UNIVERSAL CULVERT DESIGN

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

Description : Proposed Drive Pipe - 550+04 LT to 550+58 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.) : 808.84 **Outlet Invert Elevation (ft.) :** 808.70 **Tailwater Elevation (ft.) :** 809.17 **Overflow Elevation (ft.) :** 812.29

Allowable Headwater Elevation (ft.) : 811.29 **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) : 1.30 **@** 10 yrs. **Flood Discharge (cfs) :** 1.50 **@** 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		
	1.30	1	12 in.	809.53	809.55	1 - A	3.47	0.59	0.48	0.0120	OUTLET*	0.00	D	0.00
	1.30	1	15 in.	809.46	809.49	1 - A	3.08	0.52	0.45	0.0120	OUTLET*	0.00	D + 1	0.00
	1.50	1	12 in.	809.59	809.61	1 - A	3.65	0.65	0.52	0.0120	OUTLET*	0.00	F	0.00
	1.50	1	15 in.	809.52	809.54	1 - A	3.41	0.57	0.49	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)														
	1.30	1	12 in.	809.55	809.77	1 - A	3.47	0.91	0.48	0.0251	OUTLET*	0.00	D	0.00
	1.30	1	15 in.	809.49	809.65	1 - A	3.08	0.81	0.45	0.0250	OUTLET*	0.00	D + 1	0.00
	1.50	1	12 in.	809.61	809.83	1 - A	3.65	0.91	0.52	0.0251	OUTLET*	0.00	F	0.00
	1.50	1	15 in.	809.54	809.72	1 - A	3.41	0.91	0.49	0.0250	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														

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.)
	1.30	1	36 in.	809.34	809.44	1 - A	1.84	0.58	0.35	0.0281	OUTLET*	0.00	D	0.00
	1.30	1	42 in.	809.36	809.41	1 - A	1.69	0.55	0.34	0.0278	OUTLET*	0.00	D + 1	0.00
	1.50	1	36 in.	809.37	809.49	1 - A	2.12	0.63	0.38	0.0281	OUTLET*	0.00	F	0.00
	1.50	1	42 in.	809.38	809.45	1 - A	1.95	0.59	0.36	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	1.30	1	60 in.	809.46	809.39	1 - C	1.12	0.55	0.31	0.0332	INLET	0.00	D	0.00
	1.30	1	66 in.	809.50	809.36	1 - C	1.11	0.53	0.30	0.0330	INLET	0.00	D + 1	0.00
	1.50	1	60 in.	809.48	809.43	1 - C	1.17	0.58	0.33	0.0332	INLET	0.00	F	0.00
	1.50	1	66 in.	809.52	809.41	1 - C	1.16	0.57	0.32	0.0330	INLET	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	0.65	2	60 in.	809.42	809.30	1 - C	0.91	0.39	0.22	0.0332	INLET	0.00	D	0.00
	0.65	2	66 in.	809.47	809.29	1 - C	0.90	0.38	0.21	0.0330	INLET	0.00	D + 1	0.00
	0.75	2	60 in.	809.43	809.33	1 - C	0.95	0.42	0.23	0.0332	INLET	0.00	F	0.00
	0.75	2	66 in.	809.47	809.32	1 - C	0.94	0.41	0.23	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	1.30	1	60 in.	809.46	809.36	1 - C	1.33	0.49	0.31	0.0260	INLET	0.00	D	0.00
	1.30	1	66 in.	809.50	809.36	1 - C	1.31	0.47	0.30	0.0260	INLET	0.00	D + 1	0.00
	1.50	1	60 in.	809.48	809.38	1 - C	1.39	0.52	0.33	0.0260	INLET	0.00	F	0.00
	1.50	1	66 in.	809.52	809.37	1 - C	1.37	0.51	0.32	0.0260	INLET	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	0.65	2	60 in.	809.42	809.26	1 - C	1.08	0.35	0.22	0.0260	INLET	0.00	D	0.00
	0.65	2	66 in.	809.47	809.26	1 - C	1.06	0.34	0.21	0.0260	INLET	0.00	D + 1	0.00
	0.75	2	60 in.	809.43	809.29	1 - C	1.12	0.37	0.23	0.0260	INLET	0.00	F	0.00
	0.75	2	66 in.	809.47	809.28	1 - C	1.11	0.36	0.23	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 - 552+06 LT to 552+49 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.) : 809.34 **Outlet Invert Elevation (ft.) :** 809.23 **Tailwater Elevation (ft.) :** 809.83 **Overflow Elevation (ft.) :** 812.44

Allowable Headwater Elevation (ft.) : 811.44 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 43.00 **Culvert Slope (ft./ft.) :** 0.0026 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 2.00 **@** 10 yrs. **Flood Discharge (cfs) :** 2.40 **@** 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		
2.00	1	12 in.	810.22	810.27	1 - A	4.04	0.84	0.60	0.0120	OUTLET*	0.00	D	0.00
2.00	1	15 in.	810.14	810.16	1 - A	3.43	0.67	0.56	0.0120	OUTLET*	0.00	D + 1	0.00
2.40	1	12 in.	810.32	810.39	1 - A	4.34	0.91	0.66	0.0120	OUTLET*	0.00	F	0.00
2.40	1	15 in.	810.23	810.25	1 - A	3.96	0.76	0.62	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)													
2.00	1	12 in.	810.27	810.72	2 - F	4.04	1.00	0.60	0.0251	OUTLET**	0.00	D	0.00
2.00	1	15 in.	810.17	810.36	1 - A	3.43	1.14	0.56	0.0250	OUTLET*	0.00	D + 1	0.00
2.40	1	12 in.	810.42	811.06	2 - F	4.34	1.00	0.66	0.0251	OUTLET**	0.00	F	0.00
2.40	1	15 in.	810.26	810.49	1 - A	3.96	1.14	0.62	0.0250	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													

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.)
Diameter exceeds 1.25 HWA	2.00	1	36 in.	809.94	810.10	1 - A	1.99	0.73	0.44	0.0281	OUTLET*	0.00	D	0.00
	2.00	1	42 in.	809.94	810.05	1 - A	1.82	0.69	0.42	0.0278	OUTLET*	0.00	D + 1	0.00
	2.40	1	36 in.	809.99	810.17	1 - A	2.38	0.79	0.48	0.0281	OUTLET*	0.00	F	0.00
	2.40	1	42 in.	809.98	810.13	1 - A	2.19	0.75	0.46	0.0278	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	1.00	2	36 in.	809.80	809.94	1 - B	0.99	0.51	0.31	0.0281	OUTLET*	0.00	D	0.00
	1.00	2	42 in.	809.83	809.92	1 - B	0.91	0.49	0.30	0.0278	OUTLET*	0.00	D + 1	0.00
	1.20	2	36 in.	809.83	809.99	1 - B	1.19	0.56	0.34	0.0281	OUTLET*	0.00	F	0.00
	1.20	2	42 in.	809.85	809.96	1 - B	1.09	0.53	0.33	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	2.00	1	60 in.	810.01	810.02	1 - A	1.50	0.67	0.38	0.0332	OUTLET*	0.00	D	0.00
	2.00	1	66 in.	810.05	810.00	1 - C	1.26	0.65	0.37	0.0330	INLET	0.00	D + 1	0.00
	2.40	1	60 in.	810.04	810.09	1 - A	1.80	0.73	0.42	0.0332	OUTLET*	0.00	F	0.00
	2.40	1	66 in.	810.07	810.06	1 - C	1.33	0.71	0.41	0.0330	INLET	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	1.00	2	60 in.	809.94	809.91	1 - C	1.03	0.48	0.27	0.0332	INLET	0.00	D	0.00
	1.00	2	66 in.	809.99	809.90	1 - C	1.02	0.47	0.26	0.0330	INLET	0.00	D + 1	0.00
	1.20	2	60 in.	809.96	809.95	1 - C	1.09	0.53	0.30	0.0332	INLET	0.00	F	0.00
	1.20	2	66 in.	810.00	809.93	1 - C	1.08	0.51	0.29	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	2.00	1	60 in.	810.01	810.01	1 - C	1.51	0.60	0.38	0.0260	INLET	0.00	D	0.00
	2.00	1	66 in.	810.05	810.00	1 - C	1.49	0.58	0.37	0.0260	INLET	0.00	D + 1	0.00
	2.40	1	60 in.	810.04	810.03	1 - C	1.59	0.65	0.42	0.0260	INLET	0.00	F	0.00
	2.40	1	66 in.	810.07	810.02	1 - C	1.57	0.64	0.41	0.0260	INLET	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	1.00	2	60 in.	809.94	809.89	1 - C	1.22	0.43	0.27	0.0260	INLET	0.00	D	0.00

UNIVERSAL CULVERT DESIGN

FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
1.00	2	66 in.	809.99	809.89	1 - C	1.20	0.42	0.26	0.0260	INLET	0.00	D + 1	0.00
1.20	2	60 in.	809.96	809.91	1 - C	1.29	0.47	0.30	0.0260	INLET	0.00	F	0.00
1.20	2	66 in.	810.00	809.90	1 - C	1.27	0.46	0.29	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 - 557+67 LT TO 558+10 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.) : 807.94 **Outlet Invert Elevation (ft.) :** 807.83 **Tailwater Elevation (ft.) :** 808.95 **Overflow Elevation (ft.) :** 811.76

Allowable Headwater Elevation (ft.) : 810.76 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 43.00 **Culvert Slope (ft./ft.) :** 0.0026 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 6.80 **@** 10 yrs. **Flood Discharge (cfs) :** 8.30 **@** 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		
	6.80	1	15 in.	809.76	809.95	2 - F	5.86	1.25	1.05	0.0120	OUTLET**	0.00	D	0.00
	6.80	1	12 in.	810.93	811.67	2 - G	8.66	1.00	0.97	0.0120	OUTLET	0.00	D - 1	0.00
	6.80	1	18 in.	809.44	809.53	1 - A	4.81	1.37	1.01	0.0120	OUTLET*	0.00	D + 1	0.00
	8.30	1	15 in.	810.23	810.47	2 - F	7.12	1.25	1.13	0.0120	OUTLET**	0.00	F	0.00
	6.90	1	12 in.	812.03	813.01	2 - G	8.79	1.00	0.97	0.0120	OUTLET	1.40	F - 1	0.00
	8.30	1	18 in.	809.68	809.78	2 - F	5.87	1.50	1.12	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)														
	6.80	1	18 in.	809.60	810.18	2 - F	4.81	1.50	1.01	0.0249	OUTLET**	0.00	D	0.00
	6.80	1	15 in.	810.26	811.64	2 - F	5.86	1.25	1.05	0.0250	OUTLET**	0.00	D - 1	0.00
	4.00	1	12 in.	812.09	816.97	2 - G	5.09	1.00	0.85	0.0251	OUTLET	2.80	D - 2	0.00

UNIVERSAL CULVERT DESIGN

	FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
	6.80	1	21 in.	809.39	809.70	1 - A	4.18	1.60	0.96	0.0248	OUTLET*	0.00	D + 1	0.00
	8.30	1	18 in.	809.97	810.77	2 - F	5.87	1.50	1.12	0.0249	OUTLET**	0.00	F	0.00
	6.90	1	15 in.	811.01	812.98	2 - F	5.95	1.25	1.05	0.0250	OUTLET**	1.40	F - 1	0.00
	4.00	1	12 in.	813.98	820.90	2 - G	5.09	1.00	0.85	0.0251	OUTLET	4.30	F - 2	0.00
	8.30	1	21 in.	809.60	809.90	1 - A	5.11	1.60	1.07	0.0248	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	6.80	1	36 in.	809.08	809.34	1 - A	2.83	1.39	0.82	0.0281	OUTLET*	0.00	D	0.00
	6.80	1	42 in.	809.00	809.29	1 - A	2.56	1.28	0.79	0.0278	OUTLET*	0.00	D + 1	0.00
	8.30	1	36 in.	809.22	809.48	1 - A	3.45	1.56	0.91	0.0281	OUTLET*	0.00	F	0.00
	8.30	1	42 in.	809.13	809.41	1 - A	3.13	1.43	0.87	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	6.80	1	60 in.	808.91	809.21	1 - A	2.07	1.23	0.71	0.0332	OUTLET*	0.00	D	0.00
	6.80	1	66 in.	808.91	809.18	1 - A	1.96	1.18	0.69	0.0330	OUTLET*	0.00	D + 1	0.00
	8.30	1	60 in.	809.00	809.31	1 - A	2.53	1.36	0.79	0.0332	OUTLET*	0.00	F	0.00
	8.30	1	66 in.	808.99	809.27	1 - A	2.39	1.31	0.77	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	3.40	2	60 in.	808.70	809.03	1 - B	1.03	0.87	0.50	0.0332	OUTLET*	0.00	D	0.00
	3.40	2	66 in.	808.72	809.03	1 - B	0.98	0.84	0.49	0.0330	OUTLET*	0.00	D + 1	0.00
	4.15	2	60 in.	808.75	809.07	1 - B	1.26	0.96	0.55	0.0332	OUTLET*	0.00	F	0.00
	4.15	2	66 in.	808.77	809.05	1 - B	1.20	0.93	0.54	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	6.80	1	60 in.	808.91	809.19	1 - B	2.07	1.08	0.71	0.0260	OUTLET*	0.00	D	0.00
	6.80	1	66 in.	808.91	809.17	1 - B	1.96	1.05	0.69	0.0260	OUTLET*	0.00	D + 1	0.00
	8.30	1	60 in.	809.00	809.26	1 - A	2.53	1.20	0.79	0.0260	OUTLET*	0.00	F	0.00
	8.30	1	66 in.	808.99	809.22	1 - A	2.39	1.16	0.77	0.0260	OUTLET*	0.00	F + 1	0.00

UNIVERSAL CULVERT DESIGN

	FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
Diameter exceeds 1.25 HWA	3.40	2	60 in.	808.70	809.02	1 - B	1.03	0.77	0.50	0.0260	OUTLET*	0.00	D	0.00
	3.40	2	66 in.	808.72	809.01	1 - B	0.98	0.75	0.49	0.0260	OUTLET*	0.00	D + 1	0.00
	4.15	2	60 in.	808.75	809.05	1 - B	1.26	0.85	0.55	0.0260	OUTLET*	0.00	F	0.00
	4.15	2	66 in.	808.77	809.04	1 - B	1.20	0.83	0.54	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 - 559+50 LT TO 559+99 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.) : 807.48 **Outlet Invert Elevation (ft.) :** 807.35 **Tailwater Elevation (ft.) :** 808.67 **Overflow Elevation (ft.) :** 811.12

Allowable Headwater Elevation (ft.) : 810.12 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 49.00 **Culvert Slope (ft./ft.) :** 0.0027 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 9.60 **@** 10 yrs. **Flood Discharge (cfs) :** 11.60 **@** 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		
9.60	1	18 in.	809.44	809.59	2 - F	5.83	1.50	1.20	0.0120	OUTLET**	0.00	D	0.00
9.60	1	15 in.	810.24	810.73	2 - G	7.82	1.25	1.17	0.0120	OUTLET	0.00	D - 1	0.00
6.20	1	12 in.	812.85	814.47	2 - G	7.89	1.00	0.96	0.0120	OUTLET	3.40	D - 2	0.00
9.60	1	21 in.	809.19	809.28	1 - A	4.93	1.60	1.15	0.0120	OUTLET*	0.00	D + 1	0.00
11.60	1	18 in.	809.86	810.06	2 - F	7.04	1.50	1.30	0.0120	OUTLET**	0.00	F	0.00
10.40	1	15 in.	811.09	811.67	2 - G	8.47	1.25	1.19	0.0120	OUTLET	1.20	F - 1	0.00
6.20	1	12 in.	816.39	817.14	2 - G	7.89	1.00	0.96	0.0120	OUTLET	5.40	F - 2	0.00
11.60	1	21 in.	809.43	809.52	1 - A	5.96	1.60	1.27	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)													
9.60	1	21 in.	809.35	809.92	2 - F	4.93	1.75	1.15	0.0248	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.)
	9.60	1	18 in.	809.89	811.06	2 - F	5.83	1.50	1.20	0.0249	OUTLET**	0.00	D - 1	0.00
	6.20	1	15 in.	811.27	814.46	2 - G	5.05	1.25	1.01	0.0250	OUTLET	3.40	D - 2	0.00
	9.60	1	24 in.	809.15	809.49	1 - A	4.36	1.83	1.11	0.0247	OUTLET*	0.00	D + 1	0.00
	11.60	1	21 in.	809.72	810.50	2 - F	5.96	1.75	1.27	0.0248	OUTLET**	0.00	F	0.00
	9.70	1	18 in.	810.58	812.20	2 - F	5.89	1.50	1.20	0.0249	OUTLET**	1.90	F - 1	0.00
	6.20	1	15 in.	812.49	817.12	2 - G	5.05	1.25	1.01	0.0250	OUTLET	5.40	F - 2	0.00
	11.60	1	24 in.	809.38	809.74	1 - A	5.27	1.83	1.22	0.0247	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	9.60	1	36 in.	808.87	809.17	1 - A	3.20	1.68	0.98	0.0281	OUTLET*	0.00	D	0.00
	9.60	1	42 in.	808.77	809.09	1 - A	2.89	1.53	0.94	0.0278	OUTLET*	0.00	D + 1	0.00
	11.60	1	36 in.	809.03	809.33	1 - A	3.87	1.90	1.08	0.0281	OUTLET*	0.00	F	0.00
	11.60	1	42 in.	808.93	809.22	1 - A	3.49	1.71	1.03	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	9.60	1	60 in.	808.62	808.99	1 - A	2.32	1.45	0.85	0.0332	OUTLET*	0.00	D	0.00
	9.60	1	66 in.	808.60	808.95	1 - A	2.19	1.39	0.83	0.0330	OUTLET*	0.00	D + 1	0.00
	11.60	1	60 in.	808.73	809.09	1 - A	2.80	1.60	0.93	0.0332	OUTLET*	0.00	F	0.00
	11.60	1	66 in.	808.70	809.06	1 - A	2.65	1.54	0.91	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	4.80	2	60 in.	808.33	808.77	1 - B	1.16	1.02	0.60	0.0332	OUTLET*	0.00	D	0.00
	4.80	2	66 in.	808.34	808.77	1 - B	1.09	0.99	0.58	0.0330	OUTLET*	0.00	D + 1	0.00
	5.80	2	60 in.	808.39	808.81	1 - B	1.40	1.12	0.66	0.0332	OUTLET*	0.00	F	0.00
	5.80	2	66 in.	808.40	808.80	1 - B	1.32	1.08	0.64	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	9.60	1	60 in.	808.62	808.97	1 - B	2.32	1.28	0.85	0.0260	OUTLET*	0.00	D	0.00
	9.60	1	66 in.	808.60	808.93	1 - B	2.19	1.24	0.83	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.)
	11.60	1	60 in.	808.73	809.05	1 - A	2.80	1.41	0.93	0.0260	OUTLET*	0.00	F	0.00
	11.60	1	66 in.	808.70	809.00	1 - A	2.65	1.36	0.91	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	4.80	2	60 in.	808.33	808.75	1 - B	1.16	0.91	0.60	0.0260	OUTLET*	0.00	D	0.00
	4.80	2	66 in.	808.34	808.74	1 - B	1.09	0.88	0.58	0.0260	OUTLET*	0.00	D + 1	0.00
	5.80	2	60 in.	808.39	808.78	1 - B	1.40	0.99	0.66	0.0260	OUTLET*	0.00	F	0.00
	5.80	2	66 in.	808.40	808.78	1 - B	1.32	0.96	0.64	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 - 560+10 LT TO 560+53 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.) : 807.33 **Outlet Invert Elevation (ft.) :** 807.22 **Tailwater Elevation (ft.) :** 808.86 **Overflow Elevation (ft.) :** 811.51

Allowable Headwater Elevation (ft.) : 810.51 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 43.00 **Culvert Slope (ft./ft.) :** 0.0026 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 15.40 **@** 10 yrs. **Flood Discharge (cfs) :** 18.60 **@** 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		
15.40	1	21 in.	809.82	809.97	2 - F	6.58	1.75	1.45	0.0120	OUTLET	0.00	D	0.00
15.40	1	18 in.	810.72	811.06	2 - G	8.71	1.50	1.41	0.0120	OUTLET	0.00	D - 1	0.00
11.20	1	15 in.	813.01	813.86	2 - G	9.13	1.25	1.21	0.0120	OUTLET	4.20	D - 2	0.00
15.40	1	24 in.	809.47	809.59	1 - A	5.59	1.83	1.42	0.0120	OUTLET*	0.00	D + 1	0.00
18.60	1	21 in.	810.40	810.49	2 - F	7.94	1.75	1.56	0.0120	OUTLET**	0.00	F	0.00
16.90	1	18 in.	811.77	812.07	2 - G	9.56	1.50	1.44	0.0120	OUTLET	1.70	F - 1	0.00
11.20	1	15 in.	815.91	816.16	2 - G	9.13	1.25	1.21	0.0120	OUTLET	7.40	F - 2	0.00
18.60	1	24 in.	809.82	809.90	2 - F	6.75	2.00	1.55	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)													
15.40	1	24 in.	809.76	810.35	2 - F	5.59	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.)
	15.30	1	21 in.	810.48	811.54	2 - F	6.53	1.75	1.45	0.0248	OUTLET	0.10	D - 1	0.00
	10.50	1	18 in.	811.99	814.47	2 - G	5.94	1.50	1.25	0.0249	OUTLET	4.90	D - 2	0.00
	15.40	1	27 in.	809.45	809.82	1 - A	4.96	2.05	1.37	0.0245	OUTLET*	0.00	D + 1	0.00
	18.60	1	24 in.	810.32	811.07	2 - F	6.75	2.00	1.55	0.0247	OUTLET**	0.00	F	0.00
	15.30	1	21 in.	811.42	812.78	2 - F	6.53	1.75	1.45	0.0248	OUTLET	3.30	F - 1	0.00
	10.50	1	18 in.	813.49	817.05	2 - G	5.94	1.50	1.25	0.0249	OUTLET	8.10	F - 2	0.00
	18.60	1	27 in.	809.80	810.29	2 - F	5.99	2.25	1.51	0.0245	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	15.40	1	36 in.	809.15	809.50	1 - A	3.90	2.42	1.25	0.0281	OUTLET*	0.00	D	0.00
	15.40	1	42 in.	809.04	809.38	1 - A	3.48	2.05	1.20	0.0278	OUTLET*	0.00	D + 1	0.00
	18.60	1	36 in.	809.36	809.71	1 - A	4.70	2.74	1.38	0.0281	OUTLET*	0.00	F	0.00
	18.60	1	42 in.	809.23	809.56	1 - A	4.20	2.33	1.32	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.	808.78	809.24	1 - A	2.75	1.87	1.08	0.0332	OUTLET*	0.00	D	0.00
	15.40	1	66 in.	808.74	809.20	1 - A	2.59	1.79	1.05	0.0330	OUTLET*	0.00	D + 1	0.00
	18.60	1	60 in.	808.95	809.37	1 - A	3.32	2.08	1.19	0.0332	OUTLET*	0.00	F	0.00
	18.60	1	66 in.	808.89	809.32	1 - A	3.13	1.98	1.16	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	7.70	2	60 in.	808.35	808.97	1 - B	1.37	1.31	0.76	0.0332	OUTLET*	0.00	D	0.00
	7.70	2	66 in.	808.35	808.96	1 - B	1.30	1.26	0.74	0.0330	OUTLET*	0.00	D + 1	0.00
	9.30	2	60 in.	808.45	809.02	1 - B	1.66	1.44	0.83	0.0332	OUTLET*	0.00	F	0.00
	9.30	2	66 in.	808.43	809.00	1 - B	1.56	1.39	0.81	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.	808.78	809.19	1 - A	2.75	1.64	1.08	0.0260	OUTLET*	0.00	D	0.00
	15.40	1	66 in.	808.74	809.17	1 - B	2.59	1.59	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.)
	18.60	1	60 in.	808.95	809.32	1 - A	3.32	1.82	1.19	0.0260	OUTLET*	0.00	F	0.00
	18.60	1	66 in.	808.89	809.27	1 - A	3.13	1.75	1.16	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	7.70	2	60 in.	808.35	808.96	1 - B	1.37	1.15	0.76	0.0260	OUTLET*	0.00	D	0.00
	7.70	2	66 in.	808.35	808.95	1 - B	1.30	1.12	0.74	0.0260	OUTLET*	0.00	D + 1	0.00
	9.30	2	60 in.	808.45	809.00	1 - B	1.66	1.27	0.83	0.0260	OUTLET*	0.00	F	0.00
	9.30	2	66 in.	808.43	808.98	1 - B	1.56	1.23	0.81	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 - 560+98 LT TO 561+38 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.) : 807.11 **Outlet Invert Elevation (ft.) :** 807.01 **Tailwater Elevation (ft.) :** 808.66 **Overflow Elevation (ft.) :** 811.27

Allowable Headwater Elevation (ft.) : 810.27 **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) : 15.50 **@** 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		
15.50	1	21 in.	809.62	809.76	2 - F	6.59	1.75	1.46	0.0120	OUTLET	0.00	D	0.00
15.50	1	18 in.	810.53	810.83	2 - G	8.77	1.50	1.42	0.0120	OUTLET	0.00	D - 1	0.00
11.20	1	15 in.	812.86	813.58	2 - G	9.13	1.25	1.21	0.0120	OUTLET	4.30	D - 2	0.00
15.50	1	24 in.	809.26	809.38	1 - A	5.59	1.83	1.42	0.0120	OUTLET*	0.00	D + 1	0.00
18.80	1	21 in.	810.22	810.28	2 - F	8.00	1.75	1.57	0.0120	OUTLET**	0.00	F	0.00
16.90	1	18 in.	811.62	811.85	2 - G	9.56	1.50	1.44	0.0120	OUTLET	1.90	F - 1	0.00
11.20	1	15 in.	815.95	815.90	2 - G	9.13	1.25	1.21	0.0120	OUTLET	7.60	F - 2	0.00
18.80	1	24 in.	809.62	809.69	2 - F	6.78	2.00	1.56	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)													
15.50	1	24 in.	809.55	810.11	2 - F	5.59	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.	810.28	811.27	2 - F	6.55	1.75	1.45	0.0248	OUTLET	0.10	D - 1	0.00
	10.70	1	18 in.	811.81	814.11	2 - G	6.05	1.50	1.25	0.0249	OUTLET	4.80	D - 2	0.00
	15.50	1	27 in.	809.24	809.61	1 - A	4.96	2.05	1.37	0.0245	OUTLET*	0.00	D + 1	0.00
	18.80	1	24 in.	810.14	810.84	2 - F	6.78	2.00	1.56	0.0247	OUTLET**	0.00	F	0.00
	15.40	1	21 in.	811.26	812.51	2 - F	6.55	1.75	1.45	0.0248	OUTLET	3.40	F - 1	0.00
	10.70	1	18 in.	813.37	816.67	2 - G	6.05	1.50	1.25	0.0249	OUTLET	8.10	F - 2	0.00
	18.80	1	27 in.	809.60	810.07	2 - F	6.02	2.25	1.52	0.0245	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	15.50	1	36 in.	808.94	809.28	1 - A	3.89	2.47	1.26	0.0281	OUTLET*	0.00	D	0.00
	15.50	1	42 in.	808.82	809.17	1 - A	3.47	2.07	1.20	0.0278	OUTLET*	0.00	D + 1	0.00
	18.80	1	36 in.	809.15	809.51	1 - A	4.72	2.74	1.39	0.0281	OUTLET*	0.00	F	0.00
	18.80	1	42 in.	809.02	809.35	1 - A	4.21	2.37	1.33	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	15.50	1	60 in.	808.57	809.02	1 - A	2.74	1.89	1.08	0.0332	OUTLET*	0.00	D	0.00
	15.50	1	66 in.	808.52	808.98	1 - A	2.59	1.81	1.05	0.0330	OUTLET*	0.00	D + 1	0.00
	18.80	1	60 in.	808.74	809.16	1 - A	3.33	2.10	1.20	0.0332	OUTLET*	0.00	F	0.00
	18.80	1	66 in.	808.68	809.10	1 - A	3.14	2.01	1.16	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	7.75	2	60 in.	808.14	808.77	1 - B	1.37	1.32	0.76	0.0332	OUTLET*	0.00	D	0.00
	7.75	2	66 in.	808.13	808.75	1 - B	1.29	1.27	0.74	0.0330	OUTLET*	0.00	D + 1	0.00
	9.40	2	60 in.	808.23	808.81	1 - B	1.66	1.45	0.84	0.0332	OUTLET*	0.00	F	0.00
	9.40	2	66 in.	808.22	808.79	1 - B	1.57	1.40	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	15.50	1	60 in.	808.57	808.98	1 - A	2.74	1.66	1.08	0.0260	OUTLET*	0.00	D	0.00
	15.50	1	66 in.	808.52	808.97	1 - B	2.59	1.60	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.	808.74	809.11	1 - A	3.33	1.84	1.20	0.0260	OUTLET*	0.00	F	0.00
	18.80	1	66 in.	808.68	809.07	1 - A	3.14	1.77	1.16	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	7.75	2	60 in.	808.14	808.75	1 - B	1.37	1.17	0.76	0.0260	OUTLET*	0.00	D	0.00
	7.75	2	66 in.	808.13	808.74	1 - B	1.29	1.13	0.74	0.0260	OUTLET*	0.00	D + 1	0.00
	9.40	2	60 in.	808.23	808.79	1 - B	1.66	1.28	0.84	0.0260	OUTLET*	0.00	F	0.00
	9.40	2	66 in.	808.22	808.78	1 - B	1.57	1.24	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+51 LT TO 561+95 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.) : 806.98 **Outlet Invert Elevation (ft.) :** 806.87 **Tailwater Elevation (ft.) :** 808.76 **Overflow Elevation (ft.) :** 810.86

Allowable Headwater Elevation (ft.) : 809.86 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 44.00 **Culvert Slope (ft./ft.) :** 0.0025 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 20.80 **@** 10 yrs. **Flood Discharge (cfs) :** 25.30 **@** 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		
20.80	1	27 in.	809.40	809.54	1 - A	5.83	2.05	1.60	0.0120	OUTLET*	0.00	D	0.00
20.80	1	24 in.	809.74	809.89	2 - F	6.77	2.00	1.63	0.0120	OUTLET	0.00	D - 1	0.00
20.80	1	21 in.	810.51	810.80	2 - G	8.65	1.75	1.62	0.0120	OUTLET	0.00	D - 2	0.00
20.80	1	30 in.	809.25	809.38	1 - A	5.22	1.92	1.55	0.0120	OUTLET*	0.00	D + 1	0.00
25.30	1	27 in.	809.81	809.88	2 - F	7.10	2.25	1.76	0.0120	OUTLET**	0.00	F	0.00
25.30	1	24 in.	810.38	810.43	2 - F	8.23	2.00	1.77	0.0120	OUTLET	0.00	F - 1	0.00
21.10	1	21 in.	811.60	811.77	2 - G	8.77	1.75	1.62	0.0120	OUTLET	4.20	F - 2	0.00
25.30	1	30 in.	809.55	809.65	1 - A	6.35	2.28	1.71	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)													
20.80	1	30 in.	809.40	809.82	1 - A	5.22	2.28	1.55	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.)
	20.80	1	27 in.	809.73	810.30	2 - F	5.83	2.25	1.60	0.0245	OUTLET**	0.00	D - 1	0.00
	18.50	1	24 in.	810.42	811.39	2 - F	6.02	2.00	1.55	0.0247	OUTLET	2.30	D - 2	0.00
	20.80	1	33 in.	809.24	809.63	1 - A	4.78	2.51	1.50	0.0241	OUTLET*	0.00	D + 1	0.00
	25.30	1	30 in.	809.84	810.35	2 - F	6.35	2.50	1.71	0.0244	OUTLET**	0.00	F	0.00
	24.00	1	27 in.	810.40	811.11	2 - F	6.73	2.25	1.71	0.0245	OUTLET**	1.30	F - 1	0.00
	18.50	1	24 in.	811.48	812.65	2 - F	6.02	2.00	1.55	0.0247	OUTLET	6.80	F - 2	0.00
	25.30	1	33 in.	809.56	809.96	1 - A	5.81	2.51	1.67	0.0241	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	20.80	1	36 in.	809.14	809.57	1 - A	4.43	2.74	1.46	0.0281	OUTLET*	0.00	D	0.00
	20.80	1	42 in.	809.01	809.40	1 - A	3.92	2.56	1.40	0.0278	OUTLET*	0.00	D + 1	0.00
	25.30	1	36 in.	809.41	809.85	1 - A	5.39	2.74	1.62	0.0281	OUTLET*	0.00	F	0.00
	25.30	1	42 in.	809.24	809.62	1 - A	4.77	3.20	1.55	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	20.80	1	60 in.	808.71	809.20	1 - A	3.06	2.22	1.26	0.0332	OUTLET*	0.00	D	0.00
	20.80	1	66 in.	808.64	809.15	1 - A	2.88	2.12	1.23	0.0330	OUTLET*	0.00	D + 1	0.00
	25.30	1	60 in.	808.91	809.36	1 - A	3.72	2.49	1.39	0.0332	OUTLET*	0.00	F	0.00
	25.30	1	66 in.	808.83	809.30	1 - A	3.50	2.36	1.36	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	10.40	2	60 in.	808.16	808.89	1 - B	1.53	1.53	0.88	0.0332	OUTLET*	0.00	D	0.00
	10.40	2	66 in.	808.14	808.88	1 - B	1.44	1.48	0.86	0.0330	OUTLET*	0.00	D + 1	0.00
	12.65	2	60 in.	808.29	808.95	1 - B	1.86	1.70	0.98	0.0332	OUTLET*	0.00	F	0.00
	12.65	2	66 in.	808.25	808.92	1 - B	1.75	1.63	0.95	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	20.80	1	60 in.	808.71	809.14	1 - A	3.06	1.94	1.26	0.0260	OUTLET*	0.00	D	0.00
	20.80	1	66 in.	808.64	809.12	1 - B	2.88	1.87	1.23	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.)
	25.30	1	60 in.	808.91	809.31	1 - A	3.72	2.16	1.39	0.0260	OUTLET*	0.00	F	0.00
	25.30	1	66 in.	808.83	809.25	1 - A	3.50	2.07	1.36	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	10.40	2	60 in.	808.16	808.87	1 - B	1.53	1.35	0.88	0.0260	OUTLET*	0.00	D	0.00
	10.40	2	66 in.	808.14	808.86	1 - B	1.44	1.31	0.86	0.0260	OUTLET*	0.00	D + 1	0.00
	12.65	2	60 in.	808.29	808.92	1 - B	1.86	1.49	0.98	0.0260	OUTLET*	0.00	F	0.00
	12.65	2	66 in.	808.25	808.91	1 - B	1.75	1.44	0.95	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+38 LT TO 563+78 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.) : 806.51 **Outlet Invert Elevation (ft.) :** 806.41 **Tailwater Elevation (ft.) :** 808.33 **Overflow Elevation (ft.) :** 810.92

Allowable Headwater Elevation (ft.) : 809.92 **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) : 21.60 **@** 10 yrs. **Flood Discharge (cfs) :** 26.10 **@** 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		
21.60	1	24 in.	809.37	809.52	2 - F	6.97	2.00	1.66	0.0120	OUTLET	0.00	D	0.00
21.60	1	21 in.	810.22	810.46	2 - G	8.98	1.75	1.63	0.0120	OUTLET	0.00	D - 1	0.00
16.90	1	18 in.	812.10	812.55	2 - G	9.56	1.50	1.44	0.0120	OUTLET	4.70	D - 2	0.00
21.60	1	27 in.	809.00	809.13	1 - A	5.98	2.05	1.63	0.0120	OUTLET*	0.00	D + 1	0.00
26.10	1	24 in.	810.04	810.07	2 - F	8.42	2.00	1.79	0.0120	OUTLET	0.00	F	0.00
23.80	1	21 in.	811.35	811.44	2 - G	9.89	1.75	1.67	0.0120	OUTLET	2.30	F - 1	0.00
16.90	1	18 in.	814.34	814.49	2 - G	9.56	1.50	1.44	0.0120	OUTLET	9.20	F - 2	0.00
26.10	1	27 in.	809.42	809.47	2 - F	7.22	2.25	1.78	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)													
21.60	1	27 in.	809.37	809.91	2 - F	5.98	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.)
	21.10	1	24 in.	810.13	811.03	2 - F	6.81	2.00	1.65	0.0247	OUTLET	0.50	D - 1	0.00
	15.40	1	21 in.	811.58	813.40	2 - G	6.40	1.75	1.45	0.0248	OUTLET	6.20	D - 2	0.00
	21.60	1	30 in.	809.00	809.41	1 - A	5.34	2.28	1.58	0.0244	OUTLET**	0.00	D + 1	0.00
	26.10	1	27 in.	810.06	810.70	2 - F	7.22	2.25	1.78	0.0245	OUTLET**	0.00	F	0.00
	21.10	1	24 in.	811.22	812.28	2 - F	6.81	2.00	1.65	0.0247	OUTLET	5.00	F - 1	0.00
	15.40	1	21 in.	813.20	815.73	2 - G	6.40	1.75	1.45	0.0248	OUTLET	10.70	F - 2	0.00
	26.10	1	30 in.	809.45	809.93	2 - F	6.45	2.50	1.74	0.0244	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	21.60	1	36 in.	808.72	809.13	1 - A	4.52	2.74	1.49	0.0281	OUTLET*	0.00	D	0.00
	21.60	1	42 in.	808.58	808.97	1 - A	4.00	2.64	1.42	0.0278	OUTLET*	0.00	D + 1	0.00
	26.10	1	36 in.	808.99	809.40	1 - A	5.46	2.74	1.65	0.0281	OUTLET*	0.00	F	0.00
	26.10	1	42 in.	808.81	809.20	1 - A	4.83	3.20	1.57	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	21.60	1	60 in.	808.27	808.76	1 - A	3.11	2.27	1.28	0.0332	OUTLET*	0.00	D	0.00
	21.60	1	66 in.	808.20	808.72	1 - A	2.93	2.16	1.25	0.0330	OUTLET*	0.00	D + 1	0.00
	26.10	1	60 in.	808.48	808.92	1 - A	3.76	2.53	1.42	0.0332	OUTLET*	0.00	F	0.00
	26.10	1	66 in.	808.40	808.86	1 - A	3.53	2.40	1.38	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	10.80	2	60 in.	807.71	808.46	1 - B	1.56	1.56	0.90	0.0332	OUTLET*	0.00	D	0.00
	10.80	2	66 in.	807.69	808.44	1 - B	1.46	1.50	0.88	0.0330	OUTLET*	0.00	D + 1	0.00
	13.05	2	60 in.	807.84	808.51	1 - B	1.88	1.73	0.99	0.0332	OUTLET*	0.00	F	0.00
	13.05	2	66 in.	807.80	808.48	1 - B	1.77	1.66	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	21.60	1	60 in.	808.27	808.72	1 - A	3.11	1.98	1.28	0.0260	OUTLET*	0.00	D	0.00
	21.60	1	66 in.	808.20	808.69	1 - B	2.93	1.90	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.)
	26.10	1	60 in.	808.48	808.88	1 - A	3.76	2.20	1.42	0.0260	OUTLET*	0.00	F	0.00
	26.10	1	66 in.	808.40	808.82	1 - A	3.53	2.11	1.38	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	10.80	2	60 in.	807.71	808.45	1 - B	1.56	1.38	0.90	0.0260	OUTLET*	0.00	D	0.00
	10.80	2	66 in.	807.69	808.43	1 - B	1.46	1.33	0.88	0.0260	OUTLET*	0.00	D + 1	0.00
	13.05	2	60 in.	807.84	808.49	1 - B	1.88	1.52	0.99	0.0260	OUTLET*	0.00	F	0.00
	13.05	2	66 in.	807.80	808.47	1 - B	1.77	1.47	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 - 564+45 LT TO 564+79 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.) : 806.24 **Outlet Invert Elevation (ft.) :** 806.15 **Tailwater Elevation (ft.) :** 808.06 **Overflow Elevation (ft.) :** 809.97

Allowable Headwater Elevation (ft.) : 808.97 **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) : 21.30 **@** 10 yrs. **Flood Discharge (cfs) :** 25.80 **@** 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		
21.30	1	27 in.	808.71	808.83	1 - A	5.92	2.05	1.62	0.0120	OUTLET*	0.00	D	0.00
21.30	1	24 in.	809.06	809.17	2 - F	6.89	2.00	1.65	0.0120	OUTLET	0.00	D - 1	0.00
20.90	1	21 in.	809.88	810.04	2 - G	8.69	1.75	1.62	0.0120	OUTLET	0.40	D - 2	0.00
21.30	1	30 in.	808.54	808.67	1 - A	5.29	1.91	1.57	0.0120	OUTLET*	0.00	D + 1	0.00
25.80	1	27 in.	809.12	809.15	2 - F	7.17	2.25	1.77	0.0120	OUTLET**	0.00	F	0.00
25.80	1	24 in.	809.72	809.69	2 - E	8.21	2.00	1.78	0.0120	INLET	0.00	F - 1	0.00
20.90	1	21 in.	811.00	810.97	2 - G	8.69	1.75	1.62	0.0120	OUTLET	4.90	F - 2	0.00
25.80	1	30 in.	808.84	808.94	1 - A	6.41	2.28	1.73	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)													
21.30	1	33 in.	808.53	808.90	1 - A	4.84	2.51	1.52	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.)
	21.30	1	30 in.	808.70	809.08	1 - A	5.29	2.28	1.57	0.0244	OUTLET*	0.00	D - 1	0.00
	21.30	1	27 in.	809.05	809.50	2 - F	5.92	2.25	1.62	0.0245	OUTLET**	0.00	D - 2	0.00
	21.30	1	36 in.	808.43	808.80	1 - A	4.49	2.74	1.48	0.0241	OUTLET*	0.00	D + 1	0.00
	25.80	1	33 in.	808.86	809.21	1 - A	5.86	2.51	1.68	0.0241	OUTLET*	0.00	F	0.00
	25.80	1	30 in.	809.15	809.55	2 - F	6.41	2.50	1.73	0.0244	OUTLET**	0.00	F - 1	0.00
	24.20	1	27 in.	809.74	810.24	2 - F	6.73	2.25	1.72	0.0245	OUTLET**	1.60	F - 2	0.00
	25.80	1	36 in.	808.70	809.06	1 - A	5.43	2.74	1.64	0.0241	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	21.30	1	36 in.	808.43	808.83	1 - A	4.49	2.74	1.48	0.0281	OUTLET*	0.00	D	0.00
	21.30	1	42 in.	808.29	808.67	1 - A	3.97	2.55	1.41	0.0278	OUTLET*	0.00	D + 1	0.00
	25.80	1	36 in.	808.70	809.09	1 - A	5.43	2.74	1.64	0.0281	OUTLET*	0.00	F	0.00
	25.80	1	42 in.	808.53	808.89	1 - A	4.80	3.20	1.56	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	21.30	1	60 in.	807.99	808.47	1 - A	3.09	2.22	1.28	0.0332	OUTLET*	0.00	D	0.00
	21.30	1	66 in.	807.92	808.42	1 - A	2.91	2.11	1.24	0.0330	OUTLET*	0.00	D + 1	0.00
	25.80	1	60 in.	808.20	808.63	1 - A	3.74	2.48	1.41	0.0332	OUTLET*	0.00	F	0.00
	25.80	1	66 in.	808.11	808.57	1 - A	3.52	2.35	1.37	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	10.65	2	60 in.	807.44	808.18	1 - B	1.54	1.53	0.89	0.0332	OUTLET*	0.00	D	0.00
	10.65	2	66 in.	807.41	808.16	1 - B	1.45	1.47	0.87	0.0330	OUTLET*	0.00	D + 1	0.00
	12.90	2	60 in.	807.56	808.23	1 - B	1.87	1.69	0.99	0.0332	OUTLET*	0.00	F	0.00
	12.90	2	66 in.	807.53	808.21	1 - B	1.76	1.62	0.96	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	21.30	1	60 in.	807.99	808.43	1 - A	3.09	1.94	1.28	0.0260	OUTLET*	0.00	D	0.00
	21.30	1	66 in.	807.92	808.41	1 - B	2.91	1.86	1.24	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.)
	25.80	1	60 in.	808.20	808.59	1 - A	3.74	2.15	1.41	0.0260	OUTLET*	0.00	F	0.00
	25.80	1	66 in.	808.11	808.53	1 - A	3.52	2.06	1.37	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	10.65	2	60 in.	807.44	808.17	1 - B	1.54	1.35	0.89	0.0260	OUTLET*	0.00	D	0.00
	10.65	2	66 in.	807.41	808.16	1 - B	1.45	1.30	0.87	0.0260	OUTLET*	0.00	D + 1	0.00
	12.90	2	60 in.	807.56	808.21	1 - B	1.87	1.49	0.99	0.0260	OUTLET*	0.00	F	0.00
	12.90	2	66 in.	807.53	808.19	1 - B	1.76	1.44	0.96	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 - 566+53 LT TO 567+02 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.) : 805.72 **Outlet Invert Elevation (ft.) :** 805.59 **Tailwater Elevation (ft.) :** 807.63 **Overflow Elevation (ft.) :** 809.26

Allowable Headwater Elevation (ft.) : 808.26 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 49.00 **Culvert Slope (ft./ft.) :** 0.0027 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 24.80 **@** 10 yrs. **Flood Discharge (cfs) :** 30.00 **@** 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		
	24.80	1	36 in.	808.03	808.17	1 - B	4.85	1.79	1.61	0.0120	OUTLET*	0.00	D	0.00
	24.80	1	33 in.	808.12	808.26	1 - B	5.25	1.93	1.65	0.0120	OUTLET*	0.00	D - 1	0.00
	24.80	1	30 in.	808.25	808.40	1 - A	5.78	2.28	1.70	0.0120	OUTLET*	0.00	D - 2	0.00
	24.80	1	42 in.	807.89	808.04	1 - B	4.26	1.63	1.53	0.0120	OUTLET*	0.00	D + 1	0.00
	30.00	1	36 in.	808.30	808.40	1 - A	5.86	2.04	1.77	0.0120	OUTLET*	0.00	F	0.00
	30.00	1	33 in.	808.42	808.53	1 - A	6.35	2.30	1.82	0.0120	OUTLET*	0.00	F - 1	0.00
	30.00	1	30 in.	808.63	808.73	2 - F	7.00	2.50	1.87	0.0120	OUTLET*	0.00	F - 2	0.00
	30.00	1	42 in.	808.14	808.23	1 - B	5.15	1.82	1.69	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	24.80	1	48 in.	807.84	808.22	1 - A	3.85	2.25	1.47	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.)
	24.80	1	42 in.	807.96	808.34	1 - A	4.26	2.53	1.53	0.0237	OUTLET*	0.00	D - 1	0.00
	24.80	1	36 in.	808.12	808.55	1 - A	4.85	2.74	1.61	0.0241	OUTLET*	0.00	D - 2	0.00
	24.80	1	54 in.	807.73	808.12	1 - A	3.54	2.09	1.42	0.0233	OUTLET*	0.00	D + 1	0.00
	30.00	1	48 in.	808.08	808.44	1 - A	4.66	2.54	1.62	0.0235	OUTLET*	0.00	F	0.00
	30.00	1	42 in.	808.21	808.60	1 - A	5.15	3.09	1.69	0.0237	OUTLET*	0.00	F - 1	0.00
	30.00	1	36 in.	808.44	808.85	1 - A	5.86	2.74	1.77	0.0241	OUTLET*	0.00	F - 2	0.00
	30.00	1	54 in.	807.96	808.33	1 - A	4.28	2.33	1.57	0.0233	OUTLET*	0.00	F + 1	0.00
	12.40	2	27 in.	807.55	808.19	1 - A	3.27	2.05	1.22	0.0245	OUTLET	0.00	D	0.00
	12.40	2	24 in.	807.72	808.62	2 - G	3.95	2.00	1.27	0.0247	OUTLET	0.00	D - 1	0.00
	11.50	2	21 in.	808.13	809.50	2 - G	4.78	1.75	1.26	0.0248	OUTLET	0.90	D - 2	0.00
	12.40	2	30 in.	807.46	807.98	1 - A	2.89	2.28	1.18	0.0244	OUTLET	0.00	D + 1	0.00
	15.00	2	27 in.	807.80	808.46	2 - F	3.96	2.25	1.35	0.0245	OUTLET	0.00	F	0.00
	15.00	2	24 in.	808.08	809.08	2 - G	4.77	2.00	1.40	0.0247	OUTLET	0.00	F - 1	0.00
	11.50	2	21 in.	808.76	810.37	2 - G	4.78	1.75	1.26	0.0248	OUTLET	3.50	F - 2	0.00
	15.00	2	30 in.	807.66	808.14	1 - A	3.50	2.28	1.31	0.0244	OUTLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
Diameter exceeds 1.25 HWA	24.80	1	48 in.	807.84	808.25	1 - A	3.85	2.49	1.47	0.0275	OUTLET*	0.00	D	0.00
	24.80	1	42 in.	807.96	808.38	1 - A	4.26	2.95	1.53	0.0278	OUTLET*	0.00	D - 1	0.00
	24.80	1	36 in.	808.12	808.60	1 - A	4.85	2.74	1.61	0.0281	OUTLET*	0.00	D - 2	0.00
	24.80	1	54 in.	807.73	808.16	1 - A	3.54	2.29	1.42	0.0273	OUTLET*	0.00	D + 1	0.00
	30.00	1	48 in.	808.08	808.47	1 - A	4.66	2.85	1.62	0.0275	OUTLET*	0.00	F	0.00
	30.00	1	42 in.	808.21	808.65	1 - A	5.15	3.20	1.69	0.0278	OUTLET*	0.00	F - 1	0.00
	30.00	1	36 in.	808.44	808.93	1 - A	5.86	2.74	1.77	0.0281	OUTLET*	0.00	F - 2	0.00

UNIVERSAL CULVERT DESIGN

	FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
	30.00	1	54 in.	807.96	808.36	1 - A	4.28	2.57	1.57	0.0273	OUTLET*	0.00	F + 1	0.00
	12.40	2	36 in.	807.33	807.94	1 - B	2.42	1.99	1.12	0.0281	OUTLET*	0.00	D	0.00
	12.40	2	42 in.	807.22	807.86	1 - B	2.13	1.77	1.07	0.0278	OUTLET*	0.00	D + 1	0.00
	15.00	2	36 in.	807.52	808.04	1 - A	2.93	2.32	1.23	0.0281	OUTLET*	0.00	F	0.00
	15.00	2	42 in.	807.40	807.96	1 - B	2.58	1.99	1.18	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	24.80	1	60 in.	807.63	808.14	1 - A	3.29	2.42	1.38	0.0332	OUTLET*	0.00	D	0.00
	24.80	1	66 in.	807.55	808.09	1 - A	3.09	2.30	1.34	0.0330	OUTLET*	0.00	D + 1	0.00
	30.00	1	60 in.	807.86	808.32	1 - A	3.98	2.71	1.52	0.0332	OUTLET*	0.00	F	0.00
	30.00	1	66 in.	807.76	808.25	1 - A	3.74	2.55	1.48	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	12.40	2	60 in.	807.01	807.79	1 - B	1.65	1.65	0.97	0.0332	OUTLET*	0.00	D	0.00
	12.40	2	66 in.	806.98	807.76	1 - B	1.55	1.59	0.94	0.0330	OUTLET*	0.00	D + 1	0.00
	15.00	2	60 in.	807.15	807.85	1 - B	1.99	1.83	1.07	0.0332	OUTLET*	0.00	F	0.00
	15.00	2	66 in.	807.11	807.82	1 - B	1.87	1.75	1.04	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	24.80	1	60 in.	807.63	808.09	1 - A	3.29	2.11	1.38	0.0260	OUTLET*	0.00	D	0.00
	24.80	1	66 in.	807.55	808.05	1 - B	3.09	2.02	1.34	0.0260	OUTLET*	0.00	D + 1	0.00
	30.00	1	60 in.	807.86	808.26	1 - A	3.98	2.34	1.52	0.0260	OUTLET*	0.00	F	0.00
	30.00	1	66 in.	807.76	808.20	1 - A	3.74	2.24	1.48	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	12.40	2	60 in.	807.01	807.76	1 - B	1.65	1.46	0.97	0.0260	OUTLET*	0.00	D	0.00
	12.40	2	66 in.	806.98	807.74	1 - B	1.55	1.41	0.94	0.0260	OUTLET*	0.00	D + 1	0.00
	15.00	2	60 in.	807.15	807.82	1 - B	1.99	1.61	1.07	0.0260	OUTLET*	0.00	F	0.00
	15.00	2	66 in.	807.11	807.80	1 - B	1.87	1.55	1.04	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 - 567+46 LT TO 567+86 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.) : 805.49 **Outlet Invert Elevation (ft.) :** 805.39 **Tailwater Elevation (ft.) :** 807.45 **Overflow Elevation (ft.) :** 809.24

Allowable Headwater Elevation (ft.) : 808.24 **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) : 25.40 **@** 10 yrs. **Flood Discharge (cfs) :** 30.80 **@** 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		
	25.40	1	30 in.	808.07	808.21	1 - A	5.87	2.28	1.72	0.0120	OUTLET*	0.00	D	0.00
	25.40	1	27 in.	808.33	808.44	2 - F	6.66	2.25	1.76	0.0120	OUTLET	0.00	D - 1	0.00
	25.40	1	24 in.	808.91	809.10	2 - G	8.09	2.00	1.77	0.0120	OUTLET	0.00	D - 2	0.00
	25.40	1	33 in.	807.93	808.08	1 - B	5.32	2.01	1.67	0.0120	OUTLET*	0.00	D + 1	0.00
	30.80	1	30 in.	808.46	808.55	2 - F	7.12	2.50	1.89	0.0120	OUTLET*	0.00	F	0.00
	30.80	1	27 in.	808.92	808.93	2 - F	8.07	2.25	1.92	0.0120	OUTLET**	0.00	F - 1	0.00
	26.40	1	24 in.	809.85	809.87	2 - G	8.40	2.00	1.80	0.0120	OUTLET	4.40	F - 2	0.00
	30.80	1	33 in.	808.24	808.35	1 - A	6.45	2.51	1.85	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	25.40	1	42 in.	807.76	808.14	1 - A	4.31	2.65	1.55	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.)
	25.40	1	36 in.	807.92	808.34	1 - A	4.91	2.74	1.63	0.0241	OUTLET*	0.00	D - 1	0.00
	25.40	1	33 in.	808.08	808.51	1 - A	5.32	2.51	1.67	0.0241	OUTLET*	0.00	D - 2	0.00
	25.40	1	48 in.	807.64	808.02	1 - A	3.89	2.33	1.49	0.0235	OUTLET*	0.00	D + 1	0.00
	30.80	1	42 in.	808.02	808.40	1 - A	5.23	3.20	1.71	0.0237	OUTLET*	0.00	F	0.00
	30.80	1	36 in.	808.26	808.67	1 - A	5.95	2.74	1.80	0.0241	OUTLET*	0.00	F - 1	0.00
	30.80	1	33 in.	808.52	808.94	2 - F	6.45	2.75	1.85	0.0241	OUTLET**	0.00	F - 2	0.00
	30.80	1	48 in.	807.88	808.24	1 - A	4.72	2.65	1.65	0.0235	OUTLET*	0.00	F + 1	0.00
	12.70	2	27 in.	807.35	807.99	1 - B	3.33	2.05	1.24	0.0245	OUTLET	0.00	D	0.00
	12.70	2	24 in.	807.53	808.38	2 - G	4.04	2.00	1.28	0.0247	OUTLET	0.00	D - 1	0.00
	12.70	2	21 in.	807.96	809.20	2 - G	5.28	1.75	1.33	0.0248	OUTLET	0.00	D - 2	0.00
	12.70	2	30 in.	807.25	807.78	1 - A	2.94	2.28	1.20	0.0244	OUTLET	0.00	D + 1	0.00
	15.40	2	27 in.	807.61	808.24	2 - F	4.04	2.25	1.37	0.0245	OUTLET	0.00	F	0.00
	15.40	2	24 in.	807.92	808.82	2 - G	4.90	2.00	1.42	0.0247	OUTLET	0.00	F - 1	0.00
	12.80	2	21 in.	808.64	810.03	2 - G	5.32	1.75	1.33	0.0248	OUTLET	2.60	F - 2	0.00
	15.40	2	30 in.	807.46	807.94	1 - A	3.56	2.28	1.32	0.0244	OUTLET	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
Diameter exceeds 1.25 HWA	25.40	1	42 in.	807.76	808.17	1 - A	4.31	3.20	1.55	0.0278	OUTLET*	0.00	D	0.00
	25.40	1	36 in.	807.92	808.39	1 - A	4.91	2.74	1.63	0.0281	OUTLET*	0.00	D - 1	0.00
	25.40	1	48 in.	807.64	808.05	1 - A	3.89	2.58	1.49	0.0275	OUTLET*	0.00	D + 1	0.00
	30.80	1	42 in.	808.02	808.44	1 - A	5.23	3.20	1.71	0.0278	OUTLET*	0.00	F	0.00
	30.80	1	36 in.	808.26	808.72	1 - A	5.95	2.74	1.80	0.0281	OUTLET*	0.00	F - 1	0.00
	30.80	1	48 in.	807.88	808.27	1 - A	4.72	2.99	1.65	0.0275	OUTLET*	0.00	F + 1	0.00
	12.70	2	36 in.	807.12	807.73	1 - A	2.45	2.07	1.13	0.0281	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.)
	12.70	2	42 in.	807.01	807.66	1 - B	2.16	1.83	1.08	0.0278	OUTLET*	0.00	D + 1	0.00
	15.40	2	36 in.	807.31	807.85	1 - A	2.98	2.45	1.25	0.0281	OUTLET*	0.00	F	0.00
	15.40	2	42 in.	807.20	807.75	1 - A	2.61	2.07	1.20	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	25.40	1	60 in.	807.43	807.93	1 - A	3.33	2.49	1.39	0.0332	OUTLET*	0.00	D	0.00
	25.40	1	66 in.	807.35	807.88	1 - A	3.13	2.36	1.36	0.0330	OUTLET*	0.00	D + 1	0.00
	30.80	1	60 in.	807.66	808.11	1 - A	4.04	2.80	1.54	0.0332	OUTLET*	0.00	F	0.00
	30.80	1	66 in.	807.57	808.04	1 - A	3.79	2.64	1.50	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	12.70	2	60 in.	806.80	807.59	1 - B	1.66	1.70	0.98	0.0332	OUTLET*	0.00	D	0.00
	12.70	2	66 in.	806.77	807.57	1 - B	1.56	1.63	0.95	0.0330	OUTLET*	0.00	D + 1	0.00
	15.40	2	60 in.	806.94	807.65	1 - B	2.02	1.88	1.08	0.0332	OUTLET*	0.00	F	0.00
	15.40	2	66 in.	806.90	807.62	1 - B	1.90	1.81	1.05	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	25.40	1	60 in.	807.43	807.89	1 - A	3.33	2.17	1.39	0.0260	OUTLET*	0.00	D	0.00
	25.40	1	66 in.	807.35	807.84	1 - A	3.13	2.08	1.36	0.0260	OUTLET*	0.00	D + 1	0.00
	30.80	1	60 in.	807.66	808.07	1 - A	4.04	2.42	1.54	0.0260	OUTLET*	0.00	F	0.00
	30.80	1	66 in.	807.57	808.00	1 - A	3.79	2.30	1.50	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	12.70	2	60 in.	806.80	807.58	1 - B	1.66	1.50	0.98	0.0260	OUTLET*	0.00	D	0.00
	12.70	2	66 in.	806.77	807.56	1 - B	1.56	1.45	0.95	0.0260	OUTLET*	0.00	D + 1	0.00
	15.40	2	60 in.	806.94	807.62	1 - B	2.02	1.65	1.08	0.0260	OUTLET*	0.00	F	0.00
	15.40	2	66 in.	806.90	807.60	1 - B	1.90	1.60	1.05	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+64 LT TO 571+45 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.) : 804.69 **Outlet Invert Elevation (ft.) :** 804.49 **Tailwater Elevation (ft.) :** 806.61 **Overflow Elevation (ft.) :** 809.18

Allowable Headwater Elevation (ft.) : 808.18 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 81.00 **Culvert Slope (ft./ft.) :** 0.0025 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 26.90 **@** 10 yrs. **Flood Discharge (cfs) :** 32.50 **@** 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		
26.90	1	27 in.	807.68	807.98	2 - F	6.93	2.25	1.81	0.0120	OUTLET	0.00	D	0.00
26.90	1	24 in.	808.35	808.95	2 - G	8.56	2.00	1.81	0.0120	OUTLET	0.00	D - 1	0.00
20.70	1	21 in.	809.75	810.92	2 - G	8.61	1.75	1.61	0.0120	OUTLET	6.20	D - 2	0.00
26.90	1	30 in.	807.37	807.55	1 - A	6.06	2.28	1.77	0.0120	OUTLET*	0.00	D + 1	0.00
32.50	1	27 in.	808.33	808.61	2 - F	8.37	2.25	1.96	0.0120	OUTLET	0.00	F	0.00
28.20	1	24 in.	809.39	810.02	2 - G	8.98	2.00	1.83	0.0120	OUTLET	4.30	F - 1	0.00
20.70	1	21 in.	811.46	812.90	2 - G	8.61	1.75	1.61	0.0120	OUTLET	11.80	F - 2	0.00
32.50	1	30 in.	807.80	807.96	2 - F	7.32	2.50	1.94	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)													
26.90	1	33 in.	807.39	808.05	2 - F	5.47	2.75	1.72	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.)
	26.90	1	30 in.	807.72	808.73	2 - F	6.06	2.50	1.77	0.0244	OUTLET**	0.00	D - 1	0.00
	23.00	1	27 in.	808.38	810.12	2 - F	5.92	2.25	1.68	0.0245	OUTLET	3.90	D - 2	0.00
	26.90	1	36 in.	807.22	807.73	1 - A	5.04	2.74	1.68	0.0241	OUTLET*	0.00	D + 1	0.00
	32.50	1	33 in.	807.87	808.74	2 - F	6.61	2.75	1.90	0.0241	OUTLET**	0.00	F	0.00
	29.30	1	30 in.	808.43	809.78	2 - F	6.60	2.50	1.85	0.0244	OUTLET**	3.20	F - 1	0.00
	23.00	1	27 in.	809.45	811.73	2 - F	5.92	2.25	1.68	0.0245	OUTLET	9.50	F - 2	0.00
	32.50	1	36 in.	807.57	808.09	1 - A	6.09	2.74	1.85	0.0241	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	26.90	1	36 in.	807.22	807.84	1 - A	5.04	2.74	1.68	0.0281	OUTLET*	0.00	D	0.00
	26.90	1	42 in.	807.03	807.55	1 - A	4.41	3.20	1.60	0.0278	OUTLET*	0.00	D + 1	0.00
	32.50	1	36 in.	807.57	808.43	2 - F	6.09	3.00	1.85	0.0281	OUTLET**	0.00	F	0.00
	32.50	1	42 in.	807.30	807.82	1 - A	5.33	3.20	1.76	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	26.90	1	60 in.	806.69	807.26	1 - A	3.39	2.59	1.44	0.0332	OUTLET*	0.00	D	0.00
	26.90	1	66 in.	806.61	807.18	1 - A	3.19	2.45	1.40	0.0330	OUTLET*	0.00	D + 1	0.00
	32.50	1	60 in.	806.93	807.46	1 - A	4.10	2.91	1.58	0.0332	OUTLET*	0.00	F	0.00
	32.50	1	66 in.	806.83	807.36	1 - A	3.85	2.73	1.54	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	13.45	2	60 in.	806.04	806.82	1 - B	1.70	1.76	1.01	0.0332	OUTLET*	0.00	D	0.00
	13.45	2	66 in.	806.00	806.78	1 - B	1.59	1.69	0.98	0.0330	OUTLET*	0.00	D + 1	0.00
	16.25	2	60 in.	806.19	806.89	1 - B	2.05	1.95	1.11	0.0332	OUTLET*	0.00	F	0.00
	16.25	2	66 in.	806.14	806.87	1 - B	1.92	1.86	1.08	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)														
Diameter exceeds 1.25 HWA	26.90	1	60 in.	806.69	807.17	1 - A	3.39	2.25	1.44	0.0260	OUTLET*	0.00	D	0.00
	26.90	1	66 in.	806.61	807.10	1 - A	3.19	2.15	1.40	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.)
	32.50	1	60 in.	806.93	807.37	1 - A	4.10	2.51	1.58	0.0260	OUTLET*	0.00	F	0.00
	32.50	1	66 in.	806.83	807.29	1 - A	3.85	2.38	1.54	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	13.45	2	60 in.	806.04	806.79	1 - B	1.70	1.55	1.01	0.0260	OUTLET*	0.00	D	0.00
	13.45	2	66 in.	806.00	806.77	1 - B	1.59	1.49	0.98	0.0260	OUTLET*	0.00	D + 1	0.00
	16.25	2	60 in.	806.19	806.85	1 - B	2.05	1.71	1.11	0.0260	OUTLET*	0.00	F	0.00
	16.25	2	66 in.	806.14	806.83	1 - B	1.92	1.65	1.08	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 - 573+82 LT TO 574+17 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.) : 803.90 **Outlet Invert Elevation (ft.) :** 803.81 **Tailwater Elevation (ft.) :** 805.96 **Overflow Elevation (ft.) :** 808.27

Allowable Headwater Elevation (ft.) : 807.27 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 35.00 **Culvert Slope (ft./ft.) :** 0.0026 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 28.00 **@** 10 yrs. **Flood Discharge (cfs) :** 33.90 **@** 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		
28.00	1	27 in.	807.01	807.13	2 - F	7.15	2.25	1.84	0.0120	OUTLET	0.00	D	0.00
28.00	1	24 in.	807.75	807.89	2 - G	8.91	2.00	1.83	0.0120	OUTLET	0.00	D - 1	0.00
22.90	1	21 in.	809.27	809.41	2 - G	9.52	1.75	1.65	0.0120	OUTLET	5.10	D - 2	0.00
28.00	1	30 in.	806.66	806.80	1 - A	6.23	2.28	1.80	0.0120	OUTLET*	0.00	D + 1	0.00
33.90	1	27 in.	807.72	807.67	2 - E	8.53	2.25	1.99	0.0120	INLET	0.00	F	0.00
30.50	1	24 in.	808.88	808.80	2 - G	9.71	2.00	1.87	0.0120	OUTLET	3.40	F - 1	0.00
22.90	1	21 in.	811.16	811.02	2 - G	9.52	1.75	1.65	0.0120	OUTLET	11.00	F - 2	0.00
33.90	1	30 in.	807.13	807.14	2 - F	7.55	2.50	1.98	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)													
28.00	1	33 in.	806.69	807.08	1 - A	5.62	2.51	1.76	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.)
	28.00	1	30 in.	807.06	807.49	2 - F	6.23	2.50	1.80	0.0244	OUTLET**	0.00	D - 1	0.00
	27.00	1	27 in.	807.78	808.43	2 - F	6.90	2.25	1.81	0.0245	OUTLET	1.00	D - 2	0.00
	28.00	1	36 in.	806.49	806.91	1 - A	5.16	2.74	1.71	0.0241	OUTLET*	0.00	D + 1	0.00
	33.90	1	33 in.	807.21	807.61	2 - F	6.80	2.75	1.94	0.0241	OUTLET**	0.00	F	0.00
	33.70	1	30 in.	807.84	808.29	2 - F	7.50	2.50	1.97	0.0244	OUTLET**	0.20	F - 1	0.00
	27.00	1	27 in.	808.95	809.59	2 - F	6.90	2.25	1.81	0.0245	OUTLET	6.90	F - 2	0.00
	33.90	1	36 in.	806.88	807.26	1 - A	6.25	2.74	1.89	0.0241	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	28.00	1	36 in.	806.49	806.95	1 - A	5.16	2.74	1.71	0.0281	OUTLET*	0.00	D	0.00
	28.00	1	42 in.	806.30	806.72	1 - A	4.52	3.20	1.63	0.0278	OUTLET*	0.00	D + 1	0.00
	33.90	1	36 in.	806.88	807.32	1 - A	6.25	2.74	1.89	0.0281	OUTLET*	0.00	F	0.00
	33.90	1	42 in.	806.58	807.01	1 - A	5.47	3.20	1.80	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	28.00	1	60 in.	805.95	806.45	1 - A	3.47	2.62	1.47	0.0332	OUTLET*	0.00	D	0.00
	28.00	1	66 in.	805.86	806.40	1 - A	3.25	2.48	1.43	0.0330	OUTLET*	0.00	D + 1	0.00
	33.90	1	60 in.	806.20	806.64	1 - A	4.20	2.95	1.62	0.0332	OUTLET*	0.00	F	0.00
	33.90	1	66 in.	806.10	806.57	1 - A	3.94	2.77	1.58	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	14.00	2	60 in.	805.28	806.10	1 - B	1.73	1.78	1.03	0.0332	OUTLET*	0.00	D	0.00
	14.00	2	66 in.	805.24	806.08	1 - B	1.63	1.70	1.00	0.0330	OUTLET*	0.00	D + 1	0.00
	16.95	2	60 in.	805.43	806.16	1 - B	2.10	1.97	1.13	0.0332	OUTLET*	0.00	F	0.00
	16.95	2	66 in.	805.38	806.14	1 - B	1.97	1.88	1.10	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	28.00	1	60 in.	805.95	806.41	1 - A	3.47	2.27	1.47	0.0260	OUTLET*	0.00	D	0.00
	28.00	1	66 in.	805.86	806.36	1 - A	3.25	2.17	1.43	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.)
	33.90	1	60 in.	806.20	806.60	1 - A	4.20	2.54	1.62	0.0260	OUTLET*	0.00	F	0.00
	33.90	1	66 in.	806.10	806.53	1 - A	3.94	2.41	1.58	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	14.00	2	60 in.	805.28	806.08	1 - B	1.73	1.56	1.03	0.0260	OUTLET*	0.00	D	0.00
	14.00	2	66 in.	805.24	806.07	1 - B	1.63	1.51	1.00	0.0260	OUTLET*	0.00	D + 1	0.00
	16.95	2	60 in.	805.43	806.14	1 - B	2.10	1.73	1.13	0.0260	OUTLET*	0.00	F	0.00
	16.95	2	66 in.	805.38	806.12	1 - B	1.97	1.66	1.10	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 - 574+77 LT TO 575+01 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.) : 803.66 **Outlet Invert Elevation (ft.) :** 803.60 **Tailwater Elevation (ft.) :** 805.75 **Overflow Elevation (ft.) :** 808.06

Allowable Headwater Elevation (ft.) : 807.06 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 24.00 **Culvert Slope (ft./ft.) :** 0.0025 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 27.90 **@** 10 yrs. **Flood Discharge (cfs) :** 33.80 **@** 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		
	27.90	1	27 in.	806.76	806.83	2 - F	7.13	2.25	1.84	0.0120	OUTLET	0.00	D	0.00
	27.90	1	24 in.	807.49	807.53	2 - G	8.88	2.00	1.83	0.0120	OUTLET	0.00	D - 1	0.00
	23.90	1	21 in.	809.00	808.89	2 - G	9.94	1.75	1.67	0.0120	OUTLET	4.00	D - 2	0.00
	27.90	1	30 in.	806.41	806.55	1 - A	6.21	2.28	1.80	0.0120	OUTLET*	0.00	D + 1	0.00
	33.80	1	27 in.	807.46	807.34	2 - E	8.50	2.25	1.99	0.0120	INLET	0.00	F	0.00
	30.90	1	24 in.	808.62	808.36	2 - H	9.84	2.00	1.88	0.0120	INLET	2.90	F - 1	0.00
	23.90	1	21 in.	810.88	810.35	2 - G	9.94	1.75	1.67	0.0120	OUTLET	9.90	F - 2	0.00
	33.80	1	30 in.	806.88	806.86	2 - E	6.89	2.50	1.98	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)													
	27.90	1	33 in.	806.44	806.81	1 - A	5.60	2.51	1.75	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.)
	27.90	1	30 in.	806.81	807.09	2 - F	6.21	2.50	1.80	0.0244	OUTLET**	0.00	D - 1	0.00
	27.90	1	27 in.	807.53	807.89	2 - F	7.13	2.25	1.84	0.0245	OUTLET	0.00	D - 2	0.00
	27.90	1	36 in.	806.25	806.64	1 - A	5.15	2.74	1.71	0.0241	OUTLET*	0.00	D + 1	0.00
	33.80	1	33 in.	806.96	807.23	2 - F	6.78	2.75	1.94	0.0241	OUTLET**	0.00	F	0.00
	33.80	1	30 in.	807.58	807.81	2 - F	7.53	2.50	1.98	0.0244	OUTLET**	0.00	F - 1	0.00
	28.90	1	27 in.	808.69	808.89	2 - F	7.38	2.25	1.87	0.0245	OUTLET	4.90	F - 2	0.00
	33.80	1	36 in.	806.63	806.98	1 - A	6.23	2.74	1.89	0.0241	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	27.90	1	36 in.	806.25	806.68	1 - A	5.15	2.74	1.71	0.0281	OUTLET*	0.00	D	0.00
	27.90	1	42 in.	806.05	806.46	1 - A	4.50	3.20	1.63	0.0278	OUTLET*	0.00	D + 1	0.00
	33.80	1	36 in.	806.63	807.02	1 - A	6.23	2.74	1.89	0.0281	OUTLET*	0.00	F	0.00
	33.80	1	42 in.	806.33	806.73	1 - A	5.45	3.20	1.80	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	27.90	1	60 in.	805.71	806.20	1 - A	3.46	2.64	1.46	0.0332	OUTLET*	0.00	D	0.00
	27.90	1	66 in.	805.62	806.15	1 - A	3.24	2.49	1.43	0.0330	OUTLET*	0.00	D + 1	0.00
	33.80	1	60 in.	805.95	806.38	1 - A	4.19	2.97	1.62	0.0332	OUTLET*	0.00	F	0.00
	33.80	1	66 in.	805.85	806.31	1 - A	3.93	2.79	1.57	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	13.95	2	60 in.	805.04	805.88	1 - B	1.73	1.79	1.03	0.0332	OUTLET*	0.00	D	0.00
	13.95	2	66 in.	805.00	805.86	1 - B	1.62	1.71	1.00	0.0330	OUTLET*	0.00	D + 1	0.00
	16.90	2	60 in.	805.19	805.93	1 - B	2.09	1.98	1.13	0.0332	OUTLET*	0.00	F	0.00
	16.90	2	66 in.	805.14	805.91	1 - B	1.96	1.90	1.10	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	27.90	1	60 in.	805.71	806.17	1 - A	3.46	2.29	1.46	0.0260	OUTLET*	0.00	D	0.00
	27.90	1	66 in.	805.62	806.11	1 - A	3.24	2.18	1.43	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.)
	33.80	1	60 in.	805.95	806.35	1 - A	4.19	2.56	1.62	0.0260	OUTLET*	0.00	F	0.00
	33.80	1	66 in.	805.85	806.28	1 - A	3.93	2.43	1.57	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	13.95	2	60 in.	805.04	805.87	1 - B	1.73	1.57	1.03	0.0260	OUTLET*	0.00	D	0.00
	13.95	2	66 in.	805.00	805.85	1 - B	1.62	1.52	1.00	0.0260	OUTLET*	0.00	D + 1	0.00
	16.90	2	60 in.	805.19	805.91	1 - B	2.09	1.74	1.13	0.0260	OUTLET*	0.00	F	0.00
	16.90	2	66 in.	805.14	805.89	1 - B	1.96	1.67	1.10	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 - 576+29 LT TO 576+47 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.) : 803.28 **Outlet Invert Elevation (ft.) :** 803.23 **Tailwater Elevation (ft.) :** 805.39 **Overflow Elevation (ft.) :** 808.65

Allowable Headwater Elevation (ft.) : 807.65 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 18.00 **Culvert Slope (ft./ft.) :** 0.0028 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 28.10 **@** 10 yrs. **Flood Discharge (cfs) :** 34.10 **@** 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		
	28.10	1	24 in.	807.15	807.12	2 - H	8.94	2.00	1.83	0.0120	INLET	0.00	D	0.00
	28.00	1	21 in.	808.68	808.41	2 - H	11.64	1.75	1.70	0.0120	INLET	0.10	D - 1	0.00
	21.00	1	18 in.	812.50	811.19	2 - G	11.88	1.50	1.47	0.0120	OUTLET	7.10	D - 2	0.00
	28.10	1	27 in.	806.40	806.45	2 - F	7.16	2.25	1.84	0.0120	OUTLET	0.00	D + 1	0.00
	34.10	1	24 in.	808.31	807.93	2 - H	10.85	2.00	1.91	0.0120	INLET	0.00	F	0.00
	28.00	1	21 in.	810.61	809.84	2 - H	11.64	1.75	1.70	0.0120	INLET	6.10	F - 1	0.00
	21.00	1	18 in.	820.26	813.94	2 - G	11.88	1.50	1.47	0.0120	OUTLET	13.10	F - 2	0.00
	34.10	1	27 in.	807.12	806.95	2 - E	8.58	2.25	1.99	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)														
	28.10	1	27 in.	807.18	807.39	2 - F	7.16	2.25	1.84	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.)
27.60	1	24 in.	808.51	808.75	2 - G	8.79	2.00	1.82	0.0247	OUTLET	0.50	D - 1	0.00
20.50	1	21 in.	810.78	811.47	2 - G	8.52	1.75	1.61	0.0248	OUTLET	7.60	D - 2	0.00
28.10	1	30 in.	806.45	806.65	2 - F	6.23	2.50	1.81	0.0244	OUTLET	0.00	D + 1	0.00
34.10	1	27 in.	808.37	808.33	2 - E	8.58	2.25	1.99	0.0245	INLET	0.00	F	0.00
27.60	1	24 in.	810.21	810.33	2 - G	8.79	2.00	1.82	0.0247	OUTLET	6.50	F - 1	0.00
20.50	1	21 in.	814.22	814.34	2 - G	8.52	1.75	1.61	0.0248	OUTLET	13.60	F - 2	0.00
34.10	1	30 in.	807.24	807.33	2 - F	7.56	2.50	1.99	0.0244	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
28.10	1	36 in.	805.88	806.28	1 - A	5.16	2.74	1.71	0.0281	OUTLET*	0.00	D	0.00
28.10	1	42 in.	805.68	806.08	1 - A	4.51	3.20	1.63	0.0278	OUTLET*	0.00	D + 1	0.00
34.10	1	36 in.	806.27	806.63	1 - A	6.26	2.74	1.90	0.0281	OUTLET*	0.00	F	0.00
34.10	1	42 in.	805.97	806.35	1 - A	5.47	3.20	1.81	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
28.10	1	60 in.	805.34	805.82	1 - A	3.46	2.57	1.47	0.0332	OUTLET*	0.00	D	0.00
28.10	1	66 in.	805.25	805.77	1 - A	3.25	2.43	1.43	0.0330	OUTLET*	0.00	D + 1	0.00
34.10	1	60 in.	805.58	806.00	1 - A	4.20	2.89	1.62	0.0332	OUTLET*	0.00	F	0.00
34.10	1	66 in.	805.48	805.93	1 - A	3.94	2.71	1.58	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
28.10	1	60 in.	805.34	805.80	1 - A	3.46	2.23	1.47	0.0260	OUTLET*	0.00	D	0.00
28.10	1	66 in.	805.25	805.76	1 - B	3.25	2.13	1.43	0.0260	OUTLET*	0.00	D + 1	0.00
34.10	1	60 in.	805.58	805.97	1 - A	4.20	2.49	1.62	0.0260	OUTLET*	0.00	F	0.00
34.10	1	66 in.	805.48	805.91	1 - A	3.94	2.37	1.58	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 - 577+06 LT TO 577+21 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.) : 803.09 **Outlet Invert Elevation (ft.) :** 803.05 **Tailwater Elevation (ft.) :** 805.21 **Overflow Elevation (ft.) :** 808.65

Allowable Headwater Elevation (ft.) : 807.65 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 15.00 **Culvert Slope (ft./ft.) :** 0.0027 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 28.10 **@** 10 yrs. **Flood Discharge (cfs) :** 34.10 **@** 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		
28.10	1	24 in.	806.96	806.90	2 - H	8.94	2.00	1.83	0.0120	INLET	0.00	D	0.00
28.10	1	21 in.	808.49	808.15	2 - H	11.68	1.75	1.70	0.0120	INLET	0.00	D - 1	0.00
21.50	1	18 in.	812.31	810.83	2 - H	12.17	1.50	1.48	0.0120	INLET	6.60	D - 2	0.00
28.10	1	27 in.	806.21	806.25	2 - F	7.16	2.25	1.84	0.0120	OUTLET	0.00	D + 1	0.00
34.10	1	24 in.	808.12	807.69	2 - H	10.85	2.00	1.91	0.0120	INLET	0.00	F	0.00
28.60	1	21 in.	810.42	809.54	2 - H	11.89	1.75	1.71	0.0120	INLET	5.50	F - 1	0.00
21.50	1	18 in.	820.07	813.49	2 - H	12.17	1.50	1.48	0.0120	INLET	12.60	F - 2	0.00
34.10	1	27 in.	806.93	806.73	2 - E	8.58	2.25	1.99	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)													
28.10	1	27 in.	806.99	807.12	2 - F	7.16	2.25	1.84	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.)
28.10	1	24 in.	808.32	808.40	2 - G	8.94	2.00	1.83	0.0247	OUTLET	0.00	D - 1	0.00
21.70	1	21 in.	810.59	810.94	2 - G	9.02	1.75	1.63	0.0248	OUTLET	6.40	D - 2	0.00
28.10	1	30 in.	806.26	806.42	2 - F	6.23	2.50	1.81	0.0244	OUTLET	0.00	D + 1	0.00
34.10	1	27 in.	808.18	808.02	2 - E	8.58	2.25	1.99	0.0245	INLET	0.00	F	0.00
29.10	1	24 in.	810.02	809.91	2 - G	9.26	2.00	1.85	0.0247	OUTLET	5.00	F - 1	0.00
21.70	1	21 in.	814.03	813.65	2 - G	9.02	1.75	1.63	0.0248	OUTLET	12.40	F - 2	0.00
34.10	1	30 in.	807.05	807.08	2 - F	7.56	2.50	1.99	0.0244	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
28.10	1	36 in.	805.69	806.08	1 - A	5.16	2.74	1.71	0.0281	OUTLET*	0.00	D	0.00
28.10	1	42 in.	805.49	805.88	1 - A	4.51	3.20	1.63	0.0278	OUTLET*	0.00	D + 1	0.00
34.10	1	36 in.	806.08	806.43	1 - A	6.26	2.74	1.90	0.0281	OUTLET*	0.00	F	0.00
34.10	1	42 in.	805.78	806.15	1 - A	5.47	3.20	1.81	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
28.10	1	60 in.	805.15	805.62	1 - A	3.46	2.60	1.47	0.0332	OUTLET*	0.00	D	0.00
28.10	1	66 in.	805.06	805.58	1 - A	3.25	2.46	1.43	0.0330	OUTLET*	0.00	D + 1	0.00
34.10	1	60 in.	805.39	805.80	1 - A	4.20	2.93	1.62	0.0332	OUTLET*	0.00	F	0.00
34.10	1	66 in.	805.29	805.73	1 - A	3.94	2.75	1.58	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
28.10	1	60 in.	805.15	805.61	1 - A	3.46	2.25	1.47	0.0260	OUTLET*	0.00	D	0.00
28.10	1	66 in.	805.06	805.56	1 - B	3.25	2.15	1.43	0.0260	OUTLET*	0.00	D + 1	0.00
34.10	1	60 in.	805.39	805.78	1 - A	4.20	2.52	1.62	0.0260	OUTLET*	0.00	F	0.00
34.10	1	66 in.	805.29	805.71	1 - A	3.94	2.40	1.58	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 - 577+77 LT TO 578+00 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.) : 802.91 **Outlet Invert Elevation (ft.) :** 802.85 **Tailwater Elevation (ft.) :** 805.01 **Overflow Elevation (ft.) :** 808.22

Allowable Headwater Elevation (ft.) : 807.22 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 23.00 **Culvert Slope (ft./ft.) :** 0.0026 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 28.10 **@** 10 yrs. **Flood Discharge (cfs) :** 34.00 **@** 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		
28.10	1	24 in.	806.78	806.80	2 - G	8.94	2.00	1.83	0.0120	OUTLET	0.00	D	0.00
27.70	1	21 in.	808.31	808.17	2 - H	11.52	1.75	1.70	0.0120	INLET	0.40	D - 1	0.00
20.30	1	18 in.	812.13	811.12	2 - G	11.49	1.50	1.47	0.0120	OUTLET	7.80	D - 2	0.00
28.10	1	27 in.	806.03	806.10	2 - F	7.16	2.25	1.84	0.0120	OUTLET	0.00	D + 1	0.00
34.00	1	24 in.	807.91	807.63	2 - H	10.82	2.00	1.91	0.0120	INLET	0.00	F	0.00
27.70	1	21 in.	810.21	809.63	2 - H	11.52	1.75	1.70	0.0120	INLET	6.30	F - 1	0.00
20.30	1	18 in.	819.70	813.95	2 - G	11.49	1.50	1.47	0.0120	OUTLET	13.70	F - 2	0.00
34.00	1	27 in.	806.74	806.61	2 - E	8.55	2.25	1.99	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)													
28.10	1	27 in.	806.81	807.15	2 - F	7.16	2.25	1.84	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.)
26.40	1	24 in.	808.14	808.64	2 - G	8.40	2.00	1.80	0.0247	OUTLET	1.70	D - 1	0.00
19.50	1	21 in.	810.41	811.65	2 - G	8.11	1.75	1.59	0.0248	OUTLET	8.60	D - 2	0.00
28.10	1	30 in.	806.08	806.35	2 - F	6.23	2.50	1.81	0.0244	OUTLET	0.00	D + 1	0.00
34.00	1	27 in.	807.98	808.15	2 - F	8.67	2.25	1.99	0.0245	OUTLET	0.00	F	0.00
26.40	1	24 in.	809.81	810.33	2 - G	8.40	2.00	1.80	0.0247	OUTLET	7.60	F - 1	0.00
19.50	1	21 in.	813.77	814.74	2 - G	8.11	1.75	1.59	0.0248	OUTLET	14.50	F - 2	0.00
34.00	1	30 in.	806.86	807.06	2 - F	7.54	2.50	1.98	0.0244	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
28.10	1	36 in.	805.51	805.93	1 - A	5.16	2.74	1.71	0.0281	OUTLET*	0.00	D	0.00
28.10	1	42 in.	805.31	805.72	1 - A	4.51	3.20	1.63	0.0278	OUTLET*	0.00	D + 1	0.00
34.00	1	36 in.	805.90	806.28	1 - A	6.24	2.74	1.89	0.0281	OUTLET*	0.00	F	0.00
34.00	1	42 in.	805.59	805.99	1 - A	5.46	3.20	1.81	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
28.10	1	60 in.	804.97	805.46	1 - A	3.46	2.62	1.47	0.0332	OUTLET*	0.00	D	0.00
28.10	1	66 in.	804.88	805.40	1 - A	3.25	2.47	1.43	0.0330	OUTLET*	0.00	D + 1	0.00
34.00	1	60 in.	805.21	805.64	1 - A	4.19	2.94	1.62	0.0332	OUTLET*	0.00	F	0.00
34.00	1	66 in.	805.11	805.56	1 - A	3.93	2.76	1.58	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
28.10	1	60 in.	804.97	805.43	1 - A	3.46	2.27	1.47	0.0260	OUTLET*	0.00	D	0.00
28.10	1	66 in.	804.88	805.38	1 - A	3.25	2.17	1.43	0.0260	OUTLET*	0.00	D + 1	0.00
34.00	1	60 in.	805.21	805.61	1 - A	4.19	2.53	1.62	0.0260	OUTLET*	0.00	F	0.00
34.00	1	66 in.	805.11	805.54	1 - A	3.93	2.41	1.58	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+50 LT TO 578+70 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.) : 802.73 **Outlet Invert Elevation (ft.) :** 802.68 **Tailwater Elevation (ft.) :** 804.83 **Overflow Elevation (ft.) :** 807.97

Allowable Headwater Elevation (ft.) : 806.97 **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) : 28.00 **@** 10 yrs. **Flood Discharge (cfs) :** 33.90 **@** 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		
28.00	1	24 in.	806.58	806.57	2 - H	8.91	2.00	1.83	0.0120	INLET	0.00	D	0.00
27.50	1	21 in.	808.10	807.88	2 - H	11.43	1.75	1.70	0.0120	INLET	0.50	D - 1	0.00
20.40	1	18 in.	811.87	810.71	2 - G	11.54	1.50	1.47	0.0120	OUTLET	7.60	D - 2	0.00
28.00	1	27 in.	805.84	805.89	2 - F	7.15	2.25	1.84	0.0120	OUTLET	0.00	D + 1	0.00
33.90	1	24 in.	807.71	807.38	2 - H	10.79	2.00	1.91	0.0120	INLET	0.00	F	0.00
27.50	1	21 in.	809.99	809.31	2 - H	11.43	1.75	1.70	0.0120	INLET	6.40	F - 1	0.00
20.40	1	18 in.	819.32	813.45	2 - G	11.54	1.50	1.47	0.0120	OUTLET	13.50	F - 2	0.00
33.90	1	27 in.	806.55	806.39	2 - E	8.53	2.25	1.99	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)													
28.00	1	27 in.	806.61	806.87	2 - F	7.15	2.25	1.84	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.)
26.70	1	24 in.	807.94	808.27	2 - G	8.50	2.00	1.80	0.0247	OUTLET	1.30	D - 1	0.00
19.80	1	21 in.	810.19	811.09	2 - G	8.23	1.75	1.59	0.0248	OUTLET	8.20	D - 2	0.00
28.00	1	30 in.	805.89	806.12	2 - F	6.23	2.50	1.80	0.0244	OUTLET**	0.00	D + 1	0.00
33.90	1	27 in.	807.78	807.82	2 - F	8.66	2.25	1.99	0.0245	OUTLET	0.00	F	0.00
26.70	1	24 in.	809.60	809.88	2 - G	8.50	2.00	1.80	0.0247	OUTLET	7.20	F - 1	0.00
19.80	1	21 in.	813.51	814.00	2 - G	8.23	1.75	1.59	0.0248	OUTLET	14.10	F - 2	0.00
33.90	1	30 in.	806.67	806.81	2 - F	7.55	2.50	1.98	0.0244	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
28.00	1	36 in.	805.32	805.73	1 - A	5.16	2.74	1.71	0.0281	OUTLET*	0.00	D	0.00
28.00	1	42 in.	805.13	805.52	1 - A	4.52	3.20	1.63	0.0278	OUTLET*	0.00	D + 1	0.00
33.90	1	36 in.	805.71	806.07	1 - A	6.25	2.74	1.89	0.0281	OUTLET*	0.00	F	0.00
33.90	1	42 in.	805.41	805.80	1 - A	5.47	3.20	1.80	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
28.00	1	60 in.	804.78	805.27	1 - A	3.47	2.64	1.47	0.0332	OUTLET*	0.00	D	0.00
28.00	1	66 in.	804.69	805.21	1 - A	3.25	2.50	1.43	0.0330	OUTLET*	0.00	D + 1	0.00
33.90	1	60 in.	805.03	805.44	1 - A	4.20	2.98	1.62	0.0332	OUTLET*	0.00	F	0.00
33.90	1	66 in.	804.93	805.38	1 - A	3.94	2.79	1.58	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
28.00	1	60 in.	804.78	805.24	1 - A	3.47	2.29	1.47	0.0260	OUTLET*	0.00	D	0.00
28.00	1	66 in.	804.69	805.19	1 - A	3.25	2.19	1.43	0.0260	OUTLET*	0.00	D + 1	0.00
33.90	1	60 in.	805.03	805.42	1 - A	4.20	2.56	1.62	0.0260	OUTLET*	0.00	F	0.00
33.90	1	66 in.	804.93	805.35	1 - A	3.94	2.43	1.58	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+33 LT TO 579+58 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.) : 802.52 **Outlet Invert Elevation (ft.) :** 802.45 **Tailwater Elevation (ft.) :** 804.60 **Overflow Elevation (ft.) :** 807.56

Allowable Headwater Elevation (ft.) : 806.56 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 25.00 **Culvert Slope (ft./ft.) :** 0.0028 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 28.00 **@** 10 yrs. **Flood Discharge (cfs) :** 33.90 **@** 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		
28.00	1	24 in.	806.37	806.40	2 - G	8.91	2.00	1.83	0.0120	OUTLET	0.00	D	0.00
26.80	1	21 in.	807.89	807.79	2 - H	11.14	1.75	1.70	0.0120	INLET	1.20	D - 1	0.00
19.30	1	18 in.	811.66	810.78	2 - G	10.92	1.50	1.46	0.0120	OUTLET	8.70	D - 2	0.00
28.00	1	27 in.	805.63	805.70	2 - F	7.15	2.25	1.84	0.0120	OUTLET	0.00	D + 1	0.00
33.90	1	24 in.	807.50	807.25	2 - H	10.79	2.00	1.91	0.0120	INLET	0.00	F	0.00
26.80	1	21 in.	809.78	809.27	2 - H	11.14	1.75	1.70	0.0120	INLET	7.10	F - 1	0.00
19.30	1	18 in.	819.11	813.66	2 - G	10.92	1.50	1.46	0.0120	OUTLET	14.60	F - 2	0.00
33.90	1	27 in.	806.34	806.21	2 - E	8.53	2.25	1.99	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)													
28.00	1	30 in.	805.68	805.97	2 - F	6.23	2.50	1.80	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.)
28.00	1	27 in.	806.40	806.78	2 - F	7.15	2.25	1.84	0.0245	OUTLET	0.00	D - 1	0.00
24.90	1	24 in.	807.73	808.32	2 - G	7.93	2.00	1.76	0.0247	OUTLET	3.10	D - 2	0.00
28.00	1	33 in.	805.31	805.68	1 - A	5.62	2.51	1.76	0.0241	OUTLET*	0.00	D + 1	0.00
33.90	1	30 in.	806.46	806.69	2 - F	7.55	2.50	1.98	0.0244	OUTLET**	0.00	F	0.00
32.50	1	27 in.	807.57	807.80	2 - F	8.30	2.25	1.96	0.0245	OUTLET	1.40	F - 1	0.00
24.90	1	24 in.	809.39	810.05	2 - G	7.93	2.00	1.76	0.0247	OUTLET	9.00	F - 2	0.00
33.90	1	33 in.	805.83	806.11	2 - F	6.80	2.75	1.94	0.0241	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
28.00	1	36 in.	805.11	805.54	1 - A	5.16	2.74	1.71	0.0281	OUTLET*	0.00	D	0.00
28.00	1	42 in.	804.92	805.33	1 - A	4.52	3.20	1.63	0.0278	OUTLET*	0.00	D + 1	0.00
33.90	1	36 in.	805.50	805.88	1 - A	6.25	2.74	1.89	0.0281	OUTLET*	0.00	F	0.00
33.90	1	42 in.	805.20	805.60	1 - A	5.47	3.20	1.80	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
28.00	1	60 in.	804.57	805.06	1 - A	3.47	2.56	1.47	0.0332	OUTLET*	0.00	D	0.00
28.00	1	66 in.	804.48	805.00	1 - A	3.25	2.42	1.43	0.0330	OUTLET*	0.00	D + 1	0.00
33.90	1	60 in.	804.82	805.24	1 - A	4.20	2.87	1.62	0.0332	OUTLET*	0.00	F	0.00
33.90	1	66 in.	804.72	805.17	1 - A	3.94	2.70	1.58	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
28.00	1	60 in.	804.57	805.03	1 - A	3.47	2.22	1.47	0.0260	OUTLET*	0.00	D	0.00
28.00	1	66 in.	804.48	804.99	1 - B	3.25	2.12	1.43	0.0260	OUTLET*	0.00	D + 1	0.00
33.90	1	60 in.	804.82	805.21	1 - A	4.20	2.48	1.62	0.0260	OUTLET*	0.00	F	0.00
33.90	1	66 in.	804.72	805.14	1 - A	3.94	2.36	1.58	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+99 LT TO 580+27 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.) : 802.36 **Outlet Invert Elevation (ft.) :** 802.29 **Tailwater Elevation (ft.) :** 804.44 **Overflow Elevation (ft.) :** 806.81

Allowable Headwater Elevation (ft.) : 805.81 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 28.00 **Culvert Slope (ft./ft.) :** 0.0025 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 28.00 **@** 10 yrs. **Flood Discharge (cfs) :** 33.80 **@** 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		
28.00	1	27 in.	805.47	805.56	2 - F	7.15	2.25	1.84	0.0120	OUTLET	0.00	D	0.00
28.00	1	24 in.	806.21	806.28	2 - G	8.91	2.00	1.83	0.0120	OUTLET	0.00	D - 1	0.00
23.80	1	21 in.	807.73	807.71	2 - G	9.89	1.75	1.67	0.0120	OUTLET	4.20	D - 2	0.00
28.00	1	30 in.	805.12	805.26	1 - A	6.23	2.28	1.80	0.0120	OUTLET*	0.00	D + 1	0.00
33.80	1	27 in.	806.16	806.07	2 - E	8.50	2.25	1.99	0.0120	INLET	0.00	F	0.00
31.20	1	24 in.	807.32	807.13	2 - H	9.93	2.00	1.88	0.0120	INLET	2.60	F - 1	0.00
23.80	1	21 in.	809.58	809.20	2 - G	9.89	1.75	1.67	0.0120	OUTLET	10.00	F - 2	0.00
33.80	1	30 in.	805.58	805.57	2 - E	6.89	2.50	1.98	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)													
28.00	1	33 in.	805.15	805.53	1 - A	5.62	2.51	1.76	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.)
	28.00	1	30 in.	805.52	805.86	2 - F	6.23	2.50	1.80	0.0244	OUTLET**	0.00	D - 1	0.00
	28.00	1	27 in.	806.24	806.71	2 - F	7.15	2.25	1.84	0.0245	OUTLET	0.00	D - 2	0.00
	28.00	1	36 in.	804.95	805.36	1 - A	5.16	2.74	1.71	0.0241	OUTLET*	0.00	D + 1	0.00
	33.80	1	33 in.	805.66	805.98	2 - F	6.78	2.75	1.94	0.0241	OUTLET**	0.00	F	0.00
	33.80	1	30 in.	806.28	806.59	2 - F	7.53	2.50	1.98	0.0244	OUTLET**	0.00	F - 1	0.00
	28.60	1	27 in.	807.39	807.75	2 - F	7.31	2.25	1.86	0.0245	OUTLET	5.20	F - 2	0.00
	33.80	1	36 in.	805.33	805.70	1 - A	6.23	2.74	1.89	0.0241	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	28.00	1	36 in.	804.95	805.40	1 - A	5.16	2.74	1.71	0.0281	OUTLET*	0.00	D	0.00
	28.00	1	42 in.	804.76	805.17	1 - A	4.52	3.20	1.63	0.0278	OUTLET*	0.00	D + 1	0.00
	33.80	1	36 in.	805.33	805.74	1 - A	6.23	2.74	1.89	0.0281	OUTLET*	0.00	F	0.00
	33.80	1	42 in.	805.03	805.44	1 - A	5.45	3.20	1.80	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	28.00	1	60 in.	804.41	804.91	1 - A	3.47	2.64	1.47	0.0332	OUTLET*	0.00	D	0.00
	28.00	1	66 in.	804.32	804.85	1 - A	3.25	2.50	1.43	0.0330	OUTLET*	0.00	D + 1	0.00
	33.80	1	60 in.	804.65	805.09	1 - A	4.19	2.97	1.62	0.0332	OUTLET*	0.00	F	0.00
	33.80	1	66 in.	804.55	805.02	1 - A	3.93	2.79	1.57	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	14.00	2	60 in.	803.74	804.57	1 - B	1.73	1.79	1.03	0.0332	OUTLET*	0.00	D	0.00
	14.00	2	66 in.	803.70	804.55	1 - B	1.63	1.72	1.00	0.0330	OUTLET*	0.00	D + 1	0.00
	16.90	2	60 in.	803.89	804.63	1 - B	2.09	1.98	1.13	0.0332	OUTLET*	0.00	F	0.00
	16.90	2	66 in.	803.84	804.60	1 - B	1.96	1.90	1.10	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	28.00	1	60 in.	804.41	804.87	1 - A	3.47	2.29	1.47	0.0260	OUTLET*	0.00	D	0.00
	28.00	1	66 in.	804.32	804.82	1 - A	3.25	2.19	1.43	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.)
	33.80	1	60 in.	804.65	805.05	1 - A	4.19	2.56	1.62	0.0260	OUTLET*	0.00	F	0.00
	33.80	1	66 in.	804.55	804.98	1 - A	3.93	2.43	1.57	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	14.00	2	60 in.	803.74	804.55	1 - B	1.73	1.57	1.03	0.0260	OUTLET*	0.00	D	0.00
	14.00	2	66 in.	803.70	804.54	1 - B	1.63	1.52	1.00	0.0260	OUTLET*	0.00	D + 1	0.00
	16.90	2	60 in.	803.89	804.61	1 - B	2.09	1.74	1.13	0.0260	OUTLET*	0.00	F	0.00
	16.90	2	66 in.	803.84	804.59	1 - B	1.96	1.67	1.10	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 - 580+79 LT TO 581+09 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.) : 802.16 **Outlet Invert Elevation (ft.) :** 802.08 **Tailwater Elevation (ft.) :** 804.23 **Overflow Elevation (ft.) :** 807.20

Allowable Headwater Elevation (ft.) : 806.20 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 30.00 **Culvert Slope (ft./ft.) :** 0.0027 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 27.90 **@** 10 yrs. **Flood Discharge (cfs) :** 33.80 **@** 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		
27.90	1	24 in.	805.99	806.09	2 - G	8.88	2.00	1.83	0.0120	OUTLET	0.00	D	0.00
26.40	1	21 in.	807.50	807.53	2 - G	10.98	1.75	1.69	0.0120	OUTLET	1.50	D - 1	0.00
18.90	1	18 in.	811.23	810.67	2 - G	10.70	1.50	1.46	0.0120	OUTLET	9.00	D - 2	0.00
27.90	1	27 in.	805.26	805.35	2 - F	7.13	2.25	1.84	0.0120	OUTLET	0.00	D + 1	0.00
33.80	1	24 in.	807.12	806.95	2 - H	10.76	2.00	1.91	0.0120	INLET	0.00	F	0.00
26.40	1	21 in.	809.38	809.07	2 - G	10.98	1.75	1.69	0.0120	OUTLET	7.40	F - 1	0.00
18.90	1	18 in.	818.56	813.68	2 - G	10.70	1.50	1.46	0.0120	OUTLET	14.90	F - 2	0.00
33.80	1	27 in.	805.96	805.88	2 - E	8.50	2.25	1.99	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)													
27.90	1	30 in.	805.31	805.67	2 - F	6.21	2.50	1.80	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.)
27.90	1	27 in.	806.03	806.54	2 - F	7.13	2.25	1.84	0.0245	OUTLET	0.00	D - 1	0.00
24.10	1	24 in.	807.34	808.19	2 - G	7.67	2.00	1.74	0.0247	OUTLET	3.80	D - 2	0.00
27.90	1	33 in.	804.94	805.33	1 - A	5.60	2.51	1.75	0.0241	OUTLET*	0.00	D + 1	0.00
33.80	1	30 in.	806.08	806.43	2 - F	7.53	2.50	1.98	0.0244	OUTLET**	0.00	F	0.00
31.60	1	27 in.	807.19	807.62	2 - F	8.07	2.25	1.94	0.0245	OUTLET	2.20	F - 1	0.00
24.10	1	24 in.	809.00	810.05	2 - G	7.67	2.00	1.74	0.0247	OUTLET	9.70	F - 2	0.00
33.80	1	33 in.	805.46	805.80	2 - F	6.78	2.75	1.94	0.0241	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
27.90	1	36 in.	804.75	805.19	1 - A	5.15	2.74	1.71	0.0281	OUTLET*	0.00	D	0.00
27.90	1	42 in.	804.55	804.97	1 - A	4.50	3.20	1.63	0.0278	OUTLET*	0.00	D + 1	0.00
33.80	1	36 in.	805.13	805.54	1 - A	6.23	2.74	1.89	0.0281	OUTLET*	0.00	F	0.00
33.80	1	42 in.	804.83	805.24	1 - A	5.45	3.20	1.80	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
27.90	1	60 in.	804.21	804.70	1 - A	3.46	2.59	1.46	0.0332	OUTLET*	0.00	D	0.00
27.90	1	66 in.	804.12	804.65	1 - A	3.24	2.45	1.43	0.0330	OUTLET*	0.00	D + 1	0.00
33.80	1	60 in.	804.45	804.89	1 - A	4.19	2.91	1.62	0.0332	OUTLET*	0.00	F	0.00
33.80	1	66 in.	804.35	804.82	1 - A	3.93	2.73	1.57	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
27.90	1	60 in.	804.21	804.67	1 - A	3.46	2.25	1.46	0.0260	OUTLET*	0.00	D	0.00
27.90	1	66 in.	804.12	804.62	1 - B	3.24	2.15	1.43	0.0260	OUTLET*	0.00	D + 1	0.00
33.80	1	60 in.	804.45	804.85	1 - A	4.19	2.51	1.62	0.0260	OUTLET*	0.00	F	0.00
33.80	1	66 in.	804.35	804.78	1 - A	3.93	2.38	1.57	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 - 581+62 LT TO 582+18 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.) : 801.95 **Outlet Invert Elevation (ft.) :** 801.81 **Tailwater Elevation (ft.) :** 803.96 **Overflow Elevation (ft.) :** 806.25

Allowable Headwater Elevation (ft.) : 805.25 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 56.00 **Culvert Slope (ft./ft.) :** 0.0025 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 27.90 **@** 10 yrs. **Flood Discharge (cfs) :** 33.70 **@** 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		
27.90	1	30 in.	804.70	804.86	1 - A	6.21	2.28	1.80	0.0120	OUTLET*	0.00	D	0.00
27.90	1	27 in.	805.05	805.26	2 - F	7.13	2.25	1.84	0.0120	OUTLET	0.00	D - 1	0.00
27.90	1	24 in.	805.78	806.15	2 - G	8.88	2.00	1.83	0.0120	OUTLET	0.00	D - 2	0.00
27.90	1	33 in.	804.53	804.68	1 - A	5.60	2.19	1.75	0.0120	OUTLET*	0.00	D + 1	0.00
33.70	1	30 in.	805.16	805.25	2 - F	7.50	2.50	1.97	0.0120	OUTLET**	0.00	F	0.00
33.70	1	27 in.	805.74	805.86	2 - F	8.61	2.25	1.98	0.0120	OUTLET	0.00	F - 1	0.00
28.50	1	24 in.	806.89	807.16	2 - G	9.07	2.00	1.84	0.0120	OUTLET	5.20	F - 2	0.00
33.70	1	33 in.	804.87	804.99	1 - A	6.76	2.51	1.93	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)													
27.90	1	33 in.	804.73	805.25	1 - A	5.60	2.51	1.75	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.)
	27.90	1	30 in.	805.10	805.82	2 - F	6.21	2.50	1.80	0.0244	OUTLET**	0.00	D - 1	0.00
	24.10	1	27 in.	805.82	807.02	2 - F	6.16	2.25	1.72	0.0245	OUTLET	3.80	D - 2	0.00
	27.90	1	36 in.	804.54	805.01	1 - A	5.15	2.74	1.71	0.0241	OUTLET*	0.00	D + 1	0.00
	33.70	1	33 in.	805.24	805.88	2 - F	6.76	2.75	1.93	0.0241	OUTLET**	0.00	F	0.00
	30.60	1	30 in.	805.86	806.76	2 - F	6.81	2.50	1.89	0.0244	OUTLET**	3.10	F - 1	0.00
	24.10	1	27 in.	806.96	808.42	2 - F	6.16	2.25	1.72	0.0245	OUTLET	9.60	F - 2	0.00
	33.70	1	36 in.	804.91	805.39	1 - A	6.22	2.74	1.88	0.0241	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	27.90	1	36 in.	804.54	805.08	1 - A	5.15	2.74	1.71	0.0281	OUTLET*	0.00	D	0.00
	27.90	1	42 in.	804.34	804.81	1 - A	4.50	3.20	1.63	0.0278	OUTLET*	0.00	D + 1	0.00
	33.70	1	36 in.	804.91	805.59	2 - F	6.22	3.00	1.88	0.0281	OUTLET**	0.00	F	0.00
	33.70	1	42 in.	804.62	805.11	1 - A	5.44	3.20	1.80	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	27.90	1	60 in.	804.00	804.54	1 - A	3.46	2.64	1.46	0.0332	OUTLET*	0.00	D	0.00
	27.90	1	66 in.	803.91	804.46	1 - A	3.24	2.49	1.43	0.0330	OUTLET*	0.00	D + 1	0.00
	33.70	1	60 in.	804.24	804.73	1 - A	4.17	2.97	1.61	0.0332	OUTLET*	0.00	F	0.00
	33.70	1	66 in.	804.14	804.65	1 - A	3.92	2.78	1.57	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	13.95	2	60 in.	803.33	804.13	1 - B	1.73	1.79	1.03	0.0332	OUTLET*	0.00	D	0.00
	13.95	2	66 in.	803.29	804.11	1 - B	1.62	1.71	1.00	0.0330	OUTLET*	0.00	D + 1	0.00
	16.85	2	60 in.	803.48	804.20	1 - B	2.09	1.98	1.13	0.0332	OUTLET*	0.00	F	0.00
	16.85	2	66 in.	803.43	804.17	1 - B	1.96	1.89	1.10	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	27.90	1	60 in.	804.00	804.47	1 - A	3.46	2.29	1.46	0.0260	OUTLET*	0.00	D	0.00
	27.90	1	66 in.	803.91	804.40	1 - A	3.24	2.18	1.43	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.)
	33.70	1	60 in.	804.24	804.66	1 - A	4.17	2.55	1.61	0.0260	OUTLET*	0.00	F	0.00
	33.70	1	66 in.	804.14	804.58	1 - A	3.92	2.42	1.57	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	13.95	2	60 in.	803.33	804.11	1 - B	1.73	1.57	1.03	0.0260	OUTLET*	0.00	D	0.00
	13.95	2	66 in.	803.29	804.09	1 - B	1.62	1.52	1.00	0.0260	OUTLET*	0.00	D + 1	0.00
	16.85	2	60 in.	803.48	804.17	1 - B	2.09	1.74	1.13	0.0260	OUTLET*	0.00	F	0.00
	16.85	2	66 in.	803.43	804.14	1 - B	1.96	1.67	1.10	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+91 LT TO 584+25 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.) : 801.38 **Outlet Invert Elevation (ft.) :** 801.29 **Tailwater Elevation (ft.) :** 803.44 **Overflow Elevation (ft.) :** 806.27

Allowable Headwater Elevation (ft.) : 805.27 **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) : 27.80 **@** 10 yrs. **Flood Discharge (cfs) :** 33.60 **@** 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		
27.80	1	27 in.	804.47	804.58	2 - F	7.10	2.25	1.84	0.0120	OUTLET	0.00	D	0.00
27.80	1	24 in.	805.20	805.33	2 - G	8.85	2.00	1.83	0.0120	OUTLET	0.00	D - 1	0.00
25.40	1	21 in.	806.69	806.82	2 - G	10.56	1.75	1.68	0.0120	OUTLET	2.40	D - 2	0.00
27.80	1	30 in.	804.13	804.17	1 - A	6.19	2.28	1.80	0.0120	OUTLET	0.00	D + 1	0.00
33.60	1	27 in.	805.16	805.11	2 - E	8.45	2.25	1.98	0.0120	INLET	0.00	F	0.00
33.40	1	24 in.	806.30	806.21	2 - H	10.63	2.00	1.91	0.0120	INLET	0.20	F - 1	0.00
25.40	1	21 in.	808.53	808.37	2 - G	10.56	1.75	1.68	0.0120	OUTLET	8.20	F - 2	0.00
33.60	1	30 in.	804.58	804.59	2 - F	7.48	2.50	1.97	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)													
27.80	1	30 in.	804.52	804.93	2 - F	6.19	2.50	1.80	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.)
	27.80	1	27 in.	805.23	805.85	2 - F	7.10	2.25	1.84	0.0245	OUTLET	0.00	D - 1	0.00
	22.90	1	24 in.	806.53	807.59	2 - G	7.29	2.00	1.70	0.0247	OUTLET	4.90	D - 2	0.00
	27.80	1	33 in.	804.15	804.55	1 - A	5.58	2.51	1.75	0.0241	OUTLET*	0.00	D + 1	0.00
	33.60	1	30 in.	805.27	805.71	2 - F	7.48	2.50	1.97	0.0244	OUTLET**	0.00	F	0.00
	30.10	1	27 in.	806.37	806.96	2 - F	7.69	2.25	1.90	0.0245	OUTLET	3.50	F - 1	0.00
	22.90	1	24 in.	808.16	809.51	2 - G	7.29	2.00	1.70	0.0247	OUTLET	10.70	F - 2	0.00
	33.60	1	33 in.	804.66	805.04	2 - F	6.74	2.75	1.93	0.0241	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	27.80	1	36 in.	803.96	804.42	1 - A	5.13	2.74	1.70	0.0281	OUTLET*	0.00	D	0.00
	27.80	1	42 in.	803.77	804.19	1 - A	4.49	3.20	1.63	0.0278	OUTLET*	0.00	D + 1	0.00
	33.60	1	36 in.	804.34	804.78	1 - A	6.20	2.74	1.88	0.0281	OUTLET*	0.00	F	0.00
	33.60	1	42 in.	804.04	804.47	1 - A	5.42	3.20	1.80	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	27.80	1	60 in.	803.42	803.92	1 - A	3.44	2.59	1.46	0.0332	OUTLET*	0.00	D	0.00
	27.80	1	66 in.	803.34	803.87	1 - A	3.23	2.45	1.42	0.0330	OUTLET*	0.00	D + 1	0.00
	33.60	1	60 in.	803.66	804.10	1 - A	4.16	2.91	1.61	0.0332	OUTLET*	0.00	F	0.00
	33.60	1	66 in.	803.57	804.04	1 - A	3.90	2.73	1.57	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	13.90	2	60 in.	802.76	803.58	1 - B	1.72	1.76	1.02	0.0332	OUTLET*	0.00	D	0.00
	13.90	2	66 in.	802.71	803.56	1 - B	1.62	1.69	1.00	0.0330	OUTLET*	0.00	D + 1	0.00
	16.80	2	60 in.	802.91	803.64	1 - B	2.08	1.95	1.13	0.0332	OUTLET*	0.00	F	0.00
	16.80	2	66 in.	802.85	803.61	1 - B	1.95	1.86	1.10	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	27.80	1	60 in.	803.42	803.89	1 - A	3.44	2.25	1.46	0.0260	OUTLET*	0.00	D	0.00
	27.80	1	66 in.	803.34	803.84	1 - B	3.23	2.15	1.42	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.)
	33.60	1	60 in.	803.66	804.07	1 - A	4.16	2.50	1.61	0.0260	OUTLET*	0.00	F	0.00
	33.60	1	66 in.	803.57	804.00	1 - A	3.90	2.38	1.57	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	13.90	2	60 in.	802.76	803.56	1 - B	1.72	1.55	1.02	0.0260	OUTLET*	0.00	D	0.00
	13.90	2	66 in.	802.71	803.55	1 - B	1.62	1.49	1.00	0.0260	OUTLET*	0.00	D + 1	0.00
	16.80	2	60 in.	802.91	803.62	1 - B	2.08	1.71	1.13	0.0260	OUTLET*	0.00	F	0.00
	16.80	2	66 in.	802.85	803.59	1 - B	1.95	1.64	1.10	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 - 587+46 LT TO 587+80 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.) : 800.49 **Outlet Invert Elevation (ft.) :** 800.40 **Tailwater Elevation (ft.) :** 802.54 **Overflow Elevation (ft.) :** 805.05

Allowable Headwater Elevation (ft.) : 804.05 **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) : 27.70 **@** 10 yrs. **Flood Discharge (cfs) :** 33.50 **@** 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		
27.70	1	27 in.	803.57	803.67	2 - F	7.09	2.25	1.83	0.0120	OUTLET	0.00	D	0.00
27.70	1	24 in.	804.29	804.42	2 - G	8.82	2.00	1.82	0.0120	OUTLET	0.00	D - 1	0.00
23.90	1	21 in.	805.77	805.89	2 - G	9.94	1.75	1.67	0.0120	OUTLET	3.80	D - 2	0.00
27.70	1	30 in.	803.23	803.37	1 - A	6.19	2.28	1.79	0.0120	OUTLET*	0.00	D + 1	0.00
33.50	1	27 in.	804.25	804.20	2 - E	8.43	2.25	1.98	0.0120	INLET	0.00	F	0.00
31.80	1	24 in.	805.39	805.29	2 - H	10.12	2.00	1.89	0.0120	INLET	1.70	F - 1	0.00
23.90	1	21 in.	807.61	807.44	2 - G	9.94	1.75	1.67	0.0120	OUTLET	9.60	F - 2	0.00
33.50	1	30 in.	803.68	803.69	2 - F	7.49	2.50	1.97	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)													
27.70	1	30 in.	803.61	804.03	2 - F	6.19	2.50	1.79	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.)
	27.70	1	27 in.	804.32	804.93	2 - F	7.09	2.25	1.83	0.0245	OUTLET	0.00	D - 1	0.00
	21.60	1	24 in.	805.62	806.66	2 - G	6.88	2.00	1.66	0.0247	OUTLET	6.10	D - 2	0.00
	27.70	1	33 in.	803.25	803.65	1 - A	5.59	2.51	1.75	0.0241	OUTLET*	0.00	D + 1	0.00
	33.50	1	30 in.	804.37	804.80	2 - F	7.49	2.50	1.97	0.0244	OUTLET**	0.00	F	0.00
	28.30	1	27 in.	805.46	806.04	2 - F	7.25	2.25	1.85	0.0245	OUTLET	5.20	F - 1	0.00
	21.60	1	24 in.	807.24	808.57	2 - G	6.88	2.00	1.66	0.0247	OUTLET	11.90	F - 2	0.00
	33.50	1	33 in.	803.76	804.14	2 - F	6.75	2.75	1.93	0.0241	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	27.70	1	36 in.	803.06	803.52	1 - A	5.14	2.74	1.70	0.0281	OUTLET*	0.00	D	0.00
	27.70	1	42 in.	802.87	803.30	1 - A	4.49	3.20	1.62	0.0278	OUTLET*	0.00	D + 1	0.00
	33.50	1	36 in.	803.44	803.88	1 - A	6.21	2.74	1.88	0.0281	OUTLET*	0.00	F	0.00
	33.50	1	42 in.	803.15	803.57	1 - A	5.43	3.20	1.79	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	27.70	1	60 in.	802.53	803.03	1 - A	3.45	2.58	1.46	0.0332	OUTLET*	0.00	D	0.00
	27.70	1	66 in.	802.44	802.97	1 - A	3.24	2.44	1.42	0.0330	OUTLET*	0.00	D + 1	0.00
	33.50	1	60 in.	802.77	803.22	1 - A	4.18	2.90	1.61	0.0332	OUTLET*	0.00	F	0.00
	33.50	1	66 in.	802.67	803.14	1 - A	3.92	2.73	1.57	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	13.85	2	60 in.	801.86	802.68	1 - B	1.73	1.75	1.02	0.0332	OUTLET*	0.00	D	0.00
	13.85	2	66 in.	801.82	802.66	1 - B	1.62	1.68	1.00	0.0330	OUTLET*	0.00	D + 1	0.00
	16.75	2	60 in.	802.01	802.74	1 - B	2.09	1.94	1.13	0.0332	OUTLET*	0.00	F	0.00
	16.75	2	66 in.	801.96	802.71	1 - B	1.96	1.86	1.10	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	27.70	1	60 in.	802.53	802.99	1 - A	3.45	2.24	1.46	0.0260	OUTLET*	0.00	D	0.00
	27.70	1	66 in.	802.44	802.94	1 - A	3.24	2.14	1.42	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.)
	33.50	1	60 in.	802.77	803.17	1 - A	4.18	2.50	1.61	0.0260	OUTLET*	0.00	F	0.00
	33.50	1	66 in.	802.67	803.10	1 - A	3.92	2.38	1.57	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	13.85	2	60 in.	801.86	802.66	1 - B	1.73	1.54	1.02	0.0260	OUTLET*	0.00	D	0.00
	13.85	2	66 in.	801.82	802.65	1 - B	1.62	1.49	1.00	0.0260	OUTLET*	0.00	D + 1	0.00
	16.75	2	60 in.	802.01	802.72	1 - B	2.09	1.70	1.13	0.0260	OUTLET*	0.00	F	0.00
	16.75	2	66 in.	801.96	802.70	1 - B	1.96	1.64	1.10	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 - 588+36 LT TO 588+61 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.) : 800.26 **Outlet Invert Elevation (ft.) :** 800.19 **Tailwater Elevation (ft.) :** 802.33 **Overflow Elevation (ft.) :** 804.76

Allowable Headwater Elevation (ft.) : 803.76 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 25.00 **Culvert Slope (ft./ft.) :** 0.0028 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 27.70 **@** 10 yrs. **Flood Discharge (cfs) :** 33.50 **@** 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		
27.70	1	27 in.	803.34	803.40	2 - F	7.09	2.25	1.83	0.0120	OUTLET	0.00	D	0.00
27.70	1	24 in.	804.06	804.10	2 - G	8.82	2.00	1.82	0.0120	OUTLET	0.00	D - 1	0.00
24.40	1	21 in.	805.54	805.45	2 - G	10.14	1.75	1.67	0.0120	OUTLET	3.30	D - 2	0.00
27.70	1	30 in.	803.00	803.13	1 - A	6.19	2.28	1.79	0.0120	OUTLET*	0.00	D + 1	0.00
33.50	1	27 in.	804.02	803.90	2 - E	8.43	2.25	1.98	0.0120	INLET	0.00	F	0.00
31.50	1	24 in.	805.16	804.91	2 - H	10.03	2.00	1.88	0.0120	INLET	2.00	F - 1	0.00
24.40	1	21 in.	807.38	806.89	2 - G	10.14	1.75	1.67	0.0120	OUTLET	9.10	F - 2	0.00
33.50	1	30 in.	803.45	803.48	2 - F	7.49	2.50	1.97	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)													
27.70	1	30 in.	803.38	803.68	2 - F	6.19	2.50	1.79	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.)
	27.70	1	27 in.	804.09	804.47	2 - F	7.09	2.25	1.83	0.0245	OUTLET	0.00	D - 1	0.00
	22.60	1	24 in.	805.39	805.97	2 - G	7.19	2.00	1.69	0.0247	OUTLET	5.10	D - 2	0.00
	27.70	1	33 in.	803.02	803.40	1 - A	5.59	2.51	1.75	0.0241	OUTLET*	0.00	D + 1	0.00
	33.50	1	30 in.	804.14	804.38	2 - F	7.49	2.50	1.97	0.0244	OUTLET**	0.00	F	0.00
	29.50	1	27 in.	805.23	805.46	2 - F	7.56	2.25	1.88	0.0245	OUTLET	4.00	F - 1	0.00
	22.60	1	24 in.	807.01	807.65	2 - G	7.19	2.00	1.69	0.0247	OUTLET	10.90	F - 2	0.00
	33.50	1	33 in.	803.53	803.81	2 - F	6.75	2.75	1.93	0.0241	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	27.70	1	36 in.	802.83	803.25	1 - A	5.14	2.74	1.70	0.0281	OUTLET*	0.00	D	0.00
	27.70	1	42 in.	802.64	803.04	1 - A	4.49	3.20	1.62	0.0278	OUTLET*	0.00	D + 1	0.00
	33.50	1	36 in.	803.21	803.60	1 - A	6.21	2.74	1.88	0.0281	OUTLET*	0.00	F	0.00
	33.50	1	42 in.	802.92	803.32	1 - A	5.43	3.20	1.79	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	27.70	1	60 in.	802.30	802.79	1 - A	3.45	2.54	1.46	0.0332	OUTLET*	0.00	D	0.00
	27.70	1	66 in.	802.21	802.73	1 - A	3.24	2.40	1.42	0.0330	OUTLET*	0.00	D + 1	0.00
	33.50	1	60 in.	802.54	802.97	1 - A	4.18	2.85	1.61	0.0332	OUTLET*	0.00	F	0.00
	33.50	1	66 in.	802.44	802.90	1 - A	3.92	2.68	1.57	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	13.85	2	60 in.	801.63	802.45	1 - B	1.73	1.73	1.02	0.0332	OUTLET*	0.00	D	0.00
	13.85	2	66 in.	801.59	802.44	1 - B	1.62	1.66	1.00	0.0330	OUTLET*	0.00	D + 1	0.00
	16.75	2	60 in.	801.78	802.51	1 - B	2.09	1.91	1.13	0.0332	OUTLET*	0.00	F	0.00
	16.75	2	66 in.	801.73	802.49	1 - B	1.96	1.83	1.10	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	27.70	1	60 in.	802.30	802.75	1 - A	3.45	2.21	1.46	0.0260	OUTLET*	0.00	D	0.00
	27.70	1	66 in.	802.21	802.72	1 - B	3.24	2.11	1.42	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.)
	33.50	1	60 in.	802.54	802.93	1 - A	4.18	2.46	1.61	0.0260	OUTLET*	0.00	F	0.00
	33.50	1	66 in.	802.44	802.87	1 - A	3.92	2.34	1.57	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	13.85	2	60 in.	801.63	802.44	1 - B	1.73	1.52	1.02	0.0260	OUTLET*	0.00	D	0.00
	13.85	2	66 in.	801.59	802.43	1 - B	1.62	1.47	1.00	0.0260	OUTLET*	0.00	D + 1	0.00
	16.75	2	60 in.	801.78	802.49	1 - B	2.09	1.68	1.13	0.0260	OUTLET*	0.00	F	0.00
	16.75	2	66 in.	801.73	802.48	1 - B	1.96	1.62	1.10	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 - 589+32 LT TO 589+66 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.) : 800.02 **Outlet Invert Elevation (ft.) :** 799.93 **Tailwater Elevation (ft.) :** 802.07 **Overflow Elevation (ft.) :** 804.32

Allowable Headwater Elevation (ft.) : 803.32 **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) : 27.70 **@** 10 yrs. **Flood Discharge (cfs) :** 33.40 **@** 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		
27.70	1	27 in.	803.10	803.20	2 - F	7.09	2.25	1.83	0.0120	OUTLET	0.00	D	0.00
27.70	1	24 in.	803.82	803.95	2 - G	8.82	2.00	1.82	0.0120	OUTLET	0.00	D - 1	0.00
22.60	1	21 in.	805.30	805.42	2 - G	9.40	1.75	1.65	0.0120	OUTLET	5.10	D - 2	0.00
27.70	1	30 in.	802.76	802.90	1 - A	6.19	2.28	1.79	0.0120	OUTLET*	0.00	D + 1	0.00
33.40	1	27 in.	803.77	803.72	2 - E	8.40	2.25	1.98	0.0120	INLET	0.00	F	0.00
30.20	1	24 in.	804.90	804.80	2 - G	9.61	2.00	1.87	0.0120	OUTLET	3.20	F - 1	0.00
22.60	1	21 in.	807.10	806.94	2 - G	9.40	1.75	1.65	0.0120	OUTLET	10.80	F - 2	0.00
33.40	1	30 in.	803.20	803.22	2 - F	7.47	2.50	1.97	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)													
27.70	1	33 in.	802.78	803.18	1 - A	5.59	2.51	1.75	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.)
	27.70	1	30 in.	803.14	803.56	2 - F	6.19	2.50	1.79	0.0244	OUTLET**	0.00	D - 1	0.00
	26.80	1	27 in.	803.85	804.46	2 - F	6.86	2.25	1.81	0.0245	OUTLET	0.90	D - 2	0.00
	27.70	1	36 in.	802.59	803.01	1 - A	5.14	2.74	1.70	0.0241	OUTLET*	0.00	D + 1	0.00
	33.40	1	33 in.	803.28	803.66	2 - F	6.73	2.75	1.92	0.0241	OUTLET**	0.00	F	0.00
	33.40	1	30 in.	803.88	804.32	2 - F	7.47	2.50	1.97	0.0244	OUTLET**	0.00	F - 1	0.00
	26.80	1	27 in.	804.97	805.55	2 - F	6.86	2.25	1.81	0.0245	OUTLET	6.60	F - 2	0.00
	33.40	1	36 in.	802.96	803.33	1 - A	6.19	2.74	1.88	0.0241	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	27.70	1	36 in.	802.59	803.05	1 - A	5.14	2.74	1.70	0.0281	OUTLET*	0.00	D	0.00
	27.70	1	42 in.	802.40	802.83	1 - A	4.49	3.20	1.62	0.0278	OUTLET*	0.00	D + 1	0.00
	33.40	1	36 in.	802.96	803.41	1 - A	6.19	2.74	1.88	0.0281	OUTLET*	0.00	F	0.00
	33.40	1	42 in.	802.67	803.10	1 - A	5.42	3.20	1.79	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	27.70	1	60 in.	802.06	802.56	1 - A	3.45	2.58	1.46	0.0332	OUTLET*	0.00	D	0.00
	27.70	1	66 in.	801.97	802.50	1 - A	3.24	2.44	1.42	0.0330	OUTLET*	0.00	D + 1	0.00
	33.40	1	60 in.	802.30	802.75	1 - A	4.16	2.90	1.61	0.0332	OUTLET*	0.00	F	0.00
	33.40	1	66 in.	802.20	802.67	1 - A	3.91	2.72	1.56	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	13.85	2	60 in.	801.39	802.21	1 - B	1.73	1.75	1.02	0.0332	OUTLET*	0.00	D	0.00
	13.85	2	66 in.	801.35	802.19	1 - B	1.62	1.68	1.00	0.0330	OUTLET*	0.00	D + 1	0.00
	16.70	2	60 in.	801.54	802.27	1 - B	2.08	1.94	1.12	0.0332	OUTLET*	0.00	F	0.00
	16.70	2	66 in.	801.49	802.24	1 - B	1.95	1.86	1.10	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	27.70	1	60 in.	802.06	802.52	1 - A	3.45	2.24	1.46	0.0260	OUTLET*	0.00	D	0.00
	27.70	1	66 in.	801.97	802.47	1 - A	3.24	2.14	1.42	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.)
	33.40	1	60 in.	802.30	802.70	1 - A	4.16	2.50	1.61	0.0260	OUTLET*	0.00	F	0.00
	33.40	1	66 in.	802.20	802.63	1 - A	3.91	2.37	1.56	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	13.85	2	60 in.	801.39	802.19	1 - B	1.73	1.54	1.02	0.0260	OUTLET*	0.00	D	0.00
	13.85	2	66 in.	801.35	802.18	1 - B	1.62	1.49	1.00	0.0260	OUTLET*	0.00	D + 1	0.00
	16.70	2	60 in.	801.54	802.25	1 - B	2.08	1.70	1.12	0.0260	OUTLET*	0.00	F	0.00
	16.70	2	66 in.	801.49	802.23	1 - B	1.95	1.64	1.10	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 - 593+72 LT TO 594+15 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.) : 797.89 **Outlet Invert Elevation (ft.) :** 797.64 **Tailwater Elevation (ft.) :** 799.46 **Overflow Elevation (ft.) :** 801.60

Allowable Headwater Elevation (ft.) : 800.60 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 43.00 **Culvert Slope (ft./ft.) :** 0.0058 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 29.00 **@** 10 yrs. **Flood Discharge (cfs) :** 35.00 **@** 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		
	29.00	1	33 in.	800.53	N/A	1 - C	7.86	1.64	1.79	0.0120	INLET	0.00	D	0.00
	29.00	1	30 in.	800.72	N/A	1 - C	7.76	1.78	1.84	0.0120	INLET	0.00	D - 1	0.00
	29.00	1	27 in.	801.11	801.02	2 - E	7.29	2.25	1.87	0.0120	INLET	0.00	D - 2	0.00
	29.00	1	36 in.	800.42	N/A	1 - C	7.90	1.55	1.74	0.0120	INLET	0.00	D + 1	0.00
	35.00	1	33 in.	800.89	N/A	1 - C	8.17	1.86	1.97	0.0120	INLET	0.00	F	0.00
	35.00	1	30 in.	801.21	801.16	2 - E	7.85	2.13	2.01	0.0120	INLET	0.00	F - 1	0.00
	33.00	1	27 in.	801.85	801.68	2 - E	8.30	2.25	1.97	0.0120	INLET	2.00	F - 2	0.00
	35.00	1	36 in.	800.72	N/A	1 - C	8.25	1.74	1.92	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED				**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)														
Diameter exceeds 1.25 HWA	29.00	1	48 in.	800.20	800.49	1 - A	5.21	1.95	1.60	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.)
	29.00	1	42 in.	800.34	800.65	1 - A	5.74	2.14	1.66	0.0237	OUTLET*	0.00	D - 1	0.00
	29.00	1	36 in.	800.55	800.88	1 - A	6.46	2.65	1.74	0.0241	OUTLET*	0.00	D - 2	0.00
	29.00	1	54 in.	800.09	800.39	1 - A	4.81	1.83	1.54	0.0233	OUTLET*	0.00	D + 1	0.00
	35.00	1	48 in.	800.46	800.79	1 - A	6.29	2.18	1.76	0.0235	OUTLET*	0.00	F	0.00
	35.00	1	42 in.	800.62	800.98	1 - A	6.85	2.44	1.83	0.0237	OUTLET*	0.00	F - 1	0.00
	35.00	1	36 in.	800.95	801.29	1 - A	7.31	2.74	1.92	0.0241	OUTLET*	0.00	F - 2	0.00
	35.00	1	54 in.	800.34	800.66	1 - A	5.81	2.03	1.70	0.0233	OUTLET*	0.00	F + 1	0.00
	14.50	2	27 in.	799.92	800.19	1 - A	4.21	2.05	1.33	0.0245	OUTLET	0.00	D	0.00
	14.50	2	24 in.	800.18	800.72	2 - F	4.83	2.00	1.37	0.0247	OUTLET	0.00	D - 1	0.00
	13.70	2	21 in.	800.80	801.84	2 - G	5.70	1.75	1.38	0.0248	OUTLET	0.80	D - 2	0.00
	14.50	2	30 in.	799.79	800.14	1 - B	3.79	1.80	1.28	0.0244	OUTLET*	0.00	D + 1	0.00
	17.50	2	27 in.	800.23	800.55	1 - A	5.08	2.05	1.46	0.0245	OUTLET**	0.00	F	0.00
	17.50	2	24 in.	800.67	801.30	2 - F	5.83	2.00	1.51	0.0247	OUTLET	0.00	F - 1	0.00
	13.70	2	21 in.	801.64	802.92	2 - G	5.70	1.75	1.38	0.0248	OUTLET	3.80	F - 2	0.00
	17.50	2	30 in.	800.03	800.36	1 - A	4.57	2.19	1.42	0.0244	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
Diameter exceeds 1.25 HWA	29.00	1	48 in.	800.20	800.52	1 - A	5.21	2.14	1.60	0.0275	OUTLET*	0.00	D	0.00
	29.00	1	42 in.	800.34	800.68	1 - A	5.74	2.39	1.66	0.0278	OUTLET*	0.00	D - 1	0.00
	29.00	1	36 in.	800.55	800.93	1 - A	6.46	2.74	1.74	0.0281	OUTLET*	0.00	D - 2	0.00
	29.00	1	54 in.	800.09	800.40	1 - A	4.81	2.00	1.54	0.0273	OUTLET*	0.00	D + 1	0.00
	35.00	1	48 in.	800.46	800.80	1 - A	6.29	2.41	1.76	0.0275	OUTLET*	0.00	F	0.00
	35.00	1	42 in.	800.62	801.00	1 - A	6.85	2.80	1.83	0.0278	OUTLET*	0.00	F - 1	0.00
	35.00	1	36 in.	800.95	801.34	1 - A	7.31	2.74	1.92	0.0281	OUTLET*	0.00	F - 2	0.00

UNIVERSAL CULVERT DESIGN

	FLOW (cfs.)	PIPE #	CULVERT SIZE	HWI (ft.)	HWO (ft.)	FLOW TYPE	VELOCITY (fps.)	DN (ft.)	DC (ft.)	MANNING N	HEADWATER CONTROL	OVER FLOW (cfs.)	DESIGN CODE	BURIAL DEPTH (ft.)
	35.00	1	54 in.	800.34	800.66	1 - A	5.81	2.22	1.70	0.0273	OUTLET*	0.00	F + 1	0.00
	14.50	2	36 in.	799.65	799.99	1 - B	3.23	1.70	1.21	0.0281	OUTLET*	0.00	D	0.00
	14.50	2	42 in.	799.54	799.89	1 - B	2.87	1.55	1.16	0.0278	OUTLET*	0.00	D + 1	0.00
	17.50	2	36 in.	799.85	800.18	1 - A	3.90	1.93	1.34	0.0281	OUTLET*	0.00	F	0.00
	17.50	2	42 in.	799.73	800.04	1 - B	3.46	1.73	1.28	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	29.00	1	60 in.	799.99	800.34	1 - A	4.49	2.11	1.49	0.0332	OUTLET*	0.00	D	0.00
	29.00	1	66 in.	799.89	800.27	1 - A	4.23	2.02	1.45	0.0330	OUTLET*	0.00	D + 1	0.00
	35.00	1	60 in.	800.23	800.58	1 - A	5.42	2.35	1.65	0.0332	OUTLET*	0.00	F	0.00
	35.00	1	66 in.	800.13	800.50	1 - A	5.10	2.24	1.60	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	14.50	2	60 in.	799.30	799.76	1 - B	2.24	1.46	1.05	0.0332	OUTLET*	0.00	D	0.00
	14.50	2	66 in.	799.25	799.73	1 - B	2.11	1.41	1.02	0.0330	OUTLET*	0.00	D + 1	0.00
	17.50	2	60 in.	799.45	799.87	1 - B	2.71	1.61	1.15	0.0332	OUTLET*	0.00	F	0.00
	17.50	2	66 in.	799.40	799.83	1 - B	2.55	1.55	1.12	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	29.00	1	60 in.	799.99	800.29	1 - A	4.49	1.85	1.49	0.0260	OUTLET*	0.00	D	0.00
	29.00	1	66 in.	799.89	800.25	1 - B	4.23	1.78	1.45	0.0260	OUTLET*	0.00	D + 1	0.00
	35.00	1	60 in.	800.23	800.55	1 - A	5.42	2.05	1.65	0.0260	OUTLET*	0.00	F	0.00
	35.00	1	66 in.	800.13	800.47	1 - A	5.10	1.97	1.60	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	14.50	2	60 in.	799.30	799.73	1 - B	2.24	1.29	1.05	0.0260	OUTLET*	0.00	D	0.00
	14.50	2	66 in.	799.25	799.70	1 - B	2.11	1.25	1.02	0.0260	OUTLET*	0.00	D + 1	0.00
	17.50	2	60 in.	799.45	799.84	1 - B	2.71	1.42	1.15	0.0260	OUTLET*	0.00	F	0.00
	17.50	2	66 in.	799.40	799.79	1 - B	2.55	1.37	1.12	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+67 LT TO 595+09 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.) : 797.34 **Outlet Invert Elevation (ft.) :** 797.09 **Tailwater Elevation (ft.) :** 798.91 **Overflow Elevation (ft.) :** 801.80

Allowable Headwater Elevation (ft.) : 800.80 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 42.00 **Culvert Slope (ft./ft.) :** 0.0060 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 29.40 **@** 10 yrs. **Flood Discharge (cfs) :** 35.60 **@** 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		
29.40	1	27 in.	800.60	800.49	2 - E	7.39	2.25	1.88	0.0120	INLET	0.00	D	0.00
29.40	1	24 in.	801.44	801.25	2 - E	9.36	2.00	1.85	0.0120	INLET	0.00	D - 1	0.00
24.60	1	21 in.	803.12	802.92	2 - H	10.23	1.75	1.68	0.0120	INLET	4.80	D - 2	0.00
29.40	1	30 in.	800.20	N/A	1 - C	7.85	1.78	1.85	0.0120	INLET	0.00	D + 1	0.00
35.60	1	27 in.	801.39	801.19	2 - E	8.95	2.25	2.02	0.0120	INLET	0.00	F	0.00
31.30	1	24 in.	802.68	802.33	2 - E	9.96	2.00	1.88	0.0120	INLET	4.30	F - 1	0.00
24.60	1	21 in.	805.25	804.79	2 - H	10.23	1.75	1.68	0.0120	INLET	11.00	F - 2	0.00
35.60	1	30 in.	800.72	800.65	2 - E	7.93	2.15	2.02	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)													
29.40	1	33 in.	800.24	800.54	1 - A	7.05	2.51	1.80	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.)
	29.40	1	30 in.	800.67	801.08	2 - F	7.55	2.50	1.85	0.0244	OUTLET**	0.00	D - 1	0.00
	27.90	1	27 in.	801.48	802.10	2 - F	8.02	2.25	1.84	0.0245	OUTLET**	1.50	D - 2	0.00
	29.40	1	36 in.	800.02	800.36	1 - A	6.55	2.66	1.76	0.0241	OUTLET*	0.00	D + 1	0.00
	35.60	1	33 in.	800.82	801.17	2 - F	7.75	2.75	1.99	0.0241	OUTLET**	0.00	F	0.00
	34.20	1	30 in.	801.53	802.01	2 - F	8.17	2.50	1.99	0.0244	OUTLET**	1.40	F - 1	0.00
	27.90	1	27 in.	802.76	803.55	2 - F	8.02	2.25	1.84	0.0245	OUTLET**	7.70	F - 2	0.00
	35.60	1	36 in.	800.44	800.77	1 - A	7.37	2.74	1.94	0.0241	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	29.40	1	36 in.	800.02	800.40	1 - A	6.55	2.74	1.76	0.0281	OUTLET*	0.00	D	0.00
	29.40	1	42 in.	799.80	800.14	1 - A	5.82	2.39	1.67	0.0278	OUTLET*	0.00	D + 1	0.00
	35.60	1	36 in.	800.44	800.83	1 - A	7.37	2.74	1.94	0.0281	OUTLET*	0.00	F	0.00
	35.60	1	42 in.	800.10	800.48	1 - A	6.90	2.81	1.85	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	29.40	1	60 in.	799.45	799.80	1 - A	4.55	2.12	1.50	0.0332	OUTLET*	0.00	D	0.00
	29.40	1	66 in.	799.36	799.73	1 - A	4.28	2.02	1.46	0.0330	OUTLET*	0.00	D + 1	0.00
	35.60	1	60 in.	799.70	800.05	1 - A	5.51	2.36	1.66	0.0332	OUTLET*	0.00	F	0.00
	35.60	1	66 in.	799.60	799.97	1 - A	5.19	2.24	1.62	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	14.70	2	60 in.	798.76	799.21	1 - B	2.28	1.46	1.05	0.0332	OUTLET*	0.00	D	0.00
	14.70	2	66 in.	798.71	799.19	1 - B	2.14	1.41	1.03	0.0330	OUTLET*	0.00	D + 1	0.00
	17.80	2	60 in.	798.92	799.33	1 - B	2.76	1.62	1.16	0.0332	OUTLET*	0.00	F	0.00
	17.80	2	66 in.	798.86	799.29	1 - B	2.59	1.55	1.13	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	29.40	1	60 in.	799.45	799.76	1 - A	4.55	1.85	1.50	0.0260	OUTLET*	0.00	D	0.00
	29.40	1	66 in.	799.36	799.72	1 - B	4.28	1.78	1.46	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.)
	35.60	1	60 in.	799.70	800.03	1 - A	5.51	2.06	1.66	0.0260	OUTLET*	0.00	F	0.00
	35.60	1	66 in.	799.60	799.94	1 - A	5.19	1.97	1.62	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	14.70	2	60 in.	798.76	799.19	1 - B	2.28	1.29	1.05	0.0260	OUTLET*	0.00	D	0.00
	14.70	2	66 in.	798.71	799.15	1 - B	2.14	1.25	1.03	0.0260	OUTLET*	0.00	D + 1	0.00
	17.80	2	60 in.	798.92	799.30	1 - B	2.76	1.43	1.16	0.0260	OUTLET*	0.00	F	0.00
	17.80	2	66 in.	798.86	799.25	1 - B	2.59	1.38	1.13	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+37 LT TO 596+70 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.) : 796.34 **Outlet Invert Elevation (ft.) :** 796.15 **Tailwater Elevation (ft.) :** 797.97 **Overflow Elevation (ft.) :** 800.94

Allowable Headwater Elevation (ft.) : 799.94 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 33.00 **Culvert Slope (ft./ft.) :** 0.0058 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 29.60 **@** 10 yrs. **Flood Discharge (cfs) :** 35.80 **@** 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		
	29.60	1	27 in.	799.63	799.51	2 - E	7.44	2.25	1.89	0.0120	INLET	0.00	D	0.00
	29.60	1	24 in.	800.48	800.21	2 - E	9.42	2.00	1.86	0.0120	INLET	0.00	D - 1	0.00
	25.20	1	21 in.	802.18	801.77	2 - H	10.48	1.75	1.68	0.0120	INLET	4.40	D - 2	0.00
	29.60	1	30 in.	799.22	N/A	1 - C	7.75	1.82	1.85	0.0120	INLET	0.00	D + 1	0.00
	35.80	1	27 in.	800.42	800.17	2 - E	9.00	2.25	2.03	0.0120	INLET	0.00	F	0.00
	32.00	1	24 in.	801.73	801.23	2 - E	10.19	2.00	1.89	0.0120	INLET	3.80	F - 1	0.00
	25.20	1	21 in.	804.33	803.53	2 - H	10.48	1.75	1.68	0.0120	INLET	10.60	F - 2	0.00
	35.80	1	30 in.	799.74	799.67	2 - E	7.74	2.23	2.03	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED				**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)														
	29.60	1	33 in.	799.26	799.56	1 - A	7.10	2.51	1.81	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.)
	29.60	1	30 in.	799.69	800.00	2 - F	7.58	2.50	1.85	0.0244	OUTLET**	0.00	D - 1	0.00
	29.60	1	27 in.	800.52	800.92	2 - F	8.32	2.25	1.89	0.0245	OUTLET**	0.00	D - 2	0.00
	29.60	1	36 in.	799.03	799.37	1 - A	6.60	2.74	1.76	0.0241	OUTLET*	0.00	D + 1	0.00
	35.80	1	33 in.	799.84	800.11	2 - F	7.77	2.75	1.99	0.0241	OUTLET**	0.00	F	0.00
	35.80	1	30 in.	800.56	800.86	2 - F	8.39	2.50	2.03	0.0244	OUTLET**	0.00	F - 1	0.00
	29.70	1	27 in.	801.80	802.24	2 - F	8.33	2.25	1.89	0.0245	OUTLET**	6.10	F - 2	0.00
	35.80	1	36 in.	799.45	799.77	1 - A	7.38	2.74	1.94	0.0241	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)														
	29.60	1	36 in.	799.03	799.40	1 - A	6.60	2.74	1.76	0.0281	OUTLET*	0.00	D	0.00
	29.60	1	42 in.	798.81	799.15	1 - A	5.86	2.43	1.68	0.0278	OUTLET*	0.00	D + 1	0.00
	35.80	1	36 in.	799.45	799.82	1 - A	7.38	2.74	1.94	0.0281	OUTLET*	0.00	F	0.00
	35.80	1	42 in.	799.11	799.48	1 - A	6.91	2.88	1.86	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)														
Diameter exceeds 1.25 HWA	29.60	1	60 in.	798.46	798.81	1 - A	4.58	2.15	1.51	0.0332	OUTLET*	0.00	D	0.00
	29.60	1	66 in.	798.37	798.73	1 - A	4.31	2.05	1.47	0.0330	OUTLET*	0.00	D + 1	0.00
	35.80	1	60 in.	798.71	799.05	1 - A	5.54	2.39	1.67	0.0332	OUTLET*	0.00	F	0.00
	35.80	1	66 in.	798.61	798.97	1 - A	5.22	2.27	1.62	0.0330	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	14.80	2	60 in.	797.76	798.24	1 - B	2.29	1.48	1.06	0.0332	OUTLET*	0.00	D	0.00
	14.80	2	66 in.	797.72	798.21	1 - B	2.16	1.43	1.03	0.0330	OUTLET*	0.00	D + 1	0.00
	17.90	2	60 in.	797.92	798.35	1 - B	2.77	1.64	1.17	0.0332	OUTLET*	0.00	F	0.00
	17.90	2	66 in.	797.86	798.31	1 - B	2.61	1.57	1.14	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	29.60	1	60 in.	798.46	798.76	1 - A	4.58	1.88	1.51	0.0260	OUTLET*	0.00	D	0.00
	29.60	1	66 in.	798.37	798.72	1 - B	4.31	1.80	1.47	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.)
	35.80	1	60 in.	798.71	799.04	1 - A	5.54	2.08	1.67	0.0260	OUTLET*	0.00	F	0.00
	35.80	1	66 in.	798.61	798.95	1 - A	5.22	1.99	1.62	0.0260	OUTLET*	0.00	F + 1	0.00
Diameter exceeds 1.25 HWA	14.80	2	60 in.	797.76	798.23	1 - B	2.29	1.31	1.06	0.0260	OUTLET*	0.00	D	0.00
	14.80	2	66 in.	797.72	798.19	1 - B	2.16	1.27	1.03	0.0260	OUTLET*	0.00	D + 1	0.00
	17.90	2	60 in.	797.92	798.31	1 - B	2.77	1.44	1.17	0.0260	OUTLET*	0.00	F	0.00
	17.90	2	66 in.	797.86	798.28	1 - B	2.61	1.39	1.14	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+26 LT TO 598+94 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.) : 795.23 **Outlet Invert Elevation (ft.) :** 794.83 **Tailwater Elevation (ft.) :** 796.65 **Overflow Elevation (ft.) :** 800.34

Allowable Headwater Elevation (ft.) : 799.34 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 68.00 **Culvert Slope (ft./ft.) :** 0.0059 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 29.60 **@** 10 yrs. **Flood Discharge (cfs) :** 35.70 **@** 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		
29.60	1	27 in.	798.52	798.46	2 - E	7.44	2.25	1.89	0.0120	INLET	0.00	D	0.00
29.60	1	24 in.	799.37	799.40	2 - F	9.73	2.00	1.86	0.0120	OUTLET**	0.00	D - 1	0.00
25.80	1	21 in.	801.07	801.48	2 - G	10.73	1.75	1.69	0.0120	OUTLET	3.80	D - 2	0.00
29.60	1	30 in.	798.11	N/A	1 - C	7.82	1.80	1.85	0.0120	INLET	0.00	D + 1	0.00
35.70	1	27 in.	799.29	799.23	2 - E	8.98	2.25	2.02	0.0120	INLET	0.00	F	0.00
34.30	1	24 in.	800.60	800.63	2 - F	11.09	2.00	1.91	0.0120	OUTLET**	1.40	F - 1	0.00
25.80	1	21 in.	803.18	803.68	2 - G	10.73	1.75	1.69	0.0120	OUTLET	9.90	F - 2	0.00
35.70	1	30 in.	798.62	798.55	2 - E	7.87	2.18	2.03	0.0120	INLET	0.00	F + 1	0.00
CULVERT TYPE : CIRCULAR CORRUGATED			**Entrance Type :** Half Headwall								**Entrance Loss (Ke) :** 0.90		
Corrugated Metal Pipe (2 2/3 x 1/2 in. corrugations)													
29.60	1	30 in.	798.58	799.32	2 - F	7.58	2.50	1.85	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.)
28.10	1	27 in.	799.41	800.73	2 - F	8.06	2.25	1.84	0.0245	OUTLET**	1.50	D - 1	0.00
21.70	1	24 in.	800.87	803.56	2 - F	7.23	2.00	1.67	0.0247	OUTLET**	7.90	D - 2	0.00
29.60	1	33 in.	798.15	798.57	2 - F	7.10	2.51	1.81	0.0241	OUTLET**	0.00	D + 1	0.00
35.10	1	30 in.	799.43	800.46	2 - F	8.29	2.50	2.01	0.0244	OUTLET**	0.60	F	0.00
28.10	1	27 in.	800.67	802.54	2 - F	8.06	2.25	1.84	0.0245	OUTLET**	7.60	F - 1	0.00
21.70	1	24 in.	802.65	806.68	2 - F	7.23	2.00	1.67	0.0247	OUTLET**	14.00	F - 2	0.00
35.70	1	33 in.	798.72	799.32	2 - F	7.76	2.75	1.99	0.0241	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
29.60	1	36 in.	797.92	798.36	1 - A	6.60	2.74	1.76	0.0281	OUTLET*	0.00	D	0.00
29.60	1	42 in.	797.70	798.07	1 - A	5.86	2.41	1.68	0.0278	OUTLET*	0.00	D + 1	0.00
35.70	1	36 in.	798.34	798.96	2 - F	7.38	3.00	1.94	0.0281	OUTLET**	0.00	F	0.00
35.70	1	42 in.	797.99	798.41	1 - A	6.90	2.84	1.85	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
29.60	1	60 in.	797.35	797.72	1 - A	4.58	2.13	1.51	0.0332	OUTLET*	0.00	D	0.00
29.60	1	66 in.	797.26	797.64	1 - A	4.31	2.03	1.47	0.0330	OUTLET*	0.00	D + 1	0.00
35.70	1	60 in.	797.60	797.97	1 - A	5.53	2.37	1.66	0.0332	OUTLET*	0.00	F	0.00
35.70	1	66 in.	797.49	797.88	1 - A	5.20	2.25	1.62	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
29.60	1	60 in.	797.35	797.65	1 - A	4.58	1.87	1.51	0.0260	OUTLET*	0.00	D	0.00
29.60	1	66 in.	797.26	797.61	1 - B	4.31	1.79	1.47	0.0260	OUTLET*	0.00	D + 1	0.00
35.70	1	60 in.	797.60	797.91	1 - A	5.53	2.07	1.66	0.0260	OUTLET*	0.00	F	0.00
35.70	1	66 in.	797.49	797.82	1 - A	5.20	1.98	1.62	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 - 599+67 LT TO 600+12 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.) : 794.39 **Outlet Invert Elevation (ft.) :** 794.12 **Tailwater Elevation (ft.) :** 795.94 **Overflow Elevation (ft.) :** 800.43

Allowable Headwater Elevation (ft.) : 799.43 **or** Diameter + 4 ft. *(whichever is less)*

Pipe Length (ft.) : 45.00 **Culvert Slope (ft./ft.) :** 0.0060 **Design Manning 'n' :** 0.0120

Design Discharge (cfs) : 29.50 **@** 10 yrs. **Flood Discharge (cfs) :** 35.60 **@** 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		
29.50	1	24 in.	798.51	798.34	2 - E	9.39	2.00	1.85	0.0120	INLET	0.00	D	0.00
29.50	1	21 in.	800.20	800.06	2 - H	12.26	1.75	1.71	0.0120	INLET	0.00	D - 1	0.00
21.80	1	18 in.	804.84	804.14	2 - G	12.34	1.50	1.48	0.0120	OUTLET	7.70	D - 2	0.00
29.50	1	27 in.	797.66	797.56	2 - E	7.42	2.25	1.88	0.0120	INLET	0.00	D + 1	0.00
35.60	1	24 in.	799.73	799.42	2 - E	11.33	2.00	1.92	0.0120	INLET	0.00	F	0.00
30.20	1	21 in.	802.30	801.95	2 - H	12.56	1.75	1.71	0.0120	INLET	5.40	F - 1	0.00
21.80	1	18 in.	814.75	807.88	2 - G	12.34	1.50	1.48	0.0120	OUTLET	13.80	F - 2	0.00
35.60	1	27 in.	798.44	798.25	2 - E	8.95	2.25	2.02	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)													
29.50	1	27 in.	798.55	799.25	2 - F	8.30	2.25	1.88	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.)
26.70	1	24 in.	800.01	801.40	2 - F	8.90	2.00	1.80	0.0247	OUTLET**	2.80	D - 1	0.00
19.60	1	21 in.	802.52	806.02	2 - G	8.15	1.75	1.59	0.0248	OUTLET	9.90	D - 2	0.00
29.50	1	30 in.	797.73	798.18	2 - F	7.57	2.50	1.85	0.0244	OUTLET**	0.00	D + 1	0.00
34.40	1	27 in.	799.81	800.72	2 - F	9.21	2.25	2.00	0.0245	OUTLET**	1.20	F	0.00
26.70	1	24 in.	801.78	803.87	2 - F	8.90	2.00	1.80	0.0247	OUTLET**	8.90	F - 1	0.00
19.60	1	21 in.	806.65	810.62	2 - G	8.15	1.75	1.59	0.0248	OUTLET	16.00	F - 2	0.00
35.60	1	30 in.	798.58	799.12	2 - F	8.36	2.50	2.02	0.0244	OUTLET**	0.00	F + 1	0.00
Corrugated Metal Pipe (3 x 1 in. corrugations)													
29.50	1	36 in.	797.08	797.47	1 - A	6.57	2.74	1.76	0.0281	OUTLET*	0.00	D	0.00
29.50	1	42 in.	796.86	797.20	1 - A	5.84	2.39	1.68	0.0278	OUTLET*	0.00	D + 1	0.00
35.60	1	36 in.	797.49	797.91	1 - A	7.37	2.74	1.94	0.0281	OUTLET*	0.00	F	0.00
35.60	1	42 in.	797.15	797.53	1 - A	6.90	2.80	1.85	0.0278	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations)													
29.50	1	60 in.	796.51	796.86	1 - A	4.57	2.12	1.51	0.0332	OUTLET*	0.00	D	0.00
29.50	1	66 in.	796.41	796.78	1 - A	4.30	2.02	1.47	0.0330	OUTLET*	0.00	D + 1	0.00
35.60	1	60 in.	796.75	797.11	1 - A	5.51	2.35	1.66	0.0332	OUTLET*	0.00	F	0.00
35.60	1	66 in.	796.65	797.02	1 - A	5.19	2.24	1.62	0.0330	OUTLET*	0.00	F + 1	0.00
Corrugated Metal Pipe (6 x 2 in. corrugations, Field Paved Invert)													
29.50	1	60 in.	796.51	796.81	1 - A	4.57	1.85	1.51	0.0260	OUTLET*	0.00	D	0.00
29.50	1	66 in.	796.41	796.77	1 - B	4.30	1.78	1.47	0.0260	OUTLET*	0.00	D + 1	0.00
35.60	1	60 in.	796.75	797.08	1 - A	5.51	2.05	1.66	0.0260	OUTLET*	0.00	F	0.00
35.60	1	66 in.	796.65	796.98	1 - A	5.19	1.97	1.62	0.0260	OUTLET*	0.00	F + 1	0.00