Kiowa Engineering Corporation

April 12, 2006

Mr. Tim Mitros
Subdivision Engineering
City of Colorado Springs
30 South Nevada, Suite 700
Colorado Springs, Colorado 80903

RE: Wolf Ranch Detention Basin F28 and Tributary 4 Drainageway Final Design, Colorado Springs, Colorado (Kiowa Project No. 05064)

Dear Tim:

Accompanying this letter is a set of the final design plans for Detention Basin F28 and for Tributary Four upstream of Detention Basin F28 within the Wolf Ranch development. The detention basin was shown in the Kiowa's MDDP for Wolf Ranch. The design of the detention basin is in conformance with the most current revision of the MDDP. I have enclosed a set of the calculations that support the design of the detention basin.

If Kiowa can be of any further assistance, please do not hesitate to contact us.

Sincerely,
KIOWA ENGINEERING CORPORATION

Richard N. Wray, P.E.
Principal

Cc: Ralph Braden, Nor'wood Development
RNW/rnw
0412rnw1

File: Wolf Ranch MDDP

1604 South 21st Street, Colorado Springs, CO 80904
(719) 630-7342 (719) 630-0406 FAX

STATE OF COLORADO

OFFICE OF THE STATE ENGINEER
Division of Water Resources
Department of Natural Resources

1313 Sherman Street, Room 818
Denver, Colorado 80203
Phone (303) 866-3581
FAX (303) 866-3589

www.water.state.co.us

August 8, 2005

Mr. Richard N. Wray, P.E.
Kiowa Engineering Corporation
1604 South 21st Street
Colorado Springs, CO 80904

Subject: Ruling on Jurisdictional Status of Proposed Detention Pond in the Wolf Ranch Development

Dear Mr. Wray:

Thank you for submitting your letter request and drawings dated July 26, 2005 for the proposed detention pond in the Wolf Ranch Development in Colorado Springs to be created by a roadway embankment. The proposed facility is situated at the intersection of Research Parkway and Wolf Valley Drive in El Paso County. Based on a review of the submitted documentation, the subject detention basin falls under the category of an Exempt Structure, in accordance with Rule 18 of the State of Colorado's "Rules and Regulations for Dam Safety and Dam Construction". Rule 18.A.(1) states that highways, roadfills and railroad embankments are exempt from the Rules and Regulations provided the structures are not designed or modified with the purpose or effect of impounding water for uses other than flood detention. The proposed structure is considered to be exempt from our Rules and Regulations provided the following criteria is met:

1. The structure is operated as a normally dry flood detention facility.
2. The outlet conduit beneath the roadway embankment is ungated and is not provided with a gate with the intent to store water other than the temporary storage of floodwaters. The outlet conduit beneath the roadway is required be larger than 36 inches in diameter.
3. The roadway embankment is actually designed as a city street to be used for public access to facilities and structures on both sides of the embankment.
4. The design and construction of the roadway embankment falls under the purview of another state or local government agency.

We appreciate that you contacted our office for a ruling on this issue. If you have any questions concerning this matter or any dam safety related issues, please do not hesitate to contact me in our Denver office at (303) 866-3585 ext. 8276.

Sincerely,

Mark R. Haynes

Mark R. Haynes, P.E.
Design Review and Construction Inspection Engineer
Safety of Dams Program

xc: Jack Byers, Deputy State Engineer
Steve Witte, Division Engineer
Bill McCormick, Dam Safety Engineer, Colorado Springs Office

MRH/mh: WolfRanchExemptStructure.Doc

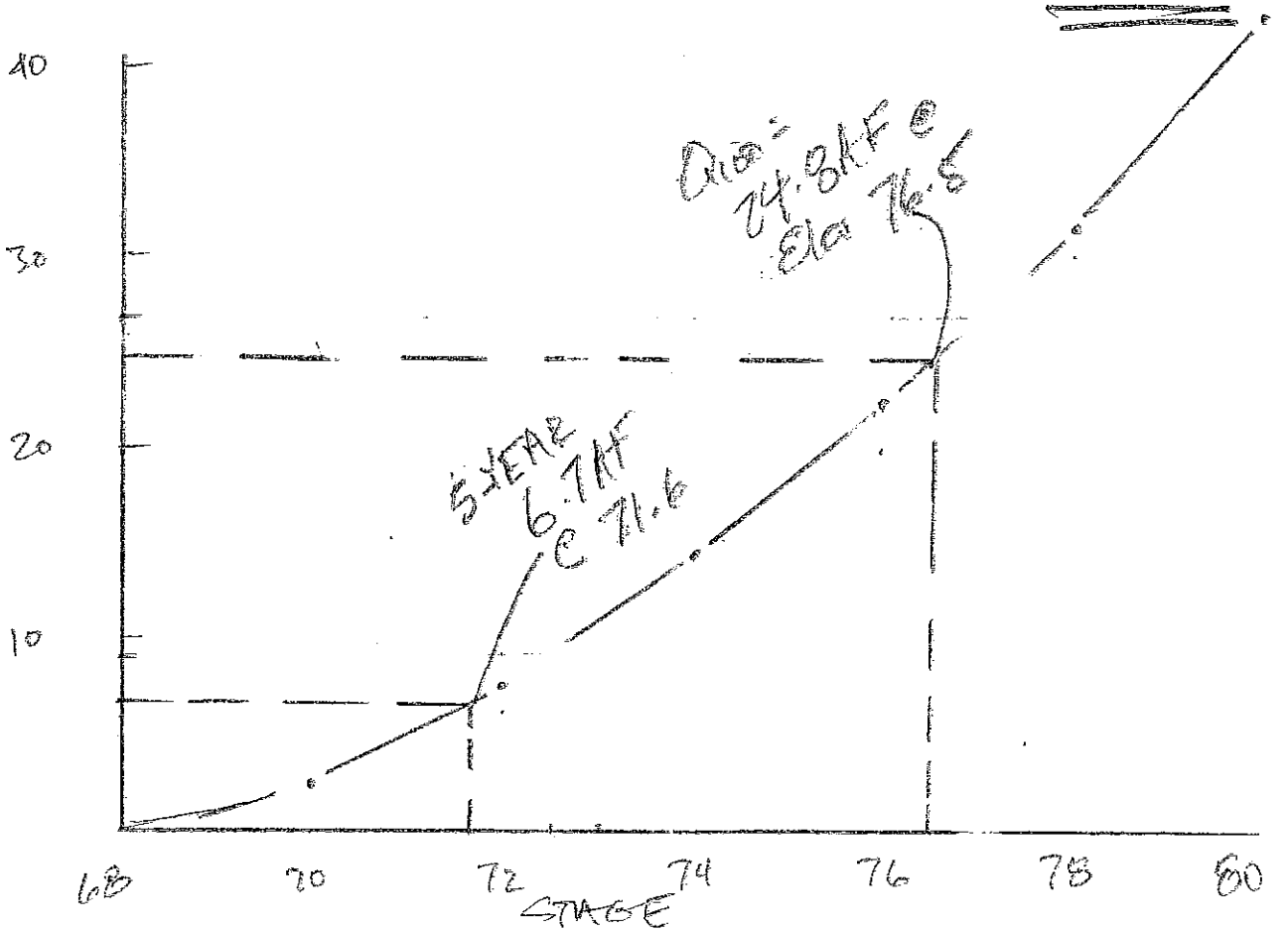
Kiowa Engineering Corporation

CLIENT Det. Basin F2B — JOB NO. 05064 — PAGE 1
PROJECT — DATE CHECKED — DATE 6/16/05
DETAIL Hydraulics — CHECKED BY — COMPUTED BY

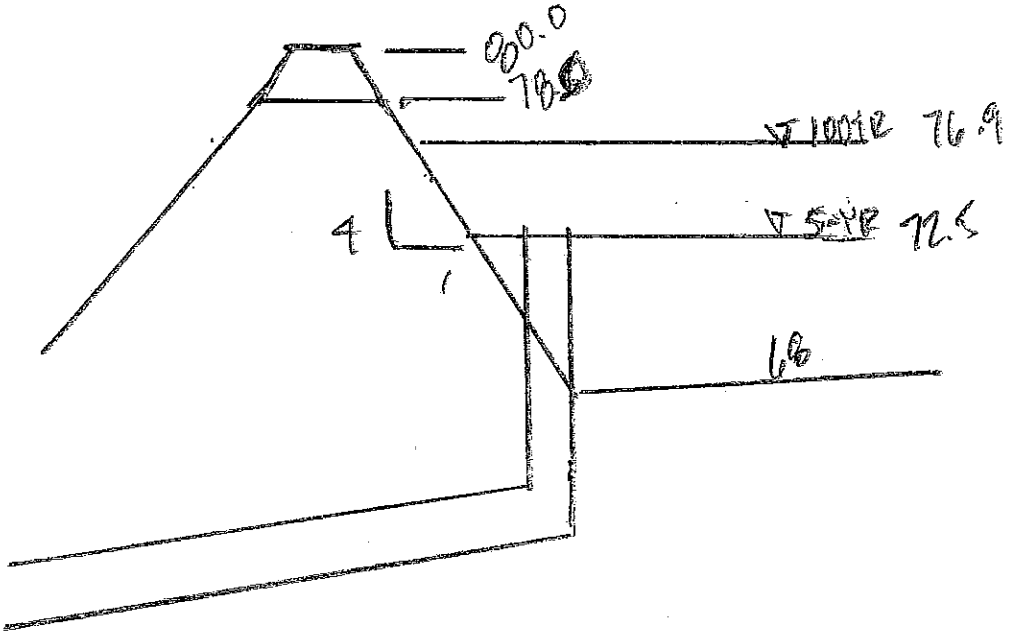
Outlet Structure Design

$Q_{100\ in} = 813$ cfs $Q_{5\ in} = 185$ cfs.

Stage	Vol (Ac)	Avg Vol	ΔH	Vol (AF)	Cum Vol (AF)
6968	0				
		1.14	2'	2.32	0
70	2.31				2.32
		2.68	2	5.36	
72	3.04				7.68
		3.32	2	6.64	
74	3.40				14.32
		4.13	2	8.25	
76	4.65				22.57
		4.45	2	8.90	
78	5.25				31.47
			2	11.00	
80	5.75				42.47 AF



Schematic Layout



Place crest of principal outlet @ elevation 72.5

∴ H' for 100-year = 76.9 − 72.5 = 4.4'

Determine Area of opening for Q 100 = 494 cfs (see HEC 1 results).

$$Q = CA\sqrt{2gH} = CA\sqrt{2g(4.4)} = 16.8CA$$

Assume 25% blockage ∴ $C_B = .75$

Orifice Coefficient $C_o = .63$

$$C = C_B C_o = .75(.63) = .47$$

@ Q = 494 cfs $A = \frac{494}{.47(16.8)} = 62.5$ sf

Assume opening width Normal to flow = 10'

∴ Need 6.25' depth. Slope grate to match embankment.

Select: outlet box Structure.

Per MDDP, try 4' x 8' CBC.

Max HW = 76.9 ; invert with outlet structure = 63.0

∴ HW = 76.9 - 63 = 13.9'

Spillway crest @ 76.0 : Top of Emb. 80.0

PER HYDRAIN: 6'W x 4' CBC provides HW El 77.0 : Use

IWrat = 6956; outlet Elev = 69.50

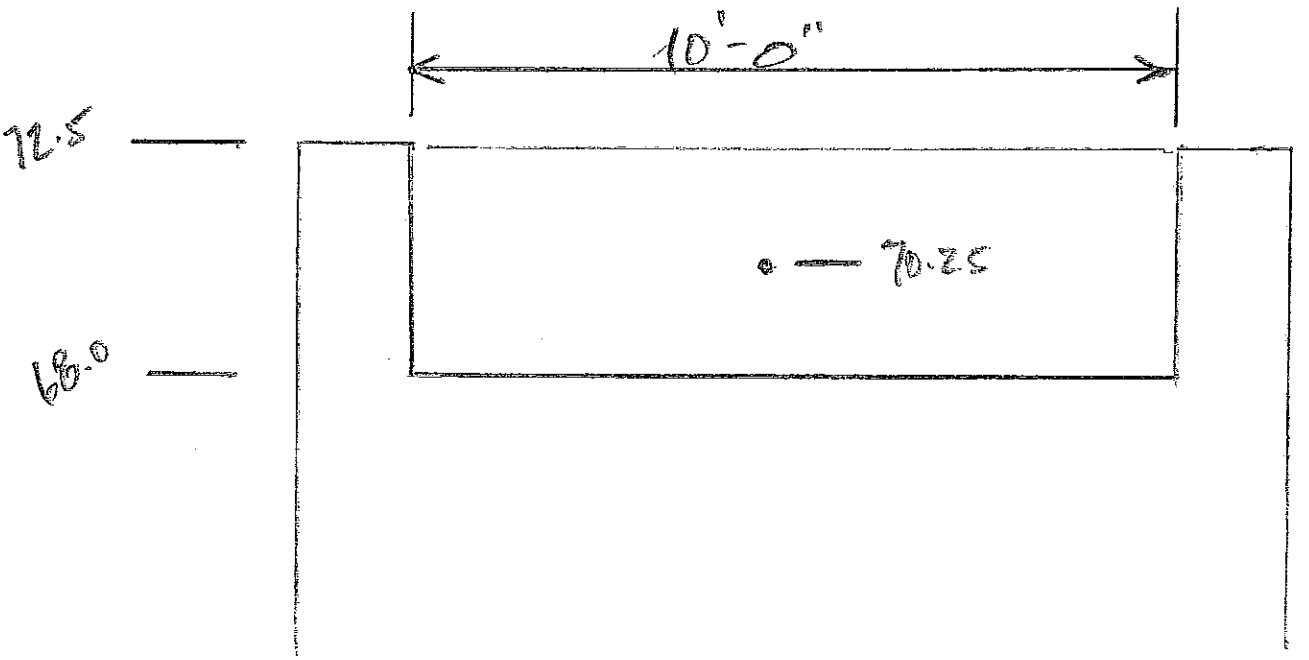
Use 6'W x 4'H CBC @ 360 LF

Q = 490 cfs @ HWE 6977.0

5-Year Outlet

HW range 6968 to 6972.5, = 4.5'

Q @ El 72.5 = 80 cfs ±



(i) Check as orifice ∴ $H = 72.5 - 68.0/2 = 2.25$

$Q = .47(10)(4.5)\sqrt{2g(2.25)} = 255$ cfs, too much

(ii) Check as Weir: $Q = 2.4LH^{3/2}$

@ 69: $Q = 2.4(10)(1)^{3/2} = 24$ cfs

@ 70 $Q = 2.4(10)(2)^{3/2} = 44.0$ cfs

@ 72.5 $Q = 2.4(10)(4.5)^{3/2} = 229$ ∴ too much

Decrease L = to 6'

(i) as orifice : $Q = .47(6)(4.5)\sqrt{2g(2.25)} = 152$ cfs too much.

(ii) as Weir: $Q = 2.4(6)(4.5)^{3/2} = 137$ cfs "

Decrease to L = 5'

(i) as orifice : $Q = .47(5)(4.0)\sqrt{2g(2.25)} = 113$ cfs (assumes 6" grate)

(ii) as weir : $Q = 2.4(5)(4.5)^{3/2} = 114.6$ cfs

(iii) check w/ weir @ H = 4.5 (assume blockage from 6" grate)

$Q = 2.4(5)(4)^{3/2} = 96$ cfs ∴ dc @ 4997.0

Relig to 5' year water surface (w/ weir)

Stage	L	H	Q
68	5	0	0
70	5	2	34
72	5	4	96
calc'd orifice → 72.5	N/A	4.5'	113

Kiowa Engineering Corporation

CLIENT Det Basin F28 JOB NO. 05064 PAGE 6
PROJECT _____ DATE CHECKED _____ DATE 6/16/05
DETAIL Hydraulics. CHECKED BY _____ COMPUTED BY RJW

Rev. 7/26/05
12'x3' opening

Combined Orifice Equations

Stage	5'x12' Opng	100-year	$Q_{TOT.}$	(Notes)
68	0		0	(1)
70	34		34	(1)
72	96		96	(1)
72.5	113		113	(2)
74	146	139 144	~~285~~ 312	(2)
76	181	~~212~~ 254	~~393~~ 435	(2)
77	196	~~240~~ 288	~~436~~ 484	(2)

Provide opening requirements @ El 77.0

$Q = 490 - 196 = 294$

$Q = .47 A \sqrt{2g(4.5)} = 8.0A$

w/ $Q = 294$ cfs $= A = 294/8 = 36.8$ sf.

w 12' normal to flow; $d = 36.8/12 = 3.07'$

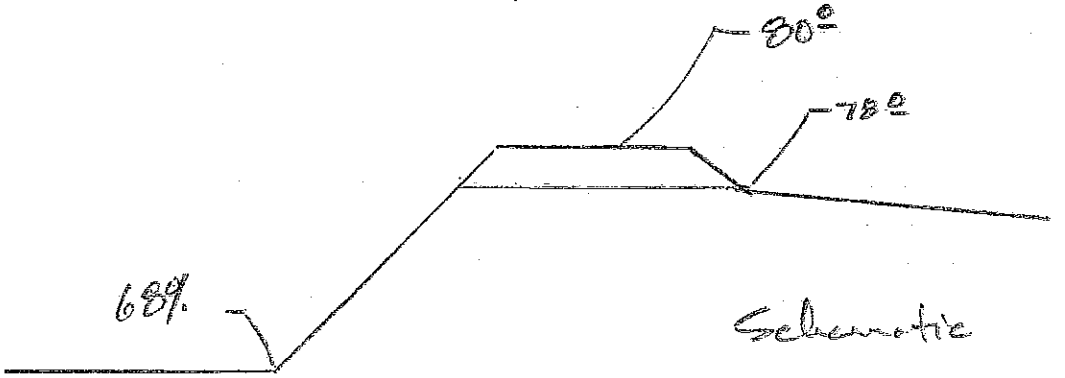
Use 3' x 12' opening on top.

(1) Weir equation controls

(2) Orifice Equation controls for 5'x12' opng

Emergency Spillway

$Q = CLH^{3/2}$



Schematic

Q = 813 cfs into pond.

Assume H = 2', C = 2.4

$\therefore Q = 2.4(L)(2)^{3/2} = 6.8L$

& $Q = 813$ $\therefore L = 813/6.8 = 119.5$

Say 120'

CURRENT DATE: 06-20-2005
CURRENT TIME: 14:59:29

FILE DATE: 06-20-2005
FILE NAME: DBF28

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

CULV NO.	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	6956.00	6950.00	400.05	1 RCB	6.00	4.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: DBF28 DATE: 06-20-2005

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
6956.00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	1
6958.18	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.00	1
6959.44	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.00	1
960.59	150.0	150.0	0.0	0.0	0.0	0.0	0.0	0.00	1
6961.88	200.0	200.0	0.0	0.0	0.0	0.0	0.0	0.00	1
6963.46	250.0	250.0	0.0	0.0	0.0	0.0	0.0	0.00	1
6965.40	300.0	300.0	0.0	0.0	0.0	0.0	0.0	0.00	1
6967.72	350.0	350.0	0.0	0.0	0.0	0.0	0.0	0.00	1
6970.67	400.0	400.0	0.0	0.0	0.0	0.0	0.0	0.00	1
6974.03	450.0	450.0	0.0	0.0	0.0	0.0	0.0	0.00	1
6977.01	490.0	490.0	0.0	0.0	0.0	0.0	0.0	0.00	1
6978.50	508.9	508.9	0.0	0.0	0.0	0.0	0.0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: DBF28 DATE: 06-20-2005

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
6956.00	0.000	0.00	0.00	0.00
6958.18	0.000	50.00	0.00	0.00
6959.44	0.000	100.00	0.00	0.00
6960.59	0.000	150.00	0.00	0.00
6961.88	0.000	200.00	0.00	0.00
6963.46	0.000	250.00	0.00	0.00
6965.40	0.000	300.00	0.00	0.00
6967.72	0.000	350.00	0.00	0.00
6970.67	0.000	400.00	0.00	0.00
6974.03	0.000	450.00	0.00	0.00
6977.01	0.000	490.00	0.00	0.00

<1> TOLERANCE (ft) = 0.010 <2> TOLERANCE (%) = 1.000

CURRENT DATE: 06-20-2005
CURRENT TIME: 14:59:29

FILE DATE: 06-20-2005
FILE NAME: DBF28

PERFORMANCE CURVE FOR CULVERT 1 - 1(6.00 (ft) BY 4.00 (ft)) RCB

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	6956.00	0.00	0.00	0-NF	0.00	0.00	0.00	0.00	0.00	0.00
50.00	6958.18	2.18	2.18	1-S2n	0.76	1.29	0.69	0.74	11.99	2.09
100.00	6959.44	3.44	3.44	1-S2n	1.21	2.06	1.16	1.12	14.43	2.69
150.00	6960.59	4.59	4.59	5-S2n	1.60	2.69	1.62	1.41	15.40	3.10
200.00	6961.88	5.88	5.88	5-S2n	1.96	3.26	2.00	1.67	16.65	3.42
250.00	6963.46	7.46	7.46	5-S2n	2.30	3.79	2.37	1.90	17.61	3.69
300.00	6965.40	9.40	4.82	6-S2n	2.63	4.00	2.72	2.10	18.38	3.92
350.00	6967.72	11.72	7.28	6-S2n	2.95	4.00	3.05	2.30	19.13	4.13
400.00	6970.67	14.67	10.12	6-S2n	3.26	4.00	3.37	2.48	19.78	4.31
450.00	6974.03	18.03	13.34	6-S2n	3.56	4.00	3.77	2.65	19.89	4.47
490.00	6977.01	21.01	16.19	6-S2n	4.00	4.00	3.90	2.78	20.94	4.60

El. inlet face invert 6956.00 ft El. outlet invert 6950.00 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********

INLET STATION	100.00 ft
INLET ELEVATION	6956.00 ft
OUTLET STATION	500.00 ft
OUTLET ELEVATION	6950.00 ft
NUMBER OF BARRELS	1
SLOPE (V/H)	0.0150
CULVERT LENGTH ALONG SLOPE	400.05 ft

***** CULVERT DATA SUMMARY **********

BARREL SHAPE	BOX
BARREL SPAN	6.00 ft
BARREL RISE	4.00 ft
BARREL MATERIAL	CONCRETE
BARREL MANNING'S n	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE (90-45 DEG.)
INLET DEPRESSION	NONE

(RENT DATE: 06-20-2005
CURRENT TIME: 14:59:29

FILE DATE: 06-20-2005
FILE NAME: DBF28

TAILWATER

******* REGULAR CHANNEL CROSS SECTION **********

BOTTOM WIDTH	30.00 ft
SIDE SLOPE H/V (X:1)	3.0
CHANNEL SLOPE V/H (ft/ft)	0.004
MANNING'S n (.01-0.1)	0.035
CHANNEL INVERT ELEVATION	6950.00 ft
CULVERT NO.1 OUTLET INVERT ELEVATION	6950.00 ft

******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	6950.00	0.000	0.00	0.00	0.00
50.00	6950.74	0.429	0.74	2.09	0.19
100.00	6951.12	0.449	1.12	2.69	0.28
150.00	6951.41	0.460	1.41	3.10	0.35
200.00	6951.67	0.467	1.67	3.42	0.42
250.00	6951.90	0.472	1.90	3.69	0.47
300.00	6952.10	0.476	2.10	3.92	0.53
350.00	6952.30	0.480	2.30	4.13	0.57
400.00	6952.48	0.482	2.48	4.31	0.62
450.00	6952.65	0.484	2.65	4.47	0.66
490.00	6952.78	0.486	2.78	4.60	0.69

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	GRAVEL
EMBANKMENT TOP WIDTH	120.00 ft
CREST LENGTH	100.00 ft
OVERTOPPING CREST ELEVATION	6978.50 ft

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1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*               JUN  1998               *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   28JUL05  TIME  10:00:41   *
*                                       *
*****************************************
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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
```

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


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

   1          ID             Wolf Ranch Tributary Four
   2          ID             F-Basins future developed condition with detention   PN 05064
   3          ID             Final design of detention basin f-28 at Research Parkway
   4          ID             5-year and 100 Year, 24 hr Type IIA  Storm  FN:  f28fd.dat
              *DIAGRAM
   5          IT       5       0       0     300
   6          IO       5       0
   7          JR    PREC     .56     1.0

   8          KK     F-8
   9          KM        RUNOFF FOR SUB-BASIN F-8
  10          BA   .0630
  11          IN      15
  12          PB     4.4
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 13          PC  0.0000  0.0005  0.0015  0.0030  0.0045  0.0060  0.0080  0.0100  0.0120  0.0143
 14          PC  0.0165  0.0188  0.0210  0.0233  0.0255  0.0278  0.0320  0.0390  0.0460  0.0530
 15          PC  0.0600  0.0750  0.1000  0.4000  0.7000  0.7250  0.7500  0.7650  0.7800  0.7900
 16          PC  0.8000  0.8100  0.8200  0.8250  0.8300  0.8350  0.8400  0.8450  0.8500  0.8550
 17          PC  0.8600  0.8638  0.8675  0.8713  0.8750  0.8788  0.8825  0.8863  0.8900  0.8938
 18          PC  0.8975  0.9013  0.9050  0.9083  0.9115  0.9148  0.9180  0.9210  0.9240  0.9270
 19          PC  0.9300  0.9325  0.9350  0.9375  0.9400  0.9425  0.9450  0.9475  0.9500  0.9525
 20          PC  0.9550  0.9575  0.9600  0.9625  0.9650  0.9675  0.9700  0.9725  0.9750  0.9775
 21          PC  0.9800  0.9813  0.9825  0.9838  0.9850  0.9863  0.9875  0.9888  0.9900  0.9913
 22          PC  0.9925  0.9938  0.9950  0.9963  0.9975  0.9988  1.0000
 23          LS      0    71.5
 24          UD   0.22

 25          KK    RF-8
 26          KM         ROUTE FLOW FROM SUB-BASIN F-8 TO DETENTION BASIN DB 19
 27          RD   1800   0.037    0.04            TRAP      15       4

 28          KK     F-1
 29          KM         RUNOFF FOR BASIN F-1
 30          BA   .1659
 31          LS      0      61
 32          UD    .20

 33          KK    RF-9
 34          KM         ROUTE FLOW FROM SUB-BASIN F-1 TO DESIGN POINT F9
 35          RD    700   0.037    0.04            TRAP      10       6

 36          KK     F-9
 37          KM         RUNOFF FOR BASIN F-9
 38          BA   .0430
 39          LS      0      70
 40          UD    .16

 41          KK    DPF9
 42          KM       COMBINE FLOW FROM SUB-BASIN F-9 AND RF-9
 43          HC       2
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LINE         ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

 44          KK   RF-19
 45          KM         ROUTE FLOW FROM DESIGN POINT DP F9 TO DETENTION BASIN DB 19
 46          RD   2000   0.018    0.04            TRAP      20       4

 47          KK    F-19
 48          KM         RUNOFF FOR BASIN F-19
 49          BA   .1020
 50          LS      0    73.2
 51          UD    .19

 52          KK   DPF19
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 53          KM        COMBINE FLOW FROM SUB-BASIN F-19, RF-8 AND RF19
 54          KM        THIS IS INFLOW TO DETENTION BASIN F-19
 55          HC       3

 56          KK   DBF19
 57          KM   ROUTE DPF19 THROUGH DETENTION BASIN F19
 58          KM   THIS OUTFLOW FROM DETENTION BASIN F-19
 59          RS       1    ELEV    7140
 60          SV       0       1       4      11    23.5      41
 61          SE    7140    7142    7144    7146    7148    7150
 62          SQ       0      10      55     100     200     300

 63          KK   RF-22
 64          KM        ROUTE FLOW FROM DESIGN POINT DPF19 TO DESIGN POINT F22
 65          RD    1800   0.033    0.04            TRAP      20       3

 66          KK     F-2
 67          KM         RUNOFF FOR BASIN F-2
 68          BA   .0424
 69          LS       0      61
 70          UD     .19

 71          KK   RF-10
 72          KM         ROUTE FLOW FROM SUB-BASIN F-2 TO DESIGN POINT F10
 73          RD     850   0.059    0.04            TRAP      10       6

 74          KK    F-10
 75          KM         RUNOFF FOR BASIN F-10
 76          BA   .0180
 77          LS       0      67
 78          UD     .15

 79          KK   DPF10
 80          KM        COMBINE FLOW FROM SUB-BASIN F-10 AND RF10
 81          HC       2

 82          KK  RF-18A
 83          KM       ROUTE FLOW FROM DESIGN POINT DP F10 TO DETENTION BASIN DB 18
 84          RD    1600   0.050    0.04            TRAP      15       4
1                                        HEC-1 INPUT                                                    PAGE  3

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

 85          KK     F-3
 86          KM         RUNOFF FOR SUB-BASIN F-3
 87          BA   .0942
 88          LS       0      61
 89          UD     .22

 90          KK   RF-11
 91          KM        ROUTE FLOW FROM SUB-BASIN F-3 TO DESIGN POINT F11
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 92          RD     950   0.038     0.04            TRAP      10       6

 93          KK    F-11
 94          KM         RUNOFF FOR SUB-BASIN F-11
 95          BA   .0460
 96          LS       0     68.2
 97          UD     .17

 98          KK   DPF11
 99          KM         COMBINE FLOW FROM SUB-BASIN F-11 AND RF-11
100          HC       2

101          KK   RF-18
102          KM         ROUTE FLOW FROM DESIGN POINT F11 TO DETENTION BASIN DB 18
103          RD    1600   0.029     0.04            TRAP      15       4

104          KK     F-4
105          KM         RUNOFF FOR SUB-BASIN F-4
106          BA   .2681
107          LS       0       61
108          UD     .28

109          KK   RF-12
110          KM         ROUTE FLOW FROM SUB-BASIN F-4 TO DESIGN POINT F12
111          RD    1150   0.044     0.04            TRAP      10       6

112          KK     F-5
113          KM         RUNOFF FOR SUB-BASIN F-5
114          BA   .1073
115          LS       0       61
116          UD     .34

117          KK  RF-12A
118          KM         ROUTE FLOW FROM SUB-BASIN F-5 TO DESIGN POINT F12
119          RD    1600   0.035     0.04            TRAP      10       6

120          KK    F-12
121          KM         RUNOFF FOR SUB-BASIN F-12
122          BA   .0590
123          LS       0     69.3
124          UD     .20
```



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

125          KK   DPF12
126          KM         COMBINE FLOW FROM SUB-BASIN RF-12 RF-12A, AND F-12
127          HC       3

128          KK   RF-17
129          KM         ROUTE FLOW FROM DESIGN POINT F-12 TO DETENTION BASIN DB 18
```

```
130          RD    1600   0.020    0.04            TRAP      15       4

131          KK    F-17
132          KM         RUNOFF FOR SUB-BASIN F-17
133          BA   .0380
134          LS       0    60.1
135          UD     .21

136          KK    F-18
137          KM         RUNOFF FOR SUB-BASIN F-18
138          BA   .0980
139          LS       0    73.1
140          UD     .21

141          KK    F-16
142          KM         RUNOFF FOR SUB-BASIN F-16
143          BA   .0270
144          LS       0    72.8
145          UD     .21

146          KK   RF-16
147          KM        ROUTE FLOW FROM SUB-BASIN F-16 TO DETENTION BASIN DB 18
148          RD     600   0.020    .013            CIRC       2

149          KK   DPF18
150          KM        COMBINE FLOW FROM SUB-BASINS F-18, F17, RF-18A, RF-18, RF-17, AND RF-16
151          KM        THIS IS INFLOW TO DETENTION BASIN F-18
152          HC       6

153          KK   DBF18
154          KM   ROUTE DPF18 THROUGH DETENTION BASIN F-18
155          KM   THIS IS OUTFLOW FROM DETENTION BASIN F-18
156          RS       1    ELEV    7140
157          SV       0       1       4      11    23.5      41
158          SE    7140    7142    7144    7146    7148    7150
159          SQ       0      10      55     100     200     300

160          KK  RF-22A
161          KM        ROUTE FLOW FROM DESIGN POINT DPF18 TO DESIGN POINT F22
162          RD    1900   0.027    0.04            TRAP      10       6

163          KK    F-22
164          KM         RUNOFF FOR SUB-BASIN F-22
165          BA   .0640
166          LS       0    64.1
167          UD     .21
```



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

168          KK   DPF22
```

```
169          KM        COMBINE FLOW FROM SUB-BASIN F-22, RF-22 AND RF-22A
170          HC       3

171          KK  RF-27
172          KM        ROUTE FLOW FROM DESIGN POINT DPF22 TO DESIGN POINT F27
173          RD    3700   0.020    0.04            TRAP      50       3

174          KK  RF-27C
175          KM        ROUTE FLOW FROM RF-27 TO DESIGN POINT F28
176          RD    1400   0.019    0.04            TRAP      50       3

177          KK    F-7
178          KM         RUNOFF FOR SUB-BASIN F-7
179          BA   .0782
180          LS       0      61
181          UD     .19

182          KK   RF-7
183          KM        ROUTE FLOW FROM SUB-BASIN F-7 TO DESIGN POINT F14
184          RD    1200   0.033    0.04            TRAP      10       6

185          KK    F-14
186          KM         RUNOFF FOR SUB-BASIN F-14
187          BA   .1290
188          LS       0    73.0
189          UD     .23

190          KK    F-6
191          KM         RUNOFF FOR SUB-BASIN F-6
192          BA   .0310
193          LS       0      61
194          UD     .19

195          KK   RF-13
196          KM        ROUTE FLOW FROM SUB-BASIN F-6 TO DESIGN POINT F13
197          RD     800   0.038    0.04            TRAP      10       6

198          KK    F-13
199          KM         RUNOFF FOR SUB-BASIN F-13
200          BA   .0140
201          LS       0      61
202          UD     .14

203          KK  DPF13
204          KM        COMBINE FLOW FROM RF-13 AND F-13
205          HC       2

206          KK   RF-14
207          KM        ROUTE FLOW FROM DESIGN POINT F13 TO DESIGN POINT F14
208          RD    3600   0.027    0.04            TRAP      20       6
```

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

 209      KK  DPF14
 210      KM        COMBINE FLOW FROM RF-7, F-14, AND RF-14
 211      HC       3

 212      KK   RF-25
 213      KM         ROUTE FLOW FROM DESIGN POINT F14 TO DESIGN POINT F25
 214      RD    2600   0.023    0.04            TRAP      20       6

 215      KK    F-25
 216      KM         RUNOFF FOR SUB-BASIN F-25
 217      BA   .0890
 218      LS       0    74.1
 219      UD     .28

 220      KK  DPF25
 221      KM        COMBINE FLOW FROM RF-25 AND RF-14
 222      HC       2

 223      KK   RF-30
 224      KM         ROUTE FLOW FROM DESIGN POINT F25 TO DESIGN POINT F30
 225      RD     900   0.027    0.04            TRAP      20       6

 226      KK    F-15
 227      KM         RUNOFF FOR SUB-BASIN F-15
 228      BA   .0210
 229      LS       0    69.1
 230      UD     .15

 231      KK   RF-23
 232      KM         ROUTE FLOW FROM SUB-BASIN F15 TO DESIGN POINT F23
 233      RD    1200   0.023    0.04            TRAP      10       3

 234      KK    F-23
 235      KM         RUNOFF FOR SUB-BASIN F-23
 236      BA   .0310
 237      LS       0    73.0
 238      UD     .18

 239      KK  DPF23
 240      KM        COMBINE FLOW FROM RF-23 AND F-23
 241      HC       2

 242      KK   RF-24
 243      KM         ROUTE FLOW FROM DESIGN POINT F23 TO DESIGN POINT F24
 244      RD    2250   0.026    0.04            TRAP      10       6

 245      KK    F-24
 246      KM         RUNOFF FOR SUB-BASIN F-24
 247      BA   .0890
```

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

  248     LS       0      79
  249     UD     .26

  250     KK  DPF24
  251     KM        COMBINE FLOW FROM RF-24 AND F-24
  252     HC       2

  253     KK   RF-30A
  254     KM         ROUTE FLOW FROM DESIGN POINT F24 TO DESIGN POINT F30
  255     RD    1100   0.033    0.04            TRAP      10       6

  256     KK    F-30
  257     KM         RUNOFF FOR SUB-BASIN F-30
  258     BA   .0220
  259     LS       0    77.7
  260     UD     .18

  261     KK  DPF30
  262     KM        COMBINE FLOW FROM RF-30, RF-30A AND F-30
  263     HC       3

  264     KK   RF-29
  265     KM         ROUTE FLOW FROM DESIGN POINT F30 TO DESIGN POINT F29
  266     RD    2350   0.027    0.04            TRAP       6       3

  267     KK    F-29
  268     KM         RUNOFF FOR SUB-BASIN F-29
  269     BA   .0250
  270     LS       0      70
  271     UD     .19

  272     KK  DPF29
  273     KM        COMBINE FLOW FROM RF-29 AND F-29
  274     HC       2

  275     KK   RF-28
  276     KM         ROUTE FLOW FROM DESIGN POINT F29 TO DESIGN POINT F28
  277     RD     750   0.015    0.04            TRAP      20       3

  278     KK    F-28
  279     KM         RUNOFF FOR SUB-BASIN F-28
  280     BA    .042
  281     LS       0      68
  282     UD     .23

  283     KK    F-27
  284     KM         RUNOFF FOR SUB-BASIN F-27
  285     BA    .213
```

```
          286          LS       0    76.2
          287          UD     .32

          288          KK    DPF28
          289          KM         COMBINE FLOW FROM RF-27C, RF-28, F-28 AND F-27
          290          KM         THIS IS INFLOW TO DETENTION BASIN F-28
          291          HC       4
1                                                  HEC-1 INPUT                                                    PAGE  8

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


          292          KK    DBF28
          293          KM         ROUTE DPF28 THROUGH DETENTION BASIN F-28
          294          KM         THIS IS OUTFLOW FROM DETENTION BASIN F-28
          295          RS       1    ELEV    6968
          296          SV       0     2.32    7.68     9.1   14.32   22.57    26.8   31.47
          297          SE    6968    6970    6972  6972.5    6974    6976    6977    6978
          298          SQ       0      34      96     113     312     435     484     550

          299          KK    RF-31
          300          KM         ROUTE FLOW FROM DPF TO DESIGN POINT F
          301          RD    3500   0.023    0.04            TRAP      20       3

          302          KK     F-31
          303          KM          RUNOFF FOR SUB-BASIN F-31
          304          BA    .069
          305          LS       0      61
          306          UD     .24

          307          KK     DP F
          308          KM         COMBINE FLOW FROM RF-31 AND F-31
          309          HC       2
          310          ZZ
1
                SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING           (--->) DIVERSION OR PUMP FLOW

   NO.      (.) CONNECTOR         (<---) RETURN OF DIVERTED OR PUMPED FLOW

     8          F-8
                  V
                  V
    25         RF-8
                  .
                  .
    28            .          F-1
                  .            V
                  .            V
    33            .         RF-9
                  .            .
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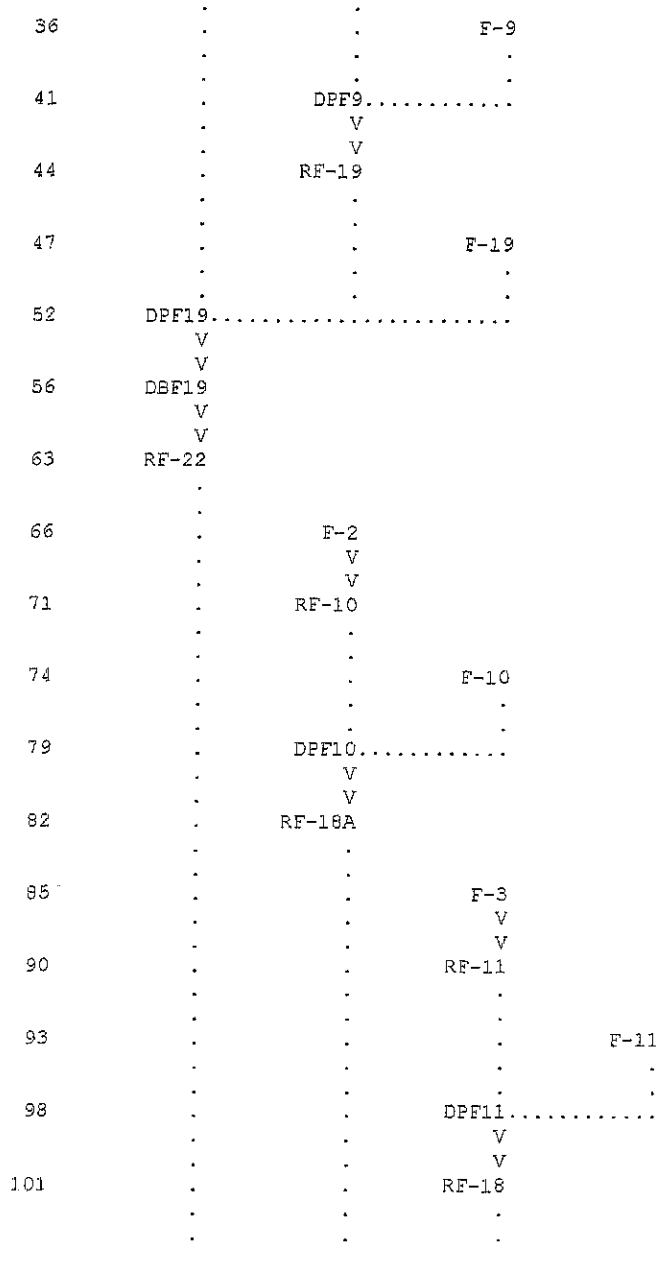
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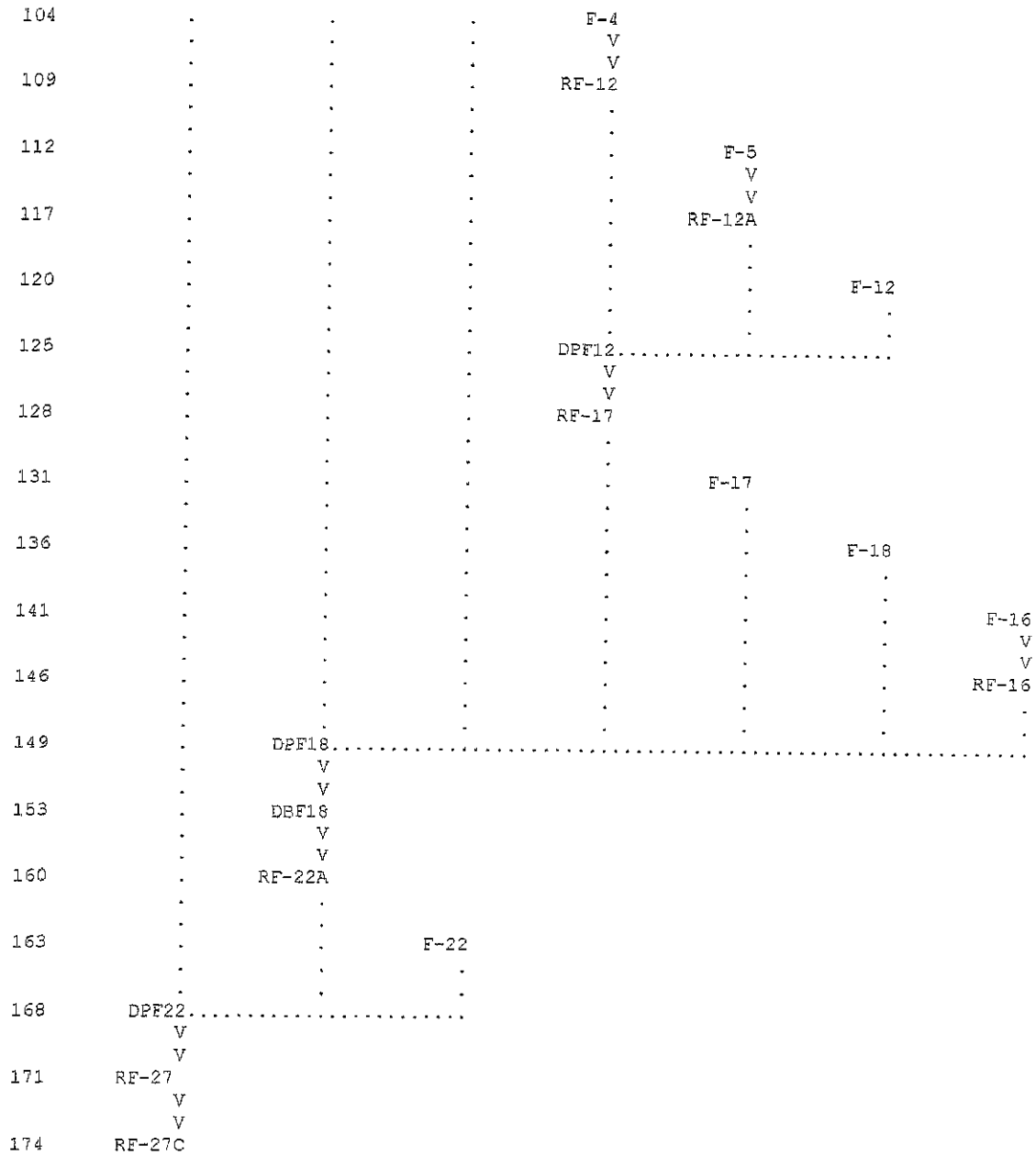
F-9
41
DPF9
44
RF-19
47
F-19
52
DPF19
56
DBF19
63
RF-22
66
F-2
71
RF-10
74
F-10
79
DPF10
82
RF-18A
85
F-3
90
RF-11
93
F-11
98
DPF11
101
RF-18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RF-12
112
F-5
117
RF-12A
120
F-12
125
DPF12
128
RF-17
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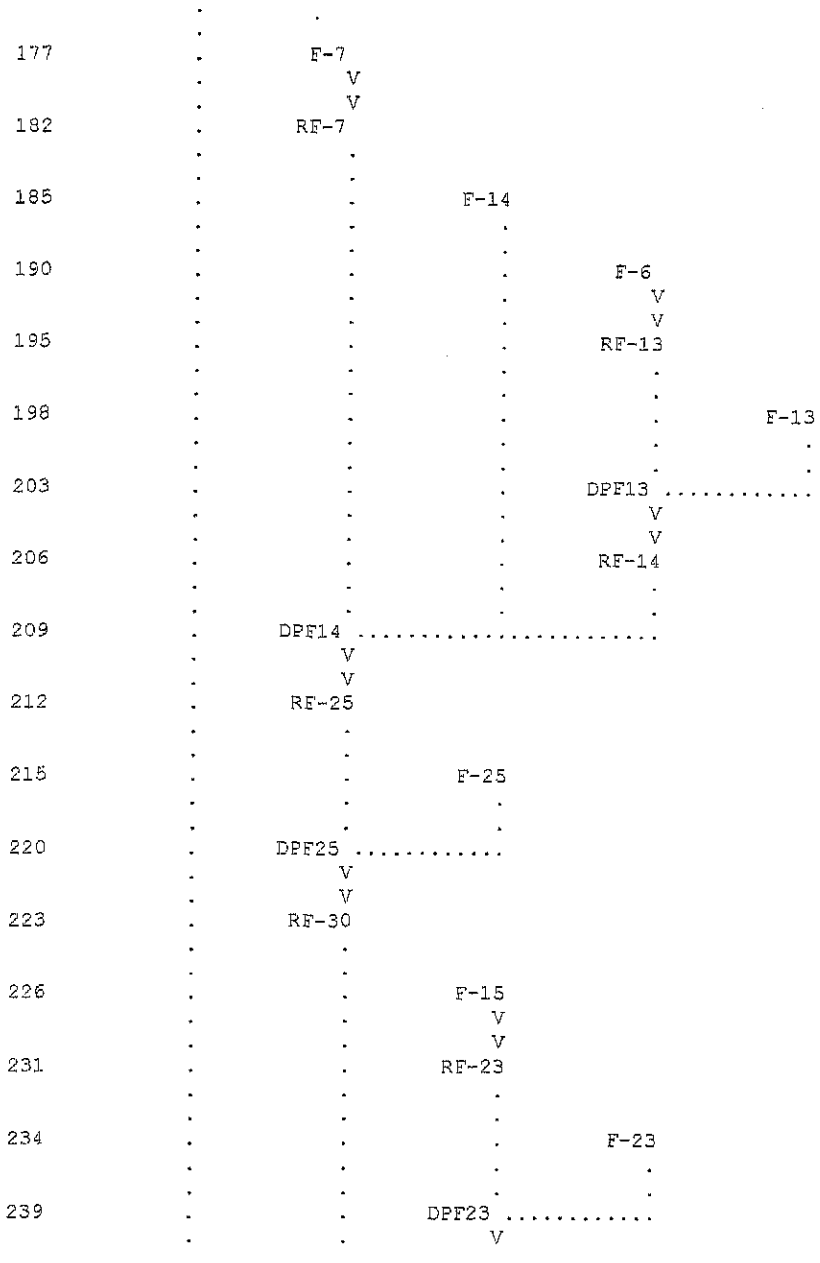
F-17
136
F-18
141
F-16
146
RF-16
149
DPF18
153
DBF18
160
RF-22A
163
F-22
168
DPF22
171
RF-27
174
RF-27C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RF-7
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F-14
190
F-6
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RF-13
198
F-13
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DPF13
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RF-14
209
DPF14
212
RF-25
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DPF25
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RF-30
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F-15
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RF-23
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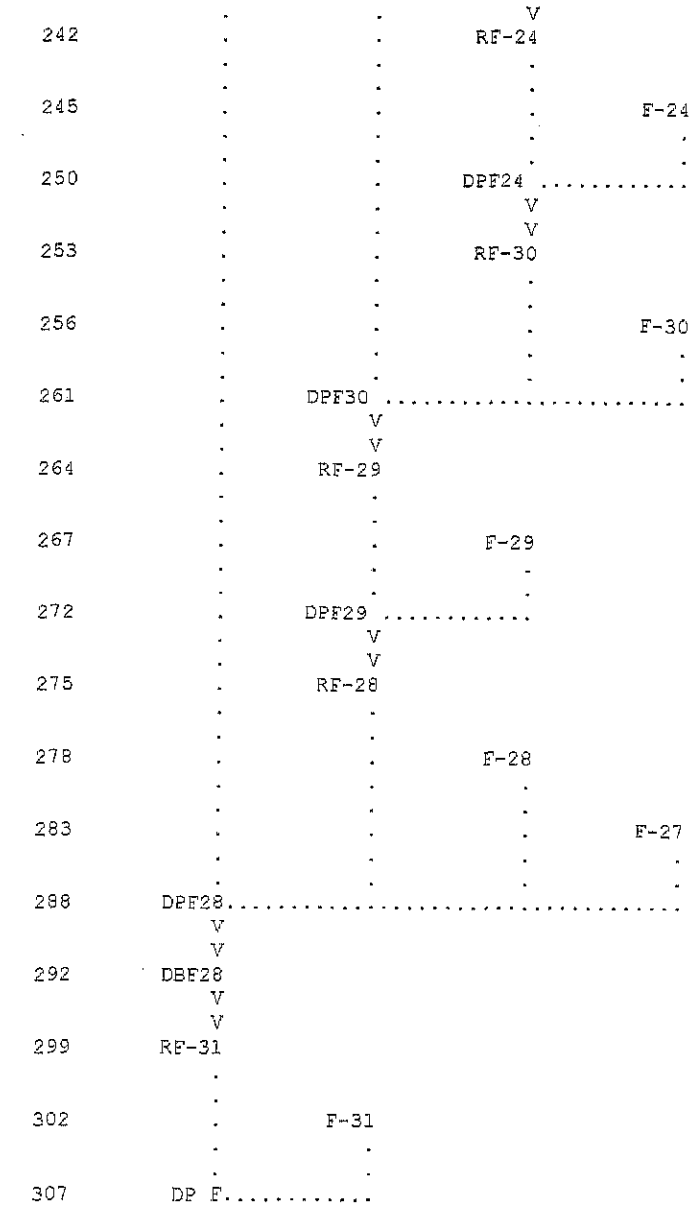
F-23
239
DPF23



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

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1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*              JUN  1998                *
*            VERSION 4.1                *
*                                       *
*  RUN DATE   20JUN05  TIME  16:23:21   *
*                                       *
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```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************
```

Wolf Ranch Tributary Four
F-Basins future developed condition with detention PN 05064
Final design of detention basin f-28 at Research Parkway
5-year and 100 Year, 24 hr Type IIA Storm FN: f28fd.dat

6 IO OUTPUT CONTROL VARIABLES

IPRNT	5	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

IT HYDROGRAPH TIME DATA

NMIN		5	MINUTES IN COMPUTATION INTERVAL
IDATE	1	0	STARTING DATE
ITIME		0000	STARTING TIME
NQ		300	NUMBER OF HYDROGRAPH ORDINATES
NDDATE	2	0	ENDING DATE
NDTIME		0055	ENDING TIME
ICENT		19	CENTURY MARK

COMPUTATION INTERVAL .08 HOURS
TOTAL TIME BASE 24.92 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

JP MULTI-PLAN OPTION

NPLAN	1	NUMBER OF PLANS

JR MULTI-RATIO OPTION
RATIOS OF PRECIPITATION
.56 1.00

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .56	RATIO 2 1.00
HYDROGRAPH AT						
+	F-8	.06	1	FLOW	18.	76.
				TIME	6.17	6.08
ROUTED TO						
+	RF-8	.06	1	FLOW	18.	74.
				TIME	6.25	6.17
HYDROGRAPH AT						
+	F-1	.17	1	FLOW	10.	110.
				TIME	6.17	6.08
ROUTED TO						
+	RF-9	.17	1	FLOW	10.	106.
				TIME	6.25	6.17
HYDROGRAPH AT						
+	F-9	.04	1	FLOW	13.	55.
				TIME	6.08	6.08
2 COMBINED AT						
+	DPF9	.21	1	FLOW	20.	157.
				TIME	6.17	6.08
ROUTED TO						
+	RF-19	.21	1	FLOW	19.	152.
				TIME	6.25	6.17
HYDROGRAPH AT						
+	F-19	.10	1	FLOW	38.	144.
				TIME	6.08	6.08
3 COMBINED AT						
+	DPF19	.37	1	FLOW	61.	349.
				TIME	6.25	6.17
ROUTED TO						
+	DBF19	.37	1	FLOW	21.	91.
				TIME	6.67	6.58

** PEAK STAGES IN FEET **

1	STAGE	7142.51	7145.62

				TIME	6.67	6.58
ROUTED TO						
+	RF-22	.37	1	FLOW	21.	91.
				TIME	6.83	6.67
HYDROGRAPH AT						
+	F-2	.04	1	FLOW	3.	29.
				TIME	6.17	6.08
ROUTED TO						
+	RF-10	.04	1	FLOW	3.	28.
				TIME	6.25	6.17
HYDROGRAPH AT						
+	F-10	.02	1	FLOW	4.	20.
				TIME	6.08	6.08
2 COMBINED AT						
+	DPF10	.06	1	FLOW	6.	46.
				TIME	6.17	6.08
ROUTED TO						
+	RF-18A	.06	1	FLOW	5.	45.
				TIME	6.25	6.17
HYDROGRAPH AT						
+	F-3	.09	1	FLOW	5.	59.
				TIME	6.17	6.17
ROUTED TO						
+	RF-11	.09	1	FLOW	5.	58.
				TIME	6.25	6.17
HYDROGRAPH AT						
+	F-11	.05	1	FLOW	11.	53.
				TIME	6.08	6.08
2 COMBINED AT						
+	DPF11	.14	1	FLOW	13.	102.
				TIME	6.17	6.08
ROUTED TO						
+	RF-18	.14	1	FLOW	13.	102.
				TIME	6.25	6.17
HYDROGRAPH AT						
+	F-4	.27	1	FLOW	13.	147.
				TIME	6.25	6.17
ROUTED TO						
+	RF-12	.27	1	FLOW	13.	144.

				TIME	6.33	6.25
HYDROGRAPH AT						
+	F-5	.11	1	FLOW	5.	52.
				TIME	6.33	6.25
ROUTED TO						
+	RF-12A	.11	1	FLOW	5.	51.
				TIME	6.50	6.33
HYDROGRAPH AT						
+	F-12	.06	1	FLOW	14.	67.
				TIME	6.08	6.08
3 COMBINED AT						
+	DPF12	.43	1	FLOW	24.	236.
				TIME	6.25	6.25
ROUTED TO						
+	RF-17	.43	1	FLOW	24.	235.
				TIME	6.42	6.25
HYDROGRAPH AT						
+	F-17	.04	1	FLOW	2.	23.
				TIME	6.17	6.08
HYDROGRAPH AT						
+	F-18	.10	1	FLOW	33.	131.
				TIME	6.08	6.08
HYDROGRAPH AT						
+	F-16	.03	1	FLOW	9.	36.
				TIME	6.08	6.08
ROUTED TO						
+	RF-16	.03	1	FLOW	9.	35.
				TIME	6.17	6.08
6 COMBINED AT						
+	DPF18	.80	1	FLOW	72.	527.
				TIME	6.25	6.17
ROUTED TO						
+	DBF18	.80	1	FLOW	29.	147.
				TIME	6.75	6.75
			**	PEAK STAGES IN FEET **		
			1	STAGE	7142.85	7146.93
				TIME	6.75	6.75
ROUTED TO						
+	RF-22A	.80	1	FLOW	29.	146.

				TIME	6.92	6.83
HYDROGRAPH AT						
+	F-22	.06	1	FLOW	7.	51.
				TIME	6.17	6.08
3 COMBINED AT						
+	DPF22	1.24	1	FLOW	52.	245.
				TIME	6.83	6.75
ROUTED TO						
+	RF-27	1.24	1	FLOW	52.	245.
				TIME	7.08	6.83
ROUTED TO						
+	RF-27C	1.24	1	FLOW	55.	245.
				TIME	7.08	6.92
HYDROGRAPH AT						
+	F-7	.08	1	FLOW	5.	54.
				TIME	6.17	6.08
ROUTED TO						
+	RF-7	.08	1	FLOW	5.	53.
				TIME	6.25	6.17
HYDROGRAPH AT						
+	F-14	.13	1	FLOW	42.	162.
				TIME	6.17	6.08
HYDROGRAPH AT						
+	F-6	.03	1	FLOW	2.	21.
				TIME	6.17	6.08
ROUTED TO						
+	RF-13	.03	1	FLOW	2.	21.
				TIME	6.25	6.17
HYDROGRAPH AT						
+	F-13	.01	1	FLOW	1.	11.
				TIME	6.08	6.08
2 COMBINED AT						
+	DPF13	.05	1	FLOW	3.	30.
				TIME	6.17	6.08
ROUTED TO						
+	RF-14	.05	1	FLOW	4.	30.
				TIME	6.75	6.33
3 COMBINED AT						
+	DPF14	.25	1	FLOW	45.	210.

				TIME	6.17	6.17
ROUTED TO						
+	RF-25	.25	1	FLOW	44.	209.
				TIME	6.33	6.25
HYDROGRAPH AT						
+	F-25	.09	1	FLOW	29.	108.
				TIME	6.17	6.17
2 COMBINED AT						
+	DPF25	.34	1	FLOW	67.	306.
				TIME	6.25	6.17
ROUTED TO						
+	RF-30	.34	1	FLOW	68.	305.
				TIME	6.33	6.25
HYDROGRAPH AT						
+	F-15	.02	1	FLOW	6.	26.
				TIME	6.08	6.08
ROUTED TO						
+	RF-23	.02	1	FLOW	6.	25.
				TIME	6.17	6.08
HYDROGRAPH AT						
+	F-23	.03	1	FLOW	12.	44.
				TIME	6.08	6.08
2 COMBINED AT						
+	DPF23	.05	1	FLOW	16.	69.
				TIME	6.17	6.08
ROUTED TO						
+	RF-24	.05	1	FLOW	15.	66.
				TIME	6.25	6.17
HYDROGRAPH AT						
+	F-24	.09	1	FLOW	45.	137.
				TIME	6.17	6.17
2 COMBINED AT						
+	DPF24	.14	1	FLOW	55.	203.
				TIME	6.25	6.17
ROUTED TO						
+	RF-30	.14	1	FLOW	55.	197.
				TIME	6.25	6.17
HYDROGRAPH AT						
+	F-30	.02	1	FLOW	12.	38.

				TIME	6.08	6.08
3 COMBINED AT						
+	DPF3C	.50	1	FLOW	124.	515.
				TIME	6.33	6.25
ROUTED TO						
+	RF-29	.50	1	FLOW	122.	517.
				TIME	6.33	6.25
HYDROGRAPH AT						
+	F-29	.03	1	FLOW	7.	30.
				TIME	6.08	6.08
2 COMBINED AT						
+	DPF29	.53	1	FLOW	125.	535.
				TIME	6.33	6.25
ROUTED TO						
+	RF-28	.53	1	FLOW	124.	519.
				TIME	6.42	6.25
HYDROGRAPH AT						
+	F-28	.04	1	FLOW	8.	40.
				TIME	6.17	6.08
HYDROGRAPH AT						
+	F-27	.21	1	FLOW	75.	264.
				TIME	6.25	6.17
4 COMBINED AT						
+	DPF28	2.02	1	FLOW	185.	813.
				TIME	6.33	6.33
ROUTED TO						
+	DBF28	2.02	1	FLOW	85.	462.
				TIME	7.33	6.83
			**	PEAK STAGES IN FEET **		
			1	STAGE	6971.65	6976.56
				TIME	7.33	6.83
ROUTED TO						
+	RF-31	2.02	1	FLOW	85.	468.
				TIME	7.50	6.83
HYDROGRAPH AT						
+	F-31	.07	1	FLOW	4.	42.
				TIME	6.25	6.17
2 COMBINED AT						
+	DP F	2.09	1	FLOW	86.	475.

TIME 7.50 6.83

1

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