SCI-823-6.81
PID 19415
(Portsmouth Bypass)

Stage 1

Hydraulic Calculations

Submitted December 21, 2006

by

TranSystems

5747 Perimeter Drive, Suite 240, Dublin, Ohio 43017

FORM LD-33
REV. 12-82

OHIO DEPARTMENT OF TRANSPORTATION
COUNTY ENGINEER
APPROVAL FORM

DATE SUBMITTED TO DISTRICT DEPUTY DIRECTOR: December 21, 2006

DATE SUBMITTED TO COUNTY ENGINEER: December 21, 2006

COUNTY: SCIOTO ROUTE: 823 SECTION: 6.81

CULVERT DATA

STATION	SIZE & TYPE	ELEVATION OF CULVERT INVERT		ELEVATION OF EXISTING CHANNEL AT		SKEW
		INLET	OUTLET	INLET	OUTLET	
353+88 SR 823	72" CMP	629.00	603.25	*	603.7	90° ⊥
364+36 SR 823	72" CMP	634.07	613.00	633.5	613.3	10.25° LF
375+08 SR 823	90" CMP	645.58	621.69	*	*	32.75° LF
404+06 SR 823	78" CMP	674.29	663.23	674.2	665.4	10° RF
412+07 SR 823	72" CMP	699.00	677.00	*	676.9	28° LF
466+45 SR 823	78" CMP	666.28	656.63	POND	POND	16° LF
473+92 SR 823	72" CMP	679.76	649.22	*	649.4	32.5° LF
504+60 SR 823	60" CMP	706.55	694.74	707.00	*	13° LF
535+50 SR 823	96" CMP	705.44	702.86	*	*	90° ⊥
383+50 TR 234 RAMP B	30" CMP	656.00	647.00	◊	◊	90° ⊥
379+00 TR 234 RAMP C	42"	665.00	666.70	◊	◊	90° ⊥
26+00 TR 234	42" CMP	676.30	669.00	◊	◊	90° ⊥
27+30 TR 234	30" CON.	670.30	669.23	◊	◊	90° ⊥
485+02 SR 823/SR 139	8'X4' BOX	628.00	627.30	◊	◊	90° ⊥
534+30 CR 28 RAMP A	30"	718.60	716.20	719.66	716.20	40° LF

I have reviewed and hereby approve the drainage proposed for the highway designated heron in accordance with the provisions of Section 6131.631 of the Revised Code of the State of Ohio.

COUNTY ENGINEER SCIOTO COUNTY

(SIGNATURE)

DATE

FORM LD-33
REV. 12-82

COMMENTS:

* Relocated Channel
◊ New Ditch Location

DATE SUBMITTED TO DISTRICT DEPUTY DIRECTOR: December 21, 2006

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COUNTY: SCIOTO ROUTE: 823 SECTION: 6.81

OHIO DEPARTMENT OF TRANSPORTATION
COUNTY ENGINEER
APPROVAL FORM

CULVERT DATA

STATION		SIZE & TYPE	ELEVATION OF CULVERT INVERT		ELEVATION OF EXISTING CHANNEL AT		SKEW	
			INLET	OUTLET	INLET	OUTLET		
507+44	CR 28 RAMP C	90" CMP	696.91	697.16	699.55	697.53	24°	LF
17+00	TR 234	48"	680.10	677.67	700.12	681.95	90°	⊥
528+00	CR 28 RAMP B	24"	755.88	750.50	786.38	779.4	90°	⊥
10+78	CR 28	48" CMP	704.5	697.30	706.58	697.44	15°	LF
22+23	CR 28	78"	707.97	707.32	715.73	724.85	25°	RF

I have reviewed and hereby approve the drainage proposed for the highway designated heron in accordance with the provisions of Section 6131.631 of the Revised Code of the State of Ohio.

COUNTY ENGINEER _____ SCIOTO _____ COUNTY

(SIGNATURE)

DATE _____

COMMENTS:

* Relocated Channel
◊ New Ditch Location

Narrative

As per discussions made with ODOT prior to the PAVR (Preferred Alternative Verification Review) it was decided that the culverts located under high fill (high is fill greater than or equal to 30') are to upsized to allow a liner with a field paved invert to be inserted into it at a later date. This upsizing would allow for traffic on the above roadway to continue essentially uninterrupted when a new culvert would need to be placed at that location. The appropriate upsizing was determined to be the design size plus two sizes. The hydraulics program when analyzing the various options would occasionally not calculate the upsized culvert as an option. In these cases a separate culvert analysis was run for the upsized culvert and included with these calculations.

In the deep cut sections of the roadway the ditch analysis was calculated. Rock rubble from the act blasting out the roadway in deep cut sections, is currently being suggested to form the proposed ditch. The ditch velocities were checked to determine if energy dissipaters were necessary.

Where existing culverts under the side roads are to be relocated, existing 100 year flood elevations were determined for those culverts. These existing 100 year flood elevations were used in the design of the relocated culvert crossing, thereby minimizing impacts of flooding to the existing conditions.

Currently there are no oversized storm sewers on this section of the project.

With regards to the LD-33 form, on June 23, 2005 the County Engineer requested that we send him a copy of the culverts at the Stage 1 Review submittal rather than prior to the Stage 1 submittal. Therefore the LD-33 form has not yet been approved by the County Engineer. A copy of the form is attached with these calculations.

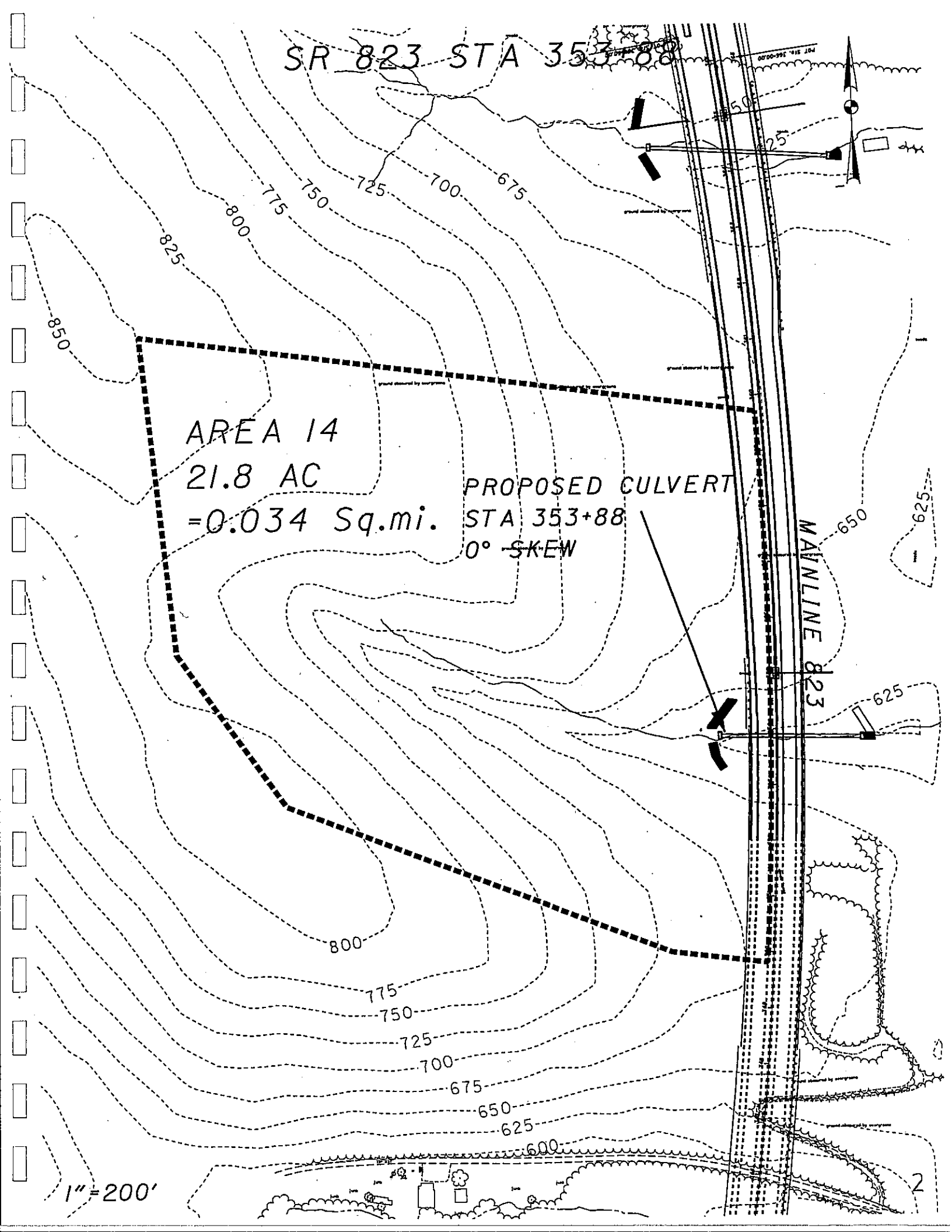
Currently there are no Flood Zone Encroachments in this phase of the project.

The drive pipe under the drive on Flowers-Ison Road at Station 10+50 was analyzed as a culvert. This was due to the upstream pipe being a larger pipe than would be necessary for the driveway design year storm. These calculations for the drive pipe have been included after the calculations for the culvert at Sta. 10+78 Lucasville-Minford Road (CR 28).

For this Phase of the project (Phase 1, SCI-823-6.81) the BMP's consisted of three measures. The first BMP is exfiltration trenches placed along median barriers and the curbs in front of the noise walls. The second BMP is vegetative ditches 15' wide placed for included areas not treated by the exfiltration trenches. The third BMP is an energy protection area placed in the roadway ditch just before the ditch ties into existing stream.

The design of the BMP's utilize an Excel spreadsheet to complete the appropriate calculations.

Culvert Calculations


SR 823 STA 353+88
AREA 14
21.8 AC
=0.034 Sq.mi.
PROPOSED CULVERT
STA 353+88
0° SKEW
MAINLINE 823
850
825
800
775
750
725
700
675
650
625
600
1"=200'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
951425.30	SQ. FT.	
0.034	SQ. MI.	**CONTDA** = Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE** = Storage Area
1425.00	FT.	**TOTAL CHANNEL LENGTH**
142.50	FT.	L_{10} = 10% of the Distance along channel
638	FT.	$Elev_{10}$ = Elevation at point L_{10}
1211.25	FT.	L_{85} = 85% of the Distance along channel
756	FT.	$Elev_{85}$ = Elevation at point L_{85}
1068.75	FT.	**Length** = $L_{85} - L_{10}$
582.96	FT./MI.	**SLOPE** = $(Elev_{10}-Elev_{85})$/Length
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	**11.95**	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	**25.71**	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	**37.25**	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	**53.20**	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	**66.55**	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	**79.79**	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

Worksheet for SR 823 STA 353+88

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.08880	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	66.60	ft^3/s

Results

Normal Depth	0.97	ft
Flow Area	5.77	ft^2
Wetted Perimeter	8.34	ft
Top Width	7.88	ft
Critical Depth	1.57	ft
Critical Slope	0.01398	ft/ft
Velocity	11.54	ft/s
Velocity Head	2.07	ft
Specific Energy	3.04	ft
Froude Number	2.38	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.97	ft
Critical Depth	1.57	ft
Channel Slope	0.08880	ft/ft
Critical Slope	0.01398	ft/ft

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 08/18/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 14, Sta. 353+88 **Designer :** hjs

HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 629.00 **Outlet Invert Elevation (ft.) :** 603.25 **Tailwater Elevation (ft.) :** 603.62 **Overflow Elevation (ft.) :** 650.04

Allowable Headwater Elevation (ft.) : 648.54 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 252.00 **Culvert Slope (ft./ft.) :** 0.1022 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 12.00 @ 50 yrs. **Flood Discharge (cfs) :** 79.80 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
12.00	1	18 in.	631.47	608.30	2 - E	18.49	0.59	1.31	0.0120	INLET	0.00	D	0.00
12.00	1	15 in.	632.80	613.63	2 - E	18.56	0.65	1.22	0.0120	INLET	0.00	D - 1	0.00
12.00	1	12 in.	639.05	632.82	2 - E	17.90	0.80	1.00	0.0120	INLET	0.00	D - 2	0.00
12.00	1	21 in.	631.00	N/A	1 - C	18.25	0.56	1.29	0.0120	INLET	0.00	D + 1	0.00
35.80	1	18 in.	3155.5	765.97	2 - E	23.48	1.21	1.50	0.0120	INLET	44.00	F	0.00
23.60	1	15 in.	30793.	1009.1	2 - E	20.61	1.10	1.25	0.0120	INLET	56.20	F - 1	0.00
14.10	1	12 in.	515700	1867.7	2 - E	17.95	1.00	1.00	0.0120	INLET	65.70	F - 2	0.00
50.80	1	21 in.	895.82	679.67	2 - E	25.89	1.33	1.75	0.0120	INLET	29.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
12.00	1	18 in.	632.25	618.02	2 - E	10.69	0.91	1.31	0.0249	INLET	0.00	D	0.00

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UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
12.00	1	15 in.	634.28	639.28	2 - F	9.85	1.25	1.22	0.0250	OUTLET**	0.00	D - 1	0.00
7.60	1	12 in.	657.22	N/A	2 - F	9.72	1.00	0.98	0.0251	OUTLET**	4.40	D - 2	0.00
12.00	1	21 in.	631.32	610.74	2 - E	10.77	0.82	1.29	0.0248	INLET	0.00	D + 1	0.00
22.00	1	18 in.	11198.	1195.4	2 - F	12.45	1.50	1.48	0.0249	OUTLET**	57.80	F	0.00
13.70	1	15 in.	117792	2143.4	2 - F	11.16	1.25	1.23	0.0250	OUTLET**	66.10	F - 1	0.00
7.60	1	12 in.	189296	5595.1	2 - F	9.68	1.00	0.98	0.0251	OUTLET**	72.20	F - 2	0.00
32.90	1	21 in.	1810.2	868.78	2 - F	13.68	1.75	1.73	0.0248	OUTLET**	46.90	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
12.00	1	36 in.	630.58	N/A	1 - C	9.44	0.71	1.10	0.0281	INLET	0.00	D	0.00
12.00	1	42 in.	630.47	N/A	1 - C	9.35	0.67	1.05	0.0278	INLET	0.00	D + 1	0.00
79.80	1	36 in.	637.20	626.65	2 - E	15.53	2.05	2.77	0.0281	INLET	0.00	F	0.00
79.80	1	42 in.	634.61	615.63	2 - E	15.87	1.81	2.79	0.0278	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
12.00	1	60 in.	630.27	N/A	1 - C	7.89	0.66	0.95	0.0332	INLET	0.00	D	0.00
12.00	1	66 in.	630.24	N/A	1 - C	7.82	0.64	0.93	0.0330	INLET	0.00	D + 1	0.00
79.80	1	60 in.	632.75	N/A	1 - C	13.72	1.69	2.53	0.0332	INLET	0.00	F	0.00
79.80	1	66 in.	632.59	N/A	1 - C	13.67	1.62	2.46	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
12.00	1	60 in.	630.27	N/A	1 - C	9.38	0.58	0.95	0.0260	INLET	0.00	D	0.00
12.00	1	66 in.	630.24	N/A	1 - C	9.24	0.57	0.93	0.0260	INLET	0.00	D + 1	0.00
79.80	1	60 in.	632.75	N/A	1 - C	16.35	1.48	2.53	0.0260	INLET	0.00	F	0.00
79.80	1	66 in.	632.59	N/A	1 - C	16.20	1.43	2.46	0.0260	INLET	0.00	F + 1	0.00

UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)

Inlet Invert Elevation (ft.) : 629.00 **Outlet Invert Elevation (ft.) :** 603.25 **Tailwater Elevation (ft.) :** 604.82 **Overflow Elevation (ft.) :** 650.00

Allowable Headwater Elevation (ft.) : 648.54 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 252.00 **Culvert Slope (ft./ft.) :** 0.1022 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 66.60 @ 50 yrs. **Flood Discharge (cfs) :** 79.79 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall							**Entrance Loss (Ke) :** 0.20			
66.60	1	36 in.	633.84	609.84	2 - E	28.28	1.10	2.61	0.0120	INLET	0.00	D	0.00
66.60	1	33 in.	634.80	611.63	2 - E	28.38	1.15	2.56	0.0120	INLET	0.00	D - 1	0.00
66.60	1	30 in.	636.39	614.77	2 - E	28.46	1.20	2.43	0.0120	INLET	0.00	D - 2	0.00
66.60	1	42 in.	632.94	N/A	1 - C	27.93	1.04	2.56	0.0120	INLET	0.00	D + 1	0.00
79.79	1	36 in.	635.03	611.56	2 - E	29.67	1.22	2.77	0.0120	INLET	0.00	F	0.00
79.79	1	33 in.	636.47	614.17	2 - E	29.77	1.27	2.65	0.0120	INLET	0.00	F - 1	0.00
79.79	1	30 in.	638.77	618.73	2 - E	29.79	1.34	2.46	0.0120	INLET	0.00	F - 2	0.00
79.79	1	42 in.	633.58	609.02	2 - E	29.37	1.14	2.79	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall							**Entrance Loss (Ke) :** 0.90			
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
66.60	1	42 in.	633.54	611.34	2 - E	17.04	1.49	2.56	0.0237	INLET	0.00	D	0.00
66.60	1	36 in.	635.33	617.26	2 - E	16.87	1.64	2.61	0.0241	INLET	0.00	D - 1	0.00
66.60	1	33 in.	636.93	623.27	2 - E	16.76	1.74	2.56	0.0241	INLET	0.00	D - 2	0.00
66.60	1	48 in.	632.84	N/A	1 - C	17.03	1.40	2.46	0.0235	INLET	0.00	D + 1	0.00

CULVERT ANALYSIS

PID : 19415 **Date :** 08/28/2006 **Project :** SCI-823 **Location :** Portsmouth OH

Description :

Designer : hjs

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 629.00 **Outlet Invert Elevation (ft.) :** 603.25

Pipe Quantity : 1

Culvert Type : Circular Corrugated **Pipe Length (ft.) :** 252.00 **Culvert Slope (ft./ft.) :** 0.1022

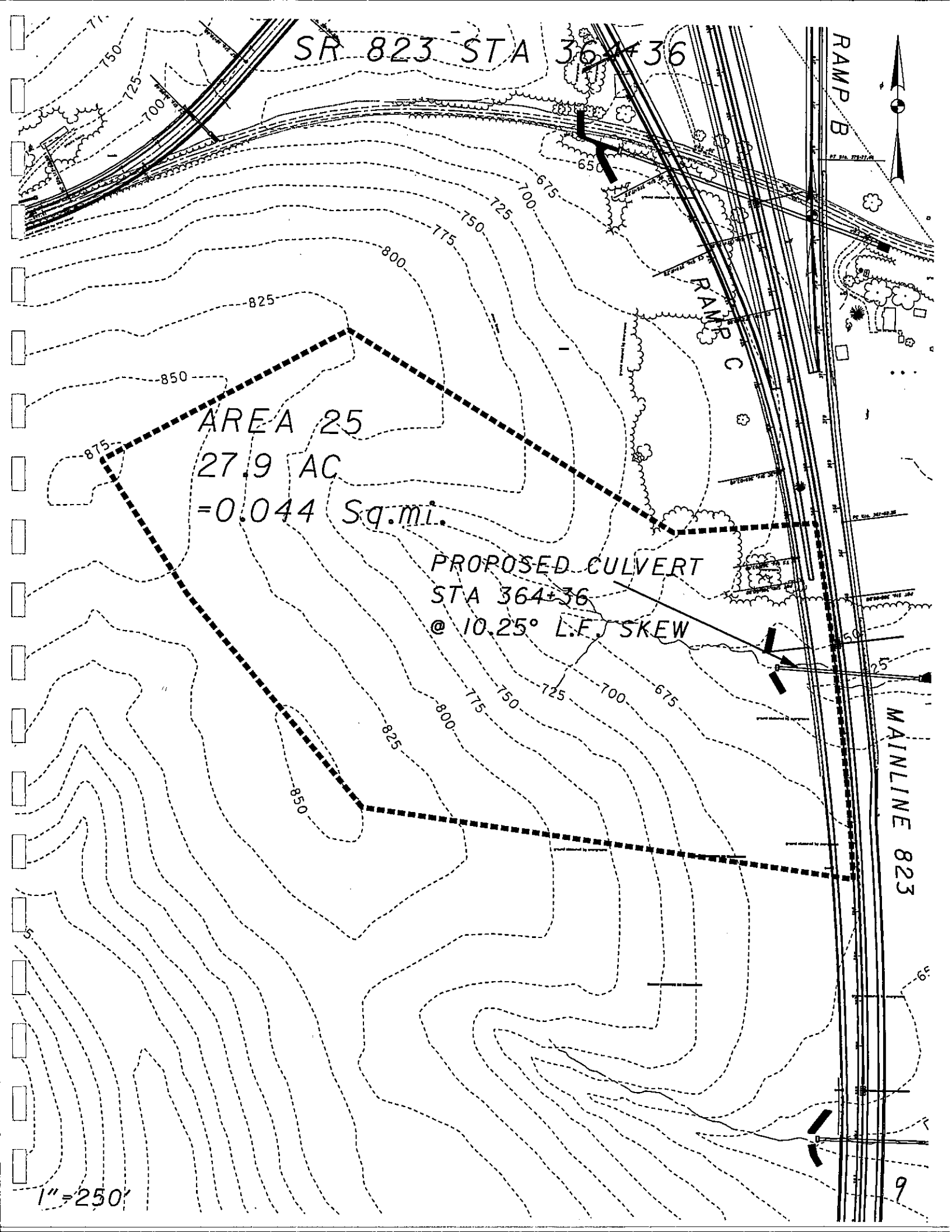
Corrugation Type : Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)

Pipe Size : 72 in.

Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
66.55	24.79	632.13	N/A	1 - C	15.23	1.27	2.18	0.0260	INLET	0.00	603.25
79.80	25.02	632.47	N/A	1 - C	16.06	1.39	2.39	0.0260	INLET	0.00	603.25


SR 823 STA 364+36
RAMP B
RAMP C
MAINLINE 823
AREA 25
27.9 AC
=0.044 Sq.mi.
PROPOSED CULVERT
STA 364+36
@ 10.25° L.F. SKEW
650
675
700
725
750
775
800
825
850
875
1"=250'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
1216219.80	SQ. FT.	
0.044	SQ. MI.	**CONTDA** = Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE** = Storage Area
1527.00	FT.	**TOTAL CHANNEL LENGTH**
152.70	FT.	L_{10} = 10% of the Distance along channel
653	FT.	$Elev_{10}$ = Elevation at point L_{10}
1297.95	FT.	L_{85} = 85% of the Distance along channel
845	FT.	$Elev_{85}$ = Elevation at point L_{85}
1145.25	FT.	**Length** = $L_{85} - L_{10}$
885.19	FT./MI.	**SLOPE** = $(Elev_{10}-Elev_{85})$/Length
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	15.56	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	34.05	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	49.76	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	71.58	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	89.94	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	108.21	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

Worksheet for SR 823 STA 364+36

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.05100	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	89.94	ft^3/s

Results

Normal Depth	1.32	ft
Flow Area	8.73	ft^2
Wetted Perimeter	9.89	ft
Top Width	9.27	ft
Critical Depth	1.85	ft
Critical Slope	0.01344	ft/ft
Velocity	10.30	ft/s
Velocity Head	1.65	ft
Specific Energy	2.96	ft
Froude Number	1.87	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.32	ft
Critical Depth	1.85	ft
Channel Slope	0.05100	ft/ft
Critical Slope	0.01344	ft/ft

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UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 08/16/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 25, Sta. 364+36 **Designer :** hjs

HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 634.07 **Outlet Invert Elevation (ft.) :** 613.04 **Tailwater Elevation (ft.) :** 614.36 **Overflow Elevation (ft.) :** 667.32

Allowable Headwater Elevation (ft.) : 663.30 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 320.00 **Culvert Slope (ft./ft.) :** 0.0657 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 15.60 @ 2 yrs. **Flood Discharge (cfs) :** 108.20 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
15.60	1	18 in.	637.52	621.93	2 - E	16.80	0.78	1.42	0.0120	INLET	0.00	D	0.00
15.60	1	15 in.	639.89	633.18	2 - H	16.46	0.90	1.24	0.0120	INLET	0.00	D - 1	0.00
14.70	1	12 in.	670.24	673.69	2 - G	18.72	1.00	1.00	0.0120	OUTLET	0.90	D - 2	0.00
15.60	1	21 in.	636.59	618.06	2 - E	16.71	0.72	1.46	0.0120	INLET	0.00	D + 1	0.00
39.30	1	18 in.	15894.	972.06	2 - E	22.24	1.50	1.50	0.0120	INLET	68.90	F	0.00
25.80	1	15 in.	164197	1519.8	2 - H	21.02	1.25	1.25	0.0120	INLET	82.40	F - 1	0.00
14.70	1	12 in.	258883	3468.6	2 - G	18.72	1.00	1.00	0.0120	OUTLET	93.50	F - 2	0.00
56.10	1	21 in.	2433.4	778.92	2 - E	23.32	1.75	1.75	0.0120	INLET	52.10	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
15.60	1	21 in.	637.27	627.11	2 - E	9.66	1.11	1.46	0.0248	INLET	0.00	D	0.00

UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
15.60	1	18 in.	638.81	642.54	2 - F	9.02	1.50	1.42	0.0249	OUTLET**	0.00	D - 1	0.00
13.20	1	15 in.	643.25	687.76	2 - G	10.76	1.25	1.23	0.0250	OUTLET	2.40	D - 2	0.00
15.60	1	24 in.	636.53	620.94	2 - E	9.77	1.01	1.42	0.0247	INLET	0.00	D + 1	0.00
32.00	1	21 in.	8277.1	1214.4	2 - F	13.30	1.75	1.72	0.0248	OUTLET**	76.20	F	0.00
21.40	1	18 in.	61198.	1963.7	2 - F	12.11	1.50	1.47	0.0249	OUTLET**	86.80	F - 1	0.00
13.20	1	15 in.	614447	4145.1	2 - G	10.76	1.25	1.23	0.0250	OUTLET	95.00	F - 2	0.00
45.30	1	24 in.	1754.6	912.81	2 - F	14.42	2.00	1.97	0.0247	OUTLET**	62.90	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
15.60	1	36 in.	635.91	N/A	1 - C	8.71	0.90	1.26	0.0281	INLET	0.00	D	0.00
15.60	1	42 in.	635.79	N/A	1 - C	8.64	0.85	1.20	0.0278	INLET	0.00	D + 1	0.00
108.20	1	36 in.	646.95	662.04	2 - F	15.41	3.00	2.92	0.0281	OUTLET**	0.00	F	0.00
108.20	1	42 in.	642.58	636.93	2 - E	14.18	2.59	3.15	0.0278	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
15.60	1	60 in.	635.54	N/A	1 - C	7.32	0.83	1.09	0.0332	INLET	0.00	D	0.00
15.60	1	66 in.	635.49	N/A	1 - C	7.25	0.80	1.06	0.0330	INLET	0.00	D + 1	0.00
108.20	1	60 in.	638.62	N/A	1 - C	12.69	2.24	2.97	0.0332	INLET	0.00	F	0.00
108.20	1	66 in.	638.36	N/A	1 - C	12.69	2.14	2.88	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
15.60	1	60 in.	635.54	N/A	1 - C	8.69	0.74	1.09	0.0260	INLET	0.00	D	0.00
15.60	1	66 in.	635.49	N/A	1 - C	8.57	0.72	1.06	0.0260	INLET	0.00	D + 1	0.00
108.20	1	60 in.	638.62	N/A	1 - C	15.18	1.96	2.97	0.0260	INLET	0.00	F	0.00
108.20	1	66 in.	638.36	N/A	1 - C	15.09	1.88	2.88	0.0260	INLET	0.00	F + 1	0.00

UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)

Inlet Invert Elevation (ft.) : 634.07 **Outlet Invert Elevation (ft.) :** 613.04 **Tailwater Elevation (ft.) :** 614.36 **Overflow Elevation (ft.) :** 667.32

Allowable Headwater Elevation (ft.) : 663.30 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 320.00 **Culvert Slope (ft./ft.) :** 0.0657 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 89.90 @ 50 yrs. **Flood Discharge (cfs) :** 108.20 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
89.90	1	42 in.	639.22	620.05	2 - E	25.89	1.36	2.94	0.0120	INLET	0.00	D	0.00
89.90	1	36 in.	641.15	623.90	2 - E	26.00	1.47	2.85	0.0120	INLET	0.00	D - 1	0.00
89.90	1	33 in.	642.98	627.86	2 - E	25.97	1.55	2.69	0.0120	INLET	0.00	D - 2	0.00
89.90	1	48 in.	638.46	N/A	1 - C	25.66	1.29	2.87	0.0120	INLET	0.00	D + 1	0.00
108.20	1	42 in.	640.42	621.86	2 - E	27.19	1.51	3.15	0.0120	INLET	0.00	F	0.00
108.20	1	36 in.	643.33	627.50	2 - E	27.22	1.65	2.92	0.0120	INLET	0.00	F - 1	0.00
108.20	1	33 in.	646.10	633.31	2 - E	27.05	1.75	2.72	0.0120	INLET	0.00	F - 2	0.00
108.20	1	48 in.	639.17	619.53	2 - E	27.00	1.42	3.15	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
89.90	1	48 in.	639.08	622.06	2 - E	15.70	1.86	2.87	0.0235	INLET	0.00	D	0.00
89.90	1	42 in.	640.63	627.28	2 - E	15.57	2.03	2.94	0.0237	INLET	0.00	D - 1	0.00
89.90	1	36 in.	643.82	640.60	2 - E	14.87	2.39	2.85	0.0241	INLET	0.00	D - 2	0.00
89.90	1	54 in.	638.41	N/A	1 - C	15.73	1.75	2.78	0.0233	INLET	0.00	D + 1	0.00

UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
108.20	1	48 in.	640.26	624.70	2 - E	16.45	2.07	3.15	0.0235	INLET	0.00	F	0.00
108.20	1	42 in.	642.58	632.33	2 - E	16.20	2.29	3.15	0.0237	INLET	0.00	F - 1	0.00
108.20	1	36 in.	646.95	651.69	2 - F	15.41	3.00	2.92	0.0241	OUTLET**	0.00	F - 2	0.00
108.20	1	54 in.	639.14	N/A	1 - C	16.53	1.94	3.06	0.0233	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
89.90	1	48 in.	639.08	623.56	2 - E	13.97	2.04	2.87	0.0275	INLET	0.00	D	0.00
89.90	1	42 in.	640.63	630.46	2 - E	13.74	2.25	2.94	0.0278	INLET	0.00	D - 1	0.00
89.90	1	36 in.	643.82	647.74	2 - F	12.97	3.00	2.85	0.0281	OUTLET**	0.00	D - 2	0.00
89.90	1	54 in.	638.41	N/A	1 - C	14.01	1.91	2.78	0.0273	INLET	0.00	D + 1	0.00
108.20	1	48 in.	640.26	626.88	2 - E	14.61	2.28	3.15	0.0275	INLET	0.00	F	0.00
108.20	1	42 in.	642.58	636.93	2 - E	14.18	2.59	3.15	0.0278	INLET	0.00	F - 1	0.00
108.20	1	36 in.	646.95	662.04	2 - F	15.41	3.00	2.92	0.0281	OUTLET**	0.00	F - 2	0.00
108.20	1	54 in.	639.14	N/A	1 - C	14.70	2.12	3.06	0.0273	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
89.90	1	60 in.	638.09	N/A	1 - C	12.08	2.02	2.69	0.0332	INLET	0.00	D	0.00
89.90	1	66 in.	637.92	N/A	1 - C	12.06	1.93	2.61	0.0330	INLET	0.00	D + 1	0.00
108.20	1	60 in.	638.62	N/A	1 - C	12.69	2.24	2.97	0.0332	INLET	0.00	F	0.00
108.20	1	66 in.	638.36	N/A	1 - C	12.69	2.14	2.88	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
89.90	1	60 in.	638.09	N/A	1 - C	14.43	1.77	2.69	0.0260	INLET	0.00	D	0.00
89.90	1	66 in.	637.92	N/A	1 - C	14.32	1.71	2.61	0.0260	INLET	0.00	D + 1	0.00
108.20	1	60 in.	638.62	N/A	1 - C	15.18	1.96	2.97	0.0260	INLET	0.00	F	0.00
108.20	1	66 in.	638.36	N/A	1 - C	15.09	1.88	2.88	0.0260	INLET	0.00	F + 1	0.00

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 05/16/2005 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : hjs

Description : Drainage area 25, Sta. 364+36

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 634.07 **Outlet Invert Elevation (ft.) :** 613.04 **Tailwater Elevation (ft.) :** 614.36 **Overflow Elevation (ft.) :** 667.32

Allowable Headwater Elevation (ft.) : 663.30 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 320.00 **Culvert Slope (ft./ft.) :** 0.0657 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 15.60 @ 50 yrs. **Flood Discharge (cfs) :** 108.20 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
15.60	1	18 in.	637.52	621.93	2 - E	16.80	0.78	1.42	0.0120	INLET	0.00	D	0.00
15.60	1	15 in.	639.89	633.18	2 - H	16.46	0.90	1.24	0.0120	INLET	0.00	D - 1	0.00
14.70	1	12 in.	670.24	673.69	2 - G	18.72	1.00	1.00	0.0120	OUTLET	0.90	D - 2	0.00
15.60	1	21 in.	636.59	618.06	2 - E	16.71	0.72	1.46	0.0120	INLET	0.00	D + 1	0.00
39.30	1	18 in.	15894.	972.06	2 - E	22.24	1.50	1.50	0.0120	INLET	68.90	F	0.00
25.80	1	15 In.	164197	1519.8	2 - H	21.02	1.25	1.25	0.0120	INLET	82.40	F - 1	0.00
14.70	1	12 in.	258883	3468.6	2 - G	18.72	1.00	1.00	0.0120	OUTLET	93.50	F - 2	0.00
56.10	1	21 in.	2433.4	778.92	2 - E	23.32	1.75	1.75	0.0120	INLET	52.10	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
15.60	1	21 in.	637.27	627.11	2 - E	9.66	1.11	1.46	0.0248	INLET	0.00	D	0.00

UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
15.60	1	18 in.	638.81	642.54	2 - F	9.02	1.50	1.42	0.0249	OUTLET**	0.00	D - 1	0.00
13.20	1	15 in.	643.25	687.76	2 - G	10.76	1.25	1.23	0.0250	OUTLET	2.40	D - 2	0.00
15.60	1	24 in.	636.53	620.94	2 - E	9.77	1.01	1.42	0.0247	INLET	0.00	D + 1	0.00
32.00	1	21 in.	8277.1	1214.4	2 - F	13.30	1.75	1.72	0.0248	OUTLET**	76.20	F	0.00
21.40	1	18 in.	61198.	1963.7	2 - F	12.11	1.50	1.47	0.0249	OUTLET**	86.80	F - 1	0.00
13.20	1	15 in.	614447	4145.1	2 - G	10.76	1.25	1.23	0.0250	OUTLET	95.00	F - 2	0.00
45.30	1	24 in.	1754.6	912.81	2 - F	14.42	2.00	1.97	0.0247	OUTLET**	62.90	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
15.60	1	36 in.	635.91	N/A	1 - C	8.71	0.90	1.26	0.0281	INLET	0.00	D	0.00
15.60	1	42 in.	635.79	N/A	1 - C	8.64	0.85	1.20	0.0278	INLET	0.00	D + 1	0.00
108.20	1	36 in.	646.95	662.04	2 - F	15.41	3.00	2.92	0.0281	OUTLET**	0.00	F	0.00
108.20	1	42 in.	642.58	636.93	2 - E	14.18	2.59	3.15	0.0278	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
15.60	1	60 in.	635.54	N/A	1 - C	7.32	0.83	1.09	0.0332	INLET	0.00	D	0.00
15.60	1	66 in.	635.49	N/A	1 - C	7.25	0.80	1.06	0.0330	INLET	0.00	D + 1	0.00
108.20	1	60 in.	638.62	N/A	1 - C	12.69	2.24	2.97	0.0332	INLET	0.00	F	0.00
108.20	1	66 in.	638.36	N/A	1 - C	12.69	2.14	2.88	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
15.60	1	60 in.	635.54	N/A	1 - C	8.69	0.74	1.09	0.0260	INLET	0.00	D	0.00
15.60	1	66 in.	635.49	N/A	1 - C	8.57	0.72	1.06	0.0260	INLET	0.00	D + 1	0.00
108.20	1	60 in.	638.62	N/A	1 - C	15.18	1.96	2.97	0.0260	INLET	0.00	F	0.00
108.20	1	66 in.	638.36	N/A	1 - C	15.09	1.88	2.88	0.0260	INLET	0.00	F + 1	0.00

UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)

Inlet Invert Elevation (ft.) : 634.07 **Outlet Invert Elevation (ft.) :** 613.04 **Tailwater Elevation (ft.) :** 614.36 **Overflow Elevation (ft.) :** 667.32

Allowable Headwater Elevation (ft.) : 663.30 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 320.00 **Culvert Slope (ft./ft.) :** 0.0657 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 89.90 @ 50 yrs. **Flood Discharge (cfs) :** 108.20 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall							**Entrance Loss (Ke) :** 0.20			
89.90	1	42 in.	639.22	620.05	2 - E	25.89	1.36	2.94	0.0120	INLET	0.00	D	0.00
89.90	1	36 in.	641.15	623.90	2 - E	26.00	1.47	2.85	0.0120	INLET	0.00	D - 1	0.00
89.90	1	33 in.	642.98	627.86	2 - E	25.97	1.55	2.69	0.0120	INLET	0.00	D - 2	0.00
89.90	1	48 in.	638.46	N/A	1 - C	25.66	1.29	2.87	0.0120	INLET	0.00	D + 1	0.00
108.20	1	42 in.	640.42	621.86	2 - E	27.19	1.51	3.15	0.0120	INLET	0.00	F	0.00
108.20	1	36 in.	643.33	627.50	2 - E	27.22	1.65	2.92	0.0120	INLET	0.00	F - 1	0.00
108.20	1	33 in.	646.10	633.31	2 - E	27.05	1.75	2.72	0.0120	INLET	0.00	F - 2	0.00
108.20	1	48 in.	639.17	619.53	2 - E	27.00	1.42	3.15	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall							**Entrance Loss (Ke) :** 0.90			
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
89.90	1	48 in.	639.08	622.06	2 - E	15.70	1.86	2.87	0.0235	INLET	0.00	D	0.00
89.90	1	42 in.	640.63	627.28	2 - E	15.57	2.03	2.94	0.0237	INLET	0.00	D - 1	0.00
89.90	1	36 in.	643.82	640.60	2 - E	14.87	2.39	2.85	0.0241	INLET	0.00	D - 2	0.00
89.90	1	54 in.	638.41	N/A	1 - C	15.73	1.75	2.78	0.0233	INLET	0.00	D + 1	0.00

UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
108.20	1	48 in.	640.26	624.70	2 - E	16.45	2.07	3.15	0.0235	INLET	0.00	F	0.00
108.20	1	42 in.	642.58	632.33	2 - E	16.20	2.29	3.15	0.0237	INLET	0.00	F - 1	0.00
108.20	1	36 in.	646.95	651.69	2 - F	15.41	3.00	2.92	0.0241	OUTLET**	0.00	F - 2	0.00
108.20	1	54 in.	639.14	N/A	1 - C	16.53	1.94	3.06	0.0233	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
89.90	1	48 in.	639.08	623.56	2 - E	13.97	2.04	2.87	0.0275	INLET	0.00	D	0.00
89.90	1	42 in.	640.63	630.46	2 - E	13.74	2.25	2.94	0.0278	INLET	0.00	D - 1	0.00
89.90	1	36 in.	643.82	647.74	2 - F	12.97	3.00	2.85	0.0281	OUTLET**	0.00	D - 2	0.00
89.90	1	54 in.	638.41	N/A	1 - C	14.01	1.91	2.78	0.0273	INLET	0.00	D + 1	0.00
108.20	1	48 in.	640.26	626.88	2 - E	14.61	2.28	3.15	0.0275	INLET	0.00	F	0.00
108.20	1	42 in.	642.58	636.93	2 - E	14.18	2.59	3.15	0.0278	INLET	0.00	F - 1	0.00
108.20	1	36 in.	646.95	662.04	2 - F	15.41	3.00	2.92	0.0281	OUTLET**	0.00	F - 2	0.00
108.20	1	54 in.	639.14	N/A	1 - C	14.70	2.12	3.06	0.0273	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
89.90	1	60 in.	638.09	N/A	1 - C	12.08	2.02	2.69	0.0332	INLET	0.00	D	0.00
89.90	1	66 in.	637.92	N/A	1 - C	12.06	1.93	2.61	0.0330	INLET	0.00	D + 1	0.00
108.20	1	60 in.	638.62	N/A	1 - C	12.69	2.24	2.97	0.0332	INLET	0.00	F	0.00
108.20	1	66 in.	638.36	N/A	1 - C	12.69	2.14	2.88	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
89.90	1	60 in.	638.09	N/A	1 - C	14.43	1.77	2.69	0.0260	INLET	0.00	D	0.00
89.90	1	66 in.	637.92	N/A	1 - C	14.32	1.71	2.61	0.0260	INLET	0.00	D + 1	0.00
108.20	1	60 in.	638.62	N/A	1 - C	15.18	1.96	2.97	0.0260	INLET	0.00	F	0.00
108.20	1	66 in.	638.36	N/A	1 - C	15.09	1.88	2.88	0.0260	INLET	0.00	F + 1	0.00

CULVERT ANALYSIS

PID : 19415 **Date :** 08/28/2006 **Project :** SCI-823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage Area 25, Sta. 364+36 **Designer :** hjs

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 634.07 **Outlet Invert Elevation (ft.) :** 613.04

Pipe Quantity : 1

Culvert Type : Circular Corrugated **Pipe Length (ft.) :** 320.00 **Culvert Slope (ft./ft.) :** 0.0657

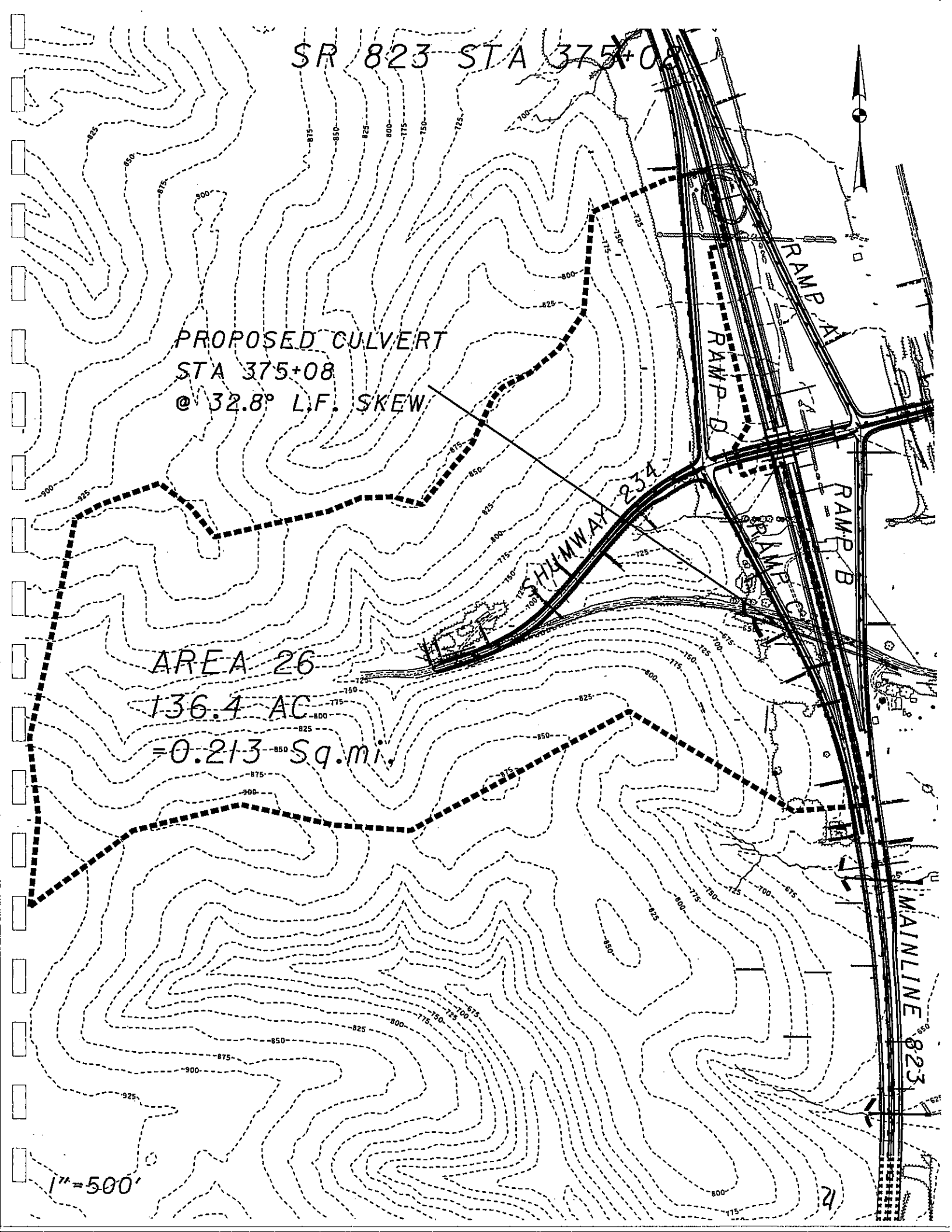
Corrugation Type : Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)

Pipe Size : 72 in.

Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
89.90	20.47	637.78	N/A	1 - C	14.21	1.65	2.55	0.0260	INLET	0.00	613.04
108.20	20.75	638.19	N/A	1 - C	14.97	1.82	2.80	0.0260	INLET	0.00	613.04


SR 823 STA 375+08
PROPOSED CULVERT
STA 375+08
@ 32.8° L.F. SKEW
AREA 26
136.4 AC
=0.213 Sq.mi.
RAMP A
RAMP D
RAMP B
RAMP C
STATE HIGHWAY 234
MAINLINE 823
1"=500'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
5940403.50	SQ. FT.	
0.213	SQ. MI.	**CONTDA** = Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE** = Storage Area
3900.00	FT.	**TOTAL CHANNEL LENGTH**
390.00	FT.	L_{10} = 10% of the Distance along channel
639	FT.	$Elev_{10}$ = Elevation at point L_{10}
3315.00	FT.	L_{85} = 85% of the Distance along channel
867	FT.	$Elev_{85}$ = Elevation at point L_{85}
2925.00	FT.	**Length** = $L_{85} - L_{10}$
410.67	FT./MI.	**SLOPE** = $(Elev_{10}-Elev_{85})$/Length
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	47.14	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	97.30	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	138.59	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	195.10	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	241.71	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	288.37	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

Worksheet for SR 823 STA 375+08

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.05100	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	89.94	ft^3/s

Results

Normal Depth	1.32	ft
Flow Area	8.73	ft^2
Wetted Perimeter	9.89	ft
Top Width	9.27	ft
Critical Depth	1.85	ft
Critical Slope	0.01344	ft/ft
Velocity	10.30	ft/s
Velocity Head	1.65	ft
Specific Energy	2.96	ft
Froude Number	1.87	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.32	ft
Critical Depth	1.85	ft
Channel Slope	0.05100	ft/ft
Critical Slope	0.01344	ft/ft

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 07/26/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 26, Sta. 375+08 **Designer :** hjs

HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 645.59 **Outlet Invert Elevation (ft.) :** 621.69 **Tailwater Elevation (ft.) :** 623.01 **Overflow Elevation (ft.) :** 682.62

Allowable Headwater Elevation (ft.) : 677.24 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 612.00 **Culvert Slope (ft./ft.) :** 0.0391 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 47.10 @ 2 yrs. **Flood Discharge (cfs) :** 288.40 @ 100 yrs.

	FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH				**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
	47.10	1	33 in.	649.46	629.48	2 - E	18.20	1.24	2.27	0.0120	INLET	0.00	D	0.00
	47.10	1	30 in.	650.18	632.62	2 - E	18.21	1.30	2.26	0.0120	INLET	0.00	D - 1	0.00
	47.10	1	27 in.	651.48	638.50	2 - E	18.09	1.40	2.16	0.0120	INLET	0.00	D - 2	0.00
	47.10	1	36 in.	649.07	N/A	1 - C	18.13	1.19	2.23	0.0120	INLET	0.00	D + 1	0.00
	156.20	1	33 in.	1761.6	822.57	2 - F	26.30	2.75	2.74	0.0120	OUTLET**	132.20	F	0.00
	123.10	1	30 in.	5058.9	944.86	2 - F	25.08	2.50	2.49	0.0120	OUTLET**	165.30	F - 1	0.00
	94.40	1	27 in.	19527.	1171.6	2 - F	23.74	2.25	2.24	0.0120	OUTLET**	194.00	F - 2	0.00
	194.00	1	36 in.	953.41	752.65	2 - F	27.45	3.00	2.99	0.0120	OUTLET**	94.40	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED				**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)														
	47.10	1	36 in.	649.65	636.05	2 - E	10.75	1.78	2.23	0.0241	INLET	0.00	D	0.00

HZ

UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
47.10	1	33 in.	650.45	642.64	2 - E	10.62	1.92	2.27	0.0241	INLET	0.00	D - 1	0.00
47.10	1	30 in.	651.75	655.05	2 - F	10.09	2.50	2.26	0.0244	OUTLET**	0.00	D - 2	0.00
47.10	1	42 in.	648.92	N/A	1 - C	10.92	1.61	2.14	0.0237	INLET	0.00	D + 1	0.00
104.60	1	36 in.	2004.8	1064.8	2 - F	14.80	3.00	2.91	0.0241	OUTLET**	183.80	F	0.00
83.60	1	33 in.	5512.5	1315.9	2 - F	14.08	2.75	2.67	0.0241	OUTLET**	204.80	F - 1	0.00
64.70	1	30 in.	19081.	1785.9	2 - F	13.18	2.50	2.42	0.0244	OUTLET**	223.70	F - 2	0.00
157.50	1	42 in.	777.27	817.89	2 - F	16.49	3.50	3.41	0.0237	OUTLET**	130.90	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
47.10	1	36 in.	649.65	639.80	2 - E	9.52	1.98	2.23	0.0281	INLET	0.00	D	0.00
47.10	1	42 in.	648.92	N/A	1 - C	9.70	1.76	2.14	0.0278	INLET	0.00	D + 1	0.00
91.10	1	36 in.	2004.8	1205.4	2 - F	12.89	3.00	2.85	0.0281	OUTLET**	197.30	F	0.00
136.90	1	42 in.	777.27	880.37	2 - F	14.46	3.50	3.34	0.0278	OUTLET**	151.50	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
47.10	1	60 in.	648.37	N/A	1 - C	8.37	1.64	1.92	0.0332	INLET	0.00	D	0.00
47.10	1	66 in.	648.25	N/A	1 - C	8.34	1.58	1.87	0.0330	INLET	0.00	D + 1	0.00
288.40	1	60 in.	659.41	681.54	2 - F	15.21	5.00	4.62	0.0332	OUTLET**	0.00	F	0.00
288.40	1	66 in.	656.42	660.06	2 - F	13.36	5.50	4.69	0.0330	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
47.10	1	60 in.	648.37	N/A	1 - C	9.98	1.45	1.92	0.0260	INLET	0.00	D	0.00
47.10	1	66 in.	648.25	N/A	1 - C	9.89	1.40	1.87	0.0260	INLET	0.00	D + 1	0.00
288.40	1	60 in.	659.41	662.72	2 - F	15.21	5.00	4.62	0.0260	OUTLET**	0.00	F	0.00
288.40	1	66 in.	656.42	649.09	2 - E	15.73	3.96	4.69	0.0260	INLET	0.00	F + 1	0.00

UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)

Inlet Invert Elevation (ft.) : 645.59 **Outlet Invert Elevation (ft.) :** 621.69 **Tailwater Elevation (ft.) :** 623.01 **Overflow Elevation (ft.) :** 682.62

Allowable Headwater Elevation (ft.) : 677.24 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 612.00 **Culvert Slope (ft./ft.) :** 0.0391 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 241.70 @ 50 yrs. **Flood Discharge (cfs) :** 288.40 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
241.70	1	66 in.	652.65	631.23	2 - E	27.28	2.20	4.34	0.0120	INLET	0.00	D	0.00
241.70	1	60 in.	653.76	633.66	2 - E	27.38	2.30	4.37	0.0120	INLET	0.00	D - 1	0.00
241.70	1	54 in.	655.86	638.20	2 - E	27.38	2.45	4.25	0.0120	INLET	0.00	D - 2	0.00
241.70	1	72 in.	652.05	N/A	1 - C	27.12	2.12	4.26	0.0120	INLET	0.00	D + 1	0.00
288.40	1	66 in.	653.99	633.36	2 - E	28.60	2.42	4.69	0.0120	INLET	0.00	F	0.00
288.40	1	60 in.	655.74	636.88	2 - E	28.64	2.55	4.62	0.0120	INLET	0.00	F - 1	0.00
288.40	1	54 in.	658.81	643.40	2 - E	28.50	2.74	4.37	0.0120	INLET	0.00	F - 2	0.00
288.40	1	72 in.	653.02	631.36	2 - E	28.49	2.33	4.65	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
241.70	1	72 in.	652.92	635.13	2 - E	16.87	3.03	4.26	0.0229	INLET	0.00	D	0.00
241.70	1	66 in.	654.17	639.62	2 - E	16.72	3.22	4.34	0.0231	INLET	0.00	D - 1	0.00
241.70	1	60 in.	656.32	647.54	2 - E	16.45	3.50	4.37	0.0232	INLET	0.00	D - 2	0.00
241.70	1	78 in.	652.21	N/A	1 - C	16.91	2.90	4.16	0.0228	INLET	0.00	D + 1	0.00

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UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
288.40	1	72 in.	654.50	638.84	2 - E	17.61	3.37	4.65	0.0229	INLET	0.00	F	0.00
288.40	1	66 in.	656.42	645.31	2 - E	17.35	3.63	4.69	0.0231	INLET	0.00	F - 1	0.00
288.40	1	60 in.	659.41	656.63	2 - E	16.74	4.10	4.62	0.0232	INLET	0.00	F - 2	0.00
288.40	1	78 in.	653.35	N/A	1 - C	17.70	3.20	4.56	0.0228	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
241.70	1	72 in.	652.92	637.34	2 - E	15.02	3.33	4.26	0.0267	INLET	0.00	D	0.00
241.70	1	66 in.	654.17	643.16	2 - E	14.83	3.57	4.34	0.0269	INLET	0.00	D - 1	0.00
241.70	1	60 in.	656.32	653.62	2 - E	14.33	4.01	4.37	0.0271	INLET	0.00	D - 2	0.00
241.70	1	78 in.	652.21	N/A	1 - C	15.08	3.16	4.16	0.0266	INLET	0.00	D + 1	0.00
288.40	1	72 in.	654.50	641.99	2 - E	15.63	3.73	4.65	0.0267	INLET	0.00	F	0.00
288.40	1	66 in.	656.42	650.35	2 - E	15.28	4.08	4.69	0.0269	INLET	0.00	F - 1	0.00
288.40	1	60 in.	659.41	665.29	2 - F	15.21	5.00	4.62	0.0271	OUTLET**	0.00	F - 2	0.00
288.40	1	78 in.	653.35	N/A	1 - C	15.75	3.51	4.56	0.0266	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
241.70	1	72 in.	652.92	641.52	2 - E	12.83	3.79	4.26	0.0327	INLET	0.00	D	0.00
241.70	1	66 in.	654.17	649.98	2 - E	12.49	4.18	4.34	0.0330	INLET	0.00	D - 1	0.00
241.70	1	60 in.	656.32	665.03	2 - F	13.28	5.00	4.37	0.0332	OUTLET**	0.00	D - 2	0.00
241.70	1	78 in.	652.21	N/A	1 - C	12.97	3.57	4.16	0.0325	INLET	0.00	D + 1	0.00
288.40	1	72 in.	654.50	647.94	2 - E	13.25	4.31	4.65	0.0327	INLET	0.00	F	0.00
288.40	1	66 in.	656.42	660.06	2 - F	13.36	5.50	4.69	0.0330	OUTLET**	0.00	F - 1	0.00
288.40	1	60 in.	659.41	681.54	2 - F	15.21	5.00	4.62	0.0332	OUTLET**	0.00	F - 2	0.00
288.40	1	78 in.	653.35	N/A	1 - C	13.49	3.99	4.56	0.0325	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
241.70	1	72 in.	652.92	636.90	2 - E	15.33	3.27	4.26	0.0260	INLET	0.00	D	0.00

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UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
241.70	1	66 in.	654.17	642.27	2 - E	15.24	3.48	4.34	0.0260	INLET	0.00	D - 1	0.00
241.70	1	60 in.	656.32	651.81	2 - E	14.90	3.85	4.37	0.0260	INLET	0.00	D - 2	0.00
241.70	1	78 in.	652.21	N/A	1 - C	15.34	3.12	4.16	0.0260	INLET	0.00	D + 1	0.00
288.40	1	72 in.	654.50	641.37	2 - E	15.96	3.66	4.65	0.0260	INLET	0.00	F	0.00
288.40	1	66 in.	656.42	649.09	2 - E	15.73	3.96	4.69	0.0260	INLET	0.00	F - 1	0.00
288.40	1	60 in.	659.41	662.72	2 - F	15.21	5.00	4.62	0.0260	OUTLET**	0.00	F - 2	0.00
288.40	1	78 in.	653.35	N/A	1 - C	16.03	3.47	4.56	0.0260	INLET	0.00	F + 1	0.00

CULVERT ANALYSIS

PID : 19415 **Date :** 08/31/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage Area 26, Sta. 375+08 **Designer :** hjs

HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 645.59 **Outlet Invert Elevation (ft.) :** 621.69
Pipe Quantity : 1

Culvert Type : Circular Corrugated **Pipe Length (ft.) :** 612.00 **Culvert Slope (ft./ft.) :** 0.0391
Corrugation Type : Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)
Pipe Size : 90 in.
Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
241.70	24.10	651.54	N/A	1 - C	15.27	2.91	3.99	0.0260	INLET	0.00	621.69
288.40	24.63	652.26	N/A	1 - C	16.01	3.21	4.37	0.0260	INLET	0.00	621.69

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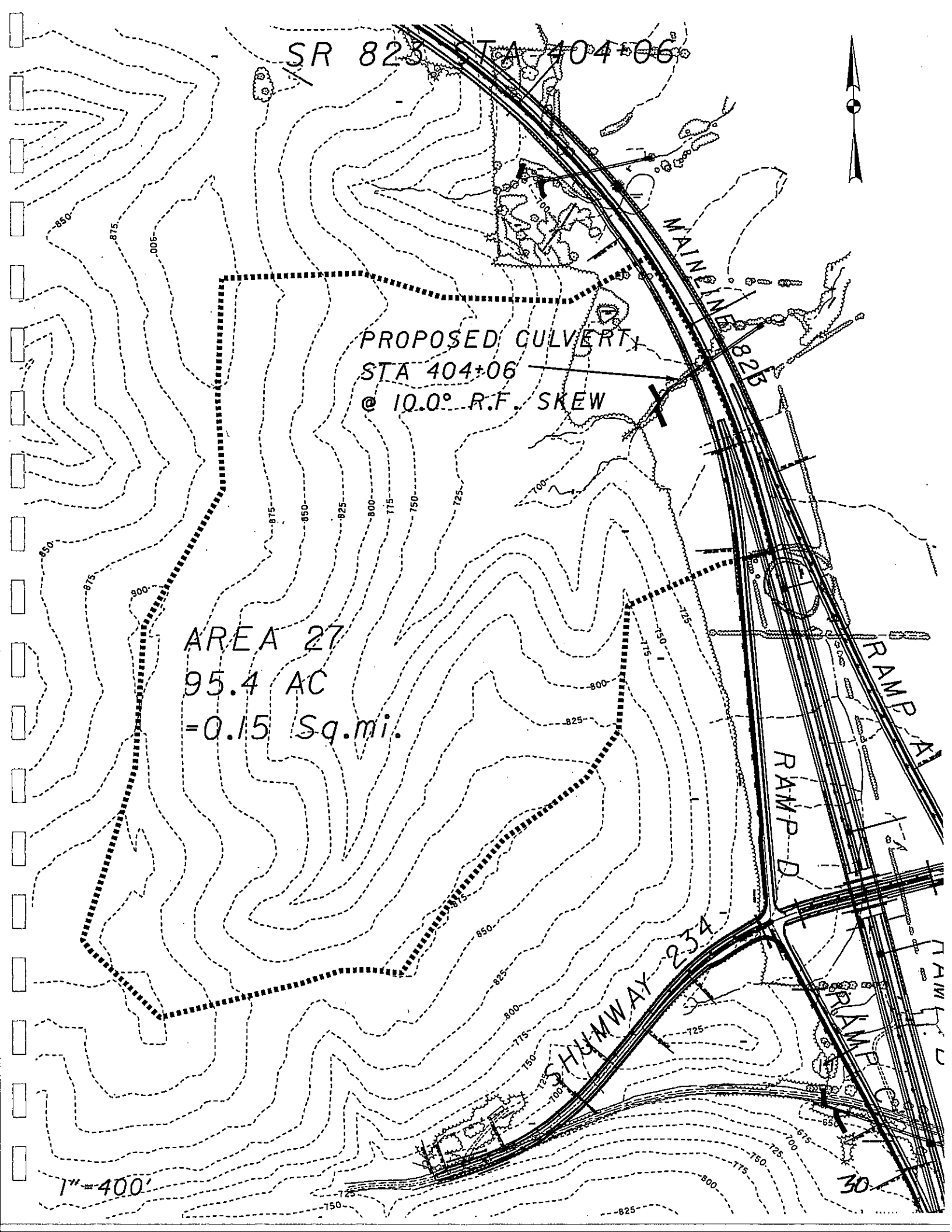
SR 823 STA 404+06
MAINLINE 823
PROPOSED CULVERT
STA 404+06
@ 10.0° R.F. SKEW
AREA 27
95.4 AC
=0.15 Sq.mi.
RAMP A
RAMP D
RAMP C
SHUMWAY 234
1"=400'
30

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
4156484.00	SQ. FT.	
0.149	SQ. MI.	**CONTDA =** Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE =** Storage Area
3134.00	FT.	**TOTAL CHANNEL LENGTH**
313.40	FT.	L_{10} = 10% of the Distance along channel
675	FT.	$Elev_{10}$ = Elevation at point L_{10}
2663.90	FT.	L_{85} = 85% of the Distance along channel
822	FT.	$Elev_{85}$ = Elevation at point L_{85}
2350.50	FT.	**Length =** $L_{85} - L_{10}$
330.21	FT./MI.	**SLOPE =** $(Elev_{10}-Elev_{85})$/Length
	CFS	$Q_{\#}$ = Flood-Peak Discharge # = Frequency of Storm

Q_2	34.34	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	70.45	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	100.03	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	140.40	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	173.68	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	206.87	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

Worksheet for SR 823 STA 404+06

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.040	
Channel Slope	0.02410	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	6.00	ft
Discharge	173.70	ft^3/s

Results

Normal Depth	2.23	ft
Flow Area	23.38	ft^2
Wetted Perimeter	15.99	ft
Top Width	14.93	ft
Critical Depth	2.29	ft
Critical Slope	0.02186	ft/ft
Velocity	7.43	ft/s
Velocity Head	0.86	ft
Specific Energy	3.09	ft
Froude Number	1.05	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.23	ft
Critical Depth	2.29	ft
Channel Slope	0.02410	ft/ft
Critical Slope	0.02186	ft/ft

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 12/23/2005 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : hjs

Description : Drainage area 27, Sta. 404+06

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 674.32 **Outlet Invert Elevation (ft.) :** 663.21 **Tailwater Elevation (ft.) :** 665.44 **Overflow Elevation (ft.) :** 722.51

Allowable Headwater Elevation (ft.) : 720.51 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 396.00 **Culvert Slope (ft./ft.) :** 0.0281 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 173.70 @ 50 yrs. **Flood Discharge (cfs) :** 206.90 @ 100 yrs.

	FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH				**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
	173.70	1	60 in.	680.25	N/A	1 - C	22.23	2.10	3.78	0.0120	INLET	0.00	D	0.00
	173.70	1	54 in.	681.15	672.22	2 - E	22.28	2.22	3.83	0.0120	INLET	0.00	D - 1	0.00
	173.70	1	48 in.	683.01	675.55	2 - E	22.20	2.39	3.75	0.0120	INLET	0.00	D - 2	0.00
	173.70	1	66 in.	679.80	N/A	1 - C	22.11	2.01	3.69	0.0120	INLET	0.00	D + 1	0.00
	206.90	1	60 in.	681.25	671.95	2 - E	23.26	2.32	4.10	0.0120	INLET	0.00	F	0.00
	206.90	1	54 in.	682.69	674.37	2 - E	23.27	2.46	4.08	0.0120	INLET	0.00	F - 1	0.00
	206.90	1	48 in.	685.44	679.15	2 - E	23.02	2.69	3.86	0.0120	INLET	0.00	F - 2	0.00
	206.90	1	66 in.	680.53	N/A	1 - C	23.18	2.21	4.03	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED				**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)														
	173.70	1	60 in.	681.31	675.49	2 - E	13.51	3.11	3.78	0.0232	INLET	0.00	D	0.00

UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
173.70	1	54 in.	683.11	680.76	2 - E	13.15	3.48	3.83	0.0233	INLET	0.00	D - 1	0.00
173.70	1	48 in.	686.22	691.54	2 - F	14.20	4.00	3.75	0.0235	OUTLET**	0.00	D - 2	0.00
173.70	1	66 in.	680.35	N/A	1 - C	13.64	2.91	3.69	0.0231	INLET	0.00	D + 1	0.00
206.90	1	60 in.	682.99	678.95	2 - E	13.96	3.53	4.10	0.0232	INLET	0.00	F	0.00
206.90	1	54 in.	685.58	686.50	2 - F	13.65	4.50	4.08	0.0233	OUTLET**	0.00	F - 1	0.00
206.90	1	48 in.	689.70	701.84	2 - F	16.64	4.00	3.86	0.0235	OUTLET**	0.00	F - 2	0.00
206.90	1	66 in.	681.49	674.93	2 - E	14.20	3.24	4.03	0.0231	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
173.70	1	60 in.	681.31	677.52	2 - E	11.92	3.48	3.78	0.0271	INLET	0.00	D	0.00
173.70	1	54 in.	683.11	684.44	2 - F	12.04	4.50	3.83	0.0273	OUTLET**	0.00	D - 1	0.00
173.70	1	48 in.	686.22	698.49	2 - F	14.20	4.00	3.75	0.0275	OUTLET**	0.00	D - 2	0.00
173.70	1	66 in.	680.35	N/A	1 - C	12.13	3.20	3.69	0.0269	INLET	0.00	D + 1	0.00
206.90	1	60 in.	682.99	681.83	2 - E	12.15	4.05	4.10	0.0271	INLET	0.00	F	0.00
206.90	1	54 in.	685.58	691.72	2 - F	13.65	4.50	4.08	0.0273	OUTLET**	0.00	F - 1	0.00
206.90	1	48 in.	689.70	711.70	2 - F	16.64	4.00	3.86	0.0275	OUTLET**	0.00	F - 2	0.00
206.90	1	66 in.	681.49	676.61	2 - E	12.59	3.59	4.03	0.0269	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
173.70	1	66 in.	680.35	N/A	1 - C	10.32	3.67	3.69	0.0330	INLET	0.00	D	0.00
173.70	1	60 in.	681.31	681.39	2 - F	10.92	4.18	3.78	0.0332	OUTLET*	0.00	D - 1	0.00
173.70	1	72 in.	679.85	N/A	1 - C	10.49	3.41	3.59	0.0327	INLET	0.00	D + 1	0.00
206.90	1	66 in.	681.49	681.84	2 - F	11.10	4.21	4.03	0.0330	OUTLET*	0.00	F	0.00
206.90	1	60 in.	682.99	687.24	2 - F	12.01	5.00	4.10	0.0332	OUTLET**	0.00	F - 1	0.00
206.90	1	72 in.	680.66	N/A	1 - C	10.90	3.82	3.93	0.0327	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													

UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
173.70	1	60 in.	681.31	676.91	2 - E	12.33	3.37	3.78	0.0260	INLET	0.00	D	0.00
173.70	1	66 in.	680.35	N/A	1 - C	12.46	3.13	3.69	0.0260	INLET	0.00	D + 1	0.00
206.90	1	60 in.	682.99	680.98	2 - E	12.64	3.88	4.10	0.0260	INLET	0.00	F	0.00
206.90	1	66 in.	681.49	676.19	2 - E	12.94	3.51	4.03	0.0260	INLET	0.00	F + 1	0.00

CULVERT ANALYSIS

PID : 19415 **Date :** 08/31/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage Area 27, Sta. 404+06 **Designer :** hjs

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 674.32 **Outlet Invert Elevation (ft.) :** 663.21

Pipe Quantity : 1

Culvert Type : Circular Corrugated **Pipe Length (ft.) :** 396.00 **Culvert Slope (ft./ft.) :** 0.0281

Corrugation Type : Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)

Pipe Size : 78 in.

Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
173.70	11.35	679.56	N/A	1 - C	12.46	2.84	3.50	0.0260	INLET	0.00	663.21
206.90	11.82	680.20	N/A	1 - C	13.03	3.14	3.84	0.0260	INLET	0.00	663.21
240.10	12.37	680.90	N/A	1 - C	13.53	3.43	4.15	0.0260	INLET	0.00	663.21

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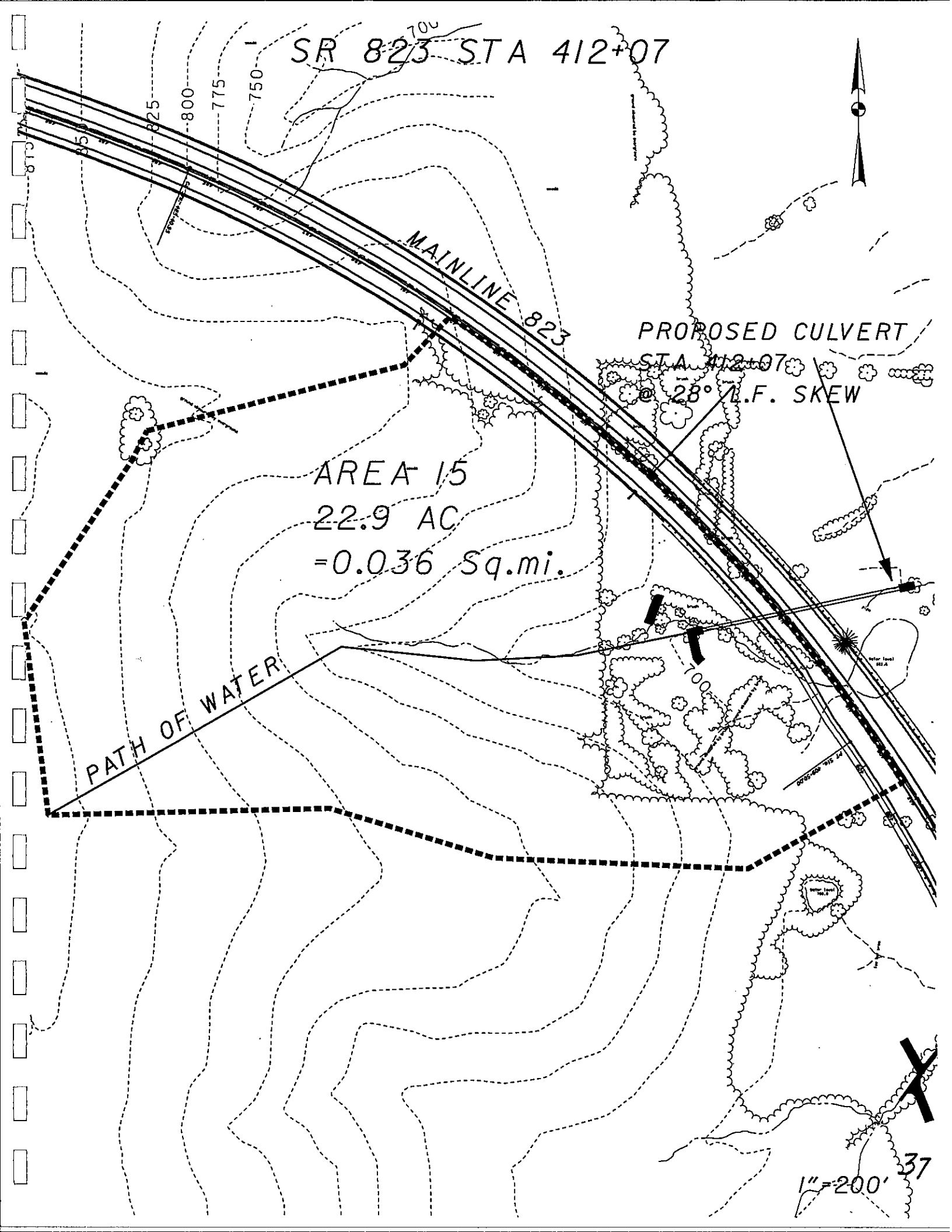
SR 823 STA 412+07
MAINLINE 823
PROPOSED CULVERT
STA 412+07
@ 28° L.F. SKEW
AREA 15
22.9 AC
=0.036 Sq.mi.
PATH OF WATER
700
825
800
775
750
1"=200'
37

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
998332.30	SQ. FT.	
0.036	SQ. MI.	**CONTDA** = Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE** = Storage Area
1278.00	FT.	**TOTAL CHANNEL LENGTH**
127.80	FT.	L_{10} = 10% of the Distance along channel
707	FT.	$Elev_{10}$ = Elevation at point L_{10}
1086.30	FT.	L_{85} = 85% of the Distance along channel
870	FT.	$Elev_{85}$ = Elevation at point L_{85}
958.50	FT.	**Length** = $L_{85} - L_{10}$
897.90	FT./MI.	**SLOPE** = $(Elev_{10}-Elev_{85})$/Length
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	13.37	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	29.35	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	42.94	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	61.84	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	77.76	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	93.59	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

Worksheet for SR 823 STA 412+07

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.08700	ft/ft
Left Side Slope	6.00	ft/ft (H:V)
Right Side Slope	6.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	77.70	ft^3/s

Results

Normal Depth	0.62	ft
Flow Area	8.58	ft^2
Wetted Perimeter	17.60	ft
Top Width	17.49	ft
Critical Depth	1.00	ft
Critical Slope	0.01472	ft/ft
Velocity	9.05	ft/s
Velocity Head	1.27	ft
Specific Energy	1.90	ft
Froude Number	2.28	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.62	ft
Critical Depth	1.00	ft
Channel Slope	0.08700	ft/ft
Critical Slope	0.01472	ft/ft

tail water

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 06/26/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 15, Sta. 412+07 **Designer :** mdc

HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 699.00 **Outlet Invert Elevation (ft.) :** 677.00 **Tailwater Elevation (ft.) :** 677.62 **Overflow Elevation (ft.) :** 739.70

Allowable Headwater Elevation (ft.) : 734.72 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 366.00 **Culvert Slope (ft./ft.) :** 0.0601 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 13.40 @ 2 yrs. **Flood Discharge (cfs) :** 96.60 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
13.40	1	18 in.	701.82	684.55	2 - E	15.61	0.73	1.36	0.0120	INLET	0.00	D	0.00
13.40	1	15 in.	703.50	693.80	2 - E	15.47	0.83	1.23	0.0120	INLET	0.00	D - 1	0.00
13.40	1	12 in.	715.06	727.29	2 - F	17.06	1.00	1.00	0.0120	OUTLET**	0.00	D - 2	0.00
13.40	1	21 in.	701.19	681.35	2 - E	15.53	0.68	1.36	0.0120	INLET	0.00	D + 1	0.00
40.80	1	18 in.	8589.3	996.43	2 - E	23.09	1.50	1.50	0.0120	INLET	55.80	F	0.00
26.60	1	15 in.	88402.	1487.1	2 - F	21.68	1.25	1.25	0.0120	OUTLET**	70.00	F - 1	0.00
14.90	1	12 in.	142412	3239.5	2 - F	18.97	1.00	1.00	0.0120	OUTLET**	81.70	F - 2	0.00
58.40	1	21 in.	1589.9	824.06	2 - E	24.28	1.75	1.75	0.0120	INLET	38.20	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
13.40	1	21 in.	701.63	688.94	2 - E	9.03	1.04	1.36	0.0248	INLET	0.00	D	0.00

OH

UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
13.40	1	18 in.	702.81	701.86	2 - E	8.67	1.23	1.36	0.0249	INLET	0.00	D - 1	0.00
13.40	1	15 in.	705.38	739.67	2 - F	10.96	1.25	1.23	0.0250	OUTLET**	0.00	D - 2	0.00
13.40	1	24 in.	701.13	N/A	1 - C	9.08	0.95	1.32	0.0247	INLET	0.00	D + 1	0.00
32.40	1	21 in.	4561.9	1218.6	2 - F	13.47	1.75	1.72	0.0248	OUTLET**	64.20	F	0.00
21.60	1	18 in.	32591.	1895.8	2 - F	12.22	1.50	1.48	0.0249	OUTLET**	75.00	F - 1	0.00
13.40	1	15 in.	333649	3870.8	2 - F	10.92	1.25	1.23	0.0250	OUTLET**	83.20	F - 2	0.00
46.00	1	24 in.	1239.8	946.45	2 - F	14.64	2.00	1.97	0.0247	OUTLET**	50.60	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
13.40	1	36 in.	700.68	N/A	1 - C	8.07	0.85	1.16	0.0281	INLET	0.00	D	0.00
13.40	1	42 in.	700.57	N/A	1 - C	8.00	0.81	1.11	0.0278	INLET	0.00	D + 1	0.00
96.60	1	36 in.	709.83	721.12	2 - F	13.85	3.00	2.88	0.0281	OUTLET**	0.00	F	0.00
96.60	1	42 in.	706.25	698.58	2 - E	13.43	2.45	3.03	0.0278	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
13.40	1	60 in.	700.35	N/A	1 - C	6.77	0.79	1.01	0.0332	INLET	0.00	D	0.00
13.40	1	66 in.	700.31	N/A	1 - C	6.73	0.76	0.98	0.0330	INLET	0.00	D + 1	0.00
96.60	1	60 in.	703.21	N/A	1 - C	11.92	2.16	2.79	0.0332	INLET	0.00	F	0.00
96.60	1	66 in.	703.01	N/A	1 - C	11.91	2.06	2.71	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
13.40	1	60 in.	700.35	N/A	1 - C	8.04	0.70	1.01	0.0260	INLET	0.00	D	0.00
13.40	1	66 in.	700.31	N/A	1 - C	7.94	0.68	0.98	0.0260	INLET	0.00	D + 1	0.00
96.60	1	60 in.	703.21	N/A	1 - C	14.24	1.89	2.79	0.0260	INLET	0.00	F	0.00
96.60	1	66 in.	703.01	N/A	1 - C	14.14	1.81	2.71	0.0260	INLET	0.00	F + 1	0.00

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UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)

Inlet Invert Elevation (ft.) : 699.00 **Outlet Invert Elevation (ft.) :** 677.00 **Tailwater Elevation (ft.) :** 677.62 **Overflow Elevation (ft.) :** 739.70

Allowable Headwater Elevation (ft.) : 734.72 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 366.00 **Culvert Slope (ft./ft.) :** 0.0601 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 77.80 @ 50 yrs. **Flood Discharge (cfs) :** 93.60 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall							**Entrance Loss (Ke) :** 0.20			
77.80	1	42 in.	703.48	683.20	2 - E	24.09	1.29	2.76	0.0120	INLET	0.00	D	0.00
77.80	1	36 in.	704.84	686.35	2 - E	24.26	1.39	2.75	0.0120	INLET	0.00	D - 1	0.00
77.80	1	33 in.	706.20	689.60	2 - E	24.25	1.46	2.64	0.0120	INLET	0.00	D - 2	0.00
77.80	1	48 in.	702.97	N/A	1 - C	23.83	1.23	2.67	0.0120	INLET	0.00	D + 1	0.00
93.60	1	42 in.	704.37	684.69	2 - E	25.33	1.43	2.99	0.0120	INLET	0.00	F	0.00
93.60	1	36 in.	706.50	689.31	2 - E	25.39	1.55	2.87	0.0120	INLET	0.00	F - 1	0.00
93.60	1	33 in.	708.48	694.06	2 - E	25.31	1.64	2.70	0.0120	INLET	0.00	F - 2	0.00
93.60	1	48 in.	703.52	N/A	1 - C	25.08	1.35	2.93	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall							**Entrance Loss (Ke) :** 0.90			
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
77.80	1	42 in.	704.44	689.29	2 - E	14.56	1.90	2.76	0.0237	INLET	0.00	D	0.00
77.80	1	36 in.	706.90	700.47	2 - E	14.09	2.19	2.75	0.0241	INLET	0.00	D - 1	0.00
77.80	1	33 in.	708.94	711.83	2 - F	13.27	2.75	2.64	0.0241	OUTLET**	0.00	D - 2	0.00
77.80	1	48 in.	703.36	N/A	1 - C	14.64	1.76	2.67	0.0235	INLET	0.00	D + 1	0.00

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UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
93.60	1	42 in.	705.93	693.51	2 - E	15.18	2.14	2.99	0.0237	INLET	0.00	F	0.00
93.60	1	36 in.	709.34	709.74	2 - F	13.45	2.67	2.87	0.0241	OUTLET**	0.00	F - 1	0.00
93.60	1	33 in.	712.35	726.23	2 - F	15.83	2.75	2.70	0.0241	OUTLET**	0.00	F - 2	0.00
93.60	1	48 in.	704.23	687.15	2 - E	15.35	1.95	2.93	0.0235	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
77.80	1	42 in.	704.44	692.01	2 - E	12.87	2.10	2.76	0.0278	INLET	0.00	D	0.00
77.80	1	36 in.	706.90	706.58	2 - E	12.17	2.54	2.75	0.0281	INLET	0.00	D - 1	0.00
77.80	1	48 in.	703.36	N/A	1 - C	13.02	1.92	2.67	0.0275	INLET	0.00	D + 1	0.00
93.60	1	42 in.	705.93	697.44	2 - E	13.35	2.39	2.99	0.0278	INLET	0.00	F	0.00
93.60	1	36 in.	709.34	718.59	2 - F	13.45	3.00	2.87	0.0281	OUTLET**	0.00	F - 1	0.00
93.60	1	48 in.	704.23	689.02	2 - E	13.63	2.15	2.93	0.0275	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
77.80	1	60 in.	702.69	N/A	1 - C	11.25	1.91	2.50	0.0332	INLET	0.00	D	0.00
77.80	1	66 in.	702.54	N/A	1 - C	11.22	1.83	2.42	0.0330	INLET	0.00	D + 1	0.00
93.60	1	60 in.	703.13	N/A	1 - C	11.81	2.12	2.75	0.0332	INLET	0.00	F	0.00
93.60	1	66 in.	702.94	N/A	1 - C	11.81	2.02	2.67	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
77.80	1	60 in.	702.69	N/A	1 - C	13.42	1.68	2.50	0.0260	INLET	0.00	D	0.00
77.80	1	66 in.	702.54	N/A	1 - C	13.31	1.62	2.42	0.0260	INLET	0.00	D + 1	0.00
93.60	1	60 in.	703.13	N/A	1 - C	14.12	1.85	2.75	0.0260	INLET	0.00	F	0.00
93.60	1	66 in.	702.94	N/A	1 - C	14.03	1.78	2.67	0.0260	INLET	0.00	F + 1	0.00

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CULVERT ANALYSIS

PID : 19415 **Date :** 06/26/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 15, Sta. 412+07 **Designer :** mdc

HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 699.00 **Outlet Invert Elevation (ft.) :** 677.00
Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (6 x 2 in. corrugations) **Pipe Length (ft.) :** 366.00 **Culvert Slope (ft./ft.) :** 0.0601
Pipe Size : 72 in.
Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
77.80	21.24	702.42	N/A	1 - C	11.21	1.76	2.36	0.0327	INLET	0.00	677.00
93.60	21.50	702.79	N/A	1 - C	11.80	1.94	2.60	0.0327	INLET	0.00	677.00

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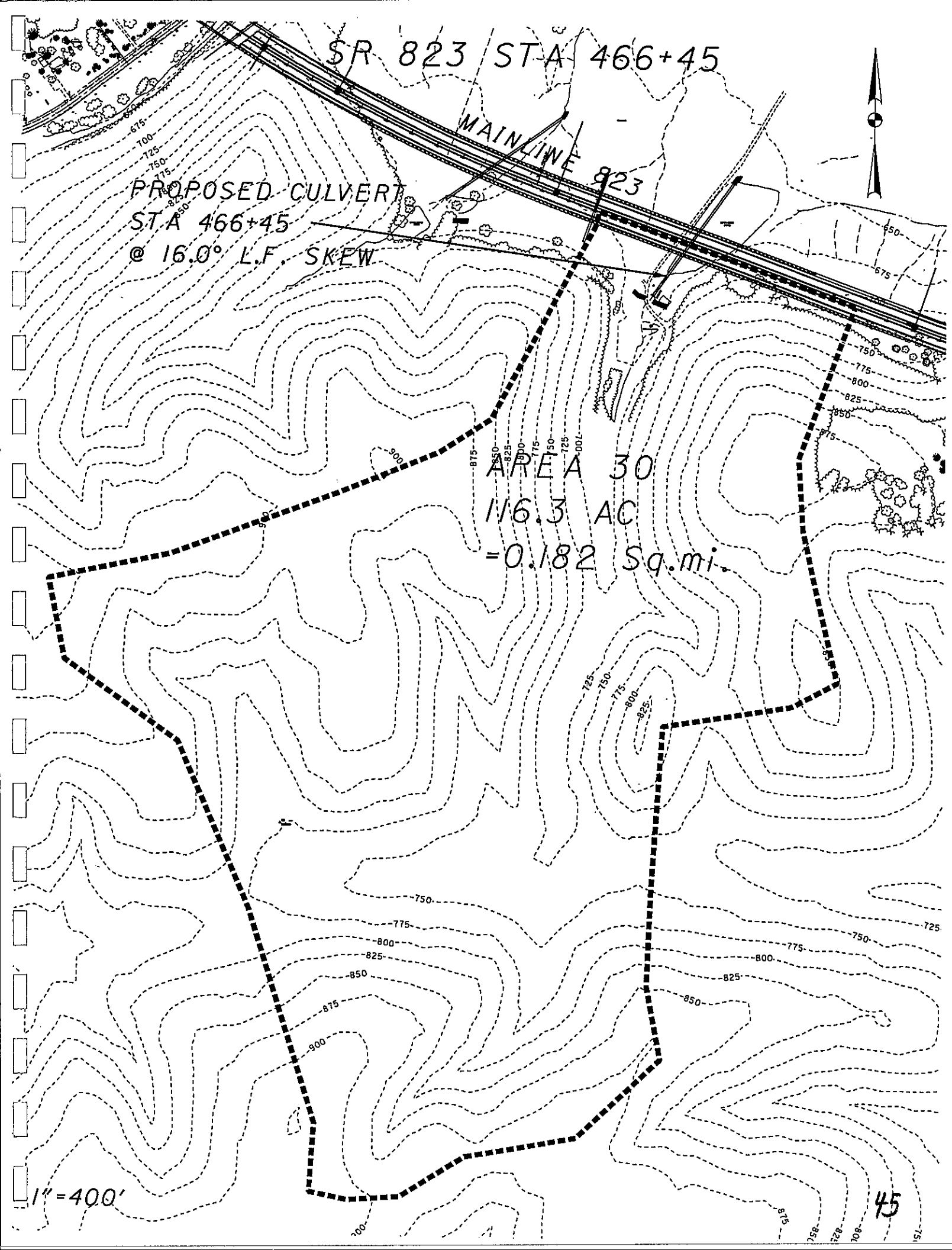
SR 823 STA 466+45
MAINLINE 823
PROPOSED CULVERT
STA 466+45
@ 16.0° L.F. SKEW
AREA 30
116.3 AC
=0.182 Sq.mi.
1" = 400'
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TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
5066123.00	SQ. FT.	
0.182	SQ. MI.	**CONTDA =** Contributing Drainage Area
27093.00	SQ. FT.	
0.53	%	**STORAGE =** Storage Area
3613.00	FT.	**TOTAL CHANNEL LENGTH**
361.30	FT.	L_{10} = 10% of the Distance along channel
677	FT.	$Elev_{10}$ = Elevation at point L_{10}
3071.05	FT.	L_{85} = 85% of the Distance along channel
820	FT.	$Elev_{85}$ = Elevation at point L_{85}
2709.75	FT.	**Length = L_{85} - L_{10}**
278.64	FT./MI.	**SLOPE** = ($Elev_{10}$-$Elev_{85}$)/Length
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	34.29	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	68.83	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	96.71	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	134.48	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	165.36	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	195.94	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

Worksheet for SR 823 STA 466+45

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.040	
Channel Slope	0.02040	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	165.36	ft^3/s

Results

Normal Depth	2.58	ft
Flow Area	23.59	ft^2
Wetted Perimeter	15.52	ft
Top Width	14.31	ft
Critical Depth	2.53	ft
Critical Slope	0.02211	ft/ft
Velocity	7.01	ft/s
Velocity Head	0.76	ft
Specific Energy	3.34	ft
Froude Number	0.96	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.58	ft
Critical Depth	2.53	ft
Channel Slope	0.02040	ft/ft
Critical Slope	0.02211	ft/ft

Worksheet for SR 823 STA 466+45

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.040	
Channel Slope	0.02040	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	165.36	ft^3/s

Results

Normal Depth	2.58	ft
Flow Area	23.59	ft^2
Wetted Perimeter	15.52	ft
Top Width	14.31	ft
Critical Depth	2.53	ft
Critical Slope	0.02211	ft/ft
Velocity	7.01	ft/s
Velocity Head	0.76	ft
Specific Energy	3.34	ft
Froude Number	0.96	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.58	ft
Critical Depth	2.53	ft
Channel Slope	0.02040	ft/ft
Critical Slope	0.02211	ft/ft

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 09/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 30, Sta. 466+45 **Designer :** mdc

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 666.28 **Outlet Invert Elevation (ft.) :** 656.63 **Tailwater Elevation (ft.) :** 659.20 **Overflow Elevation (ft.) :** 697.10

Allowable Headwater Elevation (ft.) : 695.10 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 488.00 **Culvert Slope (ft./ft.) :** 0.0198 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 165.36 @ 50 yrs. **Flood Discharge (cfs) :** 195.94 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
165.36	1	54 in.	672.77	665.69	2 - E	19.30	2.39	3.75	0.0120	INLET	0.00	D	0.00
165.36	1	48 in.	674.42	669.19	2 - E	19.14	2.60	3.70	0.0120	INLET	0.00	D - 1	0.00
165.36	1	42 in.	677.74	676.76	2 - E	17.19	3.50	3.42	0.0120	INLET	0.00	D - 2	0.00
165.36	1	60 in.	671.98	N/A	1 - C	19.29	2.25	3.69	0.0120	INLET	0.00	D + 1	0.00
195.94	1	54 in.	674.11	667.82	2 - E	20.08	2.65	4.01	0.0120	INLET	0.00	F	0.00
195.94	1	48 in.	676.56	672.77	2 - E	19.69	2.95	3.83	0.0120	INLET	0.00	F - 1	0.00
195.94	1	42 in.	681.35	683.52	2 - F	20.41	3.50	3.46	0.0120	OUTLET**	0.00	F - 2	0.00
195.94	1	60 in.	672.86	665.33	2 - E	20.14	2.48	4.00	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
165.36	1	60 in.	672.90	669.30	2 - E	11.63	3.40	3.69	0.0232	INLET	0.00	D	0.00

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UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
165.36	1	54 in.	674.51	674.97	2 - F	11.67	4.50	3.75	0.0233	OUTLET**	0.00	D - 1	0.00
165.36	1	48 in.	677.36	686.60	2 - F	13.62	4.00	3.70	0.0235	OUTLET**	0.00	D - 2	0.00
165.36	1	66 in.	672.06	N/A	1 - C	11.79	3.14	3.59	0.0231	INLET	0.00	D + 1	0.00
195.94	1	60 in.	674.37	672.81	2 - E	11.90	3.91	4.00	0.0232	INLET	0.00	F	0.00
195.94	1	54 in.	676.70	680.84	2 - F	13.10	4.50	4.01	0.0233	OUTLET**	0.00	F - 1	0.00
195.54	1	48 in.	680.47	697.23	2 - F	15.79	4.00	3.83	0.0235	OUTLET**	0.40	F - 2	0.00
195.94	1	66 in.	673.05	668.56	2 - E	12.23	3.51	3.92	0.0231	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
165.36	1	60 in.	672.90	673.19	2 - F	10.66	3.86	3.69	0.0271	OUTLET*	0.00	D	0.00
165.36	1	54 in.	674.51	679.08	2 - F	11.67	4.50	3.75	0.0273	OUTLET**	0.00	D - 1	0.00
165.36	1	48 in.	677.36	694.37	2 - F	13.62	4.00	3.70	0.0275	OUTLET**	0.00	D - 2	0.00
165.36	1	66 in.	672.06	N/A	1 - C	10.47	3.47	3.59	0.0269	INLET	0.00	D + 1	0.00
195.94	1	60 in.	674.37	676.00	2 - F	11.64	5.00	4.00	0.0271	OUTLET**	0.00	F	0.00
195.94	1	54 in.	676.70	686.61	2 - F	13.10	4.50	4.01	0.0273	OUTLET**	0.00	F - 1	0.00
171.84	1	48 in.	680.47	708.12	2 - F	14.07	4.00	3.74	0.0275	OUTLET**	24.10	F - 2	0.00
195.94	1	66 in.	673.05	673.65	2 - F	10.82	3.93	3.92	0.0269	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
165.36	1	66 in.	672.06	672.61	1 - A	10.06	4.04	3.59	0.0330	OUTLET*	0.00	D	0.00
165.36	1	60 in.	672.90	675.82	2 - F	10.66	5.00	3.69	0.0332	OUTLET**	0.00	D - 1	0.00
165.36	1	72 in.	671.62	672.39	1 - A	9.66	3.69	3.50	0.0327	OUTLET*	0.00	D + 1	0.00
195.94	1	66 in.	673.05	673.99	2 - F	10.82	4.83	3.92	0.0330	OUTLET**	0.00	F	0.00
195.94	1	60 in.	674.37	681.98	2 - F	11.64	5.00	4.00	0.0332	OUTLET**	0.00	F - 1	0.00
195.94	1	72 in.	672.34	673.02	1 - A	10.30	4.16	3.82	0.0327	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													

UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
165.36	1	66 in.	672.06	N/A	1 - C	10.76	3.39	3.59	0.0260	INLET	0.00	D	0.00
165.36	1	60 in.	672.90	673.29	2 - F	10.66	3.72	3.69	0.0260	OUTLET*	0.00	D - 1	0.00
165.36	1	72 in.	671.62	N/A	1 - C	10.81	3.19	3.50	0.0260	INLET	0.00	D + 1	0.00
195.94	1	66 in.	673.05	669.95	2 - E	11.11	3.82	3.92	0.0260	INLET	0.00	F	0.00
195.94	1	60 in.	674.37	675.05	2 - F	11.64	5.00	4.00	0.0260	OUTLET**	0.00	F - 1	0.00
195.94	1	72 in.	672.34	N/A	1 - C	11.24	3.55	3.82	0.0260	INLET	0.00	F + 1	0.00

CULVERT ANALYSIS

PID : 19415 **Date :** 09/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 30, Sta. 466+45 **Designer :** mdc

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 666.28 **Outlet Invert Elevation (ft.) :** 656.63

Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (6 x 2 in. corrugations)
Pipe Size : 78 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 488.00 **Culvert Slope (ft./ft.) :** 0.0198

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
165.36	12.18	671.37	672.22	1 - A	9.36	3.48	3.42	0.0325	OUTLET*	0.00	656.63
195.94	12.45	671.95	672.81	1 - A	9.94	3.87	3.73	0.0325	OUTLET*	0.00	656.63

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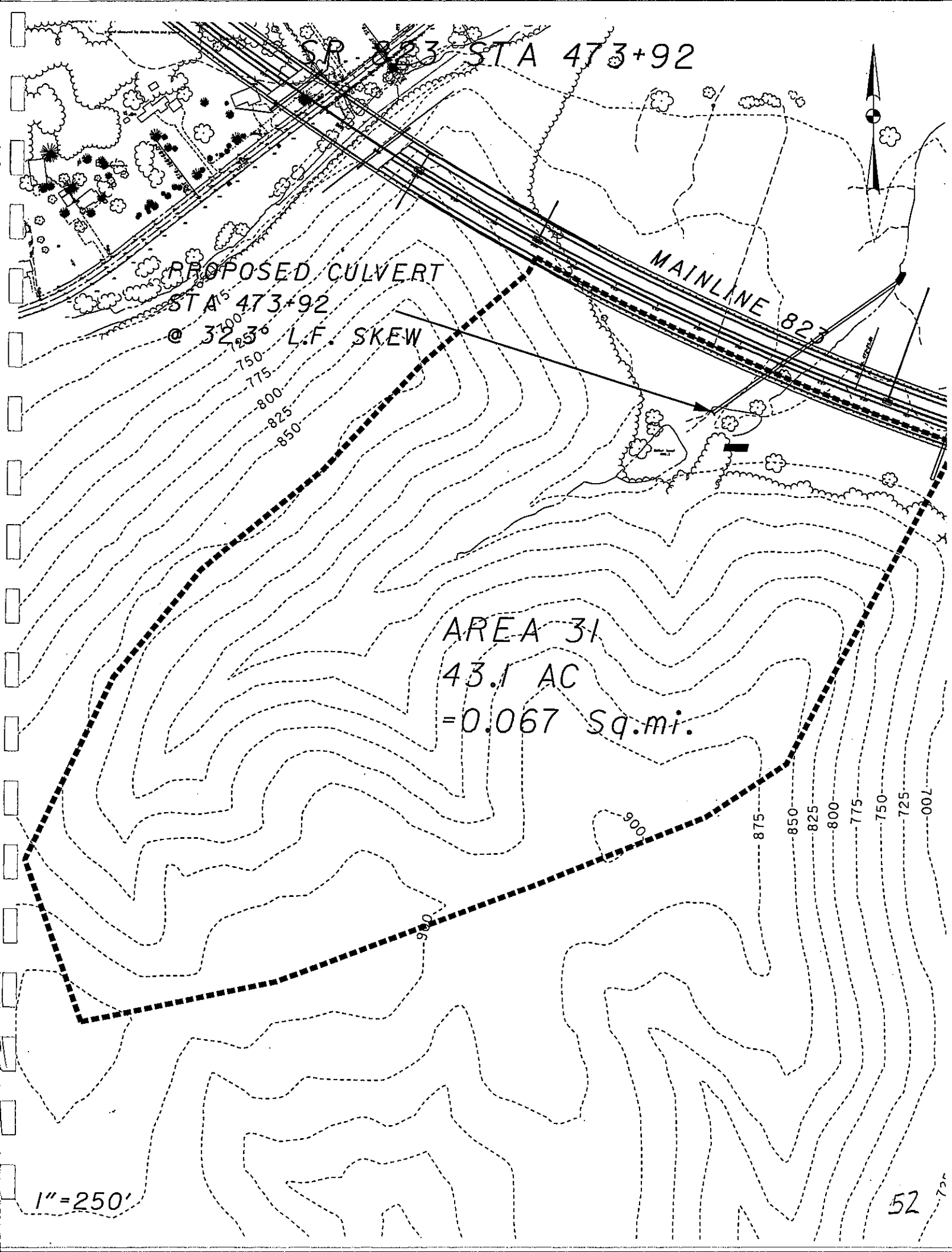

SR 823 STA 473+92
PROPOSED CULVERT
STA 473+92
@ 32.3° L.F. SKEW
MAINLINE 823
AREA 31
43.1 AC
=0.067 Sq.mi.
700
725
750
775
800
825
850
875
900
1" = 250'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
1879281.00	SQ. FT.	
0.067	SQ. MI.	**CONTDA** = Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE** = Storage Area
1960.00	FT.	**TOTAL CHANNEL LENGTH**
196.00	FT.	L_{10} = 10% of the Distance along channel
686	FT.	$Elev_{10}$ = Elevation at point L_{10}
1666.00	FT.	L_{85} = 85% of the Distance along channel
840	FT.	$Elev_{85}$ = Elevation at point L_{85}
1470.00	FT.	**Length** = $L_{85} - L_{10}$
553.14	FT./MI.	**SLOPE** = $(Elev_{10}-Elev_{85})$/Length
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	20.17	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	42.89	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	61.86	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	88.01	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	109.81	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	131.50	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

Worksheet for SR 823 STA 474+10

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.040	
Channel Slope	0.03180	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	109.80	ft^3/s

Results

Normal Depth	1.90	ft
Flow Area	14.80	ft^2
Wetted Perimeter	12.49	ft
Top Width	11.59	ft
Critical Depth	2.05	ft
Critical Slope	0.02329	ft/ft
Velocity	7.42	ft/s
Velocity Head	0.86	ft
Specific Energy	2.75	ft
Froude Number	1.16	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.90	ft
Critical Depth	2.05	ft
Channel Slope	0.03180	ft/ft
Critical Slope	0.02329	ft/ft

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 09/13/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : mdc

Description : Drainage area 31, Sta. 473+92

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 678.76 **Outlet Invert Elevation (ft.) :** 649.22 **Tailwater Elevation (ft.) :** 651.12 **Overflow Elevation (ft.) :** 703.40

Allowable Headwater Elevation (ft.) : 701.40 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 504.00 **Culvert Slope (ft./ft.) :** 0.0586 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 109.81 @ 50 yrs. **Flood Discharge (cfs) :** 131.50 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
109.81	1	48 in.	683.93	656.72	2 - E	25.99	1.48	3.17	0.0120	INLET	0.00	D	0.00
109.81	1	42 in.	685.23	660.07	2 - E	26.15	1.57	3.17	0.0120	INLET	0.00	D - 1	0.00
109.81	1	36 in.	688.23	668.26	2 - E	26.13	1.72	2.93	0.0120	INLET	0.00	D - 2	0.00
109.81	1	54 in.	683.38	N/A	1 - C	25.76	1.41	3.08	0.0120	INLET	0.00	D + 1	0.00
131.50	1	48 in.	684.94	658.55	2 - E	27.29	1.63	3.43	0.0120	INLET	0.00	F	0.00
131.50	1	42 in.	686.97	663.40	2 - E	27.39	1.75	3.32	0.0120	INLET	0.00	F - 1	0.00
131.50	1	36 in.	691.38	675.25	2 - E	27.17	1.94	2.96	0.0120	INLET	0.00	F - 2	0.00
131.50	1	54 in.	684.03	N/A	1 - C	27.10	1.55	3.37	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
109.81	1	54 in.	683.90	N/A	1 - C	15.91	2.02	3.08	0.0233	INLET	0.00	D	0.00

UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
109.81	1	48 in.	685.06	664.63	2 - E	15.82	2.17	3.17	0.0235	INLET	0.00	D - 1	0.00
109.81	1	42 in.	687.45	676.24	2 - E	15.50	2.42	3.17	0.0237	INLET	0.00	D - 2	0.00
109.81	1	60 in.	683.36	N/A	1 - C	15.89	1.91	2.99	0.0232	INLET	0.00	D + 1	0.00
131.50	1	54 in.	684.95	662.37	2 - E	16.66	2.24	3.37	0.0233	INLET	0.00	F	0.00
131.50	1	48 in.	686.75	669.89	2 - E	16.48	2.43	3.43	0.0235	INLET	0.00	F - 1	0.00
131.50	1	42 in.	690.05	686.59	2 - E	15.83	2.82	3.32	0.0237	INLET	0.00	F - 2	0.00
131.50	1	60 in.	684.06	N/A	1 - C	16.67	2.11	3.28	0.0232	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
109.81	1	54 in.	683.90	N/A	1 - C	14.14	2.21	3.08	0.0273	INLET	0.00	D	0.00
109.81	1	48 in.	685.06	668.16	2 - E	14.01	2.39	3.17	0.0275	INLET	0.00	D - 1	0.00
109.81	1	42 in.	687.45	683.70	2 - E	13.48	2.76	3.17	0.0278	INLET	0.00	D - 2	0.00
109.81	1	60 in.	683.36	N/A	1 - C	14.18	2.08	2.99	0.0271	INLET	0.00	D + 1	0.00
131.50	1	54 in.	684.95	665.06	2 - E	14.78	2.46	3.37	0.0273	INLET	0.00	F	0.00
131.50	1	48 in.	686.75	674.96	2 - E	14.53	2.71	3.43	0.0275	INLET	0.00	F - 1	0.00
131.50	1	42 in.	690.05	697.29	2 - F	13.95	3.50	3.32	0.0278	OUTLET**	0.00	F - 2	0.00
131.50	1	60 in.	684.06	N/A	1 - C	14.87	2.31	3.28	0.0271	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
109.81	1	60 in.	683.36	N/A	1 - C	12.20	2.34	2.99	0.0332	INLET	0.00	D	0.00
109.81	1	66 in.	683.08	N/A	1 - C	12.22	2.22	2.90	0.0330	INLET	0.00	D + 1	0.00
131.50	1	60 in.	684.06	N/A	1 - C	12.77	2.60	3.28	0.0332	INLET	0.00	F	0.00
131.50	1	66 in.	683.62	N/A	1 - C	12.82	2.46	3.19	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
109.81	1	60 in.	683.36	N/A	1 - C	14.61	2.04	2.99	0.0260	INLET	0.00	D	0.00
109.81	1	66 in.	683.08	N/A	1 - C	14.53	1.95	2.90	0.0260	INLET	0.00	D + 1	0.00

UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
131.50	1	60 in.	684.06	N/A	1 - C	15.33	2.25	3.28	0.0260	INLET	0.00	F	0.00
131.50	1	66 in.	683.62	N/A	1 - C	15.26	2.15	3.19	0.0260	INLET	0.00	F + 1	0.00

CULVERT ANALYSIS

PID : 19415 **Date :** 09/13/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 31, Sta. 473+92 **Designer :** mdc

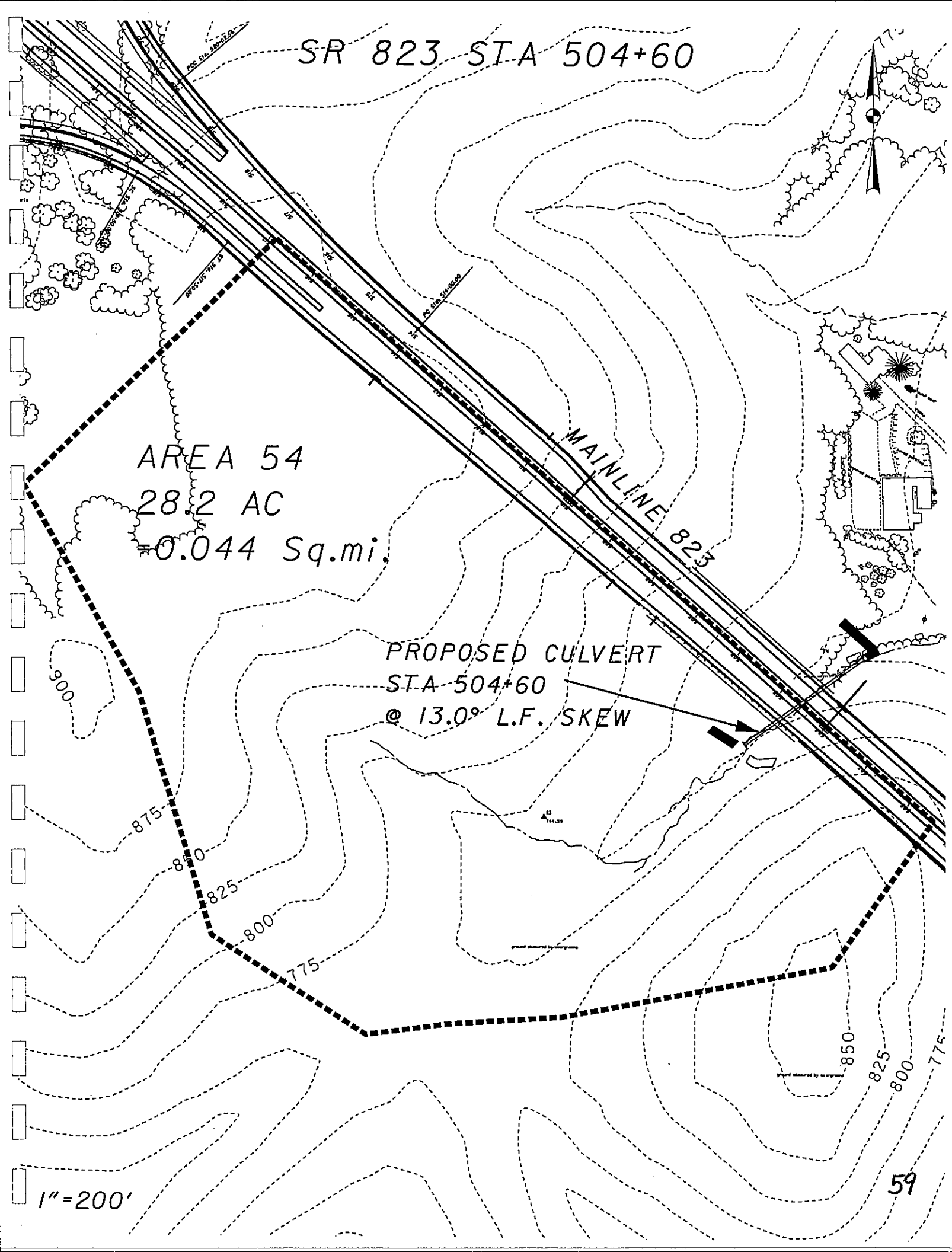
HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 678.76 **Outlet Invert Elevation (ft.) :** 649.22
Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (6 x 2 in. corrugations) **Pipe Length (ft.) :** 504.00 **Culvert Slope (ft./ft.) :** 0.0586
Pipe Size : 72 in.
Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
109.81	29.28	682.91	N/A	1 - C	12.23	2.13	2.82	0.0327	INLET	0.00	649.22
131.50	29.60	683.37	N/A	1 - C	12.86	2.34	3.10	0.0327	INLET	0.00	649.22


SR 823 STA 504+60
AREA 54
28.2 AC
0.044 Sq.mi.
MAINLINE 823
PROPOSED CULVERT
STA 504+60
@ 13.0° L.F. SKEW
900
875
850
825
800
775
850
825
800
775
1" = 200'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
1236968.00	SQ. FT.	
0.044	SQ. MI.	**CONTDA** = Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE** = Storage Area
1540.00	FT.	**TOTAL CHANNEL LENGTH**
154.00	FT.	L_{10} = 10% of the Distance along channel
722	FT.	$Elev_{10}$ = Elevation at point L_{10}
1309.00	FT.	L_{85} = 85% of the Distance along channel
880	FT.	$Elev_{85}$ = Elevation at point L_{85}
1155.00	FT.	**Length** = $L_{85} - L_{10}$
722.29	FT./MI.	**SLOPE** = $(Elev_{10}-Elev_{85})$/Length
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	15.23	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	32.98	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	47.97	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	68.72	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	86.12	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	103.43	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

Worksheet for SR 823 STA 504+60

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.040	
Channel Slope	0.03880	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	86.12	ft^3/s

Results

Normal Depth	1.60	ft
Flow Area	11.52	ft^2
Wetted Perimeter	11.16	ft
Top Width	10.40	ft
Critical Depth	1.80	ft
Critical Slope	0.02403	ft/ft
Velocity	7.48	ft/s
Velocity Head	0.87	ft
Specific Energy	2.47	ft
Froude Number	1.25	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.60	ft
Critical Depth	1.80	ft
Channel Slope	0.03880	ft/ft
Critical Slope	0.02403	ft/ft

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 09/13/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 54, Sta. 504+60 **Designer :** mdc

HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 706.55 **Outlet Invert Elevation (ft.) :** 694.74 **Tailwater Elevation (ft.) :** 696.34 **Overflow Elevation (ft.) :** 722.00

Allowable Headwater Elevation (ft.) : 732.90 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 262.00 **Culvert Slope (ft./ft.) :** 0.0451 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 86.12 @ 50 yrs. **Flood Discharge (cfs) :** 103.43 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
86.12	1	42 in.	711.48	701.05	2 - E	22.27	1.48	2.89	0.0120	INLET	0.00	D	0.00
86.12	1	36 in.	713.23	704.12	2 - E	22.33	1.61	2.82	0.0120	INLET	0.00	D - 1	0.00
86.12	1	33 in.	714.90	707.26	2 - E	22.21	1.71	2.68	0.0120	INLET	0.00	D - 2	0.00
86.12	1	48 in.	710.80	N/A	1 - C	22.11	1.39	2.81	0.0120	INLET	0.00	D + 1	0.00
103.43	1	42 in.	712.56	702.54	2 - E	23.37	1.64	3.11	0.0120	INLET	0.00	F	0.00
103.43	1	36 in.	715.21	707.02	2 - E	23.30	1.80	2.91	0.0120	INLET	0.00	F - 1	0.00
103.43	1	33 in.	717.68	711.61	2 - E	23.00	1.95	2.71	0.0120	INLET	0.00	F - 2	0.00
103.43	1	48 in.	711.45	700.69	2 - E	23.23	1.54	3.08	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
86.12	1	48 in.	711.35	N/A	1 - C	13.50	2.02	2.81	0.0235	INLET	0.00	D	0.00

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UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
86.12	1	42 in.	712.75	706.64	2 - E	13.32	2.23	2.89	0.0237	INLET	0.00	D - 1	0.00
86.12	1	36 in.	715.71	716.96	2 - F	12.49	3.00	2.82	0.0241	OUTLET**	0.00	D - 2	0.00
86.12	1	54 in.	710.75	N/A	1 - C	13.54	1.89	2.72	0.0233	INLET	0.00	D + 1	0.00
103.43	1	48 in.	712.41	704.69	2 - E	14.11	2.26	3.08	0.0235	INLET	0.00	F	0.00
103.43	1	42 in.	714.53	710.60	2 - E	13.75	2.55	3.11	0.0237	INLET	0.00	F - 1	0.00
96.63	1	36 in.	718.55	725.54	2 - F	13.85	3.00	2.88	0.0241	OUTLET**	6.80	F - 2	0.00
103.43	1	54 in.	711.41	N/A	1 - C	14.21	2.10	2.99	0.0233	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
86.12	1	48 in.	711.35	N/A	1 - C	11.98	2.23	2.81	0.0275	INLET	0.00	D	0.00
86.12	1	42 in.	712.75	709.03	2 - E	11.68	2.51	2.89	0.0278	INLET	0.00	D - 1	0.00
85.52	1	36 in.	715.71	722.32	2 - F	12.41	3.00	2.82	0.0281	OUTLET**	0.60	D - 2	0.00
86.12	1	54 in.	710.75	N/A	1 - C	12.05	2.07	2.72	0.0273	INLET	0.00	D + 1	0.00
103.43	1	48 in.	712.41	706.32	2 - E	12.48	2.51	3.08	0.0275	INLET	0.00	F	0.00
103.43	1	42 in.	714.53	714.04	2 - E	11.80	2.99	3.11	0.0278	INLET	0.00	F - 1	0.00
85.53	1	36 in.	718.55	733.28	2 - F	12.41	3.00	2.82	0.0281	OUTLET**	17.90	F - 2	0.00
103.43	1	54 in.	711.41	N/A	1 - C	12.63	2.30	2.99	0.0273	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
86.12	1	60 in.	710.47	N/A	1 - C	10.40	2.19	2.63	0.0332	INLET	0.00	D	0.00
86.12	1	66 in.	710.30	N/A	1 - C	10.40	2.09	2.56	0.0330	INLET	0.00	D + 1	0.00
103.43	1	60 in.	710.96	N/A	1 - C	10.90	2.43	2.90	0.0332	INLET	0.00	F	0.00
103.43	1	66 in.	710.72	N/A	1 - C	10.92	2.31	2.81	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
86.12	1	60 in.	710.47	N/A	1 - C	12.44	1.92	2.63	0.0260	INLET	0.00	D	0.00
86.12	1	66 in.	710.30	N/A	1 - C	12.36	1.84	2.56	0.0260	INLET	0.00	D + 1	0.00

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UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
103.43	1	60 in.	710.96	N/A	1 - C	13.06	2.12	2.90	0.0260	INLET	0.00	F	0.00
103.43	1	66 in.	710.72	N/A	1 - C	13.00	2.03	2.81	0.0260	INLET	0.00	F + 1	0.00

CULVERT ANALYSIS

PID : 19415 **Date :** 09/13/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 54, Sta. 504+60 **Designer :** mdc

HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 706.55 **Outlet Invert Elevation (ft.) :** 694.74

Pipe Quantity : 1

Culvert Type : Circular Corrugated **Pipe Length (ft.) :** 262.00 **Culvert Slope (ft./ft.) :** 0.0451

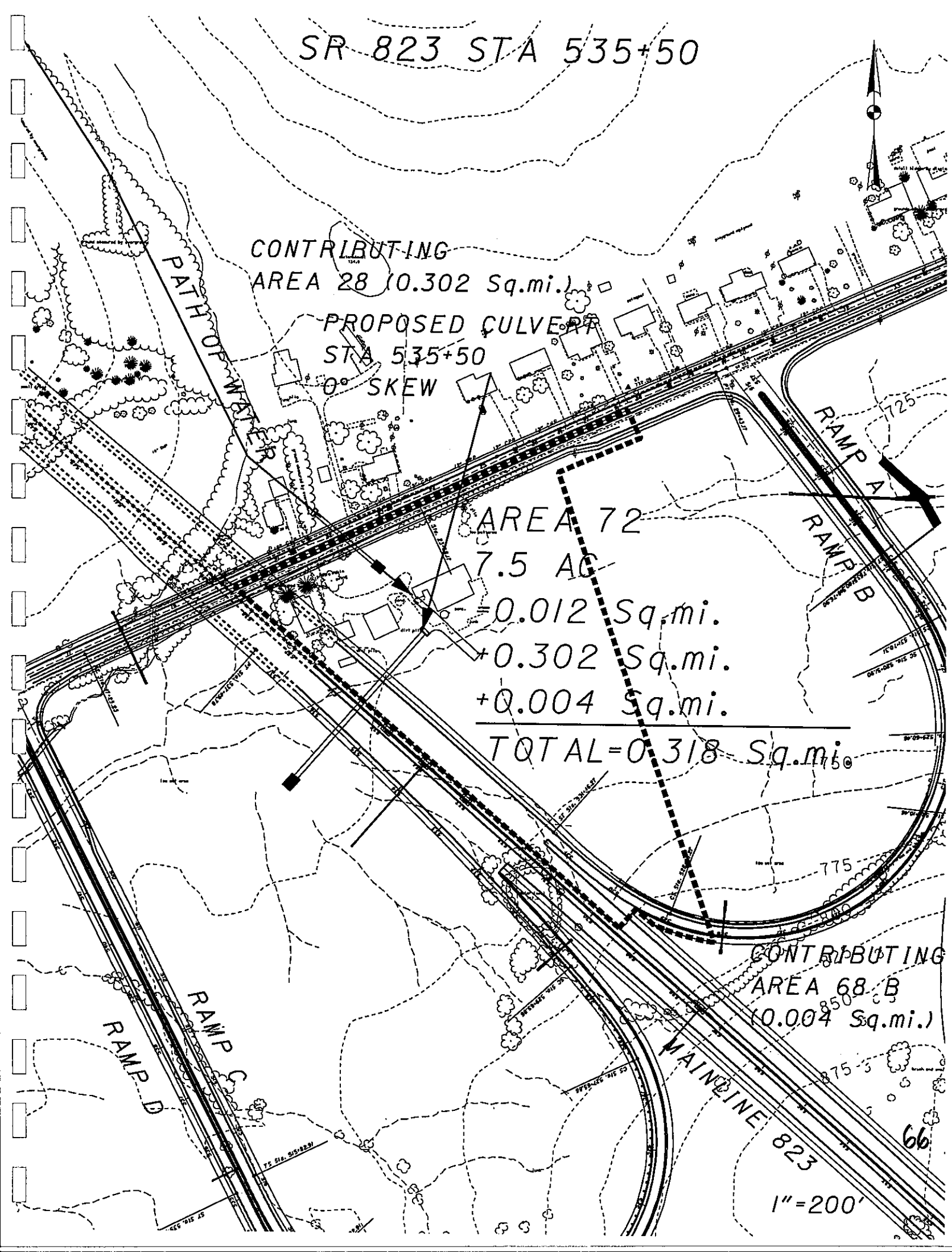
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)

Pipe Size : 60 in.

Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
86.12	11.91	710.47	N/A	1 - C	12.07	1.96	2.63	0.0271	INLET	0.00	694.74
103.43	12.27	710.96	N/A	1 - C	12.67	2.17	2.90	0.0271	INLET	0.00	694.74


SR 823 STA 535+50
CONTRIBUTING
AREA 28 (0.302 Sq.mi.)
PROPOSED CULVERT
STA 535+50
0° SKEW
PATH OF WATER
AREA 72
7.5 AC
=0.012 Sq.mi.
+0.302 Sq.mi.
+0.004 Sq.mi.
TOTAL=0.318 Sq.mi.
RAMP A
RAMP B
RAMP C
RAMP D
CONTRIBUTING
AREA 68 B
(0.004 Sq.mi.)
MAINLINE 823
1"=200'
66

SR 823 STA 535+50

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

8420975
326998
109910

Values	Units	Definitions
8857883.00	SQ. FT.	
0.318	SQ. MI.	**CONTDA** = Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE** = Storage Area
4600.00	FT.	**TOTAL CHANNEL LENGTH**
460.00	FT.	L_{10} = 10% of the Distance along channel
716	FT.	$Elev_{10}$ = Elevation at point L_{10}
3910.00	FT.	L_{85} = 85% of the Distance along channel
815	FT.	$Elev_{85}$ = Elevation at point L_{85}
3450.00	FT.	**Length** = $L_{85} - L_{10}$
151.51	FT./MI.	**SLOPE** = $(Elev_{10}-Elev_{85})$/Length
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	54.28	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	106.13	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	147.45	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	203.14	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	248.39	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	293.56	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 06/26/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 72, Sta. 535+50 **Designer :** mdc

HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 705.44 **Outlet Invert Elevation (ft.) :** 702.86 **Tailwater Elevation (ft.) :** 705.95 **Overflow Elevation (ft.) :** 753.75

Allowable Headwater Elevation (ft.) : 751.12 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 342.00 **Culvert Slope (ft./ft.) :** 0.0075 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 248.40 @ 50 yrs. **Flood Discharge (cfs) :** 293.60 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
248.40	1	66 in.	712.67	711.43	2 - E	14.73	3.67	4.40	0.0120	INLET	0.00	D	0.00
248.40	1	60 in.	713.88	713.18	2 - E	14.22	4.16	4.41	0.0120	INLET	0.00	D - 1	0.00
248.40	1	54 in.	716.10	716.41	2 - F	15.92	4.50	4.27	0.0120	OUTLET**	0.00	D - 2	0.00
248.40	1	72 in.	712.04	N/A	1 - C	14.86	3.43	4.32	0.0120	INLET	0.00	D + 1	0.00
293.60	1	66 in.	714.00	713.03	2 - E	15.10	4.19	4.73	0.0120	INLET	0.00	F	0.00
293.60	1	60 in.	715.84	715.53	2 - E	14.95	5.00	4.64	0.0120	INLET	0.00	F - 1	0.00
293.60	1	54 in.	719.01	720.11	2 - F	18.60	4.50	4.38	0.0120	OUTLET**	0.00	F - 2	0.00
293.60	1	72 in.	712.98	711.60	2 - E	15.41	3.83	4.69	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
248.40	1	78 in.	712.21	712.86	1 - A	10.88	5.09	4.22	0.0228	OUTLET*	0.00	D	0.00

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UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
248.40	1	72 in.	712.98	713.93	2 - F	11.40	6.00	4.32	0.0229	OUTLET**	0.00	D - 1	0.00
248.40	1	66 in.	714.32	716.91	2 - F	12.20	5.50	4.40	0.0231	OUTLET**	0.00	D - 2	0.00
248.40	1	84 in.	711.76	712.55	1 - A	10.51	4.66	4.13	0.0227	OUTLET*	0.00	D + 1	0.00
293.60	1	78 in.	713.34	713.87	2 - F	11.69	6.50	4.60	0.0228	OUTLET*	0.00	F	0.00
293.60	1	72 in.	714.54	716.46	2 - F	12.39	6.00	4.69	0.0229	OUTLET**	0.00	F - 1	0.00
293.60	1	66 in.	716.54	720.69	2 - F	13.52	5.50	4.73	0.0231	OUTLET**	0.00	F - 2	0.00
293.60	1	84 in.	712.62	713.32	1 - A	11.21	5.31	4.51	0.0227	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
248.40	1	78 in.	712.21	713.05	1 - A	10.88	5.93	4.22	0.0266	OUTLET*	0.00	D	0.00
248.40	1	72 in.	712.98	715.23	2 - F	11.40	6.00	4.32	0.0267	OUTLET**	0.00	D - 1	0.00
248.40	1	66 in.	714.32	719.00	2 - F	12.20	5.50	4.40	0.0269	OUTLET**	0.00	D - 2	0.00
248.40	1	84 in.	711.76	712.57	1 - A	10.51	5.25	4.13	0.0265	OUTLET*	0.00	D + 1	0.00
293.60	1	78 in.	713.34	715.18	2 - F	11.69	6.50	4.60	0.0266	OUTLET**	0.00	F	0.00
293.60	1	72 in.	714.54	718.28	2 - F	12.39	6.00	4.69	0.0267	OUTLET**	0.00	F - 1	0.00
293.60	1	66 in.	716.54	723.61	2 - F	13.52	5.50	4.73	0.0269	OUTLET**	0.00	F - 2	0.00
293.60	1	84 in.	712.62	713.47	1 - A	11.21	6.39	4.51	0.0265	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
248.40	1	84 in.	711.76	712.90	1 - A	10.51	6.39	4.13	0.0323	OUTLET*	0.00	D	0.00
248.40	1	78 in.	712.21	714.65	2 - F	10.88	6.50	4.22	0.0325	OUTLET**	0.00	D - 1	0.00
248.40	1	72 in.	712.98	717.70	2 - F	11.40	6.00	4.32	0.0327	OUTLET**	0.00	D - 2	0.00
248.40	1	90 in.	711.49	712.45	1 - A	10.23	5.67	4.04	0.0321	OUTLET*	0.00	D + 1	0.00
293.60	1	84 in.	712.62	714.76	2 - F	11.21	7.00	4.51	0.0323	OUTLET**	0.00	F	0.00
293.60	1	78 in.	713.34	717.39	2 - F	11.69	6.50	4.60	0.0325	OUTLET**	0.00	F - 1	0.00

UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
293.60	1	72 in.	714.54	721.73	2 - F	12.39	6.00	4.69	0.0327	OUTLET**	0.00	F - 2	0.00
293.60	1	90 in.	712.19	713.33	1 - A	10.86	6.85	4.41	0.0321	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
248.40	1	78 in.	712.21	712.98	1 - A	10.88	5.93	4.22	0.0260	OUTLET*	0.00	D	0.00
248.40	1	72 in.	712.98	714.98	2 - F	11.40	6.00	4.32	0.0260	OUTLET**	0.00	D - 1	0.00
248.40	1	66 in.	714.32	718.48	2 - F	12.20	5.50	4.40	0.0260	OUTLET**	0.00	D - 2	0.00
248.40	1	84 in.	711.76	712.56	1 - A	10.51	5.17	4.13	0.0260	OUTLET*	0.00	D + 1	0.00
293.60	1	78 in.	713.34	714.99	2 - F	11.69	6.50	4.60	0.0260	OUTLET**	0.00	F	0.00
293.60	1	72 in.	714.54	717.92	2 - F	12.39	6.00	4.69	0.0260	OUTLET**	0.00	F - 1	0.00
293.60	1	66 in.	716.54	722.88	2 - F	13.52	5.50	4.73	0.0260	OUTLET**	0.00	F - 2	0.00
293.60	1	84 in.	712.62	713.43	1 - A	11.21	6.20	4.51	0.0260	OUTLET*	0.00	F + 1	0.00

AL

CULVERT ANALYSIS

PID : 19415 **Date :** 06/26/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 72, Sta. 535+50, Check for HW's of 96" proposed culvert **Designer :** mdc

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 705.44 **Outlet Invert Elevation (ft.) :** 702.86

Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (6 x 2 in. corrugations)
Pipe Size : 96 in.
Design Manning 'n' : (default)

Pipe Length (ft.) : 342.00 **Culvert Slope (ft./ft.) :** 0.0075

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
248.40	5.33	711.30	712.15	1 - A	10.00	5.27	3.96	0.0320	OUTLET*	0.00	705.80
293.60	5.73	711.91	712.91	1 - A	10.58	6.00	4.33	0.0320	OUTLET*	0.00	706.52

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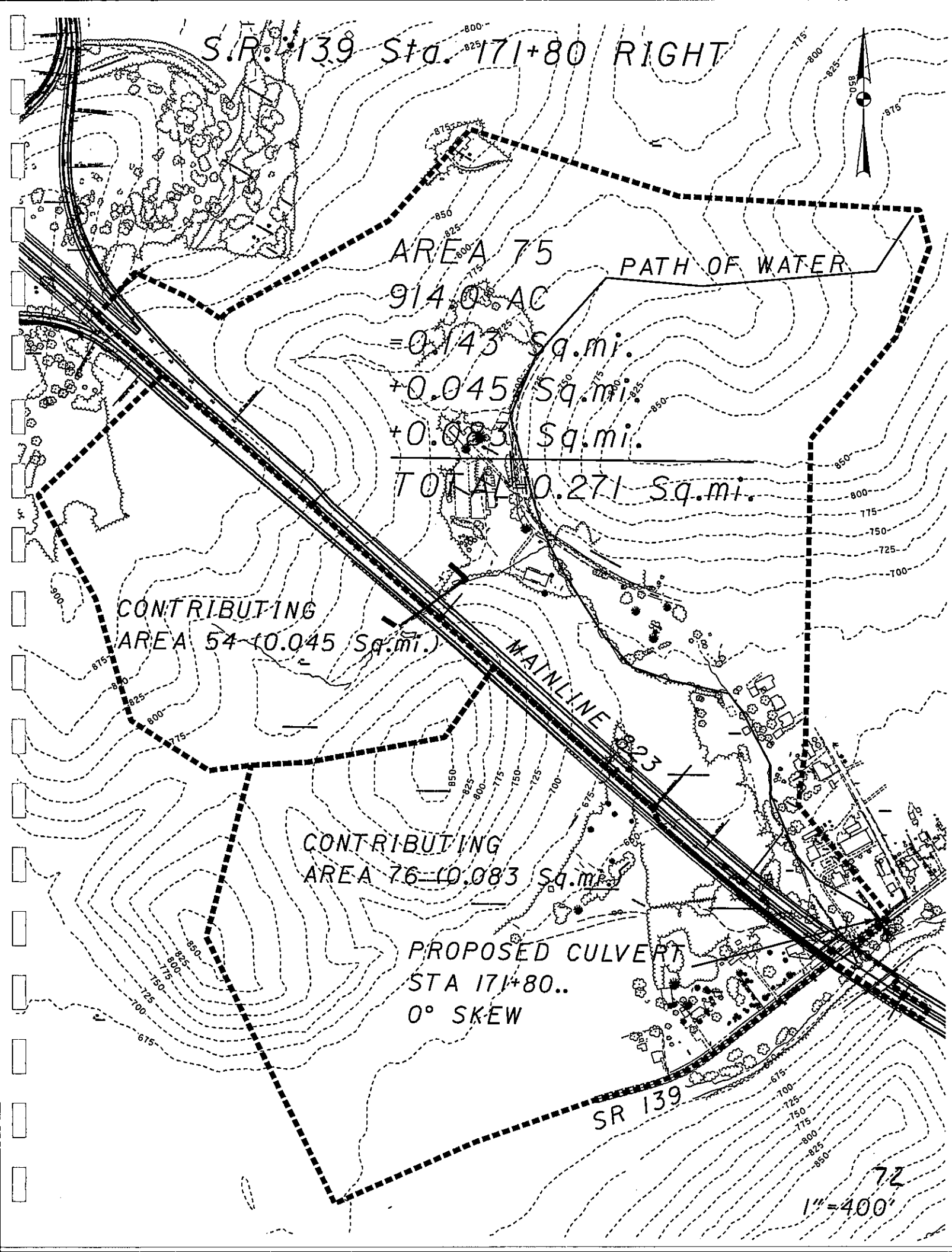
S.R. 139 Sta. 171+80 RIGHT
AREA 75
914.0 AC
=0.143 Sq.mi.
+0.045 Sq.mi.
+0.083 Sq.mi.
TOTAL 0.271 Sq.mi.
PATH OF WATER
CONTRIBUTING
AREA 54 (0.045 Sq.mi.)
MAINLINE 23
CONTRIBUTING
AREA 76 (0.083 Sq.mi.)
PROPOSED CULVERT
STA 171+80..
0° SKEW
SR 139
1"=400'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions	
7570455.00	SQ. FT.		2327644
0.272	SQ. MI.	**CONTDA** = Contributing Drainage Area	1262498
0.00	SQ. FT.		3980313
0.00	%	**STORAGE** = Storage Area	
4140.00	FT.	**TOTAL CHANNEL LENGTH**	
414.00	FT.	L_{10} = 10% of the Distance along channel	
650	FT.	$Elev_{10}$ = Elevation at point L_{10}	
3519.00	FT.	L_{85} = 85% of the Distance along channel	
790	FT.	$Elev_{85}$ = Elevation at point L_{85}	
3105.00	FT.	**Length** = $L_{85} - L_{10}$	
238.07	FT./MI.	**SLOPE** = $(Elev_{10}-Elev_{85})$/Length	
	CFS	$Q_{\#}$ = Flood-Peak Discharge	
		# = Frequency of Storm	

Q_2	51.88	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	103.93	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	146.02	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	203.13	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	249.84	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	296.53	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

Worksheet for SR 139 STA 171+80

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.01100	ft/ft
Left Side Slope	4.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	203.00	ft^3/s

Results

Normal Depth	1.88	ft
Flow Area	32.95	ft^2
Wetted Perimeter	25.51	ft
Top Width	25.04	ft
Critical Depth	1.83	ft
Critical Slope	0.01236	ft/ft
Velocity	6.16	ft/s
Velocity Head	0.59	ft
Specific Energy	2.47	ft
Froude Number	0.95	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.88	ft
Critical Depth	1.83	ft
Channel Slope	0.01100	ft/ft
Critical Slope	0.01236	ft/ft

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 07/19/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage areas 75,76,54, SR 139 Sta. 171+80 **Designer :** mdc

HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 628.00 **Outlet Invert Elevation (ft.) :** 627.30 **Tailwater Elevation (ft.) :** 629.30 **Overflow Elevation (ft.) :** 633.90

Allowable Headwater Elevation (ft.) : 632.90 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 50.00 **Culvert Slope (ft./ft.) :** 0.0140 **Design Manning 'n' :** 0.0120 **Buried Manning 'n' :** 0.0000

Design Discharge (cfs) : 203.00 @ 25 yrs. **Flood Discharge (cfs) :** 297.00 @ 100 yrs.

CULVERT TYPE : BOX **Entrance Type :** 30 - 75 degrees Wingwalls **Entrance Loss (Ke) :** 0.20

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
203.00	1	8 x 4 ft.	632.37	N/A	1 - C	15.97	1.59	2.71	0.0120	INLET	0.00	D	0.00
203.00	1	8 x 5 ft.	632.33	N/A	1 - C	15.96	1.59	2.71	0.0120	INLET	0.00	D + 1	0.00
270.90	1	8 x 4 ft.	634.40	632.84	2 - E	17.49	1.94	3.29	0.0120	INLET	26.10	F	0.00
297.00	1	8 x 5 ft.	633.64	N/A	1 - C	17.99	2.06	3.50	0.0120	INLET	0.00	F + 1	0.00

CULVERT ANALYSIS

PID : 19415 **Date :** 12/12/2006 **Project :** SCI-823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage Areas 75, 76, 54 SR 139 171=80 **Designer :** HJS

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 628.00 **Outlet Invert Elevation (ft.) :** 627.30

Pipe Quantity : 1

Culvert Type : Box **Pipe Length (ft.) :** 50.00 **Culvert Slope (ft./ft.) :** 0.0140

Corrugation Type :

Pipe Size : 8 x 4 ft.

Design Manning 'n' : (default)

Entrance Type : 30 - 75 degrees Wingwalls **Loss Coef. Ke :** 0.2000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
203.10	1.64	632.30	N/A	1 - C	15.96	1.59	2.72	0.0120	INLET	0.00	627.30
296.50	2.96	634.01	632.84	2 - E	17.98	2.06	3.49	0.0120	INLET	0.00	627.30

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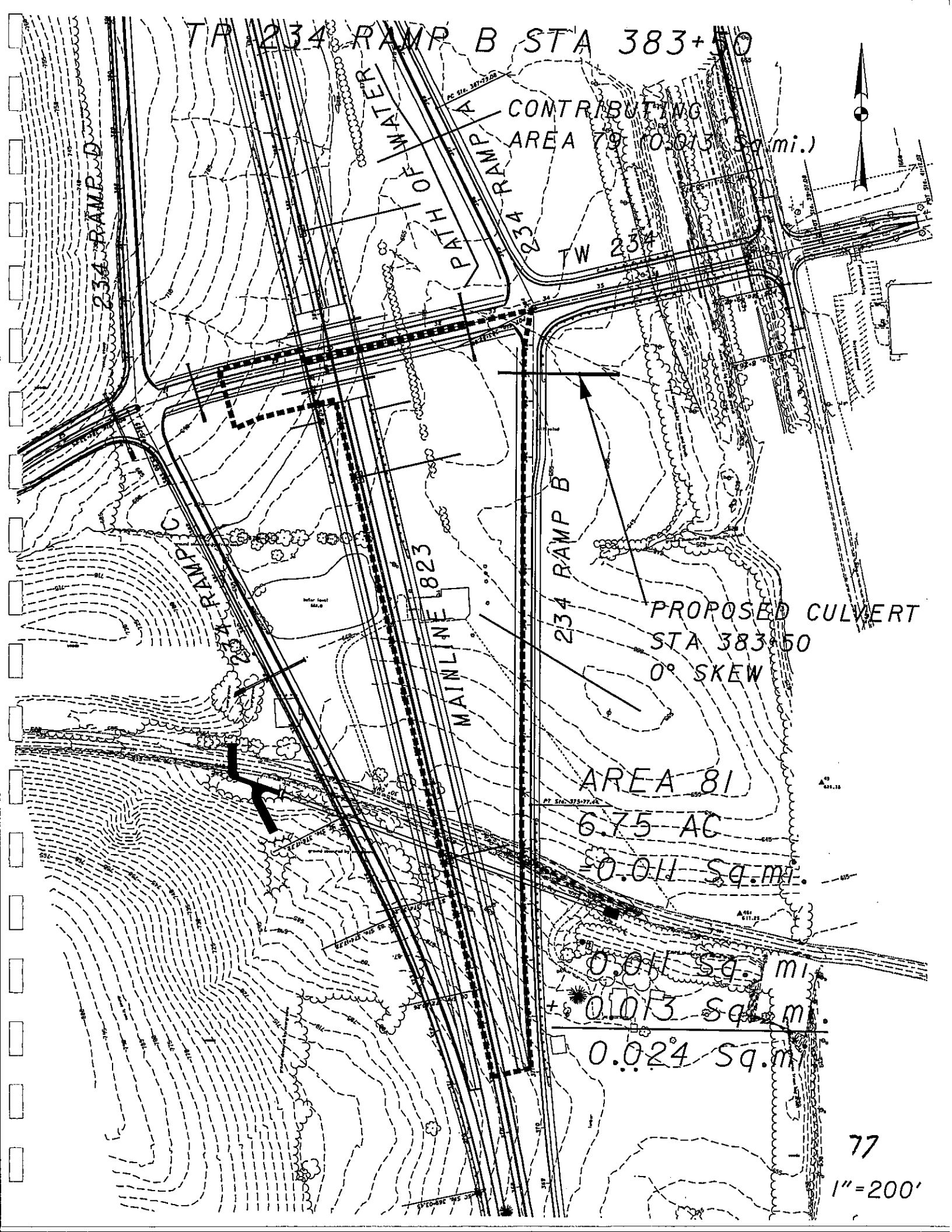
TP 234 RAMP B STA 383+50
CONTRIBUTING AREA 79.0305 Sq.mi.)
234 RAMP D
PATH OF WATER
234 RAMP A
TW 234
234 RAMP C
MAINLINE 823
234 RAMP B
PROPOSED CULVERT
STA 383+50
0° SKEW
AREA 81
675 AC
0.011 Sq.mi.
0.011 Sq. mi.
+ 0.013 Sq.mi.
0.024 Sq.mi.
77
1"=200'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions	
642510.00	SQ. FT.		419283
0.023	SQ. MI.	**CONTDA** = Contributing Drainage Area	293966
0.00	SQ. FT.		
0.00	%	**STORAGE** = Storage Area	
1788.00	FT.	**TOTAL CHANNEL LENGTH**	
178.80	FT.	L_{10} = 10% of the Distance along channel	
658	FT.	**$Elev_{10}$** = Elevation at point L_{10}	
1519.80	FT.	L_{85} = 85% of the Distance along channel	
715	FT.	**$Elev_{85}$** = Elevation at point L_{85}	
1341.00	FT.	**Length** = $L_{85} - L_{10}$	
224.43	FT./MI.	**SLOPE** = $(Elev_{10}-Elev_{85})/Length$	
	CFS	$Q_{\#}$ = Flood-Peak Discharge	
		# = Frequency of Storm	

Q_2	7.46	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	15.39	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	21.86	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	30.68	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	37.99	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	45.18	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

Worksheet for SR 234 Ramp B STA 383+50

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.05000	ft/ft
Left Side Slope	6.00	ft/ft (H:V)
Right Side Slope	6.00	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	30.68	ft^3/s

Results

Normal Depth	0.68	ft
Flow Area	4.87	ft^2
Wetted Perimeter	11.33	ft
Top Width	11.22	ft
Critical Depth	0.89	ft
Critical Slope	0.01633	ft/ft
Velocity	6.31	ft/s
Velocity Head	0.62	ft
Specific Energy	1.30	ft
Froude Number	1.69	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.68	ft
Critical Depth	0.89	ft
Channel Slope	0.05000	ft/ft
Critical Slope	0.01633	ft/ft

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 07/21/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 81, 234 Ramp B Sta. 383+50 **Designer :** mdc

HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 656.00 **Outlet Invert Elevation (ft.) :** 647.00 **Tailwater Elevation (ft.) :** 647.68 **Overflow Elevation (ft.) :** 663.10

Allowable Headwater Elevation (ft.) : 662.10 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 146.00 **Culvert Slope (ft./ft.) :** 0.0616 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 30.70 @ 25 yrs. **Flood Discharge (cfs) :** 45.20 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
30.70	1	27 in.	659.41	651.41	2 - E	19.36	0.95	1.92	0.0120	INLET	0.00	D	0.00
30.70	1	24 in.	660.34	652.99	2 - E	19.42	1.00	1.87	0.0120	INLET	0.00	D - 1	0.00
30.70	1	21 in.	662.18	656.41	2 - E	19.29	1.10	1.72	0.0120	INLET	0.00	D - 2	0.00
30.70	1	30 in.	658.96	N/A	1 - C	19.25	0.90	1.89	0.0120	INLET	0.00	D + 1	0.00
45.20	1	27 in.	661.55	654.24	2 - E	21.37	1.18	2.15	0.0120	INLET	0.00	F	0.00
43.00	1	24 in.	663.68	657.78	2 - E	20.99	1.24	1.96	0.0120	INLET	2.20	F - 1	0.00
33.40	1	21 in.	669.75	665.39	2 - E	19.61	1.17	1.73	0.0120	INLET	11.80	F - 2	0.00
45.20	1	30 in.	660.36	652.45	2 - E	21.34	1.12	2.23	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
30.70	1	30 in.	659.50	653.21	2 - E	11.40	1.35	1.89	0.0244	INLET	0.00	D	0.00

UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
30.70	1	27 in.	660.40	655.91	2 - E	11.27	1.46	1.92	0.0245	INLET	0.00	D - 1	0.00
30.70	1	24 in.	661.95	661.41	2 - E	10.69	1.72	1.87	0.0247	INLET	0.00	D - 2	0.00
30.70	1	33 in.	659.02	N/A	1 - C	11.50	1.27	1.84	0.0241	INLET	0.00	D + 1	0.00
45.20	1	30 in.	661.81	658.08	2 - E	12.36	1.74	2.23	0.0244	INLET	0.00	F	0.00
42.90	1	27 in.	663.65	663.99	2 - E	11.03	1.97	2.13	0.0245	INLET	2.30	F - 1	0.00
32.70	1	24 in.	667.09	676.01	2 - F	10.61	2.00	1.90	0.0247	OUTLET**	12.50	F - 2	0.00
45.20	1	33 in.	660.61	654.84	2 - E	12.64	1.60	2.23	0.0241	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
30.70	1	36 in.	658.76	N/A	1 - C	10.24	1.32	1.80	0.0281	INLET	0.00	D	0.00
30.70	1	42 in.	658.53	N/A	1 - C	10.24	1.22	1.71	0.0278	INLET	0.00	D + 1	0.00
45.20	1	36 in.	659.89	653.92	2 - E	11.28	1.66	2.19	0.0281	INLET	0.00	F	0.00
45.20	1	42 in.	659.23	N/A	1 - C	11.36	1.51	2.10	0.0278	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
30.70	1	60 in.	658.17	N/A	1 - C	8.72	1.18	1.54	0.0332	INLET	0.00	D	0.00
30.70	1	66 in.	658.07	N/A	1 - C	8.66	1.14	1.50	0.0330	INLET	0.00	D + 1	0.00
45.20	1	60 in.	658.71	N/A	1 - C	9.75	1.43	1.88	0.0332	INLET	0.00	F	0.00
45.20	1	66 in.	658.60	N/A	1 - C	9.70	1.38	1.83	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
30.70	1	60 in.	658.17	N/A	1 - C	10.37	1.04	1.54	0.0260	INLET	0.00	D	0.00
30.70	1	66 in.	658.07	N/A	1 - C	10.25	1.01	1.50	0.0260	INLET	0.00	D + 1	0.00
45.20	1	60 in.	658.71	N/A	1 - C	11.61	1.26	1.88	0.0260	INLET	0.00	F	0.00
45.20	1	66 in.	658.60	N/A	1 - C	11.49	1.22	1.83	0.0260	INLET	0.00	F + 1	0.00

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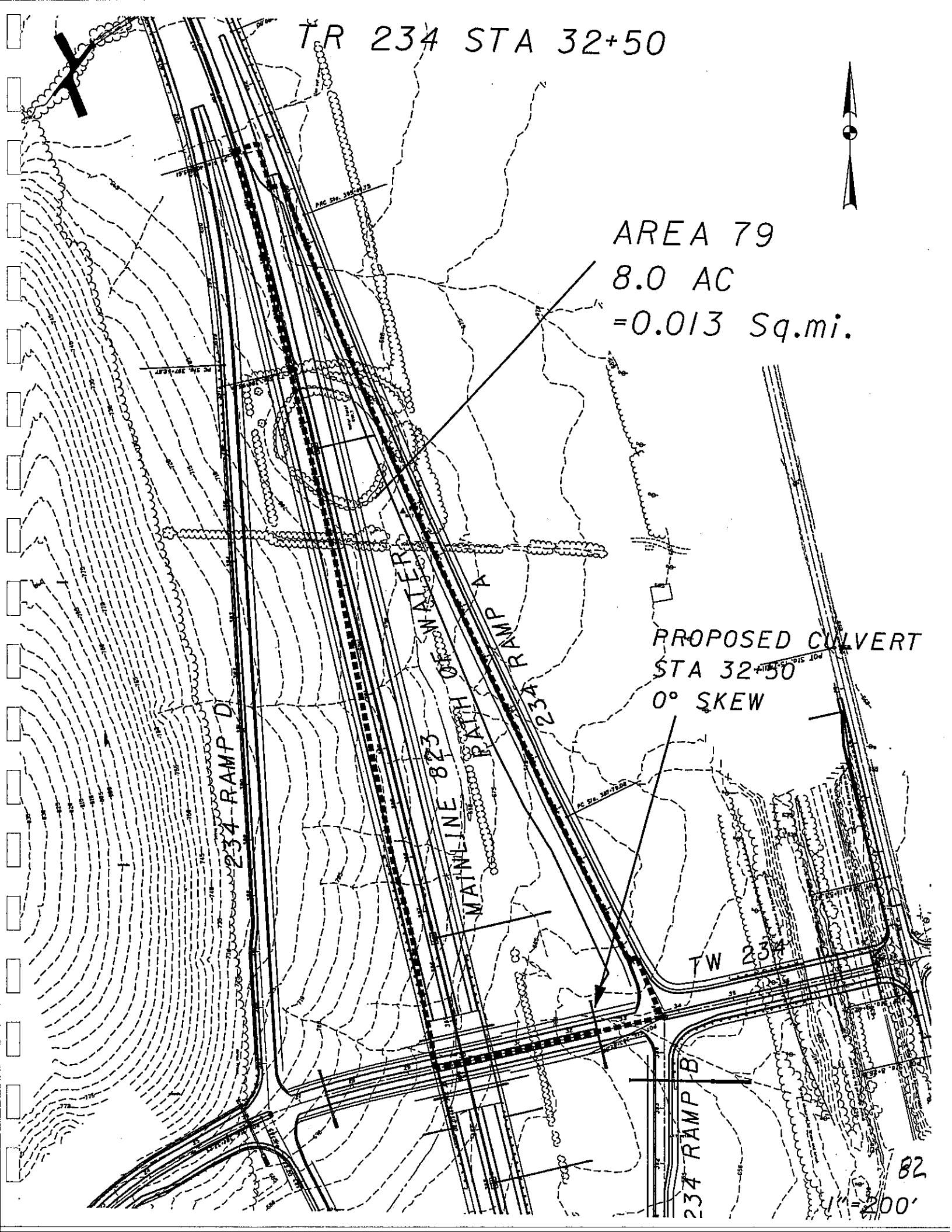
TR 234 STA 32+50
AREA 79
8.0 AC
=0.013 Sq.mi.
PROPOSED CULVERT
STA 32+50
0° SKEW
WATER MAIN LINE 823
234 RAMP A
234 RAMP D
TW 234
234 RAMP B
82
1" = 200'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
347605.73	SQ. FT.	
0.012	SQ. MI.	**CONTDA** = Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE** = Storage Area
1628.00	FT.	**TOTAL CHANNEL LENGTH**
162.80	FT.	L_{10} = 10% of the Distance along channel
664	FT.	$Elev_{10}$ = Elevation at point L_{10}
1383.80	FT.	L_{85} = 85% of the Distance along channel
716	FT.	$Elev_{85}$ = Elevation at point L_{85}
1221.00	FT.	**Length** = $L_{85} - L_{10}$
224.86	FT./MI.	**SLOPE** = $(Elev_{10}-Elev_{85})/Length$
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	4.62	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	9.60	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	13.68	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	19.25	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	23.87	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	28.41	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 07/21/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 79, 234 Sta. 32+50 **Designer :** mdc

HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 659.00 **Outlet Invert Elevation (ft.) :** 658.00 **Tailwater Elevation (ft.) :** 659.84 **Overflow Elevation (ft.) :** 663.50

Allowable Headwater Elevation (ft.) : 662.50 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 128.00 **Culvert Slope (ft./ft.) :** 0.0078 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 19.30 @ 25 yrs. **Flood Discharge (cfs) :** 28.40 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
19.30	1	24 in.	661.57	661.33	2 - E	7.79	1.47	1.58	0.0120	INLET	0.00	D	0.00
19.30	1	21 in.	662.21	662.65	2 - G	8.02	1.75	1.58	0.0120	OUTLET	0.00	D - 1	0.00
15.20	1	18 in.	663.69	665.72	2 - G	8.60	1.50	1.41	0.0120	OUTLET	4.10	D - 2	0.00
19.30	1	27 in.	661.30	N/A	1 - C	7.94	1.32	1.54	0.0120	INLET	0.00	D + 1	0.00
28.40	1	24 in.	662.92	663.15	2 - F	9.39	2.00	1.83	0.0120	OUTLET**	0.00	F	0.00
22.00	1	21 in.	664.48	665.92	2 - G	9.15	1.75	1.64	0.0120	OUTLET	6.40	F - 1	0.00
15.20	1	18 in.	668.47	672.58	2 - G	8.60	1.50	1.41	0.0120	OUTLET	13.20	F - 2	0.00
28.40	1	27 in.	662.15	661.91	2 - E	8.49	1.76	1.85	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
19.30	1	27 in.	661.55	662.34	2 - F	5.54	2.25	1.54	0.0245	OUTLET**	0.00	D	0.00

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UNIVERSAL CULVERT DESIGN

	FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
	17.40	1	24 in.	662.13	664.30	2 - F	5.75	2.00	1.50	0.0247	OUTLET	1.90	D - 1	0.00
	12.40	1	21 in.	663.31	668.61	2 - G	5.16	1.75	1.31	0.0248	OUTLET	6.90	D - 2	0.00
	19.30	1	30 in.	661.29	661.61	1 - A	4.98	2.05	1.49	0.0244	OUTLET*	0.00	D + 1	0.00
	23.10	1	27 in.	662.96	665.36	2 - F	6.64	2.25	1.68	0.0245	OUTLET**	5.30	F	0.00
	17.40	1	24 in.	664.31	669.57	2 - F	5.75	2.00	1.50	0.0247	OUTLET	11.00	F - 1	0.00
	12.40	1	21 in.	666.63	678.83	2 - G	5.16	1.75	1.31	0.0248	OUTLET	16.00	F - 2	0.00
	28.40	1	30 in.	662.21	663.30	2 - F	7.33	2.50	1.82	0.0244	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	19.30	1	36 in.	661.07	661.36	1 - A	4.25	1.86	1.41	0.0281	OUTLET*	0.00	D	0.00
	19.30	1	42 in.	660.94	661.23	1 - B	3.77	1.68	1.34	0.0278	OUTLET*	0.00	D + 1	0.00
	28.40	1	36 in.	661.62	662.05	1 - A	6.25	2.59	1.72	0.0281	OUTLET*	0.00	F	0.00
	28.40	1	42 in.	661.42	661.73	1 - A	5.54	2.12	1.64	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	19.30	1	60 in.	660.65	660.99	1 - B	2.94	1.57	1.21	0.0332	OUTLET*	0.00	D	0.00
	19.30	1	66 in.	660.59	660.92	1 - B	2.77	1.51	1.18	0.0330	OUTLET*	0.00	D + 1	0.00
	28.40	1	60 in.	661.07	661.39	1 - A	4.33	1.93	1.48	0.0332	OUTLET*	0.00	F	0.00
	28.40	1	66 in.	660.98	661.33	1 - A	4.08	1.85	1.44	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	9.65	2	60 in.	660.14	660.42	1 - B	1.47	1.11	0.85	0.0332	OUTLET*	0.00	D	0.00
	9.65	2	66 in.	660.12	660.36	1 - B	1.39	1.07	0.83	0.0330	OUTLET*	0.00	D + 1	0.00
	14.20	2	60 in.	660.39	660.70	1 - B	2.17	1.34	1.04	0.0332	OUTLET*	0.00	F	0.00
	14.20	2	66 in.	660.35	660.65	1 - B	2.04	1.29	1.01	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)														
Diameter exceeds 1.25 HWA	19.30	1	60 in.	660.65	660.96	1 - B	2.94	1.38	1.21	0.0260	OUTLET*	0.00	D	0.00
	19.30	1	66 in.	660.59	660.90	1 - B	2.77	1.34	1.18	0.0260	OUTLET*	0.00	D + 1	0.00

UNIVERSAL CULVERT DESIGN

	FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
	28.40	1	60 in.	661.07	661.41	1 - B	4.33	1.69	1.48	0.0260	OUTLET*	0.00	F	0.00
	28.40	1	66 in.	660.98	661.33	1 - B	4.08	1.63	1.44	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	9.65	2	60 in.	660.14	660.38	1 - B	1.47	0.98	0.85	0.0260	OUTLET*	0.00	D	0.00
	9.65	2	66 in.	660.12	660.34	1 - B	1.39	0.95	0.83	0.0260	OUTLET*	0.00	D + 1	0.00
	14.20	2	60 in.	660.39	660.67	1 - B	2.17	1.19	1.04	0.0260	OUTLET*	0.00	F	0.00
	14.20	2	66 in.	660.35	660.63	1 - B	2.04	1.15	1.01	0.0260	OUTLET*	0.00	F + 1	0.00

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CULVERT ANALYSIS

PID : 19415 **Date :** 11/15/2006 **Project :** SR 823 Portsmouth **Location :** Portsmouth Ohio

Description : Drainage Area 79, Sta. 32+50 TW234 **Designer :** HJS

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 659.00 **Outlet Invert Elevation (ft.) :** 658.00

Pipe Quantity : 1

Culvert Type : Circular Smooth **Pipe Length (ft.) :** 128.00 **Culvert Slope (ft./ft.) :** 0.0078

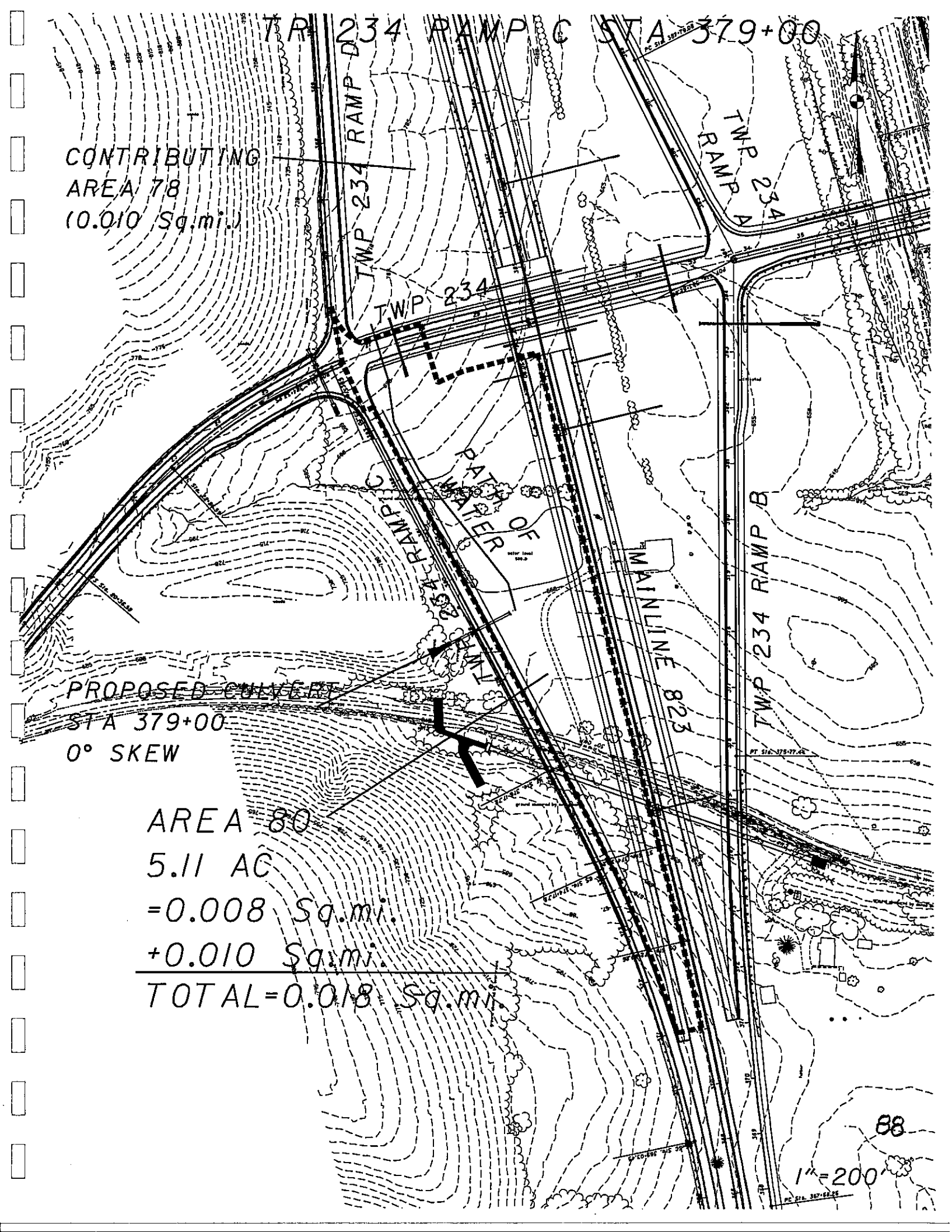
Corrugation Type :

Pipe Size : 30 in.

Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.2000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
19.30	1.17	661.17	N/A	1 - C	7.97	1.24	1.49	0.0120	INLET	0.00	659.84
28.40	1.63	661.79	N/A	1 - C	8.72	1.58	1.82	0.0120	INLET	0.00	659.84


TR 234 RAMP C STA 379+00
CONTRIBUTING
AREA 78
(0.010 Sq.mi.)
TWP 234 RAMP D
TWP 234
TWP 234 RAMP A
PATH OF WATER
TWP 234 RAMP C
MAINLINE 823
TWP 234 RAMP B
PROPOSED CULVERT
STA 379+00
0° SKEW
AREA 80
5.11 AC
=0.008 Sq.mi.
+0.010 Sq.mi.
TOTAL=0.018 Sq.mi.
88
1"=200'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Contributing Area → 287455

Drainage Area → 222749

Values	Units	Definitions
510204.00	SQ. FT.	
0.018	SQ. MI.	**CONTDA** = Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE** = Storage Area
2279.00	FT.	**TOTAL CHANNEL LENGTH**
227.90	FT.	L_{10} = 10% of the Distance along channel
668	FT.	$Elev_{10}$ = Elevation at point L_{10}
1937.15	FT.	L_{85} = 85% of the Distance along channel
710	FT.	$Elev_{85}$ = Elevation at point L_{85}
1709.25	FT.	**Length** = $L_{85} - L_{10}$
129.74	FT./MI.	**SLOPE** = $(Elev_{10}-Elev_{85})$/Length
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	5.67	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	11.42	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	16.04	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	22.28	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	27.43	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	32.46	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

Worksheet for SR 234 Ramp C STA 379+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.13150	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	6.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	22.30	ft^3/s

Results

Normal Depth	0.28	ft
Flow Area	3.11	ft^2
Wetted Perimeter	12.33	ft
Top Width	12.24	ft
Critical Depth	0.50	ft
Critical Slope	0.01766	ft/ft
Velocity	7.17	ft/s
Velocity Head	0.80	ft
Specific Energy	1.08	ft
Froude Number	2.51	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.28	ft
Critical Depth	0.50	ft
Channel Slope	0.13150	ft/ft
Critical Slope	0.01766	ft/ft

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 07/21/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 80, 234 Ramp C Sta. 379+00 **Designer :** mdc

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 666.70 **Outlet Invert Elevation (ft.) :** 665.00 **Tailwater Elevation (ft.) :** 665.28 **Overflow Elevation (ft.) :** 670.00

Allowable Headwater Elevation (ft.) : 669.00 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 120.00 **Culvert Slope (ft./ft.) :** 0.0142 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 22.28 @ 25 yrs. **Flood Discharge (cfs) :** 32.46 @ 100 yrs.

	FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH				**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
	22.28	1	33 in.	668.96	N/A	1 - C	10.27	1.08	1.56	0.0120	INLET	0.00	D	0.00
	22.28	1	30 in.	669.06	N/A	1 - C	10.31	1.13	1.61	0.0120	INLET	0.00	D - 1	0.00
	22.28	1	27 in.	669.25	N/A	1 - C	10.32	1.20	1.65	0.0120	INLET	0.00	D - 2	0.00
	22.28	1	36 in.	668.88	N/A	1 - C	10.21	1.04	1.52	0.0120	INLET	0.00	D + 1	0.00
	32.46	1	33 in.	669.55	N/A	1 - C	11.35	1.34	1.90	0.0120	INLET	0.00	F	0.00
	32.46	1	30 in.	669.81	668.67	2 - E	11.32	1.42	1.94	0.0120	INLET	0.00	F - 1	0.00
	29.66	1	27 in.	670.33	N/A	2 - E	11.00	1.44	1.89	0.0120	INLET	2.80	F - 2	0.00
	32.46	1	36 in.	669.40	N/A	1 - C	11.31	1.28	1.85	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED				**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)														
Diameter exceeds 1.25 HWA	22.28	1	42 in.	668.81	N/A	1 - C	6.17	1.41	1.45	0.0237	INLET	0.00	D	0.00

UNIVERSAL CULVERT DESIGN

	FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
	22.28	1	36 in.	668.95	669.34	1 - A	6.21	1.54	1.52	0.0241	OUTLET*	0.00	D - 1	0.00
	22.28	1	33 in.	669.06	669.42	1 - A	6.41	1.63	1.56	0.0241	OUTLET*	0.00	D - 2	0.00
	22.28	1	48 in.	668.69	N/A	1 - C	6.15	1.32	1.39	0.0235	INLET	0.00	D + 1	0.00
	32.46	1	42 in.	669.31	N/A	1 - C	6.81	1.74	1.76	0.0237	INLET	0.00	F	0.00
	32.46	1	36 in.	669.58	669.96	1 - A	7.11	1.95	1.85	0.0241	OUTLET*	0.00	F - 1	0.00
	30.96	1	33 in.	669.88	670.09	2 - F	7.28	2.06	1.85	0.0241	OUTLET*	1.50	F - 2	0.00
	32.46	1	48 in.	669.17	N/A	1 - C	6.82	1.62	1.69	0.0235	INLET	0.00	F + 1	0.00
	11.14	2	24 in.	668.54	668.76	1 - A	5.68	1.34	1.20	0.0247	OUTLET*	0.00	D	0.00
	11.14	2	21 in.	668.84	669.28	2 - F	6.10	1.75	1.24	0.0248	OUTLET**	0.00	D - 1	0.00
	8.64	2	18 in.	669.63	672.48	2 - F	6.01	1.50	1.14	0.0249	OUTLET**	2.50	D - 2	0.00
	11.14	2	27 in.	668.41	668.68	1 - A	5.42	1.22	1.15	0.0245	OUTLET*	0.00	D + 1	0.00
	16.23	2	24 in.	669.26	669.73	2 - F	6.64	2.00	1.45	0.0247	OUTLET**	0.00	F	0.00
	12.43	2	21 in.	670.08	672.52	2 - F	6.42	1.75	1.31	0.0248	OUTLET**	3.80	F - 1	0.00
	8.63	2	18 in.	671.73	679.40	2 - F	6.00	1.50	1.14	0.0249	OUTLET**	7.60	F - 2	0.00
	16.23	2	27 in.	668.90	669.15	1 - A	6.21	1.56	1.41	0.0245	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
Diameter exceeds 1.25 HWA	22.28	1	54 in.	668.59	668.95	1 - A	5.59	1.36	1.34	0.0273	OUTLET*	0.00	D	0.00
	22.28	1	48 in.	668.69	669.02	1 - A	5.73	1.44	1.39	0.0275	OUTLET*	0.00	D - 1	0.00
	22.28	1	42 in.	668.81	669.12	1 - A	5.93	1.54	1.45	0.0278	OUTLET*	0.00	D - 2	0.00
	22.28	1	60 in.	668.50	668.88	1 - A	5.47	1.31	1.30	0.0271	OUTLET*	0.00	D + 1	0.00
	32.46	1	54 in.	669.05	669.45	1 - A	6.23	1.66	1.63	0.0273	OUTLET*	0.00	F	0.00
	32.46	1	48 in.	669.17	669.55	1 - A	6.42	1.76	1.69	0.0275	OUTLET*	0.00	F - 1	0.00
	32.46	1	42 in.	669.31	669.69	1 - A	6.69	1.91	1.76	0.0278	OUTLET*	0.00	F - 2	0.00

UNIVERSAL CULVERT DESIGN

	FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
	32.46	1	60 in.	668.94	669.37	1 - A	6.08	1.59	1.58	0.0271	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	11.14	2	36 in.	668.22	668.44	1 - A	5.00	1.13	1.06	0.0281	OUTLET*	0.00	D	0.00
	11.14	2	42 in.	668.11	668.36	1 - A	4.84	1.06	1.01	0.0278	OUTLET*	0.00	D + 1	0.00
	16.23	2	36 in.	668.58	668.84	1 - A	5.60	1.40	1.29	0.0281	OUTLET*	0.00	F	0.00
	16.23	2	42 in.	668.46	668.74	1 - A	5.39	1.29	1.23	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	22.28	1	60 in.	668.50	668.79	1 - A	5.47	1.45	1.30	0.0332	OUTLET*	0.00	D	0.00
	22.28	1	66 in.	668.42	668.74	1 - A	5.37	1.40	1.27	0.0330	OUTLET*	0.00	D + 1	0.00
	32.46	1	60 in.	668.94	669.26	1 - A	6.08	1.77	1.58	0.0332	OUTLET*	0.00	F	0.00
	32.46	1	66 in.	668.84	669.20	1 - A	5.96	1.69	1.54	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	11.14	2	60 in.	667.92	668.16	1 - A	4.53	1.02	0.91	0.0332	OUTLET*	0.00	D	0.00
	11.14	2	66 in.	667.90	668.11	1 - A	4.46	0.99	0.89	0.0330	OUTLET*	0.00	D + 1	0.00
	16.23	2	60 in.	668.20	668.47	1 - A	5.01	1.23	1.11	0.0332	OUTLET*	0.00	F	0.00
	16.23	2	66 in.	668.15	668.43	1 - A	4.92	1.19	1.08	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)														
Diameter exceeds 1.25 HWA	22.28	1	60 in.	668.50	N/A	1 - C	5.61	1.28	1.30	0.0260	INLET	0.00	D	0.00
	22.28	1	66 in.	668.42	N/A	1 - C	5.37	1.24	1.27	0.0260	INLET	0.00	D + 1	0.00
	32.46	1	60 in.	668.94	N/A	1 - C	6.24	1.55	1.58	0.0260	INLET	0.00	F	0.00
	32.46	1	66 in.	668.84	N/A	1 - C	6.19	1.50	1.54	0.0260	INLET	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	11.14	2	60 in.	667.92	N/A	1 - C	4.53	0.91	0.91	0.0260	INLET	0.00	D	0.00
	11.14	2	66 in.	667.90	N/A	1 - C	4.46	0.88	0.89	0.0260	INLET	0.00	D + 1	0.00
	16.23	2	60 in.	668.20	N/A	1 - C	5.11	1.09	1.11	0.0260	INLET	0.00	F	0.00
	16.23	2	66 in.	668.15	N/A	1 - C	4.92	1.06	1.08	0.0260	INLET	0.00	F + 1	0.00

CULVERT ANALYSIS

PID : 19415 **Date :** 11/15/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage Area 80, TW 234 Ramp C Sta. 379+00 **Designer :** HJS

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 666.70 **Outlet Invert Elevation (ft.) :** 665.00

Pipe Quantity : 1

Culvert Type : Circular Smooth **Pipe Length (ft.) :** 120.00 **Culvert Slope (ft./ft.) :** 0.0142

Corrugation Type :

Pipe Size : 42 in.

Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.2000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
22.30	1.26	668.74	N/A	1 - C	10.09	0.98	1.45	0.0120	INLET	0.00	665.28
32.50	1.60	669.23	N/A	1 - C	11.22	1.19	1.76	0.0120	INLET	0.00	665.28

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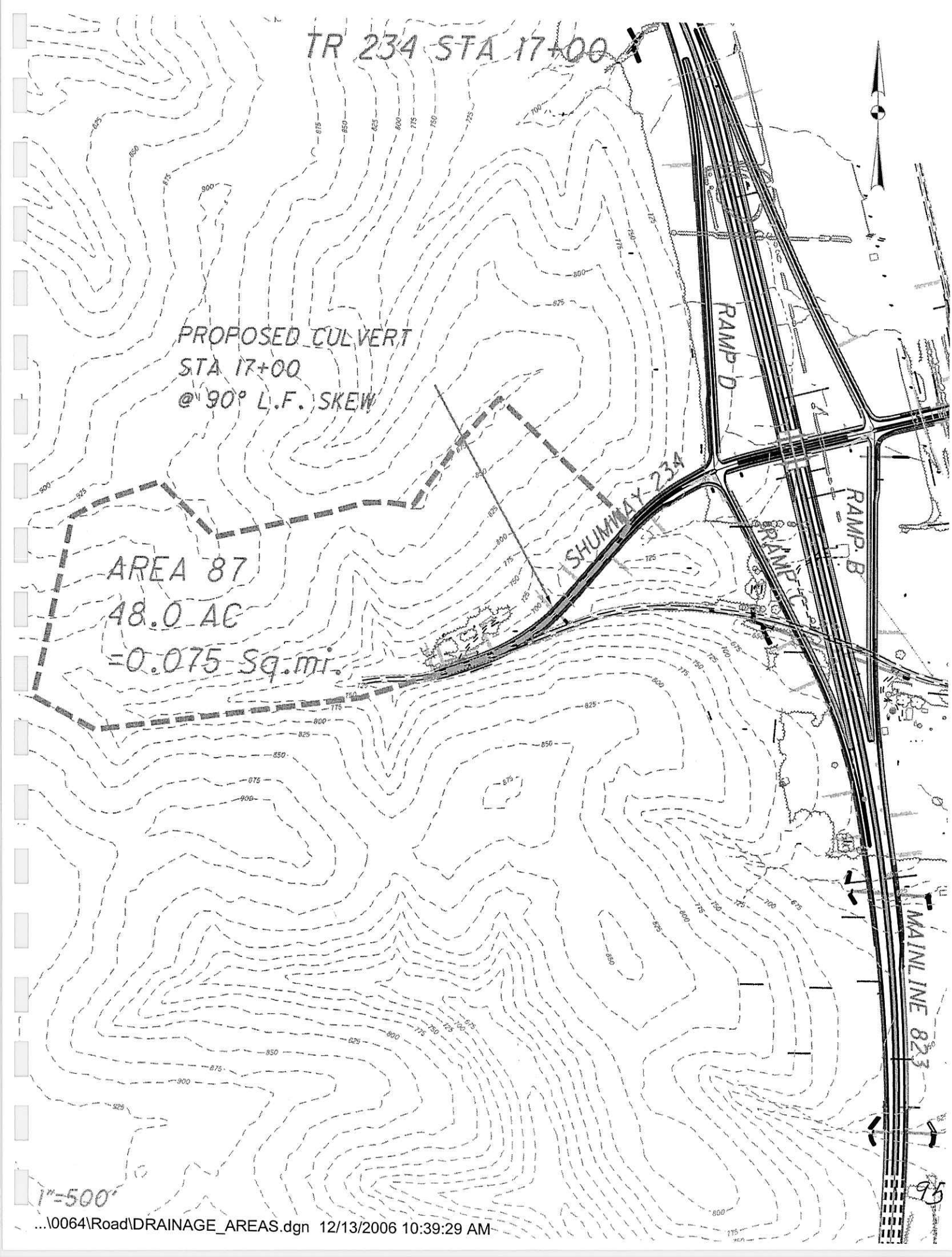

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TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
2089899.00	SQ. FT.	
0.075	SQ. MI.	**CONTDA** = Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE** = Storage Area
3120.00	FT.	**TOTAL CHANNEL LENGTH**
312.00	FT.	L_{10} = 10% of the Distance along channel
689	FT.	$Elev_{10}$ = Elevation at point L_{10}
2652.00	FT.	L_{85} = 85% of the Distance along channel
860	FT.	$Elev_{85}$ = Elevation at point L_{85}
2340.00	FT.	**Length** = $L_{85} - L_{10}$
385.85	FT./MI.	**SLOPE** = $(Elev_{10}-Elev_{85})$/Length
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	20.60	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	42.98	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	61.45	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	86.76	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	107.74	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	128.60	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

Worksheet for TR 234 STA 17+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.02100	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	86.76	ft^3/s

Results

Normal Depth	1.62	ft
Flow Area	11.75	ft^2
Wetted Perimeter	11.25	ft
Top Width	10.49	ft
Critical Depth	1.81	ft
Critical Slope	0.01351	ft/ft
Velocity	7.39	ft/s
Velocity Head	0.85	ft
Specific Energy	2.47	ft
Froude Number	1.23	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.62	ft
Critical Depth	1.81	ft
Channel Slope	0.02100	ft/ft
Critical Slope	0.01351	ft/ft

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 11/21/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 87, TR 234 Sta. 17+00 **Designer :** mdc

HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 680.10 **Outlet Invert Elevation (ft.) :** 677.67 **Tailwater Elevation (ft.) :** 679.30 **Overflow Elevation (ft.) :** 686.30

Allowable Headwater Elevation (ft.) : 685.30 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 78.00 **Culvert Slope (ft./ft.) :** 0.0312 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 86.80 @ 25 yrs. **Flood Discharge (cfs) :** 128.60 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
86.80	1	42 in.	685.06	682.88	2 - E	19.48	1.65	2.90	0.0120	INLET	0.00	D	0.00
81.50	1	36 in.	686.85	684.51	2 - E	19.14	1.74	2.78	0.0120	INLET	5.30	D - 1	0.00
69.90	1	33 in.	688.55	686.14	2 - E	18.36	1.68	2.59	0.0120	INLET	16.90	D - 2	0.00
86.80	1	48 in.	684.38	N/A	1 - C	19.36	1.55	2.82	0.0120	INLET	0.00	D + 1	0.00
106.00	1	42 in.	688.06	685.48	2 - E	20.47	1.86	3.13	0.0120	INLET	22.60	F	0.00
81.50	1	36 in.	692.25	689.27	2 - E	19.14	1.74	2.78	0.0120	INLET	47.10	F - 1	0.00
69.90	1	33 in.	697.24	693.05	2 - E	18.36	1.68	2.59	0.0120	INLET	58.70	F - 2	0.00
128.60	1	48 in.	686.13	683.85	2 - E	21.50	1.92	3.40	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
86.80	1	48 in.	684.94	683.41	2 - E	11.75	2.28	2.82	0.0235	INLET	0.00	D	0.00

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UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
86.10	1	42 in.	686.36	685.19	2 - E	11.43	2.56	2.89	0.0237	INLET	0.70	D - 1	0.00
65.60	1	36 in.	689.36	689.55	2 - E	10.10	2.56	2.59	0.0241	INLET	21.20	D - 2	0.00
86.80	1	54 in.	684.32	N/A	1 - C	11.85	2.11	2.73	0.0233	INLET	0.00	D + 1	0.00
108.40	1	48 in.	687.85	686.49	2 - E	12.32	2.64	3.15	0.0235	INLET	20.20	F	0.00
86.10	1	42 in.	691.03	690.55	2 - E	11.43	2.56	2.89	0.0237	INLET	42.50	F - 1	0.00
65.60	1	36 in.	697.96	700.33	2 - E	10.10	2.56	2.59	0.0241	INLET	63.00	F - 2	0.00
128.60	1	54 in.	686.14	684.58	2 - E	13.02	2.68	3.34	0.0233	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
86.80	1	48 in.	684.94	683.76	2 - E	10.40	2.52	2.82	0.0275	INLET	0.00	D	0.00
86.10	1	42 in.	686.36	685.96	2 - E	9.81	3.00	2.89	0.0278	INLET	0.70	D - 1	0.00
64.40	1	36 in.	689.36	691.17	2 - F	9.97	3.00	2.58	0.0281	OUTLET**	22.40	D - 2	0.00
86.80	1	54 in.	684.32	N/A	1 - C	10.52	2.32	2.73	0.0273	INLET	0.00	D + 1	0.00
108.40	1	48 in.	687.85	687.24	2 - E	10.80	2.98	3.15	0.0275	INLET	20.20	F	0.00
86.10	1	42 in.	691.03	692.14	2 - E	10.14	3.00	2.89	0.0278	INLET	42.50	F - 1	0.00
64.40	1	36 in.	697.96	703.89	2 - F	9.97	3.00	2.58	0.0281	OUTLET**	64.20	F - 2	0.00
128.60	1	54 in.	686.14	684.98	2 - E	11.48	2.98	3.34	0.0273	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
86.80	1	60 in.	684.04	N/A	1 - C	9.09	2.45	2.64	0.0332	INLET	0.00	D	0.00
86.80	1	66 in.	683.87	N/A	1 - C	9.10	2.32	2.57	0.0330	INLET	0.00	D + 1	0.00
128.60	1	60 in.	685.30	N/A	1 - C	9.96	3.12	3.24	0.0332	INLET	0.00	F	0.00
128.60	1	66 in.	684.88	N/A	1 - C	10.07	2.91	3.15	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
86.80	1	60 in.	684.04	N/A	1 - C	10.89	2.13	2.64	0.0260	INLET	0.00	D	0.00
86.80	1	66 in.	683.87	N/A	1 - C	10.83	2.04	2.57	0.0260	INLET	0.00	D + 1	0.00

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UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
128.60	1	60 in.	685.30	N/A	1 - C	12.03	2.67	3.24	0.0260	INLET	0.00	F	0.00
128.60	1	66 in.	684.88	N/A	1 - C	12.03	2.53	3.15	0.0260	INLET	0.00	F + 1	0.00

001

CULVERT ANALYSIS

PID : 19415 **Date :** 12/11/2006 **Project :** SCI 823 Portsmouth Bypass **Location :** Portsmouth, Ohio

Description : Drainage Area 87, TR 2234 Sta. 17+00 **Designer :** HJS

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 680.10 **Outlet Invert Elevation (ft.) :** 677.67

Pipe Quantity : 1

Culvert Type : Circular Corrugated
Corrugation Type : Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations) **Pipe Length (ft.) :** 78.00 **Culvert Slope (ft./ft.) :** 0.0312
Pipe Size : 48 in.
Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
86.80	3.85	684.94	683.41	2 - E	11.75	2.28	2.82	0.0235	INLET	0.00	679.30
128.60	6.48	687.85	686.49	2 - E	12.66	3.01	3.40	0.0235	INLET	0.00	679.30

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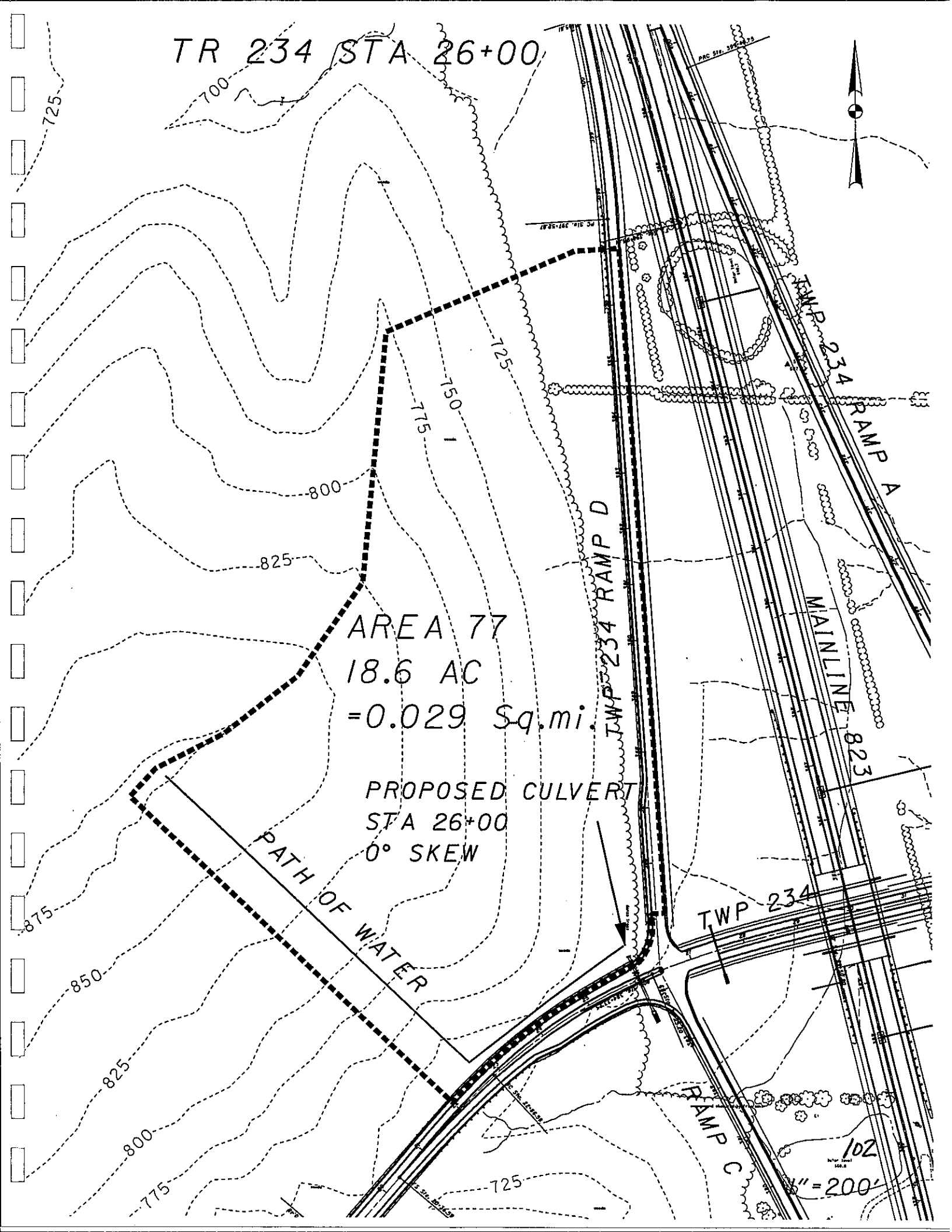
TR 234 STA 26+00
700
725
750
775
800
825
AREA 77
18.6 AC
=0.029 Sq.mi.
PROPOSED CULVERT
STA 26+00
0° SKEW
PATH OF WATER
TWP 234 RAMP D
TWP 234 RAMP A
MAINLINE 823
TWP 234
RAMP C
875
850
825
800
775
725
102
1" = 200'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
810646.00	SQ. FT.	
0.029	SQ. MI.	**CONTDA** = Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE** = Storage Area
1088.00	FT.	**TOTAL CHANNEL LENGTH**
108.80	FT.	L_{10} = 10% of the Distance along channel
679	FT.	$Elev_{10}$ = Elevation at point L_{10}
924.80	FT.	L_{85} = 85% of the Distance along channel
853	FT.	$Elev_{85}$ = Elevation at point L_{85}
816.00	FT.	**Length** = $L_{85} - L_{10}$
1125.88	FT./MI.	**SLOPE** = $(Elev_{10}-Elev_{85})$/Length
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	11.81	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	26.29	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	38.70	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	56.04	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	70.70	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	85.28	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

Worksheet for SR 234 STA 26+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.02700	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	56.04	ft^3/s

Results

Normal Depth	1.13	ft
Flow Area	8.35	ft^2
Wetted Perimeter	11.15	ft
Top Width	10.78	ft
Critical Depth	1.32	ft
Critical Slope	0.01433	ft/ft
Velocity	6.71	ft/s
Velocity Head	0.70	ft
Specific Energy	1.83	ft
Froude Number	1.34	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.13	ft
Critical Depth	1.32	ft
Channel Slope	0.02700	ft/ft
Critical Slope	0.01433	ft/ft

UNIVERSAL CULVERT DESIGN

PID : 80 **Date :** 07/21/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 77, 234 Sta. 26+00 **Designer :** mdc

HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 675.73 **Outlet Invert Elevation (ft.) :** 669.18 **Tailwater Elevation (ft.) :** 670.38 **Overflow Elevation (ft.) :** 681.50

Allowable Headwater Elevation (ft.) : 680.50 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 108.00 **Culvert Slope (ft./ft.) :** 0.0606 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 56.00 @ 25 yrs. **Flood Discharge (cfs) :** 85.00 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
56.00	1	33 in.	680.40	674.45	2 - E	22.40	1.20	2.43	0.0120	INLET	0.00	D	0.00
56.00	1	30 in.	681.49	675.74	2 - E	22.41	1.27	2.36	0.0120	INLET	0.00	D - 1	0.00
46.40	1	27 in.	683.35	678.10	2 - E	21.39	1.21	2.16	0.0120	INLET	9.60	D - 2	0.00
56.00	1	36 in.	679.77	673.71	2 - E	22.29	1.16	2.43	0.0120	INLET	0.00	D + 1	0.00
66.30	1	33 in.	683.92	678.07	2 - E	23.39	1.33	2.56	0.0120	INLET	18.70	F	0.00
56.00	1	30 in.	686.60	681.18	2 - E	22.41	1.27	2.36	0.0120	INLET	29.00	F - 1	0.00
46.40	1	27 in.	693.59	686.83	2 - E	21.39	1.21	2.16	0.0120	INLET	38.60	F - 2	0.00
77.10	1	36 in.	682.29	676.27	2 - E	24.27	1.38	2.74	0.0120	INLET	7.90	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
56.00	1	42 in.	679.56	N/A	1 - C	13.45	1.56	2.34	0.0237	INLET	0.00	D	0.00

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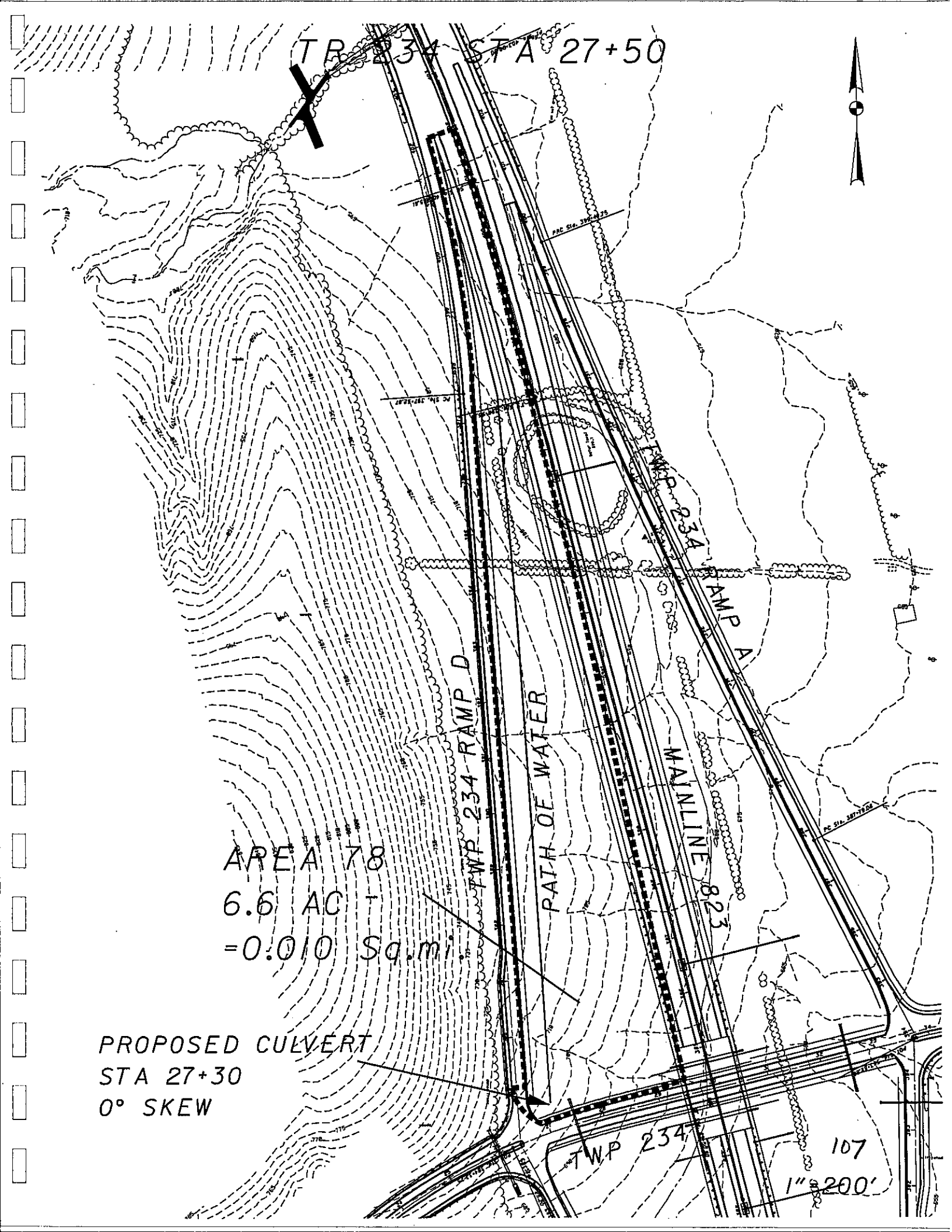
UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
56.00	1	36 in.	680.74	676.35	2 - E	13.26	1.73	2.43	0.0241	INLET	0.00	D - 1	0.00
53.30	1	33 in.	681.91	678.53	2 - E	13.02	1.79	2.39	0.0241	INLET	2.70	D - 2	0.00
56.00	1	48 in.	679.13	N/A	1 - C	13.45	1.46	2.25	0.0235	INLET	0.00	D + 1	0.00
81.50	1	42 in.	681.82	677.22	2 - E	14.77	1.95	2.82	0.0237	INLET	3.50	F	0.00
62.30	1	36 in.	684.71	682.35	2 - E	13.57	1.86	2.54	0.0241	INLET	22.70	F - 1	0.00
53.30	1	33 in.	687.10	687.47	2 - E	9.73	1.79	2.39	0.0241	INLET	31.70	F - 2	0.00
85.00	1	48 in.	680.47	N/A	1 - C	15.03	1.84	2.79	0.0235	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
56.00	1	42 in.	679.56	N/A	1 - C	11.95	1.71	2.34	0.0278	INLET	0.00	D	0.00
56.00	1	36 in.	680.74	677.28	2 - E	11.75	1.92	2.43	0.0281	INLET	0.00	D - 1	0.00
56.00	1	48 in.	679.13	N/A	1 - C	11.98	1.59	2.25	0.0275	INLET	0.00	D + 1	0.00
81.50	1	42 in.	681.82	678.17	2 - E	13.05	2.16	2.82	0.0278	INLET	3.50	F	0.00
62.30	1	36 in.	684.71	684.50	2 - E	12.00	2.07	2.54	0.0281	INLET	22.70	F - 1	0.00
85.00	1	48 in.	680.47	N/A	1 - C	13.37	2.02	2.79	0.0275	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
56.00	1	60 in.	678.79	N/A	1 - C	10.30	1.60	2.10	0.0332	INLET	0.00	D	0.00
56.00	1	66 in.	678.67	N/A	1 - C	10.25	1.54	2.04	0.0330	INLET	0.00	D + 1	0.00
85.00	1	60 in.	679.62	N/A	1 - C	11.55	2.01	2.61	0.0332	INLET	0.00	F	0.00
85.00	1	66 in.	679.45	N/A	1 - C	11.54	1.92	2.54	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
56.00	1	60 in.	678.79	N/A	1 - C	12.27	1.41	2.10	0.0260	INLET	0.00	D	0.00
56.00	1	66 in.	678.67	N/A	1 - C	12.15	1.37	2.04	0.0260	INLET	0.00	D + 1	0.00
85.00	1	60 in.	679.62	N/A	1 - C	13.80	1.76	2.61	0.0260	INLET	0.00	F	0.00
85.00	1	66 in.	679.45	N/A	1 - C	13.69	1.69	2.54	0.0260	INLET	0.00	F + 1	0.00


TR 234 STA 27+50
TWP 234 RAMP A
TWP 234 RAMP D
PATH OF WATER
MAINLINE 823
AREA 7 @
6.6 AC
=0.010 s.m.
PROPOSED CULVERT
STA 27+30
0° SKEW
TWP 234
107
1" = 200'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
287455.00	SQ. FT.	
0.010	SQ. MI.	**CONTDA** = Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE** = Storage Area
1820.00	FT.	**TOTAL CHANNEL LENGTH**
182.00	FT.	L_{10} = 10% of the Distance along channel
683	FT.	$Elev_{10}$ = Elevation at point L_{10}
1547.00	FT.	L_{85} = 85% of the Distance along channel
714	FT.	$Elev_{85}$ = Elevation at point L_{85}
1365.00	FT.	**Length** = $L_{85} - L_{10}$
116.82	FT./MI.	**SLOPE** = $(Elev_{10}-Elev_{85})$/Length
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	3.56	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	7.18	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	10.08	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	14.01	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	17.26	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	20.42	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 07/21/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 78, TR234 Sta. 27+50 **Designer :** mdc

HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 670.30 **Outlet Invert Elevation (ft.) :** 669.00 **Tailwater Elevation (ft.) :** 670.10 **Overflow Elevation (ft.) :** 672.40

Allowable Headwater Elevation (ft.) : 672.40 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 92.00 **Culvert Slope (ft./ft.) :** 0.0141 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 14.01 @ 25 yrs. **Flood Discharge (cfs) :** 20.40 @ 100 yrs.

	FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH				**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
	14.01	1	24 in.	672.31	N/A	1 - C	9.18	0.98	1.35	0.0120	INLET	0.00	D	0.00
	12.71	1	21 in.	672.58	N/A	2 - E	8.94	1.00	1.33	0.0120	INLET	1.30	D - 1	0.00
	10.21	1	18 in.	673.29	N/A	2 - E	8.41	0.97	1.23	0.0120	INLET	3.80	D - 2	0.00
	14.01	1	27 in.	672.19	N/A	1 - C	9.14	0.92	1.30	0.0120	INLET	0.00	D + 1	0.00
	14.90	1	24 in.	673.00	N/A	2 - E	9.33	1.01	1.39	0.0120	INLET	5.50	F	0.00
	12.70	1	21 in.	673.74	N/A	2 - E	8.95	1.00	1.33	0.0120	INLET	7.70	F - 1	0.00
	10.30	1	18 in.	675.41	675.91	2 - E	6.61	0.98	1.24	0.0120	INLET	10.10	F - 2	0.00
	16.70	1	27 in.	672.69	N/A	1 - C	9.58	1.02	1.43	0.0120	INLET	3.70	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED				**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
	Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
Diameter exceeds 1.25 HWA	14.01	1	36 in.	672.03	N/A	1 - C	5.42	1.18	1.19	0.0241	INLET	0.00	D	0.00

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UNIVERSAL CULVERT DESIGN

	FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
	13.91	1	33 in.	672.09	N/A	1 - A	5.48	1.23	1.22	0.0241	OUTLET*	0.10	D - 1	0.00
	13.21	1	30 in.	672.17	672.46	1 - A	5.54	1.26	1.22	0.0244	OUTLET*	0.80	D - 2	0.00
	14.01	1	42 in.	671.91	N/A	1 - C	5.42	1.10	1.14	0.0237	INLET	0.00	D + 1	0.00
	17.60	1	36 in.	672.44	N/A	1 - C	5.75	1.34	1.34	0.0241	INLET	2.80	F	0.00
	13.90	1	33 in.	672.53	N/A	1 - A	5.47	1.23	1.22	0.0241	OUTLET*	6.50	F - 1	0.00
	13.20	1	30 in.	672.68	672.97	1 - A	5.54	1.26	1.22	0.0244	OUTLET*	7.20	F - 2	0.00
	20.40	1	42 in.	672.30	N/A	1 - C	6.02	1.34	1.38	0.0237	INLET	0.00	F + 1	0.00
	7.01	2	18 in.	672.00	672.16	2 - F	5.04	1.50	1.02	0.0249	OUTLET*	0.00	D	0.00
	4.71	2	15 in.	672.71	675.09	2 - F	4.11	1.25	0.88	0.0250	OUTLET	2.30	D - 1	0.00
	2.61	2	12 in.	674.66	685.63	2 - G	3.32	1.00	0.69	0.0251	OUTLET	4.40	D - 2	0.00
	7.01	2	21 in.	671.78	671.98	1 - B	4.40	1.09	0.98	0.0248	OUTLET*	0.00	D + 1	0.00
	7.30	2	18 in.	672.90	674.51	2 - F	5.26	1.50	1.05	0.0249	OUTLET**	2.90	F	0.00
	4.70	2	15 in.	674.43	680.69	2 - F	4.11	1.25	0.88	0.0250	OUTLET	5.50	F - 1	0.00
	2.60	2	12 in.	682.32	703.03	2 - G	3.31	1.00	0.69	0.0251	OUTLET	7.60	F - 2	0.00
	10.10	2	21 in.	672.27	672.41	2 - F	5.83	1.47	1.18	0.0248	OUTLET*	0.10	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
Diameter exceeds 1.25 HWA	14.01	1	36 in.	672.03	672.27	1 - A	5.36	1.29	1.19	0.0281	OUTLET*	0.00	D	0.00
	14.01	1	42 in.	671.91	672.18	1 - A	5.16	1.19	1.14	0.0278	OUTLET*	0.00	D + 1	0.00
	15.60	1	36 in.	672.44	672.72	1 - A	5.53	1.37	1.26	0.0281	OUTLET*	4.80	F	0.00
	17.10	1	42 in.	672.30	672.60	1 - A	5.47	1.33	1.26	0.0278	OUTLET*	3.30	F + 1	0.00
Diameter exceeds 1.25 HWA	7.01	2	36 in.	671.46	671.66	1 - B	2.98	0.89	0.83	0.0281	OUTLET*	0.00	D	0.00
	7.01	2	42 in.	671.38	671.60	1 - B	2.71	0.84	0.80	0.0278	OUTLET*	0.00	D + 1	0.00
	10.20	2	36 in.	671.74	671.97	1 - B	4.34	1.08	1.01	0.0281	OUTLET*	0.00	F	0.00

UNIVERSAL CULVERT DESIGN

	FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
	10.20	2	42 in.	671.64	671.90	1 - B	3.94	1.01	0.97	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	14.01	1	60 in.	671.68	671.93	1 - A	4.37	1.15	1.03	0.0332	OUTLET*	0.00	D	0.00
	14.01	1	66 in.	671.64	671.90	1 - A	4.14	1.11	1.00	0.0330	OUTLET*	0.00	D + 1	0.00
	20.40	1	60 in.	672.01	672.30	1 - A	5.33	1.39	1.25	0.0332	OUTLET*	0.00	F	0.00
	20.40	1	66 in.	671.94	672.25	1 - A	5.24	1.34	1.21	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	7.01	2	60 in.	671.28	671.46	1 - B	2.19	0.82	0.72	0.0332	OUTLET*	0.00	D	0.00
	7.01	2	66 in.	671.28	671.42	1 - B	2.07	0.79	0.70	0.0330	OUTLET*	0.00	D + 1	0.00
	10.20	2	60 in.	671.47	671.70	1 - B	3.18	0.98	0.87	0.0332	OUTLET*	0.00	F	0.00
	10.20	2	66 in.	671.45	671.66	1 - B	3.02	0.95	0.85	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)														
Diameter exceeds 1.25 HWA	14.01	1	60 in.	671.68	N/A	1 - C	4.37	1.02	1.03	0.0260	INLET	0.00	D	0.00
	14.01	1	66 in.	671.64	N/A	1 - C	4.14	0.99	1.00	0.0260	INLET	0.00	D + 1	0.00
	20.40	1	60 in.	672.01	N/A	1 - C	5.33	1.23	1.25	0.0260	INLET	0.00	F	0.00
	20.40	1	66 in.	671.94	N/A	1 - C	5.24	1.19	1.21	0.0260	INLET	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	7.01	2	60 in.	671.28	671.50	1 - B	2.19	0.72	0.72	0.0260	OUTLET*	0.00	D	0.00
	7.01	2	66 in.	671.28	671.47	1 - B	2.07	0.71	0.70	0.0260	OUTLET*	0.00	D + 1	0.00
	10.20	2	60 in.	671.47	N/A	1 - C	3.18	0.87	0.87	0.0260	INLET	0.00	F	0.00
	10.20	2	66 in.	671.45	N/A	1 - C	3.02	0.85	0.85	0.0260	INLET	0.00	F + 1	0.00

Worksheet for SR 234 STA 27+50

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.00400	ft/ft
Left Side Slope	6.00	ft/ft (H:V)
Right Side Slope	4.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	13.86	ft^3/s

Results

Normal Depth	0.57	ft
Flow Area	7.37	ft^2
Wetted Perimeter	15.85	ft
Top Width	15.73	ft
Critical Depth	0.37	ft
Critical Slope	0.01937	ft/ft
Velocity	1.88	ft/s
Velocity Head	0.05	ft
Specific Energy	0.63	ft
Froude Number	0.48	
Flow Type	Subcritical	

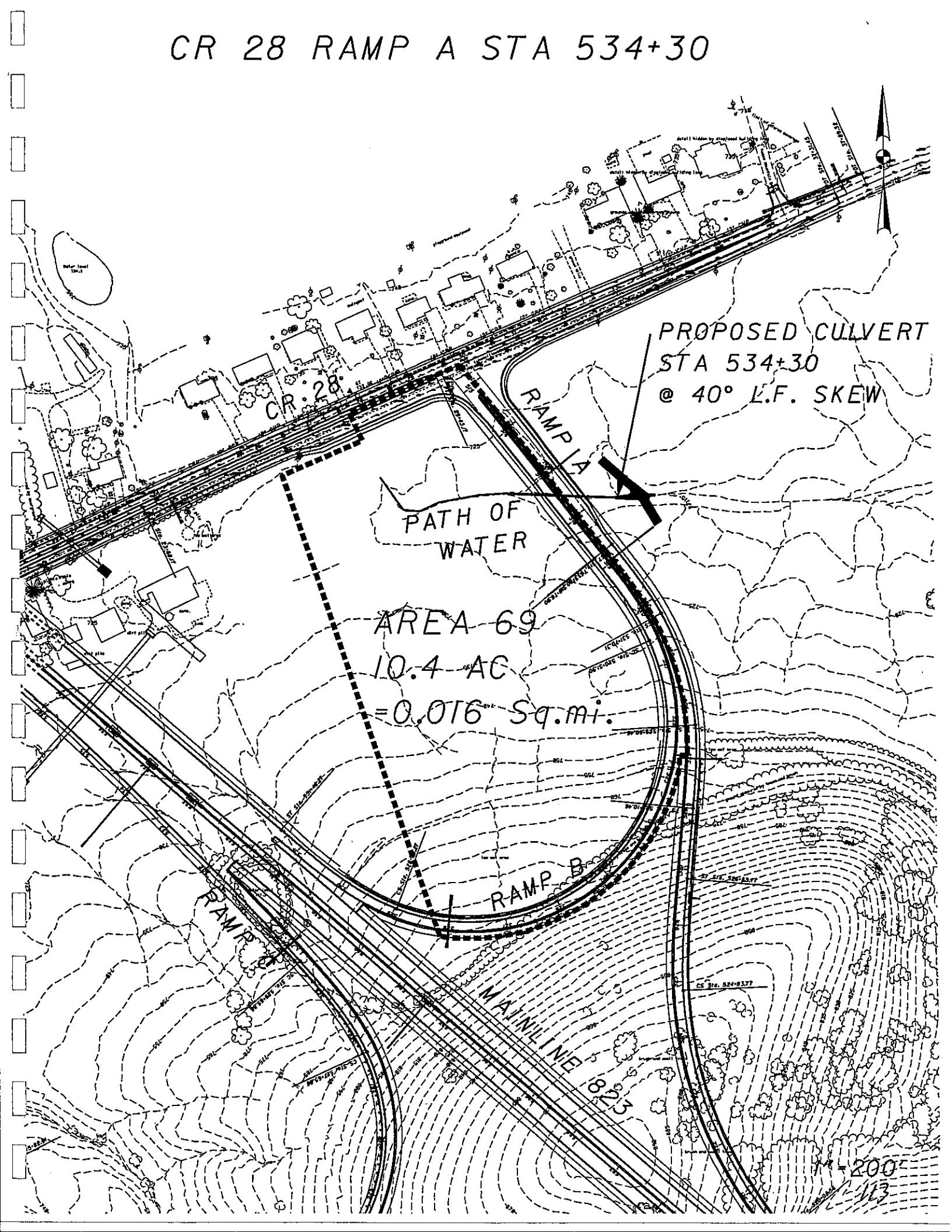
GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.57	ft
Critical Depth	0.37	ft
Channel Slope	0.00400	ft/ft
Critical Slope	0.01937	ft/ft

CR 28 RAMP A STA 534+30



728 RAMP A STA 534+30

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
453227.00	SQ. FT.	
0.016	SQ. MI.	**CONTDA** = Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE** = Storage Area
262.00	FT.	**TOTAL CHANNEL LENGTH**
26.20	FT.	L_{10} = 10% of the Distance along channel
718	FT.	$Elev_{10}$ = Elevation at point L_{10}
222.70	FT.	L_{85} = 85% of the Distance along channel
724	FT.	$Elev_{85}$ = Elevation at point L_{85}
196.50	FT.	**Length** = $L_{85} - L_{10}$
166.60	FT./MI.	**SLOPE** = $(Elev_{10}-Elev_{85})$/Length
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	5.40	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	11.02	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	15.57	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	21.75	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	26.87	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	31.87	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

Worksheet for SR 728 Ramp A STA 534+30

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.03200	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	3.00	ft/ft (H:V)
Bottom Width	4.00	ft
Discharge	26.90	ft^3/s

Results

Normal Depth	0.74	ft
Flow Area	4.62	ft^2
Wetted Perimeter	8.70	ft
Top Width	8.45	ft
Critical Depth	0.89	ft
Critical Slope	0.01588	ft/ft
Velocity	5.82	ft/s
Velocity Head	0.53	ft
Specific Energy	1.27	ft
Froude Number	1.39	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.74	ft ~ Tailwater
Critical Depth	0.89	ft
Channel Slope	0.03200	ft/ft
Critical Slope	0.01588	ft/ft

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 06/26/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 69, 728 RAMP A Sta. 534+30 **Designer :** mdc

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 718.60 **Outlet Invert Elevation (ft.) :** 716.20 **Tailwater Elevation (ft.) :** 716.94 **Overflow Elevation (ft.) :** 728.80

Allowable Headwater Elevation (ft.) : 727.80 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 184.00 **Culvert Slope (ft./ft.) :** 0.0130 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 26.90 @ 50 yrs. **Flood Discharge (cfs) :** 31.87 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
26.90	1	24 in.	722.26	721.67	2 - E	10.15	1.57	1.81	0.0120	INLET	0.00	D	0.00
26.90	1	21 in.	723.66	724.75	2 - F	11.29	1.75	1.70	0.0120	OUTLET**	0.00	D - 1	0.00
23.50	1	18 in.	726.94	732.24	2 - F	13.33	1.50	1.48	0.0120	OUTLET**	3.40	D - 2	0.00
26.90	1	27 in.	721.59	720.26	2 - E	10.44	1.39	1.81	0.0120	INLET	0.00	D + 1	0.00
31.87	1	24 in.	723.17	723.16	2 - E	10.14	2.00	1.89	0.0120	INLET	0.00	F	0.00
31.87	1	21 in.	725.16	727.51	2 - F	13.30	1.75	1.72	0.0120	OUTLET**	0.00	F - 1	0.00
23.47	1	18 in.	731.83	738.11	2 - F	13.31	1.50	1.48	0.0120	OUTLET**	8.40	F - 2	0.00
31.87	1	27 in.	722.16	721.15	2 - E	10.78	1.57	1.94	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
26.90	1	30 in.	721.63	721.99	2 - F	7.25	2.50	1.77	0.0244	OUTLET**	0.00	D	0.00

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UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
26.90	1	27 in.	722.29	724.48	2 - F	7.86	2.25	1.81	0.0245	OUTLET**	0.00	D - 1	0.00
25.90	1	24 in.	723.51	729.60	2 - F	8.75	2.00	1.78	0.0247	OUTLET**	1.00	D - 2	0.00
26.90	1	33 in.	721.30	721.60	1 - A	6.88	1.90	1.72	0.0241	OUTLET*	0.00	D + 1	0.00
31.87	1	30 in.	722.25	723.55	2 - F	7.87	2.50	1.92	0.0244	OUTLET**	0.00	F	0.00
31.87	1	27 in.	723.23	727.07	2 - F	8.73	2.25	1.94	0.0245	OUTLET**	0.00	F - 1	0.00
25.87	1	24 in.	724.88	734.29	2 - F	8.75	2.00	1.78	0.0247	OUTLET**	6.00	F - 2	0.00
31.87	1	33 in.	721.72	721.94	2 - F	7.38	2.20	1.88	0.0241	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
26.90	1	36 in.	721.13	721.44	1 - A	6.62	1.96	1.68	0.0281	OUTLET*	0.00	D	0.00
26.90	1	42 in.	720.94	721.27	1 - A	6.28	1.75	1.60	0.0278	OUTLET*	0.00	D + 1	0.00
31.87	1	36 in.	721.44	721.76	1 - A	7.06	2.23	1.83	0.0281	OUTLET*	0.00	F	0.00
31.87	1	42 in.	721.18	721.53	1 - A	6.65	1.94	1.75	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
26.90	1	60 in.	720.60	720.90	1 - A	5.76	1.63	1.44	0.0332	OUTLET*	0.00	D	0.00
26.90	1	66 in.	720.52	720.84	1 - A	5.65	1.57	1.40	0.0330	OUTLET*	0.00	D + 1	0.00
31.87	1	60 in.	720.81	721.13	1 - A	6.05	1.79	1.57	0.0332	OUTLET*	0.00	F	0.00
31.87	1	66 in.	720.72	721.05	1 - A	5.93	1.72	1.53	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
26.90	1	60 in.	720.60	721.01	1 - A	5.76	1.44	1.44	0.0260	OUTLET*	0.00	D	0.00
26.90	1	66 in.	720.52	N/A	1 - C	5.69	1.39	1.40	0.0260	INLET	0.00	D + 1	0.00
31.87	1	60 in.	720.81	721.24	1 - A	6.05	1.57	1.57	0.0260	OUTLET*	0.00	F	0.00
31.87	1	66 in.	720.72	N/A	1 - C	5.98	1.52	1.53	0.0260	INLET	0.00	F + 1	0.00

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CULVERT ANALYSIS

PID : 19415 **Date :** 11/30/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 69, 728 RAMP A Sta. 534+30 **Designer :** DL

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 718.60 **Outlet Invert Elevation (ft.) :** 716.20

Pipe Quantity : 1

Culvert Type : Circular Smooth **Pipe Length (ft.) :** 184.00 **Culvert Slope (ft./ft.) :** 0.0130

Corrugation Type :

Pipe Size : 30 in.

Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.2000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
26.90	2.95	721.28	N/A	1 - C	10.48	1.29	1.77	0.0120	INLET	0.00	716.84
31.87	3.25	721.66	720.14	2 - E	10.92	1.44	1.92	0.0120	INLET	0.00	716.84

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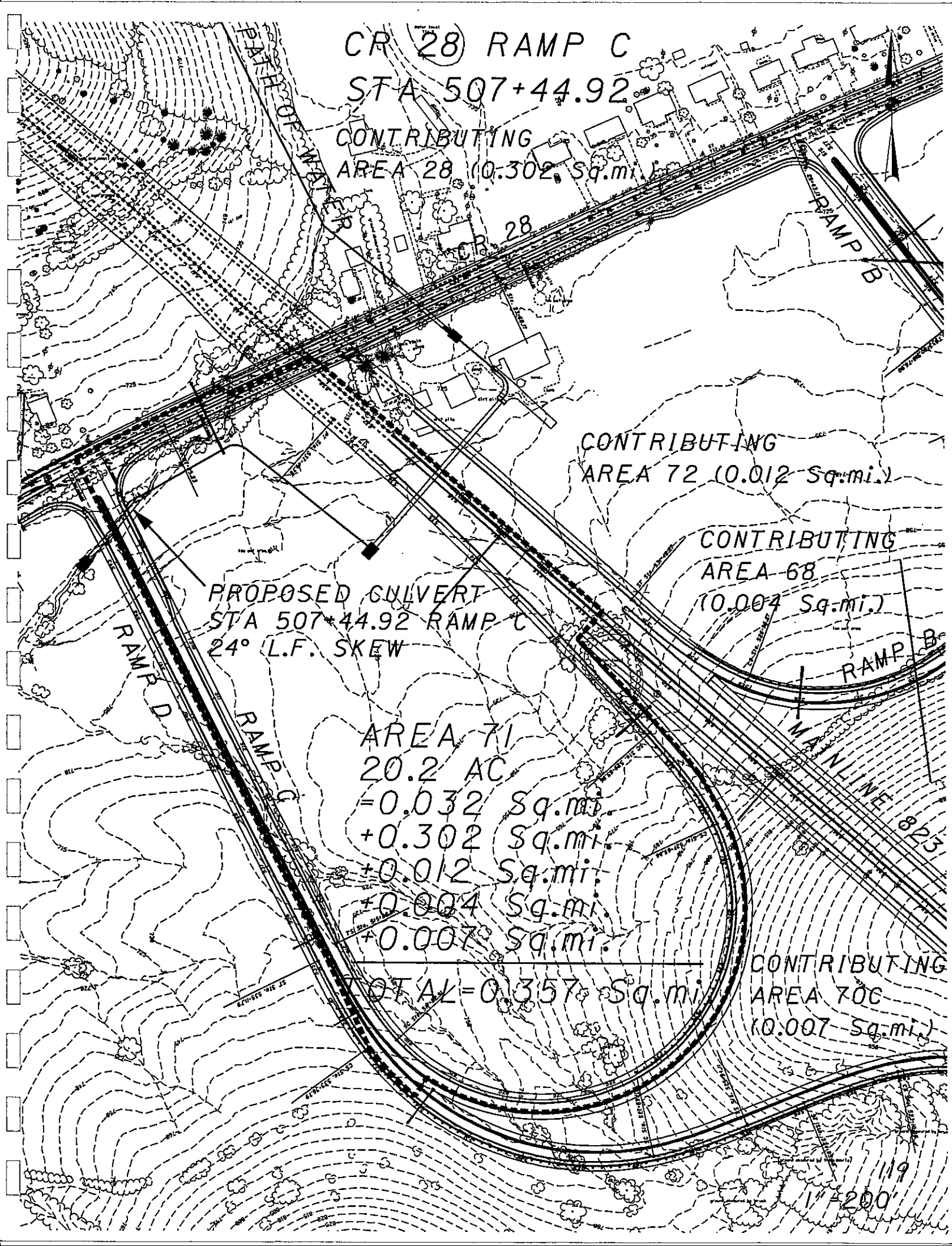
CR 28 RAMP C
STA 507+44.92
CONTRIBUTING
AREA 28 (0.302 Sq.mi.)
PATH OF WATER
CR 28
RAMP B
CONTRIBUTING
AREA 72 (0.012 Sq.mi.)
CONTRIBUTING
AREA 68
(0.004 Sq.mi.)
PROPOSED CULVERT
STA 507+44.92 RAMP C
24° L.F. SKEW
RAMP D
RAMP C
RAMP B
MANLIN
AREA 71
20.2 AC
=0.032 Sq.mi.
+0.302 Sq.mi.
+0.012 Sq.mi.
+0.004 Sq.mi.
+0.007 Sq.mi.
TOTAL=0.357 Sq.mi.
CONTRIBUTING
AREA 70C
(0.007 Sq.mi.)
119
1"=200'

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions	
10476218.00	SQ. FT.		8420975
0.376	SQ. MI.	**CONTDA** = Contributing Drainage Area	326998
0.00	SQ. FT.		208544
0.00	%	**STORAGE** = Storage Area	878713
5330.00	FT.	**TOTAL CHANNEL LENGTH**	109910
533.00	FT.	L_{10} = 10% of the Distance along channel	531078
702	FT.	$Elev_{10}$ = Elevation at point L_{10}	
4530.50	FT.	L_{85} = 85% of the Distance along channel	
810	FT.	$Elev_{85}$ = Elevation at point L_{85}	
3997.50	FT.	**Length** = $L_{85} - L_{10}$	
142.65	FT./MI.	**SLOPE** = $(Elev_{10}-Elev_{85})$/Length	
	CFS	$Q_{\#}$ = Flood-Peak Discharge # = Frequency of Storm	

Q_2	61.25	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	119.15	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	165.17	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	227.13	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	277.37	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	327.59	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

Worksheet for SR 728 Ramp C STA 507+44.92

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.04800	ft/ft
Left Side Slope	2.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	277.24	ft^3/s

Results

Normal Depth	1.65	ft
Flow Area	21.89	ft^2
Wetted Perimeter	17.36	ft
Top Width	16.59	ft
Critical Depth	2.43	ft
Critical Slope	0.01156	ft/ft
Velocity	12.67	ft/s
Velocity Head	2.49	ft
Specific Energy	4.14	ft
Froude Number	1.94	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	1.65	ft
Critical Depth	2.43	ft
Channel Slope	0.04800	ft/ft
Critical Slope	0.01156	ft/ft

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 06/26/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : mdc

Description : Drainage area 71, 728 RAMP C Sta. 507+44.92

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 698.91 **Outlet Invert Elevation (ft.) :** 697.16 **Tailwater Elevation (ft.) :** 698.40 **Overflow Elevation (ft.) :** 707.70

Allowable Headwater Elevation (ft.) : 706.70 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 144.00 **Culvert Slope (ft./ft.) :** 0.0122 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 277.37 @ 50 yrs. **Flood Discharge (cfs) :** 327.59 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
277.37	1	72 in.	706.10	N/A	1 - C	18.30	3.17	4.56	0.0120	INLET	0.00	D	0.00
277.37	1	66 in.	706.97	705.59	2 - E	18.22	3.36	4.62	0.0120	INLET	0.00	D - 1	0.00
257.07	1	60 in.	708.56	707.05	2 - E	17.70	3.47	4.47	0.0120	INLET	20.30	D - 2	0.00
277.37	1	78 in.	705.61	N/A	1 - C	18.30	3.03	4.47	0.0120	INLET	0.00	D + 1	0.00
327.59	1	72 in.	707.26	705.85	2 - E	19.02	3.52	4.93	0.0120	INLET	0.00	F	0.00
300.59	1	66 in.	708.62	707.07	2 - E	18.52	3.55	4.77	0.0120	INLET	27.00	F - 1	0.00
257.09	1	60 in.	710.98	709.16	2 - E	17.70	3.47	4.47	0.0120	INLET	70.50	F - 2	0.00
327.59	1	78 in.	706.49	N/A	1 - C	19.09	3.34	4.86	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
277.37	1	84 in.	705.77	N/A	1 - C	11.30	4.26	4.37	0.0227	INLET	0.00	D	0.00

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UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
277.37	1	78 in.	706.38	707.13	2 - F	11.40	4.57	4.47	0.0228	OUTLET*	0.00	D - 1	0.00
277.37	1	72 in.	707.42	707.46	2 - F	12.03	5.22	4.56	0.0229	OUTLET*	0.00	D - 2	0.00
326.19	1	84 in.	706.81	N/A	2 - F	11.71	4.77	4.76	0.0227	OUTLET*	1.40	F	0.00
311.39	1	78 in.	707.78	707.97	2 - F	12.02	5.03	4.74	0.0228	OUTLET*	16.20	F - 1	0.00
285.09	1	72 in.	709.37	709.24	2 - E	10.08	6.00	4.62	0.0229	INLET	42.50	F - 2	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
277.37	1	84 in.	705.77	706.58	1 - A	10.96	4.75	4.37	0.0265	OUTLET*	0.00	D	0.00
277.37	1	78 in.	706.38	706.91	2 - F	11.40	5.22	4.47	0.0266	OUTLET*	0.00	D - 1	0.00
273.37	1	72 in.	707.42	707.87	2 - F	11.94	6.00	4.53	0.0267	OUTLET**	4.00	D - 2	0.00
277.37	1	90 in.	705.40	706.39	1 - A	10.64	4.46	4.28	0.0263	OUTLET*	0.00	D + 1	0.00
327.59	1	84 in.	706.81	707.43	2 - F	11.74	5.44	4.77	0.0265	OUTLET*	0.00	F	0.00
315.89	1	78 in.	707.78	708.06	2 - F	12.10	6.50	4.77	0.0266	OUTLET*	11.70	F - 1	0.00
273.39	1	72 in.	709.37	710.20	2 - F	11.95	6.00	4.53	0.0267	OUTLET**	54.20	F - 2	0.00
327.59	1	90 in.	706.23	707.14	1 - A	11.32	5.00	4.67	0.0263	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
277.37	1	84 in.	705.77	706.54	1 - A	10.96	5.61	4.37	0.0323	OUTLET*	0.00	D	0.00
277.37	1	78 in.	706.38	707.21	2 - F	11.40	6.50	4.47	0.0325	OUTLET**	0.00	D - 1	0.00
248.07	1	72 in.	707.42	709.17	2 - F	11.40	6.00	4.31	0.0327	OUTLET**	29.30	D - 2	0.00
277.37	1	90 in.	705.40	706.22	1 - A	10.64	5.12	4.28	0.0321	OUTLET*	0.00	D + 1	0.00
327.59	1	84 in.	706.81	707.52	2 - F	11.74	7.00	4.77	0.0323	OUTLET*	0.00	F	0.00
290.29	1	78 in.	707.78	709.21	2 - F	11.63	6.50	4.57	0.0325	OUTLET**	37.30	F - 1	0.00
248.09	1	72 in.	709.37	712.00	2 - F	11.40	6.00	4.31	0.0327	OUTLET**	79.50	F - 2	0.00
327.59	1	90 in.	706.23	707.04	1 - A	11.32	5.87	4.67	0.0321	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													

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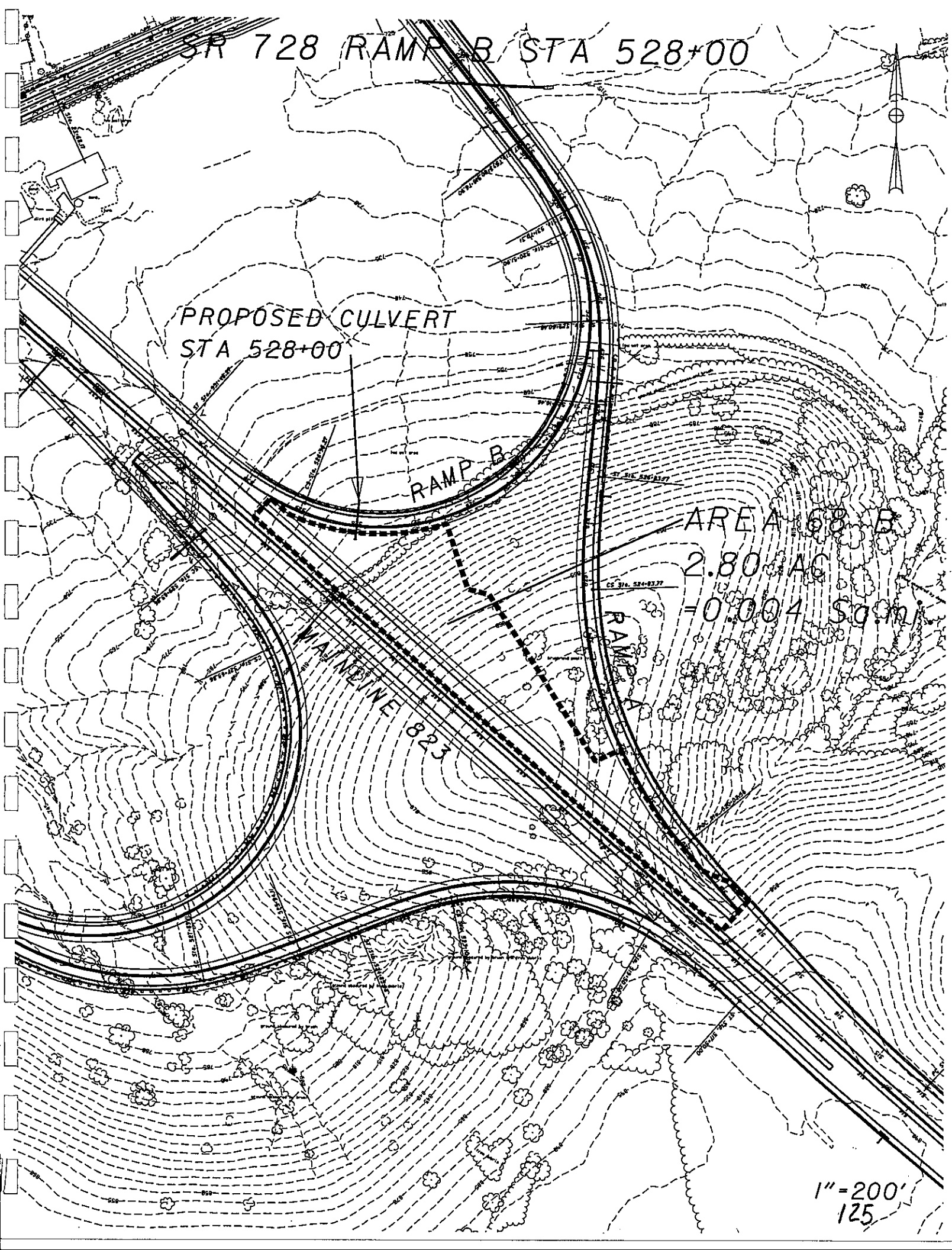
UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
277.37	1	84 in.	705.77	706.62	1 - A	10.96	4.68	4.37	0.0260	OUTLET*	0.00	D	0.00
277.37	1	78 in.	706.38	706.92	2 - F	11.40	5.11	4.47	0.0260	OUTLET*	0.00	D - 1	0.00
276.47	1	72 in.	707.42	707.74	2 - F	12.01	6.00	4.55	0.0260	OUTLET**	0.90	D - 2	0.00
277.37	1	90 in.	705.40	706.41	1 - A	10.64	4.43	4.28	0.0260	OUTLET*	0.00	D + 1	0.00
327.59	1	84 in.	706.81	707.43	2 - F	11.74	5.34	4.77	0.0260	OUTLET*	0.00	F	0.00
316.79	1	78 in.	707.78	707.94	2 - F	12.11	6.50	4.78	0.0260	OUTLET*	10.80	F - 1	0.00
276.49	1	72 in.	709.37	710.01	2 - F	12.01	6.00	4.55	0.0260	OUTLET**	51.10	F - 2	0.00
327.59	1	90 in.	706.23	707.16	1 - A	11.32	4.95	4.67	0.0260	OUTLET*	0.00	F + 1	0.00


SR 728 RAMP B STA 528+00
PROPOSED CULVERT
STA 528+00
RAMP B
RAMP A
MAINLINE 823
AREA @ B
2.80 AC
=0.004 Sq mi
1" = 200'
125

Client: ODOT Sheet: of

Subject: Pipe Culvert Calculations Order No:

Computed by: MDC Date: 6/26/2006

Checked by: Date:

Rational Method

Coefficient of Runoff (1101.2.3)

	Area (Sft)	Area (Ac)	C
Pavement Area	37400	0.86	0.9
Non-paved Area	84721	1.94	0.45
Other			
Total Area		**2.80**	**acres**

Weighted "C" = 0.59

Overland Flow

Length	44
High Elevation	775.63
Low Elevation	774.5
Slope %	2.568182

t_o 4.47 (1101.2.2)

t_o 4.47 Compare with Fig 1101-1

Shallow Concentrated Flow

Length	1100	
High Elevation	774.5	
Low Elevation	756.2	
Slope %	1.663636	
k	0.457	(Grassed waterways - Table 1101-1)
V	1.933978	(1101.2.2)
t_s	9.479595	(1101.2.2)

Since the time of concentration = to + ts t_c **13.95** min

For Intensity Zone D

Frequency	a	b	c	Ac	t_c	C	I	Q cu ft/s
2 Years	85.568	16.5	0.95	2.803512	13.95	0.59	3.33	5.49
5 Years	118.822	18.7	0.969	2.803512	13.95	0.59	4.05	6.68
10 Years	112.172	16.8	0.923	2.803512	13.95	0.59	4.75	7.83
25 Years	198.92	19.3	1.004	2.803512	13.95	0.59	5.90	9.72
50 Years	206.025	19.6	0.99	2.803512	13.95	0.59	6.36	10.48
100 Years	355.551	23.199	1.076	2.803512	13.95	0.59	7.27	11.98

921

Worksheet for SR 728 Ramp B STA 528+00

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.01000	ft/ft
Left Side Slope	3.00	ft/ft (H:V)
Right Side Slope	2.00	ft/ft (H:V)
Bottom Width	10.00	ft
Discharge	9.72	ft^3/s

Results

Normal Depth	0.37	ft
Flow Area	4.05	ft^2
Wetted Perimeter	12.00	ft
Top Width	11.85	ft
Critical Depth	0.30	ft
Critical Slope	0.02030	ft/ft
Velocity	2.40	ft/s
Velocity Head	0.09	ft
Specific Energy	0.46	ft
Froude Number	0.72	
Flow Type	Subcritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	0.37	ft
Critical Depth	0.30	ft
Channel Slope	0.01000	ft/ft
Critical Slope	0.02030	ft/ft

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 06/26/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 68B, 728 RAMP B Sta. 528+00 **Designer :** mdc

HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 755.88 **Outlet Invert Elevation (ft.) :** 750.50 **Tailwater Elevation (ft.) :** 750.87 **Overflow Elevation (ft.) :** 757.80

Allowable Headwater Elevation (ft.) : 757.80 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 70.00 **Culvert Slope (ft./ft.) :** 0.0769 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 9.72 @ 25 yrs. **Flood Discharge (cfs) :** 11.98 @ 100 yrs.

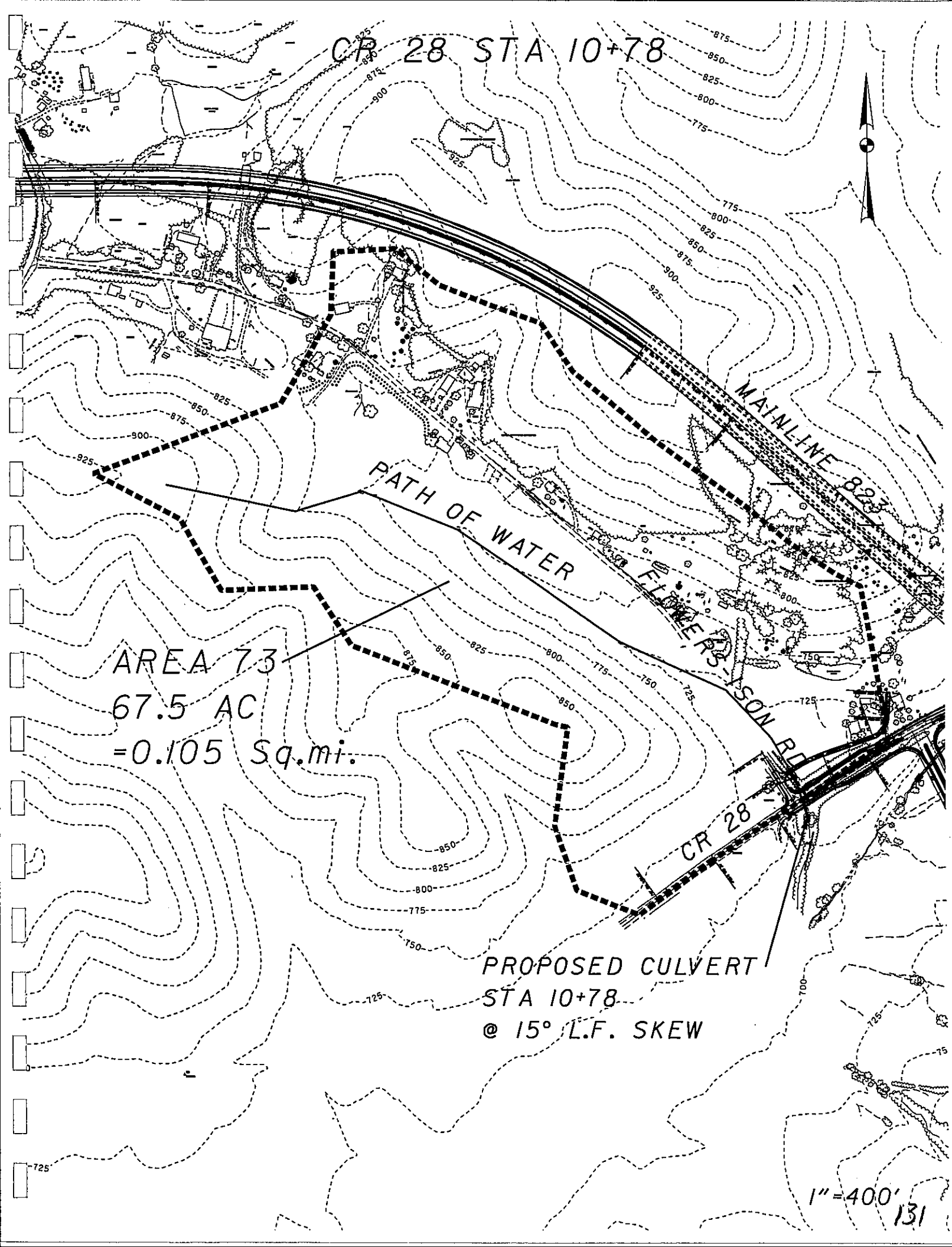
FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
9.72	1	21 in.	757.60	N/A	1 - C	15.57	0.54	1.16	0.0120	INLET	0.00	D	0.00
9.32	1	18 in.	757.87	752.92	2 - E	15.53	0.56	1.18	0.0120	INLET	0.40	D - 1	0.00
7.12	1	15 in.	758.69	754.23	2 - E	14.58	0.52	1.07	0.0120	INLET	2.60	D - 2	0.00
9.72	1	24 in.	757.49	N/A	1 - C	15.36	0.51	1.11	0.0120	INLET	0.00	D + 1	0.00
11.38	1	21 in.	757.88	N/A	1 - C	16.27	0.58	1.26	0.0120	INLET	0.60	F	0.00
9.28	1	18 in.	758.35	N/A	2 - E	15.52	0.56	1.18	0.0120	INLET	2.70	F - 1	0.00
7.08	1	15 in.	759.67	N/A	2 - E	14.59	0.52	1.07	0.0120	INLET	4.90	F - 2	0.00
11.98	1	24 in.	757.70	N/A	1 - C	16.26	0.57	1.24	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
9.72	1	21 in.	757.77	N/A	1 - C	9.16	0.79	1.16	0.0248	INLET	0.00	D	0.00

UNIVERSAL CULVERT DESIGN

	FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
	7.82	1	18 in.	758.33	754.93	2 - E	8.67	0.76	1.08	0.0249	INLET	1.90	D - 1	0.00
	5.82	1	15 in.	759.74	759.39	2 - E	8.01	0.72	0.98	0.0250	INLET	3.90	D - 2	0.00
	9.72	1	24 in.	757.56	N/A	1 - C	9.15	0.74	1.11	0.0247	INLET	0.00	D + 1	0.00
	9.88	1	21 in.	758.20	N/A	2 - E	9.21	0.80	1.17	0.0248	INLET	2.10	F	0.00
	7.88	1	18 in.	759.12	N/A	2 - E	8.67	0.77	1.09	0.0249	INLET	4.10	F - 1	0.00
	5.78	1	15 in.	761.14	N/A	2 - E	5.64	0.71	0.97	0.0250	INLET	6.20	F - 2	0.00
	11.78	1	24 in.	757.82	N/A	1 - C	9.63	0.83	1.23	0.0247	INLET	0.20	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
Diameter exceeds 1.25 HWA	9.72	1	36 in.	757.28	N/A	1 - C	8.02	0.68	0.99	0.0281	INLET	0.00	D	0.00
	9.72	1	42 in.	757.18	N/A	1 - C	7.95	0.65	0.94	0.0278	INLET	0.00	D + 1	0.00
	11.98	1	36 in.	757.46	N/A	1 - C	8.54	0.76	1.10	0.0281	INLET	0.00	F	0.00
	11.98	1	42 in.	757.35	N/A	1 - C	8.45	0.72	1.05	0.0278	INLET	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	4.86	2	36 in.	756.82	N/A	1 - C	6.55	0.49	0.69	0.0281	INLET	0.00	D	0.00
	4.86	2	42 in.	756.76	N/A	1 - C	6.46	0.46	0.66	0.0278	INLET	0.00	D + 1	0.00
	5.99	2	36 in.	756.93	N/A	1 - C	6.98	0.54	0.77	0.0281	INLET	0.00	F	0.00
	5.99	2	42 in.	756.87	N/A	1 - C	6.90	0.51	0.74	0.0278	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	9.72	1	60 in.	757.02	N/A	1 - C	6.72	0.63	0.85	0.0332	INLET	0.00	D	0.00
	9.72	1	66 in.	757.00	N/A	1 - C	6.66	0.62	0.83	0.0330	INLET	0.00	D + 1	0.00
	11.98	1	60 in.	757.15	N/A	1 - C	7.15	0.70	0.95	0.0332	INLET	0.00	F	0.00
	11.98	1	66 in.	757.12	N/A	1 - C	7.08	0.68	0.92	0.0330	INLET	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	4.86	2	60 in.	756.73	N/A	1 - C	5.45	0.46	0.60	0.0332	INLET	0.00	D	0.00
	4.86	2	66 in.	756.75	N/A	1 - C	5.39	0.44	0.59	0.0330	INLET	0.00	D + 1	0.00

UNIVERSAL CULVERT DESIGN

	FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
	5.99	2	60 in.	756.80	N/A	1 - C	5.80	0.50	0.67	0.0332	INLET	0.00	F	0.00
	5.99	2	66 in.	756.81	N/A	1 - C	5.75	0.49	0.65	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)														
Diameter exceeds 1.25 HWA	9.72	1	60 in.	757.02	N/A	1 - C	7.96	0.56	0.85	0.0260	INLET	0.00	D	0.00
	9.72	1	66 in.	757.00	N/A	1 - C	7.86	0.55	0.83	0.0260	INLET	0.00	D + 1	0.00
	11.98	1	60 in.	757.15	N/A	1 - C	8.47	0.62	0.95	0.0260	INLET	0.00	F	0.00
	11.98	1	66 in.	757.12	N/A	1 - C	8.37	0.61	0.92	0.0260	INLET	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	4.86	2	60 in.	756.73	N/A	1 - C	6.46	0.41	0.60	0.0260	INLET	0.00	D	0.00
	4.86	2	66 in.	756.75	N/A	1 - C	6.39	0.40	0.59	0.0260	INLET	0.00	D + 1	0.00
	5.99	2	60 in.	756.80	N/A	1 - C	6.87	0.45	0.67	0.0260	INLET	0.00	F	0.00
	5.99	2	66 in.	756.81	N/A	1 - C	6.79	0.44	0.65	0.0260	INLET	0.00	F + 1	0.00


CR 28 STA 10+78
MAINLINE 823
PATH OF WATER
FLOWERS-SON RD
AREA 73
67.5 AC
=0.105 Sq.mi.
CR 28
PROPOSED CULVERT
STA 10+78
@ 15° L.F. SKEW
1" = 400'

SR 728 STA 10+78

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
3476886.00	SQ. FT.	
0.125	SQ. MI.	**CONTDA** = Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE** = Storage Area
2490.00	FT.	**TOTAL CHANNEL LENGTH**
249.00	FT.	L_{10} = 10% of the Distance along channel
712	FT.	$Elev_{10}$ = Elevation at point L_{10}
2116.50	FT.	L_{85} = 85% of the Distance along channel
795	FT.	$Elev_{85}$ = Elevation at point L_{85}
1867.50	FT.	**Length** = $L_{85} - L_{10}$
234.67	FT./MI.	**SLOPE** = $(Elev_{10}-Elev_{85})$/Length
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	28.16	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	56.95	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	80.30	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	112.02	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	138.08	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	163.99	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

Worksheet for SR 728 STA 10+78

Project Description

Friction Method	Manning Formula
Solve For	Normal Depth

Input Data

Roughness Coefficient	0.030	
Channel Slope	0.05700	ft/ft
Left Side Slope	0.33	ft/ft (H:V)
Right Side Slope	0.33	ft/ft (H:V)
Bottom Width	3.00	ft
Discharge	112.00	ft^3/s

Results

Normal Depth	2.33	ft
Flow Area	8.82	ft^2
Wetted Perimeter	7.92	ft
Top Width	4.56	ft
Critical Depth	3.11	ft
Critical Slope	0.02256	ft/ft
Velocity	12.70	ft/s
Velocity Head	2.51	ft
Specific Energy	4.84	ft
Froude Number	1.61	
Flow Type	Supercritical	

GVF Input Data

Downstream Depth	0.00	ft
Length	0.00	ft
Number Of Steps	0	

GVF Output Data

Upstream Depth	0.00	ft
Profile Description		
Profile Headloss	0.00	ft
Downstream Velocity	Infinity	ft/s
Upstream Velocity	Infinity	ft/s
Normal Depth	2.33	ft — TAILWATER
Critical Depth	3.11	ft
Channel Slope	0.05700	ft/ft
Critical Slope	0.02256	ft/ft

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 06/30/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 73, 728 Sta. 10+78 **Designer :** mdc

HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 703.00 **Outlet Invert Elevation (ft.) :** 697.30 **Tailwater Elevation (ft.) :** 698.60 **Overflow Elevation (ft.) :** 711.80

Allowable Headwater Elevation (ft.) : 710.80 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 130.00 **Culvert Slope (ft./ft.) :** 0.0438 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 112.00 @ 25 yrs. **Flood Discharge (cfs) :** 164.00 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
112.00	1	48 in.	708.26	703.05	2 - E	23.50	1.62	3.20	0.0120	INLET	0.00	D	0.00
112.00	1	42 in.	709.63	704.53	2 - E	23.62	1.73	3.19	0.0120	INLET	0.00	D - 1	0.00
104.50	1	36 in.	712.76	708.05	2 - E	23.09	1.83	2.91	0.0120	INLET	7.50	D - 2	0.00
112.00	1	54 in.	707.68	N/A	1 - C	23.35	1.54	3.11	0.0120	INLET	0.00	D + 1	0.00
164.00	1	48 in.	711.05	705.76	2 - E	25.99	2.01	3.69	0.0120	INLET	0.00	F	0.00
138.20	1	42 in.	714.31	709.10	2 - E	24.86	1.96	3.35	0.0120	INLET	25.80	F - 1	0.00
104.50	1	36 in.	722.96	716.98	2 - E	23.09	1.83	2.91	0.0120	INLET	59.50	F - 2	0.00
164.00	1	54 in.	709.43	704.17	2 - E	25.91	1.89	3.74	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
112.00	1	54 in.	708.23	N/A	1 - C	14.36	2.22	3.11	0.0233	INLET	0.00	D	0.00

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UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
112.00	1	48 in.	709.46	705.81	2 - E	14.20	2.40	3.20	0.0235	INLET	0.00	D - 1	0.00
110.70	1	42 in.	711.95	709.97	2 - E	13.67	2.75	3.18	0.0237	INLET	1.30	D - 2	0.00
112.00	1	60 in.	707.66	N/A	1 - C	14.36	2.09	3.02	0.0232	INLET	0.00	D + 1	0.00
164.00	1	54 in.	711.13	707.44	2 - E	15.69	2.81	3.74	0.0233	INLET	0.00	F	0.00
140.80	1	48 in.	713.95	711.68	2 - E	14.85	2.82	3.52	0.0235	INLET	23.20	F - 1	0.00
110.70	1	42 in.	718.79	720.75	2 - E	12.07	2.75	3.18	0.0237	INLET	53.30	F - 2	0.00
164.00	1	60 in.	709.56	705.33	2 - E	15.83	2.61	3.67	0.0232	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
112.00	1	54 in.	708.23	N/A	1 - C	12.74	2.44	3.11	0.0273	INLET	0.00	D	0.00
112.00	1	48 in.	709.46	706.76	2 - E	12.53	2.68	3.20	0.0275	INLET	0.00	D - 1	0.00
110.70	1	42 in.	711.95	711.97	2 - E	12.07	3.50	3.18	0.0278	INLET	1.30	D - 2	0.00
112.00	1	60 in.	707.66	N/A	1 - C	12.80	2.29	3.02	0.0271	INLET	0.00	D + 1	0.00
164.00	1	54 in.	711.13	708.52	2 - E	13.81	3.15	3.74	0.0273	INLET	0.00	F	0.00
140.80	1	48 in.	713.95	713.71	2 - E	12.90	3.24	3.52	0.0275	INLET	23.20	F - 1	0.00
110.70	1	42 in.	718.79	725.04	2 - E	12.07	3.50	3.18	0.0278	INLET	53.30	F - 2	0.00
164.00	1	60 in.	709.56	705.92	2 - E	14.07	2.87	3.67	0.0271	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
112.00	1	60 in.	707.66	N/A	1 - C	11.01	2.57	3.02	0.0332	INLET	0.00	D	0.00
112.00	1	66 in.	707.38	N/A	1 - C	11.04	2.43	2.93	0.0330	INLET	0.00	D + 1	0.00
164.00	1	60 in.	709.56	707.04	2 - E	11.99	3.29	3.67	0.0332	INLET	0.00	F	0.00
164.00	1	66 in.	708.74	N/A	1 - C	12.15	3.04	3.58	0.0330	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
112.00	1	60 in.	707.66	N/A	1 - C	13.21	2.23	3.02	0.0260	INLET	0.00	D	0.00
112.00	1	66 in.	707.38	N/A	1 - C	13.15	2.13	2.93	0.0260	INLET	0.00	D + 1	0.00

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UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
164.00	1	60 in.	709.56	705.74	2 - E	14.52	2.80	3.67	0.0260	INLET	0.00	F	0.00
164.00	1	66 in.	708.74	N/A	1 - C	14.54	2.64	3.58	0.0260	INLET	0.00	F + 1	0.00

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CULVERT ANALYSIS

PID : 19415 **Date :** 06/30/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 73, 728 Sta. 10+78 Analysis for determining HW of 10 yr storm **Designer :** mdc

HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Pipe Number : 1 **Use HW :** 0 **Inlet Invert Elevation (ft.) :** 703.00 **Outlet Invert Elevation (ft.) :** 700.50
Pipe Quantity : 1

Culvert Type : Circular Corrugated **Pipe Length (ft.) :** 130.00 **Culvert Slope (ft./ft.) :** 0.0192
Corrugation Type : Corrugated Metal Pipe (3 x 1 in. corrugations)
Pipe Size : 54 in.
Design Manning 'n' : (default)

Entrance Type : Half Headwall **Loss Coef. Ke :** 0.9000

FLOW (cfs.)	HEAD LOSS (ft.)	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	BURIED DEPTH (ft.)	TAILWATER ELEVATION (ft.)
80.00	2.93	706.99	N/A	1 - C	8.59	2.55	2.62	0.0273	INLET	0.00	700.50
164.00	7.10	711.13	711.72	2 - F	11.61	4.50	3.74	0.0273	OUTLET**	0.00	700.50

DRIVE PIPE TAILWATER

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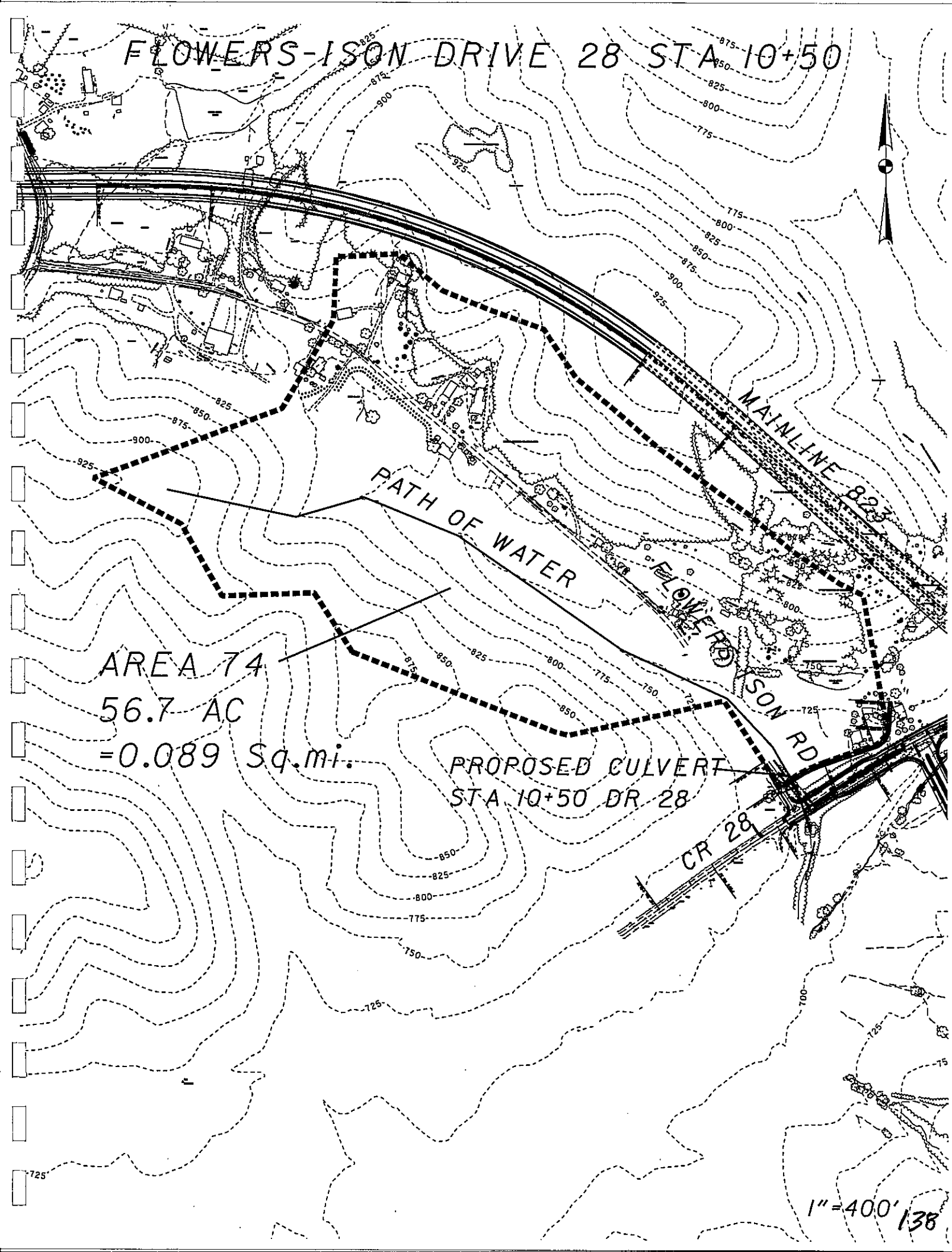
FLOWERS-ISON DRIVE 28 STA 10+50
MAINLINE 823
PATH OF WATER
FLOWERS ISON RD
AREA 74
56.7 AC
=0.089 Sq.mi.
PROPOSED CULVERT
STA 10+50 DR 28
CR 28
1" = 400'

DRIVE 28 STA 10+50

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
2470061.00	SQ. FT.	
0.089	SQ. MI.	**CONTDA** = Contributing Drainage Area
0.00	SQ. FT.	
0.00	%	**STORAGE** = Storage Area
2450.00	FT.	**TOTAL CHANNEL LENGTH**
245.00	FT.	L_{10} = 10% of the Distance along channel
713	FT.	$Elev_{10}$ = Elevation at point L_{10}
2082.50	FT.	L_{85} = 85% of the Distance along channel
795	FT.	$Elev_{85}$ = Elevation at point L_{85}
1837.50	FT.	Length = L_{85} - L_{10}
235.62	FT./MI.	SLOPE = $(Elev_{10}-Elev_{85})$/Length
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	21.57	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	43.82	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	61.90	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	86.48	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	106.71	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	126.78	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 06/30/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage area 74, Drive 28 Sta. 10+50 **Designer :** mdc

HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

SEE UPSTREAM CULVERT HW

Inlet Invert Elevation (ft.) : 705.00 **Outlet Invert Elevation (ft.) :** 704.50 **Tailwater Elevation (ft.) :** 708.60 **Overflow Elevation (ft.) :** 711.90

Allowable Headwater Elevation (ft.) : 710.90 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 40.00 **Culvert Slope (ft./ft.) :** 0.0125 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 87.00 @ 25 yrs. **Flood Discharge (cfs) :** 127.00 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH					**Entrance Type :** Half Headwall							**Entrance Loss (Ke) :** 0.20	
87.00	1	42 in.	709.98	710.38	2 - G	9.04	2.19	2.90	0.0120	OUTLET	0.00	D	0.00
85.70	1	36 in.	711.77	712.00	2 - G	12.12	2.67	2.82	0.0120	OUTLET	1.30	D - 1	0.00
71.20	1	33 in.	713.48	713.51	2 - G	11.99	2.75	2.60	0.0120	OUTLET	15.80	D - 2	0.00
87.00	1	48 in.	709.28	709.62	1 - B	6.92	2.00	2.83	0.0120	OUTLET	0.00	D + 1	0.00
115.50	1	42 in.	712.82	712.39	2 - H	14.41	2.72	3.22	0.0120	INLET	11.50	F	0.00
85.70	1	36 in.	716.90	715.84	2 - G	12.89	2.67	2.82	0.0120	OUTLET	41.30	F - 1	0.00
71.20	1	33 in.	721.63	719.07	2 - G	11.99	2.75	2.60	0.0120	OUTLET	55.80	F - 2	0.00
127.00	1	48 in.	710.95	710.77	2 - H	15.12	2.54	3.38	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED					**Entrance Type :** Half Headwall							**Entrance Loss (Ke) :** 0.90	
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
87.00	1	48 in.	709.85	710.49	2 - G	6.92	3.21	2.83	0.0235	OUTLET	0.00	D	0.00

say 48" because of upstream 48" culvert

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UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
85.60	1	42 in.	711.28	712.00	2 - G	8.90	3.50	2.88	0.0237	OUTLET	1.40	D - 1	0.00
60.60	1	36 in.	714.29	715.40	2 - G	8.57	3.00	2.51	0.0241	OUTLET	26.40	D - 2	0.00
87.00	1	54 in.	709.23	709.73	1 - B	5.72	2.80	2.73	0.0233	OUTLET	0.00	D + 1	0.00
114.90	1	48 in.	712.62	712.63	2 - G	9.14	4.00	3.24	0.0235	OUTLET	12.10	F	0.00
85.60	1	42 in.	715.73	715.85	2 - G	8.90	3.50	2.88	0.0237	OUTLET	41.40	F - 1	0.00
60.60	1	36 in.	722.36	723.08	2 - G	8.57	3.00	2.51	0.0241	OUTLET	66.40	F - 2	0.00
127.00	1	54 in.	710.95	711.01	2 - F	8.35	3.85	3.32	0.0233	OUTLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
87.00	1	48 in.	709.85	710.67	2 - G	6.92	4.00	2.83	0.0275	OUTLET	0.00	D	0.00
81.30	1	42 in.	711.28	712.37	2 - G	8.45	3.50	2.81	0.0278	OUTLET	5.70	D - 1	0.00
57.20	1	36 in.	714.29	716.23	2 - G	8.09	3.00	2.45	0.0281	OUTLET	29.80	D - 2	0.00
87.00	1	54 in.	709.23	709.83	1 - B	5.72	3.13	2.73	0.0273	OUTLET	0.00	D + 1	0.00
109.90	1	48 in.	712.62	713.00	2 - G	8.75	4.00	3.17	0.0275	OUTLET	17.10	F	0.00
81.30	1	42 in.	715.73	716.64	2 - G	8.45	3.50	2.81	0.0278	OUTLET	45.70	F - 1	0.00
57.20	1	36 in.	722.36	724.86	2 - G	8.09	3.00	2.45	0.0281	OUTLET	69.80	F - 2	0.00
127.00	1	54 in.	710.95	711.21	2 - F	8.35	4.50	3.32	0.0273	OUTLET	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
87.00	1	60 in.	708.94	709.47	1 - B	5.05	3.27	2.65	0.0332	OUTLET	0.00	D	0.00
87.00	1	66 in.	708.77	709.17	1 - B	4.58	3.03	2.57	0.0330	OUTLET	0.00	D + 1	0.00
127.00	1	60 in.	710.14	710.75	1 - A	7.37	4.57	3.22	0.0332	OUTLET*	0.00	F	0.00
127.00	1	66 in.	709.74	710.40	1 - B	6.69	3.93	3.13	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
87.00	1	60 in.	708.94	709.36	1 - B	5.05	2.78	2.65	0.0260	OUTLET	0.00	D	0.00
87.00	1	66 in.	708.77	709.10	1 - B	4.58	2.63	2.57	0.0260	OUTLET	0.00	D + 1	0.00

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UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
127.00	1	60 in.	710.14	710.68	1 - B	7.37	3.61	3.22	0.0260	OUTLET*	0.00	F	0.00
127.00	1	66 in.	709.74	710.37	1 - B	6.69	3.31	3.13	0.0260	OUTLET*	0.00	F + 1	0.00

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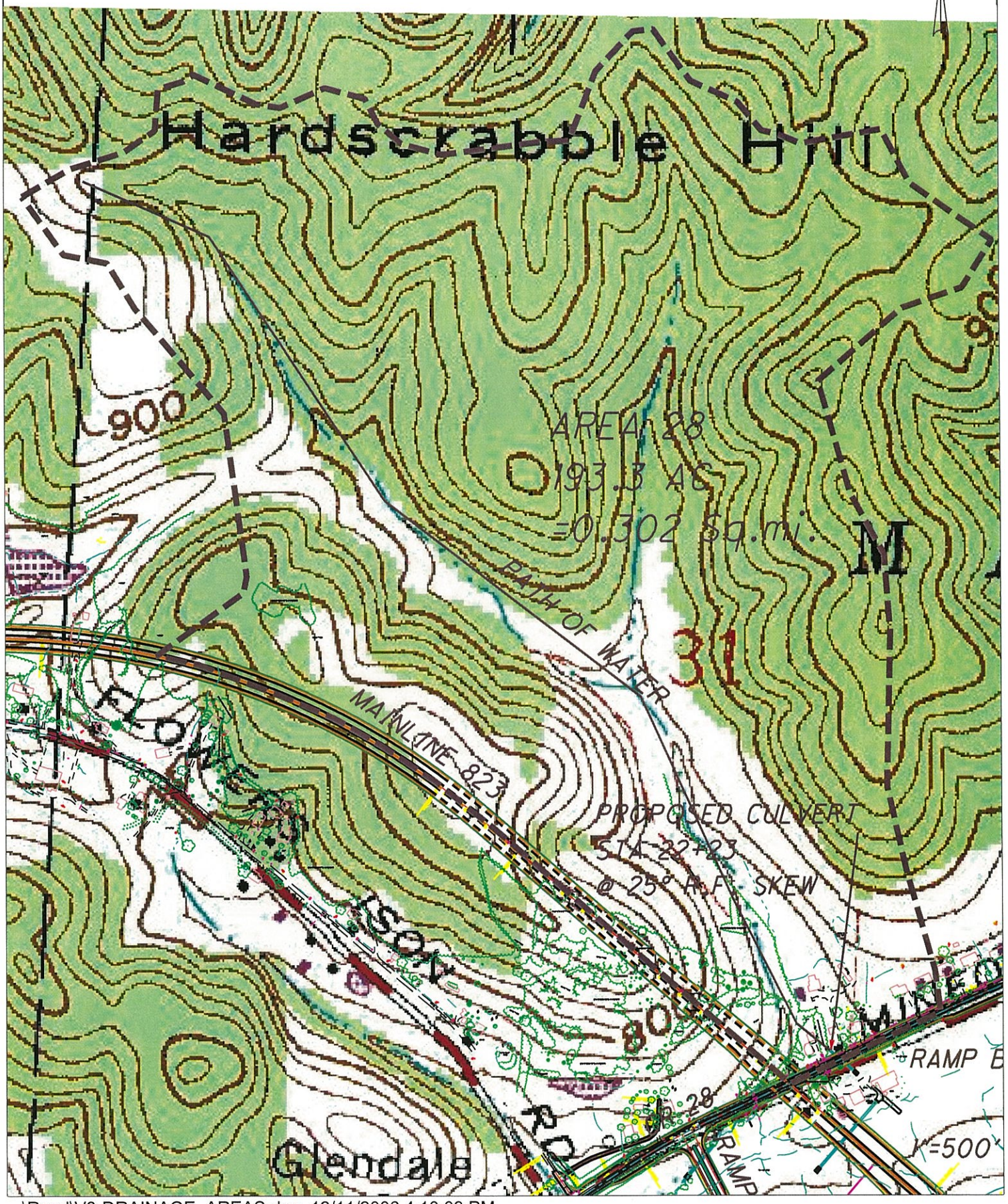
CR 28 STA 22+23



7228 STA 22+00

TECHNIQUES FOR ESTIMATING FLOOD-PEAK DISCHARGES OF RURAL, UNREGULATED STREAMS IN OHIO AREA A

U.S. GEOLOGICAL SURVEY Water Resources Investigations Report 89-4126

Values	Units	Definitions
8420974.70	SQ. FT.	
0.302	SQ. MI.	**CONTDA** = Contributing Drainage Area
	SQ. FT.	
0.00	%	**STORAGE** = Storage Area
4320.00	FT.	**TOTAL CHANNEL LENGTH**
432.00	FT.	L_{10} = 10% of the Distance along channel
720	FT.	$Elev_{10}$ = Elevation at point L_{10}
3672.00	FT.	L_{85} = 85% of the Distance along channel
820	FT.	$Elev_{85}$ = Elevation at point L_{85}
3240.00	FT.	**Length** = $L_{85} - L_{10}$
162.96	FT./MI.	**SLOPE** = $(Elev_{10}-Elev_{85})$/Length
	CFS	$Q_{\#}$ = Flood-Peak Discharge
		# = Frequency of Storm

Q_2	52.83	CFS	$= 56.1(CONTDA)^{0.782}(SLOPE)^{0.172}(STORAGE+1)^{-0.297}$
Q_5	103.73	CFS	$= 84.5(CONTDA)^{0.769}(SLOPE)^{0.221}(STORAGE+1)^{-0.322}$
Q_{10}	144.40	CFS	$= 104(CONTDA)^{0.764}(SLOPE)^{0.244}(STORAGE+1)^{-0.335}$
Q_{25}	199.28	CFS	$= 129(CONTDA)^{0.760}(SLOPE)^{0.264}(STORAGE+1)^{-0.347}$
Q_{50}	243.91	CFS	$= 148(CONTDA)^{0.757}(SLOPE)^{0.276}(STORAGE+1)^{-0.355}$
Q_{100}	288.48	CFS	$= 167(CONTDA)^{0.756}(SLOPE)^{0.285}(STORAGE+1)^{-0.363}$

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 06/30/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio **Designer :** mdc

Description : Drainage area 28, 728 Sta. 22+23

HEADWATER CONTROL CODES:
INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 708.00 **Outlet Invert Elevation (ft.) :** 707.50 **Tailwater Elevation (ft.) :** 711.35 **Overflow Elevation (ft.) :** 714.70

Allowable Headwater Elevation (ft.) : 715.50 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 106.00 **Culvert Slope (ft./ft.) :** 0.0047 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 199.30 @ 25 yrs. **Flood Discharge (cfs) :** 288.50 @ 100 yrs.

	FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : CIRCULAR SMOOTH			**Entrance Type :** Half Headwall									**Entrance Loss (Ke) :** 0.20		
	199.30	1	60 in.	714.69	714.58	2 - E	11.23	4.24	4.03	0.0120	INLET	0.00	D	0.00
	170.50	1	54 in.	715.99	715.61	2 - E	10.72	4.50	3.80	0.0120	INLET	28.80	D - 1	0.00
	141.30	1	48 in.	718.53	717.84	2 - E	11.24	4.00	3.52	0.0120	INLET	58.00	D - 2	0.00
	199.30	1	66 in.	714.03	N/A	1 - C	11.68	3.71	3.95	0.0120	INLET	0.00	D + 1	0.00
	199.60	1	60 in.	718.16	717.44	2 - E	11.23	4.25	4.03	0.0120	INLET	88.90	F	0.00
	170.50	1	54 in.	721.23	720.00	2 - E	10.72	4.50	3.80	0.0120	INLET	118.00	F - 1	0.00
	141.30	1	48 in.	726.95	724.93	2 - E	11.24	4.00	3.52	0.0120	INLET	147.20	F - 2	0.00
	227.60	1	66 in.	716.40	N/A	2 - E	11.92	4.12	4.22	0.0120	INLET	60.90	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall									**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)														
	177.00	1	66 in.	714.89	715.47	2 - F	9.96	5.50	3.72	0.0231	OUTLET*	22.30	D	0.00

Existing Headwater is 715.50. New culvert location has a higher invert.

UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
152.40	1	60 in.	716.26	717.02	2 - F	9.39	5.00	3.54	0.0232	OUTLET**	46.90	D - 1	0.00
126.90	1	54 in.	718.67	719.88	2 - F	8.76	4.50	3.32	0.0233	OUTLET**	72.40	D - 2	0.00
195.40	1	72 in.	714.14	714.79	1 - A	10.19	5.48	3.82	0.0229	OUTLET*	3.90	D + 1	0.00
177.00	1	66 in.	718.83	719.40	2 - F	9.96	5.50	3.72	0.0231	OUTLET*	111.50	F	0.00
152.40	1	60 in.	721.83	722.80	2 - F	9.39	5.00	3.54	0.0232	OUTLET**	136.10	F - 1	0.00
126.90	1	54 in.	726.34	728.93	2 - F	8.76	4.50	3.32	0.0233	OUTLET**	161.60	F - 2	0.00
195.40	1	72 in.	716.91	717.41	2 - F	10.19	5.48	3.82	0.0229	OUTLET*	93.10	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
191.10	1	72 in.	714.14	714.90	1 - A	9.97	5.48	3.77	0.0267	OUTLET*	8.20	D	0.00
169.50	1	66 in.	714.89	715.89	2 - F	9.54	5.50	3.64	0.0269	OUTLET*	29.80	D - 1	0.00
143.80	1	60 in.	716.26	717.74	2 - F	8.86	5.00	3.44	0.0271	OUTLET**	55.50	D - 2	0.00
199.30	1	78 in.	713.73	714.50	1 - A	9.74	5.93	3.77	0.0266	OUTLET*	0.00	D + 1	0.00
191.10	1	72 in.	716.91	717.96	2 - F	9.97	5.48	3.77	0.0267	OUTLET*	97.40	F	0.00
169.50	1	66 in.	718.83	720.28	2 - F	9.54	5.50	3.64	0.0269	OUTLET*	119.00	F - 1	0.00
143.80	1	60 in.	721.83	724.30	2 - F	8.86	5.00	3.44	0.0271	OUTLET**	144.70	F - 2	0.00
208.70	1	78 in.	715.76	716.60	2 - F	10.17	5.93	3.86	0.0266	OUTLET*	79.80	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
181.90	1	72 in.	714.14	715.37	2 - F	9.49	5.48	3.68	0.0327	OUTLET*	17.40	D	0.00
155.20	1	66 in.	714.89	716.69	2 - F	8.74	5.50	3.48	0.0330	OUTLET**	44.10	D - 1	0.00
131.10	1	60 in.	716.26	719.08	2 - F	8.08	5.00	3.28	0.0332	OUTLET**	68.20	D - 2	0.00
199.30	1	78 in.	713.73	714.66	1 - A	9.74	5.93	3.77	0.0325	OUTLET*	0.00	D + 1	0.00
181.90	1	72 in.	716.91	718.99	2 - F	9.49	5.48	3.68	0.0327	OUTLET*	106.60	F	0.00
155.20	1	66 in.	718.83	721.96	2 - F	8.74	5.50	3.48	0.0330	OUTLET**	133.30	F - 1	0.00

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UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
131.10	1	60 in.	721.83	727.12	2 - F	8.08	5.00	3.28	0.0332	OUTLET**	157.40	F - 2	0.00
200.30	1	78 in.	715.76	717.25	2 - F	9.79	5.93	3.78	0.0325	OUTLET*	88.20	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
191.90	1	72 in.	714.14	714.88	1 - A	10.01	5.48	3.78	0.0260	OUTLET*	7.40	D	0.00
172.70	1	66 in.	714.89	715.79	2 - F	9.72	5.50	3.67	0.0260	OUTLET*	26.60	D - 1	0.00
146.20	1	60 in.	716.26	717.52	2 - F	9.01	5.00	3.46	0.0260	OUTLET**	53.10	D - 2	0.00
199.30	1	78 in.	713.73	714.48	1 - A	9.74	5.93	3.77	0.0260	OUTLET*	0.00	D + 1	0.00
191.90	1	72 in.	716.91	717.85	2 - F	10.01	5.48	3.78	0.0260	OUTLET*	96.60	F	0.00
172.70	1	66 in.	718.83	720.06	2 - F	9.72	5.50	3.67	0.0260	OUTLET*	115.80	F - 1	0.00
146.20	1	60 in.	721.83	723.85	2 - F	9.01	5.00	3.46	0.0260	OUTLET**	142.30	F - 2	0.00
209.50	1	78 in.	715.76	716.54	2 - F	10.19	5.93	3.86	0.0260	OUTLET*	79.00	F + 1	0.00

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 06/30/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : mdc

Description : Drainage area 28, 728 Sta. 22+23, ELLIP

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 708.80 **Outlet Invert Elevation (ft.) :** 708.20 **Tailwater Elevation (ft.) :** 711.35 **Overflow Elevation (ft.) :** 714.70

Allowable Headwater Elevation (ft.) : 715.50 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 112.00 **Culvert Slope (ft./ft.) :** 0.0054 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 199.30 @ 25 yrs. **Flood Discharge (cfs) :** 288.50 @ 100 yrs.

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
CULVERT TYPE : ELLIPTICAL			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.20		
199.30	1	48 x 76 in.	714.49	714.17	2 - E	12.19	2.99	3.36	0.0120	INLET	0.00	D	0.00
173.50	1	43 x 68 in.	715.77	715.25	2 - E	11.43	3.13	3.18	0.0120	INLET	25.80	D - 1	0.00
141.10	1	38 x 60 in.	718.35	717.60	2 - E	11.00	3.17	2.90	0.0120	INLET	58.20	D - 2	0.00
199.30	1	53 x 83 in.	713.90	N/A	1 - C	12.27	2.77	3.31	0.0120	INLET	0.00	D + 1	0.00
206.70	1	48 x 76 in.	717.61	716.87	2 - E	12.26	3.08	3.41	0.0120	INLET	81.80	F	0.00
173.50	1	43 x 68 in.	720.63	719.30	2 - E	11.43	3.13	3.18	0.0120	INLET	115.00	F - 1	0.00
141.10	1	38 x 60 in.	726.68	724.44	2 - E	11.00	3.17	2.90	0.0120	INLET	147.40	F - 2	0.00
236.60	1	53 x 83 in.	716.03	715.55	2 - E	12.78	3.12	3.60	0.0120	INLET	51.90	F + 1	0.00

84/

UNIVERSAL CULVERT DESIGN

PID : 19415 **Date :** 06/30/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : mdc

Description : Drainage area 28, 728 Sta. 22+23 BOX

HEADWATER CONTROL CODES:

INLET - Inlet Control.
OUTLET - Outlet Control.
OUTLET* - Outlet Control with backwater curve used to compute headwater. See Figure III - 7E in HDS 5 for type flow.
OUTLET** - Outlet Control - See Figure III - 7D in HDS 5 for type flow.
N/A - Flow is supercritical with low headwater and low tailwater. Control Section is at the inlet.

Inlet Invert Elevation (ft.) : 709.80 **Outlet Invert Elevation (ft.) :** 709.20 **Tailwater Elevation (ft.) :** 711.35 **Overflow Elevation (ft.) :** 714.70

Allowable Headwater Elevation (ft.) : 715.50 **or** Diameter + 2 ft. *(whichever is less)*

Pipe Length (ft.) : 100.00 **Culvert Slope (ft./ft.) :** 0.0060 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 199.30 @ 25 yrs. **Flood Discharge (cfs) :** 288.50 @ 100 yrs.

CULVERT TYPE : BOX **Entrance Type :** 0 degree (Extension of sides) **Entrance Loss (Ke) :** 0.50

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
199.30	1	8 x 4 ft.	714.48	N/A	1 - C	11.87	2.10	2.68	0.0120	INLET	0.00	D	0.00
199.30	1	8 x 5 ft.	714.19	N/A	1 - C	11.87	2.10	2.68	0.0120	INLET	0.00	D + 1	0.00
208.80	1	8 x 4 ft.	716.51	715.17	2 - E	12.03	2.17	2.77	0.0120	INLET	79.70	F	0.00
230.20	1	8 x 5 ft.	715.86	N/A	2 - E	12.40	2.32	2.95	0.0120	INLET	58.30	F + 1	0.00

6h1

Inlet Spacing Design Calculations

INLET SPACING DESIGN

PID : 19415 **Date :** 05/05/2006 **Project :** SCI-823 **Location :** Portsmouth

Designer : CLM

Description : Left Side

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 0.00 **Allowable Depth (ft.)** 0.38

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)
253+04	Begin																	
263+00	I-3C	996.00	0.90	0.42	4.13	7.41	11.54	0.0115	0.0400	0.0350	9.50	0.1670	5.12	1.72	0.22	1.94	0.228	5.69
266+00	I-3C	300.00	0.90	0.24	6.33	1.85	10.00	0.0230	0.0400	0.0350	9.50	0.1670	5.39	1.26	0.12	1.38	0.176	4.41
269+00	I-3C	300.00	0.90	0.24	6.33	1.88	10.00	0.0230	0.0400	0.0350	9.50	0.1670	5.39	1.20	0.08	1.29	0.172	4.29
273+00	I-3C	300.00	0.90	0.24	6.33	1.89	10.00	0.0230	0.0400	0.0350	9.50	0.1670	5.39	1.18	0.07	1.25	0.170	4.24
276+00	I-3C	300.00	0.90	0.24	6.33	1.90	10.00	0.0230	0.0400	0.0350	9.50	0.1670	5.39	1.17	0.06	1.23	0.169	4.22
279+00	I-3C	300.00	0.90	0.24	6.51	1.90	10.00	0.0230	0.0400	0.0350	9.50	0.1670	5.39	1.17	0.06	1.23	0.168	4.21
282+00	I-3C	300.00	0.90	0.24	3.40	1.85	10.00	0.0230	0.0400	0.0350	9.50	0.1670	5.39	1.17	0.06	1.22	0.168	4.21
285+00	I-3C	300.00	0.90	0.24	6.51	1.90	10.00	0.0230	0.0400	0.0350	9.50	0.1670	5.39	1.16	0.06	1.22	0.168	4.21
288+00	I-3C	300.00	0.90	0.24	6.51	1.90	10.00	0.0230	0.0400	0.0350	9.50	0.1670	5.39	1.16	0.06	1.22	0.168	4.21
298+00	I-3B	1000.00	0.90	0.35	6.51	6.00	12.50	0.0230	0.0400	0.0350	9.50	0.1670	4.96	1.40	0.23	1.62	0.187	4.68
306+50	I-3B	850.00	0.90	0.21	3.92	5.97	10.00	0.0180	0.0400	0.0000	9.50	0.1670	5.39	1.21	0.03	1.24	0.177	4.43
316+50	I-3C	1000.00	0.90	0.25	3.92	7.08	10.99	0.0180	0.0400	0.0000	9.50	0.1670	5.21	1.19	0.02	1.21	0.175	4.38
326+50	I-3C	1000.00	0.90	0.25	3.92	7.10	11.02	0.0180	0.0400	0.0000	9.50	0.1670	5.21	1.18	0.01	1.19	0.175	4.36
336+50	I-3C	1000.00	0.90	0.24	3.92	5.03	10.00	0.0443	0.0400	0.0000	9.50	0.1670	5.39	1.05	0.13	1.18	0.147	3.67
342+50	I-3C	600.00	0.90	0.15	3.92	3.26	10.00	0.0431	0.0400	0.0000	9.50	0.1670	5.39	0.86	0.00	0.86	0.131	3.27

CDSS 1.0.0.3.

823-350+60L.xml

051

INLET SPACING DESIGN

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	RUNOFF AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
347+00	I-3C	450.00	0.90	0.11	3.92	3.67	10.00	0.0200	0.0400	0.0000	9.50	0.1670	5.39	0.53	0.00	0.53	0.127	3.17	
349+70	I-3C	270.00	0.90	0.06	3.92	4.06	10.00	0.0059	0.0400	0.0000	9.50	0.1670	5.39	0.29	0.00	0.29	0.127	3.17	
350+60	I-3C	90.00	0.90	0.02	9.04	3.29	12.32	0.0013	0.0400	0.0000	9.50	0.0000	4.99	******	******	0.09	0.109	2.72	Sag
425+25	Begin																		
415+50	I-3C	975.00	0.90	0.25	2.85	7.37	10.20	0.0150	0.0400	0.0650	4.00	0.1670	5.35	1.20	0.00	1.20	0.181	4.33	
405+50	I-3C	1000.00	0.90	0.12	2.85	9.25	12.10	0.0150	0.0400	0.0650	4.00	0.1670	5.03	0.54	0.00	0.54	0.135	3.36	
395+50	I-3B	1000.00	0.90	0.15	3.92	8.79	12.71	0.0150	0.0400	0.0160	9.50	0.1670	4.93	0.67	0.00	0.67	0.145	3.63	
386+50	I-3B	900.00	0.90	0.23	3.92	7.04	10.95	0.0150	0.0400	0.0160	9.50	0.1670	5.22	1.07	0.00	1.07	0.173	4.33	
382+00	I-3B	450.00	0.90	0.11	3.92	4.11	10.00	0.0150	0.0400	0.0160	9.50	0.1670	5.39	0.53	0.00	0.53	0.134	3.34	
375+00	I-3B	700.00	0.90	0.18	3.92	5.76	10.00	0.0150	0.0400	0.0160	9.50	0.1670	5.39	0.86	0.00	0.86	0.160	3.99	
365+00	I-3C	1000.00	0.90	0.25	3.92	7.65	11.57	0.0150	0.0400	0.0280	9.50	0.1670	5.12	1.16	0.00	1.16	0.179	4.47	
355+00	I-3C	1000.00	0.90	0.25	3.92	7.65	11.57	0.0150	0.0400	0.0280	9.50	0.1670	5.12	1.16	0.00	1.16	0.179	4.47	
351+50	I-3C	350.00	0.09	0.09	3.92	9.80	13.72	0.0046	0.0400	0.0280	9.50	0.1670	4.78	0.04	0.00	0.04	0.062	1.55	
350+60	I-3C	90.00	0.90	0.02	3.92	17.54	21.45	0.0000	0.0400	0.0280	9.50	0.1670	3.88	******	******	0.08	0.236	5.90	End

SUMP DATA

Total Flow (cfs) : 0.17

Ponded Depth (ft.) : 0.031

Spread on Pavement (ft.) : 0.54

151

INLET SPACING DESIGN

PID : 0 **Date :** 05/05/2006 **Project :** SCI-823 **Location :** Portsmouth

Designer : CLM

Description : Right Side

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 0.00 **Allowable Depth (ft.)** 0.38

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)
253+04	Begin																	
263+00	I-3C	996.00	0.90	0.19	3.50	9.11	12.61	0.0115	0.0400	0.0160	7.00	0.1670	4.95	0.85	0.00	0.85	0.167	4.17
266+00	I-3C	300.00	0.90	0.06	3.50	2.67	10.00	0.0230	0.0400	0.0160	7.00	0.1670	5.39	0.29	0.00	0.29	0.098	2.46
269+00	I-3C	300.00	0.90	0.06	3.50	2.67	10.00	0.0230	0.0400	0.0160	7.00	0.1670	5.39	0.29	0.00	0.29	0.098	2.46
276+00	I-3C	700.00	0.90	0.14	3.50	5.16	10.00	0.0230	0.0400	0.0160	7.00	0.1670	5.39	0.68	0.00	0.68	0.135	3.38
279+00	I-3C	300.00	0.90	0.06	3.50	2.67	10.00	0.0230	0.0400	0.0160	7.00	0.1670	5.39	0.29	0.00	0.29	0.098	2.46
282+00	I-3C	300.00	0.90	0.06	3.50	2.67	10.00	0.0230	0.0400	0.0160	7.00	0.1670	5.39	0.29	0.00	0.29	0.098	2.46
285+00	I-3C	300.00	0.90	0.06	3.50	2.67	10.00	0.0230	0.0400	0.0160	7.00	0.1670	5.39	0.29	0.00	0.29	0.098	2.46
288+00	I-3C	300.00	0.90	0.07	3.50	2.56	10.00	0.0230	0.0400	0.0160	7.00	0.1670	5.39	0.34	0.00	0.34	0.104	2.60
298+00	I-3B	1000.00	0.90	0.25	3.92	6.47	10.38	0.0230	0.0400	0.0160	9.50	0.1670	5.32	1.15	0.05	1.20	0.167	4.18
306+50	I-3B	850.00	0.90	0.21	3.92	6.21	10.13	0.0180	0.0400	0.0160	9.50	0.1670	5.37	1.06	0.00	1.06	0.167	4.18
316+50	I-3C	1000.00	0.90	0.34	6.23	6.71	12.93	0.0180	0.0400	0.0160	9.50	0.1670	4.90	1.37	0.13	1.50	0.190	4.76
326+50	I-3C	1000.00	0.90	0.80	6.23	3.75	10.00	0.0440	0.0400	0.0160	9.50	0.1670	5.39	2.15	1.86	4.01	0.233	5.82
336+50	I-3C	1000.00	0.90	0.80	6.23	3.41	10.00	0.0443	0.0400	0.0160	9.50	0.1670	5.39	2.63	3.11	5.74	0.266	6.65
342+50	I-3C	600.00	0.90	0.48	6.23	2.09	10.00	0.0431	0.0400	0.0160	9.50	0.1670	5.39	2.57	2.87	5.44	0.262	6.55
347+00	I-3C	450.00	0.90	0.36	2.42	2.14	10.00	0.0200	0.0400	0.0000	9.50	0.1670	5.39	2.71	1.91	4.62	0.284	7.11

251

INLET SPACING DESIGN

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
349+70	I-3C	270.00	0.90	0.22	2.42	2.27	10.00	0.0059	0.0400	0.0160	9.50	0.1670	5.39	2.50	0.47	2.98	0.303	7.58	
350+60	I-3C	90.00	0.90	0.07	2.42	1.85	10.00	0.0013	0.0400	0.0160	9.50	0.0000	5.39	******	******	0.81	0.248	6.21	Sag
425+25	Begin																		
415+50	I-3C	975.00	0.90	0.93	2.32	4.58	10.00	0.0150	0.0650	0.0650	13.00	0.1670	5.39	3.33	1.19	4.51	0.357	5.49	
405+50	I-3C	1000.00	0.90	1.18	7.78	4.40	12.18	0.0150	0.0650	0.0650	13.00	0.1670	5.02	4.22	2.31	6.53	0.410	6.31	
395+50	I-3B	1000.00	0.90	1.12	1.52	4.64	10.00	0.0150	0.0400	0.0160	9.50	0.1670	5.39	3.89	3.86	7.75	0.364	9.11	
386+50	I-3B	900.00	0.90	0.23	1.52	4.75	10.00	0.0150	0.0400	0.0160	9.50	0.1670	5.39	2.98	1.98	4.96	0.308	7.71	
382+00	I-3B	450.00	0.90	0.11	1.52	2.80	10.00	0.0150	0.0400	0.0160	9.50	0.1670	5.39	1.96	0.55	2.51	0.239	5.97	
375+00	I-3C	700.00	0.90	0.18	1.53	5.00	10.00	0.0150	0.0400	0.0104	9.50	0.1670	5.39	1.34	0.07	1.41	0.192	4.81	
365+00	I-3C	1000.00	0.90	0.85	1.52	5.40	10.00	0.0150	0.0400	0.0280	9.50	0.1670	5.39	2.69	1.50	4.19	0.289	7.24	
355+00	I-3C	1000.00	0.90	0.90	1.52	4.98	10.00	0.0150	0.0400	0.0280	9.50	0.1670	5.39	3.30	2.57	5.87	0.328	8.21	
351+50	I-3C	350.00	0.90	0.28	2.42	3.00	10.00	0.0047	0.0400	0.0280	9.50	0.1670	5.39	3.13	0.81	3.93	0.351	8.78	
351+00	I-3C	50.00	0.90	0.04	2.42	0.82	10.00	0.0021	0.0400	0.0280	9.50	0.1670	5.39	1.00	0.00	1.00	0.245	6.13	
350+60	I-3C	40.00	0.90	0.03	2.42	6.53	10.00	0.0000	0.0400	0.0280	9.50	0.1670	5.39	******	******	0.16	0.303	7.59	End

SUMP DATA

Total Flow (cfs) : 0.97

Ponded Depth (ft.) : 0.100

Spread on Pavement (ft.) : 1.73

INLET SPACING DESIGN

PID : 19415 **Date :** 10/10/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description :373+00 to 355+00, Left side **Designer :** mdc

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 10.00 **Allowable Depth (ft.)** 0.25

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (In./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)
373+00	Begin																	
369+00	CB-3	400.00	0.90	0.41	1.96	2.36	10.00	0.0136	0.0610	0.0610	8.00	0.1670	5.39	1.93	0.06	1.99	0.261	4.28
365+00	CB-3	400.00	0.90	0.53	2.92	2.39	10.00	0.0150	0.0400	0.0280	10.00	0.1670	5.39	2.12	0.51	2.63	0.243	6.08
360+00	CB-3	500.00	0.90	0.59	2.92	2.83	10.00	0.0150	0.0400	0.0280	10.00	0.1670	5.39	2.53	0.85	3.37	0.267	6.67
355+00	CB-3	500.00	0.90	0.47	2.72	2.90	10.00	0.0150	0.0400	0.0280	10.00	0.1670	5.39	2.40	0.73	3.13	0.259	6.48

151

INLET SPACING DESIGN

PID : 19415 **Date :** 10/10/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description :355+00 Right side **Designer :** mdc

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 9.50 **Allowable Depth (ft.)** 0.25

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)
361+00	Begin																	
355+00	CB-3	600.00	0.90	0.17	2.20	7.02	10.00	0.0150	0.0100	0.0000	9.50	0.1670	5.39	0.60	0.23	0.82	0.094	9.36

531

INLET SPACING DESIGN

PID : 19415 **Date :** 09/22/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 383+12 **Designer :** mdc

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 12.00 **Allowable Depth (ft.)** 0.38

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)
385+34	Begin																	
383+12	CB-3A	222.00	0.00	0.00	0.00	0.00	0.00	0.0150	0.0160	0.0000	12.00	0.1670	0.00	0.60	0.33	0.93	0.117	7.30

End of Bridge CB

951

INLET SPACING DESIGN

PID : 19415 **Date :** 10/10/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : mdc

Description :425+25 to 415+00, Left side

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 12.00 **Allowable Depth (ft.)** 0.25

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)
425+25	Begin																	
420+50	CB-3	475.00	0.90	0.42	2.29	2.67	10.00	0.0150	0.0650	0.0000	12.00	0.1670	5.39	1.99	0.05	2.04	0.265	4.08
415+50	CB-3	500.00	0.90	0.44	2.29	2.76	10.00	0.0150	0.0650	0.0000	10.00	0.1670	5.39	2.10	0.08	2.18	0.272	4.18

157

INLET SPACING DESIGN

PID : 19415 **Date :** 10/10/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : mdc

Description :425+25 to 415+50, Right side

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 9.50 **Allowable Depth (ft.)** 0.25

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)
425+25	Begin																	
415+50	CB-3	975.00	0.90	0.23	1.52	10.34	11.86	0.0150	0.0120	0.0000	9.50	0.1670	5.07	0.74	0.31	1.05	0.110	9.14

851

INLET SPACING DESIGN

PID : 19415 **Date :** 10/10/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description :425+25 to 435+00, Left side **Designer :** mdc

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 12.00 **Allowable Depth (ft.)** 0.25

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)
425+25	Begin																	
430+00	CB-3	475.00	0.90	0.41	2.48	3.57	10.00	0.0100	0.0400	0.0000	12.00	0.1670	5.39	1.74	0.25	1.99	0.236	5.90
435+00	CB-3	500.00	0.90	0.42	2.48	2.04	10.00	0.0450	0.0400	0.0000	12.00	0.1670	5.39	1.93	0.36	2.29	0.188	4.69

59

INLET SPACING DESIGN

PID : 19415 **Date :** 10/10/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description :425+25 to 435+00, Right side **Designer :** mdc

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 12.00 **Allowable Depth (ft.)** 0.25

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)
425+25	Begin																	
433+00	CB-3	775.00	0.90	0.42	1.66	4.87	10.00	0.0160	0.0400	0.0000	12.00	0.1670	5.39	1.76	0.28	2.04	0.218	5.46
437+00	CB-3	400.00	0.90	0.34	2.48	1.70	10.00	0.0450	0.0400	0.0000	12.00	0.1670	5.39	1.70	0.23	1.93	0.176	4.40
440+50	CB-3	350.00	0.90	0.29	2.48	1.55	10.00	0.0450	0.0400	0.0000	12.00	0.1670	5.39	1.50	0.14	1.64	0.166	4.14

INLET SPACING DESIGN

PID : 19415 **Date :** 09/22/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 444+60.17 **Designer :** mdc

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 12.00 **Allowable Depth (ft.)** 0.38

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	RUNOFF AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)
441+29	Begin																	
444+60	CB-3A	410.00	0.00	0.00	0.00	0.00	0.00	0.0230	0.0160	0.0000	12.00	0.1670	0.00	0.79	0.60	1.39	0.125	7.83

End of Bridge CB

191

INLET SPACING DESIGN

PID : 19415 **Date :** 09/22/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 445+39 **Designer :** mdc

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 12.00 **Allowable Depth (ft.)** 0.38

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	RUNOFF AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)
441+67	Begin																	
445+39	CB-3A	372.00	0.00	0.00	0.00	0.00	0.00	0.0230	0.0160	0.0000	12.00	0.1670	0.00	0.85	0.70	1.55	0.130	8.16

End of Bridge CB

791

INLET SPACING DESIGN

PID : 19415 **Date :** 05/08/2006 **Project :** SCI-823 **Location :** Portsmouth

Description : Left Side STA. 425+25 To 467+62 **Designer :** CLM

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 0.00 **Allowable Depth (ft.)** 0.38

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
425+25	Begin																		
435+00	I-3B	975.00	0.90	0.21	2.97	5.36	10.00	0.0380	0.0400	0.0160	9.50	0.1670	5.39	0.98	0.04	1.02	0.143	3.58	
440+50	I-3B	550.00	0.90	0.14	2.97	3.25	10.00	0.0376	0.0400	0.0160	9.50	0.0000	5.39	0.55	0.17	0.72	0.126	3.15	
446+90	I-3B	640.00	0.90	0.16	2.97	7.27	10.24	0.0060	0.0400	0.0160	9.50	0.1670	5.35	0.94	0.00	0.94	0.197	4.91	
447+74	I-3B	84.00	0.90	0.02	2.97	2.80	10.00	0.0014	0.0400	0.0160	9.50	0.0000	5.39	******	******	0.10	0.110	2.75	Sag
467+62	Begin																		
458+00	I-3B	962.00	0.90	0.24	2.97	5.93	10.00	0.0260	0.0400	0.0160	9.50	0.1670	5.39	1.11	0.05	1.16	0.162	4.04	
448+60	I-3B	940.00	0.90	0.24	2.97	10.35	13.32	0.0059	0.0400	0.0160	9.50	0.1670	4.84	1.10	0.00	1.10	0.209	5.21	
447+74	I-3B	86.00	0.90	0.02	2.97	2.86	10.00	0.0014	0.0400	0.0160	9.50	0.0000	5.39	******	******	0.10	0.110	2.75	End

SUMP DATA

Total Flow (cfs) : 0.19 **Ponded Depth (ft.) :** 0.000 **Spread on Pavement (ft.) :** 0.00

1/3

INLET SPACING DESIGN

PID : 19415 **Date :** 05/25/2006 **Project :** SCI-823 **Location :** Portsmouth

Description : Right Side STA. 425+35 To STA. 467+62 **Designer :** CLM

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 0.00 **Allowable Depth (ft.)** 0.38

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
425+25	Begin																		
435+00	I-3B	975.00	0.90	0.52	2.97	4.19	10.00	0.0390	0.0400	0.0160	9.50	0.1670	5.39	1.68	0.84	2.52	0.200	5.00	
440+50	I-3B	550.00	0.90	0.14	2.97	2.74	10.00	0.0376	0.0400	0.0160	9.50	0.1670	5.39	1.25	0.27	1.52	0.167	4.16	
446+90	I-3B	640.00	0.90	0.16	2.97	7.88	10.85	0.0046	0.0400	0.0160	9.50	0.1670	5.24	1.02	0.00	1.02	0.213	5.32	
447+74	I-3B	84.00	0.90	0.02	2.97	5.02	10.00	0.0003	0.0400	0.0160	9.50	0.1670	5.39	******	******	0.10	0.150	3.75	Sag
467+62	Begin																		
458+00	I-3B	962.00	0.90	0.24	2.97	5.91	10.00	0.0260	0.0400	0.0160	9.50	0.1670	5.39	1.12	0.06	1.18	0.162	4.06	
448+60	I-3B	940.00	0.90	0.24	10.00	10.89	20.89	0.0059	0.0400	0.0160	9.50	0.1670	3.94	0.90	0.00	0.90	0.194	4.84	
447+74	I-3B	86.00	0.90	0.02	2.97	2.80	10.00	0.0014	0.0400	0.0160	9.50	0.1670	5.39	******	******	0.11	0.113	2.84	End

SUMP DATA

Total Flow (cfs) : 0.21 **Ponded Depth (ft.) :** 0.000 **Spread on Pavement (ft.) :** 0.00

491

INLET SPACING DESIGN

PID : 19415 **Date :** 10/10/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description :462+00 to 448+60, Left side **Designer :** mdc

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 12.00 **Allowable Depth (ft.)** 0.25

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	RUNOFF AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)
462+00	Begin																	
455+00	CB-3	700.00	0.90	0.59	2.48	3.35	10.00	0.0260	0.0400	0.0000	12.00	0.1670	5.39	2.25	0.61	2.86	0.226	5.66
448+60	CB-3	640.00	0.90	0.54	2.48	2.98	10.00	0.0260	0.0400	0.0000	12.00	0.1670	5.39	2.46	0.77	3.23	0.237	5.92

165

INLET SPACING DESIGN

PID : 19415 **Date :** 10/10/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : mdc

Description :456+00 to 448+60, Right side

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 12.00 **Allowable Depth (ft.)** 0.25

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)
456+00	Begin																	
448+60	CB-3	740.00	0.90	0.62	2.48	3.50	10.00	0.0260	0.0400	0.0000	12.00	0.1670	5.39	2.34	0.67	3.01	0.231	5.76

991

INLET SPACING DESIGN

PID : 19415 **Date :** 05/25/2006 **Project :** SCI-823 **Location :** Portsmouth

Description : Left Side **Designer :** CLM

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 0.00 **Allowable Depth (ft.)** 0.38

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	RUNOFF AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
467+62	Begin																		
471+50	I-3B	388.00	0.90	0.18	2.64	3.04	10.00	0.0153	0.0400	0.0239	9.50	0.1670	5.39	0.87	0.00	0.87	0.160	4.00	
480+00	I-3C	850.00	0.90	0.68	2.50	3.78	10.00	0.0290	0.0400	0.0360	9.50	0.1670	5.39	2.08	1.22	3.30	0.234	5.85	
483+00	I-3C	300.00	0.90	0.24	2.50	1.45	10.00	0.0290	0.0400	0.0360	9.50	0.1670	5.39	1.71	0.68	2.39	0.207	5.18	
489+00	I-3C	600.00	0.90	0.48	2.50	5.71	10.00	0.0043	0.0400	0.0360	9.50	0.1670	5.39	2.63	0.38	3.01	0.323	8.07	
489+88	I-3C	88.00	0.90	0.07	2.50	2.22	10.00	0.0008	0.0400	0.0360	9.50	0.1670	5.39	******	******	0.72	0.259	6.48	Sag
519+55	Begin																		
510+00	I-3B	955.00	0.90	0.24	1.52	5.04	10.00	0.0370	0.0400	0.0160	9.50	0.1670	5.39	1.07	0.10	1.17	0.151	3.79	
504+00	I-3B	600.00	0.90	0.15	1.52	3.15	10.00	0.0450	0.0400	0.0160	9.50	0.1670	5.39	0.84	0.00	0.84	0.129	3.22	
494+00	I-3B	1000.00	0.90	0.25	1.52	6.63	10.00	0.0203	0.0400	0.0006	9.50	0.1670	5.39	1.18	0.04	1.23	0.172	4.31	
490+75	I-3C	325.00	0.90	0.26	2.50	3.73	10.00	0.0043	0.0400	0.0360	9.50	0.1670	5.39	1.31	0.00	1.31	0.236	5.91	
489+88	I-3C	87.00	0.90	0.07	10.00	2.78	12.78	0.0008	0.0400	0.0360	9.50	0.1670	4.92	******	******	0.31	0.189	4.72	End

SUMP DATA

Total Flow (cfs) : 1.03 **Ponded Depth (ft.) :** 0.104 **Spread on Pavement (ft.) :** 1.80

191

INLET SPACING DESIGN

PID : 19415 **Date :** 05/25/2006 **Project :** SCI-823 **Location :** Portsmouth

Designer : CLM

Description : Right Side

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 0.00 **Allowable Depth (ft.)** 0.38

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	RUNOFF AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
467+62	Begin																		
471+50	I-3B	388.00	0.90	0.10	1.52	8.71	10.23	0.0015	0.0400	0.0238	9.50	0.1670	5.35	0.48	0.00	0.48	0.197	4.93	
480+00	I-3C	850.00	0.90	0.17	1.28	5.37	10.00	0.0290	0.0400	0.0360	7.00	0.1670	5.39	0.82	0.00	0.82	0.139	3.48	
483+00	I-3C	300.00	0.90	0.06	1.28	2.38	10.00	0.0290	0.0400	0.0360	7.00	0.1670	5.39	0.29	0.00	0.29	0.094	2.35	
489+00	I-3C	600.00	0.90	0.11	1.28	8.93	10.21	0.0043	0.0400	0.0360	7.00	0.1670	5.35	0.53	0.00	0.53	0.168	4.21	
489+88	I-3C	88.00	0.90	0.02	1.28	3.73	10.00	0.0008	0.0400	0.0360	7.00	0.1670	5.39	******	******	0.08	0.115	2.88	Sag
519+55	Begin																		
510+00	I-3B	955.00	0.90	0.24	1.52	5.04	10.00	0.0370	0.0400	0.0160	9.50	0.1670	5.39	1.07	0.10	1.17	0.151	3.79	
504+00	I-3B	600.00	0.90	0.15	1.52	3.15	10.00	0.0450	0.0400	0.0160	9.50	0.1670	5.39	0.84	0.00	0.84	0.129	3.22	
494+00	I-3B	1000.00	0.90	0.25	1.52	6.63	10.00	0.0203	0.0400	0.0160	9.50	0.1670	5.39	1.18	0.04	1.23	0.172	4.31	
490+75	I-3C	325.00	0.90	0.07	1.28	5.09	10.00	0.0043	0.0400	0.0360	7.00	0.1670	5.39	0.38	0.00	0.38	0.149	3.72	
489+88	I-3C	87.00	0.90	0.02	10.00	4.00	14.00	0.0008	0.0400	0.0360	7.00	0.0000	4.74	******	******	0.07	0.109	2.73	End

SUMP DATA

Total Flow (cfs) : 0.16 **Ponded Depth (ft.) :** 0.029 **Spread on Pavement (ft.) :** 0.73

91/168

INLET SPACING DESIGN

PID : 19415 **Date :** 10/10/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta 483+33 and Sta 511+00 to 489+88, Right side **Designer :** mdc

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 10.00 **Allowable Depth (ft.)** 0.25

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
481+00	Begin																		
483+00	I-3D	200.00	0.90	0.18	2.55	1.21	10.00	0.0290	0.0400	0.0000	12.00	0.1670	5.39	0.87	0.00	0.87	0.142	3.55	
489+00	I-3D	600.00	0.90	0.55	2.55	5.54	10.00	0.0050	0.0400	0.0000	12.00	0.1670	5.39	2.37	0.30	2.67	0.300	7.51	
489+88	I-3D	88.00	0.90	0.08	2.48	1.58	10.00	0.0020	0.0400	0.0000	12.00	0.1670	5.39	******	******	0.69	0.214	5.35	Sag
520+00	Begin																		
511+00	CB-3	900.00	0.90	1.00	3.22	3.48	10.00	0.0330	0.0400	0.0000	10.00	0.1670	5.39	3.28	1.58	4.85	0.264	6.59	
504+00	I-3D	700.00	0.90	0.62	2.48	2.44	10.00	0.0450	0.0400	0.0000	12.00	0.1670	5.39	2.31	2.27	4.58	0.244	6.09	
494+00	I-3D	1000.00	0.90	0.86	2.48	4.16	10.00	0.0230	0.0400	0.0000	12.00	0.1670	5.39	3.21	3.24	6.45	0.314	7.85	
490+75	I-3D	325.00	0.90	0.37	2.48	2.56	10.00	0.0050	0.0400	0.0000	12.00	0.1670	5.39	3.65	1.39	5.04	0.381	9.53	
489+88	I-3D	412.00	0.90	0.08	2.48	4.25	10.00	0.0050	0.0400	0.0000	12.00	0.1670	5.39	******	******	1.77	0.258	6.44	End

SUMP DATA

Total Flow (cfs) : 2.46 **Ponded Depth (ft.) :** 0.185 **Spread on Pavement (ft.) :** 3.43

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INLET SPACING DESIGN

PID : 19415 **Date :** 10/10/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : mdc

Description :520+00 to 507+50, Left side

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 12.00 **Allowable Depth (ft.)** 0.25

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)
520+00	Begin																	
514+00	I-3D	600.00	0.90	0.81	3.18	2.88	10.00	0.0210	0.0400	0.0000	12.00	0.1670	5.39	2.44	1.49	3.93	0.265	6.63
508+50	CB-3	550.00	0.90	0.65	2.92	1.90	10.00	0.0450	0.0400	0.0000	12.00	0.1670	5.39	3.20	1.44	4.65	0.245	6.12
507+50	CB-3	100.00	0.90	0.10	2.70	0.44	10.00	0.0450	0.0400	0.0000	12.00	0.1670	5.39	1.70	0.23	1.93	0.176	4.40

170

INLET SPACING DESIGN

PID : 19415 **Date :** 10/10/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : mdc

Description :520+00 to 526+50, Right side

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 12.00 **Allowable Depth (ft.)** 0.25

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)
520+00	Begin																	
526+50	I-3D	650.00	0.90	0.42	1.94	3.05	10.00	0.0210	0.0800	0.0000	12.00	0.1670	5.39	1.94	0.09	2.04	0.269	3.36

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INLET SPACING DESIGN

PID : 19415 **Date :** 08/01/2006 **Project :** SCI-823 **Location :** Portsmouth

Description : Left Side **Designer :** CLM

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 0.00 **Allowable Depth (ft.)** 0.38

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
519+55	Begin																		
527+50	I-3B	795.00	0.90	0.20	1.28	4.79	10.00	0.0290	0.0400	0.0160	9.50	0.1670	5.39	0.97	0.00	0.97	0.148	3.70	
533+00	I-3B	550.00	0.90	0.14	1.28	7.14	10.00	0.0051	0.0400	0.0160	9.50	0.1670	5.39	0.67	0.00	0.67	0.178	4.45	
533+96	I-3B	96.00	0.90	0.02	10.00	2.84	12.84	0.0020	0.0400	0.0160	9.50	0.1670	4.91	******	******	0.11	0.107	2.67	Sag
561+80	Begin																		
553+00	I-3B	880.00	0.90	0.12	0.55	5.68	10.00	0.0340	0.0400	0.0160	9.50	0.1670	5.39	0.58	0.00	0.58	0.118	2.96	
544+00	I-3B	900.00	0.90	0.22	1.28	4.69	10.00	0.0400	0.0400	0.0160	9.50	0.1670	5.39	1.00	0.07	1.07	0.144	3.61	
534+85	I-3B	915.00	0.90	0.23	1.28	10.95	12.23	0.0047	0.0400	0.0160	9.50	0.1670	5.01	1.11	0.00	1.11	0.219	5.46	
533+96	I-3B	89.00	0.90	0.02	10.00	2.68	12.68	0.0020	0.0400	0.0160	9.50	0.1670	4.94	******	******	0.10	0.104	2.60	End

SUMP DATA

Total Flow (cfs) : 0.21 **Ponded Depth (ft.) :** 0.000 **Spread on Pavement (ft.) :** 0.00

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INLET SPACING DESIGN

PID : 19415 **Date :** 08/01/2006 **Project :** SCI-823 **Location :** Portsmouth

Description : Right Side **Designer :** CLM

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 0.00 **Allowable Depth (ft.)** 0.38

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
519+55	Begin																		
527+50	I-3B	795.00	0.90	0.20	1.28	4.79	10.00	0.0290	0.0400	0.0160	9.50	0.1670	5.39	0.97	0.00	0.97	0.148	3.70	
533+00	I-3B	550.00	0.90	0.14	1.28	7.13	10.00	0.0051	0.0400	0.0160	9.50	0.1670	5.39	0.67	0.00	0.67	0.179	4.46	
533+96	I-3B	96.00	0.90	0.02	10.00	2.84	12.84	0.0020	0.0400	0.0160	9.50	0.1670	4.91	******	******	0.11	0.107	2.67	Sag
561+80	Begin																		
553+00	I-3B	880.00	0.90	0.82	1.28	3.46	10.00	0.0342	0.0400	0.0160	13.20	0.1670	5.39	2.25	1.73	3.98	0.243	6.08	
544+00	I-3B	900.00	0.90	0.27	1.28	3.67	10.00	0.0400	0.0400	0.0160	9.50	0.1670	5.39	1.87	1.17	3.04	0.214	5.34	
534+85	I-3B	915.00	0.90	0.23	1.28	9.14	10.43	0.0047	0.0400	0.0160	9.50	0.1670	5.31	2.13	0.15	2.28	0.286	7.16	
533+96	I-3B	89.00	0.90	0.02	10.00	2.14	12.14	0.0020	0.0400	0.0160	9.50	0.1670	5.02	******	******	0.25	0.146	3.65	End

SUMP DATA

Total Flow (cfs) : 0.35 **Ponded Depth (ft.) :** 0.000 **Spread on Pavement (ft.) :** 0.00

173

INLET SPACING DESIGN

PID : 19415 **Date :** 10/10/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description :10+00 to 13+25 SR 335, Left side **Designer :** HJS

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 4.00 **Allowable Depth (ft.)** 0.25

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)	
10+00	Begin																		
12+75	I-3D	275.00	0.90	0.32	10.00	2.82	12.82	0.0096	0.0200	0.0200	4.00	0.1600	4.92	1.18	0.23	1.42	0.162	8.08	
13+25	I-3D	325.00	0.90	0.03	2.07	2.89	10.00	0.0320	0.0200	0.0200	4.00	0.1600	5.39	******	******	0.38	0.079	3.93	Sag
13+50	I-3D	150.00	0.90	0.08	10.00	2.41	12.41	0.0072	0.0200	0.0200	4.00	0.1600	4.98	0.36	0.00	0.36	0.102	5.09	
13+25	I-3D	25.00	0.90	0.01	10.00	0.63	10.63	0.0068	0.0200	0.0200	4.00	0.1600	5.28	******	******	0.07	0.055	2.74	Sag

174

INLET SPACING DESIGN

PID : 19415 **Date :** 10/10/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description :STA 535+50 and 534+00 CR 28 D, Left side **Designer :** mdc

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 7.00 **Allowable Depth (ft.)** 0.42

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)
532+20	Begin																	
534+00	CB-3A	180.00	0.90	0.12	1.79	0.94	10.00	0.0432	0.0562	0.0562	0.00	0.1670	5.39	0.58	0.00	0.58	0.129	2.29
535+50	CB-3A	150.00	0.90	0.08	2.12	1.43	10.00	0.0232	0.0200	0.0200	0.00	0.1670	5.39	0.36	0.03	0.39	0.084	4.21

S21 175

Storm Sewer Calculations

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 355+00 curb L. **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	JUNCTION To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	RAINFALL INTENSITY (25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	DISCHARGE (cfs.) (25 yrs.)	PIPE DIAM. (in.)	PIPE LENGTH (ft.)	PIPE SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	355+00	0.47	0.42	10.00	5.39	6.69	2.3	2.8	15	14.0	0.0343	647.10	6.77	11.15	0.0026	647.62	651.10	3.48	2.75	CB 3
begin		355+00	0.47	0.42									646.62				647.58	649.87			0.015

9L1

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 355+00 median to curb. **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	355+00	1.15	1.04	10.00	5.39	6.67	5.6	6.9	15	40.8	0.0100	646.52	5.21	6.04	0.0152	647.88	651.95	4.07	4.18	I 3B
begin		355+00	1.15	1.04									646.11				647.26	652.44			0.015
1	2	355+00	0.17	0.15	10.13	5.37	6.65	6.4	7.9	18	33.0	0.0100	645.84	5.58	9.79	0.0075	647.05	652.42	5.37	5.08	CB 3
final		355+00	1.32	1.19									645.51				646.80	649.01			0.015

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STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 360+00 curb L **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	360+00	0.59	0.53	10.00	5.39	6.69	2.9	3.6	15	14.0	0.0350	654.32	7.28	11.27	0.0040	654.89	658.32	3.43	2.75	CB 3
begin		360+00	0.59	0.53									653.83				654.84	657.08			0.015

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STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 365+00 curb L **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	369+00	0.53	0.48	10.00	5.39	6.69	2.6	3.2	15	8.0	0.0100	661.54	4.46	6.02	0.0032	662.47	665.54	3.07	2.75	CB 3
begin		365+00	0.53	0.48									661.46				662.44	664.71			0.015

179

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 365+00 median storm outlet. **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From	To	ΔAREA	ΣAREA (acres)	ΔCA	ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	365+00		1.10		0.99		10.00	5.39	6.65	5.3	6.6	15	70.0	0.0100	661.52	5.19	6.02	0.0138	662.93	666.95	4.02	4.18	I 3B
begin		365+00		1.10		0.99										660.82				661.96	664.07			0.015

180

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 369+00 curb L **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	JUNCTION To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	RAINFALL INTENSITY (25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	DISCHARGE (cfs.) (25 yrs.)	PIPE DIAM. (in.)	PIPE LENGTH (ft.)	PIPE SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	369+00	0.41	0.37	10.00	5.39	6.69	2.0	2.5	15	14.0	0.0329	666.77	6.42	10.92	0.0019	667.28	670.76	3.48	2.74	CB 3
begin		369+00	0.41	0.37									666.31				667.25	669.56			0.015

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STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 375+00 median storm outlet. **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From	To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	375+00		0.36	0.32	10.00	5.39	6.63	1.7	2.1	15	82.0	0.0118	676.52	4.28	6.55	0.0015	677.03	681.95	4.92	4.18	I 3B
														675.55				676.47	678.80			0.015
begin		375+00		0.36	0.32																	

182

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 382+00 median storm outlet. **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	382+00	0.22	0.20	10.00	5.39	6.64	1.1	1.3	15	57.0	0.0100	687.02	3.51	6.02	0.0006	687.43	692.45	5.02	4.18	I 3B
begin		382+00	0.22	0.20									686.45				687.30	689.70			0.015

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INLET SPACING DESIGN

PID : 19415 **Date :** 09/22/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 383+12 Same Area and Q for left and right sides **Designer :** mdc

Rainfall Area: D **Storm Frequency (yr.) :** 10 **Total Allow. Spread (ft.) :** 12.00 **Allowable Depth (ft.)** 0.38

STATION	C.B. Type	GUTTER LENGTH (ft.)	RUNOFF COEF	AREA (acres)	CONC. TIME (min.)	GUTTER TIME (min.)	TIME USED (min.)	LONG. SLOPE (ft./ft.)	GUTT. SLOPE (ft./ft.)	PAVT. SLOPE (ft./ft.)	GUTT. WIDTH (ft.)	LOCAL DEPRESS. (ft.)	RAIN FALL (in./hrs.)	INTERCPTD FLOW (cfs.)	BYPASS FLOW (cfs.)	TOTAL FLOW (cfs.)	DEPTH FLOW (ft.)	PAVT. SPREAD (ft.)
385+34	Begin																	
383+12	CB-3A	222.00	0.00	0.00	0.00	0.00	0.00	0.0150	0.0160	0.0000	12.00	0.1670	0.00	0.60	0.33	0.93	0.117	7.30

184

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 386+50 median storm outlet. **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From	To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	386+50		0.46	0.41	10.00	5.39	6.64	2.2	2.7	15	69.0	0.0100	691.77	4.31	6.02	0.0024	692.39	699.50	7.11	6.48	I 3B
begin		386+50		0.46	0.41									691.08				692.04	694.33			0.015

185

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 395+50 median storm outlet. **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	395+50	1.27	1.14	10.00	5.39	6.66	6.2	7.6	15	82.0	0.0240	707.27	7.67	9.33	0.0184	708.18	712.70	4.52	4.18	I 3B
begin		395+50	1.27	1.14									705.30				706.47	708.55			0.015

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 405+50 median storm outlet. **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (In.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	405+50	1.30	1.17	10.00	5.39	6.65	6.3	7.8	15	93.0	0.0200	721.84	7.17	8.52	0.0193	722.95	727.34	4.39	4.25	I 3C
begin		405+50	1.30	1.17									719.98				721.16	723.23			0.015

187

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 415+50 curb L. **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	415+50	0.44	0.40	10.00	5.39	6.69	2.1	2.6	15	14.0	0.0321	736.64	6.50	10.80	0.0022	737.17	740.64	3.47	2.75	CB 3
begin		415+50	0.44	0.40									736.19				737.14	739.43			0.015

881

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 415+50 median storm outlet. **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From	To	ΔAREA Σ AREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	415+50		1.05	0.95	10.00	5.39	6.65	5.1	6.3	15	46.7	0.0101	736.89	5.19	6.04	0.0126	738.14	742.34	4.20	4.20	I 3C
begin		415+50		1.05	0.95									736.42				737.55	744.61			0.015
1	2	415+50		0.23	0.21	10.15	5.36	6.65	6.2	7.7	15	30.9	0.0200	736.42	7.14	8.52	0.0187	737.55	744.61	7.06	6.94	CB 3
final		415+50		1.28	1.15									735.80				736.98	739.05			0.015

181

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : mdc

Description : Sta. 420+50 curb L.

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	PIPE LENGTH (ft.)	PIPE SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	420+50	0.42	0.38	10.00	5.39	6.69	2.0	2.5	15	14.0	0.0321	744.14	6.40	10.80	0.0020	744.66	748.14	3.48	2.75	CB 3
													743.69				744.63	746.78			0.015
begin		420+50	0.42	0.38																	

ab1

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : mdc

Description : Sta. 430+00 curb L.

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	430+00	0.41	0.37	10.00	5.39	6.69	2.0	2.5	15	14.0	0.0343	745.41	6.50	11.15	0.0019	745.90	749.41	3.51	2.75	CB 3
begin		430+00	0.41	0.37									744.93				745.87	748.18			0.015

191

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : mdc

Description : Sta. 433+00 curb R

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	433+00	0.42	0.38	10.00	5.39	6.69	2.0	2.5	15	14.0	0.0343	737.91	6.57	11.15	0.0020	738.40	741.91	3.51	2.75	CB 3
													737.43				738.37	740.68			0.015
begin		433+00	0.42	0.38																	

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 435+00 median storm outlet. **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	435+00	0.73	0.66	10.00	5.39	6.68	3.5	4.4	15	41.2	0.0400	730.07	8.10	12.05	0.0061	730.61	735.50	4.89	4.18	I 3B
begin		435+00	0.73	0.66									728.42				729.47	734.91			0.015
1	2	435+00	0.42	0.38	10.08	5.38	6.66	5.6	6.9	15	39.5	0.0400	728.42	9.10	12.04	0.0151	729.13	734.91	5.78	5.24	CB 3
final		435+00	1.15	1.04									726.84				727.99	730.09			0.015

193

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 437+00 curb R. **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	437+00	0.34	0.31	10.00	5.39	6.69	1.6	2.0	15	14.0	0.0343	722.36	6.17	11.15	0.0013	722.81	726.36	3.55	2.75	CB 3
begin		437+00	0.34	0.31									721.88				722.79	725.13			0.015

461

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 440+50 to R CB storm outlet. **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	440+50	0.28	0.25	10.00	5.39	6.64	1.4	1.7	15	42.0	0.0100	705.98	3.76	6.02	0.0009	706.50	711.48	4.98	4.25	I 3B
begin		440+50	0.28	0.25									705.56				706.46	710.88			0.015
1	2	440+50	0.29	0.26	10.19	5.36	6.64	2.7	3.4	15	15.0	0.0100	705.56	4.54	6.02	0.0037	706.46	710.88	4.42	4.07	CB 3
final		440+50	0.57	0.51									705.41				706.41	708.66			0.015

185

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/19/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 444+60 **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From	To	ΔAREA	ΣAREA (acres)	ΔCA	ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	444+60		0.29		0.26		10.00	5.39	6.69	1.4	1.7	15	7.0	0.0100	695.30	3.78	6.02	0.0009	696.12	699.26	3.14	2.71	CB 3A
																695.23				696.12	698.48			0.015
begin		444+60		0.29		0.26																		

961

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/19/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 445+39 **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	445+39	0.42	0.38	10.00	5.39	6.69	2.0	2.5	15	8.0	0.0100	694.12	4.20	6.02	0.0020	695.00	698.08	3.08	2.71	CB 3A
begin		445+39	0.42	0.38									694.04				694.98	697.29			0.015

197

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 447+74 to 446+90 median storm outlet. **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 50

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(50 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(50 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	447+74	0.08	0.07	10.00	5.39	7.09	0.4	0.5	15	84.0	0.0135	693.06	2.92	6.98	0.0001	693.30	697.16	3.86	2.85	I 3B
begin		446+90	0.08	0.07									691.93				692.69	697.36			0.015
1	2	446+90	0.26	0.23	10.48	5.30	7.03	1.6	2.2	15	57.0	0.0102	691.93	3.98	6.07	0.0015	692.47	697.36	4.89	4.18	I 3B
final		446+90	0.34	0.31									691.35				692.27	694.60			0.015

861

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 448+60 curb L **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	448+60	0.54	0.49	10.00	5.39	6.69	2.6	3.3	15	14.0	0.0329	692.77	6.95	10.92	0.0034	693.35	696.77	3.42	2.75	CB 3
begin		448+60	0.54	0.49									692.31				693.30	695.56			0.015

661

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 448+60 median to R CB storm outlet. **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	448+60	0.48	0.43	10.00	5.39	6.65	2.3	2.9	15	44.1	0.0188	693.01	5.49	8.26	0.0026	693.54	697.37	3.83	3.11	I 3B
begin		448+60	0.48	0.43									692.18				693.20	696.78			0.015
1	2	448+60	0.62	0.56	10.13	5.37	6.65	5.3	6.6	15	25.0	0.0188	692.18	6.75	8.26	0.0138	693.20	696.77	3.57	3.34	CB 3
final		448+60	1.10	0.99									691.71				692.85	694.91			0.015

002

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 455+00 curb L **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	455+00	0.59	0.53	10.00	5.39	6.69	2.9	3.6	15	16.0	0.0300	705.26	6.87	10.43	0.0040	705.85	709.26	3.41	2.75	CB 3
begin		455+00	0.59	0.53									704.78				705.79	708.03			0.015

107

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 458+00 median storm outlet. **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	458+00	0.48	0.43	10.00	5.39	6.65	2.3	2.9	15	60.0	0.0100	712.22	4.35	6.02	0.0026	712.85	717.65	4.80	4.18	I 3B
begin		458+00	0.48	0.43									711.62				712.59	714.87			0.015

202

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 471+50 median storm outlet **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From	To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	471+50		0.28	0.25	10.00	5.39	6.63	1.4	1.7	15	62.0	0.0095	725.67	3.69	5.87	0.0009	726.14	731.17	5.03	4.25	I 3B
begin		471+50		0.28	0.25									725.08				725.96	728.37			0.015

202

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 477+00 median storm outlet **Designer :** hjs

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From	To	ΔAREA Σ AREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	477+00		0.28	0.25	10.00	5.39	6.64	1.4	1.7	15	58.0	0.0100	712.12	3.76	6.02	0.0009	712.59	717.76	5.17	4.39	I 3C
begin		477+00		0.28	0.25									711.54				712.42	714.79			0.015

204

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 480+00 median storm outlet. Pipe length is actual length not pay length **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	480+00	0.75	0.68	10.00	5.39	6.66	3.6	4.5	15	54.0	0.0100	703.42	4.86	6.02	0.0064	704.28	709.06	4.78	4.39	I 3C
													702.88				703.93	706.13			0.015
begin		480+00	0.75	0.68																	

502

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 483+00 I-3D to 483+00 median inlet out to LT **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	483+00	0.18	0.16	10.00	5.39	6.64	0.9	1.1	15	49.0	0.0100	694.71	3.32	6.02	0.0004	695.08	699.21	4.13	3.25	I 3D
begin		483+00	0.18	0.16									694.22				695.05	700.22			0.015
1	2	483+00	0.30	0.27	10.25	5.35	6.60	2.3	2.8	15	81.0	0.0336	694.22	6.74	11.04	0.0026	694.67	700.22	5.55	4.75	I 3C
final		483+00	0.48	0.43									691.50				692.46	694.75			0.015

206

STORM SEWER SYSTEM

PID : 19415 **Date :** 08/25/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 490+75, 489+88, 489+00 median and outside barrier storm outlet **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	490+75	0.33	0.30	10.00	5.39	6.62	1.6	2.0	15	87.0	0.0137	684.49	4.42	7.04	0.0012	684.96	689.99	5.03	4.25	I 3C
begin		489+88	0.33	0.30									683.30				684.20	688.80			0.015
0	1	489+00	0.59	0.53	10.00	5.39	6.63	2.9	3.5	15	88.0	0.0135	684.49	5.13	7.00	0.0040	685.14	688.99	3.85	3.25	I 3C
begin		489+88	0.92	0.83									683.30				684.30	688.80			0.015
1	2	489+88	0.18	0.16	10.33	5.33	6.59	5.3	6.5	15	49.0	0.0300	683.30	8.07	10.43	0.0136	684.08	688.80	4.72	4.25	I 3C
		489+88	1.10	0.99									681.83				683.42	687.79			0.015
0	2	489+00	0.55	0.50	10.00	5.39	6.59	2.7	3.3	15	88.0	0.0225	683.81	6.08	9.03	0.0034	684.35	687.97	3.62	2.91	I 3D
begin		489+88	1.65	1.49									681.83				683.42	687.79			0.015
0	2	490+75	0.37	0.33	10.00	5.39	6.59	1.8	2.2	15	87.0	0.0228	683.81	5.47	9.09	0.0015	684.25	687.98	3.73	2.92	I 3D
begin		489+88	2.02	1.82									681.83				683.42	687.79			0.015
2	3	489+88	0.16	0.14	10.43	5.31	6.59	10.4	12.9	15	16.5	0.0320	681.83	9.28	10.78	0.0533	683.42	687.79	4.37	4.71	I 3D
final		489+88	2.18	1.96									681.30				682.54	684.55			0.015

207

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 494+00 median storm outlet. Pipe length is acutal length not payment length **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	PIPE LENGTH (ft.)	PIPE SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	494+00	0.50	0.45	10.00	5.39	6.65	2.4	3.0	15	42.5	0.0100	687.42	4.40	6.02	0.0029	688.32	692.92	4.60	4.25	I 3B
begin		494+00	0.50	0.45									687.00				688.20	692.45			0.015
1	2	494+00	0.86	0.77	10.16	5.36	6.65	6.6	8.1	15	20.0	0.0200	687.00	7.22	8.52	0.0211	688.20	692.45	4.25	4.21	I 3D
final		494+00	1.36	1.22									686.60				687.78	689.85			0.015

802

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 504+00 median storm outlet. Pipe length is actual length not payment length **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	504+00	0.30	0.27	10.00	5.39	6.65	1.5	1.8	15	44.0	0.0120	726.32	4.10	6.61	0.0010	726.90	731.75	4.85	4.18	I 3B
begin		504+00	0.30	0.27									725.79				726.85	731.29			0.015
1	2	504+00	0.52	0.47	10.18	5.36	6.65	4.0	4.9	15	6.0	0.0100	725.79	4.94	6.02	0.0077	726.85	731.28	4.43	4.24	I 3D
final		504+00	0.82	0.74									725.73				726.80	728.98			0.015

209

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 507+50 curb L. **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	507+50	0.75	0.68	10.00	5.39	6.69	3.6	4.5	15	12.0	0.0383	742.85	8.02	11.79	0.0065	743.52	746.85	3.33	2.75	CB 3
begin		507+50	0.75	0.68									742.39				743.45	745.64			0.015

012

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 508+50 curb L **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	508+50	0.65	0.59	10.00	5.39	6.69	3.2	3.9	15	14.0	0.0350	747.27	7.46	11.27	0.0049	747.87	751.27	3.40	2.75	CB 3
begin		508+50	0.65	0.59									746.78				747.81	748.03			0.015

112

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 510+00 median storm outlet **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	510+00	0.48	0.43	10.00	5.39	6.65	2.3	2.9	15	66.0	0.0176	753.87	5.34	7.98	0.0026	754.41	757.97	3.56	2.85	I 3B
begin		510+00	0.48	0.43									752.71				753.68	755.96			0.015

212

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 511+00 curb R. **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	511+00	1.00	0.90	10.00	5.39	6.69	4.9	6.0	15	14.0	0.0350	756.80	8.38	11.27	0.0116	757.59	760.80	3.21	2.75	CB 3
begin		511+00	1.00	0.90									756.31				757.43	759.56			0.015

213

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 514+00 curb L **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / Σ AREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	514+00	0.81	0.73	10.00	5.39	6.69	3.9	4.9	15	14.0	0.0314	764.83	7.63	10.68	0.0076	765.57	769.00	3.43	2.92	I 3D
begin		514+00	0.81	0.73									764.39				765.46	767.64			0.015

H12

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 527+50 median storm outlet **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From	To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	527+50		0.40	0.36	10.00	5.39	6.64	1.9	2.4	15	88.0	0.0251	758.07	5.79	9.54	0.0018	758.51	763.50	4.99	4.18	I 3B
begin		527+50		0.40	0.36									755.86				756.79	759.11			0.015

S12

STORM SEWER SYSTEM

PID : 19415 **Date :** 08/25/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 534+85,5 33+96, 533+00 median storm outlet. **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 50

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From	To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(50 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(50 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	533+00		0.28	0.25	10.00	5.39	7.06	1.4	1.8	15	96.0	0.0165	748.83	4.50	7.73	0.0010	749.25	752.93	3.68	2.85	I 3B
begin		533+96		0.28	0.25									747.25				748.23	752.68			0.015
0	1	534+85		0.46	0.41	10.00	5.39	7.06	2.2	2.9	15	89.0	0.0173	748.79	5.26	7.92	0.0027	749.34	752.89	3.55	2.85	I 3B
begin		533+96		0.74	0.67									747.25				748.23	752.68			0.015
1	2	533+96		0.08	0.07	10.36	5.33	7.06	3.9	5.2	15	77.0	0.0100	747.25	4.94	6.02	0.0086	748.23	752.68	4.45	4.18	I 3B
final		533+96		0.82	0.74									746.48				747.57	759.73			0.015

912

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 526+00, CR 28 Ramp A, curb R. **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	526+50	0.42	0.38	10.00	5.39	6.69	2.0	2.5	15	14.0	0.0157	756.49	4.96	7.55	0.0020	757.24	760.99	3.75	3.25	I 3D
begin		526+50	0.42	0.38									756.27				757.21	759.52			0.015

217

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 528+50 to 529+00, CR 28 Ramp A. Area 68A **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	528+50	1.95	0.88	10.00	5.39	6.62	4.7	5.8	15	50.0	0.0150	746.15	6.02	7.38	0.0107	747.27	747.90	0.63	0.50	CB 2-2B
begin		528+50	1.95	0.88									745.40				746.74	747.15			0.015
1	2	529+00	0.05	0.03	10.14	5.37	6.62	4.9	6.0	15	60.0	0.0080	745.40	4.65	5.39	0.0116	746.74	747.15	0.41	0.50	CB 2-2B
final		529+00	2.00	0.91									744.92				746.04	748.17			0.015

812

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 530+00+00 CR 28 Ramp C. Area 70C **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	PIPE LENGTH (ft.)	PIPE SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	530+00	4.78	2.84	12.15	5.02	6.21	14.3	17.7	24	60.0	0.0095	749.31	6.68	20.56	0.0081	750.98	752.90	1.92	1.59	CB 2-3
begin		530+00	4.78	2.84									748.74				750.50	752.74			0.015

219

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 532+00+00 SR 728 Ramp D. Area 70D **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From To	ΔAREA ΣAREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	532+00	2.38	1.22	10.00	5.39	6.66	6.6	8.1	18	60.0	0.0098	747.86	5.57	9.71	0.0079	749.05	751.61	2.56	2.25	CB 2-3
begin		532+00	2.38	1.22									747.27				748.57	750.77			0.015

220

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 10+90 Flowers Ison Rd. Area 86 **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 706.73

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	10+90	10.01	4.60	10.00	5.39	6.69	24.8	30.8	24	50.0	0.0844	708.55	17.50	61.27	0.0246	709.60	711.55	1.95	1.00	CB 2-3
begin		10+90	10.01	4.60									704.33				706.73	708.33			0.015

122

STORM SEWER SYSTEM

PID : 19415 **Date :** 08/25/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 534+85,5 33+96, 533+00 median storm outlet. **Designer :** hjs

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	534+59	0.09	0.08	10.00	5.39	6.66	0.4	0.5	15	30.0	0.0200	724.48	3.46	8.52	0.0001	724.70	729.08	4.38	3.35	CB 3A
begin		534+89	0.09	0.08									723.88				724.65	729.01			0.015
0	1	535+39	0.10	0.09	10.00	5.39	6.64	0.5	0.6	15	50.0	0.0146	724.61	3.20	7.28	0.0001	724.86	729.22	4.36	3.36	CB 3A
begin		534+89	0.19	0.17									723.88				724.66	729.01			0.015
1	2	534+89	0.06	0.05	10.26	5.34	6.59	1.2	1.5	15	78.0	0.0395	723.88	5.92	11.97	0.0007	724.19	729.01	4.82	3.88	CB 3
final		534+89	0.25	0.23									720.80				721.67	719.85			0.015

222

STORM SEWER SYSTEM

PID : 19415 **Date :** 08/25/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 534+85, 533+96, 533+00 median storm outlet. **Designer :** hjs

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	PIPE LENGTH (ft.)	PIPE SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	534+59	0.09	0.08	10.00	5.39	6.66	0.4	0.5	15	30.0	0.0200	724.48	3.46	8.52	0.0001	724.70	729.08	4.38	3.35	CB 3A
begin		534+89	0.09	0.08									723.88				724.65	729.01			0.015
0	1	535+39	0.10	0.09	10.00	5.39	6.64	0.5	0.6	15	50.0	0.0146	724.61	3.20	7.28	0.0001	724.86	729.22	4.36	3.36	CB 3A
begin		534+89	0.19	0.17									723.88				724.66	729.01			0.015
1	2	534+89	0.06	0.05	10.26	5.34	6.59	1.2	1.5	15	78.0	0.0395	723.88	5.92	11.97	0.0007	724.19	729.01	4.82	3.88	CB 3
final		534+89	0.25	0.23									720.80				721.67	719.85			0.015

223

STORM SEWER SYSTEM

PID : 19415 **Date :** 12/01/2006 **Project :** SR 823Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta.12+75 SR 335 to Sta 14+60 SR 335 **Designer :** HJS

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 12.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From To	ΔAREA Σ AREA (acres)	ΔCA ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	12+75	0.32	0.29	10.00	5.39	6.65	1.6	1.9	15	50.0	0.0100	651.73	3.91	6.02	0.0012	652.23	657.03	4.80	4.05	I Barrier
begin		13+25	0.32	0.29									651.23				652.13	656.81			0.015
1	2	13+25	0.04	0.04	10.21	5.35	6.63	1.7	2.1	15	25.0	0.0100	651.23	4.02	6.02	0.0015	651.93	656.81	4.88	4.33	I Barrier
		13+50	0.36	0.32									650.98				651.90	657.03			0.015
2	3	13+50	0.08	0.07	10.32	5.33	6.53	2.1	2.6	15	110.0	0.0100	650.98	4.25	6.02	0.0021	651.58	657.03	5.45	4.80	I Barrier
		14+60	0.44	0.40									649.88				650.83	658.12			0.015
3	4	14+60	0.00	0.00	10.75	5.26	6.51	2.1	2.6	15	18.0	0.0100	649.88	4.22	6.02	0.0021	650.69	658.12	7.43	6.99	MH 3
final		14+60	0.44	0.40									649.70				650.65	654.00			0.015

422

STORM SEWER SYSTEM

PID : 19415 **Date :** 11/29/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Drainage Area 89, Sta. 36+00 CR28, Left **Designer :** hjs

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 12.00 **Tailwater Elevation (ft.):** 0.00

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	36+00	9.50	5.89	10.00	5.39	6.63	31.8	39.0	27	163.0	0.0126	721.92	8.56	32.38	0.0211	725.48	724.54	-0.94	0.37	CB 2-2B
begin		37+64	9.50	5.89									719.87				722.03	722.88			0.015

Use equivelent elliptical size 22" x34" due to clearance issues.

225

STORM SEWER SYSTEM

PID : 19415 **Date :** 09/08/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Sta. 10+90 Flowers Ison Rd. Area 86 **Designer :** mdc

Rainfall Area: D **Just Full Capacity Frequency (yrs.) :** 10 **Hydraulic Gradient Frequency (yrs.) :** 25

Minimum Pipe Size : 15.00 **Tailwater Elevation (ft.):** 706.73

JUNCTION From	To	STATION From / To	ΔAREA / ΣAREA (acres)	ΔCA / ΣCA	BEGIN TIME (min.)	RAINFALL INTENSITY (10 yrs.)	(25 yrs.)	DISCHARGE (cfs.) (10 yrs.)	(25 yrs.)	PIPE DIAM. (in.)	LENGTH (ft.)	SLOPE (ft./ft.)	F/L PIPE IN / OUT (ft.)	MEAN VEL (fps.)	JUST FULL CAPACITY (cfs.)	FRICT SLOPE (ft./ft.)	HYGR EL. IN / OUT (ft.)	COVER IN / OUT (ft.)	COVER MINUS HY GR	COVER MINUS CROWN	INLET TYPE MANNING'S 'n'
0	1	10+95	10.01	4.60	10.00	5.39	6.68	24.8	30.7	24	60.0	0.0703	708.55	16.33	55.93	0.0245	709.66	711.55	1.89	1.00	CB 2-3
begin		10+85	10.01	4.60									704.33				706.73	708.33			0.015

922

Ditch Calculations

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections SR823, 352+00 RT TO SR823, 353+88 RT

Rainfall Area : D **Designer :** DL

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
352+00	353+88	R	188.00	14.00	3.50	2.50	0.3804 *	0.50	0.50	0.44	0.22	Seed	4.42	5	0.030	11.17	2.65	0.61	0.97	0.03	14.16
												Jute Mat	4.39	5	0.040	11.39	2.23	0.73	0.96	0.03	14.18
												Temp. Mat	4.39	5	0.040	11.39	2.23	0.73	0.96	0.03	14.18
												Temp. Mat	5.16	10	0.040	11.30	2.38	0.80	1.13	0.03	14.20

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DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 352+00 TO 353+50 Left **Designer :** DL

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00				

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
352+00	353+50	L	150.00	17.50	3.00	2.00	0.0267	0.76	0.76	0.48	0.36	Seed	4.33	5	0.030	11.84	1.33	0.11	1.58	0.07	17.84
												Seed	5.04	10	0.040	12.06	1.19	0.15	1.84	0.09	17.94
353+50	353+88	L	38.00	15.00	3.00	2.00	0.2300*	0.13	0.89	0.51	0.43	Seed	4.30	5	0.030	12.06	2.88	0.61	1.85	0.04	15.21
												Jute Mat	4.29	5	0.040	12.10	2.42	0.73	1.85	0.05	15.25
												Temp. Mat	4.29	5	0.040	12.10	2.42	0.73	1.85	0.05	15.25
												Temp. Mat	5.00	10	0.040	12.30	2.57	0.79	2.16	0.06	15.28

922

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections SR823, 361+50 RT TO SR823, 353+88 RT **Designer :** DL

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
361+50	355+50	R	600.00	10.00	6.00	4.00	0.0162	0.83	0.83	0.40	0.33	Seed	3.68	5	0.030	17.34	1.26	0.09	1.22	0.09	10.93
												Seed	4.21	10	0.040	18.28	1.10	0.12	1.39	0.12	11.20
355+50	355+00	R	50.00	10.00	3.50	3.50	0.1000*	0.07	0.90	0.40	0.36	Seed	3.65	5	0.030	17.71	2.27	0.35	1.31	0.06	10.39
												Seed	4.16	10	0.040	18.70	2.00	0.45	1.49	0.07	10.51
355+00	354+50	R	50.00	10.00	2.50	3.00	0.3000*	0.13	1.02	0.86	0.47	Seed	3.63	5	0.030	17.94	3.52	0.89	1.69	0.05	10.26
												Jute Mat	3.62	5	0.040	17.99	2.94	1.06	1.69	0.06	10.31
												Temp. Mat	3.62	5	0.040	17.99	2.94	1.06	1.69	0.06	10.31
												Perm, Type 1	3.62	5	0.040	17.99	2.94	1.06	1.69	0.06	10.31
												Perm, Type 1	4.13	10	0.040	18.96	3.11	1.14	1.92	0.06	10.33
354+50	354+00	R	50.00	15.00	2.50	3.00	0.5300*	0.18	1.20	0.43	0.54	Seed	3.60	5	0.030	18.21	3.78	1.13	1.95	0.03	15.19
												Jute Mat	3.60	5	0.040	18.25	3.18	1.34	1.95	0.04	15.22
												Temp. Mat	3.60	5	0.040	18.25	3.18	1.34	1.95	0.04	15.22
												Perm, Type 1	3.60	5	0.040	18.25	3.18	1.34	1.95	0.04	15.22

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Perm, Type 1	4.10	10	0.040	19.21	3.35	1.45	2.23	0.04	15.24
354+00	353+88	R	12.00	15.00	2.00	3.00	0.0208	0.90	2.10	0.42	0.92	Seed	3.59	5	0.030	18.36	1.74	0.16	3.30	0.12	15.62
												Seed	4.09	10	0.040	19.34	1.54	0.21	3.76	0.16	15.79

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DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections SR823, 361+50 RT TO SR823, 364+00 RT **Designer :** DL

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
361+50	363+50	R	150.00	11.00	4.50	3.00	0.1180*	0.41	0.41	0.45	0.18	Seed	4.40	5	0.030	11.28	1.90	0.28	0.81	0.04	11.29
												Seed	5.14	10	0.040	11.44	1.70	0.37	0.95	0.05	11.37
363+00	363+50	R	50.00	12.50	4.00	3.00	0.2600*	0.17	0.58	0.43	0.26	Seed	4.36	5	0.030	11.60	2.64	0.55	1.13	0.03	12.74
												Jute Mat	4.35	5	0.040	11.66	2.22	0.65	1.13	0.04	12.78
												Temp. Mat	4.35	5	0.040	11.66	2.22	0.65	1.13	0.04	12.78
												Temp. Mat	5.08	10	0.040	11.79	2.35	0.72	1.32	0.04	12.81
363+50	364+00	R	50.00	15.00	3.00	3.00	0.3160*	27.16	27.74	0.40	11.12	Seed	3.12	5	0.030	24.08	9.93	4.40	34.70	0.22	16.34
												Jute Mat	3.12	5	0.040	24.10	8.30	5.22	34.69	0.26	16.59
												Temp. Mat	3.12	5	0.040	24.10	8.30	5.22	34.69	0.26	16.59
												Perm, Type 1	3.12	5	0.040	24.10	8.30	5.22	34.69	0.26	16.59
												Perm, Type 2	3.12	5	0.040	24.10	8.30	5.22	34.69	0.26	16.59
												Perm, Type 3	3.12	5	0.040	24.10	8.30	5.22	34.69	0.26	16.59
													3.12	5	0.060	24.13	6.44		34.67	0.34	17.02

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio **Designer :** DL

Description : Ditch analysis calculations for sections 363+00 TO 353+88 Left

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
363+00	356+50	L	650.00	10.00	3.00	2.00	0.0187	7.26	7.26	0.47	3.41	Seed	4.16	5	0.030	13.11	3.36	0.45	14.18	0.39	11.93
												Jute Mat	4.08	5	0.040	13.75	2.77	0.53	13.91	0.45	12.25
												Temp. Mat	4.08	5	0.040	13.75	2.77	0.53	13.91	0.45	12.25
												Temp. Mat	4.81	10	0.040	13.54	2.94	0.58	16.40	0.50	12.48
354+50	354+00	L	50.00	15.00	3.50	3.00	0.2900*	1.14	8.39	0.42	3.89	Seed	4.07	5	0.030	13.86	7.14	2.59	15.81	0.14	15.93
												Jute Mat	4.06	5	0.040	13.88	5.98	3.07	15.80	0.17	16.10
												Temp. Mat	4.06	5	0.040	13.88	5.98	3.07	15.80	0.17	16.10
												Perm, Type 1	4.06	5	0.040	13.88	5.98	3.07	15.80	0.17	16.10
												Perm, Type 2	4.06	5	0.040	13.88	5.98	3.07	15.80	0.17	16.10
												Perm, Type 3	4.06	5	0.040	13.88	5.98	3.07	15.80	0.17	16.10
												Perm, Type 3	4.79	10	0.040	13.67	6.37	3.39	18.62	0.19	16.22
354+00	353+88	L	12.00	15.00	4.00	3.00	0.0417	0.04	8.44	0.51	3.91	Seed	4.06	5	0.030	13.94	3.91	0.66	15.86	0.26	16.79
												Jute Mat	4.06	5	0.040	13.95	3.26	0.79	15.85	0.30	17.12

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
											Temp. Mat	4.06	5	0.040	13.95	3.26	0.79	15.85	0.30	17.12
											Temp. Mat	4.78	10	0.040	13.73	3.47	0.87	18.69	0.33	17.33

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections SR823, 363+00 TO SR823, 364+63 Left **Designer :** DL

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
363+00	364+00	L	100.00	11.70	3.50	3.00	0.1470*	0.40	0.40	0.40	0.16	Seed	4.46	5	0.030	10.86	1.90	0.30	0.72	0.03	11.91
												Seed	5.22	10	0.040	10.97	1.71	0.38	0.84	0.04	11.97
364+00	364+50	L	50.00	15.00	3.00	3.00	0.2140*	0.99	1.39	0.40	0.56	Seed	4.43	5	0.030	11.13	3.15	0.69	2.47	0.05	15.31
												Jute Mat	4.42	5	0.040	11.18	2.65	0.82	2.46	0.06	15.37
												Temp. Mat	4.42	5	0.040	11.18	2.65	0.82	2.46	0.06	15.37
												Temp. Mat	5.17	10	0.040	11.26	2.82	0.90	2.88	0.07	15.40
364+50	364+63	L	13.00	15.00	2.00	3.00	0.0336	0.06	1.45	0.40	0.58	Seed	4.40	5	0.030	11.30	1.82	0.19	2.55	0.09	15.46
												Seed	5.15	10	0.040	11.39	1.63	0.25	2.98	0.12	15.60

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DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections TR234 C, 373+00 TO TR234 C, 377+07 Left **Designer :** DL

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
373+00	374+00	L	100.00	10.00	4.50	2.50	0.0430	2.59	2.59	0.41	1.06	Seed	4.10	5	0.030	13.60	2.78	0.40	4.35	0.15	11.04
												Seed	4.79	10	0.040	13.67	2.46	0.52	5.08	0.19	11.35
374+00	375+50	L	150.00	10.00	4.00	3.00	0.0200	2.51	5.10	0.42	2.12	Seed	3.99	5	0.030	14.48	2.79	0.34	8.45	0.28	11.93
												Seed	4.65	10	0.040	14.68	2.45	0.45	9.84	0.36	12.50
375+50	376+50	L	100.00	10.00	4.00	3.00	0.0900	0.60	5.70	0.44	2.38	Seed	3.95	5	0.030	14.84	4.68	1.06	9.40	0.19	11.32
												Jute Mat	3.94	5	0.040	14.91	3.90	1.25	9.39	0.22	11.56
												Temp. Mat	3.94	5	0.040	14.91	3.90	1.25	9.39	0.22	11.56
												Perm, Type 1	3.94	5	0.040	14.91	3.90	1.25	9.39	0.22	11.56
												Perm, Type 1	4.59	10	0.040	15.08	4.12	1.37	10.93	0.24	11.71
376+50	377+00	L	50.00	15.00	3.00	2.00	0.2560*	0.53	6.23	0.42	2.60	Seed	3.93	5	0.030	15.05	5.83	1.83	10.22	0.11	15.57
												Jute Mat	3.92	5	0.040	15.08	4.89	2.17	10.21	0.14	15.68
												Temp. Mat	3.92	5	0.040	15.08	4.89	2.17	10.21	0.14	15.68
												Perm, Type 1	3.92	5	0.040	15.08	4.89	2.17	10.21	0.14	15.68

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Perm, Type 2	3.92	5	0.040	15.08	4.89	2.17	10.21	0.14	15.68
												Perm, Type 2	4.57	10	0.040	15.24	5.19	2.38	11.89	0.15	15.75
377+00	377+07	L	7.41	15.00	4.00	2.00	0.3212*	0.12	6.35	0.42	2.65	Seed	3.92	5	0.030	15.10	6.28	2.17	10.40	0.11	15.65
												Jute Mat	3.92	5	0.040	15.10	5.26	2.58	10.40	0.13	15.77
												Temp. Mat	3.92	5	0.040	15.10	5.26	2.58	10.40	0.13	15.77
												Perm, Type 1	3.92	5	0.040	15.10	5.26	2.58	10.40	0.13	15.77
												Perm, Type 2	3.92	5	0.040	15.10	5.26	2.58	10.40	0.13	15.77
												Perm, Type 2	4.57	10	0.040	15.27	5.58	2.82	12.12	0.14	15.84

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections TR234 C, 373+00 TO SR823, 364+63 Left **Designer :** DL

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
373+00	366+50	L	700.00	10.00	3.00	2.00	0.1470*	3.13	3.13	0.40	1.25	Seed	4.23	5	0.030	12.55	4.42	1.07	5.29	0.12	10.58
												Jute Mat	4.17	5	0.040	13.05	3.69	1.25	5.21	0.14	10.68
												Temp. Mat	4.17	5	0.040	13.05	3.69	1.25	5.21	0.14	10.68
												Perm, Type 1	4.17	5	0.040	13.05	3.69	1.25	5.21	0.14	10.68
												Perm, Type 1	4.91	10	0.040	12.87	3.92	1.38	6.14	0.15	10.75
366+50	366+00	L	50.00	10.00	3.00	2.00	0.0800	0.16	3.28	0.40	1.31	Seed	4.14	5	0.030	13.27	3.71	0.71	5.44	0.14	10.71
												Jute Mat	4.13	5	0.040	13.32	3.10	0.84	5.43	0.17	10.84
												Temp. Mat	4.13	5	0.040	13.32	3.10	0.84	5.43	0.17	10.84
												Temp. Mat	4.87	10	0.040	13.12	3.30	0.93	6.40	0.19	10.93
366+00	365+50	L	50.00	10.00	4.00	3.00	0.1600*	0.19	3.47	0.40	1.39	Seed	4.11	5	0.030	13.50	4.64	1.18	5.71	0.12	10.83
												Jute Mat	4.11	5	0.040	13.53	3.88	1.40	5.71	0.14	10.98
												Temp. Mat	4.11	5	0.040	13.53	3.88	1.40	5.71	0.14	10.98
												Perm, Type 1	4.11	5	0.040	13.53	3.88	1.40	5.71	0.14	10.98

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DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Perm, Type 1	4.84	10	0.040	13.32	4.13	1.54	6.73	0.15	11.08
365+50	365+00	L	50.00	12.50	3.00	3.00	0.3000*	0.66	4.14	0.40	1.66	Seed	4.09	5	0.030	13.68	5.56	1.78	6.77	0.10	13.07
												Jute Mat	4.08	5	0.040	13.71	4.66	2.11	6.76	0.11	13.18
												Temp. Mat	4.08	5	0.040	13.71	4.66	2.11	6.76	0.11	13.18
												Perm, Type 1	4.08	5	0.040	13.71	4.66	2.11	6.76	0.11	13.18
												Perm, Type 2	4.08	5	0.040	13.71	4.66	2.11	6.76	0.11	13.18
												Perm, Type 2	4.82	10	0.040	13.49	4.97	2.33	7.97	0.12	13.25
365+00	364+63	L	37.00	12.50	4.00	2.00	0.0250	0.10	4.24	0.40	1.69	Seed	4.06	5	0.030	13.95	2.60	0.31	6.87	0.20	13.71
												Seed	4.78	10	0.040	13.76	2.31	0.41	8.09	0.26	14.08

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DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 393+50 TO 385+50 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
393+50	391+50	L	200.00	10.00	6.00	4.00	0.0063	0.59	0.59	0.57	0.34	Seed	4.14	5	0.030	13.27	0.98	0.05	1.39	0.13	11.33
												Seed	4.79	10	0.040	13.69	0.86	0.07	1.61	0.17	11.72
391+50	391+00	L	50.00	10.00	6.00	4.00	0.0450	0.14	0.73	0.54	0.41	Seed	4.08	5	0.030	13.70	1.95	0.23	1.67	0.08	10.83
												Seed	4.72	10	0.040	14.18	1.72	0.30	1.93	0.11	11.07
391+00	389+00	L	200.00	10.00	6.00	4.00	0.0072	0.63	1.35	0.52	0.74	Seed	3.81	5	0.030	16.15	1.32	0.09	2.80	0.19	11.93
												Seed	4.35	10	0.040	16.98	1.16	0.11	3.20	0.25	12.46
389+00	388+50	L	50.00	10.00	6.00	4.00	0.0750	0.18	1.53	0.51	0.83	Seed	3.78	5	0.030	16.44	2.88	0.48	3.12	0.10	11.03
												Jute Mat	3.77	5	0.040	16.50	2.41	0.57	3.11	0.12	11.22
												Temp. Mat	3.77	5	0.040	16.50	2.41	0.57	3.11	0.12	11.22
												Temp. Mat	4.32	10	0.040	17.31	2.53	0.62	3.56	0.13	11.32
388+50	386+50	L	200.00	10.00	4.00	4.00	0.0220	0.80	2.33	0.50	1.23	Seed	3.63	5	0.030	17.95	2.26	0.25	4.44	0.18	11.47
												Seed	4.13	10	0.040	18.96	1.98	0.32	5.06	0.23	11.87
386+50	386+00	L	50.00	10.00	4.00	4.00	0.0560	0.23	2.56	0.48	1.34	Seed	3.60	5	0.030	18.21	3.12	0.51	4.81	0.15	11.17

623

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Jute Mat	3.59	5	0.040	18.27	2.60	0.60	4.80	0.17	11.38
												Temp. Mat	3.59	5	0.040	18.27	2.60	0.60	4.80	0.17	11.38
												Temp. Mat	4.10	10	0.040	19.27	2.74	0.65	5.48	0.19	11.49
386+00	385+50	L	50.00	10.00	3.00	4.00	0.1400*	0.21	2.77	0.49	1.44	Seed	3.58	5	0.030	18.46	4.28	1.01	5.14	0.12	10.81
												Jute Mat	3.57	5	0.040	18.50	3.58	1.20	5.14	0.14	10.96
												Temp. Mat	3.57	5	0.040	18.50	3.58	1.20	5.14	0.14	10.96
												Perm, Type 1	3.57	5	0.040	18.50	3.58	1.20	5.14	0.14	10.96
												Perm, Type 1	4.08	10	0.040	19.49	3.76	1.29	5.86	0.15	11.04
385+50	387+10	L	160.00	10.00	2.00	2.00	0.0075	0.34	3.10	0.43	1.58	Seed	3.44	5	0.030	19.97	1.79	0.13	5.45	0.29	11.15
												Seed	3.91	10	0.040	21.17	1.57	0.17	6.19	0.37	11.47

DITCH ANALYSIS

PID : 823-6.81 **Date :** 11/22/2006 **Project :** Portsmouth Bypass **Location :** Phase 1

Designer : MHT

Description : Ditch analysis calculations for sections 409+00 to 403+50 left

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
409+00	408+50	L	50.00	10.00	4.00	3.00	0.0200	0.27	0.27	0.50	0.13	Seed	4.47	5	0.030	10.80	1.02	0.07	0.60	0.06	10.40
												Seed	5.23	10	0.040	10.91	0.91	0.09	0.70	0.07	10.52
408+50	408+00	L	50.00	10.00	4.00	3.00	0.0600	0.30	0.57	0.49	0.28	Seed	4.41	5	0.030	11.23	1.89	0.24	1.23	0.06	10.45
												Seed	5.14	10	0.040	11.40	1.70	0.31	1.44	0.08	10.58
408+00	407+50	L	50.00	10.00	4.00	3.00	0.1200*	0.27	0.83	0.50	0.41	Seed	4.37	5	0.030	11.54	2.72	0.49	1.80	0.06	10.45
												Jute Mat	4.36	5	0.040	11.60	2.28	0.58	1.80	0.08	10.54
												Temp. Mat	4.36	5	0.040	11.60	2.28	0.58	1.80	0.08	10.54
												Temp. Mat	5.09	10	0.040	11.74	2.42	0.63	2.10	0.08	10.59
407+50	407+00	L	50.00	10.00	4.00	3.00	0.0400	0.53	1.36	0.45	0.65	Seed	4.31	5	0.030	11.96	2.31	0.29	2.81	0.12	10.82
												Seed	5.02	10	0.040	12.14	2.04	0.38	3.27	0.15	11.06
407+00	406+50	L	50.00	10.00	4.00	3.00	0.1000*	0.50	1.87	0.46	0.88	Seed	4.28	5	0.030	12.20	3.42	0.66	3.78	0.11	10.74
												Jute Mat	4.27	5	0.040	12.25	2.87	0.79	3.77	0.13	10.88
												Temp. Mat	4.27	5	0.040	12.25	2.87	0.79	3.77	0.13	10.88

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Temp. Mat	4.98	10	0.040	12.42	3.04	0.86	4.40	0.14	10.97
406+50	406+00	L	50.00	10.00	4.00	3.00	0.0600	0.90	2.77	0.43	1.27	Seed	4.24	5	0.030	12.49	3.35	0.57	5.38	0.15	11.07
												Jute Mat	4.23	5	0.040	12.54	2.79	0.68	5.38	0.18	11.27
												Temp. Mat	4.23	5	0.040	12.54	2.79	0.68	5.38	0.18	11.27
												Temp. Mat	4.93	10	0.040	12.70	2.96	0.74	6.27	0.20	11.39
406+00	405+50	L	50.00	10.00	4.00	3.00	0.0200	0.89	3.65	0.43	1.65	Seed	4.19	5	0.030	12.86	2.60	0.31	6.92	0.25	11.72
												Seed	4.88	10	0.040	13.06	2.28	0.40	8.06	0.32	12.22
405+50	405+00	L	50.00	10.00	4.00	3.00	0.0600	0.69	4.35	0.44	1.96	Seed	4.16	5	0.030	13.08	3.90	0.73	8.14	0.20	11.37
												Jute Mat	4.16	5	0.040	13.12	3.25	0.87	8.13	0.23	11.62
												Temp. Mat	4.16	5	0.040	13.12	3.25	0.87	8.13	0.23	11.62
												Temp. Mat	4.84	10	0.040	13.30	3.44	0.95	9.48	0.25	11.77
405+00	404+50	L	50.00	10.00	4.00	3.00	0.1400 *	0.80	5.14	0.44	2.31	Seed	4.14	5	0.030	13.27	5.40	1.46	9.54	0.17	11.17
												Jute Mat	4.13	5	0.040	13.30	4.51	1.73	9.53	0.20	11.38
												Temp. Mat	4.13	5	0.040	13.30	4.51	1.73	9.53	0.20	11.38
												Perm, Type 1	4.13	5	0.040	13.30	4.51	1.73	9.53	0.20	11.38
												Perm, Type 1	4.82	10	0.040	13.48	4.77	1.89	11.11	0.22	11.52
404+50	404+00	L	50.00	15.00	4.00	4.00	0.0200	0.77	5.92	0.44	2.65	Seed	4.10	5	0.030	13.61	2.68	0.32	10.84	0.25	17.02
												Seed	4.77	10	0.040	13.83	2.36	0.41	12.62	0.33	17.62
404+00	403+50	L	50.00	15.00	4.00	4.00	0.0066	0.74	6.66	0.40	2.95	Seed	4.04	5	0.030	14.04	1.95	0.15	11.91	0.37	17.96
												Seed	4.70	10	0.040	14.31	1.71	0.20	13.84	0.48	18.82

2h2

DITCH ANALYSIS

PID : 823-6.81 **Date :** 11/28/2006 **Project :** Portsmouth Bypass **Location :** Phase 1

Description : Ditch analysis calculations for sections 409+00 to 412+50 left **Designer :** MHT

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
409+00	412+50	L	350.00	10.00	4.00	3.00	0.0229	3.72	3.72	0.44	1.64	Seed	4.29	5	0.030	12.09	2.73	0.34	7.02	0.24	11.66
												Seed	4.99	10	0.040	12.37	2.39	0.44	8.15	0.31	12.15

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DITCH ANALYSIS

PID : 823-6.81 **Date :** 11/28/2006 **Project :** Portsmouth Bypass **Location :** Phase 1

Description : Ditch analysis calculations for sections 425+00 to 416+00 right **Designer :** MHT

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
425+00	423+50	L	150.00	10.00	3.00	3.00	0.0040	0.21	0.21	0.40	0.09	Seed	3.96	5	0.030	14.72	0.51	0.02	0.34	0.07	10.39
												Seed	4.57	10	0.040	15.24	0.44	0.02	0.39	0.09	10.52
423+50	417+00	L	650.00	10.00	3.00	0.50	0.0138	1.43	1.64	0.40	0.66	Seed	3.33	5	0.030	21.34	1.53	0.12	2.19	0.14	10.49
												Seed	3.77	10	0.040	22.73	1.34	0.15	2.48	0.18	10.63
417+00	416+00	L	100.00	10.00	3.00	3.00	0.0150	0.13	1.77	0.40	0.71	Seed	3.25	5	0.030	22.38	1.58	0.13	2.30	0.14	10.84
												Seed	3.66	10	0.040	23.92	1.39	0.17	2.60	0.18	11.07

hh2

DITCH ANALYSIS

PID : 823-6.81 **Date :** 11/28/2006 **Project :** Portsmouth Bypass **Location :** Phase 1

Description : Ditch analysis calculations for sections 425+00 to 441+50 right **Designer :** MHT

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00	
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00	
	RCP	**Type B:**	6.00				

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
425+00	429+50	L	450.00	10.00	3.00	2.00	0.0127	1.44	1.44	0.40	0.57	Seed	3.97	5	0.030	14.70	1.51	0.12	2.28	0.15	10.73
												Seed	4.56	10	0.040	15.30	1.33	0.15	2.62	0.19	10.94
429+50	433+00	L	350.00	10.00	3.00	2.00	0.0251	5.46	6.89	0.40	2.76	Seed	3.78	5	0.030	16.44	3.30	0.46	10.41	0.29	11.47
												Jute Mat	3.74	5	0.040	16.79	2.74	0.54	10.31	0.35	11.73
												Temp. Mat	3.74	5	0.040	16.79	2.74	0.54	10.31	0.35	11.73
												Temp. Mat	4.32	10	0.040	17.29	2.88	0.59	11.91	0.38	11.89
433+00	437+00	L	400.00	10.00	4.00	2.00	0.0388	4.43	11.32	0.45	4.75	Seed	3.60	5	0.030	18.25	4.49	0.84	17.09	0.34	12.07
												Jute Mat	3.57	5	0.040	18.55	3.72	0.98	16.95	0.41	12.44
												Temp. Mat	3.57	5	0.040	18.55	3.72	0.98	16.95	0.41	12.44
												Temp. Mat	4.13	10	0.040	18.96	3.91	1.07	19.63	0.44	12.66
437+00	439+00	L	200.00	10.00	4.00	2.00	0.0410	0.86	12.19	0.60	5.27	Seed	3.50	5	0.030	19.26	4.70	0.91	18.46	0.36	12.13
												Jute Mat	3.49	5	0.040	19.40	3.90	1.07	18.39	0.42	12.52
												Temp. Mat	3.49	5	0.040	19.40	3.90	1.07	18.39	0.42	12.52

SH2 245

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Perm, Type 1	3.49	5	0.040	19.40	3.90	1.07	18.39	0.42	12.52
												Perm, Type 1	4.05	10	0.040	19.77	4.10	1.17	21.32	0.46	12.74
439+00	440+50	L	150.00	10.00	4.00	4.00	0.1800*	0.78	12.97	0.40	5.58	Seed	3.46	5	0.030	19.73	7.54	2.63	19.32	0.23	11.87
												Jute Mat	3.46	5	0.040	19.80	6.27	3.11	19.29	0.28	12.22
												Temp. Mat	3.46	5	0.040	19.80	6.27	3.11	19.29	0.28	12.22
												Perm, Type 1	3.46	5	0.040	19.80	6.27	3.11	19.29	0.28	12.22
												Perm, Type 2	3.46	5	0.040	19.80	6.27	3.11	19.29	0.28	12.22
												Perm, Type 3	3.46	5	0.040	19.80	6.27	3.11	19.29	0.28	12.22
												Perm, Type 3	4.01	10	0.040	20.15	6.60	3.40	22.37	0.30	12.42
440+50	441+50	L	100.00	10.00	4.00	4.00	0.2100*	1.62	14.58	0.59	6.53	Seed	3.44	5	0.030	20.00	8.36	3.21	22.47	0.24	11.96
												Jute Mat	3.44	5	0.040	20.04	6.95	3.79	22.44	0.29	12.32
												Temp. Mat	3.44	5	0.040	20.04	6.95	3.79	22.44	0.29	12.32
												Perm, Type 1	3.44	5	0.040	20.04	6.95	3.79	22.44	0.29	12.32
												Perm, Type 2	3.44	5	0.040	20.04	6.95	3.79	22.44	0.29	12.32
												Perm, Type 3	3.44	5	0.040	20.04	6.95	3.79	22.44	0.29	12.32
												Perm, Type 3	3.99	10	0.040	20.37	7.32	4.14	26.04	0.32	12.53

DITCH ANALYSIS

PID : 823-6.81 **Date :** 11/28/2006 **Project :** Portsmouth Bypass **Location :** Phase 1

Description : Ditch analysis calculations for sections 427+00 to 442+00 left **Designer :** MHT

Rainfall Area : D

Allowable Shears

	Seed:	0.40	Jute Mat: 0.45	Temporary Mat:	1.00
Permanent Mat	Type 1:	2.00	Type 2: 3.00	Type 3:	5.00
RCP	Type B:	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
427+00	430+00	L	300.00	10.00	3.00	0.50	0.0113	1.47	1.47	0.40	0.59	Seed	4.15	5	0.030	13.20	1.50	0.11	2.43	0.16	10.55
												Seed	4.80	10	0.040	13.60	1.33	0.14	2.82	0.20	10.72
430+00	434+50	L	450.00	10.00	3.00	0.50	0.0293	2.86	4.33	0.47	1.93	Seed	3.87	5	0.030	15.57	3.09	0.43	7.48	0.23	10.81
												Jute Mat	3.82	5	0.040	16.03	2.57	0.50	7.38	0.27	10.96
												Temp. Mat	3.82	5	0.040	16.03	2.57	0.50	7.38	0.27	10.96
												Temp. Mat	4.44	10	0.040	16.28	2.72	0.55	8.58	0.30	11.05
434+50	438+50	L	400.00	10.00	4.00	2.00	0.1350*	6.53	10.86	0.51	5.26	Seed	3.72	5	0.030	16.97	7.02	2.18	19.59	0.26	11.55
												Jute Mat	3.70	5	0.040	17.16	5.84	2.58	19.49	0.31	11.83
												Temp. Mat	3.70	5	0.040	17.16	5.84	2.58	19.49	0.31	11.83
												Perm, Type 1	3.70	5	0.040	17.16	5.84	2.58	19.49	0.31	11.83
												Perm, Type 2	3.70	5	0.040	17.16	5.84	2.58	19.49	0.31	11.83
												Perm, Type 2	4.31	10	0.040	17.35	6.16	2.82	22.69	0.33	12.01
438+50	440+00	L	150.00	10.00	4.00	2.00	0.0533	1.10	11.96	0.45	5.76	Seed	3.66	5	0.030	17.63	5.36	1.18	21.06	0.36	12.13

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DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Jute Mat	3.65	5	0.040	17.72	4.45	1.40	21.00	0.42	12.52
												Temp. Mat	3.65	5	0.040	17.72	4.45	1.40	21.00	0.42	12.52
												Perm, Type 1	3.65	5	0.040	17.72	4.45	1.40	21.00	0.42	12.52
												Perm, Type 1	4.25	10	0.040	17.88	4.69	1.53	24.48	0.46	12.75
440+00	441+50	L	150.00	10.00	4.00	3.00	0.1533*	0.80	12.76	0.46	6.13	Seed	3.62	5	0.030	18.05	7.58	2.56	22.15	0.27	11.87
												Jute Mat	3.61	5	0.040	18.12	6.30	3.02	22.11	0.32	12.21
												Temp. Mat	3.61	5	0.040	18.12	6.30	3.02	22.11	0.32	12.21
												Perm, Type 1	3.61	5	0.040	18.12	6.30	3.02	22.11	0.32	12.21
												Perm, Type 2	3.61	5	0.040	18.12	6.30	3.02	22.11	0.32	12.21
												Perm, Type 3	3.61	5	0.040	18.12	6.30	3.02	22.11	0.32	12.21
												Perm, Type 3	4.21	10	0.040	18.26	6.65	3.31	25.78	0.35	12.42
441+50	442+00	L	50.00	15.00	4.00	4.00	0.0200	0.33	13.09	0.40	6.26	Seed	3.59	5	0.030	18.36	3.50	0.48	22.44	0.39	18.10
												Jute Mat	3.58	5	0.040	18.40	2.90	0.57	22.41	0.46	18.67
												Temp. Mat	3.58	5	0.040	18.40	2.90	0.57	22.41	0.46	18.67
												Temp. Mat	4.18	10	0.040	18.53	3.07	0.63	26.15	0.50	19.01

DITCH ANALYSIS

PID : 823-6.81 **Date :** 11/28/2006 **Project :** Portsmouth Bypass **Location :** Phase 1

Description : Ditch analysis calculations for sections 427+00 to 412+50 left **Designer :** MHT

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
427+00	422+50	L	450.00	10.00	3.00	0.50	0.0040	3.45	3.45	0.40	1.38	Seed	3.95	5	0.030	14.82	1.47	0.09	5.45	0.35	11.22
												Seed	4.54	10	0.040	15.46	1.29	0.11	6.26	0.45	11.57
422+50	420+50	L	200.00	10.00	3.00	0.50	0.0140	0.97	4.42	0.40	1.77	Seed	3.80	5	0.030	16.21	2.36	0.24	6.71	0.27	10.95
												Seed	4.35	10	0.040	17.05	2.07	0.31	7.68	0.35	11.22
420+50	415+50	L	500.00	10.00	3.00	0.50	0.0150	1.88	6.30	0.51	2.73	Seed	3.51	5	0.030	19.15	2.75	0.31	9.58	0.33	11.15
												Seed	3.98	10	0.040	20.41	2.40	0.39	10.86	0.42	11.47
415+50	414+50	L	100.00	10.00	3.00	0.50	0.0150	0.68	6.98	0.79	3.26	Seed	3.46	5	0.030	19.72	2.92	0.34	11.29	0.36	11.27
												Seed	3.92	10	0.040	21.06	2.55	0.43	12.78	0.46	11.62
414+50	414+00	L	50.00	10.00	4.00	3.00	0.1400*	0.12	7.10	0.57	3.33	Seed	3.45	5	0.030	19.86	5.79	1.63	11.49	0.19	11.30
												Jute Mat	3.45	5	0.040	19.89	4.83	1.93	11.49	0.22	11.55
												Temp. Mat	3.45	5	0.040	19.89	4.83	1.93	11.49	0.22	11.55
												Perm, Type 1	3.45	5	0.040	19.89	4.83	1.93	11.49	0.22	11.55
												Perm, Type 1	3.90	10	0.040	21.23	5.05	2.07	13.00	0.24	11.66

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DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
414+00	413+50	L	50.00	15.00	4.00	3.00	0.4040 *	0.22	7.32	0.49	3.44	Seed	3.44	5	0.030	20.01	7.06	2.75	11.82	0.11	15.76
												Jute Mat	3.44	5	0.040	20.03	5.91	3.26	11.82	0.13	15.91
												Temp. Mat	3.44	5	0.040	20.03	5.91	3.26	11.82	0.13	15.91
												Perm, Type 1	3.44	5	0.040	20.03	5.91	3.26	11.82	0.13	15.91
												Perm, Type 2	3.44	5	0.040	20.03	5.91	3.26	11.82	0.13	15.91
												Perm, Type 3	3.44	5	0.040	20.03	5.91	3.26	11.82	0.13	15.91
												Perm, Type 3	3.89	10	0.040	21.36	6.20	3.51	13.38	0.14	15.98
413+50	413+00	L	50.00	15.00	4.00	3.00	0.0960	0.20	7.52	0.50	3.54	Seed	3.42	5	0.030	20.21	4.58	1.02	12.11	0.17	16.19
												Jute Mat	3.42	5	0.040	20.25	3.83	1.21	12.10	0.20	16.41
												Temp. Mat	3.42	5	0.040	20.25	3.83	1.21	12.10	0.20	16.41
												Perm, Type 1	3.42	5	0.040	20.25	3.83	1.21	12.10	0.20	16.41
												Perm, Type 1	3.87	10	0.040	21.57	4.02	1.30	13.71	0.22	16.52
413+00	412+50	L	50.00	15.00	4.00	3.00	0.0400	0.24	7.76	0.54	3.67	Seed	3.40	5	0.030	20.49	3.53	0.56	12.47	0.22	16.57
												Jute Mat	3.39	5	0.040	20.53	2.95	0.66	12.46	0.27	16.86
												Temp. Mat	3.39	5	0.040	20.53	2.95	0.66	12.46	0.27	16.86
												Temp. Mat	3.85	10	0.040	21.84	3.09	0.71	14.12	0.29	17.00

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DITCH ANALYSIS

PID : 823-6.81 **Date :** 11/28/2006 **Project :** Portsmouth Bypass **Location :** Phase 1 **Designer :** MHT

Description : Ditch analysis calculations for sections 456+00 to 444+50 right

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
456+00	450+00	L	600.00	10.00	3.00	3.00	0.0232	1.18	1.18	0.40	0.47	Seed	3.86	5	0.030	15.64	1.65	0.15	1.82	0.11	10.64
												Seed	4.43	10	0.040	16.35	1.47	0.20	2.09	0.14	10.82
450+00	448+50	L	150.00	10.00	3.00	2.00	0.0120	0.39	1.57	0.40	0.63	Seed	3.69	5	0.030	17.29	1.49	0.11	2.31	0.15	10.75
												Seed	4.21	10	0.040	18.22	1.31	0.14	2.64	0.19	10.96
448+50	447+00	L	150.00	10.00	4.00	2.00	0.0533	1.86	3.42	0.73	1.98	Seed	3.62	5	0.030	17.98	3.61	0.63	7.17	0.19	11.13
												Jute Mat	3.61	5	0.040	18.12	3.01	0.74	7.15	0.22	11.34
												Temp. Mat	3.61	5	0.040	18.12	3.01	0.74	7.15	0.22	11.34
												Temp. Mat	4.13	10	0.040	19.01	3.16	0.80	8.17	0.24	11.45
447+00	445+50	L	150.00	10.00	4.00	3.00	0.1933*	1.39	4.81	0.59	2.80	Seed	3.57	5	0.030	18.53	6.09	1.88	10.00	0.16	11.09
												Jute Mat	3.56	5	0.040	18.61	5.07	2.23	9.98	0.18	11.29
												Temp. Mat	3.56	5	0.040	18.61	5.07	2.23	9.98	0.18	11.29
												Perm, Type 1	3.56	5	0.040	18.61	5.07	2.23	9.98	0.18	11.29
												Perm, Type 2	3.56	5	0.040	18.61	5.07	2.23	9.98	0.18	11.29

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Perm, Type 2	4.08	10	0.040	19.47	5.34	2.41	11.42	0.20	11.40
445+50	444+50	L	100.00	15.00	4.00	4.00	0.2300*	0.88	5.69	0.64	3.36	Seed	3.54	5	0.030	18.89	5.93	1.85	11.89	0.13	16.03
												Jute Mat	3.53	5	0.040	18.94	4.96	2.20	11.87	0.15	16.23
												Temp. Mat	3.53	5	0.040	18.94	4.96	2.20	11.87	0.15	16.23
												Perm, Type 1	3.53	5	0.040	18.94	4.96	2.20	11.87	0.15	16.23
												Perm, Type 2	3.53	5	0.040	18.94	4.96	2.20	11.87	0.15	16.23
												Perm, Type 2	4.04	10	0.040	19.79	5.23	2.38	13.60	0.17	16.33

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DITCH ANALYSIS

PID : 823-6.81 **Date :** 11/28/2006 **Project :** Portsmouth Bypass **Location :** Phase 1

Designer : MHT

Description : Ditch analysis calculations for sections 462+00 to 443+50 left

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
462+00	460+50	L	150.00	10.00	4.00	2.00	0.0440	0.82	0.82	0.40	0.33	Seed	4.40	5	0.030	11.33	1.85	0.21	1.45	0.08	10.46
												Seed	5.13	10	0.040	11.49	1.64	0.27	1.69	0.10	10.60
460+50	455+00	L	550.00	10.00	3.00	0.50	0.0260	5.32	6.15	0.40	2.46	Seed	4.05	5	0.030	14.01	3.31	0.46	9.95	0.29	11.00
												Jute Mat	3.98	5	0.040	14.54	2.75	0.55	9.80	0.34	11.18
												Temp. Mat	3.98	5	0.040	14.54	2.75	0.55	9.80	0.34	11.18
												Temp. Mat	4.67	10	0.040	14.53	2.92	0.60	11.48	0.37	11.29
455+00	451+50	L	350.00	10.00	3.00	0.50	0.0251	5.83	11.98	0.45	5.08	Seed	3.83	5	0.030	15.91	4.20	0.68	19.48	0.43	11.51
												Jute Mat	3.80	5	0.040	16.19	3.48	0.80	19.33	0.51	11.78
												Temp. Mat	3.80	5	0.040	16.19	3.48	0.80	19.33	0.51	11.78
												Temp. Mat	4.46	10	0.040	16.08	3.69	0.88	22.69	0.56	11.96
451+50	448+50	L	300.00	10.00	3.00	0.50	0.0123	1.97	13.95	0.40	5.87	Seed	3.66	5	0.030	17.61	3.46	0.43	21.47	0.56	11.98
												Jute Mat	3.63	5	0.040	17.90	2.86	0.51	21.31	0.67	12.33
												Temp. Mat	3.63	5	0.040	17.90	2.86	0.51	21.31	0.67	12.33

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Temp. Mat	4.27	10	0.040	17.71	3.03	0.56	25.06	0.73	12.57
448+50	447+50	L	100.00	10.00	3.00	2.00	0.0040	1.22	15.17	0.66	6.68	Seed	3.57	5	0.030	18.59	2.43	0.20	23.80	0.82	14.08
												Seed	4.18	10	0.040	18.50	2.10	0.26	27.92	1.05	15.26
447+50	444+50	L	300.00	15.00	4.00	3.00	0.0740	2.06	17.23	0.46	7.63	Seed	3.49	5	0.030	19.46	5.68	1.35	26.58	0.29	17.05
												Jute Mat	3.47	5	0.040	19.63	4.73	1.60	26.46	0.35	17.42
												Temp. Mat	3.47	5	0.040	19.63	4.73	1.60	26.46	0.35	17.42
												Perm, Type 1	3.47	5	0.040	19.63	4.73	1.60	26.46	0.35	17.42
												Perm, Type 1	4.08	10	0.040	19.49	5.01	1.75	31.08	0.38	17.66
444+50	443+50	L	100.00	15.00	4.00	4.00	0.3400*	0.89	18.12	0.56	8.12	Seed	3.45	5	0.030	19.81	9.29	4.07	28.06	0.19	16.53
												Jute Mat	3.45	5	0.040	19.85	7.76	4.82	28.04	0.23	16.82
												Temp. Mat	3.45	5	0.040	19.85	7.76	4.82	28.04	0.23	16.82
												Perm, Type 1	3.45	5	0.040	19.85	7.76	4.82	28.04	0.23	16.82
												Perm, Type 2	3.45	5	0.040	19.85	7.76	4.82	28.04	0.23	16.82
												Perm, Type 3	3.45	5	0.040	19.85	7.76	4.82	28.04	0.23	16.82
												Perm, Type 3	4.06	10	0.040	19.69	8.24	5.30	32.94	0.25	17.00

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : DL

Description : Ditch analysis calculations for sections 462+00 TO 467+50 Left

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
462+00	463+00	L	100.00	10.00	4.00	2.00	0.0300	1.12	1.12	0.43	0.48	Seed	4.46	5	0.030	10.86	1.91	0.20	2.15	0.11	10.65
												Seed	5.22	10	0.040	10.97	1.70	0.27	2.51	0.14	10.85
463+00	464+00	L	100.00	10.00	4.00	2.00	0.0700	0.89	2.01	0.44	0.87	Seed	4.39	5	0.030	11.40	3.10	0.52	3.83	0.12	10.72
												Jute Mat	4.37	5	0.040	11.50	2.59	0.62	3.82	0.14	10.85
												Temp. Mat	4.37	5	0.040	11.50	2.59	0.62	3.82	0.14	10.85
												Temp. Mat	5.12	10	0.040	11.57	2.75	0.68	4.47	0.16	10.93
464+00	464+50	L	50.00	10.00	4.00	2.00	0.1400*	0.38	2.39	0.45	1.04	Seed	4.34	5	0.030	11.70	4.09	0.94	4.53	0.11	10.64
												Jute Mat	4.34	5	0.040	11.74	3.43	1.11	4.53	0.13	10.76
												Temp. Mat	4.34	5	0.040	11.74	3.43	1.11	4.53	0.13	10.76
												Perm, Type 1	4.34	5	0.040	11.74	3.43	1.11	4.53	0.13	10.76
												Perm, Type 1	5.08	10	0.040	11.80	3.63	1.22	5.30	0.14	10.84
464+50	465+00	L	50.00	10.00	4.00	2.00	0.1800*	0.25	2.63	0.48	1.16	Seed	4.31	5	0.030	11.92	4.59	1.19	5.01	0.11	10.63
												Jute Mat	4.31	5	0.040	11.96	3.84	1.41	5.00	0.13	10.75

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DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Temp. Mat	4.31	5	0.040	11.96	3.84	1.41	5.00	0.13	10.75
												Perm, Type 1	4.31	5	0.040	11.96	3.84	1.41	5.00	0.13	10.75
												Perm, Type 1	5.05	10	0.040	12.00	4.09	1.55	5.86	0.14	10.83
465+00	466+00	L	50.00	10.00	4.00	2.00	0.3100*	0.97	3.60	0.44	1.59	Seed	4.29	5	0.030	12.09	6.11	2.09	6.81	0.11	10.65
												Jute Mat	4.29	5	0.040	12.12	5.11	2.48	6.80	0.13	10.77
												Temp. Mat	4.29	5	0.040	12.12	5.11	2.48	6.80	0.13	10.77
												Perm, Type 1	4.29	5	0.040	12.12	5.11	2.48	6.80	0.13	10.77
												Perm, Type 2	4.29	5	0.040	12.12	5.11	2.48	6.80	0.13	10.77
												Perm, Type 2	5.02	10	0.040	12.15	5.43	2.72	7.96	0.14	10.84
466+00	466+50	L	50.00	15.00	4.00	4.00	0.0500	0.48	4.08	0.44	1.80	Seed	4.25	5	0.030	12.39	3.13	0.49	7.65	0.16	16.25
												Jute Mat	4.25	5	0.040	12.44	2.61	0.58	7.63	0.19	16.48
												Temp. Mat	4.25	5	0.040	12.44	2.61	0.58	7.63	0.19	16.48
												Temp. Mat	4.97	10	0.040	12.45	2.77	0.64	8.94	0.20	16.63
466+50	467+00	L	50.00	15.00	3.00	4.00	0.0100	0.32	4.40	0.46	1.95	Seed	4.19	5	0.030	12.86	1.95	0.16	8.16	0.26	16.84
												Seed	4.90	10	0.040	12.93	1.73	0.21	9.54	0.34	17.39

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DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : DL

Description : Ditch analysis calculations for sections 465+75 TO 462+50 Right

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
465+75	462+50	R	50.00	10.00	2.00	4.00	0.0200	118.7	118.7	0.40	47.50	Seed	4.58	5	0.030	10.10	8.17	2.18	217.49	1.75	20.48
												Jute Mat	4.57	5	0.040	10.13	6.65	2.53	217.32	2.03	22.18
												Temp. Mat	4.57	5	0.040	10.13	6.65	2.53	217.32	2.03	22.18
												Perm, Type 1	4.57	5	0.040	10.13	6.65	2.53	217.32	2.03	22.18
												Perm, Type 2	4.57	5	0.040	10.13	6.65	2.53	217.32	2.03	22.18
												Perm, Type 2	5.37	10	0.040	10.12	6.96	2.75	255.06	2.21	23.23

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 470+00 to 467+00 Right **Designer :** DL

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
470+00	469+50	L	50.00	10.00	4.00	2.00	0.0100	0.50	0.50	0.44	0.22	Seed	4.47	5	0.030	10.82	1.01	0.06	0.98	0.09	10.56
												Seed	5.23	10	0.040	10.92	0.89	0.08	1.14	0.12	10.74
469+50	468+50	L	100.00	10.00	4.00	2.00	0.0800	0.67	1.16	0.46	0.53	Seed	4.38	5	0.030	11.44	2.65	0.42	2.30	0.08	10.51
												Jute Mat	4.36	5	0.040	11.56	2.22	0.50	2.29	0.10	10.60
												Temp. Mat	4.36	5	0.040	11.56	2.22	0.50	2.29	0.10	10.60
												Temp. Mat	5.11	10	0.040	11.62	2.36	0.55	2.68	0.11	10.66
468+50	467+50	L	100.00	11.70	4.00	2.70	0.2600*	0.59	1.75	0.47	0.80	Seed	4.31	5	0.030	11.96	4.19	1.12	3.45	0.07	12.16
												Jute Mat	4.30	5	0.040	12.04	3.51	1.33	3.44	0.08	12.25
												Temp. Mat	4.30	5	0.040	12.04	3.51	1.33	3.44	0.08	12.25
												Perm, Type 1	4.30	5	0.040	12.04	3.51	1.33	3.44	0.08	12.25
												Perm, Type 1	5.04	10	0.040	12.06	3.73	1.46	4.03	0.09	12.30
467+50	467+00	L	50.00	15.00	3.00	4.00	0.1200*	0.32	2.07	0.46	0.95	Seed	4.26	5	0.030	12.29	3.21	0.62	4.03	0.08	15.58
												Jute Mat	4.26	5	0.040	12.34	2.69	0.73	4.03	0.10	15.68

052

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Temp. Mat	4.26	5	0.040	12.34	2.69	0.73	4.03	0.10	15.68
												Temp. Mat	4.99	10	0.040	12.35	2.86	0.80	4.72	0.11	15.75

652

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 470+00 to 475+00 Left **Designer :** DL

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type B:**	6.00				

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
470+00	472+50	L	250.00	10.00	4.00	2.00	0.0200	2.49	2.49	0.41	1.02	Seed	4.33	5	0.030	11.84	2.22	0.24	4.42	0.19	11.13
												Seed	5.03	10	0.040	12.08	1.96	0.31	5.15	0.25	11.47
472+50	473+00	L	50.00	10.00	4.00	2.00	0.0800	0.30	2.79	0.42	1.15	Seed	4.29	5	0.030	12.07	3.56	0.67	4.93	0.13	10.80
												Jute Mat	4.29	5	0.040	12.12	2.97	0.79	4.92	0.16	10.95
												Temp. Mat	4.29	5	0.040	12.12	2.97	0.79	4.92	0.16	10.95
												Temp. Mat	4.99	10	0.040	12.34	3.15	0.86	5.73	0.17	11.04
473+00	473+50	L	50.00	10.00	4.00	2.00	0.2000*	0.41	3.20	0.41	1.31	Seed	4.27	5	0.030	12.29	4.95	1.37	5.61	0.11	10.66
												Jute Mat	4.26	5	0.040	12.32	4.15	1.62	5.60	0.13	10.78
												Temp. Mat	4.26	5	0.040	12.32	4.15	1.62	5.60	0.13	10.78
												Perm, Type 1	4.26	5	0.040	12.32	4.15	1.62	5.60	0.13	10.78
												Perm, Type 1	4.96	10	0.040	12.53	4.39	1.78	6.52	0.14	10.85
473+50	474+00	L	50.00	10.00	4.00	2.00	0.0800	0.28	3.48	0.42	1.43	Seed	4.23	5	0.030	12.53	3.85	0.75	6.06	0.15	10.90
												Jute Mat	4.23	5	0.040	12.58	3.21	0.89	6.06	0.18	11.07

282

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Temp. Mat	4.23	5	0.040	12.58	3.21	0.89	6.06	0.18	11.07
												Temp. Mat	4.92	10	0.040	12.77	3.40	0.98	7.05	0.20	11.17
474+00	475+00	L	100.00	10.00	4.00	2.00	0.0200	1.00	4.48	0.41	1.84	Seed	4.15	5	0.030	13.19	2.72	0.33	7.65	0.26	11.57
												Seed	4.82	10	0.040	13.47	2.39	0.42	8.88	0.34	12.03

92

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 478+50 to 484+00 Left **Designer :** DL

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
478+50	482+50	L	400.00	10.00	3.00	0.50	0.0300	1.89	1.89	0.43	0.81	Seed	4.20	5	0.030	12.79	2.31	0.27	3.41	0.14	10.51
												Seed	4.87	10	0.040	13.14	2.05	0.35	3.96	0.19	10.66
482+50	483+00	L	50.00	10.00	3.00	1.75	0.1200*	0.57	2.46	0.83	1.29	Seed	4.17	5	0.030	12.99	4.19	0.93	5.37	0.12	10.59
												Jute Mat	4.17	5	0.040	13.03	3.51	1.11	5.37	0.15	10.70
												Temp. Mat	4.17	5	0.040	13.03	3.51	1.11	5.37	0.15	10.70
												Perm, Type 1	4.17	5	0.040	13.03	3.51	1.11	5.37	0.15	10.70
												Perm, Type 1	4.83	10	0.040	13.36	3.71	1.21	6.22	0.16	10.77
483+00	483+50	L	50.00	10.00	3.50	2.50	0.3200*	0.36	2.82	0.42	1.44	Seed	4.15	5	0.030	13.17	5.86	1.97	5.97	0.10	10.59
												Jute Mat	4.15	5	0.040	13.20	4.92	2.34	5.96	0.12	10.70
												Temp. Mat	4.15	5	0.040	13.20	4.92	2.34	5.96	0.12	10.70
												Perm, Type 1	4.15	5	0.040	13.20	4.92	2.34	5.96	0.12	10.70
												Perm, Type 2	4.15	5	0.040	13.20	4.92	2.34	5.96	0.12	10.70
												Perm, Type 2	4.81	10	0.040	13.52	5.19	2.56	6.92	0.13	10.77

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
483+50	484+00	L	50.00	10.00	4.00	2.00	0.4000*	0.21	3.03	0.43	1.53	Seed	4.13	5	0.030	13.33	6.42	2.39	6.31	0.10	10.57
												Jute Mat	4.13	5	0.040	13.35	5.38	2.83	6.31	0.11	10.68
												Temp. Mat	4.13	5	0.040	13.35	5.38	2.83	6.31	0.11	10.68
												Perm, Type 1	4.13	5	0.040	13.35	5.38	2.83	6.31	0.11	10.68
												Perm, Type 2	4.13	5	0.040	13.35	5.38	2.83	6.31	0.11	10.68
												Perm, Type 2	4.79	10	0.040	13.67	5.69	3.10	7.32	0.12	10.74

392

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 488+50 TO 485+30 Right **Designer :** DL

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
488+50	485+30	R	50.00	10.00	4.00	4.00	0.0200	1.26	1.26	0.40	0.50	Seed	4.52	5	0.030	10.49	1.71	0.16	2.28	0.13	11.02
												Seed	5.29	10	0.040	10.55	1.51	0.21	2.66	0.17	11.32

492

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 503+50 TO 498+00 Right **Designer :** DL

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
503+50	498+00	R	50.00	10.00	3.00	0.50	0.0400	0.96	0.96	0.40	0.38	Seed	4.53	5	0.030	10.43	1.93	0.22	1.74	0.09	10.31
												Seed	5.30	10	0.040	10.48	1.73	0.29	2.04	0.12	10.40

262

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 504+00 to 486+54Left **Designer :** DL

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type B:**	6.00				

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
504+00	497+00	L	700.00	10.00	3.00	0.84	0.0400	2.73	2.73	0.50	1.36	Seed	4.09	5	0.030	13.67	3.04	0.44	5.58	0.18	10.68
												Jute Mat	4.00	5	0.040	14.39	2.52	0.52	5.46	0.21	10.80
												Temp. Mat	4.00	5	0.040	14.39	2.52	0.52	5.46	0.21	10.80
												Temp. Mat	4.72	10	0.040	14.13	2.69	0.57	6.45	0.23	10.88
497+00	496+50	L	50.00	10.00	4.00	3.50	0.1900*	0.45	3.18	0.44	1.56	Seed	3.98	5	0.030	14.55	5.04	1.40	6.22	0.12	10.89
												Jute Mat	3.98	5	0.040	14.58	4.22	1.66	6.21	0.14	11.05
												Temp. Mat	3.98	5	0.040	14.58	4.22	1.66	6.21	0.14	11.05
												Perm, Type 1	3.98	5	0.040	14.58	4.22	1.66	6.21	0.14	11.05
												Perm, Type 1	4.70	10	0.040	14.31	4.49	1.83	7.34	0.15	11.16
496+50	496+00	L	50.00	10.00	4.00	3.50	0.2400*	0.77	3.94	0.43	1.89	Seed	3.96	5	0.030	14.73	5.82	1.84	7.50	0.12	10.92
												Jute Mat	3.96	5	0.040	14.75	4.86	2.19	7.49	0.15	11.10
												Temp. Mat	3.96	5	0.040	14.75	4.86	2.19	7.49	0.15	11.10
												Perm, Type 1	3.96	5	0.040	14.75	4.86	2.19	7.49	0.15	11.10

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DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Perm, Type 2	3.96	5	0.040	14.75	4.86	2.19	7.49	0.15	11.10
												Perm, Type 2	4.68	10	0.040	14.47	5.18	2.41	8.84	0.16	11.21
496+00	495+50	L	50.00	10.00	4.00	3.00	0.1600 *	0.67	4.61	0.43	2.18	Seed	3.94	5	0.030	14.91	5.42	1.50	8.59	0.15	11.06
												Jute Mat	3.94	5	0.040	14.94	4.53	1.78	8.59	0.18	11.25
												Temp. Mat	3.94	5	0.040	14.94	4.53	1.78	8.59	0.18	11.25
												Perm, Type 1	3.94	5	0.040	14.94	4.53	1.78	8.59	0.18	11.25
												Perm, Type 1	4.65	10	0.040	14.65	4.81	1.97	10.14	0.20	11.38
495+50	493+50	L	200.00	10.00	4.00	3.00	0.1400 *	2.21	6.83	0.44	3.15	Seed	3.88	5	0.030	15.50	5.93	1.69	12.23	0.19	11.35
												Jute Mat	3.86	5	0.040	15.61	4.94	2.00	12.19	0.23	11.60
												Temp. Mat	3.86	5	0.040	15.61	4.94	2.00	12.19	0.23	11.60
												Perm, Type 1	3.86	5	0.040	15.61	4.94	2.00	12.19	0.23	11.60
												Perm, Type 1	4.57	10	0.040	15.28	5.25	2.20	14.40	0.25	11.77
493+50	486+54	L	696.00	10.00	4.00	4.00	0.0100	7.77	14.60	0.41	6.34	Seed	3.50	5	0.030	19.27	3.07	0.37	22.21	0.59	14.69
												Seed	4.07	10	0.040	19.50	2.65	0.47	25.83	0.75	16.00

L92

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 504+00 to 505+00 Left **Designer :** DL

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
504+00	504+50	L	50.00	15.00	2.50	3.00	0.2800*	0.44	0.44	0.45	0.20	Seed	4.54	5	0.030	10.36	2.29	0.45	0.89	0.03	15.14
												Jute Mat	4.53	5	0.040	10.43	1.91	0.54	0.89	0.03	15.17
												Temp. Mat	4.53	5	0.040	10.43	1.91	0.54	0.89	0.03	15.17
												Temp. Mat	5.32	10	0.040	10.41	2.04	0.59	1.04	0.03	15.19
504+50	505+00	L	50.00	15.00	3.50	3.50	0.0800	0.52	0.96	0.44	0.42	Seed	4.47	5	0.030	10.82	2.11	0.29	1.90	0.06	15.41
												Seed	5.24	10	0.040	10.85	1.89	0.39	2.22	0.08	15.54

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 517+50 TO 505+00 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
517+50	514+50	L	300.00	10.00	3.00	0.50	0.0137	1.32	1.32	0.40	0.53	Seed	4.15	5	0.030	13.15	1.53	0.12	2.19	0.14	10.49
												Seed	4.81	10	0.040	13.54	1.35	0.16	2.54	0.18	10.64
514+50	512+00	L	250.00	10.00	3.00	0.50	0.0240	1.67	2.99	0.64	1.59	Seed	3.97	5	0.030	14.65	2.73	0.33	6.33	0.22	10.78
												Seed	4.57	10	0.040	15.24	2.40	0.43	7.29	0.29	11.01
512+00	509+50	L	250.00	10.00	3.00	0.50	0.0340	0.85	3.84	0.40	1.94	Seed	3.83	5	0.030	15.93	3.23	0.47	7.42	0.22	10.77
												Jute Mat	3.80	5	0.040	16.18	2.69	0.56	7.36	0.26	10.92
												Temp. Mat	3.80	5	0.040	16.18	2.69	0.56	7.36	0.26	10.92
												Temp. Mat	4.39	10	0.040	16.68	2.84	0.61	8.50	0.29	11.00
509+50	507+00	L	250.00	10.00	3.00	0.50	0.0408	2.26	6.10	0.72	3.56	Seed	3.70	5	0.030	17.15	4.24	0.75	13.19	0.30	11.04
												Jute Mat	3.68	5	0.040	17.34	3.53	0.89	13.12	0.35	11.22
												Temp. Mat	3.68	5	0.040	17.34	3.53	0.89	13.12	0.35	11.22
												Temp. Mat	4.26	10	0.040	17.79	3.73	0.97	15.17	0.38	11.34
507+00	506+50	L	50.00	10.00	3.00	2.00	0.1200*	0.45	6.54	0.45	3.76	Seed	3.67	5	0.030	17.48	5.99	1.64	13.81	0.22	11.09

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DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Jute Mat	3.67	5	0.040	17.51	5.00	1.94	13.80	0.26	11.30
												Temp. Mat	3.67	5	0.040	17.51	5.00	1.94	13.80	0.26	11.30
												Perm, Type 1	3.67	5	0.040	17.51	5.00	1.94	13.80	0.26	11.30
												Perm, Type 1	4.24	10	0.040	17.94	5.27	2.12	15.96	0.28	11.41
506+50	505+00	L	150.00	15.00	3.00	2.00	0.1800*	0.87	7.41	0.47	4.17	Seed	3.63	5	0.030	17.92	6.10	1.81	15.13	0.16	15.81
												Jute Mat	3.62	5	0.040	18.00	5.11	2.15	15.10	0.19	15.96
												Temp. Mat	3.62	5	0.040	18.00	5.11	2.15	15.10	0.19	15.96
												Perm, Type 1	3.62	5	0.040	18.00	5.11	2.15	15.10	0.19	15.96
												Perm, Type 2	3.62	5	0.040	18.00	5.11	2.15	15.10	0.19	15.96
												Perm, Type 2	4.19	10	0.040	18.40	5.40	2.34	17.48	0.21	16.04

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 519+50 TO 504+00 Right **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
519+50	516+00	R	350.00	10.00	3.00	0.50	0.0071	0.85	0.85	0.40	0.34	Seed	3.90	5	0.030	15.31	1.03	0.06	1.32	0.13	10.44
												Seed	4.48	10	0.040	15.98	0.91	0.07	1.52	0.16	10.57
516+00	513+00	R	300.00	10.00	3.00	0.50	0.0180	0.70	1.55	0.40	0.62	Seed	3.60	5	0.030	18.21	1.67	0.15	2.23	0.13	10.46
												Seed	4.10	10	0.040	19.26	1.47	0.19	2.54	0.17	10.59
513+00	510+00	R	300.00	10.00	3.00	0.50	0.0313	0.77	2.32	0.40	0.93	Seed	3.41	5	0.030	20.36	2.27	0.27	3.16	0.14	10.48
												Seed	3.86	10	0.040	21.71	2.00	0.34	3.58	0.17	10.61
510+00	507+50	R	250.00	10.00	3.00	0.50	0.0420	0.49	2.81	0.40	1.12	Seed	3.28	5	0.030	21.92	2.63	0.36	3.69	0.14	10.48
												Seed	3.70	10	0.040	23.49	2.31	0.46	4.16	0.17	10.61
507+50	505+00	R	250.00	10.00	3.00	3.00	0.1668*	0.93	3.75	0.40	1.50	Seed	3.21	5	0.030	22.86	4.42	1.10	4.81	0.11	10.63
												Jute Mat	3.20	5	0.040	23.04	3.70	1.30	4.79	0.12	10.75
												Temp. Mat	3.20	5	0.040	23.04	3.70	1.30	4.79	0.12	10.75
												Perm, Type 1	3.20	5	0.040	23.04	3.70	1.30	4.79	0.12	10.75
												Perm, Type 1	3.61	10	0.040	24.55	3.87	1.40	5.41	0.13	10.81

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DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
505+00	504+00	R	100.00	15.00	3.00	3.00	0.1000*	0.29	4.03	0.40	1.61	Seed	3.16	5	0.030	23.54	3.33	0.62	5.09	0.10	15.60
												Jute Mat	3.15	5	0.040	23.63	2.79	0.74	5.08	0.12	15.71
												Temp. Mat	3.15	5	0.040	23.63	2.79	0.74	5.08	0.12	15.71
												Temp. Mat	3.57	10	0.040	25.12	2.92	0.80	5.75	0.13	15.77

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DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 519+50 TO 528+00 Right **Designer :** mdc

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type B:**	6.00				

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
519+50	521+00	R	150.00	3.00	8.00	8.00	0.0053	0.39	0.39	0.65	0.25	Seed	4.26	5	0.030	12.32	1.05	0.07	1.08	0.22	6.48
												Seed	4.93	10	0.040	12.72	0.89	0.09	1.25	0.27	7.34
521+00	521+50	R	50.00	7.00	8.00	8.00	0.0220	0.11	0.50	0.58	0.32	Seed	4.19	5	0.030	12.85	1.55	0.15	1.33	0.11	8.74
												Seed	4.84	10	0.040	13.33	1.36	0.19	1.54	0.14	9.23
521+50	524+00	R	250.00	10.00	8.00	4.00	0.0124	0.61	1.11	0.56	0.66	Seed	3.87	5	0.030	15.55	1.50	0.12	2.54	0.16	11.86
												Seed	4.42	10	0.040	16.41	1.31	0.15	2.91	0.20	12.38
524+00	526+00	R	200.00	10.00	8.00	4.00	0.0215	0.57	1.68	0.54	0.96	Seed	3.70	5	0.030	17.17	2.03	0.22	3.57	0.16	11.93
												Seed	4.21	10	0.040	18.26	1.76	0.27	4.06	0.20	12.46
526+00	528+00	R	200.00	10.00	6.00	4.00	0.0440	0.48	2.16	0.55	1.23	Seed	3.59	5	0.030	18.35	2.77	0.41	4.41	0.15	11.48
												Jute Mat	3.56	5	0.040	18.59	2.31	0.48	4.38	0.17	11.75
												Temp. Mat	3.56	5	0.040	18.59	2.31	0.48	4.38	0.17	11.75
												Temp. Mat	4.06	10	0.040	19.62	2.42	0.52	5.00	0.19	11.89

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DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 521+50 TO 530+00 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
521+50	524+00	L	250.00	10.00	8.00	4.00	0.0124	0.57	0.57	0.57	0.33	Seed	4.13	5	0.030	13.37	1.19	0.08	1.35	0.11	11.27
												Seed	4.77	10	0.040	13.81	1.05	0.11	1.56	0.14	11.64
524+00	526+00	L	200.00	10.00	8.00	4.00	0.0285	0.58	1.15	0.54	0.64	Seed	3.93	5	0.030	15.05	1.94	0.21	2.51	0.12	11.44
												Seed	4.51	10	0.040	15.73	1.71	0.27	2.88	0.15	11.85
526+00	527+00	L	100.00	10.00	6.00	6.00	0.0933	0.25	1.40	0.55	0.78	Seed	3.87	5	0.030	15.60	3.02	0.55	3.01	0.09	11.13
												Jute Mat	3.85	5	0.040	15.70	2.52	0.65	3.00	0.11	11.34
												Temp. Mat	3.85	5	0.040	15.70	2.52	0.65	3.00	0.11	11.34
												Temp. Mat	4.43	10	0.040	16.35	2.65	0.71	3.45	0.12	11.45
527+00	530+00	L	300.00	10.00	6.00	6.00	0.0092	2.71	4.12	0.52	2.19	Seed	3.61	5	0.030	18.11	2.03	0.19	7.90	0.33	13.91
												Seed	4.11	10	0.040	19.14	1.75	0.24	9.00	0.41	14.95

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 526+50 TO 535+50 Right **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
526+50	527+50	R	100.00	10.00	3.00	2.00	0.0070	0.16	0.16	0.58	0.09	Seed	4.24	5	0.030	12.51	0.64	0.03	0.40	0.06	10.31
												Seed	4.92	10	0.040	12.82	0.57	0.04	0.47	0.08	10.40
527+50	528+00	R	50.00	10.00	3.00	2.00	0.0560	0.09	0.25	0.57	0.14	Seed	4.16	5	0.030	13.09	1.42	0.15	0.60	0.04	10.21
												Seed	4.82	10	0.040	13.48	1.25	0.19	0.69	0.05	10.27
528+00	529+50	R	150.00	10.00	3.00	2.00	0.0040	3.07	3.32	0.59	1.95	Seed	3.88	5	0.030	15.50	1.64	0.10	7.58	0.42	12.09
												Seed	4.51	10	0.040	15.71	1.43	0.14	8.82	0.54	12.71
529+50	530+50	R	100.00	10.00	6.00	3.00	0.0100	0.28	3.60	0.65	2.14	Seed	3.79	5	0.030	16.27	2.16	0.20	8.11	0.33	12.94
												Seed	4.40	10	0.040	16.59	1.88	0.26	9.41	0.42	13.79
530+50	534+50	R	400.00	10.00	4.00	4.00	0.0685	1.60	5.20	0.56	3.04	Seed	3.65	5	0.030	17.72	4.53	0.96	11.07	0.22	11.80
												Jute Mat	3.62	5	0.040	18.01	3.76	1.13	10.99	0.26	12.12
												Temp. Mat	3.62	5	0.040	18.01	3.76	1.13	10.99	0.26	12.12
												Perm, Type 1	3.62	5	0.040	18.01	3.76	1.13	10.99	0.26	12.12
												Perm, Type 1	4.21	10	0.040	18.25	3.96	1.24	12.78	0.29	12.31

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
534+50	535+50	R	100.00	15.00	2.00	2.00	0.1510*	0.52	5.73	0.52	3.31	Seed	3.59	5	0.030	18.33	5.28	1.39	11.88	0.15	15.59
												Jute Mat	3.58	5	0.040	18.39	4.43	1.64	11.86	0.17	15.70
												Temp. Mat	3.58	5	0.040	18.39	4.43	1.64	11.86	0.17	15.70
												Perm, Type 1	3.58	5	0.040	18.39	4.43	1.64	11.86	0.17	15.70
												Perm, Type 1	4.17	10	0.040	18.60	4.70	1.80	13.80	0.19	15.76

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 535+50 TO 538+50 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
535+50	538+50	L	300.00	10.00	2.00	2.00	0.0040	195.4	195.4	0.45	87.93	Seed	2.37	5	0.030	38.03	4.85	0.69	208.74	2.77	21.09
												Jute Mat	2.36	5	0.040	38.26	3.93	0.80	207.90	3.22	22.86
												Temp. Mat	2.36	5	0.040	38.26	3.93	0.80	207.90	3.22	22.86
												Temp. Mat	2.78	10	0.040	38.21	4.11	0.87	244.12	3.49	23.98

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 537+00 TO 535+50 Right **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
537+00	535+50	R	150.00	10.00	2.00	2.00	0.0093	195.0	195.0	0.45	87.75	Seed	2.44	5	0.030	36.38	6.60	1.31	214.36	2.24	18.97
												Jute Mat	2.44	5	0.040	36.46	5.38	1.52	214.03	2.61	20.45
												Temp. Mat	2.44	5	0.040	36.46	5.38	1.52	214.03	2.61	20.45
												Perm, Type 1	2.44	5	0.040	36.46	5.38	1.52	214.03	2.61	20.45
												Perm, Type 1	2.86	10	0.040	36.44	5.63	1.66	251.07	2.84	21.37

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections 540+00 TO 538+30 Right **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
540+00	538+30	R	170.00	10.00	2.00	2.00	0.0377	193.0	193.0	0.45	86.85	Seed	2.45	5	0.030	36.26	10.74	3.57	212.59	1.52	16.08
												Jute Mat	2.45	5	0.040	36.32	8.79	4.19	212.37	1.78	17.13
												Temp. Mat	2.45	5	0.040	36.32	8.79	4.19	212.37	1.78	17.13
												Perm, Type 1	2.45	5	0.040	36.32	8.79	4.19	212.37	1.78	17.13
												Perm, Type 2	2.45	5	0.040	36.32	8.79	4.19	212.37	1.78	17.13
												Perm, Type 3	2.45	5	0.040	36.32	8.79	4.19	212.37	1.78	17.13
												Perm, Type 3	2.87	10	0.040	36.31	9.22	4.58	249.08	1.95	17.78

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections TR234, 11+50, RT TO TR234, 17+00 RT **Designer :** DL

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type B:**	6.00				

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
11+50	17+00	R	550.00	10.00	3.00	1.50	0.0364	2.74	2.74	0.41	1.12	Seed	4.15	5	0.030	13.21	2.75	0.37	4.66	0.16	10.74
												Seed	4.80	10	0.040	13.61	2.43	0.48	5.39	0.21	10.95

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DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 sections 13+00 TO 17+00 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
13+00	15+50	L	250.00	2.00	4.00	2.00	0.0256	35.02	35.02	0.45	15.76	Seed	3.39	5	0.030	20.63	6.63	2.14	53.36	1.34	10.03
												Jute Mat	3.37	5	0.040	20.78	5.35	2.42	53.16	1.52	11.10
												Temp. Mat	3.37	5	0.040	20.78	5.35	2.42	53.16	1.52	11.10
												Perm, Type 1	3.37	5	0.040	20.78	5.35	2.42	53.16	1.52	11.10
												Perm, Type 2	3.37	5	0.040	20.78	5.35	2.42	53.16	1.52	11.10
												Perm, Type 2	3.95	10	0.040	20.75	5.57	2.60	62.24	1.63	11.76
15+50	16+00	L	50.00	6.00	4.00	2.00	0.0740	0.49	35.51	0.44	15.97	Seed	3.37	5	0.030	20.87	9.12	3.33	53.76	0.72	10.33
												Jute Mat	3.36	5	0.040	20.89	7.46	3.90	53.74	0.84	11.07
												Temp. Mat	3.36	5	0.040	20.89	7.46	3.90	53.74	0.84	11.07
												Perm, Type 1	3.36	5	0.040	20.89	7.46	3.90	53.74	0.84	11.07
												Perm, Type 2	3.36	5	0.040	20.89	7.46	3.90	53.74	0.84	11.07
												Perm, Type 3	3.36	5	0.040	20.89	7.46	3.90	53.74	0.84	11.07
												Perm, Type 3	3.94	10	0.040	20.85	7.81	4.25	62.93	0.92	11.52

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
16+00	17+00	L	100.00	10.00	3.00	2.00	0.0250	1.14	36.65	0.43	16.46	Seed	3.34	5	0.030	21.17	5.91	1.22	55.00	0.78	13.90
												Jute Mat	3.34	5	0.040	21.23	4.87	1.43	54.92	0.92	14.59
												Temp. Mat	3.34	5	0.040	21.23	4.87	1.43	54.92	0.92	14.59
												Perm, Type 1	3.34	5	0.040	21.23	4.87	1.43	54.92	0.92	14.59
												Perm, Type 1	3.91	10	0.040	21.18	5.12	1.57	64.34	1.00	15.02

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 Ramp A sections 400+00 TO 384+50 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
400+00	388+00	L	1200.0	10.00	6.00	4.00	0.0460	5.03	5.03	0.61	3.07	Seed	3.97	5	0.030	14.68	4.06	0.76	12.18	0.26	12.65
												Jute Mat	3.86	5	0.040	15.66	3.33	0.88	11.84	0.31	13.08
												Temp. Mat	3.86	5	0.040	15.66	3.33	0.88	11.84	0.31	13.08
												Temp. Mat	4.56	10	0.040	15.35	3.53	0.97	13.99	0.34	13.39
388+00	385+50	L	300.00	10.00	8.00	4.00	0.0157	2.09	7.12	0.57	4.26	Seed	3.69	5	0.030	17.28	3.04	0.40	15.72	0.41	14.97
												Jute Mat	3.66	5	0.040	17.63	2.49	0.47	15.58	0.48	15.81
												Temp. Mat	3.66	5	0.040	17.63	2.49	0.47	15.58	0.48	15.81
												Temp. Mat	4.33	10	0.040	17.22	2.63	0.52	18.43	0.53	16.38
385+50	385+00	L	50.00	10.00	9.00	4.00	0.0480	0.36	7.48	0.46	4.43	Seed	3.64	5	0.030	17.82	4.42	0.91	16.10	0.30	13.95
												Jute Mat	3.63	5	0.040	17.86	3.65	1.07	16.09	0.36	14.65
												Temp. Mat	3.63	5	0.040	17.86	3.65	1.07	16.09	0.36	14.65
												Perm, Type 1	3.63	5	0.040	17.86	3.65	1.07	16.09	0.36	14.65
												Perm, Type 1	4.30	10	0.040	17.44	3.85	1.18	19.04	0.39	15.12

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
385+00	384+50	L	50.00	10.00	6.00	4.00	0.0050	0.22	7.70	0.56	4.55	Seed	3.60	5	0.030	18.24	2.14	0.18	16.36	0.59	15.90
												Seed	4.25	10	0.040	17.89	1.85	0.24	19.32	0.76	17.58

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 Ramp B sections 373+00 TO 383+50 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
373+00	383+50	L	1050.0	10.00	6.00	4.00	0.0192	5.45	5.45	0.55	3.00	Seed	3.88	5	0.030	15.50	3.00	0.40	11.61	0.33	13.32
												Seed	4.43	10	0.040	16.33	2.59	0.51	13.28	0.42	14.23

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DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 Ramp B sections 378+50 TO 374+50 Right **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
378+50	377+00	R	150.00	10.00	4.00	4.00	0.0400	0.52	0.52	0.47	0.24	Seed	4.37	5	0.030	11.55	1.58	0.16	1.07	0.07	10.53
												Seed	5.09	10	0.040	11.74	1.41	0.21	1.24	0.09	10.68
377+00	375+50	R	150.00	10.00	4.00	4.00	0.0933	0.76	1.28	0.45	0.58	Seed	4.25	5	0.030	12.42	2.84	0.49	2.48	0.08	10.68
												Jute Mat	4.22	5	0.040	12.59	2.37	0.58	2.47	0.10	10.80
												Temp. Mat	4.22	5	0.040	12.59	2.37	0.58	2.47	0.10	10.80
												Temp. Mat	4.93	10	0.040	12.72	2.52	0.64	2.88	0.11	10.88
375+50	374+50	R	100.00	10.00	4.00	4.00	0.2100*	0.50	1.78	0.45	0.81	Seed	4.17	5	0.030	13.00	4.12	1.04	3.39	0.08	10.64
												Jute Mat	4.16	5	0.040	13.07	3.44	1.24	3.38	0.09	10.76
												Temp. Mat	4.16	5	0.040	13.07	3.44	1.24	3.38	0.09	10.76
												Perm, Type 1	4.16	5	0.040	13.07	3.44	1.24	3.38	0.09	10.76
												Perm, Type 1	4.86	10	0.040	13.17	3.65	1.36	3.95	0.10	10.83

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 Ramp C sections 371+00 TO 379+00 Right **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
371+00	379+00	R	800.00	10.00	4.00	2.00	0.0110	2.18	2.18	0.56	1.22	Seed	3.75	5	0.030	16.65	1.86	0.16	4.57	0.23	11.38
												Seed	4.29	10	0.040	17.55	1.63	0.20	5.23	0.29	11.77

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DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 Ramp C sections 384+50 TO 379+00 Right **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
384+50	384+00	R	50.00	10.00	6.00	6.00	5.9950*	0.21	0.21	0.53	0.11	Seed	4.57	5	0.030	10.16	5.36	3.45	0.50	0.01	10.11
												Jute Mat	4.57	5	0.040	10.19	4.45	4.14	0.50	0.01	10.13
												Temp. Mat	4.57	5	0.040	10.19	4.45	4.14	0.50	0.01	10.13
												Perm, Type 1	4.57	5	0.040	10.19	4.45	4.14	0.50	0.01	10.13
												Perm, Type 2	4.57	5	0.040	10.19	4.45	4.14	0.50	0.01	10.13
												Perm, Type 3	4.57	5	0.040	10.19	4.45	4.14	0.50	0.01	10.13
												Perm, Type 3	5.36	10	0.040	10.17	4.79	4.52	0.58	0.01	10.15
384+00	383+50	R	50.00	10.00	6.00	6.00	0.0380	6.75	6.96	0.45	3.15	Seed	4.53	5	0.030	10.40	3.96	0.72	14.27	0.30	13.65
												Jute Mat	4.53	5	0.040	10.44	3.27	0.85	14.25	0.36	14.30
												Temp. Mat	4.53	5	0.040	10.44	3.27	0.85	14.25	0.36	14.30
												Temp. Mat	5.32	10	0.040	10.41	3.45	0.93	16.73	0.39	14.71
383+50	379+00	R	450.00	10.00	6.00	4.00	0.0045	2.79	9.75	0.50	4.54	Seed	4.07	5	0.030	13.82	2.15	0.18	18.49	0.65	16.49
												Seed	4.69	10	0.040	14.34	1.84	0.23	21.32	0.82	18.22

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 Ramp D sections 396+50 TO 384+50 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
396+50	396+00	L	50.00	10.00	5.00	4.00	0.0100	0.42	0.42	0.43	0.18	Seed	4.46	5	0.030	10.89	0.93	0.05	0.80	0.08	10.75
												Seed	5.21	10	0.040	11.00	0.82	0.07	0.94	0.11	10.98
396+00	395+50	L	50.00	10.00	3.00	3.00	0.0800	0.44	0.86	0.43	0.37	Seed	4.41	5	0.030	11.25	2.32	0.34	1.63	0.07	10.41
												Seed	5.14	10	0.040	11.40	2.06	0.45	1.90	0.09	10.54
395+50	384+50	L	1100.0	10.00	3.00	1.00	0.0220	11.14	12.00	0.43	5.16	Seed	3.87	5	0.030	15.57	4.05	0.62	19.95	0.45	11.81
												Jute Mat	3.77	5	0.040	16.46	3.33	0.73	19.47	0.53	12.11
												Temp. Mat	3.77	5	0.040	16.46	3.33	0.73	19.47	0.53	12.11
												Temp. Mat	4.43	10	0.040	16.34	3.53	0.80	22.86	0.58	12.32

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : mdc

Description : Ditch analysis calculations for TR 234 Ramp D sections 396+50 TO 403+50 Left

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (In./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
396+50	401+50	L	500.00	10.00	4.00	4.00	0.0300	3.94	3.94	0.43	1.69	Seed	4.21	5	0.030	12.72	2.97	0.41	7.13	0.22	11.77
												Jute Mat	4.14	5	0.040	13.27	2.45	0.48	7.01	0.26	12.07
												Temp. Mat	4.14	5	0.040	13.27	2.45	0.48	7.01	0.26	12.07
												Temp. Mat	4.88	10	0.040	13.09	2.60	0.53	8.26	0.29	12.28
401+50	403+50	L	200.00	10.00	4.00	4.00	0.0750	1.41	5.35	0.48	2.37	Seed	4.05	5	0.030	14.02	4.42	0.94	9.59	0.20	11.61
												Jute Mat	4.03	5	0.040	14.17	3.68	1.11	9.54	0.24	11.90
												Temp. Mat	4.03	5	0.040	14.17	3.68	1.11	9.54	0.24	11.90
												Perm, Type 1	4.03	5	0.040	14.17	3.68	1.11	9.54	0.24	11.90
												Perm, Type 1	4.75	10	0.040	13.94	3.90	1.22	11.26	0.26	12.09

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 Ramp D sections 398+00 TO 385+00 Right **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
398+00	386+00	R	1200.0	10.00	6.00	3.00	0.0227	2.68	2.68	0.47	1.26	Seed	3.62	5	0.030	18.01	2.29	0.26	4.56	0.18	11.66
												Seed	4.12	10	0.040	19.09	2.00	0.33	5.19	0.23	12.11
386+00	385+00	R	100.00	10.00	6.00	2.00	0.0700	3.24	5.92	0.50	2.88	Seed	3.58	5	0.030	18.38	4.44	0.94	10.32	0.21	11.71
												Jute Mat	3.58	5	0.040	18.45	3.69	1.11	10.30	0.25	12.03
												Temp. Mat	3.58	5	0.040	18.45	3.69	1.11	10.30	0.25	12.03
												Perm, Type 1	3.58	5	0.040	18.45	3.69	1.11	10.30	0.25	12.03
												Perm, Type 1	4.07	10	0.040	19.52	3.87	1.19	11.73	0.27	12.19

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 sections 22+00 TO 17+00 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	Jute Mat: 0.45	Temporary Mat:	1.00
Permanent Mat	Type 1:	2.00	Type 2: 3.00	Type 3:	5.00
RCP	Type B:	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
22+00	17+00	L	500.00	10.00	3.00	0.50	0.0086	9.14	9.14	0.41	3.75	Seed	4.05	5	0.030	13.96	2.72	0.27	15.19	0.51	11.79
												Seed	4.69	10	0.040	14.37	2.38	0.35	17.57	0.66	12.31

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for TR 234 sections 22+00 TO 26+00 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
22+00	26+00	L	400.00	10.00	3.00	0.50	0.0205	5.47	5.47	0.41	2.24	Seed	4.15	5	0.030	13.17	3.00	0.38	9.31	0.29	11.03
												Seed	4.82	10	0.040	13.45	2.65	0.49	10.81	0.38	11.34

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : DL

Description : Ditch analysis calculations for sections TR234, 21+00, RT TO TR234, 17+00 RT

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
21+00	17+50	R	350.00	10.00	3.00	1.50	0.0040	0.59	0.59	0.44	0.26	Seed	3.71	5	0.030	17.08	0.76	0.03	0.97	0.12	10.56
												Seed	4.24	10	0.040	17.94	0.67	0.04	1.11	0.16	10.71
17+50	17+00	R	50.00	12.00	3.00	2.00	0.0880	47.65	48.24	0.40	19.32	Seed	3.70	5	0.030	17.17	9.35	3.13	71.51	0.57	14.85
												Jute Mat	3.70	5	0.040	17.18	7.75	3.70	71.48	0.67	15.37
												Temp. Mat	3.70	5	0.040	17.18	7.75	3.70	71.48	0.67	15.37
												Perm, Type 1	3.70	5	0.040	17.18	7.75	3.70	71.48	0.67	15.37
												Perm, Type 2	3.70	5	0.040	17.18	7.75	3.70	71.48	0.67	15.37
												Perm, Type 3	3.70	5	0.040	17.18	7.75	3.70	71.48	0.67	15.37
												Perm, Type 3	4.23	10	0.040	18.05	8.12	4.00	81.75	0.73	15.64

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections TR234, 21+00, RT TO TR234 C, 377+07 LT **Designer :** DL

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
21+00	25+50	R	450.00	10.00	3.00	1.00	0.0227	1.29	1.29	0.61	0.79	Seed	4.11	5	0.030	13.47	2.07	0.21	3.24	0.15	10.61
												Seed	4.76	10	0.040	13.90	1.83	0.28	3.74	0.20	10.79
26+00	379+00	L	500.00	10.00	4.00	2.00	0.0058	2.68	3.96	0.44	1.96	Seed	3.63	5	0.030	17.94	1.78	0.13	7.12	0.36	12.16
												Seed	4.12	10	0.040	19.02	1.55	0.17	8.10	0.46	12.76
379+00	377+50	L	150.00	12.00	4.00	3.00	0.1143*	12.55	16.52	0.51	8.36	Seed	3.59	5	0.030	18.28	7.30	2.24	30.06	0.31	14.20
												Jute Mat	3.59	5	0.040	18.35	6.07	2.65	30.01	0.37	14.60
												Temp. Mat	3.59	5	0.040	18.35	6.07	2.65	30.01	0.37	14.60
												Perm, Type 1	3.59	5	0.040	18.35	6.07	2.65	30.01	0.37	14.60
												Perm, Type 2	3.59	5	0.040	18.35	6.07	2.65	30.01	0.37	14.60
												Perm, Type 2	4.08	10	0.040	19.41	6.36	2.86	34.16	0.40	14.81
377+50	377+07	L	43.00	10.00	3.00	2.00	0.0298	0.23	16.75	0.36	8.45	Seed	3.57	5	0.030	18.49	5.11	0.97	30.20	0.52	12.62
												Jute Mat	3.57	5	0.040	18.52	4.23	1.15	30.17	0.62	13.09
												Temp. Mat	3.57	5	0.040	18.52	4.23	1.15	30.17	0.62	13.09

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Perm, Type 1	3.57	5	0.040	18.52	4.23	1.15	30.17	0.62	13.09
												Perm, Type 1	4.07	10	0.040	19.58	4.42	1.24	34.36	0.67	13.33

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for sections SR 139, 18+00 to 21+80 Left **Designer :** DL

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type B:**	6.00				

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
18+00	21+80	L	400.00	10.00	4.00	2.00	0.0100	145.6	145.6	0.40	58.27	Seed	2.15	5	0.030	44.22	5.44	0.98	125.12	1.56	19.39
												Jute Mat	2.14	5	0.040	44.49	4.43	1.13	124.59	1.82	20.91
												Temp. Mat	2.14	5	0.040	44.49	4.43	1.13	124.59	1.82	20.91
												Perm, Type 1	2.14	5	0.040	44.49	4.43	1.13	124.59	1.82	20.91
												Perm, Type 1	2.51	10	0.040	44.43	4.64	1.24	146.55	1.98	21.88

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 sections 15+00 TO 11+00 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type B:**	6.00				

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (In./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
15+00	14+00	L	100.00	1.00	3.00	3.00	0.0140	0.07	0.07	0.40	0.03	Seed	4.35	5	0.030	11.64	1.03	0.08	0.12	0.09	1.55
												Seed	5.08	10	0.040	11.79	0.88	0.10	0.14	0.12	1.71
14+00	12+50	L	150.00	1.00	6.00	4.00	0.0280	0.14	0.21	0.47	0.09	Seed	4.16	5	0.030	13.08	1.75	0.23	0.39	0.13	2.34
												Seed	4.82	10	0.040	13.45	1.46	0.30	0.46	0.17	2.69
12+50	11+50	L	100.00	1.00	3.00	3.00	0.0070	0.17	0.39	0.48	0.18	Seed	4.01	5	0.030	14.30	1.35	0.12	0.71	0.28	2.71
												Seed	4.62	10	0.040	14.89	1.15	0.15	0.82	0.35	3.09
11+50	11+00	L	50.00	2.00	3.00	3.00	0.0260	0.10	0.48	0.47	0.22	Seed	3.97	5	0.030	14.69	2.13	0.27	0.89	0.17	3.00
												Seed	4.56	10	0.040	15.35	1.82	0.34	1.02	0.21	3.27

Z98

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 sections 15+00 TO 18+00 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type B:**	6.00				

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
15+00	17+50	L	250.00	2.00	6.00	4.00	0.0060	1.93	1.93	0.40	0.77	Seed	4.25	5	0.030	12.41	1.69	0.17	3.29	0.46	6.55
												Seed	4.91	10	0.040	12.86	1.42	0.21	3.80	0.56	7.57
17+50	18+00	L	50.00	2.00	6.00	3.00	0.0340	0.18	2.11	0.40	0.85	Seed	4.22	5	0.030	12.66	3.32	0.67	3.56	0.31	4.83
												Jute Mat	4.21	5	0.040	12.72	2.69	0.77	3.56	0.36	5.28
												Temp. Mat	4.21	5	0.040	12.72	2.69	0.77	3.56	0.36	5.28
												Temp. Mat	4.86	10	0.040	13.16	2.80	0.83	4.11	0.39	5.52

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 sections 20+50 TO 18+00 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type B:**	6.00				

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
20+50	18+00	L	250.00	2.00	6.00	2.00	0.0060	0.57	0.57	0.50	0.29	Seed	4.17	5	0.030	13.05	1.33	0.11	1.19	0.28	4.28
												Seed	4.80	10	0.040	13.57	1.12	0.13	1.38	0.36	4.86

300

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : mdc

Description : Ditch analysis calculations for CR 28 sections 20+50 TO 21+50 Left

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
20+50	21+50	L	100.00	2.00	6.00	3.00	0.0100	0.29	0.29	0.50	0.15	Seed	4.41	5	0.030	11.26	1.30	0.11	0.64	0.18	3.60
												Seed	5.13	10	0.040	11.46	1.12	0.14	0.75	0.22	4.01

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 sections 21+50 TO 16+50 Right **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
21+50	19+50	R	200.00	10.00	6.00	2.00	0.0135	0.21	0.21	0.69	0.14	Seed	4.10	5	0.030	13.54	0.90	0.05	0.59	0.06	10.50
												Seed	4.74	10	0.040	13.98	0.80	0.07	0.68	0.08	10.66
19+50	19+00	R	50.00	10.00	4.00	2.00	0.0820	0.06	0.27	0.65	0.18	Seed	4.04	5	0.030	14.03	1.72	0.22	0.74	0.04	10.25
												Seed	4.67	10	0.040	14.53	1.52	0.28	0.85	0.06	10.33
19+00	18+50	R	50.00	10.00	3.00	3.00	0.0260	0.09	0.36	0.60	0.24	Seed	3.97	5	0.030	14.65	1.33	0.11	0.95	0.07	10.42
												Seed	4.57	10	0.040	15.23	1.18	0.15	1.09	0.09	10.54
18+50	18+00	R	50.00	10.00	2.00	2.00	0.1140*	0.13	0.49	0.60	0.31	Seed	3.93	5	0.030	15.01	2.34	0.37	1.24	0.05	10.21
												Seed	4.52	10	0.040	15.63	2.07	0.48	1.42	0.07	10.27
18+00	17+50	R	50.00	10.00	2.00	2.00	0.0040	196.1	196.6	0.45	88.58	Seed	2.37	5	0.030	38.17	4.85	0.69	209.76	2.78	21.11
												Jute Mat	2.37	5	0.040	38.21	3.94	0.81	209.62	3.23	22.92
												Temp. Mat	2.37	5	0.040	38.21	3.94	0.81	209.62	3.23	22.92
												Temp. Mat	2.78	10	0.040	38.20	4.12	0.88	245.95	3.51	24.03
17+50	16+50	R	100.00	10.00	3.00	2.00	0.0330	0.29	196.9	0.61	88.75	Seed	2.36	5	0.030	38.38	9.92	3.15	209.44	1.53	17.64

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
											Jute Mat	2.36	5	0.040	38.42	8.10	3.68	209.31	1.79	18.93
											Temp. Mat	2.36	5	0.040	38.42	8.10	3.68	209.31	1.79	18.93
											Perm, Type 1	2.36	5	0.040	38.42	8.10	3.68	209.31	1.79	18.93
											Perm, Type 2	2.36	5	0.040	38.42	8.10	3.68	209.31	1.79	18.93
											Perm, Type 3	2.36	5	0.040	38.42	8.10	3.68	209.31	1.79	18.93
											Perm, Type 3	2.77	10	0.040	38.40	8.49	4.01	245.63	1.95	19.73

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 sections 21+50 TO 22+50 Right **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
21+50	22+00	R	50.00	10.00	7.00	2.00	0.0040	0.06	0.06	0.64	0.04	Seed	4.29	5	0.030	12.10	0.39	0.01	0.17	0.04	10.39
												Seed	4.99	10	0.040	12.33	0.35	0.01	0.20	0.06	10.51
22+00	22+50	R	50.00	10.00	5.00	2.00	0.1760*	0.09	0.15	0.57	0.09	Seed	4.22	5	0.030	12.61	1.63	0.25	0.37	0.02	10.16
												Seed	4.90	10	0.040	12.89	1.46	0.32	0.44	0.03	10.21

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 sections 27+00 TO 22+50 Right. **Designer :** mdc

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type B:**	6.00				

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
27+00	23+00	R	400.00	10.00	6.00	4.00	0.0193	0.57	0.57	0.59	0.34	Seed	3.98	5	0.030	14.61	1.38	0.11	1.34	0.09	10.93
												Seed	4.58	10	0.040	15.19	1.21	0.15	1.55	0.12	11.21
23+00	22+50	R	50.00	10.00	5.00	2.00	0.2340*	0.19	0.76	0.56	0.45	Seed	3.95	5	0.030	14.86	3.30	0.76	1.76	0.05	10.37
												Jute Mat	3.94	5	0.040	14.91	2.77	0.91	1.76	0.06	10.43
												Temp. Mat	3.94	5	0.040	14.91	2.77	0.91	1.76	0.06	10.43
												Temp. Mat	4.54	10	0.040	15.47	2.93	0.99	2.02	0.07	10.47

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 sections 32+50 TO 22+00 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
32+50	25+50	L	700.00	2.00	6.00	4.00	0.0081	16.58	16.58	0.41	6.80	Seed	3.22	5	0.030	22.68	3.10	0.51	21.90	1.01	12.06
												Jute Mat	3.16	5	0.040	23.56	2.49	0.57	21.46	1.13	13.29
												Temp. Mat	3.16	5	0.040	23.56	2.49	0.57	21.46	1.13	13.29
												Temp. Mat	3.71	10	0.040	23.39	2.59	0.61	25.21	1.21	14.10
25+50	23+00	L	250.00	2.00	6.00	4.00	0.0240	2.01	18.59	0.44	7.68	Seed	3.10	5	0.030	24.44	4.73	1.23	23.78	0.82	10.22
												Jute Mat	3.08	5	0.040	24.65	3.81	1.40	23.67	0.93	11.32
												Temp. Mat	3.08	5	0.040	24.65	3.81	1.40	23.67	0.93	11.32
												Perm, Type 1	3.08	5	0.040	24.65	3.81	1.40	23.67	0.93	11.32
												Perm, Type 1	3.62	10	0.040	24.43	3.97	1.50	27.83	1.00	12.00
23+00	22+50	L	50.00	2.00	7.00	4.00	0.0400	0.08	18.67	0.59	7.73	Seed	3.07	5	0.030	24.80	5.59	1.78	23.73	0.72	9.87
												Jute Mat	3.07	5	0.040	24.83	4.51	2.03	23.71	0.81	10.93
												Temp. Mat	3.07	5	0.040	24.83	4.51	2.03	23.71	0.81	10.93
												Perm, Type 1	3.07	5	0.040	24.83	4.51	2.03	23.71	0.81	10.93

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
											Perm, Type 2	3.07	5	0.040	24.83	4.51	2.03	23.71	0.81	10.93
											Perm, Type 2	3.61	10	0.040	24.61	4.70	2.18	27.88	0.87	11.59
22+50		50.00	0.00	4.00	3.00	0.1800	0.09	18.75	0.57	7.78		3.06	5	0.030	24.91	10.99		23.82	0.79	5.51

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 sections 32+50 TO 36+00 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type B:**	6.00				

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
32+50	33+00	L	50.00	2.00	7.00	4.00	0.0420	0.21	0.21	0.47	0.10	Seed	4.53	5	0.030	10.44	1.85	0.25	0.44	0.09	3.03
												Seed	5.30	10	0.040	10.51	1.59	0.32	0.51	0.12	3.33
33+00	34+50	L	150.00	2.00	6.00	4.00	0.0180	2.39	2.60	0.42	1.10	Seed	3.73	5	0.030	16.93	2.68	0.44	4.10	0.39	5.88
												Jute Mat	3.70	5	0.040	17.14	2.17	0.50	4.08	0.44	6.44
												Temp. Mat	3.70	5	0.040	17.14	2.17	0.50	4.08	0.44	6.44
												Temp. Mat	4.34	10	0.040	17.10	2.27	0.54	4.78	0.48	6.79
34+50	36+00	L	150.00	2.00	6.00	4.00	0.0080	6.48	9.08	0.41	3.76	Seed	3.53	5	0.030	18.92	2.71	0.40	13.28	0.81	10.10
												Jute Mat	3.51	5	0.040	19.14	2.18	0.46	13.21	0.92	11.18
												Temp. Mat	3.51	5	0.040	19.14	2.18	0.46	13.21	0.92	11.18
												Temp. Mat	4.12	10	0.040	19.09	2.27	0.49	15.47	0.98	11.84

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp A sections 519+50 TO 533+50 Right **Designer :** mdc

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
	RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
519+50	521+50	R	200.00	10.00	3.00	0.50	0.0040	0.36	0.36	0.40	0.15	Seed	3.93	5	0.030	15.04	0.62	0.02	0.57	0.09	10.32
												Seed	4.52	10	0.040	15.66	0.55	0.03	0.66	0.12	10.41
521+50	523+00	R	150.00	10.00	3.00	0.50	0.0153	0.30	0.67	0.40	0.27	Seed	3.70	5	0.030	17.14	1.15	0.08	0.99	0.08	10.30
												Seed	4.23	10	0.040	18.03	1.02	0.10	1.13	0.11	10.38
523+00	526+00	R	300.00	10.00	3.00	1.00	0.0287	0.79	1.45	0.40	0.58	Seed	3.46	5	0.030	19.77	1.85	0.19	2.01	0.11	10.43
												Seed	3.92	10	0.040	21.01	1.63	0.24	2.28	0.14	10.55
526+00	529+50	R	350.00	10.00	3.00	1.00	0.0449	2.37	3.83	0.53	1.84	Seed	3.31	5	0.030	21.53	3.26	0.51	6.09	0.18	10.72
												Jute Mat	3.28	5	0.040	21.88	2.71	0.60	6.04	0.21	10.85
												Temp. Mat	3.28	5	0.040	21.88	2.71	0.60	6.04	0.21	10.85
												Temp. Mat	3.74	10	0.040	23.02	2.85	0.65	6.88	0.23	10.92
529+50	530+50	R	100.00	10.00	4.00	4.00	0.1510*	0.19	4.02	0.42	1.92	Seed	3.26	5	0.030	22.23	4.70	1.19	6.25	0.13	11.01
												Jute Mat	3.25	5	0.040	22.30	3.92	1.41	6.24	0.15	11.20
												Temp. Mat	3.25	5	0.040	22.30	3.92	1.41	6.24	0.15	11.20

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Perm, Type 1	3.25	5	0.040	22.30	3.92	1.41	6.24	0.15	11.20
												Perm, Type 1	3.71	10	0.040	23.42	4.12	1.53	7.12	0.16	11.30
530+50	531+00	R	50.00	10.00	4.00	4.00	0.0800	0.13	4.14	0.42	1.97	Seed	3.23	5	0.030	22.52	3.88	0.77	6.38	0.15	11.24
												Jute Mat	3.23	5	0.040	22.56	3.24	0.91	6.38	0.18	11.47
												Temp. Mat	3.23	5	0.040	22.56	3.24	0.91	6.38	0.18	11.47
												Temp. Mat	3.69	10	0.040	23.66	3.40	0.99	7.27	0.20	11.59
531+00	531+50	R	50.00	10.00	4.00	4.00	0.0100	0.12	4.27	0.42	2.03	Seed	3.20	5	0.030	22.97	2.02	0.18	6.48	0.29	12.30
												Seed	3.65	10	0.040	24.14	1.75	0.23	7.38	0.37	12.94
531+50	532+00	R	50.00	10.00	4.00	4.00	0.0600	0.12	4.39	0.42	2.08	Seed	3.18	5	0.030	23.20	3.59	0.64	6.61	0.17	11.38
												Jute Mat	3.18	5	0.040	23.25	3.00	0.76	6.60	0.20	11.63
												Temp. Mat	3.18	5	0.040	23.25	3.00	0.76	6.60	0.20	11.63
												Temp. Mat	3.62	10	0.040	24.40	3.14	0.82	7.53	0.22	11.76
532+00	533+50	R	150.00	10.00	4.00	4.00	0.0267	0.61	5.00	0.60	2.44	Seed	3.12	5	0.030	24.10	2.93	0.40	7.62	0.24	11.90
												Seed	3.55	10	0.040	25.38	2.55	0.50	8.67	0.30	12.43

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp A sections 522+00 TO 529+00 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
522+00	525+00	L	300.00	10.00	8.00	4.00	0.0240	0.66	0.66	0.40	0.26	Seed	4.10	5	0.030	13.54	1.35	0.11	1.08	0.08	10.92
												Seed	4.74	10	0.040	14.01	1.19	0.15	1.25	0.10	11.19
525+00	529+00	L	400.00	10.00	6.00	4.00	0.0454	1.34	2.00	0.43	0.84	Seed	3.81	5	0.030	16.15	2.48	0.34	3.19	0.12	11.21
												Seed	4.36	10	0.040	16.97	2.18	0.44	3.65	0.16	11.55

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp A sections 536+00 TO 533+50 Right **Designer :** mdc

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type B:**	6.00				

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
536+00	534+50	R	150.00	10.00	4.00	4.00	0.0407	1.47	1.47	0.56	0.82	Seed	4.45	5	0.030	10.97	2.55	0.35	3.67	0.14	11.09
												Seed	5.20	10	0.040	11.09	2.26	0.45	4.28	0.18	11.42
534+50	533+50	R	100.00	10.00	4.00	4.00	0.0240	0.24	1.71	0.42	0.92	Seed	4.34	5	0.030	11.71	2.24	0.25	4.01	0.17	11.34
												Seed	5.06	10	0.040	11.93	1.97	0.33	4.67	0.22	11.74

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp A sections 522+00 TO 529+00 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
522+00	525+00	L	300.00	10.00	8.00	4.00	0.0240	0.66	0.66	0.40	0.26	Seed	4.10	5	0.030	13.54	1.35	0.11	1.08	0.08	10.92
												Seed	4.74	10	0.040	14.01	1.19	0.15	1.25	0.10	11.19
525+00	529+00	L	400.00	10.00	6.00	4.00	0.0454	1.34	2.00	0.43	0.84	Seed	3.81	5	0.030	16.15	2.48	0.34	3.19	0.12	11.21
												Seed	4.36	10	0.040	16.97	2.18	0.44	3.65	0.16	11.55

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp A sections 536+00 TO 533+50 Right **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
536+00	534+50	R	150.00	10.00	4.00	4.00	0.0407	1.47	1.47	0.56	0.82	Seed	4.45	5	0.030	10.97	2.55	0.35	3.67	0.14	11.09
												Seed	5.20	10	0.040	11.09	2.26	0.45	4.28	0.18	11.42
534+50	533+50	R	100.00	10.00	4.00	4.00	0.0240	0.24	1.71	0.42	0.92	Seed	4.34	5	0.030	11.71	2.24	0.25	4.01	0.17	11.34
												Seed	5.06	10	0.040	11.93	1.97	0.33	4.67	0.22	11.74

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp B sections 515+30 TO 517+00 Right **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
515+30	517+00	R	170.00	10.00	4.00	4.00	0.0341	0.36	0.36	0.62	0.22	Seed	4.31	5	0.030	11.92	1.44	0.14	0.95	0.06	10.52
												Seed	5.02	10	0.040	12.15	1.28	0.18	1.11	0.08	10.67

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : mdc

Description : Ditch analysis calculations for CR 28 Ramp B sections 526+50 TO 517+00 Right

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
526+50	526+00	R	50.00	10.00	3.00	2.00	0.0040	0.11	0.11	0.54	0.06	Seed	4.33	5	0.030	11.82	0.45	0.01	0.25	0.05	10.27
												Seed	5.03	10	0.040	12.07	0.40	0.02	0.29	0.07	10.35
526+00	524+00	R	200.00	10.00	3.00	2.00	0.0295	0.39	0.50	0.55	0.27	Seed	4.05	5	0.030	14.02	1.47	0.14	1.10	0.07	10.37
												Seed	4.67	10	0.040	14.55	1.30	0.18	1.27	0.10	10.48
524+00	523+00	R	100.00	10.00	5.00	2.00	0.0160	0.17	0.66	0.58	0.37	Seed	3.90	5	0.030	15.24	1.34	0.10	1.44	0.10	10.72
												Seed	4.48	10	0.040	15.93	1.19	0.13	1.65	0.13	10.93
523+00	522+00	R	100.00	10.00	6.00	3.00	0.0510	0.18	0.84	0.64	0.48	Seed	3.82	5	0.030	16.03	2.11	0.27	1.85	0.08	10.76
												Seed	4.37	10	0.040	16.83	1.86	0.35	2.12	0.11	10.98
522+00	521+00	R	100.00	10.00	4.00	4.00	0.0970	0.23	1.08	0.58	0.62	Seed	3.76	5	0.030	16.62	2.81	0.49	2.32	0.08	10.64
												Jute Mat	3.75	5	0.040	16.73	2.35	0.58	2.32	0.10	10.76
												Temp. Mat	3.75	5	0.040	16.73	2.35	0.58	2.32	0.10	10.76
												Temp. Mat	4.29	10	0.040	17.49	2.48	0.62	2.66	0.10	10.82
521+00	517+50	R	350.00	10.00	4.00	4.00	0.0326	3.22	4.29	0.44	2.03	Seed	3.56	5	0.030	18.60	3.07	0.44	7.25	0.22	11.74

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Jute Mat	3.53	5	0.040	18.98	2.54	0.52	7.18	0.26	12.05
												Temp. Mat	3.53	5	0.040	18.98	2.54	0.52	7.18	0.26	12.05
												Temp. Mat	4.06	10	0.040	19.63	2.67	0.57	8.26	0.28	12.23
517+50	517+00	R	50.00	10.00	4.00	4.00	0.0020	1.19	5.49	0.42	2.54	Seed	3.47	5	0.030	19.61	1.32	0.07	8.81	0.55	14.38
												Seed	3.99	10	0.040	20.36	1.14	0.09	10.11	0.70	15.57

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : mdc

Description : Ditch analysis calculations for CR 28 Ramp B sections 526+50 TO 524+50 Left

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
526+50	524+50	L	200.00	10.00	8.00	4.00	0.0195	0.68	0.68	0.40	0.27	Seed	4.24	5	0.030	12.51	1.30	0.10	1.15	0.08	11.02
												Seed	4.92	10	0.040	12.82	1.14	0.13	1.34	0.11	11.32

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp B sections 526+50 TO 528+00 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

		Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
	Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
	RCP	**Type B:**	6.00				

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (In./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
526+50	528+00	L	150.00	10.00	8.00	4.00	0.0107	0.44	0.44	0.40	0.17	Seed	4.21	5	0.030	12.67	0.90	0.05	0.74	0.08	10.93
												Seed	4.88	10	0.040	13.03	0.80	0.07	0.85	0.10	11.21

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp C sections 517+00 TO 507+50 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00				

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
517+00	516+00	L	100.00	10.00	4.00	2.00	0.0100	1.33	1.33	0.50	0.67	Seed	4.43	5	0.030	11.07	1.53	0.11	2.95	0.18	11.10
												Seed	5.18	10	0.040	11.21	1.36	0.15	3.44	0.24	11.42
516+00	515+50	L	50.00	10.00	4.00	3.00	0.0460	0.13	1.46	0.52	0.73	Seed	4.39	5	0.030	11.40	2.53	0.35	3.21	0.12	10.85
												Seed	5.11	10	0.040	11.58	2.25	0.45	3.74	0.16	11.10
515+50	515+00	L	50.00	10.00	4.00	3.00	0.2280*	0.15	1.61	0.52	0.81	Seed	4.36	5	0.030	11.59	4.30	1.14	3.53	0.08	10.56
												Jute Mat	4.35	5	0.040	11.63	3.60	1.35	3.52	0.09	10.66
												Temp. Mat	4.35	5	0.040	11.63	3.60	1.35	3.52	0.09	10.66
												Perm, Type 1	4.35	5	0.040	11.63	3.60	1.35	3.52	0.09	10.66
												Perm, Type 1	5.08	10	0.040	11.80	3.82	1.48	4.11	0.10	10.73
515+00	509+00	L	600.00	10.00	4.00	2.00	0.0280	5.99	7.60	0.43	3.39	Seed	3.75	5	0.030	16.68	3.63	0.56	12.70	0.32	11.91
												Jute Mat	3.70	5	0.040	17.22	3.01	0.65	12.51	0.37	12.25
												Temp. Mat	3.70	5	0.040	17.22	3.01	0.65	12.51	0.37	12.25
												Temp. Mat	4.35	10	0.040	17.05	3.18	0.72	14.72	0.41	12.47

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
509+00	507+50	L	150.00	10.00	4.00	4.00	0.0100	0.53	8.13	0.52	3.66	Seed	3.60	5	0.030	18.18	2.58	0.27	13.19	0.44	13.48
												Seed	4.22	10	0.040	18.15	2.25	0.35	15.45	0.56	14.49

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Designer : mdc

Description : Ditch analysis calculations for CR 28 Ramp C sections 520+50 TO 520+00 Left

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
520+50	520+00	L	50.00	10.00	4.00	4.00	0.0920	0.07	0.07	0.60	0.04	Seed	4.48	5	0.030	10.77	1.06	0.11	0.20	0.02	10.15
												Seed	5.23	10	0.040	10.89	0.96	0.14	0.23	0.02	10.19

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp C sections 522+00 TO 521+50 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
522+00	521+50	L	50.00	10.00	4.00	4.00	0.1180*	0.09	0.09	0.57	0.05	Seed	4.49	5	0.030	10.69	1.18	0.14	0.22	0.02	10.15
												Seed	5.25	10	0.040	10.78	1.07	0.18	0.26	0.02	10.19

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp C sections 522+00 TO 527+00 Right **Designer :** mdc

Rainfall Area : D

	Seed:	0.40	**Allowable Shears**		
Permanent Mat	**Type 1:**	2.00	**Jute Mat:**	0.45	**Temporary Mat:** 1.00
RCP	**Type B:**	6.00	**Type 2:**	3.00	**Type 3:** 5.00

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
522+00	527+00	R	500.00	10.00	8.00	4.00	0.0084	1.65	1.65	0.40	0.66	Seed	3.83	5	0.030	15.89	1.32	0.09	2.53	0.17	12.08
												Seed	4.38	10	0.040	16.73	1.15	0.12	2.89	0.22	12.66

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp C sections 522+00 TO 531+50 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:**	0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:**	3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00				

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
522+00	522+50	L	50.00	10.00	4.00	2.00	0.0480	0.08	0.08	0.58	0.05	Seed	4.45	5	0.030	10.95	0.90	0.07	0.21	0.02	10.14
												Seed	5.21	10	0.040	11.04	0.77	0.09	0.24	0.03	10.19
522+50	523+00	L	50.00	10.00	3.00	2.00	0.0340	0.10	0.18	0.55	0.10	Seed	4.34	5	0.030	11.73	1.08	0.09	0.44	0.04	10.20
												Seed	5.06	10	0.040	11.90	0.96	0.11	0.51	0.05	10.26
523+00	527+50	L	450.00	10.00	3.00	2.00	0.0091	1.16	1.34	0.51	0.69	Seed	3.75	5	0.030	16.69	1.43	0.10	2.60	0.17	10.87
												Seed	4.29	10	0.040	17.51	1.26	0.13	2.98	0.22	11.12
527+50	528+00	L	50.00	10.00	3.00	2.00	0.0420	0.13	1.47	0.51	0.76	Seed	3.71	5	0.030	17.04	2.37	0.30	2.83	0.12	10.58
												Seed	4.25	10	0.040	17.90	2.09	0.39	3.23	0.15	10.75
528+00	530+50	L	250.00	10.00	3.00	2.00	0.0040	5.32	6.79	0.58	3.85	Seed	3.52	5	0.030	19.08	2.01	0.15	13.54	0.59	12.94
												Seed	4.00	10	0.040	20.26	1.73	0.19	15.38	0.75	13.74
530+50	531+50	L	100.00	10.00	4.00	4.00	0.1070*	0.26	7.05	0.50	3.98	Seed	3.49	5	0.030	19.37	5.67	1.50	13.90	0.22	11.80
												Jute Mat	3.49	5	0.040	19.43	4.71	1.78	13.87	0.27	12.13
												Temp. Mat	3.49	5	0.040	19.43	4.71	1.78	13.87	0.27	12.13

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
											Perm, Type 1	3.49	5	0.040	19.43	4.71	1.78	13.87	0.27	12.13
											Perm, Type 1	3.96	10	0.040	20.60	4.93	1.92	15.77	0.29	12.29

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp D sections 517+50 TO 539+50 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	Jute Mat: 0.45	Temporary Mat:	1.00
Permanent Mat	Type 1:	2.00	Type 2: 3.00	Type 3:	5.00
RCP	Type B:	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
517+50	529+00	L	1150.0	10.00	3.00	1.00	0.0079	14.10	14.10	0.56	7.89	Seed	3.89	5	0.030	15.37	3.37	0.39	30.71	0.79	13.15
												Seed	4.45	10	0.040	16.19	2.91	0.50	35.14	1.01	14.02
529+00	530+50	L	150.00	10.00	3.00	2.00	0.0260	1.60	15.70	0.55	8.78	Seed	3.84	5	0.030	15.87	5.07	0.94	33.67	0.58	12.90
												Jute Mat	3.83	5	0.040	15.97	4.19	1.11	33.57	0.68	13.42
												Temp. Mat	3.83	5	0.040	15.97	4.19	1.11	33.57	0.68	13.42
												Perm, Type 1	3.83	5	0.040	15.97	4.19	1.11	33.57	0.68	13.42
												Perm, Type 1	4.38	10	0.040	16.75	4.39	1.20	38.45	0.74	13.70
530+50	531+00	L	50.00	10.00	3.00	2.00	0.0480	0.52	16.22	0.55	9.06	Seed	3.81	5	0.030	16.10	6.25	1.47	34.55	0.49	12.46
												Jute Mat	3.81	5	0.040	16.13	5.18	1.74	34.52	0.58	12.91
												Temp. Mat	3.81	5	0.040	16.13	5.18	1.74	34.52	0.58	12.91
												Perm, Type 1	3.81	5	0.040	16.13	5.18	1.74	34.52	0.58	12.91
												Perm, Type 1	4.36	10	0.040	16.91	5.42	1.89	39.55	0.63	13.15
531+00	531+50	L	50.00	10.00	3.00	2.00	0.0380	0.48	16.70	0.55	9.33	Seed	3.79	5	0.030	16.27	5.84	1.27	35.39	0.53	12.67

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Jute Mat	3.79	5	0.040	16.30	4.83	1.50	35.36	0.63	13.16
												Temp. Mat	3.79	5	0.040	16.30	4.83	1.50	35.36	0.63	13.16
												Perm, Type 1	3.79	5	0.040	16.30	4.83	1.50	35.36	0.63	13.16
												Perm, Type 1	4.34	10	0.040	17.07	5.06	1.62	40.52	0.68	13.42
531+50	532+00	L	50.00	10.00	3.00	2.00	0.0940	0.34	17.05	0.55	9.52	Seed	3.78	5	0.030	16.41	7.87	2.43	35.96	0.41	12.07
												Jute Mat	3.78	5	0.040	16.43	6.54	2.87	35.94	0.49	12.45
												Temp. Mat	3.78	5	0.040	16.43	6.54	2.87	35.94	0.49	12.45
												Perm, Type 1	3.78	5	0.040	16.43	6.54	2.87	35.94	0.49	12.45
												Perm, Type 2	3.78	5	0.040	16.43	6.54	2.87	35.94	0.49	12.45
												Perm, Type 2	4.33	10	0.040	17.19	6.86	3.11	41.20	0.53	12.65
532+00	532+50	L	50.00	10.00	3.00	2.00	0.0080	2.62	19.67	0.51	10.85	Seed	3.75	5	0.030	16.66	3.65	0.45	40.74	0.91	14.55
												Jute Mat	3.75	5	0.040	16.70	3.00	0.53	40.68	1.07	15.35
												Temp. Mat	3.75	5	0.040	16.70	3.00	0.53	40.68	1.07	15.35
												Temp. Mat	4.30	10	0.040	17.46	3.14	0.58	46.65	1.15	15.77
532+50	538+00	L	550.00	10.00	4.00	2.00	0.0500	2.54	22.20	0.47	12.05	Seed	3.62	5	0.030	18.04	6.76	1.72	43.55	0.55	13.32
												Jute Mat	3.59	5	0.040	18.33	5.57	2.03	43.23	0.65	13.90
												Temp. Mat	3.59	5	0.040	18.33	5.57	2.03	43.23	0.65	13.90
												Perm, Type 1	3.59	5	0.040	18.33	5.57	2.03	43.23	0.65	13.90
												Perm, Type 2	3.59	5	0.040	18.33	5.57	2.03	43.23	0.65	13.90
												Perm, Type 2	4.13	10	0.040	19.01	5.83	2.19	49.70	0.70	14.22

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
538+00	538+50	L	50.00	10.00	5.00	2.00	0.0120	0.09	22.29	0.55	12.09	Seed	3.57	5	0.030	18.53	4.10	0.61	43.17	0.82	15.73
												Jute Mat	3.57	5	0.040	18.57	3.37	0.72	43.12	0.96	16.71
												Temp. Mat	3.57	5	0.040	18.57	3.37	0.72	43.12	0.96	16.71
												Temp. Mat	4.10	10	0.040	19.24	3.51	0.78	49.59	1.04	17.25
538+50	539+50	L	100.00	10.00	6.00	4.00	0.0930	0.38	22.67	0.47	12.27	Seed	3.55	5	0.030	18.78	7.89	2.61	43.52	0.45	14.50
												Jute Mat	3.54	5	0.040	18.83	6.50	3.07	43.47	0.53	15.29
												Temp. Mat	3.54	5	0.040	18.83	6.50	3.07	43.47	0.53	15.29
												Perm, Type 1	3.54	5	0.040	18.83	6.50	3.07	43.47	0.53	15.29
												Perm, Type 2	3.54	5	0.040	18.83	6.50	3.07	43.47	0.53	15.29
												Perm, Type 3	3.54	5	0.040	18.83	6.50	3.07	43.47	0.53	15.29
												Perm, Type 3	4.08	10	0.040	19.49	6.80	3.32	50.02	0.57	15.72

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp D sections 520+00 TO 532+00 Right **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
520+00	521+00	R	100.00	10.00	8.00	4.00	0.0290	0.05	0.05	0.40	0.02	Seed	4.19	5	0.030	12.83	0.54	0.03	0.09	0.02	10.19
												Seed	4.85	10	0.040	13.23	0.46	0.04	0.10	0.02	10.26
521+00	528+00	R	700.00	10.00	8.00	4.00	0.0134	1.60	1.65	0.44	0.73	Seed	3.45	5	0.030	19.91	1.53	0.13	2.50	0.15	11.80
												Seed	3.90	10	0.040	21.32	1.33	0.16	2.83	0.19	12.29
528+00	528+50	R	50.00	10.00	8.00	12.00	0.0380	0.31	1.97	0.77	0.97	Seed	3.41	5	0.030	20.28	2.28	0.30	3.30	0.13	12.56
												Seed	3.86	10	0.040	21.74	1.97	0.39	3.72	0.16	13.25
528+50	529+00	R	50.00	10.00	8.00	12.00	0.0050	0.31	2.27	0.77	1.20	Seed	3.36	5	0.030	20.94	1.25	0.08	4.04	0.26	15.14
												Seed	3.79	10	0.040	22.52	1.07	0.10	4.55	0.32	16.45
529+00	530+50	R	150.00	10.00	5.00	4.00	0.0260	0.25	2.52	0.54	1.34	Seed	3.28	5	0.030	22.00	2.35	0.28	4.38	0.17	11.55
												Seed	3.68	10	0.040	23.72	2.05	0.36	4.92	0.22	11.97
530+50	531+00	R	50.00	10.00	4.00	4.00	0.0070	0.06	2.59	0.58	1.37	Seed	3.23	5	0.030	22.52	1.57	0.11	4.45	0.26	12.05
												Seed	3.63	10	0.040	24.33	1.36	0.14	4.99	0.32	12.60
531+00	532+00	R	100.00	10.00	4.00	4.00	0.0330	0.10	2.69	0.63	1.44	Seed	3.19	5	0.030	23.16	2.60	0.34	4.59	0.17	11.32

DITCH ANALYSIS

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
												Seed	3.57	10	0.040	25.07	2.26	0.43	5.14	0.21	11.68

DITCH ANALYSIS

PID : 19415 **Date :** 12/07/2006 **Project :** SR 823 Portsmouth Bypass **Location :** Portsmouth Ohio

Description : Ditch analysis calculations for CR 28 Ramp D sections 540+50 TO 543+00 Left **Designer :** mdc

Rainfall Area : D

Allowable Shears

	Seed:	0.40	**Jute Mat:** 0.45	**Temporary Mat:**	1.00
Permanent Mat	**Type 1:**	2.00	**Type 2:** 3.00	**Type 3:**	5.00
RCP	**Type B:**	6.00			

(*) Warning: Grade is steeper than allowable. If value is parantheses, design parameters have been exceeded. - See user manual.

STATION BEGIN	STATION END	SIDE	LENGTH (ft.)	RADIUS WIDTH (ft.)	IN SLOPE (ft./ft.)	BACK SLOPE (ft./ft.)	GRADE (ft./ft.)	AREA (acres)	AREA SUM (acres)	RUNOFF COEFF.	CA (Sum)	PROTECT TYPE	RAIN INT. (in./hr.)	STORM FREQ. (yrs.)	MANN. COEFF.	TIME FLOW (min.)	VEL. FLOW (fps.)	SHEAR (lbs./ sq.ft.)	DESIGN FLOW (cfs.)	DEPTH FLOW (ft.)	WIDTH FLOW (ft.)
540+50	541+00	L	50.00	10.00	6.00	4.00	0.0420	0.07	0.07	0.62	0.04	Seed	4.44	5	0.030	11.03	0.83	0.06	0.19	0.02	10.23
												Seed	5.19	10	0.040	11.12	0.75	0.08	0.22	0.03	10.30
541+00	541+50	L	50.00	10.00	6.00	4.00	0.1000*	0.08	0.15	0.59	0.09	Seed	4.36	5	0.030	11.61	1.41	0.17	0.39	0.03	10.28
												Seed	5.08	10	0.040	11.78	1.26	0.22	0.46	0.04	10.36
541+50	542+50	L	100.00	10.00	6.00	4.00	0.0100	0.19	0.34	0.56	0.20	Seed	4.12	5	0.030	13.38	0.92	0.05	0.81	0.08	10.85
												Seed	4.77	10	0.040	13.77	0.82	0.07	0.94	0.11	11.09
542+50	543+00	L	50.00	10.00	6.00	4.00	0.1000*	0.12	0.46	0.53	0.26	Seed	4.07	5	0.030	13.78	2.08	0.31	1.06	0.05	10.50
												Seed	4.71	10	0.040	14.22	1.84	0.40	1.22	0.06	10.64

BMP Calculations

Date: Sept. 5, 2006 Exfiltration Trench at Median

Calculation to Determine Length of Treatment Trench - Lt

Station Solved For	Impervious Area (acres)	Impervious Area (s.f.)	Total Area	(T) Treatment Percent	Cq	(left side) Lt	(right side) Lt	Rounded up to next 4 foot increment (left side) Lt	(right side) Lt
351+50	0.09	3,920.40	3,920.40	1.0	0.90	5.1210		8	
	0.28	12,196.80	12,196.80	1.0	0.90		15.9320		16
355+00		10,992.08	10,992.08	1.0	0.90	14.3583		16	
		39,291.22	39,291.22	1.0	0.90		51.3238		52
365+00		10,992.92	10,992.92	1.0	0.90	14.3594		16	
		36,630.91	36,630.91	1.0	0.90		47.8488		48
375+00		7,700.00	7,700.00	1.0	0.90	10.0581		12	
		7,700.00	7,700.00	1.0	0.90		10.0581		12
382+00		4,635.33	4,635.33	1.0	0.90	6.0549		8	
		2,690.48	2,690.48	1.0	0.90		3.5144		4
386+50		9,900.00	9,900.00	1.0	0.90	12.9318		16	
		9,900.00	9,900.00	1.0	0.90		12.9318		16
395+50		6,452.27	6,452.27	1.0	0.90	8.4282		12	
		49,523.22	49,523.22	1.0	0.90		64.6893		68
405+50		5,394.36	5,394.36	1.0	0.90	7.0463		8	
		51,477.89	51,477.89	1.0	0.90		67.2425		68
415+50		5,259.50	5,259.50	1.0	0.90	6.8702		8	
		40,296.60	40,296.60	1.0	0.90		52.6371		56
435+00		8,602.20	8,602.20	1.0	0.90	11.2365		12	
		22,533.25	22,533.25	1.0	0.90		29.4339		32
440+50	0.15	6,534.00	6,534.00	1.0	0.90	8.5350		12	
	0.15	6,534.00	6,534.00	1.0	0.90		8.5350		12
446+90		7,036.30	7,036.30	1.0	0.90	9.1911		12	
		7,036.30	7,036.30	1.0	0.90		9.1911		12
447+74 from back sta.	0.02	871.20	871.20	1.0	0.90	1.1380		4	
	0.02	871.20	871.20	1.0	0.90		1.1380		4
447+74 from up sta.	0.02	871.20	871.20	1.0	0.90	1.1380		4	
	0.02	871.20	871.20	1.0	0.90		1.1380		4
448+60	0.24	10,454.40	10,454.40	1.0	0.90	13.6560		16	
	0.24	10,454.40	10,454.40	1.0	0.90		13.6560		16
458+00	0.24	10,454.40	10,454.40	1.0	0.90	13.6560		16	
	0.24	10,454.40	10,454.40	1.0	0.90		13.6560		16
471+50		7849.21	7849.21	1.0	0.90	10.3		12	
		4272.08	4272.08	1.0	0.90		5.6		8
477+00		15798.34	15798.34	1.0	0.90	20.6		24	
		3821.89	3821.89	1.0	0.90		5.0		8
480+00		29839.46	29839.46	1.0	0.90	39.0		40	
		7307.24	7307.24	1.0	0.90		9.5		12
482+64		9270.76	9270.76	1.0	0.90	12.1		16	
		2242.33	2242.33	1.0	0.90		2.9		4
489+00		20829.17	20829.17	1.0	0.90	27.2		28	
		4398.84	4398.84	1.0	0.90		5.7		8
489+88 (from sta. 489+00)		3091.24	3091.24	1.0	0.90	4.0		8	
		745.14	745.14	1.0	0.90		1.0		4
489+88(from sta. 490+75)		3091.24	3091.24	1.0	0.90	4.0		8	
		745.14	745.14	1.0	0.90		1.0		4
490+75		11320.12	11320.12	1.0	0.90	14.8		16	
		3234.98	3234.98	1.0	0.90		4.2		8
494+00		11021.4	11021.4	1.0	0.90	14.4		16	
		10978.6	10978.6	1.0	0.90		14.3		16
504+00		17138.28	17138.28	1.0	0.90	22.4		24	
		17071.72	17071.72	1.0	0.90		22.3		24
527+50		8762.02	8762.02	1.0	0.90	11.4		12	
		8727.98	8727.98	1.0	0.90		11.4		12
533+00		6061.77	6061.77	1.0	0.90	7.9		8	
		6038.23	6038.23	1.0	0.90		7.9		8
533+96		1058.05	1058.05	1.0	0.90	1.4		4	
		1053.95	1053.95	1.0	0.90		1.4		4
533+96		980.91	980.91	1.0	0.90	1.3		4	
		977.09	977.09	1.0	0.90		1.3		4
534+85		10084.59	10084.59	1.0	0.90	13.2		16	
		10045.41	10045.41	1.0	0.90		13.1		16
544+00		9536.59	9536.59	1.0	0.90	12.5		16	
		11718.46	11718.46	1.0	0.90		15.3		16
553+00		4996.04	4996.04	1.0	0.90	6.5		8	
		35480.82	35480.82	1.0	0.90		46.3		48

Date: Oct. 23rd, 2006 Exfiltration Trench at Shoulders

Calculation to Determine Length of Treatment Trench - Lt

					(T)				Rounded up to next 4 foot increment	
		Impervious	Impervious		Treatment		LEFT	RIGHT	(left side)	(right side)
Station	Type of Structure	Area (acres)	Area (s.f.)	Total Area	Percent	Cq	Lt	Lt	Lt	Lt
355+00	CB-3	0.47	20,473.20	20,473.20	1.0	0.90	26.7429		28	
355+00	CB-3	0.17	7,405.20	7,405.20	1.0	0.90		9.6730		12
360+00	CB-3	0.59	25,700.40	25,700.40	1.0	0.90	33.5709		36	
365+00	CB-3	0.53	23,086.80	23,086.80	1.0	0.90	30.1569		32	
369+00	CB-3	0.41	17,859.60	17,859.60	1.0	0.90	23.3289		24	
415+50	CB-3	0.44	19,166.40	19,166.40	1.0	0.90	25.0359		28	
415+50	CB-3	0.23	10,018.80	10,018.80	1.0	0.90		13.0870		16
420+50	CB-3	0.42	18,295.20	18,295.20	1.0	0.90	23.8979		24	
430+00	CB-3	0.41	17,859.60	17,859.60	1.0	0.90	23.3289		24	
433+00	CB-3	0.42	18,295.20	18,295.20	1.0	0.90		23.8979		24
435+00	CB-3	0.42	18,295.20	18,295.20	1.0	0.90	23.8979		24	
437+00	CB-3	0.34	14,810.40	14,810.40	1.0	0.90		19.3460		20
440+50	CB-3	0.29	12,632.40	12,632.40	1.0	0.90		16.5010		20
448+60	CB-3	0.54	23,522.40	23,522.40	1.0	0.90	30.7259		32	
448+60	CB-3	0.62	27,007.20	27,007.20	1.0	0.90		35.2779		36
455+00	CB-3	0.59	25,700.40	25,700.40	1.0	0.90	33.5709		36	
483+33	I-3D	0.21	9,147.60	9,147.60	1.0	0.90		11.9490		12
489+00	I-3D	0.52	22,651.20	22,651.20	1.0	0.90		29.5879		32
489+88	I-3D	0.08	3,484.80	3,484.80	1.0	0.90	4.5520		8	
489+88	I-3D	0.08	3,484.80	3,484.80	1.0	0.90		4.5520		8
490+75	I-3D	0.37	16,117.20	16,117.20	1.0	0.90		21.0529		24
494+00	I-3D	0.86	37,461.60	37,461.60	1.0	0.90		48.9339		52
504+00	I-3D	0.52	22,651.20	22,651.20	1.0	0.90		29.5879		32
507+50	CB-3	0.1	4,356.00	4,356.00	1.0	0.90	5.6900		8	
508+50	CB-3	0.65	28,314.00	28,314.00	1.0	0.90	36.9849		40	
511+00	CB-3	1	43,560.00	43,560.00	1.0	0.90		56.8999		60
514+00	I-3D	0.81	35,283.60	35,283.60	1.0	0.90	46.0889		48	
526+50	I-3D(CR28A)	0.42	18,295.20	18,295.20	1.0	0.90		23.8979		24

Cq = 0.9 when all drainage area is impervious.
Cq = 0.858i3-0.78i2+0.774i+0.04
(see figure 1116-2)

From Station	To Station	Impervious Area (SF)	Total Area (SF)	Ratio Area I	Treatment Percent	Precipitation (IN)	Cq	WQv (CF)	Ditch Width	Ditch Length	Fore Slope ?:1	Back Slope ?:1	Ditch Volume (CF)	Dv>(2*WQv)
352+00 LT	353+88 LT	6387.43	74176.09	0.09	1.00	0.75	0.10	40.49	10.00	188.00	3.00	2.00	1057.50	TRUE
355+00 LT	353+88 LT	3822.20	32471.42	0.12	1.00	0.75	0.12	29.07	15.00	112.00	4.00	3.00	938.00	TRUE
409+00 LT	403+44 LT	25368.21	290111.28	0.09	1.00	0.75	0.10	162.18	10.00	530.00	4.00	3.00	3113.75	TRUE
409+00 LT	412+91 LT	13052.89	162238.25	0.08	1.00	0.75	0.10	79.68	10.00	370.00	4.00	2.00	2127.50	TRUE
415+50 LT	412+91 LT	11745.42	39942.70	0.29	1.00	0.75	0.22	162.95	10.00	260.00	4.00	3.00	1527.50	TRUE
435+00 LT	442+00 LT	21417.88	327415.64	0.07	1.00	0.75	0.09	117.17	10.00	723.00	4.00	2.00	4157.25	TRUE
448+60 LT	444+60 LT	13657.87	119525.32	0.11	1.00	0.75	0.12	102.04	10.00	426.00	4.00	2.00	2449.50	TRUE
352+00 RT	353+88 RT	1884.67	25224.42	0.07	1.00	0.75	0.09	11.05	15.00	188.00	3.00	2.00	1527.50	TRUE
355+00 RT	353+88 RT	1167.48	16036.46	0.07	1.00	0.75	0.09	6.75	15.00	112.00	2.00	3.00	910.00	TRUE
361+00 RT	364+25 RT	2756.47	55611.66	0.05	1.00	0.75	0.08	13.19	10.00	325.00	4.00	3.00	1909.38	TRUE
365+00 RT	364+25 RT	584.29	14516.81	0.04	1.00	0.75	0.07	2.55	2.00	75.00	2.00	3.00	121.88	TRUE
448+60 RT	445+39 RT	10975.88	75672.95	0.15	1.00	0.75	0.14	94.99	10.00	372.00	4.00	4.00	2232.00	TRUE
TR 234 RAMP A&B INFIELD		112367.75	546277.69	0.21	1.00	0.75	0.17	1219.71	10.00	3350.00	6.00	4.00	20937.50	TRUE
TR 234 RAMP C&D INFIELD		117586.02	518014.70	0.23	1.00	0.75	0.19	1363.54	10.00	4100.00	6.00	4.00	25625.00	TRUE
TR 234 RAMP B RT		8690.32	75139.38	0.12	1.00	0.75	0.12	65.40	10.00	400.00	4.00	4.00	2400.00	TRUE
TR 234 RAMP C 37	376+00	7273.53	272010.42	0.03	1.00	0.75	0.06	27.35	10.00	400.00	4.00	3.00	2350.00	TRUE
TR 234 RAMP D 39	TR 234 RAMP C 376+00 LT	113073.50	4445865.13	0.03	1.00	0.75	0.06	418.34	10.00	4500.00	3.00	2.00	25312.50	TRUE
403+44 LT	TR 234 RAMP D 396+50 LT	27561.00	260898.23	0.11	1.00	0.75	0.11	196.50	10.00	600.00	4.00	4.00	3600.00	TRUE
462+00 LT	467+00 LT	17148.00	228840.20	0.07	1.00	0.75	0.09	100.72	15.00	541.00	2.00	4.00	4463.25	TRUE
470+00 LT	467+50 LT	8636.44	90029.50	0.10	1.00	0.75	0.11	58.20	15.00	261.00	4.00	4.00	2218.50	TRUE
470+00 LT	475+00 LT	5571.40	203078.30	0.03	1.00	0.75	0.06	21.12	10.00	515.00	4.00	2.00	2961.25	TRUE
478+50 LT	475+50 LT	3078.30	119868.00	0.03	1.00	0.75	0.06	11.42	10.00	350.00	2.00	2.00	1925.00	TRUE
478+50 LT	484+38.46 LT	6517.00	147423.50	0.04	1.00	0.75	0.07	29.64	10.00	638.00	4.00	2.00	3668.50	TRUE
504+00 LT	486+53.57 LT	42546.70	703688.60	0.06	1.00	0.75	0.08	223.73	10.00	1882.00	4.00	4.00	11292.00	TRUE
507+37.25 LT	505+00 LT	9101.00	79399.20	0.11	1.00	0.75	0.12	68.12	15.00	252.00	2.00	4.00	2079.00	TRUE
462+00 RT	465+75 RT	12669.00	107753.00	0.12	1.00	0.75	0.12	96.30	10.00	402.00	2.00	4.00	2311.50	TRUE
28 RAMP A 526+50	CR28 RAMP A 533+67 RT	12764	78753	0.162	1.00	0.75	0.149	118.55	10	500	4	2	2875.0	TRUE
28 RAMP A 536+00	CR28 RAMP A 533+67 RT	18626	72362	0.257	1.00	0.75	0.202	235.36	12	240	4	4	1680.0	TRUE
28 RAMP B 526+50	CR28 RAMP B 516+81 RT	33472	242686	0.138	1.00	0.75	0.134	280.67	10	960	4	4	5760.0	TRUE
28 RAMP B 515+27	CR28 RAMP B 516+81 RT	6933	15542	0.446	1.00	0.75	0.306	132.69	15	150	4	4	1275.0	TRUE
28 RAMP B 526+50	535+50 RT	45192	130082	0.347	1.00	0.75	0.251	708.19	10	900	4	4	5400.0	TRUE
537+10 RT	535+50 RT	21177	61496	0.344	1.00	0.75	0.249	329.67	12	160	2	2	1040.0	TRUE
519+00 RT	527+90 RT	31710	94119	0.337	1.00	0.75	0.245	485.65	10	890	6	3	5451.3	TRUE
528+50 RT	527+90 RT	5521	10300	0.536	1.00	0.75	0.363	125.23	5	70	7	3	262.5	TRUE
520+00 LT	530+00 LT	35563	100821	0.353	1.00	0.75	0.254	563.72	8	750	8	3	4031.3	TRUE
531+70 LT	530+00 LT	5823	9558	0.609	1.00	0.75	0.416	151.42	2	170	5	5	382.5	TRUE
535+50 LT	538+50 LT	12137	62194	0.195	1.00	0.75	0.168	127.22	10	300	2	2	1650.0	TRUE
28 RAMP C 522+00	CR28 RAMP C 531+50 LT	23030	98737	0.233	1.00	0.75	0.189	272.02	10	950	3	2	5343.8	TRUE
28 RAMP C 517+00	CR28 RAMP C 507+50 LT	41808	357616	0.117	1.00	1.75	0.121	738.94	10	950	3	2	5343.8	TRUE
28 RAMP D 524+00	CR28 RAMP D 532+00 RT	12797	60501	0.212	1.00	0.75	0.177	141.52	10	800	6	4	5000.0	TRUE
28 RAMP D 520+00	CR28 RAMP D 539+50 LT	26752	823601	0.032	1.00	0.75	0.064	107.59	10	750	2	3	4218.8	TRUE
28 RAMP D 540+50	CR28 RAMP D 543+00 LT	6625	19994	0.331	1.00	0.75	0.242	100.22	10	250	6	4	1562.5	TRUE
CR28 11+00 LT	CR28 15+00 LT	9840	30647	0.321	1.00	0.75	0.237	145.45	2	400	4	4	800.0	TRUE
CR28 21+50 LT	CR28 18+00 LT	7800	37668	0.207	1.00	0.75	0.174	85.04	2	350	6	4	787.5	TRUE
CR28 32+50 LT	CR28 22+00 LT	27251	931099	0.029	1.00	0.75	0.062	105.61	2	950	6	4	2137.5	TRUE
CR28 32+50 LT	CR28 36+00 LT	9148	395320	0.023	1.00	0.75	0.058	32.88	2	350	6	4	787.5	TRUE
CR28 21+50 RT	CR28 16+30 RT	23955	48573	0.493	1.00	0.75	0.335	501.44	5	520	2	2	1560.0	TRUE

Inlet Drainage Area Maps

INLET DRAINAGE AREAS

HORIZONTAL SCALE IN FEET
0 100 200 400

SCI-823-6.81

5

TWP 237

SHUMWAY HOLLOW RD (TR 234)

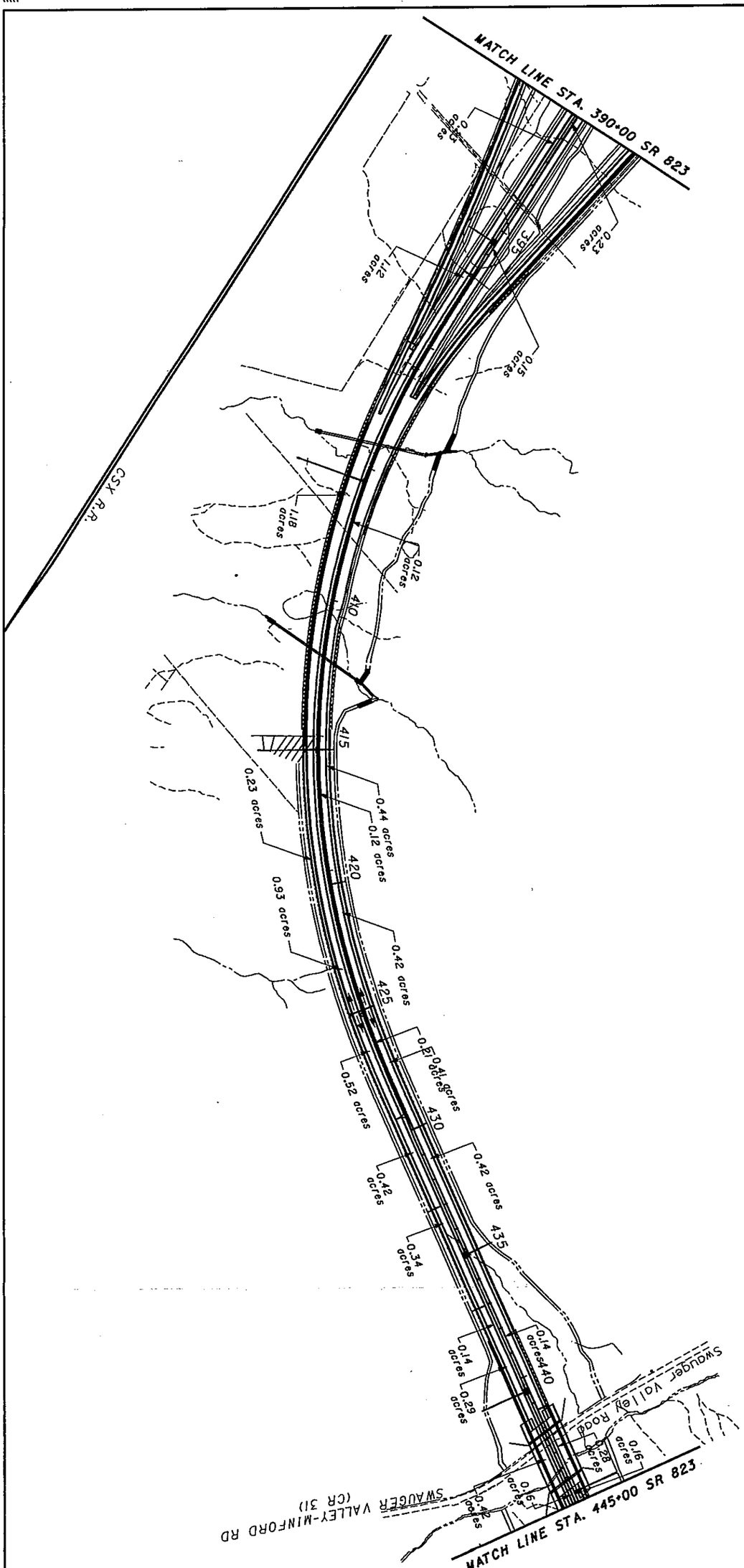
CSX R.R.

MATCH LINE STA. 390+00 SR 823

paved parking

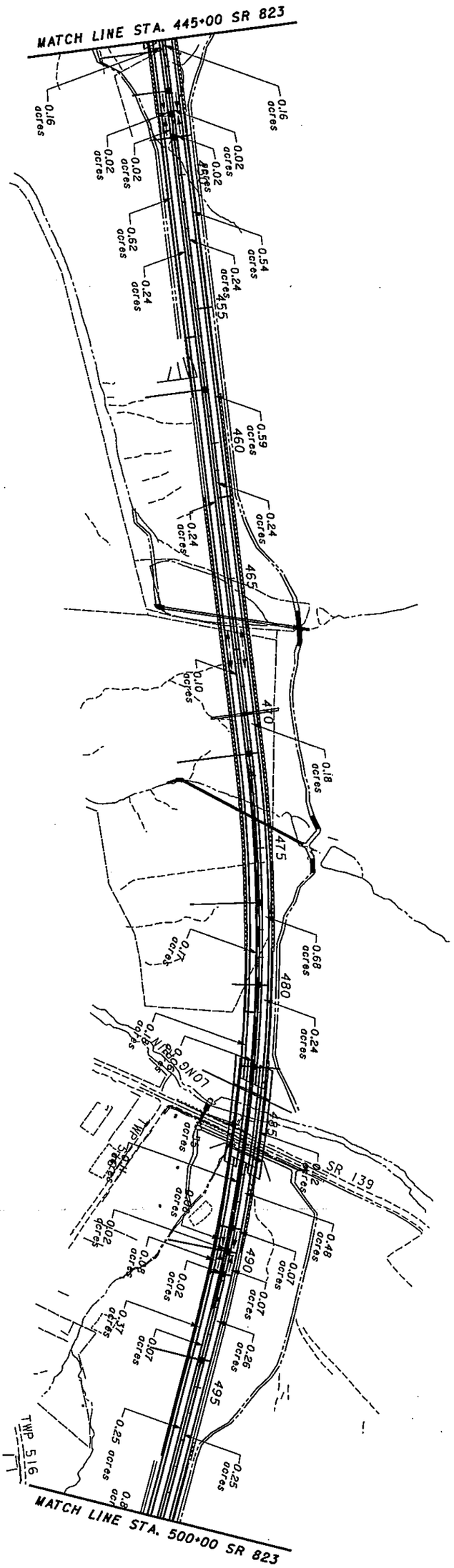
Portsmouth Airport

0.02 acres
0.09 acres
0.25 acres
0.47 acres
0.59 acres
0.53 acres
0.25 acres
0.41 acres
0.03 acres
0.04 acres
0.28 acres
0.90 acres
0.17 acres
0.85 acres
0.19 acres
0.23 acres
0.11 acres
0.18 acres
0.35 acres
0.09 acres



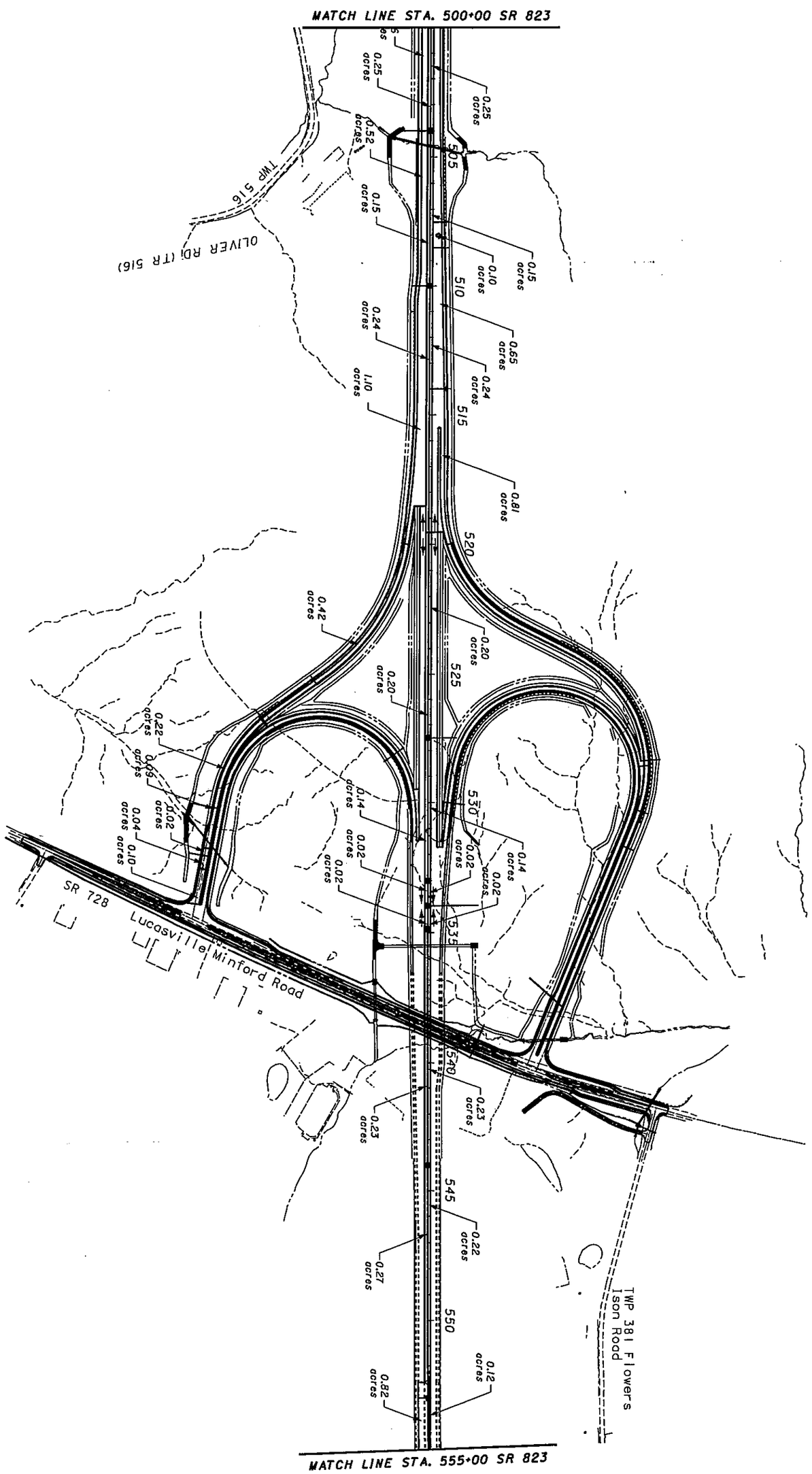
INLET DRAINAGE AREAS

HORIZONTAL SCALE IN FEET
0 100 200 400



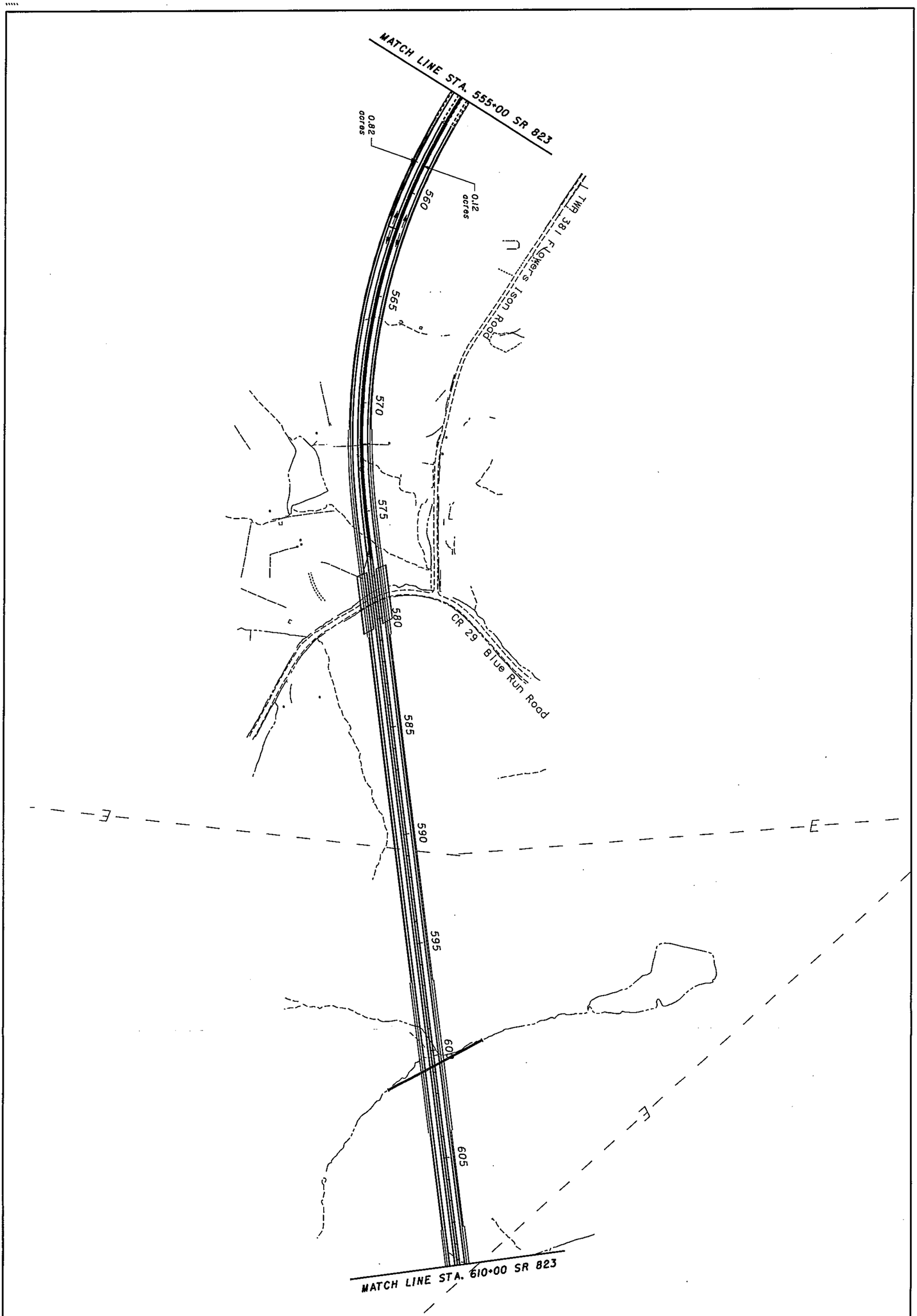
3/5	SCI-823-6.81	INLET DRAINAGE AREAS

0 200 100 400
HORIZONTAL SCALE IN FEET



4/5	SCI-823-6.81	INLET DRAINAGE AREAS

0 200
100 400
HORIZONTAL SCALE IN FEET



5/5	SCI-823-6.81	INLET DRAINAGE AREAS	0 200 100 400 HORIZONTAL SCALE IN FEET