APPENDIX A

HYDROLOGIC CALCULATIONS

HYDROLOGIC CALCULATIONS

Hydrologic analyses were conducted to determine peak discharges from a 100-year and a 500-year storm event for the Beartrap Creek, Mike Horse Creek, and Upper Blackfoot River drainages. Preliminary peak flow estimates were calculated using methods provided in WRI 92-4048 (Omang, 1992). Using the regression equation for the Northwest Region of Montana, a mean annual precipitation of 18 inches (NOAA Rogers Pass weather station), and drainage basin areas, peak flows for each drainage area were calculated. Based upon the USGS regression equation, the estimated peak flows are:

			500-Year Peak Flow (cfs)
Beartrap Creek	2.02	277.7	575
Mike Horse Creek	0.41	85.3	197.5
Upper Blackfoot River	9.9	900.2	1667.9

The Beartrap Creek Analysis applies to both the portion of Beartrap to be re-established through the Mike Horse Tailings Impoundment area, and the portion of the Creek between the impoundment and the confluence with Anaconda Creek.

An analysis was also conducted to determine preliminary estimates of floodplain dimensions for the portions of Beartrap Creek and Mike Horse Creek drainages included in the EE/CA (A similar analysis will be performed for the Upper Blackfoot River once a detailed topographic survey is completed). Depth-Duration Factors, which define the distribution of precipitation as a function of time, were obtained from WRI-97-4004 (Parrett, 1997). Once the magnitude and distribution of the 100-year and 500-year storm events with respect to time were determined, the timing and volume of resulting runoff could be determined using the HEC-1 rainfall-runoff model (Corps of Engineers, 1988). In addition to the precipitation hyetograph, new information used in conjunction with the HEC-1 model included:

- Soil-Cover Complex Curve Number of 84;
- Time of Concentration of 0.38 hours (USGS, 1996); and
- Basin Storage Coefficient of 3.27 hours (USGS, 1996).

Using the Clark Unit Hydrograph, the peak flow from the 100-yr storm is 281 cubic-feet-per-second (cfs), and the peak flow from the 500-yr storm is 486 cfs. These are similar to the results obtained using the USGS regression equation in WRI 92-4048. HEC-1 also provided estimates of flow depths, which were used to estimate the floodplain widths for both the 100-year and 500-year storm. Floodplain widths for Beartrap Creek ranged from approximately 45 feet to 25 feet, and a value of 30 feet was used in the EE/CA preliminary design.

Hydraulic calculations were also performed to determine average riprap sizes required for stream channel design for portions of Beartrap Creek and Lower Mike Horse Creek for certain removal action options (engineered channel with riprap is not proposed for the Upper

Blackfoot River). Using Flowmaster® software and assuming a roughness coefficient of 0.040, channel depths between 1 and 4 feet, depending on bottom width, flow velocities were determined for the 100-year and 500-year storms (Haestad Methods, 1994). Typical channel dimensions, velocities and average riprap dimensions are shown in the following table. More detailed analyses of channel design and riprap sizing will be completed during final design of the selected site-wide alternative.

				Avg. Riprap Size (in)*
Beartrap Creek	8	2.5-3.5	7.2-8.7	6-8
Lower Mike Horse Creek	5	1.1-1.7	9.3-11.7	8-12
Upper Blackfoot River	15	3.6-4.9	9.6-11.4	8-12

*Source: Federal Highway Administration (FHWA) 1967, Nomograph for determining the stone size based on velocity and side slope from Richardson and Julien, 1990.

References

Corps of Engineers, 1988. HEC-1 Flood Hydrograph Package.

Haestad Methods, 1994. Flowmaster Open Channel and Pipe Hydraulic Analysis Software version 5.13, Waterbury, CT.

Omang, R.J., 1992. Analysis of the Magnitude and Frequency of Floods and the Peak-Flow Gaging Network in Montana, USGS WRI-92-4048.

Parrett, C., 1997. Regression Equations For Mean Values Of Annual Precipitation Maxima Region 1, USGS WRI-97-4004.

Richardson, E.V., D.B. Simons, and P.Y. Julien, 1990. Highways in the River Environment, Federal Highway Administration.

U.S.G.S., 1996. Estimation of Unit Hydrographs For Large Floods at Ungaged Sites in Montana.

ESTIMATE OF PEAK FLOW FOR BEAR TRAP CREEK

REGIONAL FLOOD -FREQUENCY EQUATIONS BASED ON DRAINAGE-BASIN CHARACTERISTICS*

$Q_{100} = 38.9*A^{0.74}*P^{0.50}$ Northwest Region

$Q_{500} = 87.1*A^{0.67}*P^{0.49}$ Northwest Region

A = DRAINAGE AREA (mi^2)
P = MEAN ANNUAL PRECIPITATION (in)

A =	1.979	mi^2	
P =	18	in	FROM NOAA ROGERS PASS INFORMATION
Q_{100} =	273.5	cfs	
Q_{500} =	567.2	cfs	

*Omang, R.J., 1992, Analysis of the Magnitude and Frequency of Floods and the Peak-Flow Gaging Network in Montana, USGS WRI-92-4048.

ESTIMATE OF PEAK FLOW FOR MIKE HORSE CREEK

REGIONAL FLOOD -FREQUENCY EQUATIONS BASED ON DRAINAGE-BASIN CHARACTERISTICS*

$Q_{100} = 38.9*A^{0.74}*P^{0.50}$ Northwest Region

$Q_{500} = 87.1*A^{0.67}*P^{0.49}$ Northwest Region

A = DRAINAGE AREA (mi^2)
P = MEAN ANNUAL PRECIPITATION (in)

A =	0.41	mi^2	
P =	18	in	FROM NOAA ROGERS PASS INFORMATION
Q_{100} =	85.3	cfs	
Q_{500} =	197.5	cfs	

*Omang, R.J., 1992, Analysis of the Magnitude and Frequency of Floods and the Peak-Flow Gaging Network in Montana, USGS WRI-92-4048.

ESTIMATE OF PEAK FLOW FOR UPPER BLACKFOOT RIVER

REGIONAL FLOOD -FREQUENCY EQUATIONS BASED ON DRAINAGE-BASIN CHARACTERISTICS*

$Q_{100} = 38.9*A^{0.74}*P^{0.50}$ Northwest Region

$Q_{500} = 87.1*A^{0.67}*P^{0.49}$ Northwest Region

A = DRAINAGE AREA (mi^2)
P = MEAN ANNUAL PRECIPITATION (in)

A =	9.9	mi^2	
P =	18	in	FROM NOAA ROGERS PASS INFORMATION
Q_{100} =	900.2	cfs	
Q_{500} =	1667.9	cfs	

*Omang, R.J., 1992, Analysis of the Magnitude and Frequency of Floods and the Peak-Flow Gaging Network in Montana, USGS WRI-92-4048.

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 *                                      *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
 *             JUN   1998               *
 *           VERSION 4.1                *
 *                                      *
 *  RUN DATE   05JUN06  TIME  09:57:16  *
 *                                      *
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*                                      *
*   U.S. ARMY CORPS OF ENGINEERS       *
*   HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET            *
*      DAVIS, CALIFORNIA 95616         *
*          (916) 756-1104              *
*                                      *
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X     X  XXXXXXX   XXXXX          X
X     X  X       X     X        XX
X     X  X       X               X
XXXXXXX  XXXX     X        XXXXX  X
X     X  X       X               X
X     X  X       X     X         X
X     X  XXXXXXX   XXXXX         XXX
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THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1

HEC-1 INPUT PAGE 1

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LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

   1          ID   BEAR TRAP CREEK
   2          ID   100 YEAR FLOODPLAIN ASSESMENT
   3          ID   ROUTING USING HEC-1
   4          ID   M. RHODES, HYDROMETICS INC.
   5          ID   13 MAR06
              *
              * *** TIME SPECIFICATION
   6          IT       2 08APR03    1200     300
              *
              * *** GLOBAL OUTPUT OPTIONS
   7          IO       4
              *
              * *** 100 YR HYETOGRAPH
              *

   8          KK  P 100
   9          KM   PRECIP
  10          BA    1.98
  11          PH            0.00   0.23   0.78    1.38    1.59    1.88    2.21    2.86    3.60
              *
              * *** INFLOW TO CREEK
              * *** CLARK'S UNIT HYDROGRAPH
              *
  12          UC    0.33    2.88
  13          LS       0      84
              *
              * ***
              *

  14          KK  REACH1
  15          KM   BEAR TRAP CREEK BEGIN TO 25+00 FEET DOWNSTREAM
  16          RD
```

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 17          RC    0.08    0.07    0.08  2500.0    .208
 18          RX     0.0   100.0   200.0     203     205     300     400     500
 19          RY    6360    6340    6300    6298    6300    6315    6325    6370
             *
             * ***
             *

 20          KK  REACH2
 21          KM   CHANNEL ROUTING 25+00 TO 40+00
 22          RD
 23          RC    0.08    0.07    0.08    1500    .133
 24          RX     0.0     100     200     280     283     286     300     400
 25          RY    5720    5680    5620    5600    5597    5600    5610    5700
             *
             * ***
             *

 26          KK  REACH3
 27          KM   CHANNEL ROUTING 40+00 TO 59+00
 28          RD
 29          RC    0.08    0.07    0.08    1900    .060
 30          RX     0.0    40.0    44.0    48.0    60.0     120     140     160
 31          RY    5494    5486    5483    5486    5488    5489    5490    5491
             *
             * ***
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1                                        HEC-1 INPUT                                                    PAGE  2

LINE         ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 32          KK  REACH4
 33          KM   CHANNEL ROUTING 59+00 TO 68+00
 34          RD
 35          RC    0.08    0.07    0.08     900    .030
 36          RX     0.0    40.0    80.0     120     138     140     200     320
 37          RY    5467    5460    5453    5449    5443    5441    5465    5500
             *
             * ***
             *

 38          KK  REACH5
 39          KM   CHANNEL ROUTING 68+00 TO 78+00
 40          RD
 41          RC    0.08    0.07    0.08    1000    .030
 42          RX     0.0    40.0    80.0     136     140     144     180     240
 43          RY    5432    5429    5425    5422    5419    5422    5437    5460
             *
             * ***
             *

 44          KK  REACH6
 45          KM   CHANNEL ROUTING 78+00 TO 92+00
 46          RD
 47          RC    0.08    0.07    0.08    1400    .030
 48          RX     0.0    20.0    37.0    40.0    44.0      64     100     120
 49          RY    5416    5412    5410    5408    5409    5410    5412    5414
             *
             * ***
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 50          ZZ
1*****************************************
 *                                       *
 *   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
 *              JUN   1998               *
 *           VERSION 4.1                 *
 *                                       *
 *  RUN DATE   05JUN06  TIME  09:57:16   *
 *                                       *
 *****************************************

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*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
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                    BEAR TRAP CREEK
                    100 YEAR FLOODPLAIN ASSESMENT
                    ROUTING USING HEC-1
                    M. RHODES, HYDROMETICS INC.
                    13 MAR06

  7 IO        OUTPUT CONTROL VARIABLES
                IPRNT          4  PRINT CONTROL
                IPLOT          0  PLOT CONTROL
                QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT        HYDROGRAPH TIME DATA
                 NMIN          2  MINUTES IN COMPUTATION INTERVAL
                IDATE     8APR 3  STARTING DATE
                ITIME       1200  STARTING TIME
                   NQ        300  NUMBER OF HYDROGRAPH ORDINATES
               NDDATE     8APR 3  ENDING DATE
               NDTIME       2158  ENDING TIME
               ICENT          19  CENTURY MARK

            COMPUTATION INTERVAL     .03 HOURS
                 TOTAL TIME BASE    9.97 HOURS

        ENGLISH UNITS
            DRAINAGE AREA          SQUARE MILES
            PRECIPITATION DEPTH    INCHES
            LENGTH, ELEVATION      FEET
            FLOW                   CUBIC FEET PER SECOND
            STORAGE VOLUME         ACRE-FEET
            SURFACE AREA           ACRES
            TEMPERATURE            DEGREES FAHRENHEIT


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


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          *            *
  8 KK    *    P 100   *
          *            *
          **************
                    PRECIP

            SUBBASIN RUNOFF DATA

 10 BA        SUBBASIN CHARACTERISTICS
                TAREA        1.98  SUBBASIN AREA

              PRECIPITATION DATA

 11 PH                                DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
              ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
              5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
                .23     .78    1.38    1.59    1.88    2.21    2.86    3.60     .00     .00     .00     .00

                                                STORM AREA =    1.98

 13 LS        SCS LOSS RATE
                STRTL         .38  INITIAL ABSTRACTION
               CRVNBR       84.00  CURVE NUMBER
                RTIMP         .00  PERCENT IMPERVIOUS AREA

 12 UC        CLARK UNITGRAPH
                  TC         .33  TIME OF CONCENTRATION
```

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                R        2.88  STORAGE COEFFICIENT

        SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                    ***

                                        UNIT HYDROGRAPH PARAMETERS
                                  CLARK   TC=   .33 HR,       R=  2.88 HR
                                 SNYDER   TP=   .35 HR,      CP=   .11

                                            UNIT HYDROGRAPH
                                      300 END-OF-PERIOD ORDINATES
                                              VOLUME =  .97
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10.	38.	80.	131.	189.	250.	307.	354.	391.	412.
416.	411.	407.	402.	397.	393.	388.	384.	379.	375.
371.	366.	362.	358.	354.	350.	346.	342.	338.	334.
330.	326.	323.	319.	315.	312.	308.	305.	301.	298.
294.	291.	287.	284.	281.	278.	274.	271.	268.	265.
262.	259.	256.	253.	250.	247.	244.	242.	239.	236.
233.	231.	228.	225.	223.	220.	218.	215.	213.	210.
208.	205.	203.	201.	198.	196.	194.	192.	189.	187.
185.	183.	181.	179.	177.	175.	173.	171.	169.	167.
165.	163.	161.	159.	157.	156.	154.	152.	150.	149.
147.	145.	144.	142.	140.	139.	137.	135.	134.	132.
131.	129.	128.	126.	125.	123.	122.	121.	119.	118.
117.	115.	114.	113.	111.	110.	109.	107.	106.	105.
104.	103.	101.	100.	99.	98.	97.	96.	95.	94.
92.	91.	90.	89.	88.	87.	86.	85.	84.	83.
82.	81.	80.	80.	79.	78.	77.	76.	75.	74.
73.	72.	72.	71.	70.	69.	68.	68.	67.	66.
65.	65.	64.	63.	62.	62.	61.	60.	60.	59.
58.	58.	57.	56.	56.	55.	54.	54.	53.	52.
52.	51.	51.	50.	49.	49.	48.	48.	47.	47.
46.	46.	45.	45.	44.	44.	43.	43.	42.	42.
41.	41.	40.	40.	39.	39.	38.	38.	37.	37.
37.	36.	36.	35.	35.	35.	34.	34.	33.	33.
33.	32.	32.	32.	31.	31.	30.	30.	30.	29.
29.	29.	28.	28.	28.	27.	27.	27.	26.	26.
26.	26.	25.	25.	25.	24.	24.	24.	24.	23.
23.	23.	23.	22.	22.	22.	22.	21.	21.	21.
21.	20.	20.	20.	20.	19.	19.	19.	19.	19.
18.	18.	18.	18.	17.	17.	17.	17.	17.	16.
16.	16.	16.	16.	16.	15.	15.	15.	15.	15.

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          *            *
 14 KK    *    REACH1  *
          *            *
          **************
                    BEAR TRAP CREEK BEGIN TO 25+00 FEET DOWNSTREAM

            HYDROGRAPH ROUTING DATA

 16 RD        MUSKINGUM-CUNGE CHANNEL ROUTING

 17 RC        NORMAL DEPTH CHANNEL
                    ANL        .080  LEFT OVERBANK N-VALUE
                   ANCH        .070  MAIN CHANNEL N-VALUE
                    ANR        .080  RIGHT OVERBANK N-VALUE
                  RLNTH       2500.  REACH LENGTH
                    SEL       .2080  ENERGY SLOPE
                  ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                  CROSS-SECTION DATA
                    --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
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19 RY        ELEVATION   6360.00   6340.00   6300.00   6298.00   6300.00   6315.00   6325.00   6370.00
18 RX        DISTANCE        .00    100.00    200.00    203.00    205.00    300.00    400.00    500.00

                                                    ***

                                  COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00      1.61      9.78     25.22     47.95     78.36    118.71    169.36    227.86    290.31
          OUTFLOW        .00    315.01   3345.21  11793.04  27751.13  55578.52  97983.77 155250.00 231008.70 323088.30
        ELEVATION    6298.00   6301.79   6305.58   6309.37   6313.16   6316.95   6320.74   6324.53   6328.32   6332.11

          STORAGE     356.64    426.87    501.85    582.78    669.67    762.50    861.29    965.19   1071.19   1179.02
          OUTFLOW  430883.10 554365.80 688479.60 840420.701011174.001201287.001411372.001655681.001927651.002219160.00
        ELEVATION    6335.90   6339.69   6343.47   6347.26   6351.05   6354.84   6358.63   6362.42   6366.21   6370.00


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          *            *
20 KK     *    REACH2  *
          *            *
          **************
                        CHANNEL ROUTING 25+00 TO 40+00

             HYDROGRAPH ROUTING DATA

22 RD          MUSKINGUM-CUNGE CHANNEL ROUTING

23 RC          NORMAL DEPTH CHANNEL
                      ANL        .080  LEFT OVERBANK N-VALUE
                     ANCH        .070  MAIN CHANNEL N-VALUE
                      ANR        .080  RIGHT OVERBANK N-VALUE
                    RLNTH       1500.  REACH LENGTH
                      SEL       .1330  ENERGY SLOPE
                    ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                  CROSS-SECTION DATA
                        --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
25 RY        ELEVATION   5720.00   5680.00   5620.00   5600.00   5597.00   5600.00   5610.00   5700.00
24 RX        DISTANCE        .00    100.00    200.00    280.00    283.00    286.00    300.00    400.00

                                                    ***

                                  COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00      2.15     11.56     28.57     52.61     81.18    113.75    150.33    190.93    235.53
          OUTFLOW        .00    816.31   7552.93  25360.65  60857.84 116845.60 190205.90 281548.50 391588.20 521092.70
        ELEVATION    5597.00   5603.47   5609.95   5616.42   5622.89   5629.37   5635.84   5642.32   5648.79   5655.26

          STORAGE     284.13    336.75    393.38    454.03    519.49    590.16    666.04    746.19    829.94    917.31
          OUTFLOW  670855.10 841680.401034376.001248901.001484287.001746382.002038086.002376225.002743994.003141973.00
        ELEVATION    5661.74   5668.21   5674.68   5681.16   5687.63   5694.10   5700.58   5707.05   5713.53   5720.00


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          *            *
26 KK     *    REACH3  *
          *            *
          **************
                        CHANNEL ROUTING 40+00 TO 59+00
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            HYDROGRAPH ROUTING DATA

 28 RD        MUSKINGUM-CUNGE CHANNEL ROUTING

 29 RC        NORMAL DEPTH CHANNEL
                  ANL        .080  LEFT OVERBANK N-VALUE
                 ANCH        .070  MAIN CHANNEL N-VALUE
                  ANR        .080  RIGHT OVERBANK N-VALUE
                RLNTH       1900.  REACH LENGTH
                  SEL       .0600  ENERGY SLOPE
                ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                      --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 31 RY      ELEVATION   5494.00   5486.00   5483.00   5486.00   5488.00   5489.00   5490.00   5491.00
 30 RX      DISTANCE        .00     40.00     44.00     48.00     60.00    120.00    140.00    160.00

                                                  ***

                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00       .02       .08       .18       .31       .49       .74      1.16      1.73      2.52
          OUTFLOW        .00       .82      5.23     15.43     33.24     60.26     89.40    148.05    244.05    336.75
        ELEVATION    5483.00   5483.58   5484.16   5484.74   5485.32   5485.90   5486.47   5487.05   5487.63   5488.21

          STORAGE       4.10      6.52      9.33     12.51     16.06     19.77     23.55     27.41     31.35     35.35
          OUTFLOW     533.61    987.80   1664.42   2530.10   3599.11   4895.64   6381.14   8047.70   9889.78  11903.82
        ELEVATION    5488.79   5489.37   5489.95   5490.53   5491.11   5491.69   5492.27   5492.84   5493.42   5494.00


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          *            *
 32 KK    *    REACH4  *
          *            *
          **************
                     CHANNEL ROUTING 59+00 TO 68+00

            HYDROGRAPH ROUTING DATA

 34 RD        MUSKINGUM-CUNGE CHANNEL ROUTING

 35 RC        NORMAL DEPTH CHANNEL
                  ANL        .080  LEFT OVERBANK N-VALUE
                 ANCH        .070  MAIN CHANNEL N-VALUE
                  ANR        .080  RIGHT OVERBANK N-VALUE
                RLNTH        900.  REACH LENGTH
                  SEL       .0300  ENERGY SLOPE
                ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                      --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 37 RY      ELEVATION   5467.00   5460.00   5453.00   5449.00   5443.00   5441.00   5465.00   5500.00
 36 RX      DISTANCE        .00     40.00     80.00    120.00    138.00    140.00    200.00    320.00

                                                  ***

                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00       .37      1.76      4.37      9.23     16.04     24.50     34.59     46.32     59.60
          OUTFLOW        .00     71.25    552.45   1708.35   4388.24   9776.03  17572.48  28027.92  41302.52  58171.38
        ELEVATION    5441.00   5444.11   5447.21   5450.32   5453.42   5456.53   5459.63   5462.74   5465.84   5468.95

          STORAGE      73.64     88.37    103.78    119.87    136.64    154.10    172.25    191.07    210.58    230.77
          OUTFLOW   78695.67 102452.20 129417.70 159593.10 192994.30 229647.30 269584.90 312844.90 359469.00 409508.10
        ELEVATION    5472.05   5475.16   5478.27   5481.37   5484.48   5487.58   5490.69   5493.79   5496.90   5500.00
```

```
*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

          **************
          *            *
 38 KK    *   REACH5   *
          *            *
          **************
                          CHANNEL ROUTING 68+00 TO 78+00

             HYDROGRAPH ROUTING DATA

 40 RD         MUSKINGUM-CUNGE CHANNEL ROUTING

 41 RC         NORMAL DEPTH CHANNEL
                     ANL        .080  LEFT OVERBANK N-VALUE
                    ANCH        .070  MAIN CHANNEL N-VALUE
                     ANR        .080  RIGHT OVERBANK N-VALUE
                   RLNTH       1000.  REACH LENGTH
                     SEL       .0300  ENERGY SLOPE
                   ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                        --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 43 RY       ELEVATION   5432.00   5429.00   5425.00   5422.00   5419.00   5422.00   5437.00   5460.00
 42 RX       DISTANCE        .00     40.00     80.00    136.00    140.00    144.00    180.00    240.00

                                                   ***

                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00       .14       .94      3.81      8.29     14.12     21.56     30.00     38.70     47.66
          OUTFLOW        .00     20.75    158.40   1023.51   3204.80   6647.74  11552.70  18530.17  27074.96  37077.04
        ELEVATION    5419.00   5421.16   5423.32   5425.47   5427.63   5429.79   5431.95   5434.10   5436.26   5438.42

          STORAGE      56.90     66.42     76.21     86.29     96.64    107.28    118.19    129.38    140.85    152.60
          OUTFLOW   48498.60  61315.91  75508.02  91061.41 107967.80 126222.90 145825.30 166775.80 189077.20 212733.70
        ELEVATION    5440.58   5442.73   5444.89   5447.05   5449.21   5451.37   5453.52   5455.68   5457.84   5460.00


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

          **************
          *            *
 44 KK    *   REACH6   *
          *            *
          **************
                          CHANNEL ROUTING 78+00 TO 92+00

             HYDROGRAPH ROUTING DATA

 46 RD         MUSKINGUM-CUNGE CHANNEL ROUTING

 47 RC         NORMAL DEPTH CHANNEL
                     ANL        .080  LEFT OVERBANK N-VALUE
                    ANCH        .070  MAIN CHANNEL N-VALUE
                     ANR        .080  RIGHT OVERBANK N-VALUE
                   RLNTH       1400.  REACH LENGTH
                     SEL       .0300  ENERGY SLOPE
                   ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                        --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
```

49 RY	ELEVATION	5416.00	5412.00	5410.00	5408.00	5409.00	5410.00	5412.00	5414.00
48 RX	DISTANCE	.00	20.00	37.00	40.00	44.00	64.00	100.00	120.00

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	.00	.02	.06	.16	.37	.71	1.18	1.81	2.59	3.52
OUTFLOW	.00	.60	3.84	10.26	28.66	68.60	142.66	248.36	390.70	574.16
ELEVATION	5408.00	5408.42	5408.84	5409.26	5409.68	5410.10	5410.53	5410.95	5411.37	5411.79
STORAGE	4.60	5.76	7.02	8.36	9.78	11.27	12.80	14.35	15.93	17.54
OUTFLOW	807.73	1092.07	1422.43	1799.82	2225.43	2727.41	3288.49	3898.57	4556.88	5262.85
ELEVATION	5412.21	5412.63	5413.05	5413.47	5413.89	5414.31	5414.73	5415.16	5415.58	5416.00

1

RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	P 100	281.	5.70	184.	111.	111.	1.98		
+	ROUTED TO	REACH1	281.	5.77	182.	110.	110.	1.98		
+	ROUTED TO	REACH2	281.	5.80	181.	109.	109.	1.98		
+	ROUTED TO	REACH3	281.	5.87	179.	108.	108.	1.98		
+	ROUTED TO	REACH4	281.	5.93	177.	106.	106.	1.98		
+	ROUTED TO	REACH5	281.	6.00	174.	105.	105.	1.98		
+	ROUTED TO	REACH6	281.	6.07	171.	103.	103.	1.98		

1

SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)	INTERPOLATED TO COMPUTATION INTERVAL DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)
REACH1	MANE	2.00	280.70	346.00	.86	2.00	280.70	346.00	.86

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9140E+02 EXCESS= .0000E+00 OUTFLOW= .9060E+02 BASIN STORAGE= .8307E+00 PERCENT ERROR= .0

REACH2	MANE	1.94	280.70	347.92	.85	2.00	280.70	348.00	.85

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9031E+02 EXCESS= .0000E+00 OUTFLOW= .8987E+02 BASIN STORAGE= .4308E+00 PERCENT ERROR= .0

REACH3	MANE	2.00	280.66	352.00	.84	2.00	280.66	352.00	.84

CONTINUITY SUMMARY (AC-FT) - INFLOW= .9017E+02 EXCESS= .0000E+00 OUTFLOW= .8885E+02 BASIN STORAGE= .1256E+01 PERCENT ERROR= .1

```
          REACH4  MANE        2.00    280.66    356.00       .83      2.00    280.66    356.00         .83

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8885E+02 EXCESS= .0000E+00 OUTFLOW= .8785E+02 BASIN STORAGE= .6467E+00 PERCENT ERROR=    .4

          REACH5  MANE        2.00    280.64    360.00       .82      2.00    280.64    360.00         .82

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8785E+02 EXCESS= .0000E+00 OUTFLOW= .8674E+02 BASIN STORAGE= .9646E+00 PERCENT ERROR=    .2

          REACH6  MANE        2.00    280.63    364.00       .81      2.00    280.63    364.00         .81

CONTINUITY SUMMARY (AC-FT) - INFLOW= .8674E+02 EXCESS= .0000E+00 OUTFLOW= .8525E+02 BASIN STORAGE= .1339E+01 PERCENT ERROR=    .2


*** NORMAL END OF HEC-1 ***
```

```
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*              JUN   1998              *
*            VERSION 4.1               *
*                                      *
*  RUN DATE   05JUN06  TIME  09:57:36  *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
****************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X               X
XXXXXXX  XXXX     X       XXXXX   X
X     X  X        X               X
X     X  X        X     X         X
X     X  XXXXXXX   XXXXX         XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM

1

HEC-1 INPUT PAGE 1

```
LINE          ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

  1           ID   BEAR TRAP CREEK
  2           ID   500 YEAR FLOODPLAIN ASSESMENT
  3           ID   ROUTING USING HEC-1
  4           ID   M. RHODES, HYDROMETICS INC.
  5           ID   13 MAR06
              *
              * *** TIME SPECIFICATION
  6           IT       2 08APR03    1200     300
              *
              * *** GLOBAL OUTPUT OPTIONS
  7           IO       4
              *
              * *** 500 YR HYETOGRAPH
              *

  8           KK  P 500
  9           KM   PRECIP
 10           BA    1.98
 11           PH            0.00   0.33   1.12    1.97    2.23    2.58    2.99    3.82    4.76
              *
              * *** INFLOW TO CREEK
              * *** CLARK'S UNIT HYDROGRAPH
              *
 12           UC    0.33    2.88
 13           LS       0      84
```

```
                *
                * ***
                *

 14             KK  REACH1
 15             KM   BEAR TRAP CREEK BEGIN TO 25+00 FEET DOWNSTREAM
 16             RD
 17             RC    0.08    0.07    0.08  2500.0    .208
 18             RX     0.0   100.0   200.0     203     205     300     400     500
 19             RY    6360    6340    6300    6298    6300    6315    6325    6370
                *
                * ***
                *

 20             KK  REACH2
 21             KM   CHANNEL ROUTING 25+00 TO 40+00
 22             RD
 23             RC    0.08    0.07    0.08    1500    .133
 24             RX     0.0     100     200     280     283     286     300     400
 25             RY    5720    5680    5620    5600    5597    5600    5610    5700
                *
                * ***
                *

 26             KK  REACH3
 27             KM   CHANNEL ROUTING 40+00 TO 59+00
 28             RD
 29             RC    0.08    0.07    0.08    1900    .060
 30             RX     0.0    40.0    44.0    48.0    60.0     120     140     160
 31             RY    5494    5486    5483    5486    5488    5489    5490    5491
                *
                * ***
                *
```



```
LINE            ID.......1.......2.......3.......4.......5.......6.......7.......8.......9......10

 32             KK  REACH4
 33             KM   CHANNEL ROUTING 59+00 TO 68+00
 34             RD
 35             RC    0.08    0.07    0.08     900    .030
 36             RX     0.0    40.0    80.0     120     138     140     200     320
 37             RY    5467    5460    5453    5449    5443    5441    5465    5500
                *
                * ***
                *

 38             KK  REACH5
 39             KM   CHANNEL ROUTING 68+00 TO 78+00
 40             RD
 41             RC    0.08    0.07    0.08    1000   .030
 42             RX     0.0    40.0    80.0     136     140     144     180     240
 43             RY    5432    5429    5425    5422    5419    5422    5437    5460
                *
                * ***
                *

 44             KK  REACH6
 45             KM   CHANNEL ROUTING 78+00 TO 92+00
 46             RD
 47             RC    0.08    0.07    0.08    1400    .030
 48             RX     0.0    20.0    37.0    40.0    44.0      64     100     120
```

```
          49          RY    5416    5412    5410    5408    5409    5410    5412    5414
                      *
                      * ***
                      *
          50          ZZ
1****************************************
*                                      *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)  *
*             JUN   1998               *
*          VERSION 4.1                 *
*                                      *
*  RUN DATE   05JUN06  TIME  09:57:36  *
*                                      *
****************************************
```

```
****************************************
*                                      *
*    U.S. ARMY CORPS OF ENGINEERS      *
*    HYDROLOGIC ENGINEERING CENTER     *
*          609 SECOND STREET           *
*       DAVIS, CALIFORNIA 95616        *
*           (916) 756-1104             *
*                                      *
****************************************
```

```
                        BEAR TRAP CREEK
                        500 YEAR FLOODPLAIN ASSESMENT
                        ROUTING USING HEC-1
                        M. RHODES, HYDROMETICS INC.
                        13 MAR06

  7 IO          OUTPUT CONTROL VARIABLES
                      IPRNT           4  PRINT CONTROL
                      IPLOT           0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                       NMIN           2  MINUTES IN COMPUTATION INTERVAL
                      IDATE      8APR 3  STARTING DATE
                      ITIME        1200  STARTING TIME
                         NQ         300  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      8APR 3  ENDING DATE
                     NDTIME        2158  ENDING TIME
                     ICENT          19  CENTURY MARK

                 COMPUTATION INTERVAL     .03 HOURS
                      TOTAL TIME BASE    9.97 HOURS

         ENGLISH UNITS
              DRAINAGE AREA          SQUARE MILES
              PRECIPITATION DEPTH    INCHES
              LENGTH, ELEVATION      FEET
              FLOW                   CUBIC FEET PER SECOND
              STORAGE VOLUME         ACRE-FEET
              SURFACE AREA           ACRES
              TEMPERATURE            DEGREES FAHRENHEIT


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

           **************
           *            *
  8 KK     *    P 500   *
           *            *
           **************
                        PRECIP.
```

```
          SUBBASIN RUNOFF DATA

10 BA       SUBBASIN CHARACTERISTICS
                TAREA          1.98  SUBBASIN AREA

            PRECIPITATION DATA

11 PH                          DEPTHS FOR   0-PERCENT HYPOTHETICAL STORM
            ..... HYDRO-35 ......   ............... TP-40 ...............   ........... TP-49 ...........
            5-MIN  15-MIN  60-MIN    2-HR    3-HR    6-HR   12-HR   24-HR   2-DAY   4-DAY   7-DAY  10-DAY
              .33    1.12    1.97    2.23    2.58    2.99    3.82    4.76     .00     .00     .00     .00

                                          STORM AREA =    1.98

13 LS       SCS LOSS RATE
                STRTL           .38  INITIAL ABSTRACTION
               CRVNBR         84.00  CURVE NUMBER
                RTIMP           .00  PERCENT IMPERVIOUS AREA

12 UC       CLARK UNITGRAPH
                  TC           .33  TIME OF CONCENTRATION
                   R          2.88  STORAGE COEFFICIENT

            SYNTHETIC ACCUMULATED-AREA VS. TIME CURVE WILL BE USED

                                                   ***

                                      UNIT HYDROGRAPH PARAMETERS
                                CLARK   TC=   .33 HR,       R=  2.88 HR
                               SNYDER   TP=   .35 HR,      CP=   .11

                                          UNIT HYDROGRAPH
                                     300 END-OF-PERIOD ORDINATES
                                           VOLUME =  .97
```

10.	38.	80.	131.	189.	250.	307.	354.	391.	412.
416.	411.	407.	402.	397.	393.	388.	384.	379.	375.
371.	366.	362.	358.	354.	350.	346.	342.	338.	334.
330.	326.	323.	319.	315.	312.	308.	305.	301.	298.
294.	291.	287.	284.	281.	278.	274.	271.	268.	265.
262.	259.	256.	253.	250.	247.	244.	242.	239.	236.
233.	231.	228.	225.	223.	220.	218.	215.	213.	210.
208.	205.	203.	201.	198.	196.	194.	192.	189.	187.
185.	183.	181.	179.	177.	175.	173.	171.	169.	167.
165.	163.	161.	159.	157.	156.	154.	152.	150.	149.
147.	145.	144.	142.	140.	139.	137.	135.	134.	132.
131.	129.	128.	126.	125.	123.	122.	121.	119.	118.
117.	115.	114.	113.	111.	110.	109.	107.	106.	105.
104.	103.	101.	100.	99.	98.	97.	96.	95.	94.
92.	91.	90.	89.	88.	87.	86.	85.	84.	83.
82.	81.	80.	80.	79.	78.	77.	76.	75.	74.
73.	72.	72.	71.	70.	69.	68.	68.	67.	66.
65.	65.	64.	63.	62.	62.	61.	60.	60.	59.
58.	58.	57.	56.	56.	55.	54.	54.	53.	52.
52.	51.	51.	50.	49.	49.	48.	48.	47.	47.
46.	46.	45.	45.	44.	44.	43.	43.	42.	42.
41.	41.	40.	40.	39.	39.	38.	38.	37.	37.
37.	36.	36.	35.	35.	35.	34.	34.	33.	33.
33.	32.	32.	32.	31.	31.	30.	30.	30.	29.
29.	29.	28.	28.	28.	27.	27.	27.	26.	26.
26.	26.	25.	25.	25.	24.	24.	24.	24.	23.
23.	23.	23.	22.	22.	22.	22.	21.	21.	21.
21.	20.	20.	20.	20.	19.	19.	19.	19.	19.
18.	18.	18.	18.	17.	17.	17.	17.	17.	16.

```
            16.       16.       16.       16.       16.       15.       15.       15.       15.       15.

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

            **************
            *            *
 14 KK      *   REACH1   *
            *            *
            **************
                          BEAR TRAP CREEK BEGIN TO 25+00 FEET DOWNSTREAM

               HYDROGRAPH ROUTING DATA

 16 RD            MUSKINGUM-CUNGE CHANNEL ROUTING

 17 RC            NORMAL DEPTH CHANNEL
                        ANL        .080  LEFT OVERBANK N-VALUE
                       ANCH        .070  MAIN CHANNEL N-VALUE
                        ANR        .080  RIGHT OVERBANK N-VALUE
                      RLNTH       2500.  REACH LENGTH
                        SEL       .2080  ENERGY SLOPE
                      ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                          --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 19 RY          ELEVATION   6360.00   6340.00   6300.00   6298.00   6300.00   6315.00   6325.00   6370.00
 18 RX          DISTANCE        .00    100.00    200.00    203.00    205.00    300.00    400.00    500.00
                                                                  ***

                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

            STORAGE        .00      1.61      9.78     25.22     47.95     78.36    118.71    169.36    227.86    290.31
            OUTFLOW        .00    315.01   3345.21  11793.04  27751.13  55578.52  97983.77 155250.00 231008.70 323088.30
          ELEVATION    6298.00   6301.79   6305.58   6309.37   6313.16   6316.95   6320.74   6324.53   6328.32   6332.11

            STORAGE     356.64    426.87    501.85    582.78    669.67    762.50    861.29    965.19   1071.19   1179.02
            OUTFLOW  430883.10 554365.80 688479.60 840420.701011174.001201287.001411372.001655681.001927651.002219160.00
          ELEVATION    6335.90   6339.69   6343.47   6347.26   6351.05   6354.84   6358.63   6362.42   6366.21   6370.00


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

            **************
            *            *
 20 KK      *   REACH2   *
            *            *
            **************
                          CHANNEL ROUTING 25+00 TO 40+00

               HYDROGRAPH ROUTING DATA

 22 RD            MUSKINGUM-CUNGE CHANNEL ROUTING

 23 RC            NORMAL DEPTH CHANNEL
                        ANL        .080  LEFT OVERBANK N-VALUE
                       ANCH        .070  MAIN CHANNEL N-VALUE
```

```
                 ANR        .080  RIGHT OVERBANK N-VALUE
               RLNTH       1500.  REACH LENGTH
                 SEL       .1330  ENERGY SLOPE
               ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                  CROSS-SECTION DATA
                     --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 25 RY      ELEVATION   5720.00   5680.00   5620.00   5600.00   5597.00   5600.00   5610.00   5700.00
 24 RX      DISTANCE        .00    100.00    200.00    280.00    283.00    286.00    300.00    400.00

                                                    ***

                                  COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

        STORAGE        .00      2.15     11.56     28.57     52.61     81.18    113.75    150.33    190.93    235.53
        OUTFLOW        .00    816.31   7552.93  25360.65  60857.84 116845.60 190205.90 281548.50 391588.20 521092.70
      ELEVATION    5597.00   5603.47   5609.95   5616.42   5622.89   5629.37   5635.84   5642.32   5648.79   5655.26

        STORAGE     284.13    336.75    393.38    454.03    519.49    590.16    666.04    746.19    829.94    917.31
        OUTFLOW  670855.10 841680.401034376.001248901.001484287.001746382.002038086.002376225.002743994.003141973.00
      ELEVATION    5661.74   5668.21   5674.68   5681.16   5687.63   5694.10   5700.58   5707.05   5713.53   5720.00


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


        **************
        *            *
 26 KK  *    REACH3  *
        *            *
        **************
                     CHANNEL ROUTING 40+00 TO 59+00

           HYDROGRAPH ROUTING DATA

 28 RD        MUSKINGUM-CUNGE CHANNEL ROUTING

 29 RC        NORMAL DEPTH CHANNEL
                 ANL        .080  LEFT OVERBANK N-VALUE
                ANCH        .070  MAIN CHANNEL N-VALUE
                 ANR        .080  RIGHT OVERBANK N-VALUE
               RLNTH       1900.  REACH LENGTH
                 SEL       .0600  ENERGY SLOPE
               ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                  CROSS-SECTION DATA
                     --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 31 RY      ELEVATION   5494.00   5486.00   5483.00   5486.00   5488.00   5489.00   5490.00   5491.00
 30 RX      DISTANCE        .00     40.00     44.00     48.00     60.00    120.00    140.00    160.00

                                                    ***

                                  COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

        STORAGE        .00       .02       .08       .18       .31       .49       .74      1.16      1.73      2.52
        OUTFLOW        .00       .82      5.23     15.43     33.24     60.26     89.40    148.05    244.05    336.75
      ELEVATION    5483.00   5483.58   5484.16   5484.74   5485.32   5485.90   5486.47   5487.05   5487.63   5488.21

        STORAGE       4.10      6.52      9.33     12.51     16.06     19.77     23.55     27.41     31.35     35.35
        OUTFLOW     533.61    987.80   1664.42   2530.10   3599.11   4895.64   6381.14   8047.70   9889.78  11903.82
      ELEVATION    5488.79   5489.37   5489.95   5490.53   5491.11   5491.69   5492.27   5492.84   5493.42   5494.00
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*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

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          *            *
 32 KK    *    REACH4  *
          *            *
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                         CHANNEL ROUTING 59+00 TO 68+00

             HYDROGRAPH ROUTING DATA

 34 RD         MUSKINGUM-CUNGE CHANNEL ROUTING

 35 RC         NORMAL DEPTH CHANNEL
                     ANL        .080  LEFT OVERBANK N-VALUE
                    ANCH        .070  MAIN CHANNEL N-VALUE
                     ANR        .080  RIGHT OVERBANK N-VALUE
                   RLNTH        900.  REACH LENGTH
                     SEL       .0300  ENERGY SLOPE
                   ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                   CROSS-SECTION DATA
                        --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 37 RY       ELEVATION   5467.00   5460.00   5453.00   5449.00   5443.00   5441.00   5465.00   5500.00
 36 RX       DISTANCE        .00     40.00     80.00    120.00    138.00    140.00    200.00    320.00

                                                  ***

                                   COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00       .37      1.76      4.37      9.23     16.04     24.50     34.59     46.32     59.60
          OUTFLOW        .00     71.25    552.45   1708.35   4388.24   9776.03  17572.48  28027.92  41302.52  58171.38
        ELEVATION    5441.00   5444.11   5447.21   5450.32   5453.42   5456.53   5459.63   5462.74   5465.84   5468.95

          STORAGE      73.64     88.37    103.78    119.87    136.64    154.10    172.25    191.07    210.58    230.77
          OUTFLOW   78695.67 102452.20 129417.70 159593.10 192994.30 229647.30 269584.90 312844.90 359469.00 409508.10
        ELEVATION    5472.05   5475.16   5478.27   5481.37   5484.48   5487.58   5490.69   5493.79   5496.90   5500.00


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          *            *
 38 KK    *    REACH5  *
          *            *
          **************
                         CHANNEL ROUTING 68+00 TO 78+00

             HYDROGRAPH ROUTING DATA

 40 RD         MUSKINGUM-CUNGE CHANNEL ROUTING

 41 RC         NORMAL DEPTH CHANNEL
                     ANL        .080  LEFT OVERBANK N-VALUE
                    ANCH        .070  MAIN CHANNEL N-VALUE
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                 ANR        .080  RIGHT OVERBANK N-VALUE
               RLNTH       1000.  REACH LENGTH
                 SEL       .0300  ENERGY SLOPE
               ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                  CROSS-SECTION DATA
                      --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 43 RY       ELEVATION   5432.00   5429.00   5425.00   5422.00   5419.00   5422.00   5437.00   5460.00
 42 RX       DISTANCE        .00     40.00     80.00    136.00    140.00    144.00    180.00    240.00

                                                    ***

                                  COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00       .14       .94      3.81      8.29     14.12     21.56     30.00     38.70     47.66
          OUTFLOW        .00     20.75    158.40   1023.51   3204.80   6647.74  11552.70  18530.17  27074.96  37077.04
        ELEVATION    5419.00   5421.16   5423.32   5425.47   5427.63   5429.79   5431.95   5434.10   5436.26   5438.42

          STORAGE      56.90     66.42     76.21     86.29     96.64    107.28    118.19    129.38    140.85    152.60
          OUTFLOW   48498.60  61315.91  75508.02  91061.41 107967.80 126222.90 145825.30 166775.80 189077.20 212733.70
        ELEVATION    5440.58   5442.73   5444.89   5447.05   5449.21   5451.37   5453.52   5455.68   5457.84   5460.00


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          *            *
 44 KK    *    REACH6  *
          *            *
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                     CHANNEL ROUTING 78+00 TO 92+00

            HYDROGRAPH ROUTING DATA

 46 RD        MUSKINGUM-CUNGE CHANNEL ROUTING

 47 RC        NORMAL DEPTH CHANNEL
                 ANL        .080  LEFT OVERBANK N-VALUE
                ANCH        .070  MAIN CHANNEL N-VALUE
                 ANR        .080  RIGHT OVERBANK N-VALUE
               RLNTH       1400.  REACH LENGTH
                 SEL       .0300  ENERGY SLOPE
               ELMAX          .0  MAX. ELEV. FOR STORAGE/OUTFLOW CALCULATION

                                  CROSS-SECTION DATA
                      --- LEFT OVERBANK --- + ------ MAIN CHANNEL ------- + --- RIGHT OVERBANK ---
 49 RY       ELEVATION   5416.00   5412.00   5410.00   5408.00   5409.00   5410.00   5412.00   5414.00
 48 RX       DISTANCE        .00     20.00     37.00     40.00     44.00     64.00    100.00    120.00

                                                    ***

                                  COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

          STORAGE        .00       .02       .06       .16       .37       .71      1.18      1.81      2.59      3.52
          OUTFLOW        .00       .60      3.84     10.26     28.66     68.60    142.66    248.36    390.70    574.16
        ELEVATION    5408.00   5408.42   5408.84   5409.26   5409.68   5410.10   5410.53   5410.95   5411.37   5411.79

          STORAGE       4.60      5.76      7.02      8.36      9.78     11.27     12.80     14.35     15.93     17.54
          OUTFLOW     807.73   1092.07   1422.43   1799.82   2225.43   2727.41   3288.49   3898.57   4556.88   5262.85
        ELEVATION    5412.21   5412.63   5413.05   5413.47   5413.89   5414.31   5414.73   5415.16   5415.58   5416.00
```

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RUNOFF SUMMARY
FLOW IN CUBIC FEET PER SECOND
TIME IN HOURS, AREA IN SQUARE MILES

+	OPERATION	STATION	PEAK FLOW	TIME OF PEAK	AVERAGE FLOW FOR MAXIMUM PERIOD 6-HOUR	24-HOUR	72-HOUR	BASIN AREA	MAXIMUM STAGE	TIME OF MAX STAGE
+	HYDROGRAPH AT	P 500	486.	5.67	302.	182.	182.	1.98		
+	ROUTED TO	REACH1	486.	5.73	299.	181.	181.	1.98		
+	ROUTED TO	REACH2	486.	5.77	298.	180.	180.	1.98		
+	ROUTED TO	REACH3	486.	5.87	295.	177.	177.	1.98		
+	ROUTED TO	REACH4	486.	5.90	292.	176.	176.	1.98		
+	ROUTED TO	REACH5	486.	5.97	289.	174.	174.	1.98		
+	ROUTED TO	REACH6	485.	6.03	285.	171.	171.	1.98		

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SUMMARY OF KINEMATIC WAVE - MUSKINGUM-CUNGE ROUTING
(FLOW IS DIRECT RUNOFF WITHOUT BASE FLOW)

ISTAQ	ELEMENT	DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)	INTERPOLATED TO COMPUTATION INTERVAL DT (MIN)	PEAK (CFS)	TIME TO PEAK (MIN)	VOLUME (IN)
REACH1	MANE	2.00	485.91	344.00	1.41	2.00	485.91	344.00	1.41

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1502E+03 EXCESS= .0000E+00 OUTFLOW= .1490E+03 BASIN STORAGE= .1264E+01 PERCENT ERROR= .0

REACH2	MANE	1.94	485.79	345.10	1.40	2.00	485.71	346.00	1.40

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1487E+03 EXCESS= .0000E+00 OUTFLOW= .1481E+03 BASIN STORAGE= .6558E+00 PERCENT ERROR= .0

REACH3	MANE	2.00	485.68	352.00	1.38	2.00	485.68	352.00	1.38

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1484E+03 EXCESS= .0000E+00 OUTFLOW= .1465E+03 BASIN STORAGE= .1789E+01 PERCENT ERROR= .0

REACH4	MANE	2.00	485.65	354.00	1.37	2.00	485.65	354.00	1.37

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1465E+03 EXCESS= .0000E+00 OUTFLOW= .1451E+03 BASIN STORAGE= .8975E+00 PERCENT ERROR= .3

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          REACH5  MANE        2.00    485.54    358.00      1.36      2.00    485.54    358.00        1.36

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1451E+03 EXCESS= .0000E+00 OUTFLOW= .1436E+03 BASIN STORAGE= .1256E+01 PERCENT ERROR=    .2

          REACH6  MANE        2.00    485.48    362.00      1.34      2.00    485.48    362.00        1.34

CONTINUITY SUMMARY (AC-FT) - INFLOW= .1436E+03 EXCESS= .0000E+00 OUTFLOW= .1416E+03 BASIN STORAGE= .1864E+01 PERCENT ERROR=    .1


*** NORMAL END OF HEC-1 ***
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