches

PREPARED BY: M. N.
DATE: 7-10-89

Q = 1841 cfs

Reach 4

$q_{b25} = (.054)(.35 - .02)^{1.5} = 0.010$ cfs/ft

$q_{b50} = (.054)(.35 - .05)^{1.5} = 0.009$ cfs/ft

$q_{b75} = 0$ cfs/ft

Total $q_b = (.010)(.333) + (.009)(.333)$
$= 0.006$ cfs/ft

Reach 5

$q_{b25} = (.054)(.30 - .02)^{1.5} = 0.008$ cfs/ft

$q_{b50} = (.054)(.30 - .05)^{1.5} = 0.007$ cfs/ft

$q_{b75} = 0$ cfs/ft

Total $q_b = (.008)(.333) + (.007)(.333)$
$= 0.005$ cfs/ft

General Scour Calculations
Using 5 reaches

PREPARED BY M.N.
DATE 7-10-89

$Q = 614$ cfs

Reach 4

$q_{b25} = (.054)(.20 - .02)^{1.5} = 0.004$ cfs/ft

$q_{b50} = (.054)(.20 - .05)^{1.5} = 0.003$ cfs/ft

$q_{b75} = 0$ cfs/ft

Total $q_b = (.004)(.333) + (.003)(.333)$
$= 0.002$ cfs/ft

Reach 5

$q_{b25} = (.054)(.14 - .02)^{1.5} = 0.002$ cfs/ft

$q_{b50} = (.054)(.14 - .05)^{1.5} = 0.002$ cfs/ft

$q_{b75} = 0$ cfs/ft

Total $q_b = (.002)(.333) + (.002)(.333)$
$= 0.001$ cfs/ft

General Scour Calculations
Using 5 reaches

B.a.

PREPARED BY: M.N.
DATE: 7-10-89

Time (hrs)	Q (cfs)	Q (cfs) Reach 3	Δ	Reach 4	Δ	Reach 5
1	1038	1.13		0.45		0.24
			+0.68		+0.21	
2	3116	2.29		1.84		1.50
			+0.45		+0.34	
3	4532	3.07		3.08		2.78
			−0.01		+0.30	
4	4296	2.85		2.64		2.57
			+0.21		+0.07	
5	3069	2.29		1.83		1.50
			+0.46		+0.33	
6	1841	1.57		0.73		0.64
			+0.84		+0.09	
7	614	0.93		0.21		0.12
			+0.72		+0.09	

General Scour Calculations using 5 reaches

PREPARED BY M.N.
DATE 7-10-89

Reach	Q (cfs)	ΔQs (cfs)	Δt (hr)	Length (ft)	Width (ft)	Vertical Movement (ft) Unbulked	Vertical Movement (ft) Bulked (n=.04)	Cumulative Δ Elev (ft)
4	1038	+.68	1	742	112.2	+.03	+.05	+.05
5	1038	+.21	1	496	121.5	+.01	+.02	+.02
4	3116	+.45	1	742	131.1	+.02	+.03	+.08
5	3116	+.34	1	496	136.5	+.02	+.03	+.05
4	4532	-.01	1	742	140.1	0	0	+.08
5	4532	+.30	1	496	146.5	+.01	+.02	+.07
4	4296	+.21	1	742	138.7	+.01	+.01	+.09
5	4296	+.07	1	496	142.5	0	+.01	+.08
4	3069	+.46	1	742	130.8	+.02	+.03	+.12
5	3069	+.33	1	496	136.3	+.02	+.03	+.11
4	1841	+.84	1	742	121.1	+.03	+.06	+.18
5	1841	+.09	1	496	128.7	+.01	+.01	+.12
4	614	+.72	1	742	105.2	+.03	+.06	+.24
5	614	+.09	1	496	115.2	+.01	+.01	+.13

→ Reach 4 (cross-sections 5 to 8) is about ½ the length of Reach 4 (cross-sections 2 to 8) and the aggradation depth is about doubled. These results should provide a high enough level of accuracy considering the low order of magnitude of the depths.

Long - Term Degradation / Aggradation (Equilibrium Slope)

→ The 10-year discharge is assumed to be the dominant discharge. This value will be assumed to be 3069 cfs which should be conservatively high.

→ Use reach 1 as the sediment supply reach. For $Q = 3069$ cfs, $Q_s = 1.09$ cfs. This value will be used as the sediment supply for reaches 2, 3, and 4. Reach 4 includes cross-sections 2 to 8, which provides a high enough level of accuracy, in light of the fact that the hydraulics for each of the cross-sections are similar.

Reach 4 (cross-sections 2 to 8):

$Q = 3069$ cfs $\quad n = 0.04 \quad W = 133.1$ ft.

Assume slope $= 0.003$ ft/ft

$$V = 3069/A = 1.486/.04 \left(\frac{A}{133.1}\right)^{2/3} (.003)^{1/2}$$

$A = 571$ ft^2

$V = 5.37$ ft/s

$R = 571/133.1 = 4.29$ ft.

$$\tau_o = \tfrac{1}{8} \rho f V^2 = \tfrac{1}{8}(1.94)(.11)(5.37)^2 = 0.77 \text{ lb/ft}^2$$

$$f = 8(.003)/.21 = 0.11$$

$$F_r = 5.37/\sqrt{(32.2)(4.29)} = 0.46$$

$$q_{b25} = (.054)(.77 - .02)^{1.5} = 0.035 \text{ cfs/ft}$$
$$q_{b50} = (.054)(.77 - .05)^{1.5} = 0.033 \text{ cfs/ft}$$
$$q_{b75} = (.054)(.77 - .42)^{1.5} = 0.011 \text{ cfs/ft}$$

Total $q_b = (.035)(.333) + (.033)(.333) + (.011)(.333)$
$= 0.026$ cfs/ft

$Q_s = (.026)(133.1) = 3.46$ (too high)

Long-Term Degradation / Aggradation (Equilibrium Slope)

PREPARED BY: M.N. (B.C.)
DATE: 7-10-89

Assume slope = 0.002 ft/ft

$$V = 3069/A = \frac{1.486}{.04}\left(\frac{A}{133.1}\right)^{2/3}(.002)^{1/2}$$

$A = 645\ ft^2$
$V = 4.76\ ft/s^2$
$R = 4.85\ ft.$

$$\tau_o = \tfrac{1}{8}(1.94)(.11)(4.76)^2 = 0.60\ lb/ft^2$$

$$f = 8(.002)/.15 = 0.11$$

$$F_r = 4.76/\sqrt{(32.2)(4.85)} = 0.38$$

$$q_{b25} = (.054)(.60-.02)^{1.5} = 0.024\ cfs/ft$$
$$q_{b50} = (.054)(.60-.05)^{1.5} = 0.022\ cfs/ft$$
$$q_{b75} = (.054)(.60-.42)^{1.5} = 0.004\ cfs/ft$$

$$\text{Total } q_b = (.024)(.333) + (.022)(.333) + (.004)(.333) = 0.017\ cfs/ft$$

$$Q_s = (.017)(133.1) = 2.26\ cfs\ (\text{too high})$$

Assume slope = 0.001 ft/ft

$$V = 3069/A = \frac{1.486}{.04}\left(\frac{A}{133.1}\right)^{2/3}(.001)^{1/2}$$

$A = 794\ ft^2$
$V = 3.87\ ft/s$
$R = 5.97\ ft.$

$$\tau_o = \tfrac{1}{8}(1.94)(.10)(3.87)^2 = 0.36\ lb/ft^2$$

$$f = 8(.001)/0.08 = 0.10$$

$$F_r = 3.87/\sqrt{(32.2)(5.97)} = 0.30$$

Long-Term Degradation / Aggradation (Equilibrium Slope)

$q_{b25} = (.054)(.36 - .02)^{1.5} = 0.011$ cfs/ft

$q_{b50} = (.054)(.36 - .05)^{1.5} = 0.009$ cfs/ft

$q_{b75} = 0$ cfs/ft

Total $q_b = (.011)(.333) + (.009)(.333)$
$= 0.007$ cfs/ft

$Q_s = (.007)(133.1) = 0.93$ (too low)

Assume Slope = 0.0011 ft/ft

$V = 3069/A = \frac{1.486}{.04}\left(A/133.1\right)^{2/3}(.0011)^{1/2}$

$A = 772$ ft^2
$V = 3.98$ ft/s
$R = 5.80$ ft

$\tau_o = 1/8\,(1.94)(.11)(3.98)^2$
$= 0.42$ lb/ft^2

$f = 8(.0011)/.08$
$= 0.11$

$F_r = 3.98/\sqrt{(32.2)(5.80)}$
$= 0.29$

$q_{b25} = (.054)(.42 - .02)^{1.5} = 0.014$ cfs/ft

$q_{b50} = (.054)(.42 - .05)^{1.5} = 0.012$ cfs/ft

$q_{b75} = 0$ cfs/ft

Total $q_b = (.014)(.333) + (.012)(.333)$
$= 0.009$ cfs/ft

$Q_s = (.009)(133.1) = 1.20$ cfs

→ Use equilibrium slope = 0.0011 ft/ft for reach 4

Long-Term Degradation / Aggradation (Equilibrium Slope)

Reach 3

$Q = 3069$ cfs $\quad n = 0.04 \quad W = 163.5$ ft.

Assume slope $= 0.001$ ft/ft

$$V = 3069/A = 1.486/.04 \left(A/163.5\right)^{2/3} (.001)^{1/2}$$

$A = 862$ ft^2

$V = 3.56$ ft/s

$R = 5.27$ ft

$$\tau_o = 1/8\,(1.94)(.11)(3.56)^2 = 0.34 \text{ lb/ft}^2$$

$$f = 8(.001)/0.07 = 0.11$$

$$F_r = 3.56/\sqrt{(32.2)(5.27)} = 0.27$$

$$q_{b25} = (.054)(.34 - .02)^{1.5} = 0.010 \text{ cfs/ft}$$

$$q_{b50} = (.054)(.34 - .05)^{1.5} = 0.008 \text{ cfs/ft}$$

$$q_{b75} = 0 \text{ cfs/ft}$$

$$\text{Total } q_b = (.010)(.333) + (.008)(.333) = 0.006 \text{ cfs/ft}$$

$$Q_s = (.006)(163.5) = 0.98 \text{ cfs} \quad (\text{too low})$$

Assume slope $= 0.0011$ ft/ft

$$V = 3069/A = 1.486/.04 \left(A/163.5\right)^{2/3} (.0011)^{1/2}$$

$A = 838$ ft^2

$V = 3.66$ ft/s

$R = 5.13$ ft.

Long-Term Degradation / Aggradation (Equilibrium Slope)

$\tau_o = \frac{1}{8}(1.94)(.11)(3.66)^2$
$= 0.36 \ lb/ft^2$

$f = 8(.0011)/.08$
$= 0.11$

$F_r = 3.66/\sqrt{(32.2)(5.13)}$
$= 0.28$

$q_{b25} = (.054)(.36-.02)^{1.5} = 0.011 \ cfs/ft$

$q_{b50} = (.054)(.36-.05)^{1.5} = 0.009 \ cfs/ft$

$q_{b75} = 0 \ cfs/ft$

Total $q_b = (.011)(.333) + (.009)(.333)$
$= 0.007 \ cfs/ft$

$Q_s = (.007)(163.5) = 1.14 \ cfs$

$\longrightarrow$ Use equilibrium slope $= 0.0011 \ ft/ft$ for reach 3

Reach 2

$Q = 3069 \ cfs$ $\quad n = 0.045$ $\quad W = 414.8 \ ft.$

Assume slope $= 0.001 \ ft/ft$

$V = 3069/A = 1.486/.045 \left(A/414.8\right)^{2/3}(.001)^{1/2}$
$A = 1343 \ ft^2$
$V = 2.29 \ ft/s$
$R = 3.24 \ ft.$

$\tau_o = \frac{1}{8}(1.94)(.16)(2.29)^2$
$= 0.20 \ lb/ft^2$

$f = 8(.001)/.05$
$= 0.16$

$F_r = 2.29/\sqrt{(32.2)(3.24)}$
$= 0.22$

Long-Term Degradation / Aggradation (Equilibrium Slope)

$q_{b25} = (.054)(.20 - .02)^{1.5} = 0.004$ cfs/ft

$q_{b50} = (.054)(.20 - .05)^{1.5} = 0.003$ cfs/ft

$q_{b75} = 0$ cfs/ft

Total $q_b = (.004)(.333) + (.003)(.333)$
$= 0.002$ cfs/ft

$Q_s = (0.002)(414.8) = 0.82$ cfs/ft

Assume slope = 0.0012 ft/ft

$V = 3069/A = 1.486/.045 \left(A/414.8\right)^{2/3}(.0012)^{1/2}$

$A = 1272$ ft^2
$V = 2.41$ ft/s
$R = 3.07$ ft

$\tau_o = 1/8\,(1.94)(0.16)(2.41)^2$
$= 0.23$ lb/ft^2

$f = 8(.0012)/.06$
$= 0.16$
$F_r = 2.41/\sqrt{(32.2)(3.07)}$
$= 0.24$

$q_{b25} = (.054)(.23 - .02)^{1.5} = 0.005$ cfs/ft

$q_{b50} = (.054)(.23 - .05)^{1.5} = 0.004$ cfs/ft

$q_{b75} = 0$ cfs/ft

Total $q_b = (.005)(.333) + (.004)(.333)$
$= 0.003$ cfs/ft

$Q_s = (.003)(414.8) = 1.24$ cfs

→ Use equilibrium slope = 0.0011 ft/ft for reach 2

Long-Term Degradation/Aggradation (Equilibrium Slope)

B.9.

PREPARED BY	M.N.
DATE	7-10-89

Reaches 3 and 4
Equilibrium Slope = 0.0011 ft/ft

→ Cross-Section 10.74 is the control point (pivot point) due to the flow constriction and geologic stability.

Cross-Section	Cumulative Distance	Current Invert	Equilibrium Slope Invert	Long-Term Aggr / Degr, (ft)
10.74		1521.0		
1	233	1520.1	1521.3	+1.2
2	326	1520.5	1521.4	+0.9
3	379	1520.7	1521.4	+0.7
4	729	1521.7	1521.8	+0.1
5	1049	1522.3	1522.2	-0.1
6	1187	1522.6	1522.3	-0.3
7	1316	1522.8	1522.4	-0.4
8	1471	1523.0	1522.6	-0.4
9	1520	1523.1	1522.7	-0.4
10	1712	1523.5	1522.9	-0.6
11	1873	1523.8	1523.1	-0.7
12	1965	1524.0	1523.2	-0.8
13	2065	1523.0	1523.3	+0.3
14	2165	1524.1	1523.4	-0.7
15	2265	1524.0	1523.5	-0.5
16	2365	1524.0	1523.6	-0.4
17	2465	1522.9	1523.7	+0.8

Flow Impingement at XSFCs 10 to 16
Superelevation Calculations

PREPARED BY B.A. M.N.
DATE 7-10-89

→ Use the greater of the two following equations:

(1) $\Delta y_{se} = \frac{V^2}{2g} \frac{w}{r_c} \left[\frac{1}{\left[1 - \left(\frac{w}{2r_c}\right)^2\right]} \right]$, where

Δy_{se} = superelevation
r_c = radius of channel centerline
w = channel width at the elevation of the centerline water surface

(2) $\Delta y_{se} = C \frac{V^2 w}{g\, r_c}$, where

C = coefficient = 0.5 for tranquil flow

$W = 337$ ft (ave. topwidth for cross-sections 12 to 16)

$r_c = 400$ ft

$V = 4.57$ fps (ave. velocity for cross-sections 10 to 12)

(1) $\Delta y_{se} = \frac{(4.57)^2}{64.4} \frac{337}{400} \left[\frac{1}{\left[1 - \left(\frac{337}{2 \times 400}\right)^2\right]} \right]$

$= 0.33$ ft.

(2) $\Delta y_{se} = (.5) \frac{(4.57)^2 (337)}{(32.2)(400)}$

$= 0.27$ ft.

→ Use $\Delta y_{se} = 0.33$ ft.

Flow Impingement at XSECs 10 to 16
Bend Scour Calculations

$$\Delta Z_{bs} = \frac{0.0685\, Y V^{0.8}}{Y_h^{0.4}\, S_e^{0.3}} \left[2.1 \left(\sin^2 \alpha/2 \,/ \cos \alpha \right)^{0.2} - 1 \right]^{1}, \text{ where}$$

ΔZ_{bs} = bend scour depth, ft
V = mean velocity of upstream flow, fps
Y = max. depth of upstream flow, ft
Y_h = hydraulic depth of upstream flow, ft
S_e = upstream energy slope, ft/ft
α = angle formed by the projection of the channel centerline from the point of curvature to a point which meets a line tangent to the outer bank of the channel

Cross-Sections 10 - 13

Use hydraulic characteristics at cross-section 13:

$V = 2.83 \quad Y = 9.78 \quad Y_h = 7.90 \quad S_e = 0.000483 \quad \alpha = 42°$

$$\Delta Z_{bs} = \frac{0.0685\,(9.78)(2.83)^{0.8}}{(7.90)^{0.4}\,(.000483)^{0.3}} \left[2.1 \left(\sin^2 42/2 \,/ \cos 42 \right)^{0.2} - 1 \right]$$

$= 3.18$ ft.

Longitudinal extent of bend scour:

$$X = 2.3 \left(C/\sqrt{g} \right) Y$$

C = Chezy coefficient $= \frac{1.486}{n} R^{1/6}$
g = gravitational acceleration, ft/s²
Y = max. depth of flow within the bend, ft

$$C = \frac{1.486}{.045} (7.90)^{1/6} = 46.60$$

$$X = 2.3 \left(46.60/\sqrt{32.2} \right)(9.78) = 185 \text{ ft.}$$

→ The bend scour will extend approximately to cross-section 10.

[1] "Engineering Analysis of Fluvial Systems, A Short Course," Arizona Department of Transportation, July 1986, 5.105 - 5.108.

Flow Impingement at XSECs 10 to 16
Bend Scour Calculations

B.9.
PREPARED BY M.N.
DATE 7-10-89

Cross-Sections 14 - 16

Use cross-section 16 for hydraulic characteristics:

$V = 1.57 \quad Y = 8.94 \quad Y_h = 7.30 \quad S_e = 0.000168 \quad \alpha = 42°$

$$\Delta Z_{bs} = \frac{0.0685(8.94)(1.57)^{0.8}}{(7.30)^{0.4}(.000168)^{0.3}}\left[2.1\left(\sin^2 42/2 \,/\, \cos 42\right)^{0.2} - 1\right]$$

$= 2.57$ ft.

Dune Height / Anti-dune Depth Calculations

$Q = 5400$ cfs

Reach 1: max. velocity = 2.04 fps
max. depth = 6.97 ft

Reach 2: max. velocity = 2.83 fps
max. depth = 10.07 ft

Reach 3: max. velocity = 4.68 fps
max. depth = 8.74 ft

Reach 4: max. velocity = 5.76 fps
max. depth = 9.25 ft.

Use the max. value calculated from:

1. $h_a = 0.027\, V^2$
2. $h_a = 0.38\, d^{0.74}$
3. $h_a = \frac{1}{6} d$

Reach 1

1. $h_a = .027(2.04)^2 = 0.11$ ft
2. $h_a = .38(6.97)^{.74} = 1.60$ ft
3. $h_a = \frac{1}{6}(6.97) = 1.16$ ft.

→ Use $h_a = 1.60$ ft. (0.8 ft dune height, 0.8 ft. anti-dune depth)

Reach 2

1. $h_a = .027(2.83)^2 = 0.22$ ft
2. $h_a = .38(10.07)^{.74} = 2.10$ ft
3. $h_a = \frac{1}{6}(10.07) = 1.68$ ft

→ Use $h_a = 2.10$ ft. (1.05 ft dune height, 1.05 ft anti-dune depth)

Dune Height / Anti-dune Depth Calculations

Reach 3

(1) $h_a = .027(4.68)^2 = 0.59$ ft.
(2) $h_a = .38(8.74)^{.74} = 1.89$ ft.
(3) $h_a = 1/6(8.74) = 1.46$ ft.

→ Use $h_a = 1.89$ ft (0.95 ft dune height, 0.95 ft anti-dune depth)

Reach 4

(1) $h_a = .027(5.76)^2 = 0.90$ ft.
(2) $h_a = .38(9.25)^{.74} = 1.97$ ft.
(3) $h_a = 1/6(9.25) = 1.54$ ft.

→ Use $h_a = 1.97$ ft. (0.99 ft dune height, 0.99 ft anti-dune depth)

Contraction Scour Calculations

$$Q = \frac{1.49}{n} b_2 d_2^{5/3} S_2^{1/2} = \frac{1.49}{n} b_1 d_1^{5/3} S_1^{1/2}$$ [1]

At Q = 5400 cfs :

Reach 3 :

XSEC	depth	topwidth	energy slope	n
9	8.74	163.90	.001204	.04
10	8.60	191.00	.001465	.04
11	8.54	190.08	.001405	.04
12	8.51	192.02	.001534	.045
Averages :	8.60	184.25	.001402	.041

Reach 2 :

XSEC	depth	topwidth	energy slope	n
13	9.78	245.57	.000483	.045
14	8.79	355.56	.000255	.045
15	8.93	422.00	.000107	.045
16	8.94	470.00	.000168	.045
17	10.07	590.00	.000120	.045
Averages :	9.30	416.63	.000227	.045

$$1.49/.041\,(184.25)(8.60)^{5/3} S_2^{1/2} = 1.49/.045\,(416.63)(9.30)^{5/3}(.000227)^{1/2}$$

$$S_2 = 0.0013 \text{ ft/ft}$$

→ Pivoting about cross-section 8, and using a slope = 0.0013, the degradation at cross-section 12 will be 0.36 ft.

[1] "Sedimentation Engineering," American Society of Civil Engineers, 1975, p. 58-62.

B.C.

PREPARED BY M.N.

DATE 7-10-89

Summary
Degradation

(Dimensions in feet)

Cross-Section	Antidune Depth	General Scour	Contraction Scour	Bend Scour	Long-Term Degradation	Total Scour with Safety Factor 1.3
2	0.99					1.3
3	0.99					1.3
4	0.99					1.3
5	0.99				0.1	1.4
6	0.99				0.3	1.7
7	0.99				0.4	1.8
8	0.99				0.4	1.8
9	0.95	0.66	0.04		0.4	2.6
10	0.95	0.66	0.19	3.18	0.6	7.2*
11	0.95	0.66	0.28	3.18	0.7	7.4*
12	0.95	0.66	0.36	3.18	0.8	7.7*
13	1.05			3.18		5.5*
14	1.05			2.57	0.7	5.6*
15	1.05			2.57	0.5	5.4*
16	1.05			2.57	0.4	5.2*
17	1.05					1.4*

*Exceeds depth required to establish an armor layer.

B.9.

PREPARED BY M.N.

DATE 7-10-89

Summary
Aggradation

(Dimensions in feet)

Cross-Section	Dune Height	General Aggradation	Superelevation	Long-Term Aggradation	Total Aggradation with 1.3 safety factor
2	0.99	0.13		0.9	2.6
3	0.99	0.13		0.7	2.4
4	0.99	0.13		0.1	1.6
5	0.99	0.24			1.6
6	0.99	0.24			1.6
7	0.99	0.24			1.6
8	0.99	0.24			1.6
9	0.95				1.2
10	0.95		0.33		1.6
11	0.95		0.33		1.6
12	0.95		0.33		1.6
13	1.05	1.02	0.33	0.3	3.5
14	1.05	1.02	0.33		3.1
15	1.05	1.02	0.33		3.1
16	1.05	1.02	0.33		3.1
17	1.05	1.02		0.8*	2.7

* This value was ignored since the low point (invert) is in a small isolated area.

B.9.

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DATE 7-10-89

Recommended Dimensions
Toedown Depth and Freeboard Height

(Dimensions in feet)

Cross-Section	Total Scour	Scour Depth to establish Armor Layer	RECOMMENDED TOEDOWN	Total Aggradation	FEMA Requirement	RECOMMENDED FREEBOARD
2	1.3	1.8	4.0	2.6	3.0	3.0
3	1.3	1.8	4.0	2.4	3.0	3.0
4	1.3	1.8	4.0	1.6	3.0	3.0
5	1.4	1.8	4.0	1.6	3.0	3.0
6	1.7	1.8	4.0	1.6	3.0	3.0
7	1.8	1.8	4.7	1.6	3.0	3.0
8	1.8	1.8	5.6	1.6	3.0	3.0
9	2.6	1.8	5.8	1.2	4.0	4.0
10	7.2	1.8	7.0*	1.6	4.0	4.0
11	7.4	1.8	7.0*	1.6	4.0	4.0
12	7.7	1.8	7.0*	1.6	4.0	4.0
13	5.5	0.25	5.5*	3.5	4.0	4.0
14	5.6	0.25	4.0*	3.1	4.0	4.0
15	5.4	0.25	4.0*	3.1	4.0	4.0
16	5.2	0.25	4.0*	3.1	4.0	4.0
17	1.4	0.25	3.0	2.7	3.0	3.0

*This value represents the sum of the bend scour depth and the depth required to establish an armor layer (rounded up to the nearest 0.5 feet). The calculations used to determine the depth required to establish an armor layer do not take into account the secondary flow currents caused by a change in flow direction, but the bend scour calculations do take these secondary currents into account. A safety factor of 1.3 is included.

The minimum toedown depth required is 3.0 feet which matches the maximum riprap diameter. The toedown depths transition from cross-section 5 to cross-section 10 and from cross-section 12 to cross-section 14.

G.9. MN 7-10-89 76/77

KNOCKLE BROS

ENGINEERING DIVISION
QUALITY ASSURANCE DEPARTMENT

AGGREGATE SIEVE ANALYSIS

Lab Sample No. 12
Field Sample No.
Contract No. 1740
Contract No.
INDIV

Date 4-19-89
To be used for CHANNEL BANK EAST
Tested by WIESE

Sieve Size (U.S.B.S.)	~~Cumulative~~ Weight Retained	Cumulative Percent Retained	CUMW	Percent Passing	Specification Limits
6"	0	0		100	
5"	1658	1658	7.5	92	
4"					
3"	529	2187	9.9	90	
2-1/2"					
2"	942	3129	14.2	86	
1-1/2"	416/575	4120	18.7	81	
1-1/4"					
1"	640/623	5383	24.4	75	D75
3/4"	337/380	6000	27.2	73	
5/8"					
1/2"					
3/8"					
1/4 (No. 3)					
3/16" (No. 4)	1352/1952	9304	42.2	58	
No. 8	94	19/81		47	
No. 10-12					
No. 16	240	48/52		30	
No. 20					
No. 30					
No. 40	407	81/19		11	
No. 50					
No. 60-70					
No. 80					
No. 100	456	91/09		5	
No. 140-150					
No. 200	463	1/~~46~~93/7		4	← FINES
Pan	5388/7328	+22020			
TOTAL	500/466			F.M.	

NOTE: Use only sizes which are applicable. Strike out size not used where two sizes are shown in one block.

Remarks:

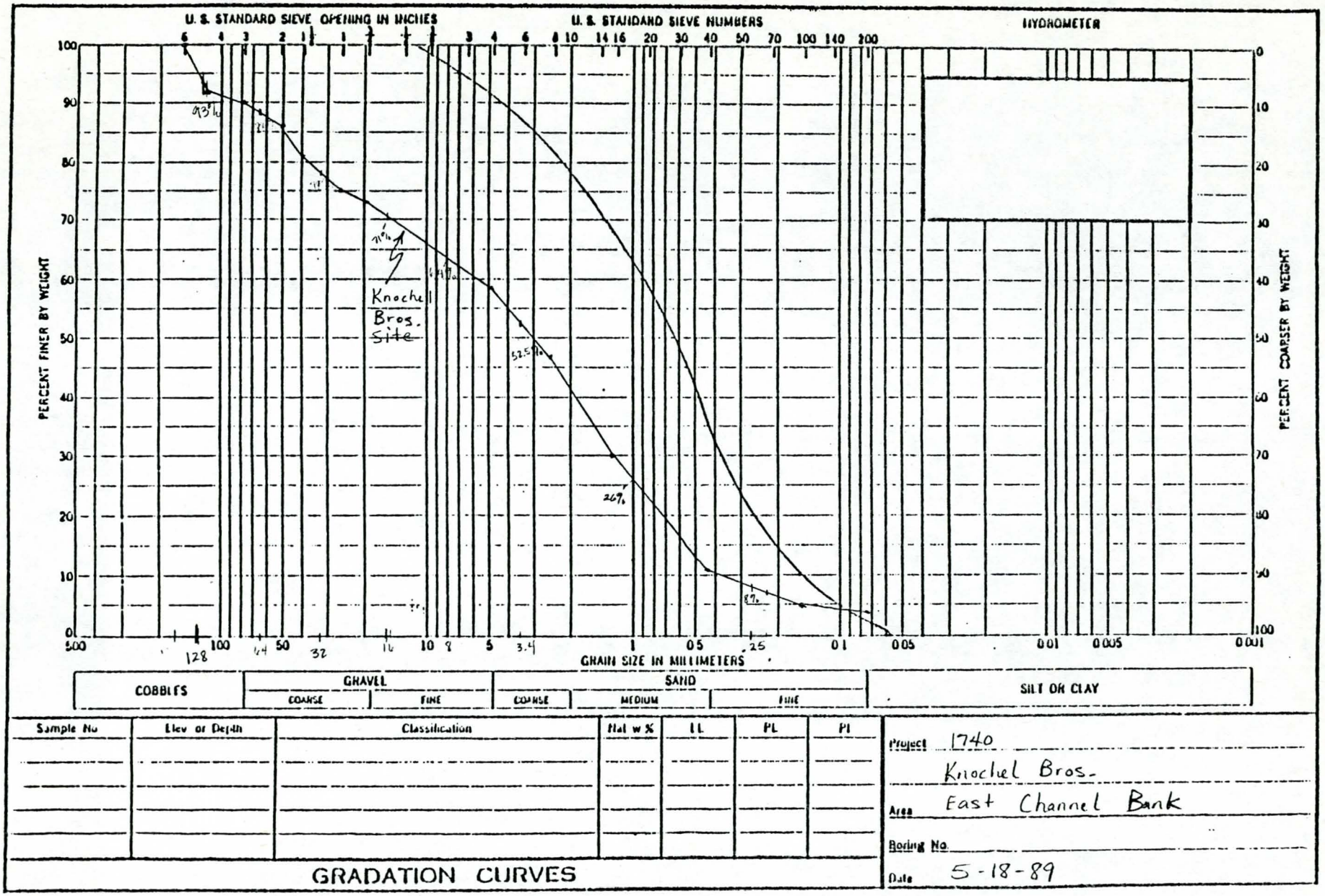


Figure 5.11b. Representative gradation curve.

APPENDIX "H"

Stability, Seepage and Filter Analysis

DIKE STABILITY, SEEPAGE, AND FILTER ANALYSIS

VESECKY
1/10

A FIELD INSPECTION WAS MADE IN APRIL 1989 BY DAVID M. NIESE, P.E., GEOTECHNICAL ENGINEER.

MR NIESE EVALUATED THE ONSITE MATERIAL AND AVAILABLE RIP RAP MATERIAL IN ORDER TO DETERMINE THE GRADATION OF RIP RAP AND EXISTING SITE SOIL.

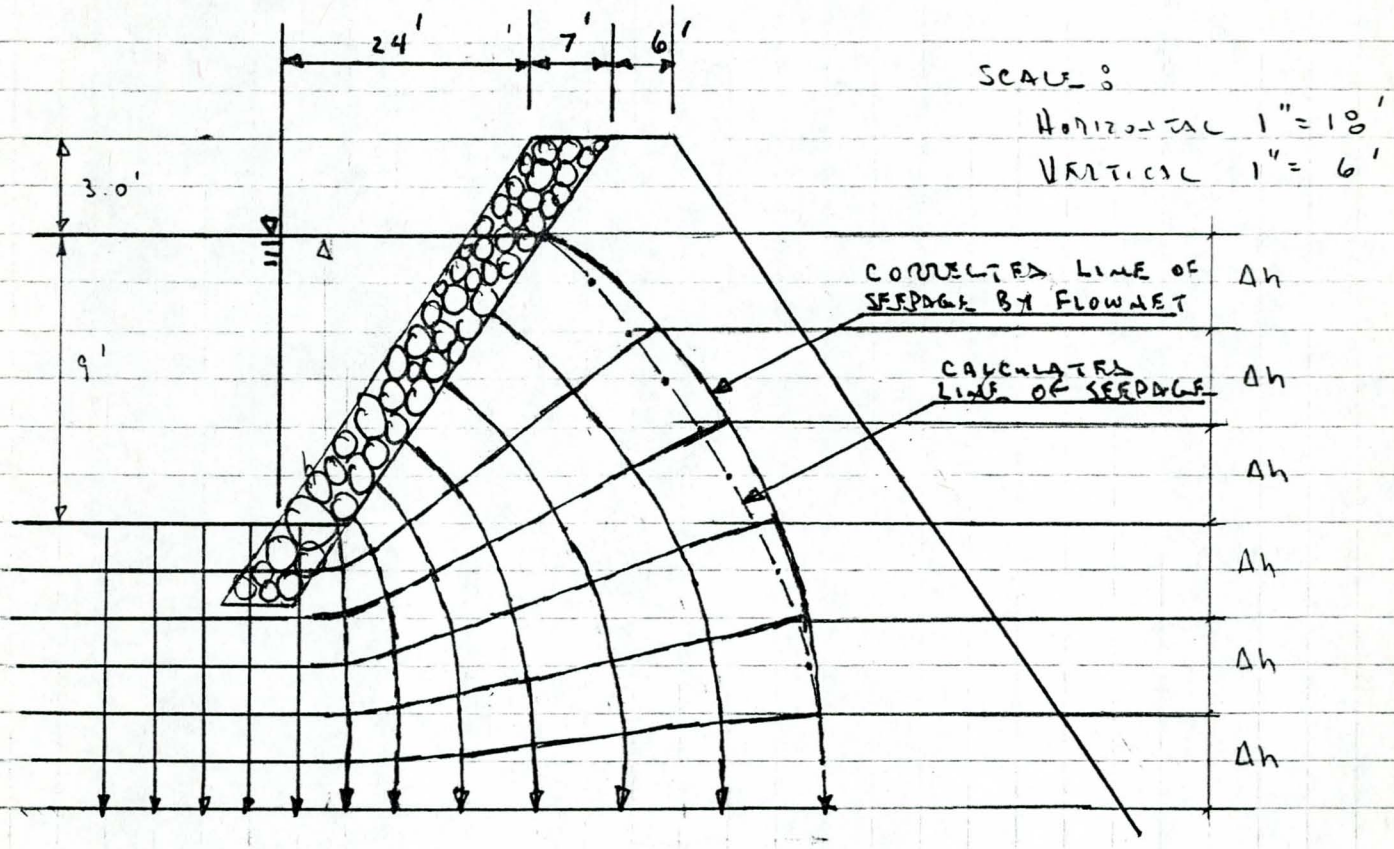
MR NIESE DETERMINED THAT THE SOIL ONSITE WAS ACCEPTABLE FOR FILL FOR THE DIKE AND THAT THE NATIVE MATERIAL WOULD FUNCTION AS A FILTER FOR THE RIP RAP. COPIES OF HIS ANALYSIS ARE ATTACHED HERETO.

SEEPAGE THROUGH DIKE

A TRENCH WAS CUT IN THE CHANNEL INVERT TO A DEPTH OF 10 FEET BELOW THE CHANNEL INVERT TO VERIFY THE PRESENCE OF ALLUVIAL MATERIAL. A WELL LOG FOR AN ONSITE WELL SHOWS THAT ALLUVIAL MATERIAL IS PRESENT TO A DEPTH OF APPROXIMATELY 40 FEET.

THIS INFORMATION ALONG WITH THE FOLLOWING ASSUMPTIONS WERE UTILIZED IN THE CONSTRUCTION OF THE FLOWNET INCLUDED HEREIN: HORIZONTAL PERMEABILITY ≈ 3 TIMES VERTICAL PERMEABILITY.
AS CAN BE SEEN THE SEEPAGE LINE DOES NOT INTERSECT THE OPPOSITE TOE OF THE DIKE SLOPE SO THE DIKE SHOULD BE SAFE FROM A FAILURE DUE TO SEEPAGE FORCES.

THE HORIZONTAL SCALE OF THE FLOWNET IS CONSTRUCTED AT 1/3 OF THE VERTICAL SCALE IN ORDER TO UTILIZE FORCHHEIMER'S GRAPHICAL SOLUTION OF SEEPAGE.



THE LINE OF SEEPAGE WILL FORM A PARABOLIC CURVE. UTILIZING THE FORM OF THE EQUATION AS PRESENTED BY A. CASAGRANDE, NEW ENGLAND WATER WORKS ASSOCIATION, SEEPAGE THROUGH DAMS, 1937; A SOLUTION CAN BE FORMULATED MAKING THE CONSERVATIVE ASSUMPTION THAT THE ALUVIAL SOIL WILL ACT AS HORIZONTAL DISCHARGE SURFACE AT A DISTANCE h BELOW THE SURFACE EQUAL TO THE DEPTH OF WATER IN THE CHANNEL

$$X = \frac{y^2 - y_0^2}{2y_0} \qquad a_0 = \frac{y_0}{2} = \frac{1}{2}\left((d^2+h^2)^{1/2} - d\right)$$

$$q = 2Ka_0 = k_1 y_0$$

$a_0 = \frac{y_0}{2} = \frac{h}{2}$ BECAUSE $d = 0$

THEN $y_0 = h = 18'$

$a_0 = 9'$

x	0.93	0.75	0.43	8	7.4	6.75	5.9	5	3.9	2.75	1.4	0
y	1.5	3	4.5	6	7.5	9	10.5	12	13.5	15	16.5	18.0

$$x = \frac{y^2 - (18)^2}{2(18)}$$

$$x = (y^2 - 324)/36$$

SLOPE STABILITY

AS DEMONSTRATED BY THE FLOWNET ANALYSIS THE SEEPAGE IS PRIMARILY VERTICAL DUE TO THE PRESENCE OF HIGHLY PERMEABLE MATERIAL BENEATH THE CHANNEL INVERT AND BENEATH THE LEVEE FOUNDATION. THIS MEANS THAT THE SEEPAGE FORCES WOULD NOT DECREASE THE SLOPE'S STABILITY SIGNIFICANTLY DURING SATURATED CONDITIONS. THEREFORE, PRACTICALLY THE SLOPES STABILITY CAN BE CALCULATED UTILIZING NON-SATURATED CONDITIONS. HOWEVER IT IS IMPORTANT TO CALCULATE STABILITY FOR SATURATED CONDITIONS ASSUMING HORIZONTAL SEEPAGE FORCES FOR COMPARISON PURPOSES:

UTILIZING METHOD BY JANBU, N., 1973

$$P_d = \frac{\gamma H - \gamma_w H_w}{m_w} \quad \& \quad P_e = \frac{\gamma H - \gamma_w' H_w'}{m_w'}$$

$$\text{FACTOR OF SAFETY} = \frac{P_e}{P_d} b \tan \phi$$

CASE # 1 - VERY RAPID DRAW DOWN (WORST CASE) 5/10

IT IS IMPORTANT TO NOTE THAT VERY RAPID DRAW DOWN IS AN UNLIKELY CASE BECAUSE THE FALLING LIMB OF THE FLOW HYDROGRAPH WOULD OCCUR OVER A RELATIVE LONG PERIOD OF TIME.

(THIS CASE REPRESENTS HORIZONTAL SEEPAGE FORCES)

$P_d = (137.5 \times 9) + (120 \times 3)$

$P_d = 1598$ psf

$P_e = \frac{(137.5 \times 9) + (120 \times 3)}{0.4} - (62.5 \times 9)$

$P_e = 1150$ psf

$F.S. = \frac{1150}{1598} \times 2 \times 0.731$

$F.S. = 1.1$

FOR WORST CASE FACTOR OF SAFETY IS GREATER THAT 1.0, THEREFORE SLOPE IS STABLE UNDER WORST CASE SCENARIO.

CASE #2 - RAPID DRAW DOWN TO 1/2 DEPTH OF FLOW (THIS CASE ALSO REPRESENTS HORIZONTAL SEEPAGE FORCES)

$P_d = 1598$ psf

$P_e = 1598 - 4.5(62.5) = 1317$ psf

$F.S. = \frac{1317}{1598} \times 2 \times 0.731$

$F.S. = 1.3$

THEREFORE DIKE STABILITY IS SATISFACTORY FOR 1/2 DEPTH OF FLOW.

CASE #3 - VERTICAL SEISMIC FORCES; THEREFORE NOT CONTRIBUTING SIGNIFICANTLY TO STABILITY ANALYZED AS NON SATURATED CONDITION.

$$F.S. = \frac{1598}{1593} \times 2 \times 0.781$$

$$F.S. = 1.6$$

THEREFORE SLOPE IS STABLE UNDER ALL CONDITIONS WITH PRACTICAL SAFETY FACTOR OF 1.6

SETTLEMENT OF DIKE

$\Delta = qB(1-\mu^2) \times F/E$, FOR SAND GRAVEL $E = 7000$ PSI
$\mu = 0.4$
$F \approx 2.0$

$q = 12 \times 130/144 = 11$ PSI

$B = 10' + 24' = 34' = 408''$

$\Delta = 11 \times 408 \times 0.84 \times 2/7000 = 1.08$ INCH

SETTLEMENT OF APPROXIMATELY 1" WILL OCCUR DURING CONSTRUCTION.

DIKE CONSTRUCTION

THE DIKE SHOULD BE CONSTRUCTED SO THAT THE MINIMUM DENSITY ACHIEVED IS 95% OF D698 MAXIMUM DENSITY.

FIELD INVESTIGATION:

A FIELD INSPECTION WAS MADE IN APRIL 1989, SUBSOILS AND SOILS FOR FILL AND RIP RAP WERE LOOKED AT ON SITE, CAT TRENCHES HAD BEEN DUG IN SUBSOILS IN THE AREA OF THE DIKE. SOIL FOR FILL WAS IN PILES ALL OVER THE SITE, (ALL SOIL SAME) WE TOOK A SAMPLE OF REPRESENTATIVE SUB SOIL. ALSO PHOTOS OF THE SITE WERE TAKEN (ATTACHED).

A SIEVE ANALYSIS AND ATTERBURG LIMITS WERE DONE ON THE SAMPLE.

THE SOIL IS A GRAVELLEY SAND WITH SILT (SW). THERE ARE AMPLE AMOUNT OF BOULDERS AND COBBLES MIXED IN SAND WHICH CAN BE USED AS RIP RAP.

THE SOIL ON SITE IS ACCEPTABLE FOR FILL IN THE CHANNEL DIKE,

DAVID M. NIESE, P.E.
Civil & Structural Engineering

KNOCHEL BRO.

DATE 6-29-89 PAGE 7 of

FILTER BLANKET.

THE GRADATION OF THE NATURAL SOIL ON SITE TO BE USED AS FILL FOR THE LEVEE (DIKE) IS SUCH THAT IT MEETS FILTER CRITERIA FOR THE RIP RAP BLANKET.

WE TOOK A SAMPLE OF SOIL OUT BY THE CHANNEL AREA AND RAN A SIEVE ANALYSIS. (SEE RESULTS OF SIEVE ATTACHED)

RIP RAP

D	% PASS
3'	100
2'	80
1.5'	65
1'	45
9"	30
6"	20
2"	15
0.5"	5

SMALLER 50% OF RIP RAP to SATISFY GRADING OF FILTER.

FILTER / SOIL

$D_{15} = 0.7$ MM

$D_{50} = 3.5$ MM

$D_{85} = 60$ MM

RIP RAP ADJUSTED

$D_{85} = 300$ MM

$D_{50} = 180$ MM

$D_{15} = 25$ MM

$$\frac{D_{15}(RR)}{D_{85}(FIL)} < 5) = \frac{75}{60} = 1.25$$

$$\frac{D_{15}\ RIP}{D_{15}\ FIL} < 40 = \frac{25}{0.7} = 36$$

∴ NATURAL SOIL ACTS AS FILTER FOR RIP RAP.

MATERIALS TESTING REPORT

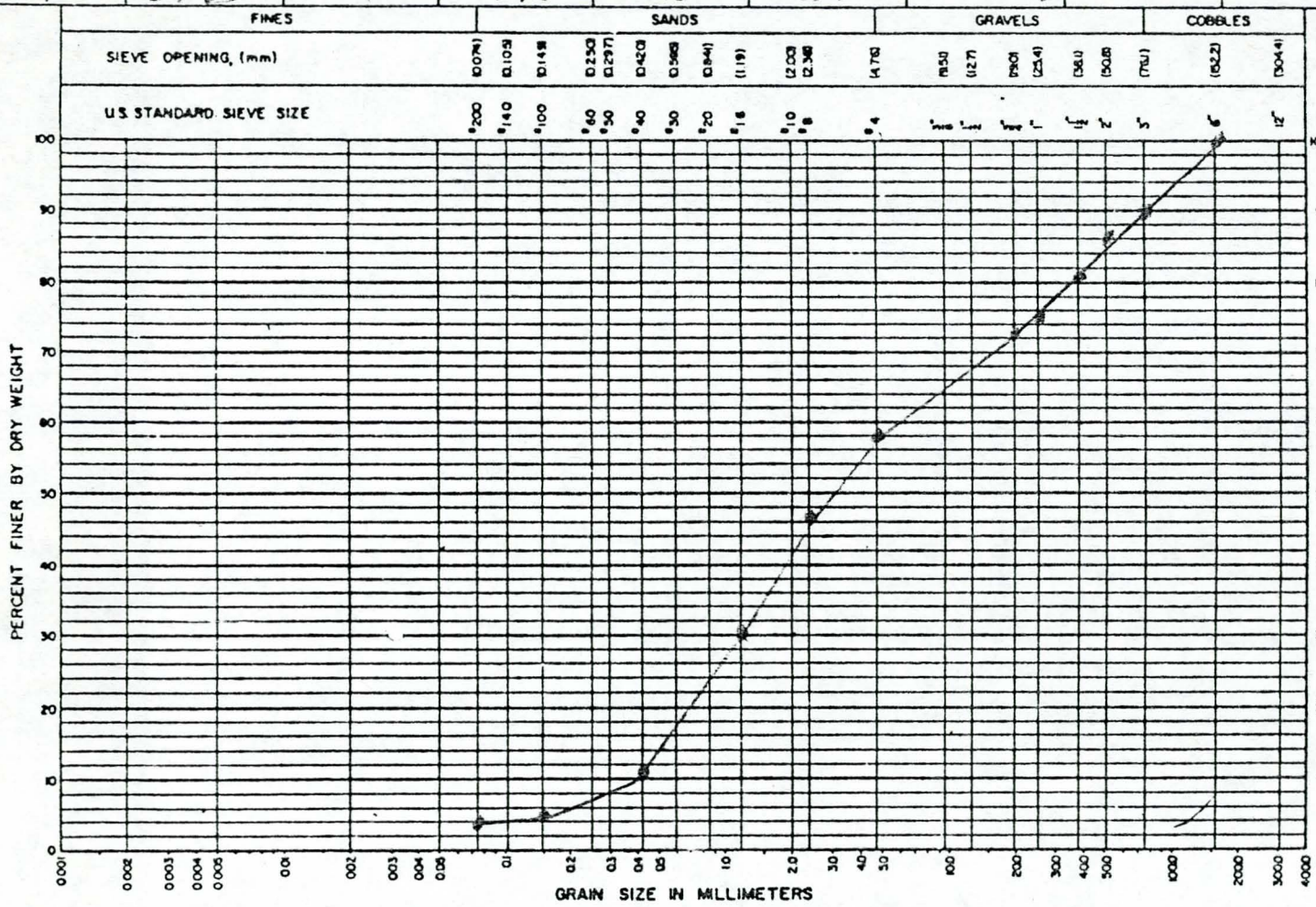
SOIL CLASSIFICATION

PROJECT and STATE	KNOCKER [illegible]
FIELD SAMPLE NO.	12
DEPTH	
GEOLOGIC ORIGIN	ALLUVIAL
SAMPLE LOCATION	[illegible] BANK
TYPE OF SAMPLE	BULK
TESTED AT	DEV FIELD
APPROVED BY	DN
DATE	5-9-69
SYMBOL	GW
DESCRIPTION	NATIVE SUBSOIL NATIVE STRUCTURE BANK, CFILTER

LABORATORY NO.

GRAIN SIZE DISTRIBUTION

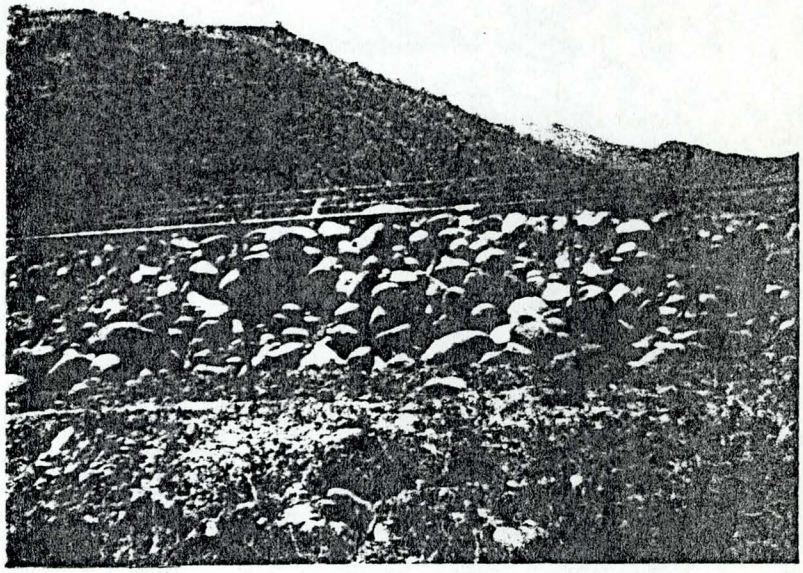
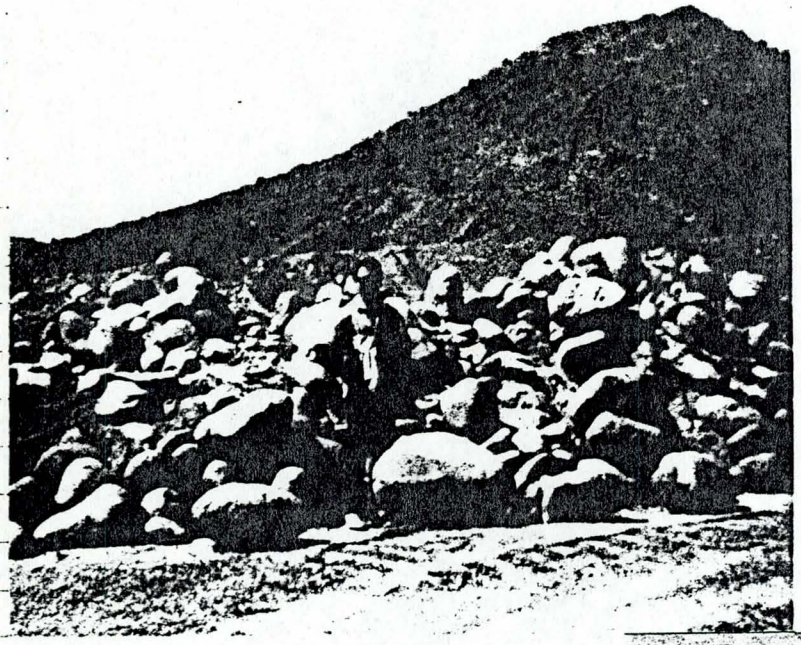
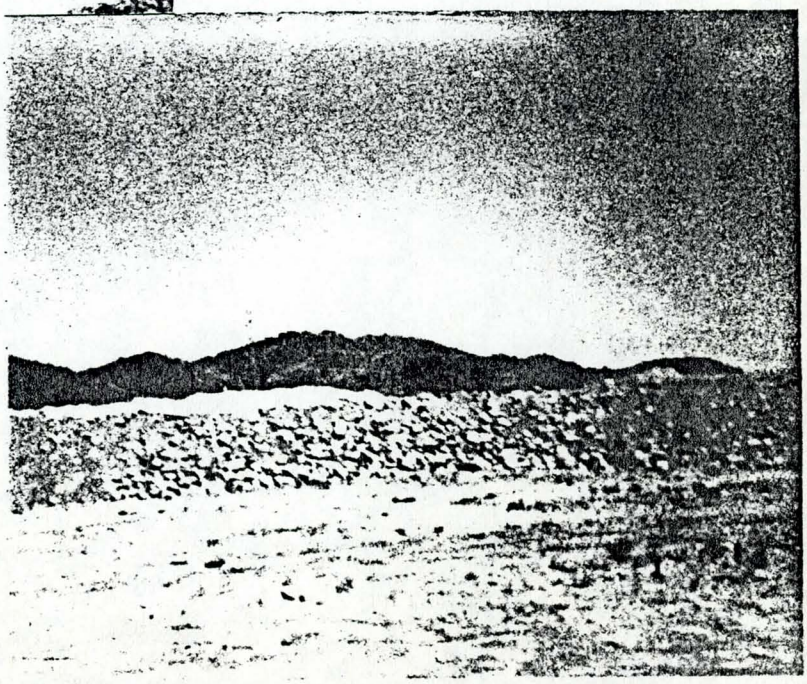
D_{10}	D_{15}	D_{30}	D_{50}	D_{60}	D_{85}	$D_{MAX.}$	C_u	C_c
0.4	3.6	1.2	3.5	6.0	65	150.0		



SPECIFIC GRAVITY (G_s)		ATTERBERG LIMITS						SOLUBLE SALTS	SHRINKAGE LIMIT	UNDISTURBED CONDITION	
		NATURAL MOISTURE		AIR DRY		OVEN DRY				MOISTURE	DRY UNIT WEIGHT
(-) #4	(+) #4	LL	PI	LL	PI	LL	PI				g/cc
	2.7						NP	%	%	%	pcf

REMARKS:

TYPICAL SUBSOIL TO BE USED FOR LEVEE FILL

9/13

KNOCHEL BROS LANDFILL
SITE PHOTOS OF AVAILABLE
RIP RAP ON ONSITE NATIVE
SOIL.