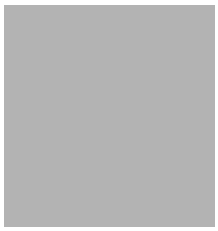
LEVEL II SCOUR ANALYSIS FOR BRIDGE 45a (BRIDUS00040045a) on U.S. ROUTE 4, crossing the OTTAUQUECHEE RIVER, BRIDGEWATER, VERMONT

U.S. Geological Survey
Open-File Report 96-244



Prepared in cooperation with
VERMONT AGENCY OF TRANSPORTATION
and
FEDERAL HIGHWAY ADMINISTRATION

LEVEL II SCOUR ANALYSIS FOR BRIDGE 45a (BRIDUS00040045a) on U.S. ROUTE 4, crossing the OTTAUQUECHEE RIVER, BRIDGEWATER, VERMONT

By SCOTT A. OLSON

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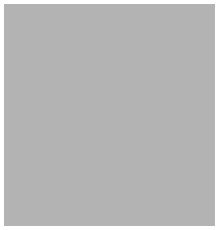

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Pembroke, New Hampshire

1996

U.S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY
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CONVERSION FACTORS, ABBREVIATIONS, AND VERTICAL DATUM

Multiply	By	To obtain
	Length	
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Slope	
foot per mile (ft/mi)	0.1894	meter per kilometer (m/km)
	Area	
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
cubic foot (ft^3)	0.02832	cubic meter (m^3)
	Velocity and Flow	
foot per second (ft/s)	0.3048	meter per second (m/s)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
cubic foot per second per square mile [$(ft^3/s)/mi^2$]	0.01093	cubic meter per second per square kilometer [$(m^3/s)/km^2$]

OTHER ABBREVIATIONS

BF	bank full	LWW	left wingwall
cfs	cubic feet per second	MC	main channel
D_{50}	median diameter of bed material	RAB	right abutment
DS	downstream	RABUT	face of right abutment
elev.	elevation	RB	right bank
f/p	flood plain	ROB	right overbank
ft^2	square feet	RWW	right wingwall
ft/ft	feet per foot	TH	town highway
JCT	junction	UB	under bridge
LAB	left abutment	US	upstream
LABUT	face of left abutment	USGS	United States Geological Survey
LB	left bank	VTAOT	Vermont Agency of Transportation
LOB	left overbank	WSPRO	water-surface profile model

In this report, the words “right” and “left” refer to directions that would be reported by an observer facing downstream.

Sea level: In this report, “sea level” refers to the National Geodetic Vertical Datum of 1929-- a geodetic datum derived from a general adjustment of the first-order level nets of the United States and Canada, formerly called Sea Level Datum of 1929.

In the appendices, the above abbreviations may be combined. For example, USLB would represent upstream left bank.

LEVEL II SCOUR ANALYSIS FOR BRIDGE 45a (BRIDUS00040045a) ON U.S. ROUTE 4, CROSSING THE OTTAUQUECHEE RIVER, BRIDGEWATER, VERMONT

By **Scott A. Olson**

INTRODUCTION AND SUMMARY OF RESULTS

This report provides the results of a detailed Level II analysis of scour potential at structure BRIDUS00040045a on U.S.. Route 4 crossing the Ottauquechee River, Bridgewater, Vermont (figures 1–8). A Level II study is a basic engineering analysis of the site, including a quantitative analysis of stream stability and scour (U.S. Department of Transportation, 1993). A Level I study is included in Appendix E of this report. A Level I study provides a qualitative geomorphic characterization of the study site. Information on the bridge available from VTAOT files was compiled prior to conducting Level I and Level II analyses and can be found in Appendix D.

The site is in the Green Mountain physiographic province of central Vermont in the town of Bridgewater. The 72.1-mi^2 drainage area is in a predominantly rural and forested basin. In the vicinity of the study site, the overbank areas are lawn or pasture with a few residences. The immediate channel banks have moderately dense woody vegetation.

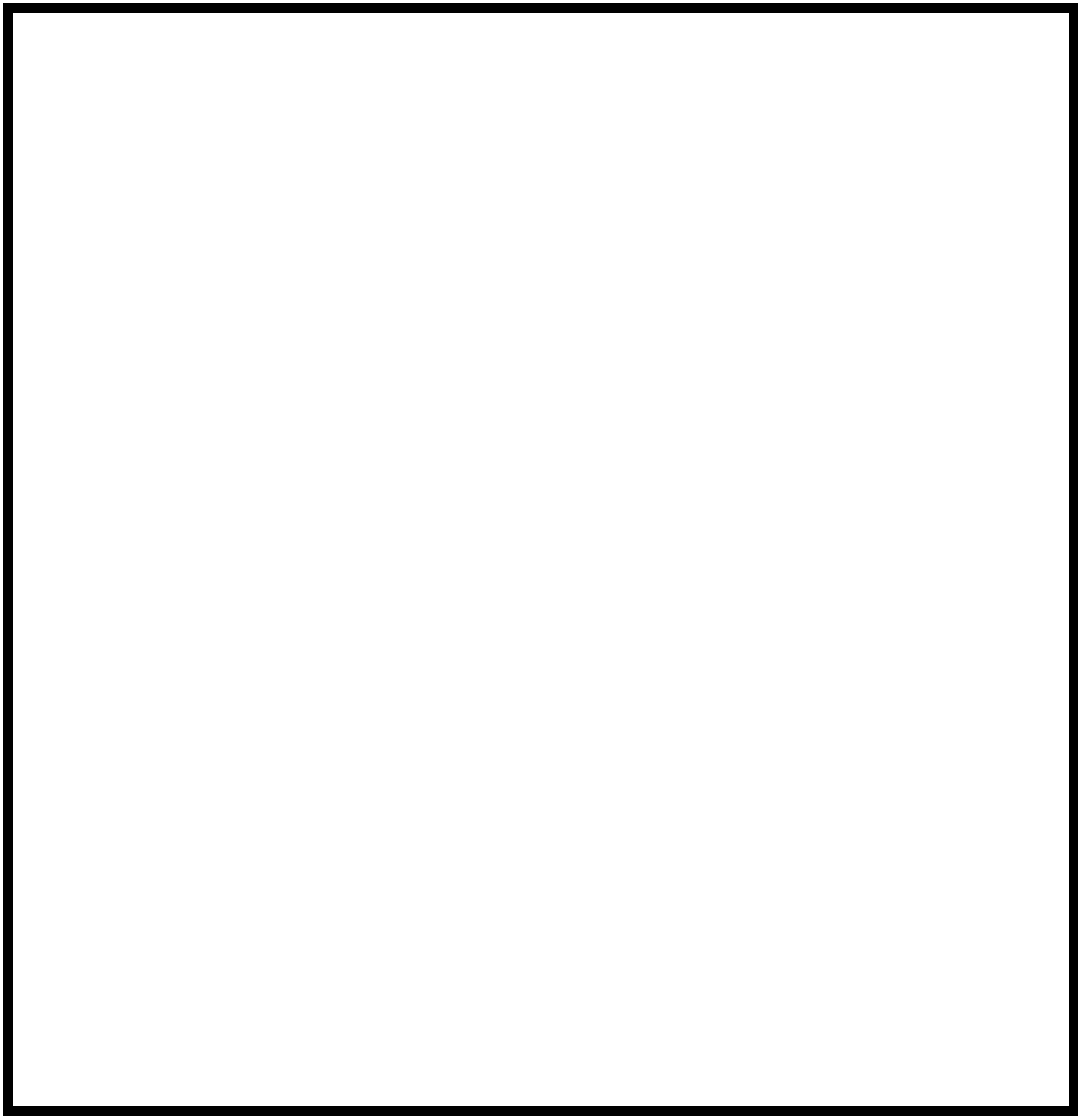
In the study area, the Ottauquechee River has a sinuous channel with a slope of approximately 0.01 ft/ft, an average channel top width of 81 ft and an average channel depth of 3 ft. The predominant channel bed materials are gravel and cobble (D_{50} is 54.9 mm or 0.180 ft). The geomorphic assessment at the time of the Level I and Level II site visit on October 26, 1994, indicated that the reach was stable.

The U.S. Route 4 crossing of the Ottauquechee River is a 172-ft-long, two-lane bridge consisting of three steel-beam spans supported by spill-through abutments and two concrete piers (Vermont Agency of Transportation, written commun., August 25, 1994). The abutment and road approaches are protected by type-2 stone fill (less than 36 inches diameter). The North Branch of the Ottauquechee River joins the Ottauquechee River approximately 200 feet upstream of the bridge on the main branch's left bank. The channel approach to the bridge has a mild bend with the bridge skewed 15 degrees to flow; the opening-skew-to-roadway is 30 degrees. Additional details describing conditions at the site are included in the Level II Summary, Appendix D, and Appendix E.

Scour depths and rock rip-rap sizes were computed using the general guidelines described in Hydraulic Engineering Circular 18 (Richardson and others, 1993). Total scour at a highway crossing is comprised of three components: 1) long-term streambed degradation; 2) contraction scour (due to accelerated flow caused by a reduction in flow area at a bridge) and; 3) local scour (caused by accelerated flow around piers and abutments). Total scour is the sum of the three components. Equations are available to compute depths for contraction and local scour and a summary of the results of these computations follows.

Contraction scour for all modelled flows ranged from 3.1 to 4.0 ft. with the worst-case contraction scour occurring at the 500-year and incipient road-overflow discharges. Abutment scour ranged from 9.3 to 15.2 ft. The worst-case abutment scour also occurred at the 500-year discharge. Pier scour ranged from 11.4 to 12.4 ft. with the worst-case scenario occurring at the incipient roadway overflow discharge. The incipient roadway overflow discharge was between the 100- and 500-year discharges. Additional information on scour depths and depths to armoring are included in the section titled "Scour Results". Scoured-streambed elevations, based on the calculated scour depths, are presented in tables 1 and 2. A cross-section of the scour computed at the bridge is presented in figure 8. Scour depths were calculated assuming an infinite depth of erosive material and a homogeneous particle-size distribution.

It is generally accepted that the Froehlich equation (abutment scour) gives "excessively conservative estimates of scour depths" (Richardson and others, 1993, p. 48). Many factors, including historical performance during flood events, the geomorphic assessment, scour protection measures, and the results of the hydraulic analyses, must be considered to properly assess the validity of abutment scour results. Therefore, scour depths adopted by VTAOT may differ from the computed values documented herein, based on the consideration of additional contributing factors and experienced engineering judgement.

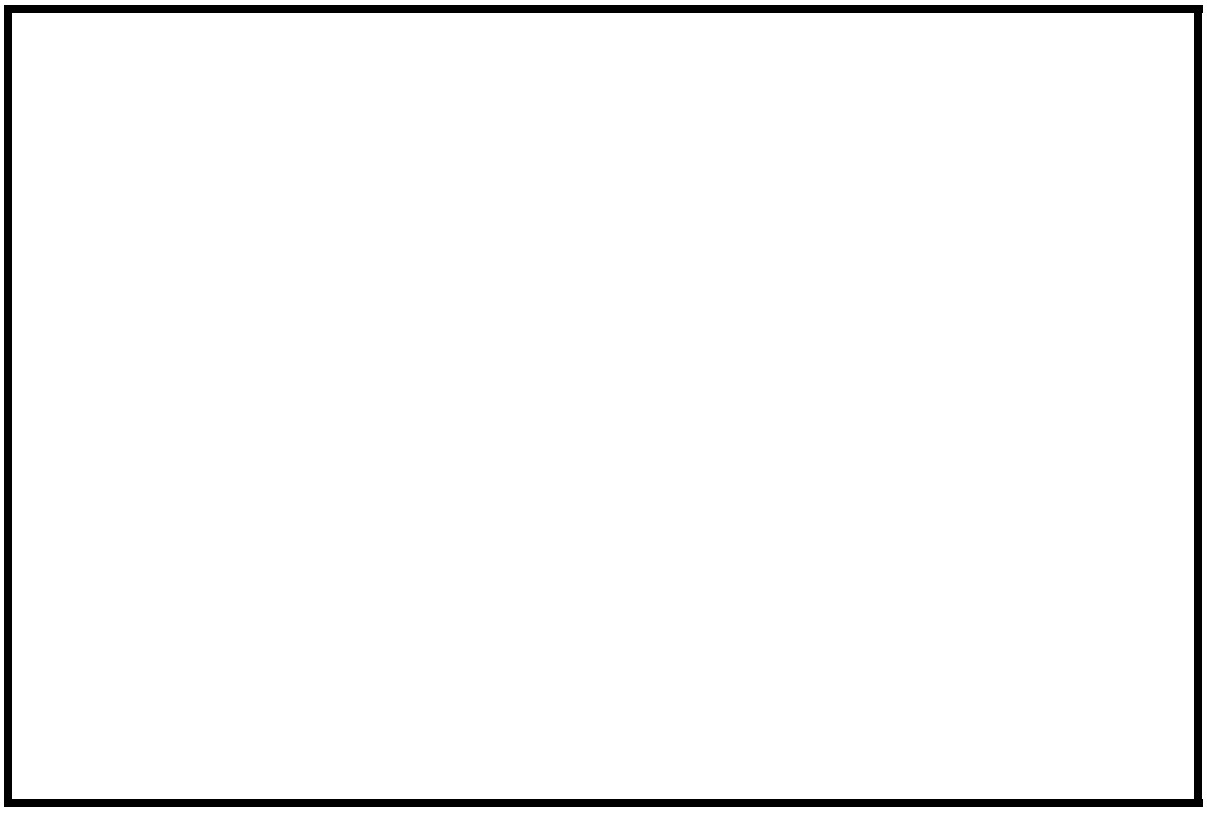


Plymouth, VT. Quadrangle, 1:24,000, 1966
Photoinspected 1983

NORTH

Figure 1. Location of study area on USGS 1:24,000 scale map.

Figure 2. Location of study area on Vermont Agency of Transportation town highway map.



LEVEL II SUMMARY

Structure Number BRIDUS00040045a ***Stream*** Ottauquechee River

County Windsor ***Road*** US 4 ***District*** 04

Description of Bridge

Bridge length 172 ***ft*** ***Bridge width*** 35.2 ***ft*** ***Max span length*** 72 ***ft***

Alignment of bridge to road (on curve or straight) slight horizontal curve

Abutment type spill-through ***Embankment type*** sloping

Stone fill on abutment? yes ***Date of inspection*** 10/26/94

Description of stone fill Type-2 protecting each abutment and the road embankment.

Brief description of piers/bents Abutments and piers are concrete. The piers are located at the toe of each of the spill-through abutments.

Is bridge skewed to flood flow according to Y ***survey?*** ***Angle*** Y 15

Comments Bridge is located on a mild bend in the channel.

Debris accumulation on bridge at time of Level I or Level II site visit:

	Date of inspection	***Percent of channel blocked horizontally***	***Percent of channel blocked vertically***
Level I	10/26/94	0	0
Level II	10/26/94	-	-

Potential for debris Low; however, capture efficiency may be significant due to the two piers.

Describe any features near or at the bridge that may affect flow (include observation date) October 26, 1994. There is a significant tributary 200 feet upstream of the bridge.

Description of the Geomorphic Setting

General topography At the study site, the channel is sinuous with narrow flood plains in a moderate relief valley.

Geomorphic conditions at bridge site: downstream (DS), upstream (US)

Date of inspection 10/26/94

DS left: Flood plain to steep valley wall.

DS right: Narrow flood plain to steep valley wall.

US left: Flood plain to steep valley wall.

US right: Flood plain to steep valley wall.

Description of the Channel

Average top width 81 ***ft*** ***Average depth*** 3 ***ft***

Predominant bed material gravel/cobbles ***Bank material*** gravel/cobbles

Stream type (straight, sinuous, upland, braided, etc.) Sinuous, upland stream.

10/26/94

Vegetative cover Immediate bank is forested overbank is pasture.

DS left: Immediate bank is lawn within one bridge length; forest cover beyond.

DS right: Immediate bank is forested with lawn on the overbank.

US left: Immediate bank is covered by brush with lawn on the overbank.

US right: Y

Do banks appear stable? 10/26/94. ~~If not, describe location and type of instability and date of observation.~~

10/26/94--None.

Describe any obstructions in channel and date of observation.

Hydrology

Drainage area 72.1 ***mi²***

Percentage of drainage area in physiographic provinces: (approximate)

Physiographic province	*Percent of drainage area*
Green Mountain	100

Is drainage area considered rural or urban? Rural ***Describe any significant urbanization***: None. Area is mostly forested, high-elevation, headwater drainage.

Is there a USGS gage on the stream of interest? No

USGS gage description

USGS gage number

Gage drainage area ***mi²***

Is there a lake/p No

Calculated Discharges

Q100 13,000 ***ft³/s*** ***Q500*** 20,500 ***ft³/s***

Q100 was taken from VTAOT files (written commun., 5/4/95). Q500 was determined by graphically extrapolating flood frequency estimates in the VTAOT files. The results were also compared with various empirical methods (Talbot, 1887; Potter, 1957a; Potter, 1957b; Johnson and Laraway, 1971, written commun.; Johnson and Tasker, 1974; Federal Highway Administration, 1983).

Description of the Water-Surface Profile Model (WSPRO) Analysis

Datum for WSPRO analysis (USGS survey, sea level, VTAOT plans) USGS survey

Datum tie between USGS survey and VTAOT plans Add 767 ft to USGS datum to get VTAOT plans datum.

Description of reference marks used to determine USGS datum. RM1 is a bronze tablet near the downstream end of the right abutment (elev. 103.48 feet, arbitrary survey datum). RM2 is a chiseled X on the upstream left corner of the bridge (elev. 100.84 feet, arbitrary survey datum).

Cross-Sections Used in WSPRO Analysis

[1]*Cross-section*	*Section Reference Distance (SRD) in feet*	[2]*Cross-section development*	*Comments*
EXITX	0	1	Exit section
FULLV	74	2	Downstream Full-valley section (Templated from EXITX)
BRIDG	74	1	Bridge section
RDWAY	92	1	Road Grade section
APPRO	174	1	Approach section

[1] For location of cross-sections see plan-view sketch included with Level I field form, Appendix E. For more detail on how cross-sections were developed see WSPRO input file.

Data and Assumptions Used in WSPRO Model

Hydraulic analyses of the reach were done by use of the Federal Highway Administration's WSPRO step-backwater computer program (Shearman and others, 1986, and Shearman, 1990). Results of the hydraulic model are presented in the Bridge Hydraulic Summary, Appendix B, and figure 7.

Channel roughness factors (Manning's "n") used in the hydraulic model were estimated using field inspections at each cross section following the general guidelines described by Arcement, Jr. and Schneider (1989). Final adjustments to the values were made during the modelling of the reach. Channel "n" values for the reach were 0.045, and overbank "n" values ranged from 0.075 to 0.085.

Normal depth at the exit section (EXITX) was assumed as the starting water surface. This depth was computed by use of the slope-conveyance method outlined in the User's manual for WSPRO (Shearman, 1990). The slope used was 0.010 ft/ft which was estimated from thalweg points surveyed downstream of the bridge.

For the 100-year discharge of 13,000 cfs and the incipient overtopping discharge of 19,540 cfs, WSPRO assumes critical depth at the bridge section. Further analysis, in which the water surface is shown to pass through critical depth in the bridge, suggests the critical depth assumtions at the bridge section are satisfactory solutions.

Bridge Hydraulics Summary

Average bridge embankment elevation 102.3 *ft*
Average low steel elevation 96.4 *ft*

100-year discharge 13,000 *ft³/s*
Water-surface elevation in bridge opening 90.8 *ft*
Road overtopping? N *Discharge over road* -- *ft³/s*
Area of flow in bridge opening 923 *ft²*
Average velocity in bridge opening 14.1 *ft/s*
Maximum WSPRO tube velocity at bridge 16.7 *ft/s*

Water-surface elevation at Approach section with bridge 93.8
Water-surface elevation at Approach section without bridge 91.8
Amount of backwater caused by bridge 2.0 *ft*

500-year discharge 20,500 *ft³/s*
Water-surface elevation in bridge opening 96.8 *ft*
Road overtopping? Y *Discharge over road* 107 *ft³/s*
Area of flow in bridge opening 1590 *ft²*
Average velocity in bridge opening 12.8 *ft/s*
Maximum WSPRO tube velocity at bridge 14.0 *ft/s*

Water-surface elevation at Approach section with bridge 101.6
Water-surface elevation at Approach section without bridge 93.7
Amount of backwater caused by bridge 7.9

Incipient overtopping discharge 19,540 *ft³/s*
Water-surface elevation in bridge opening 93.2 *ft*
Area of flow in bridge opening 1240 *ft²*
Average velocity in bridge opening 15.7 *ft/s*
Maximum WSPRO tube velocity at bridge 18.9 *ft/s*

Water-surface elevation at Approach section with bridge 96.9
Water-surface elevation at Approach section without bridge 93.5
Amount of backwater caused by bridge 3.4 *ft*

Scour Analysis Summary

Special Conditions or Assumptions Made in Scour Analysis

Scour depths were computed using the general guidelines described in Hydraulic Engineering Circular 18 (Richardson and others, 1993). Scour depths were calculated assuming an infinite depth of erosive material and a homogeneous particle-size distribution. The results of the scour analysis are presented in tables 1 and 2 and a graph of the scour depths is presented in figure 8.

Contraction scour for the 100-year and the incipient overtopping discharges were computed by use of the live-bed contraction scour equation (Richardson and others, 1993, p. 33, equation 16,17). The 500-year discharge resulted in orifice flow and contraction scour was computed by use of the Chang equation (Richardson and others, 1995, p. 145-146). Contraction scour at bridges with orifice flow is best estimated by use of the Chang pressure-flow scour equation (oral communication, J. Sterling Jones, October 4, 1996). The results of Laursen's clear-water contraction scour (Richardson and others, 1993, p. 35, equation 18,19) for the 500-year event were also computed and can be found in appendix F. For contraction scour computations using the Laursen's equation, the average depth in the contracted section (AREA/TOPWIDTH) is subtracted from the depth of flow computed by the scour equation (Y2) to determine the actual amount of scour.

Abutment scour was computed by the Froehlich equation (Richardson and others, 1993, p. 49, equation 24). Variables for the Froehlich equation include the Froude number of the flow approaching the embankments, the length of the embankment blocking flow, and the depth of flow approaching the embankment less any roadway overtopping.

Pier scour was computed by use of the Colorado State University pier scour equation (Richardson and others, 1993, p.39, equation 21).

The results of the scour computations are plotted in figure 7. Since the toes of the spill-through abutments are at the piers, the abutment scour depth was subtracted from the channel elevation of the bankward side of the respective pier. The pier scour was subtracted from the channel elevation at the pier nose. Only the worst case of the abutment and pier scour results was plotted. Abutment scour and pier scour are not considered additive.

Scour Results

Contraction scour:	*100-yr discharge*	*500-yr discharge*	*Incipient overtopping discharge*
		(Scour depths in feet)	
Main channel			
Live-bed scour	3.1	--	4.0
Clear-water scour	-- 4.0	--	N/A
Depth to armoring	21.7	N/A	--
Left overbank	--	--	--
Right overbank	--	--	12.7
Local scour:			
Abutment scour	15.0	14.4	9.3
Left abutment	15.2	11.9	11.4
Right abutment			
Pier scour	11.5	12.4	11.4
Pier 1	11.5	12.4	--
Pier 2	--	--	2.6
Pier 3			

Rock Riprap Sizing

	100-yr discharge	*500-yr discharge*	*Incipient overtopping discharge*
		(D_{50} in feet)	
Abutments:	3.2	3.3	2.6
Left abutment	3.2	3.3	2.9
Right abutment	2.4	3.6	2.9
Piers:	2.4	3.6	--
Pier 1	--	--	
Pier 2			

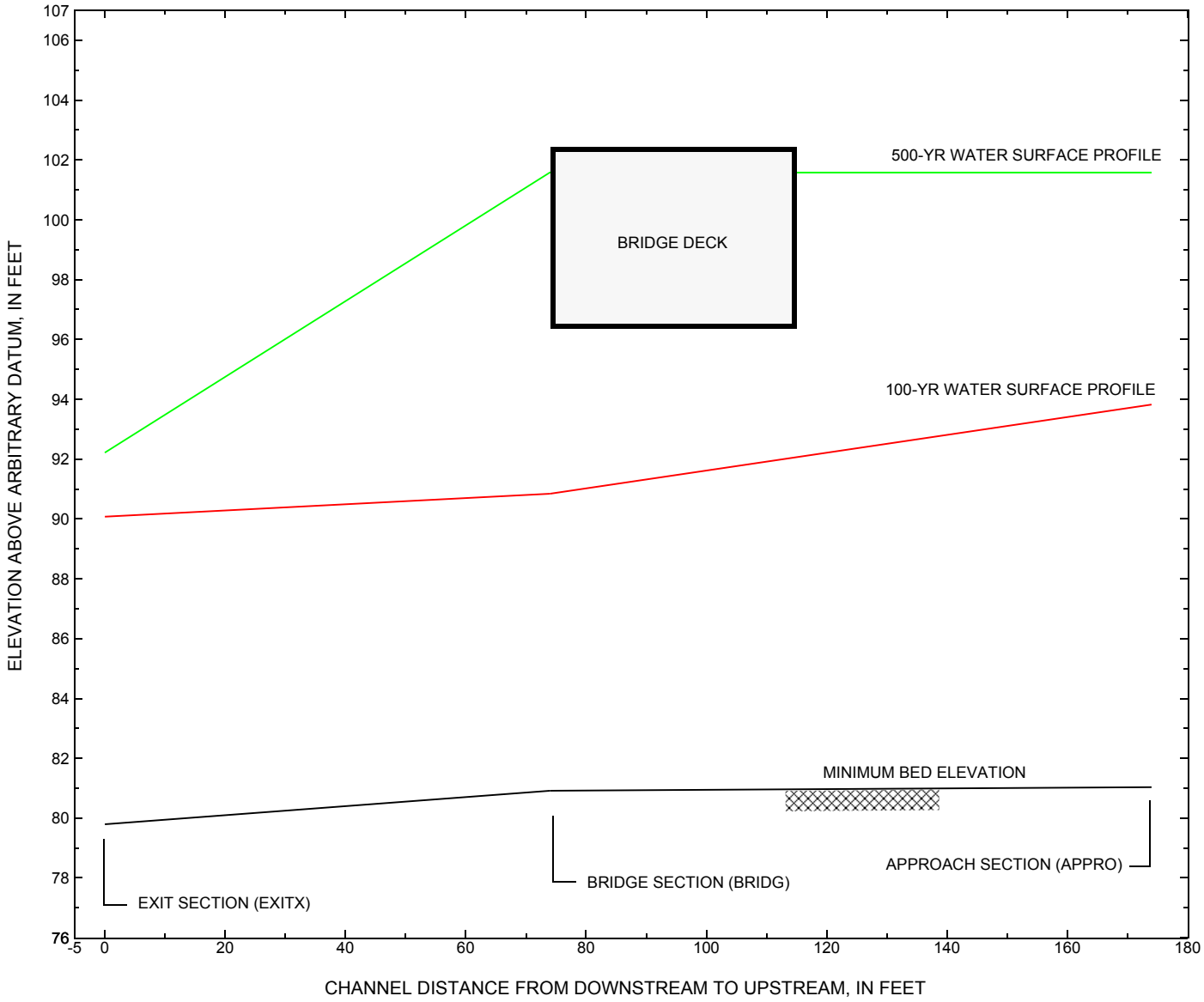


Figure 7. Water-surface profiles for the 100- and 500-yr discharges at structure BRIDUS00040045a on U.S. Route 4, crossing the Ottauquechee River, Bridgewater, Vermont.

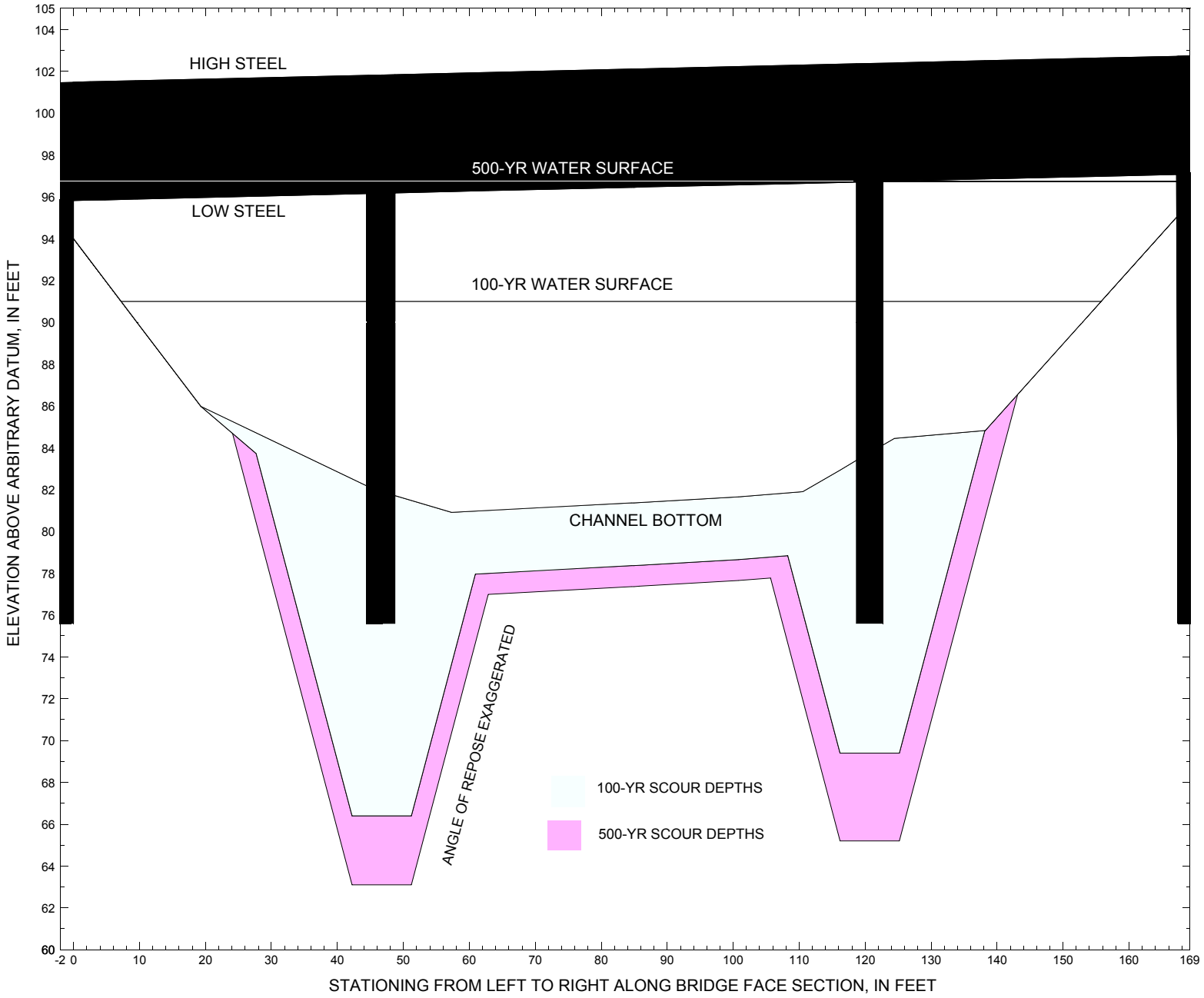


Figure 8. Scour elevations for the 100-yr and 500-yr discharges at structure BRIDUS00040045a on U.S. Route 4, crossing the Ottauquechee River, Bridgewater, Vermont.

Table 1. Remaining footing/pile depth at abutments for the 100-year discharge at structure BRIDUS00040045a on U.S. Route 4, crossing the Ottauquechee River, Bridgewater, Vermont.

[VTAOT, Vermont Agency of Transportation; --,no data]

Description	Station[1]	VTAOT plans' bridge seat elevation (feet)	Surveyed minimum low-chord elevation[2] (feet)	Bottom of footing elevation[2] (feet)	Channel elevation at abutment/ pier[2] (feet)	Contraction scour depth (feet)	Abutment scour depth (feet)	Pier scour depth (feet)	Depth of total scour (feet)	Elevation of scour[2] (feet)	Remaining footing/pile depth (feet)
100-yr. discharge is 13,000 cubic-feet per second											
Left abutment	0.0	863.2	95.8	76	--	--	--	--	--	--	--
Left abutment toe	44.7	--	--	76	82.1	3.1	12.7	--	15.8	66.3	-10
Left pier	46.7	--	--	76	81.9	3.1	--	11.4	14.5	67.4	-9
Right pier	120.7	--	--	76	83.8	3.1	--	11.4	14.5	69.3	-7
Right abutment toe	124.4	--	--	76	84.4	3.1	9.3	--	12.4	72.0	-4
Right abutment	167.2	864.5	97.0	76	--	--	--	--	--	--	--

[1] Measured along the face of the most constricting side of the bridge.
[2] Arbitrary datum for this study.

Table 2. Remaining footing/pile depth at abutments for the 500-year discharge at structure BRIDUS00040045a on U.S. Route 4, crossing the Ottauquechee River, Bridgewater, Vermont.

[VTAOT, Vermont Agency of Transportation; --, no data]

Description	Station[1]	VTAOT plans' bridge seat elevation (feet)	Surveyed minimum low-chord elevation[2] (feet)	Bottom of footing elevation[2] (feet)	Channel elevation at abutment/ pier[2] (feet)	Contraction scour depth (feet)	Abutment scour depth (feet)	Pier scour depth (feet)	Depth of total scour (feet)	Elevation of scour[2] (feet)	Remaining footing/pile depth (feet)
500-yr. discharge is 20,500 cubic-feet per second											
Left abutment	0.0	863.2	95.8	76	--	--	--	--	--	--	--
Left abutment toe	44.7	--	--	76	82.1	4.0	15.0	--	19.0	63.1	-13
Left pier	46.7	--	--	76	81.9	4.0	--	11.5	15.5	66.4	-10
Right pier	120.7	--	--	76	83.8	4.0	--	11.5	15.5	68.3	-8
Right abutment toe	124.4	--	--	76	84.4	4.0	15.2	--	19.2	65.2	-11
Right abutment	167.2	864.5	97.0	76	--	--	--	--	--	--	--

[1] Measured along the face of the most constricting side of the bridge.
[2] Arbitrary datum for this study.

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APPENDIX A:

WSPRO INPUT FILE

WSPRO INPUT FILE

```
T1        U.S. GEOLOGICAL SURVEY WSPRO INPUT FILE brid45a.wsp
T2        CREATED ON 25-APR-95 FOR BRIDGE BRIDUS0004045A USING FILE brid45a.dca
T3        Ottauquechee River, US Highway 4, Town of Bridgewater
*
J1         * * 0.005
J3         6 29 30 552 553 551 5 16 17 13 3 * 15 14 23 21 11 12 4 7 3
*
Q          13000 20500 19540
SK         0.010 0.010 0.010
*
XS   EXITX   0
GR          -88.9, 100.48    -29.7,  89.34      0.0,  87.85     46.4,  84.00
GR           58.3,  81.44     71.7,  80.54     88.6,  79.79    106.7,  80.43
GR          118.1,  81.35    125.5,  83.63    222.0,  88.61    256.1, 110.65
N           0.085        0.045        0.075
SA                 46.4      125.5
*
XS   FULLV   74 * * * 0.010
*
BR   BRIDG   74 96.4 30
GR            0.0,  95.83      0.1,  94.00     19.3,  85.98     45.7,  81.99
GR           57.3,  80.91     71.6,  81.12     85.8,  81.38    100.8,  81.65
GR          110.5,  81.90    124.4,  84.45    138.2,  84.82    167.2,  95.03
GR          167.2,  97.04      0.0, 95.83
N           0.045
PW          81.8,4 83.6,4 83.6,8
CD          3 40 2 102.3
*
XR   RDWAY  92 35.2 1
GR         -107.8, 100.75    -87.8, 100.91
GR          -86.9, 100.81    -86.7, 103.59     -7.2, 104.36     46.6, 104.82
GR          120.4, 105.25    173.2, 105.68    232.4, 105.82    301.5, 106.40
GR          302.6, 103.75    348.0, 104.08    379.3, 103.48    401.6, 107.24
BP          0
*
AS   APPRO  174
GR         -115.9,  98.05    -36.5,  99.55
GR          -16.5,  97.20      0.0,  91.21      9.7,  87.61     19.8,  82.04
GR           22.7,  81.20     32.6,  81.06     46.2,  81.03     62.3,  81.21
GR           79.5,  81.96     86.7,  82.20     93.3,  85.22    126.8,  86.91
GR          299.2, 101.75
N            0.075        0.045        0.080
SA                -16.5       93.3
BP           37.5
*
HP 1 BRIDG   90.84 1 90.84
HP 2 BRIDG   90.84 * * 13000
HP 2 BRIDG   91.60 * * 13000
HP 1 APPRO   93.82 1 93.82
HP 2 APPRO   93.82 * * 13000
*
HP 1 BRIDG   96.83 1 96.83
HP 2 BRIDG   96.83 * * 20326
*            MAX LS=97.04, 97.46 will give same results
HP 2 BRIDG   97.46 * * 20326
HP 2 RDWAY   101.58 * * 107
HP 1 APPRO   101.58 1 101.58
HP 2 APPRO   101.58 * * 20500
```

APPENDIX B:

WSPRO OUTPUT FILE

WSPRO OUTPUT FILE

```
       U.S. GEOLOGICAL SURVEY WSPRO INPUT FILE brid45a.wsp
        CREATED ON 25-APR-95 FOR BRIDGE BRIDUS0004045A USING FILE brid45a.dca
        Ottauquechee River, US Highway 4, Town of Bridgewater

    CROSS-SECTION PROPERTIES:  ISEQ =  3;  SECID = BRIDG;  SRD =      74.
     WSEL  SA#     AREA        K   TOPW   WETP  ALPH    LEW    REW     QCR
             1     923.  112507.   128.   131.                      14082.
    90.84          923.  112507.   128.   131.  1.00     8.   155.  14082.

    VELOCITY DISTRIBUTION:  ISEQ =  3;  SECID = BRIDG;  SRD =      74.
         WSEL     LEW     REW    AREA        K        Q    VEL
        90.84     7.7   155.3   923.4  112507.   13000.  14.08
X STA.          7.7       29.2       38.1       44.5       50.1       55.2
  A(I)             72.8       53.8       45.8       43.3       41.9
  V(I)             8.93      12.07      14.18      15.00      15.52

X STA.         55.2       59.9       64.5       69.1       73.8       78.5
  A(I)             40.4       38.9       38.9       39.5       39.2
  V(I)            16.09      16.70      16.72      16.45      16.59

X STA.         78.5       83.2       88.0       93.0       98.0      103.3
  A(I)             39.4       39.1       40.6       40.6       41.6
  V(I)            16.48      16.63      16.03      16.01      15.61

X STA.        103.3      108.7      114.8      122.4      132.5      155.3
  A(I)             42.6       45.8       48.7       55.6       74.7
  V(I)            15.25      14.18      13.34      11.68       8.70

    VELOCITY DISTRIBUTION:  ISEQ =  3;  SECID = BRIDG;  SRD =      74.
         WSEL     LEW     REW    AREA        K        Q    VEL
        91.60     5.8   157.5  1021.9  130709.   13000.  12.72
X STA.          5.8       28.3       36.9       43.8       49.5       54.7
  A(I)             81.9       57.2       52.1       47.9       46.2
  V(I)             7.94      11.37      12.47      13.57      14.05

X STA.         54.7       59.6       64.3       69.0       73.8       78.6
  A(I)             44.6       43.8       42.8       43.5       43.2
  V(I)            14.57      14.85      15.19      14.93      15.06

X STA.         78.6       83.5       88.4       93.5       98.7      104.1
  A(I)             43.6       43.3       44.9       45.0       46.2
  V(I)            14.90      15.03      14.47      14.45      14.08

X STA.        104.1      109.6      115.7      123.8      133.7      157.5
  A(I)             47.3       49.0       56.3       60.3       82.9
  V(I)            13.75      13.27      11.55      10.77       7.84

    CROSS-SECTION PROPERTIES:  ISEQ =  5;  SECID = APPRO;  SRD =     174.
     WSEL  SA#     AREA        K   TOPW   WETP  ALPH    LEW    REW     QCR
             2    1044.  161019.   100.   104.                      19093.
             3     537.   28099.   114.   114.                       6623.
    93.82          1581.  189118.   214.   218.  1.44    -7.   207.  20280.

    VELOCITY DISTRIBUTION:  ISEQ =  5;  SECID = APPRO;  SRD =     174.
         WSEL     LEW     REW    AREA        K        Q    VEL
        93.82    -7.2   207.1  1581.1  189118.   13000.   8.22
X STA.         -7.2       17.3       23.4       28.5       33.4       37.9
  A(I)            115.5       72.0       64.4       61.8       57.5
  V(I)             5.63       9.02      10.10      10.52      11.31

X STA.         37.9       42.3       46.7       51.0       55.3       59.6
  A(I)             56.3       56.1       55.3       54.5       54.2
  V(I)            11.54      11.58      11.75      11.94      11.98

X STA.         59.6       63.9       68.2       72.7       77.2       81.8
  A(I)             54.2       53.5       55.2       54.9       54.7
  V(I)            11.99      12.14      11.77      11.84      11.88

X STA.         81.8       86.7       93.0      109.9      132.7      207.1
  A(I)             57.1       63.8      138.5      163.7      237.8
  V(I)            11.39      10.19       4.69       3.97       2.73
```

WSPRO OUTPUT FILE (continued)

```
        U.S. GEOLOGICAL SURVEY WSPRO INPUT FILE brid45a.wsp
        CREATED ON 25-APR-95 FOR BRIDGE BRIDUS0004045A USING FILE brid45a.dca
        Ottauquechee River, US Highway 4, Town of Bridgewater

    CROSS-SECTION PROPERTIES:  ISEQ =  3;  SECID = BRIDG;  SRD =      74.
     WSEL  SA#     AREA        K   TOPW   WETP  ALPH    LEW    REW     QCR
            1    1699.  190488.    25.   273.                      79247.
    96.83           1699.  190488.    25.   273.  1.00     0.   167.  79247.

    VELOCITY DISTRIBUTION:  ISEQ =  3;  SECID = BRIDG;  SRD =      74.
         WSEL     LEW     REW    AREA        K        Q    VEL
        96.83     0.0   167.2  1698.7  190488.   20326.  11.97
X STA.          0.0        23.9        33.9        42.3        49.3        55.5
  A(I)            139.4       99.8        94.0        85.6        80.5
  V(I)             7.29       10.19       10.82       11.87       12.62

X STA.         55.5        61.5        67.3        73.2        79.1        84.9
  A(I)             79.1        77.5        77.8        76.6        76.3
  V(I)            12.85       13.12       13.06       13.26       13.32

X STA.         84.9        90.8        96.6       102.5       108.5       114.7
  A(I)             76.2        75.9        76.5        77.0        77.3
  V(I)            13.33       13.39       13.29       13.21       13.14

X STA.        114.7       121.7       129.8       138.1       146.0       167.2
  A(I)             81.6        86.1        87.1        72.7       101.7
  V(I)            12.45       11.81       11.67       13.99        9.99

    VELOCITY DISTRIBUTION:  ISEQ =  3;  SECID = BRIDG;  SRD =      74.
         WSEL     LEW     REW    AREA        K        Q    VEL
        97.46     0.0   167.2  1701.3  179990.   20326.  11.95
X STA.          0.0        23.2        32.8        40.8        47.5        53.6
  A(I)            133.4       94.1        88.3        80.4        77.6
  V(I)             7.62       10.80       11.51       12.64       13.10

X STA.         53.6        59.2        64.8        70.4        75.9        81.5
  A(I)             74.7        73.7        74.0        73.0        72.7
  V(I)            13.61       13.80       13.73       13.93       13.99

X STA.         81.5        87.1        92.8        98.5       104.4       110.2
  A(I)             73.8        73.5        74.1        76.2        74.8
  V(I)            13.77       13.83       13.72       13.33       13.58

X STA.        110.2       116.7       124.2       132.6       142.1       167.2
  A(I)             79.6        84.4        88.7        96.5       137.9
  V(I)            12.77       12.04       11.46       10.53        7.37

    VELOCITY DISTRIBUTION:  ISEQ =  4;  SECID = RDWAY;  SRD =      92.
         WSEL     LEW     REW    AREA        K        Q    VEL
       101.58  -107.8   -86.8    15.7     216.     107.   6.83
X STA.       -107.8      -106.6      -105.7      -104.8      -103.9      -102.9
  A(I)              1.0         0.8         0.7         0.7         0.7
  V(I)             5.39        7.12        7.28        7.41        7.21

X STA.       -102.9      -102.0      -101.1      -100.1       -99.2       -98.2
  A(I)              0.7         0.7         0.7         0.7         0.8
  V(I)             7.47        7.37        7.24        7.26        7.11

X STA.        -98.2       -97.2       -96.2       -95.1       -94.1       -93.0
  A(I)              0.8         0.7         0.8         0.8         0.8
  V(I)             7.13        7.21        6.96        6.97        6.80

X STA.        -93.0       -91.9       -90.7       -89.6       -88.4       -86.8
  A(I)              0.8         0.8         0.8         0.8         1.0
  V(I)             6.99        6.58        6.80        6.41        5.15

    CROSS-SECTION PROPERTIES:  ISEQ =  5;  SECID = APPRO;  SRD =     174.
     WSEL  SA#     AREA        K   TOPW   WETP  ALPH    LEW    REW     QCR
            1     285.   11143.    99.   103.                       2736.
            2    1880.  404019.   110.   114.                      44152.
            3    1770.  138903.   204.   205.                      29586.
   101.58           3935.  554065.   413.   421.  1.78  -116.   297.  51686.
```

WSPRO OUTPUT FILE (continued)

```
    VELOCITY DISTRIBUTION:  ISEQ =  5;  SECID = APPRO;  SRD =     174.
         WSEL     LEW     REW    AREA        K        Q    VEL
       101.58  -115.9   297.2  3934.9  554065.   20500.   5.21

X STA.      -115.9        1.5       14.4       22.2       28.4       34.5
  A(I)           422.0      174.7      144.6      126.7      124.4
  V(I)            2.43       5.87       7.09       8.09       8.24

X STA.        34.5       40.2       45.9       51.6       57.3       62.9
  A(I)           118.7      116.5      117.3      115.5      115.2
  V(I)            8.64       8.80       8.74       8.87       8.90

X STA.        62.9       68.6       74.3       80.2       86.2       93.4
  A(I)           114.8      113.4      117.3      117.2      128.1
  V(I)            8.93       9.04       8.74       8.75       8.00

X STA.        93.4      110.5      129.1      152.0      185.6      297.2
  A(I)           272.0      279.4      309.8      370.7      536.6
  V(I)            3.77       3.67       3.31       2.76       1.91

        U.S. GEOLOGICAL SURVEY WSPRO INPUT FILE brid45a.wsp
        CREATED ON 25-APR-95 FOR BRIDGE BRIDUS0004045A USING FILE brid45a.dca
        Ottauquechee River, US Highway 4, Town of Bridgewater

    CROSS-SECTION PROPERTIES:  ISEQ =  3;  SECID = BRIDG;  SRD =      74.
     WSEL  SA#     AREA        K   TOPW   WETP  ALPH    LEW    REW     QCR
             1    1242.  174012.   139.   143.                      21089.
    93.23         1242.  174012.   139.   143.  1.00     2.   162.  21089.

    VELOCITY DISTRIBUTION:  ISEQ =  3;  SECID = BRIDG;  SRD =      74.
         WSEL     LEW     REW    AREA        K        Q    VEL
        93.23     1.9   162.1  1242.0  174012.   19540.  15.73
X STA.          1.9       26.0       35.1       42.3       48.4       53.9
  A(I)            99.4       70.5       63.4       59.4       55.7
  V(I)            9.83      13.87      15.42      16.45      17.54

X STA.        53.9       59.0       63.9       68.9       73.9       78.9
  A(I)            53.7       52.9       51.7       52.6       52.2
  V(I)           18.20      18.48      18.89      18.56      18.70

X STA.        78.9       84.1       89.3       94.5       99.9      105.4
  A(I)            53.5       53.1       53.3       54.7       54.8
  V(I)           18.25      18.39      18.32      17.87      17.82

X STA.       105.4      111.2      117.9      126.3      136.1      162.1
  A(I)            57.3       61.5       66.6       73.2      102.4
  V(I)           17.06      15.89      14.67      13.35       9.54

    VELOCITY DISTRIBUTION:  ISEQ =  3;  SECID = BRIDG;  SRD =      74.
         WSEL     LEW     REW    AREA        K        Q    VEL
        93.87     0.4   163.9  1331.6  192612.   19540.  14.67
X STA.          0.4       25.3       34.5       41.8       47.9       53.5
  A(I)           107.8       76.0       68.0       62.0       59.8
  V(I)            9.06      12.86      14.38      15.75      16.34

X STA.        53.5       58.7       63.8       68.8       73.9       79.0
  A(I)            57.6       56.8       55.6       56.6       56.2
  V(I)           16.97      17.20      17.57      17.27      17.39

X STA.        79.0       84.2       89.5       94.9      100.4      105.9
  A(I)            56.2       57.6       56.9       58.4       58.6
  V(I)           17.37      16.96      17.16      16.73      16.68

X STA.       105.9      111.8      118.6      127.3      136.7      163.9
  A(I)            61.1       65.4       73.3       75.5      112.3
  V(I)           15.99      14.94      13.34      12.94       8.70

    CROSS-SECTION PROPERTIES:  ISEQ =  5;  SECID = APPRO;  SRD =     174.
     WSEL  SA#     AREA        K   TOPW   WETP  ALPH    LEW    REW     QCR
             2    1365.  238309.   109.   113.                      27429.
             3     941.   59657.   149.   150.                      13403.
    96.89         2307.  297966.   258.   263.  1.51   -16.   243.  31844.
```

WSPRO OUTPUT FILE (continued)

```
    VELOCITY DISTRIBUTION:  ISEQ =  5;  SECID = APPRO;  SRD =     174.
         WSEL     LEW     REW    AREA        K        Q    VEL
        96.89   -15.6   242.7  2306.6  297966.   19540.   8.47
X STA.       -15.6       14.1       21.8       27.5       32.9       38.0
  A(I)           163.2      105.7       88.9       85.4       81.3
  V(I)            5.99       9.24      10.99      11.43      12.02

X STA.        38.0       42.9       47.8       52.6       57.3       62.1
  A(I)            77.5       78.4       75.6       74.5       74.3
  V(I)           12.61      12.46      12.91      13.11      13.15

X STA.        62.1       66.9       71.7       76.6       81.7       86.8
  A(I)            75.3       74.2       74.1       75.5       75.6
  V(I)           12.98      13.16      13.19      12.94      12.93

X STA.        86.8       93.5      109.5      128.0      153.8      242.7
  A(I)            88.6      179.2      192.6      226.2      340.3
  V(I)           11.02       5.45       5.07       4.32       2.87

       U.S. GEOLOGICAL SURVEY WSPRO INPUT FILE brid45a.wsp
       CREATED ON 25-APR-95 FOR BRIDGE BRIDUS0004045A USING FILE brid45a.dca
       Ottauquechee River, US Highway 4, Town of Bridgewater
          *** RUN DATE & TIME: 12-01-95  13:30

 XSID:CODE   SRDL    LEW     AREA   VHD    HF     EGL    CRWS       Q    WSEL
       SRD   FLEN    REW        K  ALPH    HO     ERR     FR#     VEL
EXITX:XS   ******   -34.    1337.  2.59 *****   92.65   90.01  13000.   90.07
        0. ******   224.  129939.  1.76 ***** *******    1.00    9.72
 ===125 FR# EXCEEDS FNTEST AT SECID "FULLV":  TRIALS CONTINUED.
              FNTEST,FR#,WSEL,CRWS =  0.80    0.98      90.89      90.75
 ===110 WSEL NOT FOUND AT SECID "FULLV":  REDUCED DELTAY.
                  WSLIM1,WSLIM2,DELTAY =    89.57     111.39    0.50
 ===115 WSEL NOT FOUND AT SECID "FULLV":  USED WSMIN = CRWS.
                  WSLIM1,WSLIM2,CRWS =    89.57     111.39      90.75

FULLV:FV      74.   -34.    1354.  2.52  0.73   93.40   90.75  13000.   90.87
       74.    74.   224.  131990.  1.76  0.00    0.01    0.98    9.60
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>
 ===125 FR# EXCEEDS FNTEST AT SECID "APPRO":  TRIALS CONTINUED.
              FNTEST,FR#,WSEL,CRWS =  0.80    0.91      91.79      91.04
 ===110 WSEL NOT FOUND AT SECID "APPRO":  REDUCED DELTAY.
                  WSLIM1,WSLIM2,DELTAY =    90.37     101.75    0.50
 ===115 WSEL NOT FOUND AT SECID "APPRO":  USED WSMIN = CRWS.
                  WSLIM1,WSLIM2,CRWS =    90.37     101.75      91.04

APPRO:AS     100.    -2.    1176.  2.62  0.97   94.41   91.04  13000.   91.79
      174.   100.   183.  132473.  1.38  0.05    0.00    0.91   11.06
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===285 CRITICAL WATER-SURFACE ELEVATION  A _ S _ S _ U _ M _ E _ D !!!!!
                  SECID "BRIDG"     Q,CRWS =   13000.      90.84
            <<<<<RESULTS REFLECTING THE CONSTRICTED FLOW FOLLOW>>>>>

BRIDG:BR      74.     8.     923.  3.19 *****   94.03   90.84  13000.   90.84
       74.    74.   155.  112487.  1.03 ***** *******    0.94   14.08
     TYPE PPCD FLOW      C    P/A    LSEL   BLEN   XLAB   XRAB
       3.   0.   1.  0.983  0.071   96.40 ****** ****** ******
    XSID:CODE    SRD   FLEN    HF    VHD     EGL     ERR       Q    WSEL
   RDWAY:RG      92.        <<<<<EMBANKMENT IS NOT OVERTOPPED>>>>>

APPRO:AS      60.    -7.    1581.  1.52  0.56   95.34   91.04  13000.   93.82
      174.    70.   207.  189132.  1.44  0.76    0.02    0.64    8.22
       M(G)   M(K)       KQ   XLKQ   XRKQ    OTEL
      0.201  0.031  182703.   -13.   135.    93.51
                  <<<<<END OF BRIDGE COMPUTATIONS>>>>>
  FIRST USER DEFINED TABLE.
    XSID:CODE    SRD    LEW    REW       Q        K     AREA     VEL    WSEL
   EXITX:XS       0.   -34.   224.  13000.  129939.    1337.    9.72   90.07
   FULLV:FV      74.   -34.   224.  13000.  131990.    1354.    9.60   90.87
   BRIDG:BR      74.     8.   155.  13000.  112487.     923.   14.08   90.84
   RDWAY:RG      92.**************      0.******************    1.00********
   APPRO:AS     174.    -7.   207.  13000.  189132.    1581.    8.22   93.82

    XSID:CODE   XLKQ   XRKQ       KQ
   APPRO:AS     -13.   135.  182703.
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WSPRO OUTPUT FILE (continued)

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 SECOND USER DEFINED TABLE.
    XSID:CODE     CRWS      FR#     YMIN     YMAX     HF     HO  VHD       EGL     WSEL
   EXITX:XS      90.01     1.00    79.79  110.65************  2.59    92.65    90.07
   FULLV:FV      90.75     0.98    80.53  111.39  0.73  0.00  2.52    93.40    90.87
   BRIDG:BR      90.84     0.94    80.91   97.04************  3.19    94.03    90.84
   RDWAY:RG  ****************  100.75  107.24**********************************
   APPRO:AS      91.04     0.64    81.03  101.75  0.56  0.76  1.52    95.34    93.82

        U.S. GEOLOGICAL SURVEY WSPRO INPUT FILE brid45a.wsp
        CREATED ON 25-APR-95 FOR BRIDGE BRIDUS0004045A USING FILE brid45a.dca
        Ottauquechee River, US Highway 4, Town of Bridgewater
           *** RUN DATE & TIME: 12-01-95  13:30

 XSID:CODE   SRDL     LEW      AREA    VHD     HF      EGL     CRWS        Q     WSEL
       SRD   FLEN     REW         K  ALPH     HO      ERR      FR#      VEL

EXITX:XS   ******   -45.    1906.  3.18 *****   95.39   92.01  20500.   92.21
        0. ******   228.  204952.  1.77 ***** *******    0.95   10.76
 ===125 FR# EXCEEDS FNTEST AT SECID "FULLV":  TRIALS CONTINUED.
              FNTEST,FR#,WSEL,CRWS =  0.80    0.94      93.03      92.75
 ===110 WSEL NOT FOUND AT SECID "FULLV":  REDUCED DELTAY.
                   WSLIM1,WSLIM2,DELTAY =    91.71     111.39    0.50
 ===115 WSEL NOT FOUND AT SECID "FULLV":  USED WSMIN = CRWS.
                   WSLIM1,WSLIM2,CRWS =    91.71     111.39      92.75

FULLV:FV      74.   -45.    1923.  3.12  0.73   96.13   92.75  20500.   93.01
       74.    74.   228.  207300.  1.76  0.00    0.01    0.94   10.66
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>
 ===125 FR# EXCEEDS FNTEST AT SECID "APPRO":  TRIALS CONTINUED.
              FNTEST,FR#,WSEL,CRWS =  0.80    1.03      93.72      93.67
 ===110 WSEL NOT FOUND AT SECID "APPRO":  REDUCED DELTAY.
                   WSLIM1,WSLIM2,DELTAY =    92.51     101.75    0.50
 ===115 WSEL NOT FOUND AT SECID "APPRO":  USED WSMIN = CRWS.
                   WSLIM1,WSLIM2,CRWS =    92.51     101.75      93.67

APPRO:AS     100.    -7.    1561.  3.87  1.09   97.59   93.67  20500.   93.73
      174.   100.   206.  186267.  1.44  0.37    0.00    1.03   13.13
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>

 ===220 FLOW CLASS 1 (4) SOLUTION INDICATES POSSIBLE PRESSURE FLOW.
           WS3,WSIU,WS1,LSEL =    93.55      96.83      97.32      96.40
 ===245 ATTEMPTING FLOW CLASS 2 (5) SOLUTION.
            <<<<<RESULTS REFLECTING THE CONSTRICTED FLOW FOLLOW>>>>>

BRIDG:BR      74.     0.    1586.  2.56 *****   99.39   93.49  20326.   96.83
       74. ******   167.  190475.  1.00 ***** *******    0.73   12.82
     TYPE PPCD FLOW      C    P/A    LSEL   BLEN   XLAB   XRAB
        3.   0.   5.  0.495  0.067   96.40 ****** ****** ******
    XSID:CODE    SRD   FLEN    HF   VHD     EGL     ERR       Q    WSEL
   RDWAY:RG      92.    65.  0.09  0.75  102.24    0.00    107.  101.58
             Q   WLEN    LEW    REW  DMAX  DAVG  VMAX  VAVG  HAVG  CAVG
   LT:     107.    21.  -108.   -87.   0.8   0.8   5.4   6.8   1.4   3.0
   RT:      0. ****** ****** ****** ***** ***** ***** ***** ***** *****

===140 AT SECID "APPRO":  END OF CROSS SECTION EXTENDED VERTICALLY.
                            WSEL,YLT,YRT =   101.58       98.1      101.8

APPRO:AS      60.  -116.    3936.  0.75  0.27  102.33   93.67  20500.  101.58
      174.    67.   297.  554253.  1.78  0.63    0.00    0.40    5.21
                    <<<<<END OF BRIDGE COMPUTATIONS>>>>>

  FIRST USER DEFINED TABLE.
    XSID:CODE     SRD     LEW     REW        Q         K      AREA      VEL     WSEL
   EXITX:XS         0.   -45.   228.  20500.  204952.     1906.   10.76   92.21
   FULLV:FV        74.   -45.   228.  20500.  207300.     1923.   10.66   93.01
   BRIDG:BR        74.     0.   167.  20326.  190475.     1586.   12.82   96.83
   RDWAY:RG        92.*******   107.    107.*********        0.    1.00  101.58
   APPRO:AS       174.  -116.   297.  20500.  554253.     3936.    5.21  101.58

 SECOND USER DEFINED TABLE.
    XSID:CODE     CRWS      FR#     YMIN     YMAX     HF     HO  VHD       EGL     WSEL
   EXITX:XS      92.01     0.95    79.79  110.65************  3.18    95.39    92.21
   FULLV:FV      92.75     0.94    80.53  111.39  0.73  0.00  3.12    96.13    93.01
   BRIDG:BR      93.49     0.73    80.91   97.04************  2.56    99.39    96.83
   RDWAY:RG  ****************  100.75  107.24  0.09******  0.75  102.24  101.58
   APPRO:AS      93.67     0.40    81.03  101.75  0.27  0.63  0.75  102.33  101.58
```
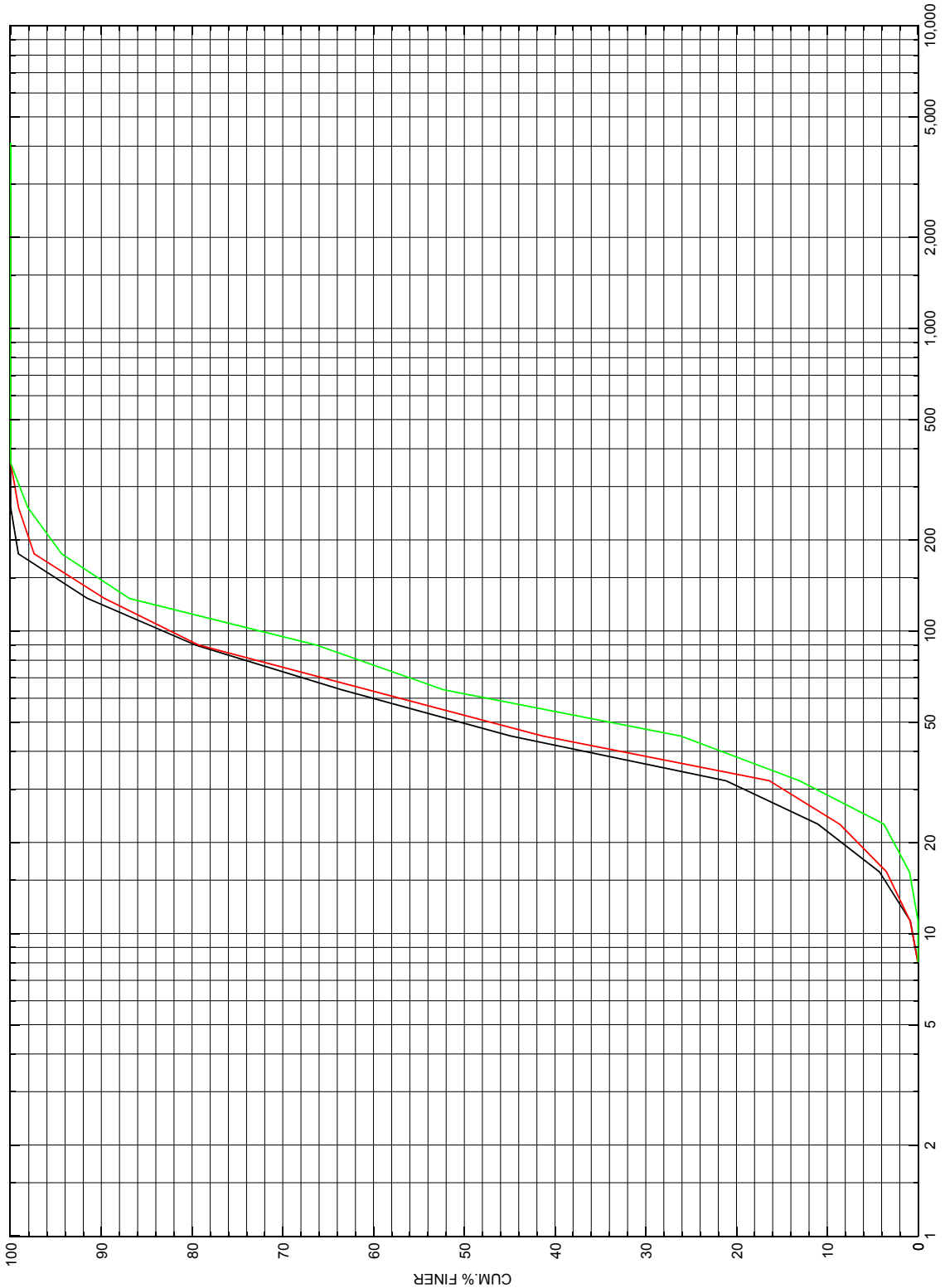

WSPRO OUTPUT FILE (continued)

```
       U.S. GEOLOGICAL SURVEY WSPRO INPUT FILE brid45a.wsp
       CREATED ON 25-APR-95 FOR BRIDGE BRIDUS0004045A USING FILE brid45a.dca
       Ottauquechee River, US Highway 4, Town of Bridgewater
          *** RUN DATE & TIME: 12-01-95  13:30

 XSID:CODE   SRDL    LEW     AREA   VHD    HF     EGL    CRWS       Q    WSEL
       SRD   FLEN    REW        K  ALPH    HO     ERR     FR#     VEL

EXITX:XS   ******   -44.    1838.  3.10 *****   95.07   91.76  19540.   91.96
        0. ******   227.  195361.  1.77 ***** *******    0.96   10.63
 ===125 FR# EXCEEDS FNTEST AT SECID "FULLV":  TRIALS CONTINUED.
             FNTEST,FR#,WSEL,CRWS =  0.80    0.94      92.78      92.50
 ===110 WSEL NOT FOUND AT SECID "FULLV":  REDUCED DELTAY.
                  WSLIM1,WSLIM2,DELTAY =    91.46     111.39    0.50
 ===115 WSEL NOT FOUND AT SECID "FULLV":  USED WSMIN = CRWS.
                  WSLIM1,WSLIM2,CRWS =    91.46     111.39      92.50

FULLV:FV      74.   -44.    1854.  3.05  0.73   95.81   92.50  19540.   92.76
       74.    74.   227.  197654.  1.77  0.00    0.01    0.94   10.54
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>
 ===125 FR# EXCEEDS FNTEST AT SECID "APPRO":  TRIALS CONTINUED.
             FNTEST,FR#,WSEL,CRWS =  0.80    1.02      93.49      93.36
 ===110 WSEL NOT FOUND AT SECID "APPRO":  REDUCED DELTAY.
                  WSLIM1,WSLIM2,DELTAY =    92.26     101.75    0.50
 ===115 WSEL NOT FOUND AT SECID "APPRO":  USED WSMIN = CRWS.
                  WSLIM1,WSLIM2,CRWS =    92.26     101.75      93.36

APPRO:AS     100.    -6.    1513.  3.72  1.08   97.22   93.36  19540.   93.50
      174.   100.   203.  179409.  1.44  0.34    0.00    1.02   12.91
         <<<<<THE ABOVE RESULTS REFLECT "NORMAL" (UNCONSTRICTED) FLOW>>>>>
 ===285 CRITICAL WATER-SURFACE ELEVATION  A _ S _ S _ U _ M _ E _ D !!!!!
                  SECID "BRIDG"     Q,CRWS =   19540.      93.23
            <<<<<RESULTS REFLECTING THE CONSTRICTED FLOW FOLLOW>>>>>

BRIDG:BR      74.     2.    1242.  4.21 *****   97.44   93.23  19540.   93.23
       74.    74.   162.  173974.  1.09 ***** *******    0.97   15.74
     TYPE PPCD FLOW      C    P/A    LSEL   BLEN   XLAB   XRAB
       3.   0.   1.  0.956  0.068   96.40 ****** ****** ******
    XSID:CODE    SRD   FLEN    HF    VHD     EGL     ERR       Q    WSEL
   RDWAY:RG      92.        <<<<<EMBANKMENT IS NOT OVERTOPPED>>>>>

APPRO:AS      60.   -16.    2308.  1.68  0.50   98.58   93.36  19540.   96.89
      174.    68.   243.  298131.  1.51  0.64    0.01    0.61    8.47
       M(G)   M(K)       KQ   XLKQ   XRKQ    OTEL
      0.248  0.049  282922.   -18.   143.    96.61
                  <<<<<END OF BRIDGE COMPUTATIONS>>>>>

  FIRST USER DEFINED TABLE.
    XSID:CODE    SRD    LEW    REW       Q        K     AREA     VEL    WSEL
   EXITX:XS       0.   -44.   227.  19540.  195361.    1838.   10.63   91.96
   FULLV:FV      74.   -44.   227.  19540.  197654.    1854.   10.54   92.76
   BRIDG:BR      74.     2.   162.  19540.  173974.    1242.   15.74   93.23
   RDWAY:RG      92.**************      0.******************    1.00********
   APPRO:AS     174.   -16.   243.  19540.  298131.    2308.    8.47   96.89

    XSID:CODE   XLKQ   XRKQ       KQ
   APPRO:AS     -18.   143.  282922.

 SECOND USER DEFINED TABLE.
    XSID:CODE    CRWS     FR#    YMIN    YMAX    HF    HO  VHD      EGL    WSEL
   EXITX:XS     91.76    0.96   79.79  110.65************  3.10   95.07   91.96
   FULLV:FV     92.50    0.94   80.53  111.39  0.73  0.00  3.05   95.81   92.76
   BRIDG:BR     93.23    0.97   80.91   97.04************  4.21   97.44   93.23
   RDWAY:RG  ***************  100.75  107.24**********************************
   APPRO:AS     93.36    0.61   81.03  101.75  0.50  0.64  1.68   98.58   96.89
```

APPENDIX C:

BED-MATERIAL PARTICAL-SIZE DISTRIBUTION



Bed material particle-size distributions for three pebble count transects at the approach cross-section for structure BRIDUS00040045a, in Bridgewater, Vermont.

APPENDIX D:

HISTORICAL DATA FORM