STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION TITLE PAGE

CLIENT & PROJECT: Private Fuel Storage, LLC-Private Fuel Storage Facility				PAGE 1 OF 36	
CALCULATION TITLE (Indicative of Objective): PFSF Flood Analysis With Proposed Access Road and Rail Road.				QA CATEGORY ☒ ☒ - I Nuclear Safety Related ☐ - II ☐ - III ☐ - Non-Safety Related ☐ - ☐ - Fossil/Industrial Plant	
CALCULATION IDENTIFICATION NUMBER					
J.O. or W.O. NO.	DIVISION & GROUP	CURRENT CALC NO.	OPTIONAL TASK CODE	OPTIONAL WORK PACKAGE NO.	
0599602	**G(B)**	**17**		**345T**	
APPROVALS - SIGNATURE & DATE					CONFIRMATION REQUIRED ☒
PREPARER(S)/DATE(S)	REVIEWER(S)/DATE(S)	INDEPENDENT REVIEWER(S)/ DATES(S)	REV. NO. OR NEW CALC. NO.	SUPERCEDES CALC. NO. OR REV. NO.	YES / NO
Ven Nan Zeng 03/09/99 Ven Nan Zeng	George H.C. Liang 03/10/99 George H.C. Liang	George H.C. Liang 03/10/99 George H.C. Liang	Original Issue		☐ / ☒
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RECORD OF CHANGES

Rev No.	Description of Changes	Pages Revised	Pages Added	Pages Replaced
0	Original Issue	N/A	N/A	N/A

CALCULATION IDENTIFICATION NUMBER				REV. NO. 0
J.O. OR W.O NUMBER **0599602**	DIVISION AND GROUP **G(B)**	CALCULATION NUMBER **17**	OPTIONAL TASK CODE N/A	PAGE 3 of 36

TABLE OF CONTENTS

COVER PAGE **1**
RECORD OF CHANGES **2**
TABLE OF CONTENTS **3**

1, OBJECTIVES **4**

2, REFERENCES **4**

3, DESCRIPTION **5**

4, HYDRAULIC MODELS AND INPUT DATA **5**

5, RESULTS **8**

5.1 Flood Level at the Access Road Crossing 8
5.2, Flood Level at the Rail Crossing 11

6, CONCLUSION **13**

ATTACHMENT 1, HEC-RAS HYDRAULIC REPORT - ACCESS ROAD CROSSING **14**

ATTACHMENT 2, HEC-RAS HYDRAULIC REPORT - RAIL ROAD CROSSING **26**

CALCULATION IDENTIFICATION NUMBER				REV. NO 0
J.O. OR W.O NUMBER **0599602**	DIVISION AND GROUP **G(B)**	CALCULATION NUMBER **17**	OPTIONAL TASK CODE N/A	PAGE 4 of 36

1, OBJECTIVES

The objective of this calculation is to determine flood level at the following two floodway crossings, after placement of the access road embankment and the rail road embankment:

(1) Floodway to the east of PFSF site, at the access road crossing.
(2) Floodway to the west of PFSF site, at the 3-mile-long rail crossing.

The PMF and the 100-year flow rates used to determine flood levels are from Ref. 3 and Ref. 4.

2, REFERENCES

1. U.S.Army Corps of Engineers, Hydrologic Center, "HEC-RAS, River Analysis System", 1997.

2. Calculation 05996.01-G(B)-10, Rev 0, "HEC-RAS Micro Computer Version 1.2 Software Test", May 20, 1997.

3. Calculation 0599603-G(B)-12 "PFSF Flood analysis with Larger Drainage Basin".

4. Calculation 0599603-G(B)-16 "PFSF Flood analysis at 3-mile-long Rail Spur".

3, DESCRIPTION

Flood levels determined in Ref. 3 and Ref. 4 were based on the existing natural topography of the flood plains. The access road and the rail road embankments, which are proposed to place across the flood plains, were not modeled in the two analyses. The embankments are subjected to deter flood flow, and thus raising the water level.

This calculation evaluates flood level changes after placement of the embankments and the culverts that were designed to pass the flood. Peak flows determined in Ref. 3 and Ref. 4 are applied in the new models to calculate water levels. The new models are derived from the hydraulic models used in Ref.3 and Ref.4, to include the access road and the rail road. (References 1 and 2). These peak flows from Ref. 3 and Ref. 4 are:

	100-year flow (cfs)	PMF (cfs)	
Access Road Crossing	2,430	53,000	Ref. 3
3-mile-long Rail Spur crossing	1,400	68,500	Ref. 4

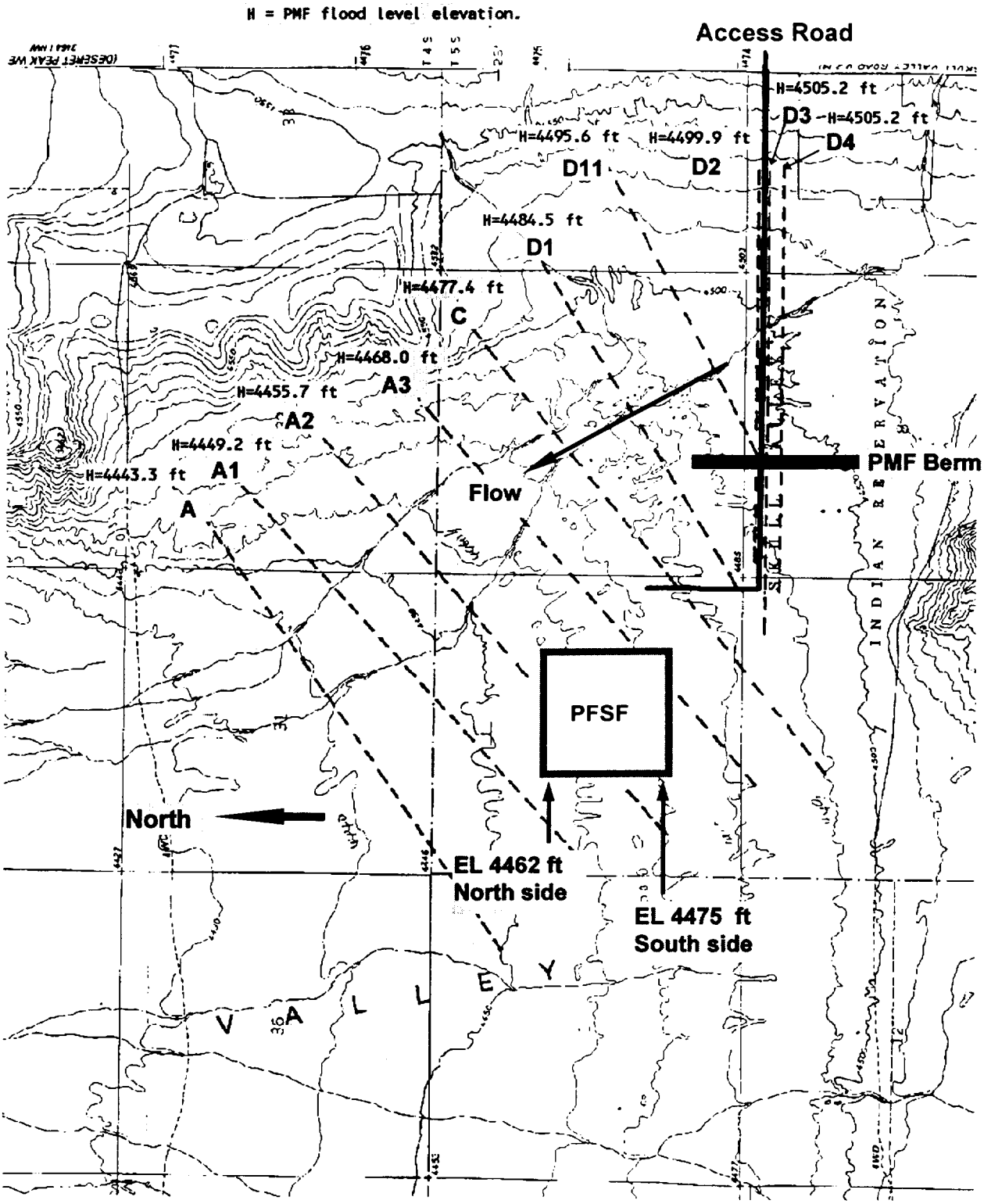
4, HYDRAULIC MODELS AND INPUT DATA

Figures 1 and 2 show the hydraulic models used in this analysis. Since the embankments change the flow patterns in the vicinity of the floodway crossing, the cross-sections in the models are revised to reflect the new flow pattern.

Input parameters to the program are basically the same as in Ref. 3 and Ref. 4, except the embankment and culvert related data. These are included in the attachments of this calculation.

CALCULATION IDENTIFICATION NUMBER				REV. NO. 0
J.O. OR W.O NUMBER 0599602	DIVISION AND GROUP G(B)	CALCULATION NUMBER 17	OPTIONAL TASK CODE N/A	PAGE 6 of 36

Figure 1, Hydraulic Model at Access Road Crossing



CALCULATION IDENTIFICATION NUMBER			REV. NO 0
J.O. OR W.O NUMBER 0599602	DIVISION AND GROUP G(B)	CALCULATION NUMBER 17	OPTIONAL TASK CODE N/A

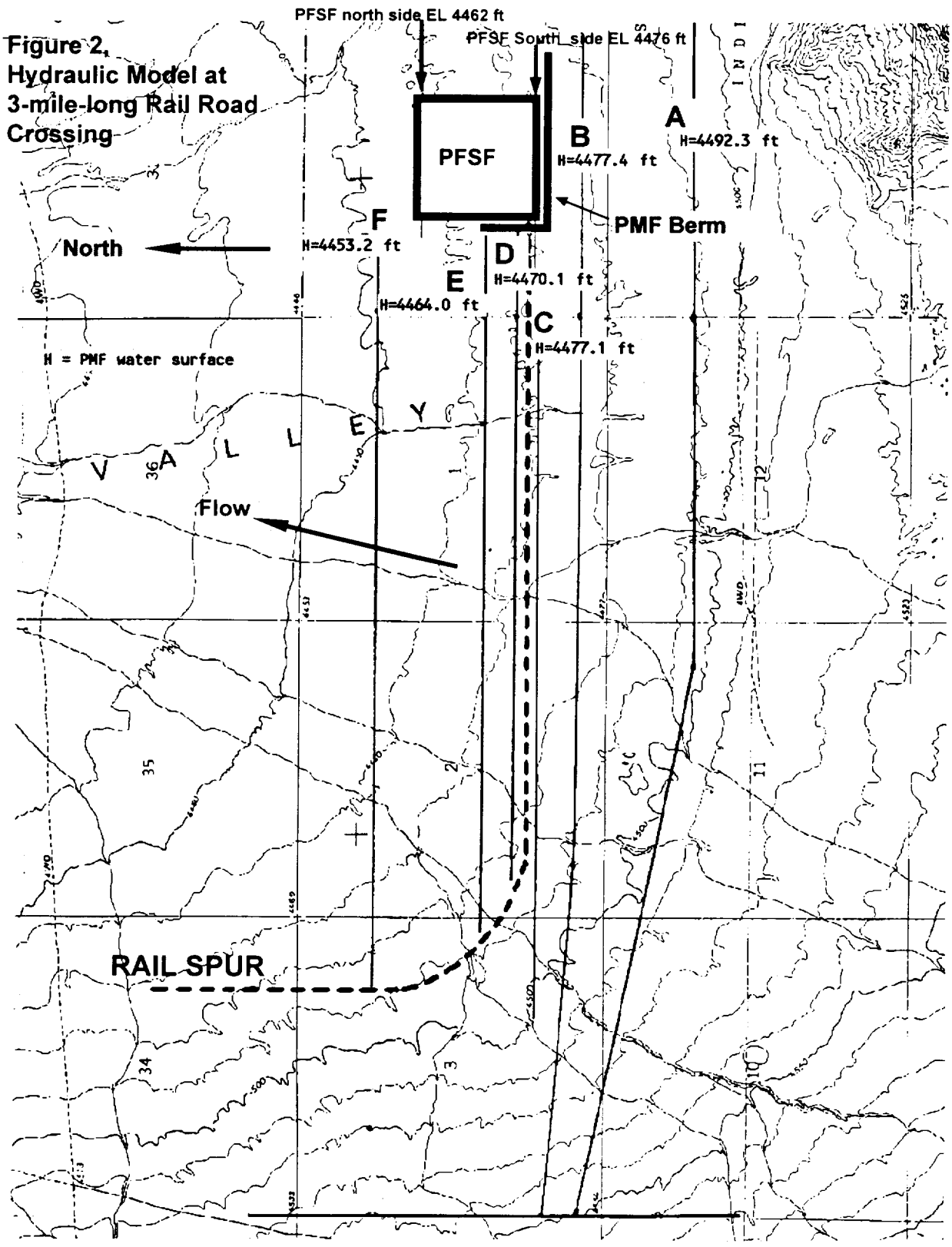


Figure 2, Hydraulic Model at 3-mile-long Rail Road Crossing

5, RESULTS

5.1 Flood Level at the Access Road Crossing

Table 1 summarized the calculated water surface elevations with other hydraulic parameters. The result indicates that the flows are under sub-critical condition, as denoted by the Froude Numbers being < 1.0 for both PMF and 100-year flood events. Consequently, the placement of the access road embankment and culverts, would only affect water level upstream from the embankment.

At the PFSF site, the water level elevations remain the same as calculated in Ref. 3. i.e., 4455.7 ft for the PMF flood and 4451.9 ft for the 100-year flood (Table 1, Cross section A2).

At the access road, the PMF would over-top the embankment (top elev = 4502 ft) by an overflow depth of 3.2 ft. The calculated water surface elevation is 4505.2 ft.

In the case of 100-year flood event, the 8 box culverts (11 ft span by 4 ft rise, each) are able to pass the flood flow at a head water (culvert inlet water level) elevation = 4500.3 ft.

Figure 3 shows the water surface profile and Figure 4 shows the 8 culverts and the water levels.

The water surface elevation of each cross section is also depicted in Figure 1.

CALCULATION IDENTIFICATION NUMBER				REV. NO 0
J.O. OR W.O NUMBER **0599602**	DIVISION AND GROUP **G(B)**	CALCULATION NUMBER **17**	OPTIONAL TASK CODE N/A	PAGE 9 of 36

Table 1, Access Road Crossing, Calculation Result Summary

Section	River Sta	Q Total (cfs)	W.S. Elev (ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
D4	10060	53000.00	**4505.19**	2.70	20208.21	3707.13	0.19
	10060	2430.00	**4500.26**	0.41	4221.82	2776.77	0.07
D3	9780	53000.00	**4505.18**	1.92	29321.84	3879.79	0.11
	9780	2430.00	**4500.26**	0.20	12124.10	3108.64	0.02
	9740	Culvert					
D2	9700	53000.00	**4499.65**	5.13	10484.21	3076.65	0.48
	9700	2430.00	**4496.11**	2.17	1121.73	1841.00	0.49
D11	8800	53000.00	**4495.63**	7.29	7440.75	2472.84	0.73
	8800	2430.00	**4491.95**	2.70	900.47	923.93	0.48
D1	7200	53000.00	**4484.47**	6.37	8320.12	3720.84	0.75
	7200	2430.00	**4481.30**	3.48	698.08	1077.78	0.76
C	5900	53000.00	**4477.40**	6.52	9332.06	3331.49	0.60
	5900	2430.00	**4474.39**	1.83	1333.60	1974.90	0.39
A3	4500	53000.00	**4467.99**	9.26	6975.88	3470.35	0.94
	4500	2430.00	**4465.49**	3.79	675.00	1570.35	0.96
A2	2800	53000.00	**4455.70**	5.77	9184.57	3065.85	0.59
	2800	2430.00	**4451.91**	2.34	1038.28	1087.95	0.42
A1	1300	53000.00	**4449.21**	5.43	9978.53	4008.66	0.59
	1300	2430.00	**4446.32**	2.12	1147.98	1740.88	0.46
A	0	53000.00	**4443.31**	6.33	9591.24	3888.38	0.61
	0	2430.00	**4440.60**	2.02	1241.60	2258.30	0.46

CALCULATION IDENTIFICATION NUMBER				REV. NO. 0
J.O. OR W.O NUMBER **0599602**	DIVISION AND GROUP **G(B)**	CALCULATION NUMBER **17**	OPTIONAL TASK CODE N/A	PAGE 10 of 36

Figure 3, Water Surface Profile at Floodway Near Access Road Crossing

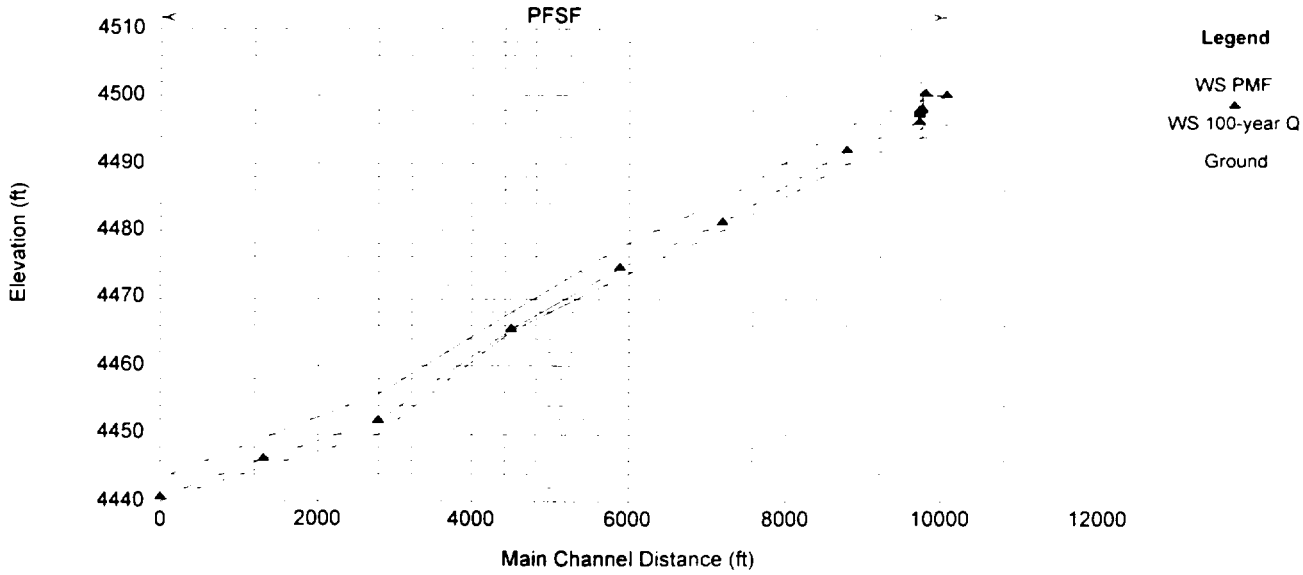
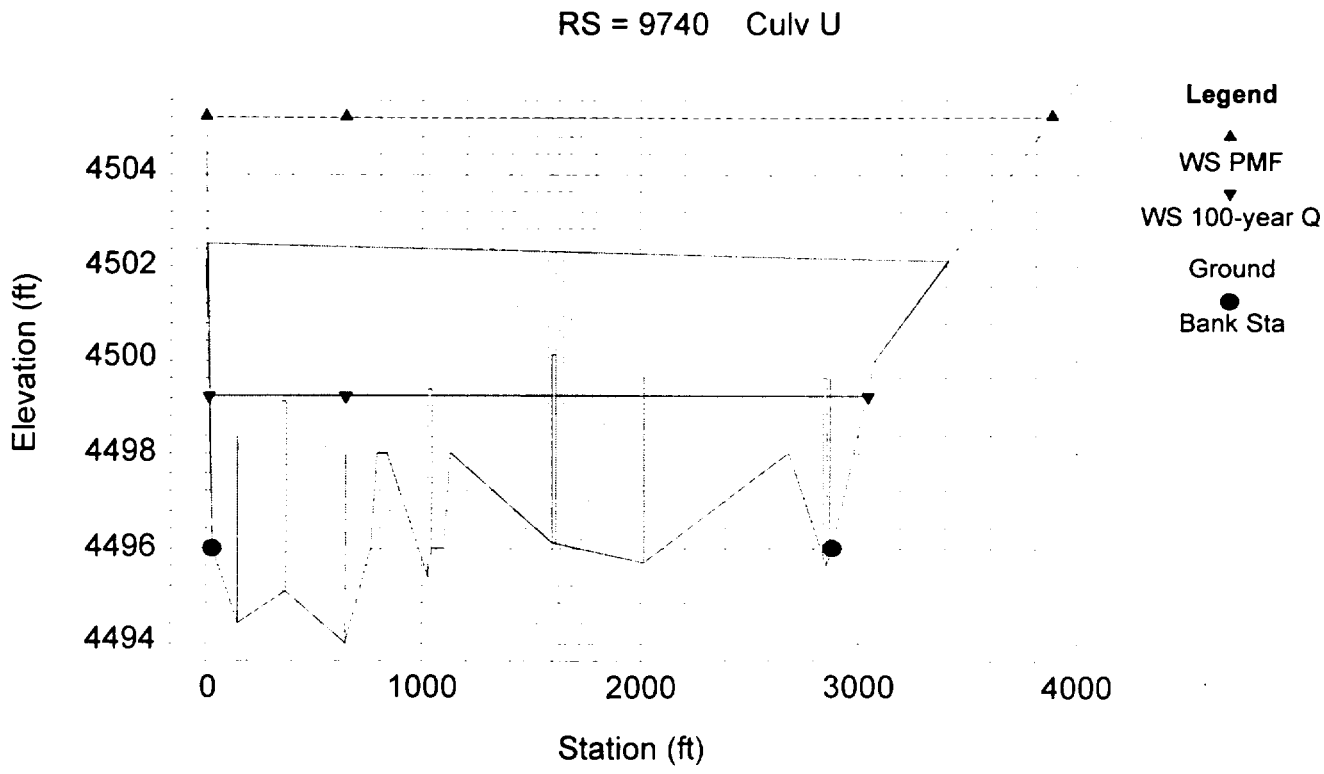


Figure 4, Access Road Embankment and Culverts with water levels



5.2, Flood Level at the Rail Crossing

The calculated water surface elevations are summarized in Table 2 with other hydraulic parameters at each cross section. The flow condition is similar to that in the Access road floodway. The placement of rail embankment and culverts would not change flood levels in the vicinity of PFSF site calculated in Ref. 4. The embankment would raise the upstream water level.

PMF Flood - The PMF flood would over-top the rail. The flood level over the rail embankment (top elev. = 4475 ft) is 4477.1 ft (Table 2, Section C).

Since the flow is sub-critical, the flood level downstream from the rail embankment should be similar to the natural flood case (without rail road) analyzed in Ref. 4. Because the location of the cross sections are different from Ref. 4. A direction comparison is not presented.

100-year flood - There are 8 box culverts designed to pass the flood flow. The culverts, providing a total flow area of 212 square ft, are able to pass the 100-year flow with a head water elevation = 4472.4.ft (Table 2, Section C). In Ref. 4, the comparable water levels were elevation 4510.5 ft (west end of rail) and 4467.22 ft (east end of rail).

Note: The culvert invert elevation in this preliminarily design is 4469.0 ft, based on the 1:24,000 USGS map. In the final design when detail survey data for the ground profile is available, the culverts invert elevation would have to be adjusted to produce enough cover depth for the loading of the rail. Other options using trestle or circular culverts could also be designed to provided the same flow area (212 square feet). This calculation demonstrates that flood level can be controlled within the allowable limit with culverts or trestles.

Figure 5 shows the water surface profile and Figure 6 shows the 8 culverts and the head water level.

Table 2, Rail Road Crossing, Calculation Result Summary

Section	River Sta	Q Total (cfs)	**W.S. Elev (ft)**	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
A	5500	1400.00	**4490.28**	0.86	1635.27	6013.18	0.29
	5500	68500.00	**4492.27**	4.75	15146.33	7547.54	0.56
B	3500	1400.00	**4475.61**	3.13	447.96	1478.54	1.00
	3500	68500.00	**4477.44**	6.69	10238.59	7082.09	0.98
C	2750	1400.00	**4472.43**	0.10	14386.86	6281.92	0.01
	2750	68500.00	**4477.09**	1.53	49255.39	8770.36	0.10
	2575	**Culvert**					
D	2400	1400.00	**4469.12**	2.10	667.85	4997.58	1.01
	2400	68500.00	**4470.74**	7.11	10225.30	6711.51	0.95
E	1800	1400.00	**4460.83**	1.71	817.14	1980.47	0.47
	1800	68500.00	**4463.96**	5.60	12221.81	5059.57	0.64
F	0	1400.00	**4450.43**	1.79	783.06	2120.08	0.52
	0	68500.00	**4453.21**	5.62	12194.65	6028.49	0.69

CALCULATION IDENTIFICATION NUMBER				REV. NO. 0
J.O. OR W.O NUMBER **0599602**	DIVISION AND GROUP **G(B)**	CALCULATION NUMBER **17**	OPTIONAL TASK CODE N/A	PAGE 12 of 36

Figure 5, Water Surface Profile at Floodway Near the Rail Road Crossing

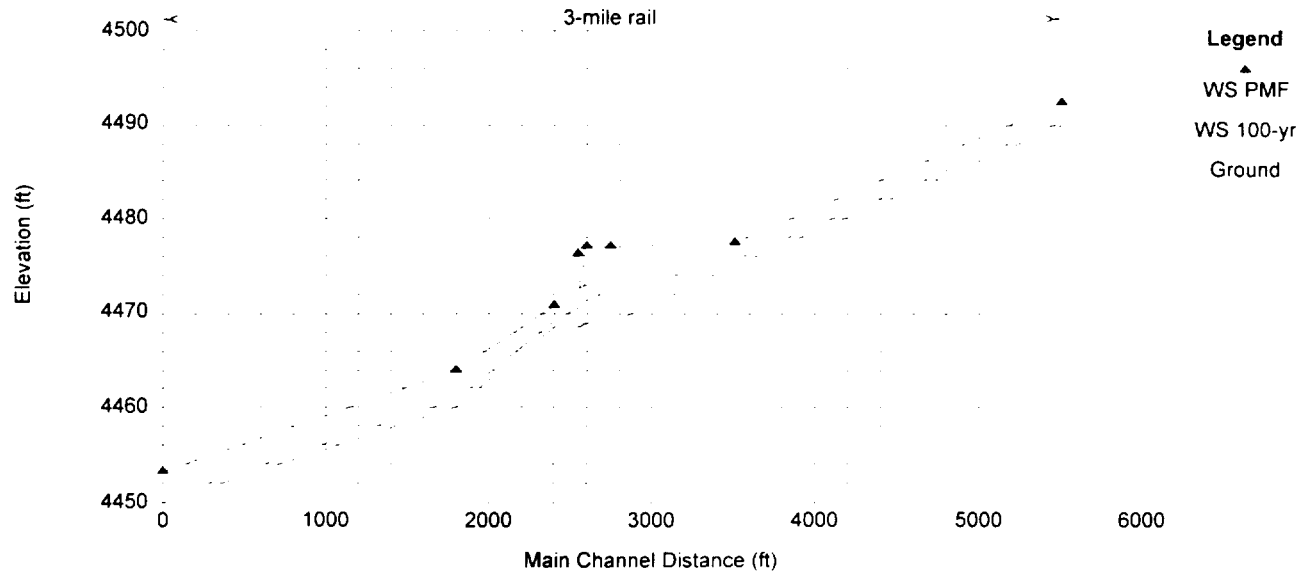
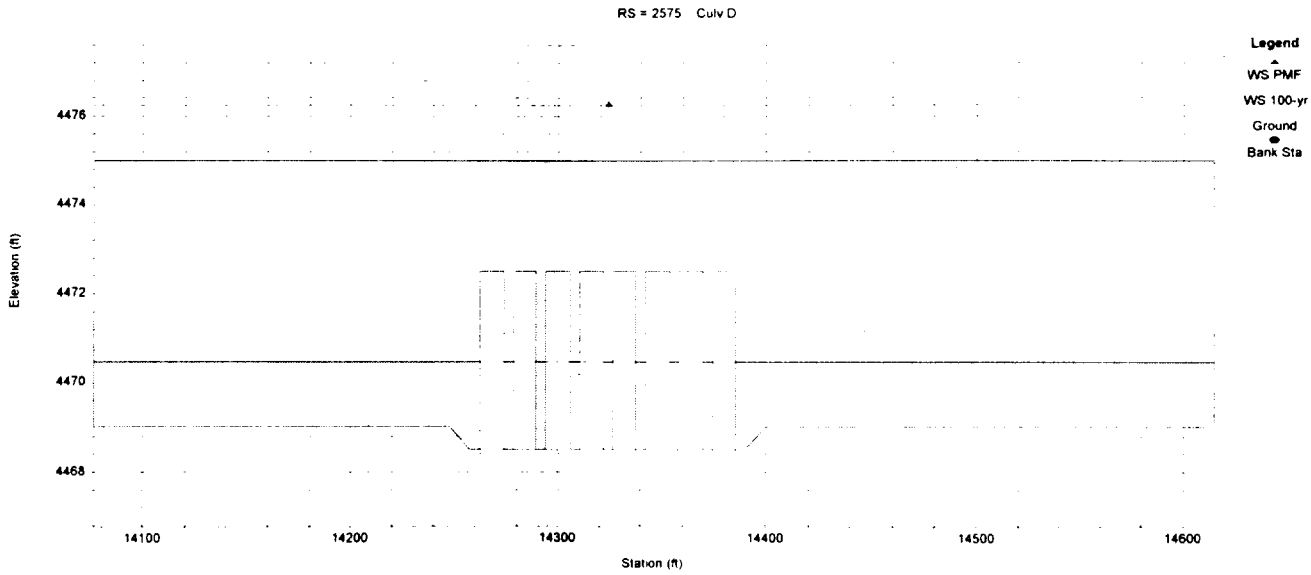


Figure 6, Rail Road Embankment and Culverts with Water Levels



6, CONCLUSION

The access road and rail road embankment raises the water level over the embankment and in the floodway upstream from the embankment.

The access road and rail road embankment does not affect water level at the downstream river reach, i.e. in the vicinity of PFSF site.

Runoff from the drainage basin, after passing the embankment with a higher flow level, would return to the natural level after passing the embankment. Consequently, the flood level near PFSF, which is located at the downstream, would remain the same before and after construction of the access road and the rail road. At the PFSF site, water surfaces calculated in this calculation are the same as those calculated in Ref. 3 and Ref. 4 (in which the road embankments were not modeled).

The PFSF site elevation (4462 ft at north boundary to 4476 ft at the south) is above maximum flood level in the east floodway (access road crossing), and the west floodway (rail road crossing).

PMF flood event - The flow would over-top the embankments. The overflow depth and elevations are:

	Top of Embankment Elevation (ft)	Water surface Elevation (ft)	Overflow Depth (ft)
Access road crossing over east flood way	4502	4505.2	3.2
Rail road crossing over west flood way	4475	4477.1	2.1

100-year flood event - The culverts designed to pass flood flow are able to control head water level below the top of embankments. The calculated water levels are:

	Top of Embankment Elevation (ft)	Head Water Elevation (ft)	Number of 11' x 4' (span x rise) Box Culverts
Access road crossing over east flood way	4502	4500.3	8
Rail road crossing over west flood way	4475	4472.4	8

CALCULATION IDENTIFICATION NUMBER				REV. NO. 0
J.O. OR W.O NUMBER **0599602**	DIVISION AND GROUP **G(B)**	CALCULATION NUMBER **17**	OPTIONAL TASK CODE N/A	PAGE 14 of 36

ATTACHMENT 1, HEC-RAS HYDRAULIC REPORT - ACCESS ROAD CROSSING

HEC-RAS Version 2.0 April 1997
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street, Suite D
Davis, California 95616-4687
(916) 756-1104

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

PROJECT DATA
Project Title: PFSF, Access Rd Post Construction Flood
Project File : access.prj
Run Date and Time: 3/10/99 3:16:18 PM

Project in English units

Project Description:
Access road embankment with 8-11(span)x4(rise) box culverts

FLOW DATA

Flow Title: PMF and 100-yr Q
Flow File : c:\a3\road\ras\access.f01

Flow Data (cfs)

River	Reach	RS	PMF	100-year Q
East	PFSF	10060	53000	2430

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
East	PFSF	PMF		Normal S = 0.0045
East	PFSF	100-year Q		Normal S = 0.0045

GEOMETRY DATA

Geometry Title: Post construction
Geometry File : c:\a3\road\ras\access.g01

CROSS SECTION RIVER: East
REACH: PFSF RS: 10060

INPUT
Description: Section D4

Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4505	28	4496	523	4498	594	4496	735	4496
792	4498	877	4498	1103	4498	1159	4500	2376	4500
2545	4498	2743	4500	4600	4510				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	523	.035	2376	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
523	2376	280	280	.1	.3

CROSS SECTION RIVER: East
REACH: PFSF RS: 9780

INPUT
Description: Section D3
Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4505	28	4496	150	4494.4	365	4495.1	645	4494
764	4496	792	4498	834	4498	1030	4495.4	1046	4496
1103	4496	1131	4498	1595	4496.1	2015	4495.7	2687	4498
2865	4495.6	2885	4496	3083	4500	4620	4510		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	28	.035	2885	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
28	2885	80	80	.1	.3

CULVERT RIVER: East
REACH: PFSF RS: 9740

INPUT
Description:
Distance from Upstream XS = 27
Deck/Roadway Width = 26
Weir Coefficient = 2.6
Bridge Deck/Roadway Skew =
Upstream Deck/Roadway Coordinates
num= 2

Sta Hi Cord	Lo Cord	Sta Hi Cord	Lo Cord
0	4502.5	5000	4502
0			

Upstream Bridge Cross Section Data
Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4505	28	4496	150	4494.4	365	4495.1	645	4494
764	4496	792	4498	834	4498	1030	4495.4	1046	4496
1103	4496	1131	4498	1595	4496.1	2015	4495.7	2687	4498
2865	4495.6	2885	4496	3083	4500	4620	4510		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	28	.035	2885	.035

Bank Sta: Left	Right	Coeff Contr.	Expan.
28	2885	.1	.3

Downstream Deck/Roadway Coordinates
num= 2

Sta Hi Cord	Lo Cord	Sta Hi Cord	Lo Cord
0	4502.5	5000	4502
0			

Downstream Bridge Cross Section Data
Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

```
      0    4505     28    4495     150  4494.4     365  4495.1     509    4496
    566    4496    636    4494     645    4494     707    4494     792    4498
    820    4498    877    4496    1030  4495.4    1103    4496    1131    4498
   1165    4498   1570    4496    1595  4496.1    2015  4495.7    2376    4496
   2687    4498   2828    4498    2865  4495.6    3111    4500    4565    4510

Manning's n Values        num=       3
     Sta   n Val      Sta   n Val      Sta   n Val
       0    .035       28    .035     2865    .035

Bank Sta: Left   Right    Coeff Contr.   Expan.
            28    2865             .1       .3

Upstream Embankment side slope             =       3 horiz. to 1.0 vertical
Downstream Embankment side slope           =       3 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins        =
Energy head used in spillway design        =
Spillway height used in design             =
Weir crest shape                           = Broad Crested

Number of Culverts =  8

Culvert Name      Shape      Rise    Span
Culvert #1            Box       4      11
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length     n Value   Entrance Loss Coef   Exit Loss Coef
                20      40         .03                   .5                1
Upstream   Elevation =  4494.4
           Centerline Station =  150
Downstream Elevation =  4494
           Centerline Station =  150

Culvert Name      Shape      Rise    Span
Culvert #2            Box       4      11
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length     n Value   Entrance Loss Coef   Exit Loss Coef
                20      40         .03                   .5                1
Upstream   Elevation =  4495.1
           Centerline Station =  365
Downstream Elevation =  4495
           Centerline Station =  365

Culvert Name      Shape      Rise    Span
Culvert #3            Box       4      11
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length     n Value   Entrance Loss Coef   Exit Loss Coef
                20      40         .03                   .5                1
Upstream   Elevation =  4494
           Centerline Station =  645
Downstream Elevation =  4493.5
           Centerline Station =  645

Culvert Name      Shape      Rise    Span
Culvert #4            Box       4      11
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length     n Value   Entrance Loss Coef   Exit Loss Coef
                20      40         .03                   .5                1
Upstream   Elevation =  4495.4
           Centerline Station =  1030
Downstream Elevation =  4495
```

CALCULATION IDENTIFICATION NUMBER			REV. NO. 0
J.O. OR W.O NUMBER: 0599602	DIVISION AND GROUP: G(B)	CALCULATION NUMBER: 17	OPTIONAL TASK CODE: N/A


```
          Centerline Station =  1030

Culvert Name      Shape      Rise    Span
Culvert #5           Box       4      11
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length     n Value   Entrance Loss Coef   Exit Loss Coef
                20      40        .03                   .5                 1
Upstream   Elevation =  4496.1
          Centerline Station =  1595
Downstream Elevation =  4496
          Centerline Station =  1595

Culvert Name      Shape      Rise    Span
Culvert #6           Box       4      11
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length     n Value   Entrance Loss Coef   Exit Loss Coef
                20      40        .03                   .5                 1
Upstream   Elevation =  4495.7
          Centerline Station =  2015
Downstream Elevation =  4495.4
          Centerline Station =  2015

Culvert Name      Shape      Rise    Span
Culvert #7           Box       4      11
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length     n Value   Entrance Loss Coef   Exit Loss Coef
                20      40        .03                   .5                 1
Upstream   Elevation =  4495.6
          Centerline Station =  2854
Downstream Elevation =  4495
          Centerline Station =  2854

Culvert Name      Shape      Rise    Span
Culvert #8           Box       4      11
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length     n Value   Entrance Loss Coef   Exit Loss Coef
                20      40        .03                   .5                 1
Upstream   Elevation =  4495.6
          Centerline Station =  2876
Downstream Elevation =  4495
          Centerline Station =  2876

CULVERT OUTPUT    Profile #PMF
Culvert ID : Culvert #1

  Culv Q (cfs)          571.64   Culv Vel In (ft/s)       12.99
  # Barrels                  1   Culv Vel Out (ft/s)      12.99
  Q Barrel (cfs)        571.64   Culv Inv El Up (ft)    4494.40
  W.S. US. (ft)         4505.18  Culv Inv El Dn (ft)    4494.00
  E.G. US. (ft)         4505.24  Culv Frctn Ls (ft)        1.65
  Delta WS (ft)            5.53  Culv Ext Lss (ft)         2.22
  Delta EG (ft)            5.18  Culv Ent Lss (ft)         1.31
  E.G. IC (ft)          4503.68  Q Weir (cfs)          48432.80
  E.G. OC (ft)          4505.24  Weir Sta Lft (ft)         0.00
  Culv WS In (ft)       4498.40  Weir Sta Rgt (ft)      4309.12
  Culv WS Out (ft)      4498.00  Weir Submerg              0.00
  Culv Nml Depth (ft)            Weir Max Depth (ft)       3.08
  Culv Crt Depth (ft)       4.00 Weir Avg Depth (ft)       2.62
  Culv Ful Lngh (ft)       40.00 Min Top Rd (ft)       4502.16
```

Warning - During subcritical analysis, while trying to calculate culvert and weir flow, the program could not get a balance of energy within the specified tolerance and number of trials. The program used the solution with the minimum error.
Note - Culvert critical depth exceeds the height of the culvert.

CULVERT OUTPUT Profile #100-year Q
Culvert ID : Culvert #1

Culv Q (cfs)	369.40	Culv Vel In (ft/s)	8.93
# Barrels	1	Culv Vel Out (ft/s)	10.26
Q Barrel (cfs)	369.40	Culv Inv El Up (ft)	4494.40
W.S. US. (ft)	4500.26	Culv Inv El Dn (ft)	4494.00
E.G. US. (ft)	4500.26	Culv Frctn Ls (ft)	0.49
Delta WS (ft)	4.15	Culv Ext Lss (ft)	2.72
Delta EG (ft)	4.08	Culv Ent Lss (ft)	0.87
E.G. IC (ft)	4500.27	Q Weir (cfs)	
E.G. OC (ft)	4500.02	Weir Sta Lft (ft)	
Culv WS In (ft)	4498.16	Weir Sta Rgt (ft)	
Culv WS Out (ft)	4497.27	Weir Submerg	
Culv Nml Depth (ft)	3.91	Weir Max Depth (ft)	
Culv Crt Depth (ft)	3.27	Weir Avg Depth (ft)	
Culv Ful Lngh (ft)		Min Top Rd (ft)	4502.16

CULVERT OUTPUT Profile #PMF
Culvert ID : Culvert #2

Culv Q (cfs)	571.75	Culv Vel In (ft/s)	12.99
# Barrels	1	Culv Vel Out (ft/s)	12.99
Q Barrel (cfs)	571.75	Culv Inv El Up (ft)	4495.10
W.S. US. (ft)	4505.18	Culv Inv El Dn (ft)	4495.00
E.G. US. (ft)	4505.24	Culv Frctn Ls (ft)	1.65
Delta WS (ft)	5.53	Culv Ext Lss (ft)	2.22
Delta EG (ft)	5.18	Culv Ent Lss (ft)	1.31
E.G. IC (ft)	4504.39	Q Weir (cfs)	48432.80
E.G. OC (ft)	4505.24	Weir Sta Lft (ft)	0.00
Culv WS In (ft)	4499.10	Weir Sta Rgt (ft)	4309.12
Culv WS Out (ft)	4499.00	Weir Submerg	0.00
Culv Nml Depth (ft)		Weir Max Depth (ft)	3.08
Culv Crt Depth (ft)	4.00	Weir Avg Depth (ft)	2.62
Culv Ful Lngh (ft)	40.00	Min Top Rd (ft)	4502.16

Warning - During subcritical analysis, while trying to calculate culvert and weir flow, the program could not get a balance of energy within the specified tolerance and number of trials. The program used the solution with the minimum error.
Note - Culvert critical depth exceeds the height of the culvert.

CULVERT OUTPUT Profile #100-year Q
Culvert ID : Culvert #2

Culv Q (cfs)	318.36	Culv Vel In (ft/s)	7.50
# Barrels	1	Culv Vel Out (ft/s)	9.77
Q Barrel (cfs)	318.36	Culv Inv El Up (ft)	4495.10
W.S. US. (ft)	4500.26	Culv Inv El Dn (ft)	4495.00
E.G. US. (ft)	4500.26	Culv Frctn Ls (ft)	0.39
Delta WS (ft)	4.15	Culv Ext Lss (ft)	3.26
Delta EG (ft)	4.08	Culv Ent Lss (ft)	0.44
E.G. IC (ft)	4500.02	Q Weir (cfs)	
E.G. OC (ft)	4500.27	Weir Sta Lft (ft)	
Culv WS In (ft)	4498.96	Weir Sta Rgt (ft)	
Culv WS Out (ft)	4497.96	Weir Submerg	
Culv Nml Depth (ft)	4.00	Weir Max Depth (ft)	
Culv Crt Depth (ft)	2.96	Weir Avg Depth (ft)	
Culv Ful Lngh (ft)		Min Top Rd (ft)	4502.16

Note - The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CULVERT OUTPUT Profile #PMF
Culvert ID : Culvert #3

Culv Q (cfs)	571.79	Culv Vel In (ft/s)	13.00
# Barrels	1	Culv Vel Out (ft/s)	13.00
Q Barrel (cfs)	571.79	Culv Inv El Up (ft)	4494.00
W.S. US. (ft)	4505.18	Culv Inv El Dn (ft)	4493.50
E.G. US. (ft)	4505.24	Culv Frctn Ls (ft)	1.65
Delta WS (ft)	5.53	Culv Ext Lss (ft)	2.22
Delta EG (ft)	5.18	Culv Ent Lss (ft)	1.31
E.G. IC (ft)	4503.27	Q Weir (cfs)	48432.80
E.G. OC (ft)	4505.24	Weir Sta Lft (ft)	0.00
Culv WS In (ft)	4498.00	Weir Sta Rgt (ft)	4309.12
Culv WS Out (ft)	4497.50	Weir Submerg	0.00
Culv Nml Depth (ft)		Weir Max Depth (ft)	3.08
Culv Crt Depth (ft)	4.00	Weir Avg Depth (ft)	2.62
Culv Ful Lngh (ft)	40.00	Min Top Rd (ft)	4502.16

Warning - During subcritical analysis, while trying to calculate culvert and weir flow, the program could not get a balance of energy within the specified tolerance and number of trials. The program used the solution with the minimum error.
Note - Culvert critical depth exceeds the height of the culvert.

CULVERT OUTPUT Profile #100-year Q
Culvert ID : Culvert #3

Culv Q (cfs)	397.68	Culv Vel In (ft/s)	9.04
# Barrels	1	Culv Vel Out (ft/s)	10.52
Q Barrel (cfs)	397.68	Culv Inv El Up (ft)	4494.00
W.S. US. (ft)	4500.26	Culv Inv El Dn (ft)	4493.50
E.G. US. (ft)	4500.26	Culv Frctn Ls (ft)	0.97
Delta WS (ft)	4.15	Culv Ext Lss (ft)	2.47
Delta EG (ft)	4.08	Culv Ent Lss (ft)	0.63
E.G. IC (ft)	4500.25	Q Weir (cfs)	
E.G. OC (ft)	4499.91	Weir Sta Lft (ft)	
Culv WS In (ft)	4498.00	Weir Sta Rgt (ft)	
Culv WS Out (ft)	4496.94	Weir Submerg	
Culv Nml Depth (ft)	3.81	Weir Max Depth (ft)	
Culv Crt Depth (ft)	3.44	Weir Avg Depth (ft)	
Culv Ful Lngh (ft)		Min Top Rd (ft)	4502.16

Warning - Since the culvert has supercritical flow, the program should be run in mixed flow in order to check if the cross section downstream of the culvert has supercritical flow.
Note - During supercritical analysis, the culvert direct step method went to critical depth. The program then assumed critical depth at the outlet.
Note - The flow in the culvert is entirely supercritical.

CULVERT OUTPUT Profile #PMF
Culvert ID : Culvert #4

Culv Q (cfs)	571.74	Culv Vel In (ft/s)	12.99
# Barrels	1	Culv Vel Out (ft/s)	12.99
Q Barrel (cfs)	571.74	Culv Inv El Up (ft)	4495.40
W.S. US. (ft)	4505.18	Culv Inv El Dn (ft)	4495.00
E.G. US. (ft)	4505.24	Culv Frctn Ls (ft)	1.65
Delta WS (ft)	5.53	Culv Ext Lss (ft)	2.22
Delta EG (ft)	5.18	Culv Ent Lss (ft)	1.31
E.G. IC (ft)	4504.68	Q Weir (cfs)	48432.80
E.G. OC (ft)	4505.24	Weir Sta Lft (ft)	0.00
Culv WS In (ft)	4499.40	Weir Sta Rgt (ft)	4309.12
Culv WS Out (ft)	4499.00	Weir Submerg	0.00
Culv Nml Depth (ft)		Weir Max Depth (ft)	3.08
Culv Crt Depth (ft)	4.00	Weir Avg Depth (ft)	2.62
Culv Ful Lngh (ft)	40.00	Min Top Rd (ft)	4502.16

Warning - During subcritical analysis, while trying to calculate culvert and weir flow, the program could not get a balance of energy within the specified tolerance and number of trials. The program used the solution with the minimum error.
Note - Culvert critical depth exceeds the height of the culvert.

CULVERT OUTPUT Profile #100-year Q
Culvert ID : Culvert #4

Culv Q (cfs)	297.76	Culv Vel In (ft/s)	8.32
# Barrels	1	Culv Vel Out (ft/s)	9.55
Q Barrel (cfs)	297.76	Culv Inv El Up (ft)	4495.40
W.S. US. (ft)	4500.26	Culv Inv El Dn (ft)	4495.00
E.G. US. (ft)	4500.26	Culv Frctn Ls (ft)	0.48
Delta WS (ft)	4.15	Culv Ext Lss (ft)	3.06
Delta EG (ft)	4.08	Culv Ent Lss (ft)	0.54
E.G. IC (ft)	4499.98	Q Weir (cfs)	
E.G. OC (ft)	4500.27	Weir Sta Lft (ft)	
Culv WS In (ft)	4498.65	Weir Sta Rgt (ft)	
Culv WS Out (ft)	4497.83	Weir Submerg	
Culv Nml Depth (ft)	3.35	Weir Max Depth (ft)	
Culv Crt Depth (ft)	2.83	Weir Avg Depth (ft)	
Culv Ful Lngh (ft)		Min Top Rd (ft)	4502.16

CULVERT OUTPUT Profile #PMF
Culvert ID : Culvert #5

Culv Q (cfs)	553.97	Culv Vel In (ft/s)	12.59
# Barrels	1	Culv Vel Out (ft/s)	12.59
Q Barrel (cfs)	553.97	Culv Inv El Up (ft)	4496.10
W.S. US. (ft)	4505.18	Culv Inv El Dn (ft)	4496.00
E.G. US. (ft)	4505.24	Culv Frctn Ls (ft)	1.55
Delta WS (ft)	5.53	Culv Ext Lss (ft)	2.41
Delta EG (ft)	5.18	Culv Ent Lss (ft)	1.23
E.G. IC (ft)	4505.04	Q Weir (cfs)	48432.80
E.G. OC (ft)	4505.24	Weir Sta Lft (ft)	0.00
Culv WS In (ft)	4500.10	Weir Sta Rgt (ft)	4309.12
Culv WS Out (ft)	4500.00	Weir Submerg	0.00
Culv Nml Depth (ft)		Weir Max Depth (ft)	3.08
Culv Crt Depth (ft)	4.00	Weir Avg Depth (ft)	2.62
Culv Ful Lngh (ft)	40.00	Min Top Rd (ft)	4502.16

Warning - During subcritical analysis, while trying to calculate culvert and weir flow, the program could not get a balance of energy within the specified tolerance and number of trials. The program used the solution with the minimum error.
Note - Culvert critical depth exceeds the height of the culvert.

CULVERT OUTPUT Profile #100-year Q
Culvert ID : Culvert #5

Culv Q (cfs)	228.96	Culv Vel In (ft/s)	6.61
# Barrels	1	Culv Vel Out (ft/s)	8.75
Q Barrel (cfs)	228.96	Culv Inv El Up (ft)	4496.10
W.S. US. (ft)	4500.26	Culv Inv El Dn (ft)	4496.00
E.G. US. (ft)	4500.26	Culv Frctn Ls (ft)	0.36
Delta WS (ft)	4.15	Culv Ext Lss (ft)	3.38
Delta EG (ft)	4.08	Culv Ent Lss (ft)	0.34
E.G. IC (ft)	4499.93	Q Weir (cfs)	
E.G. OC (ft)	4500.27	Weir Sta Lft (ft)	
Culv WS In (ft)	4499.25	Weir Sta Rgt (ft)	
Culv WS Out (ft)	4498.38	Weir Submerg	
Culv Nml Depth (ft)	4.00	Weir Max Depth (ft)	
Culv Crt Depth (ft)	2.38	Weir Avg Depth (ft)	
Culv Ful Lngh (ft)		Min Top Rd (ft)	4502.16

Note - The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CULVERT OUTPUT Profile #PMF
Culvert ID : Culvert #6

Culv Q (cfs)	571.73	Culv Vel In (ft/s)	12.99
# Barrels	1	Culv Vel Out (ft/s)	12.99
Q Barrel (cfs)	571.73	Culv Inv El Up (ft)	4495.70
W.S. US. (ft)	4505.18	Culv Inv El Dn (ft)	4495.40
E.G. US. (ft)	4505.24	Culv Frctn Ls (ft)	1.65
Delta WS (ft)	5.53	Culv Ext Lss (ft)	2.22
Delta EG (ft)	5.18	Culv Ent Lss (ft)	1.31
E.G. IC (ft)	4504.98	Q Weir (cfs)	48432.80
E.G. OC (ft)	4505.24	Weir Sta Lft (ft)	0.00
Culv WS In (ft)	4499.70	Weir Sta Rgt (ft)	4309.12
Culv WS Out (ft)	4499.40	Weir Submerg	0.00
Culv Nml Depth (ft)		Weir Max Depth (ft)	3.08
Culv Crt Depth (ft)	4.00	Weir Avg Depth (ft)	2.62
Culv Ful Lngh (ft)	40.00	Min Top Rd (ft)	4502.16

Warning - During subcritical analysis, while trying to calculate culvert and weir flow, the program could not get a balance of energy within the specified tolerance and number of trials. The program used the solution with the minimum error.
Note - Culvert critical depth exceeds the height of the culvert.

CULVERT OUTPUT Profile #100-year Q
Culvert ID : Culvert #6

Culv Q (cfs)	269.59	Culv Vel In (ft/s)	7.66
# Barrels	1	Culv Vel Out (ft/s)	9.24
Q Barrel (cfs)	269.59	Culv Inv El Up (ft)	4495.70
W.S. US. (ft)	4500.26	Culv Inv El Dn (ft)	4495.40
E.G. US. (ft)	4500.26	Culv Frctn Ls (ft)	0.43
Delta WS (ft)	4.15	Culv Ext Lss (ft)	3.19
Delta EG (ft)	4.08	Culv Ent Lss (ft)	0.46
E.G. IC (ft)	4499.98	Q Weir (cfs)	
E.G. OC (ft)	4500.27	Weir Sta Lft (ft)	
Culv WS In (ft)	4498.90	Weir Sta Rgt (ft)	
Culv WS Out (ft)	4498.05	Weir Submerg	
Culv Nml Depth (ft)	3.46	Weir Max Depth (ft)	
Culv Crt Depth (ft)	2.65	Weir Avg Depth (ft)	
Culv Ful Lngh (ft)		Min Top Rd (ft)	4502.16

CULVERT OUTPUT Profile #PMF
Culvert ID : Culvert #7

Culv Q (cfs)	571.74	Culv Vel In (ft/s)	12.99
# Barrels	1	Culv Vel Out (ft/s)	12.99
Q Barrel (cfs)	571.74	Culv Inv El Up (ft)	4495.60
W.S. US. (ft)	4505.18	Culv Inv El Dn (ft)	4495.00
E.G. US. (ft)	4505.24	Culv Frctn Ls (ft)	1.65
Delta WS (ft)	5.53	Culv Ext Lss (ft)	2.22
Delta EG (ft)	5.18	Culv Ent Lss (ft)	1.31
E.G. IC (ft)	4504.87	Q Weir (cfs)	48432.80
E.G. OC (ft)	4505.24	Weir Sta Lft (ft)	0.00
Culv WS In (ft)	4499.60	Weir Sta Rgt (ft)	4309.12
Culv WS Out (ft)	4499.00	Weir Submerg	0.00
Culv Nml Depth (ft)		Weir Max Depth (ft)	3.08
Culv Crt Depth (ft)	4.00	Weir Avg Depth (ft)	2.62
Culv Ful Lngh (ft)	40.00	Min Top Rd (ft)	4502.16

Warning - During subcritical analysis, while trying to calculate culvert and weir flow, the program could not get a balance of energy within the specified tolerance and number of trials. The program used the solution with the minimum error.
Note - Culvert critical depth exceeds the height of the culvert.

CULVERT OUTPUT Profile #100-year Q

Culvert ID : Culvert #7

Culv Q (cfs)	274.13	Culv Vel In (ft/s)	9.07
# Barrels	1	Culv Vel Out (ft/s)	9.29
Q Barrel (cfs)	274.13	Culv Inv El Up (ft)	4495.60
W.S. US. (ft)	4500.26	Culv Inv El Dn (ft)	4495.00
E.G. US. (ft)	4500.26	Culv Frctn Ls (ft)	0.60
Delta WS (ft)	4.15	Culv Ext Lss (ft)	2.84
Delta EG (ft)	4.08	Culv Ent Lss (ft)	0.64
E.G. IC (ft)	4499.92	Q Weir (cfs)	
E.G. OC (ft)	4500.26	Weir Sta Lft (ft)	
Culv WS In (ft)	4498.35	Weir Sta Rgt (ft)	
Culv WS Out (ft)	4497.68	Weir Submerg	
Culv Nml Depth (ft)	2.75	Weir Max Depth (ft)	
Culv Crt Depth (ft)	2.68	Weir Avg Depth (ft)	
Culv Ful Lngh (ft)		Min Top Rd (ft)	4502.16

Note - During subcritical analysis, the culvert direct step method, the solution went to normal depth.

CULVERT OUTPUT Profile #PMF
Culvert ID : Culvert #8

Culv Q (cfs)	571.74	Culv Vel In (ft/s)	12.99
# Barrels	1	Culv Vel Out (ft/s)	12.99
Q Barrel (cfs)	571.74	Culv Inv El Up (ft)	4495.60
W.S. US. (ft)	4505.18	Culv Inv El Dn (ft)	4495.00
E.G. US. (ft)	4505.24	Culv Frctn Ls (ft)	1.65
Delta WS (ft)	5.53	Culv Ext Lss (ft)	2.22
Delta EG (ft)	5.18	Culv Ent Lss (ft)	1.31
E.G. IC (ft)	4504.87	Q Weir (cfs)	48432.80
E.G. OC (ft)	4505.24	Weir Sta Lft (ft)	0.00
Culv WS In (ft)	4499.60	Weir Sta Rgt (ft)	4309.12
Culv WS Out (ft)	4499.00	Weir Submerg	0.00
Culv Nml Depth (ft)		Weir Max Depth (ft)	3.08
Culv Crt Depth (ft)	4.00	Weir Avg Depth (ft)	2.62
Culv Ful Lngh (ft)	40.00	Min Top Rd (ft)	4502.16

Warning - During subcritical analysis, while trying to calculate culvert and weir flow, the program could not get a balance of energy within the specified tolerance and number of trials. The program used the solution with the minimum error.
Note - Culvert critical depth exceeds the height of the culvert.

CULVERT OUTPUT Profile #100-year Q
Culvert ID : Culvert #8

Culv Q (cfs)	274.13	Culv Vel In (ft/s)	9.07
# Barrels	1	Culv Vel Out (ft/s)	9.29
Q Barrel (cfs)	274.13	Culv Inv El Up (ft)	4495.60
W.S. US. (ft)	4500.26	Culv Inv El Dn (ft)	4495.00
E.G. US. (ft)	4500.26	Culv Frctn Ls (ft)	0.60
Delta WS (ft)	4.15	Culv Ext Lss (ft)	2.84
Delta EG (ft)	4.08	Culv Ent Lss (ft)	0.64
E.G. IC (ft)	4499.92	Q Weir (cfs)	
E.G. OC (ft)	4500.26	Weir Sta Lft (ft)	
Culv WS In (ft)	4498.35	Weir Sta Rgt (ft)	
Culv WS Out (ft)	4497.68	Weir Submerg	
Culv Nml Depth (ft)	2.75	Weir Max Depth (ft)	
Culv Crt Depth (ft)	2.68	Weir Avg Depth (ft)	
Culv Ful Lngh (ft)		Min Top Rd (ft)	4502.16

Note - During subcritical analysis, the culvert direct step method, the solution went to normal depth.

CROSS SECTION RIVER: East
REACH: PFSF RS: 9700

INPUT

CALCULATION IDENTIFICATION NUMBER			REV. NO. 0
J.O. OR W.O NUMBER **0599602**	DIVISION AND GROUP **G(B)**	CALCULATION NUMBER **17**	OPTIONAL TASK CODE N/A

Description: Section D2
Station Elevation Data num= 25

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4505	28	4495	150	4494.4	365	4495.1	509	4496
566	4496	636	4494	645	4494	707	4494	792	4498
820	4498	877	4496	1030	4495.4	1103	4496	1131	4498
1165	4498	1570	4496	1595	4496.1	2015	4495.7	2376	4496
2687	4498	2828	4498	2865	4495.6	3111	4500	4565	4510

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	28	.035	2865	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
28	2865	900	900	.1	.3

CROSS SECTION RIVER: East
REACH: PFSF RS: 8800

INPUT
Description: Section D11
Station Elevation Data num= 4

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4502	30	4495	1600	4490	3200	4500

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	30	.035	1600	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
30	1600	1600	1600	.1	.3

CROSS SECTION RIVER: East
REACH: PFSF RS: 7200

INPUT
Description: Section D1
Station Elevation Data num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4502	40	4485	3600	4480	4200	4485	5100	4490

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	40	.035	4200	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
40	4200	1300	1300	.1	.3

CROSS SECTION RIVER: East
REACH: PFSF RS: 5900

INPUT
Description: Section C
Station Elevation Data num= 9

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4490	2500	4480	4000	4480	6100	4473	7000	4474
7600	4474	8500	4480	9100	4490	9500	4500		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	6100	.035	7600	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
6100	7600	1400	1400	.1	.3

CROSS SECTION RIVER: East
REACH: PFSF RS: 4500

INPUT

Description: Section A3
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4480	2000	4470	5300	4465	6500	4465	7000	4470
7900	4480								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	5300	.035	6500	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
5300	6500	1700	1700	.1	.3

CROSS SECTION RIVER: East
REACH: PFSF RS: 2800

INPUT
Description: Section A2
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4470	2400	4460	4500	4450	6300	4455	6800	4460
8200	4470								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	2400	.035	6800	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
2400	6800	1500	1500	.1	.3

CROSS SECTION RIVER: East
REACH: PFSF RS: 1300

INPUT
Description: Section A1
Station Elevation Data num= 6

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4460	2400	4450	4500	4445	6300	4447	6900	4450
7700	4460								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	2400	.035	6300	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
2400	6300	1300	1300	.1	.3

CROSS SECTION RIVER: East
REACH: PFSF RS: 0

INPUT
Description: Section A
Station Elevation Data num= 5

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4450	5100	4440	7000	4440	7900	4450	8700	4470

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	5100	.035	7000	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
5100	7000	0	0	.1	.3

SUMMARY OF MANNING'S N VALUES

River:East

Reach	River Sta.	n1	n2	n3
PFSF	10060	.035	.035	.035
PFSF	9780	.035	.035	.035
PFSF	9740	Culvert		
PFSF	9700	.035	.035	.035
PFSF	8800	.035	.035	.035
PFSF	7200	.035	.035	.035
PFSF	5900	.035	.035	.035
PFSF	4500	.035	.035	.035
PFSF	2800	.035	.035	.035
PFSF	1300	.035	.035	.035
PFSF	0	.035	.035	.035

SUMMARY OF REACH LENGTHS

River: East

Reach	River Sta.	Left	Channel	Right
PFSF	10060	280	280	280
PFSF	9780	80	80	80
PFSF	9740	Culvert		
PFSF	9700	900	900	900
PFSF	8800	1600	1600	1600
PFSF	7200	1300	1300	1300
PFSF	5900	1400	1400	1400
PFSF	4500	1700	1700	1700
PFSF	2800	1500	1500	1500
PFSF	1300	1300	1300	1300
PFSF	0	0	0	0

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: East

Reach	River Sta.	Contr.	Expan.
PFSF	10060	.1	.3
PFSF	9780	.1	.3
PFSF	9740	Culvert	
PFSF	9700	.1	.3
PFSF	8800	.1	.3
PFSF	7200	.1	.3
PFSF	5900	.1	.3
PFSF	4500	.1	.3
PFSF	2800	.1	.3
PFSF	1300	.1	.3
PFSF	0	.1	.3

CALCULATION IDENTIFICATION NUMBER				REV. NO 0
J.O. OR W.O NUMBER **0599602**	DIVISION AND GROUP **G(B)**	CALCULATION NUMBER **17**	OPTIONAL TASK CODE N/A	PAGE 26 of 36

ATTACHMENT 2, HEC-RAS HYDRAULIC REPORT - RAIL ROAD CROSSING

HEC-RAS Version 2.0 April 1997
U.S. Army Corp of Engineers
Hydrologic Engineering Center
609 Second Street, Suite D
Davis, California 95616-4687
(916) 756-1104

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

PROJECT DATA
Project Title: PFSF, Post construction, 3-mile rail
Project File : rail.prj
Run Date and Time: 3/10/99 8:28:22 AM

Project in English units

Project Description:
Flood level with rail embankment & box culvert

FLOW DATA

Flow Title: 100-year flow and PMF
Flow File : c:\a3\rail\rail.f01

Flow Data (cfs)

River	Reach	RS	100-yr	PMF
Floodway	3-mile rail	5500	1400	68500

Boundary Conditions

River	Reach	Profile	Upstream	Downstream
Floodway	3-mile rail	100-yr		Normal S = 0.0067

GEOMETRY DATA

Geometry Title: Post construction
Geometry File : c:\a3\rail\rail.g01

CROSS SECTION RIVER: Floodway
REACH: 3-mile rail RS: 5500

INPUT
Description: Section A
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4550	900	4540	1500	4530	3000	4520	4800	4510
5600	4500	9500	4500	12200	4490	18000	4490	23000	4500

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	12200	.035	18000	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
12200	18000	2000	2000	.1	.3

CROSS SECTION RIVER: Floodway
REACH: 3-mile rail RS: 3500

INPUT
Description: Section B
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4550	700	4540	1200	4530	2000	4520	2800	4510
4000	4500	5000	4500	5900	4490	6800	4490	9200	4480
10400	4475	12600	4476	15600	4476	18300	4479	20300	4480

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	9200	.035	18300	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
9200	18300	750	750	.1	.3

CROSS SECTION RIVER: Floodway
REACH: 3-mile rail RS: 2750

INPUT
Description: Section C
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
5400	4490	7100	4480	11000	4473	12000	4470	14248	4470
14258	4469	14390	4469	14400	4470	17465	4470	17500	4480

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
5400	.035	12000	.035	17465	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
12000	17465	350	350	.1	.3

CULVERT RIVER: Floodway
REACH: 3-mile rail RS: 2575

INPUT
Description:
Distance from Upstream XS = 162
Deck/Roadway Width = 26
Weir Coefficient = 2.6
Bridge Deck/Roadway Skew =
Upstream Deck/Roadway Coordinates
num= 4

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
6000	4482	0	7000	4480	0	9400	4475	0
17700	4475	0						

Upstream Bridge Cross Section Data
Station Elevation Data num= 10

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
5400	4490	7100	4480	11000	4473	12000	4470	14248	4470
14258	4469	14390	4469	14400	4470	17465	4470	17500	4480

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val

CALCULATION IDENTIFICATION NUMBER				REV. NO. 0
J.O. OR W.O NUMBER **0599602**	DIVISION AND GROUP **G(B)**	CALCULATION NUMBER **17**	OPTIONAL TASK CODE N/A	PAGE 28 of 36

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    5400    .035   12000    .035   17465    .035

Bank Sta: Left   Right    Coeff Contr.   Expan.
         12000   17465            .1       .3

Downstream  Deck/Roadway Coordinates
    num=       4
     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord     Sta Hi Cord Lo Cord
    6000    4482       0    7000    4480       0    9400    4475       0
   17700    4475       0

Downstream Bridge Cross Section Data
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
    5000    4490    5500    4487    6300    4480    7000    4480   11000    4470
   11700    4470   12500    4469   14248    4469   14258  4468.5   14390  4468.5
   14400    4469   17400    4469   17500    4480

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
    5000    .035   12500    .035   17400    .035

Bank Sta: Left   Right    Coeff Contr.   Expan.
         12500   17400            .1       .3

Upstream Embankment side slope             =       3 horiz. to 1.0 vertical
Downstream Embankment side slope           =       3 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow =     .95
Elevation at which weir flow begins        =
Energy head used in spillway design        =
Spillway height used in design             =
Weir crest shape                           = Broad Crested

Number of Culverts =  8

Culvert Name     Shape      Rise    Span
Culvert #1           Box       4      11
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    n Value   Entrance Loss Coef   Exit Loss Coef
               145      60        .03                   .5                1
Upstream   Elevation =  4469
           Centerline Station =  14268
Downstream Elevation =  4468.5
           Centerline Station =  14268

Culvert Name     Shape      Rise    Span
Culvert #2           Box       4      11
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    n Value   Entrance Loss Coef   Exit Loss Coef
               145      60        .03                   .5                1
Upstream   Elevation =  4469
           Centerline Station =  14284
Downstream Elevation =  4468.5
           Centerline Station =  14284

Culvert Name     Shape      Rise    Span
Culvert #3           Box       4      11
FHWA Chart # 8 - flared wingwalls
FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
Solution Criteria = Highest U.S. EG
Culvert Upstrm Dist  Length    n Value   Entrance Loss Coef   Exit Loss Coef
               145      60        .03                   .5                1
Upstream   Elevation =  4469
           Centerline Station =  14300
Downstream Elevation =  4468.5
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            Centerline Station =  14300

  Culvert Name      Shape      Rise    Span
  Culvert #4            Box       4      11
  FHWA Chart # 8 - flared wingwalls
  FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
  Solution Criteria = Highest U.S. EG
  Culvert Upstrm Dist  Length    n Value   Entrance Loss Coef   Exit Loss Coef
                145      60        .03                  .5                 1
  Upstream    Elevation =  4469
              Centerline Station =  14316
  Downstream Elevation =  4468.5
              Centerline Station =  14316

  Culvert Name      Shape      Rise    Span
  Culvert #5            Box       4      11
  FHWA Chart # 8 - flared wingwalls
  FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
  Solution Criteria = Highest U.S. EG
  Culvert Upstrm Dist  Length    n Value   Entrance Loss Coef   Exit Loss Coef
                145      60        .03                  .5                 1
  Upstream    Elevation =  4469
              Centerline Station =  14332
  Downstream Elevation =  4468.5
              Centerline Station =  14332

  Culvert Name      Shape      Rise    Span
  Culvert #6            Box       4      11
  FHWA Chart # 8 - flared wingwalls
  FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
  Solution Criteria = Highest U.S. EG
  Culvert Upstrm Dist  Length    n Value   Entrance Loss Coef   Exit Loss Coef
                145      60        .03                  .5                 1
  Upstream    Elevation =  4469
              Centerline Station =  14348
  Downstream Elevation =  4468.5
              Centerline Station =  14348

  Culvert Name      Shape      Rise    Span
  Culvert #7            Box       4      11
  FHWA Chart # 8 - flared wingwalls
  FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
  Solution Criteria = Highest U.S. EG
  Culvert Upstrm Dist  Length    n Value   Entrance Loss Coef   Exit Loss Coef
                145      60        .03                  .5                 1
  Upstream    Elevation =  4469
              Centerline Station =  14364
  Downstream Elevation =  4468.5
              Centerline Station =  14364

  Culvert Name      Shape      Rise    Span
  Culvert #8            Box       4      11
  FHWA Chart # 8 - flared wingwalls
  FHWA Scale # 1 - Wingwall flared 30 to 75 deg.
  Solution Criteria = Highest U.S. EG
  Culvert Upstrm Dist  Length    n Value   Entrance Loss Coef   Exit Loss Coef
                145      60        .03                  .5                 1
  Upstream    Elevation =  4469
              Centerline Station =  14380
  Downstream Elevation =  4468.5
              Centerline Station =  14380

  CULVERT OUTPUT    Profile #100-yr
  Culvert ID : Culvert #1

    Culv Q (cfs)            175.00   Culv Vel In (ft/s)        6.60
    # Barrels                    1   Culv Vel Out (ft/s)       8.00
    Q Barrel (cfs)          175.00   Culv Inv El Up (ft)    4469.00
    W.S. US. (ft)          4472.43   Culv Inv El Dn (ft)    4468.50
```

E.G. US. (ft)	4472.43	Culv Frctn Ls (ft)	0.60
Delta WS (ft)	3.30	Culv Ext Lss (ft)	2.29
Delta EG (ft)	3.24	Culv Ent Lss (ft)	0.34
E.G. IC (ft)	4472.17	Q Weir (cfs)	
E.G. OC (ft)	4472.43	Weir Sta Lft (ft)	
Culv WS In (ft)	4471.41	Weir Sta Rgt (ft)	
Culv WS Out (ft)	4470.49	Weir Submerg	
Culv Nml Depth (ft)	2.47	Weir Max Depth (ft)	
Culv Crt Depth (ft)	1.99	Weir Avg Depth (ft)	
Culv Ful Lngh (ft)		Min Top Rd (ft)	4475.00

CULVERT OUTPUT Profile #PMF
Culvert ID : Culvert #1

Culv Q (cfs)	485.82	Culv Vel In (ft/s)	11.04
# Barrels	1	Culv Vel Out (ft/s)	11.25
Q Barrel (cfs)	485.82	Culv Inv El Up (ft)	4469.00
W.S. US. (ft)	4477.09	Culv Inv El Dn (ft)	4468.50
E.G. US. (ft)	4477.13	Culv Frctn Ls (ft)	1.79
Delta WS (ft)	6.35	Culv Ext Lss (ft)	2.92
Delta EG (ft)	5.65	Culv Ent Lss (ft)	0.95
E.G. IC (ft)	4476.65	Q Weir (cfs)	64598.14
E.G. OC (ft)	4477.13	Weir Sta Lft (ft)	8701.79
Culv WS In (ft)	4473.00	Weir Sta Rgt (ft)	17497.38
Culv WS Out (ft)	4472.43	Weir Submerg	0.00
Culv Nml Depth (ft)	4.00	Weir Max Depth (ft)	2.13
Culv Crt Depth (ft)	3.93	Weir Avg Depth (ft)	1.98
Culv Ful Lngh (ft)	59.84	Min Top Rd (ft)	4475.00

Warning - During subcritical analysis, while trying to calculate culvert and weir flow, the program could not get a balance of energy within the specified tolerance and number of trials. The program used the solution with the minimum error.
Note - The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CULVERT OUTPUT Profile #100-yr
Culvert ID : Culvert #2

Culv Q (cfs)	175.00	Culv Vel In (ft/s)	6.60
# Barrels	1	Culv Vel Out (ft/s)	8.00
Q Barrel (cfs)	175.00	Culv Inv El Up (ft)	4469.00
W.S. US. (ft)	4472.43	Culv Inv El Dn (ft)	4468.50
E.G. US. (ft)	4472.43	Culv Frctn Ls (ft)	0.60
Delta WS (ft)	3.30	Culv Ext Lss (ft)	2.29
Delta EG (ft)	3.24	Culv Ent Lss (ft)	0.34
E.G. IC (ft)	4472.17	Q Weir (cfs)	
E.G. OC (ft)	4472.43	Weir Sta Lft (ft)	
Culv WS In (ft)	4471.41	Weir Sta Rgt (ft)	
Culv WS Out (ft)	4470.49	Weir Submerg	
Culv Nml Depth (ft)	2.47	Weir Max Depth (ft)	
Culv Crt Depth (ft)	1.99	Weir Avg Depth (ft)	
Culv Ful Lngh (ft)		Min Top Rd (ft)	4475.00

CULVERT OUTPUT Profile #PMF
Culvert ID : Culvert #2

Culv Q (cfs)	485.82	Culv Vel In (ft/s)	11.04
# Barrels	1	Culv Vel Out (ft/s)	11.25
Q Barrel (cfs)	485.82	Culv Inv El Up (ft)	4469.00
W.S. US. (ft)	4477.09	Culv Inv El Dn (ft)	4468.50
E.G. US. (ft)	4477.13	Culv Frctn Ls (ft)	1.79
Delta WS (ft)	6.35	Culv Ext Lss (ft)	2.92
Delta EG (ft)	5.65	Culv Ent Lss (ft)	0.95
E.G. IC (ft)	4476.65	Q Weir (cfs)	64598.14
E.G. OC (ft)	4477.13	Weir Sta Lft (ft)	8701.79
Culv WS In (ft)	4473.00	Weir Sta Rgt (ft)	17497.38

Culv WS Out (ft)	4472.43	Weir Submerg	0.00
Culv Nml Depth (ft)	4.00	Weir Max Depth (ft)	2.13
Culv Crt Depth (ft)	3.93	Weir Avg Depth (ft)	1.98
Culv Ful Lngh (ft)	59.84	Min Top Rd (ft)	4475.00

Warning - During subcritical analysis, while trying to calculate culvert and weir flow, the program could not get a balance of energy within the specified tolerance and number of trials. The program used the solution with the minimum error.
Note - The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CULVERT OUTPUT Profile #100-yr
Culvert ID : Culvert #3

Culv Q (cfs)	175.00	Culv Vel In (ft/s)	6.60
# Barrels	1	Culv Vel Out (ft/s)	8.00
Q Barrel (cfs)	175.00	Culv Inv El Up (ft)	4469.00
W.S. US. (ft)	4472.43	Culv Inv El Dn (ft)	4468.50
E.G. US. (ft)	4472.43	Culv Frctn Ls (ft)	0.60
Delta WS (ft)	3.30	Culv Ext Lss (ft)	2.29
Delta EG (ft)	3.24	Culv Ent Lss (ft)	0.34
E.G. IC (ft)	4472.17	Q Weir (cfs)	
E.G. OC (ft)	4472.43	Weir Sta Lft (ft)	
Culv WS In (ft)	4471.41	Weir Sta Rgt (ft)	
Culv WS Out (ft)	4470.49	Weir Submerg	
Culv Nml Depth (ft)	2.47	Weir Max Depth (ft)	
Culv Crt Depth (ft)	1.99	Weir Avg Depth (ft)	
Culv Ful Lngh (ft)		Min Top Rd (ft)	4475.00

CULVERT OUTPUT Profile #PMF
Culvert ID : Culvert #3

Culv Q (cfs)	485.82	Culv Vel In (ft/s)	11.04
# Barrels	1	Culv Vel Out (ft/s)	11.25
Q Barrel (cfs)	485.82	Culv Inv El Up (ft)	4469.00
W.S. US. (ft)	4477.09	Culv Inv El Dn (ft)	4468.50
E.G. US. (ft)	4477.13	Culv Frctn Ls (ft)	1.79
Delta WS (ft)	6.35	Culv Ext Lss (ft)	2.92
Delta EG (ft)	5.65	Culv Ent Lss (ft)	0.95
E.G. IC (ft)	4476.65	Q Weir (cfs)	64598.14
E.G. OC (ft)	4477.13	Weir Sta Lft (ft)	8701.79
Culv WS In (ft)	4473.00	Weir Sta Rgt (ft)	17497.38
Culv WS Out (ft)	4472.43	Weir Submerg	0.00
Culv Nml Depth (ft)	4.00	Weir Max Depth (ft)	2.13
Culv Crt Depth (ft)	3.93	Weir Avg Depth (ft)	1.98
Culv Ful Lngh (ft)	59.84	Min Top Rd (ft)	4475.00

Warning - During subcritical analysis, while trying to calculate culvert and weir flow, the program could not get a balance of energy within the specified tolerance and number of trials. The program used the solution with the minimum error.
Note - The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CULVERT OUTPUT Profile #100-yr
Culvert ID : Culvert #4

Culv Q (cfs)	175.00	Culv Vel In (ft/s)	6.60
# Barrels	1	Culv Vel Out (ft/s)	8.00
Q Barrel (cfs)	175.00	Culv Inv El Up (ft)	4469.00
W.S. US. (ft)	4472.43	Culv Inv El Dn (ft)	4468.50
E.G. US. (ft)	4472.43	Culv Frctn Ls (ft)	0.60
Delta WS (ft)	3.30	Culv Ext Lss (ft)	2.29
Delta EG (ft)	3.24	Culv Ent Lss (ft)	0.34
E.G. IC (ft)	4472.17	Q Weir (cfs)	
E.G. OC (ft)	4472.43	Weir Sta Lft (ft)	
Culv WS In (ft)	4471.41	Weir Sta Rgt (ft)	

Culv WS Out (ft)	4470.49	Weir Submerg	
Culv Nml Depth (ft)	2.47	Weir Max Depth (ft)	
Culv Crt Depth (ft)	1.99	Weir Avg Depth (ft)	
Culv Ful Lngh (ft)		Min Top Rd (ft)	4475.00

CULVERT OUTPUT Profile #PMF
Culvert ID : Culvert #4

Culv Q (cfs)	485.82	Culv Vel In (ft/s)	11.04
# Barrels	1	Culv Vel Out (ft/s)	11.25
Q Barrel (cfs)	485.82	Culv Inv El Up (ft)	4469.00
W.S. US. (ft)	4477.09	Culv Inv El Dn (ft)	4468.50
E.G. US. (ft)	4477.13	Culv Frctn Ls (ft)	1.79
Delta WS (ft)	6.35	Culv Ext Lss (ft)	2.92
Delta EG (ft)	5.65	Culv Ent Lss (ft)	0.95
E.G. IC (ft)	4476.65	Q Weir (cfs)	64598.14
E.G. OC (ft)	4477.13	Weir Sta Lft (ft)	8701.79
Culv WS In (ft)	4473.00	Weir Sta Rgt (ft)	17497.38
Culv WS Out (ft)	4472.43	Weir Submerg	0.00
Culv Nml Depth (ft)	4.00	Weir Max Depth (ft)	2.13
Culv Crt Depth (ft)	3.93	Weir Avg Depth (ft)	1.98
Culv Ful Lngh (ft)	59.84	Min Top Rd (ft)	4475.00

Warning - During subcritical analysis, while trying to calculate culvert and weir flow, the program could not get a balance of energy within the specified tolerance and number of trials. The program used the solution with the minimum error.
Note - The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CULVERT OUTPUT Profile #100-yr
Culvert ID : Culvert #5

Culv Q (cfs)	175.00	Culv Vel In (ft/s)	6.60
# Barrels	1	Culv Vel Out (ft/s)	8.00
Q Barrel (cfs)	175.00	Culv Inv El Up (ft)	4469.00
W.S. US. (ft)	4472.43	Culv Inv El Dn (ft)	4468.50
E.G. US. (ft)	4472.43	Culv Frctn Ls (ft)	0.60
Delta WS (ft)	3.30	Culv Ext Lss (ft)	2.29
Delta EG (ft)	3.24	Culv Ent Lss (ft)	0.34
E.G. IC (ft)	4472.17	Q Weir (cfs)	
E.G. OC (ft)	4472.43	Weir Sta Lft (ft)	
Culv WS In (ft)	4471.41	Weir Sta Rgt (ft)	
Culv WS Out (ft)	4470.49	Weir Submerg	
Culv Nml Depth (ft)	2.47	Weir Max Depth (ft)	
Culv Crt Depth (ft)	1.99	Weir Avg Depth (ft)	
Culv Ful Lngh (ft)		Min Top Rd (ft)	4475.00

CULVERT OUTPUT Profile #PMF
Culvert ID : Culvert #5

Culv Q (cfs)	485.82	Culv Vel In (ft/s)	11.04
# Barrels	1	Culv Vel Out (ft/s)	11.25
Q Barrel (cfs)	485.82	Culv Inv El Up (ft)	4469.00
W.S. US. (ft)	4477.09	Culv Inv El Dn (ft)	4468.50
E.G. US. (ft)	4477.13	Culv Frctn Ls (ft)	1.79
Delta WS (ft)	6.35	Culv Ext Lss (ft)	2.92
Delta EG (ft)	5.65	Culv Ent Lss (ft)	0.95
E.G. IC (ft)	4476.65	Q Weir (cfs)	64598.14
E.G. OC (ft)	4477.13	Weir Sta Lft (ft)	8701.79
Culv WS In (ft)	4473.00	Weir Sta Rgt (ft)	17497.38
Culv WS Out (ft)	4472.43	Weir Submerg	0.00
Culv Nml Depth (ft)	4.00	Weir Max Depth (ft)	2.13
Culv Crt Depth (ft)	3.93	Weir Avg Depth (ft)	1.98
Culv Ful Lngh (ft)	59.84	Min Top Rd (ft)	4475.00

Warning - During subcritical analysis, while trying to calculate culvert and weir flow, the program could not get a balance of energy within the specified tolerance and number of trials. The program used the solution with the minimum error.
Note - The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CULVERT OUTPUT Profile #100-yr
Culvert ID : Culvert #6

Culv Q (cfs)	175.00	Culv Vel In (ft/s)	6.60
# Barrels	1	Culv Vel Out (ft/s)	8.00
Q Barrel (cfs)	175.00	Culv Inv El Up (ft)	4469.00
W.S. US. (ft)	4472.43	Culv Inv El Dn (ft)	4468.50
E.G. US. (ft)	4472.43	Culv Frctn Ls (ft)	0.60
Delta WS (ft)	3.30	Culv Ext Lss (ft)	2.29
Delta EG (ft)	3.24	Culv Ent Lss (ft)	0.34
E.G. IC (ft)	4472.17	Q Weir (cfs)	
E.G. OC (ft)	4472.43	Weir Sta Lft (ft)	
Culv WS In (ft)	4471.41	Weir Sta Rgt (ft)	
Culv WS Out (ft)	4470.49	Weir Submerg	
Culv Nml Depth (ft)	2.47	Weir Max Depth (ft)	
Culv Crt Depth (ft)	1.99	Weir Avg Depth (ft)	
Culv Ful Lngh (ft)		Min Top Rd (ft)	4475.00

CULVERT OUTPUT Profile #PMF
Culvert ID : Culvert #6

Culv Q (cfs)	485.82	Culv Vel In (ft/s)	11.04
# Barrels	1	Culv Vel Out (ft/s)	11.25
Q Barrel (cfs)	485.82	Culv Inv El Up (ft)	4469.00
W.S. US. (ft)	4477.09	Culv Inv El Dn (ft)	4468.50
E.G. US. (ft)	4477.13	Culv Frctn Ls (ft)	1.79
Delta WS (ft)	6.35	Culv Ext Lss (ft)	2.92
Delta EG (ft)	5.65	Culv Ent Lss (ft)	0.95
E.G. IC (ft)	4476.65	Q Weir (cfs)	64598.14
E.G. OC (ft)	4477.13	Weir Sta Lft (ft)	8701.79
Culv WS In (ft)	4473.00	Weir Sta Rgt (ft)	17497.38
Culv WS Out (ft)	4472.43	Weir Submerg	0.00
Culv Nml Depth (ft)	4.00	Weir Max Depth (ft)	2.13
Culv Crt Depth (ft)	3.93	Weir Avg Depth (ft)	1.98
Culv Ful Lngh (ft)	59.84	Min Top Rd (ft)	4475.00

Warning - During subcritical analysis, while trying to calculate culvert and weir flow, the program could not get a balance of energy within the specified tolerance and number of trials. The program used the solution with the minimum error.
Note - The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CULVERT OUTPUT Profile #100-yr
Culvert ID : Culvert #7

Culv Q (cfs)	175.00	Culv Vel In (ft/s)	6.60
# Barrels	1	Culv Vel Out (ft/s)	8.00
Q Barrel (cfs)	175.00	Culv Inv El Up (ft)	4469.00
W.S. US. (ft)	4472.43	Culv Inv El Dn (ft)	4468.50
E.G. US. (ft)	4472.43	Culv Frctn Ls (ft)	0.60
Delta WS (ft)	3.30	Culv Ext Lss (ft)	2.29
Delta EG (ft)	3.24	Culv Ent Lss (ft)	0.34
E.G. IC (ft)	4472.17	Q Weir (cfs)	
E.G. OC (ft)	4472.43	Weir Sta Lft (ft)	
Culv WS In (ft)	4471.41	Weir Sta Rgt (ft)	
Culv WS Out (ft)	4470.49	Weir Submerg	
Culv Nml Depth (ft)	2.47	Weir Max Depth (ft)	
Culv Crt Depth (ft)	1.99	Weir Avg Depth (ft)	
Culv Ful Lngh (ft)		Min Top Rd (ft)	4475.00

CULVERT OUTPUT Profile #PMF
Culvert ID : Culvert #7

Culv Q (cfs)	485.82	Culv Vel In (ft/s)	11.04
# Barrels	1	Culv Vel Out (ft/s)	11.25
Q Barrel (cfs)	485.82	Culv Inv El Up (ft)	4469.00
W.S. US. (ft)	4477.09	Culv Inv El Dn (ft)	4468.50
E.G. US. (ft)	4477.13	Culv Frctn Ls (ft)	1.79
Delta WS (ft)	6.35	Culv Ext Lss (ft)	2.92
Delta EG (ft)	5.65	Culv Ent Lss (ft)	0.95
E.G. IC (ft)	4476.65	Q Weir (cfs)	64598.14
E.G. OC (ft)	4477.13	Weir Sta Lft (ft)	8701.79
Culv WS In (ft)	4473.00	Weir Sta Rgt (ft)	17497.38
Culv WS Out (ft)	4472.43	Weir Submerg	0.00
Culv Nml Depth (ft)	4.00	Weir Max Depth (ft)	2.13
Culv Crt Depth (ft)	3.93	Weir Avg Depth (ft)	1.98
Culv Ful Lngh (ft)	59.84	Min Top Rd (ft)	4475.00

Warning - During subcritical analysis, while trying to calculate culvert and weir flow, the program could not get a balance of energy within the specified tolerance and number of trials. The program used the solution with the minimum error.
Note - The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CULVERT OUTPUT Profile #100-yr
Culvert ID : Culvert #8

Culv Q (cfs)	175.00	Culv Vel In (ft/s)	6.60
# Barrels	1	Culv Vel Out (ft/s)	8.00
Q Barrel (cfs)	175.00	Culv Inv El Up (ft)	4469.00
W.S. US. (ft)	4472.43	Culv Inv El Dn (ft)	4468.50
E.G. US. (ft)	4472.43	Culv Frctn Ls (ft)	0.60
Delta WS (ft)	3.30	Culv Ext Lss (ft)	2.29
Delta EG (ft)	3.24	Culv Ent Lss (ft)	0.34
E.G. IC (ft)	4472.17	Q Weir (cfs)	
E.G. OC (ft)	4472.43	Weir Sta Lft (ft)	
Culv WS In (ft)	4471.41	Weir Sta Rgt (ft)	
Culv WS Out (ft)	4470.49	Weir Submerg	
Culv Nml Depth (ft)	2.47	Weir Max Depth (ft)	
Culv Crt Depth (ft)	1.99	Weir Avg Depth (ft)	
Culv Ful Lngh (ft)		Min Top Rd (ft)	4475.00

CULVERT OUTPUT Profile #PMF
Culvert ID : Culvert #8

Culv Q (cfs)	485.82	Culv Vel In (ft/s)	11.04
# Barrels	1	Culv Vel Out (ft/s)	11.25
Q Barrel (cfs)	485.82	Culv Inv El Up (ft)	4469.00
W.S. US. (ft)	4477.09	Culv Inv El Dn (ft)	4468.50
E.G. US. (ft)	4477.13	Culv Frctn Ls (ft)	1.79
Delta WS (ft)	6.35	Culv Ext Lss (ft)	2.92
Delta EG (ft)	5.65	Culv Ent Lss (ft)	0.95
E.G. IC (ft)	4476.65	Q Weir (cfs)	64598.14
E.G. OC (ft)	4477.13	Weir Sta Lft (ft)	8701.79
Culv WS In (ft)	4473.00	Weir Sta Rgt (ft)	17497.38
Culv WS Out (ft)	4472.43	Weir Submerg	0.00
Culv Nml Depth (ft)	4.00	Weir Max Depth (ft)	2.13
Culv Crt Depth (ft)	3.93	Weir Avg Depth (ft)	1.98
Culv Ful Lngh (ft)	59.84	Min Top Rd (ft)	4475.00

Warning - During subcritical analysis, while trying to calculate culvert and weir flow, the program could not get a balance of energy within the specified tolerance and number of trials. The program used the solution with the minimum error.
Note - The normal depth exceeds the height of the culvert. The program assumes that the normal depth is equal to the height of the culvert.

CALCULATION IDENTIFICATION NUMBER				REV NO. 0
J.O. OR W.O NUMBER **0599602**	DIVISION AND GROUP **G(B)**	CALCULATION NUMBER **17**	OPTIONAL TASK CODE N/A	PAGE 35 of 36

CROSS SECTION RIVER: Floodway
REACH: 3-mile rail RS: 2400

INPUT
Description: Section D
Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
5000	4490	5500	4487	6300	4480	7000	4480	11000	4470
11700	4470	12500	4469	14248	4469	14258	4468.5	14390	4468.5
14400	4469	17400	4469	17500	4480				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
5000	.035	12500	.035	17400	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
12500	17400	600	600	.1	.3

CROSS SECTION RIVER: Floodway
REACH: 3-mile rail RS: 1800

INPUT
Description: Section E
Station Elevation Data num= 8

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
6200	4480	7800	4470	9400	4470	10000	4468	14000	4460
15900	4461	17500	4465	18000	4480				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
6200	.035	9400	.035	17500	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
9400	17500	1800	1800	.1	.3

CROSS SECTION RIVER: Floodway
REACH: 3-mile rail RS: 0

INPUT
Description: Section F
Station Elevation Data num= 11

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	4540	3000	4500	3800	4490	4700	4480	5900	4470
7500	4460	8000	4460	14000	4450	15500	4450	18000	4453
21400	4460								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.035	8000	.035	18000	.035

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
8000	18000	100	100	.1	.3

SUMMARY OF MANNING'S N VALUES

River:Floodway

Reach	River Sta.	n1	n2	n3
3-mile rail	5500	.035	.035	.035
3-mile rail	3500	.035	.035	.035
3-mile rail	2750	.035	.035	.035
3-mile rail	2575	Culvert		
3-mile rail	2400	.035	.035	.035
3-mile rail	1800	.035	.035	.035
3-mile rail	0	.035	.035	.035

CALCULATION IDENTIFICATION NUMBER				REV. NO. 0
J.O. OR W.O NUMBER **0599602**	DIVISION AND GROUP **G(B)**	CALCULATION NUMBER **17**	OPTIONAL TASK CODE N/A	PAGE 36 of 36

SUMMARY OF REACH LENGTHS

River: Floodway

Reach	River Sta.	Left	Channel	Right
3-mile rail	5500	2000	2000	2000
3-mile rail	3500	750	750	750
3-mile rail	2750	350	350	350
3-mile rail	2575	Culvert		
3-mile rail	2400	600	600	600
3-mile rail	1800	1800	1800	1800
3-mile rail	0	100	100	100

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Floodway

Reach	River Sta.	Contr.	Expan.
3-mile rail	5500	.1	.3
3-mile rail	3500	.1	.3
3-mile rail	2750	.1	.3
3-mile rail	2575	Culvert	
3-mile rail	2400	.1	.3
3-mile rail	1800	.1	.3
3-mile rail	0	.1	.3