DRAINAGE PLAN

AND

SUPPORTING CALCULATIONS

FOR

BRADLEY FAIR 2ND ADDITION

WICHITA, KANSAS

PREPARED BY

PROFESSIONAL ENGINEERING CONSULTANTS, P.A.

ENGINEERS

WICHITA, KANSAS

DECEMBER 18, 1995

MEMO

PROFESSIONAL ENGINEERING CONSULTANTS
PROFESSIONAL ASSOCIATION
303 S. TOPEKA
WICHITA, KANSAS
ZIP CODE / 67202

TO: M. E. Lindebak, P.E.
455 N. Main, 7th Floor
Wichita, KS 67202

ATTN: V. R. Huang, P.E.

PROJECT NO. 36-95785-3650

PROJECT: Bradley Fair 2nd Addition

DATE: 12/18/95

COPIES TO:
George Laham
Ron Spangenberg

FROM: M. W. Berry, P.E.

REFERENCE: Drainage Plan Computations

PLEASE ADVISE IMMEDIATELY OF ANY MISCONCEPTIONS OR OMISSIONS YOU BELIEVE TO BE CONTAINED HEREIN.

Attached hereto are the drainage computations for the referenced project

The publication Interim Drainage and Storm Sewer policy for Design Criteria and Documentation, City of Wichita, as revised 7/1/87 was used as the guideline for the hydrologic and hydraulic computations. This publication is hereinafter referred to as the Design Manual.

Manual #1, as referenced herein, refers to Design of Urban Highway Drainage - The State of the Art by Reitz & Jens, Inc., April 1980. Manual #2 refers to Drainage of Highway Pavements, Hydraulic Engineering Circular #12 by Tye Engineering, Inc., March 1984.

The analysis made herein is based on the available site data which includes the following:

Contour map at two foot interval and 1"=100' scale for the final plat area
Contour map at two foot interval and 1"=200' scale for the balance of the Wilson Farms tract.
City of Wichita Flood Insurance Study, May 1986

HYDROLOGIC ANALYSIS FOR STORM WATER SEWERS

For storm sewer design, the Rational Method was used for the hydrologic analysis in accordance with the Design Manual. Runoff coefficients were estimated based on tables presented in the Design Manual.

For this development, a uniform assumption of the minimum time of concentration of 15 minutes was deemed appropriate.

Travel time for flow through defined channels, pipes, etc., for these basins was estimated on the basis of Manning's Equation.

HYDRAULIC ANALYSIS FOR STORM WATER SEWERS

For each inlet, street flooding and inlet capacity were checked for the minor storm. Conveyance in the street is based on the Modified Manning's Equation, as expressed in Manual #1, Equation (5-1), page 5-9. It has been assumed that Tc for street flow is equal for Tc for pipe flow. This is a simplifying, but conservative, assumption, since pipe flow velocities generally exceed street flow velocities.

For local streets, curb-deep flow is tolerable for the minor storm. For collector streets, a single eight-foot center lane should remain unflooded for the minor storm.

Inlet capacities were determined by the methods described in Manual #2, using Chart #12.

In this analysis, City of Wichita Type 1A inlets and 3/8 inch per foot street cross slopes have been assumed. Minimum walk grade has been assumed to be 0.3 feet above the top of curb, unless otherwise noted. Streets have been assumed to have 6-5/8 inch standard curb, unless otherwise noted.

Storm sewers are designed for the minor storm, with major storm overflows to be routed through easements and rights-of-way to an appropriate outlet.

The minor storm has a recurrence interval of five years. The major storm evaluated has a recurrence interval of one hundred years.

To simplify hydraulic analysis, the following assumptions have been made:

1. The time of concentration is identical for both the major and the minor storms.
2. The street conveyance is computed using only the pavement width. Depths above the curb up to the walk (right-of-way) elevation are used, but the conveyance of the landscaped area behind the curb was neglected. In general, this area has a very small conveyance due to the higher "n" factor.

Hydraulic computations for the pipe system were estimated using Manning's Equation to calculate friction losses for pipes flowing full. Minor losses estimated at a constant 0.5 feet per structure. All pipe area assumed to be reinforced concrete with a Manning's "n" of 0.013. It is desirable to keep the hydraulic grade line at least one foot below the top of curb for the minor storm.

HYDROLOGIC AND HYDRAULIC MODELS FOR DETENTION

Detention basins are analyzed using the US Army Corps of Engineers HEC-1 computer package. Runoff computations within that program were made using the NCRS (formerly SCS) unit hydrograph procedure utilizing the Curve Number method. Stage-discharge relationships for weirs are automatically computed by HEC-1. For culvert control structures, the FHWA HY-8 Culvert computer program is used to develop a stage-discharge curve. Reservoir routing is computed using the Modified Puls method within HEC-1.

Potential detention areas have been identified throughout the site. The effects of urbanization on the basin have been analyzed utilizing the SCS hydrologic method and the HEC-21 computer program. The results of this analysis are summarized in a table I the report.

FEMA REGULATED STREAMS

The Middle Fork of Gypsum Creek has been include in the detailed study of the City of Wichita Flood Insurance Study (FIS). Regulatory floodplain limits, regulatory floodway limits, base flood elevations, and design discharges have been identified in the FIS. For the purposes of this study, the design flows identified in the report are assumed to enter the site at 21st Street and discharge from the site at the Burlington Northern Railroad essentially unchanged. No attempt has been made to evaluate the effects of detention to be provided on this site.

DESIGN AIDS

Charts, nomographs, etc. used in these computation are reprinted in this section

DRAINAGE PLAN MAP

A map at 1"=200' scale is include in the map pocket(s) at the back of the report.

PROFESSIONAL ENGINEERING CONSULTANTS
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WICHITA, KANSAS 67211
(316) 262-2691

HYDROLOGY DATA SHEET

PAGE ____ OF ____

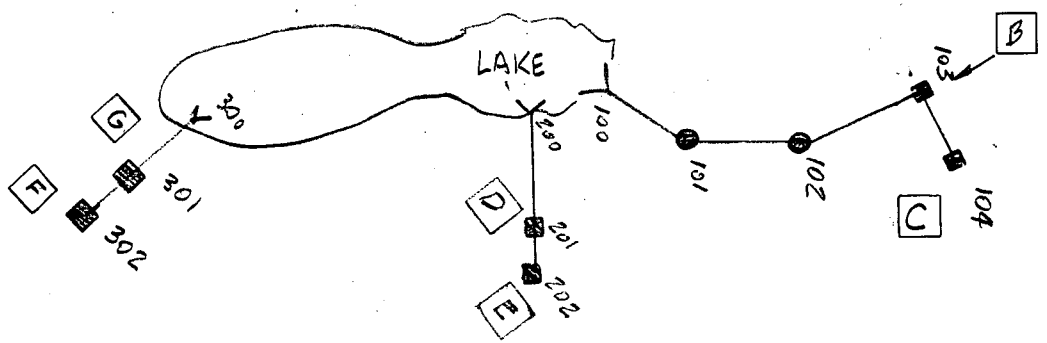
PROJECT: BRADLEY FAIR 2ND ADD PROJECT NO. 36.95785.365

ITEM: ____ DATE: 12.17.95

RETURN PERIOD: 5-YR COMPUTATIONS BY: MVB REVISIONS BY: ____

SCHEMATIC DIAGRAM:

NOTE: "G" WILL BE SERVED BY PRIVATE/PUBLIC SWS INSTALLED INTERIOR TO LOTS 1 & 2.



TRIBUTARY AREA								HYDROLOGY SUMMATION				CONDUIT DATA					
SUB-BASIN (1)	C (2)	AREA (acres) (3)	SLOPE (%) (4)	LENGTH (feet) (5)	T_{c_o} (minutes) (6)	I_o in./hr. (7)	Q_o (cfs) (8)	T_c (minutes) (9)	I in./hr. (10)	Q (cfs) (11)	ΣQ (cfs) (12)	PIPE (inches) (13)	SLOPE (%) (14)	VELOCITY (ft./sec.) (15)	LENGTH (feet) (16)	T_t (minutes) (17)	$T_c + T_t$ (minutes) (18)
C	0.69	6			15	4.56	18.9	15			18.9	30"	0.21	3.8	60	0.3	15.3
B	0.69	24			20	4.00	66.2	20	4.00	66.2	82.8	48"	0.33	6.6	525	1.3	21.3
E	0.60	2.5			15	4.56	7.9	15			7.9	24"	0.12	2.5	60	0.4	15.4
D	0.50	0.8			15	4.56	1.8	15.4	4.56	1.8	9.7	24"	0.18	3.1	75	0.4	15.8
								$\frac{15}{15.4} \times 7.9 + 1.8 = 9.5$ OR			$\frac{451}{456} \times 1.8 + 7.9 = 9.7$						
F	0.69	10			15	4.56	31.5	15			31.5	36"	0.22	4.4	75	0.3	15.3
G	0.69	8			15	4.56	25.2	15.3	4.52	25.0	56.5	48"	0.15	4.5	75	0.3	15.6

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HYDROLOGY DATA SHEET

PAGE ____ OF ____

PROJECT: BRADLEY FAIR 2ND ADDITION PROJECT NO. 36.95785.3650

ITEM: _____ DATE: 12.17.95

RETURN PERIOD: 100 Yr COMPUTATIONS BY: MMB REVISIONS BY: _____

SCHEMATIC DIAGRAM:

(SEE OTHER SHEET)

TRIBUTARY AREA								HYDROLOGY SUMMATION				CONDUIT DATA					
SUB-BASIN (1)	C (2)	AREA (acres) (3)	SLOPE (%) (4)	LENGTH (feet) (5)	T_{c_o} (minutes) (6)	I_o in./hr. (7)	Q_o (cfs) (8)	ΣT_c (minutes) (9)	I in./hr. (10)	Q (cfs) (11)	ΣQ (cfs) (12)	PIPE (inches) (13)	SLOPE (%) (14)	VELOCITY (ft/sec.) (15)	LENGTH (feet) (16)	T_t (minutes) (17)	$T_c + T_t$ (minutes) (18)
C	0.8	6			15	7.37	35.4	15			35.4	30"	0.75	7.2!	60		
B	0.8	24			20	6.53	125	20	6.53		156.7	48"	1.19	12.5!	525		
											156.7	54"	0.64	9.9!			
											156.7	60"	0.36	8.0!	USE FOR Q_{100}		
E	0.8	2.5			15	7.37	14.7				14.7	24"	0.42	4.7	60		
D	0.6	0.8			15	7.37	3.5				18.2	24"	0.65	5.8	75		
F	0.8	10			15	7.37	59	15	7.37		59	36"	0.78	8.3	75		
G	0.8	8			15	7.37	47.2	15	7.37		106	48"	0.54	8.4	75		

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Date 12.17.95 Page ____ of ____ Comp by MB

Project BRADLEY FAIR 2ND ADD 36.95785.3650

Item NOTE: ASSUME NO MORE THAN 1.25 AC PAV'T DISCHARGES DIRECTLY ONTO STREET AT EACH ENTRANCE. BALANCE IS CARRIED TO PUBLIC SWS BY PRIVATE SWS.

z/n = 2000

INLET CAPACITY

NODE No.	HYDROLOGY Q_o cfs	HYDROLOGY Q_o+Q_b cfs	APPROACHING FLOW S_o o/o	S_x in/ft	d ft	T ft	INLET TYPE	L	ON-GRADE COMP Lt ft	L/Lt	E ft	SUMP COMP. di ft	d ft	T ft	Q_i cfs	Q_b cfs	
104	18.9	—	ASSUME 3/4 Q FROM NORTH				= 14.2										
NORTH	14.2		0.5	3/8	0.5	16	OK										
SOUTH	4.7		0.4	3/8	OK BY INSPECTION												
							1A	10'				0.6	0.43	13.8	18.9	-0-	OK
103	66.2	Assume all except R/W (1.0 Ac) and 2 drives (2.5 Ac) are discharged thru pvt SWS															
NORTH	10	—	0.5	3/8	0.46	14.7	1A	10'				0.47	0.30	9.6	10	-0-	OK
SOUTH	Negligible																
202	7.9	—					1A	5'				0.4	0.23	7.4	7.9	-0-	OK
NORTH	4.0	—	0.43	3/8	0.33	10.6											
SOUTH	3.9	—	0.46	3/8	0.32	10.2											
201	1.8	OK BY INSPECTION (SEE 202)					1A	5'				0.17	—	—	1.8		OK
FOR 302 + 301, ASSUME 3 DRIVES @ 1.25 EA + R/W (1.5 AC) = 5.25 AC									5.25/10 x 31.5 = 16.5 CFS			5.25/8 x 25.2 = 16.5 CFS					
302	16.5		0.88	3/8	0.48	15.4	1A	10'				0.62	0.45	14.4	16.5	-0-	OK
301	16.5		0.88	3/8	0.48	15.4	1A	10'				0.62	0.45	14.4	16.5	-0-	OK

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Date 12.17.95 Page ____ of ____ Comp by MKB

Project BRADLEY FAIR 2ND ADD 36.95785.3650 CK by ____

Item ____

MAJOR STORM CHECK

NODE	Tc MIN	i_{100}/i_2	$Q_{\frac{1}{2}}^{5}$ cfs	Q_{100} cfs	Q_{pipe} cfs	$Q_{100}-Q_p$ cfs	ΣQ cfs	So %	Bk-Bk Street Width	MAX DISCHARGE (cfs) @ d = . T.C.	T.C. +0.3'	T.C. +0.41'	T.C. +0.52'	T.C. +0.63'	REMARKS
100	15			35.4	} ASSUME PIPE BLOCKAGE/FAILURE UPSTREAM OF SUMP										
103	15			125											
	104+103=			160			160	0.5	29'	32	110	140	200		OK
202			14.7	} OK BY INSPECTION											
201			3.5												
302	15			59											
301	15			106	} OK ABOVE AT 0.50% OK BY INSPECTION AT 0.86%										
				165											

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Date _____ Page _____ of _____

Project WILSON ESTATES

Item BASIN HYDROLOGY

PRE-DEVELOPED

BASIN #	A	C_{100}	t_{100}	Q_{100}
4	38.5 Ac.	0.67	7.36	190 cfs
9	48.3 Ac.	0.67	7.36	238 cfs

POST-DEVELOPED

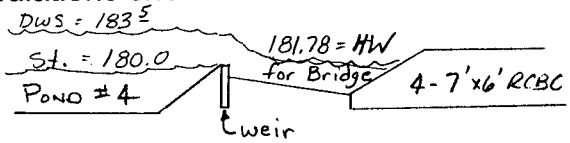
BASIN #	A	C_{100}	t_{100}	Q_{100}
4	38.5	0.76	7.36	215 cfs
9	48.3	0.76	7.36	270 cfs

NOTE:

BASINS # 1-3, 5, 6, and 8 are calculated within HEC-1
BASIN # 7 is previously calculated as shown later in this report.

Basins No. 1, 2, 3, and 9, contribute runoff to a series of proposed ponds to be built upstream of the proposed 4 - 7' X 6' RCBC at the road crossing the Middle Branch of Gypsum Creek.

All requirements for sizes and elevations of Ponds # 1 thru 3 are summarized on the drainage plan map. The outlet for Pond #1 is a 6' square drop inlet at elevation 198.0 with a 54" outlet pipe to Pond #2. Ponds #2 and #3 are each controlled by a 5' spillway and channel at elevations 195.0 and 186.0 respectively. Pond #3 drains to Pond #4, which is to constructed by damming off the creek using a 75' concrete weir at elevation 180.0. The following weir calculations show a maximum rise of 3.5' to elevation 183.5.



$Q = CLH^{3/2}$

$Q_{free} = 3.0(L)(3.5)^{3/2}$

$\frac{1243}{3.0 \times 3.5^{3/2}} = L_{free}$

$63.3' = L_{free}$

$\frac{D_{dn}}{D_{up}} = \frac{1.78}{3.5} = 0.5$

$\frac{Q_{dn}}{Q_{up}} = 0.84$ (Fig. 5-5)

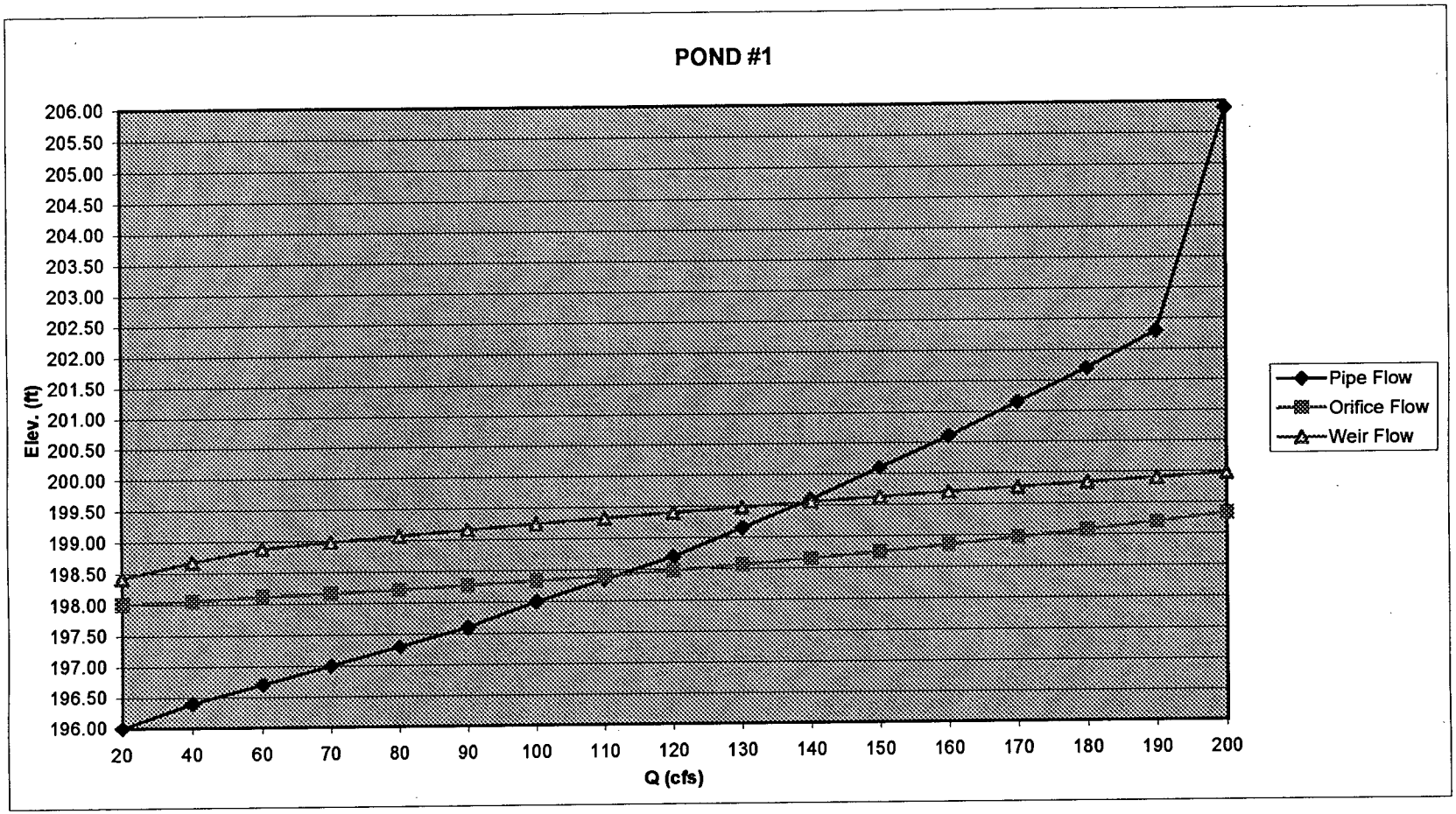
$L_{sub} = \frac{63.3}{0.84} = 75'$

Because the pond is within the creek, Q_{100} for analysis of Pond #4, and the box culvert downstream of the weir is 1243 cfs, as defined by the Federal Emergency Management Agency (FEMA) Flood Insurance Study(F.I.S.), despite the reduction of peak on-site flows provided by the proposed detention storage.

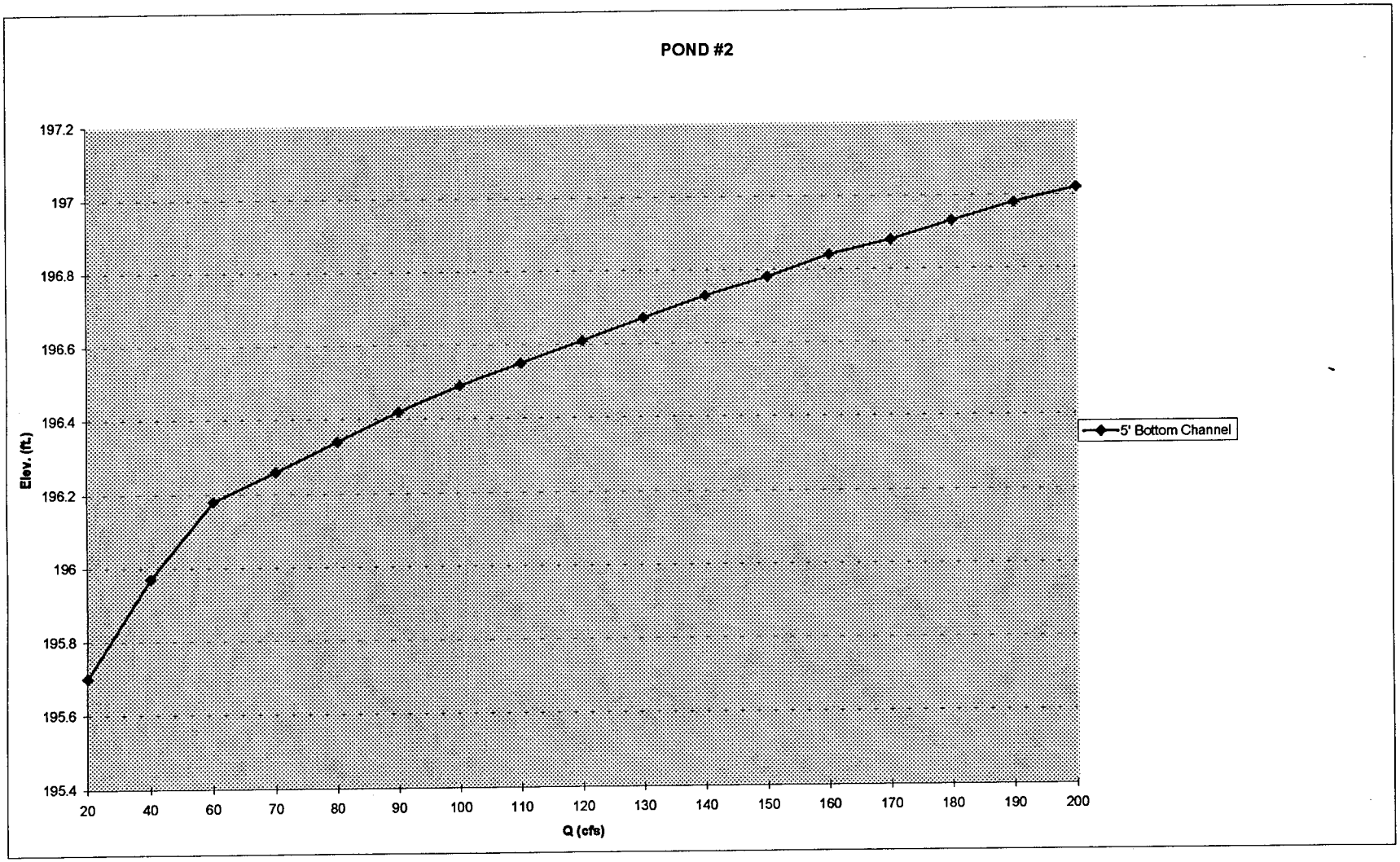
The peak stage of Pond #4 of 183.5 is slightly higher than the published Base Flood Elevation (B.F.E.) for a short reach of the creek just upstream of the new RCBC, (up to Section Q. See FEMA B.F.E's within) but is lower than the B.F.E.'s for the next reach of the creek up to near the South side of 21st St. (near Sec. S)

The proposed box culvert at the road crossing was designed to handle the 100-year flow of the creek, being 1243 cfs. The culvert run shows a maximum headwater elevation of 181.78, assuming a 25' bottom width channel with 4:1 side slopes on 0.3% grade to the South as tailwater control. This will likely require some channel cleaning and/or widening south of the box.

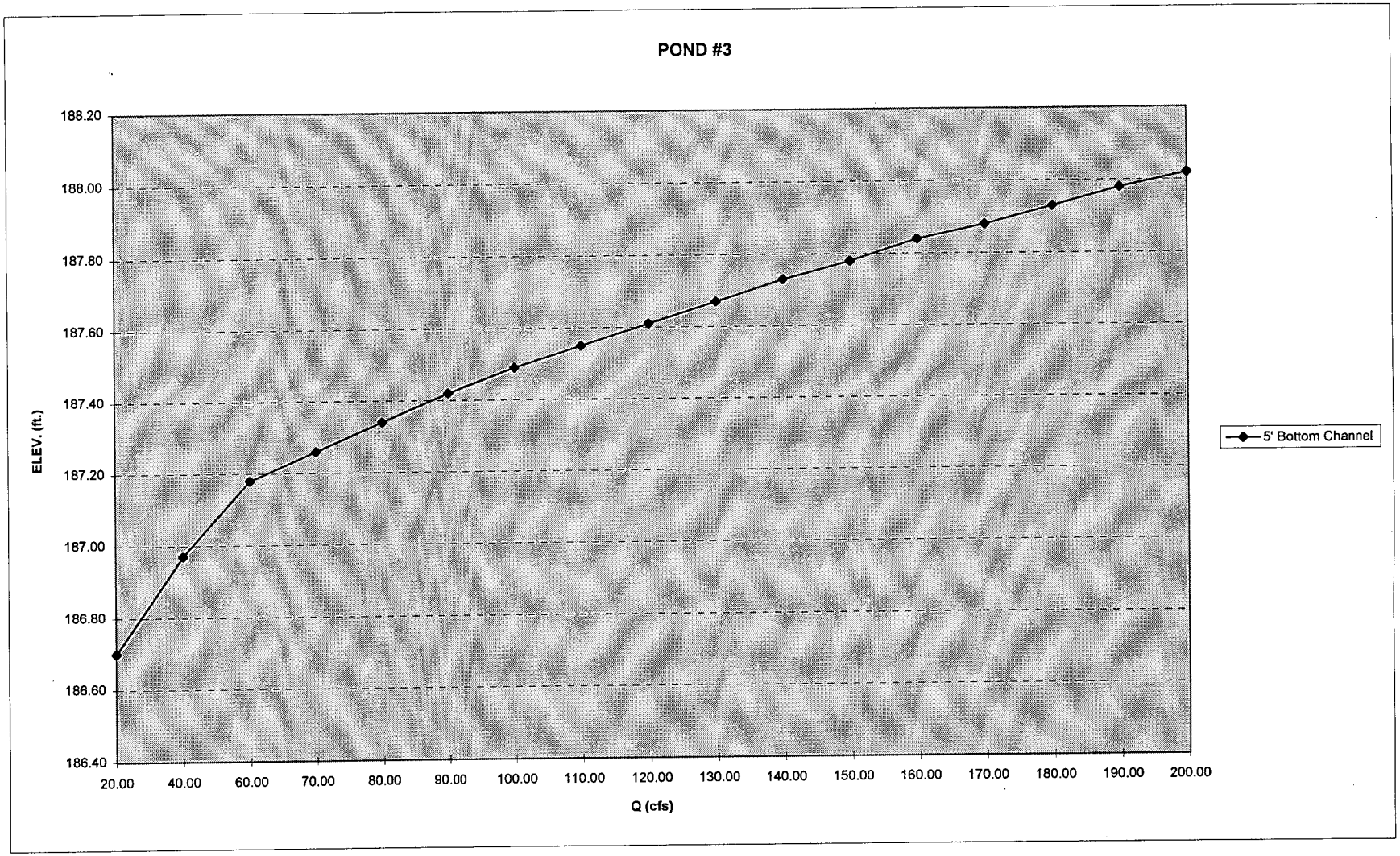
STAGE- DISCHARGE



STAGE-DISCHARGE



STAGE - DISCHARGE



CURRENT DATE: 11-20-1995
CURRENT TIME: 16:44:23

FILE DATE: 11-17-1995
FILE NAME: BRADLEY

FHWA CULVERT ANALYSIS
HY-8, VERSION 3.2

CULV	SITE DATA: INLET ELEV. (FT)	OUTLET ELEV. (FT)	CULVERT LENGTH (FT)	BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	191.00	189.00	250.01	1 RCP	4.50	4.50	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (CFS) FILE: BRADLEY DATE: 11-17-1995

ELEV (FT)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
197.97	100	100	0	0	0	0	0	0	1
198.33	110	110	0	0	0	0	0	0	1
198.72	120	120	0	0	0	0	0	0	1
199.14	130	130	0	0	0	0	0	0	1
199.61	140	140	0	0	0	0	0	0	1
200.08	150	150	0	0	0	0	0	0	1
200.59	160	160	0	0	0	0	0	0	1
201.13	170	170	0	0	0	0	0	0	1
201.70	180	180	0	0	0	0	0	0	1
202.29	190	190	0	0	0	0	0	0	1
205.90	200	200	0	0	0	0	0	0	1
210.00	261	261	0	0	0	0	0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: BRADLEY DATE: 11-17-1995

HEAD ELEV(FT)	HEAD ERROR(FT)	TOTAL FLOW(CFS)	FLOW ERROR(CFS)	% FLOW ERROR
197.97	0.00	100	0	0.00
198.33	0.00	110	0	0.00
198.72	0.00	120	0	0.00
199.14	0.00	130	0	0.00
199.61	0.00	140	0	0.00
200.08	0.00	150	0	0.00
200.59	0.00	160	0	0.00
201.13	0.00	170	0	0.00
201.70	0.00	180	0	0.00
202.29	0.00	190	0	0.00
205.90	0.00	200	0	0.00

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

```
*******************************************
*                                         *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)     *
*              MAY  1991                  *
*            VERSION 4.0.1E               *
*     Lahey F77L-EM/32 version 5.01       *
*       Dodson & Associates, Inc.         *
*  RUN DATE  11/27/95  TIME  10:38:23     *
*******************************************
```

```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 551-1748              *
*                                       *
*****************************************
```

```
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

HEC-1 INPUT

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

  1       ID       Bradley Fair Drainage Plan
  2       ID       5-, 10-, 25-, & 100-Year Storms
  3       ID       Professional Engineering Consultants
  4       ID       Wichita, Ks
  5       ID       DRC 11/20/95
  6       ID       File:  T:\DAR\HEC1\BRADLEY.ih1
  7       IT      6 01FEB95    0600       0 02FEB95    1154
  8       IN     30 01FEB95    0600
  9       IO      3       0
 10       JR    PREC  0.5902  0.6875  0.8125   1.000
          *DIAGRAM
          *

 11       KK   UNDEV        UNDEVELOPED CONDITIONS
 12       BA  .08906
 13       PB    7.8
 14       PC   0.08    .09    .10    .11    .12    .133   .147   .163   .181   .204
 15       PC   .235    .283   .663   .735   .772   .799   .820   .835   .850   .865
 16       PC   .880    .890   .900   .910   .916   .925   .934   .943   .952   .958
 17       PC   .964    .970   .976   .982   .988   .994  1.000
 18       LS      0     76      0
 19       UD   0.20
          *
          *

 20       KK  BASIN1        COMMERCIAL DEVELOPED CONDITIONS
 21       BA  .08906
 22       PB    7.8
 23       PC   0.08    .09    .10    .11    .12    .133   .147   .163   .181   .204
 24       PC   .235    .283   .663   .735   .772   .799   .820   .835   .850   .865
 25       PC   .880    .890   .900   .910   .916   .925   .934   .943   .952   .958
 26       PC   .964    .970   .976   .982   .988   .994  1.000
 27       LS      0     92      0
 28       UD   0.15
          *
          *
          * 54" OUTLET PIPE FOR POND #1

 29       KK   POND1
 30       RS      1    ELEV    198
 31       SA   2.75    3.5
 32       SE    198    201
 33       SQ      0     40     60     80     90    100    110    120    130    140
 34       SQ    150    160    170    180    190    200
 35       SE  198.0  198.65  198.9 199.05 199.15 199.25  199.3  199.4  199.5  199.6
 36       SE  200.1  200.6 201.15  201.7 202.35  205.9
          *
          *

 37       KK  BASIN2        COMMERCIAL DEVELOPED CONDITIONS
 38       BA  0.004
 39       PB    7.8
 40       PC   0.08    .09    .10    .11    .12    .133   .147   .163   .181   .204
 41       PC   .235    .283   .663   .735   .772   .799   .820   .835   .850   .865
 42       PC   .880    .890   .900   .910   .916   .925   .934   .943   .952   .958
```

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

  43      PC   .964   .970   .976   .982   .988   .994  1.000
  44      LS     0     92     0
  45      UD  0.15
          *
          *

  46      KK  INTO2       COMBINE HYDROGRAPHS FOR BASIN 2 AND OUT OF POND #1
  47      HC     2
          *
          *
          * 5' SPILLWAY FOR POND #2

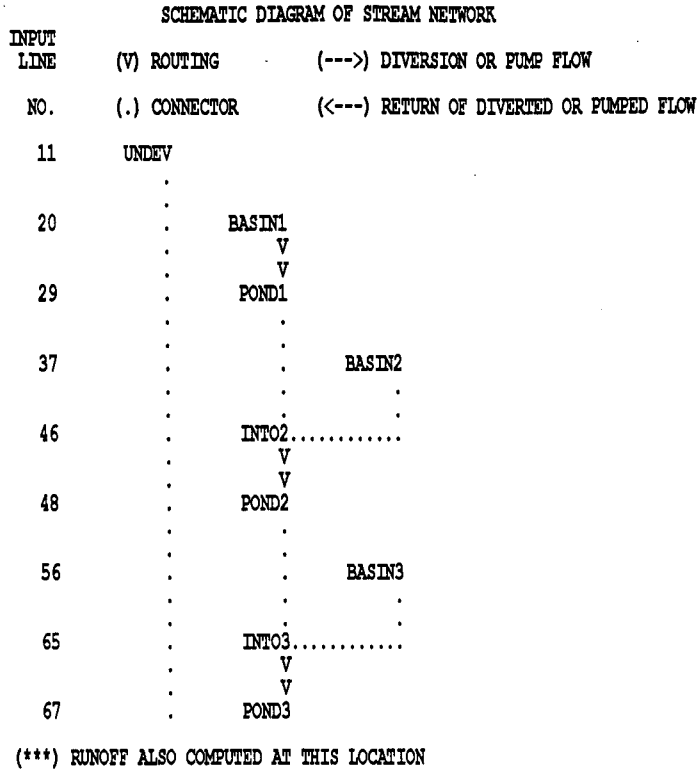
  48      KK  POND2
  49      RS     1   ELEV   195
  50      SA   0.5    0.8
  51      SE   195    197
  52      SQ     0     40     60     80     90    100    110    120    130    140
  53      SQ   150    160    170    180    190    200
  54      SE   195 195.95 196.18 196.35 196.42  196.5 196.56 196.61 196.67 196.72
  55      SE 196.78 196.84 196.89 196.93 196.98 197.02
          *
          *

  56      KK  BASIN3      COMMERCIAL DEVELOPED CONDITIONS
  57      BA  .00456
  58      PB   7.8
  59      PC  0.08   .09   .10   .11   .12   .133  .147  .163  .181  .204
  60      PC  .235   .283  .663  .735  .772  .799  .820  .835  .850  .865
  61      PC  .880   .890  .900  .910  .916  .925  .934  .943  .952  .958
  62      PC  .964   .970  .976  .982  .988  .994 1.000
  63      LS    0     92     0
  64      UD 0.15
          *
          *

  65      KK  INTO3       COMBINE HYDROGRAPHS FOR BASIN 3 AND OUT OF POND #2
  66      HC     2
          *
          *
          * 5' SPILLWAY FOR POND #3

  67      KK  POND3
  68      RS     1   ELEV   186
  69      SA   0.5    0.8
  70      SE   186    189
  71      SQ     0     40     60     80     90    100    110    120    130    140
  72      SQ   150    160    170    180    190    200
  73      SE   186 186.95 187.18 187.35 187.42  187.5 187.56 187.61 187.67 187.72
  74      SE 187.78 187.84 187.89 187.93 187.98 188.02
          *
  75      ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK



(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*******************************************
*                                         *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1)      *
*             MAY  1991                   *
*          VERSION 4.0.1E                 *
*    Lahey F77L-EM/32 version 5.01        *
*      Dodson & Associates, Inc.          *
* RUN DATE  11/27/95  TIME  10:38:23      *
*******************************************
```

```
*****************************************
*                                       *
*   U.S. ARMY CORPS OF ENGINEERS        *
*   HYDROLOGIC ENGINEERING CENTER       *
*        609 SECOND STREET              *
*      DAVIS, CALIFORNIA 95616          *
*          (916) 551-1748               *
*                                       *
*****************************************
```

Bradley Fair Drainage Plan
5-, 10-, 25-, & 100-Year Storms
Professional Engineering Consultants
Wichita, Ks
DRC 11/20/95
File: T:\DAR\HEC1\BRADLEY.ih1

```
 9 IO         OUTPUT CONTROL VARIABLES
                   IPRNT          3  PRINT CONTROL
                   IPLOT          0  PLOT CONTROL
                   QSCAL         0.  HYDROGRAPH PLOT SCALE

  IT         HYDROGRAPH TIME DATA
                    NMIN          6  MINUTES IN COMPUTATION INTERVAL
                   IDATE     1FEB95  STARTING DATE
                   ITIME       0600  STARTING TIME
                      NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                  NDDATE     2FEB95  ENDING DATE
                  NDTIME       1154  ENDING TIME
                   ICENT         19  CENTURY MARK

               COMPUTATION INTERVAL    0.10 HOURS
                   TOTAL TIME BASE   29.90 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
            0.59     0.69     0.81     1.00
```

*** ***

```
          **************
          *            *
 11 KK    *    UNDEV   *          UNDEVELOPED CONDITIONS
          *            *
          **************

  8 IN       TIME DATA FOR INPUT TIME SERIES
                  JXMIN          30  TIME INTERVAL IN MINUTES
                 JXDATE     1FEB95  STARTING DATE
                 JXTIME        600  STARTING TIME

           SUBBASIN RUNOFF DATA

 12 BA       SUBBASIN CHARACTERISTICS
                  TAREA        0.09  SUBBASIN AREA

           PRECIPITATION DATA

 13 PB            STORM        7.80  BASIN TOTAL PRECIPITATION

 14 PI         INCREMENTAL PRECIPITATION PATTERN
```

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.08	0.08	0.08	0.08	0.08
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

18 LS SCS LOSS RATE

STRTL	0.63	INITIAL ABSTRACTION
CRVNBR	76.00	CURVE NUMBER
RTIMP	0.00	PERCENT IMPERVIOUS AREA

19 UD SCS DIMENSIONLESS UNITGRAPH

TLAG 0.20 LAG

***

UNIT HYDROGRAPH
12 END-OF-PERIOD ORDINATES

54.	161.	161.	97.	49.	25.	13.	7.	4.	2.
1.	0.								

TOTAL RAINFALL = 7.80, TOTAL LOSS = 2.82, TOTAL EXCESS = 4.98

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)					
		(CFS)				
+ 242.	6.10		39.	12.	10.	10.
		(INCHES)	4.093	4.976	4.976	4.976
		(AC-FT)	19.	24.	24.	24.

CUMULATIVE AREA = 0.09 SQ MI

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

HYDROGRAPH AT STATION UNDEV
FOR PLAN 1, RATIO = 0.59

TOTAL RAINFALL = 4.60, TOTAL LOSS = 2.39, TOTAL EXCESS = 2.21

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)					
		(CFS)				
+ 106.	6.10		17.	5.	4.	4.
		(INCHES)	1.815	2.213	2.213	2.213
		(AC-FT)	9.	11.	11.	11.

CUMULATIVE AREA = 0.09 SQ MI

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

HYDROGRAPH AT STATION UNDEV
FOR PLAN 1, RATIO = 0.69

TOTAL RAINFALL = 5.36, TOTAL LOSS = 2.53, TOTAL EXCESS = 2.84

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)					
		(CFS)				
+ 138.	6.10		22.	7.	5.	5.
		(INCHES)	2.331	2.837	2.837	2.837
		(AC-FT)	11.	13.	13.	13.

CUMULATIVE AREA = 0.09 SQ MI

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

HYDROGRAPH AT STATION UNDEV
FOR PLAN 1, RATIO = 0.81

TOTAL RAINFALL = 6.34, TOTAL LOSS = 2.66, TOTAL EXCESS = 3.67

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)					
		(CFS)				
+ 179.	6.10		29.	9.	7.	7.
		(INCHES)	3.021	3.673	3.673	3.673
		(AC-FT)	14.	17.	17.	17.

CUMULATIVE AREA = 0.09 SQ MI

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

HYDROGRAPH AT STATION UNDEV
FOR PLAN 1, RATIO = 1.00

TOTAL RAINFALL = 7.80, TOTAL LOSS = 2.82, TOTAL EXCESS = 4.98

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)					
		(CFS)				
+ 242.	6.10		39.	12.	10.	10.
		(INCHES)	4.093	4.976	4.976	4.976
		(AC-FT)	19.	24.	24.	24.

CUMULATIVE AREA = 0.09 SQ MI

*** ***

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           **************
           *            *
20 KK      *   BASIN1   *          COMMERCIAL DEVELOPED CONDITIONS
           *            *
           **************
```

8 IN TIME DATA FOR INPUT TIME SERIES

JXMIN	30	TIME INTERVAL IN MINUTES
JXDATE	1FEB95	STARTING DATE
JXTIME	600	STARTING TIME

SUBBASIN RUNOFF DATA

21 BA SUBBASIN CHARACTERISTICS

TAREA 0.09 SUBBASIN AREA

PRECIPITATION DATA

22 PB STORM 7.80 BASIN TOTAL PRECIPITATION

23 PI INCREMENTAL PRECIPITATION PATTERN

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.08	0.08	0.08	0.08	0.08
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

```
                 0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                 0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                 0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00

  27 LS         SCS LOSS RATE
                    STRTL        0.17  INITIAL ABSTRACTION
                    CRVNBR      92.00  CURVE NUMBER
                    RTIMP        0.00  PERCENT IMPERVIOUS AREA

  28 UD         SCS DIMENSIONLESS UNITGRAPH
                    TLAG         0.15  LAG

                                                     ***

                                                UNIT HYDROGRAPH
                                             10 END-OF-PERIOD ORDINATES
            102.    217.    147.     61.     28.     12.      5.      2.      1.      0.

     TOTAL RAINFALL =    7.80, TOTAL LOSS =    0.95, TOTAL EXCESS =    6.85

   PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR      29.90-HR
 +   (CFS)       (HR)
                             (CFS)
 +    343.       6.00                  53.         16.         13.          13.
                          (INCHES)   5.534       6.846       6.846        6.846
                           (AC-FT)     26.         33.         33.          33.

                          CUMULATIVE AREA =     0.09 SQ MI


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

                           HYDROGRAPH AT STATION    BASIN1
                            FOR PLAN 1, RATIO = 0.59

     TOTAL RAINFALL =    4.60, TOTAL LOSS =    0.90, TOTAL EXCESS =    3.70

   PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR      29.90-HR
 +   (CFS)       (HR)
                             (CFS)
 +    191.       6.00                  29.          9.          7.           7.
                          (INCHES)   3.026       3.703       3.703        3.703
                           (AC-FT)     14.         18.         18.          18.

                          CUMULATIVE AREA =     0.09 SQ MI


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

                           HYDROGRAPH AT STATION    BASIN1
                            FOR PLAN 1, RATIO = 0.69

     TOTAL RAINFALL =    5.36, TOTAL LOSS =    0.92, TOTAL EXCESS =    4.44

   PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR      29.90-HR
 +   (CFS)       (HR)
                             (CFS)
 +    227.       6.00                  35.         11.          9.           9.
                          (INCHES)   3.622       4.444       4.444        4.444
                           (AC-FT)     17.         21.         21.          21.

                          CUMULATIVE AREA =     0.09 SQ MI


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

                           HYDROGRAPH AT STATION    BASIN1
                            FOR PLAN 1, RATIO = 0.81

     TOTAL RAINFALL =    6.34, TOTAL LOSS =    0.94, TOTAL EXCESS =    5.40

   PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                    6-HR        24-HR       72-HR      29.90-HR
 +   (CFS)       (HR)
                             (CFS)
 +    274.       6.00                  42.         13.         10.          10.
                          (INCHES)   4.388       5.402       5.402        5.402
```

```
                         (AC-FT)      21.        26.        26.         26.

                         CUMULATIVE AREA =    0.09 SQ MI


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

                          HYDROGRAPH AT STATION   BASIN1
                            FOR PLAN 1, RATIO = 1.00

    TOTAL RAINFALL =    7.80, TOTAL LOSS =    0.95, TOTAL EXCESS =    6.85

  PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR      72-HR      29.90-HR
+   (CFS)       (HR)
                           (CFS)
+     343.      6.00                  53.         16.        13.         13.
                         (INCHES)    5.534       6.846      6.846       6.846
                          (AC-FT)     26.         33.        33.         33.

                         CUMULATIVE AREA =    0.09 SQ MI


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

              **************
              *            *
   29 KK      *    POND1   *
              *            *
              **************

                HYDROGRAPH ROUTING DATA

   30 RS          STORAGE ROUTING
                       NSTPS           1  NUMBER OF SUBREACHES
                        ITYP        ELEV  TYPE OF INITIAL CONDITION
                      RSVRIC      198.00  INITIAL CONDITION
                           X        0.00  WORKING R AND D COEFFICIENT

   31 SA             AREA         2.8        3.5

   32 SE          ELEVATION     198.00     201.00

   33 SQ          DISCHARGE       0.         40.        60.        80.        90.       100.       110.       120.       130.       140.
                                150.       160.       170.       180.       190.       200.

   35 SE          ELEVATION     198.00     198.65     198.90     199.05     199.15     199.25     199.30     199.40     199.50     199.60
                                200.10     200.60     201.15     201.70     202.35     205.90

                                                          ***

                                                 COMPUTED STORAGE-ELEVATION DATA

              STORAGE      0.00      9.35
            ELEVATION    198.00    201.00

                                               COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

              STORAGE      0.00      1.84      2.57      3.02      3.32      3.62      3.78      4.08      4.39      4.71
              OUTFLOW      0.00     40.00     60.00     80.00     90.00    100.00    110.00    120.00    130.00    140.00
            ELEVATION    198.00    198.65    198.90    199.05    199.15    199.25    199.30    199.40    199.50    199.60

              STORAGE      6.31      7.97      9.35      9.88     11.87     14.32     29.88
              OUTFLOW    150.00    160.00    167.27    170.00    180.00    190.00    200.00
            ELEVATION    200.10    200.60    201.00    201.15    201.70    202.35    205.90

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

                          HYDROGRAPH AT STATION    POND1
                            FOR PLAN 1, RATIO = 0.59

  PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR      72-HR      29.90-HR
+   (CFS)       (HR)
                           (CFS)
+     128.      6.20                  29.          9.         7.          7.
                         (INCHES)    3.006       3.703      3.703       3.703
```

	(AC-FT)	14.	18.	18.	18.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (AC-FT)	(HR)				
4.	6.20	1.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (FEET)	(HR)				
199.48	6.20	198.41	198.13	198.10	198.10

CUMULATIVE AREA = 0.09 SQ MI

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

HYDROGRAPH AT STATION POND1
FOR PLAN 1, RATIO = 0.69

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)				
		(CFS)			
+ 143.	6.20	34.	11.	9.	9.
		(INCHES) 3.599	4.444	4.444	4.444
		(AC-FT) 17.	21.	21.	21.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (AC-FT)	(HR)				
5.	6.20	1.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (FEET)	(HR)				
199.75	6.20	198.48	198.15	198.12	198.12

CUMULATIVE AREA = 0.09 SQ MI

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

HYDROGRAPH AT STATION POND1
FOR PLAN 1, RATIO = 0.81

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)				
		(CFS)			
+ 151.	6.20	42.	13.	10.	10.
		(INCHES) 4.361	5.402	5.402	5.402
		(AC-FT) 21.	26.	26.	26.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (AC-FT)	(HR)				
7.	6.20	2.	1.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (FEET)	(HR)				
200.17	6.20	198.59	198.19	198.15	198.15

CUMULATIVE AREA = 0.09 SQ MI

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

HYDROGRAPH AT STATION POND1
FOR PLAN 1, RATIO = 1.00

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)				
		(CFS)			
+ 165.	6.20	53.	16.	13.	13.
		(INCHES) 5.503	6.846	6.846	6.846
		(AC-FT) 26.	33.	33.	33.

```
 PEAK STORAGE   TIME                  MAXIMUM AVERAGE STORAGE
                              6-HR       24-HR      72-HR     29.90-HR
+  (AC-FT)      (HR)
        9.      6.20           2.          1.         1.          1.

  PEAK STAGE    TIME                  MAXIMUM AVERAGE STAGE
                              6-HR       24-HR      72-HR     29.90-HR
+  (FEET)       (HR)
   200.85       6.20         198.79     198.25     198.20     198.20

                  CUMULATIVE AREA =    0.09 SQ MI


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

             **************
             *            *
  37 KK      *   BASIN2   *          COMMERCIAL DEVELOPED CONDITIONS
             *            *
             **************

   8 IN          TIME DATA FOR INPUT TIME SERIES
                    JXMIN        30  TIME INTERVAL IN MINUTES
                   JXDATE    1FEB95  STARTING DATE
                   JXTIME       600  STARTING TIME

                SUBBASIN RUNOFF DATA

  38 BA          SUBBASIN CHARACTERISTICS
                    TAREA      0.00  SUBBASIN AREA

                 PRECIPITATION DATA

  39 PB             STORM      7.80  BASIN TOTAL PRECIPITATION

  40 PI            INCREMENTAL PRECIPITATION PATTERN
                   0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                   0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                   0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                   0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                   0.00     0.00     0.00     0.00     0.00     0.01     0.01     0.01     0.01     0.01
                   0.01     0.01     0.01     0.01     0.01     0.08     0.08     0.08     0.08     0.08
                   0.01     0.01     0.01     0.01     0.01     0.01     0.01     0.01     0.01     0.01
                   0.01     0.01     0.01     0.01     0.01     0.00     0.00     0.00     0.00     0.00
                   0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                   0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                   0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                   0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                   0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                   0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                   0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                   0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                   0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                   0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00

  44 LS          SCS LOSS RATE
                    STRTL      0.17  INITIAL ABSTRACTION
                   CRVNBR     92.00  CURVE NUMBER
                    RTIMP      0.00  PERCENT IMPERVIOUS AREA

  45 UD          SCS DIMENSIONLESS UNITGRAPH
                     TLAG      0.15  LAG

                                             ***

                                        UNIT HYDROGRAPH
                                   10 END-OF-PERIOD ORDINATES
               5.      10.      7.      3.      1.      1.      0.      0.      0.      0.

      TOTAL RAINFALL =    7.80, TOTAL LOSS =    0.95, TOTAL EXCESS =    6.85

   PEAK FLOW     TIME                 MAXIMUM AVERAGE FLOW
                              6-HR       24-HR      72-HR     29.90-HR
+   (CFS)        (HR)
                         (CFS)
+      15.       6.00                2.          1.         1.          1.
                     (INCHES)     5.534       6.846      6.846       6.846
```

(AC-FT)	1.	1.	1.	1.

CUMULATIVE AREA = 0.00 SQ MI

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

HYDROGRAPH AT STATION BASIN2
FOR PLAN 1, RATIO = 0.59

TOTAL RAINFALL = 4.60, TOTAL LOSS = 0.90, TOTAL EXCESS = 3.70

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)				
		(CFS)			
+ 9.	6.00	1.	0.	0.	0.
		(INCHES) 3.026	3.703	3.703	3.703
		(AC-FT) 1.	1.	1.	1.

CUMULATIVE AREA = 0.00 SQ MI

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

HYDROGRAPH AT STATION BASIN2
FOR PLAN 1, RATIO = 0.69

TOTAL RAINFALL = 5.36, TOTAL LOSS = 0.92, TOTAL EXCESS = 4.44

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)				
		(CFS)			
+ 10.	6.00	2.	0.	0.	0.
		(INCHES) 3.622	4.444	4.444	4.444
		(AC-FT) 1.	1.	1.	1.

CUMULATIVE AREA = 0.00 SQ MI

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

HYDROGRAPH AT STATION BASIN2
FOR PLAN 1, RATIO = 0.81

TOTAL RAINFALL = 6.34, TOTAL LOSS = 0.94, TOTAL EXCESS = 5.40

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)				
		(CFS)			
+ 12.	6.00	2.	1.	0.	0.
		(INCHES) 4.388	5.402	5.402	5.402
		(AC-FT) 1.	1.	1.	1.

CUMULATIVE AREA = 0.00 SQ MI

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

HYDROGRAPH AT STATION BASIN2
FOR PLAN 1, RATIO = 1.00

TOTAL RAINFALL = 7.80, TOTAL LOSS = 0.95, TOTAL EXCESS = 6.85

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)				
		(CFS)			
+ 15.	6.00	2.	1.	1.	1.
		(INCHES) 5.534	6.846	6.846	6.846
		(AC-FT) 1.	1.	1.	1.

CUMULATIVE AREA = 0.00 SQ MI

*** ***

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            **************
            *            *
  46 KK     *    INTO2   *         COMBINE HYDROGRAPHS FOR BASIN 2 AND OUT OF POND #1
            *            *
            **************

  47 HC         HYDROGRAPH COMBINATION
                    ICOMP          2  NUMBER OF HYDROGRAPHS TO COMBINE
                                                                   ***

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

                         HYDROGRAPH AT STATION    INTO2
                           FOR PLAN 1, RATIO = 0.59

  PEAK FLOW      TIME                        MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR       29.90-HR
+   (CFS)        (HR)
                              (CFS)
+    133.        6.20                    30.          9.          7.           7.
                            (INCHES)   3.006       3.703       3.703       3.703
                             (AC-FT)     15.         18.         18.          18.

                         CUMULATIVE AREA =     0.09 SQ MI

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

                         HYDROGRAPH AT STATION    INTO2
                           FOR PLAN 1, RATIO = 0.69

  PEAK FLOW      TIME                        MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR       29.90-HR
+   (CFS)        (HR)
                              (CFS)
+    151.        6.10                    36.         11.          9.           9.
                            (INCHES)   3.599       4.444       4.444       4.444
                             (AC-FT)     18.         22.         22.          22.

                         CUMULATIVE AREA =     0.09 SQ MI

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

                         HYDROGRAPH AT STATION    INTO2
                           FOR PLAN 1, RATIO = 0.81

  PEAK FLOW      TIME                        MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR       29.90-HR
+   (CFS)        (HR)
                              (CFS)
+    160.        6.10                    44.         14.         11.          11.
                            (INCHES)   4.361       5.402       5.402       5.402
                             (AC-FT)     22.         27.         27.          27.

                         CUMULATIVE AREA =     0.09 SQ MI

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

                         HYDROGRAPH AT STATION    INTO2
                           FOR PLAN 1, RATIO = 1.00

  PEAK FLOW      TIME                        MAXIMUM AVERAGE FLOW
                                        6-HR        24-HR       72-HR       29.90-HR
+   (CFS)        (HR)
                              (CFS)
+    174.        6.10                    55.         17.         14.          14.
                            (INCHES)   5.503       6.846       6.846       6.846
                             (AC-FT)     27.         34.         34.          34.

                         CUMULATIVE AREA =     0.09 SQ MI


*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***
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              **************
              *            *
 48 KK        *    POND2   *
              *            *
              **************

                HYDROGRAPH ROUTING DATA

 49 RS            STORAGE ROUTING
                       NSTPS          1  NUMBER OF SUBREACHES
                        ITYP       ELEV  TYPE OF INITIAL CONDITION
                      RSVRIC     195.00  INITIAL CONDITION
                           X       0.00  WORKING R AND D COEFFICIENT

 50 SA                  AREA        0.5       0.8

 51 SE            ELEVATION      195.00    197.00

 52 SQ            DISCHARGE          0.       40.       60.       80.       90.      100.      110.      120.      130.      140.
                                   150.      160.      170.      180.      190.      200.

 54 SE            ELEVATION      195.00    195.95    196.18    196.35    196.42    196.50    196.56    196.61    196.67    196.72
                                 196.78    196.84    196.89    196.93    196.98    197.02

                                                        ***

                                            COMPUTED STORAGE-ELEVATION DATA

           STORAGE       0.00      1.29
         ELEVATION     195.00    197.00

                                        COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

           STORAGE       0.00      0.54      0.69      0.80      0.85      0.91      0.95      0.99      1.03      1.07
           OUTFLOW       0.00     40.00     60.00     80.00     90.00    100.00    110.00    120.00    130.00    140.00
         ELEVATION     195.00    195.95    196.18    196.35    196.42    196.50    196.56    196.61    196.67    196.72

           STORAGE       1.12      1.16      1.20      1.23      1.27      1.29      1.30
           OUTFLOW     150.00    160.00    170.00    180.00    190.00    195.00    200.00
         ELEVATION     196.78    196.84    196.89    196.93    196.98    197.00    197.02

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN       110. TO       200.
                THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
                THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

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

                          HYDROGRAPH AT STATION     POND2
                           FOR PLAN 1, RATIO = 0.59

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                       6-HR         24-HR        72-HR       29.90-HR
 +   (CFS)       (HR)
                             (CFS)
 +     132.      6.20                    30.           9.           7.            7.
                          (INCHES)     3.005        3.703        3.703         3.703
                           (AC-FT)       15.          18.          18.           18.

  PEAK STORAGE   TIME                         MAXIMUM AVERAGE STORAGE
                                       6-HR         24-HR        72-HR       29.90-HR
 +  (AC-FT)      (HR)
        1.       6.20                     0.           0.           0.            0.

   PEAK STAGE    TIME                          MAXIMUM AVERAGE STAGE
                                       6-HR         24-HR        72-HR       29.90-HR
 +   (FEET)      (HR)
    196.68       6.20                 195.57       195.18       195.15        195.15

                          CUMULATIVE AREA =      0.09 SQ MI

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

                          HYDROGRAPH AT STATION     POND2
                           FOR PLAN 1, RATIO = 0.69

   PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                       6-HR         24-HR        72-HR       29.90-HR
```

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+   (CFS)       (HR)
                          (CFS)
+    150.       6.20                 36.         11.         9.          9.
                          (INCHES)   3.597       4.444       4.444       4.444
                          (AC-FT)    18.         22.         22.         22.

 PEAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
                                     6-HR        24-HR       72-HR       29.90-HR
+  (AC-FT)      (HR)
       1.       6.20                 0.          0.          0.          0.

  PEAK STAGE    TIME                       MAXIMUM AVERAGE STAGE
                                     6-HR        24-HR       72-HR       29.90-HR
+  (FEET)       (HR)
   196.78       6.20                 195.65      195.21      195.17      195.17

                          CUMULATIVE AREA =    0.09 SQ MI

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

                          HYDROGRAPH AT STATION    POND2
                            FOR PLAN 1, RATIO = 0.81

  PEAK FLOW     TIME                       MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR       29.90-HR
+   (CFS)       (HR)
                          (CFS)
+    159.       6.20                 44.         14.         11.         11.
                          (INCHES)   4.359       5.402       5.402       5.402
                          (AC-FT)    22.         27.         27.         27.

 PEAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
                                     6-HR        24-HR       72-HR       29.90-HR
+  (AC-FT)      (HR)
       1.       6.20                 0.          0.          0.          0.

  PEAK STAGE    TIME                       MAXIMUM AVERAGE STAGE
                                     6-HR        24-HR       72-HR       29.90-HR
+  (FEET)       (HR)
   196.83       6.20                 195.74      195.25      195.20      195.20

                          CUMULATIVE AREA =    0.09 SQ MI

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

                          HYDROGRAPH AT STATION    POND2
                            FOR PLAN 1, RATIO = 1.00

  PEAK FLOW     TIME                       MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR       29.90-HR
+   (CFS)       (HR)
                          (CFS)
+    174.       6.20                 55.         17.         14.         14.
                          (INCHES)   5.500       6.846       6.846       6.846
                          (AC-FT)    27.         34.         34.         34.

 PEAK STORAGE   TIME                       MAXIMUM AVERAGE STORAGE
                                     6-HR        24-HR       72-HR       29.90-HR
+  (AC-FT)      (HR)
       1.       6.20                 1.          0.          0.          0.

  PEAK STAGE    TIME                       MAXIMUM AVERAGE STAGE
                                     6-HR        24-HR       72-HR       29.90-HR
+  (FEET)       (HR)
   196.91       6.20                 195.87      195.30      195.24      195.24

                          CUMULATIVE AREA =    0.09 SQ MI


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

              **************
              *            *
  56 KK       *   BASIN3   *            COMMERCIAL DEVELOPED CONDITIONS
              *            *
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              **************

    8 IN          TIME DATA FOR INPUT TIME SERIES
                      JXMIN         30  TIME INTERVAL IN MINUTES
                      JXDATE    1FEB95  STARTING DATE
                      JXTIME       600  STARTING TIME

                SUBBASIN RUNOFF DATA

   57 BA          SUBBASIN CHARACTERISTICS
                      TAREA       0.00  SUBBASIN AREA

                  PRECIPITATION DATA

   58 PB              STORM       7.80  BASIN TOTAL PRECIPITATION

   59 PI            INCREMENTAL PRECIPITATION PATTERN
                      0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                      0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                      0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                      0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                      0.00     0.00     0.00     0.00     0.00     0.01     0.01     0.01     0.01     0.01
                      0.01     0.01     0.01     0.01     0.01     0.08     0.08     0.08     0.08     0.08
                      0.01     0.01     0.01     0.01     0.01     0.01     0.01     0.01     0.01     0.01
                      0.01     0.01     0.01     0.01     0.01     0.00     0.00     0.00     0.00     0.00
                      0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                      0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                      0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                      0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                      0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                      0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                      0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                      0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                      0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                      0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00

   63 LS          SCS LOSS RATE
                      STRTL       0.17  INITIAL ABSTRACTION
                      CRVNBR     92.00  CURVE NUMBER
                      RTIMP       0.00  PERCENT IMPERVIOUS AREA

   64 UD          SCS DIMENSIONLESS UNITGRAPH
                      TLAG        0.15  LAG

                                                   ***

                                           UNIT HYDROGRAPH
                                       10 END-OF-PERIOD ORDINATES
                 5.       11.       8.       3.       1.       1.       0.       0.       0.       0.

      TOTAL RAINFALL =     7.80, TOTAL LOSS =     0.95, TOTAL EXCESS =     6.85

    PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR      29.90-HR
  +   (CFS)       (HR)
                            (CFS)
  +      18.       6.00                3.          1.          1.          1.
                          (INCHES)   5.534       6.846       6.846       6.846
                           (AC-FT)     1.          2.          2.          2.

                          CUMULATIVE AREA =     0.00 SQ MI

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

                              HYDROGRAPH AT STATION    BASIN3
                                FOR PLAN 1, RATIO = 0.59

      TOTAL RAINFALL =     4.60, TOTAL LOSS =     0.90, TOTAL EXCESS =     3.70

    PEAK FLOW     TIME                        MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR       72-HR      29.90-HR
  +   (CFS)       (HR)
                            (CFS)
  +      10.       6.00                1.          0.          0.          0.
                          (INCHES)   3.026       3.703       3.703       3.703
                           (AC-FT)     1.          1.          1.          1.

                          CUMULATIVE AREA =     0.00 SQ MI
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    ***            ***            ***            ***            ***

                    HYDROGRAPH AT STATION   BASIN3
                     FOR PLAN 1, RATIO = 0.69

   TOTAL RAINFALL =    5.36, TOTAL LOSS =    0.92, TOTAL EXCESS =    4.44

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR      29.90-HR
+   (CFS)       (HR)
                          (CFS)
+     12.       6.00                    2.          1.          0.           0.
                         (INCHES)    3.622       4.444       4.444        4.444
                         (AC-FT)        1.          1.          1.           1.

                         CUMULATIVE AREA =     0.00 SQ MI

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

                    HYDROGRAPH AT STATION   BASIN3
                     FOR PLAN 1, RATIO = 0.81

   TOTAL RAINFALL =    6.34, TOTAL LOSS =    0.94, TOTAL EXCESS =    5.40

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR      29.90-HR
+   (CFS)       (HR)
                          (CFS)
+     14.       6.00                    2.          1.          1.           1.
                         (INCHES)    4.388       5.402       5.402        5.402
                         (AC-FT)        1.          1.          1.           1.

                         CUMULATIVE AREA =     0.00 SQ MI

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

                    HYDROGRAPH AT STATION   BASIN3
                     FOR PLAN 1, RATIO = 1.00

   TOTAL RAINFALL =    7.80, TOTAL LOSS =    0.95, TOTAL EXCESS =    6.85

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR      29.90-HR
+   (CFS)       (HR)
                          (CFS)
+     18.       6.00                    3.          1.          1.           1.
                         (INCHES)    5.534       6.846       6.846        6.846
                         (AC-FT)        1.          2.          2.           2.

                         CUMULATIVE AREA =     0.00 SQ MI


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

              **************
              *            *
  65 KK       *    INTO3   *          COMBINE HYDROGRAPHS FOR BASIN 3 AND OUT OF POND #2
              *            *
              **************

  66 HC          HYDROGRAPH COMBINATION
                     ICOMP           2  NUMBER OF HYDROGRAPHS TO COMBINE
                                                                ***

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

                    HYDROGRAPH AT STATION    INTO3
                     FOR PLAN 1, RATIO = 0.59

  PEAK FLOW     TIME                           MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR       72-HR      29.90-HR
+   (CFS)       (HR)
                          (CFS)
```

```
+     137.      6.20              32.        10.         8.          8.
                      (INCHES)  3.004      3.703      3.703       3.703
                      (AC-FT)     16.        19.        19.         19.

                      CUMULATIVE AREA =    0.10 SQ MI

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

                       HYDROGRAPH AT STATION    INTO3
                         FOR PLAN 1, RATIO = 0.69

   PEAK FLOW    TIME                       MAXIMUM AVERAGE FLOW
                                  6-HR       24-HR      72-HR      29.90-HR
 +   (CFS)       (HR)
                       (CFS)
 +    156.      6.20              38.        12.         9.          9.
                      (INCHES)  3.596      4.444      4.444       4.444
                      (AC-FT)     19.        23.        23.         23.

                      CUMULATIVE AREA =    0.10 SQ MI

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

                       HYDROGRAPH AT STATION    INTO3
                         FOR PLAN 1, RATIO = 0.81

   PEAK FLOW    TIME                       MAXIMUM AVERAGE FLOW
                                  6-HR       24-HR      72-HR      29.90-HR
 +   (CFS)       (HR)
                       (CFS)
 +    169.      6.10              46.        14.        11.         11.
                      (INCHES)  4.358      5.402      5.402       5.402
                      (AC-FT)     23.        28.        28.         28.

                      CUMULATIVE AREA =    0.10 SQ MI

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

                       HYDROGRAPH AT STATION    INTO3
                         FOR PLAN 1, RATIO = 1.00

   PEAK FLOW    TIME                       MAXIMUM AVERAGE FLOW
                                  6-HR       24-HR      72-HR      29.90-HR
 +   (CFS)       (HR)
                       (CFS)
 +    187.      6.10              58.        18.        14.         14.
                      (INCHES)  5.500      6.846      6.846       6.846
                      (AC-FT)     29.        36.        36.         36.

                      CUMULATIVE AREA =    0.10 SQ MI


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

                **************
                *            *
   67 KK        *    POND3   *
                *            *
                **************

                  HYDROGRAPH ROUTING DATA

   68 RS            STORAGE ROUTING
                        NSTPS          1  NUMBER OF SUBREACHES
                         ITYP       ELEV  TYPE OF INITIAL CONDITION
                       RSVRIC     186.00  INITIAL CONDITION
                            X       0.00  WORKING R AND D COEFFICIENT

   69 SA                 AREA        0.5        0.8

   70 SE            ELEVATION     186.00     189.00

   71 SQ            DISCHARGE         0.        40.        60.        80.        90.       100.       110.       120.       130.       140.
                                    150.       160.       170.       180.       190.       200.
```

73 SE	ELEVATION	186.00	186.95	187.18	187.35	187.42	187.50	187.56	187.61	187.67	187.72
		187.78	187.84	187.89	187.93	187.98	188.02				

***

COMPUTED STORAGE-ELEVATION DATA

STORAGE	0.00	1.93
ELEVATION	186.00	189.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.52	0.65	0.76	0.80	0.85	0.89	0.92	0.96	1.00
OUTFLOW	0.00	40.00	60.00	80.00	90.00	100.00	110.00	120.00	130.00	140.00
ELEVATION	186.00	186.95	187.18	187.35	187.42	187.50	187.56	187.61	187.67	187.72
STORAGE	1.04	1.08	1.11	1.14	1.17	1.20	1.93			
OUTFLOW	150.00	160.00	170.00	180.00	190.00	200.00	444.95			
ELEVATION	187.78	187.84	187.89	187.93	187.98	188.02	189.00			

*** WARNING *** MODIFIED PULS ROUTING MAY BE NUMERICALLY UNSTABLE FOR OUTFLOWS BETWEEN 100. TO 445.
THE ROUTED HYDROGRAPH SHOULD BE EXAMINED FOR OSCILLATIONS OR OUTFLOWS GREATER THAN PEAK INFLOWS.
THIS CAN BE CORRECTED BY DECREASING THE TIME INTERVAL OR INCREASING STORAGE (USE A LONGER REACH.)

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

HYDROGRAPH AT STATION POND3
FOR PLAN 1, RATIO = 0.59

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)	(CFS)				
+ 134.	6.20		32.	10.	8.	8.
		(INCHES)	3.003	3.703	3.703	3.703
		(AC-FT)	16.	19.	19.	19.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (AC-FT)	(HR)				
1.	6.20	0.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (FEET)	(HR)				
187.69	6.20	186.60	186.19	186.16	186.16

CUMULATIVE AREA = 0.10 SQ MI

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

HYDROGRAPH AT STATION POND3
FOR PLAN 1, RATIO = 0.69

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)	(CFS)				
+ 156.	6.20		38.	12.	9.	9.
		(INCHES)	3.595	4.444	4.444	4.444
		(AC-FT)	19.	23.	23.	23.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (AC-FT)	(HR)				
1.	6.20	0.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (FEET)	(HR)				
187.81	6.20	186.67	186.22	186.18	186.18

CUMULATIVE AREA = 0.10 SQ MI

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

HYDROGRAPH AT STATION POND3

FOR PLAN 1, RATIO = 0.81

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)					
		(CFS)				
+ 168.	6.20		46.	14.	11.	11.
		(INCHES)	4.356	5.402	5.402	5.402
		(AC-FT)	23.	28.	28.	28.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (AC-FT)	(HR)				
1.	6.20	0.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (FEET)	(HR)				
187.88	6.20	186.77	186.26	186.21	186.21

CUMULATIVE AREA = 0.10 SQ MI

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

HYDROGRAPH AT STATION POND3
FOR PLAN 1, RATIO = 1.00

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)					
		(CFS)				
+ 186.	6.10		58.	18.	14.	14.
		(INCHES)	5.497	6.846	6.846	6.846
		(AC-FT)	29.	36.	36.	36.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (AC-FT)	(HR)				
1.	6.10	1.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (FEET)	(HR)				
187.96	6.10	186.90	186.31	186.25	186.25

CUMULATIVE AREA = 0.10 SQ MI

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

					RATIOS APPLIED TO PRECIPITATION			
OPERATION	STATION	AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4
					0.59	0.69	0.81	1.00
HYDROGRAPH AT								
+	UNDEV	0.09	1	FLOW	106.	138.	179.	242.
				TIME	6.10	6.10	6.10	6.10
HYDROGRAPH AT								
+	BASIN1	0.09	1	FLOW	191.	227.	274.	343.
				TIME	6.00	6.00	6.00	6.00
ROUTED TO								
+	POND1	0.09	1	FLOW	128.	143.	151.	165.
				TIME	6.20	6.20	6.20	6.20
			** PEAK STAGES IN FEET **					
			1	STAGE	199.48	199.75	200.17	200.85
				TIME	6.20	6.20	6.20	6.20
HYDROGRAPH AT								
+	BASIN2	0.00	1	FLOW	9.	10.	12.	15.
				TIME	6.00	6.00	6.00	6.00
2 COMBINED AT								
+	INTO2	0.09	1	FLOW	133.	151.	160.	174.
				TIME	6.20	6.10	6.10	6.10
ROUTED TO								
+	POND2	0.09	1	FLOW	132.	150.	159.	174.
				TIME	6.20	6.20	6.20	6.20
			** PEAK STAGES IN FEET **					
			1	STAGE	196.68	196.78	196.83	196.91
				TIME	6.20	6.20	6.20	6.20
HYDROGRAPH AT								
+	BASIN3	0.00	1	FLOW	10.	12.	14.	18.
				TIME	6.00	6.00	6.00	6.00
2 COMBINED AT								
+	INTO3	0.10	1	FLOW	137.	156.	169.	187.
				TIME	6.20	6.20	6.10	6.10
ROUTED TO								
+	POND3	0.10	1	FLOW	134.	156.	168.	186.
				TIME	6.20	6.20	6.20	6.10
			** PEAK STAGES IN FEET **					
			1	STAGE	187.69	187.81	187.88	187.96
				TIME	6.20	6.20	6.20	6.10

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

POND #4 4-7'x6' RCBB 11-22-1995

CURRENT DATE: 11-22-1995 FILE DATE: 11-21-1995
CURRENT TIME: 08:45:46 FILE NAME: BRADLY#4

FHWA CULVERT ANALYSIS
HY-8, VERSION 3.2

CU LV	SITE DATA: INLET ELEV. (FT)	OUTLET ELEV. (FT)	CULVERT LENGTH (FT)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	175.50	175.00	90.00	4 RCB	7.00	6.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (CFS) FILE: BRADLY#4 DATE: 11-21-1995

ELEV (FT)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
180.77	1000	1000	0	0	0	0	0	0	1
180.85	1024	1024	0	0	0	0	0	0	1
180.94	1049	1049	0	0	0	0	0	0	1
181.03	1073	1073	0	0	0	0	0	0	1
181.12	1097	1097	0	0	0	0	0	0	1
181.21	1122	1122	0	0	0	0	0	0	1
181.30	1146	1146	0	0	0	0	0	0	1
181.39	1170	1170	0	0	0	0	0	0	1
181.48	1194	1194	0	0	0	0	0	0	1
181.62	1219	1219	0	0	0	0	0	0	1
181.78	1243	1243	0	0	0	0	0	0	1
186.00	2189	2189	0	0	0	0	0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: BRADLY#4 DATE: 11-21-1995

HEAD ELEV(FT)	HEAD ERROR(FT)	TOTAL FLOW(CFS)	FLOW ERROR(CFS)	% FLOW ERROR
180.77	0.00	1000	0	0.00
180.85	0.00	1024	0	0.00
180.94	0.00	1049	0	0.00
181.03	0.00	1073	0	0.00
181.12	0.00	1097	0	0.00
181.21	0.00	1122	0	0.00
181.30	0.00	1146	0	0.00
181.39	0.00	1170	0	0.00
181.48	0.00	1194	0	0.00
181.62	0.00	1219	0	0.00
181.78	0.00	1243	0	0.00

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

CURRENT DATE: 11-22-1995 FILE DATE: 11-21-1995
CURRENT TIME: 08:45:46 FILE NAME: BRADLY#4

CULVERT # 1

PERFORMANCE CURVE FOR 4 BARREL(S)

Q (cfs)	HWE (ft)	TWE (ft)	ICH (ft)	OCH (ft)	FLOW TYPE	CCE (ft)	FCE (ft)	TCE (ft)	VO (fps)
1000	180.77	179.91	5.27	4.67	5-S2	0.00	0.00	0.00	11.93
1024	180.85	179.98	5.35	4.84	5-S2	0.00	0.00	0.00	12.01
1049	180.94	180.03	5.44	5.01	5-S2	0.00	0.00	0.00	12.09
1073	181.03	180.09	5.53	5.18	5-S2	0.00	0.00	0.00	12.16
1097	181.12	180.15	5.62	5.35	5-S2	0.00	0.00	0.00	12.24
1122	181.21	180.21	5.71	5.51	5-S2	0.00	0.00	0.00	12.31
1146	181.30	180.26	5.80	5.62	5-S2	0.00	0.00	0.00	12.38
1170	181.39	180.32	5.89	5.79	5-S2	0.00	0.00	0.00	12.45
1194	181.48	180.37	5.98	5.95	5-S2	0.00	0.00	0.00	12.52
1219	181.62	180.43	6.07	6.12	5-S2	0.00	0.00	0.00	8.02
1243	181.78	180.48	6.16	6.28	5-S2	0.00	0.00	0.00	8.10

El. inlet face invert 175.50 ft El. outlet invert 175.00 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

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

INLET STATION (FT)	0.00
INLET ELEVATION (FT)	175.50
OUTLET STATION (FT)	90.00
OUTLET ELEVATION (FT)	175.00
NUMBER OF BARRELS	4.00
SLOPE (V-FT/H-FT)	0.0056
CULVERT LENGTH ALONG SLOPE (FT)	90.00

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

BARREL SHAPE	BOX
BARREL SPAN	7.00 FT
BARREL RISE	6.00 FT
BARREL MATERIAL	CONCRETE
BARREL MANNING'S N	0.012
INLET TYPE	CONVENTIONAL
INLET EDGE AND WALL	SQUARE EDGE (30-75 DEG. FLARE)
INLET DEPRESSION	NONE

CURRENT DATE: 11-22-1995 FILE DATE: 11-21-1995
CURRENT TIME: 08:45:46 FILE NAME: BRADLY#4

TAILWATER

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

BOTTOM WIDTH (FT)	25.00
SIDE SLOPE H/V (X:1)	4.0
CHANNEL SLOPE V/H (FT/FT)	0.003
MANNING'S N (.01-0.1)	0.040
CHANNEL INVERT ELEVATION (FT)	175.00
CULVERT NO.1 OUTLET INVERT ELEVATION	175.00 FT

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

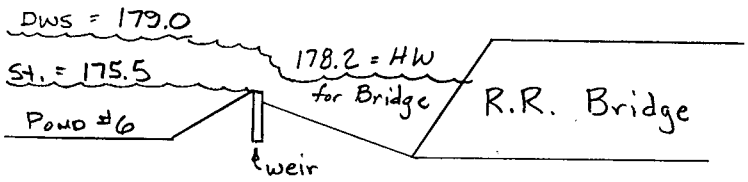
FLOW (CFS)	W.S.E. (FT)	FROUDE NUMBER	VEL. (FPS)	SHEAR (PSF)
1000.00	179.91	0.362	4.55	0.92
1024.30	179.98	0.362	4.59	0.93
1048.60	180.03	0.362	4.61	0.94
1072.90	180.09	0.363	4.64	0.95
1097.20	180.15	0.363	4.67	0.96
1121.50	180.21	0.363	4.70	0.98
1145.80	180.26	0.363	4.73	0.99
1170.10	180.32	0.363	4.76	1.00
1194.40	180.37	0.364	4.78	1.01
1218.70	180.43	0.364	4.81	1.02
1243.00	180.48	0.364	4.83	1.03

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH (FT)	35.00
CREST LENGTH (FT)	50.00
OVERTOPPING CREST ELEVATION (FT)	186.00

Basin #5 drains to an existing pond, No. 5. However, the pond will have to be modified to meet the size and elevation requirements shown on the drainage plan map. The outlet for the pond is a 54" RCP with a 6' square drop inlet structure at elevation 181.5. Pond #5 discharges into Pond #6, which is to be constructed by damming the creek at elevation 175.5 using a 97' weir. Maximum stage for Pond #6 is 197.0, using FEMA defined Q_{100} = 1243 cfs. Pond No. 6 also collects runoff from Basin #4.

The tailwater elevation used in analysis of Pond #5 was assumed to be 2.0' above the static pool elevation of Pond #6, or 177.5. FEMA's BFE just upstream of the railroad bridge of 178.2 was used the tailwater elevation for analysis of flow over the weir control structure for Pond #6. The following are the weir length calculations for Pond #6.



$Q = CLH^{1.5}$

$Q_{free} = 3.0(L)(3.5)^{1.5}$

$\frac{1243}{3.0 \times 3.5^{1.5}} = L_{free}$

$63.3 = L_{free}$

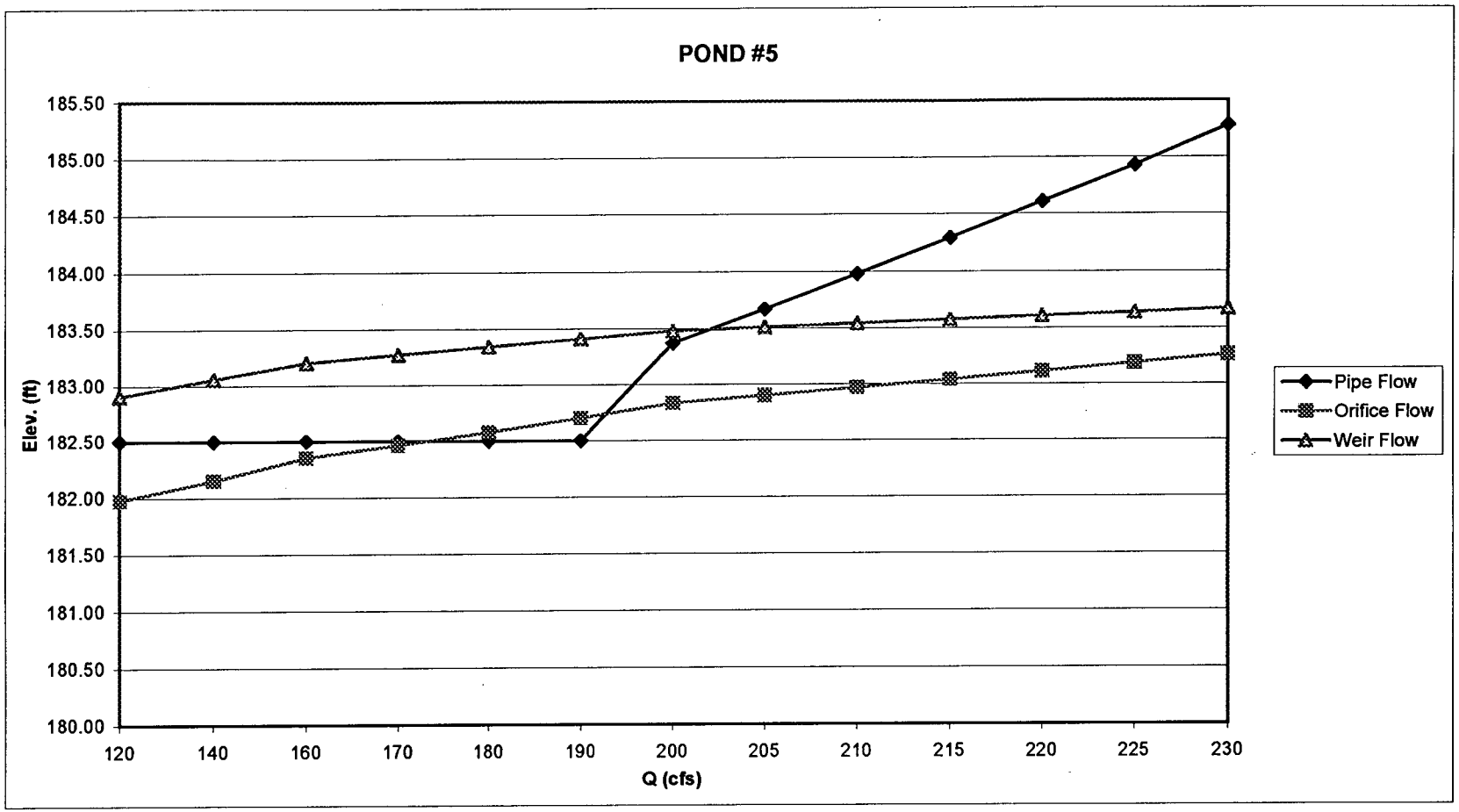
$\frac{D_{dn}}{D_{up}} = \frac{2.7}{3.5} = 0.77$

$\frac{Q_{dn}}{Q_{up}} = 0.65$

$L_{sub} = \frac{63.3}{0.65} = 97'$

A short reach of the creek (from Pond #6 to approximately Section O) will have a maximum stage higher than the published B.F.E.'s. However, the rise occurs only this property and will not affect any neighboring property, upstream or downstream.

STAGE - DISCHARGE



CURRENT DATE: 11-22-1995
CURRENT TIME: 16:08:43

FILE DATE: 11-22-1995
FILE NAME: BRADLY#5

FHWA CULVERT ANALYSIS
HY-8, VERSION 3.2

CU LV	SITE DATA: INLET ELEV. (FT)	SITE DATA: OUTLET ELEV. (FT)	SITE DATA: CULVERT LENGTH (FT)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	174.00	171.50	250.01	1 RCP	4.50	4.50	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (CFS) FILE: BRADLY#5 DATE: 11-22-1995

ELEV (FT)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
183.37	200	200	0	0	0	0	0	0	1
183.67	205	205	0	0	0	0	0	0	1
183.98	210	210	0	0	0	0	0	0	1
184.29	215	215	0	0	0	0	0	0	1
184.61	220	220	0	0	0	0	0	0	1
184.93	225	225	0	0	0	0	0	0	1
185.28	230	230	0	0	0	0	0	0	1
185.65	235	235	0	0	0	0	0	0	1
186.01	240	240	0	0	0	0	0	0	7
186.21	245	242	0	0	0	0	0	3	3
186.34	250	244	0	0	0	0	0	6	3
186.00	240	240	0	0	0	0	0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: BRADLY#5 DATE: 11-22-1995

HEAD ELEV(FT)	HEAD ERROR(FT)	TOTAL FLOW(CFS)	FLOW ERROR(CFS)	% FLOW ERROR
183.37	0.00	200	0	0.00
183.67	0.00	205	0	0.00
183.98	0.00	210	0	0.00
184.29	0.00	215	0	0.00
184.61	0.00	220	0	0.00
184.93	0.00	225	0	0.00
185.28	0.00	230	0	0.00
185.65	0.00	235	0	0.00
186.01	-0.01	240	0	0.09
186.21	0.00	245	-0	-0.01
186.34	-0.00	250	0	0.00

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

```
*******************************************
*                                         *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)     *
*              MAY  1991                  *
*           VERSION 4.0.1E                *
*     Lahey F77L-EM/32 version 5.01       *
*       Dodson & Associates, Inc.         *
*  RUN DATE  11/27/95  TIME  10:03:23     *
*******************************************
```


```
*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*         609 SECOND STREET             *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 551-1748              *
*                                       *
*****************************************
```


```
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

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

  1       ID       Bradley Fair Drainage Plan
  2       ID       Pond #5
  3       ID       5-, 10-, 25-, & 100-Year Storms
  4       ID       Professional Engineering Consultants
  5       ID       Wichita, Ks
  6       ID       DRC 11/20/95
  7       ID       File:  T:\DAR\HEC1\BRADLEY2.ih1
  8       IT      6 01FEB95    0600       0 02FEB95    1154
  9       IN     30 01FEB95    0600
 10       IO      3       0
 11       JR    PREC  0.5902  0.6875  0.8125   1.000
          *
          *DIAGRAM
          *

 12       KK   UNDEV        UNDEVELOPED BASIN
 13       BA  .11992
 14       PB    7.8
 15       PC   0.08    .09    .10    .11    .12    .133   .147   .163   .181   .204
 16       PC   .235    .283   .663   .735   .772   .799   .820   .835   .850   .865
 17       PC   .880    .890   .900   .910   .916   .925   .934   .943   .952   .958
 18       PC   .964    .970   .976   .982   .988   .994  1.000
 19       LS     0      80     0
 20       UD   0.15
          *
          *

 21       KK  BASIN1       RESIDENTIAL DEVELOPED CONDITIONS
 22       BA  .11992
 23       PB    7.8
 24       PC   0.08    .09    .10    .11    .12    .133   .147   .163   .181   .204
 25       PC   .235    .283   .663   .735   .772   .799   .820   .835   .850   .865
 26       PC   .880    .890   .900   .910   .916   .925   .934   .943   .952   .958
 27       PC   .964    .970   .976   .982   .988   .994  1.000
 28       LS     0      87     0
 29       UD   0.15
          *
          *      54" OUTLET FROM POND #5

 30       KK   POND5
 31       RS     1    ELEV   181.5
 32       SA  2.75     3.5
 33       SE 181.5     186
 34       SQ     0     140    160    170    180    190    200    205    210    215
 35       SQ   220     225    230
 36       SE 181.5  183.05  183.2  183.27  183.4  183.45  183.49  183.65  184.0  184.3
 37       SE 184.6   184.9  185.3
          *
 38       ZZ
```

SCHEMATIC DIAGRAM OF STREAM NETWORK

INPUT LINE NO.

(V) ROUTING (---->) DIVERSION OR PUMP FLOW

(.) CONNECTOR (<----) RETURN OF DIVERTED OR PUMPED FLOW

```
 12      UNDEV
           .
           .
 21        .     BASIN1
           .       V
           .       V
 30        .     POND5
```

(***) RUNOFF ALSO COMPUTED AT THIS LOCATION

```
*****************************************
*                                       *
*  FLOOD HYDROGRAPH PACKAGE (HEC-1)     *
*             MAY  1991                 *
*          VERSION 4.0.1E               *
*    Lahey F77L-EM/32 version 5.01      *
*      Dodson & Associates, Inc.        *
* RUN DATE 11/27/95  TIME 10:03:23      *
*****************************************
```


```
*****************************************
*                                       *
*   U.S. ARMY CORPS OF ENGINEERS        *
*   HYDROLOGIC ENGINEERING CENTER       *
*        609 SECOND STREET              *
*     DAVIS, CALIFORNIA 95616           *
*         (916) 551-1748                *
*                                       *
*****************************************
```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                        Bradley Fair Drainage Plan
                        Pond #5
                        5-, 10-, 25-, & 100-Year Storms
                        Professional Engineering Consultants
                        Wichita, Ks
                        DRC  11/20/95
                        File:  T:\DAR\HEC1\BRADLEY2.ih1

 10 IO          OUTPUT CONTROL VARIABLES
                     IPRNT          3  PRINT CONTROL
                     IPLOT          0  PLOT CONTROL
                     QSCAL         0.  HYDROGRAPH PLOT SCALE

    IT          HYDROGRAPH TIME DATA
                      NMIN          6  MINUTES IN COMPUTATION INTERVAL
                     IDATE      1FEB95  STARTING DATE
                     ITIME        0600  STARTING TIME
                        NQ         300  NUMBER OF HYDROGRAPH ORDINATES
                     NDDATE      2FEB95  ENDING DATE
                     NDTIME        1154  ENDING TIME
                     ICENT          19  CENTURY MARK

                   COMPUTATION INTERVAL    0.10 HOURS
                       TOTAL TIME BASE   29.90 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
                   0.59      0.69      0.81      1.00


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


           ***************
           *             *
 12 KK     *     UNDEV   *            UNDEVELOPED BASIN
           *             *
           ***************

  9 IN          TIME DATA FOR INPUT TIME SERIES
                     JXMIN         30  TIME INTERVAL IN MINUTES
                    JXDATE      1FEB95  STARTING DATE
                    JXTIME        600  STARTING TIME

                SUBBASIN RUNOFF DATA

 13 BA          SUBBASIN CHARACTERISTICS
                     TAREA       0.12  SUBBASIN AREA

                PRECIPITATION DATA

 14 PB               STORM       7.80  BASIN TOTAL PRECIPITATION
```

```
15 PI          INCREMENTAL PRECIPITATION PATTERN
                  0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                  0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                  0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                  0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                  0.00    0.00    0.00    0.00    0.00    0.01    0.01    0.01    0.01    0.01
                  0.01    0.01    0.01    0.01    0.01    0.08    0.08    0.08    0.08    0.08
                  0.01    0.01    0.01    0.01    0.01    0.01    0.01    0.01    0.01    0.01
                  0.01    0.01    0.01    0.01    0.01    0.00    0.00    0.00    0.00    0.00
                  0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                  0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                  0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                  0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                  0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                  0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                  0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                  0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                  0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                  0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00

19 LS          SCS LOSS RATE
                 STRTL        0.50  INITIAL ABSTRACTION
                 CRVNBR      80.00  CURVE NUMBER
                 RTIMP        0.00  PERCENT IMPERVIOUS AREA

20 UD          SCS DIMENSIONLESS UNITGRAPH
                 TLAG         0.15  LAG

                                        ***

                                   UNIT HYDROGRAPH
                              10 END-OF-PERIOD ORDINATES
        137.     292.     198.      82.      37.      16.       7.       3.       1.       0.

     TOTAL RAINFALL =    7.80, TOTAL LOSS =    2.36, TOTAL EXCESS =    5.44

   PEAK FLOW     TIME                     MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR      72-HR     29.90-HR
 +   (CFS)       (HR)
                              (CFS)
 +    384.       6.00                  58.         18.        14.         14.
                           (INCHES)   4.469       5.438      5.438       5.438
                            (AC-FT)    29.         35.        35.         35.

                           CUMULATIVE AREA =    0.12 SQ MI

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

                           HYDROGRAPH AT STATION    UNDEV
                             FOR PLAN 1, RATIO = 0.59

     TOTAL RAINFALL =    4.60, TOTAL LOSS =    2.05, TOTAL EXCESS =    2.55

   PEAK FLOW     TIME                     MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR      72-HR     29.90-HR
 +   (CFS)       (HR)
                              (CFS)
 +    179.       6.00                  27.          8.         7.          7.
                           (INCHES)   2.097       2.550      2.550       2.550
                            (AC-FT)    13.         16.        16.         16.

                           CUMULATIVE AREA =    0.12 SQ MI

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

                           HYDROGRAPH AT STATION    UNDEV
                             FOR PLAN 1, RATIO = 0.69

     TOTAL RAINFALL =    5.36, TOTAL LOSS =    2.15, TOTAL EXCESS =    3.21

   PEAK FLOW     TIME                     MAXIMUM AVERAGE FLOW
                                     6-HR       24-HR      72-HR     29.90-HR
 +   (CFS)       (HR)
                              (CFS)
 +    227.       6.00                  34.         10.         8.          8.
                           (INCHES)   2.643       3.211      3.211       3.211
                            (AC-FT)    17.         21.        21.         21.
```

CUMULATIVE AREA = 0.12 SQ MI

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

HYDROGRAPH AT STATION UNDEV
FOR PLAN 1, RATIO = 0.81

TOTAL RAINFALL = 6.34, TOTAL LOSS = 2.25, TOTAL EXCESS = 4.09

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)					
		(CFS)				
+ 289.	6.00		43.	13.	11.	11.
		(INCHES)	3.362	4.087	4.087	4.087
		(AC-FT)	22.	26.	26.	26.

CUMULATIVE AREA = 0.12 SQ MI

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

HYDROGRAPH AT STATION UNDEV
FOR PLAN 1, RATIO = 1.00

TOTAL RAINFALL = 7.80, TOTAL LOSS = 2.36, TOTAL EXCESS = 5.44

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)					
		(CFS)				
+ 384.	6.00		58.	18.	14.	14.
		(INCHES)	4.469	5.438	5.438	5.438
		(AC-FT)	29.	35.	35.	35.

CUMULATIVE AREA = 0.12 SQ MI

*** ***

```
              **************
              *            *
  21 KK       *   BASIN1   *          RESIDENTIAL DEVELOPED CONDITIONS
              *            *
              **************
```

9 IN TIME DATA FOR INPUT TIME SERIES

JXMIN	30	TIME INTERVAL IN MINUTES
JXDATE	1FEB95	STARTING DATE
JXTIME	600	STARTING TIME

SUBBASIN RUNOFF DATA

22 BA SUBBASIN CHARACTERISTICS
TAREA 0.12 SUBBASIN AREA

PRECIPITATION DATA

23 PB STORM 7.80 BASIN TOTAL PRECIPITATION

24 PI INCREMENTAL PRECIPITATION PATTERN

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.08	0.08	0.08	0.08	0.08
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

```
                0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00
                0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00    0.00

 28 LS        SCS LOSS RATE
                  STRTL      0.30  INITIAL ABSTRACTION
                  CRVNBR    87.00  CURVE NUMBER
                  RTIMP      0.00  PERCENT IMPERVIOUS AREA

 29 UD        SCS DIMENSIONLESS UNITGRAPH
                  TLAG       0.15  LAG

                                                  ***

                                                UNIT HYDROGRAPH
                                            10 END-OF-PERIOD ORDINATES
            137.     292.     198.      82.      37.      16.       7.       3.       1.       0.

   TOTAL RAINFALL =   7.80, TOTAL LOSS =   1.54, TOTAL EXCESS =   6.26

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR      24-HR      72-HR    29.90-HR
+   (CFS)       (HR)
                                    (CFS)
+    434.      6.00                   66.       20.        16.        16.
                                  (INCHES)   5.112     6.255      6.255      6.255
                                  (AC-FT)      33.       40.        40.        40.

                                  CUMULATIVE AREA =   0.12 SQ MI

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

                                HYDROGRAPH AT STATION   BASIN1
                                  FOR PLAN 1, RATIO = 0.59

   TOTAL RAINFALL =   4.60, TOTAL LOSS =   1.41, TOTAL EXCESS =   3.20

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR      24-HR      72-HR    29.90-HR
+   (CFS)       (HR)
                                    (CFS)
+    226.      6.00                   34.       10.        8.         8.
                                  (INCHES)   2.627     3.195      3.195      3.195
                                  (AC-FT)      17.       20.        20.        20.

                                  CUMULATIVE AREA =   0.12 SQ MI

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

                                HYDROGRAPH AT STATION   BASIN1
                                  FOR PLAN 1, RATIO = 0.69

   TOTAL RAINFALL =   5.36, TOTAL LOSS =   1.45, TOTAL EXCESS =   3.91

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR      24-HR      72-HR    29.90-HR
+   (CFS)       (HR)
                                    (CFS)
+    275.      6.00                   41.       13.        10.        10.
                                  (INCHES)   3.210     3.910      3.910      3.910
                                  (AC-FT)      21.       25.        25.        25.

                                  CUMULATIVE AREA =   0.12 SQ MI

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

                                HYDROGRAPH AT STATION   BASIN1
                                  FOR PLAN 1, RATIO = 0.81

   TOTAL RAINFALL =   6.34, TOTAL LOSS =   1.50, TOTAL EXCESS =   4.84

  PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                      6-HR      24-HR      72-HR    29.90-HR
+   (CFS)       (HR)
                                    (CFS)
+    339.      6.00                   51.       16.        13.        13.
                                  (INCHES)   3.967     4.841      4.841      4.841
```

(AC-FT)	25.	31.	31.	31.

CUMULATIVE AREA = 0.12 SQ MI

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

HYDROGRAPH AT STATION BASIN1
FOR PLAN 1, RATIO = 1.00

TOTAL RAINFALL = 7.80, TOTAL LOSS = 1.54, TOTAL EXCESS = 6.26

	PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
				6-HR	24-HR	72-HR	29.90-HR
+	(CFS)	(HR)					
			(CFS)				
+	434.	6.00		66.	20.	16.	16.
			(INCHES)	5.112	6.255	6.255	6.255
			(AC-FT)	33.	40.	40.	40.

CUMULATIVE AREA = 0.12 SQ MI

*** ***

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          **************
          *            *
 30 KK    *   POND5    *
          *            *
          **************
```

HYDROGRAPH ROUTING DATA

31 RS STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	ELEV	TYPE OF INITIAL CONDITION
RSVRIC	181.50	INITIAL CONDITION
X	0.00	WORKING R AND D COEFFICIENT

32 SA	AREA	2.8	3.5								
33 SE	ELEVATION	181.50	186.00								
34 SQ	DISCHARGE	0.	140.	160.	170.	180.	190.	200.	205.	210.	215.
		220.	225.	230.							
36 SE	ELEVATION	181.50	183.05	183.20	183.27	183.40	183.45	183.49	183.65	184.00	184.30
		184.60	184.90	185.30							

***

COMPUTED STORAGE-ELEVATION DATA

STORAGE	0.00	14.03
ELEVATION	181.50	186.00

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	4.45	4.90	5.12	5.51	5.67	5.79	6.28	7.38	8.33
OUTFLOW	0.00	140.00	160.00	170.00	180.00	190.00	200.00	205.00	210.00	215.00
ELEVATION	181.50	183.05	183.20	183.27	183.40	183.45	183.49	183.65	184.00	184.30
STORAGE	9.30	10.28	11.62	14.03						
OUTFLOW	220.00	225.00	230.00	238.75						
ELEVATION	184.60	184.90	185.30	186.00						

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

HYDROGRAPH AT STATION POND5
FOR PLAN 1, RATIO = 0.59

	PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
				6-HR	24-HR	72-HR	29.90-HR
+	(CFS)	(HR)					
			(CFS)				
+	148.	6.20		34.	10.	8.	8.
			(INCHES)	2.618	3.195	3.195	3.195

		(AC-FT)	17.	20.	20.	20.

PEAK STORAGE	TIME		MAXIMUM AVERAGE STORAGE			
			6-HR	24-HR	72-HR	29.90-HR
+ (AC-FT)	(HR)					
5.	6.20		1.	0.	0.	0.

PEAK STAGE	TIME		MAXIMUM AVERAGE STAGE			
			6-HR	24-HR	72-HR	29.90-HR
+ (FEET)	(HR)					
183.11	6.20		181.87	181.61	181.59	181.59

CUMULATIVE AREA = 0.12 SQ MI

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

HYDROGRAPH AT STATION POND5
FOR PLAN 1, RATIO = 0.69

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)					
		(CFS)				
+ 185.	6.20		41.	13.	10.	10.
		(INCHES)	3.200	3.910	3.910	3.910
		(AC-FT)	20.	25.	25.	25.

PEAK STORAGE	TIME		MAXIMUM AVERAGE STORAGE			
			6-HR	24-HR	72-HR	29.90-HR
+ (AC-FT)	(HR)					
6.	6.20		1.	0.	0.	0.

PEAK STAGE	TIME		MAXIMUM AVERAGE STAGE			
			6-HR	24-HR	72-HR	29.90-HR
+ (FEET)	(HR)					
183.43	6.20		181.95	181.64	181.61	181.61

CUMULATIVE AREA = 0.12 SQ MI

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

HYDROGRAPH AT STATION POND5
FOR PLAN 1, RATIO = 0.81

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)					
		(CFS)				
+ 208.	6.20		51.	16.	13.	13.
		(INCHES)	3.954	4.841	4.841	4.841
		(AC-FT)	25.	31.	31.	31.

PEAK STORAGE	TIME		MAXIMUM AVERAGE STORAGE			
			6-HR	24-HR	72-HR	29.90-HR
+ (AC-FT)	(HR)					
7.	6.20		2.	0.	0.	0.

PEAK STAGE	TIME		MAXIMUM AVERAGE STAGE			
			6-HR	24-HR	72-HR	29.90-HR
+ (FEET)	(HR)					
183.89	6.20		182.06	181.67	181.64	181.64

CUMULATIVE AREA = 0.12 SQ MI

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

HYDROGRAPH AT STATION POND5
FOR PLAN 1, RATIO = 1.00

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)					
		(CFS)				
+ 223.	6.20		66.	20.	16.	16.
		(INCHES)	5.095	6.255	6.255	6.255
		(AC-FT)	33.	40.	40.	40.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (AC-FT)	(HR)				
10.	6.20	2.	1.	1.	1.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (FEET)	(HR)				
184.78	6.20	182.28	181.74	181.69	181.69

CUMULATIVE AREA = 0.12 SQ MI

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	RATIO 2	RATIO 3	RATIO 4
					0.59	0.69	0.81	1.00
HYDROGRAPH AT								
+	UNDEV	0.12	1	FLOW	179.	227.	289.	384.
				TIME	6.00	6.00	6.00	6.00
HYDROGRAPH AT								
+	BASIN1	0.12	1	FLOW	226.	275.	339.	434.
				TIME	6.00	6.00	6.00	6.00
ROUTED TO								
+	POND5	0.12	1	FLOW	148.	185.	208.	223.
				TIME	6.20	6.20	6.20	6.20
			** PEAK STAGES IN FEET **					
			1	STAGE	183.11	183.43	183.89	184.78
				TIME	6.20	6.20	6.20	6.20

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

ESSIONAL
NEERING
SULTANTS
PROFESSIONAL ASSOCIATION
303 S. TOPEKA
WICHITA, KANSAS
ZIP CODE/67202

Date _____ Page _____ of _____

Project BRADLEY FAIR II / WILSON ESTATES

Item BASIN #6

$A_{dev.} = 23.15$ Ac.

$A_{undev.} = 28.85$ Ac.

Q DEVELOPED

$C_{100} = 0.76$
$i_{100} = 7.36$
$A = 23.15$

$Q_{100} = 0.76(7.36)(23.15)$
$Q_{100} = 129.5$ cfs

Q UNDEVELOPED

$C_{100} = 0.67$
$i_{100} = 7.36$
$A = 28.85$

$Q_{100} = 0.67(7.36)(28.85)$
$Q_{100} = 142.3$ cfs

Q_{100} (DEV.) < Q_{100} (UNDEV.)

DETENTION STORAGE NOT REQUIRED

4.5' HEAD REQ'D FOR 129.5 cfs in 5'x4' RCBC. (Proposed. Part of Webb Rd. Project)

1.0' + 4.5' + 186.5 ft = 192.0 ⇒ min. pad for Lots adjacent to Box.

NOTE: 100-YEAR FLOW DOES NOT TOP WEBB RD.

THEREFORE, SET MIN PAD LOTS ADJACENT TO WEBB RD. AT ELEV. 192.12 + 1.0' = 193.12 or higher

℄ Low Pt. WEBB + 1.0'

PROJECT: WILSON ESTATES

STATION: _____

SHEET _____ OF _____

CULVERT DESIGN FORM

DESIGNER / DATE: _____ / _____

REVIEWER / DATE: _____ / _____

HYDROLOGICAL DATA

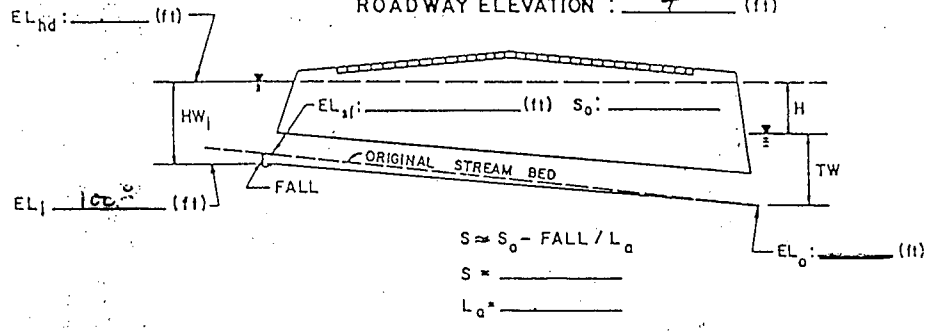
SEE ADD'L SHTS.

- [X] METHOD: RATIONAL
- [X] DRAINAGE AREA: 23.15 [ ] STREAM SLOPE: _____
- [ ] CHANNEL SHAPE: _____
- [ ] ROUTING: _____ [ ] OTHER: _____

DESIGN FLOWS/TAILWATER

R.I. (YEARS)	FLOW (cfs)	TW (ft)
100	129.5	

ROADWAY ELEVATION: 4 (ft)



$S \approx S_o - FALL / L_a$

$S =$ _____

$L_a =$ _____

CULVERT DESCRIPTION: MATERIAL - SHAPE - SIZE - ENTRANCE	TOTAL FLOW Q (cfs)	FLOW PER BARREL Q/N (1)	HEADWATER CALCULATIONS											CONTROL HEADWATER ELEVATION	OUTLET VELOCITY	COMMENTS
			INLET CONTROL				OUTLET CONTROL									
			HW_i/D (2)	HW_i	FALL (3)	EL_{hi} (4)	TW (5)	d_c	$\frac{d_c+D}{2}$	h_o (6)	k_e	H (7)	EL_{ho} (8)			
5'x4' RCBC	129.5	129.5	1.1	4.4		104.4		2.8	3.4	3.4	0.5	1.2	4.6	104.5		

TECHNICAL FOOTNOTES:

(1) USE Q/NB FOR BOX CULVERTS

(2) $HW_i/D = HW/D$ OR HW_i/D FROM DESIGN CHARTS

(3) $FALL = HW_i - (EL_{hd} - EL_{sf})$; FALL IS ZERO FOR CULVERTS ON GRADE

(4) $EL_{hi} = HW_i + EL_i$ (INVERT OF INLET CONTROL SECTION)

(5) TW BASED ON DOWN STREAM CONTROL OR FLOW DEPTH IN CHANNEL.

(6) $h_o = TW$ or $(d_c + D/2)$ (WHICHEVER IS GREATER)

(7) $H = \left[1 + k_e + (29n^2 L)/R^{1.33}\right] V^2/2g$

(8) $EL_{ho} = EL_o + H + h_o$

SUBSCRIPT DEFINITIONS:

- a. APPROXIMATE
- f. CULVERT FACE
- hd. DESIGN HEADWATER
- hi. HEADWATER IN INLET CONTROL
- ho. HEADWATER IN OUTLET CONTROL
- i. INLET CONTROL SECTION
- o. OUTLET
- sf. STREAMBED AT CULVERT FACE
- tw. TAILWATER

COMMENTS / DISCUSSION:

CULVERT BARREL SELECTED:

SIZE: _____

SHAPE: _____

MATERIAL: _____

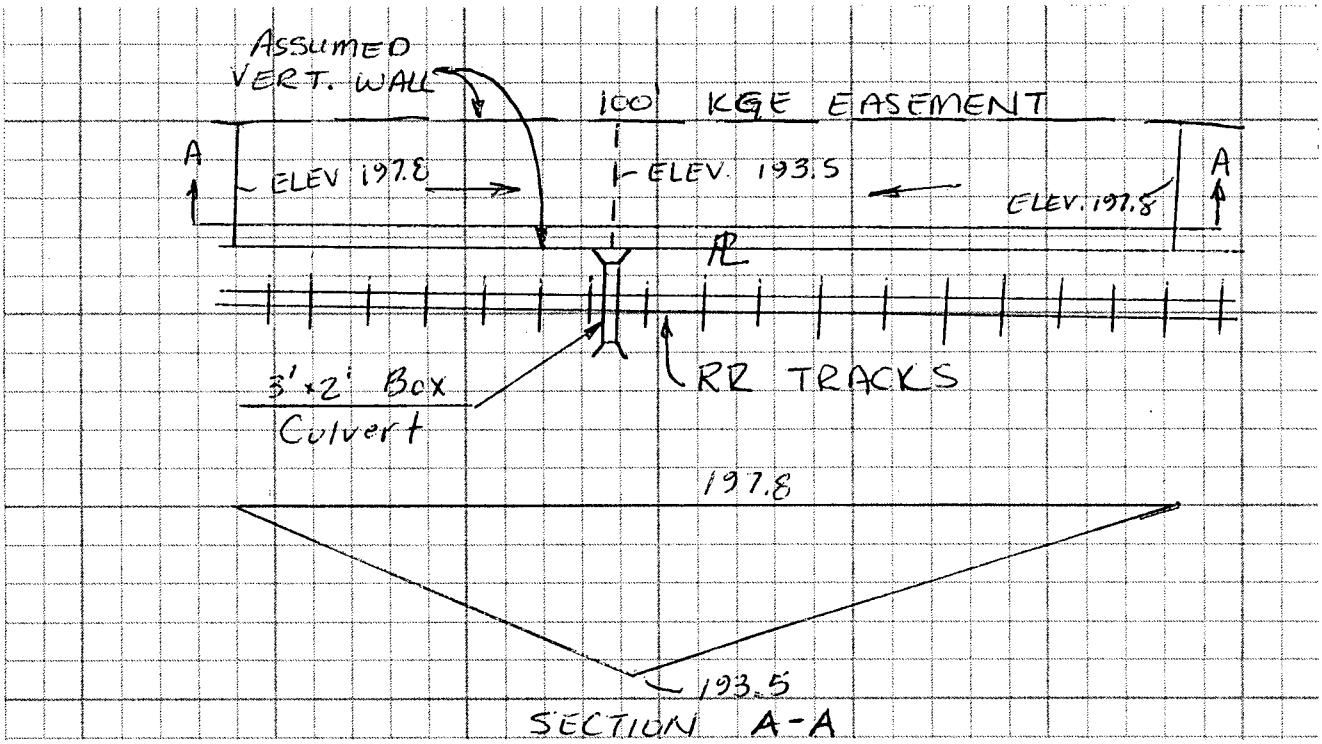
ENTRANCE: _____

Basin #7 drains to the existing 2 - 5' X 4' RCBC under Webb Rd. North of 19th St. The attached table shows that the "C" factors used in the hydrology analysis of the basins flowing to the box represent developed conditions, and therefore, no further analysis of the basin is necessary.

WEBB ROAD (21ST TO 29TH STREETS NORTH) – SOUTH OF 21ST STREET

DRAINAGE AREA	AREA ACRES	AREA ACCUM.	C5	C100	TC5	TC100	I5	I100	Q5	Q100	PIPE SIZE	PIPE SLOPE	INLETS
AREA #8-1 NORTH SIDE OF 21ST ST. N. C.O.W. WATER PUMP STA.	7.17		0.54	0.68	42	31	2.68	5.32	10.38	25.94	30" RCP	0.40%	AREA INLET
AREA #8-2 EXISTING 24" RCP							ASSUMED DESIGN Q = 30 CFS						
AREA #8-3 NORTH SIDE OF 21ST ST. N WEST OF WEBB ROAD	1.07		0.71	0.81	15	15	4.56	7.37	3.46	6.39			1L(l)=10' (SUMP)
		8.24 (+)	0.56	0.70	42	31	2.68	5.32	12.4	30.7			
									42.4	60.7	48" RCP	0.20%	
AREA #8-4 SOUTH SIDE OF 21ST ST. N WEST OF WEBB ROAD	0.96		0.71	0.81	15	15	4.56	7.37	3.17	5.85			1L(l)=5'
AREA #8-5 EXISTING 38"X60" HERCP							ASSUMED DESIGN Q = 85 CFS						
		9.22(++)	0.58	0.71	42	31	2.68	5.32	14.3	34.8			
									129.3	150.0	48" RCP	1.20%	
AREA #8-6 NORTH END OF WILSON PROPERTY	6.86		0.86	0.91	15	15	4.56	7.37	26.9	46.0	42" RCP	0.25%	AREA INLET (FUTURE)
AREA #8-8 EAST SIDE OF WEBB RD. SOUTH OF 21ST ST. N.	0.74		0.71	0.81	15	15	4.56	7.37	2.40 QI=1.79 Qby=0.61	4.42 QI=2.95 Qby=1.47	15" RCP	0.40% MIN.	1L(l)=10'
AREA #8-7 WEST SIDE OF WEBB RD. SOUTH OF 21ST ST. N.	0.74		0.71	0.81	15	15	4.56	7.37	2.40 QI=1.79 Qby=0.61	4.42 QI=2.95 Qby=1.47			1L(l)=10'
		17.58(++)	0.70	0.80	42	31	2.68	5.32	32.9	74.7			
									148.0	190.0	66" RCP or 6'x4' RCB	0.35%	
AREA #8-9 MIDDLE PART OF WILSON PROPERTY	11.2		0.86	0.91	15	15	4.56	7.37	43.9	75.1	48" RCP	0.30%	AREA INLET (FUTURE)
		28.78(++)	0.76	0.84	42	31	2.68	5.32	58.8	12.9			
									174.0	244.0	REPLACE EXISTING 2 – 5'X2' RCB WITH 2 – 5'X4' RCB		

Basin No. 8 drains to the existing 3' X 2' stone and concrete box culvert under the railroad tracks near the southwest corner of the site. Runoff will be directed to the culvert via storm sewer and /or ditches. No detention ponds will be constructed within this basin. However, storage will occur naturally within the 100' KG&E easement. For use in the HEC-1 model, a pond with vee-shaped bottom and vertical sides at the property line and easement line was assumed, as shown:



Per the HEC-1 output, the peak Pre-Developed Q_{100} is 66 cfs, the peak Developed Q_{100}, with detention, is 30 cfs, and the maximum ponding elevation is 196.02.

1

CURRENT DATE: 12-13-1995
CURRENT TIME: 10:28:45

FILE DATE: 12-13-1995
FILE NAME: RR_3X2

FHWA CULVERT ANALYSIS
HY-8, VERSION 3.2

CU LV	SITE DATA: INLET ELEV. (FT)	OUTLET ELEV. (FT)	CULVERT LENGTH (FT)	CULVERT SHAPE, MATERIAL, INLET: BARRELS SHAPE MATERIAL	SPAN (FT)	RISE (FT)	MANNING n	INLET TYPE
1	193.50	193.49	50.00	1 RCB	3.00	2.00	.012	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (CFS) FILE: RR_3X2 DATE: 12-13-1995

ELEV (FT)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
196.43	35	35	0	0	0	0	0	0	1
196.76	39	39	0	0	0	0	0	0	1
197.13	43	43	0	0	0	0	0	0	1
197.53	47	47	0	0	0	0	0	0	1
197.82	51	50	0	0	0	0	0	1	30
197.86	55	50	0	0	0	0	0	5	7
197.89	59	50	0	0	0	0	0	8	6
197.92	63	50	0	0	0	0	0	12	5
197.94	67	51	0	0	0	0	0	16	4
197.96	71	51	0	0	0	0	0	20	4
197.98	75	51	0	0	0	0	0	23	4
197.80	49	49	0	0	0	0	0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: RR_3X2 DATE: 12-13-1995

HEAD ELEV(FT)	HEAD ERROR(FT)	TOTAL FLOW(CFS)	FLOW ERROR(CFS)	% FLOW ERROR
196.43	0.00	35	0	0.00
196.76	0.00	39	0	0.00
197.13	0.00	43	0	0.00
197.53	0.00	47	0	0.00
197.82	-0.00	51	1	1.37
197.86	-0.00	55	0	0.87
197.89	-0.00	59	0	0.59
197.92	-0.00	63	0	0.66
197.94	-0.00	67	1	0.98
197.96	-0.00	71	1	0.87
197.98	-0.00	75	1	0.72

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

```
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*             MAY  1991                 *
*          VERSION 4.0.1E               *
*     Lahey F77L-EM/32 version 5.01     *
*       Dodson & Associates, Inc.       *
*  RUN DATE  12/13/95  TIME  10:34:13   *
*****************************************
```

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*****************************************
*                                       *
*   U.S. ARMY CORPS OF ENGINEERS        *
*   HYDROLOGIC ENGINEERING CENTER       *
*        609 SECOND STREET              *
*      DAVIS, CALIFORNIA 95616          *
*          (916) 551-1748               *
*                                       *
*****************************************
```

```
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       Bradley Fair Drainage Plan
  2       ID       Pond #5
  3       ID       5-, 10-, 25-, & 100-Year Storms
  4       ID       Professional Engineering Consultants
  5       ID       Wichita, Ks
  6       ID       DRC 11/20/95        RR_Rows.IN1
  7       ID       File:  T:\DAR\HEC1\BRADLEY2.IN1
  8       IT     6 01FEB95    0600       0 02FEB95    1154
  9       IN    30 01FEB95    0600
 10       IO     3      0
 11       JR    PREC  0.5902  0.6875  0.8125   1.000
                 *
                 *DIAGRAM
                 *

 12       KK   UNDEV        UNDEVELOPED BASIN
 13       BA   .0206
 14       PB    7.8
 15       PC   0.08    .09     .10     .11     .12     .133    .147    .163    .181    .204
 16       PC   .235    .283    .663    .735    .772    .799    .820    .835    .850    .865
 17       PC   .880    .890    .900    .910    .916    .925    .934    .943    .952    .958
 18       PC   .964    .970    .976    .982    .988    .994   1.000
 19       LS     0      80      0
 20       UD   0.15
                 *
                 *

 21       KK  BASIN1        RESIDENTIAL DEVELOPED CONDITIONS
 22       BA   .0206
 23       PB    7.8
 24       PC   0.08    .09     .10     .11     .12     .133    .147    .163    .181    .204
 25       PC   .235    .283    .663    .735    .772    .799    .820    .835    .850    .865
 26       PC   .880    .890    .900    .910    .916    .925    .934    .943    .952    .958
 27       PC   .964    .970    .976    .982    .988    .994   1.000
 28       LS     0      87      0
 29       UD   0.15
                 *
                 *       3' X 2' BOX CULVERT UNDER RR TRACKS

 30       KK   RRROW
 31       RS     1    ELEV   193.5
 32       SA     0    0.69    1.37    2.41
```

```
          33          SE   193.5    194    196   197.8
          34          SQ       0     35     39      43      47      51      55      59      63      67
          35          SQ      71     75
          36          SE   193.5  196.43  196.76  197.13  197.53  197.82  197.86  197.89  197.92  197.94
          37          SE  197.96  197.98
                      *
          38          ZZ
1
              SCHEMATIC DIAGRAM OF STREAM NETWORK
 INPUT
  LINE      (V) ROUTING          (--->) DIVERSION OR PUMP FLOW

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

    12       UNDEV
                .
                .
    21          .      BASIN1
                .          V
                .          V
    30          .       RRROW

  (***) RUNOFF ALSO COMPUTED AT THIS LOCATION
1*****************************************                    *****************************************
*                                       *                    *                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *                    *   U.S. ARMY CORPS OF ENGINEERS        *
*             MAY  1991                 *                    *   HYDROLOGIC ENGINEERING CENTER       *
*          VERSION 4.0.1E               *                    *        609 SECOND STREET              *
*     Lahey F77L-EM/32 version 5.01     *                    *      DAVIS, CALIFORNIA 95616          *
*       Dodson & Associates, Inc.       *                    *         (916) 551-1748                *
*  RUN DATE  12/13/95  TIME  10:34:13   *                    *                                       *
*****************************************                    *****************************************

                            Bradley Fair Drainage Plan
                            Pond #5
                            5-, 10-, 25-, & 100-Year Storms
                            Professional Engineering Consultants
                            Wichita, Ks
                            DRC  11/20/95
                            File:  T:\DAR\HEC1\BRADLEY2.ih1

   10 IO          OUTPUT CONTROL VARIABLES
                       IPRNT          3  PRINT CONTROL
                       IPLOT          0  PLOT CONTROL
                       QSCAL         0.  HYDROGRAPH PLOT SCALE

      IT          HYDROGRAPH TIME DATA
                        NMIN          6  MINUTES IN COMPUTATION INTERVAL
                       IDATE     1FEB95  STARTING DATE
                       ITIME       0600  STARTING TIME
                          NQ        300  NUMBER OF HYDROGRAPH ORDINATES
                      NDDATE     2FEB95  ENDING DATE
                      NDTIME       1154  ENDING TIME
                       ICENT         19  CENTURY MARK

                    COMPUTATION INTERVAL    0.10 HOURS
                        TOTAL TIME BASE   29.90 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
                    0.59      0.69      0.81      1.00
```

12-13-1995

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

               **************
               *            *
  12 KK        *   UNDEV    *           UNDEVELOPED BASIN
               *            *
               **************

   9 IN          TIME DATA FOR INPUT TIME SERIES
                      JXMIN         30  TIME INTERVAL IN MINUTES
                      JXDATE    1FEB95  STARTING DATE
                      JXTIME       600  STARTING TIME

                SUBBASIN RUNOFF DATA

  13 BA          SUBBASIN CHARACTERISTICS
                      TAREA       0.02  SUBBASIN AREA

                 PRECIPITATION DATA

  14 PB               STORM       7.80  BASIN TOTAL PRECIPITATION

  15 PI            INCREMENTAL PRECIPITATION PATTERN
                    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                    0.00     0.00     0.00     0.00     0.00     0.01     0.01     0.01     0.01     0.01
                    0.01     0.01     0.01     0.01     0.01     0.08     0.08     0.08     0.08     0.08
                    0.01     0.01     0.01     0.01     0.01     0.01     0.01     0.01     0.01     0.01
                    0.01     0.01     0.01     0.01     0.01     0.00     0.00     0.00     0.00     0.00
                    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00
                    0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00     0.00

  19 LS          SCS LOSS RATE
                      STRTL       0.50  INITIAL ABSTRACTION
                      CRVNBR     80.00  CURVE NUMBER
                      RTIMP       0.00  PERCENT IMPERVIOUS AREA

  20 UD          SCS DIMENSIONLESS UNITGRAPH
                      TLAG        0.15  LAG

                                                   ***

                                              UNIT HYDROGRAPH
                                          10 END-OF-PERIOD ORDINATES
                 24.      50.      34.      14.       6.       3.       1.       1.       0.       0.

      TOTAL RAINFALL =     7.80, TOTAL LOSS =     2.36, TOTAL EXCESS =     5.44

    PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR        72-HR      29.90-HR
 +    (CFS)       (HR)
                            (CFS)
 +      66.       6.00                10.           3.           2.           2.
                          (INCHES)   4.469        5.438        5.438        5.438
                           (AC-FT)      5.           6.           6.           6.

                        CUMULATIVE AREA =      0.02 SQ MI


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

                          HYDROGRAPH AT STATION     UNDEV
                            FOR PLAN 1, RATIO = 0.59

      TOTAL RAINFALL =     4.60, TOTAL LOSS =     2.05, TOTAL EXCESS =     2.55

    PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                     6-HR        24-HR        72-HR      29.90-HR
 +    (CFS)       (HR)
```

```
                           (CFS)
 +     31.      6.00                  5.         1.         1.          1.
                         (INCHES)   2.097      2.550      2.550       2.550
                          (AC-FT)     2.         3.         3.          3.

                         CUMULATIVE AREA =    0.02 SQ MI

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

                          HYDROGRAPH AT STATION    UNDEV
                            FOR PLAN 1, RATIO = 0.69

      TOTAL RAINFALL =    5.36, TOTAL LOSS =    2.15, TOTAL EXCESS =    3.21

   PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR      72-HR       29.90-HR
 +   (CFS)       (HR)
                           (CFS)
 +     39.      6.00                  6.         2.         1.          1.
                         (INCHES)   2.643      3.211      3.211       3.211
                          (AC-FT)     3.         4.         4.          4.

                         CUMULATIVE AREA =    0.02 SQ MI

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

                          HYDROGRAPH AT STATION    UNDEV
                            FOR PLAN 1, RATIO = 0.81

      TOTAL RAINFALL =    6.34, TOTAL LOSS =    2.25, TOTAL EXCESS =    4.09

   PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR      72-HR       29.90-HR
 +   (CFS)       (HR)
                           (CFS)
 +     50.      6.00                  7.         2.         2.          2.
                         (INCHES)   3.362      4.087      4.087       4.087
                          (AC-FT)     4.         4.         4.          4.

                         CUMULATIVE AREA =    0.02 SQ MI

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

                          HYDROGRAPH AT STATION    UNDEV
                            FOR PLAN 1, RATIO = 1.00

      TOTAL RAINFALL =    7.80, TOTAL LOSS =    2.36, TOTAL EXCESS =    5.44

   PEAK FLOW     TIME                         MAXIMUM AVERAGE FLOW
                                      6-HR       24-HR      72-HR       29.90-HR
 +   (CFS)       (HR)
                           (CFS)
 +     66.      6.00                 10.         3.         2.          2.
                         (INCHES)   4.469      5.438      5.438       5.438
                          (AC-FT)     5.         6.         6.          6.

                         CUMULATIVE AREA =    0.02 SQ MI


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


              **************
              *            *
    21 KK     *   BASIN1   *            RESIDENTIAL DEVELOPED CONDITIONS
              *            *
              **************

     9 IN           TIME DATA FOR INPUT TIME SERIES
                          JXMIN          30  TIME INTERVAL IN MINUTES
                          JXDATE     1FEB95  STARTING DATE
                          JXTIME        600  STARTING TIME

                   SUBBASIN RUNOFF DATA
```

22 BA SUBBASIN CHARACTERISTICS
TAREA 0.02 SUBBASIN AREA

PRECIPITATION DATA

23 PB STORM 7.80 BASIN TOTAL PRECIPITATION

24 PI INCREMENTAL PRECIPITATION PATTERN

0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.08	0.08	0.08	0.08	0.08
0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

28 LS SCS LOSS RATE
STRTL 0.30 INITIAL ABSTRACTION
CRVNBR 87.00 CURVE NUMBER
RTIMP 0.00 PERCENT IMPERVIOUS AREA

29 UD SCS DIMENSIONLESS UNITGRAPH
TLAG 0.15 LAG

***

UNIT HYDROGRAPH
10 END-OF-PERIOD ORDINATES

24.	50.	34.	14.	6.	3.	1.	1.	0.	0.

TOTAL RAINFALL = 7.80, TOTAL LOSS = 1.54, TOTAL EXCESS = 6.26

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)					
		(CFS)				
+ 74.	6.00		11.	3.	3.	3.
		(INCHES)	5.112	6.255	6.255	6.255
		(AC-FT)	6.	7.	7.	7.

CUMULATIVE AREA = 0.02 SQ MI

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

HYDROGRAPH AT STATION BASIN1
FOR PLAN 1, RATIO = 0.59

TOTAL RAINFALL = 4.60, TOTAL LOSS = 1.41, TOTAL EXCESS = 3.20

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)					
		(CFS)				
+ 39.	6.00		6.	2.	1.	1.
		(INCHES)	2.627	3.195	3.195	3.195
		(AC-FT)	3.	4.	4.	4.

CUMULATIVE AREA = 0.02 SQ MI

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

HYDROGRAPH AT STATION BASIN1
FOR PLAN 1, RATIO = 0.69

TOTAL RAINFALL = 5.36, TOTAL LOSS = 1.45, TOTAL EXCESS = 3.91

PEAK FLOW TIME MAXIMUM AVERAGE FLOW

```
                                  6-HR       24-HR       72-HR     29.90-HR
+   (CFS)       (HR)
                          (CFS)
+      47.      6.00                 7.          2.          2.           2.
                        (INCHES)   3.210       3.910       3.910        3.910
                         (AC-FT)     4.          4.          4.           4.

                        CUMULATIVE AREA =     0.02 SQ MI

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

                          HYDROGRAPH AT STATION    BASIN1
                            FOR PLAN 1, RATIO = 0.81

   TOTAL RAINFALL =     6.34, TOTAL LOSS =     1.50, TOTAL EXCESS =     4.84

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                  6-HR       24-HR       72-HR     29.90-HR
+   (CFS)       (HR)
                          (CFS)
+      58.      6.00                 9.          3.          2.           2.
                        (INCHES)   3.967       4.841       4.841        4.841
                         (AC-FT)     4.          5.          5.           5.

                        CUMULATIVE AREA =     0.02 SQ MI

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

                          HYDROGRAPH AT STATION    BASIN1
                            FOR PLAN 1, RATIO = 1.00

   TOTAL RAINFALL =     7.80, TOTAL LOSS =     1.54, TOTAL EXCESS =     6.26

 PEAK FLOW     TIME                          MAXIMUM AVERAGE FLOW
                                  6-HR       24-HR       72-HR     29.90-HR
+   (CFS)       (HR)
                          (CFS)
+      74.      6.00                11.          3.          3.           3.
                        (INCHES)   5.112       6.255       6.255        6.255
                         (AC-FT)     6.          7.          7.           7.

                        CUMULATIVE AREA =     0.02 SQ MI


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

                **************
                *            *
  30 KK         *    RRROW   *
                *            *
                **************

                  HYDROGRAPH ROUTING DATA

  31 RS             STORAGE ROUTING
                         NSTPS           1  NUMBER OF SUBREACHES
                          ITYP        ELEV  TYPE OF INITIAL CONDITION
                        RSVRIC      193.50  INITIAL CONDITION
                             X        0.00  WORKING R AND D COEFFICIENT

  32 SA                   AREA         0.0        0.7        1.4        2.4

  33 SE             ELEVATION       193.50     194.00     196.00     197.80

  34 SQ             DISCHARGE           0.        35.        39.        43.        47.        51.        55.        59.        63.        67.
                                       71.        75.

  36 SE             ELEVATION       193.50     196.43     196.76     197.13     197.53     197.82     197.86     197.89     197.92     197.94
                                    197.96     197.98

                                                    ***

                                       COMPUTED STORAGE-ELEVATION DATA

             STORAGE        0.00       0.12       2.14       5.49
```

ELEVATION	193.50	194.00	196.00	197.80						

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

STORAGE	0.00	0.12	2.14	2.77	3.33	4.02	4.87	5.49	5.54	5.64
OUTFLOW	0.00	5.97	29.86	35.00	39.00	43.00	47.00	50.72	51.00	55.00
ELEVATION	193.50	194.00	196.00	196.43	196.76	197.13	197.53	197.80	197.82	197.86

STORAGE	5.71	5.79	5.84	5.89	5.94
OUTFLOW	59.00	63.00	67.00	71.00	75.00
ELEVATION	197.89	197.92	197.94	197.96	197.98

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

HYDROGRAPH AT STATION RRROW
FOR PLAN 1, RATIO = 0.59

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)					
		(CFS)				
+ 16.	6.30		6.	2.	1.	1.
		(INCHES)	2.623	3.195	3.195	3.195
		(AC-FT)	3.	4.	4.	4.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (AC-FT)	(HR)				
1.	6.30	0.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (FEET)	(HR)				
194.88	6.30	193.99	193.65	193.62	193.62

CUMULATIVE AREA = 0.02 SQ MI

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

HYDROGRAPH AT STATION RRROW
FOR PLAN 1, RATIO = 0.69

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)					
		(CFS)				
+ 20.	6.30		7.	2.	2.	2.
		(INCHES)	3.206	3.910	3.910	3.910
		(AC-FT)	4.	4.	4.	4.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (AC-FT)	(HR)				
1.	6.30	0.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (FEET)	(HR)				
195.15	6.30	194.09	193.68	193.65	193.65

CUMULATIVE AREA = 0.02 SQ MI

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

HYDROGRAPH AT STATION RRROW
FOR PLAN 1, RATIO = 0.81

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)					
		(CFS)				
+ 24.	6.30		9.	3.	2.	2.
		(INCHES)	3.963	4.841	4.841	4.841
		(AC-FT)	4.	5.	5.	5.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (AC-FT)	(HR)				

2.	6.30		0.	0.	0.	0.

PEAK STAGE	TIME		MAXIMUM AVERAGE STAGE			
			6-HR	24-HR	72-HR	29.90-HR
+ (FEET)	(HR)					
195.49	6.30		194.23	193.72	193.68	193.68

CUMULATIVE AREA = 0.02 SQ MI

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

HYDROGRAPH AT STATION RRROW
FOR PLAN 1, RATIO = 1.00

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	29.90-HR
+ (CFS)	(HR)					
		(CFS)				
+ 30.	6.30		11.	3.	3.	3.
		(INCHES)	5.105	6.255	6.255	6.255
		(AC-FT)	6.	7.	7.	7.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	29.90-HR
+ (AC-FT)	(HR)				
2.	6.30	1.	0.	0.	0.

PEAK STAGE	TIME		MAXIMUM AVERAGE STAGE			
			6-HR	24-HR	72-HR	29.90-HR
+ (FEET)	(HR)					
196.02	6.30		194.45	193.79	193.73	193.73

CUMULATIVE AREA = 0.02 SQ MI

1

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

					RATIOS APPLIED TO PRECIPITATION			
OPERATION	STATION	AREA	PLAN		RATIO 1	RATIO 2	RATIO 3	RATIO 4
					0.59	0.69	0.81	1.00
HYDROGRAPH AT								
+	UNDEV	0.02	1	FLOW	31.	39.	50.	66.
				TIME	6.00	6.00	6.00	6.00
HYDROGRAPH AT								
+	BASIN1	0.02	1	FLOW	39.	47.	58.	74.
				TIME	6.00	6.00	6.00	6.00
ROUTED TO								
+	RRROW	0.02	1	FLOW	16.	20.	24.	30.
				TIME	6.30	6.30	6.30	6.30

** PEAK STAGES IN FEET **

1	STAGE	194.88	195.15	195.49	196.02
	TIME	6.30	6.30	6.30	6.30

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

The second portion of this drainage plan was devoted to Pond design and detention storage analysis for the entire site. The purpose of this analysis is to ensure that development of this property does not adversely affect any neighboring properties. To show this, there are four points of concentration where on-site runoff will exit the Wiilson Property, these being: 1. 3' X 2' box culvert under RR in SW corner, @. RR biidge at aprroximately center of section, 3. Proposed 5' X 4' RCBC at SE corner to be built with Webb Rd. Project byt County, and 4. 2 - 5' X 4' RCBC just north of 19th St.

Following are the peak Pre-Developed and Developed on-site generated Q_{100}'s for each point.

Point #	Contributing Basin	$Q_{100\ pre.}$	$Q_{100\ dev.}$
1	8	66	30
2	1-5,9	1083	894
3	6	142	130
4	RCBC and drainage system previously designed for Q_{100}		

In each case the peak developed flow is less than the peak pre-developed flow. This is accomplished through detention storage to be provided by construction of new ponds.

(3 pages)

ATTACHMENT D

DRAINAGE CRITERIA

CITY OF WICHITA, KANSAS

RECOMMENDED RUNOFF COEFFICIENTS FOR RATIONAL METHOD
AND PERCENT IMPERVIOUS FOR UNIT HYDROGRAPH METHOD

Land Use or Surface Characteristics	Percent Impervious	Frequency 2	5	10	100
1. Business:					
Downtown Areas	95	0.84	0.85	0.87	0.91
Neighborhood Areas	70	0.68	0.69	0.73	0.80
2. Residential:					
Single Family (Soil Group D)					
1/8 Acre	50	0.57	0.61	0.66	0.79
1/4 Acre	38	0.50	0.54	0.62	0.76
1/3 Acre	30	0.46	0.50	0.59	0.73
1/2 Acre	25	0.42	0.48	0.56	0.72
3/4 Acre	22	0.42	0.46	0.55	0.71
1 Acre	20	0.41	0.45	0.54	0.71
Multi-Family (Soil Group D)					
Multi-Unit (detached)	60	0.62	0.66	0.72	0.82
Multi-Unit (attached)	65	0.64	0.68	0.73	0.83
Apartments	75	0.70	0.73	0.79	0.86
Single Family (Soil Group C)					
1/8 Acre	50	0.55	0.58	0.64	0.73
1/4 Acre	38	0.48	0.51	0.57	0.68
1/3 Acre	30	0.43	0.46	0.53	0.65
1/2 Acre	25	0.40	0.43	0.50	0.63
3/4 Acre	22	0.39	0.42	0.49	0.62
1 Acre	20	0.37	0.40	0.48	0.61
Multi-Family (Soil Group C)					
Multi-Unit (detached)	60	0.60	0.63	0.69	0.77
Multi-Unit (attached)	65	0.63	0.66	0.71	0.79
Apartments	75	0.68	0.72	0.77	0.83
Single-Family (Soil Group B)					
1/8 Acre	50	0.52	0.54	0.59	0.67
1/4 Acre	38	0.44	0.46	0.52	0.61
1/3 Acre	30	0.39	0.41	0.47	0.57
1/2 Acre	25	0.36	0.38	0.44	0.54
3/4 Acre	22	0.34	0.36	0.42	0.52
1 Acre	20	0.33	0.35	0.40	0.51
Multi-Family (Soil Group B)					
Multi-Unit (detached)	60	0.58	0.60	0.65	0.72
Multi-Unit (attached)	65	0.61	0.64	0.68	0.75
Apartments	75	0.67	0.70	0.74	0.80

Land Use or face Characteristics	Percent Impervious	Frequency 2	5	10	100
Single Family (Soil Group A)					
1/8 Acre	50	0.47	0.50	0.54	0.60
1/4 Acre	38	0.39	0.41	0.45	0.52
1/3 Acre	30	0.33	0.35	0.39	0.47
1/2 Acre	25	0.30	0.31	0.35	0.44
3/4 Acre	22	0.28	0.29	0.33	0.42
1 Acre	20	0.26	0.28	0.32	0.40
Multi-Family (Soil Group A)					
Multi-Unit (detached)	60	0.55	0.57	0.61	0.67
Multi-Unit (attached)	65	0.58	0.60	0.64	0.70
Apartments	75	0.65	0.68	0.72	0.77
3. Industrial:					
Light Areas	70	0.68	0.69	0.73	0.80
Heavy Areas	80	0.74	0.76	0.79	0.84
4. Playgrounds:	15	0.33	0.35	0.42	0.55
5. Schools:	40	0.49	0.51	0.56	0.66
6. Railroad Yard Areas:	30	0.43	0.45	0.50	0.62
Undeveloped Urban Areas:					
Offsite Flow Analysis (when land use not defined)	45	0.52	0.54	0.59	0.68
8. Streets:					
Paved	99	0.87	0.88	0.90	0.93
Gravel	00	0.24	0.26	0.33	0.48
9. Drive, Parking Lots and Walks:	96	0.87	0.87	0.88	0.89
10. Roofs:	90	0.80	0.85	0.90	0.93
11. Urban Lawn Areas (See Note No. 1 below):					
Soil Group A					
Slope less than 1%	00	0.08	0.09	0.13	0.23
Slope 1% to 4%	00	0.12	0.13	0.17	0.27
Slope more than 4%	00	0.16	0.17	0.21	0.31
Soil Group B					
Slope less than 1%	00	0.16	0.18	0.24	0.37
Slope 1% to 4%	00	0.20	0.22	0.28	0.41
Slope more than 4%	00	0.24	0.26	0.32	0.45
Soil Group C					
Slope less than 1%	00	0.24	0.27	0.35	0.51
Slope 1% to 4%	00	0.26	0.29	0.37	0.53
Slope more than 4%	00	0.28	0.31	0.39	0.55

Land Use or Surface Characteristics	Percent Impervious	Frequency 2	5	10	100
Soil Group D					
Slope less than 1%	00	0.28	0.33	0.43	0.63
Slope 1% to 4%	00	0.30	0.35	0.45	0.65
Slope more than 4%	00	0.32	0.37	0.47	0.67

Note No. 1: Coefficients shown in the above table are for pervious open space areas with thick turf which includes pervious areas in parks and cemeteries. Coefficients shown above must be increased 0.02 for use with agricultural pasture areas. Coefficients shown above must be reduced by 0.04 for use with agricultural cultivated areas. Group A soils are well-drained, coarse textured sands with high infiltration rates. Group B soils are moderately well-drained, moderately coarse textured soils with moderate infiltration rates. Group C soils are moderately poor-drained, moderately fine textured soils with slow infiltration rates. Group D soils are poor-drained, fine textured soils with very slow infiltration rates.

GENERAL NOTE: These Rational Formula Coefficients may not be valid for basins 320 acres or larger.

April 15, 1986

ATTACHMENT A
DRAINAGE CRITERIA MANUAL

CITY OF WICHITA, KANSAS

RAINFALL INTENSITY TABLE FOR SEDGWICK COUNTY, KANSAS

The following tabulation contains rainfall intensity in inches per hour as derived from ESSA Weather Bureau Technical Paper 40 Modified to NWS Hydro-35, 1977 During First Hour

DURATION IN MINUTES	RETURN PERIODS OF 1-YR	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
5	4.18	5.57	6.53	7.41	8.52	9.48	10.32
6	3.99	5.32	6.25	7.09	8.16	9.09	9.89
7	3.81	5.09	5.99	6.81	7.84	8.74	9.50
8	3.66	4.89	5.75	6.55	7.55	8.42	9.15
9	3.52	4.70	5.54	6.31	7.28	8.13	8.83
10	3.39	4.52	5.34	6.09	7.04	7.86	8.54
11	3.27	4.36	5.16	5.89	6.81	7.61	8.27
12	3.18	4.21	4.99	5.71	6.60	7.38	8.02
13	3.05	4.08	4.84	5.53	6.41	7.17	7.79
14	2.96	3.95	4.69	5.37	6.23	6.97	7.57
15	2.87	3.83	4.56	5.22	6.06	6.78	7.37
16	2.78	3.72	4.43	5.08	5.90	6.60	7.18
17	2.71	3.61	4.31	4.95	5.75	6.44	7.00
18	2.63	3.51	4.20	4.83	5.61	6.29	6.84
19	2.56	3.42	4.10	4.71	5.47	6.14	6.68
20	2.50	3.33	4.00	4.60	5.35	6.00	6.53
21	2.44	3.25	3.90	4.50	5.23	5.87	6.39
22	2.38	3.17	3.81	4.40	5.12	5.75	6.26
23	2.32	3.10	3.73	4.31	5.01	5.63	6.13
24	2.27	3.03	3.65	4.22	4.91	5.52	6.01
25	2.22	2.96	3.57	4.13	4.81	5.41	5.90
26	2.20	2.90	3.50	4.05	4.72	5.31	5.79
27	2.16	2.84	3.43	3.98	4.63	5.21	5.69
28	2.14	2.78	3.37	3.90	4.55	5.12	5.59
29	2.11	2.72	3.30	3.83	4.47	5.03	5.49
30	2.08	2.67	3.24	3.76	4.39	4.94	5.40
31	2.05	2.62	3.19	3.70	4.32	4.86	5.32
32	2.02	2.57	3.10	3.63	4.25	4.79	5.22
33	1.99	2.52	3.05	3.57	4.18	4.71	5.14
34	1.96	2.48	3.01	3.51	4.11	4.63	5.07
35	1.93	2.44	2.98	3.46	4.05	4.56	5.00
36	1.91	2.39	2.93	3.41	3.99	4.50	4.93
37	1.89	2.35	2.88	3.36	3.93	4.43	4.86
38	1.87	2.32	2.84	3.31	3.87	4.37	4.79
39	1.85	2.28	2.80	3.26	3.82	4.31	4.73
40	1.83	2.24	2.76	3.22	3.76	4.25	4.66
41	1.81	2.21	2.72	3.17	3.71	4.19	4.60
42	1.79	2.18	2.68	3.13	3.66	4.13	4.54
43	1.77	2.14	2.64	3.09	3.61	4.08	4.49
44	1.75	2.11	2.61	3.05	3.57	4.03	4.43
45	1.73	2.08	2.57	3.01	3.52	3.98	4.38

$S = Q^2/K^2$

$Q = KVS$

$K = Q/VS$

cfs

TABLE 3

FULL FLOW COEFFICIENT VALUES CIRCULAR CONCRETE PIPE

D Pipe Diameter (inches)	A Area (Square Feet)	R Hydraulic Radius (Feet)	Value of $C_1 = \frac{1.486}{n} \times A \times R^{2/3} = K$			
			n=0.010	n=0.011	n=0.012	n=0.013
8	0.349	0.167	15.8	14.3	13.1	12.1
10	0.545	0.208	28.4	25.8	23.6	21.8
12	0.785	0.250	46.4	42.1	38.6	35.7
15	1.227	0.312	84.1	76.5	70.1	64.7
18	1.767	0.375	137	124	114	105
21	2.405	0.437	206	187	172	158
24	3.142	0.500	294	267	245	226
27	3.976	0.562	402	366	335	310
30	4.909	0.625	533	485	444	410
33	5.940	0.688	686	624	574	530
36	7.069	0.750	867	788	722	666
42	9.621	0.875	1308	1189	1090	1006
48	12.566	1.000	1867	1698	1556	1436
54	15.904	1.125	2557	2325	2131	1967
60	19.635	1.250	3385	3077	2821	2604
66	23.758	1.375	4364	3967	3636	3357
72	28.274	1.500	5504	5004	4587	4234
78	33.183	1.625	6815	6195	5679	5242
84	38.485	1.750	8304	7549	6920	6388
90	44.170	1.875	9985	9078	8321	7681
96	50.266	2.000	11850	10780	9878	9119
102	56.745	2.125	13940	12670	11620	10720
108	63.617	2.250	16230	14760	13530	12490
114	70.882	2.375	18750	17040	15620	14420
120	78.540	2.500	21500	19540	17920	16540
126	86.590	2.625	24480	22260	20400	18830
132	95.033	2.750	27720	25200	23100	21330
138	103.870	2.875	31210	28370	26010	24010
144	113.100	3.000	34960	31780	29130	26890

TABLE 4

FULL FLOW COEFFICIENT VALUES ELLIPTICAL CONCRETE PIPE

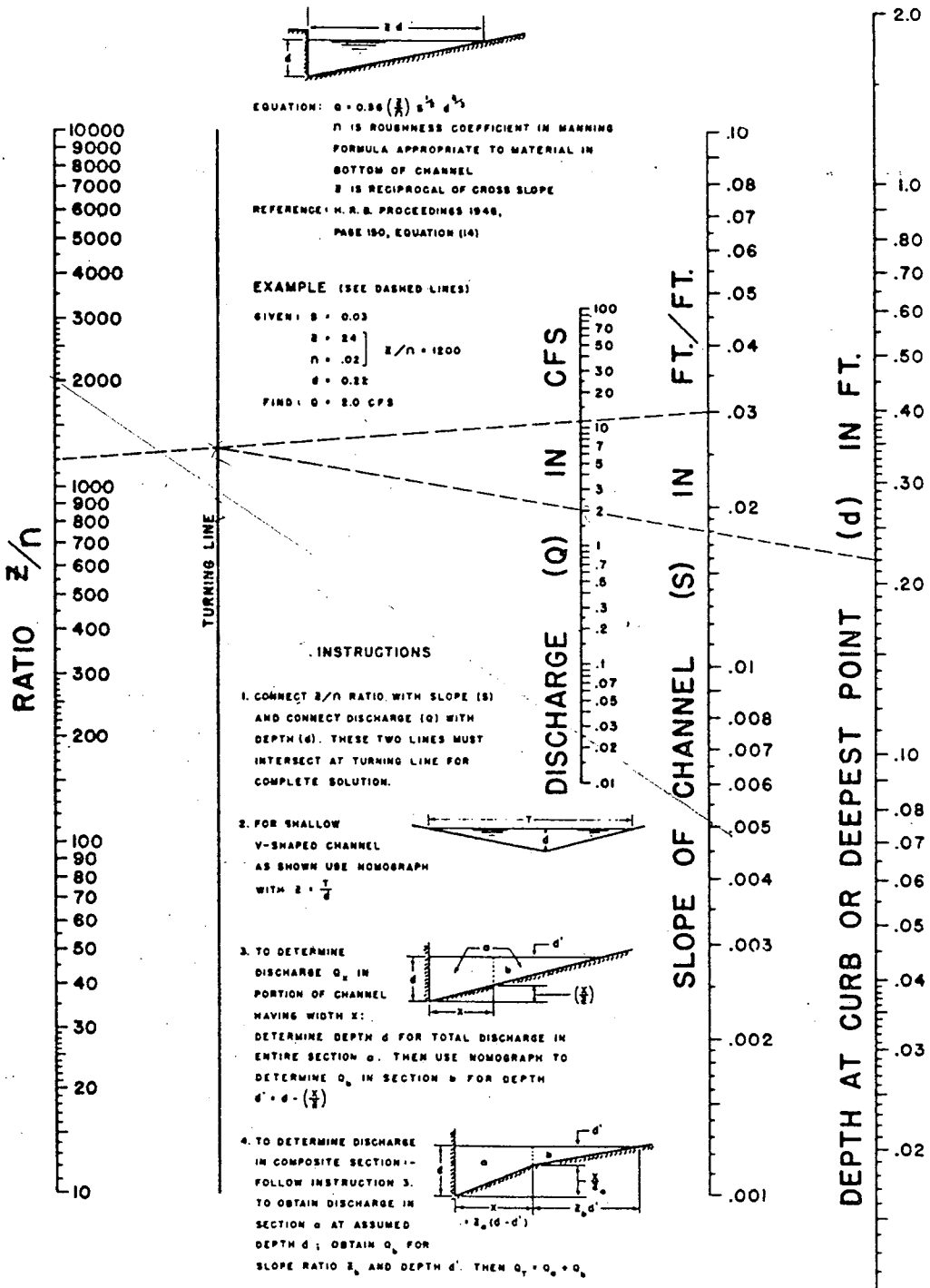
Pipe Size R x S (HE) S x R (VE) (Inches)	Approximate Equivalent Circular Diameter (Inches)	A Area (Square Feet)	R Hydraulic Radius (Feet)	Value of $C_1 = \frac{1.486}{n} \times A \times R^{2/3} = K$			
				n = 0.010	n = 0.011	n = 0.012	n = 0.013
14 x 23	18	1.8	0.367	138	125	116	108
19 x 30	24	3.3	0.490	301	274	252	232
22 x 34	27	4.1	0.546	405	368	339	313
24 x 38	30	5.1	0.613	547	497	456	421
27 x 42	33	6.3	0.686	728	662	607	560
29 x 45	36	7.4	0.736	891	810	746	686
32 x 49	39	8.8	0.812	1140	1036	948	875
34 x 53	42	10.2	0.875	1386	1260	1156	1067
38 x 60	48	12.9	0.969	1878	1707	1565	1445
43 x 68	54	16.6	1.106	2635	2395	2196	2027
48 x 76	60	20.5	1.229	3491	3174	2910	2686
53 x 83	66	24.8	1.352	4503	4094	3753	3464
58 x 91	72	29.5	1.475	5680	5164	4734	4370
63 x 98	78	34.6	1.598	7027	6388	5856	5406
68 x 106	84	40.1	1.721	8560	7790	7140	6590
72 x 113	90	46.1	1.845	10300	9365	8584	7925
77 x 121	96	52.4	1.967	12220	11110	10190	9403
82 x 128	102	59.2	2.091	14380	13070	11980	11060
87 x 136	108	66.4	2.215	16770	15240	13970	12900
92 x 143	114	74.0	2.340	19380	17620	16150	14910
97 x 151	120	82.0	2.461	22190	20180	18490	17070
106 x 166	132	99.2	2.707	28630	26020	23860	22020
116 x 180	144	118.6	2.968	36400	33100	30340	28000

TABLE 5

FULL FLOW COEFFICIENT VALUES CONCRETE ARCH PIPE

Pipe Size R x S (Inches)	Approximate Equivalent Circular Diameter (Inches)	A Area (Square Feet)	R Hydraulic Radius (Feet)	Value of $C_1 = \frac{1.486}{n} \times A \times R^{2/3} = K$			
				n - 0.010	n - 0.011	n - 0.012	n - 0.013
11 x 18	15	1.1	0.25	65	59	54	50
13½ x 22	18	1.6	0.30	110	100	91	84
15½ x 26	21	2.2	0.36	165	150	137	127
18 x 28½	24	2.8	0.45	243	221	203	187
22½ x 36¼	30	4.4	0.56	441	401	368	339
26⅝ x 43¾	36	6.4	0.68	736	669	613	566
31⁹⁄₁₆ x 51⅛	42	8.8	0.80	1125	1023	938	866
36 x 58½	48	11.4	0.90	1579	1435	1315	1214
40 x 65	54	14.3	1.01	2140	1945	1783	1646
45 x 73	60	17.7	1.13	2851	2592	2376	2193
54 x 88	72	25.6	1.35	4641	4219	3867	3569
62 x 102	84	34.6	1.57	6941	6310	5784	5339
72 x 115	90	44.5	1.77	9668	8789	8056	7436
77¼ x 122	96	51.7	1.92	11850	10770	9872	9112
87⅛ x 138	108	66.0	2.17	16430	14940	13690	12640
96⅞ x 154	120	81.8	2.42	21975	19977	18312	16904
106½ x 168¾	132	99.1	2.65	28292	25720	23577	21763

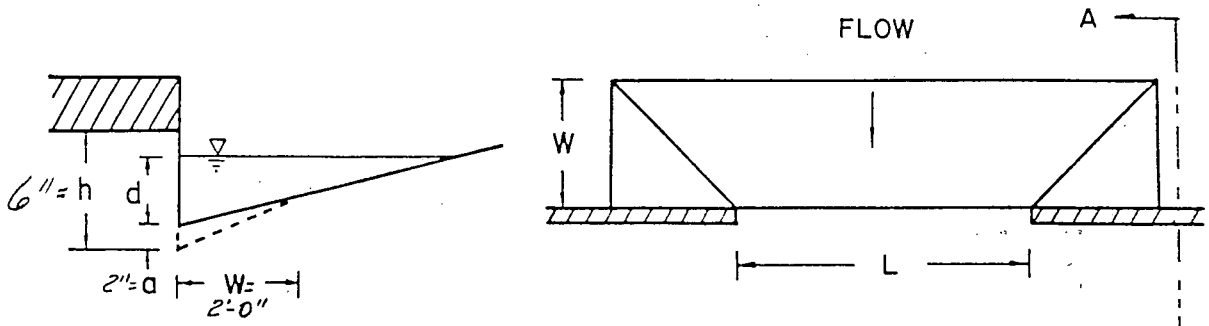
NOMOGRAPH FOR FLOW IN TRIANGULAR CHANNELS



One foot is 0.3048m
One cubic foot is $0.0283 m^3$

$\frac{1}{Z} = \frac{3/8}{12}$ $Z = 32$

$\frac{Z}{n} = \frac{32}{0.016} = 2000$



DEF. SKETCH, C.O.W. TYPE 1A INLET

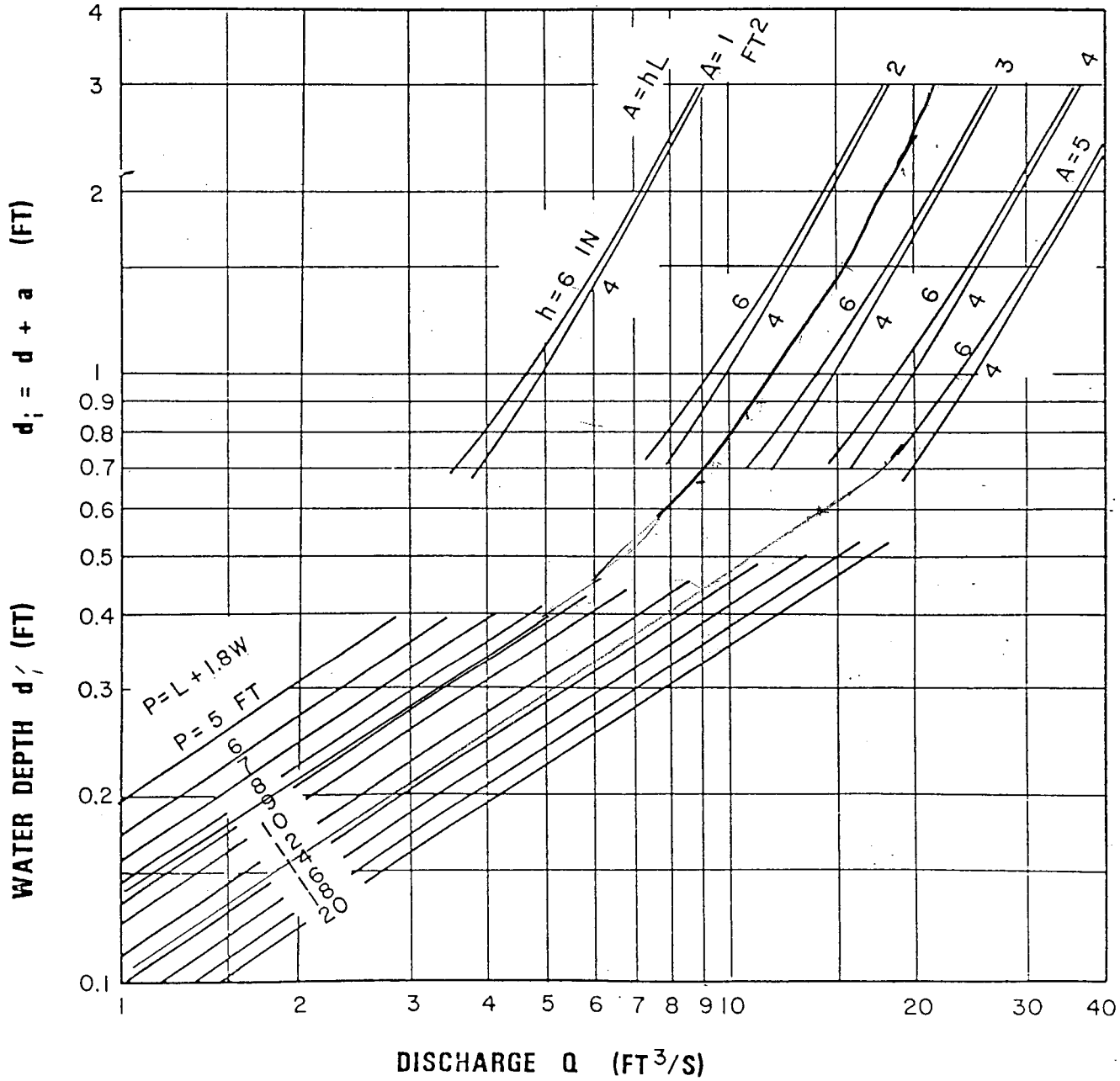
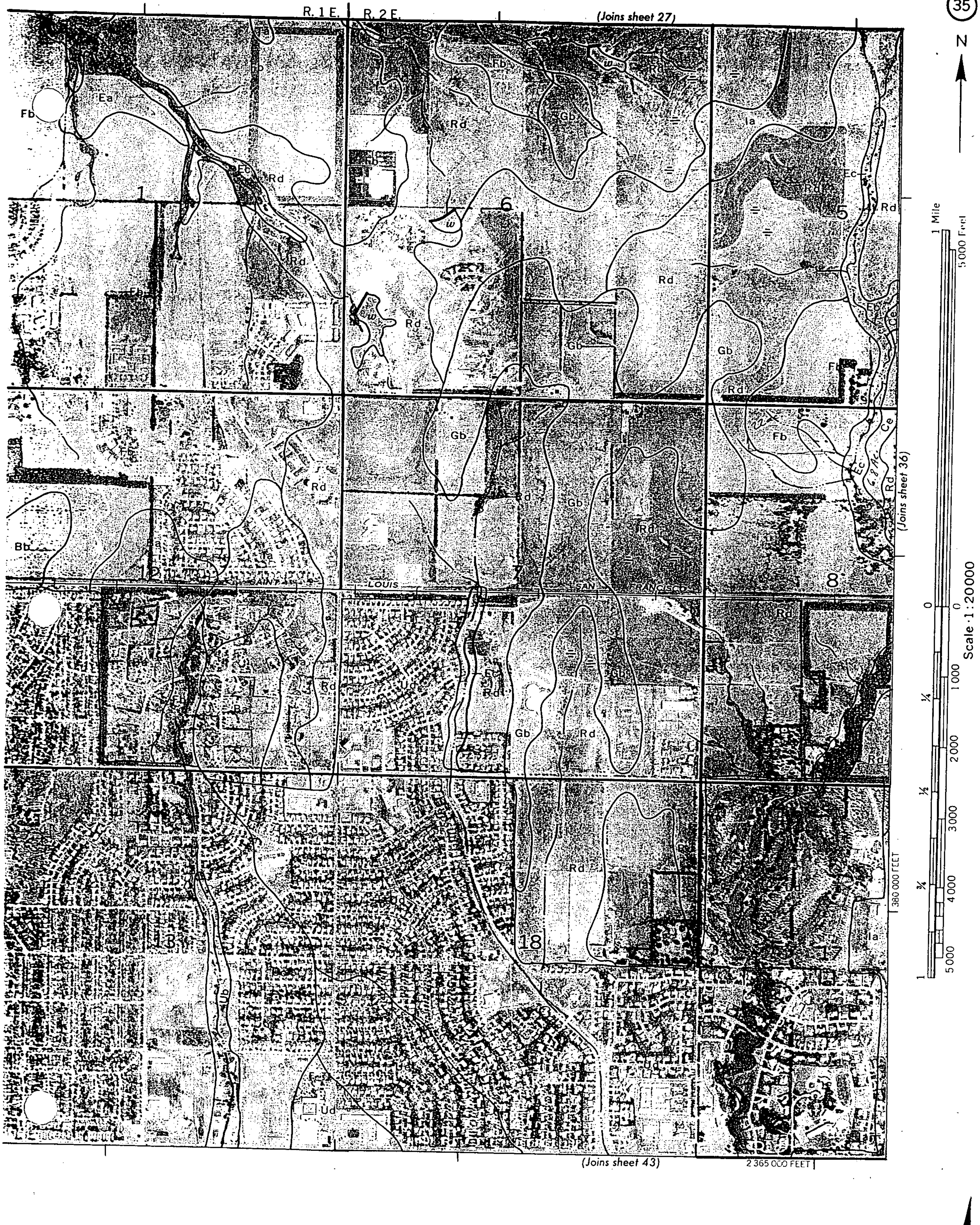


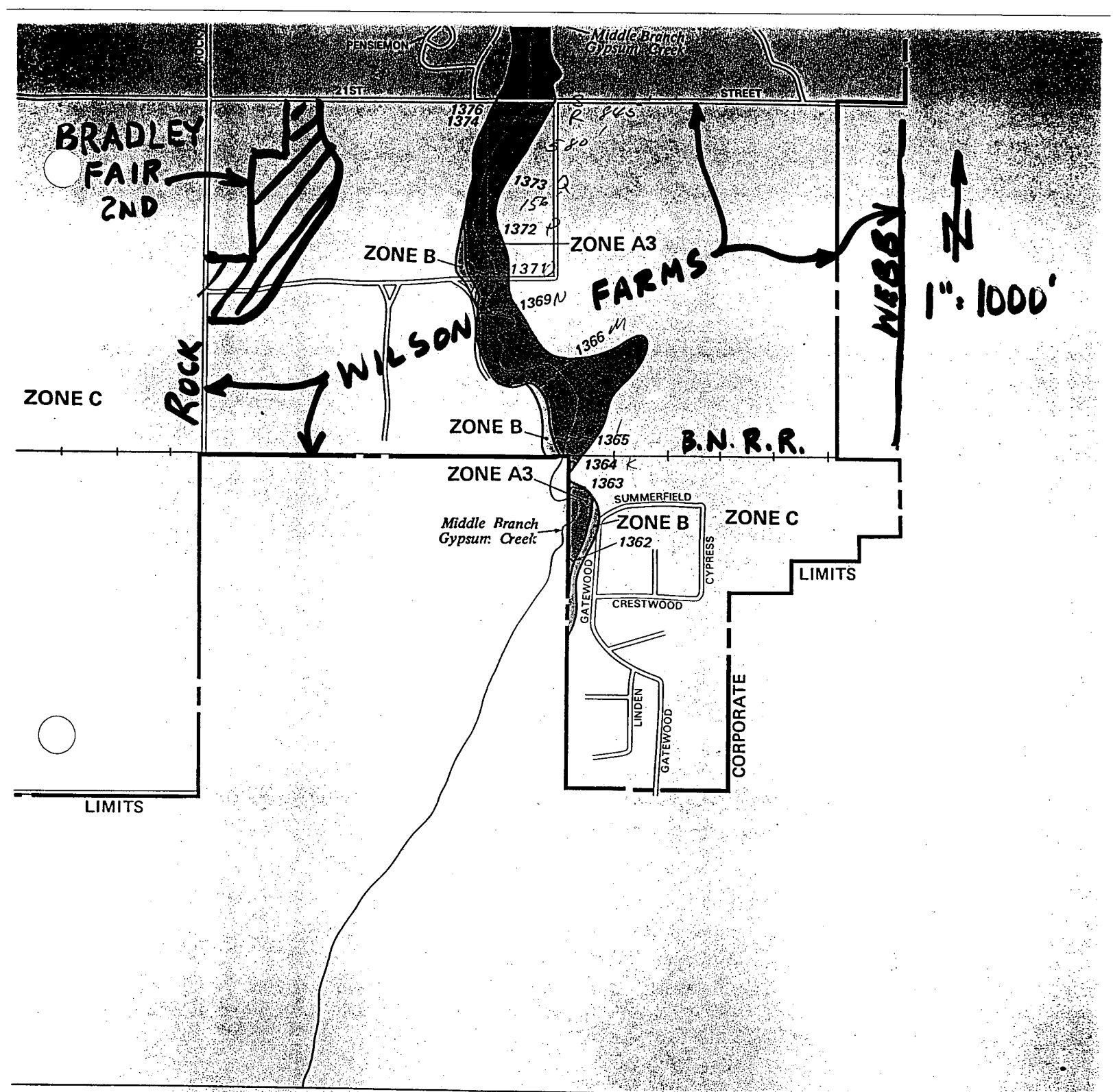
CHART 12. Depressed curb-opening inlet capacity in sump locations.

FROM: HEC-12, DRAINAGE OF HIGHWAY PAVEMENTS, F.H.W.A., MAR., 1984

SOIL LEGEND

SYMBOL	HYDROLOGIC GROUP	NAME
Aa	B	Albion–Shellabarger sandy loams, 1 to 4 percent slopes
Ab	B	Albion and Shellabarger sandy loams, 7 to 15 percent slopes
Ba	C	Blanket silt loam, 0 to 1 percent slopes
Bb	C	Blanket silt loam, 1 to 3 percent slopes
Ca	B	Canadian fine sandy loam
Cb	B	Canadian–Waldeck fine sandy loams
Cc	D	Carwile fine sandy loam
Cd	B	Clark–Ost clay loams, 1 to 4 percent slopes
Ce	C	Clime silty clay, 3 to 6 percent slopes
Ea	B	Elandco silt loam
Eb	B	Elandco silt loam, occasionally flooded
Ec	B	Elandco silt loam, frequently flooded
Fa	B	Farnum loam, 0 to 1 percent slopes
Fb	B	Farnum loam, 1 to 3 percent slopes
Fc	B	Farnum loam, sandy substratum, 0 to 1 percent slopes
Ga	D	Goessel silty clay, 0 to 1 percent slopes
Gb	D	Goessel silty clay, 1 to 2 percent slopes
Ia	D	Irwin silty clay loam, 1 to 3 percent slopes
Ib	D	Irwin silty clay loam, 3 to 6 percent slopes
Ic	D	Irwin silty clay loam, 2 to 6 percent slopes, eroded
La	C	Lesho loam
Lb	A	Lincoln soils
Ma	B	Milan loam, 1 to 3 percent slopes
Mb	B	Milan loam, 3 to 6 percent slopes
Mc	B	Milan clay loam, 2 to 6 percent slopes, eroded
Na	B	Naron fine sandy loam
Oc	D	Owens clay loam, 1 to 3 percent slopes
Od	D	Owens–Rock outcrop complex, 3 to 10 percent slopes
Pa		Pits
Pb	D	Plevna fine sandy loam
Pc	A	Pratt loamy fine sand, undulating
Pd	A	Pratt–Tivoli complex, rolling
Ra	D	Renfrow silty clay loam, 1 to 3 percent slopes
Rb	D	Renfrow silty clay loam, 3 to 6 percent slopes
Rc	D	Renfrow–Owens clay loams, 1 to 4 percent slopes
Rd	D	Rosehill silty clay, 1 to 3 percent slopes
Sa	B	Shellabarger sandy loam, 1 to 3 percent slopes
Sb	B	Shellabarger sandy loam, 3 to 6 percent slopes
Sc	B	Shellabarger sandy loam, 3 to 6 percent slopes, eroded
Ta	D	Tabler silty clay loam
Tb	D	Tabler–Drummond complex
Ua	B	Urban land–Canadian complex
Ub	B	Urban land–Elandco complex
Uc	B	Urban land–Farnum complex, 0 to 3 percent slopes
Ud	D	Urban land–Irwin complex, 1 to 3 percent slopes
Ue	D	Urban land–Tabler complex
Va	B	Vanoss silt loam, 0 to 1 percent slopes
Vb	B	Vanoss silt loam, 1 to 3 percent slopes
Vc	B	Vanoss silt loam, 3 to 6 percent slopes
Vd	B	Vanoss silt loam, 3 to 6 percent slopes, eroded
Ve	D	Vernon sandy loam, 1 to 3 percent slopes
Vf	D	Vernon sandy loam, 3 to 6 percent slopes
Wa	C	Waldeck sandy loam
Wb	D	Waurika silt loam


35
R. 1 E.
R. 2 E.
(Joins sheet 27)
(Joins sheet 36)
(Joins sheet 43)
N
1 Mile
5000 Feet
Scale 1:20000
0
¼
½
¾
1
0
1000
2000
3000
4000
5000
380 000 FEET
2 365 000 FEET
LOUIS
SAN
FRANCISCO
1
6
5
12
7
8
13
18
17
Ea
Fb
Ec
Rd
Gb
Ia
Ce
Bb
Ba
Ud
Ub
w


PENSIEMON
Middle Branch Gypsum Creek
21ST
STREET
BRADLEY FAIR 2ND
1376
1374
1373
1372
1371
1369
1366
ZONE B
ZONE A3
FARMS
WILSON
Rock
WEBB
N
1" = 1000'
ZONE C
ZONE B
1365
B.N.R.R.
1364
ZONE A3
1363
SUMMERFIELD
Middle Branch Gypsum Creek
ZONE B
ZONE C
1362
CYPRESS
GATEWOOD
CRESTWOOD
LIMITS
LINDEN
GATEWOOD
CORPORATE
LIMITS

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE (FEET)
MIDDLE BRANCH GYPSUM CREEK								
A	1000	109	690	2.7	1339.7	1339.7	1340.3	0.6
B	1269	109	646	2.9	1339.8	1339.8	1340.4	0.6
C	1391	32	270	7.0	1340.6	1340.6	1340.6	0.0
D	1891	45	405	4.7	1341.2	1341.2	1341.9	0.7
E	3760	70	202	9.3	1346.8	1346.8	1346.8	0.0
F	3860	70	376	5.0	1348.0	1348.0	1348.5	0.5
G	5010	119	626	3.0	1349.4	1349.4	1350.3	0.9
H	5460	110	474	4.0	1350.1	1350.1	1350.8	0.7
M	12,627	60[2]	216	5.8	1363.1	1363.1	1364.0	0.9
N	12,821	80	478	2.6	1365.6	1365.6	1365.8	0.2
O	13,611	150	530	2.3	1366.2	1366.2	1366.9	0.7
P	15,301	75	399	3.1	1369.3	1369.3	1369.4	0.1
Q	15,457	75	276	4.5	1370.8	1370.8	1370.8	0.0
R	16,037	100	327	3.8	1372.6	1372.6	1373.4	0.8
S	16,882	100	479	2.6	1376.1	1376.1	1376.3	0.2

[1]FEET ABOVE CONFLUENCE WITH GYPSUM CREEK
[2]THIS WIDTH IS BEYOND CORPORATE LIMITS

TABLE 4

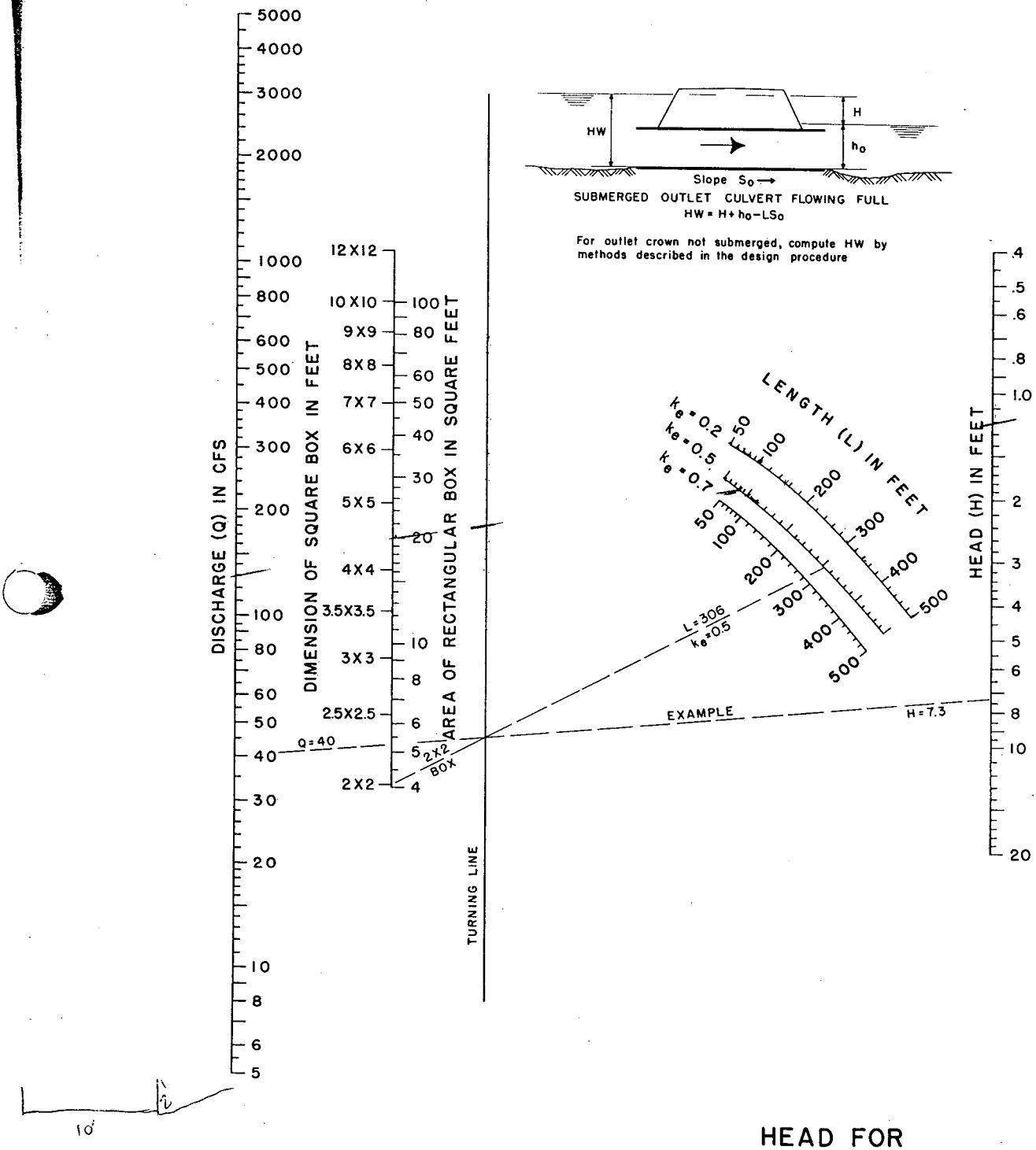
FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF WICHITA, KS
(SEDGWICK CO.)

FLOODWAY DATA

MIDDLE BRANCH GYPSUM CREEK

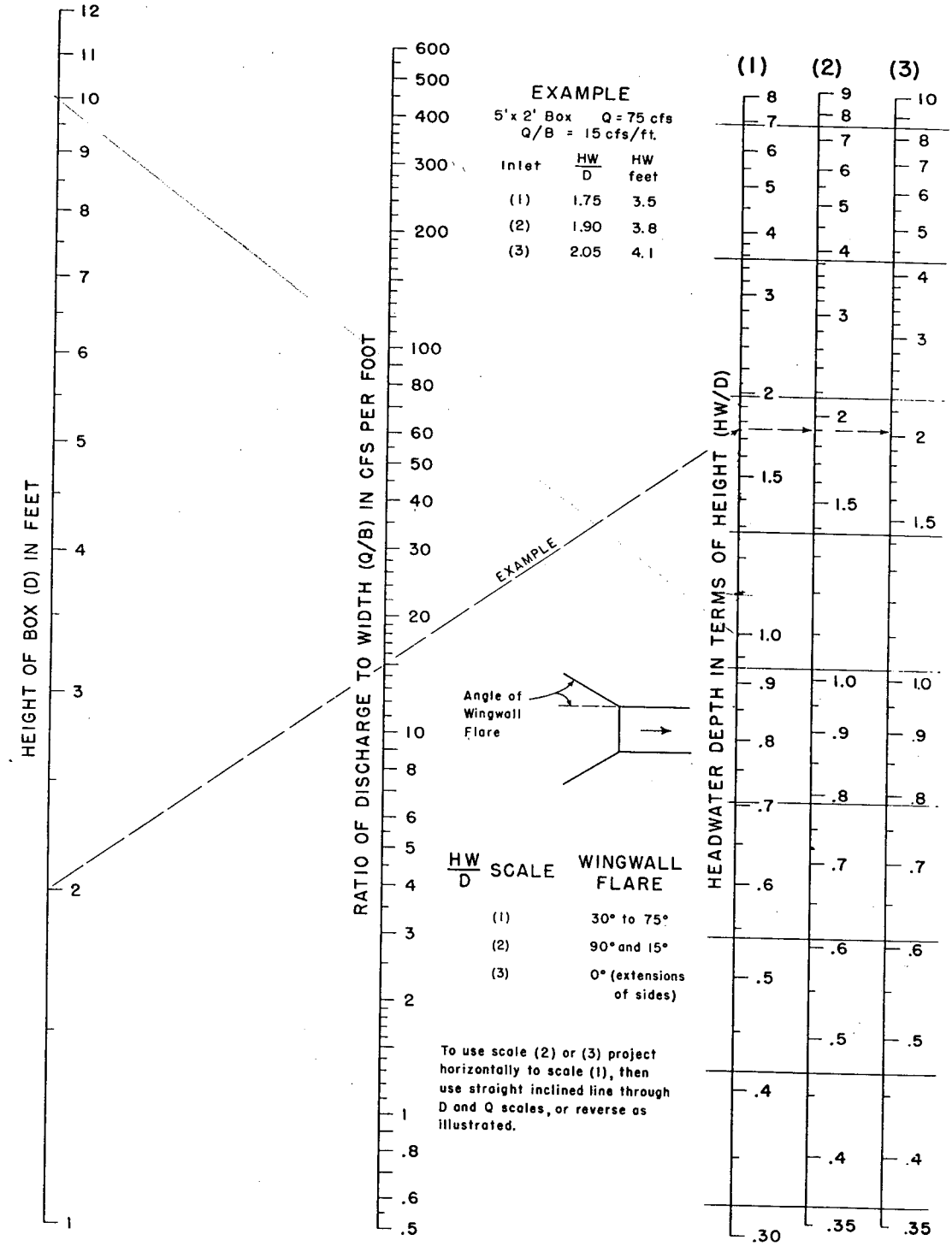
CHART 8



HEAD FOR CONCRETE BOX CULVERTS FLOWING FULL n = 0.012

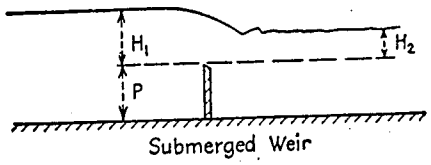
BUREAU OF PUBLIC ROADS JAN. 1963

CHART 1



HEADWATER DEPTH FOR BOX CULVERTS WITH INLET CONTROL

BUREAU OF PUBLIC ROADS JAN. 1963



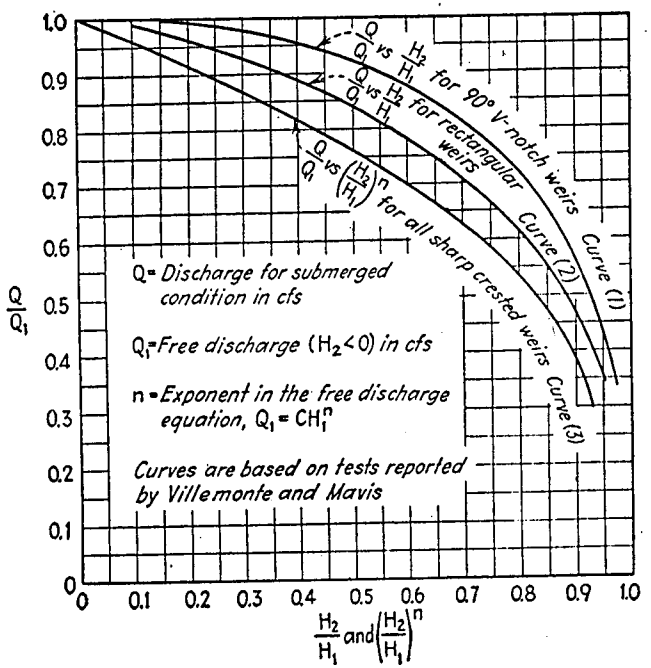


FIG. 5-5

the upstream side of the weir, H_1, but also to the head on the downstream side, H_2, and to a lesser extent, to the height of the weir crest above the floor of the channel, P. Early experiments by Francis (1848, 1883), Fteley and Stearns (1882), Bázin (1894), Cone (1916), and Cox (1928) have been summarized by Vennard and Weston.[1] They showed that the various test data could be presented in an orderly manner by selecting as variables Q/Q_1 and H_2/H_1, where Q_1 is the discharge at the head H_1, computed from the equation for free discharge (unsubmerged), which is expressed in general terms as follows:

$$Q_1 = CH_1^n \tag{5-49}$$

By plotting Q/Q_1 against H_2/H_1, they found that the various data tended to fall on a single curve, except for small values of P/H_1.

In 1947, Villemonte[2] presented the results of a series of tests on submerged sharp-crested weirs. He conducted tests on rectangular, triangular, parabolic, cusped, and proportional weirs. He showed that the results for all types could be represented by the single equation

$$\frac{Q}{Q_1} = \left[1 - \left(\frac{H_2}{H_1}\right)^n\right]^{0.385} \tag{5-50}$$

where n is the exponent in the free-discharge equation [Eq. (5-49)], and the other terms are as previously defined. This equation was found to satisfy all test results, with a maximum deviation of 5 per cent for some of the individual test results.

In 1949, Mavis[3] presented results of tests on rectangular, triangular, parabolic, circular, sutro, and cusped weirs. He found that a single equation could be used to express the results for all the tests. His equation with subscripts changed to conform with usage in this book is

$$\frac{Q}{Q_1} = 1 - \left(0.45S + \frac{0.40}{2^{(10-10S)}}\right) \tag{5-51}$$

[1] John K. Vennard and Ray F. Weston, Submergence Effect on Sharp-crested Weirs, *Eng. News-Record*, June 3, 1943, p. 818.

[2] James R. Villemonte, Submerged-weir Discharge Studies, *Eng. News-Record*, Dec. 25, 1947, p. 866.

[3] F. T. Mavis, How to Calculate Flow over Submerged Thin-plate Weirs, *Eng. News-Record*, July 7, 1949, p. 65.