



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH
Description : Proposed Drive Pipe - 550+27 RT TO 550+82 RT **Designer :** SJD

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.) : 810.03 **Outlet Invert Elevation (ft.) :** 809.84 **Tailwater Elevation (ft.) :** 810.31 **Overflow Elevation (ft.) :** 812.45
Allowable Headwater Elevation (ft.) : 811.45 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 55.00 **Culvert Slope (ft./ft.) :** 0.0035 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 1.50 @ 10 yrs. **Flood Discharge (cfs) :** 1.80 @ 25 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													
1.50	1	12 in.	810.78	810.79	1 - A	3.65	0.59	0.52	0.0120	OUTLET*	0.00	D	0.00
1.50	1	15 in.	810.71	810.73	1 - A	3.41	0.52	0.49	0.0120	OUTLET*	0.00	D + 1	0.00
1.80	1	12 in.	810.86	810.88	1 - A	3.88	0.67	0.57	0.0120	OUTLET*	0.00	F	0.00
1.80	1	15 in.	810.78	810.80	1 - A	3.61	0.58	0.53	0.0120	OUTLET*	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)													
1.50	1	12 in.	810.80	811.02	1 - A	3.65	0.91	0.52	0.0251	OUTLET*	0.00	D	0.00
1.50	1	15 in.	810.73	810.89	1 - A	3.41	0.81	0.49	0.0250	OUTLET*	0.00	D + 1	0.00
1.80	1	12 in.	810.90	811.30	2 - F	3.88	1.00	0.57	0.0251	OUTLET**	0.00	F	0.00
1.80	1	15 in.	810.81	810.99	1 - A	3.61	0.94	0.53	0.0250	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													



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	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.)
Diameter exceeds 1.25 HWA	1.50	1	36 in.	810.56	810.65	1 - A	2.12	0.58	0.38	0.0281	OUTLET*	0.00	D	0.00
	1.50	1	42 in.	810.57	810.62	1 - A	1.95	0.55	0.36	0.0278	OUTLET*	0.00	D + 1	0.00
	1.80	1	36 in.	810.60	810.71	1 - A	2.54	0.64	0.42	0.0281	OUTLET*	0.00	F	0.00
	1.80	1	42 in.	810.61	810.68	1 - A	2.34	0.61	0.40	0.0278	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	0.75	2	36 in.	810.46	810.53	1 - B	1.06	0.42	0.27	0.0281	OUTLET*	0.00	D	0.00
	0.75	2	42 in.	810.49	810.51	1 - B	0.97	0.40	0.26	0.0278	OUTLET*	0.00	D + 1	0.00
	0.90	2	36 in.	810.48	810.55	1 - B	1.27	0.45	0.29	0.0281	OUTLET*	0.00	F	0.00
	0.90	2	42 in.	810.51	810.55	1 - B	1.17	0.43	0.28	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	1.50	1	60 in.	810.67	810.59	1 - C	1.29	0.55	0.33	0.0332	INLET	0.00	D	0.00
	1.50	1	66 in.	810.71	810.57	1 - C	1.28	0.53	0.32	0.0330	INLET	0.00	D + 1	0.00
	1.80	1	60 in.	810.69	810.65	1 - C	1.36	0.60	0.36	0.0332	INLET	0.00	F	0.00
	1.80	1	66 in.	810.72	810.62	1 - C	1.35	0.58	0.36	0.0330	INLET	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	0.75	2	60 in.	810.62	810.49	1 - C	1.05	0.39	0.23	0.0332	INLET	0.00	D	0.00
	0.75	2	66 in.	810.66	810.48	1 - C	1.04	0.38	0.23	0.0330	INLET	0.00	D + 1	0.00
	0.90	2	60 in.	810.63	810.53	1 - C	1.11	0.43	0.26	0.0332	INLET	0.00	F	0.00
	0.90	2	66 in.	810.67	810.52	1 - C	1.10	0.42	0.25	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	1.50	1	60 in.	810.67	810.57	1 - C	1.53	0.49	0.33	0.0260	INLET	0.00	D	0.00
	1.50	1	66 in.	810.71	810.57	1 - C	1.51	0.47	0.32	0.0260	INLET	0.00	D + 1	0.00
	1.80	1	60 in.	810.69	810.61	1 - C	1.62	0.53	0.36	0.0260	INLET	0.00	F	0.00
	1.80	1	66 in.	810.72	810.59	1 - C	1.60	0.52	0.36	0.0260	INLET	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	0.75	2	60 in.	810.62	810.46	1 - C	1.24	0.35	0.23	0.0260	INLET	0.00	D	0.00



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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.)
0.75	2	66 in.	810.66	810.45	1 - C	1.22	0.34	0.23	0.0260	INLET	0.00	D + 1	0.00
0.90	2	60 in.	810.63	810.49	1 - C	1.31	0.38	0.26	0.0260	INLET	0.00	F	0.00
0.90	2	66 in.	810.67	810.49	1 - C	1.30	0.37	0.25	0.0260	INLET	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH

Description : Proposed Drive Pipe - 550+89 LT TO 551+48 LT

Designer : SJD

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.) : 809.81 **Outlet Invert Elevation (ft.) :** 809.60 **Tailwater Elevation (ft.) :** 810.69 **Overflow Elevation (ft.) :** 812.25
Allowable Headwater Elevation (ft.) : 811.25 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 59.00 **Culvert Slope (ft./ft.) :** 0.0036 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 7.60 @ 10 yrs. **Flood Discharge (cfs) :** 9.20 @ 25 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							
Diameter exceeds 1.25 HWA	7.60	1	27 in.	811.14	811.18	1 - B	3.98	0.96	0.95	0.0120	OUTLET*	0.00	D	0.00	
	7.60	1	24 in.	811.21	811.25	1 - B	4.34	1.02	0.98	0.0120	OUTLET*	0.00	D - 1	0.00	
	7.60	1	21 in.	811.29	811.33	1 - A	4.83	1.12	1.02	0.0120	OUTLET*	0.00	D - 2	0.00	
	7.60	1	30 in.	811.08	811.14	1 - B	3.70	0.92	0.92	0.0120	OUTLET*	0.00	D + 1	0.00	
	9.20	1	27 in.	811.30	811.34	1 - B	4.82	1.07	1.04	0.0120	OUTLET*	0.00	F	0.00	
	9.20	1	24 in.	811.37	811.41	1 - A	5.26	1.15	1.08	0.0120	OUTLET*	0.00	F - 1	0.00	
	9.20	1	21 in.	811.47	811.52	1 - A	5.61	1.30	1.13	0.0120	OUTLET*	0.00	F - 2	0.00	
	9.20	1	30 in.	811.23	811.28	1 - B	4.48	1.02	1.01	0.0120	OUTLET*	0.00	F + 1	0.00	
	3.80	2	15 in.	810.97	811.04	1 - B	3.35	0.94	0.79	0.0120	OUTLET	0.00	D	0.00	
	3.80	2	12 in.	811.23	811.69	2 - G	4.84	1.00	0.83	0.0120	OUTLET	0.00	D - 1	0.00	
	3.80	2	18 in.	810.88	810.95	1 - B	2.76	0.80	0.74	0.0120	OUTLET*	0.00	D + 1	0.00	



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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.)
4.60	2	15 in.	811.12	811.21	1 - A	4.05	1.14	0.87	0.0120	OUTLET	0.00	F	0.00
4.60	2	12 in.	811.57	812.16	2 - G	5.86	1.00	0.89	0.0120	OUTLET	0.00	F - 1	0.00
4.60	2	18 in.	811.00	811.06	1 - B	3.34	0.90	0.82	0.0120	OUTLET*	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	7.60	1	36 in.	811.02	811.23	1 - A	3.28	1.23	0.87	0.0241	OUTLET*	0.00	D	0.00
	7.60	1	33 in.	811.07	811.29	1 - A	3.47	1.29	0.89	0.0241	OUTLET*	0.00	D - 1	0.00
	7.60	1	30 in.	811.13	811.35	1 - A	3.70	1.37	0.92	0.0244	OUTLET*	0.00	D - 2	0.00
	7.60	1	42 in.	810.94	811.15	1 - A	2.97	1.14	0.83	0.0237	OUTLET*	0.00	D + 1	0.00
	9.20	1	36 in.	811.17	811.39	1 - A	3.97	1.37	0.96	0.0241	OUTLET*	0.00	F	0.00
	9.20	1	33 in.	811.22	811.44	1 - A	4.20	1.44	0.98	0.0241	OUTLET*	0.00	F - 1	0.00
	9.20	1	30 in.	811.28	811.51	1 - A	4.48	1.55	1.01	0.0244	OUTLET*	0.00	F - 2	0.00
	9.20	1	42 in.	811.07	811.31	1 - A	3.60	1.27	0.92	0.0237	OUTLET*	0.00	F + 1	0.00
	3.80	2	18 in.	810.91	811.20	1 - A	2.76	1.37	0.74	0.0249	OUTLET*	0.00	D	0.00
	3.80	2	15 in.	811.05	811.72	2 - F	3.35	1.25	0.79	0.0250	OUTLET	0.00	D - 1	0.00
	2.60	2	12 in.	811.61	813.87	2 - G	3.31	1.00	0.69	0.0251	OUTLET	1.20	D - 2	0.00
	3.80	2	21 in.	810.84	811.07	1 - A	2.41	1.15	0.71	0.0248	OUTLET*	0.00	D + 1	0.00
	4.60	2	18 in.	811.05	811.37	1 - A	3.34	1.37	0.82	0.0249	OUTLET*	0.00	F	0.00
	4.60	2	15 in.	811.28	812.20	2 - F	4.05	1.25	0.87	0.0250	OUTLET	0.00	F - 1	0.00
	2.60	2	12 in.	812.15	815.35	2 - G	3.31	1.00	0.69	0.0251	OUTLET	2.00	F - 2	0.00
	4.60	2	21 in.	810.96	811.21	1 - A	2.92	1.33	0.79	0.0248	OUTLET*	0.00	F + 1	0.00

Corrugated Metal Pipe (3 x 1 in. corrugations)

Diameter exceeds 1.25 HWA	7.60	1	42 in.	810.94	811.20	1 - A	2.97	1.24	0.83	0.0278	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.)
	7.60	1	36 in.	811.02	811.28	1 - A	3.28	1.34	0.87	0.0281	OUTLET*	0.00	D - 1	0.00
	7.60	1	48 in.	810.88	811.13	1 - A	2.74	1.17	0.80	0.0275	OUTLET*	0.00	D + 1	0.00
	9.20	1	42 in.	811.07	811.34	1 - A	3.60	1.38	0.92	0.0278	OUTLET*	0.00	F	0.00
	9.20	1	36 in.	811.17	811.43	1 - A	3.97	1.50	0.96	0.0281	OUTLET*	0.00	F - 1	0.00
	9.20	1	48 in.	811.00	811.27	1 - A	3.32	1.30	0.88	0.0275	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	3.80	2	36 in.	810.63	810.92	1 - B	1.64	0.93	0.61	0.0281	OUTLET*	0.00	D	0.00
	3.80	2	42 in.	810.59	810.88	1 - B	1.49	0.87	0.58	0.0278	OUTLET*	0.00	D + 1	0.00
	4.60	2	36 in.	810.72	811.01	1 - B	1.98	1.02	0.67	0.0281	OUTLET*	0.00	F	0.00
	4.60	2	42 in.	810.67	810.95	1 - B	1.80	0.96	0.64	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	7.60	1	60 in.	810.83	811.10	1 - A	2.40	1.19	0.75	0.0332	OUTLET*	0.00	D	0.00
	7.60	1	66 in.	810.82	811.06	1 - A	2.28	1.15	0.73	0.0330	OUTLET*	0.00	D + 1	0.00
	9.20	1	60 in.	810.92	811.22	1 - A	2.91	1.31	0.83	0.0332	OUTLET*	0.00	F	0.00
	9.20	1	66 in.	810.91	811.18	1 - A	2.76	1.27	0.81	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	3.80	2	60 in.	810.60	810.85	1 - B	1.20	0.85	0.53	0.0332	OUTLET*	0.00	D	0.00
	3.80	2	66 in.	810.62	810.83	1 - B	1.14	0.82	0.52	0.0330	OUTLET*	0.00	D + 1	0.00
	4.60	2	60 in.	810.65	810.90	1 - B	1.46	0.93	0.58	0.0332	OUTLET*	0.00	F	0.00
	4.60	2	66 in.	810.66	810.88	1 - B	1.38	0.90	0.57	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	7.60	1	60 in.	810.83	811.08	1 - B	2.40	1.06	0.75	0.0260	OUTLET*	0.00	D	0.00
	7.60	1	66 in.	810.82	811.05	1 - B	2.28	1.03	0.73	0.0260	OUTLET*	0.00	D + 1	0.00
	9.20	1	60 in.	810.92	811.15	1 - A	2.91	1.16	0.83	0.0260	OUTLET*	0.00	F	0.00
	9.20	1	66 in.	810.91	811.11	1 - A	2.76	1.13	0.81	0.0260	OUTLET*	0.00	F + 1	0.00



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	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.)
Diameter exceeds 1.25 HWA	3.80	2	60 in.	810.60	810.82	1 - B	1.20	0.75	0.53	0.0260	OUTLET*	0.00	D	0.00
	3.80	2	66 in.	810.62	810.81	1 - B	1.14	0.73	0.52	0.0260	OUTLET*	0.00	D + 1	0.00
	4.60	2	60 in.	810.65	810.87	1 - B	1.46	0.83	0.58	0.0260	OUTLET*	0.00	F	0.00
	4.60	2	66 in.	810.66	810.85	1 - B	1.38	0.80	0.57	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH
Description : Proposed Drive Pipe - 554+00 RT TO 554+40 RT **Designer :** SJD

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.) : 808.72 **Outlet Invert Elevation (ft.) :** 808.58 **Tailwater Elevation (ft.) :** 809.96 **Overflow Elevation (ft.) :** 812.16
Allowable Headwater Elevation (ft.) : 811.16 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 40.00 **Culvert Slope (ft./ft.) :** 0.0035 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 12.50 @ 10 yrs. **Flood Discharge (cfs) :** 15.20 @ 25 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							
12.50	1	21 in.	810.78	810.84	2 - F	6.14	1.75	1.32	0.0120	OUTLET*	0.00	D	0.00
12.50	1	18 in.	811.31	811.41	2 - F	7.35	1.50	1.33	0.0120	OUTLET**	0.00	D - 1	0.00
10.30	1	15 in.	812.76	813.16	2 - G	8.39	1.25	1.19	0.0120	OUTLET	2.20	D - 2	0.00
12.50	1	24 in.	810.59	810.64	1 - A	5.41	1.43	1.27	0.0120	OUTLET*	0.00	D + 1	0.00
15.20	1	21 in.	811.18	811.23	2 - F	7.16	1.75	1.44	0.0120	OUTLET**	0.00	F	0.00
15.20	1	18 in.	812.05	812.12	2 - F	8.82	1.50	1.41	0.0120	OUTLET**	0.00	F - 1	0.00
10.30	1	15 in.	814.27	814.70	2 - G	8.39	1.25	1.19	0.0120	OUTLET	4.90	F - 2	0.00
15.20	1	24 in.	810.84	810.91	1 - A	6.44	1.74	1.41	0.0120	OUTLET*	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)													
12.50	1	24 in.	810.73	811.12	2 - F	5.41	2.00	1.27	0.0247	OUTLET**	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.)
	12.50	1	21 in.	811.15	811.81	2 - F	6.14	1.75	1.32	0.0248	OUTLET**	0.00	D - 1	0.00
	9.80	1	18 in.	812.16	813.54	2 - F	5.76	1.50	1.21	0.0249	OUTLET	2.70	D - 2	0.00
	12.50	1	27 in.	810.56	810.86	1 - A	4.89	2.05	1.23	0.0245	OUTLET*	0.00	D + 1	0.00
	15.20	1	24 in.	811.12	811.62	2 - F	6.44	2.00	1.41	0.0247	OUTLET**	0.00	F	0.00
	13.60	1	21 in.	811.81	812.69	2 - F	6.68	1.75	1.37	0.0248	OUTLET**	1.60	F - 1	0.00
	9.80	1	18 in.	813.29	815.27	2 - F	5.76	1.50	1.21	0.0249	OUTLET	5.40	F - 2	0.00
	15.20	1	27 in.	810.82	811.15	1 - A	5.94	2.05	1.36	0.0245	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	12.50	1	36 in.	810.34	810.61	1 - A	3.94	1.82	1.12	0.0281	OUTLET*	0.00	D	0.00
	12.50	1	42 in.	810.23	810.51	1 - A	3.55	1.64	1.07	0.0278	OUTLET*	0.00	D + 1	0.00
	15.20	1	36 in.	810.53	810.81	1 - A	4.79	2.09	1.24	0.0281	OUTLET*	0.00	F	0.00
	15.20	1	42 in.	810.41	810.69	1 - A	4.31	1.84	1.19	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	12.50	1	60 in.	810.02	810.37	1 - A	2.83	1.54	0.97	0.0332	OUTLET*	0.00	D	0.00
	12.50	1	66 in.	809.99	810.34	1 - A	2.68	1.49	0.94	0.0330	OUTLET*	0.00	D + 1	0.00
	15.20	1	60 in.	810.16	810.51	1 - A	3.45	1.71	1.07	0.0332	OUTLET*	0.00	F	0.00
	15.20	1	66 in.	810.12	810.46	1 - A	3.26	1.64	1.04	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	6.25	2	60 in.	809.66	810.10	1 - B	1.42	1.09	0.68	0.0332	OUTLET*	0.00	D	0.00
	6.25	2	66 in.	809.66	810.08	1 - B	1.34	1.05	0.67	0.0330	OUTLET*	0.00	D + 1	0.00
	7.60	2	60 in.	809.74	810.14	1 - B	1.72	1.20	0.75	0.0332	OUTLET*	0.00	F	0.00
	7.60	2	66 in.	809.73	810.12	1 - B	1.63	1.16	0.73	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	12.50	1	60 in.	810.02	810.34	1 - B	2.83	1.36	0.97	0.0260	OUTLET*	0.00	D	0.00
	12.50	1	66 in.	809.99	810.32	1 - B	2.68	1.32	0.94	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.)
	15.20	1	60 in.	810.16	810.47	1 - A	3.45	1.51	1.07	0.0260	OUTLET*	0.00	F	0.00
	15.20	1	66 in.	810.12	810.41	1 - A	3.26	1.45	1.04	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	6.25	2	60 in.	809.66	810.07	1 - B	1.42	0.96	0.68	0.0260	OUTLET*	0.00	D	0.00
	6.25	2	66 in.	809.66	810.06	1 - B	1.34	0.94	0.67	0.0260	OUTLET*	0.00	D + 1	0.00
	7.60	2	60 in.	809.74	810.12	1 - B	1.72	1.06	0.75	0.0260	OUTLET*	0.00	F	0.00
	7.60	2	66 in.	809.73	810.11	1 - B	1.63	1.03	0.73	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH

Description : Proposed Drive Pipe - 554+76 RT TO 555+08 RT

Designer : SJD

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.) : 808.46 **Outlet Invert Elevation (ft.) :** 808.35 **Tailwater Elevation (ft.) :** 809.83 **Overflow Elevation (ft.) :** 812.14
Allowable Headwater Elevation (ft.) : 811.14 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 31.00 **Culvert Slope (ft./ft.) :** 0.0035 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 14.50 @ 10 yrs. **Flood Discharge (cfs) :** 17.60 @ 25 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							
14.50	1	21 in.	810.81	810.83	2 - F	6.68	1.75	1.41	0.0120	OUTLET**	0.00	D	0.00
14.50	1	18 in.	811.59	811.59	2 - E	8.21	1.50	1.39	0.0120	INLET	0.00	D - 1	0.00
11.10	1	15 in.	813.57	813.75	2 - G	9.05	1.25	1.21	0.0120	OUTLET	3.40	D - 2	0.00
14.50	1	24 in.	810.52	810.58	1 - A	5.82	1.63	1.37	0.0120	OUTLET*	0.00	D + 1	0.00
17.60	1	21 in.	811.34	811.31	2 - E	7.32	1.75	1.53	0.0120	INLET	0.00	F	0.00
16.30	1	18 in.	812.56	812.42	2 - E	9.22	1.50	1.43	0.0120	INLET	1.30	F - 1	0.00
11.10	1	15 in.	815.93	815.61	2 - G	9.05	1.25	1.21	0.0120	OUTLET	6.50	F - 2	0.00
17.60	1	24 in.	810.83	810.87	2 - F	6.91	2.00	1.51	0.0120	OUTLET*	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)													
14.50	1	24 in.	810.75	811.12	2 - F	5.82	2.00	1.37	0.0247	OUTLET**	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.)
	14.50	1	21 in.	811.37	811.94	2 - F	6.68	1.75	1.41	0.0248	OUTLET**	0.00	D - 1	0.00
	10.80	1	18 in.	812.73	813.97	2 - F	6.13	1.50	1.26	0.0249	OUTLET	3.70	D - 2	0.00
	14.50	1	27 in.	810.49	810.79	1 - A	5.23	2.05	1.33	0.0245	OUTLET*	0.00	D + 1	0.00
	17.60	1	24 in.	811.26	811.70	2 - F	6.91	2.00	1.51	0.0247	OUTLET**	0.00	F	0.00
	15.10	1	21 in.	812.24	812.95	2 - F	6.96	1.75	1.44	0.0248	OUTLET**	2.50	F - 1	0.00
	10.80	1	18 in.	814.12	815.93	2 - F	6.13	1.50	1.26	0.0249	OUTLET	6.80	F - 2	0.00
	17.60	1	27 in.	810.81	811.09	1 - A	6.35	2.05	1.47	0.0245	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	14.50	1	36 in.	810.22	810.50	1 - A	4.17	2.01	1.21	0.0281	OUTLET*	0.00	D	0.00
	14.50	1	42 in.	810.11	810.39	1 - A	3.75	1.79	1.16	0.0278	OUTLET*	0.00	D + 1	0.00
	17.60	1	36 in.	810.42	810.72	1 - A	5.07	2.35	1.34	0.0281	OUTLET*	0.00	F	0.00
	17.60	1	42 in.	810.30	810.57	1 - A	4.55	2.01	1.28	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	14.50	1	60 in.	809.87	810.24	1 - A	2.98	1.66	1.05	0.0332	OUTLET*	0.00	D	0.00
	14.50	1	66 in.	809.82	810.19	1 - A	2.81	1.60	1.02	0.0330	OUTLET*	0.00	D + 1	0.00
	17.60	1	60 in.	810.03	810.38	1 - A	3.62	1.84	1.16	0.0332	OUTLET*	0.00	F	0.00
	17.60	1	66 in.	809.97	810.32	1 - A	3.42	1.77	1.13	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	7.25	2	60 in.	809.46	809.95	1 - B	1.49	1.17	0.74	0.0332	OUTLET*	0.00	D	0.00
	7.25	2	66 in.	809.46	809.94	1 - B	1.41	1.13	0.72	0.0330	OUTLET*	0.00	D + 1	0.00
	8.80	2	60 in.	809.55	810.00	1 - B	1.81	1.29	0.81	0.0332	OUTLET*	0.00	F	0.00
	8.80	2	66 in.	809.54	809.99	1 - B	1.71	1.24	0.79	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	14.50	1	60 in.	809.87	810.21	1 - B	2.98	1.46	1.05	0.0260	OUTLET*	0.00	D	0.00
	14.50	1	66 in.	809.82	810.17	1 - B	2.81	1.41	1.02	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.)
	17.60	1	60 in.	810.03	810.34	1 - A	3.62	1.62	1.16	0.0260	OUTLET*	0.00	F	0.00
	17.60	1	66 in.	809.97	810.29	1 - A	3.42	1.56	1.13	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	7.25	2	60 in.	809.46	809.94	1 - B	1.49	1.03	0.74	0.0260	OUTLET*	0.00	D	0.00
	7.25	2	66 in.	809.46	809.92	1 - B	1.41	1.00	0.72	0.0260	OUTLET*	0.00	D + 1	0.00
	8.80	2	60 in.	809.55	809.99	1 - B	1.81	1.14	0.81	0.0260	OUTLET*	0.00	F	0.00
	8.80	2	66 in.	809.54	809.97	1 - B	1.71	1.10	0.79	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH

Description : Proposed Drive Pipe - 557+16 RT TO 557+49 RT

Designer : SJD

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.) : 807.62 **Outlet Invert Elevation (ft.) :** 807.50 **Tailwater Elevation (ft.) :** 809.02 **Overflow Elevation (ft.) :** 812.25
Allowable Headwater Elevation (ft.) : 811.25 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 33.00 **Culvert Slope (ft./ft.) :** 0.0036 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 15.40 @ 10 yrs. **Flood Discharge (cfs) :** 18.80 @ 25 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							
15.40	1	18 in.	811.01	811.04	2 - G	8.71	1.50	1.41	0.0120	OUTLET	0.00	D	0.00
13.00	1	15 in.	813.30	813.54	2 - G	10.59	1.25	1.22	0.0120	OUTLET	2.40	D - 1	0.00
7.80	1	12 in.	841.18	821.41	2 - G	9.93	1.00	0.98	0.0120	OUTLET	7.60	D - 2	0.00
15.40	1	21 in.	810.11	810.13	2 - F	6.94	1.75	1.45	0.0120	OUTLET**	0.00	D + 1	0.00
18.80	1	18 in.	812.13	812.02	2 - H	10.64	1.50	1.46	0.0120	INLET	0.00	F	0.00
13.00	1	15 in.	816.46	815.76	2 - G	10.59	1.25	1.22	0.0120	OUTLET	5.80	F - 1	0.00
7.80	1	12 in.	921.14	827.48	2 - G	9.93	1.00	0.98	0.0120	OUTLET	11.00	F - 2	0.00
18.80	1	21 in.	810.73	810.69	2 - E	7.82	1.75	1.57	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)													
15.40	1	24 in.	810.05	810.47	2 - F	6.01	2.00	1.42	0.0247	OUTLET**	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.)
	15.40	1	21 in.	810.77	811.44	2 - F	6.94	1.75	1.45	0.0248	OUTLET**	0.00	D - 1	0.00
	12.50	1	18 in.	812.28	813.85	2 - G	7.07	1.50	1.33	0.0249	OUTLET	2.90	D - 2	0.00
	15.40	1	27 in.	809.74	810.04	1 - A	5.39	2.05	1.37	0.0245	OUTLET*	0.00	D + 1	0.00
	18.80	1	24 in.	810.65	811.15	2 - F	7.15	2.00	1.56	0.0247	OUTLET**	0.00	F	0.00
	17.70	1	21 in.	811.77	812.64	2 - F	7.91	1.75	1.54	0.0248	OUTLET**	1.10	F - 1	0.00
	12.50	1	18 in.	813.88	816.22	2 - G	7.07	1.50	1.33	0.0249	OUTLET	6.30	F - 2	0.00
	18.80	1	27 in.	810.11	810.47	2 - F	6.58	2.25	1.52	0.0245	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	15.40	1	36 in.	809.44	809.73	1 - A	4.28	2.08	1.25	0.0281	OUTLET*	0.00	D	0.00
	15.40	1	42 in.	809.33	809.61	1 - A	3.84	1.84	1.20	0.0278	OUTLET*	0.00	D + 1	0.00
	18.80	1	36 in.	809.66	809.97	1 - A	5.23	2.49	1.39	0.0281	OUTLET*	0.00	F	0.00
	18.80	1	42 in.	809.53	809.81	1 - A	4.69	2.08	1.33	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	15.40	1	60 in.	809.07	809.45	1 - A	3.05	1.71	1.08	0.0332	OUTLET*	0.00	D	0.00
	15.40	1	66 in.	809.03	809.40	1 - A	2.88	1.64	1.05	0.0330	OUTLET*	0.00	D + 1	0.00
	18.80	1	60 in.	809.25	809.60	1 - A	3.73	1.90	1.20	0.0332	OUTLET*	0.00	F	0.00
	18.80	1	66 in.	809.19	809.55	1 - A	3.52	1.82	1.16	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	7.70	2	60 in.	808.64	809.16	1 - B	1.53	1.19	0.76	0.0332	OUTLET*	0.00	D	0.00
	7.70	2	66 in.	808.64	809.14	1 - B	1.44	1.15	0.74	0.0330	OUTLET*	0.00	D + 1	0.00
	9.40	2	60 in.	808.74	809.20	1 - B	1.86	1.32	0.84	0.0332	OUTLET*	0.00	F	0.00
	9.40	2	66 in.	808.73	809.19	1 - B	1.76	1.27	0.82	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	15.40	1	60 in.	809.07	809.42	1 - B	3.05	1.50	1.08	0.0260	OUTLET*	0.00	D	0.00
	15.40	1	66 in.	809.03	809.38	1 - B	2.88	1.45	1.05	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.)
	18.80	1	60 in.	809.25	809.56	1 - A	3.73	1.67	1.20	0.0260	OUTLET*	0.00	F	0.00
	18.80	1	66 in.	809.19	809.51	1 - A	3.52	1.61	1.16	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	7.70	2	60 in.	808.64	809.13	1 - B	1.53	1.06	0.76	0.0260	OUTLET*	0.00	D	0.00
	7.70	2	66 in.	808.64	809.13	1 - B	1.44	1.03	0.74	0.0260	OUTLET*	0.00	D + 1	0.00
	9.40	2	60 in.	808.74	809.18	1 - B	1.86	1.17	0.84	0.0260	OUTLET*	0.00	F	0.00
	9.40	2	66 in.	808.73	809.17	1 - B	1.76	1.13	0.82	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH
Description : Proposed Drive Pipe - 561+12 RT TO 561+46 RT **Designer :** SJD

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.) : 806.23 **Outlet Invert Elevation (ft.) :** 806.11 **Tailwater Elevation (ft.) :** 807.74 **Overflow Elevation (ft.) :** 810.82
Allowable Headwater Elevation (ft.) : 809.82 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 34.00 **Culvert Slope (ft./ft.) :** 0.0035 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 17.90 @ 10 yrs. **Flood Discharge (cfs) :** 21.70 @ 25 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							
17.90	1	21 in.	809.16	809.15	2 - E	7.44	1.75	1.54	0.0120	INLET	0.00	D	0.00
17.90	1	18 in.	810.43	810.49	2 - G	10.13	1.50	1.45	0.0120	OUTLET	0.00	D - 1	0.00
12.60	1	15 in.	814.01	813.92	2 - G	10.27	1.25	1.22	0.0120	OUTLET	5.30	D - 2	0.00
17.90	1	24 in.	808.64	808.68	2 - F	6.53	2.00	1.52	0.0120	OUTLET*	0.00	D + 1	0.00
21.70	1	21 in.	809.96	809.86	2 - E	9.02	1.75	1.63	0.0120	INLET	0.00	F	0.00
18.90	1	18 in.	811.86	811.78	2 - G	10.70	1.50	1.46	0.0120	OUTLET	2.80	F - 1	0.00
12.60	1	15 in.	820.60	816.82	2 - G	10.27	1.25	1.22	0.0120	OUTLET	9.10	F - 2	0.00
21.70	1	24 in.	809.10	809.10	2 - E	6.91	2.00	1.67	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)													
17.90	1	24 in.	809.09	809.59	2 - F	6.53	2.00	1.52	0.0247	OUTLET**	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.)
	17.50	1	21 in.	810.10	810.96	2 - F	7.50	1.75	1.53	0.0248	OUTLET**	0.40	D - 1	0.00
	12.20	1	18 in.	812.04	814.37	2 - G	6.90	1.50	1.32	0.0249	OUTLET	5.70	D - 2	0.00
	17.90	1	27 in.	808.62	808.97	2 - F	5.80	2.25	1.48	0.0245	OUTLET**	0.00	D + 1	0.00
	21.70	1	24 in.	809.87	810.47	2 - F	7.76	2.00	1.67	0.0247	OUTLET**	0.00	F	0.00
	17.50	1	21 in.	811.34	812.51	2 - F	7.50	1.75	1.53	0.0248	OUTLET**	4.20	F - 1	0.00
	12.20	1	18 in.	814.30	817.48	2 - G	6.90	1.50	1.32	0.0249	OUTLET	9.50	F - 2	0.00
	21.70	1	27 in.	809.10	809.52	2 - F	7.03	2.25	1.63	0.0245	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	17.90	1	36 in.	808.21	808.53	1 - A	4.56	2.40	1.35	0.0281	OUTLET*	0.00	D	0.00
	17.90	1	42 in.	808.09	808.39	1 - A	4.08	2.04	1.29	0.0278	OUTLET*	0.00	D + 1	0.00
	21.70	1	36 in.	808.44	808.79	1 - A	5.53	2.74	1.50	0.0281	OUTLET*	0.00	F	0.00
	21.70	1	42 in.	808.31	808.60	1 - A	4.94	2.32	1.43	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	17.90	1	60 in.	807.81	808.20	1 - A	3.22	1.86	1.17	0.0332	OUTLET*	0.00	D	0.00
	17.90	1	66 in.	807.75	808.16	1 - A	3.04	1.79	1.14	0.0330	OUTLET*	0.00	D + 1	0.00
	21.70	1	60 in.	808.00	808.37	1 - A	3.91	2.07	1.29	0.0332	OUTLET*	0.00	F	0.00
	21.70	1	66 in.	807.93	808.31	1 - A	3.68	1.98	1.25	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	8.95	2	60 in.	807.33	807.88	1 - B	1.61	1.30	0.82	0.0332	OUTLET*	0.00	D	0.00
	8.95	2	66 in.	807.31	807.86	1 - B	1.52	1.25	0.80	0.0330	OUTLET*	0.00	D + 1	0.00
	10.85	2	60 in.	807.44	807.94	1 - B	1.95	1.43	0.90	0.0332	OUTLET*	0.00	F	0.00
	10.85	2	66 in.	807.41	807.91	1 - B	1.84	1.38	0.88	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	17.90	1	60 in.	807.81	808.16	1 - A	3.22	1.64	1.17	0.0260	OUTLET*	0.00	D	0.00
	17.90	1	66 in.	807.75	808.14	1 - B	3.04	1.58	1.14	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.)
	21.70	1	60 in.	808.00	808.33	1 - A	3.91	1.81	1.29	0.0260	OUTLET*	0.00	F	0.00
	21.70	1	66 in.	807.93	808.27	1 - A	3.68	1.74	1.25	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	8.95	2	60 in.	807.33	807.86	1 - B	1.61	1.15	0.82	0.0260	OUTLET*	0.00	D	0.00
	8.95	2	66 in.	807.31	807.85	1 - B	1.52	1.11	0.80	0.0260	OUTLET*	0.00	D + 1	0.00
	10.85	2	60 in.	807.44	807.91	1 - B	1.95	1.27	0.90	0.0260	OUTLET*	0.00	F	0.00
	10.85	2	66 in.	807.41	807.90	1 - B	1.84	1.23	0.88	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH

Description : Proposed Drive Pipe - 563+32 RT TO 563+77 RT

Designer : SJD

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.) : 805.46 **Outlet Invert Elevation (ft.) :** 805.30 **Tailwater Elevation (ft.) :** 807.01 **Overflow Elevation (ft.) :** 809.92
Allowable Headwater Elevation (ft.) : 808.92 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 45.00 **Culvert Slope (ft./ft.) :** 0.0036 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 19.90 @ 10 yrs. **Flood Discharge (cfs) :** 24.20 @ 25 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							
19.90	1	21 in.	808.80	808.89	2 - F	8.32	1.75	1.60	0.0120	OUTLET	0.00	D	0.00
17.50	1	18 in.	810.38	810.74	2 - G	9.90	1.50	1.45	0.0120	OUTLET	2.40	D - 1	0.00
11.60	1	15 in.	815.95	815.53	2 - G	9.45	1.25	1.21	0.0120	OUTLET	8.30	D - 2	0.00
19.90	1	24 in.	808.10	808.14	2 - F	6.96	2.00	1.60	0.0120	OUTLET**	0.00	D + 1	0.00
24.20	1	21 in.	809.80	809.79	2 - E	10.06	1.75	1.67	0.0120	INLET	0.00	F	0.00
17.50	1	18 in.	812.23	812.53	2 - G	9.90	1.50	1.45	0.0120	OUTLET	6.70	F - 1	0.00
11.60	1	15 in.	829.08	819.61	2 - G	9.45	1.25	1.21	0.0120	OUTLET	12.60	F - 2	0.00
24.20	1	24 in.	808.69	808.71	2 - F	8.34	2.00	1.74	0.0120	OUTLET**	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)													
19.90	1	27 in.	808.09	808.60	2 - F	6.14	2.25	1.56	0.0245	OUTLET**	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.)
	19.90	1	24 in.	808.71	809.54	2 - F	6.96	2.00	1.60	0.0247	OUTLET**	0.00	D - 1	0.00
	15.80	1	21 in.	809.97	811.60	2 - F	6.61	1.75	1.47	0.0248	OUTLET	4.10	D - 2	0.00
	19.90	1	30 in.	807.80	808.16	1 - A	5.56	2.28	1.51	0.0244	OUTLET*	0.00	D + 1	0.00
	24.20	1	27 in.	808.70	809.35	2 - F	7.42	2.25	1.72	0.0245	OUTLET**	0.00	F	0.00
	21.30	1	24 in.	809.69	810.77	2 - F	7.45	2.00	1.65	0.0247	OUTLET**	2.90	F - 1	0.00
	15.80	1	21 in.	811.44	813.80	2 - F	6.61	1.75	1.47	0.0248	OUTLET	8.40	F - 2	0.00
	24.20	1	30 in.	808.20	808.65	2 - F	6.76	2.50	1.68	0.0244	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	19.90	1	36 in.	807.57	807.93	1 - A	4.78	2.74	1.43	0.0281	OUTLET*	0.00	D	0.00
	19.90	1	42 in.	807.44	807.77	1 - A	4.26	2.18	1.37	0.0278	OUTLET*	0.00	D + 1	0.00
	24.20	1	36 in.	807.82	808.22	1 - A	5.81	2.74	1.59	0.0281	OUTLET*	0.00	F	0.00
	24.20	1	42 in.	807.67	808.00	1 - A	5.18	2.51	1.51	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	19.90	1	60 in.	807.14	807.55	1 - A	3.35	1.97	1.23	0.0332	OUTLET*	0.00	D	0.00
	19.90	1	66 in.	807.08	807.50	1 - A	3.16	1.88	1.20	0.0330	OUTLET*	0.00	D + 1	0.00
	24.20	1	60 in.	807.34	807.73	1 - A	4.08	2.19	1.36	0.0332	OUTLET*	0.00	F	0.00
	24.20	1	66 in.	807.27	807.67	1 - A	3.84	2.09	1.32	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	9.95	2	60 in.	806.62	807.18	1 - B	1.68	1.37	0.86	0.0332	OUTLET*	0.00	D	0.00
	9.95	2	66 in.	806.60	807.16	1 - B	1.58	1.32	0.84	0.0330	OUTLET*	0.00	D + 1	0.00
	12.10	2	60 in.	806.74	807.25	1 - B	2.04	1.51	0.95	0.0332	OUTLET*	0.00	F	0.00
	12.10	2	66 in.	806.71	807.23	1 - B	1.92	1.46	0.93	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	19.90	1	60 in.	807.14	807.50	1 - A	3.35	1.73	1.23	0.0260	OUTLET*	0.00	D	0.00
	19.90	1	66 in.	807.08	807.48	1 - B	3.16	1.66	1.20	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.)
	24.20	1	60 in.	807.34	807.68	1 - A	4.08	1.92	1.36	0.0260	OUTLET*	0.00	F	0.00
	24.20	1	66 in.	807.27	807.62	1 - A	3.84	1.84	1.32	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	9.95	2	60 in.	806.62	807.16	1 - B	1.68	1.21	0.86	0.0260	OUTLET*	0.00	D	0.00
	9.95	2	66 in.	806.60	807.14	1 - B	1.58	1.17	0.84	0.0260	OUTLET*	0.00	D + 1	0.00
	12.10	2	60 in.	806.74	807.22	1 - B	2.04	1.33	0.95	0.0260	OUTLET*	0.00	F	0.00
	12.10	2	66 in.	806.71	807.20	1 - B	1.92	1.29	0.93	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH

Description : Proposed Drive Pipe - 565+47 RT TO 565+85 RT

Designer : SJD

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.) : 804.71 **Outlet Invert Elevation (ft.) :** 804.58 **Tailwater Elevation (ft.) :** 806.36 **Overflow Elevation (ft.) :** 809.20
Allowable Headwater Elevation (ft.) : 808.20 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 38.00 **Culvert Slope (ft./ft.) :** 0.0034 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 21.70 @ 10 yrs. **Flood Discharge (cfs) :** 26.40 @ 25 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							
21.70	1	24 in.	807.58	807.60	2 - F	7.35	2.00	1.67	0.0120	OUTLET**	0.00	D	0.00
21.70	1	21 in.	808.44	808.48	2 - G	9.02	1.75	1.63	0.0120	OUTLET	0.00	D - 1	0.00
17.80	1	18 in.	810.34	810.54	2 - G	10.07	1.50	1.45	0.0120	OUTLET	3.90	D - 2	0.00
21.70	1	27 in.	807.21	807.28	1 - A	6.43	2.05	1.63	0.0120	OUTLET*	0.00	D + 1	0.00
26.40	1	24 in.	808.29	808.23	2 - E	8.40	2.00	1.80	0.0120	INLET	0.00	F	0.00
24.70	1	21 in.	809.63	809.50	2 - H	10.27	1.75	1.68	0.0120	INLET	1.70	F - 1	0.00
17.80	1	18 in.	812.72	812.55	2 - G	10.07	1.50	1.45	0.0120	OUTLET	8.60	F - 2	0.00
26.40	1	27 in.	807.65	807.66	2 - F	7.77	2.25	1.79	0.0120	OUTLET**	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)													
21.70	1	27 in.	807.58	808.06	2 - F	6.43	2.25	1.63	0.0245	OUTLET**	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.)
	21.70	1	24 in.	808.35	809.08	2 - F	7.35	2.00	1.67	0.0247	OUTLET**	0.00	D - 1	0.00
	16.30	1	21 in.	809.82	811.34	2 - G	6.78	1.75	1.49	0.0248	OUTLET	5.40	D - 2	0.00
	21.70	1	30 in.	807.21	807.55	1 - A	5.80	2.28	1.58	0.0244	OUTLET*	0.00	D + 1	0.00
	26.40	1	27 in.	808.31	808.88	2 - F	7.77	2.25	1.79	0.0245	OUTLET**	0.00	F	0.00
	22.10	1	24 in.	809.49	810.42	2 - F	7.48	2.00	1.68	0.0247	OUTLET**	4.30	F - 1	0.00
	16.30	1	21 in.	811.52	813.73	2 - G	6.78	1.75	1.49	0.0248	OUTLET	10.10	F - 2	0.00
	26.40	1	30 in.	807.69	808.11	2 - F	7.06	2.50	1.75	0.0244	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	21.70	1	36 in.	806.92	807.29	1 - A	4.97	2.74	1.50	0.0281	OUTLET*	0.00	D	0.00
	21.70	1	42 in.	806.79	807.11	1 - A	4.41	2.34	1.43	0.0278	OUTLET*	0.00	D + 1	0.00
	26.40	1	36 in.	807.21	807.60	1 - A	6.04	2.74	1.66	0.0281	OUTLET*	0.00	F	0.00
	26.40	1	42 in.	807.03	807.37	1 - A	5.37	2.75	1.58	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	21.70	1	60 in.	806.48	806.89	1 - A	3.46	2.09	1.29	0.0332	OUTLET*	0.00	D	0.00
	21.70	1	66 in.	806.41	806.84	1 - A	3.26	1.99	1.25	0.0330	OUTLET*	0.00	D + 1	0.00
	26.40	1	60 in.	806.69	807.08	1 - A	4.21	2.33	1.42	0.0332	OUTLET*	0.00	F	0.00
	26.40	1	66 in.	806.61	807.01	1 - A	3.97	2.21	1.39	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	10.85	2	60 in.	805.92	806.53	1 - B	1.73	1.44	0.90	0.0332	OUTLET*	0.00	D	0.00
	10.85	2	66 in.	805.89	806.50	1 - B	1.63	1.39	0.88	0.0330	OUTLET*	0.00	D + 1	0.00
	13.20	2	60 in.	806.05	806.59	1 - B	2.11	1.60	1.00	0.0332	OUTLET*	0.00	F	0.00
	13.20	2	66 in.	806.01	806.56	1 - B	1.98	1.54	0.97	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	21.70	1	60 in.	806.48	806.83	1 - A	3.46	1.83	1.29	0.0260	OUTLET*	0.00	D	0.00
	21.70	1	66 in.	806.41	806.81	1 - B	3.26	1.76	1.25	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.)
	26.40	1	60 in.	806.69	807.03	1 - A	4.21	2.03	1.42	0.0260	OUTLET*	0.00	F	0.00
	26.40	1	66 in.	806.61	806.97	1 - A	3.97	1.95	1.39	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	10.85	2	60 in.	805.92	806.50	1 - B	1.73	1.28	0.90	0.0260	OUTLET*	0.00	D	0.00
	10.85	2	66 in.	805.89	806.48	1 - B	1.63	1.23	0.88	0.0260	OUTLET*	0.00	D + 1	0.00
	13.20	2	60 in.	806.05	806.56	1 - B	2.11	1.41	1.00	0.0260	OUTLET*	0.00	F	0.00
	13.20	2	66 in.	806.01	806.54	1 - B	1.98	1.36	0.97	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH
Description : Proposed Drive Pipe - 566+15 RT TO 566+35 RT **Designer :** SJD

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.) : 804.47 **Outlet Invert Elevation (ft.) :** 804.40 **Tailwater Elevation (ft.) :** 806.19 **Overflow Elevation (ft.) :** 808.58
Allowable Headwater Elevation (ft.) : 807.58 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 20.00 **Culvert Slope (ft./ft.) :** 0.0035 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 21.80 @ 10 yrs. **Flood Discharge (cfs) :** 26.50 @ 25 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							
21.80	1	24 in.	807.36	807.29	2 - E	6.94	2.00	1.67	0.0120	INLET	0.00	D	0.00
21.80	1	21 in.	808.23	808.04	2 - H	9.06	1.75	1.63	0.0120	INLET	0.00	D - 1	0.00
17.60	1	18 in.	810.14	809.76	2 - H	9.96	1.50	1.45	0.0120	INLET	4.20	D - 2	0.00
21.80	1	27 in.	806.98	807.04	1 - A	6.43	2.05	1.63	0.0120	OUTLET*	0.00	D + 1	0.00
26.50	1	24 in.	808.06	807.86	2 - E	8.44	2.00	1.80	0.0120	INLET	0.00	F	0.00
23.20	1	21 in.	809.42	808.93	2 - H	9.65	1.75	1.66	0.0120	INLET	3.30	F - 1	0.00
17.60	1	18 in.	812.55	811.46	2 - H	9.96	1.50	1.45	0.0120	INLET	8.90	F - 2	0.00
26.50	1	27 in.	807.42	807.41	2 - E	6.66	2.25	1.80	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)													
21.80	1	27 in.	807.35	807.58	2 - F	6.43	2.25	1.63	0.0245	OUTLET**	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.)
	21.80	1	24 in.	808.13	808.32	2 - F	7.35	2.00	1.67	0.0247	OUTLET**	0.00	D - 1	0.00
	17.30	1	21 in.	809.61	809.98	2 - G	7.19	1.75	1.52	0.0248	OUTLET	4.50	D - 2	0.00
	21.80	1	30 in.	806.98	807.27	1 - A	5.80	2.28	1.59	0.0244	OUTLET*	0.00	D + 1	0.00
	26.50	1	27 in.	808.09	808.25	2 - F	7.79	2.25	1.80	0.0245	OUTLET**	0.00	F	0.00
	23.00	1	24 in.	809.28	809.38	2 - F	7.75	2.00	1.71	0.0247	OUTLET**	3.50	F - 1	0.00
	17.30	1	21 in.	811.32	811.80	2 - G	7.19	1.75	1.52	0.0248	OUTLET	9.20	F - 2	0.00
	26.50	1	30 in.	807.46	807.66	2 - F	7.05	2.50	1.75	0.0244	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	21.80	1	36 in.	806.69	807.02	1 - A	4.96	2.74	1.50	0.0281	OUTLET*	0.00	D	0.00
	21.80	1	42 in.	806.55	806.86	1 - A	4.40	2.33	1.43	0.0278	OUTLET*	0.00	D + 1	0.00
	26.50	1	36 in.	806.97	807.31	1 - A	6.02	2.74	1.66	0.0281	OUTLET*	0.00	F	0.00
	26.50	1	42 in.	806.79	807.11	1 - A	5.35	2.73	1.59	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	21.80	1	60 in.	806.24	806.64	1 - A	3.45	2.08	1.29	0.0332	OUTLET*	0.00	D	0.00
	21.80	1	66 in.	806.17	806.59	1 - A	3.25	1.99	1.26	0.0330	OUTLET*	0.00	D + 1	0.00
	26.50	1	60 in.	806.46	806.81	1 - A	4.20	2.32	1.43	0.0332	OUTLET*	0.00	F	0.00
	26.50	1	66 in.	806.37	806.75	1 - A	3.95	2.21	1.39	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	10.90	2	60 in.	805.68	806.32	1 - B	1.73	1.44	0.91	0.0332	OUTLET*	0.00	D	0.00
	10.90	2	66 in.	805.66	806.30	1 - B	1.62	1.39	0.88	0.0330	OUTLET*	0.00	D + 1	0.00
	13.25	2	60 in.	805.81	806.37	1 - B	2.10	1.59	1.00	0.0332	OUTLET*	0.00	F	0.00
	13.25	2	66 in.	805.77	806.35	1 - B	1.98	1.53	0.97	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	21.80	1	60 in.	806.24	806.60	1 - A	3.45	1.82	1.29	0.0260	OUTLET*	0.00	D	0.00
	21.80	1	66 in.	806.17	806.58	1 - B	3.25	1.75	1.26	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.)
	26.50	1	60 in.	806.46	806.79	1 - A	4.20	2.02	1.43	0.0260	OUTLET*	0.00	F	0.00
	26.50	1	66 in.	806.37	806.73	1 - A	3.95	1.94	1.39	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	10.90	2	60 in.	805.68	806.31	1 - B	1.73	1.27	0.91	0.0260	OUTLET*	0.00	D	0.00
	10.90	2	66 in.	805.66	806.29	1 - B	1.62	1.23	0.88	0.0260	OUTLET*	0.00	D + 1	0.00
	13.25	2	60 in.	805.81	806.36	1 - B	2.10	1.40	1.00	0.0260	OUTLET*	0.00	F	0.00
	13.25	2	66 in.	805.77	806.34	1 - B	1.98	1.36	0.97	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH

Description : Proposed Drive Pipe - 568+54 RT TO 569+27 RT

Designer : SJD

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.) : 803.63 **Outlet Invert Elevation (ft.) :** 803.37 **Tailwater Elevation (ft.) :** 805.24 **Overflow Elevation (ft.) :** 809.39
Allowable Headwater Elevation (ft.) : 808.39 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 73.00 **Culvert Slope (ft./ft.) :** 0.0036 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 24.10 @ 10 yrs. **Flood Discharge (cfs) :** 29.20 @ 25 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							
24.10	1	24 in.	806.85	807.04	2 - F	7.89	2.00	1.74	0.0120	OUTLET	0.00	D	0.00
24.10	1	21 in.	807.95	808.54	2 - G	10.02	1.75	1.67	0.0120	OUTLET	0.00	D - 1	0.00
18.90	1	18 in.	810.35	811.96	2 - G	10.70	1.50	1.46	0.0120	OUTLET	5.20	D - 2	0.00
24.10	1	27 in.	806.35	806.43	2 - F	6.82	2.25	1.72	0.0120	OUTLET*	0.00	D + 1	0.00
29.20	1	24 in.	807.69	807.93	2 - F	9.56	2.00	1.85	0.0120	OUTLET**	0.00	F	0.00
27.00	1	21 in.	809.35	810.09	2 - G	11.23	1.75	1.70	0.0120	OUTLET	2.20	F - 1	0.00
18.90	1	18 in.	813.80	815.11	2 - G	10.70	1.50	1.46	0.0120	OUTLET	10.30	F - 2	0.00
29.20	1	27 in.	806.87	806.99	2 - F	8.25	2.25	1.87	0.0120	OUTLET**	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)													
24.10	1	27 in.	806.85	808.00	2 - F	6.82	2.25	1.72	0.0245	OUTLET**	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.)
22.60	1	24 in.	807.83	809.95	2 - F	7.40	2.00	1.69	0.0247	OUTLET	1.50	D - 1	0.00
16.20	1	21 in.	809.58	814.31	2 - G	6.74	1.75	1.48	0.0248	OUTLET	7.90	D - 2	0.00
24.10	1	30 in.	806.36	807.05	2 - F	6.12	2.50	1.67	0.0244	OUTLET**	0.00	D + 1	0.00
29.20	1	27 in.	807.74	809.32	2 - F	8.25	2.25	1.87	0.0245	OUTLET**	0.00	F	0.00
22.60	1	24 in.	809.16	812.21	2 - F	7.40	2.00	1.69	0.0247	OUTLET	6.60	F - 1	0.00
16.20	1	21 in.	811.62	818.56	2 - G	6.74	1.75	1.48	0.0248	OUTLET	13.00	F - 2	0.00
29.20	1	30 in.	806.93	807.88	2 - F	7.41	2.50	1.84	0.0244	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
24.10	1	36 in.	805.99	806.47	1 - A	5.20	2.74	1.58	0.0281	OUTLET*	0.00	D	0.00
24.10	1	42 in.	805.83	806.23	1 - A	4.61	2.50	1.51	0.0278	OUTLET*	0.00	D + 1	0.00
29.20	1	36 in.	806.30	806.83	1 - A	6.30	2.74	1.75	0.0281	OUTLET*	0.00	F	0.00
29.20	1	42 in.	806.08	806.52	1 - A	5.58	3.01	1.67	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
24.10	1	60 in.	805.51	805.97	1 - A	3.60	2.19	1.36	0.0332	OUTLET*	0.00	D	0.00
24.10	1	66 in.	805.43	805.89	1 - A	3.38	2.08	1.32	0.0330	OUTLET*	0.00	D + 1	0.00
29.20	1	60 in.	805.73	806.17	1 - A	4.36	2.44	1.50	0.0332	OUTLET*	0.00	F	0.00
29.20	1	66 in.	805.64	806.08	1 - A	4.10	2.32	1.46	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
24.10	1	60 in.	805.51	805.87	1 - A	3.60	1.91	1.36	0.0260	OUTLET*	0.00	D	0.00
24.10	1	66 in.	805.43	805.85	1 - B	3.38	1.84	1.32	0.0260	OUTLET*	0.00	D + 1	0.00
29.20	1	60 in.	805.73	806.10	1 - A	4.36	2.12	1.50	0.0260	OUTLET*	0.00	F	0.00
29.20	1	66 in.	805.64	806.02	1 - A	4.10	2.03	1.46	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH

Description : Proposed Drive Pipe - 570+49 RT TO 570+95 RT

Designer : SJD

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.) : 802.95 **Outlet Invert Elevation (ft.) :** 802.79 **Tailwater Elevation (ft.) :** 804.68 **Overflow Elevation (ft.) :** 809.39
Allowable Headwater Elevation (ft.) : 808.39 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 46.00 **Culvert Slope (ft./ft.) :** 0.0035 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 24.70 @ 10 yrs. **Flood Discharge (cfs) :** 29.90 @ 25 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							
24.70	1	21 in.	807.42	807.59	2 - G	10.27	1.75	1.68	0.0120	OUTLET	0.00	D	0.00
22.20	1	18 in.	809.98	810.48	2 - G	12.56	1.50	1.48	0.0120	OUTLET	2.50	D - 1	0.00
14.70	1	15 in.	829.18	817.93	2 - G	11.98	1.25	1.23	0.0120	OUTLET	10.00	D - 2	0.00
24.70	1	24 in.	806.26	806.30	2 - F	8.04	2.00	1.75	0.0120	OUTLET	0.00	D + 1	0.00
29.90	1	21 in.	808.88	808.95	2 - G	12.43	1.75	1.71	0.0120	OUTLET	0.00	F	0.00
22.20	1	18 in.	813.80	813.17	2 - G	12.56	1.50	1.48	0.0120	OUTLET	7.70	F - 1	0.00
14.70	1	15 in.	881.88	824.09	2 - G	11.98	1.25	1.23	0.0120	OUTLET	15.20	F - 2	0.00
29.90	1	24 in.	807.14	807.09	2 - E	9.52	2.00	1.86	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)													
24.70	1	27 in.	806.27	806.96	2 - F	6.93	2.25	1.74	0.0245	OUTLET**	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.)
24.70	1	24 in.	807.30	808.47	2 - F	8.04	2.00	1.75	0.0247	OUTLET	0.00	D - 1	0.00
20.00	1	21 in.	809.12	811.84	2 - G	8.32	1.75	1.60	0.0248	OUTLET	4.70	D - 2	0.00
24.70	1	30 in.	805.74	806.22	2 - F	6.20	2.50	1.69	0.0244	OUTLET**	0.00	D + 1	0.00
29.90	1	27 in.	807.19	808.04	2 - F	8.37	2.25	1.89	0.0245	OUTLET**	0.00	F	0.00
27.40	1	24 in.	808.68	810.28	2 - F	8.91	2.00	1.82	0.0247	OUTLET**	2.50	F - 1	0.00
20.00	1	21 in.	811.28	815.17	2 - G	8.32	1.75	1.60	0.0248	OUTLET	9.90	F - 2	0.00
29.90	1	30 in.	806.34	806.92	2 - F	7.51	2.50	1.86	0.0244	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
24.70	1	36 in.	805.34	805.77	1 - A	5.27	2.74	1.60	0.0281	OUTLET*	0.00	D	0.00
24.70	1	42 in.	805.18	805.55	1 - A	4.66	2.57	1.53	0.0278	OUTLET*	0.00	D + 1	0.00
29.90	1	36 in.	805.66	806.10	1 - A	6.37	2.74	1.77	0.0281	OUTLET*	0.00	F	0.00
29.90	1	42 in.	805.44	805.83	1 - A	5.64	3.20	1.69	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
24.70	1	60 in.	804.86	805.29	1 - A	3.63	2.23	1.38	0.0332	OUTLET*	0.00	D	0.00
24.70	1	66 in.	804.78	805.22	1 - A	3.42	2.13	1.34	0.0330	OUTLET*	0.00	D + 1	0.00
29.90	1	60 in.	805.08	805.49	1 - A	4.40	2.49	1.52	0.0332	OUTLET*	0.00	F	0.00
29.90	1	66 in.	804.99	805.41	1 - A	4.14	2.36	1.48	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
24.70	1	60 in.	804.86	805.22	1 - A	3.63	1.95	1.38	0.0260	OUTLET*	0.00	D	0.00
24.70	1	66 in.	804.78	805.19	1 - B	3.42	1.87	1.34	0.0260	OUTLET*	0.00	D + 1	0.00
29.90	1	60 in.	805.08	805.44	1 - A	4.40	2.17	1.52	0.0260	OUTLET*	0.00	F	0.00
29.90	1	66 in.	804.99	805.37	1 - A	4.14	2.07	1.48	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH

Description : Proposed Drive Pipe - 572+50 RT TO 573+00 RT

Designer : SJD

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.) : 802.25 **Outlet Invert Elevation (ft.) :** 802.12 **Tailwater Elevation (ft.) :** 804.59 **Overflow Elevation (ft.) :** 807.35
Allowable Headwater Elevation (ft.) : 806.35 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 50.00 **Culvert Slope (ft./ft.) :** 0.0026 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 38.10 @ 10 yrs. **Flood Discharge (cfs) :** 46.10 @ 25 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							
38.10	1	30 in.	805.86	806.08	2 - F	7.78	2.50	2.09	0.0120	OUTLET	0.00	D	0.00
38.10	1	27 in.	806.66	806.94	2 - G	9.58	2.25	2.06	0.0120	OUTLET	0.00	D - 1	0.00
31.80	1	24 in.	808.15	808.53	2 - G	10.12	2.00	1.89	0.0120	OUTLET	6.30	D - 2	0.00
38.10	1	33 in.	805.45	805.58	2 - F	6.78	2.75	2.05	0.0120	OUTLET	0.00	D + 1	0.00
46.10	1	30 in.	806.72	806.77	2 - F	9.41	2.50	2.24	0.0120	OUTLET	0.00	F	0.00
41.20	1	27 in.	807.96	808.03	2 - G	10.36	2.25	2.11	0.0120	OUTLET	4.90	F - 1	0.00
31.80	1	24 in.	810.19	810.36	2 - G	10.12	2.00	1.89	0.0120	OUTLET	14.30	F - 2	0.00
46.10	1	33 in.	806.04	806.06	2 - F	8.20	2.75	2.25	0.0120	OUTLET**	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)													
38.10	1	36 in.	805.54	806.04	2 - F	6.12	3.00	2.01	0.0241	OUTLET**	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.)
38.10	1	33 in.	806.00	806.69	2 - F	6.78	2.75	2.05	0.0241	OUTLET	0.00	D - 1	0.00
34.90	1	30 in.	806.83	807.88	2 - F	7.13	2.50	2.01	0.0244	OUTLET	3.20	D - 2	0.00
38.10	1	42 in.	805.13	805.62	1 - A	5.25	3.20	1.92	0.0237	OUTLET*	0.00	D + 1	0.00
46.10	1	36 in.	806.22	806.80	2 - F	7.40	3.00	2.21	0.0241	OUTLET**	0.00	F	0.00
43.60	1	33 in.	806.98	807.69	2 - F	7.76	2.75	2.19	0.0241	OUTLET**	2.50	F - 1	0.00
34.90	1	30 in.	808.23	809.40	2 - F	7.13	2.50	2.01	0.0244	OUTLET	11.20	F - 2	0.00
46.10	1	42 in.	805.52	805.99	1 - A	6.35	3.20	2.12	0.0237	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
38.10	1	36 in.	805.54	806.24	2 - F	6.12	3.00	2.01	0.0281	OUTLET**	0.00	D	0.00
38.10	1	42 in.	805.13	805.68	1 - A	5.25	3.20	1.92	0.0278	OUTLET*	0.00	D + 1	0.00
46.10	1	36 in.	806.22	807.09	2 - F	7.40	3.00	2.21	0.0281	OUTLET**	0.00	F	0.00
46.10	1	42 in.	805.52	806.06	1 - A	6.35	3.20	2.12	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
38.10	1	60 in.	804.71	805.26	1 - A	3.94	3.18	1.72	0.0332	OUTLET*	0.00	D	0.00
38.10	1	66 in.	804.60	805.19	1 - A	3.68	2.96	1.67	0.0330	OUTLET*	0.00	D + 1	0.00
46.10	1	60 in.	804.99	805.52	1 - A	4.77	3.66	1.90	0.0332	OUTLET*	0.00	F	0.00
46.10	1	66 in.	804.88	805.41	1 - A	4.46	3.34	1.85	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
38.10	1	60 in.	804.71	805.20	1 - A	3.94	2.72	1.72	0.0260	OUTLET*	0.00	D	0.00
38.10	1	66 in.	804.60	805.13	1 - A	3.68	2.57	1.67	0.0260	OUTLET*	0.00	D + 1	0.00
46.10	1	60 in.	804.99	805.44	1 - A	4.77	3.07	1.90	0.0260	OUTLET*	0.00	F	0.00
46.10	1	66 in.	804.88	805.35	1 - A	4.46	2.87	1.85	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH
Description : Proposed Drive Pipe - 575+65 RT TO 576+19 RT **Designer :** SJD

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.) : 801.46 **Outlet Invert Elevation (ft.) :** 801.32 **Tailwater Elevation (ft.) :** 803.82 **Overflow Elevation (ft.) :** 808.23
Allowable Headwater Elevation (ft.) : 807.23 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 54.00 **Culvert Slope (ft./ft.) :** 0.0026 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 39.20 @ 10 yrs. **Flood Discharge (cfs) :** 47.40 @ 25 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							
39.20	1	27 in.	806.03	806.36	2 - G	9.86	2.25	2.08	0.0120	OUTLET	0.00	D	0.00
39.20	1	24 in.	807.62	808.09	2 - G	12.48	2.00	1.95	0.0120	OUTLET	0.00	D - 1	0.00
29.50	1	21 in.	811.01	811.57	2 - G	12.26	1.75	1.71	0.0120	OUTLET	9.70	D - 2	0.00
39.20	1	30 in.	805.18	805.43	2 - G	7.99	2.50	2.11	0.0120	OUTLET	0.00	D + 1	0.00
47.40	1	27 in.	807.40	807.54	2 - G	11.92	2.25	2.16	0.0120	OUTLET	0.00	F	0.00
39.80	1	24 in.	809.78	810.07	2 - G	12.67	2.00	1.95	0.0120	OUTLET	7.60	F - 1	0.00
29.50	1	21 in.	817.52	815.15	2 - G	12.26	1.75	1.71	0.0120	OUTLET	17.90	F - 2	0.00
47.40	1	30 in.	806.09	806.17	2 - G	9.66	2.50	2.26	0.0120	OUTLET	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)													
39.20	1	33 in.	805.33	806.12	2 - F	6.91	2.75	2.08	0.0241	OUTLET	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.)
39.20	1	30 in.	806.22	807.43	2 - G	7.99	2.50	2.11	0.0244	OUTLET	0.00	D - 1	0.00
33.80	1	27 in.	807.68	809.74	2 - G	8.50	2.25	1.99	0.0245	OUTLET	5.40	D - 2	0.00
39.20	1	36 in.	804.83	805.38	2 - F	6.23	3.00	2.04	0.0241	OUTLET**	0.00	D + 1	0.00
47.40	1	33 in.	806.37	807.19	2 - F	8.36	2.75	2.28	0.0241	OUTLET**	0.00	F	0.00
43.30	1	30 in.	807.68	809.10	2 - G	8.82	2.50	2.20	0.0244	OUTLET	4.10	F - 1	0.00
33.80	1	27 in.	809.67	812.48	2 - G	8.50	2.25	1.99	0.0245	OUTLET	13.60	F - 2	0.00
47.40	1	36 in.	805.55	806.20	2 - F	7.53	3.00	2.24	0.0241	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
39.20	1	36 in.	804.83	805.61	2 - F	6.23	3.00	2.04	0.0281	OUTLET**	0.00	D	0.00
39.20	1	42 in.	804.39	804.94	1 - A	5.33	3.20	1.95	0.0278	OUTLET*	0.00	D + 1	0.00
47.40	1	36 in.	805.55	806.53	2 - F	7.53	3.00	2.24	0.0281	OUTLET**	0.00	F	0.00
47.40	1	42 in.	804.80	805.37	1 - A	6.45	3.20	2.15	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
39.20	1	60 in.	803.96	804.53	1 - A	3.99	3.25	1.75	0.0332	OUTLET*	0.00	D	0.00
39.20	1	66 in.	803.85	804.44	1 - A	3.73	3.01	1.70	0.0330	OUTLET*	0.00	D + 1	0.00
47.40	1	60 in.	804.25	804.79	1 - A	4.83	3.75	1.93	0.0332	OUTLET*	0.00	F	0.00
47.40	1	66 in.	804.13	804.66	1 - A	4.51	3.40	1.87	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
39.20	1	60 in.	803.96	804.46	1 - A	3.99	2.77	1.75	0.0260	OUTLET*	0.00	D	0.00
39.20	1	66 in.	803.85	804.38	1 - A	3.73	2.62	1.70	0.0260	OUTLET*	0.00	D + 1	0.00
47.40	1	60 in.	804.25	804.70	1 - A	4.83	3.13	1.93	0.0260	OUTLET*	0.00	F	0.00
47.40	1	66 in.	804.13	804.61	1 - A	4.51	2.93	1.87	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH
Description : Proposed Drive Pipe - 578+05 RT TO 578+38 RT **Designer :** SJD

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.) : 800.86 **Outlet Invert Elevation (ft.) :** 800.76 **Tailwater Elevation (ft.) :** 803.31 **Overflow Elevation (ft.) :** 807.95
Allowable Headwater Elevation (ft.) : 806.95 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 38.00 **Culvert Slope (ft./ft.) :** 0.0026 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 40.90 @ 10 yrs. **Flood Discharge (cfs) :** 49.50 @ 25 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							
40.90	1	27 in.	805.70	805.84	2 - G	10.29	2.25	2.10	0.0120	OUTLET	0.00	D	0.00
40.90	1	24 in.	807.43	807.52	2 - G	13.02	2.00	1.96	0.0120	OUTLET	0.00	D - 1	0.00
32.00	1	21 in.	811.37	810.84	2 - G	13.30	1.75	1.72	0.0120	OUTLET	8.90	D - 2	0.00
40.90	1	30 in.	804.75	804.92	2 - G	8.33	2.50	2.15	0.0120	OUTLET	0.00	D + 1	0.00
49.50	1	27 in.	807.19	807.02	2 - H	12.45	2.25	2.18	0.0120	INLET	0.00	F	0.00
42.90	1	24 in.	809.83	809.48	2 - G	13.66	2.00	1.96	0.0120	OUTLET	6.60	F - 1	0.00
32.00	1	21 in.	819.70	814.34	2 - G	13.30	1.75	1.72	0.0120	OUTLET	17.50	F - 2	0.00
49.50	1	30 in.	805.75	805.67	2 - H	10.08	2.50	2.29	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)													
40.90	1	30 in.	805.91	806.68	2 - G	8.33	2.50	2.15	0.0244	OUTLET	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.)
37.60	1	27 in.	807.48	808.77	2 - G	9.46	2.25	2.06	0.0245	OUTLET	3.30	D - 1	0.00
28.60	1	24 in.	810.04	812.77	2 - G	9.10	2.00	1.84	0.0247	OUTLET	12.30	D - 2	0.00
40.90	1	33 in.	804.93	805.49	2 - F	7.12	2.75	2.13	0.0241	OUTLET	0.00	D + 1	0.00
47.90	1	30 in.	807.48	808.25	2 - G	9.76	2.50	2.27	0.0244	OUTLET	1.60	F	0.00
37.60	1	27 in.	809.62	811.31	2 - G	9.46	2.25	2.06	0.0245	OUTLET	11.90	F - 1	0.00
28.60	1	24 in.	814.71	817.17	2 - G	9.10	2.00	1.84	0.0247	OUTLET	20.90	F - 2	0.00
49.50	1	33 in.	806.06	806.50	2 - F	8.61	2.75	2.32	0.0241	OUTLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
40.90	1	36 in.	804.37	804.96	2 - F	6.39	3.00	2.08	0.0281	OUTLET	0.00	D	0.00
40.90	1	42 in.	803.87	804.41	1 - A	5.45	3.20	1.99	0.0278	OUTLET*	0.00	D + 1	0.00
49.50	1	36 in.	805.16	805.82	2 - F	7.73	3.00	2.29	0.0281	OUTLET**	0.00	F	0.00
49.50	1	42 in.	804.32	804.81	1 - A	6.59	3.20	2.20	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
40.90	1	60 in.	803.42	803.97	1 - A	4.06	3.33	1.79	0.0332	OUTLET*	0.00	D	0.00
40.90	1	66 in.	803.31	803.88	1 - A	3.79	3.08	1.74	0.0330	OUTLET*	0.00	D + 1	0.00
49.50	1	60 in.	803.71	804.22	1 - A	4.92	3.88	1.97	0.0332	OUTLET*	0.00	F	0.00
49.50	1	66 in.	803.60	804.10	1 - A	4.59	3.49	1.92	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
40.90	1	60 in.	803.42	803.92	1 - A	4.06	2.83	1.79	0.0260	OUTLET*	0.00	D	0.00
40.90	1	66 in.	803.31	803.84	1 - A	3.79	2.67	1.74	0.0260	OUTLET*	0.00	D + 1	0.00
49.50	1	60 in.	803.71	804.16	1 - A	4.92	3.20	1.97	0.0260	OUTLET*	0.00	F	0.00
49.50	1	66 in.	803.60	804.06	1 - A	4.59	2.99	1.92	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH
Description : Proposed Drive Pipe - 578+60 RT TO 578+93 RT **Designer :** SJD

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.) : 800.72 **Outlet Invert Elevation (ft.) :** 800.63 **Tailwater Elevation (ft.) :** 803.18 **Overflow Elevation (ft.) :** 807.47
Allowable Headwater Elevation (ft.) : 806.47 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 33.00 **Culvert Slope (ft./ft.) :** 0.0027 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 41.40 @ 10 yrs. **Flood Discharge (cfs) :** 50.10 @ 25 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							
41.40	1	27 in.	805.64	805.70	2 - G	10.41	2.25	2.11	0.0120	OUTLET	0.00	D	0.00
41.40	1	24 in.	807.41	807.35	2 - H	13.18	2.00	1.96	0.0120	INLET	0.00	D - 1	0.00
31.40	1	21 in.	811.54	810.61	2 - G	13.05	1.75	1.72	0.0120	OUTLET	10.00	D - 2	0.00
41.40	1	30 in.	804.66	804.79	2 - G	8.43	2.50	2.16	0.0120	OUTLET	0.00	D + 1	0.00
50.10	1	27 in.	807.16	806.87	2 - H	12.60	2.25	2.18	0.0120	INLET	0.00	F	0.00
41.60	1	24 in.	809.89	809.29	2 - H	13.24	2.00	1.96	0.0120	INLET	8.50	F - 1	0.00
31.40	1	21 in.	820.48	814.06	2 - G	13.05	1.75	1.72	0.0120	OUTLET	18.70	F - 2	0.00
50.10	1	30 in.	805.68	805.54	2 - H	10.21	2.50	2.30	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)													
41.40	1	30 in.	805.85	806.46	2 - G	8.43	2.50	2.16	0.0244	OUTLET	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.)
37.30	1	27 in.	807.46	808.46	2 - G	9.38	2.25	2.05	0.0245	OUTLET	4.10	D - 1	0.00
28.40	1	24 in.	810.10	812.27	2 - G	9.04	2.00	1.83	0.0247	OUTLET	13.00	D - 2	0.00
41.40	1	33 in.	804.85	805.30	2 - F	7.20	2.75	2.14	0.0241	OUTLET	0.00	D + 1	0.00
47.30	1	30 in.	807.46	807.98	2 - G	9.64	2.50	2.26	0.0244	OUTLET	2.80	F	0.00
37.30	1	27 in.	809.64	810.91	2 - G	9.38	2.25	2.05	0.0245	OUTLET	12.80	F - 1	0.00
28.40	1	24 in.	815.05	816.49	2 - G	9.04	2.00	1.83	0.0247	OUTLET	21.70	F - 2	0.00
50.10	1	33 in.	806.01	806.29	2 - F	8.72	2.75	2.33	0.0241	OUTLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
41.40	1	36 in.	804.27	804.78	2 - F	6.47	3.00	2.10	0.0281	OUTLET	0.00	D	0.00
41.40	1	42 in.	803.76	804.27	1 - A	5.51	3.20	2.00	0.0278	OUTLET*	0.00	D + 1	0.00
50.10	1	36 in.	805.08	805.63	2 - F	7.82	3.00	2.30	0.0281	OUTLET**	0.00	F	0.00
50.10	1	42 in.	804.21	804.67	1 - A	6.67	3.20	2.21	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
41.40	1	60 in.	803.30	803.83	1 - A	4.11	3.31	1.80	0.0332	OUTLET*	0.00	D	0.00
41.40	1	66 in.	803.19	803.75	1 - A	3.84	3.07	1.75	0.0330	OUTLET*	0.00	D + 1	0.00
50.10	1	60 in.	803.59	804.08	1 - A	4.98	3.86	1.98	0.0332	OUTLET*	0.00	F	0.00
50.10	1	66 in.	803.48	803.98	1 - A	4.65	3.47	1.93	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
41.40	1	60 in.	803.30	803.79	1 - A	4.11	2.82	1.80	0.0260	OUTLET*	0.00	D	0.00
41.40	1	66 in.	803.19	803.71	1 - A	3.84	2.66	1.75	0.0260	OUTLET*	0.00	D + 1	0.00
50.10	1	60 in.	803.59	804.03	1 - A	4.98	3.19	1.98	0.0260	OUTLET*	0.00	F	0.00
50.10	1	66 in.	803.48	803.93	1 - A	4.65	2.98	1.93	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH

Description : Proposed Drive Pipe - 579+59 RT TO 579+93 RT

Designer : SJD

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.) : 800.48 **Outlet Invert Elevation (ft.) :** 800.39 **Tailwater Elevation (ft.) :** 802.95 **Overflow Elevation (ft.) :** 806.88
Allowable Headwater Elevation (ft.) : 805.88 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 34.00 **Culvert Slope (ft./ft.) :** 0.0026 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 41.30 @ 10 yrs. **Flood Discharge (cfs) :** 49.90 @ 25 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							
41.30	1	27 in.	805.38	805.47	2 - G	10.39	2.25	2.11	0.0120	OUTLET	0.00	D	0.00
40.00	1	24 in.	807.15	807.13	2 - G	12.73	2.00	1.95	0.0120	OUTLET	1.30	D - 1	0.00
29.90	1	21 in.	811.23	810.40	2 - G	12.43	1.75	1.71	0.0120	OUTLET	11.40	D - 2	0.00
41.30	1	30 in.	804.41	804.56	2 - G	8.41	2.50	2.16	0.0120	OUTLET	0.00	D + 1	0.00
49.80	1	27 in.	806.88	806.63	2 - H	12.52	2.25	2.18	0.0120	INLET	0.10	F	0.00
40.00	1	24 in.	809.58	809.05	2 - G	12.73	2.00	1.95	0.0120	OUTLET	9.90	F - 1	0.00
29.90	1	21 in.	819.93	813.83	2 - G	12.43	1.75	1.71	0.0120	OUTLET	20.00	F - 2	0.00
49.90	1	30 in.	805.42	805.30	2 - H	10.17	2.50	2.30	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)													
41.30	1	33 in.	804.60	805.09	2 - F	7.17	2.75	2.14	0.0241	OUTLET	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.)
41.30	1	30 in.	805.59	806.25	2 - G	8.41	2.50	2.16	0.0244	OUTLET	0.00	D - 1	0.00
35.50	1	27 in.	807.19	808.27	2 - G	8.93	2.25	2.02	0.0245	OUTLET	5.80	D - 2	0.00
41.30	1	36 in.	804.02	804.40	2 - F	6.43	3.00	2.09	0.0241	OUTLET	0.00	D + 1	0.00
49.90	1	33 in.	805.74	806.07	2 - F	8.66	2.75	2.33	0.0241	OUTLET	0.00	F	0.00
45.00	1	30 in.	807.18	807.76	2 - G	9.17	2.50	2.23	0.0244	OUTLET	4.90	F - 1	0.00
35.50	1	27 in.	809.35	810.71	2 - G	8.93	2.25	2.02	0.0245	OUTLET	14.40	F - 2	0.00
49.90	1	36 in.	804.82	805.16	2 - F	7.77	3.00	2.30	0.0241	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
41.30	1	36 in.	804.02	804.56	2 - F	6.43	3.00	2.09	0.0281	OUTLET	0.00	D	0.00
41.30	1	42 in.	803.51	804.03	1 - A	5.48	3.20	2.00	0.0278	OUTLET*	0.00	D + 1	0.00
49.90	1	36 in.	804.82	805.39	2 - F	7.77	3.00	2.30	0.0281	OUTLET**	0.00	F	0.00
49.90	1	42 in.	803.96	804.43	1 - A	6.62	3.20	2.21	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
41.30	1	60 in.	803.05	803.60	1 - A	4.08	3.34	1.79	0.0332	OUTLET*	0.00	D	0.00
41.30	1	66 in.	802.95	803.52	1 - A	3.81	3.09	1.74	0.0330	OUTLET*	0.00	D + 1	0.00
49.90	1	60 in.	803.35	803.84	1 - A	4.93	3.89	1.98	0.0332	OUTLET*	0.00	F	0.00
49.90	1	66 in.	803.23	803.74	1 - A	4.61	3.50	1.92	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
41.30	1	60 in.	803.05	803.55	1 - A	4.08	2.84	1.79	0.0260	OUTLET*	0.00	D	0.00
41.30	1	66 in.	802.95	803.47	1 - A	3.81	2.68	1.74	0.0260	OUTLET*	0.00	D + 1	0.00
49.90	1	60 in.	803.35	803.79	1 - A	4.93	3.21	1.98	0.0260	OUTLET*	0.00	F	0.00
49.90	1	66 in.	803.23	803.69	1 - A	4.61	3.00	1.92	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH
Description : Proposed Drive Pipe - 581+04 RT TO 581+45 RT **Designer :** SJD

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.) : 800.11 **Outlet Invert Elevation (ft.) :** 800.00 **Tailwater Elevation (ft.) :** 802.57 **Overflow Elevation (ft.) :** 806.54
Allowable Headwater Elevation (ft.) : 805.54 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 41.00 **Culvert Slope (ft./ft.) :** 0.0027 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 42.00 @ 10 yrs. **Flood Discharge (cfs) :** 50.80 @ 25 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							
42.00	1	27 in.	805.12	805.29	2 - G	10.56	2.25	2.12	0.0120	OUTLET	0.00	D	0.00
39.30	1	24 in.	806.95	807.10	2 - G	12.51	2.00	1.95	0.0120	OUTLET	2.70	D - 1	0.00
29.30	1	21 in.	811.32	810.69	2 - G	12.18	1.75	1.71	0.0120	OUTLET	12.70	D - 2	0.00
42.00	1	30 in.	804.12	804.30	2 - G	8.56	2.50	2.17	0.0120	OUTLET	0.00	D + 1	0.00
50.00	1	27 in.	806.68	806.55	2 - H	12.58	2.25	2.18	0.0120	INLET	0.80	F	0.00
39.30	1	24 in.	809.51	809.19	2 - G	12.51	2.00	1.95	0.0120	OUTLET	11.50	F - 1	0.00
29.30	1	21 in.	821.02	814.45	2 - G	12.18	1.75	1.71	0.0120	OUTLET	21.50	F - 2	0.00
50.80	1	30 in.	805.16	805.10	2 - H	10.35	2.50	2.31	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)													
42.00	1	33 in.	804.31	804.93	2 - F	7.27	2.75	2.15	0.0241	OUTLET	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.)
42.00	1	30 in.	805.35	806.24	2 - G	8.56	2.50	2.17	0.0244	OUTLET	0.00	D - 1	0.00
34.20	1	27 in.	806.99	808.53	2 - G	8.60	2.25	2.00	0.0245	OUTLET	7.80	D - 2	0.00
42.00	1	36 in.	803.71	804.17	2 - F	6.52	3.00	2.11	0.0241	OUTLET	0.00	D + 1	0.00
50.80	1	33 in.	805.50	806.02	2 - F	8.80	2.75	2.34	0.0241	OUTLET	0.00	F	0.00
43.70	1	30 in.	806.98	807.93	2 - G	8.90	2.50	2.20	0.0244	OUTLET	7.10	F - 1	0.00
34.20	1	27 in.	809.22	811.28	2 - G	8.60	2.25	2.00	0.0245	OUTLET	16.60	F - 2	0.00
50.80	1	36 in.	804.55	805.00	2 - F	7.88	3.00	2.32	0.0241	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
42.00	1	36 in.	803.71	804.37	2 - F	6.52	3.00	2.11	0.0281	OUTLET	0.00	D	0.00
42.00	1	42 in.	803.18	803.70	1 - A	5.55	3.20	2.02	0.0278	OUTLET*	0.00	D + 1	0.00
50.80	1	36 in.	804.55	805.29	2 - F	7.88	3.00	2.32	0.0281	OUTLET**	0.00	F	0.00
50.80	1	42 in.	803.64	804.15	1 - A	6.71	3.20	2.23	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
42.00	1	60 in.	802.71	803.26	1 - A	4.13	3.37	1.81	0.0332	OUTLET*	0.00	D	0.00
42.00	1	66 in.	802.60	803.18	1 - A	3.86	3.11	1.76	0.0330	OUTLET*	0.00	D + 1	0.00
50.80	1	60 in.	803.01	803.52	1 - A	5.00	3.94	2.00	0.0332	OUTLET*	0.00	F	0.00
50.80	1	66 in.	802.89	803.40	1 - A	4.66	3.53	1.94	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
42.00	1	60 in.	802.71	803.21	1 - A	4.13	2.86	1.81	0.0260	OUTLET*	0.00	D	0.00
42.00	1	66 in.	802.60	803.13	1 - A	3.86	2.69	1.76	0.0260	OUTLET*	0.00	D + 1	0.00
50.80	1	60 in.	803.01	803.46	1 - A	5.00	3.24	2.00	0.0260	OUTLET*	0.00	F	0.00
50.80	1	66 in.	802.89	803.35	1 - A	4.66	3.02	1.94	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH

Description : Proposed Drive Pipe - 581+99 RT TO 582+39 RT

Designer : SJD

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.) : 799.88 **Outlet Invert Elevation (ft.) :** 799.78 **Tailwater Elevation (ft.) :** 802.37 **Overflow Elevation (ft.) :** 806.08
Allowable Headwater Elevation (ft.) : 805.08 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 40.00 **Culvert Slope (ft./ft.) :** 0.0025 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 42.70 @ 10 yrs. **Flood Discharge (cfs) :** 51.60 @ 25 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							
42.70	1	30 in.	803.96	804.15	2 - G	8.70	2.50	2.18	0.0120	OUTLET	0.00	D	0.00
42.70	1	27 in.	805.01	805.16	2 - G	10.74	2.25	2.12	0.0120	OUTLET	0.00	D - 1	0.00
38.10	1	24 in.	806.90	807.02	2 - G	12.13	2.00	1.94	0.0120	OUTLET	4.60	D - 2	0.00
42.70	1	33 in.	803.41	803.55	2 - F	7.36	2.75	2.17	0.0120	OUTLET	0.00	D + 1	0.00
51.60	1	30 in.	805.04	804.97	2 - H	10.51	2.50	2.32	0.0120	INLET	0.00	F	0.00
48.80	1	27 in.	806.61	806.45	2 - H	12.27	2.25	2.17	0.0120	INLET	2.80	F - 1	0.00
38.10	1	24 in.	809.57	809.16	2 - G	12.13	2.00	1.94	0.0120	OUTLET	13.50	F - 2	0.00
51.60	1	33 in.	804.13	804.10	2 - E	8.69	2.75	2.36	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)													
42.70	1	33 in.	804.17	804.79	2 - F	7.36	2.75	2.17	0.0241	OUTLET	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.)
42.40	1	30 in.	805.24	806.12	2 - G	8.64	2.50	2.18	0.0244	OUTLET	0.30	D - 1	0.00
33.30	1	27 in.	806.93	808.46	2 - G	8.38	2.25	1.98	0.0245	OUTLET	9.40	D - 2	0.00
42.70	1	36 in.	803.54	804.01	2 - F	6.58	3.00	2.13	0.0241	OUTLET	0.00	D + 1	0.00
51.60	1	33 in.	805.38	805.90	2 - F	8.90	2.75	2.36	0.0241	OUTLET	0.00	F	0.00
42.40	1	30 in.	806.91	807.85	2 - G	8.64	2.50	2.18	0.0244	OUTLET	9.20	F - 1	0.00
33.30	1	27 in.	809.22	811.26	2 - G	8.38	2.25	1.98	0.0245	OUTLET	18.30	F - 2	0.00
51.60	1	36 in.	804.40	804.84	2 - F	7.95	3.00	2.34	0.0241	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
42.70	1	36 in.	803.54	804.21	2 - F	6.58	3.00	2.13	0.0281	OUTLET	0.00	D	0.00
42.70	1	42 in.	802.98	803.53	1 - A	5.59	3.20	2.03	0.0278	OUTLET*	0.00	D + 1	0.00
51.60	1	36 in.	804.40	805.13	2 - F	7.95	3.00	2.34	0.0281	OUTLET**	0.00	F	0.00
51.60	1	42 in.	803.45	803.96	1 - A	6.76	3.20	2.25	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
42.70	1	60 in.	802.50	803.06	1 - A	4.16	3.50	1.83	0.0332	OUTLET*	0.00	D	0.00
42.70	1	66 in.	802.39	802.98	1 - A	3.88	3.22	1.77	0.0330	OUTLET*	0.00	D + 1	0.00
51.60	1	60 in.	802.80	803.32	1 - A	5.03	4.15	2.01	0.0332	OUTLET*	0.00	F	0.00
51.60	1	66 in.	802.69	803.20	1 - A	4.69	3.65	1.96	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
42.70	1	60 in.	802.50	803.01	1 - A	4.16	2.95	1.83	0.0260	OUTLET*	0.00	D	0.00
42.70	1	66 in.	802.39	802.93	1 - A	3.88	2.78	1.77	0.0260	OUTLET*	0.00	D + 1	0.00
51.60	1	60 in.	802.80	803.26	1 - A	5.03	3.36	2.01	0.0260	OUTLET*	0.00	F	0.00
51.60	1	66 in.	802.69	803.16	1 - A	4.69	3.12	1.96	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH
Description : Proposed Drive Pipe - 582+61 RT TO 582+94 RT **Designer :** SJD

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.) : 799.72 **Outlet Invert Elevation (ft.) :** 799.63 **Tailwater Elevation (ft.) :** 802.22 **Overflow Elevation (ft.) :** 805.57
Allowable Headwater Elevation (ft.) : 804.57 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 33.00 **Culvert Slope (ft./ft.) :** 0.0027 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 45.00 @ 10 yrs. **Flood Discharge (cfs) :** 54.40 @ 25 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							
45.00	1	30 in.	804.06	804.12	2 - G	9.17	2.50	2.23	0.0120	OUTLET	0.00	D	0.00
45.00	1	27 in.	805.24	805.20	2 - H	11.32	2.25	2.15	0.0120	INLET	0.00	D - 1	0.00
37.00	1	24 in.	807.35	807.15	2 - G	11.78	2.00	1.93	0.0120	OUTLET	8.00	D - 2	0.00
45.00	1	33 in.	803.42	803.49	2 - F	7.76	2.75	2.22	0.0120	OUTLET	0.00	D + 1	0.00
54.40	1	30 in.	805.26	805.00	2 - H	11.08	2.50	2.35	0.0120	INLET	0.00	F	0.00
46.80	1	27 in.	807.00	806.57	2 - H	11.77	2.25	2.16	0.0120	INLET	7.60	F - 1	0.00
37.00	1	24 in.	810.49	809.42	2 - G	11.78	2.00	1.93	0.0120	OUTLET	17.40	F - 2	0.00
54.40	1	33 in.	804.23	804.08	2 - E	9.16	2.75	2.41	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)													
45.00	1	36 in.	803.59	803.93	2 - F	6.94	3.00	2.18	0.0241	OUTLET**	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.)
45.00	1	33 in.	804.30	804.73	2 - F	7.76	2.75	2.22	0.0241	OUTLET	0.00	D - 1	0.00
41.80	1	30 in.	805.49	806.09	2 - G	8.52	2.50	2.17	0.0244	OUTLET	3.20	D - 2	0.00
45.00	1	42 in.	802.94	803.40	1 - A	5.90	3.20	2.09	0.0237	OUTLET*	0.00	D + 1	0.00
54.40	1	36 in.	804.55	804.82	2 - F	8.38	3.00	2.39	0.0241	OUTLET**	0.00	F	0.00
51.90	1	33 in.	805.65	805.89	2 - F	8.95	2.75	2.36	0.0241	OUTLET	2.50	F - 1	0.00
41.80	1	30 in.	807.31	807.88	2 - G	8.52	2.50	2.17	0.0244	OUTLET	12.60	F - 2	0.00
54.40	1	42 in.	803.46	803.83	1 - A	7.13	3.20	2.31	0.0237	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
45.00	1	36 in.	803.59	804.12	2 - F	6.94	3.00	2.18	0.0281	OUTLET**	0.00	D	0.00
45.00	1	42 in.	802.94	803.43	1 - A	5.90	3.20	2.09	0.0278	OUTLET*	0.00	D + 1	0.00
54.40	1	36 in.	804.55	805.09	2 - F	8.38	3.00	2.39	0.0281	OUTLET**	0.00	F	0.00
54.40	1	42 in.	803.46	803.90	1 - A	7.13	3.20	2.31	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
45.00	1	60 in.	802.42	802.95	1 - A	4.38	3.52	1.88	0.0332	OUTLET*	0.00	D	0.00
45.00	1	66 in.	802.31	802.86	1 - A	4.09	3.23	1.82	0.0330	OUTLET*	0.00	D + 1	0.00
54.40	1	60 in.	802.73	803.22	1 - A	5.30	4.20	2.07	0.0332	OUTLET*	0.00	F	0.00
54.40	1	66 in.	802.61	803.10	1 - A	4.95	3.68	2.01	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
45.00	1	60 in.	802.42	802.90	1 - A	4.38	2.97	1.88	0.0260	OUTLET*	0.00	D	0.00
45.00	1	66 in.	802.31	802.82	1 - A	4.09	2.79	1.82	0.0260	OUTLET*	0.00	D + 1	0.00
54.40	1	60 in.	802.73	803.18	1 - A	5.30	3.38	2.07	0.0260	OUTLET*	0.00	F	0.00
54.40	1	66 in.	802.61	803.06	1 - A	4.95	3.14	2.01	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH
Description : Proposed Drive Pipe - 583+65 RT TO 583+86 RT **Designer :** SJD

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.) : 799.46 **Outlet Invert Elevation (ft.) :** 799.40 **Tailwater Elevation (ft.) :** 802.05 **Overflow Elevation (ft.) :** 806.42
Allowable Headwater Elevation (ft.) : 805.42 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 21.00 **Culvert Slope (ft./ft.) :** 0.0029 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 44.80 @ 10 yrs. **Flood Discharge (cfs) :** 54.20 @ 25 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							
44.80	1	27 in.	804.94	804.79	2 - H	11.27	2.25	2.14	0.0120	INLET	0.00	D	0.00
42.40	1	24 in.	807.03	806.54	2 - H	13.50	2.00	1.96	0.0120	INLET	2.40	D - 1	0.00
33.00	1	21 in.	812.84	809.94	2 - H	13.72	1.75	1.73	0.0120	INLET	11.80	D - 2	0.00
44.80	1	30 in.	803.78	803.81	2 - G	9.13	2.50	2.22	0.0120	OUTLET	0.00	D + 1	0.00
52.70	1	27 in.	806.70	806.06	2 - H	13.25	2.25	2.19	0.0120	INLET	1.50	F	0.00
42.40	1	24 in.	810.15	808.62	2 - H	13.50	2.00	1.96	0.0120	INLET	11.80	F - 1	0.00
33.00	1	21 in.	827.35	813.59	2 - H	13.72	1.75	1.73	0.0120	INLET	21.20	F - 2	0.00
54.20	1	30 in.	804.97	804.63	2 - H	11.04	2.50	2.35	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)													
44.80	1	30 in.	805.20	805.39	2 - G	9.13	2.50	2.22	0.0244	OUTLET	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.)
40.60	1	27 in.	807.02	807.35	2 - G	10.21	2.25	2.10	0.0245	OUTLET	4.20	D - 1	0.00
31.20	1	24 in.	810.35	811.01	2 - G	9.93	2.00	1.88	0.0247	OUTLET	13.60	D - 2	0.00
44.80	1	33 in.	804.02	804.24	2 - F	7.63	2.75	2.22	0.0241	OUTLET	0.00	D + 1	0.00
51.20	1	30 in.	807.01	806.93	2 - H	10.43	2.50	2.31	0.0244	INLET	3.00	F	0.00
40.60	1	27 in.	809.57	809.80	2 - G	10.21	2.25	2.10	0.0245	OUTLET	13.60	F - 1	0.00
31.20	1	24 in.	818.06	815.16	2 - G	9.93	2.00	1.88	0.0247	OUTLET	23.00	F - 2	0.00
54.20	1	33 in.	805.36	805.26	2 - E	9.13	2.75	2.40	0.0241	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
44.80	1	36 in.	803.31	803.68	2 - F	6.78	3.00	2.18	0.0281	OUTLET	0.00	D	0.00
44.80	1	42 in.	802.67	803.14	1 - A	5.73	3.20	2.09	0.0278	OUTLET*	0.00	D + 1	0.00
54.20	1	36 in.	804.26	804.47	2 - F	8.20	3.00	2.39	0.0281	OUTLET**	0.00	F	0.00
54.20	1	42 in.	803.18	803.57	1 - A	6.93	3.20	2.30	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
44.80	1	60 in.	802.16	802.68	1 - A	4.24	3.45	1.87	0.0332	OUTLET*	0.00	D	0.00
44.80	1	66 in.	802.05	802.60	1 - A	3.95	3.18	1.82	0.0330	OUTLET*	0.00	D + 1	0.00
54.20	1	60 in.	802.46	802.93	1 - A	5.13	4.07	2.07	0.0332	OUTLET*	0.00	F	0.00
54.20	1	66 in.	802.35	802.83	1 - A	4.78	3.61	2.01	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
44.80	1	60 in.	802.16	802.65	1 - A	4.24	2.92	1.87	0.0260	OUTLET*	0.00	D	0.00
44.80	1	66 in.	802.05	802.57	1 - A	3.95	2.75	1.82	0.0260	OUTLET*	0.00	D + 1	0.00
54.20	1	60 in.	802.46	802.91	1 - A	5.13	3.32	2.07	0.0260	OUTLET*	0.00	F	0.00
54.20	1	66 in.	802.35	802.80	1 - A	4.78	3.08	2.01	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH
Description : Proposed Drive Pipe - 584+63 RT TO 584+83 RT **Designer :** SJD

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.) : 799.22 **Outlet Invert Elevation (ft.) :** 799.17 **Tailwater Elevation (ft.) :** 801.85 **Overflow Elevation (ft.) :** 806.40
Allowable Headwater Elevation (ft.) : 805.40 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 20.00 **Culvert Slope (ft./ft.) :** 0.0025 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 46.00 @ 10 yrs. **Flood Discharge (cfs) :** 55.60 @ 25 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							
46.00	1	27 in.	804.91	804.72	2 - H	11.57	2.25	2.15	0.0120	INLET	0.00	D	0.00
43.30	1	24 in.	807.13	806.55	2 - H	13.78	2.00	1.96	0.0120	INLET	2.70	D - 1	0.00
33.60	1	21 in.	813.75	810.09	2 - H	13.97	1.75	1.73	0.0120	INLET	12.40	D - 2	0.00
46.00	1	30 in.	803.68	803.70	2 - G	9.37	2.50	2.24	0.0120	OUTLET	0.00	D + 1	0.00
53.80	1	27 in.	806.75	806.04	2 - H	13.53	2.25	2.20	0.0120	INLET	1.80	F	0.00
43.30	1	24 in.	810.51	808.71	2 - H	13.78	2.00	1.96	0.0120	INLET	12.30	F - 1	0.00
33.60	1	21 in.	830.78	813.89	2 - H	13.97	1.75	1.73	0.0120	INLET	22.00	F - 2	0.00
55.60	1	30 in.	804.92	804.55	2 - H	11.33	2.50	2.36	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)													
46.00	1	30 in.	805.18	805.32	2 - G	9.37	2.50	2.24	0.0244	OUTLET	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.)
41.80	1	27 in.	807.07	807.36	2 - G	10.51	2.25	2.11	0.0245	OUTLET	4.20	D - 1	0.00
32.10	1	24 in.	810.74	811.14	2 - G	10.22	2.00	1.89	0.0247	OUTLET	13.90	D - 2	0.00
46.00	1	33 in.	803.94	804.14	2 - F	7.80	2.75	2.25	0.0241	OUTLET	0.00	D + 1	0.00
52.30	1	30 in.	807.06	806.92	2 - H	10.65	2.50	2.33	0.0244	INLET	3.30	F	0.00
41.80	1	27 in.	809.78	809.90	2 - G	10.51	2.25	2.11	0.0245	OUTLET	13.80	F - 1	0.00
32.10	1	24 in.	819.76	815.43	2 - G	10.22	2.00	1.89	0.0247	OUTLET	23.50	F - 2	0.00
55.60	1	33 in.	805.33	805.19	2 - E	9.36	2.75	2.42	0.0241	INLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
46.00	1	36 in.	803.18	803.54	2 - F	6.90	3.00	2.21	0.0281	OUTLET	0.00	D	0.00
46.00	1	42 in.	802.49	802.98	1 - A	5.82	3.20	2.12	0.0278	OUTLET*	0.00	D + 1	0.00
55.60	1	36 in.	804.18	804.35	2 - F	8.34	3.00	2.42	0.0281	OUTLET**	0.00	F	0.00
55.60	1	42 in.	803.03	803.40	1 - A	7.03	3.20	2.33	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
46.00	1	60 in.	801.96	802.49	1 - A	4.29	3.72	1.90	0.0332	OUTLET*	0.00	D	0.00
46.00	1	66 in.	801.85	802.41	1 - A	4.00	3.38	1.84	0.0330	OUTLET*	0.00	D + 1	0.00
55.60	1	60 in.	802.27	802.75	1 - A	5.19	4.57	2.09	0.0332	OUTLET*	0.00	F	0.00
55.60	1	66 in.	802.15	802.64	1 - A	4.84	3.86	2.03	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
46.00	1	60 in.	801.96	802.46	1 - A	4.29	3.10	1.90	0.0260	OUTLET*	0.00	D	0.00
46.00	1	66 in.	801.85	802.38	1 - A	4.00	2.90	1.84	0.0260	OUTLET*	0.00	D + 1	0.00
55.60	1	60 in.	802.27	802.72	1 - A	5.19	3.55	2.09	0.0260	OUTLET*	0.00	F	0.00
55.60	1	66 in.	802.15	802.61	1 - A	4.84	3.27	2.03	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH
Description : Proposed Drive Pipe - 586+21 RT TO 586+82 RT **Designer :** SJD

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.) : 798.82 **Outlet Invert Elevation (ft.) :** 798.66 **Tailwater Elevation (ft.) :** 801.35 **Overflow Elevation (ft.) :** 806.40
Allowable Headwater Elevation (ft.) : 805.40 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 61.00 **Culvert Slope (ft./ft.) :** 0.0026 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 46.40 @ 10 yrs. **Flood Discharge (cfs) :** 56.10 @ 25 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							
46.40	1	27 in.	804.58	805.05	2 - G	11.67	2.25	2.16	0.0120	OUTLET	0.00	D	0.00
41.70	1	24 in.	806.84	807.59	2 - G	13.27	2.00	1.96	0.0120	OUTLET	4.70	D - 1	0.00
30.90	1	21 in.	813.76	812.72	2 - G	12.85	1.75	1.72	0.0120	OUTLET	15.50	D - 2	0.00
46.40	1	30 in.	803.33	803.68	2 - G	9.45	2.50	2.25	0.0120	OUTLET	0.00	D + 1	0.00
54.20	1	27 in.	806.46	806.76	2 - G	13.63	2.25	2.20	0.0120	OUTLET	1.90	F	0.00
41.70	1	24 in.	810.34	810.47	2 - G	13.27	2.00	1.96	0.0120	OUTLET	14.40	F - 1	0.00
30.90	1	21 in.	831.83	817.97	2 - G	12.85	1.75	1.72	0.0120	OUTLET	25.20	F - 2	0.00
56.10	1	30 in.	804.59	804.75	2 - G	11.43	2.50	2.36	0.0120	OUTLET	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)													
46.40	1	33 in.	803.59	804.76	2 - F	7.85	2.75	2.25	0.0241	OUTLET	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.)
44.90	1	30 in.	804.85	806.72	2 - G	9.15	2.50	2.22	0.0244	OUTLET	1.50	D - 1	0.00
35.00	1	27 in.	806.77	810.20	2 - G	8.80	2.25	2.01	0.0245	OUTLET	11.40	D - 2	0.00
46.40	1	36 in.	802.82	803.63	2 - F	6.94	3.00	2.22	0.0241	OUTLET	0.00	D + 1	0.00
56.10	1	33 in.	805.01	806.33	2 - F	9.50	2.75	2.43	0.0241	OUTLET	0.00	F	0.00
44.90	1	30 in.	806.76	809.20	2 - G	9.15	2.50	2.22	0.0244	OUTLET	11.20	F - 1	0.00
35.00	1	27 in.	809.54	814.29	2 - G	8.80	2.25	2.01	0.0245	OUTLET	21.10	F - 2	0.00
56.10	1	36 in.	803.84	804.71	2 - F	8.39	3.00	2.43	0.0241	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
46.40	1	36 in.	802.82	803.99	2 - F	6.94	3.00	2.22	0.0281	OUTLET	0.00	D	0.00
46.40	1	42 in.	802.11	802.76	1 - A	5.85	3.20	2.13	0.0278	OUTLET*	0.00	D + 1	0.00
56.10	1	36 in.	803.84	805.24	2 - F	8.39	3.00	2.43	0.0281	OUTLET**	0.00	F	0.00
56.10	1	42 in.	802.66	803.45	2 - F	7.07	3.50	2.35	0.0278	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
46.40	1	60 in.	801.57	802.18	1 - A	4.31	3.67	1.91	0.0332	OUTLET*	0.00	D	0.00
46.40	1	66 in.	801.46	802.07	1 - A	4.02	3.34	1.85	0.0330	OUTLET*	0.00	D + 1	0.00
56.10	1	60 in.	801.88	802.47	1 - A	5.21	4.57	2.10	0.0332	OUTLET*	0.00	F	0.00
56.10	1	66 in.	801.76	802.34	1 - A	4.86	3.82	2.04	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
46.40	1	60 in.	801.57	802.10	1 - A	4.31	3.07	1.91	0.0260	OUTLET*	0.00	D	0.00
46.40	1	66 in.	801.46	802.01	1 - A	4.02	2.88	1.85	0.0260	OUTLET*	0.00	D + 1	0.00
56.10	1	60 in.	801.88	802.37	1 - A	5.21	3.51	2.10	0.0260	OUTLET*	0.00	F	0.00
56.10	1	66 in.	801.76	802.26	1 - A	4.86	3.24	2.04	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH

Description : Proposed Drive Pipe - 592+18 RT TO 593+49 RT

Designer : SJD

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.) : 797.24 **Outlet Invert Elevation (ft.) :** 796.85 **Tailwater Elevation (ft.) :** 799.51 **Overflow Elevation (ft.) :** 802.70
Allowable Headwater Elevation (ft.) : 801.70 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 131.00 **Culvert Slope (ft./ft.) :** 0.0030 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 49.50 @ 10 yrs. **Flood Discharge (cfs) :** 59.60 @ 25 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							
49.50	1	36 in.	800.86	801.04	2 - F	7.47	3.00	2.29	0.0120	OUTLET	0.00	D	0.00
49.50	1	33 in.	801.31	801.78	2 - F	8.42	2.75	2.32	0.0120	OUTLET	0.00	D - 1	0.00
47.10	1	30 in.	802.13	803.02	2 - G	9.60	2.50	2.26	0.0120	OUTLET	2.40	D - 2	0.00
49.50	1	42 in.	800.46	800.60	1 - B	6.31	2.44	2.20	0.0120	OUTLET*	0.00	D + 1	0.00
59.60	1	36 in.	801.54	801.81	2 - F	8.99	3.00	2.49	0.0120	OUTLET**	0.00	F	0.00
58.70	1	33 in.	802.27	802.80	2 - F	9.98	2.75	2.47	0.0120	OUTLET	0.90	F - 1	0.00
47.10	1	30 in.	803.53	804.60	2 - G	9.60	2.50	2.26	0.0120	OUTLET	12.50	F - 2	0.00
59.60	1	42 in.	800.87	801.00	1 - A	7.60	2.88	2.42	0.0120	OUTLET*	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)													
49.50	1	42 in.	800.70	801.53	2 - F	6.31	3.50	2.20	0.0237	OUTLET**	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.)
44.60	1	36 in.	801.54	803.42	2 - F	6.73	3.00	2.18	0.0241	OUTLET	4.90	D - 1	0.00
36.10	1	33 in.	802.44	805.48	2 - F	6.14	2.75	2.00	0.0241	OUTLET	13.40	D - 2	0.00
49.50	1	48 in.	800.38	800.97	1 - A	5.58	3.65	2.11	0.0235	OUTLET*	0.00	D + 1	0.00
59.60	1	42 in.	801.30	802.46	2 - F	7.60	3.50	2.42	0.0237	OUTLET**	0.00	F	0.00
44.60	1	36 in.	802.67	805.27	2 - F	6.73	3.00	2.18	0.0241	OUTLET	15.00	F - 1	0.00
36.10	1	33 in.	803.99	808.17	2 - F	6.14	2.75	2.00	0.0241	OUTLET	23.50	F - 2	0.00
59.60	1	48 in.	800.78	801.42	1 - A	6.72	3.65	2.33	0.0235	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
49.50	1	48 in.	800.38	801.09	1 - A	5.58	3.65	2.11	0.0275	OUTLET*	0.00	D	0.00
49.50	1	42 in.	800.70	801.92	2 - F	6.31	3.50	2.20	0.0278	OUTLET**	0.00	D - 1	0.00
40.30	1	36 in.	801.54	804.31	2 - F	6.08	3.00	2.07	0.0281	OUTLET	9.20	D - 2	0.00
49.50	1	54 in.	800.22	800.83	1 - A	5.06	3.57	2.04	0.0273	OUTLET*	0.00	D + 1	0.00
59.60	1	48 in.	800.78	801.58	1 - A	6.72	3.65	2.33	0.0275	OUTLET*	0.00	F	0.00
56.70	1	42 in.	801.30	803.03	2 - F	7.23	3.50	2.36	0.0278	OUTLET**	2.90	F - 1	0.00
40.30	1	36 in.	802.67	806.55	2 - F	6.08	3.00	2.07	0.0281	OUTLET	19.30	F - 2	0.00
59.60	1	54 in.	800.56	801.21	1 - A	6.09	4.11	2.24	0.0273	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
49.50	1	60 in.	800.09	800.78	1 - A	4.66	3.67	1.97	0.0332	OUTLET*	0.00	D	0.00
49.50	1	66 in.	799.98	800.64	1 - A	4.35	3.34	1.92	0.0330	OUTLET*	0.00	D + 1	0.00
59.60	1	60 in.	800.41	801.12	1 - A	5.61	4.57	2.17	0.0332	OUTLET*	0.00	F	0.00
59.60	1	66 in.	800.29	800.95	1 - A	5.24	3.81	2.11	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
49.50	1	60 in.	800.09	800.63	1 - A	4.66	3.07	1.97	0.0260	OUTLET*	0.00	D	0.00
49.50	1	66 in.	799.98	800.50	1 - A	4.35	2.88	1.92	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.)
59.60	1	60 in.	800.41	800.97	1 - A	5.61	3.51	2.17	0.0260	OUTLET*	0.00	F	0.00
59.60	1	66 in.	800.29	800.81	1 - A	5.24	3.23	2.11	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH
Description : Proposed Drive Pipe - 594+07 RT TO 594+31 RT **Designer :** SJD

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.) : 796.68 **Outlet Invert Elevation (ft.) :** 796.61 **Tailwater Elevation (ft.) :** 799.31 **Overflow Elevation (ft.) :** 801.47
Allowable Headwater Elevation (ft.) : 800.47 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 24.00 **Culvert Slope (ft./ft.) :** 0.0029 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 51.40 @ 10 yrs. **Flood Discharge (cfs) :** 62.00 @ 25 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							
51.40	1	36 in.	800.42	800.42	2 - E	7.27	3.00	2.33	0.0120	INLET	0.00	D	0.00
51.40	1	33 in.	800.92	800.90	2 - E	8.65	2.75	2.35	0.0120	INLET	0.00	D - 1	0.00
48.70	1	30 in.	801.81	801.67	2 - H	9.92	2.50	2.28	0.0120	INLET	2.70	D - 2	0.00
51.40	1	42 in.	799.98	800.15	1 - B	6.45	2.53	2.24	0.0120	OUTLET*	0.00	D + 1	0.00
62.00	1	36 in.	801.15	800.99	2 - E	8.77	3.00	2.54	0.0120	INLET	0.00	F	0.00
57.20	1	33 in.	801.97	801.62	2 - E	9.63	2.75	2.45	0.0120	INLET	4.80	F - 1	0.00
48.70	1	30 in.	803.33	802.75	2 - H	9.92	2.50	2.28	0.0120	INLET	13.30	F - 2	0.00
62.00	1	42 in.	800.42	800.52	1 - A	7.78	3.08	2.47	0.0120	OUTLET*	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)													
51.40	1	48 in.	799.90	800.37	1 - A	5.70	3.65	2.15	0.0235	OUTLET*	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.)
	51.40	1	42 in.	800.24	800.65	1 - A	6.45	3.20	2.24	0.0237	OUTLET*	0.00	D - 1	0.00
	51.40	1	36 in.	801.18	801.36	2 - F	7.67	3.00	2.33	0.0241	OUTLET	0.00	D - 2	0.00
	51.40	1	54 in.	799.73	800.18	1 - A	5.16	3.24	2.07	0.0233	OUTLET*	0.00	D + 1	0.00
	62.00	1	48 in.	800.32	800.77	1 - A	6.87	3.65	2.37	0.0235	OUTLET*	0.00	F	0.00
	62.00	1	42 in.	800.90	801.16	2 - F	7.78	3.50	2.47	0.0237	OUTLET*	0.00	F - 1	0.00
	52.70	1	36 in.	802.41	802.36	2 - F	7.46	3.00	2.36	0.0241	OUTLET	9.30	F - 2	0.00
	62.00	1	54 in.	800.07	800.53	1 - A	6.22	3.91	2.29	0.0233	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	51.40	1	48 in.	799.90	800.38	1 - A	5.70	3.65	2.15	0.0275	OUTLET*	0.00	D	0.00
	51.40	1	42 in.	800.24	800.68	1 - A	6.45	3.20	2.24	0.0278	OUTLET*	0.00	D - 1	0.00
	50.60	1	36 in.	801.18	801.53	2 - F	7.55	3.00	2.31	0.0281	OUTLET	0.80	D - 2	0.00
	51.40	1	54 in.	799.73	800.20	1 - A	5.16	3.76	2.07	0.0273	OUTLET*	0.00	D + 1	0.00
	62.00	1	48 in.	800.32	800.79	1 - A	6.87	3.65	2.37	0.0275	OUTLET*	0.00	F	0.00
	62.00	1	42 in.	800.90	801.23	2 - F	7.78	3.50	2.47	0.0278	OUTLET**	0.00	F - 1	0.00
	50.60	1	36 in.	802.41	802.61	2 - F	7.55	3.00	2.31	0.0281	OUTLET	11.40	F - 2	0.00
	62.00	1	54 in.	800.07	800.54	1 - A	6.22	4.11	2.29	0.0273	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	51.40	1	60 in.	799.60	800.10	1 - A	4.75	3.83	2.01	0.0332	OUTLET*	0.00	D	0.00
	51.40	1	66 in.	799.48	800.00	1 - A	4.43	3.45	1.95	0.0330	OUTLET*	0.00	D + 1	0.00
	62.00	1	60 in.	799.92	800.40	1 - A	5.73	4.57	2.22	0.0332	OUTLET*	0.00	F	0.00
	62.00	1	66 in.	799.80	800.28	1 - A	5.34	3.96	2.15	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	25.70	2	60 in.	798.63	799.53	1 - B	2.38	2.40	1.40	0.0332	OUTLET*	0.00	D	0.00
	25.70	2	66 in.	798.55	799.50	1 - B	2.21	2.28	1.37	0.0330	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.)
	31.00	2	60 in.	798.86	799.62	1 - B	2.87	2.68	1.55	0.0332	OUTLET*	0.00	F	0.00
	31.00	2	66 in.	798.76	799.58	1 - B	2.67	2.53	1.50	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	51.40	1	60 in.	799.60	800.07	1 - A	4.75	3.17	2.01	0.0260	OUTLET*	0.00	D	0.00
	51.40	1	66 in.	799.48	799.97	1 - A	4.43	2.96	1.95	0.0260	OUTLET*	0.00	D + 1	0.00
	62.00	1	60 in.	799.92	800.37	1 - A	5.73	3.65	2.22	0.0260	OUTLET*	0.00	F	0.00
	62.00	1	66 in.	799.80	800.24	1 - A	5.34	3.34	2.15	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	25.70	2	60 in.	798.63	799.51	1 - B	2.38	2.09	1.40	0.0260	OUTLET*	0.00	D	0.00
	25.70	2	66 in.	798.55	799.49	1 - B	2.21	2.00	1.37	0.0260	OUTLET*	0.00	D + 1	0.00
	31.00	2	60 in.	798.86	799.60	1 - B	2.87	2.32	1.55	0.0260	OUTLET*	0.00	F	0.00
	31.00	2	66 in.	798.76	799.56	1 - B	2.67	2.22	1.50	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH
Description : Proposed Drive Pipe - 595+38 RT TO 596+13 RT **Designer :** SJD

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.) : 796.28 **Outlet Invert Elevation (ft.) :** 796.05 **Tailwater Elevation (ft.) :** 798.76 **Overflow Elevation (ft.) :** 801.31
Allowable Headwater Elevation (ft.) : 800.31 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 75.00 **Culvert Slope (ft./ft.) :** 0.0031 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 51.60 @ 10 yrs. **Flood Discharge (cfs) :** 62.30 @ 25 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							
51.60	1	36 in.	800.03	800.13	2 - F	7.68	3.00	2.34	0.0120	OUTLET	0.00	D	0.00
51.60	1	33 in.	800.53	800.77	2 - F	8.71	2.75	2.36	0.0120	OUTLET	0.00	D - 1	0.00
47.00	1	30 in.	801.44	801.82	2 - G	9.57	2.50	2.26	0.0120	OUTLET	4.60	D - 2	0.00
51.60	1	42 in.	799.59	799.74	1 - B	6.46	2.49	2.25	0.0120	OUTLET*	0.00	D + 1	0.00
62.30	1	36 in.	800.78	800.82	2 - F	9.27	3.00	2.54	0.0120	OUTLET**	0.00	F	0.00
58.10	1	33 in.	801.60	801.69	2 - F	9.81	2.75	2.46	0.0120	OUTLET	4.20	F - 1	0.00
47.00	1	30 in.	802.98	803.23	2 - G	9.57	2.50	2.26	0.0120	OUTLET	15.30	F - 2	0.00
62.30	1	42 in.	800.03	800.14	1 - A	7.79	2.98	2.47	0.0120	OUTLET*	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)													
51.60	1	48 in.	799.51	800.04	1 - A	5.69	3.65	2.16	0.0235	OUTLET*	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.)
51.60	1	42 in.	799.85	800.37	1 - A	6.46	3.20	2.25	0.0237	OUTLET*	0.00	D - 1	0.00
46.70	1	36 in.	800.80	801.87	2 - F	6.95	3.00	2.23	0.0241	OUTLET	4.90	D - 2	0.00
51.60	1	54 in.	799.33	799.83	1 - A	5.16	3.18	2.08	0.0233	OUTLET*	0.00	D + 1	0.00
62.30	1	48 in.	799.93	800.46	1 - A	6.87	3.65	2.38	0.0235	OUTLET*	0.00	F	0.00
62.30	1	42 in.	800.52	801.22	2 - F	7.79	3.50	2.47	0.0237	OUTLET**	0.00	F - 1	0.00
46.70	1	36 in.	802.05	803.35	2 - F	6.95	3.00	2.23	0.0241	OUTLET	15.60	F - 2	0.00
62.30	1	54 in.	799.68	800.19	1 - A	6.23	3.80	2.29	0.0233	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
51.60	1	48 in.	799.51	800.09	1 - A	5.69	3.65	2.16	0.0275	OUTLET*	0.00	D	0.00
51.60	1	42 in.	799.85	800.67	2 - F	6.46	3.50	2.25	0.0278	OUTLET**	0.00	D - 1	0.00
43.00	1	36 in.	800.80	802.42	2 - F	6.40	3.00	2.14	0.0281	OUTLET	8.60	D - 2	0.00
51.60	1	54 in.	799.33	799.89	1 - A	5.16	3.67	2.08	0.0273	OUTLET*	0.00	D + 1	0.00
62.30	1	48 in.	799.93	800.56	1 - A	6.87	3.65	2.38	0.0275	OUTLET*	0.00	F	0.00
59.20	1	42 in.	800.52	801.58	2 - F	7.41	3.50	2.41	0.0278	OUTLET**	3.10	F - 1	0.00
43.00	1	36 in.	802.05	804.15	2 - F	6.40	3.00	2.14	0.0281	OUTLET	19.30	F - 2	0.00
62.30	1	54 in.	799.68	800.26	1 - A	6.23	4.11	2.29	0.0273	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
51.60	1	60 in.	799.20	799.82	1 - A	4.75	3.76	2.01	0.0332	OUTLET*	0.00	D	0.00
51.60	1	66 in.	799.09	799.68	1 - A	4.43	3.40	1.96	0.0330	OUTLET*	0.00	D + 1	0.00
62.30	1	60 in.	799.53	800.15	1 - A	5.73	4.57	2.22	0.0332	OUTLET*	0.00	F	0.00
62.30	1	66 in.	799.41	799.98	1 - A	5.34	3.90	2.16	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
51.60	1	60 in.	799.20	799.71	1 - A	4.75	3.13	2.01	0.0260	OUTLET*	0.00	D	0.00
51.60	1	66 in.	799.09	799.60	1 - A	4.43	2.93	1.96	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.)
62.30	1	60 in.	799.53	800.03	1 - A	5.73	3.59	2.22	0.0260	OUTLET*	0.00	F	0.00
62.30	1	66 in.	799.41	799.89	1 - A	5.34	3.29	2.16	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH
Description : Proposed Drive Pipe - 596+90 RT TO 597+31 RT **Designer :** SJD

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.) : 795.83 **Outlet Invert Elevation (ft.) :** 795.71 **Tailwater Elevation (ft.) :** 798.43 **Overflow Elevation (ft.) :** 800.57
Allowable Headwater Elevation (ft.) : 799.57 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 41.00 **Culvert Slope (ft./ft.) :** 0.0029 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 52.00 @ 10 yrs. **Flood Discharge (cfs) :** 62.80 @ 25 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							
52.00	1	42 in.	799.15	799.32	1 - B	6.48	2.55	2.26	0.0120	OUTLET*	0.00	D	0.00
52.00	1	36 in.	799.61	799.65	2 - F	7.72	3.00	2.34	0.0120	OUTLET	0.00	D - 1	0.00
52.00	1	33 in.	800.12	800.19	2 - F	8.77	2.75	2.36	0.0120	OUTLET	0.00	D - 2	0.00
52.00	1	48 in.	798.95	799.12	1 - B	5.71	2.27	2.17	0.0120	OUTLET*	0.00	D + 1	0.00
62.80	1	42 in.	799.60	799.71	1 - A	7.83	3.20	2.48	0.0120	OUTLET*	0.00	F	0.00
62.80	1	36 in.	800.37	800.26	2 - E	8.88	3.00	2.55	0.0120	INLET	0.00	F - 1	0.00
56.70	1	33 in.	801.20	801.00	2 - E	9.55	2.75	2.44	0.0120	INLET	6.10	F - 2	0.00
62.80	1	48 in.	799.31	799.43	1 - B	6.90	2.58	2.39	0.0120	OUTLET*	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)													
52.00	1	48 in.	799.07	799.56	1 - A	5.71	3.65	2.17	0.0235	OUTLET*	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.)
	52.00	1	42 in.	799.43	799.89	1 - A	6.48	3.20	2.26	0.0237	OUTLET*	0.00	D - 1	0.00
	48.60	1	36 in.	800.39	800.88	2 - F	7.21	3.00	2.27	0.0241	OUTLET	3.40	D - 2	0.00
	52.00	1	54 in.	798.90	799.37	1 - A	5.17	3.26	2.09	0.0233	OUTLET*	0.00	D + 1	0.00
	62.80	1	48 in.	799.51	799.97	1 - A	6.90	3.65	2.39	0.0235	OUTLET*	0.00	F	0.00
	62.80	1	42 in.	800.10	800.49	2 - F	7.83	3.50	2.48	0.0237	OUTLET**	0.00	F - 1	0.00
	48.60	1	36 in.	801.66	802.06	2 - F	7.21	3.00	2.27	0.0241	OUTLET	14.20	F - 2	0.00
	62.80	1	54 in.	799.25	799.72	1 - A	6.25	3.99	2.30	0.0233	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	52.00	1	54 in.	798.90	799.40	1 - A	5.17	3.81	2.09	0.0273	OUTLET*	0.00	D	0.00
	52.00	1	48 in.	799.07	799.61	1 - A	5.71	3.65	2.17	0.0275	OUTLET*	0.00	D - 1	0.00
	52.00	1	42 in.	799.43	799.95	1 - A	6.48	3.20	2.26	0.0278	OUTLET*	0.00	D - 2	0.00
	52.00	1	60 in.	798.77	799.27	1 - A	4.76	3.29	2.02	0.0271	OUTLET*	0.00	D + 1	0.00
	62.80	1	54 in.	799.25	799.76	1 - A	6.25	4.11	2.30	0.0273	OUTLET*	0.00	F	0.00
	62.80	1	48 in.	799.51	800.03	1 - A	6.90	3.65	2.39	0.0275	OUTLET*	0.00	F - 1	0.00
	61.20	1	42 in.	800.10	800.69	2 - F	7.63	3.50	2.45	0.0278	OUTLET**	1.60	F - 2	0.00
	62.80	1	60 in.	799.09	799.57	1 - A	5.75	3.81	2.23	0.0271	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	52.00	1	60 in.	798.77	799.31	1 - A	4.76	3.86	2.02	0.0332	OUTLET*	0.00	D	0.00
	52.00	1	66 in.	798.65	799.20	1 - A	4.44	3.48	1.97	0.0330	OUTLET*	0.00	D + 1	0.00
	62.80	1	60 in.	799.09	799.62	1 - A	5.75	4.57	2.23	0.0332	OUTLET*	0.00	F	0.00
	62.80	1	66 in.	798.97	799.48	1 - A	5.36	4.00	2.17	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	26.00	2	60 in.	797.80	798.69	1 - B	2.38	2.42	1.41	0.0332	OUTLET*	0.00	D	0.00
	26.00	2	66 in.	797.71	798.65	1 - B	2.22	2.29	1.37	0.0330	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.)
	31.40	2	60 in.	798.03	798.80	1 - B	2.88	2.70	1.56	0.0332	OUTLET*	0.00	F	0.00
	31.40	2	66 in.	797.93	798.74	1 - B	2.68	2.55	1.51	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	52.00	1	60 in.	798.77	799.25	1 - A	4.76	3.20	2.02	0.0260	OUTLET*	0.00	D	0.00
	52.00	1	66 in.	798.65	799.15	1 - A	4.44	2.98	1.97	0.0260	OUTLET*	0.00	D + 1	0.00
	62.80	1	60 in.	799.09	799.56	1 - A	5.75	3.68	2.23	0.0260	OUTLET*	0.00	F	0.00
	62.80	1	66 in.	798.97	799.44	1 - A	5.36	3.36	2.17	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	26.00	2	60 in.	797.80	798.67	1 - B	2.38	2.10	1.41	0.0260	OUTLET*	0.00	D	0.00
	26.00	2	66 in.	797.71	798.63	1 - B	2.22	2.01	1.37	0.0260	OUTLET*	0.00	D + 1	0.00
	31.40	2	60 in.	798.03	798.76	1 - B	2.88	2.34	1.56	0.0260	OUTLET*	0.00	F	0.00
	31.40	2	66 in.	797.93	798.71	1 - B	2.68	2.23	1.51	0.0260	OUTLET*	0.00	F + 1	0.00



UNIVERSAL CULVERT DESIGN

PID : 95358 **Date :** 01/20/2016 **Project :** LOR-82-Drainage Study **Location :** Columbia Station, OH

Description : Proposed Drive Pipe - 598+16 RT TO 599+00 RT

Designer : SJD

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.) : 795.45 **Outlet Invert Elevation (ft.) :** 795.20 **Tailwater Elevation (ft.) :** 797.93 **Overflow Elevation (ft.) :** 800.33
Allowable Headwater Elevation (ft.) : 799.33 or Diameter + 4 ft. (*whichever is less*)
Pipe Length (ft.) : 84.00 **Culvert Slope (ft./ft.) :** 0.0030 **Design Manning 'n' :** 0.0120
Design Discharge (cfs) : 52.20 @ 10 yrs. **Flood Discharge (cfs) :** 63.00 @ 25 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							
52.20	1	42 in.	798.78	798.94	1 - B	6.48	2.54	2.26	0.0120	OUTLET*	0.00	D	0.00
52.20	1	36 in.	799.24	799.38	2 - F	7.73	3.00	2.35	0.0120	OUTLET	0.00	D - 1	0.00
52.20	1	33 in.	799.76	800.06	2 - F	8.80	2.75	2.37	0.0120	OUTLET	0.00	D - 2	0.00
52.20	1	48 in.	798.58	798.72	1 - B	5.71	2.27	2.17	0.0120	OUTLET*	0.00	D + 1	0.00
63.00	1	42 in.	799.23	799.35	1 - A	7.82	3.11	2.49	0.0120	OUTLET*	0.00	F	0.00
63.00	1	36 in.	800.00	800.09	2 - F	9.33	3.00	2.55	0.0120	OUTLET**	0.00	F - 1	0.00
55.30	1	33 in.	800.85	801.04	2 - F	9.32	2.75	2.42	0.0120	OUTLET	7.70	F - 2	0.00
63.00	1	48 in.	798.94	799.05	1 - B	6.90	2.57	2.39	0.0120	OUTLET*	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)													
52.20	1	48 in.	798.70	799.26	1 - A	5.71	3.65	2.17	0.0235	OUTLET*	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.)
	52.20	1	42 in.	799.06	799.70	2 - F	6.48	3.50	2.26	0.0237	OUTLET**	0.00	D - 1	0.00
	44.00	1	36 in.	800.03	801.30	2 - F	6.52	3.00	2.16	0.0241	OUTLET	8.20	D - 2	0.00
	52.20	1	54 in.	798.52	799.02	1 - A	5.17	3.25	2.09	0.0233	OUTLET*	0.00	D + 1	0.00
	63.00	1	48 in.	799.13	799.68	1 - A	6.90	3.65	2.39	0.0235	OUTLET*	0.00	F	0.00
	60.30	1	42 in.	799.74	800.55	2 - F	7.49	3.50	2.43	0.0237	OUTLET**	2.70	F - 1	0.00
	44.00	1	36 in.	801.31	802.88	2 - F	6.52	3.00	2.16	0.0241	OUTLET	19.00	F - 2	0.00
	63.00	1	54 in.	798.88	799.40	1 - A	6.24	3.95	2.31	0.0233	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	52.20	1	48 in.	798.70	799.32	1 - A	5.71	3.65	2.17	0.0275	OUTLET*	0.00	D	0.00
	52.20	1	42 in.	799.06	799.98	2 - F	6.48	3.50	2.26	0.0278	OUTLET**	0.00	D - 1	0.00
	40.40	1	36 in.	800.03	801.93	2 - F	5.98	3.00	2.07	0.0281	OUTLET	11.80	D - 2	0.00
	52.20	1	54 in.	798.52	799.09	1 - A	5.17	3.78	2.09	0.0273	OUTLET*	0.00	D + 1	0.00
	63.00	1	48 in.	799.13	799.82	1 - A	6.90	3.65	2.39	0.0275	OUTLET*	0.00	F	0.00
	56.20	1	42 in.	799.74	800.96	2 - F	6.98	3.50	2.35	0.0278	OUTLET**	6.80	F - 1	0.00
	40.40	1	36 in.	801.31	803.80	2 - F	5.98	3.00	2.07	0.0281	OUTLET	22.60	F - 2	0.00
	63.00	1	54 in.	798.88	799.48	1 - A	6.24	4.11	2.31	0.0273	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	52.20	1	60 in.	798.39	799.02	1 - A	4.76	3.85	2.03	0.0332	OUTLET*	0.00	D	0.00
	52.20	1	66 in.	798.28	798.89	1 - A	4.44	3.47	1.97	0.0330	OUTLET*	0.00	D + 1	0.00
	63.00	1	60 in.	798.72	799.38	1 - A	5.75	4.57	2.23	0.0332	OUTLET*	0.00	F	0.00
	63.00	1	66 in.	798.60	799.20	1 - A	5.35	3.98	2.17	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	26.10	2	60 in.	797.42	798.29	1 - B	2.38	2.41	1.42	0.0332	OUTLET*	0.00	D	0.00
	26.10	2	66 in.	797.34	798.23	1 - B	2.22	2.29	1.38	0.0330	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.)
	31.50	2	60 in.	797.65	798.43	1 - B	2.87	2.69	1.56	0.0332	OUTLET*	0.00	F	0.00
	31.50	2	66 in.	797.55	798.35	1 - B	2.68	2.54	1.52	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	52.20	1	60 in.	798.39	798.91	1 - A	4.76	3.19	2.03	0.0260	OUTLET*	0.00	D	0.00
	52.20	1	66 in.	798.28	798.79	1 - A	4.44	2.97	1.97	0.0260	OUTLET*	0.00	D + 1	0.00
	63.00	1	60 in.	798.72	799.24	1 - A	5.75	3.66	2.23	0.0260	OUTLET*	0.00	F	0.00
	63.00	1	66 in.	798.60	799.09	1 - A	5.35	3.35	2.17	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	26.10	2	60 in.	797.42	798.22	1 - B	2.38	2.10	1.42	0.0260	OUTLET*	0.00	D	0.00
	26.10	2	66 in.	797.34	798.20	1 - B	2.22	2.01	1.38	0.0260	OUTLET*	0.00	D + 1	0.00
	31.50	2	60 in.	797.65	798.35	1 - B	2.87	2.33	1.56	0.0260	OUTLET*	0.00	F	0.00
	31.50	2	66 in.	797.55	798.29	1 - B	2.68	2.22	1.52	0.0260	OUTLET*	0.00	F + 1	0.00