

# Appendix F

## Hydrology and Hydraulics

### Data

Content:

- Culvert Data Table
- HY8 Culvert Analysis Report

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Table F.1

North Salt Creek					Evaluate	GIS Contour Data			Overtopping Evaluation				
OBJECTID*	Shape	Point_X	Point_Y	Note	Evaluate_(yes/no/insufficient_data)	Road_elevation	Channel_elevation_Upstream	Channel_depth_at_Road	Approx_Dist_between_DNR_Xsect	DS_Backwater	Approx_100yr_WSE_at_Road	Road_Overtopped_per_DNR_Data	Depth_Overtopped
0	Point	163349	214500	No Xsect, unmodeled Tributary	Insufficient	1144	1130	14			1130.0	No	-14.0
1	Point	163690	213291	No Xsect, unmodeled Tributary	Insufficient	1144	1134	10			1134.0	No	-10.0
2	Point	164827	213174	No Xsect, unmodeled Tributary	Insufficient	1145	1137	8			1137.0	No	-8.0
3	Point	165024	217737	No Xsect, unmodeled Tributary	Insufficient	1142.5	1136	6.5			1136.0	No	-6.5
4	Point	164689	217810	No Xsect, unmodeled Tributary	Insufficient	1142	1136	6			1136.0	No	-6.0
5	Point	162737	218878	No Xsect, unmodeled Tributary	Insufficient	1170.5	1166	4.5					
6	Point	166251	218471	No Xsect, unmodeled Tributary	Insufficient	1145	1132	13			1132.0	No	-13.0
7	Point	165967	219942	No Xsect, unmodeled Tributary	Insufficient	1146	1142	4			1142.0	No	-4.0
8	Point	165680	219948	No Xsect, unmodeled Tributary	Insufficient	1150	1143	7			1143.0	No	-7.0
9	Point	165148	220971	No Xsect, unmodeled Tributary	Insufficient	1157	1151	6			1151.0	No	-6.0
10	Point	165104	221195	No Xsect, unmodeled Tributary	Insufficient	1158	1151	7			1151.0	No	-7.0
11	Point	164857	221540	No Xsect, unmodeled Tributary	Insufficient	1164	1156	8			1156.0	No	-8.0
12	Point	163851	222376	No Xsect, unmodeled Tributary	Insufficient	1177.5	1171	6.5			1171.0	No	-6.5
13	Point	169964	220577	No Xsect, unmodeled Tributary	Insufficient	1143	1125	18			1125.0	No	-18.0
14	Point	170935	220429	No Xsect, unmodeled Tributary	Insufficient	1141.5	1130	11.5			1130.0	No	-11.5
15	Point	171339	219942	No Xsect, unmodeled Tributary	Insufficient	1138	1131	7			1131.0	No	-7.0
16	Point	172115	220634	No Xsect, unmodeled Tributary	Insufficient	1139	1131	8			1131.0	No	-8.0
17	Point	170387	221214	Located within FEMA Floodway	No			0					
18	Point	173642	223920	No Xsect, unmodeled Tributary	Insufficient	1137	1126	11					
19	Point	174270	223637	No Xsect, unmodeled Tributary	Insufficient	1137	1129	8					
20	Point	174257	222964	No Xsect, unmodeled Tributary	Insufficient	1139	1129	10			1129.0	No	-10.0
21	Point	174307	222292	No Xsect, unmodeled Tributary	Insufficient	1140	1129	11					
22	Point	174500	221214	No Xsect, unmodeled Tributary	Insufficient	1142	1133	9					
23	Point	174982	220374	No Xsect, unmodeled Tributary	Insufficient	1147	1141	6			1141.0	No	-6.0
24	Point	175207	220135	No Xsect, unmodeled Tributary	Insufficient	1152	1144	8					
25	Point	175985	219103	No Xsect, unmodeled Tributary	Insufficient	1153.5	1149	4.5	0		1149.0	No	-4.5
26	Point	168292	226115	No Xsect, unmodeled Tributary	Insufficient	1142	1129	13			1129.0	No	-13.0
27	Point	168221	225745	No Xsect, unmodeled Tributary	Insufficient	1144	1139	5					

North Salt Creek					Evaluate	GIS Contour Data			Overtopping Evaluation				
OBJECTID*	Shape	Point_X	Point_Y	Note	Evaluate_(yes/no/insufficient_data)	Road_elevation	Channel_elevation_Upstream	Channel_depth_at_Road	Approx_Dist_between_DNR_Xsect	DS_Backwater	Approx_100yr_WSE_at_Road	Road_Overtopped_per_DNR_Data	Depth_Overtopped
28	Point	165733	226954	No Xsect, unmodeled Tributary	Insufficient	1153	1145	8			1145.0	No	-8.0
29	Point	165275	227591	No Xsect, unmodeled Tributary	Insufficient	1156.5	1147	9.5			1147.0	No	-9.5
30	Point	164759	227847	No Xsect, unmodeled Tributary	Insufficient	1162	1155	7			1155.0	No	-7.0
31	Point	164105	227612	No Xsect, unmodeled Tributary	Insufficient	1166	1157	9			1157.0	No	-9.0
32	Point	163161	228873	No Xsect, unmodeled Tributary	Insufficient	1185	1165	20			1165.0	No	-20.0
33	Point	173672	228384	No Xsect, unmodeled Tributary	Insufficient	1135	1122	13			1122.0	No	-13.0
34	Point	174918	231672	No Xsect, unmodeled Tributary	Insufficient	1139	1135	4			1135.0	No	-4.0
35	Point	176067	232967	No Xsect, unmodeled Tributary	Insufficient	1143	1140	3			1140.0	No	-3.0
36	Point	175749	234296	No Xsect, unmodeled Tributary	Insufficient	1154	1152	2			1152.0	No	-2.0
37	Point	175493	235579	No Xsect, unmodeled Tributary	Insufficient	1169	1156	13			1156.0	No	-13.0
38	Point	180631	234272	No Xsect, unmodeled Tributary	Insufficient	1154	1143	11			1143.0	No	-11.0
39	Point	180164	235653	No Xsect, unmodeled Tributary	Insufficient	1182	1165	17			1165.0	No	-17.0
40	Point	183149	234238	No Xsect, unmodeled Tributary	Insufficient	1134	1137	-3			1137.0	Yes	3.0
41	Point	182739	235542	No Xsect, unmodeled Tributary	Insufficient	1160	1157	3			1157.0	No	-3.0
42	Point	187131	234072	Located within FEMA Floodway	No			0					
43	Point	187946	235660	Located within FEMA Floodway	No			0					
44	Point	186878	237477	No Xsect, unmodeled Tributary	Insufficient	1128	1110	18					
45	Point	183867	240783	No Xsect, unmodeled Tributary	Insufficient	1154	1144	10					
46	Point	181619	240449	No Xsect, unmodeled Tributary	Insufficient	1181	1168	13					
47	Point	182537	242158	No Xsect, unmodeled Tributary	Insufficient	1164	1154	10					
48	Point	181616	243493	No Xsect, unmodeled Tributary	Insufficient	1177.5	1168	9.5	0	No	1168.0	No	-9.5
49	Point	181608	246218	No Xsect, unmodeled Tributary	Insufficient	1202.5	1197	5.5					
50	Point	182781	247414	No Xsect, unmodeled Tributary	Insufficient	1220	1202	18					

North Salt Creek					Evaluate	GIS Contour Data			Overtopping Evaluation				
OBJECTID*	Shape	Point_X	Point_Y	Note	Evaluate_(yes/no/insufficient_data)	Road_elevation	Channel_elevation_Upstream	Channel_depth_at_Road	Approx_Dist_between_DNR_Xsect	DS_Backwater	Approx_100yr_WSE_at_Road	Road_Overtopped_per_DNR_Data	Depth_Overtopped
51	Point	184647	242132	No Xsect, unmodeled Tributary	Insufficient	1178	1176	2					
52	Point	192164	239456	No Xsect, unmodeled Tributary	Insufficient	1131.5	1130	1.5	0	Yes	0.0	No	-1131.5
53	Point	188577	242093	No Xsect, unmodeled Tributary	Insufficient	1152.5	1149	3.5					
54	Point	189550	242086	No Xsect, unmodeled Tributary	Insufficient	1143	1139	4					
55	Point	192154	244333	No Xsect, unmodeled Tributary	Insufficient	1140	1137	3					
56	Point	191924	235801	No Xsect, unmodeled Tributary	Insufficient	1126	1114	12					
57	Point	190675	230843	No Xsect, unmodeled Tributary	Insufficient	1129	1123	6					
58	Point	190756	230695	No Xsect, unmodeled Tributary	Insufficient	1127	1124	3	0	No	1124.0	No	-3.0
59	Point	192141	230590	No Xsect, unmodeled Tributary	Insufficient	1131	1129	2					
60	Point	194170	226251	No Xsect, unmodeled Tributary	Insufficient	1172	1160	12					
61	Point	194834	235926	Downstream Xsect	No	1125	1112	13					
62	Point	195499	234185	Downstream Xsect	No	1132	1122	10					
63	Point	195582	234072	Downstream Xsect	Insufficient	1127.5	1123	4.5					
64	Point	196725	234850	No Xsect, unmodeled Tributary	Insufficient	1127	1124	3	0	No	1124.0	No	-3.0
65	Point	197152	231488	Downstream Xsect	No	1140	1129	11					
66	Point	197384	231091	Downstream Xsect	No	1142	1130	12					
67	Point	199327	226216	Downstream Xsect	Yes	1163.25	1152	11.25	0	No	1152.0	No	-11.3
68	Point	202483	220999	Downstream Xsect	Insufficient	1202	1193	9					
69	Point	204978	223362	Downstream Xsect	Insufficient	1214	1208	6					
70	Point	204503	226207	No Xsect, unmodeled Tributary	Insufficient	1222	1218	4					
71	Point	199705	233297	No Xsect, unmodeled Tributary	Insufficient	1140	1135	5					
72	Point	200962	231472	No Xsect, unmodeled Tributary	Insufficient	1161	1156	5					
73	Point	171307	218963	No Xsect, unmodeled Tributary	Insufficient	1139	1133	6			1133.0	No	-6.0
74	Point	175189	219915	No Xsect, unmodeled Tributary	Insufficient	1150	1145	5			1145.0	No	-5.0
75	Point	175217	219360	No Xsect, unmodeled Tributary	Insufficient	1155	1147	8			1147.0	No	-8.0
76	Point	192163	238662	Located within FEMA Floodway	No								
77	Point	181612	231549	Located within FEMA Floodway	No								
78	Point	176358	230988	Located within FEMA Floodway	No								
79	Point	165682	217480	Located within FEMA Floodway	No								
80	Point	164627	215903	Located within FEMA Floodway	No								

Culverts to Evaluate

1

Table F.1

OBJECTID *	DNR HYDRAULIC STUDY DATA							County Culvert Data						
	US_100yr_ depth	US_100yr_ Elevation	US_Q100	US_Distance_ to_point_ (ft)	DS_100yr_ depth	DS_100yr_ Elevation	DS_Q100	DS_Distance_ to_point_(ft)	County_ Longitude	County_ Latitude	Known_ WSE_100yr	Road_ Name	Culvert_ Description	Culvert_ Openings
0									163349	214500		Private Street	8'x13'	SINGLE
1									163690	213291		Private Street	8'x6'	SINGLE
2									164827	213174		Salt Creek Roadway	6'x5'	SINGLE
3									165024	217737		Fairfield Street	8'x5'	TWIN
4									164689	217810		Driveway	8'x5'	TWIN
5									162737	218878		N 20th Street		
6									166251	218471		Private Street	6'x6'	
7									165967	219942		Driveway	8'x6'	TWIN
8									165680	219948		Driveway	8x6'	TWIN
9									165148	220971		Northview Road		
10									165104	221195		Superior Street	8'x5'	TRIPLE
11									164857	221540		Independence Drive	6'x6'	TWIN
12									163851	222376		Boston Drive		
13									169964	220577		Outer Road	5' x 5'	TWIN
14									170935	220429		N 40th Street	10' x 8'	TWIN
15									171339	219942		Turner Street	6'x5'	TWIN
16									172115	220634		N 44th Street	9'x6'	TWIN
17									170387	221214		Superior Street		
18									173642	223920		N 48th Street		
19									174270	223637		Driveway		
20									174257	222964		Driveway	10'x7'	TWIN
21									174307	222292		Driveway		
22									174500	221214		Superior Street	10' x 7'	TWIN
23									174982	220374		Cornhusker Highway	5'x10'	TWIN
24									175207	220135		Railroad Crossing	6' x 7.5'	SINGLE
25									175985	219103		Private Street	6.5'x4.5'	
26									168292	226115		N 33rd Street	10'x10'	TWIN
27									168221	225745		N 33rd Street		

DNR HYDRAULIC STUDY DATA								County Culvert Data						
OBJECTID *	US_100yr_ depth	US_100yr_ Elevation	US_Q100	US_Distance_ to_point_ (ft)	DS_100yr_ depth	DS_100yr_ Elevation	DS_Q100	DS_Distance_ to_point_(ft)	County_ Longitude	County_ Latitude	Known_ WSE_100yr	Road_ Name	Culvert_ Description	Culvert_ Openings
28									165733	226954		N 27th Street	12'x9'	
29									165275	227591		Fletcher Ave	12'x6'	TWIN
30									164759	227847		Telluride Drive	10'x5'	
31									164105	227612		Fletcher Ave	10' x 5'	TWIN
32									163161	228873		Interstate 80	12'x12'	
33									173672	228384		Outer Road		
34									174918	231672		Alvo Road	8'x4'	TRIPLE
35									176067	232967		Private Street		
36									175749	234296		Arbor Road		
37									175493	235579		Interstate 80	12'x10'	
38									180631	234272		Arbor Road		
39									180164	235653		Interstate 80	8'x6'	
40									183149	234238		Arbor Road		
41									182739	235542		Interstate 80	8'x6'	
42									187131	234072		N 84th Street		
43									187946	235660		Interstate 80		
44									186878	237477		N 84th Street		
45									183867	240783		Private Street		
46									181619	240449		N 70th Street		
47									182537	242158		Bluff Road		
48									181616	243493		G-80 (N 70th Street)	6'x8'	TWIN
49									181608	246218		N 70th Street		
50									182781	247414		Waverly Road		

DNR HYDRAULIC STUDY DATA								County Culvert Data						
OBJECTID *	US_100yr_ depth	US_100yr_ Elevation	US_Q100	US_Distance_ to_point_ (ft)	DS_100yr_ depth	DS_100yr_ Elevation	DS_Q100	DS_Distance_ to_point_(ft)	County_ Longitude	County_ Latitude	Known_ WSE_100yr	Road_Name	Culvert_ Description	Culvert_Openings
51									184647	242132		Bluff Road		
52									192164	239456		N 98th Street		
53									188577	242093		Bluff Road		
54									189550	242086		Bluff Road		
55									192154	244333		N 98th Street		
56									191924	235801		Interstate 80	Bridge	
57									190675	230843		Railroad Crossing		
58									190756	230695		US Highway 6		TRIPLE
59									192141	230590		N 98th Street		
60									194170	226251		Fletcher Ave		
61									194834	235926		Interstate 80	Bridge	
62									195499	234185		Railroad Crossing	Bridge	
63									195582	234072		US Highway 6		
64									196725	234850		US Highway 6		
65									197152	231488		Alvo Road	Bridge	
66									197384	231091		112th Street	Bridge	
67									199327	226216		H-60 (Fletcher Ave)	12'x10'	Triple
68									202483	220999		Havelock Ave		
69									204978	223362		N 134th Street		
70									204503	226207		Fletcher Ave		
71									199705	233297		N 120th Street		
72									200962	231472		Alvo Road		
73									171307	218963		Colfax Ave	6'x5'	TWIN
74									175189	219915		Driveway	6'x6'	TWIN
75									175217	219360		Driveway	6'x6'	TWIN
76									192163	238662		N 98th Street		
77									181612	231549		N 70th Street		
78									176358	230988		N 56th Street		
79									165682	217480		N 27th Street		
80									164627	215903		Cornhusker Highway		



Table F.1

Modeled Culvert - per As-Built data from County																
OBJECTID *	Structure Type		Downstream Flowline (ft)	Tailwater Elevation (ft)	Assumed Crest Length (ft)	Embedment depth (in)	Culvert type	Inlet Configuration	Number of barrels	Inlet Elevation (ft)	Outlet Elevation (ft)	Crest Elevation (ft)	Extra	Roadway Overtopped?	Overtopping Elevation (ft)	Overtopping Depth (ft)
0	CBC		17.3													
1	CBC		30.01													
2	CBC		35.29													
3	CBC		34													
4	CBC															
5																
6	CBC		19.85													
7	CBC		39.4													
8	CBC		41													
9																
10	CBC		50.09													
11	CBC		54.78													
12																
13	CBC		7.85													
14	CBC		29.2													
15	CBC		29.98													
16	CBC		30.91													
17																
18																
19																
20	CBC		27.95													
21																
22	CBC		30.9													
23	CBC		39.39													
24	CBC		43.55													
25	CBC		47.06													
26	CBC		25.02													
27																

Modeled Culvert - per As-Built data from County																
OBJECTID *	Structure Type		Downstream Flowline (ft)	Tailwater Elevation (ft)	Assumed Crest Length (ft)	Embedment depth (in)	Culvert type	Inlet Configuration	Number of barrels	Inlet Elevation (ft)	Outlet Elevation (ft)	Crest Elevation (ft)	Extra	Roadway Overtopped?	Overtopping Elevation (ft)	Overtopping Depth (ft)
28	CBC		41.85													
29	CBC		45.2													
30	CBC		49.76													
31	CBC		56.2													
32	CBC		60.92													
33																
34	CBC		33.35													
35																
36																
37	CBC		51.95													
38																
39	CBC		55.06													
40																
41	CBC															
42																
43																
44																
45																
46																
47																
48	CBC															
49																
50																

Modeled Culvert - per As-Built data from County																
OBJECTID *	Structure_Type		Downstream_Flowline_(ft)	Tailwater_Elevation_(ft)	Assumed_Crest_Length_(ft)	Embedment_depth_(in)	Culvert_type	Inlet_Configuration	Number_of_barrels	Inlet_Elevation_(ft)	Outlet_Elevation_(ft)	Crest_Elevation_(ft)	Extra	Roadway_Overtopped?	Overtopping_Elevation (ft)	Overtopping_Depth (ft)
51																
52																
53																
54																
55																
56																
57																
58	CBC		20.65													
59																
60																
61																
62																
63																
64																
65																
66																
67	CBC		1151.74	1557.28	964	0	Box	1:1 Bevel (45 Degree Flared) Wingwall	3	1152	1151.74	1163.25		No	1163.25	N/A
68																
69																
70																
71																
72																
73	CBC		31.95													
74	CBC		44.86													
75	CBC															
76																
77																
78																
79																
80																

# HY-8 Culvert Analysis Report

## Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 899.14 cfs

Maximum Flow: 1241.94 cfs

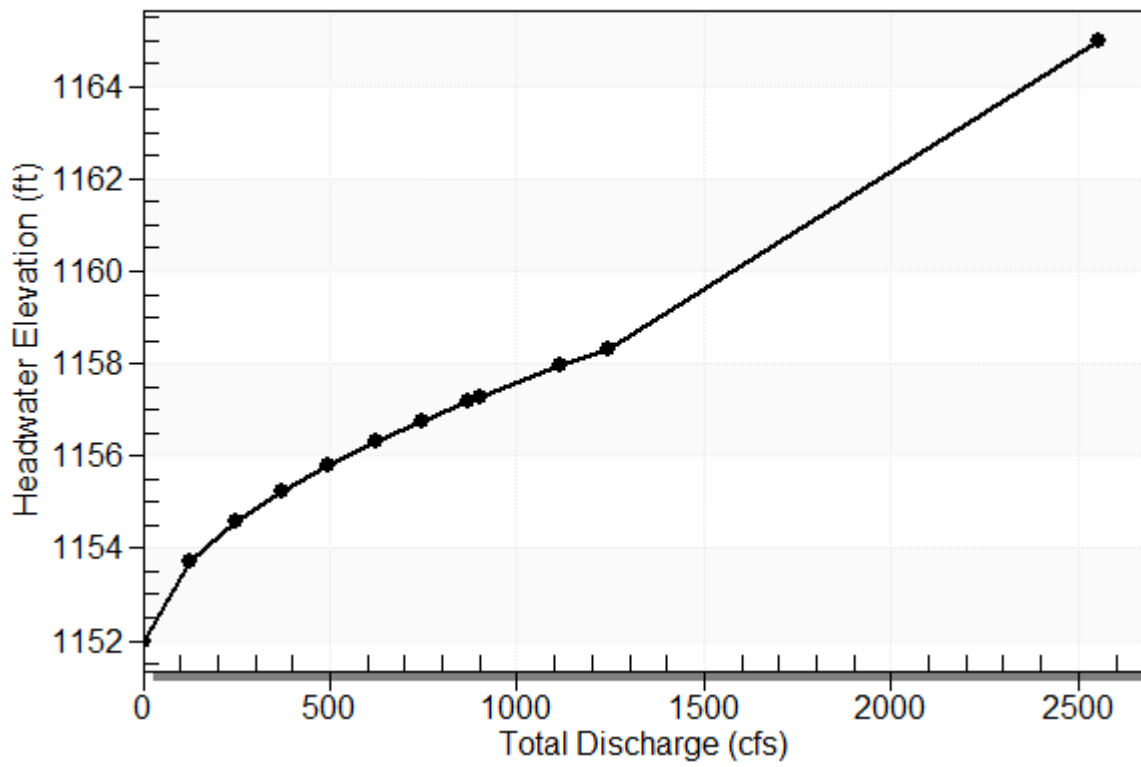
**Table 1 - Summary of Culvert Flows at Crossing: H-60**

Headwater Elevation (ft)	Total Discharge (cfs)	12'x10' Box Culverts Discharge (cfs)	Roadway Discharge (cfs)	Iterations
1152.00	0.00	0.00	0.00	1
1153.72	124.19	124.19	0.00	1
1154.56	248.39	248.39	0.00	1
1155.23	372.58	372.58	0.00	1
1155.79	496.78	496.78	0.00	1
1156.30	620.97	620.97	0.00	1
1156.76	745.16	745.16	0.00	1
1157.18	869.36	869.36	0.00	1
1157.28	899.14	899.14	0.00	1
1157.96	1117.75	1117.75	0.00	1
1158.32	1241.94	1241.94	0.00	1
1163.25	2552.38	2552.38	0.00	Overtopping

# Rating Curve Plot for Crossing: H-60

## Total Rating Curve

Crossing: H-60



**Table 2 - Culvert Summary Table: 12'x10' Box Culverts**

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	1152.00	0.000	0.000	0-NF	0.000	0.000	0.260	0.000	0.000	0.000
124.19	124.19	1153.72	1.088	1.718	1-S1t	0.572	0.718	1.905	1.645	1.811	3.368
248.39	248.39	1154.56	1.728	2.562	1-S1t	0.888	1.139	2.682	2.422	2.573	4.184
372.58	372.58	1155.23	2.264	3.225	1-S1t	1.153	1.493	3.280	3.020	3.156	4.723
496.78	496.78	1155.79	2.743	3.793	1-S1t	1.390	1.808	3.781	3.521	3.650	5.136
620.97	620.97	1156.30	3.182	4.297	1-S1t	1.609	2.098	4.219	3.959	4.088	5.474
745.16	745.16	1156.76	3.594	4.757	1-S1t	1.817	2.370	4.613	4.353	4.487	5.762
869.36	869.36	1157.18	3.983	5.184	1-S1t	2.013	2.626	4.972	4.712	4.857	6.015
899.14	899.14	1157.28	4.073	5.281	1-S1t	2.059	2.686	5.053	4.793	4.943	6.072
1117.75	1117.75	1157.96	4.709	5.960	1-S1t	2.384	3.105	5.612	5.352	5.532	6.446
1241.94	1241.94	1158.32	5.054	6.320	1-S1t	2.562	3.331	5.903	5.643	5.844	6.634

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Straight Culvert

Inlet Elevation (invert): 1152.00 ft, Outlet Elevation (invert): 1151.74 ft

Culvert Length: 52.00 ft, Culvert Slope: 0.0050

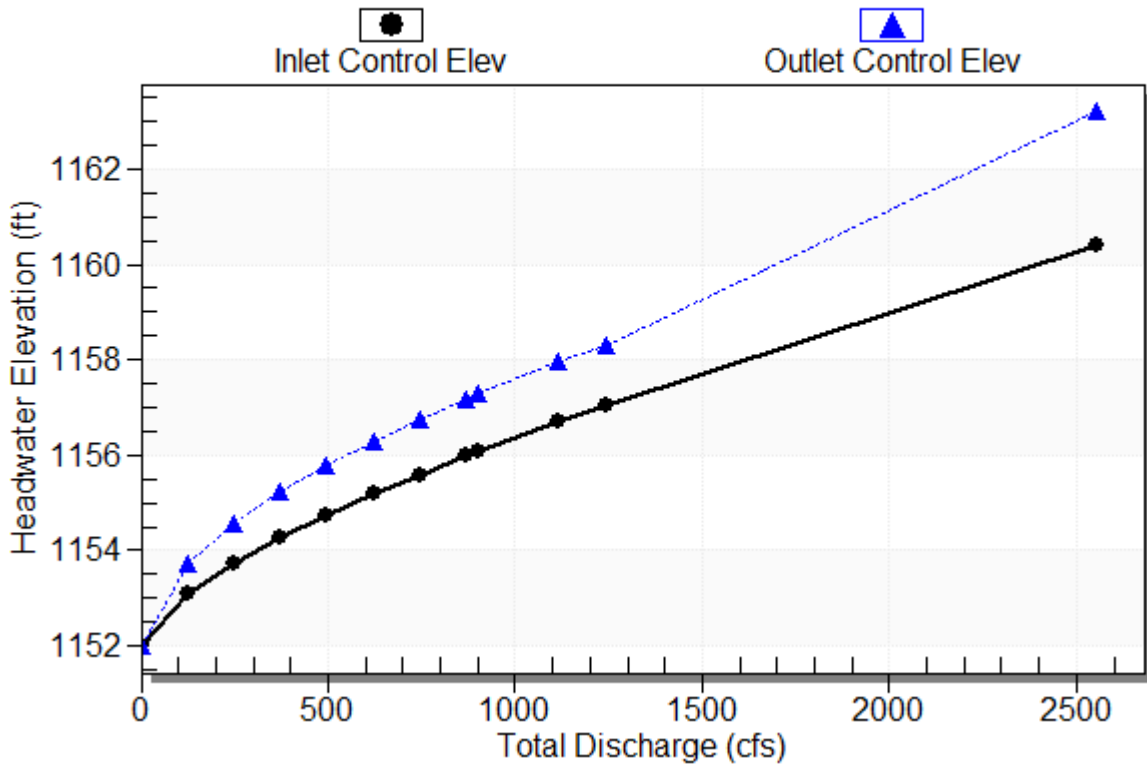
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# Culvert Performance Curve Plot: 12'x10' Box Culverts

## Performance Curve

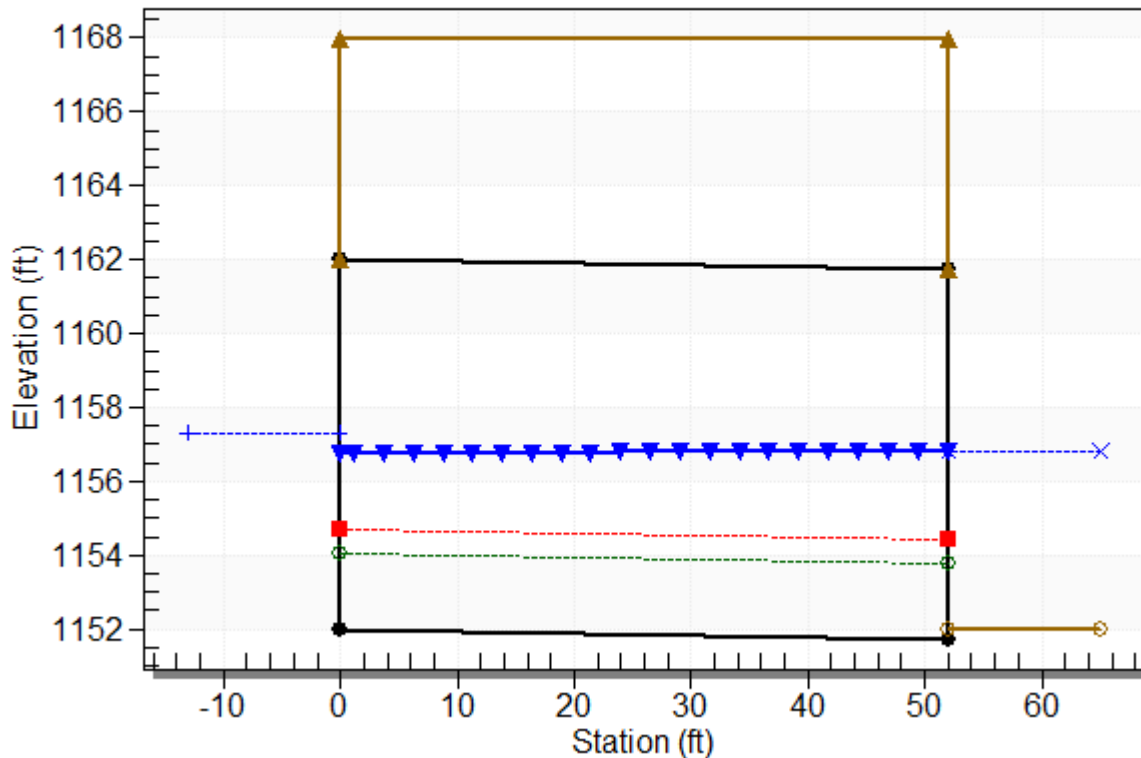
Culvert: 12'x10' Box Culverts



## Water Surface Profile Plot for Culvert: 12'x10' Box Culverts

### Crossing - H-60, Design Discharge - 899.1 cfs

Culvert - 12'x10' Box Culverts, Culvert Discharge - 899.1 cfs



### Site Data - 12'x10' Box Culverts

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 1152.00 ft

Outlet Station: 52.00 ft

Outlet Elevation: 1151.74 ft

Number of Barrels: 3

### Culvert Data Summary - 12'x10' Box Culverts

Barrel Shape: Concrete Box

Barrel Span: 12.00 ft

Barrel Rise: 10.00 ft

Barrel Material: Concrete

Embedment: 0.00 in

Barrel Manning's n: 0.0120

Culvert Type: Straight

Inlet Configuration: 1:1 Bevel (45° flare) Wingwall

Inlet Depression: None

**Table 3 - Downstream Channel Rating Curve (Crossing: H-60)**

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	1152.00	0.00	0.00	0.00	0.00
124.19	1153.64	1.64	3.37	0.51	0.51
248.39	1154.42	2.42	4.18	0.76	0.53
372.58	1155.02	3.02	4.72	0.94	0.55
496.78	1155.52	3.52	5.14	1.10	0.56
620.97	1155.96	3.96	5.47	1.24	0.57
745.16	1156.35	4.35	5.76	1.36	0.57
869.36	1156.71	4.71	6.02	1.47	0.58
899.14	1156.79	4.79	6.07	1.50	0.58
1117.75	1157.35	5.35	6.45	1.67	0.59
1241.94	1157.64	5.64	6.63	1.76	0.59

### **Tailwater Channel Data - H-60**

Tailwater Channel Option: Trapezoidal Channel

Bottom Width: 18.00 ft

Side Slope (H:V): 2.69 (1:1)

Channel Slope: 0.0050

Channel Manning's n: 0.0380

Channel Invert Elevation: 1152.00 ft

### **Roadway Data for Crossing: H-60**

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Roadway Surface: Gravel

Roadway Top Width: 52.00 ft