1 **Station 252+00 Existing conditions**

CURRENT DATE: 08-17-2006 FILE DATE: 08-17-2006
CURRENT TIME: 11:28:57 FILE NAME: 252-EX

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

C SITE DATA CULVERT SHAPE, MATERIAL, INLET
U
L INLET OUTLET CULVERT BARRELS
V ELEV. ELEV. LENGTH SHAPE SPAN RISE MANNING INLET
NO. (ft) (ft) (ft) MATERIAL (ft) (ft) n TYPE
1 22.29 21.43 70.01 1 CSP 2.00 2.00 .024 CONVENTIONAL
2
3
4
5
6

SUMMARY OF CULVERT FLOWS (cfs) FILE: 252-EX DATE: 08-17-2006

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
22.29	0	0	0	0	0	0	0	0	1
23.31	3	3	0	0	0	0	0	0	1
23.6	5	5	0	0	0	0	0	0	1
24.12	9	9	0	0	0	0	0	0	1
24.45	12	12	0	0	0	0	0	0	1
24.81	15	15	0	0	0	0	0	0	1
25.44	18	18	0	0	0	0	0	0	1
26.56	21	21	0	0	0	0	0	0	1
26.81	24	21.6	0	0	0	0	0	2.22	9
26.89	27	21.9	0	0	0	0	0	4.96	5
26.96	30	22.1	0	0	0	0	0	7.71	4
26.7	21.4	21.4	0	0	0	0	0	OVERTOPP	ING

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: 252-EX DATE: 08-17-2006

HEAD ELEV (ft)	HEAD ERROR (ft	TOTAL FLOW (cfs	FLOW ERROR (c	% FLOW ERROR
22.29	0	0	0	0
23.31	0	3	0	0
23.6	0	5	0	0
24.12	0	9	0	0
24.45	0	12	0	0
24.81	0	15	0	0
25.44	0	18	0	0

26.56	0	21	0	0
26.81	-0.004	24	0.13	0.54
26.89	-0.004	27	0.15	0.56
26.96	-0.007	30	0.21	0.7

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

2

CURRENT DATE: 08-17-2006 FILE DATE: 08-17-2006
CURRENT TIME: 11:28:57 FILE NAME: 252-EX

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.00 (ft) BY 2.00 (ft)) CSP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)
0	22.29	0	0	0-NF	0	0	0	-0.8	0
3	23.31	0.89	1.02	2-M2c	0.63	0.6	0.6	0.32	3.75
5	23.6	1.18	1.31	2-M2c	0.84	0.79	0.79	0.44	4.36
9	24.12	1.69	1.83	2-M2c	1.19	1.07	1.07	0.57	5.28
12	24.45	2.08	2.16	2-M2c	1.46	1.24	1.24	0.64	5.85
15	24.81	2.52	2.52	2-M2c	2	1.4	1.4	0.69	6.41
18	25.44	3.04	3.15	2-M2c	2	1.52	1.52	0.74	7.03
21	26.56	3.66	4.27	2-M2c	2	1.63	1.63	0.78	7.63
21.65	26.8	3.81	4.51	2-M2c	2	1.65	1.65	0.82	7.82
21.89	26.89	3.86	4.6	2-M2c	2	1.66	1.66	0.86	7.88
22.08	26.95	3.91	4.66	2-M2c	2	1.67	1.67	0.89	7.92

El. inlet face invert 22.29 ft El. outlet invert 21.43 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

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

INLET STATION 0.00 ft
INLET ELEVATION 22.29 ft
OUTLET STATION 70.00 ft
OUTLET ELEVATION 21.43 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0123
CULVERT LENGTH ALONG SLOPE 70.01 ft

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

BARREL SHAPE CIRCULAR
BARREL DIAMETER 2.00 ft
BARREL MATERIAL CORRUGATED STEEL
BARREL MANNING'S n 0.024
INLET TYPE CONVENTIONAL
INLET EDGE AND WALL THIN EDGE PROJECTING

INLET DEPRESSION NONE

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□

CURRENT DATE: 08-17-2006 FILE DATE: 08-17-2006
CURRENT TIME: 11:28:57 FILE NAME: 252-EX

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□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□ TAILWATER □□□□□□□□□□□□□□□□□□□□□□□□□□□□□□
□□□

***** USER DEFINED CHANNEL CROSS-SECTION FILE NAME: 252-TW
MAIN CHANNEL AND LT & RT OVER BANKS FILE DATE: 08-16-2006
LEFT CHANNEL BOUNDARY 2
RIGHT CHANNEL BOUNDARY 5
MANNING n LEFT OVER BANK 0.050
MANNING n MAIN CHANNEL 0.038
MANNING n RIGHT OVER BANK 0.050
SLOPE OF CHANNEL 0.0020 ft/ft

CROSS-SECTION COORD. NO.	X (ft)	Y (ft)
1	0.00	23.00
2	100.00	21.63
3	100.50	20.63
4	102.50	20.63
5	103.00	21.63
6	203.00	23.00

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

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	20.63	0.000	-0.80	0.00	0.00
3.00	21.75	0.243	0.32	1.34	0.08
5.00	21.87	0.248	0.44	1.45	0.09
9.00	22.00	0.253	0.57	1.57	0.11
12.00	22.07	0.255	0.64	1.63	0.11
15.00	22.12	0.257	0.69	1.68	0.12
18.00	22.17	0.258	0.74	1.72	0.12
21.00	22.21	0.260	0.78	1.75	0.13
24.00	22.25	0.261	0.82	1.78	0.13
27.00	22.29	0.262	0.86	1.81	0.13
30.00	22.32	0.263	0.89	1.84	0.14

Note: Shear stress was calculated using R.

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□□□□□□□□□□□□□□□□□□□□□□□□□□□□□□ ROADWAY OVERTOPPING DATA □□□□□□□□□□□□□□□□□□□□□□□
□□□

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	22.00 ft
CREST LENGTH	20.00 ft
OVERTOPPING CREST ELEVATION	26.70 ft

252+00 Tier 2 FISH PASS design

Analysis of **Existing conditions**

no baffles

Juvenile Coho

C:\Client\ALASKA~1\ADFGFI~1\fishpass.exe

Help Print Status Backwater Inlet CalcMode cOrrugations

Weak Swimming Fish Passage

Fish (mm)	Length Culvert (ft)	Slope (%)	Manning n Wall	Manning n Bed	Q (cfs)	Culvert Diam. (ft)	Depth Bed (ft)	Depth Outlet (ft)
96	70	1.2	.024	0	3	2	0	.7

Calculated Fish Parameters

--- Fish Passage ---

Allowable Vel.	Min. Flow Depth	Possible Power	Possible Energy (joules) Outlet	Possible Energy (joules) Inlet
4.4 ft/sec	0.54 ft	0.42 watts	0.77	0.77

Calculated Flow Parameters

	Normal Flow	Critical Flow
Depth (ft)	0.64	0.60
Avg., cross-section, water velocity (ft/sec)	3.44	3.75
Fish power required in outlet zone (watts)		
Fish energy required in outlet zone (joules)		
Fish power required at inlet (watts)	0.21	
Fish energy required at inlet (joules)	0.43	

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

Adult Coho 600-mm

C:\Client\ALASKA~1\ADFGFI~1\fishpass.exe

Help Print Status Backwater Inlet CalcMode cOrrugations

Weak Swimming Fish Passage

Fish (mm)	Length Culvert (ft)	Slope (%)	Manning n Wall	Manning n Bed	Q (cfs)	Culvert Diam. (ft)	Depth Bed (ft)	Depth Outlet (ft)
600	70	1.2	.024	0	3	2	0	.7

Calculated Fish Parameters

--- Fish Passage ---

Allowable Vel.	Min. Flow Depth	Possible Power	Possible Energy (joules) Outlet	Possible Energy (joules) Inlet
6.0 ft/sec	0.43 ft	38.11 watts	187.50	187.50

Calculated Flow Parameters

	Normal Flow	Critical Flow
Depth (ft)	0.64	0.60
Avg., cross-section, water velocity (ft/sec)	3.44	3.75
Fish power required in outlet zone (watts)		
Fish energy required in outlet zone (joules)		
Fish power required at inlet (watts)	9.84	
Fish energy required at inlet (joules)	19.68	

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

Adult Coho 600 1.57 942

Note: L * 1.57 converts swimming ability to 'equivalent' grayling

Assume depth based on actual body size of 600-mm fish above

C:\Client\ALASKA~1\ADFGFI~1\fishpass.exe

Help Print Status Backwater Inlet CalcMode cOrrugations

Weak Swimming Fish Passage

Fish (mm)	Length Culvert (ft)	Slope (%)	Manning n Wall	Manning n Bed	Q (cfs)	Culvert Diam. (ft)	Depth Bed (ft)	Depth Outlet (ft)
942	70	1.2	.024	0	3	2	0	.7

Calculated Fish Parameters

--- Fish Passage ---

Allowable Vel.	Min. Flow Depth	Possible Power	Possible Energy (joules) Outlet	Possible Energy (joules) Inlet
6.4 ft/sec	0.41 ft	115.59 watts	725.60	

Calculated Flow Parameters

	Normal Flow	Critical Flow
Depth (ft)	0.64	0.60
Avg., cross-section, water velocity (ft/sec)	3.44	3.75
Fish power required in outlet zone (watts)		
Fish energy required in outlet zone (joules)		
Fish power required at inlet (watts)		
Fish energy required at inlet (joules)		

Normal Depth too shallow

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

1 **Station 263+50 Existing conditions**

CURRENT DATE: 08-17-2006 FILE DATE: 08-17-2006
CURRENT TIME: 12:26:58 FILE NAME: 26350

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

C SITE DATA CULVERT SHAPE, MATERIAL, INLET
U
L INLET OUTLET CULVERT BARRELS
V ELEV. ELEV. LENGTH SHAPE SPAN RISE MANNING INLET
NO. (ft) (ft) (ft) MATERIAL (ft) (ft) n TYPE
1 22.66 21.49 59.01 1 CSP 2.00 2.00 .024 CONVENTIONAL
2
3
4
5
6

SUMMARY OF CULVERT FLOWS (cfs) FILE: 26350 DATE: 08-17-2006

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
22.66	0	0	0	0	0	0	0	0	1
23.83	5	5	0	0	0	0	0	0	1
24.74	12	12	0	0	0	0	0	0	1
25.69	18	18	0	0	0	0	0	0	1
27.32	24	24	0	0	0	0	0	0	1
28.95	30	28.3	0	0	0	0	0	1.54	8
29.19	36	28.9	0	0	0	0	0	6.96	4
29.36	42	29.3	0	0	0	0	0	12.34	3
29.52	48	29.7	0	0	0	0	0	18.02	3
29.66	54	30	0	0	0	0	0	23.83	3
29.79	60	30.2	0	0	0	0	0	29.57	3
28.81	28	28	0	0	0	0	0	OVERTOPP	ING

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: 26350 DATE: 08-17-2006

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
22.66	0.000	0.00	0.00	0.00
23.83	0.000	5.00	0.00	0.00
24.74	0.000	12.00	0.00	0.00
25.69	0.000	18.00	0.00	0.00
27.32	0.000	24.00	0.00	0.00
28.95	-0.005	30.00	0.14	0.47
29.19	-0.005	36.00	0.19	0.53

29.36	-0.008	42.00	0.39	0.93
29.52	-0.006	48.00	0.32	0.67
29.66	-0.003	54.00	0.17	0.31
29.79	-0.004	60.00	0.20	0.33

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

2

CURRENT DATE: 08-17-2006 FILE DATE: 08-17-2006
CURRENT TIME: 12:26:58 FILE NAME: 26350

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.00 (ft) BY 2.00 (ft)) CSP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)
0	22.66	0	0	0-NF	0	0	0	0.16	0
5	23.83	1.17	1.17	1-S2n	0.73	0.79	0.73	1.31	4.84
12	24.74	2.08	2.08	5-S2n	1.23	1.24	1.14	1.52	6.48
18	25.69	3.03	2.89	3-M2t	1.75	1.52	1.62	1.62	6.6
24	27.32	4.38	4.66	2-M2c	2	1.72	1.72	1.69	8.37
28.32	28.97	5.66	6.31	2-M2c	2	1.85	1.85	1.76	9.38
28.85	29.19	5.83	6.53	2-M2c	2	1.87	1.87	1.81	9.52
29.28	29.36	5.98	6.7	2-M2c	2	1.88	1.88	1.86	9.62
29.66	29.52	6.11	6.86	3-M2t	2	1.89	1.9	1.9	9.7
30	29.7	6.22	7.04	3-M2t	2	1.9	1.94	1.94	9.71
30.24	29.8	6.31	7.14	3-M2t	2	1.91	1.98	1.98	9.69

El. inlet face invert 22.66 ft El. outlet invert 21.49 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

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

INLET STATION 0.00 ft
INLET ELEVATION 22.66 ft
OUTLET STATION 59.00 ft
OUTLET ELEVATION 21.49 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0198
CULVERT LENGTH ALONG SLOPE 59.01 ft

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

BARREL SHAPE CIRCULAR
BARREL DIAMETER 2.00 ft
BARREL MATERIAL CORRUGATED STEEL
BARREL MANNING'S n 0.024
INLET TYPE CONVENTIONAL
INLET EDGE AND WALL THIN EDGE PROJECTING

INLET DEPRESSION NONE

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3

CURRENT DATE: 08-17-2006 FILE DATE: 08-17-2006
CURRENT TIME: 12:26:58 FILE NAME: 26350

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□□

***** USER DEFINED CHANNEL CROSS-SECTION FILE NAME: 263-TW
MAIN CHANNEL AND LT & RT OVER BANKS FILE DATE: 08-17-2006
LEFT CHANNEL BOUNDARY 2
RIGHT CHANNEL BOUNDARY 5
MANNING n LEFT OVER BANK 0.050
MANNING n MAIN CHANNEL 0.038
MANNING n RIGHT OVER BANK 0.050
SLOPE OF CHANNEL 0.0036 ft/ft

CROSS-SECTION COORD. NO.	X (ft)	Y (ft)
1	0.00	24.00
2	100.00	22.65
3	100.50	21.65
4	102.50	21.65
5	103.00	22.65
6	203.00	24.00

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

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	21.65	0.000	0.16	0.00	0.00
5.00	22.80	0.328	1.31	1.85	0.16
12.00	23.01	0.338	1.52	2.10	0.19
18.00	23.11	0.343	1.62	2.21	0.21
24.00	23.18	0.346	1.69	2.30	0.22
30.00	23.25	0.349	1.76	2.37	0.23
36.00	23.30	0.351	1.81	2.42	0.24
42.00	23.35	0.353	1.86	2.47	0.24
48.00	23.39	0.354	1.90	2.52	0.25
54.00	23.43	0.356	1.94	2.56	0.26
60.00	23.47	0.357	1.98	2.60	0.26

Note: Shear stress was calculated using R.

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□□

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	22.00 ft
CREST LENGTH	10.00 ft
OVERTOPPING CREST ELEVATION	28.81 ft

263+00 Tier 2 FISH PASS design

Analysis of **Existing conditions**

no baffles

Juvenile Coho

C:\Client\ALASKA~1\ADFGFI~1\fishpass.exe

Help Print Status Backwater Inlet CalcMode cOrrugations

Weak Swimming Fish Passage

Fish Length (mm)	Culvert (ft)	Slope (%)	Manning n Wall	Manning n Bed	Q (cfs)	Culvert Diam. (ft)	Depth Bed (ft)	Depth Outlet (ft)
96	66	1.4	.024	0	3	2	0	.65

Calculated Fish Parameters

--- Fish Passage ---

Allowable Vel.	Min. Flow Depth	Possible Power	Possible Energy (joules) Outlet	Possible Energy (joules) Inlet
4.4 ft/sec	0.54 ft	0.42 watts	0.77	0.77

Calculated Flow Parameters

	Normal Flow	Critical Flow
Depth (ft)	0.62	0.60
Avg., cross-section, water velocity (ft/sec)	3.64	3.75
Fish power required in outlet zone (watts)		
Fish energy required in outlet zone (joules)		
Fish power required at inlet (watts)	0.23	
Fish energy required at inlet (joules)	0.46	

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

Adult Coho 600-mm Adult Coho

C:\Client\ALASKA~1\ADFGFI~1\fishpass.exe

Help Print Status Backwater Inlet CalcMode cOrrugations

Weak Swimming Fish Passage

Fish Length (mm)	Culvert (ft)	Slope (%)	Manning n Wall	Manning n Bed	Q (cfs)	Culvert Diam. (ft)	Depth Bed (ft)	Depth Outlet (ft)
600	66	1.4	.024	0	3	2	0	.65

Calculated Fish Parameters

--- Fish Passage ---

Allowable Vel.	Min. Flow Depth	Possible Power	Possible Energy (joules) Outlet	Possible Energy (joules) Inlet
6.0 ft/sec	0.43 ft	38.11 watts	187.50	187.50

Calculated Flow Parameters

	Normal Flow	Critical Flow
Depth (ft)	0.62	0.60
Avg., cross-section, water velocity (ft/sec)	3.64	3.75
Fish power required in outlet zone (watts)		
Fish energy required in outlet zone (joules)		
Fish power required at inlet (watts)	10.69	
Fish energy required at inlet (joules)	21.39	

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

Adult Coho 600 1.57 942

Note: L * 1.57 converts swimming ability to 'equivalent' grayling

Assume depth based on actual body size of 600-mm fish above

C:\Client\ALASKA~1\ADFGFI~1\fishpass.exe

Help Print Status Backwater Inlet CalcMode cOrrugations

Weak Swimming Fish Passage

Fish Length (mm)	Culvert (ft)	Slope (%)	Manning n Wall	Manning n Bed	Q (cfs)	Culvert Diam. (ft)	Depth Bed (ft)	Depth Outlet (ft)
942	66	1.4	.024	0	3	2	0	.65

Calculated Fish Parameters

--- Fish Passage ---

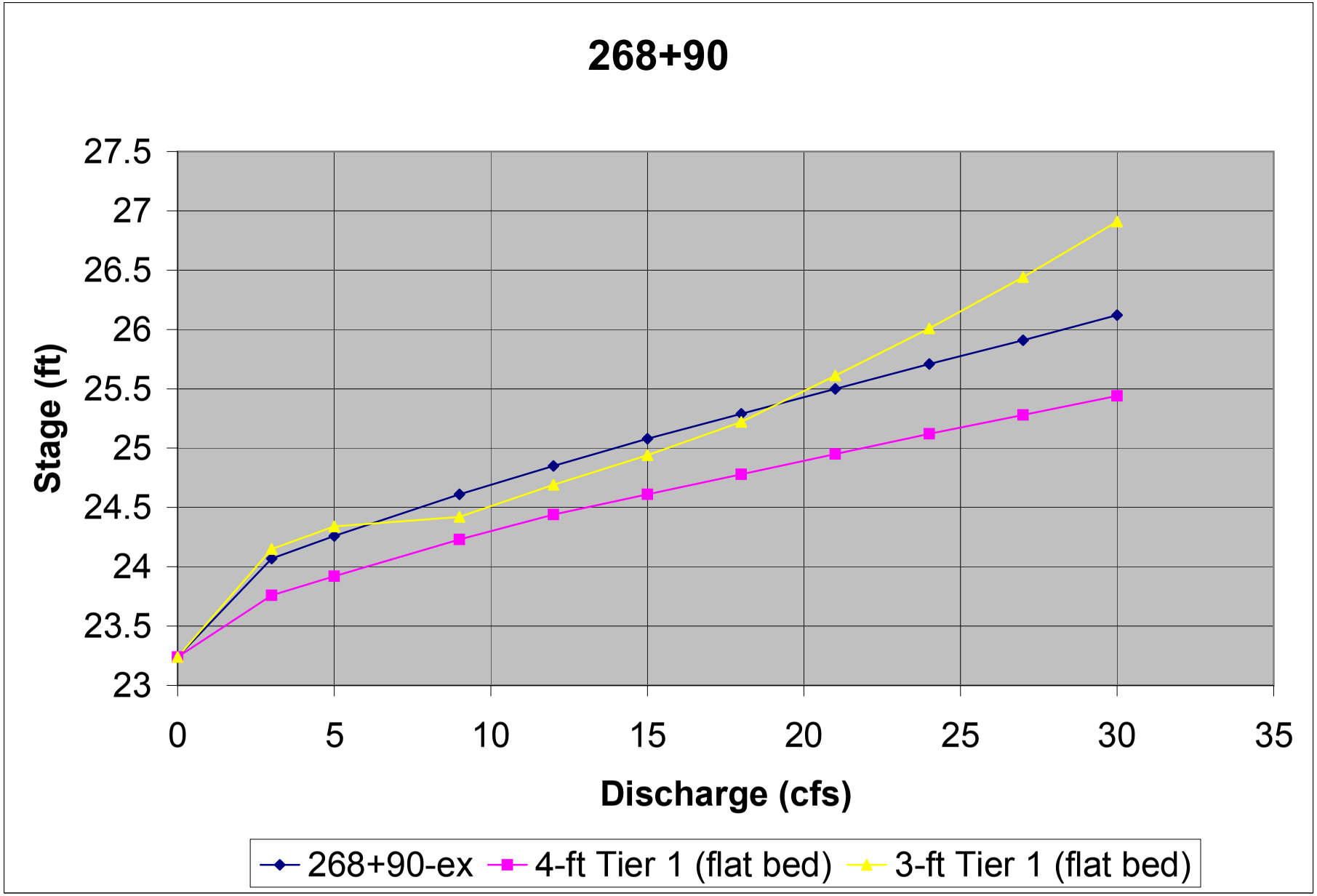
Allowable Vel.	Min. Flow Depth	Possible Power	Possible Energy (joules) Outlet	Possible Energy (joules) Inlet
6.3 ft/sec	0.42 ft	115.59 watts	725.60	

Calculated Flow Parameters

	Normal Flow	Critical Flow
Depth (ft)	0.62	0.60
Avg., cross-section, water velocity (ft/sec)	3.64	3.75
Fish power required in outlet zone (watts)		
Fish energy required in outlet zone (joules)		
Fish power required at inlet (watts)		
Fish energy required at inlet (joules)		

Normal Depth too shallow

Alt = Menu <F1 = Current Field Help> <Esc = Exit>


268+90
Stage (ft)
27.5
27
26.5
26
25.5
25
24.5
24
23.5
23
0
5
10
15
20
25
30
35
Discharge (cfs)
268+90-ex
4-ft Tier 1 (flat bed)
3-ft Tier 1 (flat bed)

1 Station 263+50 Existing conditions

CURRENT DATE: 08-17-2006 FILE DATE: 08-17-2006
CURRENT TIME: 12:26:58 FILE NAME: 26350

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

C SITE DATA CULVERT SHAPE, MATERIAL, INLET
U
L INLET OUTLET CULVERT BARRELS
V ELEV. ELEV. LENGTH SHAPE SPAN RISE MANNING INLET
NO. (ft) (ft) (ft) MATERIAL (ft) (ft) n TYPE
1 22.66 21.49 59.01 1 CSP 2.00 2.00 .024 CONVENTIONAL
2
3
4
5
6

SUMMARY OF CULVERT FLOWS (cfs) FILE: 26350 DATE: 08-17-2006

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
22.66	0	0	0	0	0	0	0	0	1
23.83	5	5	0	0	0	0	0	0	1
24.74	12	12	0	0	0	0	0	0	1
25.69	18	18	0	0	0	0	0	0	1
27.32	24	24	0	0	0	0	0	0	1
28.95	30	28.3	0	0	0	0	0	1.54	8
29.19	36	28.9	0	0	0	0	0	6.96	4
29.36	42	29.3	0	0	0	0	0	12.34	3
29.52	48	29.7	0	0	0	0	0	18.02	3
29.66	54	30	0	0	0	0	0	23.83	3
29.79	60	30.2	0	0	0	0	0	29.57	3
28.81	28	28	0	0	0	0	0	OVERTOPP	ING

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: 26350 DATE: 08-17-2006

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
22.66	0.000	0.00	0.00	0.00
23.83	0.000	5.00	0.00	0.00
24.74	0.000	12.00	0.00	0.00
25.69	0.000	18.00	0.00	0.00
27.32	0.000	24.00	0.00	0.00
28.95	-0.005	30.00	0.14	0.47
29.19	-0.005	36.00	0.19	0.53

29.36	-0.008	42.00	0.39	0.93
29.52	-0.006	48.00	0.32	0.67
29.66	-0.003	54.00	0.17	0.31
29.79	-0.004	60.00	0.20	0.33

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

2

CURRENT DATE: 08-17-2006 FILE DATE: 08-17-2006
CURRENT TIME: 12:26:58 FILE NAME: 26350

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.00 (ft) BY 2.00 (ft)) CSP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)
0	22.66	0	0	0-NF	0	0	0	0.16	0
5	23.83	1.17	1.17	1-S2n	0.73	0.79	0.73	1.31	4.84
12	24.74	2.08	2.08	5-S2n	1.23	1.24	1.14	1.52	6.48
18	25.69	3.03	2.89	3-M2t	1.75	1.52	1.62	1.62	6.6
24	27.32	4.38	4.66	2-M2c	2	1.72	1.72	1.69	8.37
28.32	28.97	5.66	6.31	2-M2c	2	1.85	1.85	1.76	9.38
28.85	29.19	5.83	6.53	2-M2c	2	1.87	1.87	1.81	9.52
29.28	29.36	5.98	6.7	2-M2c	2	1.88	1.88	1.86	9.62
29.66	29.52	6.11	6.86	3-M2t	2	1.89	1.9	1.9	9.7
30	29.7	6.22	7.04	3-M2t	2	1.9	1.94	1.94	9.71
30.24	29.8	6.31	7.14	3-M2t	2	1.91	1.98	1.98	9.69

El. inlet face invert 22.66 ft El. outlet invert 21.49 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

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

INLET STATION 0.00 ft
INLET ELEVATION 22.66 ft
OUTLET STATION 59.00 ft
OUTLET ELEVATION 21.49 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0198
CULVERT LENGTH ALONG SLOPE 59.01 ft

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

BARREL SHAPE CIRCULAR
BARREL DIAMETER 2.00 ft
BARREL MATERIAL CORRUGATED STEEL
BARREL MANNING'S n 0.024
INLET TYPE CONVENTIONAL
INLET EDGE AND WALL THIN EDGE PROJECTING

INLET DEPRESSION NONE

3

CURRENT DATE: 08-17-2006 FILE DATE: 08-17-2006
CURRENT TIME: 12:26:58 FILE NAME: 26350

TAILWATER

***** USER DEFINED CHANNEL CROSS-SECTION FILE NAME: 263-TW
MAIN CHANNEL AND LT & RT OVER BANKS FILE DATE: 08-17-2006
LEFT CHANNEL BOUNDARY 2
RIGHT CHANNEL BOUNDARY 5
MANNING n LEFT OVER BANK 0.050
MANNING n MAIN CHANNEL 0.038
MANNING n RIGHT OVER BANK 0.050
SLOPE OF CHANNEL 0.0036 ft/ft

CROSS-SECTION COORD. NO.	X (ft)	Y (ft)
1	0.00	24.00
2	100.00	22.65
3	100.50	21.65
4	102.50	21.65
5	103.00	22.65
6	203.00	24.00

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

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	21.65	0.000	0.16	0.00	0.00
5.00	22.80	0.328	1.31	1.85	0.16
12.00	23.01	0.338	1.52	2.10	0.19
18.00	23.11	0.343	1.62	2.21	0.21
24.00	23.18	0.346	1.69	2.30	0.22
30.00	23.25	0.349	1.76	2.37	0.23
36.00	23.30	0.351	1.81	2.42	0.24
42.00	23.35	0.353	1.86	2.47	0.24
48.00	23.39	0.354	1.90	2.52	0.25
54.00	23.43	0.356	1.94	2.56	0.26
60.00	23.47	0.357	1.98	2.60	0.26

Note: Shear stress was calculated using R.

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	22.00 ft
CREST LENGTH	10.00 ft
OVERTOPPING CREST ELEVATION	28.81 ft

1 **Station 268+90 Tier 1 fish passage - 4-ft CMP**

CURRENT DATE: 08-29-2006 FILE DATE: 08-29-2006
CURRENT TIME: 19:31:05 FILE NAME: 268-TW

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

SITE DATA CULVERT SHAPE, MATERIAL, INLET

C U L V NO.	INLET ELEV. (ft)	OUTLET ELEV. (ft)	CULVERT LENGTH (ft)	BARRELS SHAPE MATERIAL	SPAN (ft)	RISE (ft)	MANNING n	INLET TYPE
1	23.24	21.71	58.02	1 ICMP	4.00	2.40	.024	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: 268-TW DATE: 08-29-2006

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
23.24	0	0	0	0	0	0	0	0	1
23.76	3	3	0	0	0	0	0	0	1
23.92	5	5	0	0	0	0	0	0	1
24.23	9	9	0	0	0	0	0	0	1
24.44	12	12	0	0	0	0	0	0	1
24.61	15	15	0	0	0	0	0	0	1
24.78	18	18	0	0	0	0	0	0	1
24.95	21	21	0	0	0	0	0	0	1
25.12	24	24	0	0	0	0	0	0	1
25.28	27	27	0	0	0	0	0	0	1
25.44	30	30	0	0	0	0	0	0	1
27.64	57.4	57.4	0	0	0	0	0	OVERTOPP	ING

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: 268-TW DATE: 08-29-2006

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
23.24	0.000	0.00	0.00	0.00
23.76	0.000	3.00	0.00	0.00
23.92	0.000	5.00	0.00	0.00
24.23	0.000	9.00	0.00	0.00
24.44	0.000	12.00	0.00	0.00
24.61	0.000	15.00	0.00	0.00
24.78	0.000	18.00	0.00	0.00
24.95	0.000	21.00	0.00	0.00
25.12	0.000	24.00	0.00	0.00
25.28	0.000	27.00	0.00	0.00
25.44	0.000	30.00	0.00	0.00

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

2

CURRENT DATE: 08-29-2006 FILE DATE: 08-29-2006
CURRENT TIME: 19:31:05 FILE NAME: 268-TW

PERFORMANCE CURVE FOR CULVERT 1 - 1(4.00 (ft) BY 2.40 (ft)) ICMP

DIS- CHARGE FLOW (cfs)	HEAD- WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	23.24	0.00	0.00	0-NF	0.00	0.00	0.00	-0.56	0.00	0.00
3.00	23.76	0.52	0.52	1-S2n	0.21	0.26	0.16	0.33	3.59	1.85
5.00	23.92	0.68	0.68	1-S2n	0.30	0.36	0.30	0.39	4.25	1.96
9.00	24.23	0.99	0.99	1-S2n	0.44	0.54	0.34	0.47	6.73	2.10
12.00	24.44	1.20	1.20	1-S2n	0.53	0.65	0.45	0.52	6.70	2.17
15.00	24.61	1.37	1.37	1-S2n	0.61	0.76	0.56	0.56	6.79	2.23
18.00	24.78	1.54	1.54	1-S2n	0.70	0.85	0.69	0.60	6.58	2.29
21.00	24.95	1.71	1.71	1-S2n	0.78	0.95	0.65	0.63	8.23	2.34
24.00	25.12	1.88	1.88	1-S2n	0.85	1.03	0.73	0.65	8.33	2.38
27.00	25.28	2.04	2.04	1-S2n	0.93	1.11	0.81	0.68	8.45	2.42
30.00	25.44	2.20	2.20	1-S2n	1.00	1.19	0.89	0.70	8.54	2.45

El. inlet face invert 23.24 ft El. outlet invert 21.71 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

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

INLET STATION 0.00 ft
INLET ELEVATION 23.24 ft
OUTLET STATION 58.00 ft
OUTLET ELEVATION 21.71 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0264
CULVERT LENGTH ALONG SLOPE 58.02 ft

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

BARREL SHAPE USER DEFINED
BARREL SPAN 4.00 ft
BARREL RISE 2.40 ft
BARREL MATERIAL STEEL OR ALUMINUM
BARREL MANNING'S n 0.024 FOR SIDES AND TOP
0.038 FOR BOTTOM
INLET TYPE CONVENTIONAL
INLET EDGE AND WALL MITERED
INLET DEPRESSION NONE

3

CURRENT DATE: 08-29-2006 FILE DATE: 08-29-2006
CURRENT TIME: 19:31:05 FILE NAME: 268-TW

***** USER DEFINED CULVERT CROSS-SECTION - CULVERT # 1

COORDINATE NUMBER	X (ft)	Y-TOP (ft)	Y-BOTTOM (ft)
1	73.20	23.64	23.64
2	73.21	24.04	23.24
3	73.60	24.88	23.24
4	74.00	25.26	23.24
5	74.40	25.48	23.24
6	74.80	25.60	23.24
7	75.20	25.64	23.24

8	75.60	25.60	23.24
9	76.00	25.48	23.24
10	76.30	25.26	23.24
11	76.70	24.88	23.24
12	77.10	24.04	23.24
13	77.20	23.64	23.64

4

CURRENT DATE: 08-29-2006   FILE DATE: 08-29-2006
CURRENT TIME: 19:31:05   FILE NAME: 268-TW

TAILWATER

***** USER DEFINED CHANNEL CROSS-SECTION   FILE NAME: 268TW4
MAIN CHANNEL AND LT & RT OVER BANKS   FILE DATE: 08-29-2006
LEFT CHANNEL BOUNDARY 2
RIGHT CHANNEL BOUNDARY 5
MANNING n LEFT OVER BANK 0.050
MANNING n MAIN CHANNEL 0.038
MANNING n RIGHT OVER BANK 0.050
SLOPE OF CHANNEL 0.0053 ft/ft

CROSS-SECTION COORD. NO.	X (ft)	Y (ft)
1	0.00	23.00
2	100.00	21.85
3	100.50	21.15
4	101.50	21.15
5	102.00	21.85
6	202.00	23.00

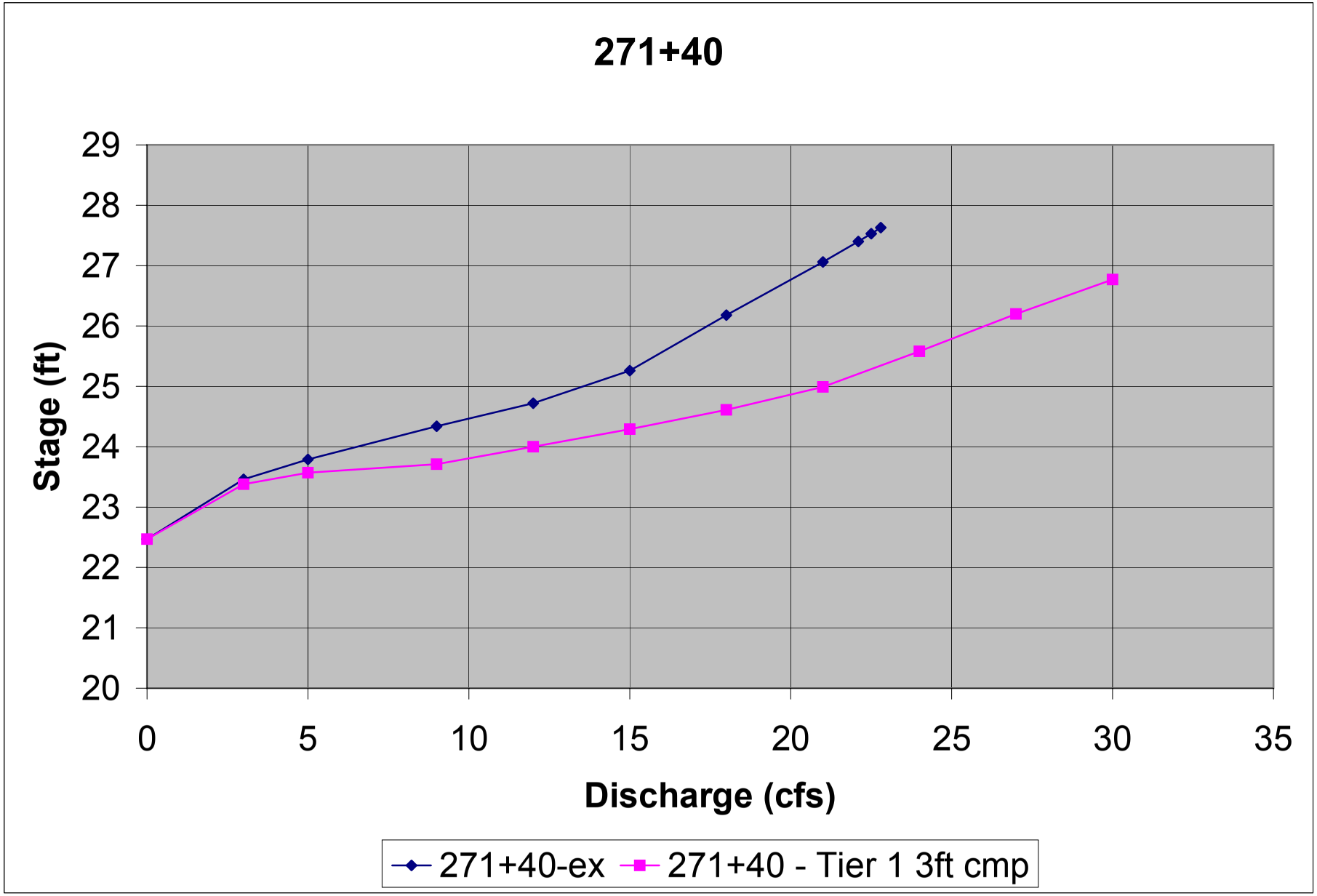
******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	21.15	0.000	-0.56	0.00	0.00
3.00	22.04	0.386	0.33	1.85	0.17
5.00	22.10	0.392	0.39	1.96	0.19
9.00	22.18	0.398	0.47	2.10	0.21
12.00	22.23	0.402	0.52	2.17	0.22
15.00	22.27	0.405	0.56	2.23	0.23
18.00	22.31	0.407	0.60	2.29	0.24
21.00	22.34	0.409	0.63	2.34	0.25
24.00	22.36	0.411	0.65	2.38	0.25
27.00	22.39	0.413	0.68	2.42	0.26
30.00	22.41	0.414	0.70	2.45	0.26

Note: Shear stress was calculated using R.

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE PAVED
EMBANKMENT TOP WIDTH 24.00 ft
CREST LENGTH 10.00 ft
OVERTOPPING CREST ELEVATION 27.64 ft


271+40
Stage (ft)
29
28
27
26
25
24
23
22
21
20
0
5
10
15
20
25
30
35
Discharge (cfs)
271+40-ex
271+40 - Tier 1 3ft cmp

1 **Station 271+40 Existing conditions**

CURRENT DATE: 08-25-2006 FILE DATE: 08-25-2006
CURRENT TIME: 11:21:00 FILE NAME: 27140EX

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

C SITE DATA CULVERT SHAPE, MATERIAL, INLET
U
L INLET OUTLET CULVERT BARRELS
V ELEV. ELEV. LENGTH SHAPE SPAN RISE MANNING INLET
NO. (ft) (ft) (ft) MATERIAL (ft) (ft) n TYPE
1 22.47 22.20 58.00 1 CSP 2.00 2.00 .024 CONVENTIONAL
2
3
4
5
6

SUMMARY OF CULVERT FLOWS (cfs) FILE: 27140EX DATE: 08-25-2006

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
22.47	0	0	0	0	0	0	0	0	1
23.46	3	3	0	0	0	0	0	0	1
23.79	5	5	0	0	0	0	0	0	1
24.34	9	9	0	0	0	0	0	0	1
24.72	12	12	0	0	0	0	0	0	1
25.26	15	15	0	0	0	0	0	0	1
26.18	18	18	0	0	0	0	0	0	1
27.06	21	21	0	0	0	0	0	0	1
27.4	24	22.1	0	0	0	0	0	1.7	6
27.53	27	22.5	0	0	0	0	0	4.33	4
27.63	30	22.8	0	0	0	0	0	7.08	4
27.25	21.6	21.6	0	0	0	0	0	OVERTOPP	ING

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: 27140EX DATE: 08-25-2006

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
22.47	0.000	0.00	0.00	0.00
23.46	0.000	3.00	0.00	0.00
23.79	0.000	5.00	0.00	0.00
24.34	0.000	9.00	0.00	0.00
24.72	0.000	12.00	0.00	0.00
25.26	0.000	15.00	0.00	0.00
26.18	0.000	18.00	0.00	0.00
27.06	0.000	21.00	0.00	0.00
27.40	-0.007	24.00	0.22	0.92
27.53	-0.004	27.00	0.18	0.67

27.63 -0.008 30.00 0.09 0.30

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

2

CURRENT DATE: 08-25-2006 FILE DATE: 08-25-2006
CURRENT TIME: 11:21:00 FILE NAME: 27140EX

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.00 (ft) BY 2.00 (ft)) CSP

DIS- CHARGE FLOW (cfs)	HEAD- WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	22.47	0.00	0.00	0-NF	0.00	0.00	0.00	-0.54	0.00	0.00
3.00	23.46	0.90	0.99	2-M2c	0.82	0.60	0.60	0.22	3.75	2.00
5.00	23.79	1.19	1.32	2-M2c	1.11	0.79	0.79	0.31	4.36	2.17
9.00	24.34	1.70	1.87	2-M2c	2.00	1.07	1.07	0.39	5.28	2.34
12.00	24.72	2.09	2.25	2-M2c	2.00	1.24	1.24	0.43	5.85	2.42
15.00	25.26	2.53	2.79	2-M2c	2.00	1.40	1.40	0.47	6.41	2.48
18.00	26.18	3.05	3.71	2-M2c	2.00	1.52	1.52	0.50	7.03	2.54
21.00	27.06	3.67	4.59	2-M2c	2.00	1.63	1.63	0.53	7.63	2.59
22.09	27.40	3.92	4.93	2-M2c	2.00	1.67	1.67	0.55	7.92	2.63
22.49	27.52	4.02	5.05	2-M2c	2.00	1.68	1.68	0.57	8.02	2.67
22.83	27.63	4.10	5.16	2-M2c	2.00	1.69	1.69	0.59	8.10	2.71

El. inlet face invert 22.47 ft El. outlet invert 22.20 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

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

INLET STATION 0.00 ft
INLET ELEVATION 22.47 ft
OUTLET STATION 58.00 ft
OUTLET ELEVATION 22.20 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0047
CULVERT LENGTH ALONG SLOPE 58.00 ft

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

BARREL SHAPE CIRCULAR
BARREL DIAMETER 2.00 ft
BARREL MATERIAL CORRUGATED STEEL
BARREL MANNING'S n 0.024
INLET TYPE CONVENTIONAL
INLET EDGE AND WALL THIN EDGE PROJECTING
INLET DEPRESSION NONE

3

CURRENT DATE: 08-25-2006 FILE DATE: 08-25-2006
CURRENT TIME: 11:21:00 FILE NAME: 27140EX

TAILWATER

***** USER DEFINED CHANNEL CROSS-SECTION FILE NAME: 27140TW
MAIN CHANNEL AND LT & RT OVER BANKS FILE DATE: 08-25-2006

LEFT CHANNEL BOUNDARY	2
RIGHT CHANNEL BOUNDARY	5
MANNING n LEFT OVER BANK	0.050
MANNING n MAIN CHANNEL	0.035
MANNING n RIGHT OVER BANK	0.050
SLOPE OF CHANNEL	0.0053 ft/ft

CROSS-SECTION COORD. NO.	X (ft)	Y (ft)
1	0.00	23.00
2	100.00	22.36
3	100.50	21.66
4	102.50	21.66
5	103.00	22.36
6	203.00	23.00

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

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	21.66	0.000	-0.54	0.00	0.00
3.00	22.42	0.439	0.22	2.00	0.17
5.00	22.51	0.448	0.31	2.17	0.19
9.00	22.59	0.456	0.39	2.34	0.22
12.00	22.64	0.460	0.43	2.42	0.23
15.00	22.67	0.463	0.47	2.48	0.24
18.00	22.70	0.466	0.50	2.54	0.25
21.00	22.73	0.468	0.53	2.59	0.25
24.00	22.75	0.470	0.55	2.63	0.26
27.00	22.77	0.472	0.57	2.67	0.27
30.00	22.79	0.473	0.59	2.71	0.27

Note: Shear stress was calculated using R.

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	24.00 ft
CREST LENGTH	10.00 ft
OVERTOPPING CREST ELEVATION	27.25 ft

1 **Station 271+40 Tier 1 fish passage - 3-ft CMP**

CURRENT DATE: 08-29-2006 FILE DATE: 08-29-2006
CURRENT TIME: 20:14:01 FILE NAME: 271-T3

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

C SITE DATA CULVERT SHAPE, MATERIAL, INLET
U
L INLET OUTLET CULVERT BARRELS
V ELEV. ELEV. LENGTH SHAPE SPAN RISE MANNING INLET
NO. (ft) (ft) (ft) MATERIAL (ft) (ft) n TYPE
1 22.47 22.20 58.00 1 ICMP 3.10 1.80 .024 CONVENTIONAL
2
3
4
5
6

SUMMARY OF CULVERT FLOWS (cfs) FILE: 271-T3 DATE: 08-29-2006

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
22.47	0	0	0	0	0	0	0	0	1
23.38	3	3	0	0	0	0	0	0	1
23.57	5	5	0	0	0	0	0	0	1
23.71	9	9	0	0	0	0	0	0	1
24	12	12	0	0	0	0	0	0	1
24.29	15	15	0	0	0	0	0	0	1
24.61	18	18	0	0	0	0	0	0	1
24.99	21	21	0	0	0	0	0	0	1
25.58	24	24	0	0	0	0	0	0	1
26.2	27	27	0	0	0	0	0	0	1
26.77	30	30	0	0	0	0	0	0	1
27.25	32	32	0	0	0	0	0	OVERTOPP	ING

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: 271-T3 DATE: 08-29-2006

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
22.47	0.000	0.00	0.00	0.00
23.38	0.000	3.00	0.00	0.00
23.57	0.000	5.00	0.00	0.00
23.71	0.000	9.00	0.00	0.00
24.00	0.000	12.00	0.00	0.00
24.29	0.000	15.00	0.00	0.00
24.61	0.000	18.00	0.00	0.00

24.99	0.000	21.00	0.00	0.00
25.58	0.000	24.00	0.00	0.00
26.20	0.000	27.00	0.00	0.00
26.77	0.000	30.00	0.00	0.00

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

2

CURRENT DATE: 08-29-2006 FILE DATE: 08-29-2006
CURRENT TIME: 20:14:01 FILE NAME: 271-T3

PERFORMANCE CURVE FOR CULVERT 1 - 1(3.10 (ft) BY 1.80 (ft)) ICMP

DIS- CHARGE FLOW (cfs)	HEAD- WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	22.47	0.00	0.00	0-NF	0.00	0.00	0.00	-0.54	0.00	0.00
3.00	23.38	0.91	0.57	2-M2c	0.46	0.31	0.31	0.24	3.22	1.88
5.00	23.57	1.10	0.82	2-M2c	0.66	0.44	0.44	0.32	3.81	2.02
9.00	23.71	1.18	1.24	2-M2c	1.06	0.64	0.64	0.40	4.70	2.16
12.00	24.00	1.44	1.53	2-M2c	1.43	0.78	0.78	0.44	5.23	2.24
15.00	24.29	1.69	1.82	2-M2c	1.80	0.90	0.90	0.47	5.70	2.30
18.00	24.61	1.97	2.14	2-M2c	1.80	1.02	1.02	0.50	6.16	2.35
21.00	24.99	2.35	2.52	2-M2c	1.80	1.13	1.13	0.53	6.56	2.39
24.00	25.58	2.75	3.11	2-M2c	1.80	1.23	1.23	0.55	6.99	2.43
27.00	26.20	3.18	3.73	2-M2c	1.80	1.31	1.31	0.58	7.46	2.47
30.00	26.77	3.64	4.30	2-M2c	1.80	1.39	1.39	0.60	7.94	2.50

El. inlet face invert 22.47 ft El. outlet invert 22.20 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

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

INLET STATION 0.00 ft
INLET ELEVATION 22.47 ft
OUTLET STATION 58.00 ft
OUTLET ELEVATION 22.20 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0047
CULVERT LENGTH ALONG SLOPE 58.00 ft

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

BARREL SHAPE USER DEFINED
BARREL SPAN 3.10 ft
BARREL RISE 1.80 ft
BARREL MATERIAL STEEL OR ALUMINUM
BARREL MANNING'S n 0.024 FOR SIDES AND TOP
0.038 FOR BOTTOM

INLET TYPE CONVENTIONAL
INLET EDGE AND WALL MITERED
INLET DEPRESSION NONE

3

CURRENT DATE: 08-29-2006 FILE DATE: 08-29-2006
CURRENT TIME: 20:14:01 FILE NAME: 271-T3

***** USER DEFINED CULVERT CROSS-SECTION - CULVERT # 1

COORDINATE NUMBER	X (ft)	Y-TOP (ft)	Y-BOTTOM (ft)
1	73.30	22.77	22.77
2	73.40	23.07	22.47
3	73.70	23.70	22.47
4	74.00	23.98	22.47
5	74.30	24.15	22.47
6	74.60	24.24	22.47
7	74.80	24.27	22.47
8	75.10	24.24	22.47
9	75.40	24.15	22.47
10	75.70	23.98	22.47
11	76.00	23.70	22.47
12	76.30	23.07	22.47
13	76.40	22.77	22.77

4

CURRENT DATE: 08-29-2006 FILE DATE: 08-29-2006
CURRENT TIME: 20:14:01 FILE NAME: 271-T3

TAILWATER

***** USER DEFINED CHANNEL CROSS-SECTION FILE NAME: 271-T3
MAIN CHANNEL AND LT & RT OVER BANKS FILE DATE: 08-29-2006
LEFT CHANNEL BOUNDARY 2
RIGHT CHANNEL BOUNDARY 5
MANNING n LEFT OVER BANK 0.050
MANNING n MAIN CHANNEL 0.038
MANNING n RIGHT OVER BANK 0.050
SLOPE OF CHANNEL 0.0053 ft/ft

CROSS-SECTION X Y
COORD. NO. (ft) (ft)

1	0.00	23.00
2	100.00	22.36
3	100.50	21.66
4	102.50	21.66
5	103.00	22.36
6	203.00	23.00

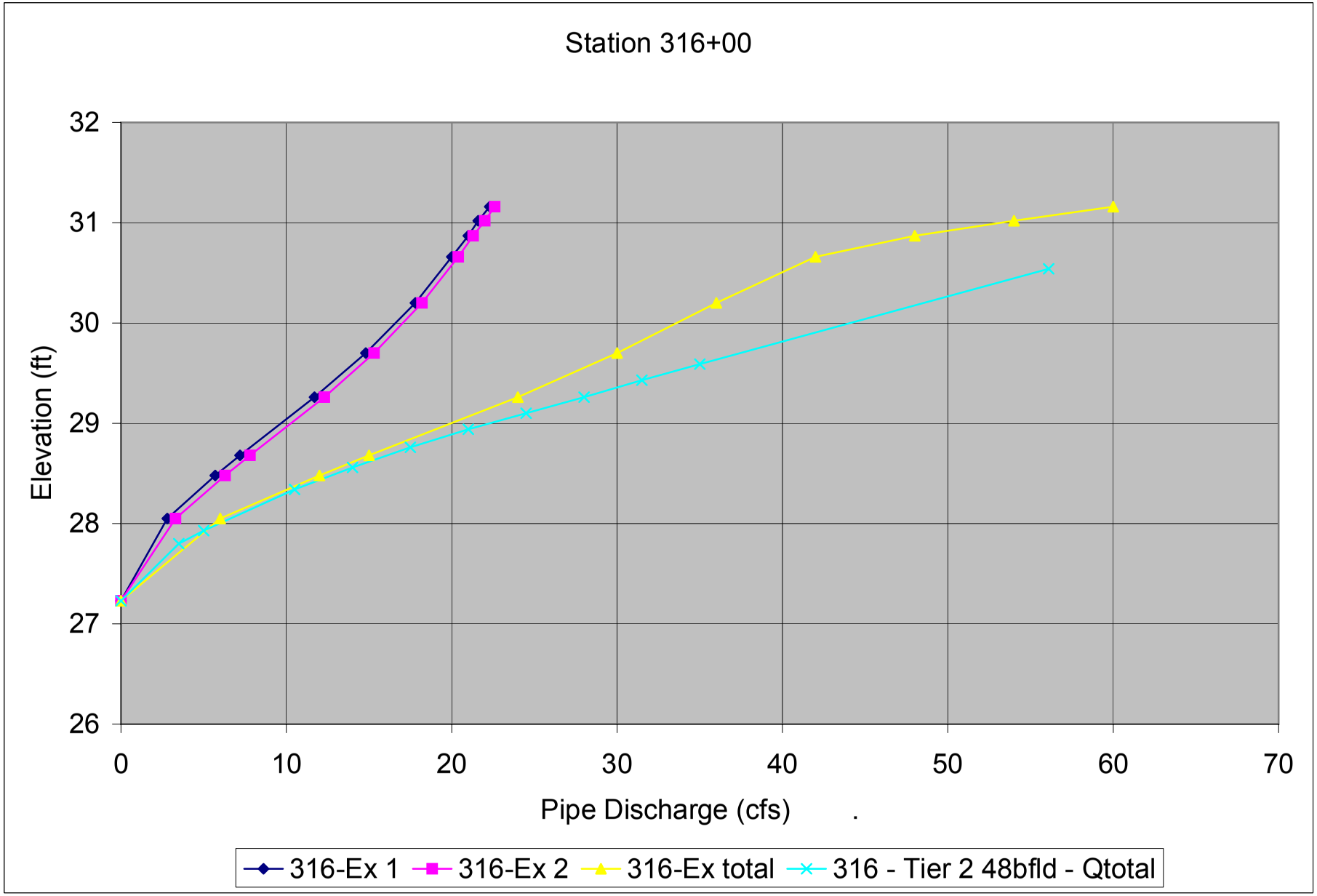
******* UNIFORM FLOW RATING CURVE FOR DOWNSTREAM CHANNEL

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	21.66	0.000	-0.54	0.00	0.00
3.00	22.44	0.406	0.24	1.88	0.18
5.00	22.52	0.413	0.32	2.02	0.20
9.00	22.60	0.421	0.40	2.16	0.22
12.00	22.64	0.424	0.44	2.24	0.23
15.00	22.67	0.427	0.47	2.30	0.24
18.00	22.70	0.429	0.50	2.35	0.25
21.00	22.73	0.431	0.53	2.39	0.25
24.00	22.75	0.433	0.55	2.43	0.26
27.00	22.78	0.435	0.58	2.47	0.27
30.00	22.80	0.436	0.60	2.50	0.27

Note: Shear stress was calculated using R.

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE PAVED
EMBANKMENT TOP WIDTH 24.00 ft
CREST LENGTH 10.00 ft
OVERTOPPING CREST ELEVATION 27.25 ft


Station 316+00
Elevation (ft)
32
31
30
29
28
27
26
0
10
20
30
40
50
60
70
Pipe Discharge (cfs)
316-Ex 1
316-Ex 2
316-Ex total
316 - Tier 2 48bfld - Qtotal

1 Station 316+00 Existing conditions

CURRENT DATE: 08-17-2006 FILE DATE: 08-17-2006
CURRENT TIME: 13:41:30 FILE NAME: 316-EX

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

C U L V NO.	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	27.23	25.55	49.03	1 CSP	2.00	2.00	.024	CONVENTIONAL
2	27.15	25.52	50.03	1 CSP	2.00	2.00	.024	CONVENTIONAL
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: 316-EX DATE: 08-17-2006

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWA	ITR
27.23	0	0	0	0	0	0	0	0	0
28.05	6	2.8	3.3	0	0	0	0	0	4
28.48	12	5.7	6.3	0	0	0	0	0	3
28.68	15	7.2	7.8	0	0	0	0	0	2
29.26	24	11.7	12.3	0	0	0	0	0	3
29.7	30	14.8	15.3	0	0	0	0	0	3
30.2	36	17.8	18.2	0	0	0	0	0	3
30.66	42	20	20.4	0	0	0	0	1.2	5
30.87	48	21	21.3	0	0	0	0	5.55	4
31.02	54	21.6	22	0	0	0	0	10.05	3
31.16	60	22.3	22.6	0	0	0	0	14.9	3
30.54	39.3	19.5	19.9	0	0	0	0	OVERTOF	ING

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: 316-EX DATE: 08-17-2006

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
27.23	0.000	0.00	0.00	0.00
28.05	-0.005	6.00	0.00	0.00
28.48	0.001	12.00	-0.01	-0.08
28.68	0.003	15.00	-0.05	-0.33
29.26	0.002	24.00	-0.03	-0.13
29.70	0.004	30.00	-0.05	-0.17
30.20	-0.006	36.00	0.09	0.25
30.66	-0.010	42.00	0.35	0.83
30.87	-0.004	48.00	0.19	0.40
31.02	-0.006	54.00	0.33	0.61
31.16	-0.005	60.00	0.26	0.43

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

2

CURRENT DATE: 08-17-2006 FILE DATE: 08-17-2006
CURRENT TIME: 13:41:30 FILE NAME: 316-EX

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.00 (ft) BY 2.00 (ft)) CSP

DIS-CHARGE	HEAD-WATER	INLET	OUTLET

DISCHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	27.15	0.00	0.00	0-NF	0.00	0.00	0.00	0.05	0.00	0.00
3.25	28.06	0.91	0.91	1-S2n	0.51	0.63	0.43	0.37	6.70	1.75
6.28	28.48	1.33	1.33	1-S2n	0.72	0.88	0.72	0.51	6.13	2.19
7.83	28.68	1.53	1.53	1-S2n	0.82	0.99	0.69	0.57	8.04	2.37
12.30	29.25	2.10	2.10	5-S2n	1.06	1.26	0.96	0.72	8.28	2.78
15.27	29.70	2.55	2.55	5-S2n	1.22	1.41	1.11	0.81	8.56	3.00
18.16	30.20	3.05	3.05	5-S2n	1.38	1.53	1.37	0.90	7.93	3.19
20.41	30.66	3.51	3.51	5-S2n	1.52	1.62	1.42	0.98	8.57	3.36
21.30	30.86	3.71	3.71	5-S2n	1.58	1.64	1.44	1.05	8.76	3.51
21.98	31.01	3.86	3.86	5-S2n	1.63	1.66	1.56	1.12	8.36	3.65
22.58	31.16	4.01	3.59	2-M2c	1.69	1.68	1.68	1.18	8.04	3.77

El. inlet face invert 27.15 ft El. outlet invert 25.52 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **************
INLET STATION 0.00 ft
INLET ELEVATION 27.15 ft
OUTLET STATION 50.00 ft
OUTLET ELEVATION 25.52 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0326
CULVERT LENGTH ALONG SLOPE 50.03 ft

***** CULVERT DATA SUMMARY ************************
BARREL SHAPE CIRCULAR
BARREL DIAMETER 2.00 ft
BARREL MATERIAL CORRUGATED STEEL
BARREL MANNING'S n 0.024
INLET TYPE CONVENTIONAL
INLET EDGE AND WALL THIN EDGE PROJECTING
INLET DEPRESSION NONE

4

CURRENT DATE: 08-17-2006 FILE DATE: 08-17-2006
CURRENT TIME: 13:41:30 FILE NAME: 316-EX

TAILWATER

***** USER DEFINED CHANNEL CROSS-SECTION FILE NAME: 316-TW
MAIN CHANNEL AND LT & RT OVER BANKS FILE DATE: 08-17-2006
LEFT CHANNEL BOUNDARY 2
RIGHT CHANNEL BOUNDARY 5
MANNING n LEFT OVER BANK 0.050
MANNING n MAIN CHANNEL 0.038

MANNING n RIGHT OVER BANK 0.050
SLOPE OF CHANNEL 0.0100 ft/ft

CROSS-SECTION COORD. NO.	X (ft)	Y (ft)
1	0.00	29.32
2	17.50	28.65
3	23.50	25.57
4	35.50	25.57
5	40.50	28.02
6	58.50	29.30

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

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	25.57	0.000	0.02	0.00	0.00
6.00	25.89	0.560	0.34	1.75	0.19
12.00	26.03	0.592	0.48	2.19	0.26
15.00	26.09	0.603	0.54	2.37	0.29
24.00	26.24	0.626	0.69	2.78	0.37
30.00	26.33	0.637	0.78	3.00	0.42
36.00	26.42	0.646	0.87	3.19	0.46
42.00	26.50	0.654	0.95	3.36	0.50
48.00	26.57	0.661	1.02	3.51	0.53
54.00	26.64	0.667	1.09	3.65	0.56
60.00	26.70	0.672	1.15	3.77	0.59

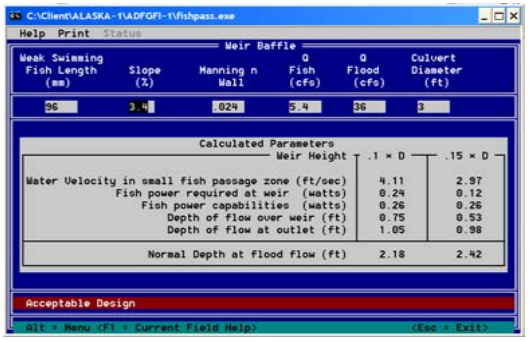
Note: Shear stress was calculated using R.

ROADWAY OVERTOPPING DATA

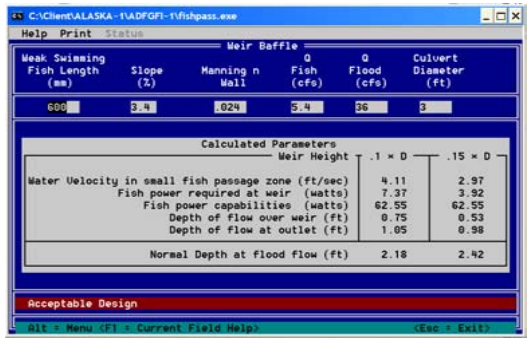
ROADWAY SURFACE PAVED
EMBANKMENT TOP WIDTH 24.00 ft
CREST LENGTH 10.00 ft
OVERTOPPING CREST ELEVATION 30.54 ft

316+00 Tier 2 FISH PASS design

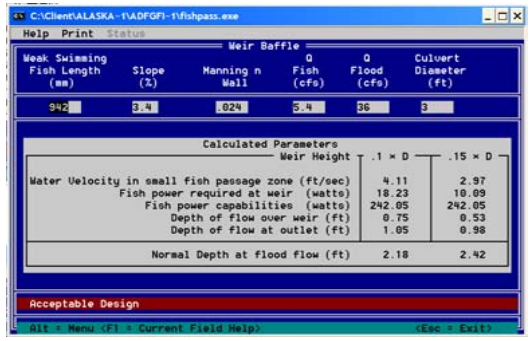
Baffle design: Juvenile Fish



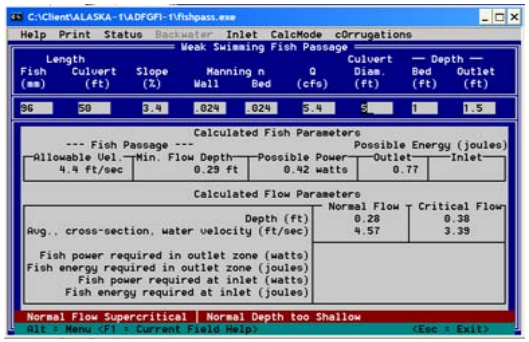
Adult fish - 600-mm

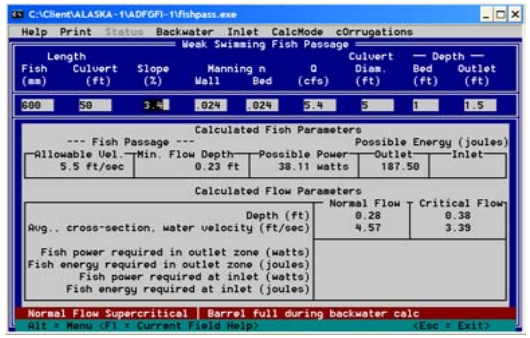


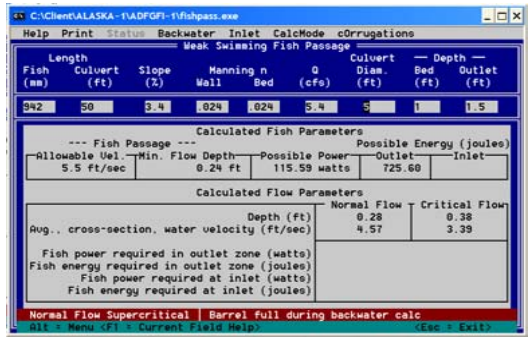
Adult fish - adjusted to 'equivalent' grayling



non-baffle design big pipe:







1 **Station 316+00 Tier 2 fish passage - 4-ft baffled CMP**

CURRENT DATE: 09-07-2006 FILE DATE: 09-07-2006
CURRENT TIME: 16:17:10 FILE NAME: 316T2-4B

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

C	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
U								
L	INLET	OUTLET	CULVERT	BARRELS				
V	ELEV.	ELEV.	LENGTH	SHAPE	SPAN	RISE	MANNING	INLET
NO.	(ft)	(ft)	(ft)	MATERIAL	(ft)	(ft)	n	TYPE
1	27.23	25.55	50.03	1 ICMP	4.00	3.40	.024	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: 316T2-4B DATE: 09-07-2006

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWA`	ITR
27.23	0	0	0	0	0	0	0	0	1
27.8	3.5	3.5	0	0	0	0	0	0	1
27.93	5	5	0	0	0	0	0	0	1
28.34	10.5	10.5	0	0	0	0	0	0	1
28.56	14	14	0	0	0	0	0	0	1
28.76	17.5	17.5	0	0	0	0	0	0	1
28.94	21	21	0	0	0	0	0	0	1
29.1	24.5	24.5	0	0	0	0	0	0	1
29.26	28	28	0	0	0	0	0	0	1
29.43	31.5	31.5	0	0	0	0	0	0	1
29.59	35	35	0	0	0	0	0	0	1
30.54	56.1	56.1	0	0	0	0	0	OVERTOF	ING

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: 316T2-4B DATE: 09-07-2006

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
27.23	0.000	0.00	0.00	0.00
27.80	0.000	3.50	0.00	0.00
27.93	0.000	5.00	0.00	0.00
28.34	0.000	10.50	0.00	0.00
28.56	0.000	14.00	0.00	0.00
28.76	0.000	17.50	0.00	0.00
28.94	0.000	21.00	0.00	0.00
29.10	0.000	24.50	0.00	0.00
29.26	0.000	28.00	0.00	0.00
29.43	0.000	31.50	0.00	0.00
29.59	0.000	35.00	0.00	0.00

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

2

CURRENT DATE: 09-07-2006 FILE DATE: 09-07-2006
CURRENT TIME: 16:17:10 FILE NAME: 316T2-4B

PERFORMANCE CURVE FOR CULVERT 1 - 1(4.00 (ft) BY 3.40 (ft)) ICMP

DIS-CHARGE (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	27.23	0.00	0.00	0-NF	0.00	0.00	0.00	0.02	0.00	0.00
3.50	27.80	0.57	0.57	1-S2n	0.23	0.35	0.15	0.26	4.89	1.50
5.00	27.93	0.70	0.70	1-S2n	0.32	0.42	0.22	0.31	5.35	1.67
10.50	28.34	1.11	1.11	1-S2n	0.50	0.69	0.39	0.44	8.37	2.13
14.00	28.56	1.33	1.33	1-S2n	0.60	0.82	0.52	0.51	8.18	2.35
17.50	28.76	1.53	1.53	1-S2n	0.70	0.95	0.65	0.58	8.07	2.53
21.00	28.94	1.71	1.71	1-S2n	0.78	1.07	0.67	0.64	9.40	2.69
24.50	29.10	1.87	1.87	1-S2n	0.86	1.17	0.77	0.69	9.32	2.84
28.00	29.26	2.03	2.03	1-S2n	0.94	1.28	0.88	0.75	9.25	2.97
31.50	29.43	2.20	2.20	1-S2n	1.02	1.38	1.03	0.80	8.81	3.09
35.00	29.59	2.36	2.36	1-S2n	1.09	1.47	1.10	0.85	9.05	3.20

El. inlet face invert 27.23 ft El. outlet invert 25.55 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********
INLET STATION 0.00 ft
INLET ELEVATION 27.23 ft
OUTLET STATION 50.00 ft
OUTLET ELEVATION 25.55 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0336
CULVERT LENGTH ALONG SLOPE 50.03 ft

***** CULVERT DATA SUMMARY **********
BARREL SHAPE USER DEFINED
BARREL SPAN 4.00 ft
BARREL RISE 3.40 ft
BARREL MATERIAL STEEL OR ALUMINUM
BARREL MANNING'S n 0.024 FOR SIDES AND TOP
0.038 FOR BOTTOM
INLET TYPE CONVENTIONAL
INLET EDGE AND WALL MITERED
INLET DEPRESSION NONE

3

CURRENT DATE: 09-07-2006 FILE DATE: 09-07-2006
CURRENT TIME: 16:17:10 FILE NAME: 316T2-4B

***** USER DEFINED CULVERT CROSS-SECTION - CULVERT # 1

COORDIN NUMBER	X (ft)	Y-TOP (ft)	Y-BOTTOM (ft)
1	0	28.63	28.63
2	0.19	29.48	27.78
3	0.38	29.8	27.46
4	0.57	30.03	27.23
5	0.93	30.32	27.23
6	1.29	30.5	27.23
7	1.64	30.6	27.23
8	2	30.63	27.23
9	2.36	30.6	27.23
10	2.71	30.5	27.23
11	3.07	30.32	27.23
12	3.43	30.03	27.23
13	3.62	29.8	27.46
14	3.81	29.48	27.78
15	4	28.63	28.63

4

CURRENT DATE: 09-07-2006 FILE DATE: 09-07-2006
CURRENT TIME: 16:17:10 FILE NAME: 316T2-4B

TAILWATER

***** USER DEFINED CHANNEL CROSS-SECTION FILE NAME: 316T2-4
MAIN CHANNEL AND LT & RT OVER BANKS FILE DATE: 09-07-2006
LEFT CHANNEL BOUNDARY 2
RIGHT CHANNEL BOUNDARY 5
MANNING n LEFT OVER BANK 0.050
MANNING n MAIN CHANNEL 0.038
MANNING n RIGHT OVER BANK 0.050
SLOPE OF CHANNEL 0.0104 ft/ft

CROSS-SECTION COORD. NO.	X (ft)	Y (ft)
1	0.00	29.32
2	17.50	28.65
3	23.50	25.57
4	35.50	25.57
5	40.50	28.02
6	58.50	29.30

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

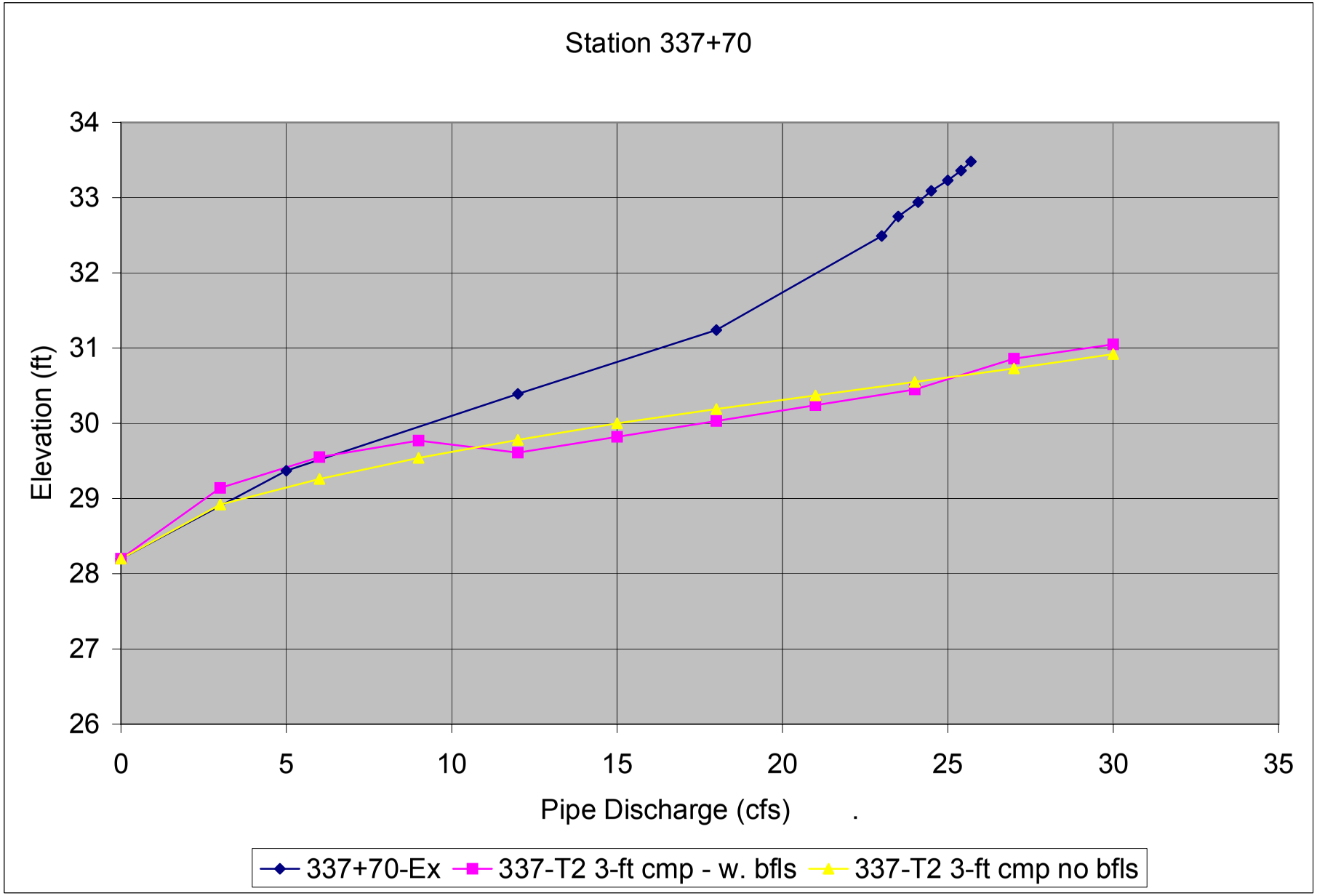
FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	25.57	0.000	0.02	0.00	0.00
3.50	25.81	0.548	0.26	1.50	0.15

5.00	25.86	0.562	0.31	1.67	0.18
10.50	25.99	0.596	0.44	2.13	0.25
14.00	26.06	0.610	0.51	2.35	0.29
17.50	26.13	0.622	0.58	2.53	0.33
21.00	26.19	0.631	0.64	2.69	0.36
24.50	26.24	0.638	0.69	2.84	0.39
28.00	26.30	0.645	0.75	2.97	0.42
31.50	26.35	0.651	0.80	3.09	0.44
35.00	26.40	0.657	0.85	3.20	0.47

Note: Shear stress was calculated using R.

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	24.00 ft
CREST LENGTH	10.00 ft
OVERTOPPING CREST ELEVATION	30.54 ft


Station 337+70
Elevation (ft)
34
33
32
31
30
29
28
27
26
0
5
10
15
20
25
30
35
Pipe Discharge (cfs)
337+70-Ex
337-T2 3-ft cmp - w. bfls
337-T2 3-ft cmp no bfls

1 **Station 337+70 Existing conditions**

CURRENT DATE: 08-17-2006 FILE DATE: 08-17-2006
CURRENT TIME: 13:50:32 FILE NAME: 33770

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

C SITE DATA CULVERT SHAPE, MATERIAL, INLET
U
L INLET OUTLET CULVERT BARRELS
V ELEV. ELEV. LENGTH SHAPE SPAN RISE MANNING INLET
NO. (ft) (ft) (ft) MATERIAL (ft) (ft) n TYPE
1 28.20 27.33 52.01 1 CSP 2.00 2.00 .024 CONVENTIONAL

33.09	-0.005	42.00	0.26	0.62
33.23	-0.004	48.00	0.23	0.48
33.36	-0.003	54.00	0.19	0.35
33.48	-0.003	60.00	0.16	0.27

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

2

CURRENT DATE: 08-17-2006 FILE DATE: 08-17-2006
CURRENT TIME: 13:50:32 FILE NAME: 33770

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.00 (ft) BY 2.00 (ft)) CSP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)
0	28.2	0	0	0-NF	0	0	0	-0.05	0
5	29.37	1.17	1.17	1-S2n	0.77	0.79	0.69	0.23	5.23
12	30.39	2.08	2.19	2-M2c	1.3	1.24	1.24	0.36	5.85
18	31.24	3.04	2.88	2-M2c	2	1.52	1.52	0.46	7.03
22.96	32.49	4.12	4.29	2-M2c	2	1.69	1.69	0.54	8.13
23.47	32.75	4.25	4.55	2-M2c	2	1.71	1.71	0.61	8.25
24.06	32.93	4.4	4.73	2-M2c	2	1.72	1.72	0.68	8.38
24.54	33.08	4.53	4.88	2-M2c	2	1.74	1.74	0.74	8.49
24.98	33.23	4.65	5.03	2-M2c	2	1.75	1.75	0.8	8.59
25.37	33.35	4.76	5.15	2-M2c	2	1.76	1.76	0.85	8.67
25.74	33.47	4.87	5.27	2-M2c	2	1.77	1.77	0.91	8.75

El. inlet face invert 28.20 ft El. outlet invert 27.33 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

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

INLET STATION 0.00 ft
INLET ELEVATION 28.20 ft
OUTLET STATION 52.00 ft
OUTLET ELEVATION 27.33 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0167
CULVERT LENGTH ALONG SLOPE 52.01 ft

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

BARREL SHAPE CIRCULAR
BARREL DIAMETER 2.00 ft
BARREL MATERIAL CORRUGATED STEEL
BARREL MANNING'S n 0.024
INLET TYPE CONVENTIONAL
INLET EDGE AND WALL THIN EDGE PROJECTING

INLET DEPRESSION NONE

3

CURRENT DATE: 08-17-2006 FILE DATE: 08-17-2006
CURRENT TIME: 13:50:32 FILE NAME: 33770

TAILWATER

***** USER DEFINED CHANNEL CROSS-SECTION FILE NAME: 33770-TW

MAIN CHANNEL ONLY FILE DATE: 08-17-2006
LEFT CHANNEL BOUNDARY 0
RIGHT CHANNEL BOUNDARY 0
MANNING n LEFT OVER BANK 0.000
MANNING n MAIN CHANNEL 0.040
MANNING n RIGHT OVER BANK 0.000
SLOPE OF CHANNEL 0.0290 ft/ft

CROSS-SECTION COORD. NO.	X (ft)	Y (ft)
1	0.00	31.19
2	7.00	27.36
3	17.20	27.28
4	30.20	31.04

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

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	27.28	0.000	-0.05	0.00	0.00
5.00	27.56	0.865	0.23	2.32	0.40
12.00	27.69	0.926	0.36	3.08	0.62
18.00	27.79	0.957	0.46	3.54	0.76
24.00	27.87	0.979	0.54	3.88	0.87
30.00	27.94	0.996	0.61	4.18	0.97
36.00	28.01	1.011	0.68	4.44	1.07
42.00	28.07	1.023	0.74	4.67	1.15
48.00	28.13	1.033	0.80	4.88	1.22
54.00	28.18	1.043	0.85	5.06	1.29
60.00	28.24	1.051	0.91	5.24	1.36

Note: Shear stress was calculated using R.

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE PAVED
EMBANKMENT TOP WIDTH 24.00 ft

CREST LENGTH 10.00 ft
OVERTOPPING CREST ELEVATION 32.40 ft

□□□

337+70 Tier 2 FISH PASS design

non-baffle design: Juvenile Coho

C:\Client\ALASKA~1\ADFGFI~1\fishpass.exe

Help Print Status Backwater Inlet CalcMode cOrrugations

Weak Swimming Fish Passage

Fish Length (mm)	Culvert (ft)	Slope (%)	Manning n Wall	Manning n Bed	Q (cfs)	Culvert Diam. (ft)	Depth Bed (ft)	Depth Outlet (ft)
96	52	1.7	.024	.024	2.7	3	1	1.5

Calculated Fish Parameters

--- Fish Passage ---

Allowable Vel.	Min. Flow Depth	Possible Power	Possible Energy (joules) Outlet	Possible Energy (joules) Inlet
4.5 ft/sec	0.21 ft	0.42 watts	0.77	0.77

Calculated Flow Parameters

	Normal Flow	Critical Flow
Depth (ft)	0.29	0.30
Avg., cross-section, water velocity (ft/sec)	3.18	3.08
Fish power required in outlet zone (watts)		
Fish energy required in outlet zone (joules)		
Fish power required at inlet (watts)	0.04	
Fish energy required at inlet (joules)	0.08	

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

adult coho - 600mm

C:\Client\ALASKA~1\ADFGFI~1\fishpass.exe

Help Print Status Backwater Inlet CalcMode cOrrugations

Weak Swimming Fish Passage

Fish Length (mm)	Culvert (ft)	Slope (%)	Manning n Wall	Manning n Bed	Q (cfs)	Culvert Diam. (ft)	Depth Bed (ft)	Depth Outlet (ft)
600	52	1.7	.024	.024	2.7	3	1	1.5

Calculated Fish Parameters

--- Fish Passage ---

Allowable Vel.	Min. Flow Depth	Possible Power	Possible Energy (joules) Outlet	Possible Energy (joules) Inlet
6.1 ft/sec	0.15 ft	38.11 watts	187.50	187.50

Calculated Flow Parameters

	Normal Flow	Critical Flow
Depth (ft)	0.29	0.30
Avg., cross-section, water velocity (ft/sec)	3.18	3.08
Fish power required in outlet zone (watts)		
Fish energy required in outlet zone (joules)		
Fish power required at inlet (watts)	1.46	
Fish energy required at inlet (joules)	2.92	

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

Adult coho - adjusted to 'equivalent' grayling

C:\Client\ALASKA~1\ADFGFI~1\fishpass.exe

Help Print Status Backwater Inlet CalcMode cOrrugations

Weak Swimming Fish Passage

Fish Length (mm)	Culvert (ft)	Slope (%)	Manning n Wall	Manning n Bed	Q (cfs)	Culvert Diam. (ft)	Depth Bed (ft)	Depth Outlet (ft)
942	52	1.7	.024	.024	2.7	3	1	1.5

Calculated Fish Parameters

--- Fish Passage ---

Allowable Vel.	Min. Flow Depth	Possible Power	Possible Energy (joules) Outlet	Possible Energy (joules) Inlet
6.3 ft/sec	0.15 ft	115.59 watts	725.60	725.60

Calculated Flow Parameters

	Normal Flow	Critical Flow
Depth (ft)	0.29	0.30
Avg., cross-section, water velocity (ft/sec)	3.18	3.08
Fish power required in outlet zone (watts)		
Fish energy required in outlet zone (joules)		
Fish power required at inlet (watts)	4.01	
Fish energy required at inlet (joules)	8.01	

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

1 **Station 337+70 Tier 2 fish passage - 3-ft CMP**

CURRENT DATE: 09-07-2006 FILE DATE: 09-07-2006
CURRENT TIME: 16:53:01 FILE NAME: 337T2-3

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

C	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
U								
L	INLET	OUTLET	CULVERT	BARRELS				
V	ELEV.	ELEV.	LENGTH	SHAPE	SPAN	RISE	MANNING	INLET
NO.	(ft)	(ft)	(ft)	MATERIAL	(ft)	(ft)	n	TYPE
1	28.20	27.33	52.01	1 CSP	3.00	3.00	.024	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: 337T2-3 DATE: 09-07-2006

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWA`	ITR
28.2	0	0	0	0	0	0	0	0	1
28.92	3	3	0	0	0	0	0	0	1
29.26	6	6	0	0	0	0	0	0	1
29.54	9	9	0	0	0	0	0	0	1
29.78	12	12	0	0	0	0	0	0	1
30	15	15	0	0	0	0	0	0	1
30.19	18	18	0	0	0	0	0	0	1
30.37	21	21	0	0	0	0	0	0	1
30.55	24	24	0	0	0	0	0	0	1
30.73	27	27	0	0	0	0	0	0	1
30.92	30	30	0	0	0	0	0	0	1
32.4	48.5	48.5	0	0	0	0	0	OVERTOF	ING

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: 337T2-3 DATE: 09-07-2006

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
28.20	0.000	0.00	0.00	0.00
28.92	0.000	3.00	0.00	0.00
29.26	0.000	6.00	0.00	0.00
29.54	0.000	9.00	0.00	0.00
29.78	0.000	12.00	0.00	0.00
30.00	0.000	15.00	0.00	0.00
30.19	0.000	18.00	0.00	0.00

30.37	0.000	21.00	0.00	0.00
30.55	0.000	24.00	0.00	0.00
30.73	0.000	27.00	0.00	0.00
30.92	0.000	30.00	0.00	0.00

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

2

CURRENT DATE: 09-07-2006 FILE DATE: 09-07-2006
CURRENT TIME: 16:53:01 FILE NAME: 337T2-3

PERFORMANCE CURVE FOR CULVERT 1 - 1(3.00 (ft) BY 3.00 (ft)) CSP

DIS- CHARGE FLOW (cfs)	HEAD- WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	28.20	0.00	0.00	0-NF	0.00	0.00	0.00	-0.05	0.00	0.00
3.00	28.92	0.72	0.72	1-S2n	0.49	0.52	0.42	0.17	4.75	2.07
6.00	29.26	1.06	1.06	1-S2n	0.71	0.76	0.66	0.24	5.22	2.55
9.00	29.54	1.34	1.34	1-S2n	0.89	0.94	0.88	0.30	5.18	2.91
12.00	29.78	1.58	1.58	1-S2n	1.03	1.09	1.03	0.35	5.56	3.20
15.00	30.00	1.80	1.80	1-S2n	1.17	1.23	1.03	0.40	6.95	3.45
18.00	30.19	1.99	1.99	1-S2n	1.29	1.35	1.15	0.44	7.20	3.66
21.00	30.37	2.17	2.17	1-S2n	1.41	1.47	1.27	0.48	7.37	3.86
24.00	30.55	2.35	2.35	1-S2n	1.52	1.57	1.47	0.52	6.94	4.04
27.00	30.73	2.53	2.53	1-S2n	1.63	1.67	1.57	0.56	7.20	4.20
30.00	30.92	2.72	2.72	1-S2n	1.75	1.77	1.67	0.59	7.41	4.35

El. inlet face invert 28.20 ft El. outlet invert 27.33 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

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

INLET STATION 0.00 ft
INLET ELEVATION 28.20 ft
OUTLET STATION 52.00 ft
OUTLET ELEVATION 27.33 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0167
CULVERT LENGTH ALONG SLOPE 52.01 ft

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

BARREL SHAPE CIRCULAR
BARREL DIAMETER 3.00 ft
BARREL MATERIAL CORRUGATED STEEL
BARREL MANNING'S n 0.024
INLET TYPE CONVENTIONAL
INLET EDGE AND WALL MITERED TO CONFORM TO SLOPE

INLET DEPRESSION NONE

3

CURRENT DATE: 09-07-2006 FILE DATE: 09-07-2006
CURRENT TIME: 16:53:01 FILE NAME: 337T2-3

TAILWATER

***** USER DEFINED CHANNEL CROSS-SECTION FILE NAME: 337T2-3
MAIN CHANNEL ONLY FILE DATE: 09-07-2006
LEFT CHANNEL BOUNDARY 0
RIGHT CHANNEL BOUNDARY 0
MANNING n LEFT OVER BANK 0.000
MANNING n MAIN CHANNEL 0.038
MANNING n RIGHT OVER BANK 0.000
SLOPE OF CHANNEL 0.0294 ft/ft

CROSS-SECTION COORD. NO.	X (ft)	Y (ft)
1	0.00	31.19
2	7.00	27.36
3	17.20	27.28
4	30.20	31.04

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

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	27.28	0.000	-0.05	0.00	0.00
3.00	27.50	0.878	0.17	2.07	0.31
6.00	27.57	0.924	0.24	2.55	0.43
9.00	27.63	0.954	0.30	2.91	0.52
12.00	27.68	0.977	0.35	3.20	0.61
15.00	27.73	0.994	0.40	3.45	0.68
18.00	27.77	1.009	0.44	3.66	0.74
21.00	27.81	1.022	0.48	3.86	0.80
24.00	27.85	1.033	0.52	4.04	0.86
27.00	27.89	1.043	0.56	4.20	0.91
30.00	27.92	1.051	0.59	4.35	0.96

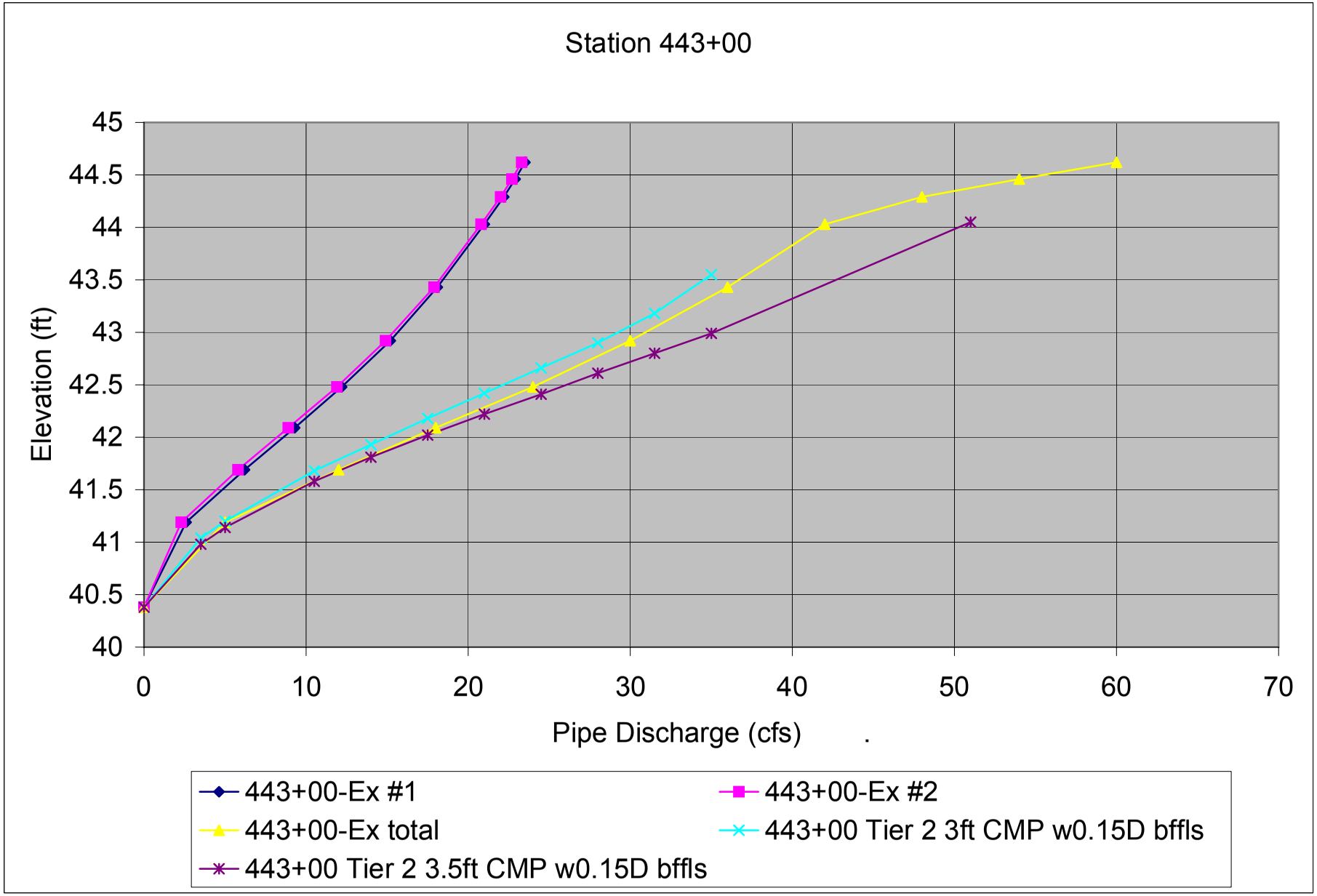
Note: Shear stress was calculated using R.

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE PAVED
EMBANKMENT TOP WIDTH 24.00 ft

CREST LENGTH 10.00 ft
OVERTOPPING CREST ELEVATION 32.40 ft

□□□


Station 443+00
Elevation (ft)
45
44.5
44
43.5
43
42.5
42
41.5
41
40.5
40
0
10
20
30
40
50
60
70
Pipe Discharge (cfs)
443+00-Ex #1
443+00-Ex #2
443+00-Ex total
443+00 Tier 2 3ft CMP w0.15D bffls
443+00 Tier 2 3.5ft CMP w0.15D bffls

1 **Station 443+00 Existing conditions**

CURRENT DATE: 08-17-2006 FILE DATE: 08-17-2006
CURRENT TIME: 14:33:05 FILE NAME: 44300-EX

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

C	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
U								
L	INLET	OUTLET	CULVERT	BARRELS				
V	ELEV.	ELEV.	LENGTH	SHAPE	SPAN	RISE	MANNING	INLET
NO.	(ft)	(ft)	(ft)	MATERIAL	(ft)	(ft)	n	TYPE
1	40.38	38.75	55.17	1 CSP	2.00	2.00	.024	CONVENTIONAL
2	40.43	38.67	55.03	1 CSP	2.00	2.00	.024	CONVENTIONAL
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: 44300-EX DATE: 08-17-2006

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
40.38	0	0	0	0	0	0	0	0	0
41.19	5	2.6	2.3	0	0	0	0	0	4
41.69	12	6.2	5.8	0	0	0	0	0	3
42.09	18	9.3	8.9	0	0	0	0	0	2
42.48	24	12.2	11.9	0	0	0	0	0	3
42.92	30	15.2	14.9	0	0	0	0	0	3
43.43	36	18.1	17.9	0	0	0	0	0	3
44.03	42	21	20.8	0	0	0	0	0	7
44.29	48	22.2	22	0	0	0	0	3.57	4
44.46	54	22.9	22.7	0	0	0	0	8.03	3
44.62	60	23.5	23.3	0	0	0	0	12.92	3
44.05	42	21.1	20.9	0	0	0	0	OVERTOPP	ING

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: 44300-EX DATE: 08-17-2006

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
40.38	0.000	0.00	0.00	0.00
41.19	-0.006	5.00	0.01	0.20
41.69	0.000	12.00	0.00	0.00
42.09	0.008	18.00	-0.13	-0.72
42.48	0.005	24.00	-0.08	-0.33
42.92	0.003	30.00	-0.05	-0.17
43.43	0.002	36.00	-0.03	-0.08
44.03	-0.007	42.00	0.19	0.45
44.29	-0.007	48.00	0.30	0.63
44.46	-0.009	54.00	0.43	0.80
44.62	-0.006	60.00	0.32	0.53

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

2

CURRENT DATE: 08-17-2006 FILE DATE: 08-17-2006
CURRENT TIME: 14:33:05 FILE NAME: 44300-EX

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.00 (ft) BY 2.00 (ft)) CSP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0	40.38	0	0	0-NF	0	0	0	-0.6	0	0
2.64	41.2	0.82	0.82	1-S2n	0.47	0.56	0.36	-0.28	6.74	2.24
6.18	41.7	1.32	1.32	1-S2n	0.74	0.88	0.68	-0.14	6.61	2.95
9.25	42.09	1.71	1.71	1-S2n	0.92	1.08	0.92	-0.04	6.53	3.37
12.2	42.47	2.09	2.09	5-S2n	1.09	1.25	1.08	0.04	7.04	3.7
15.17	42.91	2.53	2.53	5-S2n	1.26	1.4	1.2	0.12	7.68	3.97
18.14	43.43	3.05	3.05	5-S2n	1.43	1.53	1.33	0.19	8.2	4.21
21.01	44.02	3.64	3.35	2-M2c	1.64	1.63	1.63	0.25	7.63	4.42
22.16	44.29	3.91	3.45	2-M2c	1.76	1.67	1.67	0.31	7.94	4.61
22.87	44.46	4.08	2.43	2-M2c	2	1.69	1.69	0.36	8.11	4.78
23.47	44.62	4.24	3.48	2-M2c	2	1.71	1.71	0.42	8.25	4.94

El. inlet face invert 40.38 ft El. outlet invert 38.75 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

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

INLET STATION 0.00 ft
INLET ELEVATION 40.38 ft
OUTLET STATION 55.15 ft
OUTLET ELEVATION 38.75 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0296
CULVERT LENGTH ALONG SLOPE 55.17 ft

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

BARREL SHAPE CIRCULAR
BARREL DIAMETER 2.00 ft
BARREL MATERIAL CORRUGATED STEEL
BARREL MANNING'S n 0.024
INLET TYPE CONVENTIONAL
INLET EDGE AND WALL THIN EDGE PROJECTING
INLET DEPRESSION NONE

3

CURRENT DATE: 08-17-2006 FILE DATE: 08-17-2006
CURRENT TIME: 14:33:05 FILE NAME: 44300-EX

PERFORMANCE CURVE FOR CULVERT 2 - 1(2.00 (ft) BY 2.00 (ft)) CSP

DIS- HEAD- INLET OUTLET
CHARGE WATER CONTROL CONTROL FLOW NORMAL CRIT. OUTLET TW OUTLET TW
FLOW ELEV. DEPTH DEPTH TYPE DEPTH DEPTH DEPTH DEPTH VEL. VEL.

(cfs)	(ft)	(ft)	(ft)	<F4>	(ft)	(ft)	(ft)	(ft)	(fps)	(fps)
0.00	40.43	0.00	0.00	0-NF	0.00	0.00	0.00	-0.52	0.00	0.00
2.35	41.20	0.77	0.77	1-S2n	0.44	0.53	0.33	-0.20	6.90	2.24
5.82	41.70	1.27	1.27	1-S2n	0.70	0.85	0.65	-0.06	6.64	2.95
8.88	42.09	1.66	1.66	1-S2n	0.88	1.06	0.76	0.04	8.10	3.37
11.88	42.48	2.05	2.05	5-S2n	1.05	1.24	0.94	0.12	8.24	3.70
14.87	42.91	2.48	2.48	5-S2n	1.21	1.39	1.09	0.20	8.51	3.97
17.89	43.43	3.00	3.00	5-S2n	1.37	1.52	1.32	0.27	8.16	4.21
20.80	44.02	3.59	3.59	5-S2n	1.56	1.63	1.43	0.33	8.66	4.42
21.96	44.29	3.86	3.86	5-S2n	1.65	1.66	1.56	0.39	8.35	4.61
22.67	44.46	4.03	3.60	2-M2c	1.72	1.68	1.68	0.44	8.06	4.78
23.29	44.62	4.19	3.60	2-M2c	1.79	1.70	1.70	0.50	8.20	4.94

El. inlet face invert 40.43 ft El. outlet invert 38.67 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********
INLET STATION 0.00 ft
INLET ELEVATION 40.43 ft
OUTLET STATION 55.00 ft
OUTLET ELEVATION 38.67 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0320
CULVERT LENGTH ALONG SLOPE 55.03 ft

***** CULVERT DATA SUMMARY **********
BARREL SHAPE CIRCULAR
BARREL DIAMETER 2.00 ft
BARREL MATERIAL CORRUGATED STEEL
BARREL MANNING'S n 0.024
INLET TYPE CONVENTIONAL
INLET EDGE AND WALL THIN EDGE PROJECTING
INLET DEPRESSION NONE

4

CURRENT DATE: 08-17-2006 FILE DATE: 08-17-2006
CURRENT TIME: 14:33:05 FILE NAME: 44300-EX

TAILWATER

***** USER DEFINED CHANNEL CROSS-SECTION FILE NAME: 44300-TW
MAIN CHANNEL ONLY FILE DATE: 08-17-2006
LEFT CHANNEL BOUNDARY 0
RIGHT CHANNEL BOUNDARY 0
MANNING n LEFT OVER BANK 0.000
MANNING n MAIN CHANNEL 0.040
MANNING n RIGHT OVER BANK 0.000
SLOPE OF CHANNEL 0.0260 ft/ft

CROSS-SECTION X Y
COORD. NO. (ft) (ft)
1 0.00 41.52

2	7.00	38.15
3	17.20	38.30
4	30.20	41.20

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

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	38.15	0.000	-0.60	0.00	0.00
5.00	38.47	0.822	-0.28	2.24	0.37
12.00	38.61	0.880	-0.14	2.95	0.56
18.00	38.71	0.909	-0.04	3.37	0.69
24.00	38.79	0.929	0.04	3.70	0.79
30.00	38.87	0.945	0.12	3.97	0.88
36.00	38.94	0.959	0.19	4.21	0.96
42.00	39.00	0.970	0.25	4.42	1.03
48.00	39.06	0.979	0.31	4.61	1.09
54.00	39.11	0.988	0.36	4.78	1.16
60.00	39.17	0.996	0.42	4.94	1.21

Note: Shear stress was calculated using R.

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	24.00 ft
CREST LENGTH	10.00 ft
OVERTOPPING CREST ELEVATION	44.05 ft

443+00 Tier 2 FISH PASS design

baffle design: 3-ft pipe / Juvenile Coho

C:\Client\ALASKA~1\ADFGFI~1\fishpass.exe

Help Print Status

Weir Baffle

Weak Swimming Fish Length (mm)	Slope (%)	Manning n Wall	Q Fish (cfs)	Q Flood (cfs)	Culvert Diameter (ft)
96	3	.024	5.3	35	3

Calculated Parameters

	Weir Height .1 × D	.15 × D
Water Velocity in small fish passage zone (ft/sec)	3.83	2.84
Fish power required at weir (watts)	0.20	0.11
Fish power capabilities (watts)	0.26	0.26
Depth of flow over weir (ft)	0.76	0.54
Depth of flow at outlet (ft)	1.06	0.99
Normal Depth at flood flow (ft)	2.22	2.45

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

4-ft pipe / Juvenile Coho

C:\Client\ALASKA~1\ADFGFI~1\fishpass.exe

Help Print Status

Weir Baffle

Weak Swimming Fish Length (mm)	Slope (%)	Manning n Wall	Q Fish (cfs)	Q Flood (cfs)	Culvert Diameter (ft)
96	3	.024	5.3	35	4

Calculated Parameters

	Weir Height .1 × D	.15 × D
Water Velocity in small fish passage zone (ft/sec)	3.79	2.44
Fish power required at weir (watts)	0.20	0.08
Fish power capabilities (watts)	0.26	0.26
Depth of flow over weir (ft)	0.78	0.54
Depth of flow at outlet (ft)	1.18	1.14
Normal Depth at flood flow (ft)	2.14	2.39

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

non-baffle design:

C:\Client\ALASKA~1\ADFGFI~1\fishpass.exe

Help Print Status Backwater Inlet CalcMode cOrrugations

Weak Swimming Fish Passage

Length Fish (mm)	Culvert (ft)	Slope (%)	Manning n Wall	Manning n Bed	Q (cfs)	Culvert Diam. (ft)	Depth Bed (ft)	Depth Outlet (ft)
96	55	3	.024	0	5.3	3	0	.8

Calculated Fish Parameters

--- Fish Passage --- Allowable Vel.	Min. Flow Depth	Possible Power	Possible Energy (joules) Outlet	Inlet
4.4 ft/sec	0.68 ft	0.42 watts	0.77	

Calculated Flow Parameters

	Normal Flow	Critical Flow
Depth (ft)	0.59	0.72
Avg., cross-section, water velocity (ft/sec)	5.39	4.05
Fish power required in outlet zone (watts)		
Fish energy required in outlet zone (joules)		
Fish power required at inlet (watts)		
Fish energy required at inlet (joules)		

Normal Flow Supercritical | Normal Depth too Shallow

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

C:\Client\ALASKA~1\ADFGFI~1\fishpass.exe

Help Print Status Backwater Inlet CalcMode cOrrugations

Weak Swimming Fish Passage

Length Fish (mm)	Culvert (ft)	Slope (%)	Manning n Wall	Manning n Bed	Q (cfs)	Culvert Diam. (ft)	Depth Bed (ft)	Depth Outlet (ft)
96	55	3	.024	0	5.3	4	0	.8

Calculated Fish Parameters

--- Fish Passage --- Allowable Vel.	Min. Flow Depth	Possible Power	Possible Energy (joules) Outlet	Inlet
4.4 ft/sec	0.61 ft	0.42 watts	0.77	

Calculated Flow Parameters

	Normal Flow	Critical Flow
Depth (ft)	0.54	0.67
Avg., cross-section, water velocity (ft/sec)	5.20	3.85
Fish power required in outlet zone (watts)		
Fish energy required in outlet zone (joules)		
Fish power required at inlet (watts)		
Fish energy required at inlet (joules)		

Normal Flow Supercritical | Normal Depth too Shallow

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

443+00 Tier 2 FISH PASS design

3-ft pipe / Adult Coho

C:\Client\ALASKA~1\ADFGFI~1\fishpass.exe

Help Print Status

Weir Baffle

Weak Swimming Fish Length (mm)	Slope (%)	Manning n Wall	Q Fish (cfs)	Q Flood (cfs)	Culvert Diameter (ft)
600	3	.024	5.3	35	3

Calculated Parameters

	Weir Height .1 × D	.15 × D
Water Velocity in small fish passage zone (ft/sec)	3.83	2.84
Fish power required at weir (watts)	6.26	3.52
Fish power capabilities (watts)	62.55	62.55
Depth of flow over weir (ft)	0.76	0.54
Depth of flow at outlet (ft)	1.06	0.99
Normal Depth at flood flow (ft)	2.22	2.45

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

4-ft pipe / Adult Coho

C:\Client\ALASKA~1\ADFGFI~1\fishpass.exe

Help Print Status

Weir Baffle

Weak Swimming Fish Length (mm)	Slope (%)	Manning n Wall	Q Fish (cfs)	Q Flood (cfs)	Culvert Diameter (ft)
600	3	.024	5.3	35	4

Calculated Parameters

	Weir Height .1 × D	.15 × D
Water Velocity in small fish passage zone (ft/sec)	3.79	2.44
Fish power required at weir (watts)	6.15	2.70
Fish power capabilities (watts)	62.55	62.55
Depth of flow over weir (ft)	0.78	0.54
Depth of flow at outlet (ft)	1.18	1.14
Normal Depth at flood flow (ft)	2.14	2.39

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

C:\Client\ALASKA~1\ADFGFI~1\fishpass.exe

Help Print Status Backwater Inlet CalcMode cOrrugations

Weak Swimming Fish Passage

Length Fish (mm)	Culvert (ft)	Slope (%)	Manning n Wall	Manning n Bed	Q (cfs)	Culvert Diam. (ft)	Depth Bed (ft)	Depth Outlet (ft)
600	55	3	.024	0	5.3	3	0	.8

Calculated Fish Parameters

--- Fish Passage --- Allowable Vel.	Min. Flow Depth	Possible Power	Possible Energy (joules) Outlet	Possible Energy (joules) Inlet
5.6 ft/sec	0.58 ft	38.11 watts	187.50	

Calculated Flow Parameters

	Normal Flow	Critical Flow
Depth (ft)	0.59	0.72
Avg., cross-section, water velocity (ft/sec)	5.39	4.05
Fish power required in outlet zone (watts)		
Fish energy required in outlet zone (joules)		
Fish power required at inlet (watts)		
Fish energy required at inlet (joules)		

Normal Flow Supercritical | Supercritical flow in culvert

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

C:\Client\ALASKA~1\ADFGFI~1\fishpass.exe

Help Print Status Backwater Inlet CalcMode cOrrugations

Weak Swimming Fish Passage

Length Fish (mm)	Culvert (ft)	Slope (%)	Manning n Wall	Manning n Bed	Q (cfs)	Culvert Diam. (ft)	Depth Bed (ft)	Depth Outlet (ft)
600	55	3	.024	0	5.3	4	0	.8

Calculated Fish Parameters

--- Fish Passage --- Allowable Vel.	Min. Flow Depth	Possible Power	Possible Energy (joules) Outlet	Possible Energy (joules) Inlet
5.6 ft/sec	0.52 ft	38.11 watts	187.50	

Calculated Flow Parameters

	Normal Flow	Critical Flow
Depth (ft)	0.54	0.67
Avg., cross-section, water velocity (ft/sec)	5.20	3.85
Fish power required in outlet zone (watts)		
Fish energy required in outlet zone (joules)		
Fish power required at inlet (watts)		
Fish energy required at inlet (joules)		

Normal Flow Supercritical | Supercritical flow in culvert

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

1 **Station 443+00 Tier 2 fish passage - 3.5-ft baffled CMP**

CURRENT DATE: 09-05-2006 FILE DATE: 09-05-2006
CURRENT TIME: 17:16:59 FILE NAME: 443T42

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

C	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
U								
L	INLET	OUTLET	CULVERT	BARRELS				
V	ELEV.	ELEV.	LENGTH	SHAPE	SPAN	RISE	MANNING	INLET
NO.	(ft)	(ft)	(ft)	MATERIAL	(ft)	(ft)	n	TYPE
1	40.38	38.75	55.02	1 ICMP	3.50	2.98	.024	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: 443T42 DATE: 09-05-2006

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
40.38	0	0	0	0	0	0	0	0	1
40.98	3.5	3.5	0	0	0	0	0	0	1
41.14	5	5	0	0	0	0	0	0	1
41.58	10.5	10.5	0	0	0	0	0	0	1
41.81	14	14	0	0	0	0	0	0	1
42.02	17.5	17.5	0	0	0	0	0	0	1
42.22	21	21	0	0	0	0	0	0	1
42.41	24.5	24.5	0	0	0	0	0	0	1
42.61	28	28	0	0	0	0	0	0	1
42.8	31.5	31.5	0	0	0	0	0	0	1
42.99	35	35	0	0	0	0	0	0	1
44.05	51	51	0	0	0	0	0	OVERTOPP	ING

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: 443T42 DATE: 09-05-2006

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
40.38	0.000	0.00	0.00	0.00
40.98	0.000	3.50	0.00	0.00
41.14	0.000	5.00	0.00	0.00
41.58	0.000	10.50	0.00	0.00
41.81	0.000	14.00	0.00	0.00
42.02	0.000	17.50	0.00	0.00
42.22	0.000	21.00	0.00	0.00
42.41	0.000	24.50	0.00	0.00
42.61	0.000	28.00	0.00	0.00
42.80	0.000	31.50	0.00	0.00
42.99	0.000	35.00	0.00	0.00

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

2

CURRENT DATE: 09-05-2006 FILE DATE: 09-05-2006
CURRENT TIME: 17:16:59 FILE NAME: 443T42

PERFORMANCE CURVE FOR CULVERT 1 - 1(3.50 (ft) BY 2.98 (ft)) ICMP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	40.38	0.00	0.00	0-NF	0.00	0.00	0.00	-0.60	0.00	0.00
3.50	40.98	0.60	0.60	1-S2n	0.30	0.36	0.16	-0.32	5.38	2.08
5.00	41.14	0.76	0.76	1-S2n	0.36	0.46	0.26	-0.29	6.24	2.31
10.50	41.58	1.20	1.20	1-S2n	0.58	0.74	0.58	-0.17	6.16	2.92
14.00	41.81	1.43	1.43	1-S2n	0.69	0.90	0.60	-0.12	8.02	3.21
17.50	42.02	1.64	1.64	1-S2n	0.80	1.03	0.73	-0.06	8.06	3.45
21.00	42.22	1.84	1.84	1-S2n	0.90	1.16	0.90	-0.01	7.70	3.66
24.50	42.41	2.03	2.03	1-S2n	0.99	1.27	1.00	0.03	7.95	3.85
28.00	42.61	2.23	2.23	1-S2n	1.08	1.37	0.97	0.08	9.40	4.03
31.50	42.80	2.42	2.42	1-S2n	1.17	1.47	1.07	0.12	9.46	4.18
35.00	42.99	2.61	2.61	1-S2n	1.26	1.57	1.17	0.15	9.59	4.32

El. inlet face invert 40.38 ft El. outlet invert 38.75 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********
INLET STATION 0.00 ft
INLET ELEVATION 40.38 ft
OUTLET STATION 55.00 ft
OUTLET ELEVATION 38.75 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0296
CULVERT LENGTH ALONG SLOPE 55.02 ft

***** CULVERT DATA SUMMARY **********
BARREL SHAPE USER DEFINED
BARREL SPAN 3.50 ft
BARREL RISE 2.98 ft
BARREL MATERIAL STEEL OR ALUMINUM
BARREL MANNING'S n 0.024 FOR SIDES AND TOP
0.038 FOR BOTTOM
INLET TYPE CONVENTIONAL
INLET EDGE AND WALL MITERED
INLET DEPRESSION NONE

3

CURRENT DATE: 09-05-2006 FILE DATE: 09-05-2006
CURRENT TIME: 17:16:59 FILE NAME: 443T42

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***** USER DEFINED CULVERT CROSS-SECTION - CULVERT # 1

COORDIN NUMBER	X (ft)	Y-TOP (ft)	Y-BOTTOM (ft)
1	0	41.61	41.61
2	0.17	42.35	40.86
3	0.33	42.63	40.58
4	0.5	42.83	40.38
5	0.81	43.08	40.38
6	1.13	43.24	40.38
7	1.44	43.33	40.38
8	1.75	43.36	40.38
9	2.06	43.33	40.38
10	2.37	43.24	40.38
11	2.69	43.08	40.38
12	3	42.83	40.38
13	3.17	42.63	40.58
14	3.33	42.35	40.86
15	3.5	41.61	41.61

□□
□

4

CURRENT DATE: 09-05-2006 FILE DATE: 09-05-2006
CURRENT TIME: 17:16:59 FILE NAME: 443T42

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□□

***** USER DEFINED CHANNEL CROSS-SECTION FILE NAME: 443T42BF
MAIN CHANNEL ONLY FILE DATE: 09-05-2006
LEFT CHANNEL BOUNDARY 0
RIGHT CHANNEL BOUNDARY 0
MANNING n LEFT OVER BANK 0.000
MANNING n MAIN CHANNEL 0.038
MANNING n RIGHT OVER BANK 0.000
SLOPE OF CHANNEL 0.0260 ft/ft

CROSS-SECTION COORD. NO.	X (ft)	Y (ft)
1	0.00	41.52
2	7.00	38.15
3	17.20	38.30
4	30.20	41.20

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

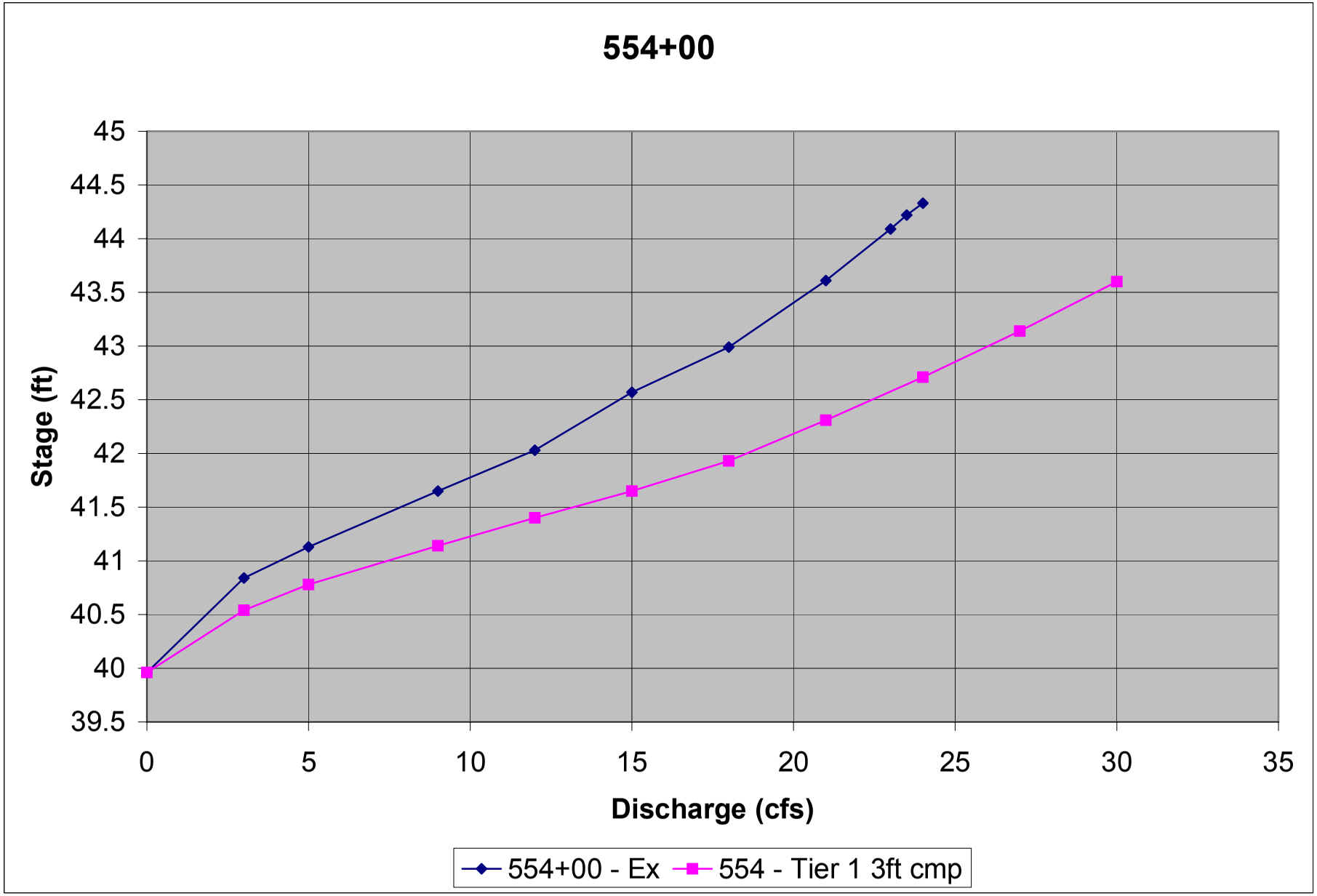
FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	38.15	0.000	-0.60	0.00	0.00
3.50	38.43	0.839	-0.32	2.08	0.31
5.00	38.46	0.862	-0.29	2.31	0.36
10.50	38.58	0.912	-0.17	2.92	0.51

14.00	38.63	0.933	-0.12	3.21	0.59
17.50	38.69	0.950	-0.06	3.45	0.66
21.00	38.74	0.964	-0.01	3.66	0.72
24.50	38.78	0.975	0.03	3.85	0.77
28.00	38.83	0.986	0.08	4.03	0.83
31.50	38.87	0.995	0.12	4.18	0.87
35.00	38.90	1.003	0.15	4.32	0.92

Note: Shear stress was calculated using R.

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	24.00 ft
CREST LENGTH	10.00 ft
OVERTOPPING CREST ELEVATION	44.05 ft


554+00
Stage (ft)
45
44.5
44
43.5
43
42.5
42
41.5
41
40.5
40
39.5
0
5
10
15
20
25
30
35
Discharge (cfs)
554+00 - Ex
554 - Tier 1 3ft cmp

1 Station 554+00 Existing conditions

CURRENT DATE: 08-25-2006 FILE DATE: 08-25-2006
CURRENT TIME: 16:36:43 FILE NAME: 55400EX

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

C SITE DATA CULVERT SHAPE, MATERIAL, INLET
U
L INLET OUTLET CULVERT BARRELS
V ELEV. ELEV. LENGTH SHAPE SPAN RISE MANNING INLET
NO. (ft) (ft) (ft) MATERIAL (ft) (ft) n TYPE
1 39.96 38.91 49.01 1 CSP 2.00 2.00 .024 CONVENTIONAL
2
3
4
5
6

SUMMARY OF CULVERT FLOWS (cfs) FILE: 55400EX DATE: 08-25-2006

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWA	ITR
39.96	0	0	0	0	0	0	0	0	1
40.84	3	3	0	0	0	0	0	0	1
41.13	5	5	0	0	0	0	0	0	1
41.65	9	9	0	0	0	0	0	0	1
42.03	12	12	0	0	0	0	0	0	1
42.57	15	15	0	0	0	0	0	0	1
42.99	18	18	0	0	0	0	0	0	1
43.61	21	21	0	0	0	0	0	0	1
44.09	24	23	0	0	0	0	0	0.88	8
44.22	27	23.5	0	0	0	0	0	3.29	4
44.33	30	24	0	0	0	0	0	5.95	4
43.99	22.6	22.6	0	0	0	0	0	OVERTOF	ING

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: 55400EX DATE: 08-25-2006

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
39.96	0.000	0.00	0.00	0.00
40.84	0.000	3.00	0.00	0.00
41.13	0.000	5.00	0.00	0.00
41.65	0.000	9.00	0.00	0.00
42.03	0.000	12.00	0.00	0.00
42.57	0.000	15.00	0.00	0.00
42.99	0.000	18.00	0.00	0.00
43.61	0.000	21.00	0.00	0.00
44.09	-0.010	24.00	0.12	0.50
44.22	-0.005	27.00	0.21	0.78
44.33	-0.008	30.00	0.10	0.33

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

2

CURRENT DATE: 08-25-2006 FILE DATE: 08-25-2006
CURRENT TIME: 16:36:43 FILE NAME: 55400EX

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.00 (ft) BY 2.00 (ft)) CSP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	39.96	0.00	0.00	0-NF	0.00	0.00	0.00	0.59	0.00	0.00
3.00	40.84	0.88	0.88	1-S2n	0.55	0.60	0.40	1.04	6.63	1.63
5.00	41.13	1.17	1.17	1-S2n	0.72	0.79	0.59	1.10	6.51	1.76
9.00	41.65	1.69	1.69	1-S2n	1.00	1.07	0.87	1.17	6.89	1.94
12.00	42.03	2.07	2.07	5-S2n	1.20	1.24	1.14	1.22	6.48	2.04
15.00	42.57	2.51	2.61	2-M2c	1.40	1.40	1.40	1.26	6.41	2.13
18.00	42.99	3.03	2.90	2-M2c	1.66	1.52	1.52	1.29	7.03	2.21
21.00	43.61	3.65	3.06	2-M2c	2.00	1.63	1.63	1.32	7.63	2.27
23.01	44.09	4.13	3.92	2-M2c	2.00	1.69	1.69	1.35	8.14	2.33
23.50	44.21	4.25	4.23	2-M2c	2.00	1.71	1.71	1.37	8.25	2.39
23.95	44.33	4.37	4.36	2-M2c	2.00	1.72	1.72	1.40	8.36	2.44

El. inlet face invert 39.96 ft El. outlet invert 38.91 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

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

INLET STATION 0.00 ft
INLET ELEVATION 39.96 ft
OUTLET STATION 49.00 ft
OUTLET ELEVATION 38.91 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0214
CULVERT LENGTH ALONG SLOPE 49.01 ft

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

BARREL SHAPE CIRCULAR
BARREL DIAMETER 2.00 ft
BARREL MATERIAL CORRUGATED STEEL
BARREL MANNING'S n 0.024
INLET TYPE CONVENTIONAL
INLET EDGE AND WALL THIN EDGE PROJECTING
INLET DEPRESSION NONE

3

CURRENT DATE: 08-25-2006 FILE DATE: 08-25-2006
CURRENT TIME: 16:36:43 FILE NAME: 55400EX

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1 **Station 554+00 Tier 1 fish passage - 3-ft CMP**

CURRENT DATE: 08-29-2006 FILE DATE: 08-29-2006
CURRENT TIME: 20:53:14 FILE NAME: 554-T3

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

C U L V NO.	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	39.96	38.91	49.01	1 ICMP	3.10	1.80	.024	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: 554-T3 DATE: 08-29-2006

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWA	ITR
39.96	0	0	0	0	0	0	0	0	1
40.54	3	3	0	0	0	0	0	0	1
40.78	5	5	0	0	0	0	0	0	1
41.14	9	9	0	0	0	0	0	0	1
41.4	12	12	0	0	0	0	0	0	1
41.65	15	15	0	0	0	0	0	0	1
41.93	18	18	0	0	0	0	0	0	1
42.31	21	21	0	0	0	0	0	0	1
42.71	24	24	0	0	0	0	0	0	1
43.14	27	27	0	0	0	0	0	0	1
43.6	30	30	0	0	0	0	0	0	1
43.99	32.3	32.3	0	0	0	0	0	OVERTOF	ING

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: 554-T3 DATE: 08-29-2006

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
39.96	0.000	0.00	0.00	0.00
40.54	0.000	3.00	0.00	0.00
40.78	0.000	5.00	0.00	0.00
41.14	0.000	9.00	0.00	0.00
41.40	0.000	12.00	0.00	0.00
41.65	0.000	15.00	0.00	0.00
41.93	0.000	18.00	0.00	0.00
42.31	0.000	21.00	0.00	0.00
42.71	0.000	24.00	0.00	0.00
43.14	0.000	27.00	0.00	0.00
43.60	0.000	30.00	0.00	0.00

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

2

CURRENT DATE: 08-29-2006 FILE DATE: 08-29-2006
CURRENT TIME: 20:53:14 FILE NAME: 554-T3

PERFORMANCE CURVE FOR CULVERT 1 - 1(3.10 (ft) BY 1.80 (ft)) ICMP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	39.96	0.00	0.00	0-NF	0.00	0.00	0.00	0.59	0.00	0.00
3.00	40.54	0.58	0.58	1-S2n	0.28	0.31	0.21	1.05	5.79	1.51
5.00	40.78	0.82	0.82	1-S2n	0.39	0.44	0.34	1.10	4.95	1.63
9.00	41.14	1.18	1.18	1-S2n	0.58	0.64	0.44	1.17	6.77	1.79
12.00	41.40	1.44	1.44	1-S2n	0.72	0.78	0.72	1.22	5.63	1.89
15.00	41.65	1.69	1.69	1-S2n	0.86	0.90	0.80	1.26	6.35	1.97
18.00	41.93	1.97	1.97	5-S2n	1.00	1.02	0.92	1.29	6.73	2.04
21.00	42.31	2.35	2.27	3-M1t	1.15	1.13	1.32	1.32	5.78	2.10
24.00	42.71	2.75	2.47	3-M1t	1.32	1.23	1.35	1.35	6.50	2.15
27.00	43.14	3.18	2.72	3-M2t	1.60	1.31	1.38	1.38	7.21	2.20
30.00	43.60	3.64	2.92	3-M2t	1.80	1.39	1.40	1.40	7.91	2.25

El. inlet face invert 39.96 ft El. outlet invert 38.91 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

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

INLET STATION 0.00 ft
INLET ELEVATION 39.96 ft
OUTLET STATION 49.00 ft
OUTLET ELEVATION 38.91 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0214
CULVERT LENGTH ALONG SLOPE 49.01 ft

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

BARREL SHAPE USER DEFINED
BARREL SPAN 3.10 ft
BARREL RISE 1.80 ft
BARREL MATERIAL STEEL OR ALUMINUM
BARREL MANNING'S n 0.024 FOR SIDES AND TOP
0.038 FOR BOTTOM
INLET TYPE CONVENTIONAL
INLET EDGE AND WALL MITERED
INLET DEPRESSION NONE

3

CURRENT DATE: 08-29-2006 FILE DATE: 08-29-2006
CURRENT TIME: 20:53:14 FILE NAME: 554-T3

□□

***** USER DEFINED CULVERT CROSS-SECTION - CULVERT # 1

COORDIN NUMBER	X (ft)	Y-TOP (ft)	Y-BOTTOM (ft)
1	73.3	40.26	40.26
2	73.4	40.56	39.96
3	73.7	41.19	39.96
4	74	41.47	39.96
5	74.3	41.64	39.96
6	74.6	41.73	39.96
7	74.8	41.76	39.96
8	75.1	41.73	39.96
9	75.4	41.64	39.96
10	75.7	41.47	39.96
11	76	41.19	39.96
12	76.3	40.56	39.96
13	76.4	40.26	40.26

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□

4

CURRENT DATE: 08-29-2006 FILE DATE: 08-29-2006
CURRENT TIME: 20:53:14 FILE NAME: 554-T3

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***** USER DEFINED CHANNEL CROSS-SECTION FILE NAME: 554-T3
MAIN CHANNEL AND LT & RT OVER BANKS FILE DATE: 08-29-2006
LEFT CHANNEL BOUNDARY 2
RIGHT CHANNEL BOUNDARY 5
MANNING n LEFT OVER BANK 0.050
MANNING n MAIN CHANNEL 0.038
MANNING n RIGHT OVER BANK 0.050
SLOPE OF CHANNEL 0.0050 ft/ft

CROSS-SECTION COORD. NO.	X (ft)	Y (ft)
1	0.00	41.00
2	100.00	39.70
3	100.25	39.50
4	101.75	39.50
5	102.00	39.70
6	203.00	41.00

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

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	39.50	0.000	0.59	0.00	0.00
3.00	39.96	0.405	1.05	1.51	0.13
5.00	40.01	0.413	1.10	1.63	0.14
9.00	40.08	0.423	1.17	1.79	0.16

12.00	40.13	0.428	1.22	1.89	0.18
15.00	40.17	0.433	1.26	1.97	0.19
18.00	40.20	0.436	1.29	2.04	0.20
21.00	40.23	0.440	1.32	2.10	0.21
24.00	40.26	0.443	1.35	2.15	0.21
27.00	40.29	0.445	1.38	2.20	0.22
30.00	40.31	0.447	1.40	2.25	0.23

Note: Shear stress was calculated using R.

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	24.00 ft
CREST LENGTH	10.00 ft
OVERTOPPING CREST ELEVATION	43.99 ft

1 Station 630+00 Existing conditions

CURRENT DATE: 08-25-2006 FILE DATE: 08-25-2006
CURRENT TIME: 16:39:00 FILE NAME: 63000

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

C SITE DATA CULVERT SHAPE, MATERIAL, INLET
U
L INLET OUTLET CULVERT BARRELS
V ELEV. ELEV. LENGTH SHAPE SPAN RISE MANNING INLET
NO. (ft) (ft) (ft) MATERIAL (ft) (ft) n TYPE
1 45.81 45.36 59.00 1 CSP 2.00 2.00 .024 CONVENTIONAL
2
3
4
5
6

SUMMARY OF CULVERT FLOWS (cfs) FILE: 63000 DATE: 08-25-2006

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
45.81	0	0	0	0	0	0	0	0	1
46.78	3	3	0	0	0	0	0	0	1
47.1	5	5	0	0	0	0	0	0	1
47.63	9	9	0	0	0	0	0	0	1
48.03	12	12	0	0	0	0	0	0	1
48.34	15	15	0	0	0	0	0	0	1
49.31	18	18	0	0	0	0	0	0	1
50.23	21	21	0	0	0	0	0	0	1
51.11	24	23.6	0	0	0	0	0	0.33	6
51.27	27	24	0	0	0	0	0	2.84	5
51.38	30	24.4	0	0	0	0	0	5.49	4
51.06	23.4	23.4	0	0	0	0	0	OVERTOPP	ING

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: 63000 DATE: 08-25-2006

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
45.81	0.000	0.00	0.00	0.00
46.78	0.000	3.00	0.00	0.00
47.10	0.000	5.00	0.00	0.00
47.63	0.000	9.00	0.00	0.00
48.03	0.000	12.00	0.00	0.00
48.34	0.000	15.00	0.00	0.00
49.31	0.000	18.00	0.00	0.00
50.23	0.000	21.00	0.00	0.00
51.11	-0.005	24.00	0.08	0.33
51.27	-0.008	27.00	0.12	0.44
51.38	-0.009	30.00	0.12	0.40

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

2

CURRENT DATE: 08-25-2006 FILE DATE: 08-25-2006
CURRENT TIME: 16:39:00 FILE NAME: 63000

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.00 (ft) BY 2.00 (ft)) CSP

DIS-CHARGE (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	45.81	0.00	0.00	0-NF	0.00	0.00	0.00	0.14	0.00	0.00
3.00	46.78	0.89	0.97	2-M2c	0.72	0.60	0.60	0.14	3.75	0.00
5.00	47.10	1.18	1.29	2-M2c	0.96	0.79	0.79	0.14	4.36	0.00
9.00	47.63	1.70	1.82	2-M2c	1.41	1.07	1.07	0.14	5.28	0.00
12.00	48.03	2.09	2.22	2-M2c	2.00	1.24	1.24	0.14	5.85	0.00
15.00	48.34	2.53	2.41	2-M2c	2.00	1.40	1.40	0.14	6.41	0.00
18.00	49.31	3.04	3.50	2-M2c	2.00	1.52	1.52	0.14	7.03	0.00
21.00	50.23	3.66	4.42	2-M2c	2.00	1.63	1.63	0.14	7.63	0.00
23.59	51.12	4.29	5.31	2-M2c	2.00	1.71	1.71	0.14	8.27	0.00
24.05	51.27	4.41	5.46	2-M2c	2.00	1.72	1.72	0.14	8.38	0.00
24.39	51.38	4.50	5.57	2-M2c	2.00	1.73	1.73	0.14	8.46	0.00

El. inlet face invert 45.81 ft El. outlet invert 45.36 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

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

INLET STATION 0.00 ft
INLET ELEVATION 45.81 ft
OUTLET STATION 59.00 ft
OUTLET ELEVATION 45.36 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0076
CULVERT LENGTH ALONG SLOPE 59.00 ft

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

BARREL SHAPE CIRCULAR
BARREL DIAMETER 2.00 ft
BARREL MATERIAL CORRUGATED STEEL
BARREL MANNING'S n 0.024
INLET TYPE CONVENTIONAL
INLET EDGE AND WALL THIN EDGE PROJECTING
INLET DEPRESSION NONE

3

CURRENT DATE: 08-25-2006 FILE DATE: 08-25-2006
CURRENT TIME: 16:39:00 FILE NAME: 63000

TAILWATER

CONSTANT WATER SURFACE ELEVATION
45.5

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	24.00 ft
CREST LENGTH	10.00 ft
OVERTOPPING CREST ELEVATION	51.06 ft

630+00 Tier 2 FISH PASS design

baffle design: 3-ft pipe / Juvenile Cutthroat
Juvenile Cutthroat trout assumed equal to Dolly Varden - equivalent length to input to Fish Pass is 85mm

C:\Client\ALASKA-1\ADFGFI-1\fishpass.exe

Help Print Status

Weir Baffle

Weak Swimming Fish Length (mm)	Slope (%)	Manning n Wall	Q Fish (cfs)	Q Flood (cfs)	Culvert Diameter (ft)
85	.8	.024	3	17	3

Calculated Parameters

	Weir Height .1 × D	.15 × D
Water Velocity in small fish passage zone (ft/sec)	2.05	1.52
Fish power required at weir (watts)	0.04	0.03
Fish power capabilities (watts)	0.18	0.18
Depth of flow over weir (ft)	0.78	0.56
Depth of flow at outlet (ft)	1.08	1.01
Normal Depth at flood flow (ft)	2.16	2.39

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

3-ft pipe / Adult Cutthroat
Adult Cutthroat trout assumed equal to Arctic Grayling - equivalent length to input to Fish Pass is 240 mm

C:\Client\ALASKA-1\ADFGFI-1\fishpass.exe

Help Print Status

Weir Baffle

Weak Swimming Fish Length (mm)	Slope (%)	Manning n Wall	Q Fish (cfs)	Q Flood (cfs)	Culvert Diameter (ft)
240	.8	.024	3	17	3

Calculated Parameters

	Weir Height .1 × D	.15 × D
Water Velocity in small fish passage zone (ft/sec)	2.05	1.52
Fish power required at weir (watts)	0.30	0.18
Fish power capabilities (watts)	4.00	4.00
Depth of flow over weir (ft)	0.78	0.56
Depth of flow at outlet (ft)	1.08	1.01
Normal Depth at flood flow (ft)	2.16	2.39

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

non-baffle design: 3-ft pipe / Juvenile Coho
Need to maintain 0.6-ft of TW

C:\Client\ALASKA-1\ADFGFI-1\fishpass.exe

Help Print Status Backwater Inlet CalcMode cOrrugations

Weak Swimming Fish Passage

Length Fish (mm)	Culvert (ft)	Slope (%)	Manning n Wall	Manning n Bed	Q (cfs)	Culvert Diam. (ft)	Depth Bed (ft)	Depth Outlet (ft)
85	59	.8	.024	0	3	3	0	.6

Calculated Fish Parameters

--- Fish Passage ---

Allowable Vel.	Min. Flow Depth	Possible Power	Possible Energy (joules) Outlet	Possible Energy (joules) Inlet
4.4 ft/sec	0.46 ft	0.31 watts	0.53	0.53

Calculated Flow Parameters

	Normal Flow	Critical Flow
Depth (ft)	0.62	0.54
Avg., cross-section, water velocity (ft/sec)	2.86	3.47
Fish power required in outlet zone (watts)		
Fish energy required in outlet zone (joules)		
Fish power required at inlet (watts)	0.12	
Fish energy required at inlet (joules)	0.23	

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

2-ft pipe / Juvenile Coho

C:\Client\ALASKA-1\ADFGFI-1\fishpass.exe

Help Print Status Backwater Inlet CalcMode cOrrugations

Weak Swimming Fish Passage

Length Fish (mm)	Culvert (ft)	Slope (%)	Manning n Wall	Manning n Bed	Q (cfs)	Culvert Diam. (ft)	Depth Bed (ft)	Depth Outlet (ft)
85	59	.8	.024	0	3	2	0	.61

Calculated Fish Parameters

--- Fish Passage ---

Allowable Vel.	Min. Flow Depth	Possible Power	Possible Energy (joules) Outlet	Possible Energy (joules) Inlet
4.4 ft/sec	0.54 ft	0.31 watts	0.53	0.53

Calculated Flow Parameters

	Normal Flow	Critical Flow
Depth (ft)	0.72	0.60
Avg., cross-section, water velocity (ft/sec)	2.97	3.75
Fish power required in outlet zone (watts)		
Fish energy required in outlet zone (joules)		
Fish power required at inlet (watts)	0.13	
Fish energy required at inlet (joules)	0.25	

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

2-ft pipe / Adult Cutthroat
Adult Cutthroat trout assumed equal to Arctic Grayling - equivalent length to input to Fish Pass is 240 mm

C:\Client\ALASKA-1\ADFGFI-1\fishpass.exe

Help Print Status Backwater Inlet CalcMode cOrrugations

Weak Swimming Fish Passage

Length Fish (mm)	Culvert (ft)	Slope (%)	Manning n Wall	Manning n Bed	Q (cfs)	Culvert Diam. (ft)	Depth Bed (ft)	Depth Outlet (ft)
240	59	.8	.024	0	3	2	0	.61

Calculated Fish Parameters

--- Fish Passage ---

Allowable Vel.	Min. Flow Depth	Possible Power	Possible Energy (joules) Outlet	Possible Energy (joules) Inlet
5.3 ft/sec	0.47 ft	4.00 watts	12.00	12.00

Calculated Flow Parameters

	Normal Flow	Critical Flow
Depth (ft)	0.72	0.60
Avg., cross-section, water velocity (ft/sec)	2.97	3.75
Fish power required in outlet zone (watts)		
Fish energy required in outlet zone (joules)		
Fish power required at inlet (watts)	0.98	
Fish energy required at inlet (joules)	1.97	

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

2-ft pipe / Adult Coho

C:\Client\ALASKA-1\ADFGFI-1\fishpass.exe

Help Print Status Backwater Inlet CalcMode cOrrugations

Weak Swimming Fish Passage

Length Fish (mm)	Culvert (ft)	Slope (%)	Manning n Wall	Manning n Bed	Q (cfs)	Culvert Diam. (ft)	Depth Bed (ft)	Depth Outlet (ft)
600	59	.8	.024	0	3	2	0	.61

Calculated Fish Parameters

--- Fish Passage ---

Allowable Vel.	Min. Flow Depth	Possible Power	Possible Energy (joules) Outlet	Possible Energy (joules) Inlet
6.3 ft/sec	0.42 ft	38.11 watts	187.50	187.50

Calculated Flow Parameters

	Normal Flow	Critical Flow
Depth (ft)	0.72	0.60
Avg., cross-section, water velocity (ft/sec)	2.97	3.75
Fish power required in outlet zone (watts)		
Fish energy required in outlet zone (joules)		
Fish power required at inlet (watts)	7.62	
Fish energy required at inlet (joules)	15.24	

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

Adult Coho
Note: L * 1.57 converts swimming ability to 'equivalent' grayling
Assume depth based on actual body size o600-mm fish shown to adjacen

C:\Client\ALASKA-1\ADFGFI-1\fishpass.exe

Help Print Status Backwater Inlet CalcMode cOrrugations

Weak Swimming Fish Passage

Length Fish (mm)	Culvert (ft)	Slope (%)	Manning n Wall	Manning n Bed	Q (cfs)	Culvert Diam. (ft)	Depth Bed (ft)	Depth Outlet (ft)
942	59	.8	.024	0	3	2	0	.61

Calculated Fish Parameters

--- Fish Passage ---

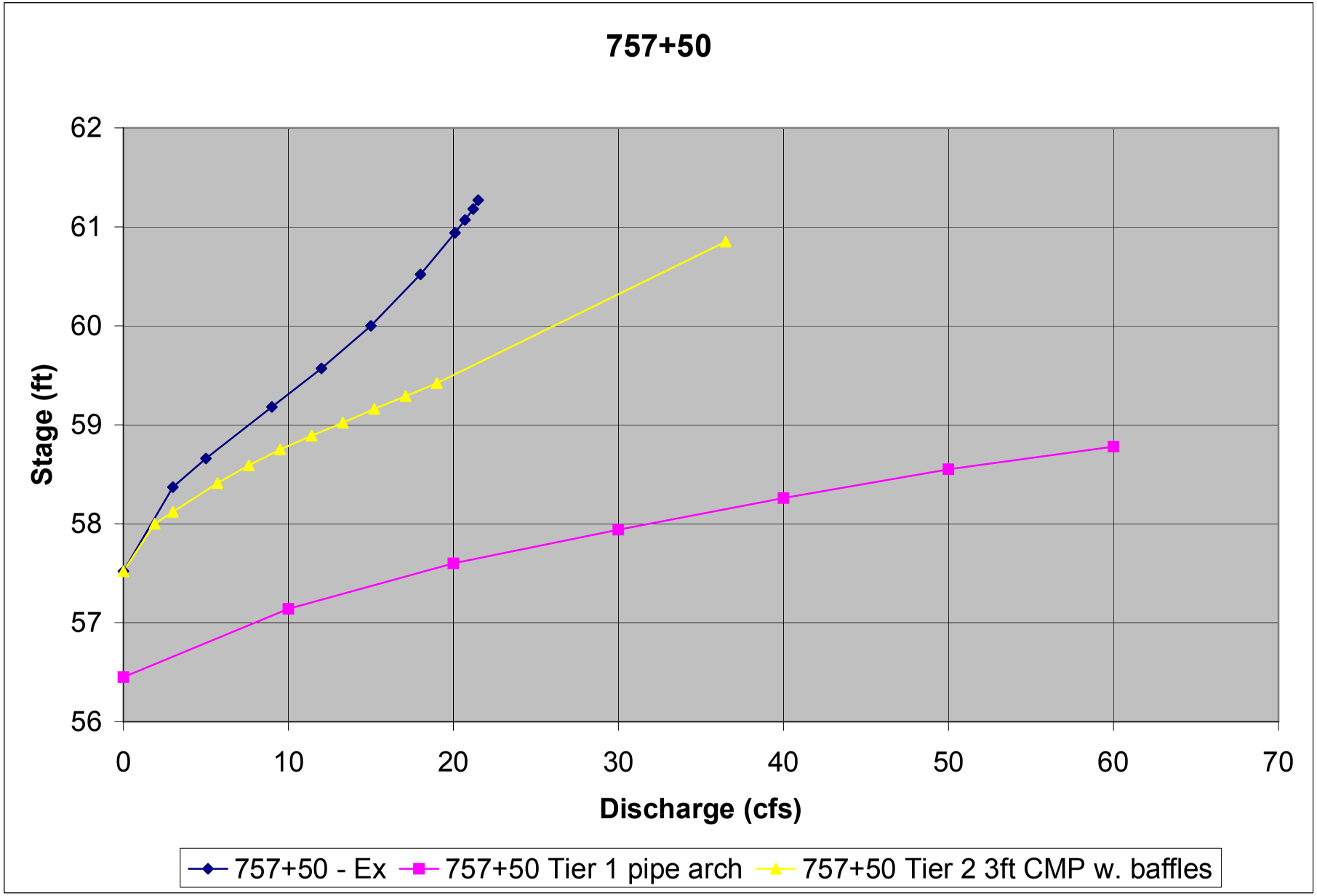
Allowable Vel.	Min. Flow Depth	Possible Power	Possible Energy (joules) Outlet	Possible Energy (joules) Inlet
6.7 ft/sec	0.40 ft	115.59 watts	725.60	

Calculated Flow Parameters

	Normal Flow	Critical Flow
Depth (ft)	0.72	0.60
Avg., cross-section, water velocity (ft/sec)	2.97	3.75
Fish power required in outlet zone (watts)		
Fish energy required in outlet zone (joules)		
Fish power required at inlet (watts)		
Fish energy required at inlet (joules)		

Normal Depth too shallow

Alt = Menu <F1 = Current Field Help> <Esc = Exit>


757+50
Stage (ft)
62
61
60
59
58
57
56
0
10
20
30
40
50
60
70
Discharge (cfs)
757+50 - Ex
757+50 Tier 1 pipe arch
757+50 Tier 2 3ft CMP w. baffles

1 Station 757+50 Existing conditions

CURRENT DATE: 08-25-2006 FILE DATE: 08-25-2006
CURRENT TIME: 16:42:47 FILE NAME: 75750EX

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

C SITE DATA CULVERT SHAPE, MATERIAL, INLET
U
L INLET OUTLET CULVERT BARRELS
V ELEV. ELEV. LENGTH SHAPE SPAN RISE MANNING INLET
NO. (ft) (ft) (ft) MATERIAL (ft) (ft) n TYPE
1 57.52 54.50 60.48 1 CSP 2.00 2.00 .024 CONVENTIONAL
2
3
4
5
6

SUMMARY OF CULVERT FLOWS (cfs) FILE: 75750EX DATE: 08-25-2006

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
57.52	0	0	0	0	0	0	0	0	1
58.37	3	3	0	0	0	0	0	0	1
58.66	5	5	0	0	0	0	0	0	1
59.18	9	9	0	0	0	0	0	0	1
59.57	12	12	0	0	0	0	0	0	1
60	15	15	0	0	0	0	0	0	1
60.52	18	18	0	0	0	0	0	0	1
60.94	21	20.1	0	0	0	0	0	0.8	8
61.07	24	20.7	0	0	0	0	0	3.12	4
61.18	27	21.2	0	0	0	0	0	5.72	4
61.27	30	21.5	0	0	0	0	0	8.21	3
60.85	19.6	19.6	0	0	0	0	0	OVERTOPP	ING

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: 75750EX DATE: 08-25-2006

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
57.52	0.000	0.00	0.00	0.00
58.37	0.000	3.00	0.00	0.00
58.66	0.000	5.00	0.00	0.00
59.18	0.000	9.00	0.00	0.00
59.57	0.000	12.00	0.00	0.00
60.00	0.000	15.00	0.00	0.00
60.52	0.000	18.00	0.00	0.00
60.94	-0.008	21.00	0.12	0.57
61.07	-0.005	24.00	0.21	0.88
61.18	-0.009	27.00	0.12	0.44
61.27	-0.006	30.00	0.26	0.87

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

2

CURRENT DATE: 08-25-2006 FILE DATE: 08-25-2006
CURRENT TIME: 16:42:47 FILE NAME: 75750EX

PERFORMANCE CURVE FOR CULVERT 1 - 1(2.00 (ft) BY 2.00 (ft)) CSP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	57.52	0.00	0.00	0-NF	0.00	0.00	0.00	-0.74	0.00	0.00
3.00	58.37	0.85	0.85	1-S2n	0.44	0.60	0.30	-0.41	9.65	2.21
5.00	58.66	1.14	1.14	1-S2n	0.57	0.79	0.49	-0.34	8.39	2.58
9.00	59.18	1.66	1.66	1-S2n	0.79	1.07	0.67	-0.22	9.78	3.11
12.00	59.57	2.05	2.05	5-S2n	0.92	1.24	0.84	-0.15	9.58	3.42
15.00	60.00	2.48	2.48	5-S2n	1.05	1.40	1.00	-0.08	9.60	3.68
18.00	60.52	3.00	3.00	5-S2n	1.18	1.52	1.12	-0.01	9.92	3.92
20.09	60.94	3.42	3.42	5-S2n	1.27	1.61	1.21	0.05	10.13	4.12
20.67	61.07	3.55	3.55	5-S2n	1.30	1.62	1.22	0.11	10.25	4.30
21.17	61.18	3.66	3.66	5-S2n	1.32	1.64	1.24	0.16	10.35	4.48
21.53	61.26	3.74	3.74	5-S2n	1.34	1.65	1.25	0.22	10.42	4.63

El. inlet face invert 57.52 ft El. outlet invert 54.50 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

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

INLET STATION 0.00 ft
INLET ELEVATION 57.52 ft
OUTLET STATION 60.40 ft
OUTLET ELEVATION 54.50 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0500
CULVERT LENGTH ALONG SLOPE 60.48 ft

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

BARREL SHAPE CIRCULAR
BARREL DIAMETER 2.00 ft
BARREL MATERIAL CORRUGATED STEEL
BARREL MANNING'S n 0.024
INLET TYPE CONVENTIONAL
INLET EDGE AND WALL THIN EDGE PROJECTING
INLET DEPRESSION NONE

3

CURRENT DATE: 08-25-2006 FILE DATE: 08-25-2006
CURRENT TIME: 16:42:47 FILE NAME: 75750EX

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1 **Station 757+50 Tier 1 fish passage - Pipe arch**

CURRENT DATE: 09-07-2006 FILE DATE: 09-07-2006
CURRENT TIME: 18:39:05 FILE NAME: 757T1AR

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

C U L V NO.	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	56.45	53.43	60.48	1 ICMP	7.26	4.18	.028	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: 757T1AR DATE: 09-07-2006

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
56.45	0	0	0	0	0	0	0	0	1
57.14	10	10	0	0	0	0	0	0	1
57.6	20	20	0	0	0	0	0	0	1
57.94	30	30	0	0	0	0	0	0	1
58.26	40	40	0	0	0	0	0	0	1
58.55	50	50	0	0	0	0	0	0	1
58.78	60	60	0	0	0	0	0	0	1
59.02	70	70	0	0	0	0	0	0	1
59.25	80	80	0	0	0	0	0	0	1
59.49	90	90	0	0	0	0	0	0	1
59.72	100	100	0	0	0	0	0	0	1
60.85	149.4	149.4	0	0	0	0	0	OVERTOPPING	

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: 757T1AR DATE: 09-07-2006

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
56.45	0.000	0.00	0.00	0.00
57.14	0.000	10.00	0.00	0.00
57.60	0.000	20.00	0.00	0.00
57.94	0.000	30.00	0.00	0.00
58.26	0.000	40.00	0.00	0.00
58.55	0.000	50.00	0.00	0.00
58.78	0.000	60.00	0.00	0.00

59.02	0.000	70.00	0.00	0.00
59.25	0.000	80.00	0.00	0.00
59.49	0.000	90.00	0.00	0.00
59.72	0.000	100.00	0.00	0.00

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

2

CURRENT DATE: 09-07-2006 FILE DATE: 09-07-2006
CURRENT TIME: 18:39:05 FILE NAME: 757T1AR

PERFORMANCE CURVE FOR CULVERT 1 - 1(7.26 (ft) BY 4.18 (ft)) ICMP

DIS-CHARGE (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	56.45	0.00	0.00	0-NF	0.00	0.00	0.00	0.33	0.00	0.00
10.00	57.14	0.69	0.69	1-S2n	0.23	0.39	0.09	0.88	8.78	3.22
20.00	57.60	1.15	1.15	1-S2n	0.44	0.61	0.31	1.10	7.27	4.05
30.00	57.94	1.49	1.49	1-S2n	0.55	0.82	0.56	1.29	7.54	4.63
40.00	58.26	1.81	1.81	1-S2n	0.66	0.98	0.58	1.45	9.67	5.09
50.00	58.55	2.10	2.10	1-S2n	0.78	1.14	0.79	1.59	8.93	5.47
60.00	58.78	2.33	2.33	1-S2n	0.88	1.29	0.79	1.73	10.63	5.79
70.00	59.02	2.57	2.57	1-S2n	0.97	1.43	0.93	1.85	10.60	6.07
80.00	59.25	2.80	2.80	1-S2n	1.06	1.56	0.96	1.97	11.68	6.33
90.00	59.49	3.04	3.04	1-S2n	1.15	1.69	1.09	2.09	11.57	6.56
100.00	59.72	3.27	3.27	1-S2n	1.24	1.81	1.25	2.19	11.28	6.78

El. inlet face invert 56.45 ft El. outlet invert 53.43 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

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

INLET STATION 0.00 ft
INLET ELEVATION 56.45 ft
OUTLET STATION 60.40 ft
OUTLET ELEVATION 53.43 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0500
CULVERT LENGTH ALONG SLOPE 60.48 ft

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

BARREL SHAPE USER DEFINED
BARREL SPAN 7.26 ft
BARREL RISE 4.18 ft
BARREL MATERIAL STEEL OR ALUMINUM
BARREL MANNING'S n 0.028 FOR SIDES AND TOP
0.038 FOR BOTTOM

INLET TYPE CONVENTIONAL
INLET EDGE AND WALL MITERED
INLET DEPRESSION NONE

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□

3

CURRENT DATE: 09-07-2006 FILE DATE: 09-07-2006
CURRENT TIME: 18:39:05 FILE NAME: 757T1AR

□□

***** USER DEFINED CULVERT CROSS-SECTION - CULVERT # 1

COORDINATE NUMBER	X (ft)	Y-TOP (ft)	Y-BOTTOM (ft)
1	0.00	58.26	58.26
2	0.17	59.16	57.52
3	0.86	60.42	57.52
4	1.55	61.05	57.52
5	2.24	61.43	57.52
6	2.94	61.63	57.52
7	3.63	61.70	57.52
8	4.32	61.63	57.52
9	5.01	61.43	57.52
10	5.71	61.05	57.52
11	6.40	60.42	57.52
12	7.09	59.16	57.52
13	7.26	58.18	58.18

□□
□

4

CURRENT DATE: 09-07-2006 FILE DATE: 09-07-2006
CURRENT TIME: 18:39:05 FILE NAME: 757T1AR

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□□

***** USER DEFINED CHANNEL CROSS-SECTION FILE NAME: 75750TW
MAIN CHANNEL ONLY FILE DATE: 08-25-2006
LEFT CHANNEL BOUNDARY 0
RIGHT CHANNEL BOUNDARY 0
MANNING n LEFT OVER BANK 0.000
MANNING n MAIN CHANNEL 0.035
MANNING n RIGHT OVER BANK 0.000
SLOPE OF CHANNEL 0.0180 ft/ft

CROSS-SECTION X Y
COORD. NO. (ft) (ft)

1	0.00	57.61
2	3.40	53.76
3	6.50	53.82
4	10.20	53.91
5	12.80	57.07

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

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	53.76	0.000	0.33	0.00	0.00
10.00	54.31	0.847	0.88	3.22	0.48
20.00	54.53	0.887	1.10	4.05	0.67
30.00	54.72	0.910	1.29	4.63	0.82
40.00	54.88	0.925	1.45	5.09	0.95
50.00	55.02	0.937	1.59	5.47	1.06
60.00	55.16	0.946	1.73	5.79	1.15
70.00	55.28	0.954	1.85	6.07	1.24
80.00	55.40	0.960	1.97	6.33	1.32
90.00	55.52	0.965	2.09	6.56	1.39
100.00	55.62	0.970	2.19	6.78	1.46

Note: Shear stress was calculated using R.

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE	PAVED
EMBANKMENT TOP WIDTH	24.00 ft
CREST LENGTH	10.00 ft
OVERTOPPING CREST ELEVATION	60.85 ft

1 **Station 757+50 Tier 2 fish passage - 3-ft baffled CMP**

CURRENT DATE: 09-07-2006 FILE DATE: 09-07-2006
CURRENT TIME: 19:05:25 FILE NAME: 757T2-3B

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

C	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
U								
L	INLET	OUTLET	CULVERT	BARRELS				
V	ELEV.	ELEV.	LENGTH	SHAPE	SPAN	RISE	MANNING	INLET
NO.	(ft)	(ft)	(ft)	MATERIAL	(ft)	(ft)	n	TYPE
1	57.52	54.50	60.08	1 ICMP	3.00	2.55	.024	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: 757T2-3B DATE: 09-07-2006

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWA	ITR
57.52	0	0	0	0	0	0	0	0	1
58	1.9	1.9	0	0	0	0	0	0	1
58.12	3	3	0	0	0	0	0	0	1
58.41	5.7	5.7	0	0	0	0	0	0	1
58.59	7.6	7.6	0	0	0	0	0	0	1
58.75	9.5	9.5	0	0	0	0	0	0	1
58.89	11.4	11.4	0	0	0	0	0	0	1
59.02	13.3	13.3	0	0	0	0	0	0	1
59.16	15.2	15.2	0	0	0	0	0	0	1
59.29	17.1	17.1	0	0	0	0	0	0	1
59.42	19	19	0	0	0	0	0	0	1
60.85	36.5	36.5	0	0	0	0	0	OVERTOF	ING

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: 757T2-3B DATE: 09-07-2006

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
57.52	0.000	0.00	0.00	0.00
58.00	0.000	1.90	0.00	0.00
58.12	0.000	3.00	0.00	0.00
58.41	0.000	5.70	0.00	0.00
58.59	0.000	7.60	0.00	0.00
58.75	0.000	9.50	0.00	0.00
58.89	0.000	11.40	0.00	0.00
59.02	0.000	13.30	0.00	0.00
59.16	0.000	15.20	0.00	0.00
59.29	0.000	17.10	0.00	0.00
59.42	0.000	19.00	0.00	0.00

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

2

CURRENT DATE: 09-07-2006 FILE DATE: 09-07-2006
CURRENT TIME: 19:05:25 FILE NAME: 757T2-3B

PERFORMANCE CURVE FOR CULVERT 1 - 1(3.00 (ft) BY 2.55 (ft)) ICMP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	57.52	0.00	0.00	0-NF	0.00	0.00	0.00	-0.74	0.00	0.00
1.90	58.00	0.48	0.48	1-S2n	0.16	0.27	0.07	-0.45	6.38	1.86
3.00	58.12	0.60	0.60	1-S2n	0.26	0.36	0.16	-0.40	5.83	2.10
5.70	58.41	0.89	0.89	1-S2n	0.36	0.55	0.25	-0.30	9.54	2.55
7.60	58.59	1.07	1.07	1-S2n	0.44	0.66	0.36	-0.24	8.64	2.79
9.50	58.75	1.23	1.23	1-S2n	0.51	0.77	0.51	-0.19	7.47	3.01
11.40	58.89	1.37	1.37	1-S2n	0.57	0.86	0.46	-0.13	10.05	3.19
13.30	59.02	1.50	1.50	1-S2n	0.63	0.94	0.54	-0.08	9.71	3.36
15.20	59.16	1.64	1.64	1-S2n	0.68	1.03	0.63	-0.04	9.40	3.51
17.10	59.29	1.77	1.77	1-S2n	0.74	1.10	0.75	0.00	8.80	3.65
19.00	59.42	1.90	1.90	1-S2n	0.79	1.17	0.67	0.04	10.97	3.78

El. inlet face invert 57.52 ft El. outlet invert 54.50 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

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

INLET STATION 0.00 ft
INLET ELEVATION 57.52 ft
OUTLET STATION 60.00 ft
OUTLET ELEVATION 54.50 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0503
CULVERT LENGTH ALONG SLOPE 60.08 ft

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

BARREL SHAPE USER DEFINED
BARREL SPAN 3.00 ft
BARREL RISE 2.55 ft
BARREL MATERIAL STEEL OR ALUMINUM
BARREL MANNING'S n 0.024 FOR SIDES AND TOP
0.038 FOR BOTTOM
INLET TYPE CONVENTIONAL
INLET EDGE AND WALL MITERED
INLET DEPRESSION NONE

3

CURRENT DATE: 09-07-2006 FILE DATE: 09-07-2006
CURRENT TIME: 19:05:25 FILE NAME: 757T2-3B

***** USER DEFINED CULVERT CROSS-SECTION - CULVERT # 1

COORDINATE NUMBER	X (ft)	Y-TOP (ft)	Y-BOTTOM (ft)
1	0.00	58.57	58.57
2	0.14	59.21	57.93
3	0.29	59.45	57.69
4	0.43	59.62	57.52
5	0.70	59.84	57.52
6	0.96	59.97	57.52
7	1.23	60.05	57.52
8	1.50	60.07	57.52
9	1.77	60.05	57.52
10	2.04	59.97	57.52
11	2.30	59.84	57.52
12	2.57	59.62	57.52
13	2.71	59.45	57.69
14	2.86	59.21	57.93
15	3.00	58.57	58.57

CURRENT DATE: 09-07-2006 FILE DATE: 09-07-2006
CURRENT TIME: 19:05:25 FILE NAME: 757T2-3B

TAILWATER

***** USER DEFINED CHANNEL CROSS-SECTION FILE NAME: 757T2-3B
MAIN CHANNEL ONLY FILE DATE: 09-07-2006
LEFT CHANNEL BOUNDARY 0
RIGHT CHANNEL BOUNDARY 0
MANNING n LEFT OVER BANK 0.000
MANNING n MAIN CHANNEL 0.038
MANNING n RIGHT OVER BANK 0.000
SLOPE OF CHANNEL 0.0180 ft/ft

CROSS-SECTION COORD. NO.	X (ft)	Y (ft)
1	0.00	57.61
2	3.40	53.76
3	6.50	53.82
4	10.20	53.91
5	12.80	57.07

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

FLOW (cfs)	W.S.E. (ft)	FROUDE NUMBER	DEPTH (ft)	VEL. (f/s)	SHEAR (psf)
0.00	53.76	0.000	-0.74	0.00	0.00
1.90	54.05	0.704	-0.45	1.86	0.24
3.00	54.10	0.724	-0.40	2.10	0.28

5.70	54.20	0.755	-0.30	2.55	0.38
7.60	54.26	0.770	-0.24	2.79	0.44
9.50	54.31	0.782	-0.19	3.01	0.49
11.40	54.37	0.792	-0.13	3.19	0.53
13.30	54.42	0.800	-0.08	3.36	0.58
15.20	54.46	0.807	-0.04	3.51	0.61
17.10	54.50	0.813	0.00	3.65	0.65
19.00	54.54	0.819	0.04	3.78	0.69

Note: Shear stress was calculated using R.

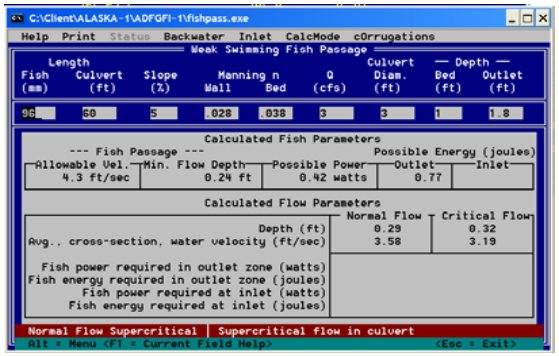
ROADWAY OVERTOPPING DATA

ROADWAY SURFACE PAVED
EMBANKMENT TOP WIDTH 24.00 ft
CREST LENGTH 10.00 ft
OVERTOPPING CREST ELEVATION 60.85 ft

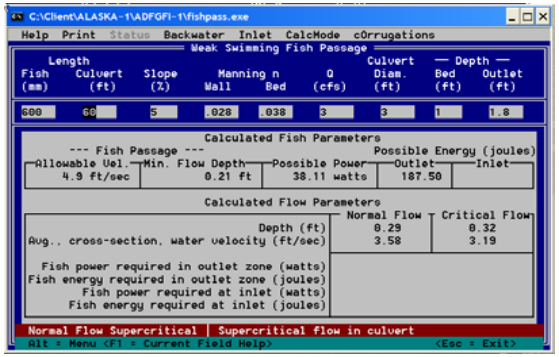
757+00 Tier 2 FISH PASS design

non baffled design:

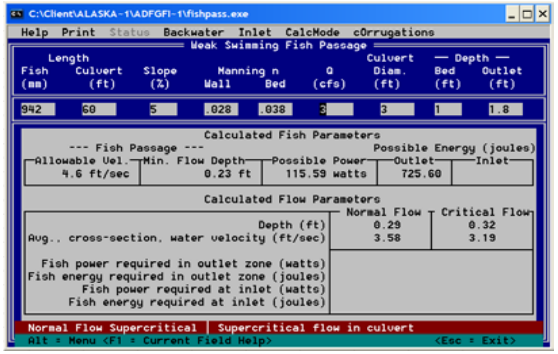
3-ft pipe at slope of existing pipe
Juvenile Coho



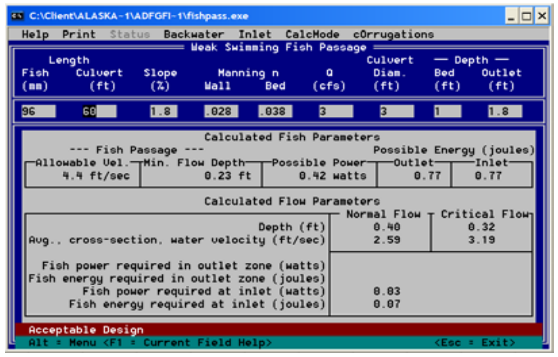
Adult Coho



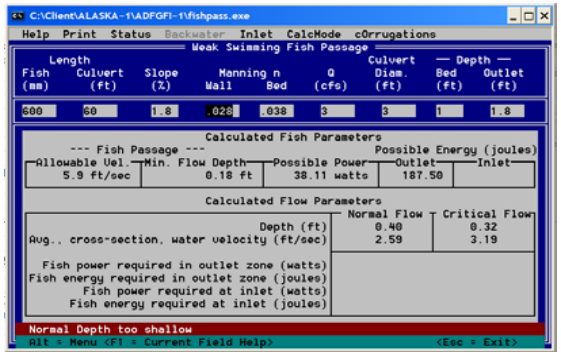
Adult coho - adjusted to 'equivalent' grayling

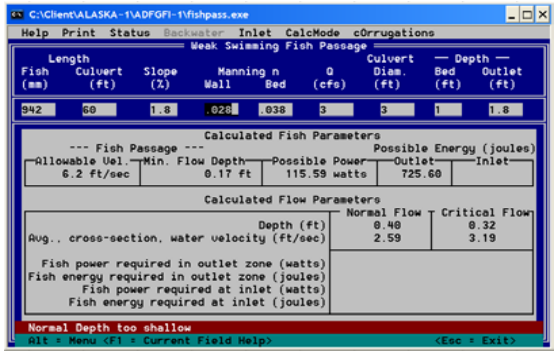


3-ft pipe at slope of existing d/s channel
Juvenile Coho



Adult Coho





baffle design:

3-ft pipe at slope of existing d/s channel
Juvenile Coho

C:\Client\ALASKA-1\ADFGFI-1\fishpass.exe

Help Print Status

Weir Baffle

Weak Swimming Fish Length (mm)	Slope (%)	Manning n Wall	Q Fish (cfs)	Q Flood (cfs)	Culvert Diameter (ft)
96	1.8	.024	3	19	3

Calculated Parameters

Weir Height	.1 × D	.15 × D
Water Velocity in small fish passage zone (ft/sec)	2.81	1.94
Fish power required at weir (watts)	0.10	0.05
Fish power capabilities (watts)	0.26	0.26
Depth of flow over weir (ft)	0.68	0.48
Depth of flow at outlet (ft)	0.98	0.93
Normal Depth at flood flow (ft)	1.90	2.11

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

Adult Coho

C:\Client\ALASKA-1\ADFGFI-1\fishpass.exe

Help Print Status

Weir Baffle

Weak Swimming Fish Length (mm)	Slope (%)	Manning n Wall	Q Fish (cfs)	Q Flood (cfs)	Culvert Diameter (ft)
600	1.8	.024	3	19	3

Calculated Parameters

Weir Height	.1 × D	.15 × D
Water Velocity in small fish passage zone (ft/sec)	2.81	1.94
Fish power required at weir (watts)	3.18	1.65
Fish power capabilities (watts)	62.55	62.55
Depth of flow over weir (ft)	0.68	0.48
Depth of flow at outlet (ft)	0.98	0.93
Normal Depth at flood flow (ft)	1.90	2.11

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

Adult coho - adjusted to 'equivalent' grayling

C:\Client\ALASKA-1\ADFGFI-1\fishpass.exe

Help Print Status

Weir Baffle

Weak Swimming Fish Length (mm)	Slope (%)	Manning n Wall	Q Fish (cfs)	Q Flood (cfs)	Culvert Diameter (ft)
942	1.8	.024	3	19	3

Calculated Parameters

Weir Height	.1 × D	.15 × D
Water Velocity in small fish passage zone (ft/sec)	2.81	1.94
Fish power required at weir (watts)	7.80	4.21
Fish power capabilities (watts)	242.05	242.05
Depth of flow over weir (ft)	0.68	0.48
Depth of flow at outlet (ft)	0.98	0.93
Normal Depth at flood flow (ft)	1.90	2.11

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

3-ft pipe at slope of existing pipe

C:\Client\ALASKA-1\ADFGFI-1\fishpass.exe

Help Print Status

Weir Baffle

Weak Swimming Fish Length (mm)	Slope (%)	Manning n Wall	Q Fish (cfs)	Q Flood (cfs)	Culvert Diameter (ft)
96	5	.024	3	19	3

Calculated Parameters

Weir Height	.1 × D	.15 × D
Water Velocity in small fish passage zone (ft/sec)	4.14	2.62
Fish power required at weir (watts)	0.24	0.09
Fish power capabilities (watts)	0.26	0.26
Depth of flow over weir (ft)	0.56	0.39
Depth of flow at outlet (ft)	0.86	0.84
Normal Depth at flood flow (ft)	1.57	1.75

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

C:\Client\ALASKA-1\ADFGFI-1\fishpass.exe

Help Print Status

Weir Baffle

Weak Swimming Fish Length (mm)	Slope (%)	Manning n Wall	Q Fish (cfs)	Q Flood (cfs)	Culvert Diameter (ft)
600	5	.024	3	19	3

Calculated Parameters

Weir Height	.1 × D	.15 × D
Water Velocity in small fish passage zone (ft/sec)	4.14	2.62
Fish power required at weir (watts)	7.93	3.46
Fish power capabilities (watts)	62.55	62.55
Depth of flow over weir (ft)	0.56	0.39
Depth of flow at outlet (ft)	0.86	0.84
Normal Depth at flood flow (ft)	1.57	1.75

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>

C:\Client\ALASKA-1\ADFGFI-1\fishpass.exe

Help Print Status

Weir Baffle

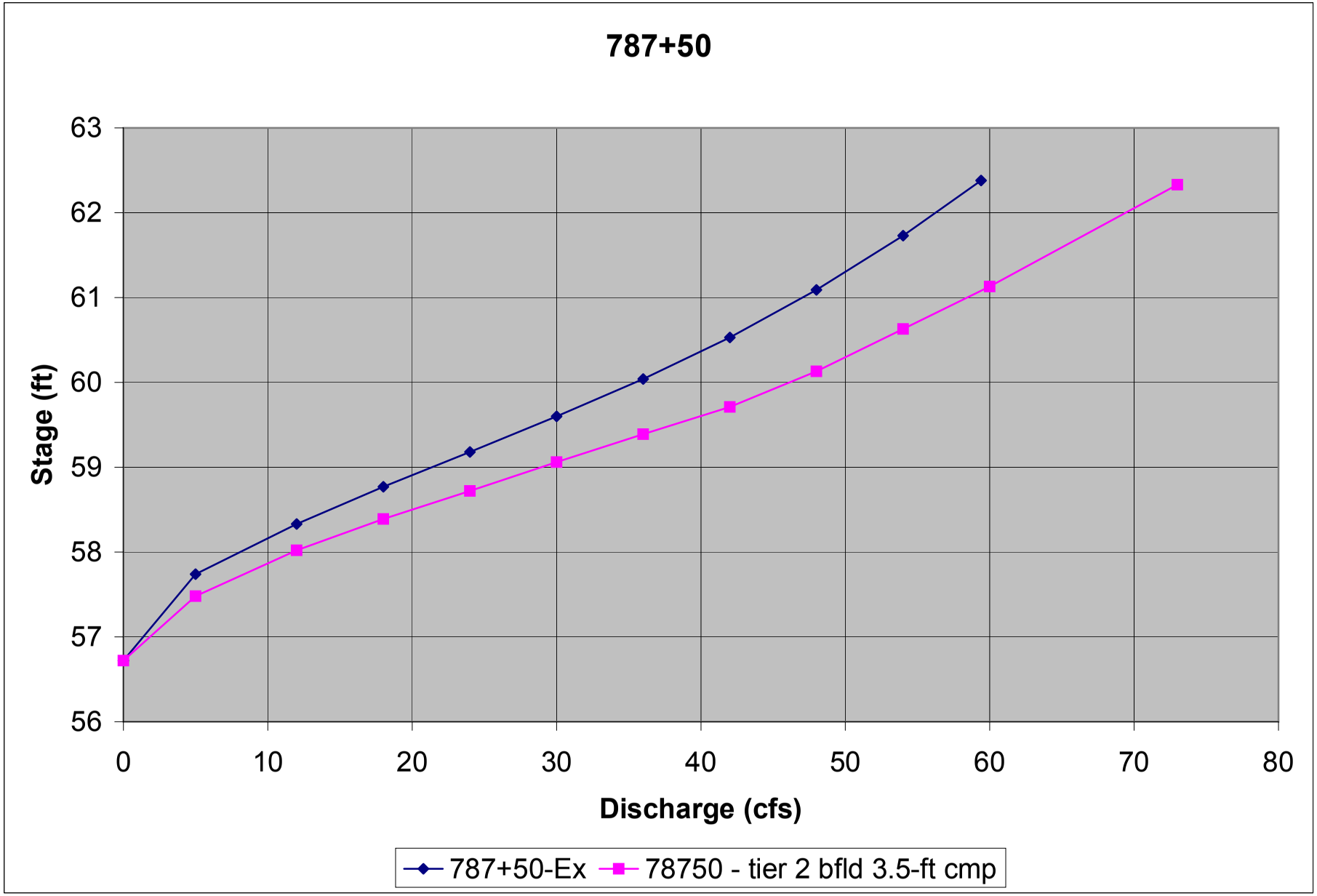
Weak Swimming Fish Length (mm)	Slope (%)	Manning n Wall	Q Fish (cfs)	Q Flood (cfs)	Culvert Diameter (ft)
942	5	.024	3	19	3

Calculated Parameters

Weir Height	.1 × D	.15 × D
Water Velocity in small fish passage zone (ft/sec)	4.14	2.62
Fish power required at weir (watts)	20.26	9.48
Fish power capabilities (watts)	242.05	242.05
Depth of flow over weir (ft)	0.56	0.39
Depth of flow at outlet (ft)	0.86	0.84
Normal Depth at flood flow (ft)	1.57	1.75

Acceptable Design

Alt = Menu <F1 = Current Field Help> <Esc = Exit>


787+50
Stage (ft)
63
62
61
60
59
58
57
56
0
10
20
30
40
50
60
70
80
Discharge (cfs)
787+50-Ex
78750 - tier 2 bfld 3.5-ft cmp

1 Station 787+50 Existing conditions

CURRENT DATE: 08-25-2006 FILE DATE: 08-25-2006
CURRENT TIME: 16:45:22 FILE NAME: 78750EX

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

C SITE DATA CULVERT SHAPE, MATERIAL, INLET
U
L INLET OUTLET CULVERT BARRELS
V ELEV. ELEV. LENGTH SHAPE SPAN RISE MANNING INLET
NO. (ft) (ft) (ft) MATERIAL (ft) (ft) n TYPE
1 56.72 55.16 52.02 1 CSP 3.00 3.00 .024 CONVENTIONAL
2
3
4
5
6

SUMMARY OF CULVERT FLOWS (cfs) FILE: 78750EX DATE: 08-25-2006

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWAY	ITR
56.72	0	0	0	0	0	0	0	0	1
57.74	5	5	0	0	0	0	0	0	1
58.33	12	12	0	0	0	0	0	0	1
58.77	18	18	0	0	0	0	0	0	1
59.18	24	24	0	0	0	0	0	0	1
59.6	30	30	0	0	0	0	0	0	1
60.04	36	36	0	0	0	0	0	0	1
60.53	42	42	0	0	0	0	0	0	1
61.09	48	48	0	0	0	0	0	0	1
61.73	54	54	0	0	0	0	0	0	1
62.38	60	59.4	0	0	0	0	0	0.32	6
62.33	59	59	0	0	0	0	0	OVERTOPP	ING

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: 78750EX DATE: 08-25-2006

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
56.72	0.000	0.00	0.00	0.00
57.74	0.000	5.00	0.00	0.00
58.33	0.000	12.00	0.00	0.00
58.77	0.000	18.00	0.00	0.00
59.18	0.000	24.00	0.00	0.00
59.60	0.000	30.00	0.00	0.00
60.04	0.000	36.00	0.00	0.00
60.53	0.000	42.00	0.00	0.00
61.09	0.000	48.00	0.00	0.00
61.73	0.000	54.00	0.00	0.00
62.38	-0.008	60.00	0.23	0.38

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

2

CURRENT DATE: 08-25-2006 FILE DATE: 08-25-2006
CURRENT TIME: 16:45:22 FILE NAME: 78750EX

PERFORMANCE CURVE FOR CULVERT 1 - 1(3.00 (ft) BY 3.00 (ft)) CSP

DIS-CHARGE (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	56.72	0.00	0.00	0-NF	0.00	0.00	0.00	0.34	0.00	0.00
5.00	57.74	1.02	1.02	1-S2n	0.56	0.69	0.49	0.34	6.52	0.00
12.00	58.33	1.61	1.61	1-S2n	0.89	1.09	0.79	0.34	8.00	0.00
18.00	58.77	2.05	2.05	1-S2n	1.09	1.35	1.10	0.34	7.64	0.00
24.00	59.18	2.46	2.46	1-S2n	1.28	1.57	1.17	0.34	9.36	0.00
30.00	59.60	2.88	2.88	1-S2n	1.46	1.77	1.37	0.34	9.51	0.00
36.00	60.04	3.32	3.32	5-S2n	1.63	1.94	1.54	0.34	9.82	0.00
42.00	60.53	3.81	3.81	5-S2n	1.80	2.11	1.71	0.34	10.10	0.00
48.00	61.09	4.37	4.37	5-S2n	1.97	2.25	1.98	0.34	9.72	0.00
54.00	61.73	5.01	5.01	5-S2n	2.15	2.38	2.08	0.34	10.30	0.00
59.44	62.38	5.66	5.66	5-S2n	2.34	2.48	2.28	0.34	10.35	0.00

El. inlet face invert 56.72 ft El. outlet invert 55.16 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********
INLET STATION 0.00 ft
INLET ELEVATION 56.72 ft
OUTLET STATION 52.00 ft
OUTLET ELEVATION 55.16 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0300
CULVERT LENGTH ALONG SLOPE 52.02 ft

***** CULVERT DATA SUMMARY **********
BARREL SHAPE CIRCULAR
BARREL DIAMETER 3.00 ft
BARREL MATERIAL CORRUGATED STEEL
BARREL MANNING'S n 0.024
INLET TYPE CONVENTIONAL
INLET EDGE AND WALL THIN EDGE PROJECTING
INLET DEPRESSION NONE

3

CURRENT DATE: 08-25-2006 FILE DATE: 08-25-2006
CURRENT TIME: 16:45:22 FILE NAME: 78750EX

TAILWATER

CONSTANT WATER SURFACE ELEVATION
55.5

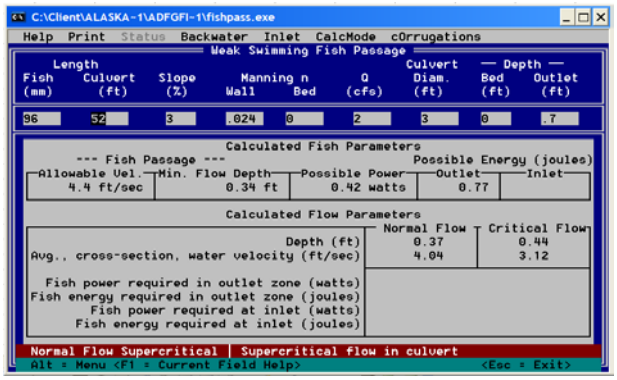
ROADWAY OVERTOPPING DATA

ROADWAY SURFACE PAVED
EMBANKMENT TOP WIDTH 24.00 ft
CREST LENGTH 10.00 ft
OVERTOPPING CREST ELEVATION 62.33 ft

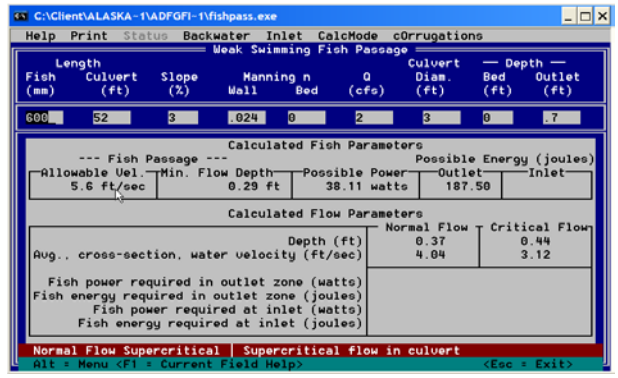
787+50 Tier 2 FISH PASS design

Non baffle design

Juvenile coho in 3-ft CMP

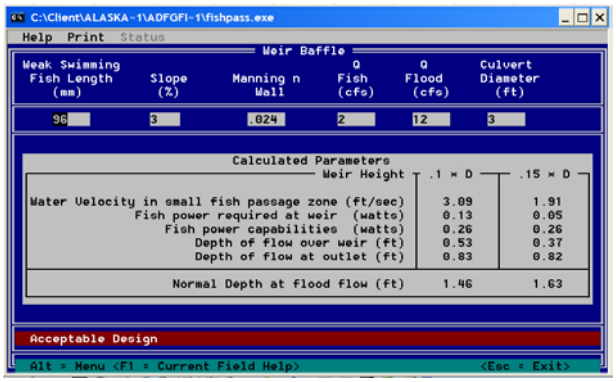


adult coho

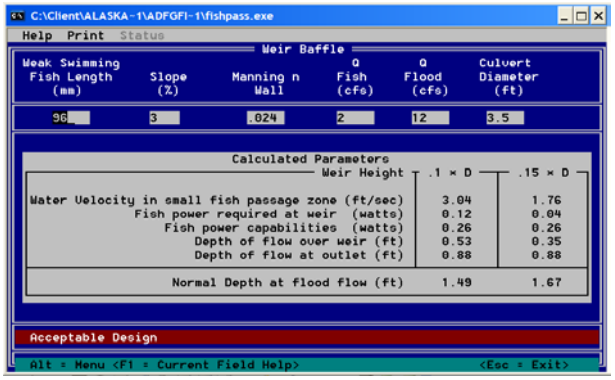


Baffle design

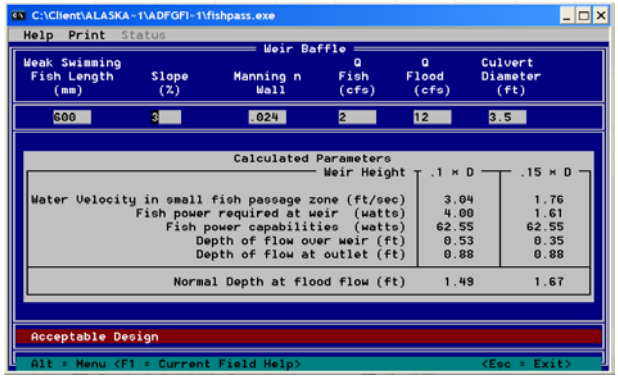
Juvenile coho in 3-ft CMP



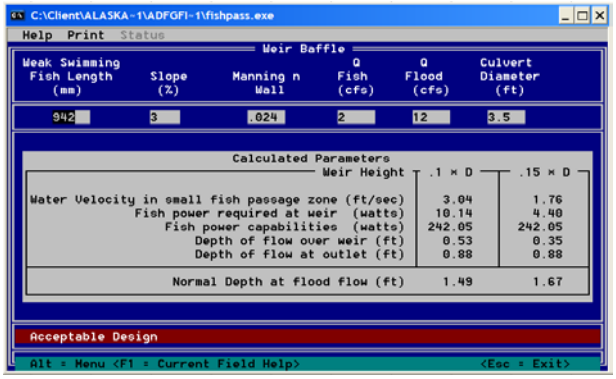
Juvenile coho in 3.5-ft CMP



Adult coho in 3.5-ft CMP



Adult coho adjusted to 'equivalent' grayling



1 Station 787+50 Tier 2 fish passage - 3.5-ft baffled CMP

CURRENT DATE: 09-07-2006 FILE DATE: 09-07-2006
CURRENT TIME: 19:53:59 FILE NAME: 787T2-42

FHWA CULVERT ANALYSIS
HY-8, VERSION 6.1

C	SITE DATA			CULVERT SHAPE, MATERIAL, INLET				
U								
L	INLET	OUTLET	CULVERT	BARRELS				
V	ELEV.	ELEV.	LENGTH	SHAPE	SPAN	RISE	MANNING	INLET
NO.	(ft)	(ft)	(ft)	MATERIAL	(ft)	(ft)	n	TYPE
1	56.72	55.16	52.02	1 ICMP	3.50	2.98	.024	CONVENTIONAL
2								
3								
4								
5								
6								

SUMMARY OF CULVERT FLOWS (cfs) FILE: 787T2-42 DATE: 09-07-2006

ELEV (ft)	TOTAL	1	2	3	4	5	6	ROADWA`	ITR
56.72	0	0	0	0	0	0	0	0	1
57.48	5	5	0	0	0	0	0	0	1
58.02	12	12	0	0	0	0	0	0	1
58.39	18	18	0	0	0	0	0	0	1
58.72	24	24	0	0	0	0	0	0	1
59.06	30	30	0	0	0	0	0	0	1
59.39	36	36	0	0	0	0	0	0	1
59.71	42	42	0	0	0	0	0	0	1
60.13	48	48	0	0	0	0	0	0	1
60.63	54	54	0	0	0	0	0	0	1
61.13	60	60	0	0	0	0	0	0	1
62.33	73	73	0	0	0	0	0	OVERTOF	ING

SUMMARY OF ITERATIVE SOLUTION ERRORS FILE: 787T2-42 DATE: 09-07-2006

HEAD ELEV (ft)	HEAD ERROR (ft)	TOTAL FLOW (cfs)	FLOW ERROR (cfs)	% FLOW ERROR
56.72	0.000	0.00	0.00	0.00
57.48	0.000	5.00	0.00	0.00
58.02	0.000	12.00	0.00	0.00
58.39	0.000	18.00	0.00	0.00
58.72	0.000	24.00	0.00	0.00
59.06	0.000	30.00	0.00	0.00
59.39	0.000	36.00	0.00	0.00
59.71	0.000	42.00	0.00	0.00
60.13	0.000	48.00	0.00	0.00
60.63	0.000	54.00	0.00	0.00
61.13	0.000	60.00	0.00	0.00

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

2

CURRENT DATE: 09-07-2006 FILE DATE: 09-07-2006
CURRENT TIME: 19:53:59 FILE NAME: 787T2-42

PERFORMANCE CURVE FOR CULVERT 1 - 1(3.50 (ft) BY 2.98 (ft)) ICMP

DIS-CHARGE FLOW (cfs)	HEAD-WATER ELEV. (ft)	INLET CONTROL DEPTH (ft)	OUTLET CONTROL DEPTH (ft)	FLOW TYPE <F4>	NORMAL DEPTH (ft)	CRIT. DEPTH (ft)	OUTLET DEPTH (ft)	TW DEPTH (ft)	OUTLET VEL. (fps)	TW VEL. (fps)
0.00	56.72	0.00	0.00	0-NF	0.00	0.00	0.00	0.34	0.00	0.00
5.00	57.48	0.76	0.76	1-S2n	0.36	0.46	0.26	0.34	6.24	0.00
12.00	58.02	1.30	1.30	1-S2n	0.63	0.81	0.51	0.34	8.17	0.00
18.00	58.39	1.67	1.67	1-S2n	0.81	1.04	0.74	0.34	8.07	0.00
24.00	58.72	2.00	2.00	1-S2n	0.97	1.25	0.97	0.34	8.04	0.00
30.00	59.06	2.34	2.34	1-S2n	1.13	1.43	1.03	0.34	9.44	0.00
36.00	59.39	2.67	2.67	1-S2n	1.27	1.59	1.19	0.34	9.63	0.00
42.00	59.71	2.99	2.99	5-S2n	1.41	1.75	1.35	0.34	9.81	0.00
48.00	60.13	3.41	3.41	5-S2n	1.56	1.89	1.49	0.34	10.06	0.00
54.00	60.63	3.91	3.91	5-S2n	1.70	2.03	1.63	0.34	10.33	0.00
60.00	61.13	4.41	4.41	5-S2n	1.84	2.15	1.75	0.34	10.66	0.00

El. inlet face invert 56.72 ft El. outlet invert 55.16 ft
El. inlet throat invert 0.00 ft El. inlet crest 0.00 ft

***** SITE DATA ***** CULVERT INVERT **********
INLET STATION 0.00 ft
INLET ELEVATION 56.72 ft
OUTLET STATION 52.00 ft
OUTLET ELEVATION 55.16 ft
NUMBER OF BARRELS 1
SLOPE (V/H) 0.0300
CULVERT LENGTH ALONG SLOPE 52.02 ft

***** CULVERT DATA SUMMARY **********
BARREL SHAPE USER DEFINED
BARREL SPAN 3.50 ft
BARREL RISE 2.98 ft
BARREL MATERIAL STEEL OR ALUMINUM
BARREL MANNING'S n 0.024 FOR SIDES AND TOP
0.038 FOR BOTTOM
INLET TYPE CONVENTIONAL
INLET EDGE AND WALL MITERED
INLET DEPRESSION NONE

3

CURRENT DATE: 09-07-2006 FILE DATE: 09-07-2006
CURRENT TIME: 19:53:59 FILE NAME: 787T2-42

***** USER DEFINED CULVERT CROSS-SECTION - CULVERT # 1

COORDINATE NUMBER	X (ft)	Y-TOP (ft)	Y-BOTTOM (ft)
1	0.00	57.95	57.95
2	0.17	58.69	57.20
3	0.33	58.97	56.92
4	0.50	59.17	56.72
5	0.81	59.42	56.72
6	1.13	59.58	56.72
7	1.44	59.67	56.72
8	1.75	59.70	56.72
9	2.06	59.67	56.72
10	2.37	59.58	56.72
11	2.69	59.42	56.72
12	3.00	59.17	56.72
13	3.17	58.97	56.92
14	3.33	58.69	57.20
15	3.50	57.95	57.95

TAILWATER

CONSTANT WATER SURFACE ELEVATION
55.5

ROADWAY OVERTOPPING DATA

ROADWAY SURFACE PAVED
EMBANKMENT TOP WIDTH 24.00 ft
CREST LENGTH 10.00 ft
OVERTOPPING CREST ELEVATION 62.33 ft