MILONE & MACBROOM

MEMORANDUM

TO:	Mr. Carter Terenzini, Town Administrator
FROM:	Milone & MacBroom, Inc.
RE:	Stoney Bridge Road Culvert Replacement Alternatives Analysis Alternative 4 – Single-Lane Bridge Alternative
DATE:	June 24, 2019
MMI #:	6679-01-07

Pursuant to your request and as a result of the comment heard at the June 5, 2019, select board meeting for the consideration of a single lane roadway crossing, Milone & MacBroom, Inc. (MMI) has prepared an assessment of this alternative that considers a one-lane road crossing.

Alternative 4 is similar to Alternative 1 in that it includes a three-sided open-bottom box culvert with a 20-foot span and a height of 6 feet. The length of the culvert in this alternative is 18 feet, which supports a single lane of alternating one-way vehicle traffic. This alternative also provides the same flood conveyance capacity improvements as Alternative 1 and provides significant aquatic organism passage (AOP) enhancements over existing conditions as well.

TABLE 1
Flood Capacity Summary – Single-Lane Bridge

Event (Year)	Flow (cfs)	HW/D
2	166	0.45
10	377	0.64
25	518	0.79
100	766	1.02

cfs = cubic square feet per second

As with Alternative 1, this alternative will require substantial reconstruction of the roadway approaches including the four wingwalls that support the roadway and highway guardrail improvements to minimize encroachment into the adjacent watercourse area. This alternative also does not include the same pedestrian or recreational access improvements provided in Alternatives 2 and 3 of the Alternatives Analysis report. Although not as significant as Alternative 1, this alternative still involves some alteration of the adjacent wetland resource areas to facilitate the construction of the culvert and wingwalls as shown on the concept plan included herein.

This alternative has an estimated construction cost of $730,000. Although the average daily traffic (ADT) volume is within the threshold to warrant stop control with stop signs at each approach, an unobstructed sightline along the roadway is not possible between the stop bars due to the horizontal curve along the causeway and obstructions within the line of sight. Thus, a traffic signal is proposed to stop traffic on each approach and control alternating one-way traffic through the crossing. The cost of the signal and appurtenances is estimated at $100,000, and the town will also have to incur ongoing maintenance and electricity usage charges for the signal.

As with Alternative 1, this alternative involves substantial engineering design for the preparation of construction documents associated with the reconstruction of the roadway approaches and wingwalls on each side of the culvert crossing along the causeway. The alternative will require Commonwealth of

Massachusetts Chapter 85 bridge review since the span exceeds 10 feet. If this alternative is pursued by the town, we highly recommend early consultation with MassDOT District 2 office for its concurrence with alternating one-way crossing as this approach is somewhat unconventional with respect to current design standards.

Massachusetts Wetland Protection Act (WPA) wetland permits include the filing of a Notice of Intent (NOI) for construction activities within the wetland resource areas. A Water Quality Certification (WQC) filing will be required for work within the Outstanding Resource Water (ORW) that is associated with the Department of Conservation and Recreation (DCR) Water Supply protection area. We suspect that a U.S. Army Corps of Engineers (USACE) Pre-Construction Notification (PCN) is required for the alteration of inland bank, which is anticipated to exceed 100 feet, pursuant to the General Permit for Massachusetts for activities subject to USACE's jurisdiction in waters of the United States. Duration of permitting and design is similar to Alternative 1 where permitting and design through the bid process is expected to take 9 to 12 months, and construction is estimated at 12 to 15 months.

The permanent alternating one-way traffic pattern is unique with respect to current roadway design standards, so funding opportunities for this alternative by federal agencies such as the Federal Highway Administration (FHWA) or the Surface Transportation Program (STP) are most likely limited. Other grant opportunities such as the Massachusetts Municipal Vulnerability Preparedness (MVP) Program or the Community Preservation Act (CPA) may warrant consideration for this alternative.

In summary, this alternative is not highly recommended recognizing it is only $80,000 less than the two-way vehicle traffic alternative putting it as the second most costly alternative of all the alternatives presented in the study. The narrower roadway does not provide any significant reduction in wetland alteration either. The town would have to incur ongoing maintenance and utility usage charges for the signal, and the unconventional one-way traffic pattern presents challenges with respect to grant funding opportunities and buy-in by MassDOT.

Enclosure

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TABLE 2
Alternatives Matrix

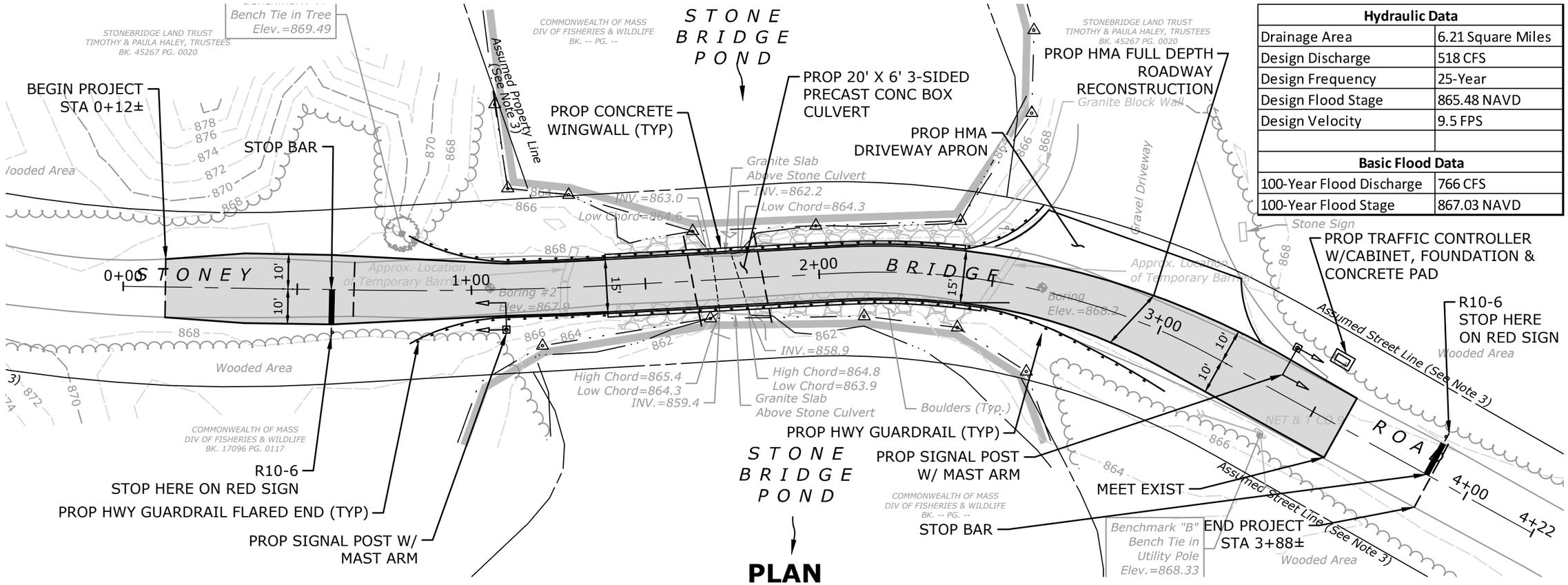
Alternative	Description	Reduce Outlet Drop	Lower Velocity in Culvert	Increase Low Flow Depth	Retain Sediment in Structure	Improve Conveyance of Water & Sediment	Improve Flood Resiliency	Sustainability	Comparative Installation Cost	Brook Trout		Brown Trout		Permits[1]	Remarks
										Fish Passage Barrier(s)	% Fish Passability (AB, JB)	Fish Passage Barrier(s)	% Fish Passability (AB, JB)		
Existing Structure	5.5′ ± wide, 2.1′ high, 18′ long, open bottom structure, stone masonry abutments, granite slab top	-	-	-	-	-	-	O	Low	Velocity	23.9, 7.4	Velocity	43.9, 16.7	N/A	Sediment deposition at inlet, scour hole at outlet, roadway overtopping for 2-yr storm
Alt-1 Full Vehicle Crossing	20′ span concrete arch x 6′ high, wingwalls, 26′ wide	+	+	+	+	+	+	O	High	Velocity	80.5, 26.1	Velocity	100, 56.6	NOI, ENF, WQC, PCN	Structure supports full two-way vehicle roadway traffic
Alt-2 Pedestrian Crossing	16′ span concrete arch x 6′ high, headwalls, 12′ wide	+	+	+	+	+	+	+	Moderate	Velocity	64.4, 20.8	Velocity	100, 45.3	NOI, WQC, SV	Pedestrian crossing with capability for emergency vehicle crossing only
Alt-2A Pedestrian Crossing	16′ span concrete arch x 6′ high, headwalls, 6′ wide	+	+	+	+	+	+	+	Moderate	Velocity	64.8, 21.0	Velocity	100, 45.6	NOI, WQC, SV	Pedestrian crossing only
Alt-3 Permanently Abandon Structure	Increase channel width to 15′, remove stone abutments, grade 2:1 with riprap revetment	+	+	+	+	+	+	+	Low	N/A	N/A	N/A	N/A	NOI, SV	Alternative abandons existing crossing, with open channel, flood benches and boulder riparian enhancement
Alt-4 Single Lane Bridge	20′ span concrete arch x 6′ high, wingwalls, 18′ wide	+	+	+	+	+	+	+	High	Velocity	81.9, 26.6	Velocity	100, 57.6	NOI, ENF, WQC, PCN	Structure supports single lane vehicle roadway traffic with traffic signals at each end

Key: **+** = good; **o** = none; **-** = poor

Note 1: Permit Abbreviations

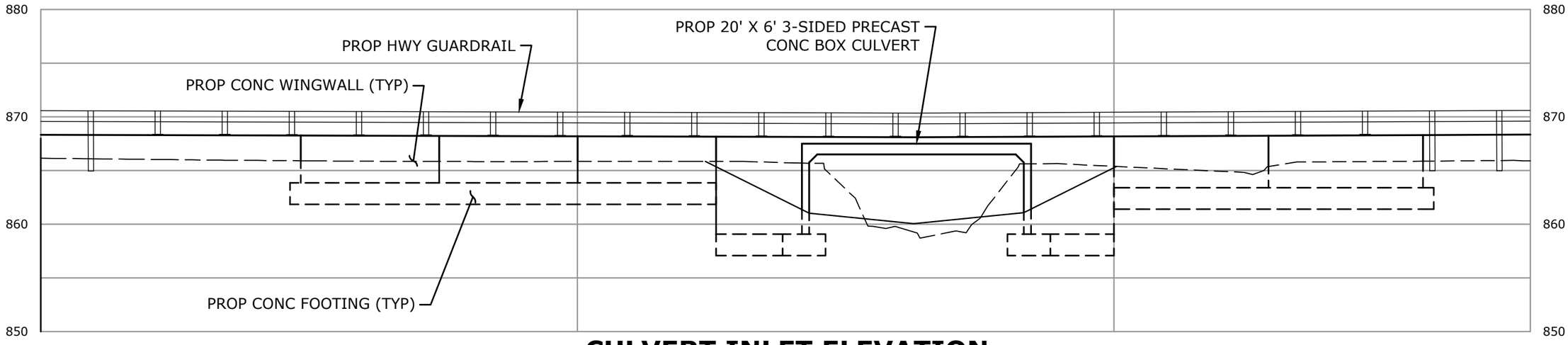
NOI = Massachusetts Wetland Protection Act Notice of Intent
ENF = Massachusetts Environmental Policy Act Environmental Notification Form
WQC = MassDEP 401 Water Quality Certification
SV = United States Army Corps of Engineers Self-Verification Eligible
PCN = United States Army Corps of Engineers Pre-Construction Notification Required

Hydraulic Data	
Drainage Area	6.21 Square Miles
Design Discharge	518 CFS
Design Frequency	25-Year
Design Flood Stage	865.48 NAVD
Design Velocity	9.5 FPS
Basic Flood Data	
100-Year Flood Discharge	766 CFS
100-Year Flood Stage	867.03 NAVD



PLAN

SCALE: 1"=30'



CULVERT INLET ELEVATION

SCALE: 1"=10'

MILONE & MACBROOM
1350 MAIN STREET, SUITE 1012
SPRINGFIELD, MA 01103
413.241.6260
WWW.MMM-CC.COM

REVISIONS

ALTERNATIVE NO. 4 - SINGLE LANE OVER 3-SIDED BOX CULVERT

STONEY BRIDGE ROAD
CULVERT CROSSING

TEMPLETON, MASSACHUSETTS

MRG	HM	MRA
DESIGNED	DRAWN	CHECKED

SCALE: AS NOTED
DATE: JUNE 21, 2019
PROJECT NO.: 6679-01
SHEET NO.: ALT-4

MILONE & MACBROOM

ORDER OF MAGNITUDE[1] CONSTRUCTION COST

Project	6679-01
Made By:	HMM
Date:	06/21/19
Chkd by:	MRG
Date:	06/21/19

Project: **Stoney Bridge Road Culvert Replacement**
Alternative 4 - Single Lane Bridge
Templeton, Massachusetts

Item No.	Qty	Unit	Item Name	Unit Cost	Amount
120.1	145	CY	UNCLASSIFIED EXCAVATION	$30.00	$4,350.00
141.	235	CY	CLASS A TRENCH EXCAVATION	$35.00	$8,225.00
151.	225	CY	GRAVEL BORROW	$45.00	$10,125.00
170.	660	SY	FINE GRADING & COMPACTING	$3.25	$2,145.00
402.	75	CY	DENSE GRADED CRUSHED STONE FOR SUB-BASE	$72.00	$5,400.00
440.	650	LB	CALCIUM CHLORIDE FOR ROADWAY DUST CONTROL	$1.10	$715.00
450.23	65	TON	SUPERPAVE SURFACE COURSE - 12.5 (SSC - 12.5)	$80.00	$5,200.00
450.32	82	TON	SUPERPAVE INTERMEDIATE COURSE - 19.0 (SIC - 19.0)	$110.00	$9,020.00
450.42	150	TON	SUPERPAVE BASE COURSE - 37.5 (SBC - 37.5)	$100.00	$15,000.00
452.	33	GAL	ASPHALT EMULSION FOR TACK COAT	$7.00	$231.00
453.	350	FT	HMA JOINT SEALANT	$0.85	$297.50
620.12	410	FT	GUARDRAIL TL-2 (SINGLE FACED)	$29.00	$11,890.00
627.92	4	EA	GUARDRAIL FLARED END TREATMENT TL-2	$2,800.00	$11,200.00
748.	1	LS	MOBILIZATION	$20,000.00	$20,000.00
751.	17	CY	LOAM BORROW	$45.00	$765.00
815.	1	LS	TRAFFIC CONTROL SIGNAL	$100,000.00	$100,000.00
904.	95	CY	4000 PSI, 3/4 INCH, 610 CEMENT CONCRETE	$1,500.00	$142,500.00
991.3	1	LS	HANDLING WATER	$80,000.00	$80,000.00
995.011	1	LS	CULVERT STRUCTURE (20 FT span x 6 FT high x 18 FT long)	$130,000.00	$130,000.00

Subtotal	$557,063.50
10% Engineering & CDs	$55,706.35
20% Contingency	$111,412.70
Total (Rounded)	**$730,000.00**

Notes

[1] This is an order of magnitude cost estimate, as defined by the American Association of Cost Engineers, that is expected to be within -30 to +50 percent of the actual project cost. Milone & MacBroom, Inc. (MMI) has no control over the cost of labor, materials, equipment or services furnished by others or market conditions. MMI's opinion of probable Total Project Costs and Construction Cost are made on the basis of MMI's experience and qualifications and represent MMI's best judgment as an experienced and qualified professional engineer, familiar with the construction industry. MMI cannot and does not guarantee that proposals, bids or actual Total Project or Construction Costs will not vary from opinions of probable cost prepared by MMI.

AOP Summary (Single Lane Bridge)

		Low Passage Flow		High Passage Flow		
Species	Age	Q (cfs)	Barrier Type	Q (cfs)	Barrier Type	Passability (%)
Brook Trout	Adult	0.9	None	107	Velocity	81.9%
Brook Trout	Juvenile	0.9	None	107	Velocity	26.6%
Brown Trout	Adult	0.9	None	107	None	100.0%
Brown Trout	Juvenile	0.9	None	107	Velocity	57.6%

HY-8 Culvert Analysis Report: Alt 4

Site Data - Conc 3-sided box 20 x 6

Site Data Option: Culvert Invert Data

Inlet Station: 0.00 ft

Inlet Elevation: 858.60 ft

Outlet Station: 18.00 ft

Outlet Elevation: 858.48 ft

Number of Barrels: 1

Culvert Data Summary - Conc 3-sided box 20 x 6

Barrel Shape: Concrete Box

Barrel Span: 20.00 ft

Barrel Rise: 8.00 ft

Barrel Material: Concrete

Embedment: 24.00 in

Barrel Manning's n: 0.0120 (top and sides)

Manning's n: 0.0350 (bottom)

Culvert Type: Straight

Inlet Configuration: Square Edge with Headwall

Inlet Depression: None

Table 1 - Culvert Summary Table: Conc 3-sided box 20 x 6

Discharge Names	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)
2 year	166.00	166.00	863.30	1.857	2.702	3-M1t	1.755	1.296	2.520	2.600	3.294
10 year	377.00	377.00	864.43	3.198	3.835	3-M2t	2.891	2.233	2.520	2.600	7.480
25 year	518.00	518.00	865.33	3.975	4.727	2-M2c	3.498	2.758	2.758	2.600	9.390
100 year	766.00	766.00	866.73	5.196	6.135	7-M2c	4.424	3.565	3.565	2.600	10.742

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Straight Culvert

Inlet Elevation (invert): 860.60 ft, Outlet Elevation (invert): 860.48 ft

Culvert Length: 18.00 ft, Culvert Slope: 0.0067

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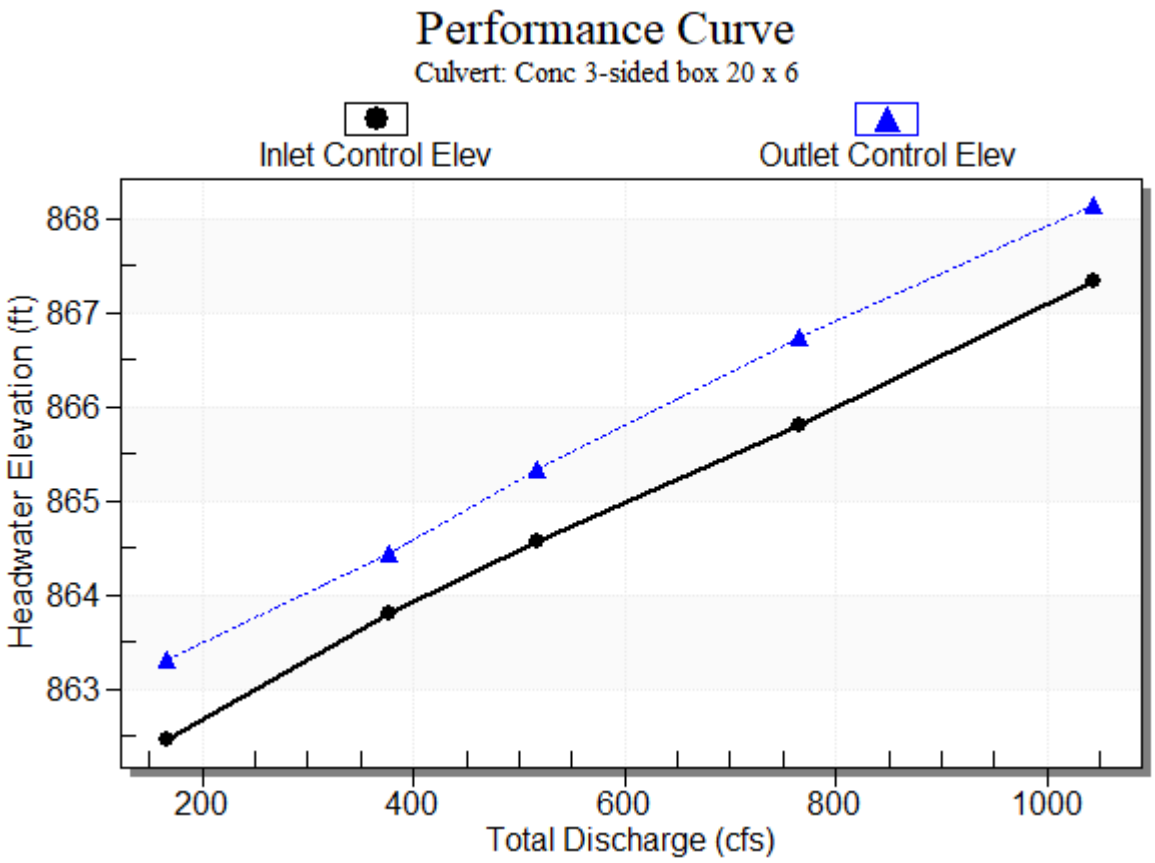
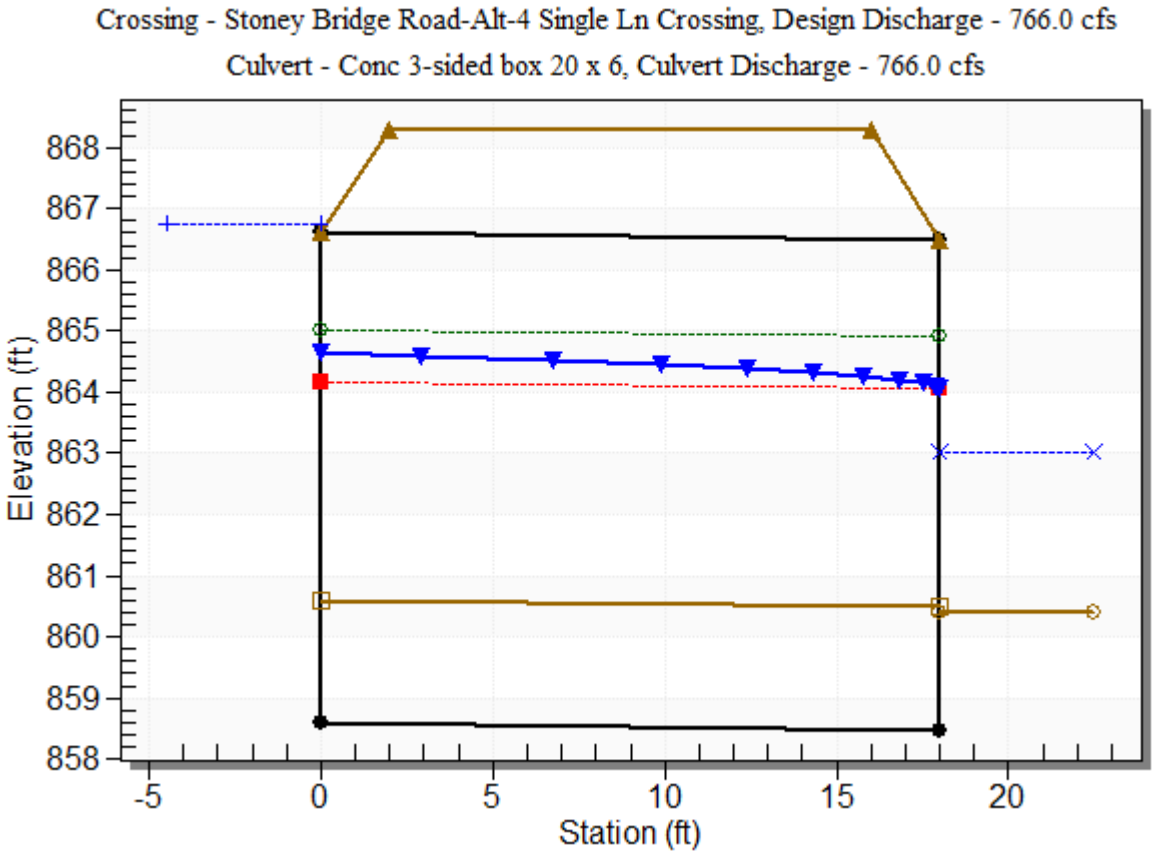
Culvert Performance Curve Plot: Conc 3-sided box 20 x 6



Water Surface Profile Plot for Culvert: Conc 3-sided box 20 x 6



Crossing Notes:

Crossing Discharge Data

Discharge Selection Method: Recurrence

Table 2 - Summary of Culvert Flows at Crossing: Stoney Bridge Road-Alt-4 Single Ln

Headwater Elevation (ft)	Discharge Names	Total Discharge (cfs)	Conc 3-sided box 20 x 6 Discharge (cfs)	Roadway Discharge (cfs)	Iterations
863.30	2 year	166.00	166.00	0.00	1
864.43	10 year	377.00	377.00	0.00	1
865.33	25 year	518.00	518.00	0.00	1
866.73	100 year	766.00	766.00	0.00	1
868.15	Overtopping	1044.67	1044.67	0.00	Overtopping

Rating Curve Plot for Crossing: Stoney Bridge Road-Alt-4 Single Ln Crossing