



# Maine Department of Transportation

## Scour Critical Bridge Plan of Action (POA) Report

- Full POA
- Abbreviated POA

Town: Augusta

Bridge Number: 3077

Bridge Name: Bond Brook No 1

Feature Carried: Routes 8,11, & 27

Waterway Crossed: Bond Brook

### Final Recommended Action:

Increased Inspection Frequency:  Yes  No \_\_\_\_\_

#### Flood Monitoring:

Flood Warning Issued by National Weather Service

USGS Gage Station Station#: \_\_\_\_\_

Frequency of Flood Monitoring: 12 hrs \_\_\_\_\_

#### Closure Trigger:

Water Surface Elevation Reaches Low Chord

Water Reaches Closure Elevation:

9.5 ft NAVD88 (10-yr), Placard \_\_\_\_\_

**SEE SECTION 8 FOR OTHER CLOSURE CONSIDERATIONS**

#### Interim Reopening Trigger:

**SEE FIELD VERIFICATION CARD**

**SEE SECTION 9 FOR OTHER REOPENING CONSIDERATIONS**

Hydraulic/Structural Countermeasures:  Yes  No



The Following Materials Are Being Submitted With This Report:

- POA Report
- Attachment A: Hydraulic and Hydrologic Summary Page
- Attachment B: Photos
- Attachment C: Map Showing Detour Route(s)
- Attachment D: Bridge Elevation Summary Showing Existing Streambed and Foundation Depth(s)
- Attachment E: Boring Logs and/or Other Subsurface Information
- Attachment F: Supporting Documentation, Calculations, Estimates, and Conceptual Designs for Scour Countermeasures
- Attachment G: Plan View Showing Location of Scour Holes, Debris, etc,
- Attachment H: Post Flood Inspection Documentation
- Attachment I: Field Verification Card
- Attachment J: MaineDOT Underwater Inspection Reports
- Attachment K: T.Y. LIN 1995 Bridge Scour Evaluation Report
- Attachment L: 2008 USGS Report
- Attachment M: Scour / H&H Backup Calculations



# SCOUR CRITICAL BRIDGE - PLAN OF ACTION

## Augusta 3077

### 1. GENERAL INFORMATION

<b>Structure:</b> Bond Brook No 1	<b>City, County:</b> Augusta, Kennebec	<b>Bridge Number:</b> 3077
<b>Feature On:</b> Routes 8,11, & 27	<b>Waterway Crossed:</b> Bond Brook	<b>Owner:</b> State Highway Agency
<b>Year Built:</b> 1934	<b>Year Reconstruction:</b> NA	

**Structure Size and Description:**

Two-lane single-span bridge built 1934 (plans available) incorporating previous stone abutments with new concrete abutments. This is a concrete deck on steel multi-beam superstructure. Downstream stone abutments on unknown footings, the upstream widening (1934) was with concrete extensions on 18-ton piles, unknown pile length. At the time of CHA's 2009 site visit the footings were exposed along both abutments, but conditions appear stable and no undermining was detected. The lowest layer of stone of the downstream masonry section of the Left Abutment was exposed up to 1 foot with about 1.3 feet of remaining embedment, based on the 1933 plans. The 3.5 feet thick concrete pile cap of the upstream section of the Left Abutment was exposed about 0.5 feet (3 feet of remaining pile cap embedment). The lowest stone of the downstream masonry section of the Right Abutment was exposed a maximum of 0.5 feet. Remaining embedment of that older section is unknown but appears to be about 1 foot per the plans. The 4 feet thick concrete pile cap of the upstream section of the Right Abutment was exposed about 0.5 feet (3.5 feet of remaining pile cap embedment). There is 1 foot stone along both footings.

<b>Foundation Details:</b> (Looking Downstream L to R)  KNOWN <input type="checkbox"/> UNKNOWN <input checked="" type="checkbox"/>	<b>Left Abutment</b> (Looking Downstream)	<b>Embedment (ft):</b> 1.3	<b>Exposure (ft):</b> 1.0
	<b>Right Abutment</b> (Looking Downstream)	<b>Embedment (ft):</b> 1.0	<b>Exposure (ft):</b> 0.5
	<b>Pier 1</b>	<b>Embedment (ft):</b> N/A	<b>Exposure (ft):</b> N/A
	<b>Pier 2</b>	<b>Embedment (ft):</b> N/A	<b>Exposure (ft):</b> N/A
	<b>Pier 3</b>	<b>Embedment (ft):</b> N/A	<b>Exposure (ft):</b> N/A
	<b>Pier 4</b>	<b>Embedment (ft):</b> N/A	<b>Exposure (ft):</b> N/A

**Reference Datum:** NAVD 1988

<b>Scour Critical Footing Elevation(s) (ft):</b>	<b>Left Abutment</b> 4.5 (Looking Downstream)	<b>Pier 1:</b> N/A
	<b>Right Abutment</b> 2.6 (Looking Downstream)	<b>Pier 2:</b> N/A
		<b>Pier 3:</b> N/A
		<b>Pier 4:</b> N/A

### 2. RESPONSIBLE FOR POA

**Author(s) of POA (name, title, agency/organization, telephone, email):**

Robert Faulkner P.E., CHA Principal Eng. VI, (603) 357-2445, chakeene@chacompanies.com

**Signature:** **Date:** 8/30/2011

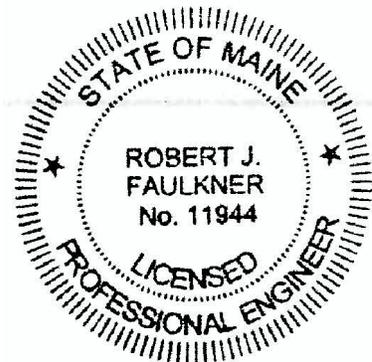
**Concurrences on POA (name, title, agency/organization, telephone, email):**

Assistant Bridge Maintenance Engineer, Maine DOT Bridge Maintenance Division - (207) 624-3580 **Date:**

**POA Updated by:** Assistant Bridge Maintenance Engineer, Maine DOT Bridge Maintenance Division - (207) 624-3580

**Date of Update:** \_\_\_\_\_ **Items Updated:** \_\_\_\_\_

**Reason for Update:**  Inspection Cycle  Monitoring Event  Post Flood Inspection



**POA Updated Every** \_\_\_\_\_ **months by (name, title, agency, organization):** Assistant Bridge Maintenance Engineer, Maine DOT Bridge Maintenance Division - (207) 624-3580  
**Next Update:** \_\_\_\_\_ **months**

### 3. SCOUR VULNERABILITY

Current Item 113 Code:  3  2  1 **Other:**

Source of Scour Critical Code:  Observation  Assessment  Calculation **Other:**

**Scour Evaluation Summary:** Single-span stone masonry bridge that was widened in 1934. Primary bed material was field estimated as sand and secondary bed material was estimated as gravel. There is no bed armoring potential. The original downstream abutments are stone masonry with unknown foundations, and the new upstream abutments are concrete and founded on piles with capacities of 18 tons, but unknown length. The abutments are located in the channel. Field observations show that the abutment footings are exposed a maximum of about 1 foot with minimum remaining embedment estimated to be at least 1 foot. The footings are not undermined. The stream banks are slumping and bank vegetation is tipping, therefore Bond Brook is somewhat laterally unstable. Potential migration or erosion at the bend may increase erosion on the left abutment.

**Scour History:** Bridge 3077 was originally built 1934 incorporating previous stone abutments - no additional work. According to the Maine State Planning Office Report, flooding has occurred in the Lower Kennebec (Kennebec) Watershed in March 1936, March 1953, December 1969, April 1987, December 2003 and March 2005. The City of Augusta FIS provides estimated recurrence intervals for the 1936 and 1987 Kennebec River floods as 50-100 year and >100 year, respectively.

### 4. NBI CODING INFORMATION

Date		<u>Current</u> 4/21/2010	<u>Previous</u> 1/26/2007
Item 113	Scour Critical	3	3
Item 60	Substructure	6	6
Item 61	Channel & Channel Protection	5	6
Item 71	Waterway Adequacy	6	8

### 5. RECOMMENDED ACTION(S)

	<u>Recommended</u>		<u>Implemented</u>		<u>Date</u>
a. Increased Inspection Frequency:	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
b. Fixed Monitoring Device(s):	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
c. Flood Monitoring Program:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
d. Hydraulic/Structural Countermeasures:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> No	

### 6. MONITORING PROGRAM RECOMMENDATION

**6a. Regular Inspection Cycle**

Biennial  
 Annual  
 Riverbed Profile Readings - Upstream Face  
 Riverbed Profile Readings - Downstream Face  
 Surveyed Cross-Section

**Underwater Inspection Required**

4 Year Cycle  
 2 Year Cycle  
 1 Year Cycle

**Items to Watch:** Changes to embedment at abutments. Remaining embedment at Left and Right abutments (old stone) observed as 1.3 ft and 1.0 ft in April 2009. Movement of stone protection along abutments. Perform a drop-line survey to establish the riverbed profile at the upstream and downstream fascia and along each substructure. Provide photo documentation of countermeasures at abutments.

**Items to Watch:** Recommend adding this bridge to underwater inspection program. Verify original masonry footing configuration.

**6b. Fixed Monitoring Device(s)**       **Not Applicable**

Type of Instrument:

Installation Location(s):

Routine Sample Interval       30 minute    1 hr    6 hrs    12 hrs    Other

Frequency of Data Download and Review:    Daily    Weekly    Monthly    Other:

Action(s) Required if Scour Critical Elevation Detected:   *(See Section 7 and Section 8)*

Criteria of Termination For Fixed Monitoring:

Event Sample Interval:       Continual    10 min    30 min    1 hour    Other

Frequency of Data Download and Review:    Daily    Weekly    Monthly    Other:

Action(s) Required if Scour Critical Elevation Detected:   *(See Section 7 and Section 8)*

Criteria of Termination For Event Monitoring

**6c. Flood Monitoring Program**

Type:       Visual Inspection

Instrument      *(check all that apply)*

Portable    Geophysical    Sonar    Other

**During Inspection Event, Look For:**

Water surface at or above placard elevation. Monitoring elevation is based on a flood event on Bond Brook, and is independent of backwater from the Kennebec River. Flows will be fast if no backwater.

Flood Monitoring event defined by:

*(check all that apply)*

Notified By Public

Flood Warning Issued by NWS

DOT Situation Report

USGS Gage Station      Station#:

Stage (Water Surf. Elev.)

Discharge

NOAA Gage Station #

Stage (WSE)

Frequency of Flood Monitoring:    Continual    3 hrs    12 hrs    Daily

Criteria to End Flood Monitoring    Revisit Bridge       Recommended Post Flood Inspection

Close Bridge (See Section 8)    Conditions Stable / Water Receding

Action(s) Required if Scour Critical Elevation Detected:   *(See Section 7 and Section 8)*

Assess changes in channel/riverbed profiles, debris, possible undermining evidence, and overall stability. Consider closing bridge.

**6d. Post-Flood Inspection Tasks Required**

- Visual Inspection
- Riverbed Profile Readings - Upstream and Downstream face
- Profile at Substructure
- Undermining
- Underwater Inspection
- Probing

**Items to Watch:** Changes to embedment at abutments. Remaining embedment at Left and Right abutments (old stone) observed as 1.3 ft and 1.0 ft in April 2009. Movement of stone protection. Perform a drop-line survey to establish the riverbed profile at the upstream and downstream fascia and along each substructure. Provide photo documentation of countermeasures at abutments.

Date of Event: \_\_\_\_\_ Date of Post Flood Inspection: \_\_\_\_\_

**Agency and Department Responsible for Monitoring:**

Maine DOT

**Contact Person (name, title, agency/organization, telephone, e-mail):**

- Bridge Maintenance Engineer, Maine DOT Bridge Maintenance Division - (207) 624-3580
- Assistant Bridge Maintenance Engineer, Maine DOT Bridge Maintenance Division - (207) 624-3580

## 7. DETOUR ROUTE

**Detour Route Description:**

Bond St, Civic Center Dr, Townsend Rd (must remove left turn prohibition from Bond St). This detour crosses Augusta 0563 which is also a scour critical bridge, consider bridge closure or longer detour. The detour route may be shortened by using Mill St.

**Bridges on Detour Route:** To be provided by Maine DOT

Bridge Number	Feature On	Feature Under	Item 113	Load Posting (tons) / Date	Vertical Clearance (feet)	Width Restrictions (feet)

**Traffic Control Equipment and Storage location(s):**

**Additional Considerations or Critical Issues:**

**News Release, Other Public Notice Information to be provided and limitations:**

Public Information Officer, Office of Communications - (207) 624-3030

## 8. BRIDGE CLOSURE PLAN

**Criteria For Consideration of Bridge Closure:**

*Check all that apply*

- |  |   |
|--|---|
| <input checked="" type="checkbox"/> Water Surface Elevation Reaches Low Chord  | <input checked="" type="checkbox"/> Overtopping Road or Structure                                 |
| <input checked="" type="checkbox"/> Water Reaches Critical Elevation:<br>9.5 ft NAVD88 (10-yr), Placard _____  | <input checked="" type="checkbox"/> Scour Measurement Results / Monitoring Device (See Section 6) |
| <input type="checkbox"/> USGS Gage Station # _____   | <input type="checkbox"/> Stage (WSE)  |
|  | <input type="checkbox"/> Discharge  |
| <input type="checkbox"/> NOAA Gage Station # _____   | <input type="checkbox"/> Stage (WSE)  |
| <input checked="" type="checkbox"/> Other: <input checked="" type="checkbox"/> Loss of Road Embankment <input checked="" type="checkbox"/> Ice Jam <input checked="" type="checkbox"/> Debris Accumulation <input checked="" type="checkbox"/> Movement of RipRap / Other Armor Protection |   |

**Agency and Department Responsible for Closure:**

- DOT     Municipality:     Other

**Contact Person(s) (name, title, telephone, email):**

Maine DOT Radio Operations, (207) 624-3339

## 9. BRIDGE REOPENING PLAN

**9a. Criteria for Consideration to Complete Interim Bridge Reopening:**

- |  |  |
|--|--|
| <input checked="" type="checkbox"/> Water Surface Levels Dropping        | <input checked="" type="checkbox"/> No Approach Settlement                                 |
| <input checked="" type="checkbox"/> Critical Elevation Marker Is Visible | <input checked="" type="checkbox"/> No Embankment Erosion Endangering Abutment             |
| <input checked="" type="checkbox"/> Reasons for Closure Have Abated      | <input checked="" type="checkbox"/> Abutments and Piers are Plumb and Stable               |
| <input checked="" type="checkbox"/> Straight and Consistant Bridgerails  | <input checked="" type="checkbox"/> Assess Riverbed Elevation at Piers (drop line reading) |

**Agency and Person Responsible for Interim Re-Opening Bridge After Inspection:**

**9b. Criteria for Completing Bridge Reopening Process:**

- |  |  |
|--|--|
| <input checked="" type="checkbox"/> Post Flood Inspection Completed                    | <input checked="" type="checkbox"/> Verify Riverbed Elevation (drop line readings) |
| <input checked="" type="checkbox"/> Diving Inspection Completed within 7 calendar days | <input checked="" type="checkbox"/> Streambed Elevation Drops Less than 0.1 Feet   |

**Agency and Person Responsible for Re-Opening Bridge After Inspection:**

- Region Bridge Manager
- Bridge Maintenance Engineer, Maine DOT Bridge Maintenance Division - (207) 624-3580
- Assistant Bridge Maintenance Engineer, Maine DOT Bridge Maintenance Division - (207) 624-3580

## 10. COUNTERMEASURE RECOMMENDATIONS

**Conceptual Structural / Hydraulic Countermeasures:**

	<u>Priority</u>	<u>Estimated Cost</u>
(1) <u>Articulated Concrete Block System at abutments</u>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	\$ <u>250,000</u>
(2)	<input type="checkbox"/> Yes <input type="checkbox"/> No	\$
(3)	<input type="checkbox"/> Yes <input type="checkbox"/> No	\$

**Basis for the Selection of the Preferred Scour Countermeasure:** Minimal embedment at abutments.

**Recommended Countermeasures to be Performed by:**

- Maintenance  
 Bridge Program  
 Highway Program  
 Other

**Recommended Completion Date:** \_\_\_\_\_

**Contact Person:** (include name, title, telephone, e-mail)

- Bridge Maintenance Engineer, Maine DOT Bridge Maintenance Division - (207) 624-3580
- Assistant Bridge Maintenance Engineer, Maine DOT Bridge Maintenance Division - (207) 624-3580



# MaineDOT Scour Investigation East PIN:15631.10

## Hydraulic and Hydrologic Summary Page (POA Attachment A)

Bridge ID: Augusta 3077

Name: Bond Brook No 1

Date: 4/7/2009

### GENERAL INFORMATION

<b>Town:</b> Augusta	<b>Owner:</b> State Highway Agency	
<b>Feature Carried:</b> Routes 8,11, & 27	<b>Feature Crossed:</b> Bond Brook	
<b>Functional Class:</b> 16 - Urban Minor Arterial	<b>Major Basin (HU8):</b> Lower Kennebec	
<b>Detour Length:</b> 0 (miles)	<b>Bridge Plan File Loc:</b> NO DATA	
<b>Year Built:</b> 1934	<b>Capacity (Actual Metric Tons, Signed) :</b> 49 ,	
<b>Year of Reconstruction:</b> NA	<b>ADT:</b> 16517	<b>Year of ADT:</b> 2007
<b>Overall Fed Sufficiency Rating:</b>		95.7

<b>Current:</b> (scale of 1-9) (worst - best)	<b>Substructure</b>	<b>Channel Stability</b>	<b>Hydraulic Adequacy</b>	<b>Scour Risk</b>
	<b>Item 60:</b> 6	<b>Item 61:</b> 5	<b>Item 71:</b> 6	<b>Item 113:</b> 3

### HYDRAULIC INFORMATION

<b>FEMA Study:</b>	<input checked="" type="checkbox"/>	6/15/1994
<b>USGS Report:</b>	<input type="checkbox"/>	
<b>Tidal Influence:</b>	<input type="checkbox"/>	
<b>Watershed Area (sq. mi):</b>		21.3
<b>100-Yr Overtopping Relief:</b>		On Bridge

<b>T.Y. Lin Information</b>	(Bridge Scour Report) : <input checked="" type="checkbox"/>
	Nov 1995
<b>100-Yr Water Velocity (feet per sec):</b>	8.5
<b>Angle Of Attack (Flood Flow) :</b>	15

#### Other Hydrologic & Hydraulic Data:

City of Augusta FEMA FIS (6/94) provides flows and backwater elevations (from Kennebec River). Hydraulic model created by CHA in HEC-RAS using downloaded DTM (Intermap Technologies) and field measurements. CHA model provides water surface and velocity data. Monitoring elevation is based on a flood event on Bond Brook, and is independent of backwater from the Kennebec River. Maine DOT also provides flow data at bridge (DA=19.9 sq-mi, Q10=1382cfs, Q50=2093cfs, Q100=2428cfs, Q500=3265cfs). FEMA back-up data available.

Table:	Flow (cfs)	Elevation (ft)	Flow Impacting Bridge	Flow Overtopping Bridge
Low Chord		29.3		
Roadway		33.2		
10 year	1390			
50 year	2310			
100 year	2800	34.8	Yes	Yes
500 year	4210	43.8	Yes	Yes

### BRIDGE INFORMATION

<b>Bridge Width (in feet):</b>	41.00
<b>Plans Available:</b>	<input checked="" type="checkbox"/>
<b>Worst Abutment (Looking Downstream L to R) :</b>	Right
<b>Abutment Foundation:</b>	Unknown

<b>Bridge Length (in feet):</b>	38.00
<b>Number of Spans:</b>	1
<b>Borings Available:</b>	<input type="checkbox"/>
<b>Worst Pier (Looking Downstream L to R) :</b>	
<b>Pier Foundation:</b>	N/A

#### Flood / Scour History Comments:

Bridge 3077 was originally built 1934 incorporating previous stone abutments - no additional work. According to the Maine State Planning Office Report, flooding has occurred in the Lower Kennebec (Kennebec) Watershed in March 1936, March 1953, December 1969, April 1987, December 2003 and March 2005. The City of Augusta FIS provides estimated recurrence intervals for the 1936 and 1987 Kennebec River floods as 50-100 year and >100 year, respectively.

### RECOMMENDATIONS

<b>Field Investigation Rec:</b> <input checked="" type="checkbox"/>	<b>Agree w/ Item 113 Rating:</b> <input checked="" type="checkbox"/>	<b>Scour POA Recommended:</b> <input checked="" type="checkbox"/>
<b>Comp:</b> <input checked="" type="checkbox"/>	<b>CHA Rec Item 113 Rating:</b> 3	<b>CHA Recommended POA Choice:</b> Monitoring

**Bridge:** Augusta 3077  
**Date Taken:** 4/20/2009 1:03:24 PM  
**Source:** CHA  
**Description:** Downstream Elevation



**Bridge:** Augusta 3077  
**Date Taken:** 4/20/2009 1:14:26 PM  
**Source:** CHA  
**Description:** View Looking Upstream.

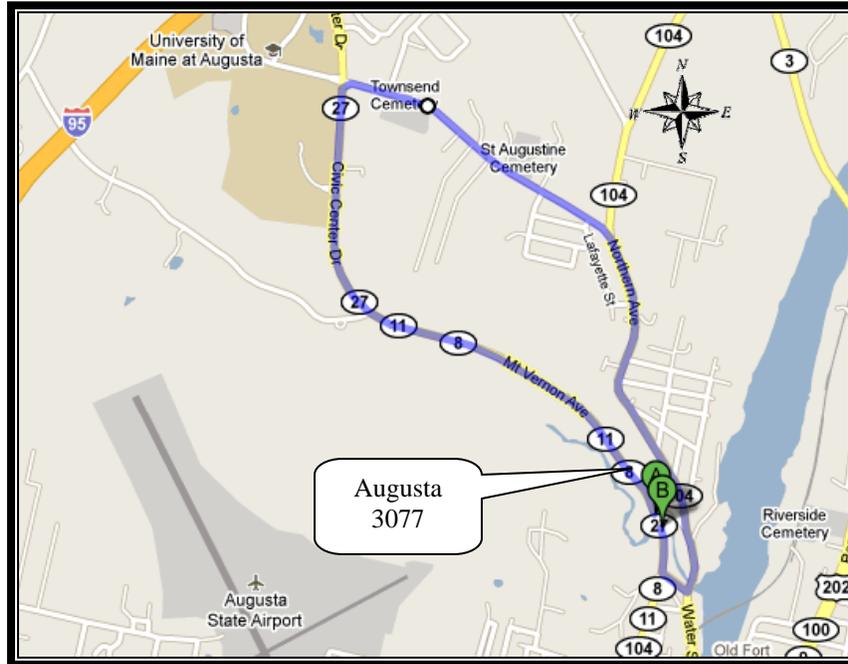


**Bridge:** Augusta 3077  
**Date Taken:** 4/20/2009 1:02:56 PM  
**Source:** CHA  
**Description:** View Looking Downstream



**Bridge:** Augusta 3077  
**Date Taken:** 4/20/2009 6:54:55 PM  
**Source:** CHA  
**Description:** Left Abutment.





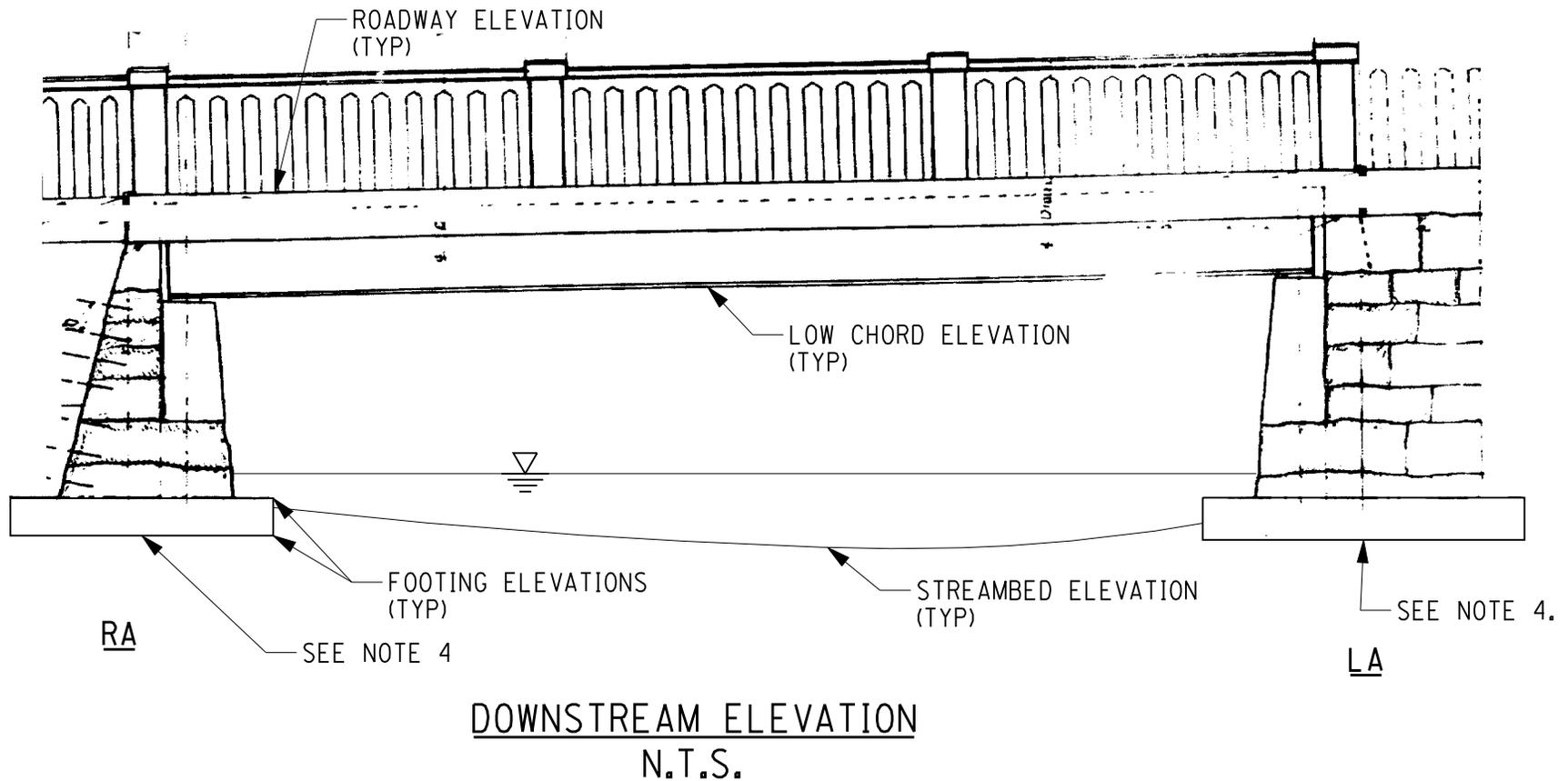
DETOUR MAP

GOING NORTHWEST ON CIVIC CENTER DR/MT VERNON AVE.

	Civic Center Dr/Mt Vernon Ave/New Belgrade Rd	
	1. Head <b>northwest</b> on <b>Civic Center Dr/Mt Vernon Ave/New Belgrade Rd</b> toward <b>Mill St</b>	go 1.6 mi
	Continue to follow Civic Center Dr/New Belgrade Rd	total 1.6 mi
	About 2 mins	
	2. Turn <b>right</b> at <b>Townsend Rd</b>	go 0.9 mi
	About 2 mins	total 2.5 mi
	3. Continue onto <b>Northern Ave</b>	go 1.0 mi
	About 3 mins	total 3.5 mi
	4. Turn <b>right</b> at <b>Bond St</b>	go 459 ft
		total 3.6 mi
	5. Turn <b>right</b> at <b>Civic Center Dr/Mt Vernon Ave/New Belgrade Rd</b>	go 0.1 mi
		total 3.7 mi
	Civic Center Dr/Mt Vernon Ave/New Belgrade Rd	

IF GOING SOUTHEAST ON CIVIC CENTER DR/MT VERNON AVE, REVERSE DIRECTIONS.

		<p><b>Augusta 3077</b></p> <p><b>Attachment C: Detour Route</b></p>
	<p>11 King Court Keene, NH 03431-4648 Main: (603)-357-2445</p>	<p><b>Maine Scour Investigation</b></p>



SUBSTR. UNIT	ROADWAY ELEVATION (FT)	LOW CHORD ELEVATION (FT)	FOOTING ELEVATION (FT)		STREAMBED ELEVATION (FT)			
			TOP	BOTTOM	ORIGINAL DESIGN PLANS (1933)	TY LIN (1995)	FIELD (2009)	CHA 100-YEAR SCOUR ELEVATION
LEFT ABUT.	33.5±	29.9±	5.5±	3.2±	7.0	3.1±	4.5± (DS)	N/A
RIGHT ABUT.	33.2±	29.3±	3.1±	1.7±	7.0	5.1±	2.6± (US)	N/A

- 1) UNLESS OTHERWISE SPECIFIED, ALL ELEVATIONS ARE REFERENCED TO NGVD 1988.
- 2) THE SUBSTRUCTURE LABELING CONVENTION ESTABLISHED BY CHA DEFINES LEFT AND RIGHT LOOKING DOWNSTREAM.
- 3) STREAMBED ELEVATIONS GIVEN ARE APPROXIMATE AT EACH SUBSTRUCTURE UNIT AND ALONG THE FASCIA INDICATED. FOR DETAILED SUBSTRUCTURE RIVERBED PROFILE MEASUREMENTS, SEE ATTACHMENT H. ATTACHMENT G PROVIDES THE LOCATION OF SCOUR RELATED FEATURES AND OTHER MINOR STREAMBED VARIATIONS.
- 4) ORIGINAL ABUTMENTS ARE STONE MASONRY WITH UNKNOWN FOUNDATIONS. NEW ABUTMENT SECTIONS ARE CONCRETE AND ARE FOUNDED ON PILES OF UNKNOWN LENGTH. NEW ABUTMENTS ARE LOCATED UPSTREAM OF OLD ABUTMENTS.



11 King Court • Keene, NH 03431-6848  
Main: (603) 357-2445 • www.chacompanies.com

MAINE BRIDGE SCOUR  
INVESTIGATION

AUGUSTA 3077

BRIDGE ELEVATION SUMMARY

ATTACHMENT

**D**

DATE: 4/10

**Attachment F:  
Supporting Documentation, Calculations,  
Estimates, and Conceptual Designs for Scour  
Countermeasures**



11 King Court  
Keene, NH 03431-4648  
Main: (603)-357-2445

**Augusta 3077  
Attachment F: Scour Countermeasures**

**Maine Scour Investigation**

MAINE DOT PROTECTIVE COUNTERMEASURES

4/7/2010

**ESTIMATED COST OF PROPOSED COUNTERMEASURE - Articulated Concrete Block System:**

Bridge No.	3077	SSU's Protected	Both abutments
Town	Augusta	Spans Protected	N/A
Dist. Between Abutment Faces - estimate	30	Approved Countermeasure Type	Articulated Concrete Block System
Bridge Width	40.7	Low Flow Water Depth	5
		Design Flow Water Depth	27

SSU	CM TYPE	Item	Length (ft)	Width (ft)	Depth (ft)	No. Items	Quantity	Unit	Unit Price	Subtotal
		Access for work - using barges				1	1	LS	\$25,000	\$25,000
		Barge rental for work				1	1	LS	\$10,000	\$10,000
Both abutments	Articulated Concrete Block System	Water Diversion System				0	0	LS	\$0	\$0
		Excavation and site prep	91	25	-	2	504	SY	\$25	\$12,597
		Provide and place filter	91	25	-	2	504	SY	\$63	\$31,493
		Provide and place ACB system	91	25	-	2	504	SY	\$213	\$107,076
		Proposed work: - use barge for access - no diversion of water - minor excavation and leveling - place filter - place ACB system underwater	Note - in light of deeper "normal low" flow, PGR is considered unacceptable due to higher costs of dewatering/diversion of water. Width at abutment = 2 x design flow, but limited to 25 ft in this case. Accordingly, use ACB system. Steep banks in the vicinity of the bridge drives need for barge for work access.					<b>Mobilization</b>		\$10,000
								<b>Subtotal</b>		\$196,167
							<b>25%</b>	<b>Contingency</b>		\$49,042
							<b>Total Estimated Cost</b>			\$245,208
							<b>Conceptual Budget</b>			<b>\$250,000</b>

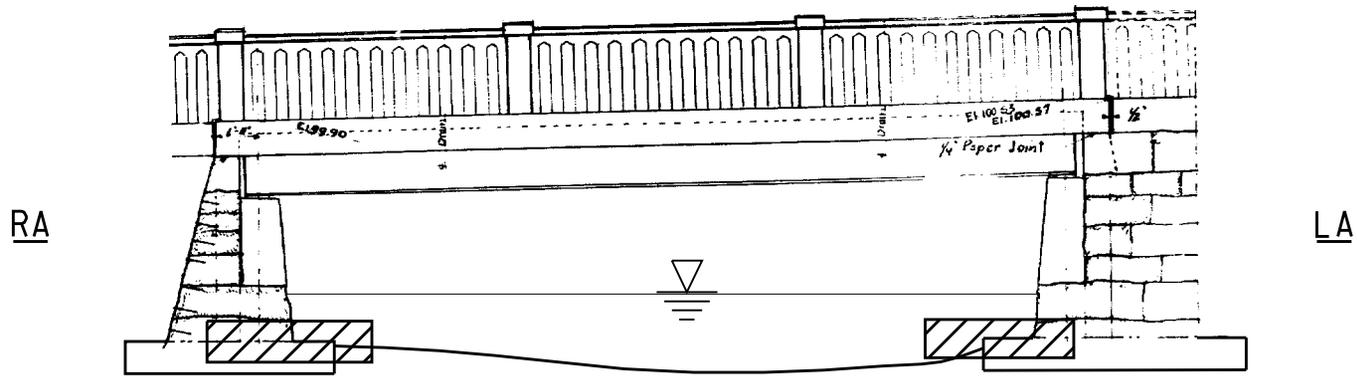
Assumptions:

Environmental impact associated with the proposed work is judged to be: *potentially significant*  
 Given the estimated quantities for this item, the unit price is judged to be *equal to* average unit prices.

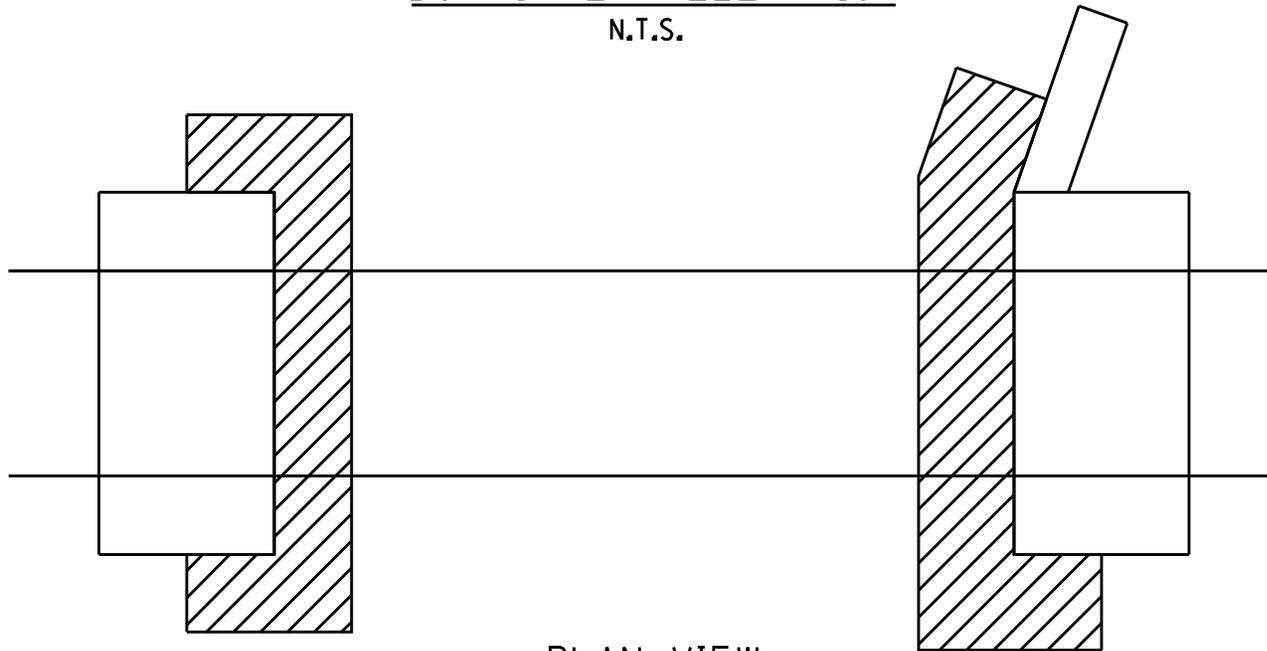
Notes:

The cost of mitigating or eliminating potential environmental impacts is not included in this estimate.  
 The cost of environmental permit preparation is also not included herein.

FILE NAME = K:\0971\GADDAMSTN\B-idge PDA Files - Test Br-idge\Augusta 3077\1971-1971-cpb-cmudgn  
 DATE / USER = 2/20/2010



DOWNSTREAM ELEVATION  
N.T.S.



PLAN VIEW  
N.T.S.

LEGEND



INSTALL ARTICULATED  
CONCRETE BLOCK SYSTEM



11 King Court • Keene, NH 03431-6648  
 Main: (603) 357-2445 • www.chacompanies.com

MAINE BRIDGE SCOUR  
INVESTIGATION

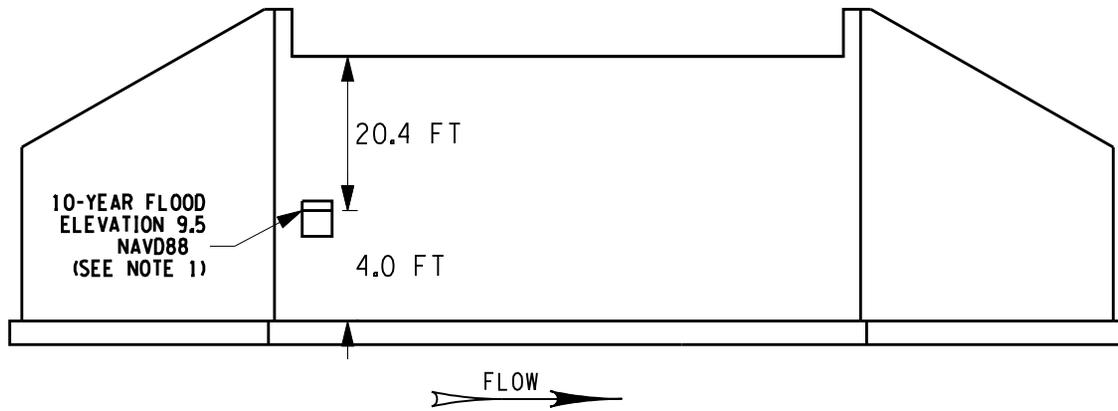
AUGUSTA 3077

CONCEPTUAL COUNTERMEASURE SUMMARY

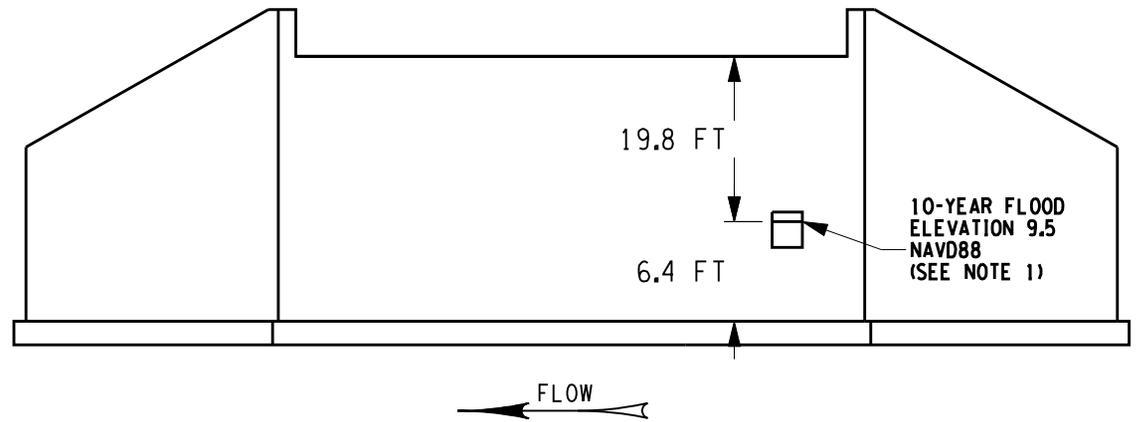
ATTACHMENT

**F**

DATE: 4/10



LEFT ABUTMENT ELEVATION  
N.T.S.



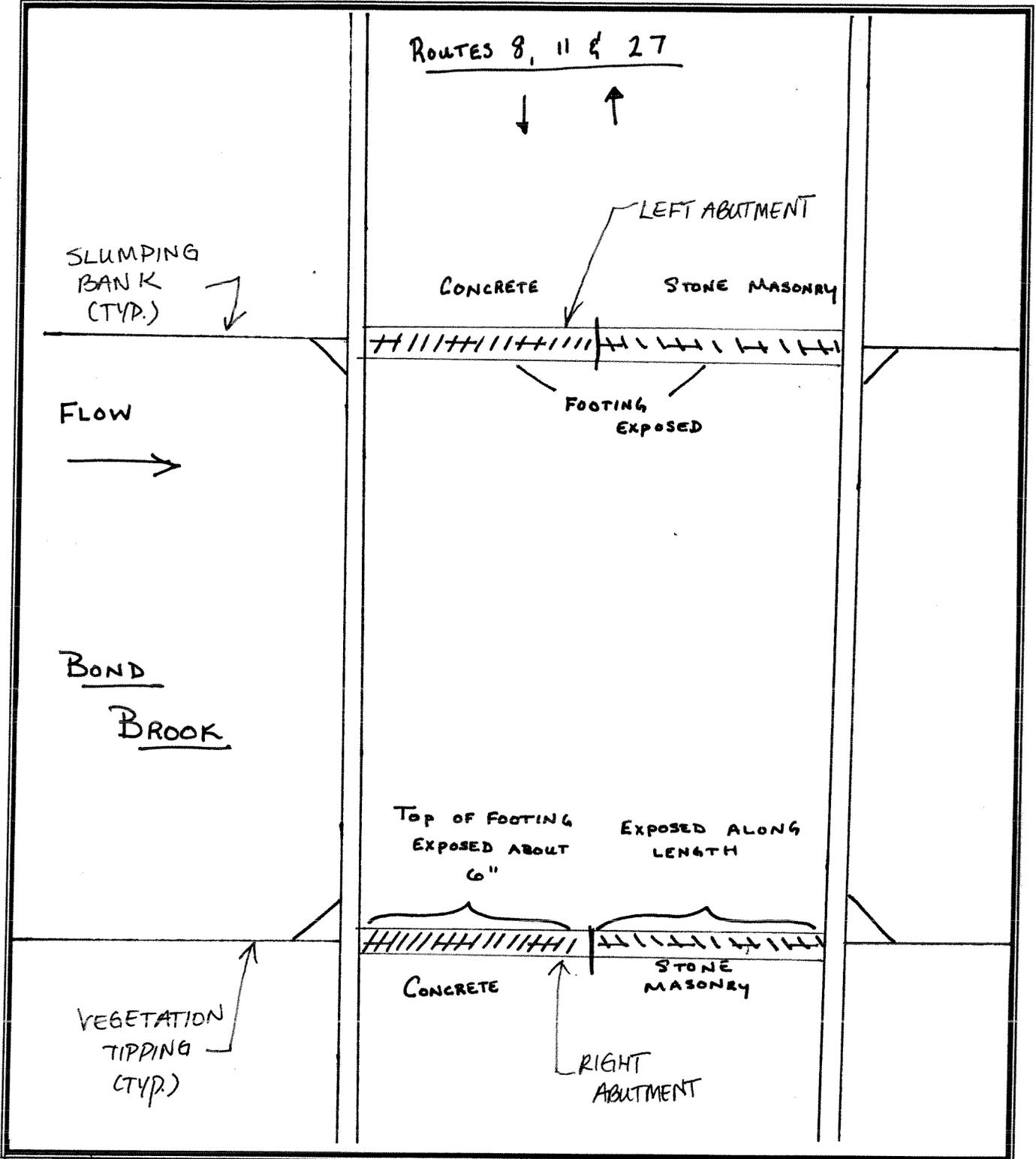
RIGHT ABUTMENT ELEVATION  
N.T.S.

NOTES:

1. ELEVATION 9.5 CORRESPONDS TO A 10 YEAR FLOOD EVENT.
2. PLACARD LOCATIONS ARE AT THE UPSTREAM END OF BOTH ABUTMENTS.
3. PLACARD LOCATION MEASURED TO LOW CHORD AND TOP OF FOOTING.
4. ALL WORK IS TO BE PERFORMED IN DRY CONDITIONS.
5. SKETCH IS CONCEPTUAL ONLY, NOT FOR CONSTRUCTION, AND NOT TO SCALE.

FILE NAME = K:\0971\CG00\MAIN\Br-edge PDA Files - Test Br-edges\Augusta 3077\19271-cpb.plt.dgn  
DATE = 8/20/2010  
USER = JCS

<small>Drawing Copyright © 2009</small>  11 King Court • Keene, NH 03431-6848 Main: (603) 357-2445 • www.chacompanies.com	MAINE BRIDGE SCOUR INVESTIGATION	ATTACHMENT <b>F</b>
	AUGUSTA 3077	
	PLACARD INSTALLATION LOCATION	DATE: 4/10



**CHIA**

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 Keene, NH 03431-4648  
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**Augusta 3077**  
 Attachment G: Plan view showing  
 location of scour holes, debris, etc.

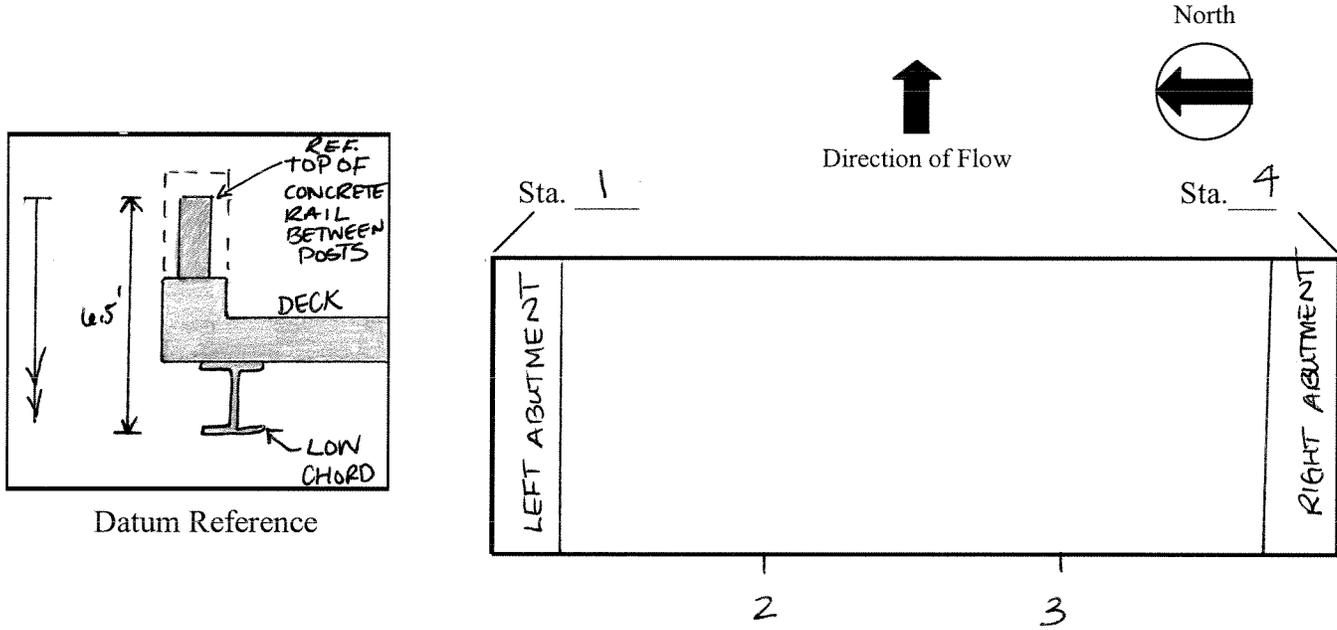
Maine Scour Investigation

# MAINE DOT CHANNEL PROFILE

## Bridge Information

Town/Bridge No. Augusta 3077  
 Feature Carried Routes 8, 11 & 27  
 Feature Crossed Bond Brook  
 Owner Maine DOT

Date of Inspection 3/18/2009  
 Inspector P. Pierce



\*Actual skew, if present, not shown

Fascia Location	Location/Description	Date: 3/18/2009		Date:		Date:	
		Upstream Readings (ft)	Downstream Readings (ft)	Upstream Readings (ft)	Downstream Readings (ft)	Upstream Readings (ft)	Downstream Readings (ft)
Sta. 1	L. Abutment	30.0	32.3				
Sta. 2	1/3 of length from L. Abutment	30.6	31.8				
Sta. 3	2/3 of length from L. Abutment	31.0	*				
Sta. 4	R. Abutment	31.0	*				
	Water Surface	27.2	27.2				

Notes: Stations are numbered from left to right looking downstream. All measurements taken from top of concrete barrier between posts. Location iced over at time of measurement.

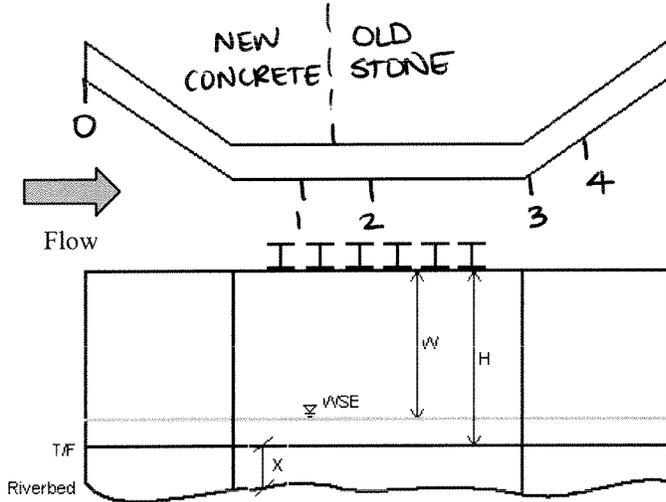
\*All units are in English and in decimal form

# MAINE DOT ABUTMENT RIVERBED PROFILE FORM

## Bridge Information

Town/Bridge No. Augusta 3077  
 Feature Carried Routes 8, 11 & 27  
 Feature Crossed Bond Brook  
 Owner Maine DOT

Date of Inspection 3/18/2009  
 Inspector P. Pierce



Abutment: Left

W = Distance from Low Chord to Water Surface = 20.7 ft

H = Distance from Low Chord to top of footing = 24.6 ft

Location	Location Description	DATE: 3/18/2009	DATE:	DATE:
		X (ft)	X (ft)	X (ft)
0	U/S End of Wingwall	0.5 +/-		
1	D/S End New Concrete	0.7		
2	U/S End Old Stone	0.5		
3	D/S End Old Stone	1.0		
4	3' Around D/S Corner	0		
5				
6				
7				
8				
9				
10				

Notes: Two types of foundations exist. There is a concrete pile cap at the upstream end and cut masonry block at the downstream end.

*\*All units are in English and in decimal form*

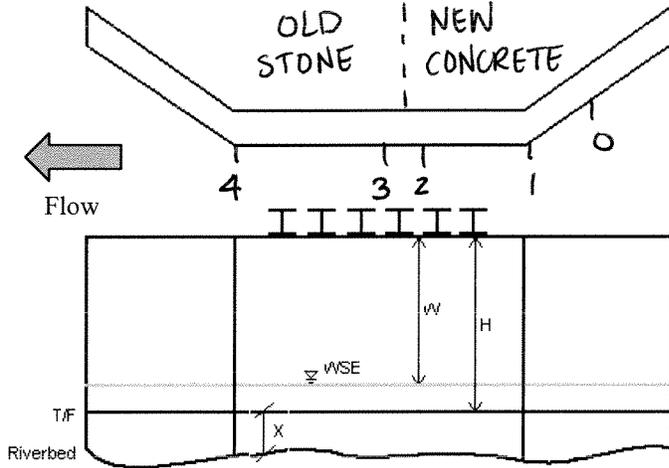
# MAINE DOT ABUTMENT RIVERBED PROFILE FORM

## Bridge Information

Town/Bridge No. Augusta 3077  
 Feature Carried Routes 8, 11 & 27  
 Feature Crossed Bond Brook  
 Owner Maine DOT

Date of Inspection 3/18/2009  
 Inspector P. Pierce

Abutment: Right



W = Distance from Low Chord to Water Surface = 20.7 ft

H = Distance from Low Chord to top of footing = 26.4 ft

Location	Location Description	DATE: 3/18/2009	DATE:	DATE:
		X (ft)	X (ft)	X (ft)
0	3' From D/S Corner	0		
1	U/S Corner	0.5		
2	End Concrete Pile Cap	0.5		
3	Begin Stone Abutment	0.5		
4	End Stone Abutment	0		
5				
6				
7				
8				
9				
10				

Notes: Two types of foundations exist. There is a concrete pile cap at the upstream end and cut masonry block at the downstream end.

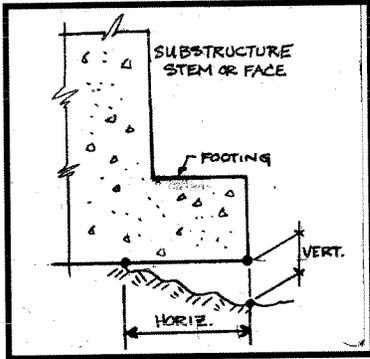
*\*All units are in English and in decimal form*

# MAINE DOT UNDERMINING FORM

## Bridge Information

Town/Bridge No. Augusta 3077  
 Feature Carried Routes 8, 11 & 27  
 Feature Crossed Bond Brook  
 Owner Maine DOT

Date of Inspection 3/18/2009  
 Inspector P. Pierce



Location 0 \_\_\_\_\_

SSU: \_\_\_\_\_

FACE: \_\_\_\_\_

Start of Measurement:  
 \_\_\_\_\_

Interval of Measurement:  
 \_\_\_\_\_ FT

Location	Date:		Date:		Date:		Date:	
	Vertical (ft)	Horizontal (ft)						
0								
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Notes: No undermining found in 2009 site visit.

\*All units are in English and in decimal form

# FIELD VERIFICATION CARD (POA Attachment I)

## GENERAL INFORMATION

**Structure:** Bond Brook No 1  
**Owner:** State Highway Agency  
**City, County:** Augusta - Kennebec  
**Contact Person:** - Bridge Maintenance Engineer, Maine DOT Bridge Maintenance Division - (207) 624-3580  
- Assistant Bridge Maintenance Engineer, Maine DOT Bridge Maintenance Division - (207) 624-3580

**Bridge Number:** 3077  
**Feature On:** Routes 8,11, & 27  
**Waterway Crossed:** Bond Brook

## BRIDGE INFORMATION

**Detour (miles):** 0  
**Last ADT: Total:** 16130  
**Year:** 2008  
**USGS Gage Station:** 1049320  
**USGS Station Prox To Bridge:** 1900 ft DS of bridge on Kennebec River  
**Superstructure Type:** Stringer/Multi-Beam or Girder  
**Number of Spans:** 1  
**Superstructure Material:** Steel  
**Diving Insp Reports:**  **Dates:**

<b>Foundation Details:</b> <input checked="" type="checkbox"/> UNKNOWN (Looking Downstream L to R) <input type="checkbox"/> KNOWN	<b>Worst Abutment:</b> Right	<b>Embedment (feet):</b> 1.3	<b>Exposure:</b> Footing Exposed
	<b>Worst Pier:</b>	<b>Embedment (feet):</b>	<b>Exposure:</b>

**Scour Critical Feature:** Both Abutment Footings (Downstream Section)

**Placard Location:** Upstream end of both abutments.

**Items to Watch:** Changes to embedment at abutments. Remaining embedment at Left and Right abutments (old stone) observed as 1.3 ft and 1.0 ft in April 2009. Movement of stone protection. Perform a drop-line survey to establish the riverbed profile at the upstream and downstream fascia and along each substructure. Provide photo documentation of countermeasures at abutments.

## CRITERIA FOR CONSIDERATION OF BRIDGE CLOSURE

- |   |   |
|---|---|
| <input checked="" type="checkbox"/> Water Surface Elevation Reaches Low Chord                         | <input checked="" type="checkbox"/> Loss of Road Embankment                                       |
| <input checked="" type="checkbox"/> Water Reaches Closure Elevation<br>9.5 ft NAVD88 (10-yr), Placard | <input checked="" type="checkbox"/> Scour Measurement Results / Monitoring Device (See Section 6) |
| <input checked="" type="checkbox"/> Overtopping Road or Structure                                     | <input checked="" type="checkbox"/> Observed Structure Movement / Settlement                      |
| <input checked="" type="checkbox"/> Debris Accumulation   | <input checked="" type="checkbox"/> Movement of RipRap / Other Armor Protection                   |
| <input type="checkbox"/> USGS Gage Station #  | <input type="checkbox"/> Stage (WSE)  |
| <input type="checkbox"/> NOAA Gage Station #  | <input type="checkbox"/> Stage (WSE)  |
|   | <input type="checkbox"/> Discharge  |

**ACTION TAKEN**  Post-Flood Inspection Recommendations  Revisit Bridge  Close Bridge

**POST-FIELD VERIFICATION**  Completed Proper Notification **Date/Time Notified:** **Agency:**

## CRITERIA FOR CONSIDERATION TO COMPLETE INTERIM BRIDGE REOPENING:

- |  |   |
|--|---|
| <input checked="" type="checkbox"/> Water Surface Levels Dropping        | <input checked="" type="checkbox"/> No Approach Settlement                                  |
| <input checked="" type="checkbox"/> Critical Elevation Marker Is Visible | <input checked="" type="checkbox"/> No Embankments Erosion Endangering Abutment             |
| <input checked="" type="checkbox"/> Reasons for Closure Have Abated      | <input checked="" type="checkbox"/> Abutments and Piers are Plumb and Stable                |
| <input checked="" type="checkbox"/> Straight and Consistent Bridgerails  | <input checked="" type="checkbox"/> Assess Riverbed Elevation at Piers (drop line readings) |

**Agency and Person Responsible for Interim Re-Opening Bridge After Inspection:**

**Interim Reopening Approved By:** **Interim Reopening Date:** **Time:**

## INTERIM REOPENING COMMENTS

**REFERENCE PHOTOS** (Left to Right Convention Looking Downstream)

**Upstream Low Water**



**Downstream Low Water**



**Downstream Elevation of Bridge at Low Water**



**Attachment K: T.Y. Lin 1995 Bridge Scour  
Evaluation Report**

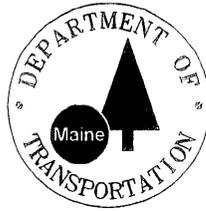


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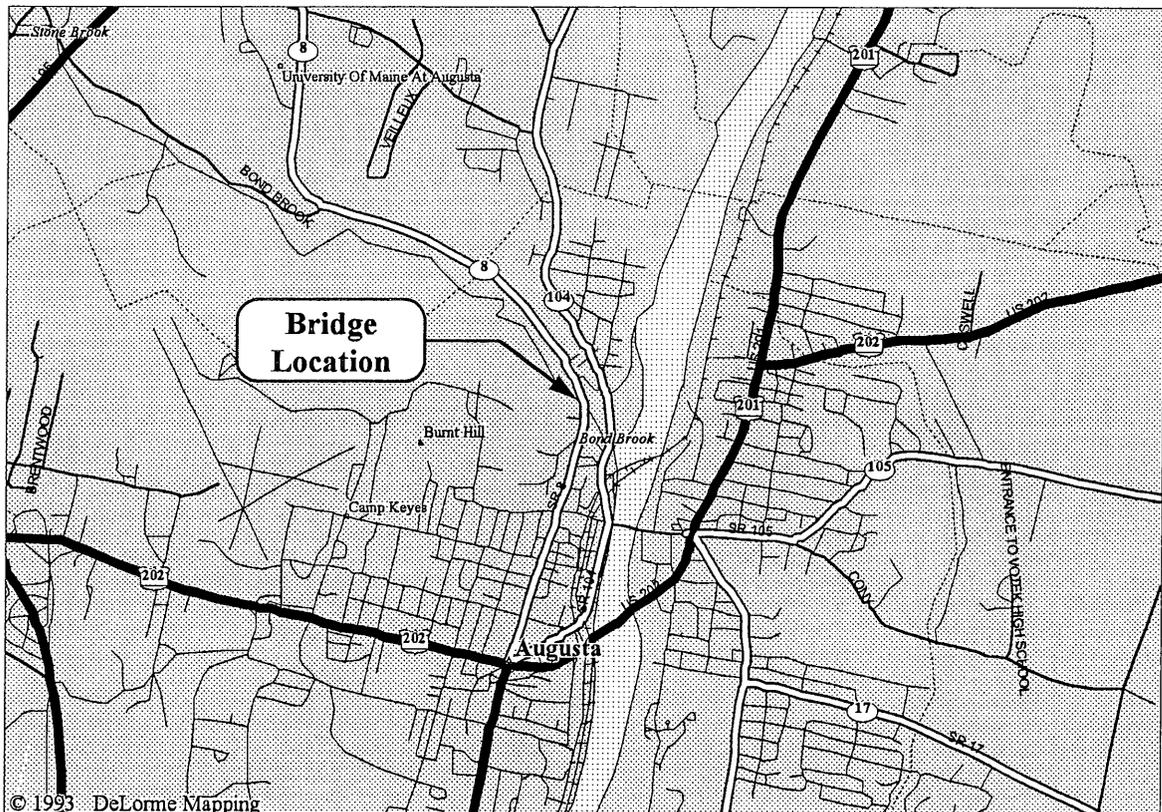
**Augusta 3077  
Attachment K: T.Y. Lin 1995 Bridge  
Scour Evaluation Report**

**Maine Scour Investigation**

# BRIDGE SCOUR EVALUATION REPORT



*Name:* **Bond Brook No. 1 Bridge**  
*County:* **Kennebec**  
*Town:* **Augusta**  
*Route:* **Route 8/11/27**  
*Stream:* **Bond Brook**  
*Bridge #:* **3077**  
*Date:* **December 1995**



*Prepared by:* **T.Y. Lin International**  
**5 Fundy Road**  
**Falmouth, Maine 04105**

**BRIDGE SCOUR EVALUATION SUMMARY**

Bridge Name: Bond Brook

Town: Augusta

Bridge Number: 3077

Route/Name: Routes 8, 11, 27

Stream: Bond Brook

River Basin: Kennebec

Review Date: 16-Oct-95

**Note : See Office/Field Review Report for Additional Data.****SUMMARY AND CONCLUSIONS**

This crossing of Bond Brook is a single span steel bridge seated on stone/concrete abutments. The old stone abutments form the downstream portion of the bridge, and the upstream section is concrete (1934 widening). Piles support the upstream (widened) part of the right abutment.

In 1936 the bridge was overtopped, and the FEMA report indicates that the bridge will be overtopped and subjected to pressure flow during a 100 year event. The bridge is located upstream of its confluence with the Kennebec River so backwater from the Kennebec River is a contributor to flood levels.

The channel bottom is soft silt clay and alluvium with some rocks. The bridge is located on a long meander curve which cuts the left bank. The left banks are quite steep and subject to erosion both upstream and downstream. The channel has a potential to migrate both left and downward. The thalweg is at mid channel upstream and shifts left through the bridge to attack the left downstream abutment corner. Both erosional and depositional bed features can be observed, including a scour hole at the left downstream corner and a bar deposit along the right channel section.

The bridge forms a substantial contraction in the channel and overbanks. In addition to the scour hole at the left abutment, there is a blow hole just below a pipe crossing downstream. The banks are eroding at the hole, and it is about 4' deep with at least 2' of penetration in soft bed material.

No structural evidences of scour damage to the bridge were observed. However, the scour hole at the left downstream abutment may be below the base of the timber grillage which supports the granite footing. Probes penetrated 5.5' between the timbers and the granite block footing and several feet between the granite blocks, indicating a loss of fines behind the blocks.

Based on the potential for channel migration, the angle of attack, the evidence of scour, and the potential for future scour, an Item 113 rating of 3B is recommended. Since the channel section has not changed significantly from the 1934 sections and the riprap loss has not increased significantly since 1988, no additional riprap protection is recommended. Scour should be monitored during routine bridge inspections.

**RECOMMENDATIONS**

Countermeasures: Supplemental Monitoring - Monitor scour along left abutment and blowhole

Recommended Repair Code:	Element:	Work:	Priority:	Effect:
--------------------------	----------	-------	-----------	---------

Level Two Analysis: Not Required -

**RECOMMENDED SCOUR VULNERABILITY RATING (PER FHWA)**

Scour Vulnerability: Contraction - Abutment

Recommended NBI Rating	Item 61: 7	Item 71: 6	Item 113: 3B
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# BRIDGE SCOUR EVALUATION SUMMARY

## BRIDGE DESCRIPTION

Bridge Description: <b>Single Span</b>	Number of Spans: <b>1</b>	Bridge Datum: <b>Assumed</b>
Date Built: <b>1934</b>	Date of Widening/Major Repairs: <b>None</b>	
Low Chord Elev (ft): <b>95.8 - 96.4</b>	Bridge Deck Elev (ft): <b>99.6 - 100.2</b>	Thalweg Elev (ft): <b>70.0</b>
Overtopping Elev (ft): <b>101.0</b>	Overtopping Location: <b>At Bridge</b>	

## ABUTMENTS

	Left Abutment	Right Abutment
Type:	Vert stone/conc w/ w/w	Vert stone/conc w/ w/w
Support:	Expansion	Expansion
Foundation Type:	Spread Footings	Spread/ Piles under conc
Footing Exposed:	Yes	Yes
Top of Footing Elev (ft):	71	70
Footing Height (ft):	3.0	4.0
Exposure (ft):	1.5 conc.;2.5 stone	2.5
Piles Exposed:	No	No
Pile Tip Elev (ft):	Unknown	Unknown
Rock Elev (ft):	Unknown	Unknown
Riprap (Type/Size):	Granite block u/s & d/s	Granite block u/s
Riprap Condition:	Fair	Fair
Other Protection:	None	None
Condition:	NA	NA
Scour		
Tilt/Settlement:	No	No
Max Depth Undermining (ft):	0	0
Scour Holes:	Yes	No
Location:	Left d/s footing	NA

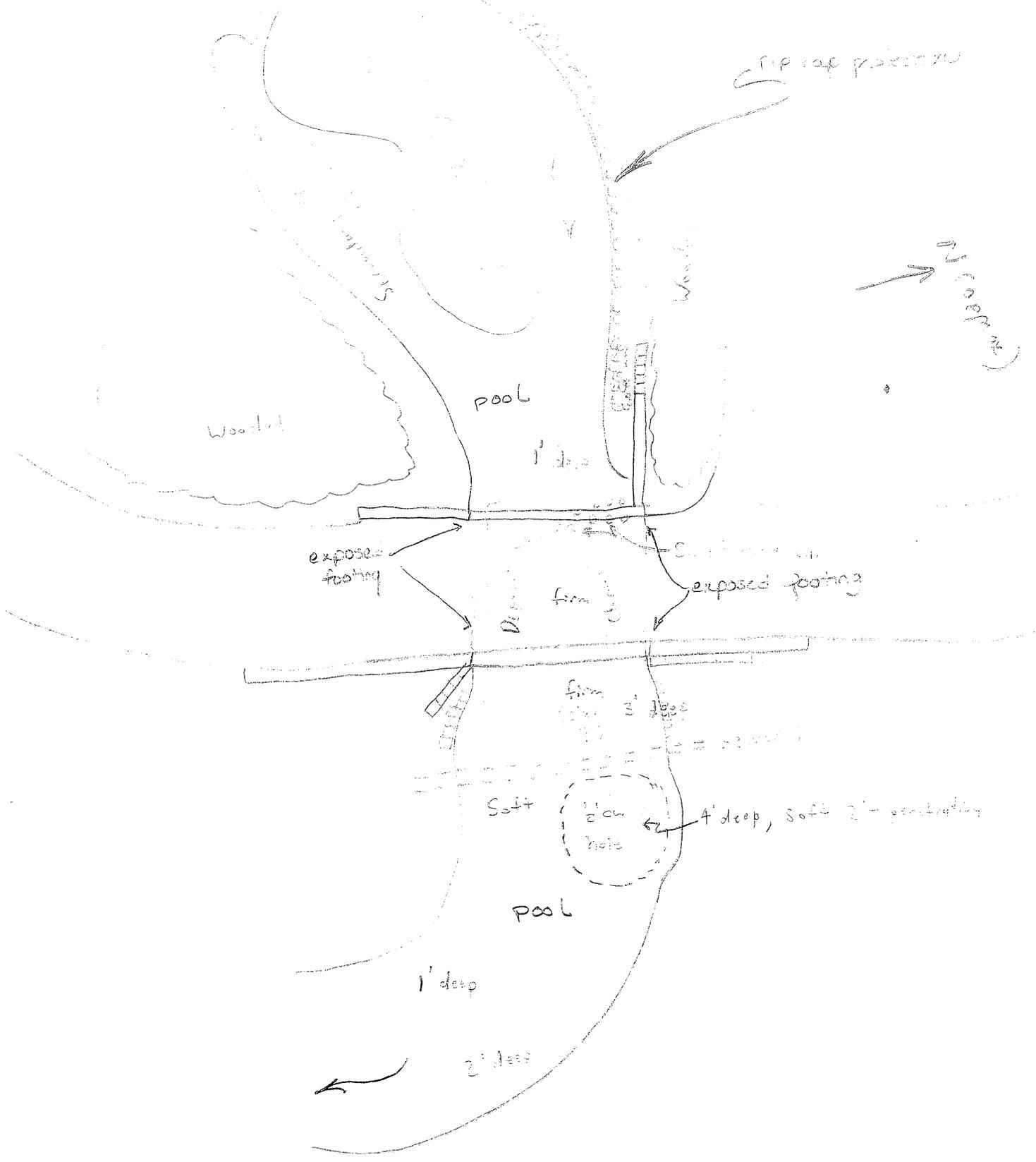
## PIERS

OFFICE/FIELD REVIEW REPORT

Bridge Name: <u>Bonifacio</u>	Town: <u>Aradon</u>	Bridge #: <u>3077</u>
Route No./Name <u>8.11.27</u>	Stream: <u>Estid Brook</u>	Review Date: <u>10/10/95</u>

Sketch (Plan view)

Bridge plans supplemented by field sketch.

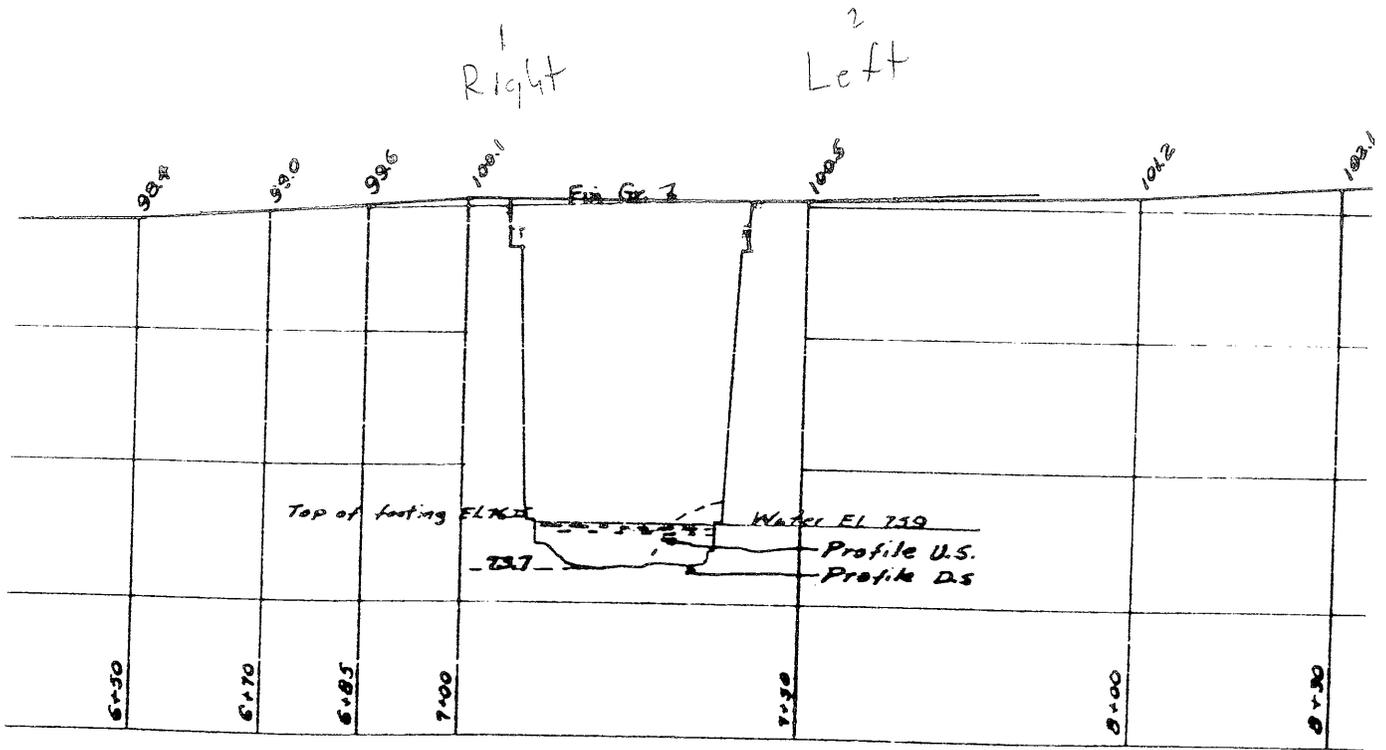


OFFICE/FIELD REVIEW REPORT

Bridge Name: <u>BJABL</u>	Town: <u>Avonlea</u>	Bridge #: <u>327</u>
Route No./Name: <u>3112</u>	Stream: <u>East Fork</u>	Review Date: <u>1/15/25</u>

Sketch (Profile)

Bridge plans supplemented by field sketch.



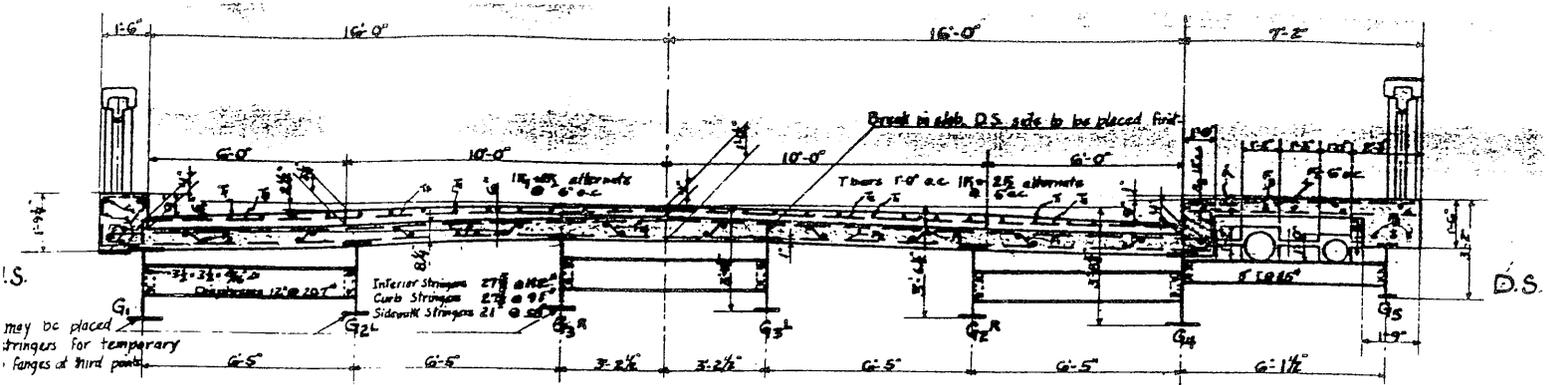
PROFILE along transit line

# OFFICE/FIELD REVIEW REPORT

Bridge Name: <u>Bond Brook</u>	Town: <u>Andover</u>	Bridge #: <u>3277</u>
Route No./Name: <u>8.1.27</u>	Stream: <u>Bond Brook</u>	Review Date: <u>10/16/85</u>

## Sketch (Typical Section)

Transverse section, abutment, pier or other views as required.



TRANSVERSE SECTION

Note: All stringers are recessed into slab 1". Except outside of outside stringers at 1/4" of span where stringers are recessed 1/4". The outside of bridge will show a camber of 1/4".

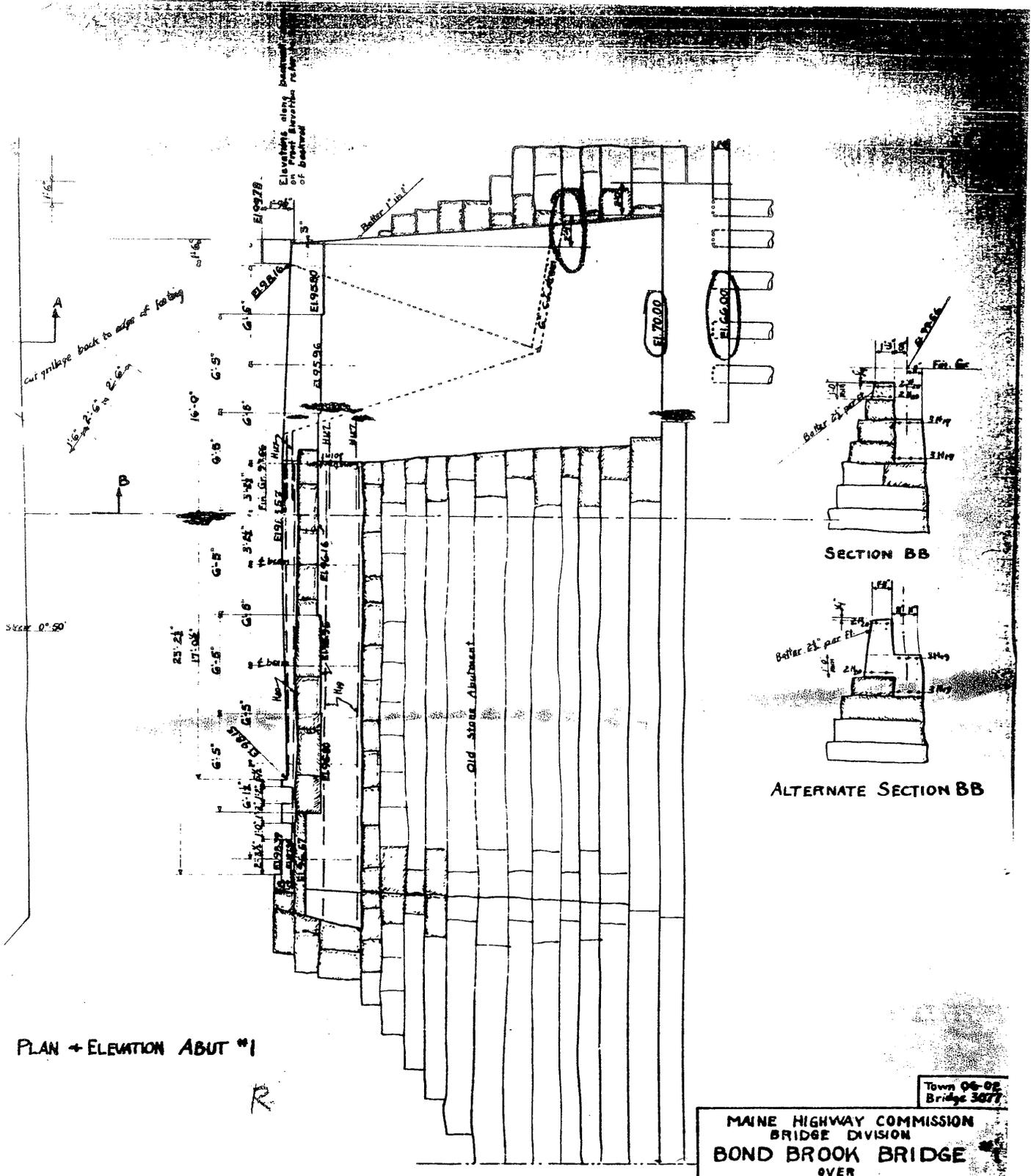


# OFFICE/FIELD REVIEW REPORT

Bridge Name: <u>Bond Brook</u>	Town: <u>Augusta</u>	Bridge #: <u>3077</u>
Route No./Name: <u>8, 11, 27</u>	Stream: <u>Bond Brook</u>	Review Date: <u>10/16/95</u>

Sketch (Typical Section)

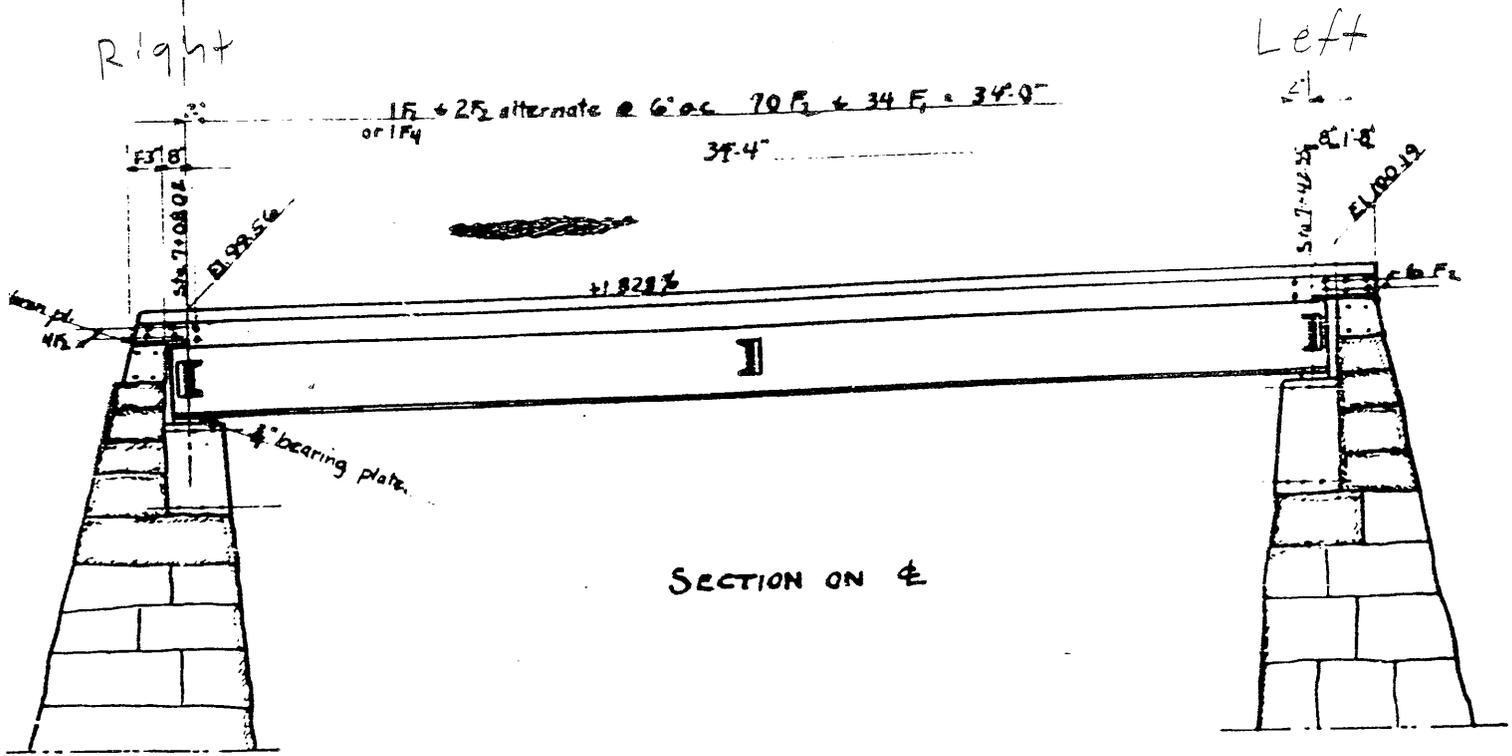
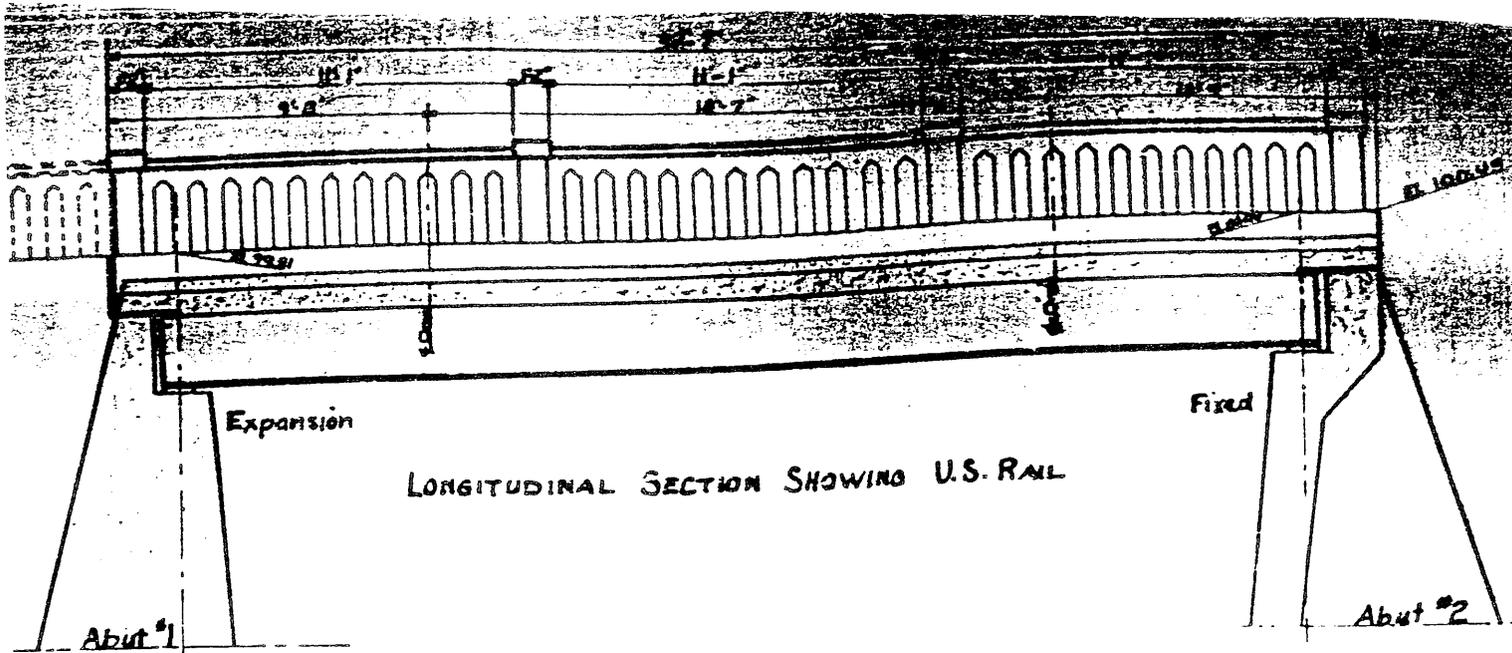
Transverse section, abutment, pier or other views as required.



Bridge Name: <u>Bond Brook</u>	Town: <u>Augusta</u>	Bridge #: <u>3077</u>
Route No./Name <u>8, 11, 27</u>	Stream: <u>Bond Brook</u>	Review Date: <u>10/16/95</u>

Sketch (Typical Section)

Transverse section, abutment, pier or other views as required.

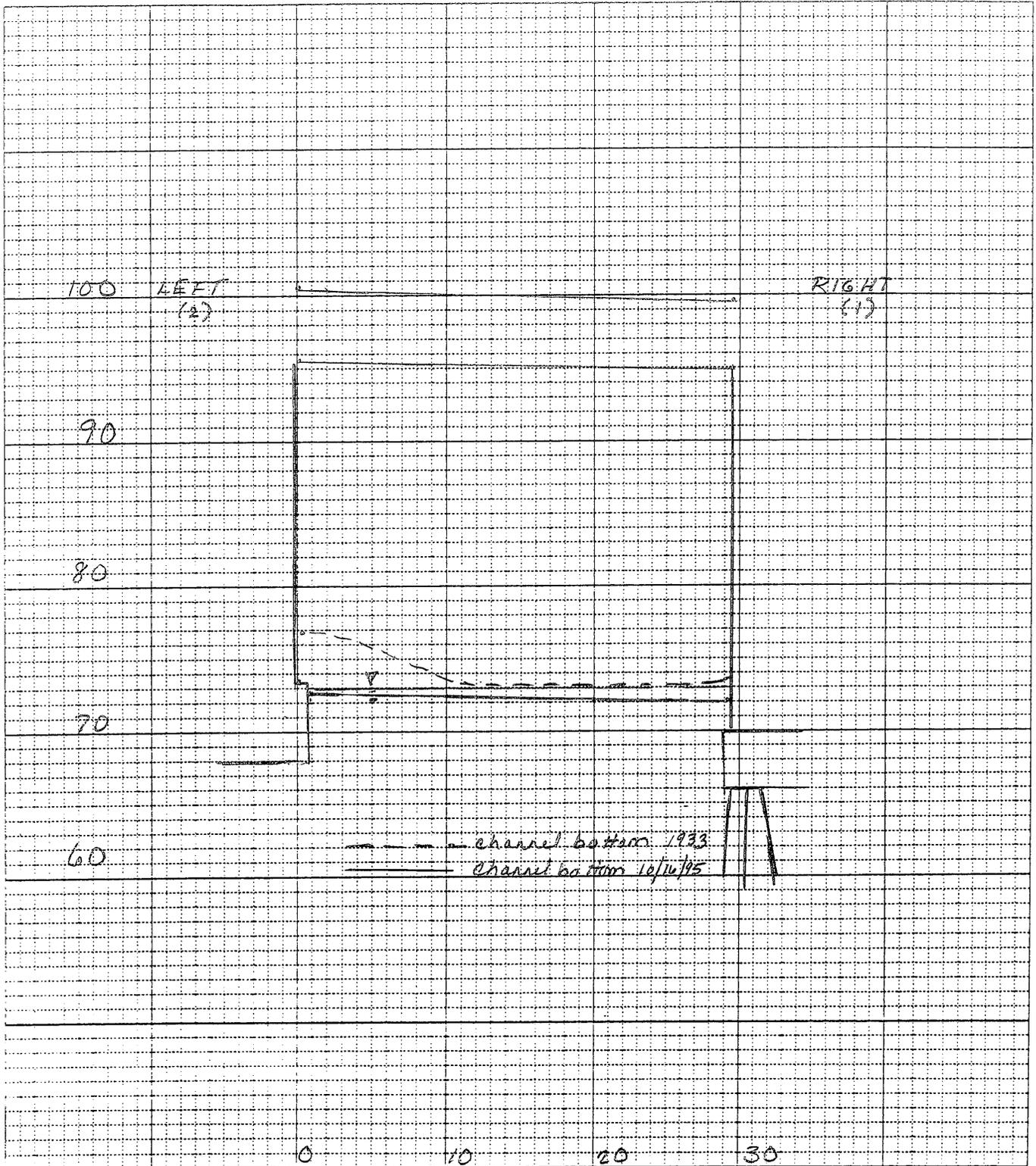




Bridge Name: <u>Burrhead</u>	Town: <u>AUGUSTA</u>	Bridge #: <u>207</u>
Route No./Name: <u>8/1127</u>	Stream: <u>BOX BROOK</u>	Review Date: <u>5/1/95</u>

**Stream Cross Section at Bridge (Facing Downstream)**

Upstream Side:  Downstream Side:

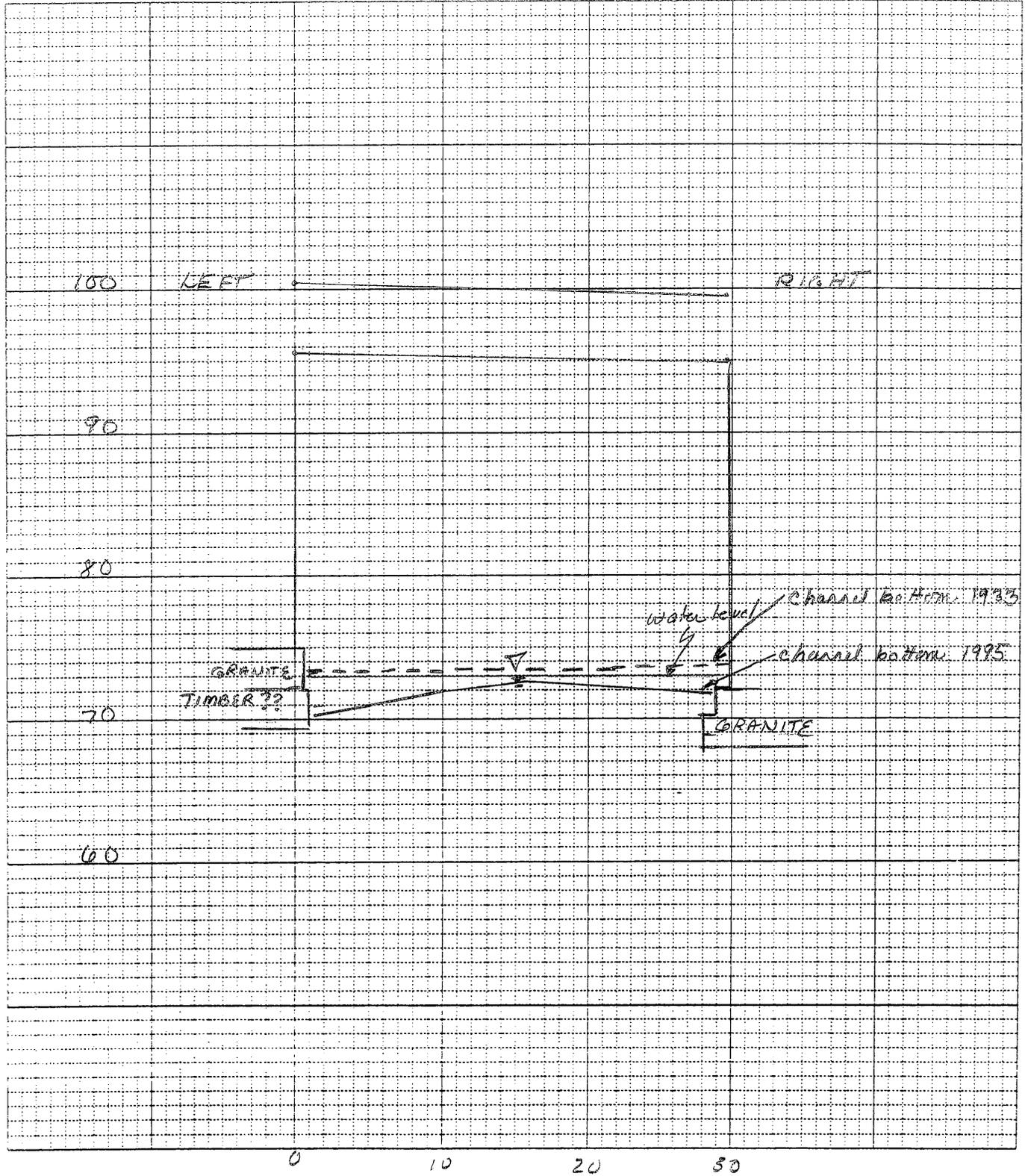


1" = 10'

Bridge Name: <u>BOND BROOK</u>	Town: <u>AUGUSTA</u>	Bridge #: <u>3077</u>
Route No./Name: <u>8/11/27</u>	Stream: <u>BOND BROOK</u>	Review Date: <u>10/16/95</u>

**Stream Cross Section at Bridge (Facing Downstream)**

Upstream Side: \_\_\_\_\_ Downstream Side:  (CHANNEL BOTTOM MEASURED FROM WATER SURFACE)  
 (FROM PROBINGS)



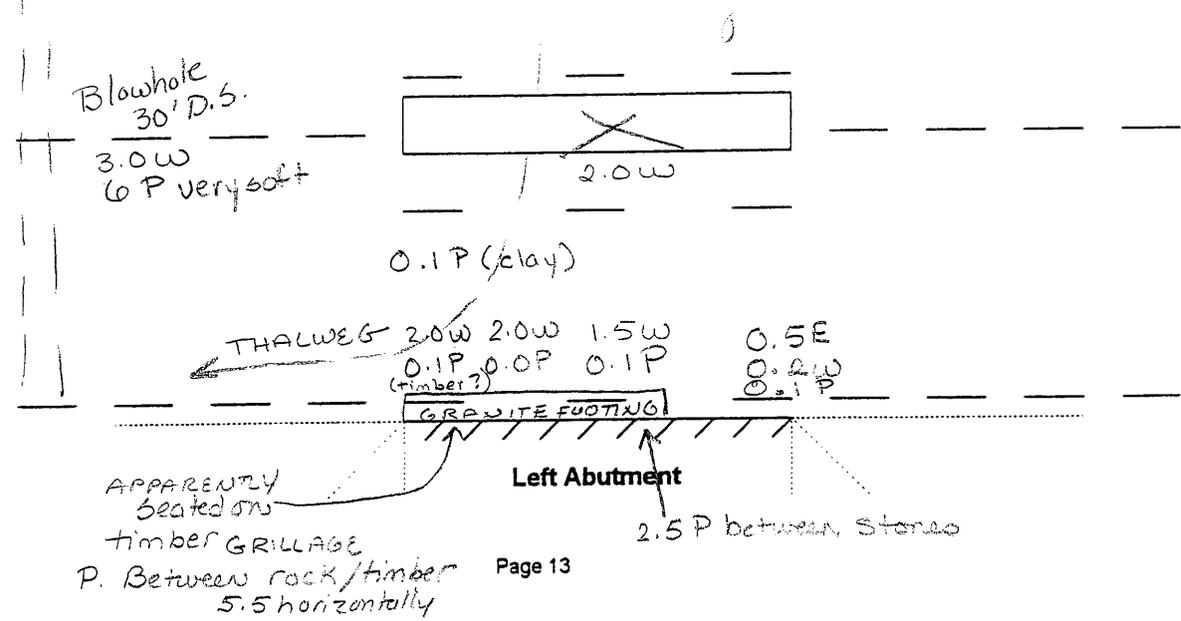
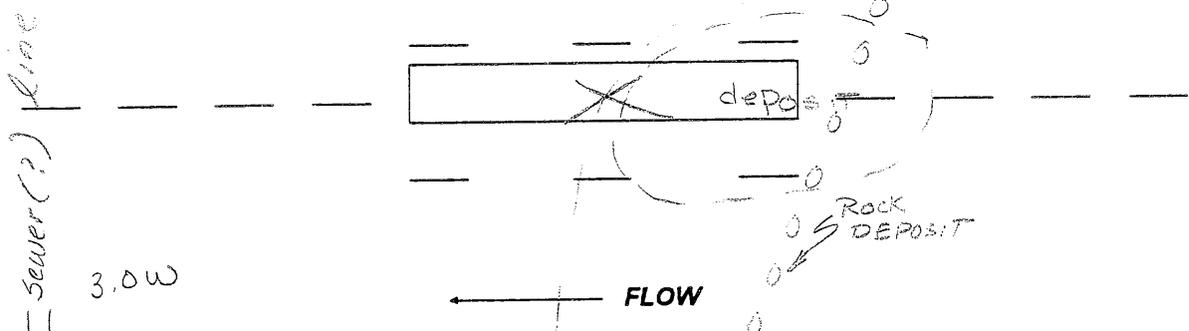
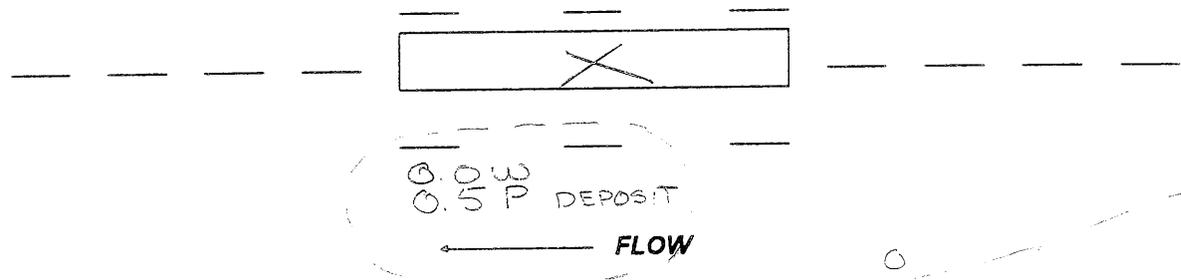
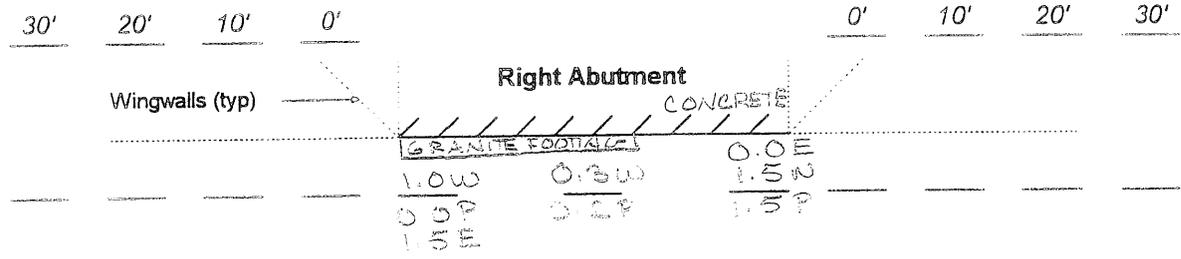
# OFFICE/FIELD REVIEW REPORT

Bridge Name: <u>BOND BROOK</u>	Town: <u>AUGUSTA</u>	Bridge #: <u>3037</u>
Route No./Name: <u>211/27</u>	Stream: <u>BOND BROOK</u>	Review Date: <u>10/16/95</u>

## Soundings/Problings

E - Footing Exposure  
 P - Depth of Rod Probe  
 U - Depth of Undermining  
 W - Water Depth

WATER LEVEL 293.0  
 5.5'



**Attachment M: Scour/H&H Backup Calculations**



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Main: (603)-357-2445

**Augusta 3077**  
**Attachment M: Scour/H&H Backup**  
**Calculations**

**Maine Scour Investigation**

Computed by: SVE  
Checked by: RKW

Augusta 3077 – Route 8, 11 & 27 over Bond Brook in the Town of Augusta, ME

Contraction Scour 100-yr (Approach XS 1385)

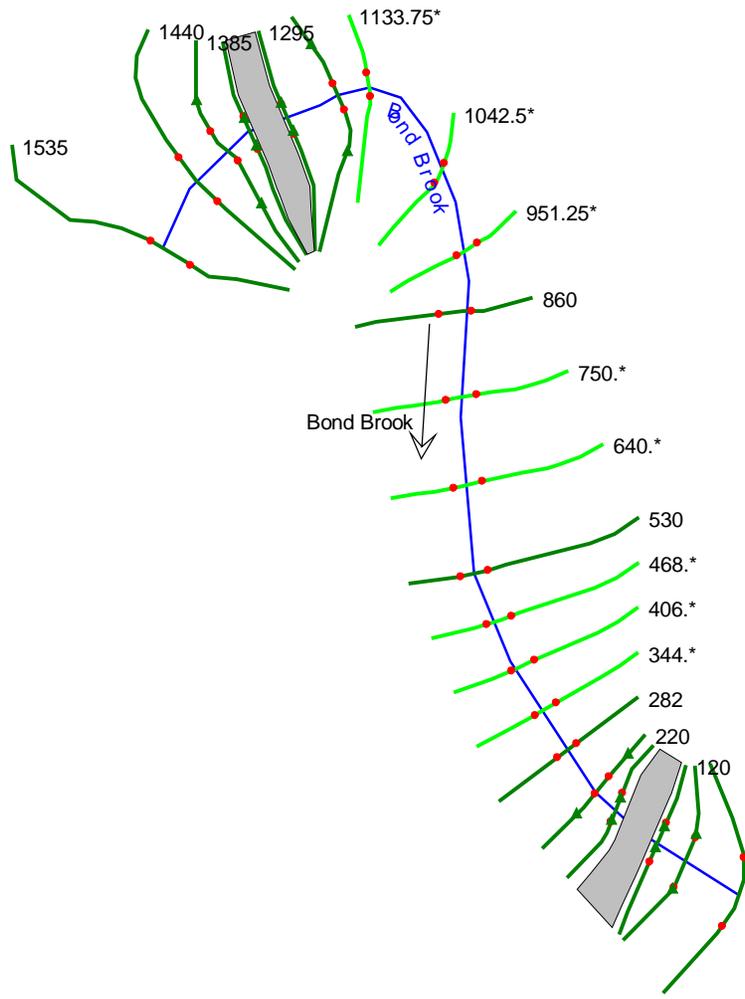
	Left	Channel	Right
Input Data			
Average Depth (ft):	2.58	9.72	3.87
Approach Velocity (ft/s):	1.04	5.05	1.37
Br Average Depth (ft):		9.70	
BR Opening Flow (cfs):		2800.00	
BR Top WD (ft):		38.00	
Grain Size D50 (mm):	0.50	0.50	0.50
Approach Flow (cfs):	88.76	2500.13	211.12
Approach Top WD (ft):	33.11	51.00	39.67
K1 Coefficient:	0.640	0.690	0.640

#### Results

Scour Depth Ys (ft):	3.42
Critical Velocity (ft/s):	1.93
Equation:	Live

#### Notes:

Soil grain size (D50 & D90) is based on field observations.



HEC-RAS Plan: Exist\_Cond River: Bond Brook Reach: Bond Brook

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Bond Brook	1535	10-yr	1390.00	2.70	10.12		10.44	0.002319	4.76	358.02	116.06	0.39
Bond Brook	1535	50-yr	2310.00	2.70	12.61		12.90	0.001242	4.65	675.71	138.52	0.31
Bond Brook	1535	100-yr	2800.00	2.70	13.90		14.17	0.000969	4.60	861.32	150.10	0.28
Bond Brook	1535	500-yr	4210.00	2.70	17.57		17.81	0.000550	4.41	1487.36	193.97	0.22
Bond Brook	1440	10-yr	1390.00	2.40	10.01		10.24	0.001437	3.87	384.59	102.17	0.31
Bond Brook	1440	50-yr	2310.00	2.40	12.55		12.79	0.000880	4.02	684.04	134.11	0.26
Bond Brook	1440	100-yr	2800.00	2.40	13.85		14.08	0.000711	4.03	868.76	150.47	0.24
Bond Brook	1440	500-yr	4210.00	2.40	17.55		17.75	0.000416	3.91	1502.05	189.45	0.20
Bond Brook	1385	10-yr	1390.00	2.20	9.85	6.74	10.16	0.001429	4.51	341.40	81.28	0.33
Bond Brook	1385	50-yr	2310.00	2.20	12.36	7.98	12.72	0.001080	4.97	582.29	109.89	0.30
Bond Brook	1385	100-yr	2800.00	2.20	13.67	8.56	14.02	0.000920	5.05	734.34	123.77	0.29
Bond Brook	1385	500-yr	4210.00	2.20	17.40	10.05	17.71	0.000576	4.96	1251.27	158.14	0.24
Bond Brook	1345	10-yr	1390.00	2.00	9.50	6.67	10.02	0.002225	5.81	239.14	64.79	0.41
Bond Brook	1345	50-yr	2310.00	2.00	11.74	8.06	12.53	0.002220	7.12	324.57	79.09	0.43
Bond Brook	1345	100-yr	2800.00	2.00	12.91	8.72	13.81	0.002127	7.59	368.98	85.16	0.43
Bond Brook	1345	500-yr	4210.00	2.00	16.33	10.46	17.44	0.001759	8.44	498.92	111.72	0.41
Bond Brook	1320		Bridge									
Bond Brook	1295	10-yr	1390.00	2.00	9.11	7.19	9.82	0.003683	6.79	204.67	74.58	0.52
Bond Brook	1295	50-yr	2310.00	2.00	11.36	8.58	12.34	0.003176	7.96	290.21	95.32	0.51
Bond Brook	1295	100-yr	2800.00	2.00	12.55	9.25	13.63	0.002880	8.35	335.42	104.36	0.50
Bond Brook	1295	500-yr	4210.00	2.00	16.04	10.97	17.30	0.002142	8.99	468.22	130.92	0.45
Bond Brook	1225	10-yr	1390.00	1.80	8.87	7.16	9.55	0.003788	6.80	253.04	87.25	0.52
Bond Brook	1225	50-yr	2310.00	1.80	11.39	8.77	11.96	0.002172	6.65	506.57	127.71	0.42
Bond Brook	1225	100-yr	2800.00	1.80	12.68	9.57	13.20	0.001696	6.51	651.87	140.53	0.38
Bond Brook	1225	500-yr	4210.00	1.80	16.37	10.90	16.78	0.000946	6.09	1119.80	174.89	0.30
Bond Brook	1133.75*	10-yr	1390.00	1.52	8.58		9.22	0.003251	6.55	246.80	72.19	0.49
Bond Brook	1133.75*	50-yr	2310.00	1.52	11.14		11.77	0.002066	6.75	486.67	116.84	0.42
Bond Brook	1133.75*	100-yr	2800.00	1.52	12.51		13.06	0.001572	6.54	654.44	129.29	0.38
Bond Brook	1133.75*	500-yr	4210.00	1.52	16.30		16.71	0.000842	6.00	1209.32	162.35	0.29
Bond Brook	1042.5*	10-yr	1390.00	1.25	8.36		8.94	0.002648	6.19	252.21	65.03	0.46
Bond Brook	1042.5*	50-yr	2310.00	1.25	10.98		11.60	0.001784	6.57	466.14	101.18	0.40

HEC-RAS Plan: Exist\_Cond River: Bond Brook Reach: Bond Brook (Continued)

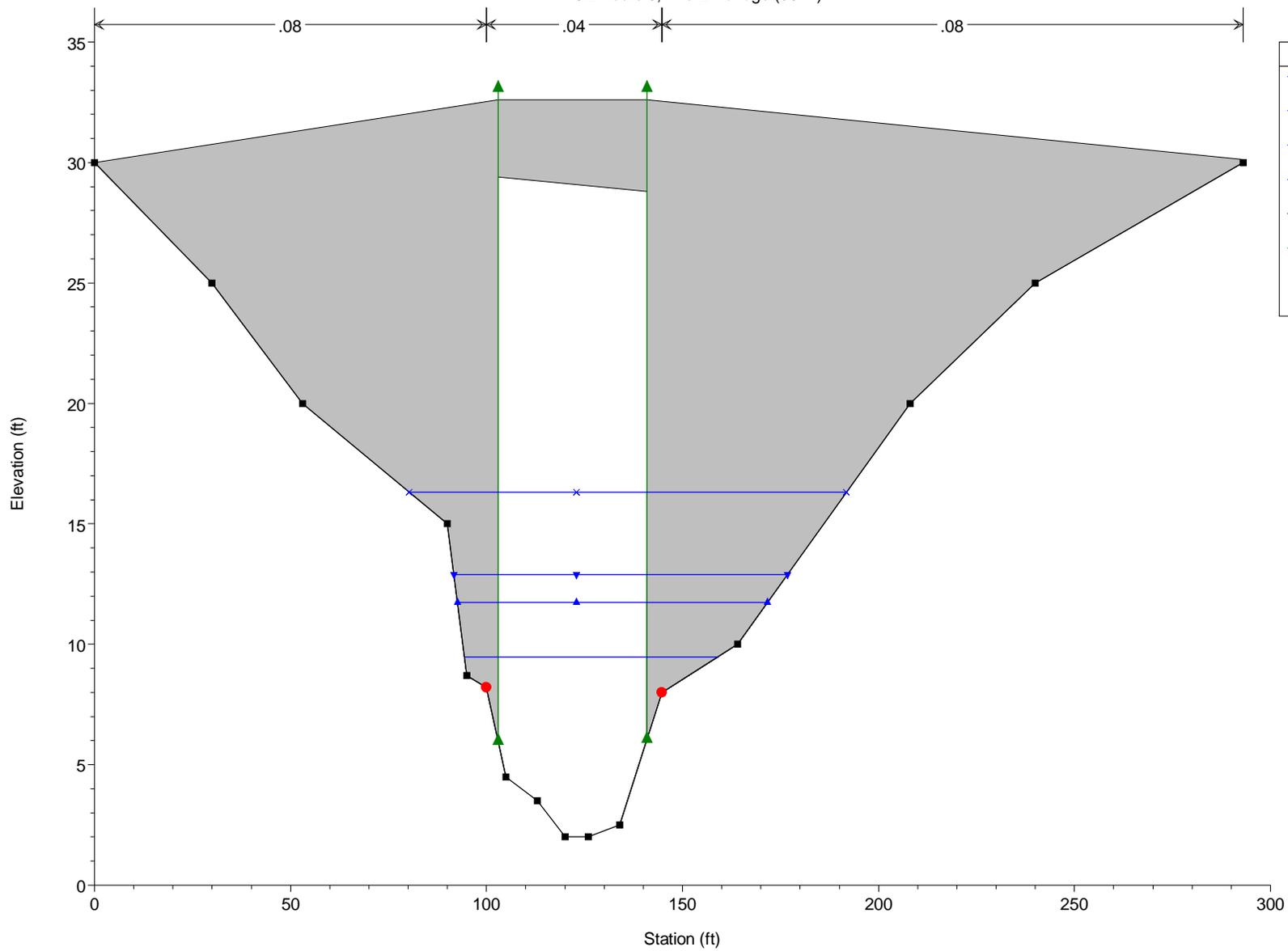
Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Bond Brook	1042.5*	100-yr	2800.00	1.25	12.34		12.93	0.001436	6.53	615.77	117.93	0.37
Bond Brook	1042.5*	500-yr	4210.00	1.25	16.18		16.63	0.000813	6.14	1128.77	149.45	0.30
Bond Brook	951.25*	10-yr	1390.00	0.97	8.20		8.71	0.001962	5.78	264.77	61.30	0.42
Bond Brook	951.25*	50-yr	2310.00	0.97	10.87		11.44	0.001403	6.29	464.03	91.31	0.38
Bond Brook	951.25*	100-yr	2800.00	0.97	12.24		12.81	0.001171	6.34	598.33	104.73	0.36
Bond Brook	951.25*	500-yr	4210.00	0.97	16.06		16.56	0.000727	6.22	1062.87	136.61	0.30
Bond Brook	860	10-yr	1390.00	0.70	8.10		8.53	0.001498	5.35	281.44	58.98	0.38
Bond Brook	860	50-yr	2310.00	0.70	10.79		11.32	0.001135	5.95	471.50	84.60	0.35
Bond Brook	860	100-yr	2800.00	0.70	12.17		12.70	0.000975	6.08	595.11	95.02	0.34
Bond Brook	860	500-yr	4210.00	0.70	15.99		16.50	0.000654	6.16	1013.41	123.94	0.29
Bond Brook	750.*	10-yr	1390.00	0.30	7.95		8.37	0.001373	5.31	305.30	70.73	0.37
Bond Brook	750.*	50-yr	2310.00	0.30	10.71		11.18	0.001004	5.78	536.57	94.08	0.34
Bond Brook	750.*	100-yr	2800.00	0.30	12.11		12.58	0.000860	5.88	674.98	103.91	0.32
Bond Brook	750.*	500-yr	4210.00	0.30	15.96		16.42	0.000582	5.96	1128.78	132.13	0.28
Bond Brook	640.*	10-yr	1390.00	-0.10	7.85		8.22	0.001164	5.08	361.12	83.23	0.35
Bond Brook	640.*	50-yr	2310.00	-0.10	10.66		11.06	0.000852	5.49	619.93	100.80	0.31
Bond Brook	640.*	100-yr	2800.00	-0.10	12.07		12.48	0.000738	5.61	768.64	110.05	0.30
Bond Brook	640.*	500-yr	4210.00	-0.10	15.94		16.34	0.000517	5.75	1245.08	137.06	0.26
Bond Brook	530	10-yr	1390.00	-0.50	7.80		8.08	0.000913	4.67	438.10	89.96	0.31
Bond Brook	530	50-yr	2310.00	-0.50	10.63		10.95	0.000706	5.15	714.61	105.62	0.29
Bond Brook	530	100-yr	2800.00	-0.50	12.05		12.38	0.000626	5.30	870.42	114.33	0.28
Bond Brook	530	500-yr	4210.00	-0.50	15.93		16.27	0.000459	5.53	1361.15	139.68	0.25
Bond Brook	468.*	10-yr	1390.00	-0.76	7.73		8.02	0.000916	4.73	438.27	89.35	0.31
Bond Brook	468.*	50-yr	2310.00	-0.76	10.58		10.91	0.000717	5.23	717.10	107.25	0.29
Bond Brook	468.*	100-yr	2800.00	-0.76	12.00		12.34	0.000634	5.38	876.42	116.57	0.28
Bond Brook	468.*	500-yr	4210.00	-0.76	15.90		16.24	0.000463	5.59	1386.86	146.01	0.25
Bond Brook	406.*	10-yr	1390.00	-1.02	7.67		7.96	0.000925	4.81	437.84	89.37	0.31
Bond Brook	406.*	50-yr	2310.00	-1.02	10.53		10.86	0.000727	5.31	721.86	109.45	0.29
Bond Brook	406.*	100-yr	2800.00	-1.02	11.95		12.30	0.000645	5.46	886.42	121.20	0.28
Bond Brook	406.*	500-yr	4210.00	-1.02	15.87		16.21	0.000462	5.62	1418.87	151.06	0.25
Bond Brook	344.*	10-yr	1390.00	-1.28	7.60		7.91	0.000943	4.90	438.00	90.69	0.32

HEC-RAS Plan: Exist\_Cond River: Bond Brook Reach: Bond Brook (Continued)

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
Bond Brook	344.*	50-yr	2310.00	-1.28	10.47		10.82	0.000737	5.39	731.87	113.66	0.30
Bond Brook	344.*	100-yr	2800.00	-1.28	11.92		12.26	0.000645	5.50	902.97	123.77	0.28
Bond Brook	344.*	500-yr	4210.00	-1.28	15.85		16.18	0.000460	5.64	1447.67	153.46	0.25
Bond Brook	282	10-yr	1390.00	-1.54	7.53		7.85	0.000956	4.98	442.77	93.86	0.32
Bond Brook	282	50-yr	2310.00	-1.54	10.43		10.77	0.000733	5.42	742.96	113.45	0.30
Bond Brook	282	100-yr	2800.00	-1.54	11.88		12.22	0.000644	5.54	914.33	123.50	0.28
Bond Brook	282	500-yr	4210.00	-1.54	15.82		16.15	0.000462	5.68	1455.61	151.30	0.25
Bond Brook	220	10-yr	1390.00	-1.80	7.40	3.96	7.78	0.000827	5.43	395.50	71.96	0.35
Bond Brook	220	50-yr	2310.00	-1.80	10.24	5.45	10.71	0.000705	6.19	605.06	80.15	0.34
Bond Brook	220	100-yr	2800.00	-1.80	11.65	6.08	12.16	0.000649	6.47	710.06	84.24	0.33
Bond Brook	220	500-yr	4210.00	-1.80	15.51	7.70	16.09	0.000532	7.06	995.97	95.37	0.31
Bond Brook	195	10-yr	1390.00	-1.90	4.87	4.87	7.16	0.008466	12.14	114.46	56.30	1.00
Bond Brook	195	50-yr	2310.00	-1.90	7.19	6.72	9.98	0.005962	13.39	172.46	63.59	0.90
Bond Brook	195	100-yr	2800.00	-1.90	8.68	7.60	11.45	0.004575	13.36	209.56	67.05	0.81
Bond Brook	195	500-yr	4210.00	-1.90	12.22	9.88	15.31	0.003199	14.13	298.01	75.28	0.72
Bond Brook	155		Culvert									
Bond Brook	120	10-yr	1390.00	-1.90	4.30	4.30	6.59	0.008096	12.15	114.44	56.68	1.00
Bond Brook	120	50-yr	2310.00	-1.90	6.15	6.15	9.36	0.007217	14.38	160.66	62.65	1.00
Bond Brook	120	100-yr	2800.00	-1.90	7.02	7.02	10.68	0.006935	15.34	182.48	65.37	1.00
Bond Brook	120	500-yr	4210.00	-1.90	9.31	9.31	14.10	0.006327	17.57	239.58	72.49	1.00
Bond Brook	80	10-yr	1390.00	-1.90	3.27	3.27	4.49	0.010016	8.87	156.75	64.23	1.00
Bond Brook	80	50-yr	2310.00	-1.90	4.28	4.28	5.93	0.009009	10.32	224.77	69.44	1.00
Bond Brook	80	100-yr	2800.00	-1.90	4.75	4.75	6.61	0.008650	10.95	257.66	71.29	1.00
Bond Brook	80	500-yr	4210.00	-1.90	5.93	5.93	8.33	0.007813	12.48	345.79	80.40	0.99
Bond Brook	0	10-yr	1390.00	-2.10	2.38	1.52	2.81	0.003001	5.34	275.89	114.85	0.57
Bond Brook	0	50-yr	2310.00	-2.10	3.33	2.30	3.98	0.003004	6.51	390.23	124.04	0.59
Bond Brook	0	100-yr	2800.00	-2.10	3.78	2.65	4.52	0.003002	7.01	445.98	128.00	0.61
Bond Brook	0	500-yr	4210.00	-2.10	4.89	3.59	5.89	0.003003	8.21	594.88	139.80	0.63

Bond Brook - Augusta, ME Plan: Existing Condition 3/2/2010

CL Route 8,11 & 27 bridge (3077)



Legend	
WS 500-yr	✕
WS 100-yr	▼
WS 50-yr	▲
WS 10-yr	●
Ground	■
Ineff	▲
Bank Sta	●

Plan: Exist\_Cond Bond Brook Bond Brook RS: 1320 Profile: 100-yr

E.G. US. (ft)	13.81	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	12.91	E.G. Elev (ft)	13.80	13.64
Q Total (cfs)	2800.00	W.S. Elev (ft)	12.90	12.57
Q Bridge (cfs)	2800.00	Crit W.S. (ft)	8.73	9.25
Q Weir (cfs)		Max Chl Dpth (ft)	10.90	10.57
Weir Sta Lft (ft)		Vel Total (ft/s)	7.60	8.33
Weir Sta Rgt (ft)		Flow Area (sq ft)	368.47	336.10
Weir Submerg		Froude # Chl	0.41	0.45
Weir Max Depth (ft)		Specif Force (cu ft)	2471.63	2241.49
Min El Weir Flow (ft)	32.61	Hydr Depth (ft)	9.70	8.84
Min El Prs (ft)	29.40	W.P. Total (ft)	39.58	39.15
Delta EG (ft)	0.18	Conv. Total (cfs)	60573.2	52349.1
Delta WS (ft)	0.37	Top Width (ft)	38.00	38.00
BR Open Area (sq ft)	964.41	Frctn Loss (ft)	0.10	0.01
BR Open Vel (ft/s)	8.33	C & E Loss (ft)	0.05	0.00
Coef of Q		Shear Total (lb/sq ft)	1.24	1.53
Br Sel Method	Energy only	Power Total (lb/ft s)	9.44	12.77