



Scour Critical Bridge
Plan of Action (POA) Report

Form with checkboxes for Full POA and Abbreviated POA

Town: Falmouth
Bridge Number: 5553
Bridge Name: Lambert Street
Feature Carried: Lambert Street
Waterway Crossed: Presumpscot River



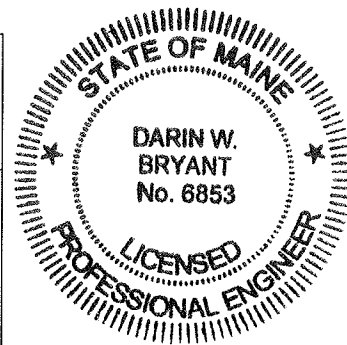
Final Recommended Action section with checkboxes for inspection frequency, flood monitoring, closure triggers, and countermeasures.

The Following Materials Are Being Submitted With This Report: List of attachments with checkboxes.

### Scour Critical Bridge Plan of Action

1. GENERAL INFORMATION				
Structure: Androscoggin River	City, County: Bethel, Oxford		Bridge Number: 6149	
Feature On: Route 2/5/26	Waterway Crossed: Androscoggin River		Owner: State Highway Agency	
Year Built: 1968	Year Reconstruction: N/A	Structure Size and Description: 400 Ft. 3-Span Continuous Plate Girder Bridge on Stub Abutments on Piles and Solid Shaft Piers on Spread Footings.		
Foundation Details <small>(Looking Downstream L to R)</small>	Left Abutment:	Pile Cap Pile Tip	Embedment (ft): 3'+ Embedment (ft): 28'	Exposure (ft): 0.0 Exposure (ft): 0.0
KNOWN <input checked="" type="checkbox"/>	Right Abutment:	Pile Cap Pile Tip	Embedment (ft): 3'+ Embedment (ft): 26'	Exposure (ft): 0.0 Exposure (ft): 0.0
UNKNOWN <input type="checkbox"/>	Pier 1:	Footing Seal	Embedment (ft): 0.0 Embedment (ft): 5.5	Exposure (ft): 3.0 Exposure (ft): 2.5
	Pier 2:	Footing Seal	Embedment (ft): 0.0 Embedment (ft): 7.0	Exposure (ft): 3.0 Exposure (ft): 1.0
	Pier 3:	N/A	Embedment (ft): N/A	Exposure (ft): N/A
Reference Datum: NGVD – Upstream Rt. Curb at Jt. – El = 661.07.				
Scour Critical Elevations(s): <i>(Bottom of Footings)</i>	Left Abutment:	641.00	Right Abutment:	641.00
	Pier 1 – Ftg	623.00	Pier 2 – Ftg	623.00
	Pier 1 - Seal	615.00	Pier 2 - Seal	615.00
	Pier 3:	N/A		

2. RESPONSIBLE FOR POA	
Author(s) of POA (name, title, agency/organization, telephone, email):  Darin Bryant, T.Y. Lin International, (207) 781-4721, darin.bryant@tylin.com	
Signature:	Date: 7-26-2011
Concurrences on POA (name, title, agency/organization, telephone, email):  Assistant Bridge Maintenance Engineer, Date: _____ MaineDOT Bridge Maintenance Division, 207-624-3580	
POA Updated by (name, title, agency/organization):  Assistant Bridge Maintenance Engineer, MaineDOT Bridge Maintenance Division, 207-624-3580	
Date of Update: _____ Items Updated: _____	
Reason for Update: <input type="checkbox"/> Inspection Cycle <input type="checkbox"/> Monitoring Event <input type="checkbox"/> Post Flood Inspection	
POA Updated Every _____ months by (name, title, agency, organization):	Assistant Bridge Maintenance Engineer, MaineDOT 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:    Observed    Assessment    Calculated    Other

Scour Evaluation Summary:  
 High potential for contraction scour and local pier scour. Bed material is highly scourable. Reported Q<sub>500</sub> below low chord, although bridge inspection report photos show debris on bridge seat. The abutments are setback from channel, right abutment pile cap exposed, riprap slopes in front of abutments in good condition. Heavy riprap in good condition on left side of left pier footing and on right side of right pier footing and there is no footing exposure in these areas. The HEC-RAS calculated scour results indicate critical scour under flows less than the 10 year event, but based on historic performance this is considered overly conservative. Bridge considered unstable for assessed scour for a storm even with a recurrence interval > 10-years, a discharge > 10,162 cfs, and corresponding bridge upstream water surface elevation of 41.3' corresponding to the assessed scour critical condition for the bridge.

Scour History:  
 Thalweg has not moved horizontally since construction. Bridge circa 1961 has withstood at least one flood event >Q100 in 1996 and inspection indicated some scour occurred. Right and left upstream pier footings exposed up to 1.5' based on soundings. 1997 underwater inspection indicates footing exposure of up to 2' for right pier and 6' for left pier. However, there is no riprap on left side of right pier footing and right side of left pier footing and footings are exposed in these areas. Comparison between 1961 and current measured cross sections only indicate minor changes in the stream cross section. Thalweg is near bottom of pier footing.

**4. NBI CODING INFORMATION**

		<u>Current</u>	<u>Previous</u>
	Inspection Date	8/11/09	8/01/07
Item 113	Scour Critical	3	3
Item 60	Substructure	5	5
Item 61	Channel & Channel Protection	5	4
Item 71	Waterway Adequacy	9	6

**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. Post Flood Inspection:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> No	
e. Hydraulic/Structural Countermeasures:	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Yes	<input type="checkbox"/> No	

6. MONITORING PROGRAM RECOMMENDATION	
<b>6a. Regular Inspection Cycle</b> <input type="checkbox"/> Annual <input checked="" type="checkbox"/> Biennial <input checked="" type="checkbox"/> Riverbed Profile Readings - Upstream face <input checked="" type="checkbox"/> Riverbed Profile Readings - Downstream face <input type="checkbox"/> Surveyed Cross-section(s)	<b>Items to Watch:</b> Changes in streambed section. Changes in abutment and pier pile cap embedment and exposure. Condition of abutment riprap slopes. Debris collection at piers.
<b>Underwater Inspection Required:</b> <input checked="" type="checkbox"/> 4 Year Cycle <input type="checkbox"/> 2 Year Cycle <input type="checkbox"/> 1 Year Cycle	<b>Items to Watch:</b> Changes in pier pile cap embedment and exposure. Potential undermining of pier pile caps on sides near middle of channel.

<b>6b. Fixed Monitoring Device(s)</b> <input checked="" type="checkbox"/> Not Applicable
Type of Instrument:
Installation Location(s):
Routine Sample Interval: <input type="checkbox"/> 30 minute <input type="checkbox"/> 1 hour <input type="checkbox"/> 6 hours <input type="checkbox"/> 12 hours <input type="checkbox"/> Other
Frequency of Data Download and Review: <input type="checkbox"/> Daily <input type="checkbox"/> Weekly <input type="checkbox"/> Monthly <input type="checkbox"/> Other
Event Sample Interval: <input type="checkbox"/> Continual <input type="checkbox"/> 10 min <input type="checkbox"/> 30 min <input type="checkbox"/> 1 hour <input type="checkbox"/> Other
Frequency of Data Download and Review <input type="checkbox"/> 1 hour <input type="checkbox"/> 3 hour <input type="checkbox"/> 6 hour <input type="checkbox"/> Other
Action(s) Required if Scour Critical Elevation Detected:
Criteria for Termination For Fixed Monitoring:

<b>6c. Flood Monitoring Program</b>	During Inspection Event Look For: Stage discharge above 9,890 cfs at USGS Gage Station #01064118, water surface elevation 41.3 at bridge, measured streambed below 14.4 at piers, or displacement of abutment riprap.		
	Type:	<input checked="" type="checkbox"/> Visual Inspection <input checked="" type="checkbox"/> Instrument	(Check all that apply) <input checked="" type="checkbox"/> Portable <input type="checkbox"/> Geophysical <input type="checkbox"/> Sonar <input type="checkbox"/> Other:
Flood Monitoring event defined by: (Check all that apply)			
<input type="checkbox"/> Stage (Water Surface Elevation) (ft)	<input type="checkbox"/> USGS Gage Station	Station #:	
<input type="checkbox"/> Discharge - (cfs)	<input type="checkbox"/> Other		
<input checked="" type="checkbox"/> Notified by Public			
<input checked="" type="checkbox"/> Flood Warning Issued by National Weather Service			
<input checked="" type="checkbox"/> DOT Situation Report			
Scour Monitoring event defined by: (Check all that apply)			
<input type="checkbox"/> Stage (Water Surface Elevation) (ft)	<input type="checkbox"/> USGS Gage Station	Station #:	
<input type="checkbox"/> Discharge (cfs)			
<input checked="" type="checkbox"/> Flood Warning Issued by National Weather Service			
Frequency of Flood Monitoring: <input type="checkbox"/> Continual <input type="checkbox"/> 3 hours <input checked="" type="checkbox"/> 12 hours <input type="checkbox"/> Daily			
Criteria to End Flood Monitoring: <input checked="" type="checkbox"/> Revisit Bridge <input checked="" type="checkbox"/> Recommended Post Flood Inspection (check all that apply) <input checked="" type="checkbox"/> Close Bridge <input checked="" type="checkbox"/> Conditions Stable / Water Receding			
Action(s) required if Scour Critical Elevation Detected: Detour traffic (see Section 7). Close bridge (see Section 8). Post-flood Inspection (see Section 6.d.).			

<b>6d. Post-Flood Inspection Tasks Required</b>	Items to Watch:
<input checked="" type="checkbox"/> Visual Inspection	Changes in streambed section. Changes in abutment and pier pile cap embedment and exposure. Condition of abutment riprap slopes. Debris collection at piers.
<input checked="" type="checkbox"/> Riverbed Profile Readings – Upstream and downstream face	
<input checked="" type="checkbox"/> Profile at Substructure	
<input checked="" type="checkbox"/> Underwater Inspection	
<input checked="" type="checkbox"/> Probing	
Agency and Department Responsible for Monitoring:  MaineDOT Bridge Maintenance Division	
Contact Person (name, title, agency/organization, telephone, email):  Bridge Maintenance Engineer, MaineDOT Bridge Maintenance Division, 207-624-3580 Assistant Bridge Maintenance Engineer, MaineDOT Bridge Maintenance Division, 207-624-3580	

7. DETOUR ROUTE						
Detour Route Description: Rte 26 to Leighton to Brook Rd back to Black Strap						
Bridges on Detour Route:						
Bridge Number	Feature On	Feature Under	Item 113	Load Posting/Weight (tons)	Vertical Clearance (feet)	Width Restrictions (feet)
0283	Blackstrap Road	MTPK	N	-	-	-
0361	Leighton Road	MTPK	N	-	-	-
0365	Auburn St/Fal Spur	MTPK Spur	N	-	-	-
2702	Routes 26 & 100	MCRR & Presumpscot	8	-	-	-
Traffic Control Equipment and Storage location(s): TBD by MaineDOT						
Additional Considerations or Critical Issues: TBD by MaineDOT						
News Release, Other Public Notice Information to be provided and limitations: Public Information Officer, Office of Communications, 624-3030						

8. BRIDGE CLOSURE PLAN	
Criteria For Consideration of Bridge Closure: <i>(Check all that apply)</i>	
<input type="checkbox"/> Water Surface Elevation Reaches Low Chord	<input type="checkbox"/> Overtopping Road or Structure
<input checked="" type="checkbox"/> Water Reaches Closure Elevation: 41.3 ft 12.3 ft below Low Chord (10-yr WSE), Placard	<input checked="" type="checkbox"/> Scour Measurement Results / Monitoring Devices
	<input checked="" type="checkbox"/> Observed Structure Movement / Settlement
<input type="checkbox"/> USGS Gage Station #	<input type="checkbox"/> Stage (WSE)      ft
	<input type="checkbox"/> Discharge      cfs
<input checked="" type="checkbox"/> Other	<input checked="" type="checkbox"/> Debris Accumulation <input checked="" type="checkbox"/> Movement of Riprap / Other Armor Protection
	<input checked="" type="checkbox"/> Loss of Road Embankment <input checked="" type="checkbox"/> Ice Jam
Agency and Department Responsible for Closure:	
<input checked="" type="checkbox"/> DOT	<input type="checkbox"/> Municipality <input type="checkbox"/> Other
Contact Person(s) (name, title, telephone, e-mail): MaineDOT Radio Operations, 207-624-3339	

9. BRIDGE REOPENING PLAN	
9a. Criteria for Consideration to Complete Interim Bridge Reopening: <i>(Check all that apply)</i>	
<input checked="" type="checkbox"/> Water Surface Levels Dropping	<input checked="" type="checkbox"/> Reasons for Closure Have Abated
<input checked="" type="checkbox"/> Critical Elevation Marker Is Visible	
Agency and Person Responsible for Interim Bridge Reopening After Inspection:	
Region Manager Region Engineer Region Superintendent	
9b. Criteria for Completing Bridge Reopening Process: <i>(Check all that apply)</i>	
<input checked="" type="checkbox"/> Riverbed Elevation Verified (drop line readings)	<input checked="" type="checkbox"/> Post Flood Inspection Completed
<input checked="" type="checkbox"/> Streambed Elevation Drops Less Than 0.0 ft	<input checked="" type="checkbox"/> Diving Inspection Completed
Agency and Person Responsible for Completing Bridge Reopening:	
Bridge Maintenance Engineer, MaineDOT Bridge Maintenance Division, 207-624-3580 Assistant Bridge Maintenance Engineer, MaineDOT Bridge Maintenance Division, 207-624-3580	

10. COUNTERMEASURE RECOMMENDATIONS	
<i>Include Information on Hydraulic, Structural, or Monitoring Countermeasures</i>	
Conceptual Structural / Hydraulic Countermeasures:	
	Priority                      Estimated Cost
(1) Concrete cable mat or grout mat at Piers	<input checked="" type="checkbox"/> High <input type="checkbox"/> Medium <input type="checkbox"/> Low
(2) Monitoring	<input checked="" type="checkbox"/> High <input type="checkbox"/> Medium <input type="checkbox"/> Low
(3)	<input type="checkbox"/> High <input type="checkbox"/> Medium <input type="checkbox"/> Low
Basis for the Selection of the Preferred Scour Countermeasure:	Relative cost, water depth at normal flow, and available underclearance. Barge access likely required to install countermeasures.
Recommended Countermeasure to be Performed by:	
<input type="checkbox"/> Maintenance <input type="checkbox"/> Bridge Program <input type="checkbox"/> Highway Program <input type="checkbox"/> Other:	
Recommended Completion Date	
Contact Person(s): (name, title, telephone, e-mail):	
Bridge Maintenance Engineer, MaineDOT Bridge Maintenance Division, 207-624-3580 Assistant Bridge Maintenance Engineer, MaineDOT Bridge Maintenance Division, 207-624-3580	

# **ATTACHMENT A**

**Maine Department of Transportation**  
**Bridge Scour Evaluation**  
**Hydraulic, Scour & Structural Stability Analysis Summary**

Town: Falmouth                      Bridge Name: Lambert St.                      Bridge #: 5553  
 Feature Carried: Lambert St.                      Stream: Presumpscot River  
 By: EOB                      Date: 7/9/2010                      Check By: RMH                      Date: 12/23/10  
 MDOT PIN: 15631.10                      TYLI Project No.: 411588.00

**Hydrology & Hydraulic Analysis:**

Discharge data for the 10, 50, 100 & 500 year recurrence intervals (Q10, Q50, Q100 & Q500) provided by MaineDOT Hydraulics Unit. Bridge not expected to overtop up to 500-year flood. Scour critical discharge derived for the discharge 10-year storm. The U.S. Army Corps of Engineers HEC-RAS River Analysis System computer program (ver. 4.0) was used to perform all of the backwater calculations. All elevations are based on an assumed datum (reference bridge datum elevation and location: El. 59.41, upstream right Top of Curb.)

Critical hydraulic discharge conditions for the existing bridge are summarized as follows:

Discharge Event	Discharge (cfs)	Headwater El. At Bridge (ft) (1)	Maximum Discharge Velocity (ft/sec) (2)
500-year	<u>28690</u>	<u>53.5</u>	<u>9.4</u>
100-year	<u>19357</u>	<u>48.3</u>	<u>8.4</u>
10-year	<u>10162</u>	<u>41.3</u>	<u>7.2</u>

(1) Headwater elevation at bridge reported for contracted cross section located at the upstream side of the bridge.

(2) Largest of discharge velocity reported for contracted cross section located at the upstream inside or downstream inside section of the bridge.

**Scour Analysis:**

Scour computations were performed according to the FHWA Hydraulic Engineering Circular No. 18 (HEC-18), Evaluating Scour at Bridges, 4<sup>th</sup> edition (2001). The U.S. Army Corps of Engineers HEC-RAS River Analysis System computer program (ver. 4.0) was used to perform the scour calculations. Supplemental hand computations were performed to evaluate scour for complex piers for the 10-YR event using the superposition method outlined in HEC-18. Additional pile stability analysis calculations were performed to evaluate risk of failure in the pier pile groups due to the calculated scour depths and exposure of piles. Top and bottom of footing (TOF and BOF) elevations and estimated total scour elevations at the abutments and piers are summarized as follows:

	Left Abut.	Pier 1	Pier 2	Right Abut.
TOF El. (ft)	<u>49.5</u>	<u>26</u>	<u>26</u>	<u>50.2</u>
BOF El. (ft)	<u>46.5</u>	<u>20</u>	<u>20</u>	<u>47.2</u>
Pile Tip El. (ft)	<u>+/- -25</u>	<u>+/- -20***</u>	<u>+/- -20***</u>	<u>+/- -25</u>
500-year El.	<u>*</u>	<u>-7.4**</u>	<u>-12.9**</u>	<u>*</u>
10-year El.	<u>*</u>	<u>1.3</u>	<u>0.8</u>	<u>*</u>

\* Abutment scour was not computed. Abutments do not significantly restrict flow. Abutments are supported on timber piles and are located near the top of the slope, and slopes are protected by riprap in good condition. Pier scour governs critical scour condition for the bridge.

\*\* Complex pier scour computations not performed. Pier scour critical for lesser event.

\*\* Plans indicate 2/3 of piles in group founded at Elev. -20 or at practical refusal and 1/3 of piles in group founded at practical refusal and below Elev. -5.

**Conclusion:** Bridge considered to be unstable for calculated scour for a storm event with a recurrence interval of 10-years, a discharge of 10,162 cfs, and corresponding inside bridge upstream water surface elevation of 41.3 feet which corresponds to the calculated scour critical condition for the bridge.

The HEC-RAS calculated scour results indicate critical scour under flows less than the 10-YR event, but this is considered overly conservative. Based on a review of the historic flood data for the Presumpscot River, the bridge has been subject to one flood event greater than 100-YR and has a history of notable pier scour, but not to the depth determined by analysis and no evidence of abutment scour or pier movement. The soil strata consists of an upper layer of silty sand over silty clay. Although the same total scour depths may be achieved in cohesive soils as non-cohesive soils, it is known that the duration of exposure to high flows has a significant influence on the actual scour depth. The bridge site is susceptible to contraction scour to depths of 5.6 ft and 20 ft for the 10-YR and 500-YR events respectively. Although scour is computed to occur for flows lower than a 10-year event, the observed site conditions and historic performance support using the 10-year storm as the scour critical event. In the 1990 underwater inspection, pier bottom of footing was exposed but the bridge withstood a greater than 100-year storm in 1996. Pile structural analysis calculations consider bearing capacity, buckling capacity, and lateral movement. Structural evaluations indicate high risk of failures for bearing, lateral movement, and buckling capacity for the scour event. Computed capacity/demand ratios for the governing buckling capacity are 69% and 66% at Piers 1 and 2 respectively for the 10-YR event and 38% and 28% at Piers 1 and 2 respectively for the 500-YR event.

**Recommendations:**

Scour Vulnerability (Long term, Contraction, Abutment and Pier): Contraction and pier scour potential high. Abutment scour potential low. Highly scourable bed. Narrow upstream floodplain. Wide foundation seal constructed just below the bed are exposed by contraction scour. No protection at piers. Sharp angle nosed piers and square nosed pile cap. Piers located within main channel well aligned with the flow. Moderate potential for debris buildup. Pile supported foundations. Storms up to 100-year and no reported evidence of abutment scour.

It is recommended the monitoring begin when a Flood Warning is issued by the National Weather Service and that the bridge be closed at the 10-YR event (10,162 cfs, WSE 41.3).

b. Recommended NBI Ratings:

Item 60: 5

Item 61: 5

Item 71: 9

Item 113: 3

c. POA Recommended (Y/N): Yes

# **ATTACHMENT B**

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



①

Looking right  
from left approach



②

Looking left  
from right approach

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



3

U/S center  
channel



4

U/S channel  
right bank

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



5

U/S channel  
left bank



6

D/S center  
channel

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



7

D/S channel  
left bank



8

D/S channel  
right bank

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



9

Downstream  
face from  
D/S right bank



10

D/S left bank  
from D/S right  
bank showing  
bank erosion

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



11

Looking left  
along approach  
sideslope - swale



12

Right Abutment  
showing minor  
cracks and  
bearing condition

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



13

U/S face &  
left bank  
from U/S  
right bank



14

U/S face &  
right bank  
from U/S  
right bank

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



15

U/S face and  
left bank from  
U/S left bank



16

Left Abutment  
showing slope  
protection

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



17

D/S left bank  
from Left Bank  
Under Bridge  
showing bank  
erosion



18

D/S face of  
right pier from  
D/S right bank  
showing riprap  
to left & deep  
water to right  
where riprap  
is missing

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



19

Looking U/S at right pier from D/S right bank showing riprap condition and extent



20

Looking U/S at slope protection under bridge - showing riprap condition and extent on right bank

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



21

U/S face of right pier from U/S right bank showing riprap to right & deep water to left where riprap is missing



22

Looking U/S at left pier from D/S left bank showing riprap condition and extent

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



23

Looking U/S at slope protection under bridge - showing riprap condition and extent on left bank



24

Looking U/S at left bank from under bridge showing bank erosion

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures

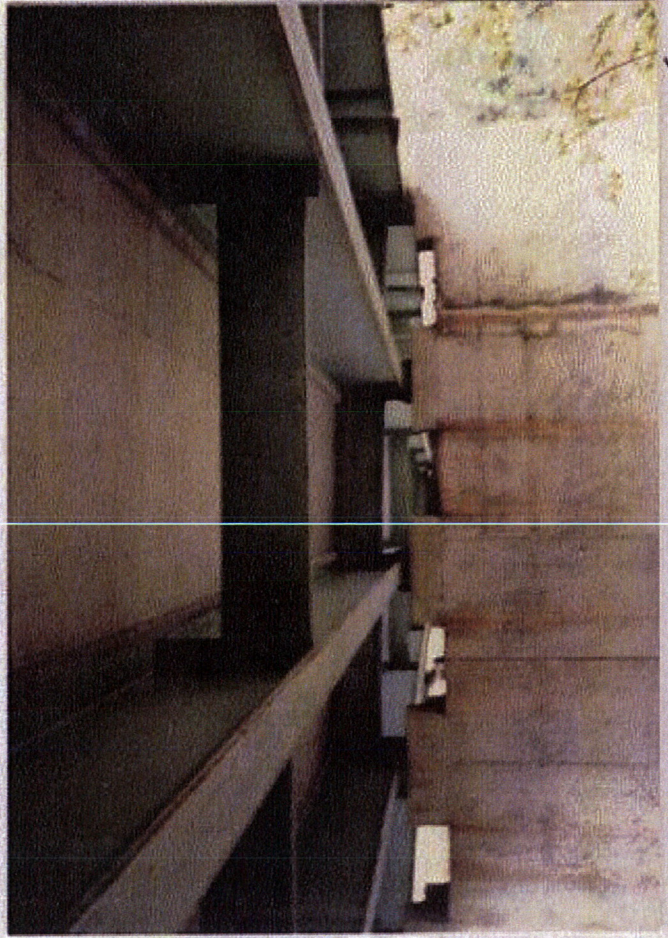
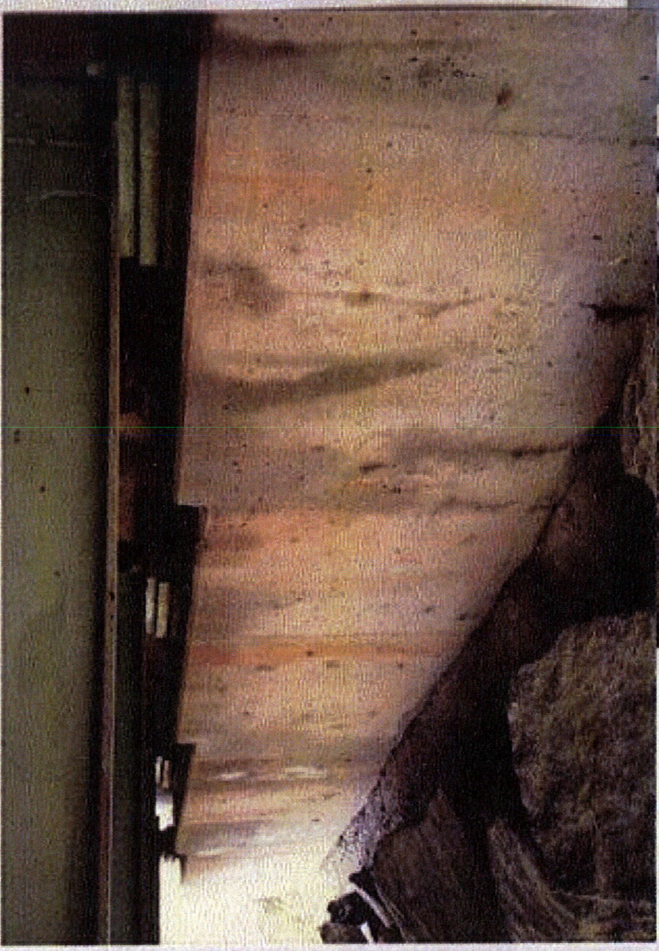


25

Looking right from  
left bank U/S  
of bridge - showing  
right bank erosion



*End post broken*

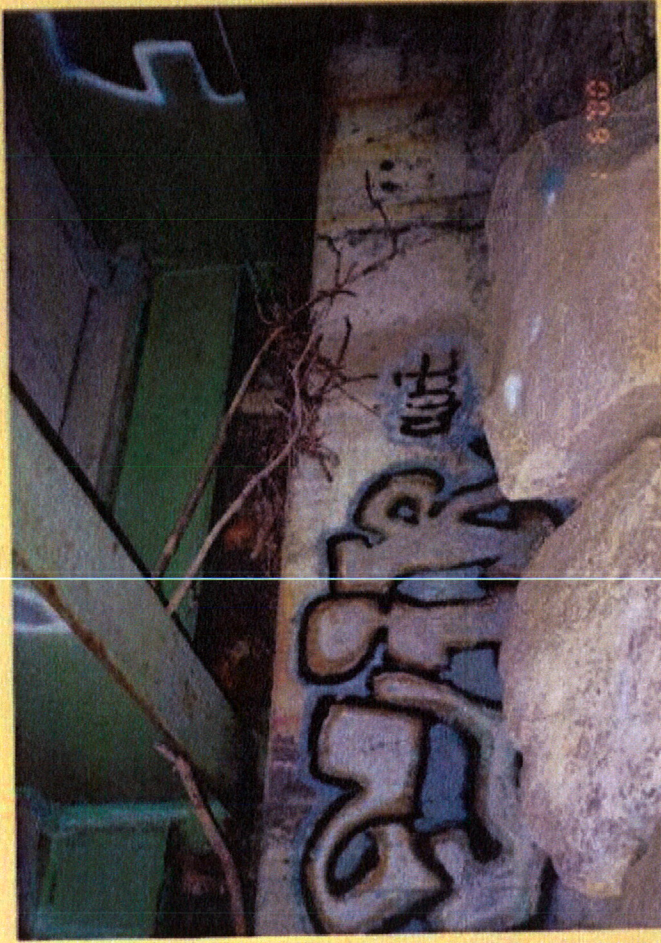


*Felwood, Lambert St.  
# 5553*

*10/7/87*



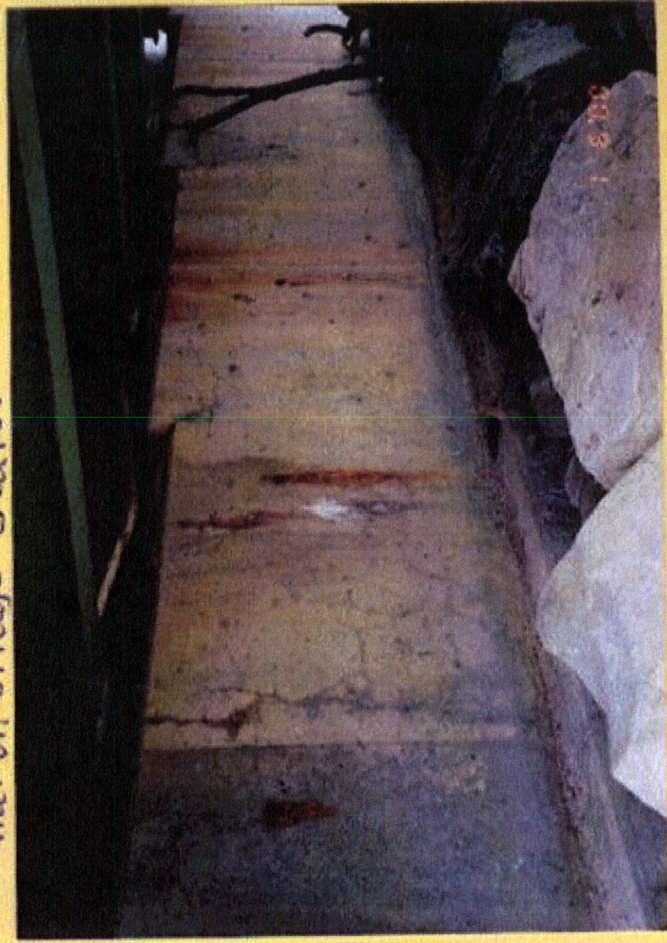
Corrosion defer. w. penetration est.  $\leq 3/16"$ .



At N/ly abut., apparent drift accumulation. Note riprap configuration compared to S/ly abut. # 5553  
FALMOUTH

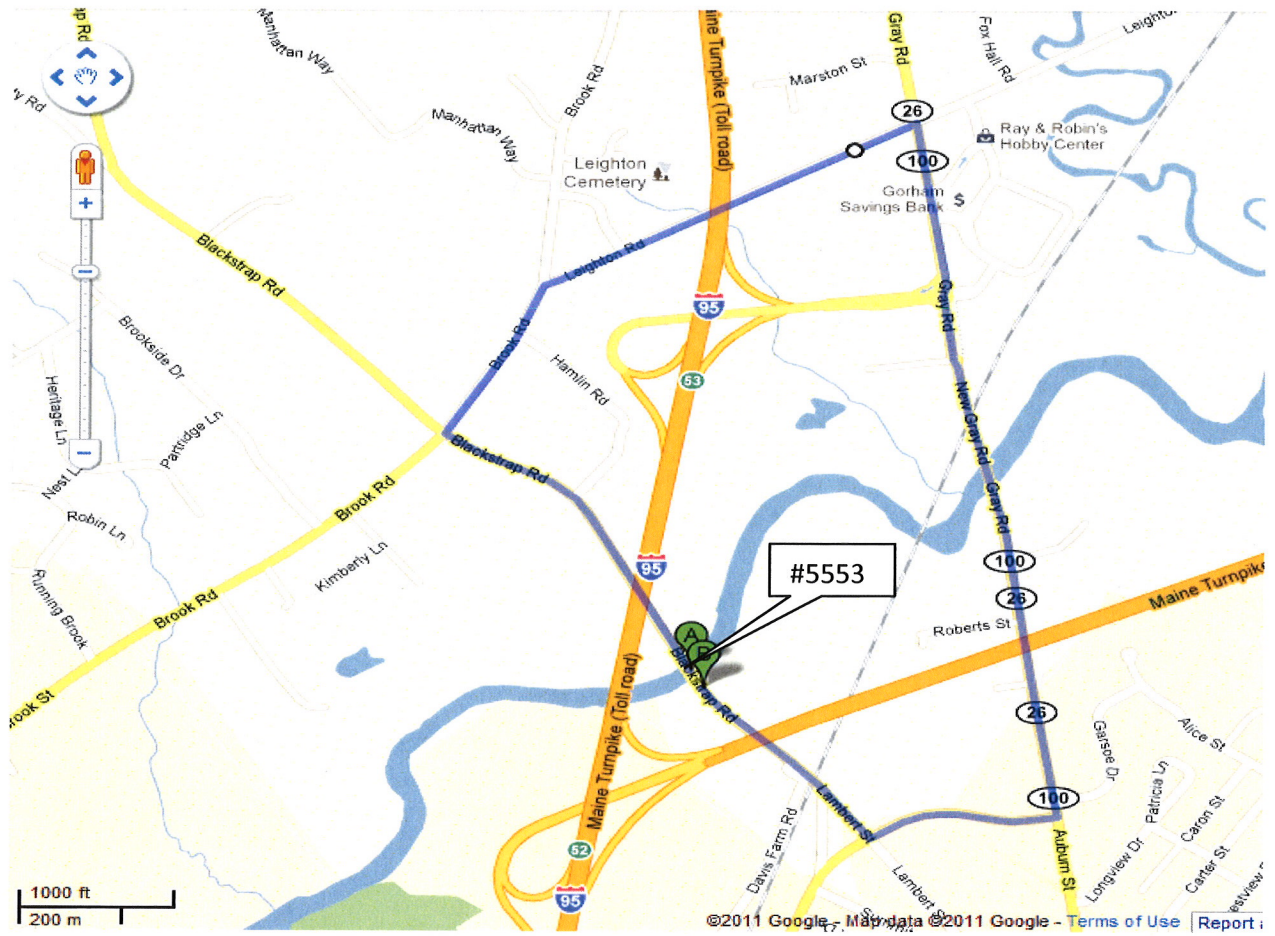


Concrete deterioration. S/ly footing exp'd  $\leq 0.7'$  vertical. Appears to be drift accum. inc. on bridge seats.



Hambert Street  
1/6/2000  
DIV. 6

# **ATTACHMENT C**



Detour Map – Falmouth #5553

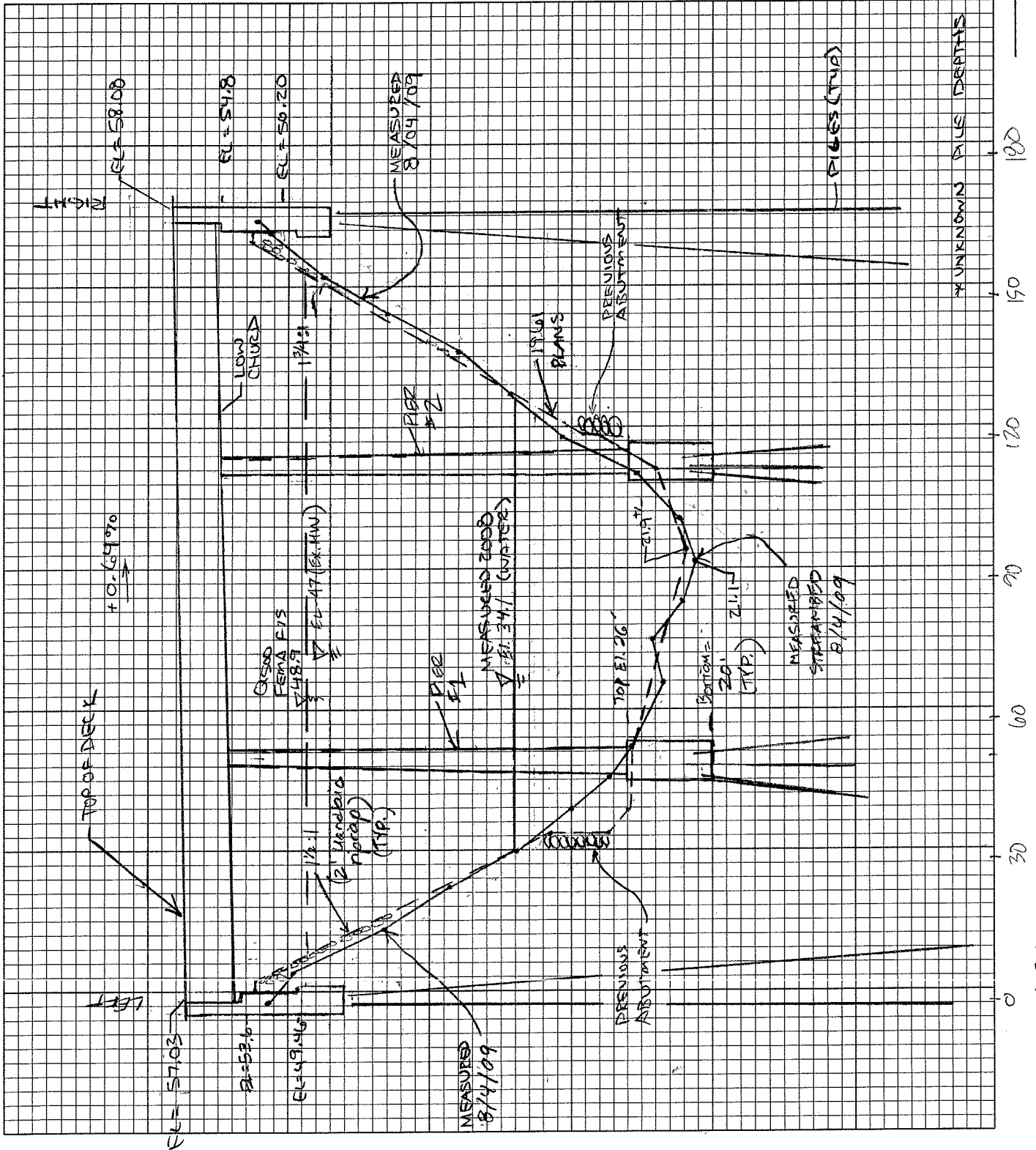
Detour Route Description: Rte 26 to Leighton to Brook Rd back to Black Strap

# **ATTACHMENT D**

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: <u>Lambert St.</u>	Town: <u>Falmouth</u>	Bridge #: <u>SSS 3</u>
Feature Carried: <u>Lambert St.</u>	Stream: <u>Presumpscot Rv.</u>	Review Date:

## Stream Cross Section at Bridge (Upstream Side - Facing Downstream)



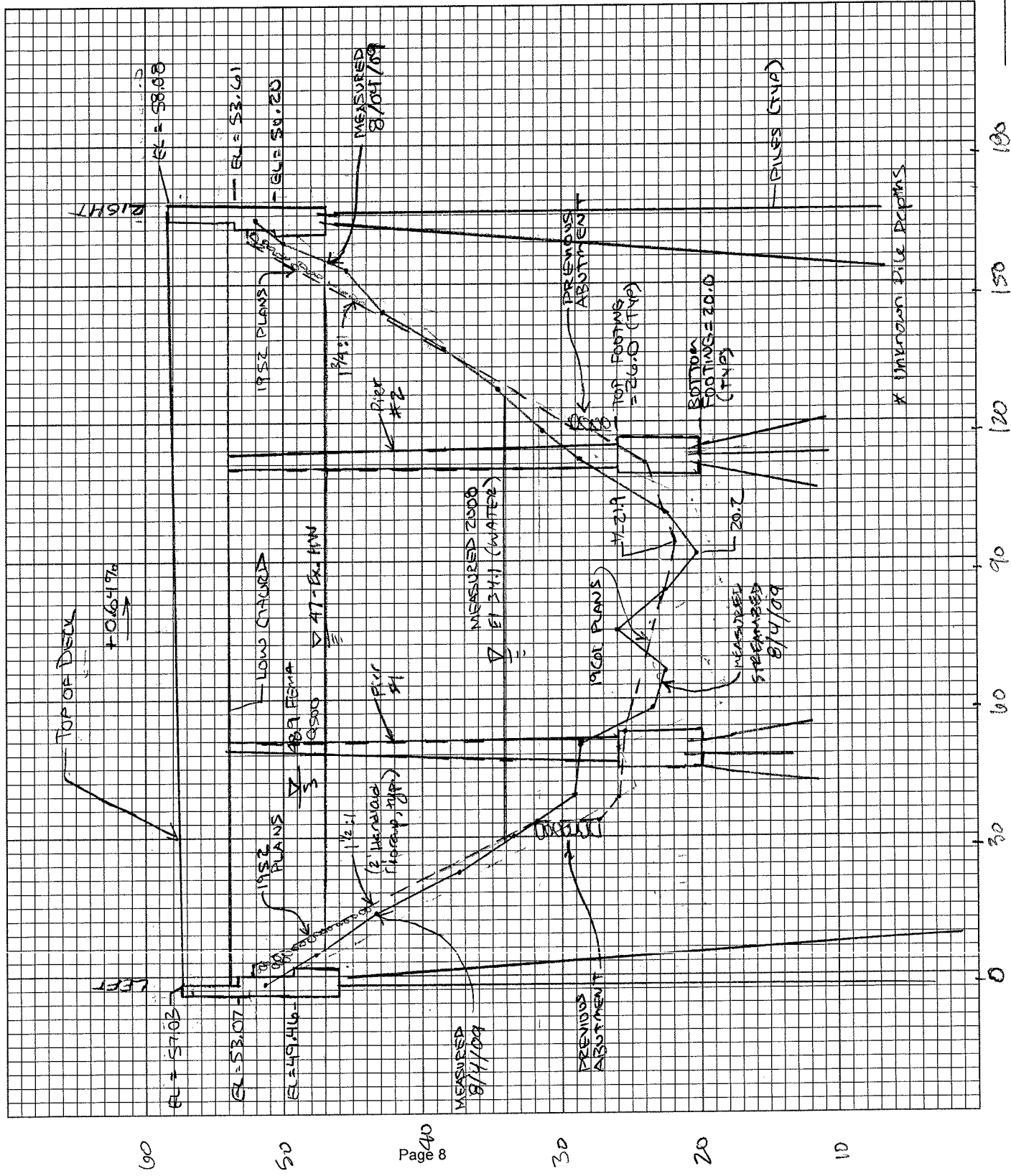
Scale: H 1"=30'  
V 1"=10'

MEASURED 2008  
1961 PLANS

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: <u>Lambert St.</u>	Town: <u>Falmouth</u>	Bridge #: <u>S553</u>
Feature Carried: <u>Lambert St.</u>	Stream: <u>Presumpscot Rv.</u>	Review Date:

## Stream Cross Section at Bridge (Downstream Side - Facing Downstream)

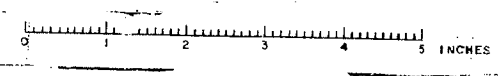
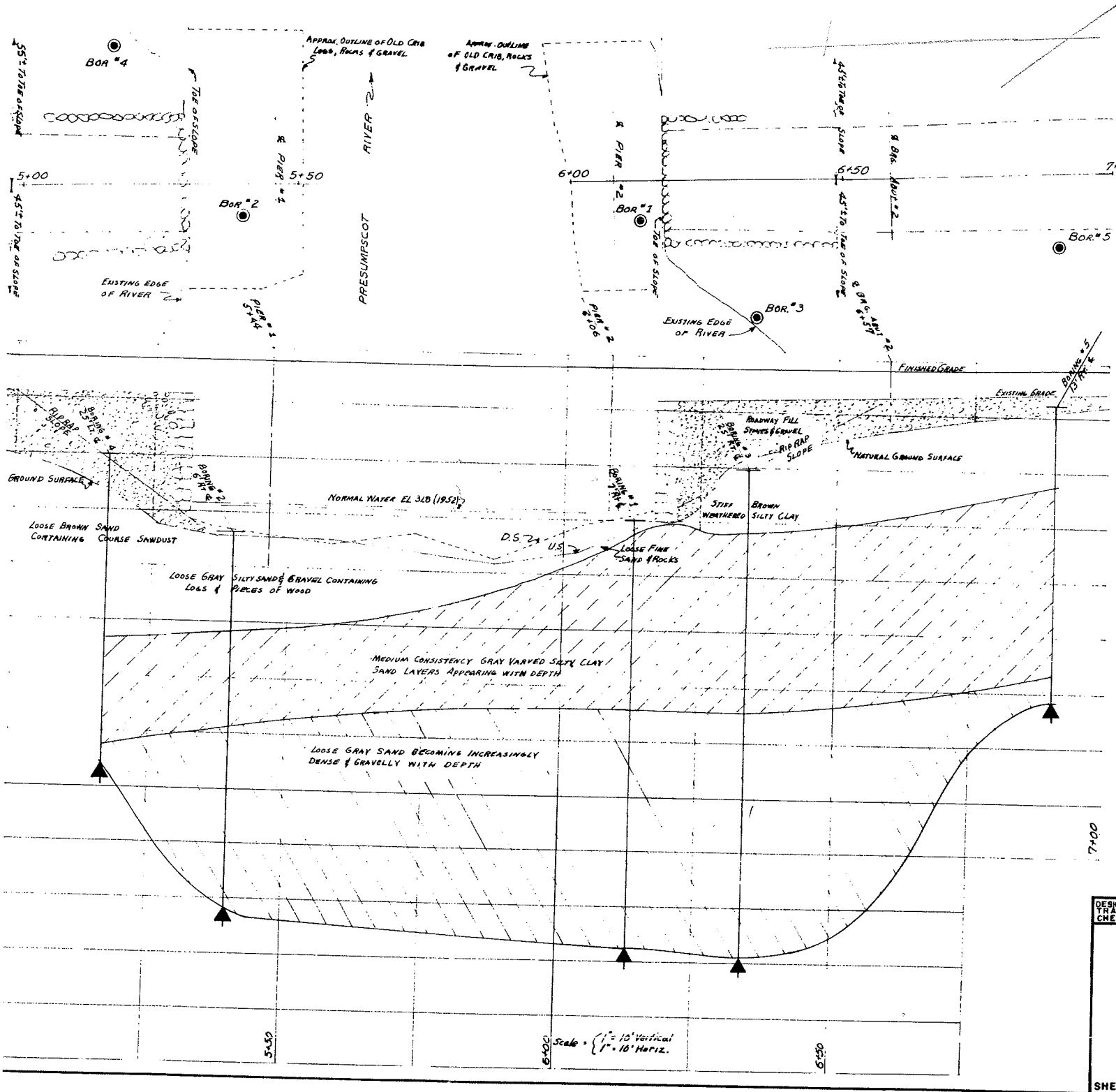


MEASURED 2008  
1961 PLANS

SCALE: H 1" = 30'  
V 1" = 10'

ASSUMED

# **ATTACHMENT E**



DESK  
TRAIL  
CHECK

SHE

# OFFICE/FIELD REVIEW DATA REPORT

Bridge #: 5553

b. Contraction Scour Potential (due to encroachment) Medium

1) Potential for Overbank Flow (Y/N/Unk.): N Left N Right

2) Relief Structure (X): Bridge — Culvert — Location (ft. L/R) —

3) Potential for Over Topping (Y/N/Unk.):

c. Long Term Potential for: Aggradation (Y/N): Y Degradation (Y/N): N

Source of Sediment (X):  Bed Load — Other

d. Bed Material (Circle):

Silt/Clay

Sand

Gravel

Cobbles/Boulder

Bedrock

Other

Bed Material D50 (Visual Classification): .03 mm = d50

## BRIDGE SITE CONDITIONS

5. STREAM CROSS SECTION (X) (See sheet 11):  Upstream Face  Downstream Face

### 6. FLOW CONDITIONS

a. Obstructions/Beaver Dams/Etc... (Describe): —

b. Confluences (L/R, ft. upstream or downstream): N/A

c. High Water Mark

1) Date/Estimated Flood Frequency: Extreme High / Normal / Q500 / Q100

2) Approx. Elev. (Based on bridge datum): 77.0 / 31.8 / 48.9 (33.7 NGVD) / 46.4 (31.1 NGVD)

3) Source/Reliability: Plans - 1961 / Plans 1961 / FEMA FIS / FEMA FIS

d. Feasibility of Adding Riprap or Other Scour Countermeasures (Explain):

rip-rap could be added at piers from barge. Headroom reduces on high end of slope in front of abutments - could add grout bags or mattress.

### 7. BRIDGE DESCRIPTION

a. Description of Bridge/Bridge Type (Single/Multi Span, Continuous/Non-continuous, Superstructure Type):

3-span, non-continuous, steel girder bridge. U/s pier noses tapered, d/s are square

b. Bridge Length (ft): 169'-T Bridge Width (ft): 31' Number of Spans: 3

c. Date Built: 1961

d. Reconstruction/Scour Repairs (Date/Description):

e. Bridge datum (NGVD/Assumed): FROM BRIDGE PLANS Elev. 59.41 Location U/S RT TOP CURB

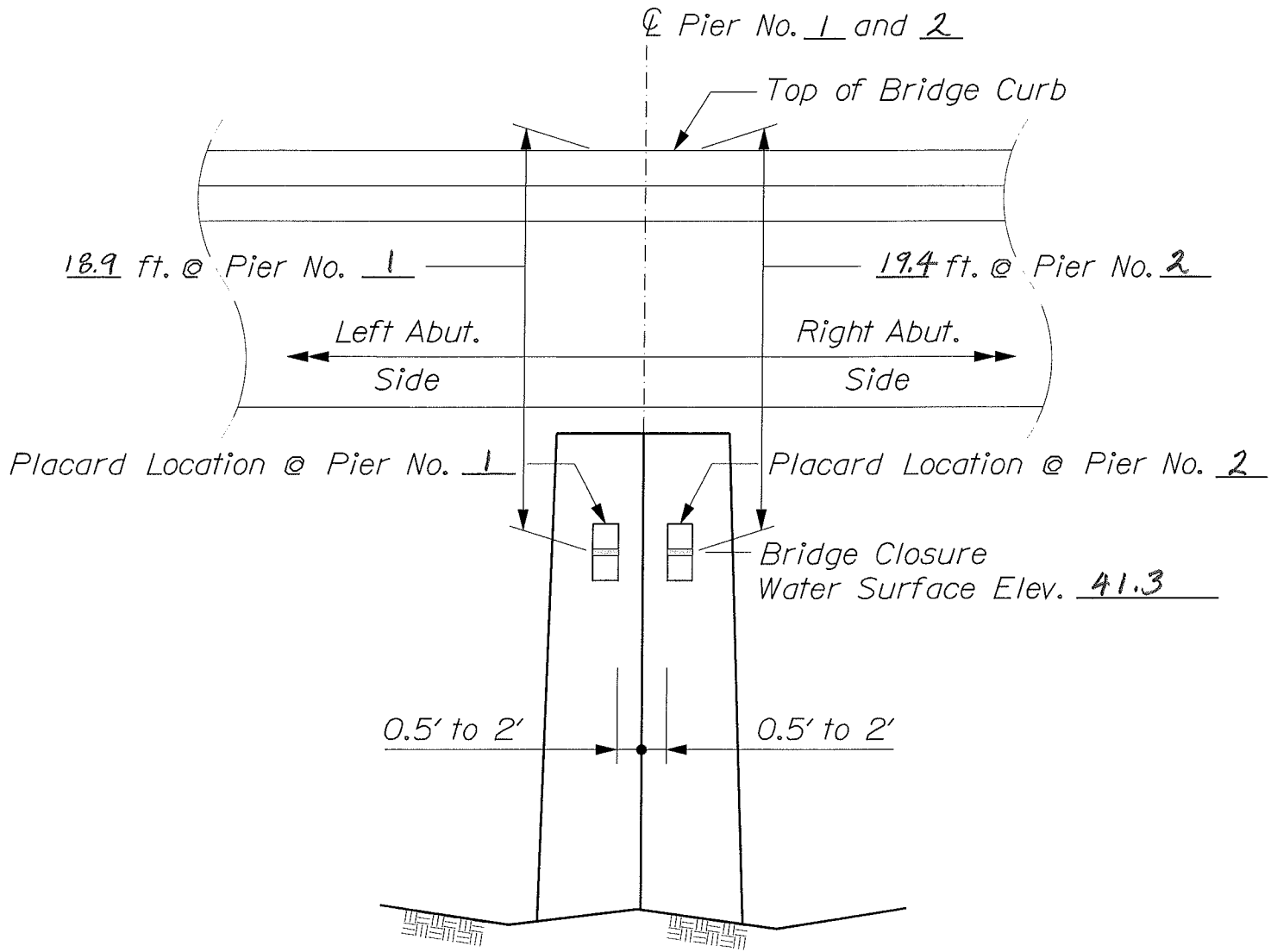
f. Low Chord Elev., (ft): 53.55

g. Bridge Deck Elev., (ft): 57.03 TO 58.00

h. Top of Bank Elevation at Bridge, (ft): 40 (est. from photos, notes, shts 2/14 & 6/14)

i. Overtopping Elev., (ft): 57.0 At Bridge (Y/N): N Approaches (ft. L/R): —

# **ATTACHMENT F**



PIER SIDE ELEVATION  
N.T.S.

NOTES:

1. Bridge shall be monitored for scour for flood warning issued by the National Weather Service.
2. Bridge shall be closed for water surface above Elev. 41.3 corresponding to a discharge Q<sub>10</sub> year event.
3. Two placards shall be located on the upstream side of the pier nose. One placard shall be located on the left side of the left most pier and one placard shall be located on the right side of the right most pier as noted and in the locations shown.

PLACARD INSTALLATION LOCATION

FCMA FIS APRIL 1984

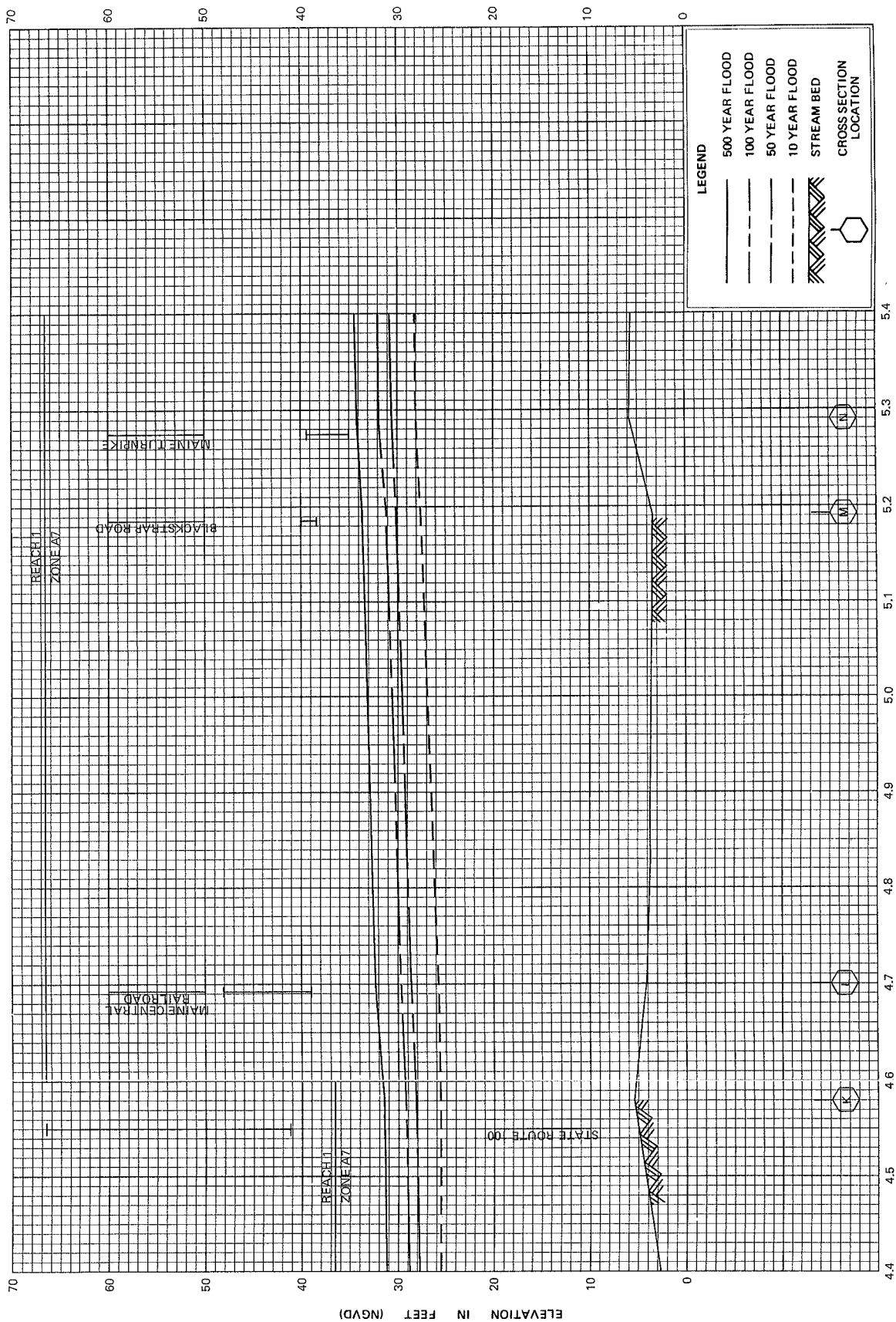
PRESUMPSCOT RIVER

FLOOD PROFILES

TOWN OF FALMOUTH, ME  
(CUMBERLAND CO.)

FEDERAL EMERGENCY MANAGEMENT AGENCY

03P



STREAM DISTANCE IN MILES ABOVE CONFLUENCE WITH CASCO BAY

ELEVATION IN FEET (NGVD)

## 2.2 Community Description

The Town of Falmouth is located in the northeastern portion of Cumberland County in southwestern Maine, and has a total land area of 30.9 square miles. It is bordered by the City of Cumberland to the north, the Town of Windham to the west, and the Cities of Westbrook and Portland to the south.

The climate of Falmouth is moderate, and the mean annual temperature is 45 degrees Fahrenheit (°F). Temperatures range from an average 21.8°F in January to an average of 68.1°F in July. The rainfall averages 42.9 inches annually, and the annual snowfall averages 74.6 inches (Reference 1).

The terrain in Falmouth varies from sea level along the coast and the Presumpscot River to areas of high elevations that reach a maximum of 176 feet. Falmouth is a predominantly suburban community with a population of approximately 6,291 (Reference 2). Areas in the northern parts of the town are relatively undeveloped with some farming and large tracts of open unwooded land. The watersheds of the Presumpscot and Piscataqua Rivers are largely undeveloped, however, there are some residential properties on the Piscataqua. The Highland Lake watershed is moderately developed with residential properties, while most of the properties along the Atlantic coast, Clapboard Island, and Mackworth Island are also residential.

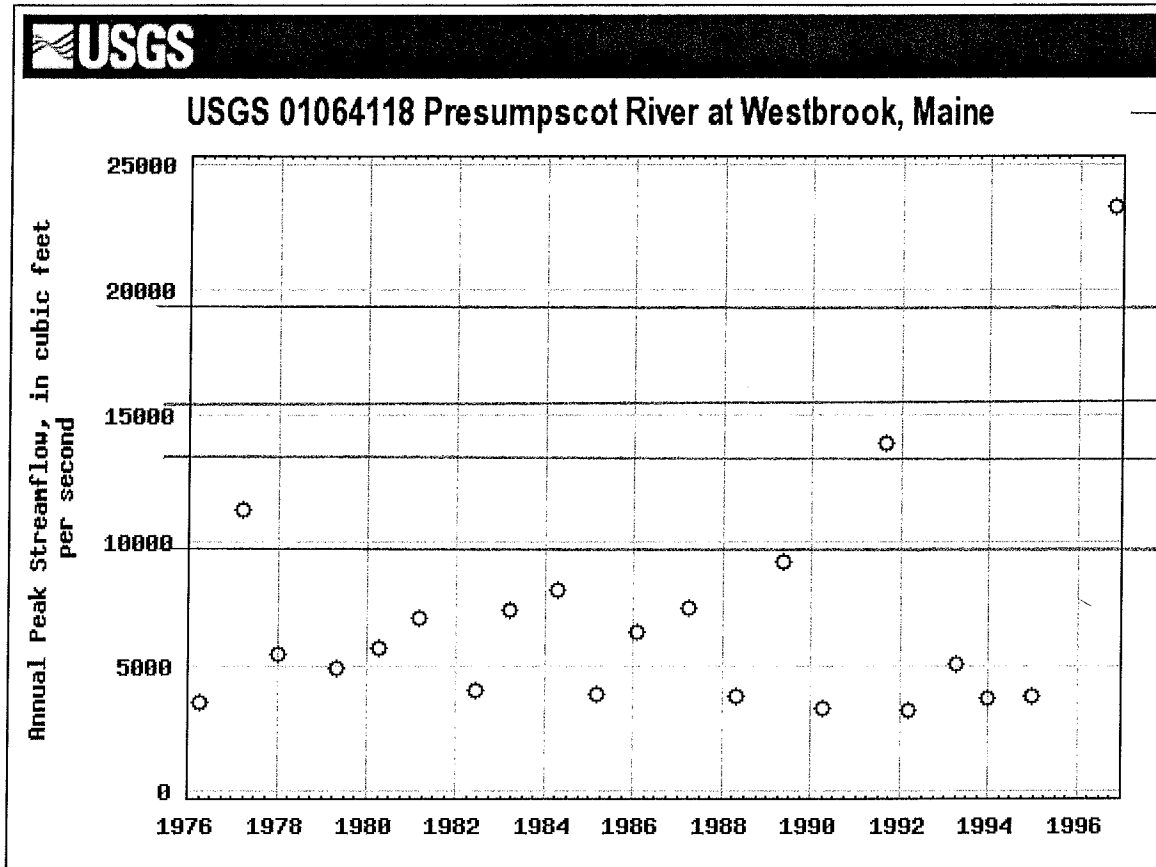
## 2.3 Principal Flood Problems

The Town of Falmouth is subject to severe coastal storms commonly referred to as northeasters, and hurricanes which cause extreme high tide levels and flooding of low-lying areas along the coast and the Presumpscot River. The northeasters can occur at any time of the year but are more prevalent in the winter months, whereas hurricanes occur in the late summer and early fall months.

Tidal levels along Falmouth's coastline are greatly influenced by the force, duration, and direction of winds as well as the distance across open water (fetch) over which these winds act. A northeaster produces high tide levels along the coastline of Falmouth. The winter storm of February 1978 was the storm of record in this area. Storm surge damage occurred along the coast and along the Presumpscot River. Highland Lake sustained some storm damage during the 1973 storm.

## 2.4 Flood Protection Measures

There are no flood protection structures existing or planned in the Town of Falmouth. The Falmouth zoning ordinance has provisions for building



$Q_{500} = 27,973$

$Q_{100}$

$Q_{50}$

$Q_{95}$

$Q_{10}$

Bridg~~e~~ # 5553 (FALM)  
 BUILT 1961

$I > Q_{100}$   
 $Q_{25} < I < Q_{50}$

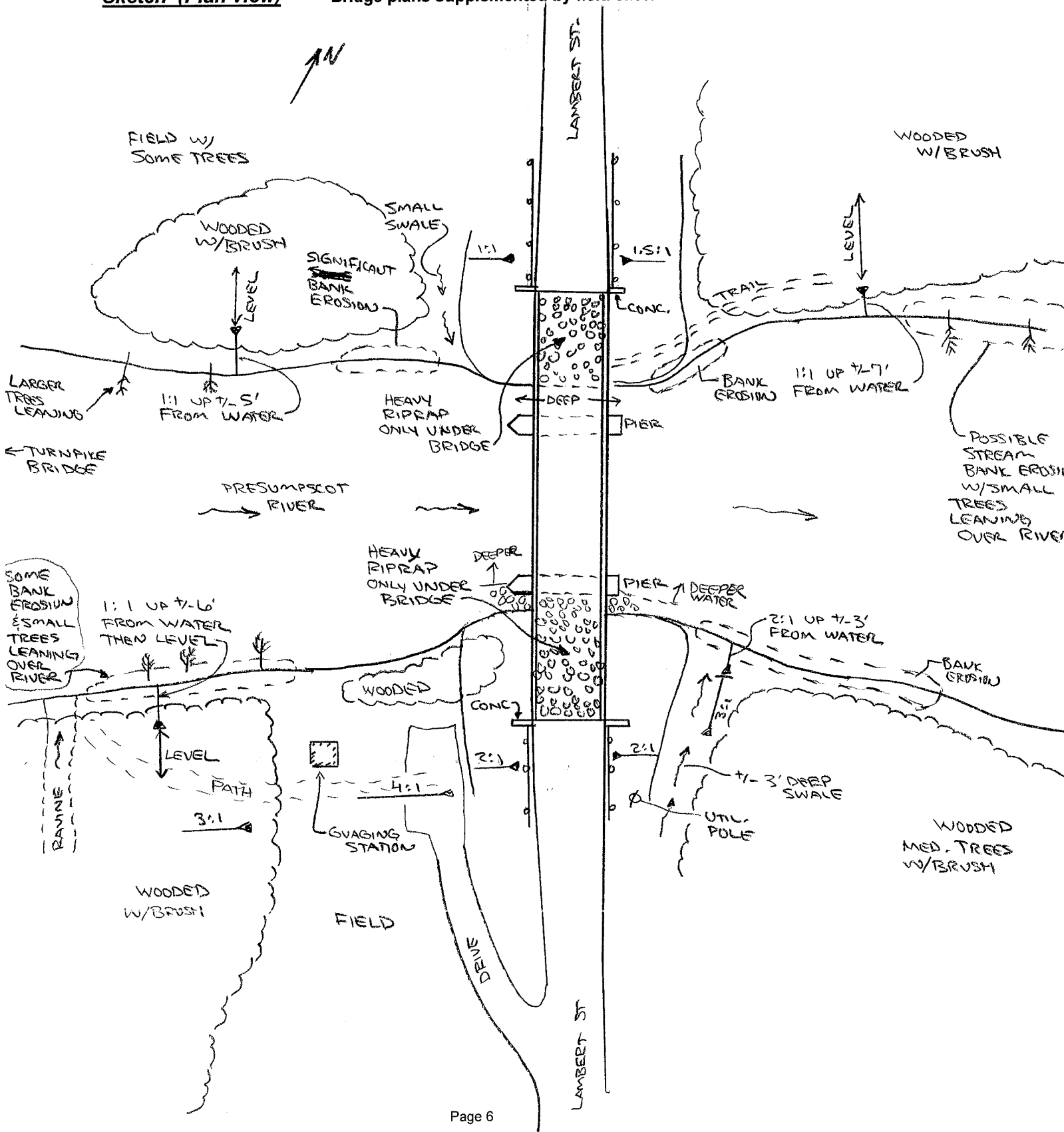
# **ATTACHMENT G**

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: LAMBERT ST.	Town: FALMOUTH	Bridge #: SSS3
Feature Carried: LAMBERT ST.	Stream: PRESUMPSCOT RIVER	Review Date: 12/23/08

**Sketch (Plan view)**

Bridge plans supplemented by field sketch.



# **ATTACHMENT H**

# **ATTACHMENT I**

# **ATTACHMENT J**

# UNDERWATER DIVE INSPECTION FIELD REPORT

Revised May 5, 2005

BridgeNo	5553	DiveID:	4643	Feature On Struc:	SA6 (LAMBERT STREET)
Town1:	Falmouth	Feature Under Struc:	PRESUMPCOT RIVER		
Town2:		Region:	1		
Bridge Name:	LAMBERT STREET				
Location:	1.8 MI N JCT 26				

Tidal: (Y/N) No		Tide Information:	
Dive Entry Loc:	downstream off rt. pier then swim across to lft. pier if current allowable		Photos
Comments/Haz.:	Moderate current - can use ropes Heavy debris on lft. pier nose - full length trees - be careful		
STREAMBED/Comp Material:	Sandy gravel bottom with heavy riprap, boulders Some very large boulders laid up against nose of rt. pier and down channel side. Some deposits along		

**CHANNEL DESCRIPTION / CONDITION:**

Irregular and scour susceptible bottom. Large active scouring at upstream noses of both piers - heavy tree debris contributing.  
Some sand deposits.

**STRUCTURE DESCRIPTION / CONDITION:**

Bridge has 2 conc. piers on sheet pile seals which are both exposed on channel side. Lft. pier seal is undermined on U.S. channel corner up to 12' in max. and 12' hi. Heavy tree debris against seal which has to be removed before any repairs can take place.  
Large boulders against rt. pier seal. ~~Seouring taking place.~~ Recommend changing to 24 mo. cycle until fixed.

Pier shaft conc. in good cond.

NO MAJOR CHANGE IN COND.  
SHOULD BE GROUT REPAIRED.

**INSPECTION TEAM:**

EDWARDS	D	Edwards			
SMALL	D	Hannum	SD		
HANNUM	SD	Falla	D		
BARDEN	SD	McLaughlin	T		

TL = Team Leader, D = Diver, SD = Safety Diver, T = Tender

**DIVE CONDITIONS:**

5:50	Time: Entry:	1:50
6:20	Time: Exit:	2:20
60	Water Temp:	64
4	Visibility (ft.):	5
10	Max Depth (ft.):	12
MODERATE	Current:	moderate
cloudy	Weather:	cloudy

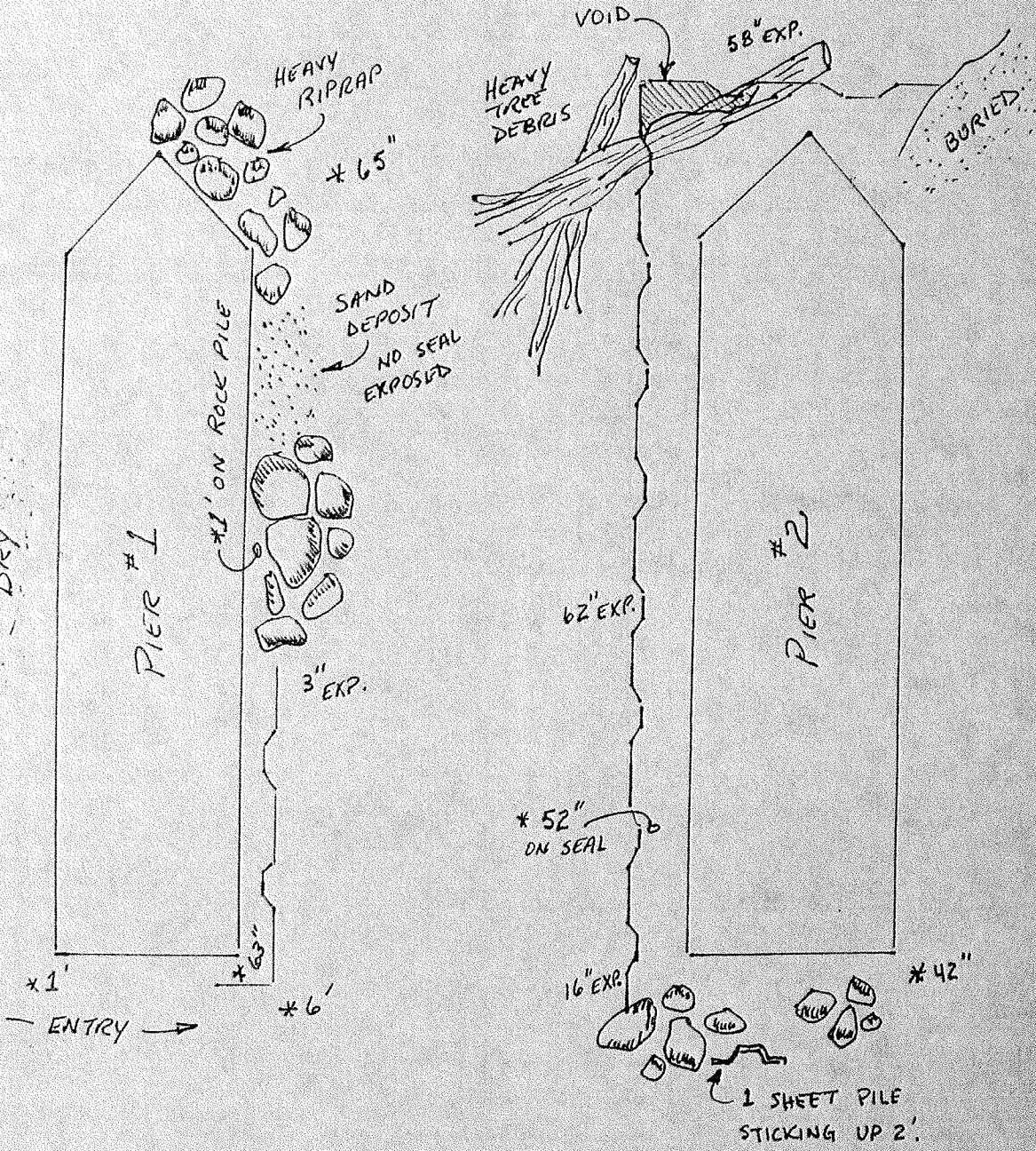
INSPECTION DATE 06032008 0929 2005

Y24

Signature Carl Edwards

Channel Condition: 4  
Substruc/Culvert Condition: 5

\* = WATER DEPTH  
EXP. = EXPOSED SEAL



LAMBERT STREET

FALMOUTH

5553

06-03-08

UNDERWATER INSPECTION REPORT

TOWN(S) FALMOUTH

BR. NAME LAIBERT STREET BR.

	5	5	5	3
193	0	1	0	9
493				
460	5			
461	5			
697				
698				

BRIDGE NO. \_\_\_\_\_  
 DATE \_\_\_\_\_  
 EQUIP/ADD. INSP (ROCK) \_\_\_\_\_  
 SUBST. COND. (DETERMINED) \_\_\_\_\_  
 CHAN. COND. (SCOOP) \_\_\_\_\_  
 SHAFT TYPE \_\_\_\_\_  
 FOUNDATION \_\_\_\_\_

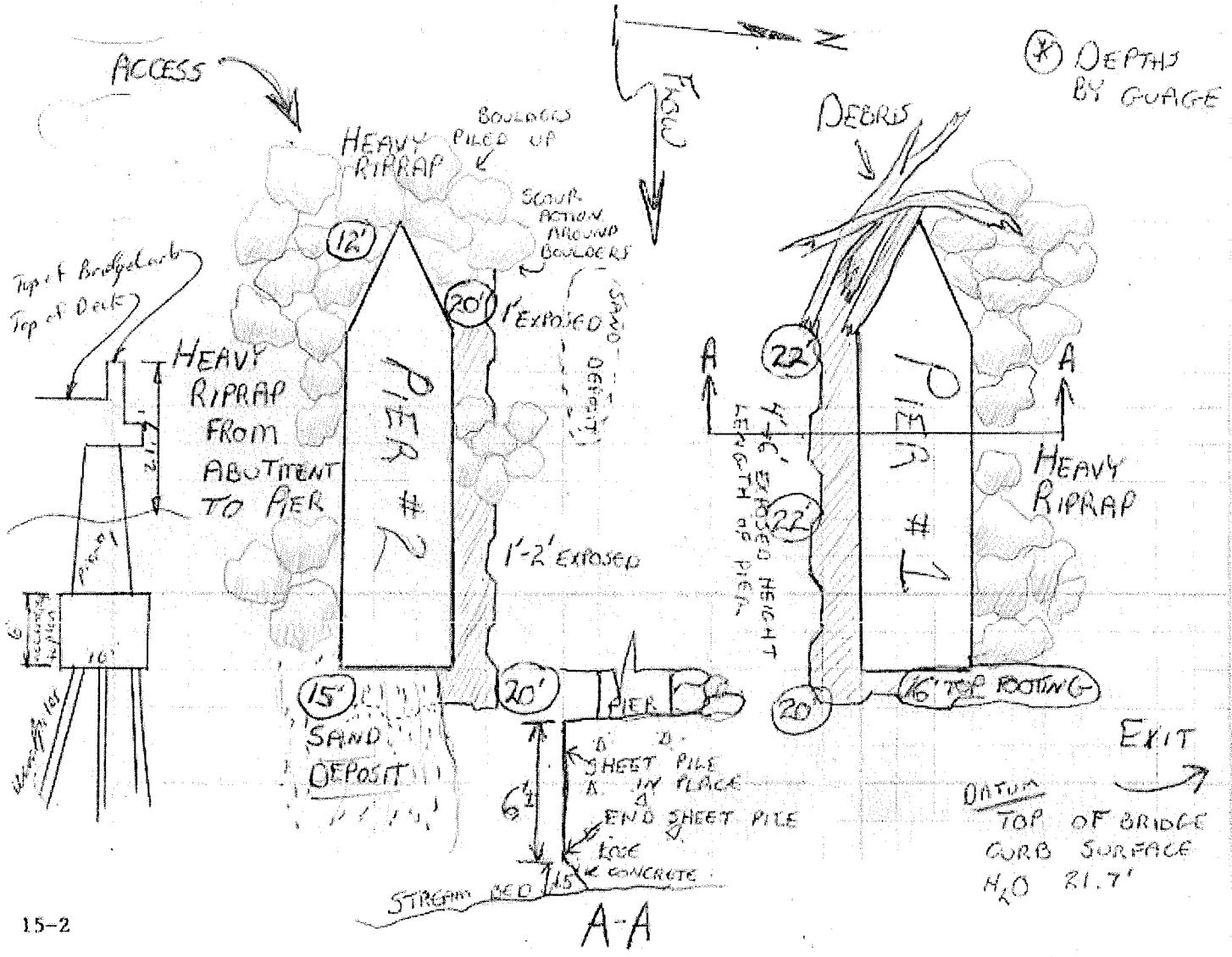
TEAM LEADER M. BARDEN  
 DIVERS C. EDWARDS M. FALLA  
 TIME: ENTRY 9:20 AM  
 EXIT 10:31 AM (RTIME)  
 WEATHER CLOUDY 30°  
 WATER: TEMP: 26'  
 MAX. DEPTH 22' FT  
 VISIBILITY 5-10' FT  
 CURRENT Swift  
 INSP. SIGN M. Barden

Try to  
 Hunt  
 Safety  
 Under-  
 beam  
 Tenders

RECOM. REPAIRS

685	4	1	6	9
686				

STREAMBED DESC. SANDY GRAVEL BOTTOM WITH HEAVY RIPRAP BOULDERS  
 COMMENTS/PROBLEMS/HAZARDS SWIFT CURRENT @ TIME OF INSPECTION  
CAN BE DONE WITH MILD CURRENT, SOME DEBRIS  
 INSPECTION REPORT INSPECTION WAS REQUESTED BECAUSE OF HEAVY  
FLOW 2 MONTHS EARLIER. BRIDGE HAS 2 CONC. PIERS IN WATER ON 6' HIGH  
FOOTINGS WITH PILES SHOWN ON PLANS. COMPARED TO PREVIOUS REPORT (6/9/93)  
MORE FOOTING IS EXPOSED ON PIER #2 AND SLIGHTLY MORE EXPOSED  
ON PIER #1 EXTREMELY SWIFT CURRENT PREVENTED MEASUREMENTS  
OF EXPOSED PIER BUT ESTIMATED @ 4'-6' ON PIER #1



UNDERWATER INSPECTION REPORT

TOWN(S) FALMOUTH

BR. NAME LAMBERT STREET BR.

193	5	5	3			
493	0	6	0	9	9	3
460	8					
461	7					
697						
698						

BRIDGE NO.  
DATE  
EQUIP/ADD. INSP  
SUBST. COND.  
CHAN. COND.  
SHAFT TYPE  
FOUNDATION

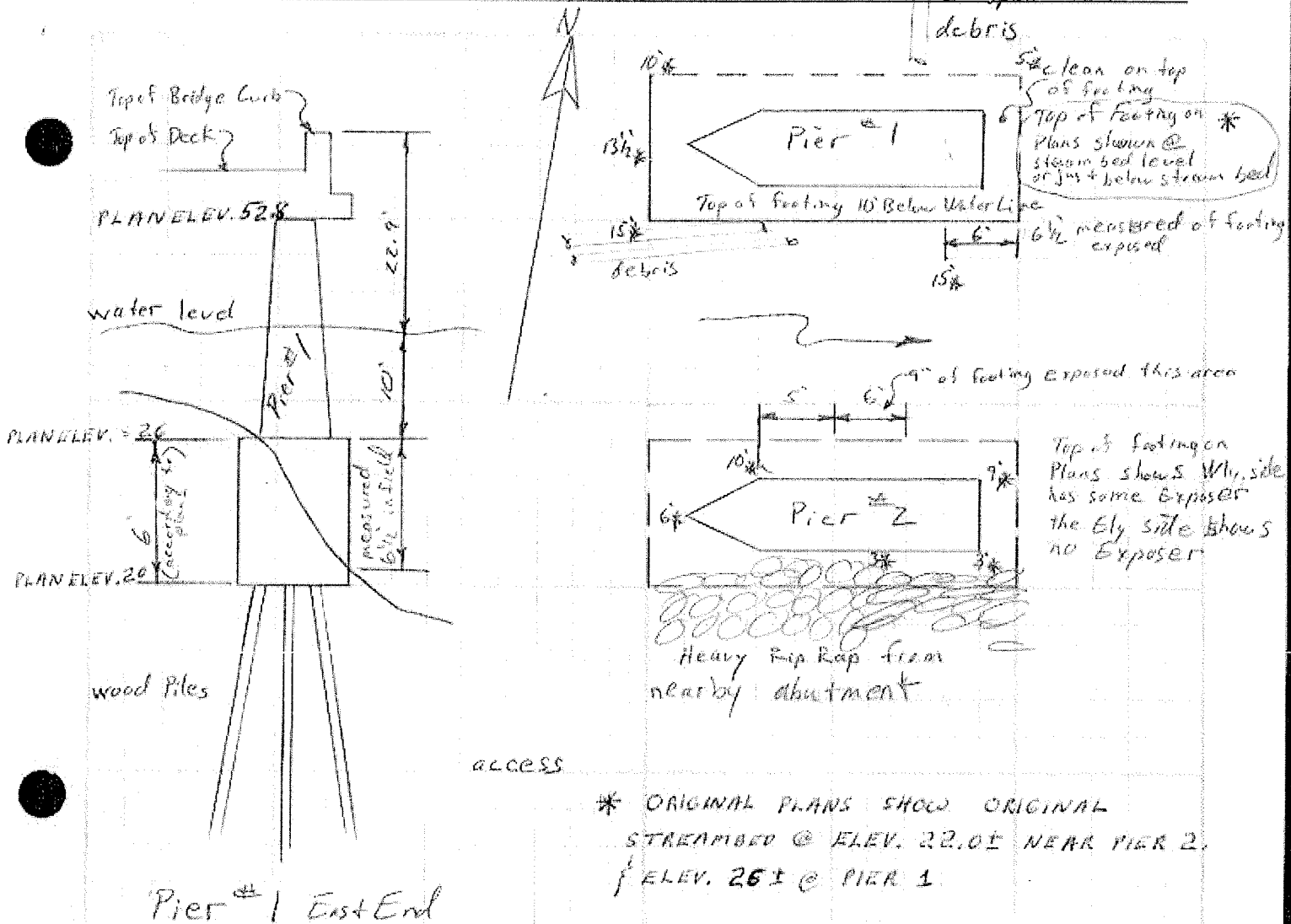
TEAM LEADER MIKE BARDEN  
 DIVERS CARL EDWARDS *Michael Borden*  
 TIME: ENTRY 9:10 AM  
 EXIT 9:45 AM  
 WEATHER MOSTLY CLOUDY - 65° ±  
 WATER: TEMP: 61°  
 MAX. DEPTH 15' FT  
 VISIBILITY 1-2' FT  
 CURRENT MILD  
 INSP. SIGN Michael Borden

RECOM. REPAIRS

685	4	0	1	6	9	<i>pier 1 replace rip rap</i>
686						

STREAMBED DESC. Sandy and silt bottom w/boulders 1'-3' dia.  
 COMMENTS/PROBLEMS/HAZARDS some debris, tree logs and branches laying on bottom next to piers

INSPECTION REPORT (2) mass conc. piers 10' W x 46' L w/ leveled up stream ends on 6' conc. footings. Pier #1 has exposed footing while Pier #2 has one small section exposed.  
on Pier #2 some things are above the footing while one is below. Also some things are above the footing to stream and other side of stream. Would recommend placing some rip rap on the Nly. pier.



# **ATTACHMENT K**

# MAINE DEPARTMENT OF TRANSPORTATION

## BRIDGE SCOUR ASSESSMENT

### SUMMARY REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert Street	Stream: Presumpscot River	River Basin: Presumpscot
Assessment By: D. Bryant	Assessment Date: 8/11/09	
Check By: <i>D. Reynolds</i>	Check Date: <i>9/22/09</i>	
MDOT PIN: 15631.10	TYLI Project No: 411588.10	

#### NOTES

- Observations left and right are facing downstream -
- Elevations refer to bridge plan datum unless otherwise noted -
- The information shown in this report is obtained from available MDOT bridge plans and records, supplemented by field review -

#### 1. SUMMARY AND CONCLUSIONS

The following factors have the most significant influence on the recommendations:

##### Positive Influence:

- No overtopping. No pressure flow. Q100 approximately 7' below low chord.
- Abutment and pier foundations on piles. Abutments set back from channel. No exposure on abutment footings.
- Thalweg has not moved horizontally since construction.
- Riprap slopes in front of abutments in good condition.
- Heavy riprap in good condition on left side of left pier footing and right side of right pier footing. No footing exposure in these areas.
- Good flow alignment.

##### Negative Influence:

- Bridge circa 1961 has withstood at least one >100 year flood event in 1996 based on historic flood data, but inspection report after the flood indicates some scour occurred.
- 1961 plan cross section compared to measured 2009 cross sections indicates some scouring of up to 1.5 feet. Right and left upstream pier footings exposed up to 1.5' based on soundings. 1997 underwater inspection indicates footing exposure of up to 2' for right pier and 6' for left pier.
- Scourable bed material.
- Downstream thalweg approximately 0.2 feet above bottom of pier footings.
- Non-continuous superstructure. Structure length > 150' and cost of replacement would be significant.
- Heavy riprap missing on left side of right pier footing and right side of left pier footing. Footing exposure noted in these areas.

##### Conclusions:

- Barge access likely to install countermeasures, access difficult (most likely from upstream right bank near gauging station). Headroom adequate.
- Concrete cable mat or riprap would be a cost effective countermeasure alternative.
- Hydraulic and scour evaluation recommended. At least one pass/fail abbreviated POA criteria was not met. Full POA recommended. Installation of countermeasures required to improve Item 113 rating.

#### 2. RECOMMENDATIONS

##### a. Scour Vulnerability (Long term, Contraction, Abutment, Pier):

- Contraction and pier scour. Scourable bed. Portions of pier footings unprotected. Slight deepening of channel (approximately 1.5') since 1961 plan cross sections. Thalweg near bottom of pier footing. Wide upstream floodplain with low banks.

##### b. Recommended NBI Ratings:

Item 60 : 5      Item 61: 5      Item 71: 9      Item 113: 3

c. POA Recommended (X):      Full   X        Abbreviated \_\_\_\_\_

## Abbreviated Scour POA Checklist

Town: FALMOUTH Bridge Name: LAMBERT ST. Bridge #: SSS3

### Pass / Fail Criteria

Detour Length	< 25 miles	<u>Yes</u>	No
Roadway Classification	Less than Arterial	<u>Yes</u>	No
Traffic Count	< 5000 AADT	<u>Yes</u>	No
Structure Length	< 150 feet	Yes	<u>No</u>
Scour Critical Bridge on Detour		Yes	<u>No</u>
Detour Roadway Condition / Width	Adequate	<u>Yes</u>	No

### Judgment Criteria

Hydraulics:			
Lateral stream stability	<u>Low</u>	Medium	High
Channel vertical stability	Low	<u>Medium</u>	High
Degree of constriction	<u>Low</u>	Medium	High
Angle of attack	<u>Low</u>	Medium	High
Potential for pressure flow	<u>Low</u>	Medium	High
Geotechnical:			
Stream bed erodibility	Low	Medium	<u>High</u>
History:			
Scour history	Low	Medium	<u>High</u>
Flood	<u>Low</u>	Medium	High
Ice / Debris	<u>Low</u>	Medium	High
Structural:			
Substructure Condition	<u>Low</u>	Medium	High

Other Comments:

Recommended POA:

Full

Abbreviated

Submitted by:

Daniel W. B...

Date:

9-22-09

# MAINE DEPARTMENT OF TRANSPORTATION

## BRIDGE SCOUR ASSESSMENT

### OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: <u>Lambert St.</u>	Town: <u>Falmouth</u>	Bridge #: <u>5553</u>
Feature Carried: <u>Lambert St.</u>	Stream: <u>Presumpscot Rv.</u>	River Basin:
Review By: <u>Darin Bryant, Joshua Olund, SBC, ASU</u>	Review Date: <u>12/23/08</u> & <u>8/04/09</u>	
Checked By: <u>P. Reynolds</u>	Check Date: <u>9/22/09</u>	
MDOT PIN: <u>15631.10</u>	TYLI Project No: <u>411588.10</u>	

#### NOTES

- Observations left and right are facing downstream -
- Elevations refer to bridge plan datum unless otherwise noted -
- The information shown in this report is obtained from available MDOT bridge plans and records, supplemented by field review -

#### STREAM STABILITY ASSESSMENT

##### 1. CHANNEL

Upstream

Downstream

At Bridge

Mannings 'n' :

.09.09.09

##### 2. FLOOD PLAIN

Mannings 'n' , (L/R):

.1 L/R.1 L/R.1 L/R

##### 3. CHANNEL LATERAL STABILITY

a. Bends (see sketch plan)

1) Bridge Location: 200 ft./Upstream of Bend 300 ft./Downstream of Bend - On Bend2) Migration Potential (Describe): Eroding banks u/s & d/s

b. Bank Condition

Upstream

Downstream

At Bridge

1) Vegetation (Describe): Trees (L/R) & Grass (R) Trees (L/R) Brush & Trees2) Material (Describe): Silt/Sand Silt/Sand Riprap3) Eroding or Stable (see sketch-plan): eroding eroding stable4) Bank Slope (X Horiz.:1 Vert.): 2:1(L), 1:1(R) 1:1(L/R) 2:1(L/R)5) Bank Protection (Describe): N/A N/A -c. Islands/Bars/Deposits: N/A ft./Upstream N/A ft./Downstream N/A At Bridge

##### 4. CHANNEL VERTICAL STABILITY

a. Channel Profile (X):

Pool

Riffle

Upstream: ✓ -at Bridge: ✓ -Downstream: ✓ -

# OFFICE/FIELD REVIEW DATA REPORT

Bridge #: 5553

b. Contraction Scour Potential (due to encroachment) Medium

1) Potential for Overbank Flow (Y/N/Unk.): N Left N Right

2) Relief Structure (X): Bridge — Culvert — Location (ft. L/R) —

3) Potential for Over Topping (Y/N/Unk.):

c. Long Term Potential for : Aggradation (Y/N): Y Degradation (Y/N): N

Source of Sediment (X):  Bed Load — Other

d. Bed Material (Circle):

Silt/Clay

Sand

Gravel

Cobbles/Boulder

Bedrock

Other

Bed Material D50 (Visual Classification): .03 mm = 250

## BRIDGE SITE CONDITIONS

5. STREAM CROSS SECTION (X) (See sheet 11):  Upstream Face  Downstream Face

### 6. FLOW CONDITIONS

a. Obstructions/Beaver Dams/Etc... (Describe): —

b. Confluences (L/R, ft. upstream or downstream): N/A

c. High Water Mark

1) Date/Estimated Flood Frequency: Extreme High / Normal / Q<sub>500</sub> / Q<sub>100</sub>

2) Approx. Elev. (Based on bridge datum): 77.0 / 31.8 / 48.9 (33.7 NGVD) / 46.4 (31.1 NGVD)

3) Source/Reliability: Plans - 1961 / Plans 1961 / FEMA FIS / FEMA FIS

d. Feasibility of Adding Riprap or Other Scour Countermeasures (Explain):

rip-rap could be added at piers from barge. Headroom reduces on high end of slope in front of abutments - could add grout bags or mattress.

### 7. BRIDGE DESCRIPTION

a. Description of Bridge/Bridge Type (Single/Multi Span, Continuous/Non-continuous, Superstructure Type):

3-span, non-continuous, steel girder bridge. U/S pier noses tapered, d/s are square

b. Bridge Length (ft): 109'-T Bridge Width (ft): 34' Number of Spans: 3  
164'-max span

c. Date Built: 1961

d. Reconstruction/Scour Repairs (Date/Description):

e. Bridge datum (NGVD/Assumed): FROM BRIDGE PLANS Elev. 59.41 Location U/S RT TOP CURBS

f. Low Chord Elev., (ft): 53.55

g. Bridge Deck Elev., (ft): 57.03 to 58.08

h. Top of Bank Elevation at Bridge, (ft): 40 (est. from photos, notes, shts 2/14 & 6/14)

i. Overtopping Elev., (ft): 57.0 At Bridge (Y/N): N Approaches (ft. L/R): —

# OFFICE/FIELD REVIEW DATA REPORT

Bridge #: 5563

 j. Pressure Flow Potential (Y/N): N

 k. Functional Class: 17

 l. ADT: 4280

 Year of ADT: 2007

 m. Detour Length (mi): 3

 Scour Critical Bridge on Detour (Y/N): -

 Detour Roadway Condition / Width (Poor, Adequate): -

 n. Sufficiency Rating: 62.1

 Posting (Y/N): N
**8. ABUTMENTS**

Left

Right

 a. Type: (Stub abut. on slope), Vertical wall, Vertical wall w/wingwalls

Dry Laid Granite, Granite Masonry):

X
X

 b. Support: (Fix), (Exp.)

Fix
Exp

c. Angle of Inclination (Degrees):

0
0

d. Foundation:

1) Spread Footings (X):

-
-

2) Piles (X):

X
X

3) Other (Type):

-
-

4) Footing Exposed (Y/N):

N
N

5) Top of Footing Elev., (ft):

49.46'
50.20'

6) Footing Height, (ft):

3'
3'

7) Exposure, (ft) (See Sounding Sheet):

-
-

8) Piles Exposed (Y/N):

-
-

9) Pile Tip Elev., (ft):

-
-

10) Rock Elev., (ft):

-
-

 11) Source of Data (Field review, Design plans, As-built drawings,

Pile driving records, Inspection reports, Other):

X
X

 e. Location from bank: (Set back), At bank, In channel, In floodplain):

X
X

f. Protection:

1) Riprap Location (Describe):

2) Riprap (Type/Size):

1'  $\phi$  - 3'  $\phi$  \*
-
X

 3) Riprap Condition: (Good), Fair, Poor):

-
X

4) Other Protection:

(granite blocks) \*\*
X
-

 5) Condition: (Good), Fair, Poor).

X
-

\* FROM ABUTMENT TO PIER UNDER BRIDGE

 \*\* " " " EDGE CHANNEL (+/- 4'-5' FROM PIER)  
UNDER BRIDGE

# OFFICE/FIELD REVIEW DATA REPORT

Bridge #: 5553

## 9. PIERS

	Pier #	1	2	3	4	5
a. Type <u>(Solid shaft)</u> Single Column,		<u>X</u>	<u>X</u>			
Multi-column, Pile bent, Dry Laid Granite, Granite Masonry):						
b. Support (Fix./Exp.):		<u>Fix/Exp</u>	<u>Fix/Exp</u>			
c. Channel/Floodplain (Chan/Fld):		<u>X</u>	<u>X</u>			
d. Shape (square, round nose, sharp nose)						
Upstream:		<u>Sharp</u>	<u>Sharp</u>			
Downstream:		<u>Square</u>	<u>Square</u>			
e. Width x Length, (ft):						
f. Angle of Attack, (Degrees):		<u>90°</u>	<u>90°</u>			
g. Foundation:						
1) Spread Footings (X):		—	—			
2) Piles (X):		<u>X</u>	<u>X</u>			
3) Other (X):		—	—			
4) Footing Exposed (Y/N): <small>(From drop line)</small>		<u>Y</u>	<u>Y</u>			
5) Top of Footing Elev., (ft):		<u>26'</u>	<u>26'</u>			
6) Footing Height, (ft):		<u>6'</u>	<u>6'</u>			
7) Exposure, (ft) (See Sounding Sht):		<u>± 0.5'</u>	<u>± 1.25'</u>	<small>(from sounding - 1997 under water insp. shows 1-2' RT &amp; 4-6' LT)</small>		
8) Footing Width x Length, (ft):		<u>10'3" x 40'</u>	<u>10'3" x 40'</u>			
9) Piles Exposed (Y/N):		—	—			
10) Pile Tip Elev., (ft):		<u>-5</u>	<u>-5</u>	<small>(Plans indicate lengths vary - 5' min, 25' max)</small>		
11) Rock Elev., (ft):		—	—			
12) Source of Data (Field review, <u>Design Plans</u> , as-built drawings, Pile driving records, Inspection reports, Other):						
h. Protection:						
1) Riprap Location (Describe):		<u>Y</u>	<u>Y</u>	<small>(none shown on plans, but 1997 underwater inspect. show riprap around pier)</small>		
2) Riprap (Size/Type):		<u>X</u>	<u>X</u>			
3) Riprap Cond. ( <u>Good</u> , Fair, Poor):		<u>1-2' φ</u>	<u>1-2' φ</u>			
4) Other Protection:		—	—			
5) Condition (Good, Fair, Poor):		—	—			
<b>10. EVIDENCE OF SCOUR</b>						
a. Existing NBI Rating:		<u>5</u> Item 60	<u>4</u> Item 61	<u>6</u> Item 71	<small>(Bridge records)</small>	
b. Previous MDOT Underwater Inspection (Y/N Date):		<u>Y - 1990, '96</u>		Frequency (Months): <u>24</u>		
a. Abutments				Left	Right	
1) Tilt / Settlement * (Y/N):				<u>N</u>	<u>N</u>	
2) Cracks * (Y/N):				<u>(2-girder D/S) Y</u>	<u>Y (possibly exp. cracks)</u>	
3) Adjacent Roadway Settlement * (Y/N):				<u>N</u>	<u>N</u>	
* Describe Cause, If not scour :						

1/2 to 3/4 of

# OFFICE/FIELD REVIEW DATA REPORT

Bridge #: 555 3

Left Right

4) Max. Depth Undermining, (ft) (See sketch-plan): — —

5) Scour Holes (Y/N) (See sketch-plan): —

6) Comments (Expansion Joints, Rockers, etc.): highly eroded

b. Piers Pier # 1 2 3 4 5

1) Tilt / Settlement (Y/N): N N — — —

2) Max. Depth Undermining, (ft)

(see sketch-plan): — — — — —

3) Scour Holes (Y/N) (sketch-plan): — — — — —

4) Comments (Expansion Joints, Rockers, etc.):

c. Contraction Scour Potential (Low, Moderate, High): Low

1) Bed Deposits Downstream (Y/N): N

Distance, (ft): —

2) Blowhole (Y/N): N

3) Comments (Channel/Floodplain Contraction, Scour Holes, etc.):

Channel narrower U/S

## 11. DEBRIS

a. Potential for Debris Accumulation (See sketch-plan):

Low: X

Moderate: A

High: —

b. Comments (Location, Type, Size, Etc.):

- Fallen tree U/S left.

- brush & trees found in channel & floodplain

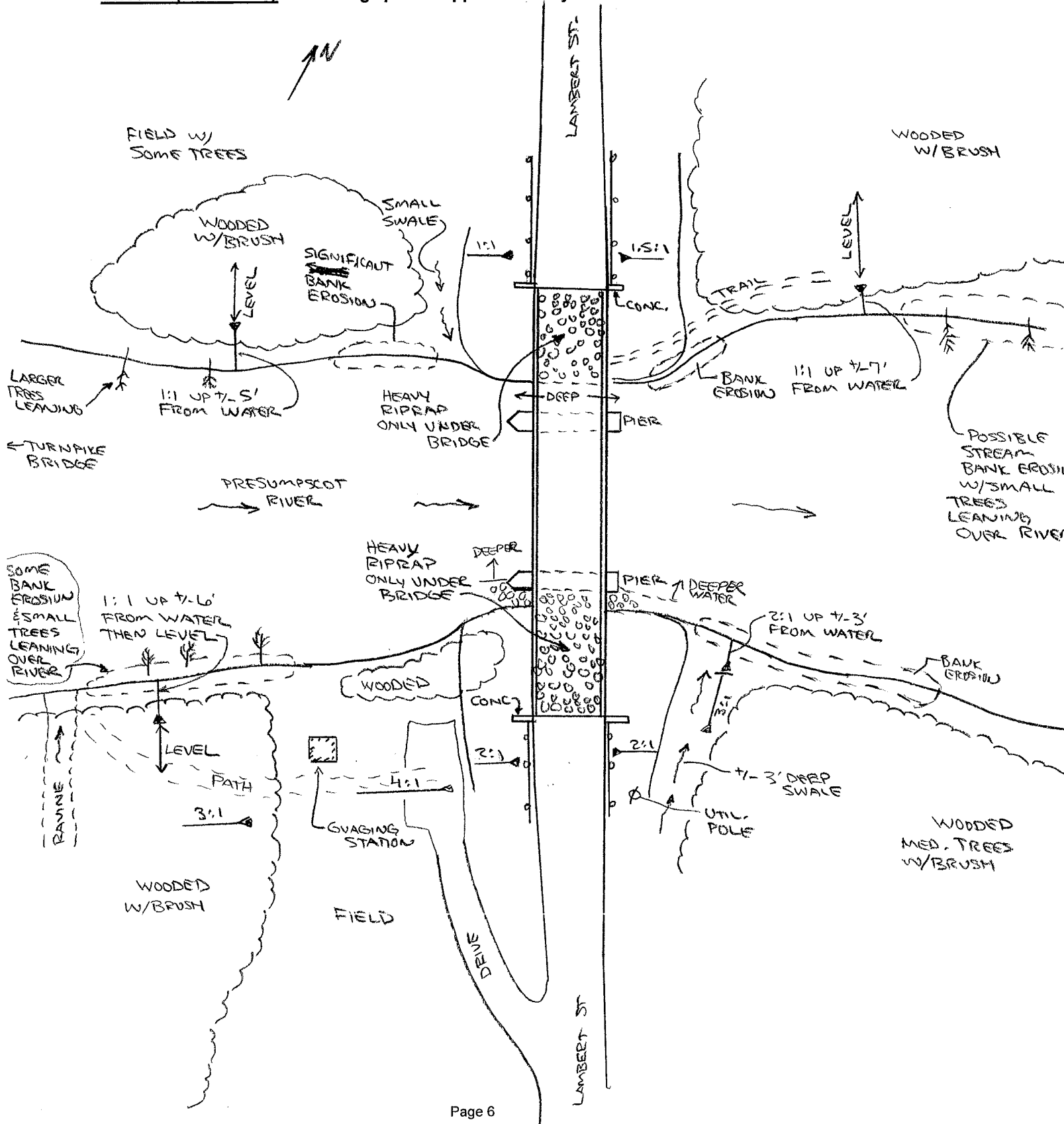
- Underwater inspection 1997 notes debris at nose of one pier

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: LAMBERT ST.	Town: FALMOUTH	Bridge #: 5553
Feature Carried: LAMBERT ST.	Stream: PRESUMPSCOT RIVER	Review Date: 12/23/08

## Sketch (Plan view)

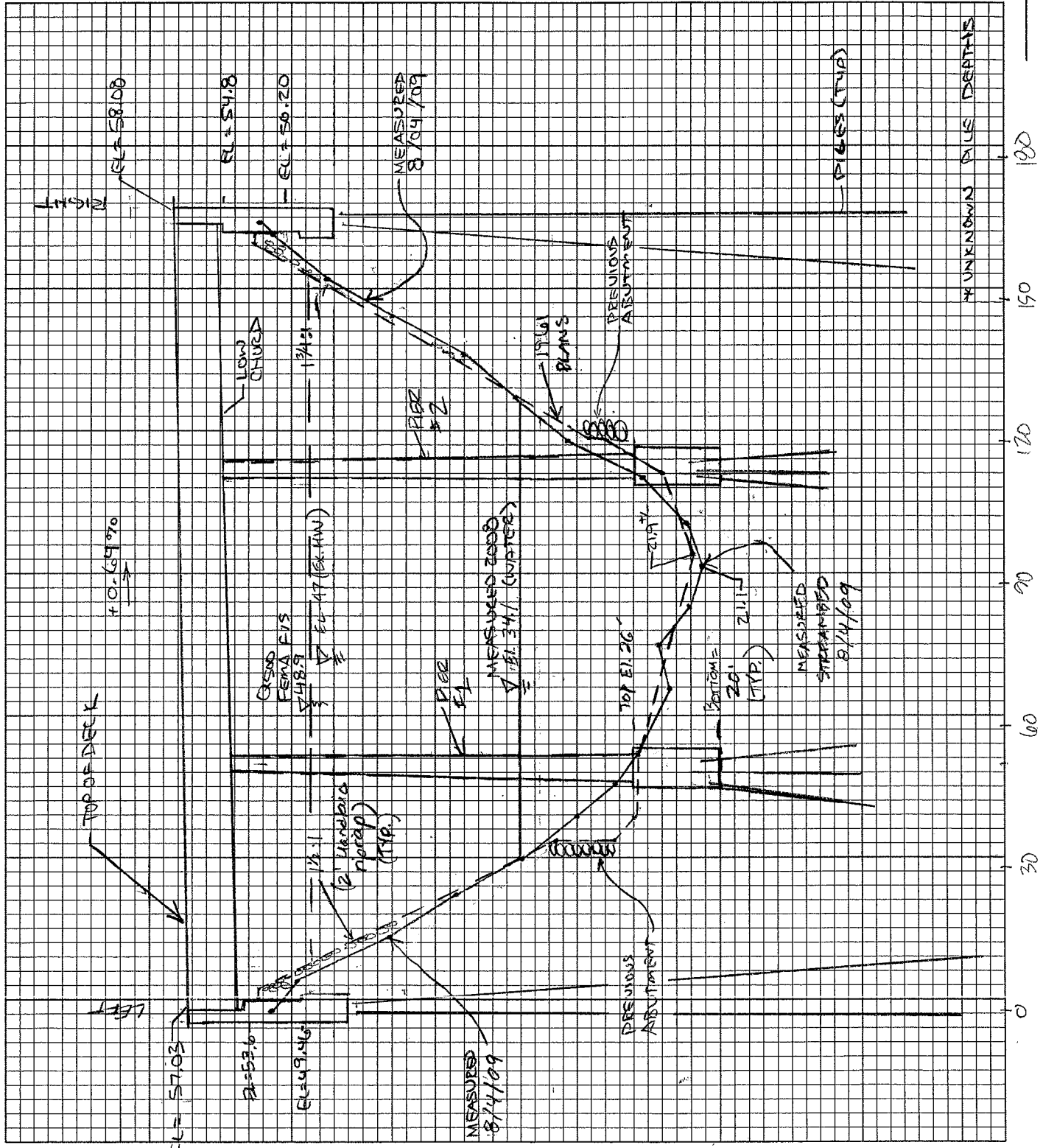
Bridge plans supplemented by field sketch.



# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: <u>Lambert St.</u>	Town: <u>Falmouth</u>	Bridge #: <u>5553</u>
Feature Carried: <u>Lambert St.</u>	Stream: <u>Presumpscot Rv.</u>	Review Date:

## Stream Cross Section at Bridge (Upstream Side - Facing Downstream)



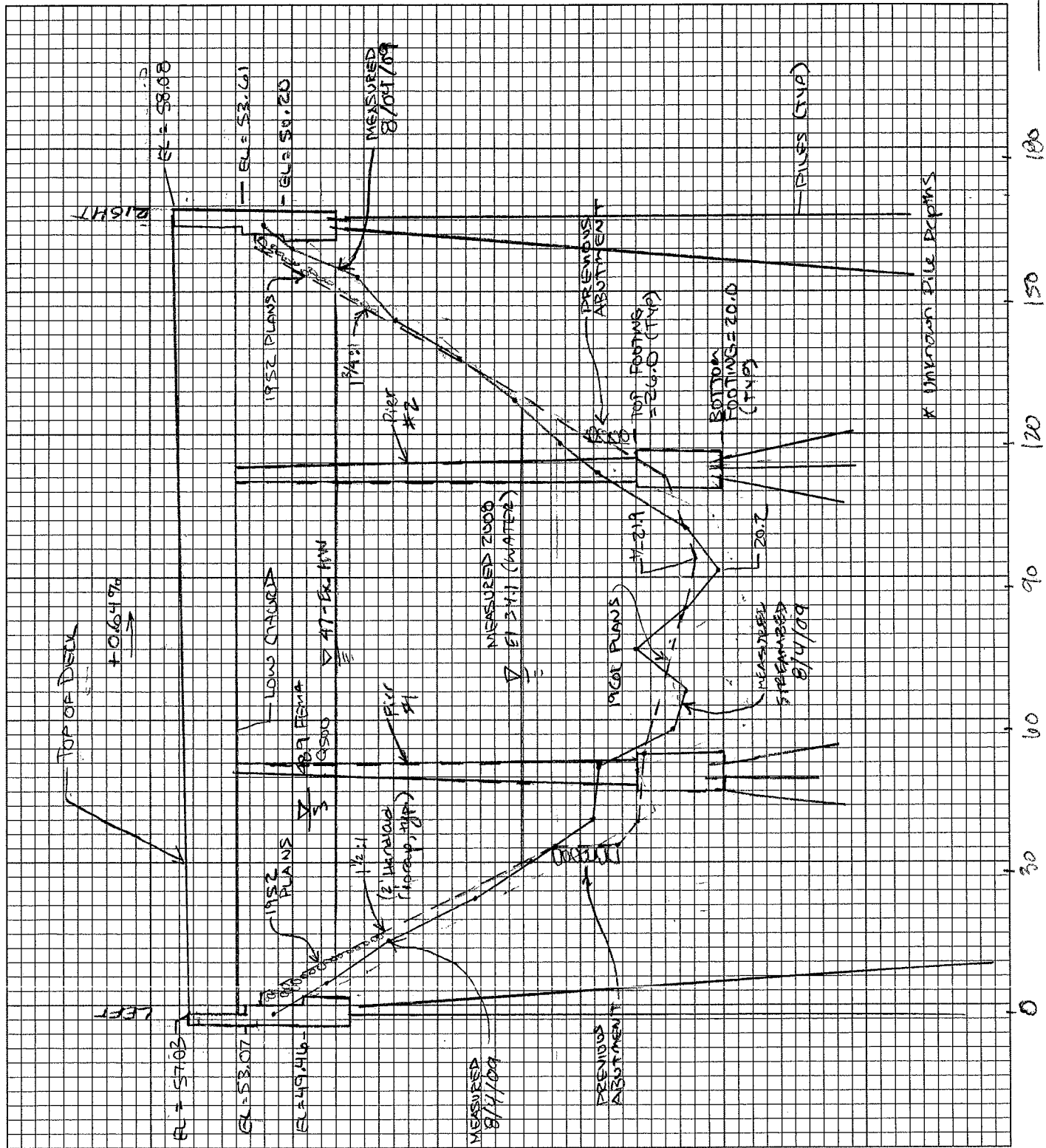
——— MEASURED 2008  
 - - - 1961 PLANS

Scale: H 1" = 30'  
 V 1" = 10'

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: <u>Lambert St.</u>	Town: <u>Falmouth</u>	Bridge #: <u>5553</u>
Feature Carried: <u>Lambert St.</u>	Stream: <u>Presumpscot Rv.</u>	Review Date:

## Stream Cross Section at Bridge (Downstream Side - Facing Downstream)



MEASURED 2008  
1961 PLANS

Scale: H 1" = 30'  
V 1" = 10'

Assumes

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: <b>Lambert Street</b>	Town: <b>Falmouth</b>	Bridge #: <b>5553</b>
Feature Carried: <b>Lambert Street</b>	Stream: <b>Presumpscot R.</b>	Review Date: <b>8/4/09</b>

Datum Elev. (ft): 58.03 Location: Top of Curb, L. u/s Water Surface Elev. (ft): 34.1

Upstream Side Curb Conc. Barrier  
 Top of Datum Wingwall to Top of Curb Gage (ft): 1.75

Location	Station	Elev A, ft. <sup>a</sup>	H1, ft. <sup>b</sup>	H2, ft. <sup>c</sup>	Elev B, ft. <sup>d</sup>	Wet (W) Dry (D)	Comments
L. ABUT	0+00	59.8		8.5	51.3	D	Abut 1 backwall face
	0+07	59.8		10.5	49.3		* Stations are 2' short of posts
	0+15.5	59.9		17.0	42.9		
	0+24	60.0		21.25	38.8	↓	
	0+32.5	60.1		26.25	33.9	W	
	0+41	60.1	26.0	30.25	29.9		
	0+50.25	60.2		33.0	27.2		L. of Pier 1
	0+54	60.2		34.5	25.7		R. of Pier 1 (possible top of footing)
	<del>0+59.5</del>	<del>60.3</del>		<del>40.25</del>	<del>20.1</del>		<del>(Possible debris interference)</del>
	0+68	60.4		37.25	23.2		
	0+76.5	60.4		36.0	24.4		
	0+85	60.5		38.5	22.0		
	0+93.5	60.6		39.5	21.1		
	1+02.75	60.7		38.5	22.2		
	1+12	60.7		35.5	25.2		L. of Pier 2
	1+20.5	60.8		30.0	30.8		
	1+29	60.9		26.5	34.4	↓	
	1+37.5	61.0		23.0	38.0	D	
	1+46	61.0		18.0	43.0		
	1+54.5	61.1		13.5	47.6		
	1+61.5	61.2		9.75	51.5		
R. Abut	1+66	61.2		9.0	52.2	↓	Abut. 2 backwall face

← tangled in debris

- a. Top of bridge curb/parapet\* (From bridge plans)
  - b. Distance from top of bridge curb\* to water surface.
  - c. Distance from top of bridge curb\* to streambed or ground.
  - d. Streambed or ground elevation.
- \* Unless noted otherwise



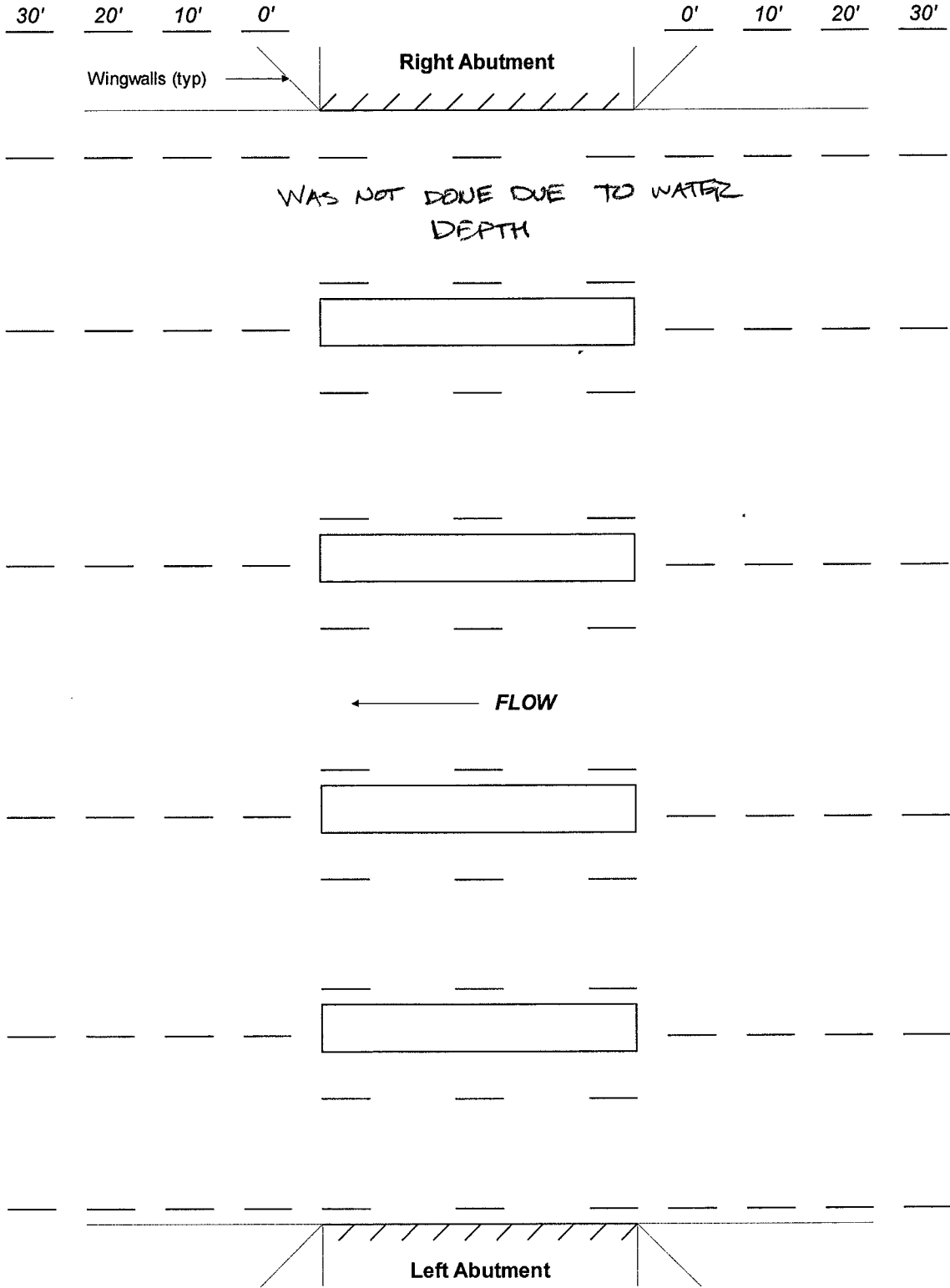
# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name:	Town:	Bridge #:
Feature Carried:	Stream:	Review Date:

## Soundings/Probings

E - Footing Exposure  
P - Depth of Rod Probe

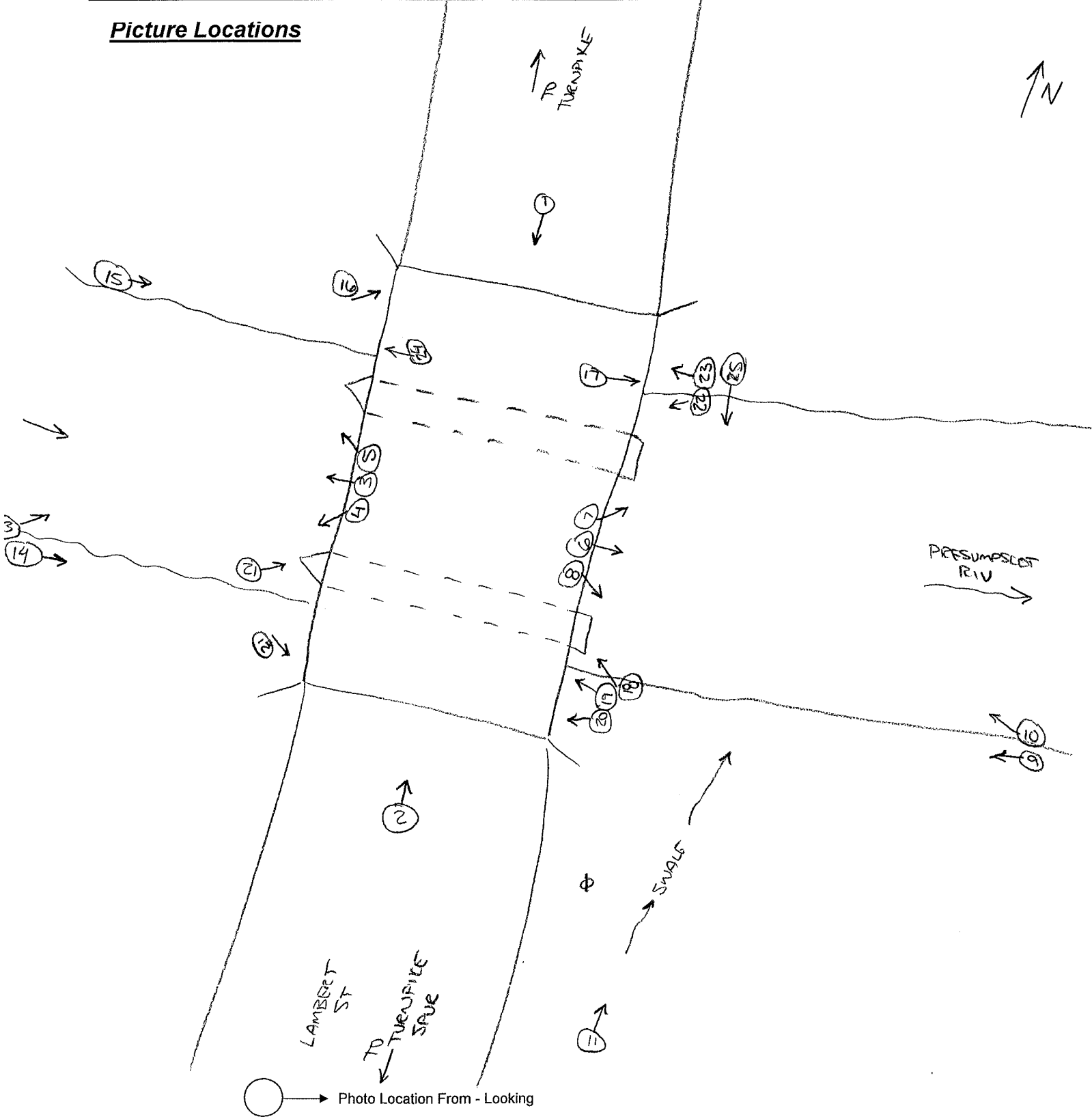
U - Depth of Undermining  
W - Water Depth



# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Picture Locations



# OFFICE/FIELD REVIEW DATA REPORT

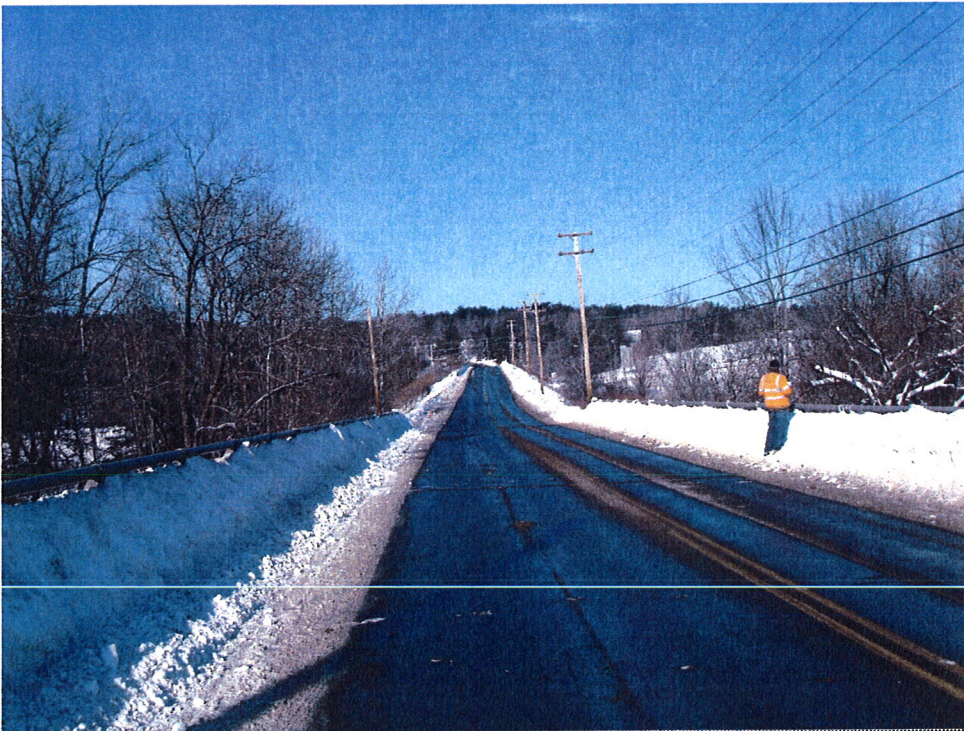
Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



①

Looking right  
from left approach



②

Looking left  
from right approach

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



3

U/S center channel



4

U/S channel right bank

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



5

U/S channel  
left bank



6

D/S center  
channel

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



7

D/S channel  
left bank



8

D/S channel  
right bank

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



9

Downstream  
face from  
D/S right bank



10

D/S left bank  
from D/S right  
bank showing  
bank erosion

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



11

Looking left  
along approach  
sideslope - swale



12

Right Abutment  
showing minor  
cracks and  
bearing condition

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



13

U/S face & left bank from U/S right bank



14

U/S face & right bank from U/S right bank

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



15

U/S face and  
left bank from  
U/S left bank



16

Left Abutment  
showing slope  
protection

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St

Town: Falmouth

Bridge #: 5553

Feature Carried: Lambert St

Stream: Presumpscot

Review Date: 12/08 & 8/09

## Site Investigation Pictures



17

D/S left bank  
from Left Bank  
Under Bridge  
showing bank  
erosion



18

D/S face of  
right pier from  
D/S right bank  
showing riprap  
to left & deep  
water to right  
where riprap  
is missing

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



19

Looking U/S at right pier from D/S right bank showing riprap condition and extent



20

Looking U/S at slope protection under bridge - showing riprap condition and extent on right bank

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



21

U/S face of right pier from U/S right bank showing riprap to right & deep water to left where riprap is missing



22

Looking U/S at left pier from D/S left bank showing riprap condition and extent

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



23

Looking U/S at slope protection under bridge - showing riprap condition and extent on left bank



24

Looking U/S at left bank from under bridge showing bank erosion

# OFFICE/FIELD REVIEW DATA REPORT

Bridge Name: Lambert St	Town: Falmouth	Bridge #: 5553
Feature Carried: Lambert St	Stream: Presumpscot	Review Date: 12/08 & 8/09

## Site Investigation Pictures



25

Looking right from left bank U/S of bridge - showing right bank erosion

# **ATTACHMENT L**

# **ATTACHMENT M**

HEC-RAS Plan: Plan 05 River: Presumpcot River Reach: 1

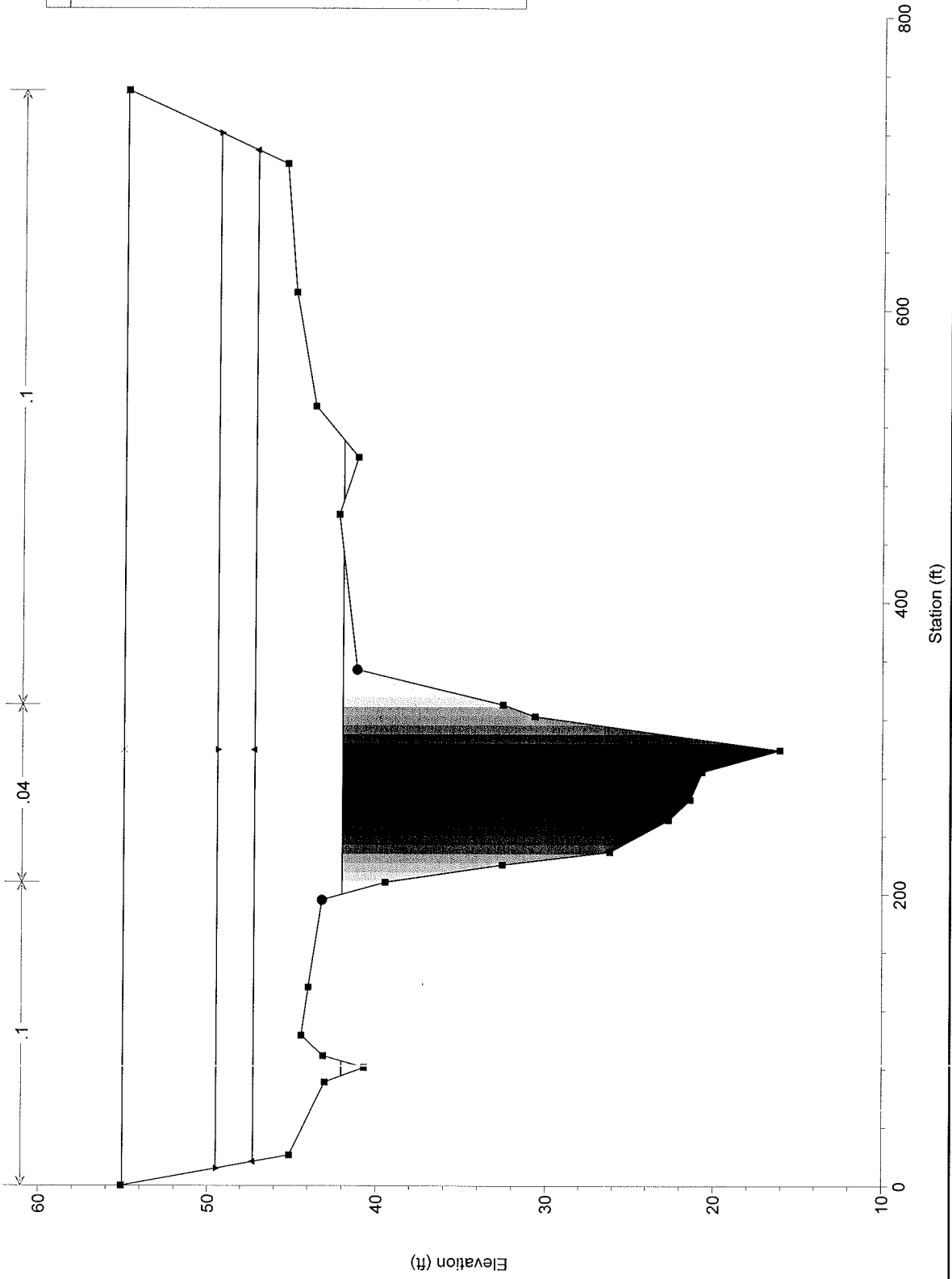
Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl
1	1206	10 year	10162.00	16.10	42.04		42.35	0.000855	4.51	2308.67	286.35	0.21
1	1206	50 year	16172.00	16.10	47.25		47.55	0.000851	4.66	5088.80	692.75	0.19
1	1206	100 year	19357.00	16.10	49.48		49.75	0.000547	4.59	6649.02	709.14	0.17
1	1206	500 year	28690.00	16.10	55.03		55.26	0.000394	4.54	10698.81	749.85	0.15
1	1154.66*	10 year	10162.00	16.27	41.95		42.31	0.000537	4.82	2106.64	147.75	0.23
1	1154.66*	50 year	16172.00	16.27	47.07		47.51	0.000468	5.42	3793.34	548.02	0.22
1	1154.66*	100 year	19357.00	16.27	49.26		49.71	0.000426	5.57	5113.47	662.78	0.21
1	1154.66*	500 year	28690.00	16.27	54.81		55.22	0.000325	5.69	8924.42	710.12	0.19
1	1103.33*	10 year	10162.00	16.43	41.86		42.28	0.000624	5.15	1971.96	139.50	0.24
1	1103.33*	50 year	16172.00	16.43	46.94		47.47	0.000581	5.90	3106.32	436.06	0.24
1	1103.33*	100 year	19357.00	16.43	49.12		49.67	0.000535	6.10	4210.09	545.38	0.24
1	1103.33*	500 year	28690.00	16.43	54.66		55.19	0.000415	6.30	7626.96	668.73	0.22
1	1052	10 year	10162.00	16.60	41.75	30.27	42.22	0.001496	5.52	1841.90	131.48	0.26
1	1052	50 year	16172.00	16.60	46.82	33.43	47.42	0.001618	6.27	2714.94	245.71	0.26
1	1052	100 year	19357.00	16.60	48.95	34.92	49.62	0.001571	6.61	3138.92	493.79	0.26
1	1052	500 year	28690.00	16.60	54.32	38.50	55.13	0.001439	7.43	4350.89	609.62	0.26
1	1000		Bridge									
1	949	10 year	10162.00	19.40	41.38	30.20	41.70	0.000422	4.57	2271.13	215.87	0.20
1	949	50 year	16172.00	19.40	46.39	32.64	46.84	0.000410	5.42	3304.02	401.48	0.21
1	949	100 year	19357.00	19.40	48.49	33.65	49.00	0.000419	5.84	3759.19	412.04	0.21
1	949	500 year	28690.00	19.40	53.69	36.32	54.38	0.000444	6.88	4956.96	467.64	0.23
1	863.6*	10 year	10162.00	20.20	41.32		41.66	0.000473	4.69	2214.64	237.52	0.21
1	863.6*	50 year	16172.00	20.20	46.38		46.79	0.000404	5.27	4101.86	439.07	0.21
1	863.6*	100 year	19357.00	20.20	48.50		48.92	0.000384	5.49	5046.33	453.31	0.21
1	863.6*	500 year	28690.00	20.20	53.76		54.24	0.000349	6.04	7629.84	524.12	0.20
1	778.2*	10 year	10162.00	21.00	41.25		41.62	0.000542	4.84	2149.12	243.75	0.23
1	778.2*	50 year	16172.00	21.00	46.34		46.75	0.000428	5.29	4183.27	477.57	0.21
1	778.2*	100 year	19357.00	21.00	48.47		48.89	0.000397	5.47	5219.93	502.29	0.21
1	778.2*	500 year	28690.00	21.00	53.76		54.20	0.000342	5.88	8144.51	585.41	0.20
1	692.8*	10 year	10162.00	21.80	41.18		41.56	0.000631	5.01	2081.29	242.35	0.24
1	692.8*	50 year	16172.00	21.80	46.30		46.71	0.000459	5.32	4264.06	514.10	0.22
1	692.8*	100 year	19357.00	21.80	48.44		48.85	0.000415	5.44	5428.32	578.15	0.21
1	692.8*	500 year	28690.00	21.80	53.75		54.16	0.000337	5.73	8756.16	688.14	0.20
1	607.4*	10 year	10162.00	22.60	41.08		41.50	0.000738	5.22	2008.68	245.37	0.26
1	607.4*	50 year	16172.00	22.60	46.26		46.67	0.000496	5.35	4367.04	584.89	0.23
1	607.4*	100 year	19357.00	22.60	48.41		48.81	0.000432	5.40	5697.52	649.17	0.22
1	607.4*	500 year	28690.00	22.60	53.76		54.12	0.000324	5.50	9669.27	789.47	0.19
1	522	10 year	10162.00	23.40	40.97		41.43	0.000844	5.44	1937.99	237.08	0.28
1	522	50 year	16172.00	23.40	46.22		46.62	0.000645	5.33	4562.11	777.75	0.23
1	522	100 year	19357.00	23.40	48.41		48.76	0.000519	5.20	6287.87	803.25	0.21
1	522	500 year	28690.00	23.40	53.79		54.07	0.000348	5.04	10786.25	882.54	0.18
1	423.5*	10 year	10162.00	23.02	40.92		41.34	0.000737	5.23	1970.26	203.48	0.26
1	423.5*	50 year	16172.00	23.02	46.15		46.56	0.000509	5.34	4498.56	765.20	0.23
1	423.5*	100 year	19357.00	23.02	48.34		48.71	0.000422	5.27	6202.04	795.56	0.21
1	423.5*	500 year	28690.00	23.02	53.72		54.03	0.000295	5.20	10771.72	879.64	0.19
1	325.*	10 year	10162.00	22.65	40.88		41.27	0.000650	5.02	2026.09	173.21	0.25
1	325.*	50 year	16172.00	22.65	46.12		46.51	0.000470	5.22	4604.57	775.06	0.22
1	325.*	100 year	19357.00	22.65	48.31		48.66	0.000393	5.16	6398.13	839.45	0.21
1	325.*	500 year	28690.00	22.65	53.70		54.00	0.000275	5.08	10991.46	862.33	0.18
1	226.5*	10 year	10162.00	22.27	40.84		41.20	0.000577	4.83	2104.89	158.68	0.23
1	226.5*	50 year	16172.00	22.27	46.10		46.45	0.000419	5.00	5048.25	820.84	0.21
1	226.5*	100 year	19357.00	22.27	48.30		48.62	0.000349	4.93	6861.85	830.23	0.19
1	226.5*	500 year	28690.00	22.27	53.70		53.97	0.000251	4.90	11393.74	848.53	0.17
1	128	10 year	10162.00	21.90	40.80	31.18	41.13	0.000564	4.64	2291.12	329.24	0.22
1	128	50 year	16172.00	21.90	46.10	33.25	46.40	0.000398	4.66	5676.49	818.80	0.19
1	128	100 year	19357.00	21.90	48.30	34.21	48.57	0.000332	4.59	7483.99	824.39	0.18
1	128	500 year	28690.00	21.90	53.70	36.74	53.93	0.000244	4.60	11972.76	838.11	0.16

HEC-RAS Plan: Plan 05 River: Presumpcot River Reach: 1

Reach	River Sta	Profile	E.G. Elev (ft)	W.S. Elev (ft)	Vel Head (ft)	Frctn Loss (ft)	C & E Loss (ft)	Q Left (cfs)	Q Channel (cfs)	Q Right (cfs)	Top Width (ft)
1	1206	10 year	42.35	42.04	0.32	0.03	0.00	2.22	10147.41	12.36	286.35
1	1206	50 year	47.55	47.25	0.30	0.03	0.01	550.23	14321.76	1300.02	692.75
1	1206	100 year	49.75	49.48	0.27	0.02	0.02	1130.86	15726.72	2499.42	709.14
1	1206	500 year	55.26	55.03	0.23	0.02	0.02	2957.77	19510.60	6221.64	749.85
1	1154.66*	10 year	42.31	41.95	0.36	0.03	0.01		10162.00		147.75
1	1154.66*	50 year	47.51	47.07	0.44	0.03	0.01	306.84	15666.32	198.84	548.02
1	1154.66*	100 year	49.71	49.26	0.45	0.02	0.01	881.63	17947.55	527.81	662.78
1	1154.66*	500 year	55.22	54.81	0.41	0.02	0.01	2977.46	23181.94	2530.60	710.12
1	1103.33*	10 year	42.28	41.86	0.41	0.05	0.01		10162.00		139.50
1	1103.33*	50 year	47.47	46.94	0.53	0.05	0.01	164.20	15996.15	11.65	436.06
1	1103.33*	100 year	49.67	49.12	0.55	0.04	0.01	736.01	18514.70	106.28	545.38
1	1103.33*	500 year	55.19	54.66	0.53	0.04	0.03	3423.40	24331.59	935.01	668.73
1	1052	10 year	42.22	41.75	0.47	0.06	0.10		10162.00		131.48
1	1052	50 year	47.42	46.82	0.60	0.07	0.12	252.07	15919.93		245.71
1	1052	100 year	49.62	48.95	0.66	0.06	0.13	529.81	18818.90	8.28	493.79
1	1052	500 year	55.13	54.32	0.81	0.06	0.18	1500.77	26867.52	321.72	609.62
1	1000		Bridge								
1	949	10 year	41.70	41.38	0.32	0.04	0.01	8.08	10146.00	7.92	215.87
1	949	50 year	46.84	46.39	0.45	0.03	0.02	249.28	15825.67	97.04	401.48
1	949	100 year	49.00	48.49	0.51	0.03	0.04	422.94	18758.37	175.69	412.04
1	949	500 year	54.38	53.69	0.70	0.03	0.11	1016.78	27131.23	541.99	467.64
1	863.6*	10 year	41.66	41.32	0.34	0.04	0.00	8.40	10150.26	3.34	237.52
1	863.6*	50 year	46.79	46.38	0.41	0.04	0.00	828.72	15251.76	91.51	439.07
1	863.6*	100 year	48.92	48.50	0.43	0.03	0.00	1592.44	17589.53	175.02	453.31
1	863.6*	500 year	54.24	53.76	0.48	0.03	0.01	4182.94	23954.85	552.21	524.12
1	778.2*	10 year	41.62	41.25	0.36	0.05	0.00	11.27	10150.21	0.53	243.75
1	778.2*	50 year	46.75	46.34	0.41	0.04	0.00	946.26	15138.85	86.90	477.57
1	778.2*	100 year	48.89	48.47	0.42	0.03	0.00	1793.99	17388.13	174.88	502.29
1	778.2*	500 year	54.20	53.76	0.44	0.03	0.01	4585.46	23377.88	726.66	585.41
1	692.8*	10 year	41.56	41.18	0.39	0.06	0.00	15.73	10146.26		242.35
1	692.8*	50 year	46.71	46.30	0.41	0.04	0.00	1095.61	14994.08	82.31	514.10
1	692.8*	100 year	48.85	48.44	0.41	0.04	0.00	2013.92	17154.40	188.68	578.15
1	692.8*	500 year	54.16	53.75	0.41	0.03	0.01	4991.56	22783.36	915.08	688.14
1	607.4*	10 year	41.50	41.08	0.42	0.07	0.00	23.83	10138.17		245.37
1	607.4*	50 year	46.67	46.26	0.41	0.05	0.00	1264.50	14826.70	80.80	584.89
1	607.4*	100 year	48.81	48.41	0.40	0.04	0.01	2255.82	16820.82	280.37	649.17
1	607.4*	500 year	54.12	53.76	0.36	0.03	0.02	5330.27	21830.16	1529.57	789.47
1	522	10 year	41.43	40.97	0.46	0.08	0.01	34.19	10127.81		237.08
1	522	50 year	46.62	46.22	0.40	0.06	0.00	1587.68	14464.21	120.11	777.75
1	522	100 year	48.76	48.41	0.35	0.05	0.00	2727.64	15978.15	651.21	803.25
1	522	500 year	54.07	53.79	0.28	0.03	0.00	5996.86	19972.96	2720.19	882.54
1	423.5*	10 year	41.34	40.92	0.42	0.07	0.01	8.24	10153.75		203.48
1	423.5*	50 year	46.56	46.15	0.41	0.05	0.00	1032.15	14900.67	239.18	765.20
1	423.5*	100 year	48.71	48.34	0.37	0.04	0.00	1874.98	16602.55	879.47	795.56
1	423.5*	500 year	54.03	53.72	0.31	0.03	0.00	4376.04	20998.73	3315.24	879.64
1	325.*	10 year	41.27	40.88	0.39	0.06	0.01	0.41	10161.59		173.21
1	325.*	50 year	46.51	46.12	0.39	0.04	0.01	722.39	15003.00	446.61	775.06
1	325.*	100 year	48.66	48.31	0.36	0.04	0.01	1367.21	16703.53	1286.27	839.45
1	325.*	500 year	54.00	53.70	0.30	0.03	0.01	3299.14	20976.22	4414.65	862.33
1	226.5*	10 year	41.20	40.84	0.36	0.06	0.01		10162.00		158.68
1	226.5*	50 year	46.45	46.10	0.36	0.04	0.02	495.01	14793.68	883.31	820.84
1	226.5*	100 year	48.62	48.30	0.32	0.03	0.02	952.18	16380.01	2024.81	830.23
1	226.5*	500 year	53.97	53.70	0.27	0.02	0.01	2382.23	20682.32	5625.45	848.53
1	128	10 year	41.13	40.80	0.33				10135.40	26.60	329.24
1	128	50 year	46.40	46.10	0.30			332.20	14215.08	1624.72	818.80
1	128	100 year	48.57	48.30	0.27			656.87	15680.34	3019.78	824.39
1	128	500 year	53.93	53.70	0.23			1677.21	19817.96	7194.83	838.11

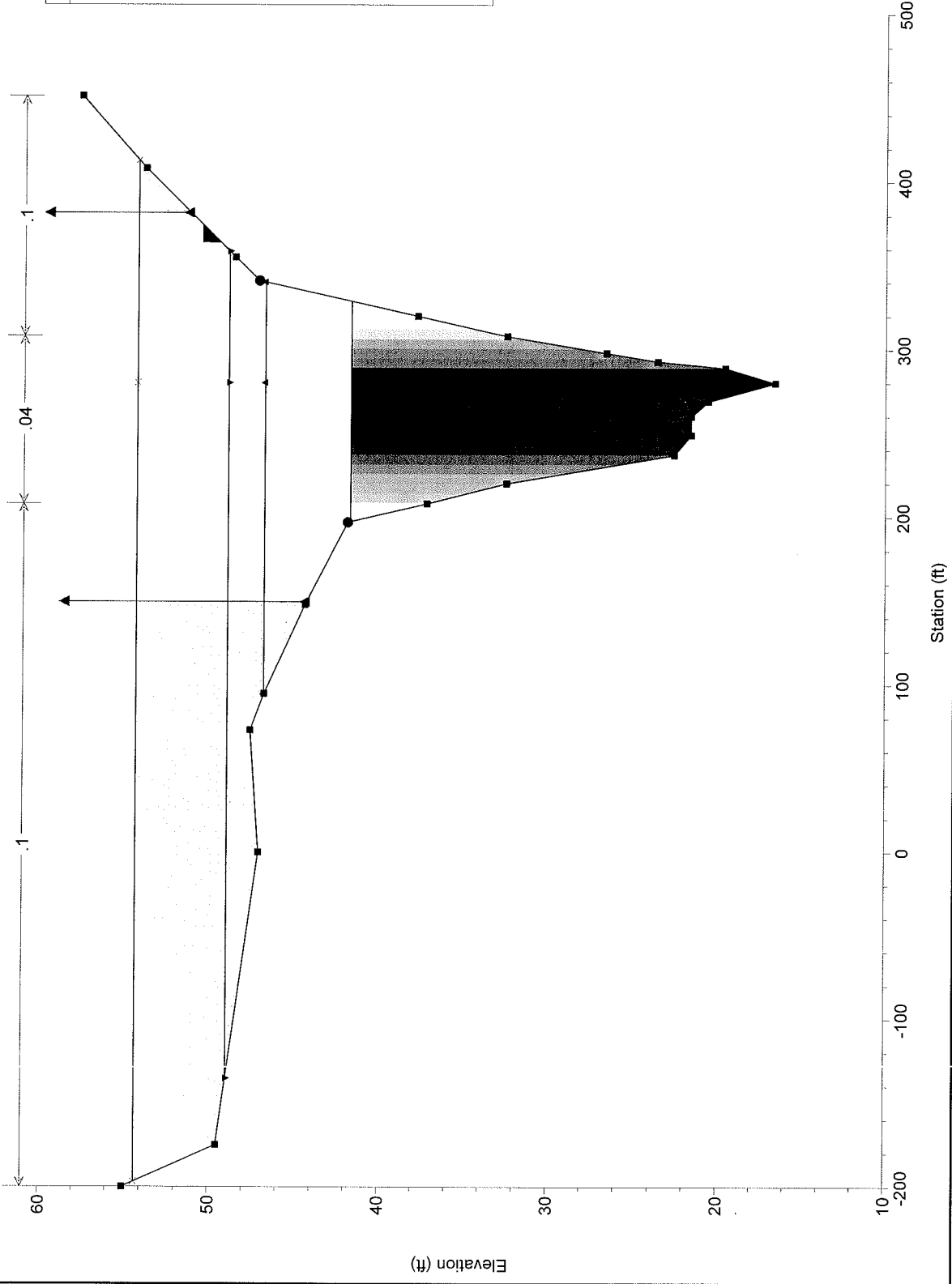
Falmouth 5553 FINAL Plan: Plan 05 7/15/2011

RS = 1206



Falmouth 5553 FINAL Plan: Plan 05 7/15/2011

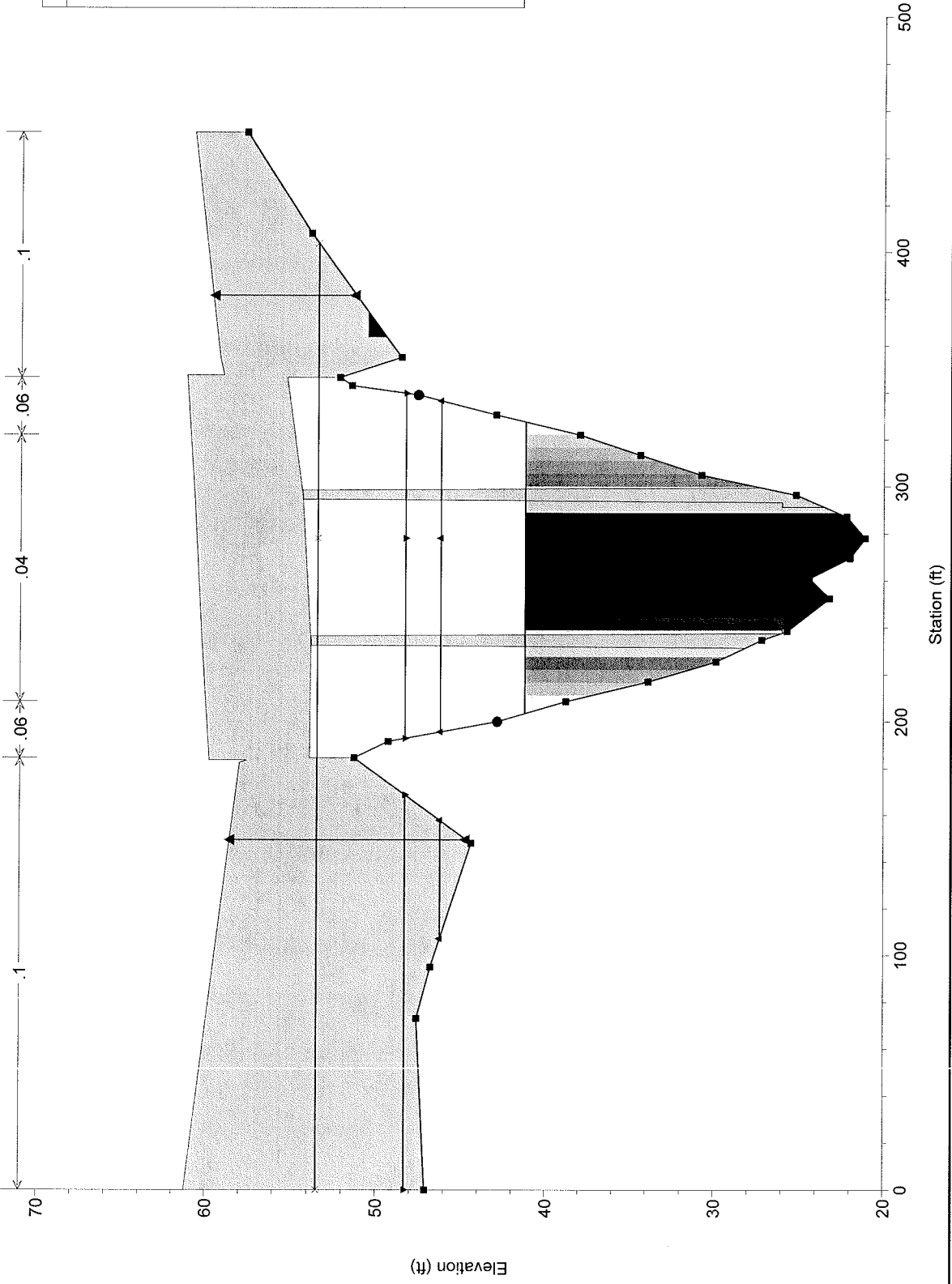
RS = 1052



Legend	
WS 500 year	(Solid line)
WS 100 year	(Solid line)
WS 50 year	(Solid line)
WS 10 year	(Solid line)
0 ft/s	(Lightest shading)
2 ft/s	(Light shading)
4 ft/s	(Medium shading)
6 ft/s	(Dark shading)
8 ft/s	(Darkest shading)
Ground	(Solid line)
Ineff	(Solid triangle)
Bank Sta	(Solid circle)

Falmouth 5553 FINAL Plan: Plan 05 7/15/2011

RS = 1000 BR



Legend	
WS 500 year	→
WS 100 year	→
WS 50 year	→
WS 10 year	→
0 ft/s	□
2 ft/s	□
4 ft/s	□
6 ft/s	□
8 ft/s	□
10 ft/s	□
Ground	■
Ineff	●
Bank Sta	●

Plan: Plan 05 Presumpcot River 1 RS: 1206 Profile: 10 year

E.G. Elev (ft)	42.35	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.32	Wt. n-Val.	0.100	0.055	0.100
W.S. Elev (ft)	42.04	Reach Len. (ft)	50.67	51.33	50.33
Crit W.S. (ft)		Flow Area (sq ft)	6.85	2250.89	50.92
E.G. Slope (ft/ft)	0.000855	Area (sq ft)	6.85	2250.89	50.92
Q Total (cfs)	10162.00	Flow (cfs)	2.22	10147.41	12.36
Top Width (ft)	286.35	Top Width (ft)	10.26	154.22	121.87
Vel Total (ft/s)	4.40	Avg. Vel. (ft/s)	0.32	4.51	0.24
Max Chl Dpth (ft)	25.94	Hydr. Depth (ft)	0.67	14.59	0.42
Conv. Total (cfs)	347559.9	Conv. (cfs)	76.1	347061.0	422.8
Length Wtd. (ft)	51.33	Wetted Per. (ft)	10.61	165.49	121.91
Min Ch EI (ft)	16.10	Shear (lb/sq ft)	0.03	0.73	0.02
Alpha	1.05	Stream Power (lb/ft s)	0.01	3.27	0.01
Frctn Loss (ft)	0.03	Cum Volume (acre-ft)	0.61	49.49	0.21
C & E Loss (ft)	0.00	Cum SA (acres)	0.95	3.70	0.31

Plan: Plan 05 Presumpcot River 1 RS: 1206 Profile: 500 year

E.G. Elev (ft)	55.26	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.23	Wt. n-Val.	0.100	0.056	0.100
W.S. Elev (ft)	55.03	Reach Len. (ft)	50.67	51.33	50.33
Crit W.S. (ft)		Flow Area (sq ft)	2090.40	4301.72	4306.70
E.G. Slope (ft/ft)	0.000394	Area (sq ft)	2090.40	4301.72	4306.70
Q Total (cfs)	28690.00	Flow (cfs)	2957.77	19510.59	6221.64
Top Width (ft)	749.85	Top Width (ft)	195.85	158.00	396.00
Vel Total (ft/s)	2.68	Avg. Vel. (ft/s)	1.41	4.54	1.44
Max Chl Dpth (ft)	38.93	Hydr. Depth (ft)	10.67	27.23	10.88
Conv. Total (cfs)	1445999.0	Conv. (cfs)	149073.7	983349.4	313575.6
Length Wtd. (ft)	51.11	Wetted Per. (ft)	198.82	169.44	397.05
Min Ch EI (ft)	16.10	Shear (lb/sq ft)	0.26	0.62	0.27
Alpha	2.04	Stream Power (lb/ft s)	0.37	2.83	0.39
Frctn Loss (ft)	0.02	Cum Volume (acre-ft)	66.02	97.93	56.12
C & E Loss (ft)	0.02	Cum SA (acres)	6.34	3.77	6.72

Plan: Plan 05 Presumpcot River 1 RS: 1052 Profile: 10 year

E.G. Elev (ft)	42.22	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.47	Wt. n-Val.		0.057	
W.S. Elev (ft)	41.75	Reach Len. (ft)	34.00	34.00	34.00
Crit W.S. (ft)	30.27	Flow Area (sq ft)		1841.90	
E.G. Slope (ft/ft)	0.001496	Area (sq ft)		1841.90	
Q Total (cfs)	10162.00	Flow (cfs)		10162.00	
Top Width (ft)	131.48	Top Width (ft)		131.48	
Vel Total (ft/s)	5.52	Avg. Vel. (ft/s)		5.52	
Max Chl Dpth (ft)	25.15	Hydr. Depth (ft)		14.01	
Conv. Total (cfs)	262710.2	Conv. (cfs)		262710.2	
Length Wtd. (ft)	34.00	Wetted Per. (ft)		143.32	
Min Ch EI (ft)	16.60	Shear (lb/sq ft)		1.20	
Alpha	1.00	Stream Power (lb/ft s)		6.62	
Frctn Loss (ft)	0.06	Cum Volume (acre-ft)	0.61	42.27	0.18
C & E Loss (ft)	0.10	Cum SA (acres)	0.94	3.19	0.24

Plan: Plan 05 Presumpcot River 1 RS: 1052 Profile: 10 year

	Pos	Left Sta	Right Sta	Flow	Area	W.P.	Percent	Hydr	Velocity
		(ft)	(ft)	(cfs)	(sq ft)	(ft)	Conv	Depth(ft)	(ft/s)
1	Chan	197.00	202.76	2.26	6.26	5.89	0.02	1.16	0.36
2	Chan	202.76	208.52	19.00	20.40	6.26	0.19	3.54	0.93
3	Chan	208.52	214.28	91.31	33.89	6.19	0.90	5.88	2.69
4	Chan	214.28	220.04	156.79	46.88	6.19	1.54	8.14	3.34
5	Chan	220.04	225.80	244.75	63.08	6.67	2.41	10.95	3.88
6	Chan	225.80	231.56	382.04	82.40	6.67	3.76	14.31	4.64
7	Chan	231.56	237.32	545.18	101.70	6.62	5.36	17.66	5.36
8	Chan	237.32	243.08	699.07	111.85	5.78	6.88	19.42	6.25
9	Chan	243.08	248.84	728.10	114.61	5.78	7.16	19.90	6.35
10	Chan	248.84	254.60	745.28	116.07	5.76	7.33	20.15	6.42
11	Chan	254.60	260.36	745.22	116.08	5.76	7.33	20.15	6.42
12	Chan	260.36	266.12	764.53	118.15	5.80	7.52	20.51	6.47
13	Chan	266.12	271.88	800.97	122.88	5.96	7.88	21.33	6.52
14	Chan	271.88	277.64	907.36	133.90	6.13	8.93	23.25	6.78
15	Chan	277.64	283.40	1003.62	141.93	6.10	9.88	24.64	7.07
16	Chan	283.40	289.16	895.05	132.81	6.13	8.81	23.06	6.74
17	Chan	289.16	294.92	570.07	110.82	7.67	5.61	19.24	5.14
18	Chan	294.92	300.68	424.63	88.00	6.70	4.18	15.28	4.83
19	Chan	300.68	306.44	279.31	68.38	6.69	2.75	11.87	4.08
20	Chan	306.44	312.20	101.07	50.11	6.40	0.99	8.70	2.02
21	Chan	312.20	317.96	38.60	35.28	6.30	0.38	6.12	1.09
22	Chan	317.96	323.72	15.71	20.58	6.31	0.15	3.57	0.76
23	Chan	323.72	329.48	2.08	5.84	5.60	0.02	1.14	0.36

Plan: Plan 05 Presumpcot River 1 RS: 1052 Profile: 500 year

	Pos	Left Sta	Right Sta	Flow	Area	W.P.	Percent	Hydr	Velocity
		(ft)	(ft)	(cfs)	(sq ft)	(ft)	Conv	Depth(ft)	(ft/s)
1	LOB	-200.00	-112.63	0.00	379.88	84.80	0.00	4.51	0.00
2	LOB	-112.63	-25.25	0.00	547.99	87.38	0.00	6.27	0.00
3	LOB	-25.25	62.13	0.00	613.01	87.38	0.00	7.02	0.00
4	LOB	62.13	149.50	0.00	706.97	87.45	0.00	8.09	0.00
5	LOB	149.50	197.00	1500.77	532.26	47.56	5.23	11.21	2.82
6	Chan	197.00	202.76	156.06	78.61	6.26	0.54	13.65	1.99
7	Chan	202.76	208.52	237.33	92.78	6.26	0.83	16.11	2.56
8	Chan	208.52	214.28	650.16	106.26	6.19	2.27	18.45	6.12
9	Chan	214.28	220.04	787.72	119.26	6.19	2.75	20.70	6.61
10	Chan	220.04	225.80	927.08	135.46	6.67	3.23	23.52	6.84
11	Chan	225.80	231.56	1157.78	154.78	6.67	4.04	26.87	7.48
12	Chan	231.56	237.32	1415.17	174.08	6.62	4.93	30.22	8.13
13	Chan	237.32	243.08	1701.97	184.23	5.78	5.93	31.98	9.24
14	Chan	243.08	248.84	1744.75	186.99	5.78	6.08	32.46	9.33
15	Chan	248.84	254.60	1771.46	188.45	5.76	6.17	32.72	9.40
16	Chan	254.60	260.36	1771.24	188.46	5.76	6.17	32.72	9.40
17	Chan	260.36	266.12	1796.83	190.52	5.80	6.26	33.08	9.43
18	Chan	266.12	271.88	1836.78	195.26	5.96	6.40	33.90	9.41
19	Chan	271.88	277.64	1976.06	206.28	6.13	6.89	35.81	9.58
20	Chan	277.64	283.40	2113.81	214.31	6.10	7.37	37.21	9.86
21	Chan	283.40	289.16	1958.63	205.18	6.13	6.83	35.62	9.55
22	Chan	289.16	294.92	1396.36	183.20	7.67	4.87	31.81	7.62
23	Chan	294.92	300.68	1223.72	160.38	6.70	4.27	27.84	7.63
24	Chan	300.68	306.44	986.06	140.76	6.69	3.44	24.44	7.01

Plan: Plan 05 Presumpcot River 1 RS: 1000 Profile: 10 year

E.G. US. (ft)	42.22	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	41.75	E.G. Elev (ft)	42.06	41.98
Q Total (cfs)	10162.00	W.S. Elev (ft)	41.26	41.17
Q Bridge (cfs)	10162.00	Crit W.S. (ft)	33.38	33.54
Q Weir (cfs)		Max Chl Dpth (ft)	20.16	20.97
Weir Sta Lft (ft)		Vel Total (ft/s)	7.18	7.24
Weir Sta Rgt (ft)		Flow Area (sq ft)	1415.91	1404.26
Weir Submerg		Froude # Chl	0.36	0.36
Weir Max Depth (ft)		Specif Force (cu ft)	13273.05	13044.77
Min EI Weir Flow (ft)	57.59	Hydr Depth (ft)	12.40	12.30
Min EI Prs (ft)	55.30	W.P. Total (ft)	179.82	175.88
Delta EG (ft)	0.52	Conv. Total (cfs)	208177.4	208389.6
Delta WS (ft)	0.37	Top Width (ft)	114.21	114.19
BR Open Area (sq ft)	3081.21	Frctn Loss (ft)	0.08	0.03
BR Open Vel (ft/s)	7.24	C & E Loss (ft)	0.00	0.24
Coef of Q		Shear Total (lb/sq ft)	1.17	1.19
Br Sel Method	Energy only	Power Total (lb/ft s)	8.41	8.58

Plan: Plan 05 Presumpcot River 1 RS: 1000 Profile: 100 year

E.G. US. (ft)	49.62	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	48.95	E.G. Elev (ft)	49.42	49.33
Q Total (cfs)	19357.00	W.S. Elev (ft)	48.32	48.22
Q Bridge (cfs)	19357.00	Crit W.S. (ft)	37.93	38.02
Q Weir (cfs)		Max Chl Dpth (ft)	27.22	28.02
Weir Sta Lft (ft)		Vel Total (ft/s)	8.38	8.39
Weir Sta Rgt (ft)		Flow Area (sq ft)	2310.66	2306.88
Weir Submerg		Froude # Chl	0.35	0.36
Weir Max Depth (ft)		Specif Force (cu ft)	29115.20	28809.30
Min EI Weir Flow (ft)	57.59	Hydr Depth (ft)	16.72	16.33
Min EI Prs (ft)	55.30	W.P. Total (ft)	234.96	233.79
Delta EG (ft)	0.62	Conv. Total (cfs)	400685.1	355411.8
Delta WS (ft)	0.47	Top Width (ft)	138.17	141.28
BR Open Area (sq ft)	3081.21	Frctn Loss (ft)	0.09	0.03
BR Open Vel (ft/s)	8.39	C & E Loss (ft)	0.00	0.30
Coef of Q		Shear Total (lb/sq ft)	1.43	1.83
Br Sel Method	Energy only	Power Total (lb/ft s)	12.00	15.33

Plan: Plan 05 Presumpcot River 1 RS: 1000 Profile: 500 year

E.G. US. (ft)	55.13	Element	Inside BR US	Inside BR DS
W.S. US. (ft)	54.32	E.G. Elev (ft)	54.88	54.77
Q Total (cfs)	28690.00	W.S. Elev (ft)	53.48	53.37
Q Bridge (cfs)	28690.00	Crit W.S. (ft)	41.40	41.42
Q Weir (cfs)		Max Chl Dpth (ft)	32.38	33.17
Weir Sta Lft (ft)		Vel Total (ft/s)	9.34	9.37
Weir Sta Rgt (ft)		Flow Area (sq ft)	3071.66	3063.37
Weir Submerg		Froude # Chl	0.29	0.29
Weir Max Depth (ft)		Specif Force (cu ft)	46357.97	46005.42
Min EI Weir Flow (ft)	57.59	Hydr Depth (ft)	19.95	60.03
Min EI Prs (ft)	55.30	W.P. Total (ft)	272.67	374.76
Delta EG (ft)	0.74	Conv. Total (cfs)	586677.1	411603.7
Delta WS (ft)	0.63	Top Width (ft)	154.00	51.03
BR Open Area (sq ft)	3081.21	Frctn Loss (ft)	0.11	0.04
BR Open Vel (ft/s)	9.37	C & E Loss (ft)	0.00	0.35

Plan: Plan 05 Presumpcot River 1 RS: 1000 Profile: 500 year (Continued)

Coef of Q		Shear Total (lb/sq ft)	1.68	2.48
Br Sel Method	Energy only	Power Total (lb/ft s)	15.71	23.22

Falmouth # 5553

10-YR EVENT

Contraction Scour

	Left	Channel	Right
Input Data			
Average Depth (ft):	0.67	14.59	0.42
Approach Velocity (ft/s):	0.32	4.51	0.24
Br Average Depth (ft):		12.40	
BR Opening Flow (cfs):		10162.00	
BR Top WD (ft):		114.21	
Grain Size D50 (mm):	0.03	0.03	0.03
Approach Flow (cfs):	2.22	10147.41	12.36
Approach Top WD (ft):	10.26	154.22	121.87
K1 Coefficient:	0.690	0.690	0.690
Results			
Scour Depth Ys (ft):		5.57	
Critical Velocity (ft/s):		0.81	
Equation:		Live	

Pier Scour

Pier: #1 (CL = 234.5)

Input Data

Pier Shape:	Sharp nose
Pier Width (ft):	6.14
Grain Size D50 (mm):	0.03000
Depth Upstream (ft):	24.64
Velocity Upstream (ft/s):	7.07
K1 Nose Shape:	1.00
Pier Angle:	
Pier Length (ft):	33.00
K2 Angle Coef:	1.00
K3 Bed Cond Coef:	1.10
Grain Size D90 (mm):	20.00000
K4 Armouring Coef:	1.00
Set K1 value to 1.0 because angle > 5 degrees	

Results

Scour Depth Ys (ft):	12.13
Froude #:	0.25
Equation:	CSU equation

Pier: #2 (CL = 296.5)

Input Data

Pier Shape:	Sharp nose
Pier Width (ft):	10.25
Grain Size D50 (mm):	0.03000
Depth Upstream (ft):	24.64
Velocity Upstream (ft/s):	7.07
K1 Nose Shape:	1.00
Pier Angle:	
Pier Length (ft):	33.00
K2 Angle Coef:	1.00
K3 Bed Cond Coef:	1.10
Grain Size D90 (mm):	20.00000
K4 Armouring Coef:	1.00
Set K1 value to 1.0 because angle > 5 degrees	

Results

Scour Depth Ys (ft):	16.92
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Froude #:	0.25
Equation:	CSU equation

Combined Scour Depths

Pier : #1 (CL = 234.5) (Contr + Pier) (ft):	17.70
Pier : #2 (CL = 296.5) (Contr + Pier) (ft):	22.49

Complex Pier Scour - Q10 Event, Pier 2

Pier stem component:

$$\frac{y_{spier}}{y_1} = K_{hpier} \left[ 2.0 K_1 K_2 K_3 K_4 \left( \frac{a_{pier}}{y_1} \right)^{0.65} \left( \frac{V_1}{\sqrt{g y_1}} \right)^{0.43} \right]$$

↳ From HEC-RAS Results for stem only

$y_s = 16.92'$  (Not exact since HEC-RAS used  $a_{pier} = 10.25'$ , but close enough)

Find  $K_{hpier}$  from Fig 6.5 (Pier 2 on spread footing)

$f \approx 1.54 + 4.67/2 = 3.1'$

$a_{pier} = 6.25'$

$h_1 \div \text{Bed EL} = 25.2$

$\text{TOF EL} = 26.0$

$h_1 = 26 - 25.2 = 0.8'$

$f/a_{pier} = 3.1/6.25 = 0.50$

$h_1/a_{pier} = 0.8/6.25 = 0.13$

$\Rightarrow K_{hpier} = 0.3$

$y_{spier} = K_{hpier} y_s = 0.3(16.92) = 5.08'$

Footing Component:

- Case 2, Bottom of Footing located on or below the bed.

$y_2 = y_1 + y_{spier}/2 + y_c$

$y_c = 5.57'$  From HEC-RAS

$y_1 = 24.64'$  From HEC-RAS

$y_2 = 24.64 + 5.08/2 + 5.57 = 32.75'$

$\frac{V_f}{V_L} = \ln \left( 10.93 \frac{y_f}{K_s} + 1 \right)$

$\ln \left( 10.93 \frac{y_2}{K_s} + 1 \right)$

$y_f = h_1 + y_{spier}/2 + y_c = 0.8' + 5.08'/2 + 5.57' = 8.91'$

Project:

Job No.

Sheet: 2 of

Item:

Designer:

Date:

Checker:

Date:

Grid: 1/8"

$$K_s \approx 0.006 \text{ mm} \\ = 0.0002'$$

Assume D39 = upper range of material "Silty-clay", coarse silt say  $\approx 0.006$

$$V_2 = V_1 \gamma_1 / \gamma_2$$

$$V_1 = 7.07' \text{ ft/sec}$$

$$V_2 = 7.07 (24.64 / 32.75) = 5.32' \text{ ft/sec}$$

$$\frac{V_f}{V_2} = \frac{\ln (10.93 (3.91' / 0.0002') + 1)}{\ln (10.93 (32.75' / 0.0002') + 1)} = \frac{\ln 486932}{\ln 1789788} = 0.910$$

$$V_f = 0.91 (5.32) = 4.84' \text{ ft/sec}$$

$$a_{pc} = 10.25'$$

$$\frac{y_{spc}}{y_f} = 2.0 K_1 K_2 K_3 K_4 K_w \left( \frac{a_{pc}}{y_f} \right)^{0.65} \left( \frac{V_f}{\sqrt{g y_c}} \right)^{0.43}$$

$$K_1 = 1.1 \quad (\text{square ft, nose})$$

$$K_2 = 1.0$$

$$K_3 = 1.1 \quad (\text{Plan Bed})$$

$$K_4 = 1.0$$

$$K_w = 1 \quad (\text{or N.A.})$$

$$\frac{y_{spc}}{y_f} = 2.0 (1.1) (1.0) (1.1) (1.0) \left( \frac{10.25}{8.91} \right)^{0.65} \left( \frac{4.84}{\sqrt{32.2 \times 3.91}} \right)^{0.43} \\ = 1.55$$

$$y_{spc} = 8.91 (1.55) = 13.78'$$

Neglect small difference in timber pile group vs. pile cap width. Piles closely spaced, near same o-o width as cap & likely collect debris.

$$y_{s \text{ total}} = 5.57' + 5.03' + 13.78' = 24.43'$$

	P1	P2
lowest Bnd	25.7	25.2
Scour Depth	- 24.4	- 24.4
Scour Elev.	1.3	0.8

Project:

Job No.

Sheet: 3 of

Item:

Designer:

Date:

Checker:

Date:

Grid: 1/8"

	P1	P2	
BOF EL =	22.0	22.0	
Exposed Pile L =	18.7'	19.2'	
Pile Tip EL =	-25	-25	(1/3 of Piles to -5)
Pile Embedment L =	26.3'	25.8'	
% Exposed Pile L =	41%	43%	

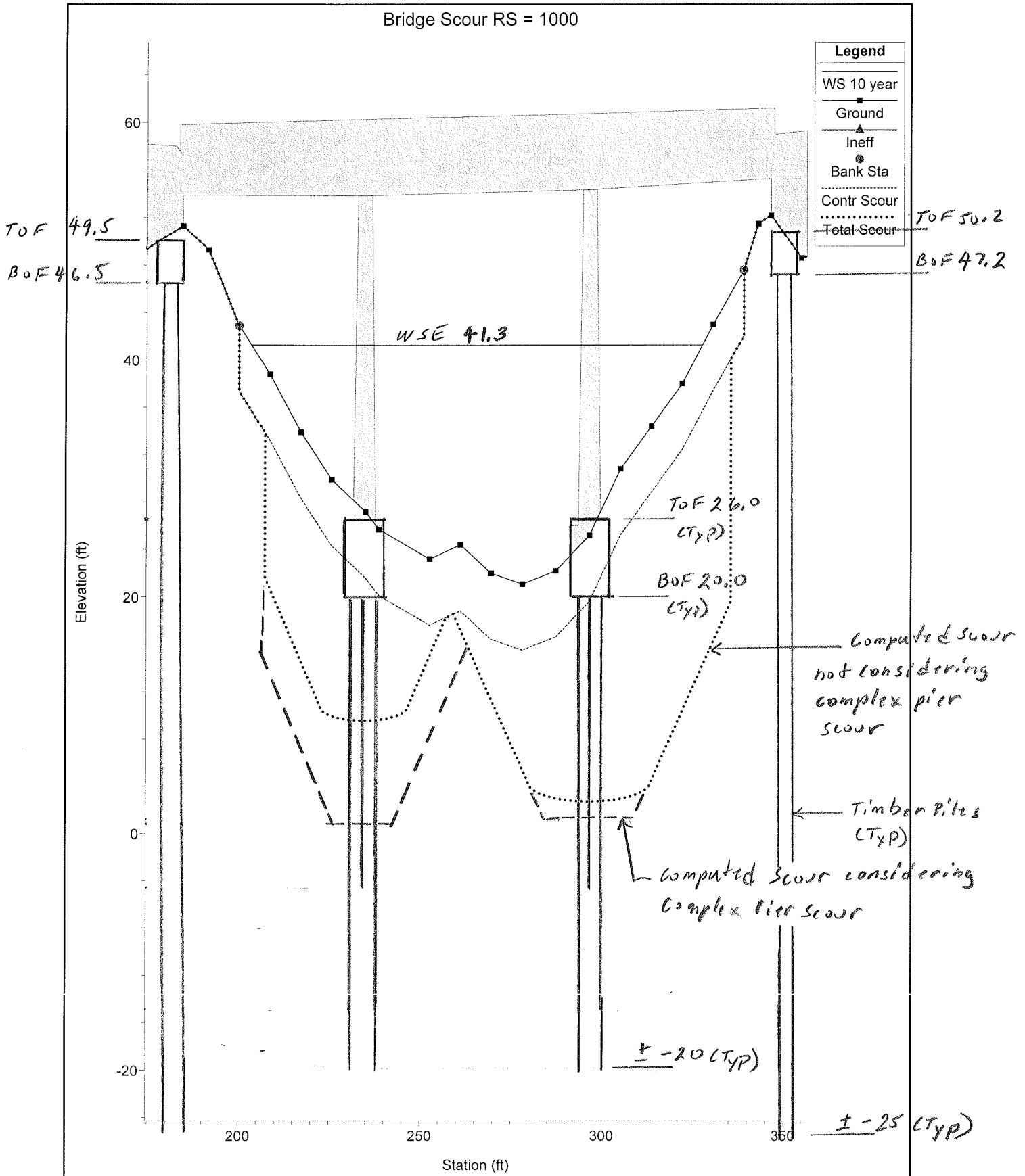
Conclude Bridge Scour Critical for Q10 Event.

Note piles embedded in cohesive soils, scour depth known to be similar to non-cohesive soils, but duration of flow influences results significantly since cohesive forces somewhat resist scour action.

Falmouth #5553

10-YR Event

Bridge Scour RS = 1000



COMP BY: RMH  
 CHECK BY:  
 DATE: 12/23/2010

PROJECT NAME: Scour POA - West  
 SUBJECT: Bearing Capacity Failure

Bridge #: 5553 Lambert Street Bridge in Falmouth

Technical Assumptions:

- 1.) The pier is founded on timber friction piles as shown on the contract plans. 66 ft. embedment, Abutment  
45 ft. embedment, Pier
- 2.) Assume total bearing capacity equals 100% friction resistance
- 3.) Assume 100% bearing capacity has a factor of safety of 2.
- 4.) The three risk designations are:
 

Low Risk	F.S. $\geq$ 1.75
Moderate Risk	1.75 > F.S. $\geq$ 1.25
High Risk	F.S. < 1.25

Calculations

Bearing Capacity F.S. =  $2.0 * (L - \text{Scour Depth}) / L$

Factor of Safety for each storm event and at each substructure unit.

Event & Location	Scour Depth (ft) *	F.S.	Risk
Scour Critical - Left Abutment	8.1	1.75	Low
Scour Critical - Pier 1 (Left)	5.6	1.75	Low
Scour Critical - Pier 2 (Right)	5.6	1.75	Low
Scour Critical - Right Abutment	8.1	1.75	Low
10-year Left Abutment	0	2.00	Low
10-year Pier 1 (Left)	18.7	1.17	High
10-year Pier 2 (Right)	19.2	1.15	High
10-year Right Abutment	0	2.00	Low
500-year Left Abutment	0	2.00	Low
500-year Pier 1 (Left)	27.4	0.78	High
500-year Pier 2 (Right)	32.9	0.54	High
500-year Right Abutment	0	2.00	Low

\* Scour depths listed are depths below the base of the footing

COMP BY: RMH  
 CHECK BY: 0  
 DATE: 12/23/2010

PROJECT NAME: Scour POA - West  
 SUBJECT: Buckling/Compression Failure

Bridge #: 5553 Lambert Street Bridge in Falmouth

- 1.) Assume Eastern Hemlock (similar to Hem-Fir) with an allowable working stress equal to 800 psi, where the pile has full lateral support. (AASHTO Table 4.5.7.3A)
- 2.) Design of a round column (pile) shall be based on the design of a square column of the same area. (AASHTO 13.7.3.5)
- 3.) Assume that, where scour occurs, the pile is unsupported to a depth 5 feet below scour level.

Column stability factor, Cp: (AASHTO 13.7.3.3.5)

$$C_p = \frac{1 + (F_{ce}/F_c'')}{2 * c} - \sqrt{\frac{[1 + (F_{ce}/F_c'')]^2 - F_{ce}/F_c''}{(2 * c)^2}} \quad \text{(AASHTO 13-17)}$$

$F_{ce} = \frac{K_{ce} * E'}{(l_e/d')^2}$  (AASHTO 13-18),  $K_{ce} = 0.3$ ,  $E' = E * C_m = 900$  ksi, (AASHTO 13-1)  
 $c = 0.85$ ,  $E = 900$  ksi, (#2 Eastern Hemlock)  
 $F_c = 800$  psi,  $C_m = 1$  (AASHTO T.13.5.1A)

Pile Diameter (d) 12 inches (assume)  
 d'=dimension of square pile with same area as round pile = 10.63 inches  
 $l_e$  (Unsupported length) = K\*(Scour Depth + 5 ft)  
 K= 1.2  $F_c' = (F_c * C_m * C_d * C_f) * C_p$  (AASHTO 13-15)  
 $F_c'' * AREA = 81.4$  kips  $F_c'' = (F_c * C_m * C_d * C_f) = 720$  psi  
 Maximum vertical design load per pile = 50 kips, Abutment  $C_d = 0.9$  (AASHTO 13.5.5.2.2)  
 40 kips, Pier  $C_f = 1.0$  (AASHTO 13.7.3.2)

- 4.) The three risk designations are:
- |               |              |                          |
|---------------|--------------|--------------------------|
| Low Risk      | greater than | 85 % of pile load        |
| Moderate Risk | between      | 70% and 85% of pile load |
| High Risk     | less than    | 70% of pile load         |

Determine Pile Capacity as a percent of maximum design load

Event & Location	Scour Depth* (ft)	le/d'	Fce (psi)	Cp	P All (kips)	Design Load %	Risk
Scour Critical - Left Abutment	13.3	24.78	440	0.52	42.68	85.4%	Low
Scour Critical - Pier 1 (Left)	16	28.44	334	0.42	34.09	85.2%	Low
Scour Critical - Pier 2 (Right)	16	28.44	334	0.42	34.09	85.2%	Low
Scour Critical - Right Abutment	13.3	24.78	440	0.52	42.68	85.4%	Low
10-year Left Abutment	0	NA	NA	NA	N/A	N/A	N/A
10-year Pier 1 (Left)	18.7	32.09	262	0.34	27.54	68.9%	High
10-year Pier 2 (Right)	19.2	32.77	251	0.33	26.52	66.3%	High
10-year Right Abutment	0	NA	NA	NA	N/A	N/A	N/A
500-year Left Abutment	0	NA	NA	NA	N/A	N/A	N/A
500-year Pier 1 (Left)	27.4	43.87	140	0.19	15.33	38.3%	High
500-year Pier 2 (Right)	32.9	51.32	103	0.14	11.32	28.3%	High
500-year Right Abutment	0	NA	NA	NA	N/A	N/A	N/A

\* Scour depths listed are depths below the base of the footing



Plan: Plan 05 Presumpcot River 1 RS: 1052 Profile: 500 year

E.G. Elev (ft)	55.13	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.81	Wt. n-Val.	0.100	0.061	0.100
W.S. Elev (ft)	54.32	Reach Len. (ft)	34.00	34.00	34.00
Crit W.S. (ft)	38.51	Flow Area (sq ft)	532.26	3618.16	200.47
E.G. Slope (ft/ft)	0.001439	Area (sq ft)	2780.10	3618.16	247.62
Q Total (cfs)	28690.00	Flow (cfs)	1500.77	26867.52	321.72
Top Width (ft)	609.62	Top Width (ft)	393.90	144.00	71.72
Vel Total (ft/s)	6.59	Avg. Vel. (ft/s)	2.82	7.43	1.60
Max Chl Dpth (ft)	37.72	Hydr. Depth (ft)	11.21	25.13	4.95
Conv. Total (cfs)	756437.3	Conv. (cfs)	39569.1	708385.8	8482.4
Length Wtd. (ft)	34.00	Wetted Per. (ft)	47.56	157.04	41.72
Min Ch EI (ft)	16.60	Shear (lb/sq ft)	1.01	2.07	0.43
Alpha	1.20	Stream Power (lb/ft s)	2.83	15.37	0.69
Frctn Loss (ft)	0.06	Cum Volume (acre-ft)	57.09	83.91	49.59
C & E Loss (ft)	0.18	Cum SA (acres)	5.31	3.23	5.89

Plan: Plan 05 Presumpcot River 1 RS: 1000 BR U Profile: 10 year

E.G. Elev (ft)	42.06	Element	Left OB	Channel	Right OB
Vel Head (ft)	0.80	Wt. n-Val.		0.040	
W.S. Elev (ft)	41.26	Reach Len. (ft)	33.00	33.00	33.00
Crit W.S. (ft)	33.38	Flow Area (sq ft)		1415.91	
E.G. Slope (ft/ft)	0.002383	Area (sq ft)		1415.91	
Q Total (cfs)	10162.00	Flow (cfs)		10162.00	
Top Width (ft)	114.21	Top Width (ft)		114.21	
Vel Total (ft/s)	7.18	Avg. Vel. (ft/s)		7.18	
Max Chl Dpth (ft)	20.16	Hydr. Depth (ft)		12.40	
Conv. Total (cfs)	208177.4	Conv. (cfs)		208177.4	
Length Wtd. (ft)	33.00	Wetted Per. (ft)		179.82	
Min Ch EI (ft)	21.10	Shear (lb/sq ft)		1.17	
Alpha	1.00	Stream Power (lb/ft s)		8.41	
Frctn Loss (ft)	0.08	Cum Volume (acre-ft)	0.61	41.00	0.18
C & E Loss (ft)	0.00	Cum SA (acres)	0.94	3.10	0.24

Plan: Plan 05 Presumpcot River 1 RS: 1000 BR U Profile: 500 year

E.G. Elev (ft)	54.88	Element	Left OB	Channel	Right OB
Vel Head (ft)	1.40	Wt. n-Val.	0.060	0.040	0.060
W.S. Elev (ft)	53.48	Reach Len. (ft)	33.00	33.00	33.00
Crit W.S. (ft)	41.40	Flow Area (sq ft)	84.99	2965.44	21.42
E.G. Slope (ft/ft)	0.002391	Area (sq ft)	84.99	2965.44	21.42
Q Total (cfs)	28690.00	Flow (cfs)	290.55	28353.72	45.73
Top Width (ft)	154.00	Top Width (ft)	15.50	131.00	7.50
Vel Total (ft/s)	9.34	Avg. Vel. (ft/s)	3.42	9.56	2.13
Max Chl Dpth (ft)	32.38	Hydr. Depth (ft)	5.48	22.64	2.86
Conv. Total (cfs)	586677.1	Conv. (cfs)	5941.4	579800.5	935.2
Length Wtd. (ft)	33.00	Wetted Per. (ft)	17.92	245.59	9.16
Min Ch EI (ft)	21.10	Shear (lb/sq ft)	0.71	1.80	0.35
Alpha	1.04	Stream Power (lb/ft s)	2.42	17.24	0.75
Frctn Loss (ft)	0.11	Cum Volume (acre-ft)	55.98	81.34	49.48
C & E Loss (ft)	0.00	Cum SA (acres)	5.15	3.13	5.86

Plan: Plan 05 Presumpcot River 1 RS: 1052 Profile: 500 year (Continued)

	Pos	Left Sta (ft)	Right Sta (ft)	Flow (cfs)	Area (sq ft)	W.P. (ft)	Percent Conv	Hydr Depth(ft)	Velocity (ft/s)
25	Chan	306.44	312.20	459.42	122.49	6.40	1.60	21.27	3.75
26	Chan	312.20	317.96	262.63	107.65	6.30	0.92	18.69	2.44
27	Chan	317.96	323.72	205.45	92.96	6.31	0.72	16.14	2.21
28	Chan	323.72	329.48	153.68	78.12	6.31	0.54	13.56	1.97
29	Chan	329.48	335.24	108.14	63.27	6.31	0.38	10.98	1.71
30	Chan	335.24	341.00	69.24	48.42	6.31	0.24	8.41	1.43
31	ROB	341.00	361.25	223.67	123.62	20.35	0.78	6.10	1.81
32	ROB	361.25	381.50	98.05	76.86	21.37	0.34	3.80	1.28
33	ROB	381.50	404.67	0.00	44.22	23.28	0.00	1.91	0.00
34	ROB	404.67	427.83	0.00	2.93	8.09	0.00	0.36	0.00

Falmouth # 5553  
500-YR EVENT

Contraction Scour

	Left	Channel	Right
<b>Input Data</b>			
Average Depth (ft):	10.67	27.23	10.88
Approach Velocity (ft/s):	1.41	4.54	1.44
Br Average Depth (ft):	5.48	22.64	2.86
BR Opening Flow (cfs):	290.55	28353.72	45.73
BR Top WD (ft):	15.50	131.00	7.50
Grain Size D50 (mm):	0.03	0.03	0.03
Approach Flow (cfs):	2957.77	19510.59	6221.64
Approach Top WD (ft):	195.85	158.00	396.00
K1 Coefficient:	0.690	0.690	0.690
<b>Results</b>			
Scour Depth Ys (ft):	2.93	20.05	0.00
Critical Velocity (ft/s):	0.77	0.90	0.77
Equation:	Live	Live	Live

Pier Scour

Pier: #1 (CL = 234.5)

Input Data

Pier Shape:	Sharp nose
Pier Width (ft):	6.14
Grain Size D50 (mm):	0.03000
Depth Upstream (ft):	27.04
Velocity Upstream (ft/s):	8.13
K1 Nose Shape:	1.00
Pier Angle:	
Pier Length (ft):	33.00
K2 Angle Coef:	1.00
K3 Bed Cond Coef:	1.10
Grain Size D90 (mm):	25.00000
K4 Armouring Coef:	1.00

Set K1 value to 1.0 because angle > 5 degrees

Results

Scour Depth Ys (ft):	13.04
Froude #:	0.28
Equation:	CSU equation

Pier: #2 (CL = 296.5)

Input Data

Pier Shape:	Sharp nose
Pier Width (ft):	10.25
Grain Size D50 (mm):	0.03000
Depth Upstream (ft):	29.12
Velocity Upstream (ft/s):	7.63
K1 Nose Shape:	1.00
Pier Angle:	
Pier Length (ft):	33.00
K2 Angle Coef:	1.00
K3 Bed Cond Coef:	1.10
Grain Size D90 (mm):	25.00000
K4 Armouring Coef:	1.00

Set K1 value to 1.0 because angle > 5 degrees

Results

Scour Depth Ys (ft):	17.88
----------------------	-------

Froude #:  
Equation:

0.25  
CSU equation

Combined Scour Depths

Pier : #1 (CL = 234.5) (Contr + Pier) (ft):  
Pier : #2 (CL = 296.5) (Contr + Pier) (ft):

33.09  
37.93

Lowest Bed

P1  
25.7  
-33.1  
-7.4

P2  
25.2  
-37.9  
-12.9

Falmouth #5553

500-YR EVENT

Bridge Scour RS = 1000

