

Town of Haverhill, MA

Rosemont Street Bridge over Little River

Bridge No. H-12-024

April 2024

HYDRAULIC AND SCOUR ANALYSIS REPORT



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TABLE OF CONTENTS

1.0 Executive Summary	1
2.0 Project Description	2
2.1 Existing Bridge System	2
2.1.1 Crossed Waterway at the Bridge Location	2
2.1.2 Highway Conveyed	4
2.1.3 Land Use in Vicinity of the Bridge	4
2.1.4 Special Site Considerations	4
2.2 Proposed Action	4
3.0 Data Collection	5
3.1 Data Sources	5
3.2 Data Application	6
4.0 Engineering Methods	7
4.1 Hydrologic Analysis	7
4.1.1 1D HEC-RAS Model	7
4.1.2 2D HEC-RAS Model	7
4.2 Hydraulic Analysis	7
4.2.1 1D HEC-RAS Duplicate Effective	7
4.2.2 1D HEC-RAS Existing and Proposed Model	9
4.2.3 2D HEC-RAS Model	10
4.3 Scour Safety/Stability Analysis	12
4.3.1 Long-Term Aggregate/Degradation	12
4.3.2 Contraction Scour	12
4.3.3 Local Abutment Scour	12
4.3.4 Local Pier Scour	13
4.4 Scour Countermeasure Design	13
5.0 Conclusions and Recommendations	14
5.1 Conclusions	14
5.2 Recommendations	14
5.3 Hydraulic Data Tables	14
6.0 References	15
7.0 Appendices	15

LIST OF FIGURES

Figure 2.1 – Project Locus	3
Figure 4.1 – 1D HEC-RAS Model Overview.....	8
Figure 4.2 - 2D HEC-RAS Model Overview	11
Figure 4.3 - 2D HEC-RAS Model Particle Tracing.....	13

LIST OF TABLES

Table 3-1 – Data Sources	5
Table 4-1 – Summary of Discharges.....	7
Table 4-2 – Summary of Duplicate Effective Model Results	9
Table 4-3 – Comparison of Hydraulic Performance for Base Flood Elevation (BFE).....	10
Table 4-4- Summary of 2D Hydraulic Performance	11
Table 4-5 – Contraction Scour.....	12
Table 4-6 - Summary of Calculated Scour Bridges	12
Table 5-1 – Hydraulic Data Tables.....	14

1.0 EXECUTIVE SUMMARY

The following report presents the hydraulic and scour analysis conducted for Rosemont Street (Bridge No. H-12-024) crossing over Little River in Haverhill, MA.

Rosemont Street over Little River is classified as an Urban Minor Arterial Roadway. The minimum hydraulic design for this bridge is a 25-year flood return frequency and a minimum scour design of 50-year frequency with a 100-year scour countermeasure and check frequency.

The existing bridge spans the NFIP Regulatory Floodway Zone AE of the regulatory floodway delineations. A duplicate effective model was created using HEC-2 data and a no-rise analysis was performed using a HECRAS 1D model. A HECRAS 2D model was generated to analyze hydraulic and scour performance and design scour countermeasures.

The FEMA flood profile attached in **Appendix B** shows a high chord elevation of approximately 35.8 feet, compared with the surveyed bridge high chord of 34.4 feet. However, the low point of Rosemont Street profile in the project vicinity that would cause roadway overtopping is at an elevation of 33.53 feet, approximately 120 feet west of the center of the bridge opening. The surveyed roadway elevations were used in the existing and proposed models.

The FEMA FIS profiles do not indicate overtopping during the 50-year and 100-year design storms due to inaccurate graphical representation of the roadway elevation. However, both the 1D and 2D models indicate roadway overtopping at these flood event frequencies.

The proposed bridge will consist of cast-in-place abutments and wingwalls founded on spread footings/pile cap and a 35'-11" span structure comprised of Next 24F deck beams, with an 8" reinforced concrete deck, and 3" superpave wearing surface. The bridge's hydraulic opening will be increased from 16'-8" wide to 32'-0".

The results from the 2D HECRAS design analysis show the proposed water surface elevation at the bridge is 30.28 feet, compared with an existing condition water surface elevation of 31.07 feet, a reduction of 0.79 feet.

2.0 PROJECT DESCRIPTION

2.1 EXISTING BRIDGE SYSTEM

The Rosemont Street Bridge (No. H-12-024) crosses over Little River in Haverhill, Massachusetts with the following characteristics:

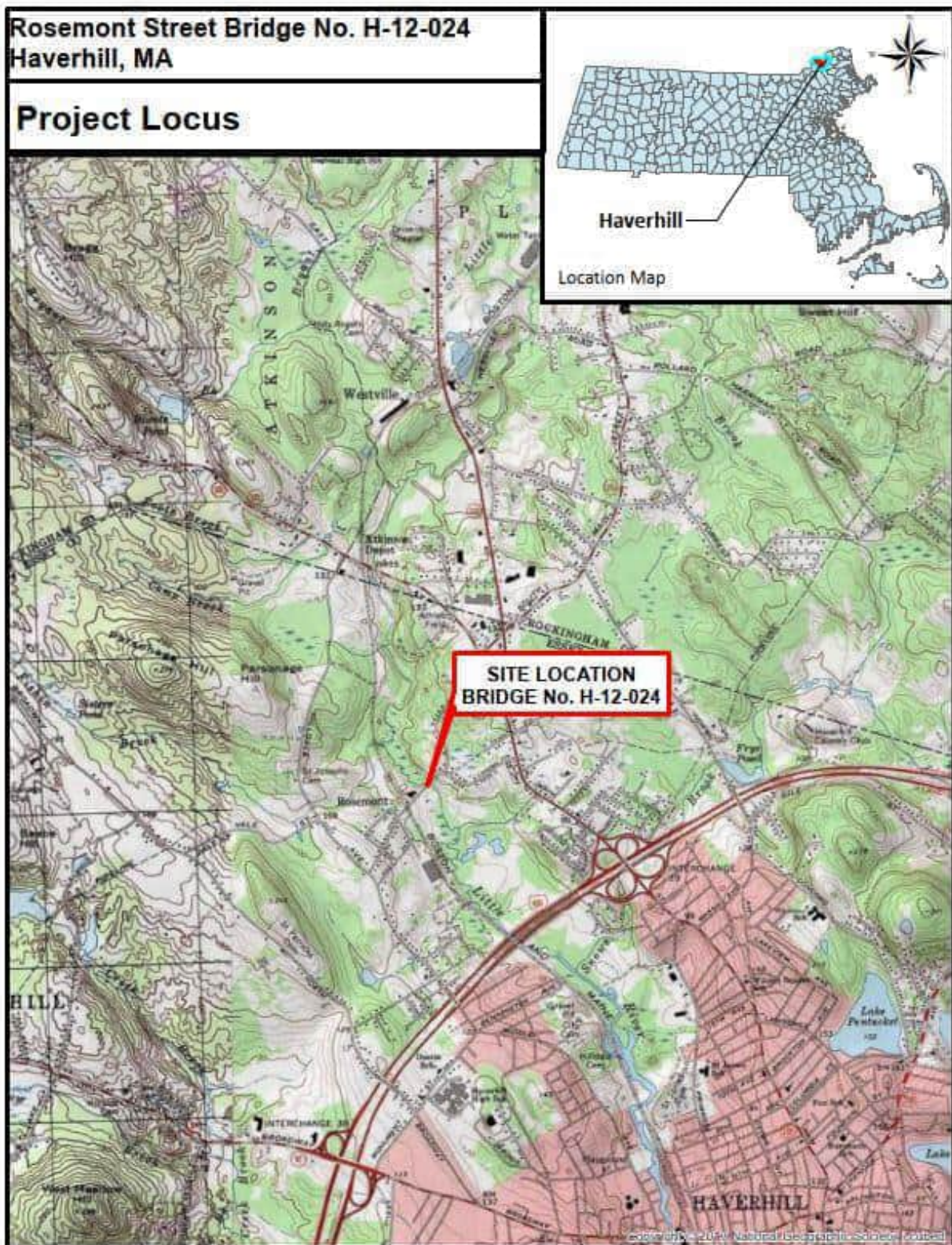
- The existing Rosemont Street Bridge is a single span bridge with a 16'-8" clear span on an east-west alignment over Little River that flows from North to South.
- Constructed in 1934
- The superstructure is comprised of concrete encased steel stringers and steel rails. The wingwalls and abutments are constructed of poured concrete and stone masonry.
- The roadway width is approximately 32'-3" with a non-standard concrete bridge railing on both sides.
- The riding surface is hot mix asphalt with guardrail on both sides.
- The bridge is one lane in each direction.
- MassDOT Routine Inspection Report dated May 2018.

Per the Routine Inspection Report prepared by MassDOT, the rating of the bridge is Structurally Deficient (Condition Rating of 4) for the deck and superstructure and \ Fair (Condition Rating of 5) for the substructure. The bridge deck exhibits extensive areas of spalling, cracking, and exposed steel reinforcement. Concrete encasement on the steel beams and rails have large areas of spalling concrete exposing the steel beam and rails which have areas of 100% section loss and areas of heavy rusting. The concrete bridge railing is non-standard with extensive deterioration, spalls, and posts that are undermined and failed. The abutments exhibit areas of scaling, exposed and rusting steel reinforcement, water abrasion, cracking, and areas of delamination. The stone wingwalls have failed due to areas of undermining and erosion.

2.1.1 CROSSED WATERWAY AT THE BRIDGE LOCATION

The Little River is tributary to the Merrimack River and flows from north to south, passing under the Rosemont Street Bridge. The hydraulic opening of the existing bridge is 16-8" feet wide. The Little River is fed upstream from the north by multiple tributaries including Fishin Brook (approximately 1300' upstream from the bridge) and others that span 22.7 sq. miles, crossing the state border into East Hampstead and Newton, NH.

Figure 2.1 – Project Locus



2.1.2 HIGHWAY CONVEYED

- This segment of Rosemont Street has a functional classification as an Urban Minor Arterial Roadway.
- The roadway can generally be considered a one-lane road in each direction between Hilldale Avenue and Main Street (Rte 125).
- The bridge conveys an ADT volume of 646 vehicles per day, with 12.6% trucks.

2.1.3 LAND USE IN VICINITY OF THE BRIDGE

The land use in the vicinity of the bridge is a mix of low/medium density residential as well as industrial/business park.

2.1.4 SPECIAL SITE CONSIDERATIONS

The Rosemont Street Bridge is located within the National Flood Insurance Program (NFIP) Special Flood Hazard Area (SFHA) Zone AE delineation determined for the Little River by the Flood Insurance Rate Map (FIRM) No. 25009C0086F dated July 3, 2012. The base flood elevation determined for this Zone AE is 34.8 feet on the upstream side and 31.0 feet on the downstream side of the bridge.

A narrow band of bordering vegetated wetlands is located along the banks of Little River adjacent to the northwest corner of the existing bridge. The wetland resource areas of Bordering Vegetated Wetlands, Inland Bank, and Bordering Land Subject to Flooding are all under the jurisdiction of the Haverhill Conservation Commission and are all subject to protection under the MA Wetlands Protection Act and the Town of Haverhill Wetland Protection Bylaws. Impacts to these areas will be minimized, to the extent possible.

2.2 PROPOSED ACTION

The proposed bridge will consist of cast-in-place abutments and wingwalls founded on spread footings/pile cap and a 35'-11" span structure comprised of Next 24F deck beams, with an 8" reinforced concrete deck, and 3" superpave wearing surface. The bridge's hydraulic opening will be increased from 16'-8" wide to 32'-0". The hydraulic low chord of the proposed bridge, including the relocated hanging sewer pipe, will be sloped from an elevation of 30.84 feet to 31.39 feet, 1.76 feet lower than the existing superstructure's low chord (32.6 feet).

A sewer pump station is located at the northwest corner of the project, on the upstream approach. The elevation of the structure surface grade is approximately 32', 1.7' higher than the water surface elevation under the proposed conditions 25-year flood event.

3.0 DATA COLLECTION

3.1 DATA SOURCES

Table 3-1 – Data Sources

Data Type	Source	Details
Rosemont Street Survey	Lighthouse Land Surveying, LLC (2018)	
Type Study Analysis	BETA Group, Inc. (2019)	
Rehabilitation of Rosemont Street Bridge over Little River (Bridge No. H-12-024) Plan Set (25% Submission)	BETA Group, Inc. (September 2022)	
USGS Map	MassGIS (2012)	
Aerial Mapping	Nearmap (2022)	
FEMA Flood Insurance Rate Map for Essex County	FEMA (2011)	Little River FIRM Map No. 25009C00866F
StreamStats Report	USGS (2022)	Workspace IDs: MA20190227195157602000
Web Soil Survey	USDA-NRCS (2022)	
LIDAR Data	USGS: Central Eastern Massachusetts (2021)	
HEC2	FEMA	Little River HEC2 Release Date Nov 76 Updated 1979 Run Executed 6/28/1980

3.2 DATA APPLICATION

Surface elevations were derived from Lighthouse Land Surveying, LLC (2018) and supplemented with USGS Lidar Data. No record plans of the existing bridge are available; therefore, the bridge geometry was derived from the BETA Group, Inc.'s Rehabilitation of Rosemont Street Bridge over Little River (Bridge No. H-12-024) 100% Plan Set (April 2024) and the BETA Group, Inc. Type Study Analysis (2019).

The design flows at the bridge were estimated using the USGS StreamStats Peak-Flow Statistics Flow Reports for the Little River at Rosemont Street in Haverhill, MA. The Little River is fed upstream from the north by multiple tributaries including Fishin Brook (approximately 1700' upstream from the bridge) and others that span 22.7 sq. miles crossing the state border into East Hampstead and Newton, NH.

The Little River flows into the Merrimack River approximately 2.75 miles downstream of the Rosemont Street Bridge.

The FEMA flood profile attached in **Appendix B** shows a high chord elevation of approximately 35.8 feet, compared with the surveyed bridge high chord of 34.4 feet. However, the low point of Rosemont Street profile in the project vicinity that would cause roadway overtopping is at an elevation of 33.53 feet, approximately 120 feet west of the center of the bridge opening. The surveyed roadway elevations were used in the existing and proposed models.

HEC-2 data for the Little River was supplied by FEMA for the model dated 6/28/1980. This model was used to create a duplicate effective model of the Little River for use in the no-rise evaluation.

4.0 ENGINEERING METHODS

4.1 HYDROLOGIC ANALYSIS

4.1.1 1D HEC-RAS MODEL

The no-rise HECRAS 1D existing and proposed conditions model was created from the duplicate effective model. The no-rise model hydrologic inputs for the 1% (100-year) were taken from the HEC-2 data.

4.1.2 2D HEC-RAS MODEL

As specified in Section 1.3.4 of the MassDOT LRFD Bridge Manual, an Urban Minor Arterial Roadway is subject to a 25-year hydraulic design flood return frequency. The 50-year and 100-year flows were included for scour analysis. The USGS StreamStats Peak-Flow Report flows were utilized in the HEC-RAS 2D model for discharges at the bridge.

Table 4-1 contains a summary of the discharges used in the analysis.

Table 4-1 – Summary of Discharges

Model	River/Reach Name	Drainage Area (mi ²)	4% Annual Chance [25-yr] (CFS)	2% Annual Chance [50-yr] (CFS)	1% Annual Chance [100-yr] (CFS)
1D No-Rise	FEMA-LR	-	-	-	1,990
2D	Little River	22.7	1,150	1,380	1,630

4.2 HYDRAULIC ANALYSIS

4.2.1 1D HEC-RAS DUPLICATE EFFECTIVE

The bridge is within the National Flood Insurance Program (NFIP) Special Flood Hazard Area (SFHA) Zone AE, therefore a 1D steady flow analysis was also performed to show “no-rise”. The duplicate effective model was created using FEMA provided HEC-2 Data (1980) and analyzed using USACE HEC-RAS 6.4.1. The limits of the model are approximately 4,800 feet upstream and 2,200 feet downstream and include the river embankment and the geometry of the bridge structure. The downstream boundary condition was set to the FIS known water surface elevation. No upstream boundary condition was set due to the subcritical flow condition within the river channel. An overview of the 1D HEC-RAS model is shown in **Figure 4.1**.

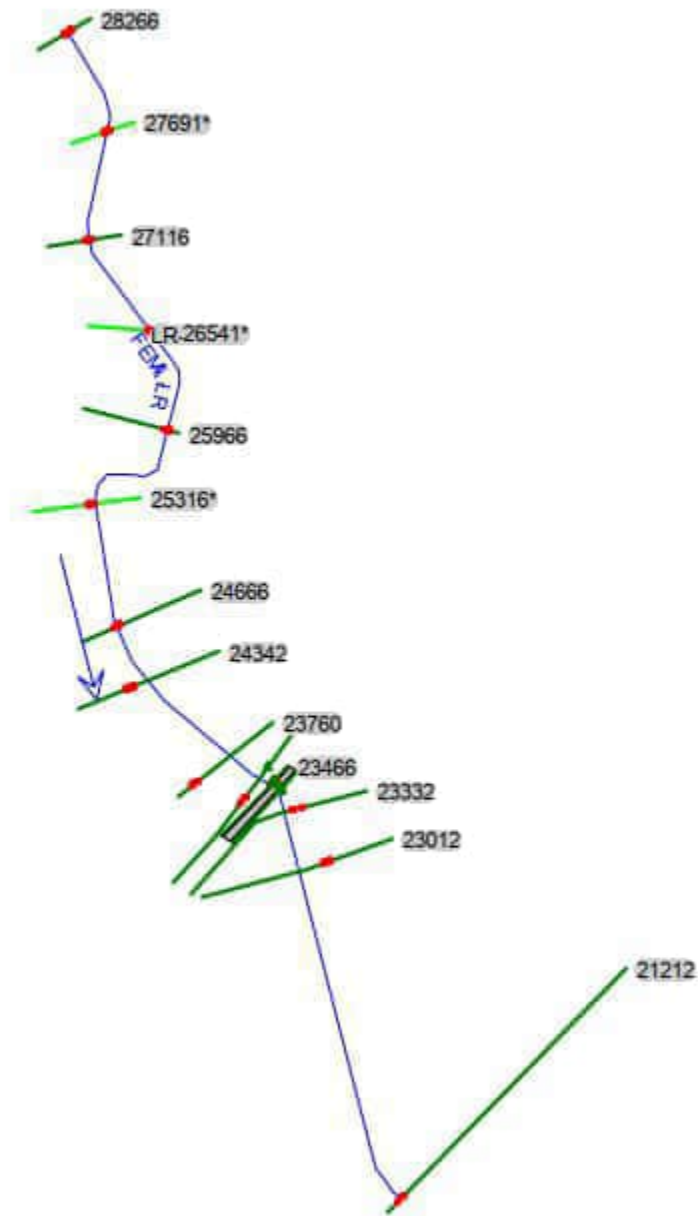


Figure 4.1 – 1D HEC-RAS Model Overview

Table 4-2 – Summary of Duplicate Effective Model Results

River Station	FIS Cross-Section	[1] Published Data (FEET, NAVD)	[2] Duplicate Effective Model (FEET, NAVD)	[2]-[1]
28266	P	38.71	38.76	-0.05
27116	-	36.72	36.94	0.22
25966	-	35.85	36.23	0.38
24666	-	35.74	36.11	0.37
23566	O	35.61	36.01	0.40
23466	N	31.26	35.80	4.54*
23432	-	30.58	31.16	0.58
23332	-	31.79	31.91	0.12
23012	-	31.66	31.70	0.04
21212	M	31.04	31.04	0.00

*Duplicate effective reflects overtopping at the bridge

The duplicate effective results show that the model ties in within 0.5' of the HEC-2 results, except for at the bridge (Cross Section N). The HECRAS duplicate effective model indicates overtopping, while the HEC-2 data references the low cord elevation.

4.2.2 1D HEC-RAS EXISTING AND PROPOSED MODEL

The duplicate effective model was supplemented with topography from Lighthouse Land Surveying. The geometry was corrected to generate the existing conditions model and proposed model.

The bridge structure is represented by two cross sections, taken at the upstream and downstream faces of the structure. The geometry for the existing conditions was generated from field observation, Lighthouse Survey, and BETA Group, Inc.'s Type Study Analysis. The geometry for the proposed conditions was generated from BETA Group, Inc.'s Type Study Analysis and the BETA Group, Inc.'s 'Rehabilitation of Rosemont Street Bridge over Little River (Bridge No. H-12-024)' 100% Plan Set.

In accordance with Sections 1.3.2.1 through 1.3.2.3 of the LRFD Bridge Manual, the proposed bridge design was analyzed and compared to the existing bridge geometry to ensure there will be no increase in flood water surface elevations for the 1% (100-yr) flood event caused by the proposed bridge. The horizontal datum is NAD83 Massachusetts State Plane Coordinates and the vertical datum is the North American Vertical Datum of 1988 (NAVD88).

The results of the no-rise analysis can be seen in Table 4-3. The model confirms that there is not rise in the BFE flood elevations as a result of the bridge replacement.

Table 4-3 – Comparison of Hydraulic Performance for Base Flood Elevation (BFE)

Model Cross Sections	FIS Cross-Section	[1] Existing Condition Model (FEET)	[2] Proposed Condition Model (FEET)	[2]-[1] No Rise Evaluation
28266	P	38.91	38.91	0
27116	-	37.25	37.24	-0.01
25966	-	35.4	34.45	-0.95
24666	-	35.04	33.61	-1.43
23566	O	34.91	33.37	-1.54
23466	N	33.85	32.4	-1.45
23432	-	31.75	31.69	-0.06
23332	-	31.91	31.91	0
23012	-	31.68	31.68	0
21212	M	31.04	31.04	0

4.2.3 2D HEC-RAS MODEL

The flood plains on both sides of Rosemont Street are relatively wide in comparison to the main channel and the water takes multiple flow paths as it approaches the bridge. Therefore, it was determined that a two-dimensional hydraulic analysis would be a more suitable modeling method to estimate the water surface elevations for the existing and proposed conditions. The two-dimensional model was developed using HECRAS. The horizontal datum is NAD83 Massachusetts State Plane Coordinates and the vertical datum is the North American Vertical Datum of 1988 (NAVD88). The main channel was analyzed with a manning's n value on 0.04, while the overbanks were set to 0.07 to simulate wetland vegetation.

A mesh was developed by merging the survey data with the USGS LIDAR. An overview of the model mesh can be seen in Figure 4.2.

As referenced in section 1.3.4 of the LRFD Bridge Manual, a Major Rural Collector Roadway should be modelled using the 25-year hydraulic design flood. A 25-year storm was run for both existing and proposed conditions in HEC-RAS.

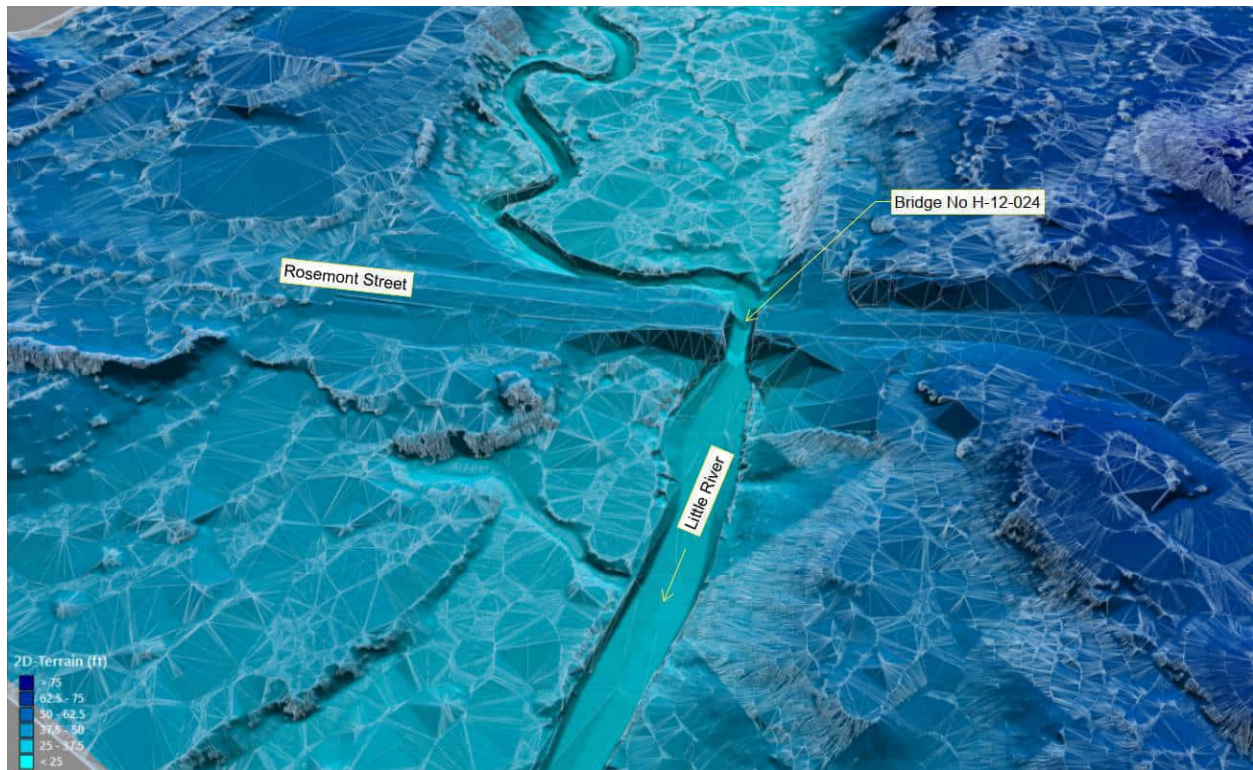


Figure 4.2 - 2D HEC-RAS Model Overview

Table 4-4 summarizes the existing and proposed hydraulic performance at the upstream section of the structure. The results of the hydraulic analysis for the 25-year storm can be found in **Appendix C**.

Table 4-4- Summary of 2D Hydraulic Performance

AEP [%]	Peak Flow (CFS)	Existing		Proposed	
		WSEL (FT)	Velocity* (FT/S)	WSEL (FT)	Velocity* (FT/S)
4%	1,150	31.07	7.65	30.28	5.57
2%	1,380	31.99	8.49	31.84	6.54
1%	1,630	34.42	8.87	32.24	7.66

The results of the HEC-RAS 2D model indicate that the water surface elevation at the Rosemont Street Bridge during the 25 year flood event is 31.07 feet under existing conditions and 30.28 feet for the proposed conditions. Under proposed conditions, the low chord elevation of the bridge is approximately 30.83 feet at its lowest, which is 0.55 feet above the 25-year flood elevation.

4.3 SCOUR SAFETY/STABILITY ANALYSIS

In accordance with the MassDOT LRFD Bridge Manual guidance for an Urban Minor Arterial Roadway, the scour was analyzed for a 50-year storm event and checked for the 100-year storm event. See **Appendix D** for scour computations. Scour countermeasures were analyzed for the 100-year storm event.

4.3.1 LONG-TERM AGGREGATE/DEGRADATION

There is insufficient data available to determine a long-term aggradation and degradation rate, therefore, no aggradation/degradation was analyzed.

4.3.2 CONTRACTION SCOUR

Contraction Scour was calculated to determine whether the channel is in a live-bed or clear-water condition. For the 50-year and 100-year design storms, the channel operates in a live-bed condition. A summary of the predicted contraction scour is summarized in **Table 4-5**.

Table 4-5 – Contraction Scour

	50 Yr	100 Yr
	Channel	Channel
	Live	Live
Ys (ft)	0.78	0.89

4.3.3 LOCAL ABUTMENT SCOUR

The local abutment scour was analyzed using the NHCPR 24-20 Equation. A summary of the results can be seen in **Table 4-6**.

Table 4-6 - Summary of Calculated Scour Bridges

	Return Frequency	[1] Contraction Scour	[2] Maximum Local Pier Scour	[3] Long Term Degradation	[4] Abutment Scour	[3]+[4] Design Total Abutment Scour*	[1]+[2]+[3] Design Total Pier Scour
	(Year)	(Feet)	(Feet)	(Feet)	(Feet)	(Feet)	(Feet)
Proposed Conditions	50	0.78	N/A	N/A	5.65	5.65	N/A
	100	0.89	N/A	N/A	7.04	7.04	N/A

4.3.4 LOCAL PIER SCOUR

The proposed bridge does not have piers.

4.4 SCOUR COUNTERMEASURE DESIGN

For the east abutment, a spread footing is proposed. The depth of the bedrock is less than the calculated design and check scour, therefore the footing will be keyed into the bedrock.

For the west abutment, the footing is designed on piles. The underside of the pile cap has been set below the contraction scour elevation at the thalweg. The piles will be designed to support the abutment if they're exposed due to abutment scour.

Although not required, the proposed improvements shall include a layer of 1.0' D50 dumped rip-rap along the sloped channel bed below the natural stream bed material.

Rip-Rap was added on the northeast bridge approach as a preventative measure for potential bend scour. The flow pattern of the river is such that a river bend only occurs at relatively low flows. At a 2-yr storm event, the river exceeds the top of bank and the approaching flow direction is perpendicular to the bridge opening. Therefore, the elevation at the top of riprap slope was set to 29'; slightly exceeding the 2-year flood event water surface elevation upstream of the bridge.

The particle tracing for the HECRAS 2D 2-Year flood event can be seen in Figure 4.3.



Figure 4.3 - 2D HEC-RAS Model Particle Tracing

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The proposed bridge will have a greater hydraulic opening as compared to the existing bridge and safely convey the design storm. The proposed improvements will not cause any increase in the waterway's base flood elevation. The water surface elevations upstream of the bridge will be lowered for the analyzed flood events as a result of the bridge replacement but will match into existing downstream flood elevations during peak flows.

The free board predicted during the 4% (25-year) design storm is 0.55' which does not meet the recommended 2' freeboard. Due to the site geometry, utilities, and sewer pump station further widening or raising of profile is not a viable alternative to obtain additional freeboard.

5.2 RECOMMENDATIONS

The proposed improvements should maintain the geometry shown in BETA Group, Inc.'s Rehabilitation of Rosemont Street Bridge over Little River (Bridge No. H-12-024) 100% Plan Set (April 2024) and as modeled in HEC-RAS. If design plans change, the hydraulic and scour analysis should be reevaluated.

5.3 HYDRAULIC DATA TABLES

Table 5-1 – Hydraulic Data Tables

HYDRAULIC DESIGN DATA	
Drainage Area	22.7 Square Miles
Design Flood Discharge	1,150 cfs
Design Flood Frequency	4% (25-Year)
Design Flood Velocity	5.57 ft/s
Design Flood Elevation	30.28 Ft NAVD88
BASE (100-YEAR) FLOOD DATA	
Base Flood Discharge	1,630 cfs
Base Flood Elevation	30.53 Ft NAVD88
DESIGN AND CHECK SCOUR DATA	
Design Scour Flood Event Return Frequency	2% (50-Year)
Design Flood Abutment Scour Depth	5.65
Design Flood Pier Scour Depth	N/A
Check Scour Flood Event Return Frequency	1% (100-Year)
Check Flood Abutment Scour Depth	7.04
Check Flood Pier Scour Depth	N/A
FLOOD OF RECORD	
Discharge	Not Known
Frequency	Not Known
Maximum Elevation	Not Known
Date	Not Known
History of Ice Floes	None Documented
Evidence of Scour and Erosion	Scour Documented at Abutment

6.0 REFERENCES

The analysis sites the following references:

- Federal Highway Administration (2012) “Evaluating Scour at Bridges”, Hydraulic Engineering Circular No. 18 (HEC-18), Fifth Edition, U.S. Department of Transportation. April 2012
- LRFD Bridge Manual - 2013 Edition. (January 2020 Revision). Retrieved from <https://www.mass.gov/info-details/part-i-design-guidelines>
- United States Army Corps of Engineers (2023) “HEC-RAS River Analysis System – Version 6.4.1”, Hydrologic Engineering Center, US Army Corps of Engineers, Davis CA.
- United States Department of Agriculture (1986) “Urban Hydrology for Small Watersheds”, Technical Release 55, National Resources Conservation Service, Conservation Engineering Division, June 1986.
- Zarriello, P.J., 2017, Magnitude of flood flows at selected annual exceedance probabilities for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2016-5156, 54 p., <https://doi.org/10.3133/sir20165156>.

7.0 APPENDICES

Appendix A – StreamStats Peak Flow Reports

Appendix B – FEMA Worcester County Flood Insurance Study

Appendix C – Hydraulic Computations

Appendix D – Scour Computations

Appendix E – Geotechnical Report

Appendix F – Site Photos

APPENDIX A

STREAMSTATS PEAK FLOW REPORTS

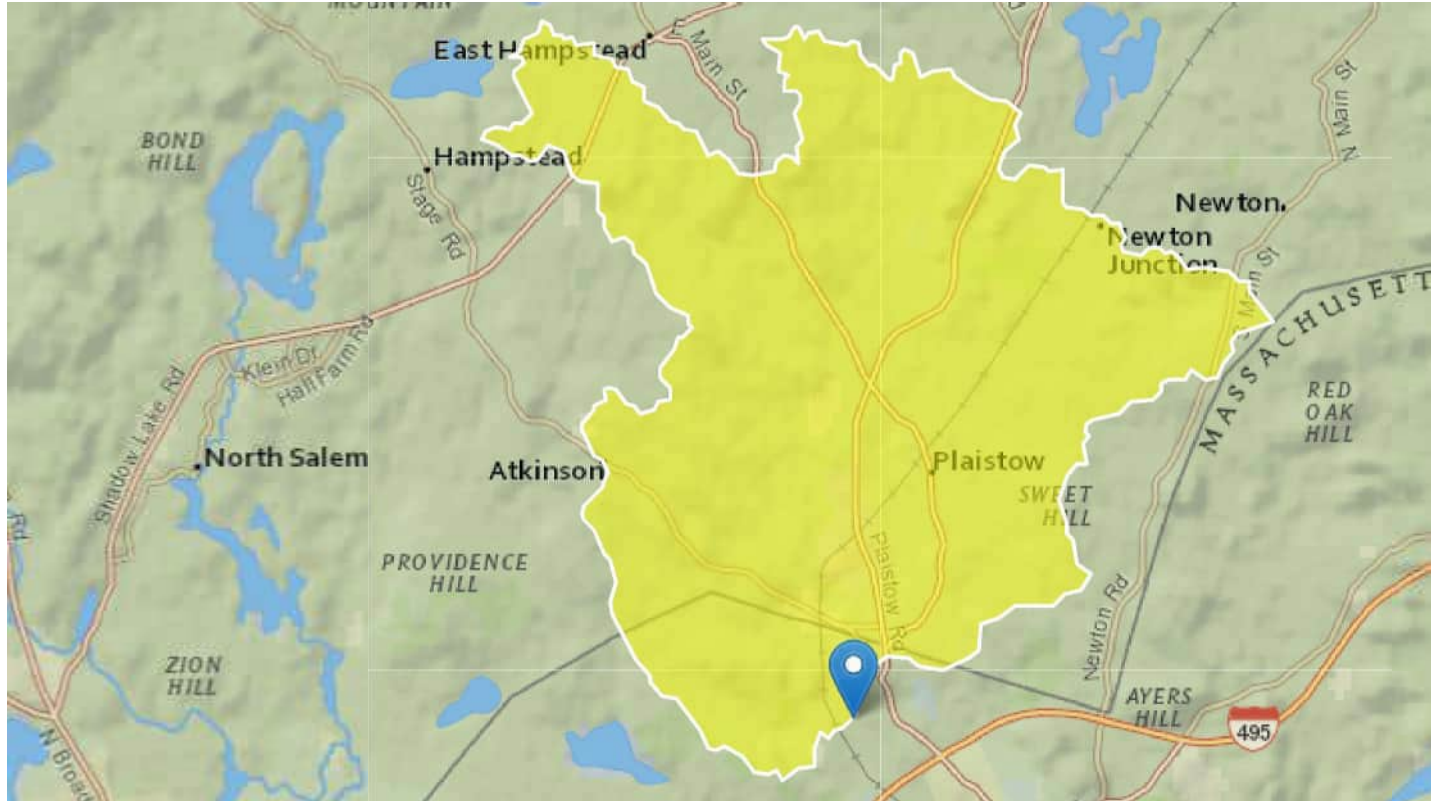
Rosemont St Bridge - StreamStats Report

Region ID: MA

Workspace ID: MA20190227195157602000

Clicked Point (Latitude, Longitude): 42.80531, -71.10855

Time: 2019-02-27 14:52:13 -0500



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	22.7	square miles
ELEV	Mean Basin Elevation	164	feet
LC06STOR	Percentage of water bodies and wetlands determined from the NLCD 2006	10.95	percent

Peak-Flow Statistics Parameters [Peak Statewide 2016 5156]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	22.7	square miles	0.16	512
ELEV	Mean Basin Elevation	164	feet	80.6	1948

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
LC06STOR	Percent Storage from NLCD2006	10.95	percent	0	32.3

Peak-Flow Statistics Flow Report^[Peak Statewide 2016 5156]

PII: Prediction Interval-Lower, Plu: Prediction Interval-Upper, SEp: Standard Error of Prediction, SE: Standard Error (other -- see report)

Statistic	Value	Unit	PII	Plu	SEp
2 Year Peak Flood	419	ft ³ /s	215	817	42.3
5 Year Peak Flood	675	ft ³ /s	341	1330	43.4
10 Year Peak Flood	871	ft ³ /s	431	1760	44.7
25 Year Peak Flood	1150	ft ³ /s	551	2410	47.1
50 Year Peak Flood	1380	ft ³ /s	641	2990	49.4
100 Year Peak Flood	1630	ft ³ /s	730	3620	51.8
200 Year Peak Flood	1890	ft ³ /s	824	4330	54.1
500 Year Peak Flood	2260	ft ³ /s	960	5320	57.6

Peak-Flow Statistics Citations

Zarriello, P.J.,2017, Magnitude of flood flows at selected annual exceedance probabilities for streams in Massachusetts: U.S. Geological Survey Scientific Investigations Report 2016–5156, 99 p. (<https://dx.doi.org/10.3133/sir20165156>)

USGS Data Disclaimer: Unless otherwise stated, all data, metadata and related materials are considered to satisfy the quality standards relative to the purpose for which the data were collected. Although these data and associated metadata have been reviewed for accuracy and completeness and approved for release by the U.S. Geological Survey (USGS), no warranty expressed or implied is made regarding the display or utility of the data for other purposes, nor on all computer systems, nor shall the act of distribution constitute any such warranty.

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USGS Product Names Disclaimer: Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Application Version: 4.3.0

APPENDIX B

FEMA WORCESTER COUNTY FLOOD INSURANCE STUDY

APPENDIX C

HYDRAULIC COMPUTATIONS

1D Modeling Results

DUPLICATE EFFECTIVE MODEL (HEC-2)

HEC-RAS HEC-RAS 6.4.1 June 2023
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```

X      X  XXXXXX   XXXX      XXXX      XX      XXXX
X      X  X        X      X      X  X      X
X      X  X        X        X  X      X  X      X
XXXXXXXX XXXX      X        XXX XXXX      XXXXXX   XXXX
X      X  X        X        X  X      X      X      X
X      X  X        X      X      X  X      X      X
X      X  XXXXXX   XXXX      X      X      X      XXXXX

```

PROJECT DATA

Project Title: Rosemont Bridge
Project File : RosemontBridge-03.prj
Run Date and Time: 4/24/2024 1:36:45 PM

Project in English units

Project Description:

CRS Info=<SpatialReference> <CoordinateSystem Code="2249"
Unit="US_survey_Foot" AcadCode="" /> <Registration OffsetX="0" OffsetY="0"
OffsetZ="0" ScaleX="1" ScaleY="1" ScaleZ="1" /></SpatialReference>

PLAN DATA

Plan Title: DE-HEC-2

Plan File : \\beta-inc.com\ma\Projects\6100s\6155 - Haverill - Rosemont St
Bridge\Engineering\Modeling\HECRAS\1D\RosemontBridge-03.p01

Geometry Title: DE-HEC-2

Geometry File : \\beta-inc.com\ma\Projects\6100s\6155 - Haverill -
Rosemont St Bridge\Engineering\Modeling\HECRAS\1D\RosemontBridge-03.g01

Flow Title : DE-HEC-2

Flow File : \\beta-inc.com\ma\Projects\6100s\6155 - Haverill -
Rosemont St Bridge\Engineering\Modeling\HECRAS\1D\RosemontBridge-03.f02

Plan Description:

Duplicate Effective HEC-2 Model

Plan Summary Information:

Number of: Cross Sections = 10 Multiple Openings = 0
 Culverts = 0 Inline Structures = 0
 Bridges = 1 Lateral Structures = 0

Computational Information

Water surface calculation tolerance = 0.01
 Critical depth calculation tolerance = 0.01
 Maximum number of iterations = 20
 Maximum difference tolerance = 0.3
 Flow tolerance factor = 0.001

Computation Options

Critical depth computed only where necessary
 Conveyance Calculation Method: At breaks in n values only
 Friction Slope Method: Average Conveyance
 Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: DE-HEC-2

Flow File : \\beta-inc.com\ma\Projects\6100s\6155 - Haverill - Rosemont St
 Bridge\Engineering\Modeling\HECRAS\1D\RosemontBridge-03.f02

Flow Data (cfs)

River	Reach	RS	10 YR	50 YR
100 YR	500 YR			
FEMA-LR	LR-BL	28266	660	1065
1275	1865			
FEMA-LR	LR-BL	24666	980	1640
1990	3030			
Little River	BLPLR-BLP_FIRM	24666	980	1640
1990	3030			

Boundary Conditions

River	Reach	Profile	Upstream
Downstream			
FEMA-LR	LR-BL	10 YR	
Known WS = 28.16			

FEMA-LR	LR-BL	50 YR
Known WS = 30.01		
FEMA-LR	LR-BL	100 YR
Known WS = 31.04		
FEMA-LR	LR-BL	500 YR
Known WS = 33.38		

Observed Water Surface Marks

River	Reach	RS	10 YR	50 YR
100 YR	500 YR			
Little River	BLPLR-BLP_FIRM	23465		31.61

GEOMETRY DATA

Geometry Title: DE-HEC-2
 Geometry File : \\beta-inc.com\ma\Projects\6100s\6155 - Haverill - Rosemont St Bridge\Engineering\Modeling\HECRAS\1D\RosemontBridge-03.g01

CROSS SECTION

RIVER: FEMA-LR
 REACH: LR-BL RS: 28266

INPUT

Description: (P) Surveyed Section at Dam LR10
 HEC-2 STA 28266

Station Elevation Data				num=	15				
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1862.5	45.8	1882.5	42.4	1899.5	35.5	1932.5	34.1	1947.5	33.2
1967.5	33.5	1973.5	34.1	1985.5	34.7	2000	31.7	2013.5	33.3
2016.5	33.8	2035.5	33.4	2051.5	41.5	2062.5	42	2180	50

Manning's n Values		num=	3
Sta	n Val	Sta	n Val
1862.5	.08	1985.5	.04
		2013.5	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
1985.5	2013.5	1150	1150.25	1150.25		.1	.3

CROSS SECTION

RIVER: FEMA-LR
REACH: LR-BL RS: 27116

INPUT
Description: Scaled Section
HEC-2 STA 27116

Station Elevation Data				num=	7				
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1835	50	1910	35	1989	34.9	2000	28.9	2011	34.9
2110	35	2220	50						

Manning's n Values				num=	3
Sta	n Val	Sta	n Val	Sta	n Val
1835	.08	1989	.04	2011	.08

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1989	2011		1150 1150	1150		.1	.3

CROSS SECTION

RIVER: FEMA-LR
REACH: LR-BL RS: 25966

INPUT
Description: Scaled Section
HEC-2 STA 25966

Station Elevation Data				num=	9				
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1938	50	1988	32	2000	26	2012	32	2142	30
2200	35	2210	40	2300	45	2450	50		

Manning's n Values				num=	3
Sta	n Val	Sta	n Val	Sta	n Val
1938	.08	1988	.04	2012	.08

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1988	2012		1300 1300	1300		.1	.3

CROSS SECTION

RIVER: FEMA-LR
REACH: LR-BL RS: 24666

INPUT
Description: Scaled Section
HEC-2 STA 24666

Station Elevation Data				num=	10				
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1525	50	1565	45	1635	40	1685	35	1755	30
1985	28.4	2000	22.4	2015	28.4	2175	30	2195	40

Manning's n Values				num=	3
Sta	n Val	Sta	n Val	Sta	n Val
1525	.08	1985	.04	2015	.08

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1985	2015		1100	1100		.1	.3

CROSS SECTION

RIVER: FEMA-LR
 REACH: LR-BL RS: 23566

INPUT
 Description: (0) Surveyed Section U/S LR9-S
 HEC-2 STA23566

Station Elevation Data				num=	15				
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1614.235	50	1684.235	45	1719.235	35	1765.235	27.6	1800.235	24.4
1835.235	24.4	1923	26.4	1990	25.2	2000	19.2	2010	25.2
2030	30	2050	35	2130	40	2380	45	2470	50

Manning's n Values				num=	3
Sta	n Val	Sta	n Val	Sta	n Val
1614.235	.125	1990	.042	2010	.125

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1990	2010		99	99		.3	.5

Ineffective Flow				num=	2
Sta L	Sta R	Elev	Permanent		
1614.235	1983.88	34.5	F		
2016.2	2470	33.5	F		

CROSS SECTION

RIVER: FEMA-LR
 REACH: LR-BL RS: 23465

INPUT
 Description: (N) Surveyed Section U/S Face LR9-5
 HEC-2 STA 23466

Adjusted
 1' further upstream
 Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1770	50	1850	45	1900	40	1987	30.5	1987.1	30.5
1992	22.8	2000	22.8	2008	22.8	2012.9	29.7	2013	29.7
2020	29.9	2025	30	2070	30.8	2120	31.7	2170	32.5
2310	35	2500	40	2650	45	2715	50		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1770	.125	1987	.042	2012.9	.125

Bank Sta: Left Right Lengths: Left Channel Right Coeff Contr. Expan.

1987	2012.9	36	36	36	.1	.3
------	--------	----	----	----	----	----

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
1770	1983.88	34.5	F
2016.2	2715	33.5	F

BRIDGE

RIVER: FEMA-LR
REACH: LR-BL RS: 23449

INPUT

Description: (N) Surveyed Section U/S Face LR9-S & Computed Section D/S of LR9-S

Distance from Upstream XS = 1
Deck/Roadway Width = 34
Weir Coefficient = 2.6

Upstream Deck/Roadway Coordinates

num=	14													
Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord
1901.26		40			1987		35.3			1987.1		36.8		
1992		36.7		32.3	2000		36.6		32.3	2008		36.4		32.3
2012.9		36.4			2013		34.9			2020		34.5		
2070		34.4			2120		34.4			2170		34.9		
2310		35			2493.01		35							

Upstream Bridge Cross Section Data

Station	Elevation	Data	num=	19										
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev			
1770	50	1850	45	1900	40	1987	30.5	1987.1	30.5					
1992	22.8	2000	22.8	2008	22.8	2012.9	29.7	2013	29.7					
2020	29.9	2025	30	2070	30.8	2120	31.7	2170	32.5					
2310	35	2500	40	2650	45	2715	50							

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1770	.125	1987	.042	2012.9	.125

Bank Sta:	Left	Right	Coeff	Contr.	Expan.
	1987	2012.9		.1	.3

Ineffective Flow	num=	2
Sta L	Sta R	Elev
1770	1983.88	34.5
2016.2	2715	33.5
		F
		F

Downstream Deck/Roadway Coordinates

num=	14													
Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord
1901.26		40			1987		35.3			1987.1		36.8		
1992		36.7		32.3	2000		36.6		32.3	2008		36.4		32.3
2012.9		36.4			2013		34.9			2020		34.5		
2070		34.4			2120		34.4			2170		34.9		
2310		35			2493.01		35							

Downstream Bridge Cross Section Data

Station Elevation Data	num=	19							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1770	50	1850	45	1900	40	1987	30.5	1987.1	30.5
1992	22.7	2000	22.8	2008	22.8	2012.9	29.7	2013	29.7
2020	29.9	2025	30	2070	30.8	2120	31.7	2170	32.5
2310	35	2500	40	2650	45	2715	50		

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
1770	.125	1987	.042	2012.9	.125

Bank Sta:	Left	Right	Coeff	Contr.	Expan.
	1987	2012.9		.1	.3

Ineffective Flow	num=	2
Sta L	Sta R	Elev
1770	1983.88	34.5
2016.2	2715	33.5
		F
		F

Upstream Embankment side slope	=	0 horiz. to 1.0 vertical
Downstream Embankment side slope	=	0 horiz. to 1.0 vertical
Maximum allowable submergence for weir flow	=	.98
Elevation at which weir flow begins	=	
Energy head used in spillway design	=	
Spillway height used in design	=	
Weir crest shape	=	Broad Crested

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data

Energy

Selected Low Flow Methods = Highest Energy Answer

High Flow Method

Energy Only

Additional Bridge Parameters

Add Friction component to Momentum

Do not add Weight component to Momentum

Class B flow critical depth computations use critical depth
inside the bridge at the upstream end

Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: FEMA-LR

REACH: LR-BL

RS: 23431

INPUT

Description: Computed Section D/S Face LR9-5

HEC-2 STA 23432

Adjusted 1'

further downstream

Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1770	50	1850	45	1900	40	1987	30.5	1987.1	30.5
1992	22.7	2000	22.8	2008	22.8	2012.9	29.7	2013	29.7
2020	29.9	2025	30	2070	30.8	2120	31.7	2170	32.5
2310	35	2500	40	2650	45	2715	50		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1770	.125	1987	.042	2012.9	.125

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1987	2012.9		99	99		.1	.3

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
1770	1983.88	34.5	F
2016.2	2715	33.5	F

CROSS SECTION

RIVER: FEMA-LR

REACH: LR-BL

RS: 23332

INPUT

Description: Approx Section D/S of LR9-5
(XS-5)

HEC-2 STA 23332

Station Elevation Data num= 7

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-----	------	-----	------	-----	------	-----	------	-----	------

1555	40	1835	35	1975	27	2000	23	2025	27
2040	30	2095	40						

Manning's n Values		num=		3	
Sta	n Val	Sta	n Val	Sta	n Val
1555	.112	1975	.042	2025	.112

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1975	2025		320 320	320		.3	.5

CROSS SECTION

RIVER: FEMA-LR
 REACH: LR-BL RS: 23012

INPUT
 Description: Approximated Section (XS-6)
 HEC-2 STA 23012

Station Elevation Data		num=		15					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1640	50	1700	45	1750	40	1830	35	1890	35
1910	30	1982	25	2000	24	2018	25	2220	30
2340	30	2540	35	2570	40	2695	45	2975	50

Manning's n Values		num=		3	
Sta	n Val	Sta	n Val	Sta	n Val
1640	.112	1982	.042	2018	.112

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1982	2018		1800 1800	1800		.1	.3

CROSS SECTION

RIVER: FEMA-LR
 REACH: LR-BL RS: 21212

INPUT
 Description: (M) Surveyed Section LR8
 HEC-2 STA 21212

Station Elevation Data		num=		10					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
320	50	1710	25	1835	25	1970	30	1981	22.4
2000	21.7	2020	22.8	2030	30	2080	35	2095	40

Manning's n Values		num=		3	
Sta	n Val	Sta	n Val	Sta	n Val
320	.112	1981	.042	2020	.112

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
-----------	------	-------	----------	--------------	-------	-------	--------	--------

1981	2020	800	800	800	.1	.3
------	------	-----	-----	-----	----	----

SUMMARY OF MANNING'S N VALUES

River:FEMA-LR

Reach	River Sta.	n1	n2	n3
LR-BL	28266	.08	.04	.08
LR-BL	27116	.08	.04	.08
LR-BL	25966	.08	.04	.08
LR-BL	24666	.08	.04	.08
LR-BL	23566	.125	.042	.125
LR-BL	23465	.125	.042	.125
LR-BL	23449	Bridge		
LR-BL	23431	.125	.042	.125
LR-BL	23332	.112	.042	.112
LR-BL	23012	.112	.042	.112
LR-BL	21212	.112	.042	.112

SUMMARY OF REACH LENGTHS

River: FEMA-LR

Reach	River Sta.	Left	Channel	Right
LR-BL	28266	1150	1150.25	1150.25
LR-BL	27116	1150	1150	1150
LR-BL	25966	1300	1300	1300
LR-BL	24666	1100	1100	1100
LR-BL	23566	99	99	99
LR-BL	23465	36	36	36
LR-BL	23449	Bridge		
LR-BL	23431	99	99	99
LR-BL	23332	320	320	320
LR-BL	23012	1800	1800	1800
LR-BL	21212	800	800	800

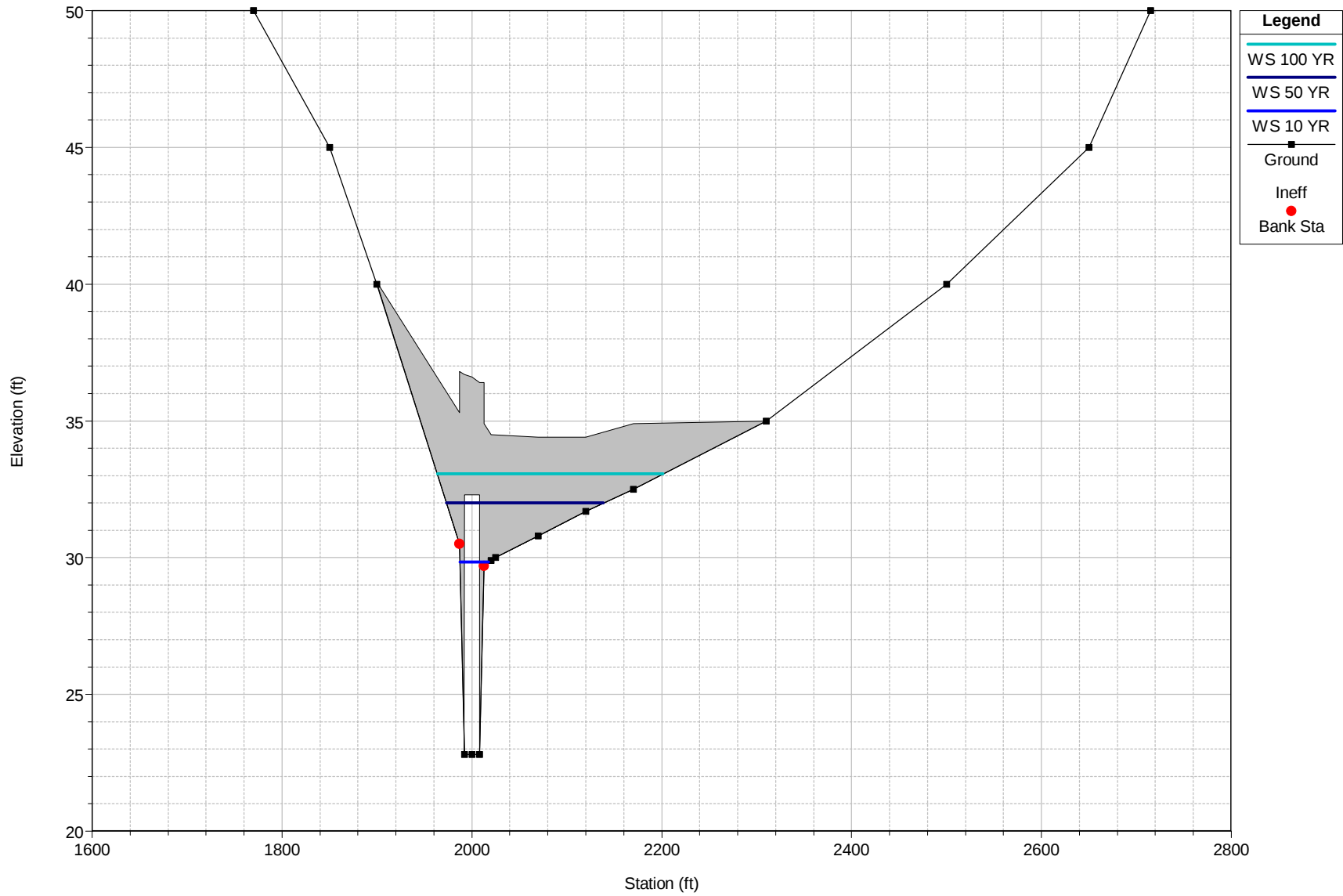
SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS

River: FEMA-LR

Reach	River Sta.	Contr.	Expan.
-------	------------	--------	--------

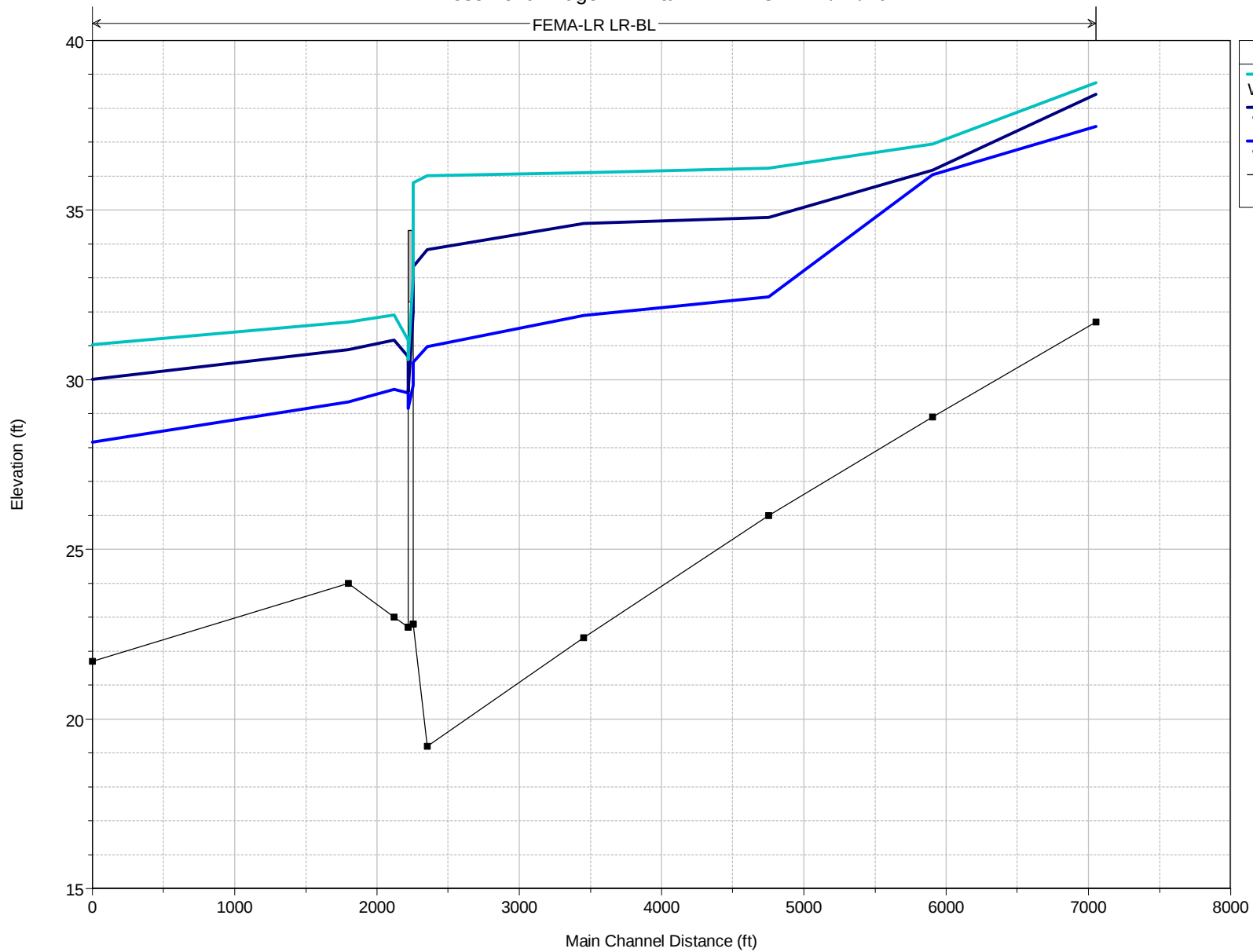
LR-BL	28266		.1	.3
LR-BL	27116		.1	.3
LR-BL	25966		.1	.3
LR-BL	24666		.1	.3
LR-BL	23566		.3	.5
LR-BL	23465		.1	.3
LR-BL	23449	Bridge		
LR-BL	23431		.1	.3
LR-BL	23332		.3	.5
LR-BL	23012		.1	.3
LR-BL	21212		.1	.3

Rosemont Bridge Plan: DE-HEC-2 4/24/2024
(N) Surveyed Section U/S Face LR9-S & Computed Section D/S of LR



Rosemont Bridge Plan: DE-HEC-2 4/24/2024

FEMA-LR LR-BL



1D Modeling Results

EXISTING CONDITIONS

HEC-RAS HEC-RAS 6.4.1 June 2023
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```

X      X  XXXXXX   XXXX       XXXX       XX       XXXX
X      X  X        X      X       X  X       X  X       X
X      X  X        X        X       X  X       X  X       X
XXXXXXXX XXXX      X          XXX XXXX      XXXXXX      XXXX
X      X  X        X          X       X  X       X      X
X      X  X        X      X       X  X       X  X       X
X      X  XXXXXX   XXXX       X      X       X  X       XXXXX

```

PROJECT DATA

Project Title: Rosemont Bridge
Project File : RosemontBridge-03.prj
Run Date and Time: 4/24/2024 11:30:29 AM

Project in English units

Project Description:

CRS Info=<SpatialReference> <CoordinateSystem Code="2249"
Unit="US_survey_Foot" AcadCode="" /> <Registration OffsetX="0" OffsetY="0"
OffsetZ="0" ScaleX="1" ScaleY="1" ScaleZ="1" /></SpatialReference>

PLAN DATA

Plan Title: Existing Conditions

Plan File : o:\6100s\6155 - Haverill - Rosemont St
Bridge\Engineering\Modeling\HECRAS\1D\RosemontBridge-03.p06

Geometry Title: Existing Conditions Model

Geometry File : o:\6100s\6155 - Haverill - Rosemont St
Bridge\Engineering\Modeling\HECRAS\1D\RosemontBridge-03.g07

Flow Title : DE-HEC-2

Flow File : o:\6100s\6155 - Haverill - Rosemont St
Bridge\Engineering\Modeling\HECRAS\1D\RosemontBridge-03.f02

Plan Description:

Existing Conditons

Plan Summary Information:

Number of: Cross Sections = 15 Multiple Openings = 0
 Culverts = 0 Inline Structures = 0
 Bridges = 1 Lateral Structures = 0

Computational Information

Water surface calculation tolerance = 0.01
 Critical depth calculation tolerance = 0.01
 Maximum number of iterations = 20
 Maximum difference tolerance = 0.3
 Flow tolerance factor = 0.001

Computation Options

Critical depth computed only where necessary
 Conveyance Calculation Method: At breaks in n values only
 Friction Slope Method: Average Conveyance
 Computational Flow Regime: Subcritical Flow

FLOW DATA

Flow Title: DE-HEC-2

Flow File : o:\6100s\6155 - Haverill - Rosemont St

Bridge\Engineering\Modeling\HECRAS\1D\RosemontBridge-03.f02

Flow Data (cfs)

River	Reach	RS	10 YR	50 YR
100 YR	500 YR			
FEMA-LR	LR-BL	28266	660	1065
1275	1865			
FEMA-LR	LR-BL	24666	980	1640
1990	3030			
Little River	BLPLR-BLP_FIRM	24666	980	1640
1990	3030			

Boundary Conditions

River	Reach	Profile	Upstream
Downstream			
FEMA-LR	LR-BL	10 YR	
Known WS = 28.16			

FEMA-LR	LR-BL	50 YR
Known WS = 30.01		
FEMA-LR	LR-BL	100 YR
Known WS = 31.04		
FEMA-LR	LR-BL	500 YR
Known WS = 33.38		

Observed Water Surface Marks

River	Reach	RS	10 YR	50 YR
100 YR	500 YR			
Little River	BLPLR-BLP_FIRM	23465		31.61

GEOMETRY DATA

Geometry Title: Existing Conditions Model
 Geometry File : o:\6100s\6155 - Haverill - Rosemont St
 Bridge\Engineering\Modeling\HECRAS\1D\RosemontBridge-03.g07

CROSS SECTION

RIVER: FEMA-LR
 REACH: LR-BL RS: 28266

INPUT

Description: (P) Surveyed Section at Dam LR10
 HEC-2 STA 28266

Station Elevation Data				num=	15				
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1862.5	45.8	1882.5	42.4	1899.5	35.5	1932.5	34.1	1947.5	33.2
1967.5	33.5	1973.5	34.1	1985.5	34.7	2000	31.7	2013.5	33.3
2016.5	33.8	2035.5	33.4	2051.5	41.5	2062.5	42	2180	50

Manning's n Values		num=	3
Sta	n Val	Sta	n Val
1862.5	.08	1985.5	.04
		2013.5	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
1985.5	2013.5	575.12	575.12	575.12		.1	.3

CROSS SECTION

RS: 27691*

Description:

num= 19

Manning's	n Values		num=	3	
Sta	n Val	Sta	n Val	Sta	n Val
1814.44	.08	1950.37	.04	1974.9	.08

CROSS SECTION

RS: 27116

Description: Scaled Section
HEC-2 STA 27116

num= 7

Manning's	n Values		num=	3	
Sta	n Val	Sta	n Val	Sta	n Val
1835	.08	1989	.04	2011	.08

CROSS SECTION

RS: 26541*

Description:

num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1849.73	50	1898.45	38.12	1949.75	33.45	1961.02	27.45	1972.3	33.45
1988.5	33.28	2011.5	33.04	2066.45	32.48	2108.44	35	2115.69	37.5
2122.55	37.76	2180.86	42.62	2289.49	50				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1849.73	.08	1949.75	.04	1972.3	.08

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1949.75	1972.3		575	575		.1	.3

CROSS SECTION

RIVER: FEMA-LR
 REACH: LR-BL RS: 25966

INPUT
 Description: Scaled Section
 HEC-2 STA 25966

Station Elevation Data				num=	9				
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1938	50	1988	32	2000	26	2012	32	2142	30
2200	35	2210	40	2300	45	2450	50		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1938	.08	1988	.04	2012	.08

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1988	2012		650	650		.1	.3

CROSS SECTION

RIVER: FEMA-LR
 REACH: LR-BL RS: 25316*

INPUT
 Description:

Station Elevation Data				num=	16				
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1639.12	50	1660.11	46.72	1696.85	42.85	1723.09	39.37	1759.82	35.5
1880.52	30.2	1893.3	24.2	1906.08	30.2	1986.5	29.52	1992.9	29.47
2013.5	30.86	2031.63	32.09	2038.31	34.61	2098.42	37.29	2166.1	39.19
2198.59	45								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-----	-------	-----	-------	-----	-------

1639.12 .08 1880.52 .04 1906.08 .08

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1880.52	1906.08		650	650		.1	.3

CROSS SECTION

RIVER: FEMA-LR

REACH: LR-BL RS: 24666

INPUT

Description: Scaled Section

HEC-2 STA 24666

Station Elevation Data				num=	10				
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1525	50	1565	45	1635	40	1685	35	1755	30
1985	28.4	2000	22.4	2015	28.4	2175	30	2195	40

Manning's n Values				num=	3				
Sta	n Val	Sta	n Val	Sta	n Val				
1525	.08	1985	.04	2015	.08				

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1985	2015		327.3	327.3		.1	.3

CROSS SECTION

RIVER: FEMA-LR

REACH: LR-BL RS: 24342

INPUT

Description:

Station Elevation Data				num=	492				
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	51	9.34	51	10.63	51.08	10.8	51.1	11.84	51.25
12.58	51.33	13.69	51.5	14.27	51.53	14.94	51.58	16.44	51.72
18.97	51.98	19.14	52	22.8	52.45	23.6	52.57	27.15	53.04
27.25	53.05	28.36	53.2	29.18	53.3	30.37	53.43	30.85	53.49
31.33	53.53	32.11	53.61	33.19	53.73	33.85	53.8	34.59	53.86
35.9	53.95	35.97	53.96	36.38	53.98	36.4	53.99	38.4	54.12
38.73	54.14	39.3	54.2	40.34	54.29	41.71	54.4	41.74	54.4
42.42	54.48	43.66	54.58	44.64	54.7	45.66	54.79	46.91	54.91
46.96	54.91	47.68	54.98	47.69	54.99	47.91	55	50.27	55
50.59	54.95	51.36	54.92	57.04	54.64	68.89	54	72.36	53.58
73.53	53.45	74.27	53.37	75.32	53.27	77.38	53	77.94	52.91
83.64	52	83.88	51.99	84.73	51.76	85.96	51.47	87.87	51.03
88.21	51	88.37	51	94.07	50	96.42	49.58	99.73	49
103.71	48.35	105.15	48.13	105.95	48	108.36	47.68	111.58	47.27
112.85	47.1	113.64	47	122.06	46.17	123.78	46	125.45	45.83

126.7	45.71	127.16	45.68	128.44	45.57	129.09	45.51	129.91	45.45
130.69	45.39	135.41	45	135.57	45	136.52	44.85	136.63	44.84
137.19	44.75	138.95	44.45	140.33	44.21	140.35	44.21	143.07	43.78
143.42	43.73	143.85	43.69	144.43	43.63	145.12	43.54	148.25	43.07
148.43	43.05	148.73	43	149.67	42.72	150.05	42.6	152.81	41.76
155.27	41	158.31	40.29	159.61	40	159.64	39.99	163.67	39
164.58	38.66	165.44	38.35	166.42	38	167.98	37.33	168.7	37
169.37	36.76	170.07	36.53	171.61	36	172.17	35.82	174.67	35
177.2	34.08	177.41	34	178.65	33.51	179.75	33.08	179.97	33
182.06	32.33	182.97	32	184.95	31.38	186.24	31	187.99	30.28
188.81	30	191.11	29.37	191.92	29.13	192.34	29	192.45	28.96
195.27	28	197.81	27.18	198.11	27.1	198.41	27	200.36	26.94
205.51	26.79	209.26	26.69	214.86	26.54	230.43	26.13	231.99	26.09
232.77	26.06	235.21	26	238.09	26	240.15	26.14	243.36	26.35
244.86	26.46	245.31	26.49	247.15	26.62	250.34	26.85	250.59	26.86
250.78	26.88	252.53	27	257.26	27	270.01	27.36	278.1	27.57
278.64	27.57	279.38	27.56	281.38	27.42	285.3	27.13	285.5	27.13
286.12	27.09	287.08	27	287.58	27	287.71	26.99	289.43	26.99
291.3	26.98	291.45	26.97	292.2	26.97	293.17	26.96	295.77	26.94
297.44	26.92	297.99	26.91	299.11	26.91	300.68	26.89	301.94	26.88
307.79	26.89	311.28	26.9	319.7	26.99	320.65	26.99	320.78	27
341.82	27	341.99	26.99	343.87	26.95	346.97	26.67	350.42	26.42
350.85	26.4	351.31	26.37	351.97	26.34	352.71	26.29	353.14	26.28
353.61	26.26	353.88	26.26	354.14	26.25	354.43	26.25	354.67	26.26
354.96	26.26	355.33	26.24	355.73	26.23	356.1	26.21	356.44	26.21
356.57	26.2	357.55	26.2	358.43	26.22	358.63	26.23	360.5	26.38
367.2	26.99	367.64	27	383.65	27	400.46	27	404.33	27.3
406.76	27.45	408.2	27.59	408.96	27.66	409.17	27.67	409.32	27.69
410.19	27.76	410.67	27.77	413.65	27.73	414.06	27.72	417.32	27.74
417.84	27.78	418.53	27.8	422.39	27.98	422.91	28	427.71	28
433.19	27.99	436.39	27.99	442.62	28	456.41	28	465.42	28.01
467.53	28.01	474.99	28	479.02	28	479.07	27.65	479.39	27.16
479.49	27.08	480.71	26.64	481.62	26.33	483.26	25.79	483.4	25.74
484.05	25.53	484.46	25.39	486.09	25.15	500.14	23.13	504.59	24.29
508.84	25.13	510.38	26.3	511.49	27.14	515	26.36	515.58	26.28
516.55	26.13	517.44	26	517.58	26	517.87	26.35	518.02	26.5
518.47	27	519.07	27.58	519.35	27.81	519.49	27.96	519.58	28
520.7	28	521.12	28.07	521.29	28.08	522.45	28.17	522.96	28.24
524.19	28.31	525.21	28.37	525.35	28.36	526.29	28.41	526.7	28.37
527.04	28.38	529.98	28.02	536.3	28.02	537.01	28.01	541.23	28.01
545.74	28	550.09	28	551.32	27.97	551.7	27.97	559.94	27.62
569.13	27.25	569.43	27.24	571.42	27.16	573.86	27.06	574.41	27.04
575.9	26.99	576.55	26.87	576.8	26.81	578.08	26.58	578.48	26.53
578.71	26.47	579.71	26.24	579.96	26.19	580.61	26	593.9	26
594.66	26.69	594.95	27	595.29	27.33	595.94	28	596.4	28.25
597.6	29	598.96	29.91	599.08	30	599.23	30.13	599.3	30.21
599.47	30.36	599.74	30.62	600.18	31	600.96	31.45	602.03	32
603.03	32.37	603.26	32.46	603.94	32.74	604.56	33	605.59	33.37
607.32	34	607.45	34.02	610.85	34.44	614.73	34.99	614.85	34.98
615.01	34.99	617.11	34.99	617.29	35	618.82	34.99	620.79	35
621.44	35	621.54	35.01	621.79	35.01	623.17	35.16	624.87	35.27

625.58	35.3	626.79	35.38	627.11	35.39	628.85	35.48	632.77	35.93
632.92	35.94	633.5	35.96	634.02	35.96	634.35	35.97	634.57	35.97
634.92	35.98	635.42	35.98	635.64	35.99	636.1	35.99	636.11	36
636.49	36.1	636.88	36.1	643.23	36.47	646.15	36.59	646.49	36.55
646.85	36.55	647.24	36.54	647.62	36.54	649.02	36.57	650.75	36.66
650.98	36.65	651.27	36.69	651.61	36.73	652.44	36.85	653.3	37
653.61	37.09	655.93	37.65	656.82	37.88	657.2	38	657.3	38
658.5	38.16	659.82	38.31	660.26	38.4	660.69	38.46	661.02	38.52
661.29	38.55	661.65	38.62	662.1	38.67	662.62	38.76	662.85	38.81
663.68	38.94	663.7	38.95	664.18	39	665.31	39.05	666.12	39.09
667.31	39.12	667.45	39.12	668.48	39.1	669.99	39.08	670.12	39.09
671.6	39.12	671.9	39.12	672.92	39.19	674.26	39.19	675.19	39.17
675.32	39.17	676.24	39.15	676.41	39.14	677.34	39.1	677.47	39.1
678.09	39.08	678.27	39.08	678.73	39.1	679.61	39.13	680.04	39.13
680.38	39.14	681.43	39.23	681.94	39.28	682.81	39.39	682.85	39.39
685.59	39.56	687.26	39.63	687.61	39.62	689.3	39.65	691.3	39.74
691.75	39.74	693.87	39.89	695.01	39.99	695.16	40	696.71	40.17
698.45	40.28	699.86	40.33	700.78	40.34	701.53	40.36	702.47	40.42
703.35	40.47	703.46	40.48	704.47	40.55	705.54	40.65	706.19	40.72
706.62	40.77	706.92	40.81	708.82	40.95	709.05	40.98	709.39	41
711.7	41.21	712.18	41.26	713.19	41.35	713.56	41.39	714.15	41.46
716.25	41.77	716.69	41.82	717.12	41.88	717.38	41.91	718.02	42
719.18	42.18	719.96	42.29	720	42.29	720.55	42.37	720.83	42.4
721.45	42.42	721.87	42.45	722.36	42.49	723.04	42.56	724.39	42.71
724.44	42.71	726.48	43	727.39	43.23	727.94	43.33	728.97	43.57
729.43	43.67	729.84	43.75	730.01	43.79	731.3	44	732.09	44.07
732.37	44.11	732.87	44.15	732.92	44.16	733.97	44.27	735.6	44.55
736.06	44.61	736.84	44.7	737.06	44.73	738.39	45	739.73	45.02
740.47	45.02	741.47	45.04	742.68	45.03	743.05	45.03	743.7	45.02
744.09	45.02	745.59	45.01	745.98	45	746.43	45	746.91	44.99
748.49	44.99	749.41	44.98	750.38	44.98	753.07	45	757.41	45.99
757.62	46	764.37	46.21	772.66	46.48	774.46	46.53	776.74	46.6
783.74	46.82	788.72	46.82						

Manning's n	Values		num=	3	
Sta	n Val	Sta	n Val	Sta	n Val
0	.12	479.02	.042	511.49	.12

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	479.02	511.49		582.42	582.42	582.42		.1	.3

CROSS SECTION

RIVER: FEMA-LR
REACH: LR-BL RS: 23760

INPUT									
Description:									
Station	Elevation	Data	num=	415					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

0	57.72	.02	57.72	1.07	57.68	2.51	57.61	2.69	57.6
3.11	57.55	7.39	57.21	9.65	57.02	9.87	57.02	10.28	57.01
10.3	57.01	10.33	57	10.61	57	11.54	56.99	11.82	56.99
12.32	56.98	12.91	56.97	13.25	56.97	14.07	56.98	15.57	56.98
17.73	56.74	17.81	56.73	18.13	56.68	18.46	56.64	19.28	56.59
20.01	56.56	20.29	56.51	20.98	56.38	21.26	56.36	21.62	56.35
21.88	56.3	22.09	56.29	22.73	56.19	23.27	56.09	23.68	56
24.25	55.95	29.74	55.56	32.23	55.43	32.39	55.41	32.85	55.32
32.94	55.32	33.43	55.25	33.84	55.25	33.97	55.24	35.22	55
35.44	55	37.03	54.91	37.45	54.89	38.19	54.85	39.29	54.79
40.26	54.75	41.37	54.67	43.43	54.53	44.34	54.48	45.08	54.43
47.49	54.25	50.77	54	51.01	54	52.94	53.45	53.39	53.33
53.65	53.26	54.58	53.09	55.01	53.01	55.04	53	55.18	53
55.33	52.95	55.63	52.86	57.85	52.14	57.94	52.1	58	52.08
58.24	52	58.25	52	58.71	51.91	63.29	51.01	63.43	51
63.58	51	64.2	50.97	65.78	50.9	65.94	50.9	66.26	50.89
66.66	50.87	67.12	50.85	67.61	50.84	68.46	50.81	69.68	50.77
80.42	50.37	84.06	50.26	84.98	50.23	85.98	50.19	86.34	50.19
87.88	50.15	89.46	50.11	89.76	50.11	90.02	50.1	90.25	50.09
90.44	50.09	92.12	50.05	93.97	50	94.19	50	95.1	49.95
95.89	49.91	96.62	49.87	96.72	49.87	97.12	49.82	97.88	49.78
98.65	49.68	98.85	49.65	100.42	49.5	101.53	49.35	104.08	49
105.01	48.81	106.38	48.55	106.6	48.51	107.87	48.25	109.16	48
110.97	47.57	111.74	47.39	111.95	47.34	113.31	47	116.64	46.26
117.79	46	118.26	45.91	118.55	45.86	120.41	45.54	121.02	45.42
123.75	45	124.11	44.95	124.17	44.94	124.25	44.93	124.37	44.9
125.08	44.8	125.58	44.71	126.89	44.49	127.01	44.48	127.23	44.44
128.1	44.31	129.94	44	131.73	43.64	131.91	43.59	132.88	43.37
133.32	43.27	133.57	43.21	134.54	43	138.69	42.09	138.75	42.07
139.1	42	139.49	41.93	140.38	41.77	140.49	41.75	140.73	41.69
141.05	41.62	141.67	41.48	142.63	41.29	142.89	41.24	143.92	41
145.3	40.76	145.83	40.64	147.07	40.36	148.67	40	153.3	39.22
153.91	39.12	154.59	39	154.61	39	154.85	38.97	155.09	38.94
155.27	38.91	155.68	38.86	160.68	38.21	162.22	38	162.3	37.99
162.33	37.98	163.95	37.72	166.57	37.3	167.49	37.11	167.59	37.09
168.05	37	168.07	37	173.01	36.16	173.95	36	174.2	35.95
176.41	35.49	178.61	35.03	178.72	35	178.99	34.93	182.63	34
183.21	33.82	183.41	33.79	183.72	33.73	184.22	33.61	185.08	33.43
185.96	33.23	186.79	33.01	186.97	33	187.03	32.98	187.05	32.97
187.11	32.95	188.12	32.52	188.51	32.37	188.84	32.25	189.59	32.08
189.66	32.06	189.71	32.05	190.06	32	190.11	32	190.16	31.98
190.17	31.98	190.2	31.97	190.9	31.79	191.55	31.56	192.81	31.01
192.88	31.01	192.89	31	193.3	30.4	193.6	30	194.63	29
195.09	28.98	195.3	28.97	197.01	28.49	197.86	28.3	198.9	28
198.97	27.96	199.1	27.87	199.29	27.74	200.22	27.12	200.34	27.04
200.4	27	200.64	26.99	205.1	26.35	207.17	26	207.18	26
214.63	25.26	216.92	25.04	217.33	25	225.94	25	226.45	25.01
227.59	25.02	229.51	25.02	239.54	25.31	239.69	25.31	239.92	25.32
240.5	25.33	241.06	25.34	249.8	25.68	257.21	25.98	257.67	25.99
260.92	25.99	262.95	26	266.62	26	269.57	26	269.7	25.97
269.71	25.97	271.44	25.62	271.5	25.61	271.68	25.57	273.42	25.29

274.76	25.01	275.47	25.01	276.05	25	279.22	25	279.36	25.02
279.75	25.13	279.85	25.18	280.66	25.5	281.62	25.83	282.12	26
296.62	26	308.68	26	311.59	25.98	312.42	25.98	313.45	25.99
315.42	26	315.49	26	316.34	26.06	320.18	26.34	322.29	26.49
323.69	26.58	324.67	26.64	325.56	26.7	325.71	26.7	327.08	26.79
327.85	26.83	329.65	26.99	329.72	27	377.75	27	378.86	27.01
380.83	27.01	381.63	27	395.64	27	414.78	27.29	426.66	27.45
433.72	27.35	443.86	27.2	443.94	27.21	444.45	27.19	444.98	27.17
445.1	27.17	446.8	27.13	448.69	27.08	449.51	27.06	450.37	27.04
451.16	27.02	451.98	27	452.36	27	452.5	26.99	452.7	26.99
453.65	26.97	454.4	26.98	454.79	26.95	457.1	26.99	457.63	27
486.56	27	486.97	26.99	487.75	26.99	492.53	26.98	494.17	26.98
498.02	26.85	499.95	26.81	500.13	26.38	504.07	25.4	507.57	23.85
517.23	21.89	519.63	21.39	523.55	22.27	529.79	23.75	529.85	23.8
531.3	26.09	532.35	25.16	532.38	25	534.3	25	534.44	25.03
534.47	25.04	534.51	25.05	534.52	25.05	534.58	25.07	535.01	25.22
536.55	25.72	537.4	25.99	537.48	26	537.89	26.47	538.24	27
538.51	27.49	538.87	28	539.86	28.37	541.3	28.96	541.32	28.96
541.45	28.98	541.54	28.98	541.77	29	542.4	29.6	542.82	30
544.51	30.92	544.77	31	545.8	31.58	546.42	32	547.33	32.55
548.11	32.95	548.2	33	549.12	33.84	549.35	34	549.86	34.32
550.32	34.54	550.66	34.77	551.02	34.92	551.16	34.99	551.24	35
551.46	35.14	552.68	35.93	552.77	35.99	552.78	36	553.02	36.12
553.35	36.29	554.15	36.52	554.65	36.69	554.74	36.72	554.83	36.76
555.54	37	555.72	37.12	556.35	37.58	556.81	37.96	556.82	37.96
556.86	38	557.64	38.79	557.86	39	558.6	39.37	559.51	40
559.52	40	560.17	40.16	561.51	40.47	562.7	40.73	563.1	40.82
563.8	41	563.9	41	564.73	41.02	564.86	41.02	567.06	41.24
574.24	41.94	574.38	41.96	574.45	41.96	574.5	41.97	574.87	42
575.55	42	584.73	42.37	588.03	42.5	590.23	42.58	591.8	42.64
600.53	42.99	600.9	43	600.93	43	603.26	43.08	603.49	43.09
603.95	43.11	604.61	43.13	610.18	43.33	612.19	43.4	626.41	43.4

Manning's n Values			num=	3
Sta	n Val	Sta	n Val	Sta
0	.125	499.95	.042	531.3

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	499.95	531.3		171.8	195.55	249.91		.1	.3

CROSS SECTION

RIVER: FEMA-LR
 REACH: LR-BL RS: 23566

INPUT
 Description: (0) Surveyed Section U/S LR9-S
 HEC-2 STA23566

Station Elevation Data			num=	496
Sta	Elev	Sta	Elev	Sta
				Elev
				Sta
				Elev
				Sta
				Elev

1614.24	50	1623.11	49.37	1623.11	64.24	1624.34	64.24	1624.61	64.19
1625.41	64	1628.93	63	1630.78	62.76	1633.78	62.41	1636.71	62.04
1637.41	62.02	1637.83	62.02	1638.01	62	1639.81	61.66	1644.09	60.7
1644.87	60.59	1646.6	60.33	1648.46	60	1650.6	60	1652.06	59.99
1652.99	60	1654.48	59.88	1656.33	59.75	1660.04	59.36	1663.39	59
1663.46	59	1670.86	58	1685.69	58	1687.12	57.99	1688.48	58
1688.56	57.99	1689.23	58	1689.91	57.99	1690.47	58	1691.48	58
1692.29	58.02	1696.3	58.07	1697.01	58.1	1698.9	58.16	1702.26	58.24
1703.14	58.28	1705.77	58.31	1708.26	58.32	1709.22	58.32	1710.69	58.31
1712.7	58.27	1714.58	58.19	1714.73	58.19	1715.9	58.14	1716.88	58.14
1717.84	58.15	1719.96	58.15	1722.01	58.04	1722.33	58.04	1723.49	58.01
1724.4	58	1724.7	57.98	1725.51	57.83	1727.39	57.51	1727.97	57.42
1729.85	57.11	1730.54	57	1736.36	56.04	1736.62	56	1739.51	55.47
1740.5	55.31	1741.07	55.17	1741.89	55	1749.2	54	1749.61	54
1756.09	53.01	1757.98	52.67	1761.76	52	1763.01	51.85	1766.35	51.46
1770.41	51	1770.61	51	1771.92	50.94	1772.52	50.92	1778.48	50.66
1781.53	50.55	1793.87	50	1802.75	49.12	1804.4	49.04	1804.9	49
1806.63	49	1807.96	48.99	1809.67	48.99	1813.68	48.69	1814.3	48.67
1820.42	48.43	1823.25	48.38	1825.3	48.32	1826.05	48.28	1828.71	48.15
1830.33	48.06	1830.47	48.06	1831.77	48	1833.64	47.88	1834.03	47.87
1835.81	47.78	1837.6	47.7	1838.55	47.62	1839.72	47.55	1841.9	47.39
1842.51	47.33	1844.2	47.23	1846.61	47.07	1847.56	47	1849.23	46.85
1850.76	46.76	1851.28	46.72	1852.09	46.63	1853.05	46.55	1854.46	46.45
1855.93	46.3	1858.47	46.05	1859.22	45.97	1860.78	45.59	1863.49	45
1864.79	44.62	1866.06	44.24	1866.92	44.01	1866.99	44	1867.54	43.56
1867.96	43	1868.58	41.81	1868.94	41.17	1869.11	41	1899.47	41
1904	40.74	1905.01	40.69	1916.97	40	1918.51	40	1918.54	39.99
1920.99	39.47	1923.07	39	1925.55	38	1926.62	37.22	1926.87	37
1927.22	36.5	1927.53	36	1927.88	35.4	1928.1	35	1928.61	34.19
1929.2	33.39	1929.5	33	1930.33	32.24	1930.57	32	1931.4	31.48
1932.15	31	1932.18	31	1932.74	30.67	1933.68	30.15	1934.48	29.6
1935.44	29	1935.87	28.76	1937.71	28	1938.39	27.78	1939.97	27.29
1940.68	27.14	1941.28	27	1941.78	26.93	1942	26.88	1944.27	26.49
1944.87	26.35	1946.24	26	1951.12	25.7	1952.09	25.65	1963.04	25.01
1963.57	25	1971.91	25	1973.39	24.91	1974.2	24.84	1977.19	24.57
1979.31	24.4	1981.34	24.19	1983.22	24	1983.79	24	1990	24
1998.79	24	2010	24	2013.79	24	2022.33	24	2024.71	24.14
2027.83	24.39	2031.88	24.53	2032.33	24.54	2033.45	24.54	2035.04	24.57
2035.88	24.57	2036.78	24.59	2038.03	24.61	2038.71	24.64	2039.76	24.66
2041.05	24.71	2042.21	24.73	2043.26	24.74	2044.64	24.73	2045.81	24.74
2048.93	24.99	2051.36	24.98	2054.03	25	2055.86	25.16	2056.61	25.2
2056.77	25.22	2058.38	25.32	2059.2	25.39	2060.17	25.5	2060.94	25.56
2061.47	25.59	2061.7	25.62	2063.46	25.71	2063.77	25.74	2064.8	25.79
2066.41	25.98	2069.12	25.95	2070.19	25.97	2071.28	26	2087.75	26
2091.47	26.01	2096.88	26.01	2102.89	26	2104.48	26.01	2105.25	25.84
2105.42	25.84	2117.79	26.07	2124.33	25.12	2126.2	24.64	2129.24	23.12
2132.12	22.76	2133.32	22.6	2141.39	21.5	2157.42	23.58	2157.92	23.7
2162.05	24.44	2163.35	24.53	2163.97	24.55	2164.35	24.58	2164.72	24.63
2165.49	24.7	2166.89	24.85	2168.04	25	2168.85	25	2173.24	26
2173.89	26.2	2176.36	27	2176.7	27.01	2177.15	27.1	2178.25	27.3
2178.76	27.42	2179.44	27.53	2179.88	27.63	2180.91	27.83	2181.69	28

2181.94	28.1	2183.14	28.52	2184.36	29	2185.25	29.27	2186.15	29.52
2187.01	29.78	2187.25	29.81	2187.46	29.8	2187.84	30	2189.01	30.54
2189.8	30.86	2190.15	30.94	2190.71	31	2191.73	31.01	2191.89	31
2192.82	31	2193.9	32.48	2193.99	33.65	2206.22	34.15	2207.09	34.19
2227.04	34.96	2234.37	35.12	2239.92	35.26	2262.37	35.55	2274.51	35.71
2280.69	35.79	2281.78	35.82	2281.98	35.95	2282.46	35.96	2284.29	35.96
2285.07	35.97	2288.15	35.99	2289.29	36	2291.68	36	2293.38	36.08
2294.97	36.11	2296.4	36.13	2296.68	36.14	2298.94	36.17	2299.95	36.2
2300.5	36.2	2304.2	36.31	2304.63	36.31	2306.95	36.34	2308.48	36.35
2310.17	36.37	2310.64	36.39	2312.2	36.42	2313.41	36.43	2315.78	36.49
2318.7	36.59	2319.63	36.63	2321.23	36.66	2324.6	36.74	2324.9	36.76
2326.69	36.81	2328.23	36.84	2328.73	36.86	2332.87	36.96	2334.85	37
2335.23	37	2337.26	37.23	2338.38	37.31	2339.48	37.33	2340.08	37.36
2341.24	37.45	2341.74	37.47	2342.59	37.54	2343.26	37.58	2344.78	37.63
2345.91	37.7	2346.76	37.7	2349.32	37.73	2349.58	37.75	2350.53	37.76
2351.22	37.8	2351.74	37.82	2353.65	37.86	2355.79	37.92	2357	37.96
2358.11	38.01	2359.38	38.09	2361.03	38.18	2361.57	38.19	2362.2	38.22
2363.37	38.25	2366.18	38.39	2366.7	38.4	2366.95	38.42	2367.8	38.46
2368.49	38.48	2369.31	38.52	2370.33	38.54	2371.46	38.58	2372.49	38.63
2374.53	38.7	2374.66	38.7	2376.56	38.76	2378.88	38.85	2380.93	38.94
2380.98	38.95	2381.79	38.98	2382.21	39	2382.5	39	2386.07	39.24
2387.55	39.33	2389.81	39.45	2390.47	39.48	2391.28	39.5	2392.16	39.54
2392.78	39.54	2394.6	39.59	2394.75	39.58	2395.18	39.62	2395.87	39.66
2398.91	39.67	2402.03	39.7	2403.69	39.77	2404.53	39.79	2404.87	39.81
2405.98	39.83	2407.44	39.87	2408.64	39.89	2409.92	39.92	2410.66	39.93
2416.6	39.95	2417.64	39.99	2421.16	39.97	2421.69	39.98	2422.96	39.98
2424.06	40	2424.57	40	2427.28	40.09	2429.97	40.17	2431.16	40.21
2433.55	40.28	2434.11	40.3	2436.47	40.37	2438.37	40.43	2438.95	40.44
2440.35	40.49	2440.71	40.51	2441.68	40.54	2442.49	40.58	2443.6	40.65
2444.27	40.67	2445.64	40.74	2446.47	40.75	2446.75	40.77	2448.42	40.76
2451.56	40.76	2453.09	40.77	2459.57	41	2473.96	41	2475.77	41.06
2477.52	41.13	2477.99	41.13	2481.53	41.23	2507.94	42	2512.07	42
2514.36	42.06	2515.09	42.07	2527.84	42.37	2534.58	42.51	2535.62	42.52
2536.42	42.52	2539.13	42.55	2542.14	42.58	2543.05	42.6	2545.01	42.63
2547.74	42.66	2547.97	42.67	2551.43	42.73	2555.62	42.81	2556.14	42.81
2556.79	42.83	2561.33	42.92	2564.84	43	2565.83	43.01	2567.61	43.14
2570.34	43.32	2571.49	43.38	2573.68	43.53	2575.8	43.68	2578.48	43.86
2580.31	44	2580.65	44.02	2584.1	44.27	2586.17	44.41	2588.6	44.58
2588.83	44.6	2590.81	44.73	2594.41	45	2595.84	45.03	2597.47	45.03
2600.96	45.17	2608.58	45.4	2612.46	45.42	2615.03	45.42	2615.84	45.43
2616.68	45.43	2631.36	46.56	2632.02	46.57	2636.06	46.67	2638.98	46.71
2640.67	47	2646.03	47	2650.04	47.15	2651.21	47.13	2651.75	47.14
2653.96	47.26	2656.25	47.16	2656.8	47.16	2657.68	47.18	2660.33	47.53
2661.39	47.71	2662.89	48	2662.99	48	2663.29	48.13	2663.91	48.44
2664.43	48.46	2664.84	48.53	2665.46	48.72	2666.35	48.86	2666.56	48.91
2667.21	49	2667.93	49.07	2668.87	49.14	2669.88	49.25	2670.56	49.34
2675.26	49.18	2677.52	49.16	2680.75	49.24	2683.49	49.3	2686.97	49.37
2692.43	49.47	2692.51	49.47	2697.01	49.57	2698.44	49.57	2698.44	49.94
2702.77	50								

Sta	n Val	Sta	n Val	Sta	n Val
1614.24	.125	2126.2	.042	2162.05	.125

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	2126.2	2162.05		74.4	68.75	45.59	.3	.5
Ineffective Flow		num=	1					
Sta L	Sta R	Elev	Permanent					
1614.24	1930.33	34.5	F					

CROSS SECTION

RIVER: FEMA-LR

REACH: LR-BL

RS: 23466

INPUT

Description:

Station Elevation Data	num=	109							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	43.133	160004	42.483	380005	42.533	900024	42.511	3.42001	42.08
14.94	41.94	23.19	41.05	32.16	39.66	32.44	39.453	3.30002	37.8
35.15002	37.69	39.91	37.424	4.83002	37.135	0.15002	36.955	7.48001	36.73
57.70001	36.735	7.74002	36.725	8.58002	36.69	72.63	36.187	7.52002	35.6
78.35001	35.449	2.45001	29.619	5.10001	28.749	6.45001	28.898	3.36002	25.44
100.29	24.15	101.26	23.51	102.54	22.68	110.22	21.1	110.55	21.12
117.41	21.63	124.27	22.4	124.59	22.43	125.71	23.41	130.33	24.49
131.77	26.52	134.82	29.87	138.5	30.31	144.14	32.07	144.39	32.04
144.89	32.28	145.09	32.37	145.18	32.39	152.91	33.16	160.88	32.75
163.48	32.73	167.28	32.73	171.16	32.72	172.85	33	172.93	33.01
181.84	33.01	182.01	32.97	188.54	32.79	189.12	32.7	190.57	32.82
190.72	32.82	195.62	32.84	199.99	32.42	205.92	33.09	206.19	33.1
206.54	33.09	206.82	33.08	207.11	33.07	213.86	32.54	216.14	33.05
217.3	33.1	223.44	33.19	229.56	31.41	236.42	30.15	250.19	31.3
258.93	33.49	266.11	33.71	273.28	33.57	281.82	33.55	290.48	33.55
294.64	33.77	299.52	33.83	311.9	34.24	312.35	34.25	312.64	34.24
320.71	33.84	337.22	33.82	345.35	34.19	351.5	34.57	359.45	34.19
369.73	34.02	390.54	34.45	398.68	34.69	412.49	34.78	413.64	34.8
414.03	34.83	424.74	35.07	425.3	35.08	425.9	35.09	428.33	35.15
429.23	35.19	429.63	35.21	430.83	35.3	433.35	35.54	434.04	35.66
436	35.58	441.77	36.29	444.47	36.64	446.38	37.05	446.44	39.12
450.5	39.12	456.7	39.15	464.17	39.18	501.14	40.3		

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
0	.12	102.54	.042	125.71	.12

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	102.54	125.71		52.58	52.58	52.58	.3	.5
Ineffective Flow		num=	2					
Sta L	Sta R	Elev	Permanent					
0	106.41	34.5	F					

125.71 501.14 33.39 F

BRIDGE

RIVER: FEMA-LR

REACH: LR-BL

RS: 23449

INPUT

Description: Rosemont Street Bridge

Distance from Upstream XS = 8

Deck/Roadway Width = 33

Weir Coefficient = 2.6

Upstream Deck/Roadway Coordinates

num= 83

Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord	Sta	Hi	Cord	Lo	Cord
-16		41			-15.62		40.97			-13.68		40.91		
-5.48		40.27			-2.24		40			-2.15		39.99		
-2.11		39.99			3.03		39.61			19.02		38.44		
19.48		38.41			30.92		37.7			39.9		37.13		
49.3		36.59			50.68		36.52			69.48		35.55		
80.85		35.12			81.79		35.09			108		34.5		
108		34.5	32.6		124		34	32.6		124		34		
154.02		33.71			156.22		33.71			173.79		33.61		
177.79		33.59			177.9		33.59			180.8		33.6		
189.34		33.55			194.48		33.52			202.21		33.47		
203.36		33.45			203.86		33.47			204.59		33.44		
218.39		33.39			218.73		33.39			219.08		33.4		
220.99		33.4			228.92		33.39			242.28		33.42		
242.9		33.47			243.56		33.39			246.61		33.43		
246.84		33.49			247.11		33.44			250.85		33.47		
258.43		33.53			262.76		33.51			267.75		33.71		
268.03		33.61			275.77		33.71			276.46		33.79		
277.23		33.68			280.6		33.7			283.44		33.79		
288.99		33.84			298.43		33.71			311.01		34.03		
316.52		34.1			317.25		34.1			318.92		34.11		
320.17		34.18			335.77		34.44			343.21		34.57		
348.95		34.66			350.47		34.82			352.25		34.63		
361.44		34.68			362.05		34.97			362.58		34.82		
365		34.86			382.33		35.12			384.72		35.16		
395.33		35.23			396.11		35.23			400.6		35.4		
403.21		35.43			411.64		35.56			415.02		35.63		
420.42		35.62			421.63		35.66			425.45		35.78		
429.86		35.88			432.76		36							

Upstream Bridge Cross Section Data

Station Elevation Data

num= 109

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-16	43.13	3.16	42.483.380005	42.533.900024	42.5113.42001	42.08			
14.94	41.94	23.19	41.05	32.16	39.66	32.44	39.4533.30002	37.8	
35.15002	37.69	39.91	37.4244.83002	37.1350.15002	36.9557.48001	36.73			

57.70001	36.7357	74002	36.7258	58002	36.69	72.63	36.1877	52002	35.6
78.35001	35.4492	45001	29.6195	10001	28.7496	45001	28.898	36002	25.44
100.29	24.15	101.26	23.51	102.54	22.68	110.22	21.1	110.55	21.12
117.41	21.63	124.27	22.4	124.59	22.43	125.71	23.41	130.33	24.49
131.77	26.52	134.82	29.87	138.5	30.31	144.14	32.07	144.39	32.04
144.89	32.28	145.09	32.37	145.18	32.39	152.91	33.16	160.88	32.75
163.48	32.73	167.28	32.73	171.16	32.72	172.85	33	172.93	33.01
181.84	33.01	182.01	32.97	188.54	32.79	189.12	32.7	190.57	32.82
190.72	32.82	195.62	32.84	199.99	32.42	205.92	33.09	206.19	33.1
206.54	33.09	206.82	33.08	207.11	33.07	213.86	32.54	216.14	33.05
217.3	33.1	223.44	33.19	229.56	31.41	236.42	30.15	250.19	31.3
258.93	33.49	266.11	33.71	273.28	33.57	281.82	33.55	290.48	33.55
294.64	33.77	299.52	33.83	311.9	34.24	312.35	34.25	312.64	34.24
320.71	33.84	337.22	33.82	345.35	34.19	351.5	34.57	359.45	34.19
369.73	34.02	390.54	34.45	398.68	34.69	412.49	34.78	413.64	34.8
414.03	34.83	424.74	35.07	425.3	35.08	425.9	35.09	428.33	35.15
429.23	35.19	429.63	35.21	430.83	35.3	433.35	35.54	434.04	35.66
436	35.58	441.77	36.29	444.47	36.64	446.38	37.05	446.44	39.12
450.5	39.12	456.7	39.15	464.17	39.18	501.14	40.3		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-16	.12	102.54	.042	125.71	.12

Bank Sta: Left Right Coeff Contr. Expan.

92.45001	134.82		.3	.5
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Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-16	106.41	34.5	F
125.71	501.14	33.39	F

Downstream Deck/Roadway Coordinates

num= 61											
Sta	Hi	Cord	Lo Cord	Sta	Hi	Cord	Lo Cord	Sta	Hi	Cord	Lo Cord
-7	41.01			-6.34	40.95			3.3	40.24		
9.86	39.72			16.85	39.14			17.4	39.12		
18.21	39.03			28.03	38.23			28.22	38.22		
32.78	38.29			51.74	36.94			52.62	36.84		
63.68	36.33			65.33	36.3			65.99	36.3		
66.04	36.23			66.49	36.22			68.49	36.13		
75.15	35.85			79.09	35.68			81.44	35.6		
82.06	35.58			86.43	35.43			89.67	35.33		
89.83	35.33			90.76	35.3			105.15	34.83		
106.24	34.79			108.05	34.74			124.5	34.5		
124.5	34.5	32.6		140.5	34	32.6		140.5	34		
151.54	33.94			152.07	33.94			152.75	33.93		
159.64	33.85			163.71	33.82			164.1	33.82		
168.89	33.81			169.51	33.8			194.83	33.64		
199.76	33.61			202.14	33.6			207.02	33.6		
224.78	33.57			235.05	33.56			241.68	33.54		
264.78	33.53			272.06	33.59			282.58	33.67		

290.54	33.76	296.6	33.83	303.32	33.89
306.73	33.95	317.63	34.09	335.26	34.28
348.8	34.44	352.03	34.47	355.49	34.52
369.77	34.75				

Downstream Bridge Cross Section Data

Station Elevation Data num= 100

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-7	40.81	.23	40.8	.48	40.79	.61	40.82	5.14	41.03
6.87	41.42	21.49	39.82	26.29	39.36	27.04	39.31	28.36	39.27
40.46	38.01	44.32	37.54	45.77	37.44	46.96	37.4	53.89	37.32
62.79	36.17	70.7	35.64	82.96	34.99	84.26	34.76	84.88	34.63
96.01	32.36	100.73	29.99	107.06	27.22	115.49	26.2	117.56	25.98
118.98	24.92	120.66	24.21	122.2	23.09	125.17	22.65	130.83	21.8
130.86	21.8	130.89	21.79	130.91	21.8	138.75	23.04	142.87	23.69
145.12	27.24	145.69	28.69	146.08	28.59	146.66	28.7	146.87	28.69
152.7	28.37	156.55	29.07	163.07	29.43	167.05	29.33	174.58	29.67
178.57	29.68	181.18	29.68	200.29	30.58	201.82	30.56	202.09	30.58
204.19	30.7	206.43	31.07	216.36	32.47	218.78	32.29	225.63	32.35
232.41	32.46	235.17	32.7	238.58	32.93	248.05	33.39	248.16	33.4
262.71	33.09	263.05	33.08	263.2	33.08	268.3	32.81	268.34	32.86
270.26	32.84	285.18	33.21	286.32	33.24	286.48	33.24	293.81	33.65
302.99	33.96	303.41	33.95	313.31	33.46	317.84	33.33	317.87	33.33
326.98	33.46	335.72	33.42	338.02	33.36	343.23	33.76	344.66	33.86
345.47	33.88	354.78	34.23	362.92	34.56	363.55	34.57	364.51	34.53
370.05	34.33	383.82	34.23	388.49	34.27	389.58	34.2	393.19	34.22
393.75	34.32	415.3	34.58	420.68	34.61	432.13	34.84	457.52	35.4
459.97	35.53	461.7	36.34	479.35	36.97	479.43	37.93	502.74	38.41

Manning's n Values

num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-7	.12	120.66	.04	142.87	.12

Bank Sta:	Left	Right	Coeff	Contr.	Expan.
	107.06	152.7		.3	.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-7	122.78	31.5	F
141.81	502.74	30.5	F

Upstream Embankment side slope	=	horiz. to 1.0 vertical
Downstream Embankment side slope	=	horiz. to 1.0 vertical
Maximum allowable submergence for weir flow	=	.98
Elevation at which weir flow begins	=	
Energy head used in spillway design	=	
Spillway height used in design	=	
Weir crest shape	=	Broad Crested

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data

Energy
 Selected Low Flow Methods = Energy

High Flow Method

Pressure and Weir flow
 Submerged Inlet Cd =
 Submerged Inlet + Outlet Cd = .8
 Max Low Cord =

Additional Bridge Parameters

Add Friction component to Momentum
 Do not add Weight component to Momentum
 Class B flow critical depth computations use critical depth
 inside the bridge at the upstream end
 Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: FEMA-LR

REACH: LR-BL

RS: 23432

INPUT

Description:

Station Elevation Data			num= 100		
Sta	Elev	Sta	Elev	Sta	Elev
0	40.81	.22998	40.8	.47998	40.79
6.869995	41.4221	.48999	39.8226	.28998	39.3627
40.45999	38.0144	.31998	37.5445	.76999	37.4446
62.78998	36.1770	.69998	35.6482	.95999	34.9984
96.00998	32.36	100.73	29.99	107.06	27.22
118.98	24.92	120.66	24.21	122.2	23.09
130.86	21.8	130.89	21.79	130.91	21.8
145.12	27.24	145.69	28.69	146.08	28.59
152.7	28.37	156.55	29.07	163.07	29.43
178.57	29.68	181.18	29.68	200.29	30.58
204.19	30.7	206.43	31.07	216.36	32.47
232.41	32.46	235.17	32.7	238.58	32.93
262.71	33.09	263.05	33.08	263.2	33.08
270.26	32.84	285.18	33.21	286.32	33.24
302.99	33.96	303.41	33.95	313.31	33.46
326.98	33.46	335.72	33.42	338.02	33.36
345.47	33.88	354.78	34.23	362.92	34.56
370.05	34.33	383.82	34.23	388.49	34.27
393.75	34.32	415.3	34.58	420.68	34.61
459.97	35.53	461.7	36.34	479.35	36.97

Manning's n Values

num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.125	120.66	.06	142.87	.125

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
120.66	142.87	161.37	131.63	53.58	.3	.5
Ineffective Flow	num=	2				
Sta L	Sta R	Elev	Permanent			
0	122.78	31.5	F			
141.81	502.74	30.5	F			

CROSS SECTION

RIVER: FEMA-LR

REACH: LR-BL

RS: 23332

INPUT

Description: Approx Section D/S of LR9-5
(XS-5)

HEC-2 STA 23332

Station Elevation Data				num=	494				
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1555	40	1561.28	39.89	1561.28	51.54	1562.31	51.54	1562.5	51.63
1563.39	51.56	1564.18	51.53	1565.53	51.59	1566.02	51.58	1567.81	51.67
1570.85	51.85	1573.13	52	1574.59	52.15	1576.94	52.4	1577.43	52.44
1579.49	52.66	1580.44	52.74	1582.71	52.86	1584.71	52.99	1585.63	53.01
1589.52	53.46	1591.5	53.67	1594.42	54	1618.02	54	1618.65	53.9
1619.73	53.7	1619.94	53.68	1621.28	53.45	1623.58	53.04	1624.97	53.01
1626.37	53	1627.08	52.92	1628.4	52.67	1629.37	52.5	1631.87	52
1634.43	51.48	1636.41	51	1636.52	51	1640.56	50.54	1642.28	50.35
1643.43	50.25	1644.02	50.22	1644.61	50.15	1646.16	50.02	1646.7	49.99
1648.01	49.99	1648.97	49.98	1649.93	49.99	1652.96	49.99	1654.21	49.93
1655.53	49.77	1656.61	49.66	1658.49	49.45	1659.68	49.31	1661.99	49
1664.68	48.55	1669.03	48.06	1670.64	47.89	1671.94	47.77	1673.68	47.63
1674.33	47.54	1675.25	47.44	1677.58	47.15	1678.94	47	1680.06	46.86
1680.41	46.83	1682.69	46.54	1683.36	46.47	1684.69	46.31	1685.7	46.2
1687.06	46	1687.44	45.93	1688.71	45.75	1691.39	45.39	1692.78	45.21
1694.17	45	1697.19	44.56	1698.34	44.41	1699.17	44.32	1699.89	44.21
1701.44	44	1701.68	43.98	1706.54	43.53	1709.29	43.16	1710.46	43.03
1712.56	42.84	1713.16	42.78	1714.04	42.71	1717.31	42.42	1717.85	42.39
1718.83	42.31	1719.64	42.23	1721.36	42.12	1722.92	42	1760.46	42
1761.7	42.05	1776.59	42.59	1779.09	42.67	1782.44	42.79	1787.84	42.95
1788.36	42.94	1789.06	43	1812.57	43	1814.47	42.7	1818.74	42
1821.07	41.49	1823.48	41	1827.47	40	1827.82	39.97	1829.74	39.59
1830.74	39.4	1832.94	39	1834.31	38.66	1835.94	38.32	1837.31	38
1841.3	37	1843.17	36.67	1846.6	36	1849.07	35.54	1851.16	35.25
1852.76	35	1854.41	34.81	1854.85	34.75	1856.08	34.61	1857.32	34.45
1859.4	34.21	1861.03	34.01	1861.25	34	1863.54	33.69	1867.49	33.15
1868.62	33	1871.53	32.6	1872.51	32.47	1875.61	32	1876.18	31.87
1877.8	31.47	1878.98	31.22	1879.93	31	1882.73	30	1883.72	29.58
1885.35	29	1887.05	28.51	1888.19	28.2	1888.87	28	1890	27.81
1890.44	27.75	1891.43	27.58	1895.19	27.04	1896.64	27	1898.88	27
1899.02	26.7	1899.45	26.57	1900.55	25.75	1909.72	23.15	1911.99	22.45
1913.9	22.37	1931.55	21.59	1938.75	22.11	1942.36	22.42	1944.61	23.3

1945.82	23.5	1946.7	23.74	1948.12	24.15	1950.26	24.24	1952.15	25.59
1954.23	25.82	1954.41	25.76	1955.21	25.78	1955.65	25.85	1956.01	25.94
1956.73	25.97	1957.01	26	1960.2	26	1962.52	26.43	1963.85	26.6
1964.47	26.76	1965.27	26.92	1965.92	27	1975	27	1980.55	27
1980.99	26.99	1985	26.97	1986.61	26.96	1991.78	26.99	1992.72	27
1993.83	27	1994.84	27.01	1997.98	27.17	1998.65	27.2	2000	27.24
2003.45	27.34	2006.59	27.42	2007.3	27.43	2008.45	27.43	2015	27.54
2019.66	27.61	2025	27.72	2038.16	27.99	2038.53	28	2044.49	28
2045.01	28.01	2047.55	28.01	2048.73	28.02	2054.73	28.45	2058.93	28.81
2060.94	28.99	2061.73	29	2062.54	29.43	2064.07	30.47	2065.25	31
2066.14	31.37	2067.26	31.97	2067.81	31.98	2068.45	31.88	2069.4	31.95
2069.93	32.01	2071.43	32.02	2072.02	32.01	2072.64	32.02	2073.25	32.01
2073.72	32.02	2074.91	32.15	2075.46	32.18	2076.78	32.32	2077.78	32.4
2079.09	32.49	2080.52	32.62	2081.4	32.69	2082.49	32.76	2083.76	32.8
2086.04	32.88	2086.76	33	2137.38	33	2140.34	32.94	2143.06	32.92
2151.2	33.2	2160.08	33.48	2168.92	33.74	2179.01	34.16	2182.82	34.03
2197.4	33.94	2206.48	34.03	2227.14	34.21	2235.07	34.32	2242.22	34.46
2268.46	35	2269.36	35	2271.04	35.11	2273.5	35.26	2275.42	35.26
2275.69	35.28	2276.94	35.3	2278.34	35.38	2279.1	35.41	2282.23	35.6
2285.44	35.74	2286.46	35.77	2286.89	35.77	2288.19	35.8	2288.65	35.82
2289.49	35.83	2290.84	35.87	2293.25	35.95	2294.77	35.97	2296.31	36
2299.27	36	2300.91	36.15	2301.78	36.25	2302.26	36.29	2302.8	36.37
2304.21	36.53	2304.6	36.59	2305.79	36.7	2307.26	36.73	2307.6	36.78
2308.35	36.79	2308.63	36.82	2309.51	36.82	2311.1	36.8	2313.27	36.83
2314.72	36.86	2315.81	36.93	2318.65	37	2319.14	37	2319.45	37.03
2319.92	37.03	2321.65	37.1	2323.65	37.16	2325.46	37.18	2326.03	37.26
2328.81	37.46	2329.67	37.5	2330.3	37.57	2331.89	37.56	2333.64	37.62
2334.3	37.68	2334.74	37.69	2335.79	37.75	2336.22	37.76	2337.32	37.85
2337.94	37.85	2339.7	37.91	2342.04	38	2342.37	38.08	2345.24	38.7
2345.67	38.77	2346.22	38.89	2346.79	38.93	2347.33	39	2351.24	39
2351.87	38.9	2351.98	38.92	2352.81	38.79	2353.07	38.82	2355.96	38.74
2358.53	38.72	2359.3	38.78	2359.84	38.79	2360.15	38.83	2363.3	38.92
2365.69	39	2366.66	39	2367.32	39.16	2367.89	39.26	2368.31	39.31
2368.47	39.29	2369.14	39.32	2370	39.39	2370.97	39.51	2371.73	39.64
2372.02	39.62	2373.04	39.66	2373.36	39.72	2374.27	39.8	2374.79	39.79
2376.91	39.82	2379.26	39.87	2379.79	39.9	2380.3	39.95	2383.72	39.97
2384.5	39.98	2384.88	39.97	2386.5	39.97	2388.8	39.99	2389.12	40
2408.09	40	2410.69	40.26	2411.01	40.26	2411.43	40.34	2412.25	40.42
2413	40.51	2413.89	40.58	2414.49	40.71	2415.01	40.78	2416.2	41
2416.83	41	2418.25	41.02	2419.31	41.02	2421.75	41.05	2422.49	41.05
2423.92	41.07	2424.93	41.07	2426.37	41.1	2426.79	41.1	2428.32	41.13
2430.08	41.48	2432.14	41.84	2433.86	42	2435.72	42.31	2436.35	42.4
2437.28	42.43	2437.95	42.7	2438.09	42.71	2438.43	42.83	2438.69	42.87
2439.16	43	2439.92	43	2440.91	42.76	2441.48	42.73	2441.92	42.6
2442.12	42.6	2444.64	42.03	2445.71	42.04	2449.35	42.51	2450.6	42.63
2452.57	42.78	2453.54	42.81	2454.86	42.88	2456.65	42.88	2458.56	42.89
2460.08	42.98	2464.48	42.98	2465.29	42.97	2466.37	42.98	2467.95	42.97
2469.82	42.99	2470.83	42.99	2470.99	43	2472.24	43	2473.07	43.07
2474.13	43.13	2475.01	43.11	2475.76	43.2	2476.53	43.27	2476.82	43.28
2477.28	43.37	2477.49	43.36	2477.75	43.42	2478.99	43.38	2480.03	43.38
2480.84	43.47	2482.47	43.54	2485.34	43.69	2486.29	43.75	2489.81	43.99

2490.71	44	2496.06	44	2496.52	44.07	2498.14	44.18	2499.21	44.23
2499.77	44.27	2500.26	44.34	2501.75	44.5	2502.34	44.53	2502.78	44.57
2504.25	44.62	2504.5	44.68	2505.68	44.67	2506.66	44.68	2506.9	44.72
2507.82	44.74	2510.53	45	2518.26	45	2518.5	45.04	2520.45	45.21
2521.92	45.28	2522.82	45.26	2523.37	45.2	2523.84	45.2	2524.41	45.26
2525.11	45.37	2525.88	45.38	2526.11	45.42	2526.55	45.42	2526.95	45.5
2527.92	45.49	2528.05	45.51	2529.11	45.51	2529.76	45.54	2530.11	45.59
2530.85	45.59	2535.99	45.98	2538.5	45.98	2539.13	45.99	2544.22	45.99
2545.3	46	2546.95	46	2548.35	46.01	2549.54	46.18	2550.99	46.32
2551.66	46.33	2561.49	46.99	2567.19	46.99	2568.2	47	2571.89	47
2581.45	47.52	2590.66	48	2593.71	48	2594.29	48.1	2595.98	48.18
2597.29	48.29	2598.79	48.29	2600.46	48.34	2601.73	48.41	2602.65	48.47
2603.65	48.55	2610.67	48.99	2610.97	49	2623.74	49	2625.04	49.13
2625.64	49.21	2626.08	49.21	2626.5	49.27	2635.57	49.93	2636.47	49.98
2639.11	49.97	2643.6	49.74	2649.77	49.46	2651.84	49.51	2652.37	49.5
2654.04	49.55	2656.2	49.64	2658.2	49.77	2660.85	49.99		

Manning's n Values		num=	3
Sta	n Val	Sta	n Val
1555	.125	1900.55	.042
1900.55		1952.15	.125

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	1900.55	1952.15		320	320	320		.1	.3

CROSS SECTION

RIVER: FEMA-LR

REACH: LR-BL

RS: 23012

INPUT

Description: Approximated Section (XS-6)

HEC-2 STA 23012

Station Elevation Data		num=	492						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1489.07	50	1497.7	49.5	1497.7	45.06	1500.82	45.06	1501.29	45.05
1501.85	45.06	1503.34	45.04	1509.46	45.04	1509.6	45.03	1513.03	45.03
1514.67	45.02	1515.83	45.02	1521.27	45.01	1550.19	45.01	1550.99	45
1558.88	45	1560.96	44.81	1569.59	44	1570.14	44	1576.17	43.43
1580.68	43	1583.26	42.78	1592.36	42	1594.25	41.57	1595.72	41.26
1595.73	41.25	1596.78	41	1598.36	40.61	1600.81	40	1602.89	39.68
1603.27	39.63	1607.5	39	1609.5	38.69	1613.67	38.01	1613.86	38
1616.18	37.73	1617.76	37.53	1619.33	37.34	1621.98	37	1623.26	36.83
1624.8	36.67	1630.77	36.01	1631	36	1632.42	35.83	1634.44	35.63
1640.44	35	1641.19	35	1644.37	34.85	1644.51	34.84	1646.26	34.76
1649.8	34.61	1663.87	34.01	1664.4	34	1672.87	34	1673.28	33.99
1684.36	33.1	1685.71	33	1689.56	32.77	1694.81	32.48	1696.73	32.32
1697.24	32.29	1698.3	32.2	1700.41	32	1705.09	31.19	1706.14	31
1706.4	30.97	1708.83	30.75	1710.39	30.59	1711.36	30.51	1712.34	30.42
1713.79	30.28	1714.25	30.24	1716.5	30	1719.01	29.98	1719.42	29.97
1721.42	29.97	1721.92	29.98	1722.65	29.98	1725.45	30	1725.86	30.07

1727.03	30.23	1728.09	30.32	1728.27	30.32	1729.54	30.49	1730.96	30.73
1731.36	30.78	1732.18	30.93	1732.52	31	1732.98	31	1733.36	31.02
1734.75	31.07	1735	31.07	1736.41	31.12	1737.42	31.16	1738.68	31.2
1739.01	31.2	1739.63	31.22	1742.59	31.14	1746.34	31	1747.39	31
1747.83	30.99	1749.91	30.99	1750.82	31	1752.02	31	1754.37	31.12
1755.52	31.2	1756.15	31.2	1757.67	31.29	1759.27	31.33	1759.64	31.31
1760.32	31.31	1761.32	31.37	1762.54	31.4	1763.26	31.4	1766.1	31.29
1767.48	31.23	1769.06	31.18	1770.36	31.08	1771.34	31.04	1772.73	31.07
1773.36	31.06	1774.66	31.06	1775.53	31.03	1776.66	31	1777.8	30.98
1779.43	30.99	1779.98	30.98	1781.07	30.98	1782.62	31.02	1785.59	31.12
1786.63	31.12	1787.58	31.11	1788.58	31.08	1788.97	31.1	1790.13	31.11
1790.88	31.14	1791.37	31.17	1792.14	31.2	1792.8	31.24	1793.87	31.26
1794.91	31.26	1795.32	31.29	1797.57	31.29	1798.01	31.31	1799.2	31.28
1799.9	31.29	1800.35	31.32	1801.8	31.33	1802.31	31.35	1803.08	31.35
1803.95	31.34	1804.5	31.32	1805.24	31.32	1806.02	31.28	1806.39	31.27
1806.73	31.29	1807.76	31.28	1808.89	31.22	1809.61	31.14	1810.72	31.03
1812.12	30.86	1812.41	30.84	1812.88	30.78	1814.19	30.66	1814.45	30.61
1814.77	30.58	1815.48	30.44	1816.09	30.35	1817.36	30	1819.24	29.17
1819.61	29	1820.87	28.28	1821.47	28	1823.97	27.25	1824.96	27
1827.74	27	1828.75	29.18	1829.49	28.34	1831.17	26.41	1831.27	26.31
1836.39	22.63	1839.93	21.69	1845.53	20.71	1849.24	20.83	1850.62	20.88
1853.9	21.23	1856.19	22.76	1860.97	26.13	1861.49	26.14	1862.46	26.14
1862.6	26.01	1863.96	26	1865.34	26	1866.67	25.95	1866.87	25.95
1867.79	25.81	1870.1	25.56	1870.16	25.56	1872.66	25.66	1876.51	25.87
1877.15	25.96	1877.5	26	1884.02	26	1885.13	26.01	1885.2	26
1891.53	26	1893.42	25.99	1893.87	26	1896.72	26	1899.76	26.29
1901.34	26.45	1906.67	27	1908.47	27.11	1909.89	27.19	1909.99	27.19
1912.64	27.35	1914.46	27.45	1920.77	27.99	1924.81	27.99	1932.56	27.67
1934.2	27.62	1936.48	27.54	1937.26	27.52	1937.62	27.5	1940.69	27.39
1943.88	27.27	1948.78	27.06	1950.37	27	1950.75	26.99	1951.53	26.99
1952.29	26.91	1954.93	26.67	1955.19	26.67	1956.14	26.64	1957.2	26.57
1957.79	26.55	1958.39	26.54	1959.19	26.48	1959.86	26.48	1961.27	26.46
1961.53	26.44	1972.57	26	1978.5	26	1980.26	25.87	1980.33	25.87
1982	25.75	1985	25.54	1986.15	25.46	1991.13	25.09	1992.36	25
2005.49	25	2006.24	25.09	2007.69	25.28	2013.29	25.99	2013.67	26
2015	26.45	2015.65	26.67	2016.75	27	2016.99	27.09	2018	27.42
2018.28	27.52	2019.35	28	2022.06	28.77	2022.86	29	2023.96	29.4
2025.68	30	2034.76	30	2035.29	30.02	2065.13	30.97	2065.59	30.99
2066.19	31	2092.74	31	2096.29	31.17	2098.17	31.24	2098.97	31.29
2100.77	31.38	2104.45	31.58	2105.77	31.66	2107.47	31.75	2111.33	31.99
2111.56	32	2152.77	32	2157.58	32.48	2159.98	32.71	2161.59	32.85
2162.24	32.92	2162.85	32.92	2163.49	32.91	2164.24	32.88	2165.3	32.79
2166.05	32.72	2168.32	32.57	2175.37	32.01	2175.46	32	2184.62	32
2186.32	32.03	2188.77	32.09	2197.24	32.36	2203.63	32.31	2203.8	32.32
2208.7	32.33	2213.81	32.33	2214.24	32.34	2218.34	32.42	2225.38	32.58
2225.64	32.59	2228.01	32.63	2229.93	32.67	2230.63	32.68	2231.34	32.68
2236.3	32.79	2243.3	32.96	2244.6	33	2247.9	33	2249.05	32.99
2250.04	32.99	2250.21	33	2264.87	33	2265.27	33.02	2266.99	33.04
2268.46	33.07	2270.32	33.18	2270.99	33.23	2271.55	33.25	2273	33.32
2275.62	33.44	2277.42	33.55	2284.38	33.99	2285.48	33.99	2285.88	34
2286.14	33.99	2287.19	34	2288.01	34.07	2288.71	34.14	2297.07	35

2297.58	35	2299.33	35.15	2300.77	35.28	2303.82	35.55	2305.25	35.67
2308.3	35.99	2308.84	36	2309.74	36.17	2314.02	37	2314.45	37.22
2314.7	37.32	2316.16	38	2316.41	38.02	2318.68	38.62	2320.31	39
2321.54	39.56	2322.21	39.79	2322.43	40	2325.71	40	2327.56	39.84
2327.75	39.85	2328.6	39.72	2331.08	39.64	2333.14	39.6	2334.12	39.67
2335.37	39.78	2338.21	40	2339.1	40	2342.07	40.19	2344.37	40.31
2344.86	40.34	2348.02	40.56	2349.65	40.66	2350.23	40.7	2353.11	40.91
2354.1	40.99	2355.06	41.01	2356.21	41.04	2356.51	41.04	2364.38	41.52
2364.67	41.54	2369.48	41.9	2370.64	41.99	2371.59	42	2373.01	42.07
2378.55	42.32	2378.61	42.33	2392.97	42.99	2393.83	42.99	2394.09	43
2396.39	43	2398.73	43.14	2401.02	43.27	2401.77	43.32	2403.7	43.46
2405.92	43.6	2406.55	43.65	2407.11	43.68	2408.33	43.76	2408.55	43.78
2409.55	43.83	2411.07	43.92	2412.06	43.97	2412.5	44	2413.39	44.02
2414.24	44.06	2416.57	44.16	2421.72	44.37	2425.49	44.53	2429.41	44.72
2430.95	44.79	2433.33	44.93	2434.88	45	2441.01	45	2446.03	45.35
2449.31	45.53	2456.6	45.99	2457.75	45.99	2458.03	46	2458.76	46
2464.77	46.57	2466.99	46.77	2468.31	46.84	2469.44	46.91	2470.17	46.95
2470.69	46.96	2472.63	46.98	2473.72	47	2474.2	47.03	2475.34	47.06
2475.41	47.07	2476.43	47.12	2477.92	47.22	2478.17	47.22	2478.87	47.25
2479.37	47.3	2479.6	47.3	2480.57	47.37	2481.19	47.37	2481.82	47.43
2482.41	47.46	2483.55	47.45	2483.99	47.48	2484.57	47.49	2485.2	47.53
2485.76	47.55	2486.73	47.56	2487.79	47.6	2488.59	47.64	2489.52	47.7
2490.17	47.75	2491.2	47.82	2492.94	47.92	2494.01	48	2495.32	48.33
2496.4	48.62	2496.72	48.68	2498.12	49	2499.2	49.42	2499.92	49.54
2500.16	49.59	2500.75	49.63	2501.52	49.84	2502.36	50	2503.13	50.2
2504.08	50.5	2504.56	50.64	2505.01	50.81	2505.41	51	2506.28	51.24
2507.05	51.38	2508	51.68	2508.5	51.83	2509.73	52.31	2510.05	52.4
2512.36	52.83	2512.96	53	2513.14	53.03	2513.47	53.05	2513.67	53.01
2514.95	53.02	2515.6	53.04	2516.85	53.05	2518.6	53.73	2519.04	53.88
2519.23	53.87	2519.59	53.91	2520.41	53.92	2521.68	53.73	2522.42	53.63
2522.5	53.64	2523.4	53.49	2523.67	53.49	2524.05	53.46	2524.33	53.41
2525.06	53.32	2525.54	53.27						

Manning's n Values			num= 3		
Sta	n Val	Sta	n Val	Sta	n Val
1489.07	.125	1831.17	.042	1861.49	.125

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	1831.17	1861.49		1800	1800	1800		.1	.3

CROSS SECTION

RIVER: FEMA-LR

REACH: LR-BL

RS: 21212

INPUT

Description: (M) Surveyed Section LR8

HEC-2 STA 21212

Station Elevation Data			num= 10						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

320	50	1710	25	1835	25	1970	30	1981	22.4
2000	21.7	2020	22.8	2030	30	2080	35	2095	40

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
320	.112	1981	.042	2020	.112

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1981	2020		800	800		.1	.3

SUMMARY OF MANNING'S N VALUES

River:FEMA-LR

Reach	River Sta.	n1	n2	n3
LR-BL	28266	.08	.04	.08
LR-BL	27691*	.08	.04	.08
LR-BL	27116	.08	.04	.08
LR-BL	26541*	.08	.04	.08
LR-BL	25966	.08	.04	.08
LR-BL	25316*	.08	.04	.08
LR-BL	24666	.08	.04	.08
LR-BL	24342	.12	.042	.12
LR-BL	23760	.125	.042	.125
LR-BL	23566	.125	.042	.125
LR-BL	23466	.12	.042	.12
LR-BL	23449	Bridge		
LR-BL	23432	.125	.06	.125
LR-BL	23332	.125	.042	.125
LR-BL	23012	.125	.042	.125
LR-BL	21212	.112	.042	.112

SUMMARY OF REACH LENGTHS

River: FEMA-LR

Reach	River Sta.	Left	Channel	Right
LR-BL	28266	575.12	575.12	575.12
LR-BL	27691*	575.13	575.13	575.13
LR-BL	27116	575	575	575
LR-BL	26541*	575	575	575
LR-BL	25966	650	650	650
LR-BL	25316*	650	650	650
LR-BL	24666	327.3	327.3	327.3

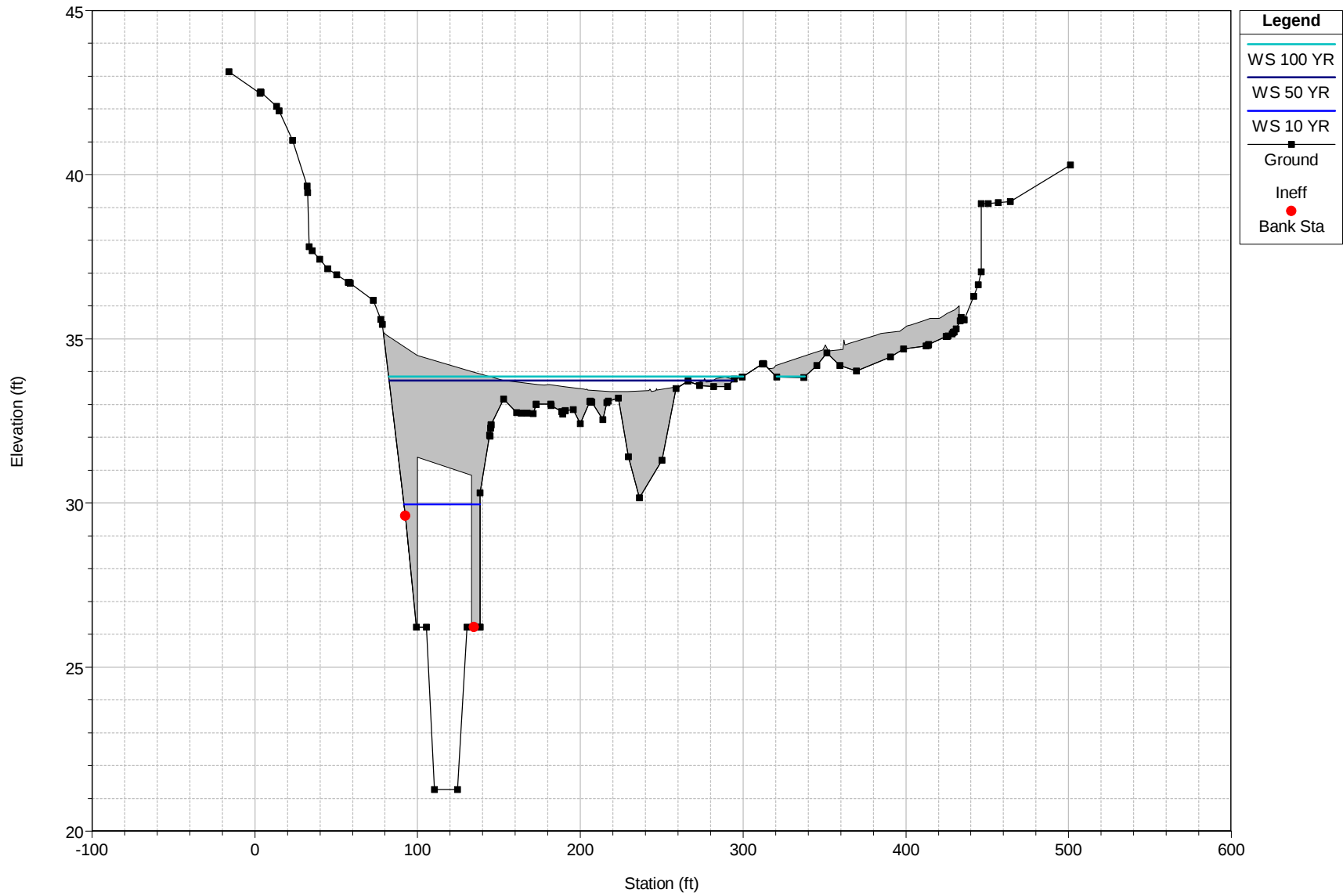
LR-BL	24342	582.42	582.42	582.42
LR-BL	23760	171.8	195.55	249.91
LR-BL	23566	74.4	68.75	45.59
LR-BL	23466	52.58	52.58	52.58
LR-BL	23449	Bridge		
LR-BL	23432	161.37	131.63	53.58
LR-BL	23332	320	320	320
LR-BL	23012	1800	1800	1800
LR-BL	21212	800	800	800

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS

River: FEMA-LR

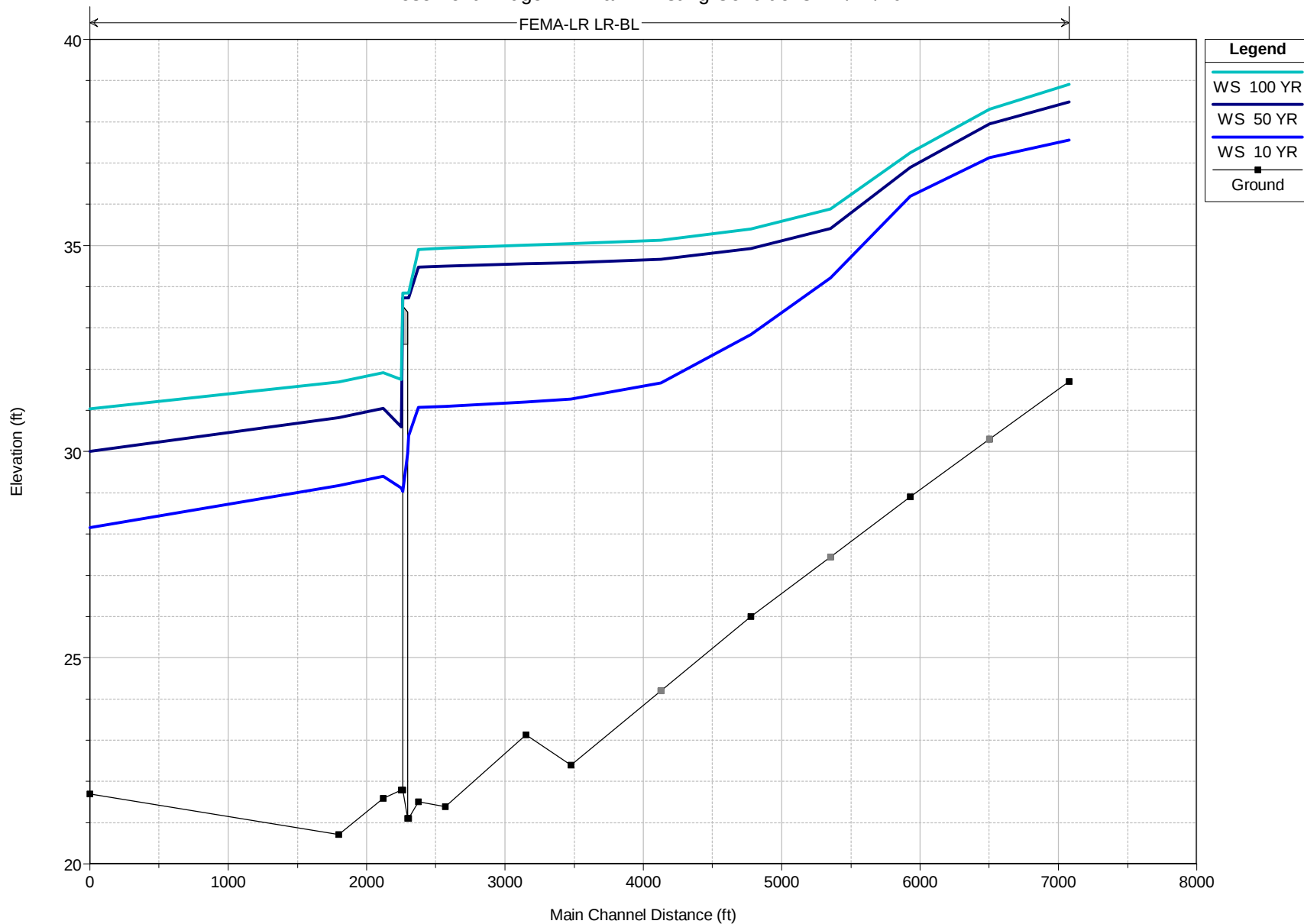
Reach	River Sta.	Contr.	Expan.
LR-BL	28266	.1	.3
LR-BL	27691*	.1	.3
LR-BL	27116	.1	.3
LR-BL	26541*	.1	.3
LR-BL	25966	.1	.3
LR-BL	25316*	.1	.3
LR-BL	24666	.1	.3
LR-BL	24342	.1	.3
LR-BL	23760	.1	.3
LR-BL	23566	.3	.5
LR-BL	23466	.3	.5
LR-BL	23449	Bridge	
LR-BL	23432	.3	.5
LR-BL	23332	.1	.3
LR-BL	23012	.1	.3
LR-BL	21212	.1	.3

Rosemont Bridge Plan: 1) Existing Conditions 4/24/2024
Rosemont Street Bridge



Rosemont Bridge Plan: Existing Conditions 4/24/2024

FEMA-LR LR-BL



1D Modeling Results

PROPOSED CONDITIONS

HEC-RAS HEC-RAS 6.4.1 June 2023
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

```

X      X  XXXXXX   XXXX       XXXX       XX       XXXX
X      X  X        X      X       X  X       X  X       X
X      X  X        X              X  X       X  X       X
XXXXXXXX XXXX      X          XXX XXXX      XXXXXX      XXXX
X      X  X        X              X  X       X  X       X
X      X  X        X      X       X  X       X  X       X
X      X  XXXXXX   XXXX       X      X       X  X       XXXXX

```

PROJECT DATA

Project Title: Rosemont Bridge
Project File : RosemontBridge-03.prj
Run Date and Time: 4/24/2024 1:00:33 PM

Project in English units

Project Description:

CRS Info=<SpatialReference> <CoordinateSystem Code="2249"
Unit="US_survey_Foot" AcadCode="" /> <Registration OffsetX="0" OffsetY="0"
OffsetZ="0" ScaleX="1" ScaleY="1" ScaleZ="1" /></SpatialReference>

PLAN DATA

Plan Title: Proposed Conditions

Plan File : \\beta-inc.com\ma\Projects\6100s\6155 - Haverill - Rosemont St
Bridge\Engineering\Modeling\HECRAS\1D\RosemontBridge-03.p02

Geometry Title: Proposed Conditions

Geometry File : \\beta-inc.com\ma\Projects\6100s\6155 - Haverill -
Rosemont St Bridge\Engineering\Modeling\HECRAS\1D\RosemontBridge-03.g02

Flow Title : DE-HEC-2

Flow File : \\beta-inc.com\ma\Projects\6100s\6155 - Haverill -
Rosemont St Bridge\Engineering\Modeling\HECRAS\1D\RosemontBridge-03.f02

Plan Description:

Proposed Conditions

Plan Summary Information:

```

Number of:  Cross Sections = 15    Multiple Openings = 0
            Culverts       = 0     Inline Structures  = 0
            Bridges        = 1     Lateral Structures = 0
    
```

Computational Information

```

Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01
Maximum number of iterations        = 20
Maximum difference tolerance        = 0.3
Flow tolerance factor                = 0.001
    
```

Computation Options

```

Critical depth computed only where necessary
Conveyance Calculation Method: At breaks in n values only
Friction Slope Method:         Average Conveyance
Computational Flow Regime:     Subcritical Flow
    
```

FLOW DATA

Flow Title: DE-HEC-2

Flow File : \\beta-inc.com\ma\Projects\6100s\6155 - Haverill - Rosemont St
 Bridge\Engineering\Modeling\HECRAS\1D\RosemontBridge-03.f02

Flow Data (cfs)

River	Reach	RS	10 YR	50 YR
100 YR	500 YR			
FEMA-LR	LR-BL	28266	660	1065
1275	1865			
FEMA-LR	LR-BL	24666	980	1640
1990	3030			
Little River	BLPLR-BLP_FIRM	24666	980	1640
1990	3030			

Boundary Conditions

River	Reach	Profile	Upstream
Downstream			
FEMA-LR	LR-BL	10 YR	
Known WS = 28.16			

FEMA-LR	LR-BL	50 YR
Known WS = 30.01		
FEMA-LR	LR-BL	100 YR
Known WS = 31.04		
FEMA-LR	LR-BL	500 YR
Known WS = 33.38		

Observed Water Surface Marks

River	Reach	RS	10 YR	50 YR
100 YR	500 YR			
Little River	BLPLR-BLP_FIRM	23465		31.61

GEOMETRY DATA

Geometry Title: Proposed Conditions
 Geometry File : \\beta-inc.com\ma\Projects\6100s\6155 - Haverill - Rosemont St Bridge\Engineering\Modeling\HECRAS\1D\RosemontBridge-03.g02

CROSS SECTION

RIVER: FEMA-LR
 REACH: LR-BL RS: 28266

INPUT

Description: (P) Surveyed Section at Dam LR10
 HEC-2 STA 28266

Station Elevation Data				num=	15				
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1862.5	45.8	1882.5	42.4	1899.5	35.5	1932.5	34.1	1947.5	33.2
1967.5	33.5	1973.5	34.1	1985.5	34.7	2000	31.7	2013.5	33.3
2016.5	33.8	2035.5	33.4	2051.5	41.5	2062.5	42	2180	50

Manning's n Values		num=	3
Sta	n Val	Sta	n Val
1862.5	.08	1985.5	.04
		2013.5	.08

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
1985.5	2013.5	575.12	575.12	575.12		.1	.3

CROSS SECTION

RIVER: FEMA-LR
REACH: LR-BL

RS: 27691*

INPUT

Description:

Station Elevation Data num= 19

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1814.44	47.9	1836.54	43.7	1855.32	38.12	1880.63	34.76	1891.79	34.54
1908.37	34.08	1930.47	34.21	1937.11	34.51	1950.37	34.8	1962.88	30.3
1974.9	34.1	1978.22	34.35	1987.25	34.27	1999.25	34.16	2012.25	37.14
2016.96	38.22	2029.13	38.48	2062.18	39.52	2159.17	50		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1814.44	.08	1950.37	.04	1974.9	.08

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	1950.37	1974.9		575.13	575.13	575.13		.1	.3

CROSS SECTION

RIVER: FEMA-LR
REACH: LR-BL

RS: 27116

INPUT

Description: Scaled Section
HEC-2 STA 27116

Station Elevation Data num= 7

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1835	50	1910	35	1989	34.9	2000	28.9	2011	34.9
2110	35	2220	50						

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1835	.08	1989	.04	2011	.08

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	1989	2011		575	575	575		.1	.3

CROSS SECTION

RIVER: FEMA-LR
REACH: LR-BL

RS: 26541*

INPUT

Description:

Station Elevation Data num= 13

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1849.73	50	1898.45	38.12	1949.75	33.45	1961.02	27.45	1972.3	33.45
1988.5	33.28	2011.5	33.04	2066.45	32.48	2108.44	35	2115.69	37.5
2122.55	37.76	2180.86	42.62	2289.49	50				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1849.73	.08	1949.75	.04	1972.3	.08

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1949.75	1972.3		575	575		.1	.3

CROSS SECTION

RIVER: FEMA-LR
 REACH: LR-BL RS: 25966

INPUT
 Description: Scaled Section
 HEC-2 STA 25966

Station Elevation Data				num=	9				
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1938	50	1988	32	2000	26	2012	32	2142	30
2200	35	2210	40	2300	45	2450	50		

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
1938	.08	1988	.04	2012	.08

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1988	2012		650	650		.1	.3

CROSS SECTION

RIVER: FEMA-LR
 REACH: LR-BL RS: 25316*

INPUT
 Description:

Station Elevation Data				num=	16				
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1639.12	50	1660.11	46.72	1696.85	42.85	1723.09	39.37	1759.82	35.5
1880.52	30.2	1893.3	24.2	1906.08	30.2	1986.5	29.52	1992.9	29.47
2013.5	30.86	2031.63	32.09	2038.31	34.61	2098.42	37.29	2166.1	39.19
2198.59	45								

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-----	-------	-----	-------	-----	-------

1639.12 .08 1880.52 .04 1906.08 .08

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1880.52	1906.08		650	650		.1	.3

CROSS SECTION

RIVER: FEMA-LR

REACH: LR-BL RS: 24666

INPUT

Description: Scaled Section

HEC-2 STA 24666

Station Elevation Data				num=	10				
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1525	50	1565	45	1635	40	1685	35	1755	30
1985	28.4	2000	22.4	2015	28.4	2175	30	2195	40

Manning's n Values				num=	3				
Sta	n Val	Sta	n Val	Sta	n Val				
1525	.08	1985	.04	2015	.08				

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	1985	2015		327.3	327.3		.1	.3

CROSS SECTION

RIVER: FEMA-LR

REACH: LR-BL RS: 24342

INPUT

Description:

Station Elevation Data				num=	492				
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	51	9.34	51	10.63	51.08	10.8	51.1	11.84	51.25
12.58	51.33	13.69	51.5	14.27	51.53	14.94	51.58	16.44	51.72
18.97	51.98	19.14	52	22.8	52.45	23.6	52.57	27.15	53.04
27.25	53.05	28.36	53.2	29.18	53.3	30.37	53.43	30.85	53.49
31.33	53.53	32.11	53.61	33.19	53.73	33.85	53.8	34.59	53.86
35.9	53.95	35.97	53.96	36.38	53.98	36.4	53.99	38.4	54.12
38.73	54.14	39.3	54.2	40.34	54.29	41.71	54.4	41.74	54.4
42.42	54.48	43.66	54.58	44.64	54.7	45.66	54.79	46.91	54.91
46.96	54.91	47.68	54.98	47.69	54.99	47.91	55	50.27	55
50.59	54.95	51.36	54.92	57.04	54.64	68.89	54	72.36	53.58
73.53	53.45	74.27	53.37	75.32	53.27	77.38	53	77.94	52.91
83.64	52	83.88	51.99	84.73	51.76	85.96	51.47	87.87	51.03
88.21	51	88.37	51	94.07	50	96.42	49.58	99.73	49
103.71	48.35	105.15	48.13	105.95	48	108.36	47.68	111.58	47.27
112.85	47.1	113.64	47	122.06	46.17	123.78	46	125.45	45.83

126.7	45.71	127.16	45.68	128.44	45.57	129.09	45.51	129.91	45.45
130.69	45.39	135.41	45	135.57	45	136.52	44.85	136.63	44.84
137.19	44.75	138.95	44.45	140.33	44.21	140.35	44.21	143.07	43.78
143.42	43.73	143.85	43.69	144.43	43.63	145.12	43.54	148.25	43.07
148.43	43.05	148.73	43	149.67	42.72	150.05	42.6	152.81	41.76
155.27	41	158.31	40.29	159.61	40	159.64	39.99	163.67	39
164.58	38.66	165.44	38.35	166.42	38	167.98	37.33	168.7	37
169.37	36.76	170.07	36.53	171.61	36	172.17	35.82	174.67	35
177.2	34.08	177.41	34	178.65	33.51	179.75	33.08	179.97	33
182.06	32.33	182.97	32	184.95	31.38	186.24	31	187.99	30.28
188.81	30	191.11	29.37	191.92	29.13	192.34	29	192.45	28.96
195.27	28	197.81	27.18	198.11	27.1	198.41	27	200.36	26.94
205.51	26.79	209.26	26.69	214.86	26.54	230.43	26.13	231.99	26.09
232.77	26.06	235.21	26	238.09	26	240.15	26.14	243.36	26.35
244.86	26.46	245.31	26.49	247.15	26.62	250.34	26.85	250.59	26.86
250.78	26.88	252.53	27	257.26	27	270.01	27.36	278.1	27.57
278.64	27.57	279.38	27.56	281.38	27.42	285.3	27.13	285.5	27.13
286.12	27.09	287.08	27	287.58	27	287.71	26.99	289.43	26.99
291.3	26.98	291.45	26.97	292.2	26.97	293.17	26.96	295.77	26.94
297.44	26.92	297.99	26.91	299.11	26.91	300.68	26.89	301.94	26.88
307.79	26.89	311.28	26.9	319.7	26.99	320.65	26.99	320.78	27
341.82	27	341.99	26.99	343.87	26.95	346.97	26.67	350.42	26.42
350.85	26.4	351.31	26.37	351.97	26.34	352.71	26.29	353.14	26.28
353.61	26.26	353.88	26.26	354.14	26.25	354.43	26.25	354.67	26.26
354.96	26.26	355.33	26.24	355.73	26.23	356.1	26.21	356.44	26.21
356.57	26.2	357.55	26.2	358.43	26.22	358.63	26.23	360.5	26.38
367.2	26.99	367.64	27	383.65	27	400.46	27	404.33	27.3
406.76	27.45	408.2	27.59	408.96	27.66	409.17	27.67	409.32	27.69
410.19	27.76	410.67	27.77	413.65	27.73	414.06	27.72	417.32	27.74
417.84	27.78	418.53	27.8	422.39	27.98	422.91	28	427.71	28
433.19	27.99	436.39	27.99	442.62	28	456.41	28	465.42	28.01
467.53	28.01	474.99	28	479.02	28	479.07	27.65	479.39	27.16
479.49	27.08	480.71	26.64	481.62	26.33	483.26	25.79	483.4	25.74
484.05	25.53	484.46	25.39	486.09	25.15	500.14	23.13	504.59	24.29
508.84	25.13	510.38	26.3	511.49	27.14	515	26.36	515.58	26.28
516.55	26.13	517.44	26	517.58	26	517.87	26.35	518.02	26.5
518.47	27	519.07	27.58	519.35	27.81	519.49	27.96	519.58	28
520.7	28	521.12	28.07	521.29	28.08	522.45	28.17	522.96	28.24
524.19	28.31	525.21	28.37	525.35	28.36	526.29	28.41	526.7	28.37
527.04	28.38	529.98	28.02	536.3	28.02	537.01	28.01	541.23	28.01
545.74	28	550.09	28	551.32	27.97	551.7	27.97	559.94	27.62
569.13	27.25	569.43	27.24	571.42	27.16	573.86	27.06	574.41	27.04
575.9	26.99	576.55	26.87	576.8	26.81	578.08	26.58	578.48	26.53
578.71	26.47	579.71	26.24	579.96	26.19	580.61	26	593.9	26
594.66	26.69	594.95	27	595.29	27.33	595.94	28	596.4	28.25
597.6	29	598.96	29.91	599.08	30	599.23	30.13	599.3	30.21
599.47	30.36	599.74	30.62	600.18	31	600.96	31.45	602.03	32
603.03	32.37	603.26	32.46	603.94	32.74	604.56	33	605.59	33.37
607.32	34	607.45	34.02	610.85	34.44	614.73	34.99	614.85	34.98
615.01	34.99	617.11	34.99	617.29	35	618.82	34.99	620.79	35
621.44	35	621.54	35.01	621.79	35.01	623.17	35.16	624.87	35.27

625.58	35.3	626.79	35.38	627.11	35.39	628.85	35.48	632.77	35.93
632.92	35.94	633.5	35.96	634.02	35.96	634.35	35.97	634.57	35.97
634.92	35.98	635.42	35.98	635.64	35.99	636.1	35.99	636.11	36
636.49	36.1	636.88	36.1	643.23	36.47	646.15	36.59	646.49	36.55
646.85	36.55	647.24	36.54	647.62	36.54	649.02	36.57	650.75	36.66
650.98	36.65	651.27	36.69	651.61	36.73	652.44	36.85	653.3	37
653.61	37.09	655.93	37.65	656.82	37.88	657.2	38	657.3	38
658.5	38.16	659.82	38.31	660.26	38.4	660.69	38.46	661.02	38.52
661.29	38.55	661.65	38.62	662.1	38.67	662.62	38.76	662.85	38.81
663.68	38.94	663.7	38.95	664.18	39	665.31	39.05	666.12	39.09
667.31	39.12	667.45	39.12	668.48	39.1	669.99	39.08	670.12	39.09
671.6	39.12	671.9	39.12	672.92	39.19	674.26	39.19	675.19	39.17
675.32	39.17	676.24	39.15	676.41	39.14	677.34	39.1	677.47	39.1
678.09	39.08	678.27	39.08	678.73	39.1	679.61	39.13	680.04	39.13
680.38	39.14	681.43	39.23	681.94	39.28	682.81	39.39	682.85	39.39
685.59	39.56	687.26	39.63	687.61	39.62	689.3	39.65	691.3	39.74
691.75	39.74	693.87	39.89	695.01	39.99	695.16	40	696.71	40.17
698.45	40.28	699.86	40.33	700.78	40.34	701.53	40.36	702.47	40.42
703.35	40.47	703.46	40.48	704.47	40.55	705.54	40.65	706.19	40.72
706.62	40.77	706.92	40.81	708.82	40.95	709.05	40.98	709.39	41
711.7	41.21	712.18	41.26	713.19	41.35	713.56	41.39	714.15	41.46
716.25	41.77	716.69	41.82	717.12	41.88	717.38	41.91	718.02	42
719.18	42.18	719.96	42.29	720	42.29	720.55	42.37	720.83	42.4
721.45	42.42	721.87	42.45	722.36	42.49	723.04	42.56	724.39	42.71
724.44	42.71	726.48	43	727.39	43.23	727.94	43.33	728.97	43.57
729.43	43.67	729.84	43.75	730.01	43.79	731.3	44	732.09	44.07
732.37	44.11	732.87	44.15	732.92	44.16	733.97	44.27	735.6	44.55
736.06	44.61	736.84	44.7	737.06	44.73	738.39	45	739.73	45.02
740.47	45.02	741.47	45.04	742.68	45.03	743.05	45.03	743.7	45.02
744.09	45.02	745.59	45.01	745.98	45	746.43	45	746.91	44.99
748.49	44.99	749.41	44.98	750.38	44.98	753.07	45	757.41	45.99
757.62	46	764.37	46.21	772.66	46.48	774.46	46.53	776.74	46.6
783.74	46.82	788.72	46.82						

Manning's n	Values		num=	3	
Sta	n Val	Sta	n Val	Sta	n Val
0	.12	479.02	.042	511.49	.12

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	479.02	511.49		582.42	582.42	582.42		.1	.3

CROSS SECTION

RIVER: FEMA-LR
REACH: LR-BL RS: 23760

INPUT									
Description:									
Station	Elevation	Data	num=	415					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev

0	57.72	.02	57.72	1.07	57.68	2.51	57.61	2.69	57.6
3.11	57.55	7.39	57.21	9.65	57.02	9.87	57.02	10.28	57.01
10.3	57.01	10.33	57	10.61	57	11.54	56.99	11.82	56.99
12.32	56.98	12.91	56.97	13.25	56.97	14.07	56.98	15.57	56.98
17.73	56.74	17.81	56.73	18.13	56.68	18.46	56.64	19.28	56.59
20.01	56.56	20.29	56.51	20.98	56.38	21.26	56.36	21.62	56.35
21.88	56.3	22.09	56.29	22.73	56.19	23.27	56.09	23.68	56
24.25	55.95	29.74	55.56	32.23	55.43	32.39	55.41	32.85	55.32
32.94	55.32	33.43	55.25	33.84	55.25	33.97	55.24	35.22	55
35.44	55	37.03	54.91	37.45	54.89	38.19	54.85	39.29	54.79
40.26	54.75	41.37	54.67	43.43	54.53	44.34	54.48	45.08	54.43
47.49	54.25	50.77	54	51.01	54	52.94	53.45	53.39	53.33
53.65	53.26	54.58	53.09	55.01	53.01	55.04	53	55.18	53
55.33	52.95	55.63	52.86	57.85	52.14	57.94	52.1	58	52.08
58.24	52	58.25	52	58.71	51.91	63.29	51.01	63.43	51
63.58	51	64.2	50.97	65.78	50.9	65.94	50.9	66.26	50.89
66.66	50.87	67.12	50.85	67.61	50.84	68.46	50.81	69.68	50.77
80.42	50.37	84.06	50.26	84.98	50.23	85.98	50.19	86.34	50.19
87.88	50.15	89.46	50.11	89.76	50.11	90.02	50.1	90.25	50.09
90.44	50.09	92.12	50.05	93.97	50	94.19	50	95.1	49.95
95.89	49.91	96.62	49.87	96.72	49.87	97.12	49.82	97.88	49.78
98.65	49.68	98.85	49.65	100.42	49.5	101.53	49.35	104.08	49
105.01	48.81	106.38	48.55	106.6	48.51	107.87	48.25	109.16	48
110.97	47.57	111.74	47.39	111.95	47.34	113.31	47	116.64	46.26
117.79	46	118.26	45.91	118.55	45.86	120.41	45.54	121.02	45.42
123.75	45	124.11	44.95	124.17	44.94	124.25	44.93	124.37	44.9
125.08	44.8	125.58	44.71	126.89	44.49	127.01	44.48	127.23	44.44
128.1	44.31	129.94	44	131.73	43.64	131.91	43.59	132.88	43.37
133.32	43.27	133.57	43.21	134.54	43	138.69	42.09	138.75	42.07
139.1	42	139.49	41.93	140.38	41.77	140.49	41.75	140.73	41.69
141.05	41.62	141.67	41.48	142.63	41.29	142.89	41.24	143.92	41
145.3	40.76	145.83	40.64	147.07	40.36	148.67	40	153.3	39.22
153.91	39.12	154.59	39	154.61	39	154.85	38.97	155.09	38.94
155.27	38.91	155.68	38.86	160.68	38.21	162.22	38	162.3	37.99
162.33	37.98	163.95	37.72	166.57	37.3	167.49	37.11	167.59	37.09
168.05	37	168.07	37	173.01	36.16	173.95	36	174.2	35.95
176.41	35.49	178.61	35.03	178.72	35	178.99	34.93	182.63	34
183.21	33.82	183.41	33.79	183.72	33.73	184.22	33.61	185.08	33.43
185.96	33.23	186.79	33.01	186.97	33	187.03	32.98	187.05	32.97
187.11	32.95	188.12	32.52	188.51	32.37	188.84	32.25	189.59	32.08
189.66	32.06	189.71	32.05	190.06	32	190.11	32	190.16	31.98
190.17	31.98	190.2	31.97	190.9	31.79	191.55	31.56	192.81	31.01
192.88	31.01	192.89	31	193.3	30.4	193.6	30	194.63	29
195.09	28.98	195.3	28.97	197.01	28.49	197.86	28.3	198.9	28
198.97	27.96	199.1	27.87	199.29	27.74	200.22	27.12	200.34	27.04
200.4	27	200.64	26.99	205.1	26.35	207.17	26	207.18	26
214.63	25.26	216.92	25.04	217.33	25	225.94	25	226.45	25.01
227.59	25.02	229.51	25.02	239.54	25.31	239.69	25.31	239.92	25.32
240.5	25.33	241.06	25.34	249.8	25.68	257.21	25.98	257.67	25.99
260.92	25.99	262.95	26	266.62	26	269.57	26	269.7	25.97
269.71	25.97	271.44	25.62	271.5	25.61	271.68	25.57	273.42	25.29

274.76	25.01	275.47	25.01	276.05	25	279.22	25	279.36	25.02
279.75	25.13	279.85	25.18	280.66	25.5	281.62	25.83	282.12	26
296.62	26	308.68	26	311.59	25.98	312.42	25.98	313.45	25.99
315.42	26	315.49	26	316.34	26.06	320.18	26.34	322.29	26.49
323.69	26.58	324.67	26.64	325.56	26.7	325.71	26.7	327.08	26.79
327.85	26.83	329.65	26.99	329.72	27	377.75	27	378.86	27.01
380.83	27.01	381.63	27	395.64	27	414.78	27.29	426.66	27.45
433.72	27.35	443.86	27.2	443.94	27.21	444.45	27.19	444.98	27.17
445.1	27.17	446.8	27.13	448.69	27.08	449.51	27.06	450.37	27.04
451.16	27.02	451.98	27	452.36	27	452.5	26.99	452.7	26.99
453.65	26.97	454.4	26.98	454.79	26.95	457.1	26.99	457.63	27
486.56	27	486.97	26.99	487.75	26.99	492.53	26.98	494.17	26.98
498.02	26.85	499.95	26.81	500.13	26.38	504.07	25.4	507.57	23.85
517.23	21.89	519.63	21.39	523.55	22.27	529.79	23.75	529.85	23.8
531.3	26.09	532.35	25.16	532.38	25	534.3	25	534.44	25.03
534.47	25.04	534.51	25.05	534.52	25.05	534.58	25.07	535.01	25.22
536.55	25.72	537.4	25.99	537.48	26	537.89	26.47	538.24	27
538.51	27.49	538.87	28	539.86	28.37	541.3	28.96	541.32	28.96
541.45	28.98	541.54	28.98	541.77	29	542.4	29.6	542.82	30
544.51	30.92	544.77	31	545.8	31.58	546.42	32	547.33	32.55
548.11	32.95	548.2	33	549.12	33.84	549.35	34	549.86	34.32
550.32	34.54	550.66	34.77	551.02	34.92	551.16	34.99	551.24	35
551.46	35.14	552.68	35.93	552.77	35.99	552.78	36	553.02	36.12
553.35	36.29	554.15	36.52	554.65	36.69	554.74	36.72	554.83	36.76
555.54	37	555.72	37.12	556.35	37.58	556.81	37.96	556.82	37.96
556.86	38	557.64	38.79	557.86	39	558.6	39.37	559.51	40
559.52	40	560.17	40.16	561.51	40.47	562.7	40.73	563.1	40.82
563.8	41	563.9	41	564.73	41.02	564.86	41.02	567.06	41.24
574.24	41.94	574.38	41.96	574.45	41.96	574.5	41.97	574.87	42
575.55	42	584.73	42.37	588.03	42.5	590.23	42.58	591.8	42.64
600.53	42.99	600.9	43	600.93	43	603.26	43.08	603.49	43.09
603.95	43.11	604.61	43.13	610.18	43.33	612.19	43.4	626.41	43.4

Manning's n Values			num=	3
Sta	n Val	Sta	n Val	Sta
0	.125	499.95	.042	531.3

Bank Sta:	Left	Right	Lengths:	Left	Channel	Right	Coeff	Contr.	Expan.
	499.95	531.3		171.8	195.55	249.91		.1	.3

CROSS SECTION

RIVER: FEMA-LR
 REACH: LR-BL RS: 23566

INPUT
 Description: (0) Surveyed Section U/S LR9-S
 HEC-2 STA23566

Station Elevation Data			num=	496
Sta	Elev	Sta	Elev	Sta
				Elev
				Sta
				Elev
				Sta
				Elev
				Sta
				Elev

1614.24	50	1623.11	49.37	1623.11	64.24	1624.34	64.24	1624.61	64.19
1625.41	64	1628.93	63	1630.78	62.76	1633.78	62.41	1636.71	62.04
1637.41	62.02	1637.83	62.02	1638.01	62	1639.81	61.66	1644.09	60.7
1644.87	60.59	1646.6	60.33	1648.46	60	1650.6	60	1652.06	59.99
1652.99	60	1654.48	59.88	1656.33	59.75	1660.04	59.36	1663.39	59
1663.46	59	1670.86	58	1685.69	58	1687.12	57.99	1688.48	58
1688.56	57.99	1689.23	58	1689.91	57.99	1690.47	58	1691.48	58
1692.29	58.02	1696.3	58.07	1697.01	58.1	1698.9	58.16	1702.26	58.24
1703.14	58.28	1705.77	58.31	1708.26	58.32	1709.22	58.32	1710.69	58.31
1712.7	58.27	1714.58	58.19	1714.73	58.19	1715.9	58.14	1716.88	58.14
1717.84	58.15	1719.96	58.15	1722.01	58.04	1722.33	58.04	1723.49	58.01
1724.4	58	1724.7	57.98	1725.51	57.83	1727.39	57.51	1727.97	57.42
1729.85	57.11	1730.54	57	1736.36	56.04	1736.62	56	1739.51	55.47
1740.5	55.31	1741.07	55.17	1741.89	55	1749.2	54	1749.61	54
1756.09	53.01	1757.98	52.67	1761.76	52	1763.01	51.85	1766.35	51.46
1770.41	51	1770.61	51	1771.92	50.94	1772.52	50.92	1778.48	50.66
1781.53	50.55	1793.87	50	1802.75	49.12	1804.4	49.04	1804.9	49
1806.63	49	1807.96	48.99	1809.67	48.99	1813.68	48.69	1814.3	48.67
1820.42	48.43	1823.25	48.38	1825.3	48.32	1826.05	48.28	1828.71	48.15
1830.33	48.06	1830.47	48.06	1831.77	48	1833.64	47.88	1834.03	47.87
1835.81	47.78	1837.6	47.7	1838.55	47.62	1839.72	47.55	1841.9	47.39
1842.51	47.33	1844.2	47.23	1846.61	47.07	1847.56	47	1849.23	46.85
1850.76	46.76	1851.28	46.72	1852.09	46.63	1853.05	46.55	1854.46	46.45
1855.93	46.3	1858.47	46.05	1859.22	45.97	1860.78	45.59	1863.49	45
1864.79	44.62	1866.06	44.24	1866.92	44.01	1866.99	44	1867.54	43.56
1867.96	43	1868.58	41.81	1868.94	41.17	1869.11	41	1899.47	41
1904	40.74	1905.01	40.69	1916.97	40	1918.51	40	1918.54	39.99
1920.99	39.47	1923.07	39	1925.55	38	1926.62	37.22	1926.87	37
1927.22	36.5	1927.53	36	1927.88	35.4	1928.1	35	1928.61	34.19
1929.2	33.39	1929.5	33	1930.33	32.24	1930.57	32	1931.4	31.48
1932.15	31	1932.18	31	1932.74	30.67	1933.68	30.15	1934.48	29.6
1935.44	29	1935.87	28.76	1937.71	28	1938.39	27.78	1939.97	27.29
1940.68	27.14	1941.28	27	1941.78	26.93	1942	26.88	1944.27	26.49
1944.87	26.35	1946.24	26	1951.12	25.7	1952.09	25.65	1963.04	25.01
1963.57	25	1971.91	25	1973.39	24.91	1974.2	24.84	1977.19	24.57
1979.31	24.4	1981.34	24.19	1983.22	24	1983.79	24	1990	24
1998.79	24	2010	24	2013.79	24	2022.33	24	2024.71	24.14
2027.83	24.39	2031.88	24.53	2032.33	24.54	2033.45	24.54	2035.04	24.57
2035.88	24.57	2036.78	24.59	2038.03	24.61	2038.71	24.64	2039.76	24.66
2041.05	24.71	2042.21	24.73	2043.26	24.74	2044.64	24.73	2045.81	24.74
2048.93	24.99	2051.36	24.98	2054.03	25	2055.86	25.16	2056.61	25.2
2056.77	25.22	2058.38	25.32	2059.2	25.39	2060.17	25.5	2060.94	25.56
2061.47	25.59	2061.7	25.62	2063.46	25.71	2063.77	25.74	2064.8	25.79
2066.41	25.98	2069.12	25.95	2070.19	25.97	2071.28	26	2087.75	26
2091.47	26.01	2096.88	26.01	2102.89	26	2104.48	26.01	2105.25	25.84
2105.42	25.84	2117.79	26.07	2124.33	25.12	2126.2	24.64	2129.24	23.12
2132.12	22.76	2133.32	22.6	2141.39	21.5	2157.42	23.58	2157.92	23.7
2162.05	24.44	2163.35	24.53	2163.97	24.55	2164.35	24.58	2164.72	24.63
2165.49	24.7	2166.89	24.85	2168.04	25	2168.85	25	2173.24	26
2173.89	26.2	2176.36	27	2176.7	27.01	2177.15	27.1	2178.25	27.3
2178.76	27.42	2179.44	27.53	2179.88	27.63	2180.91	27.83	2181.69	28

2181.94	28.1	2183.14	28.52	2184.36	29	2185.25	29.27	2186.15	29.52
2187.01	29.78	2187.25	29.81	2187.46	29.8	2187.84	30	2189.01	30.54
2189.8	30.86	2190.15	30.94	2190.71	31	2191.73	31.01	2191.89	31
2192.82	31	2193.9	32.48	2193.99	33.65	2206.22	34.15	2207.09	34.19
2227.04	34.96	2234.37	35.12	2239.92	35.26	2262.37	35.55	2274.51	35.71
2280.69	35.79	2281.78	35.82	2281.98	35.95	2282.46	35.96	2284.29	35.96
2285.07	35.97	2288.15	35.99	2289.29	36	2291.68	36	2293.38	36.08
2294.97	36.11	2296.4	36.13	2296.68	36.14	2298.94	36.17	2299.95	36.2
2300.5	36.2	2304.2	36.31	2304.63	36.31	2306.95	36.34	2308.48	36.35
2310.17	36.37	2310.64	36.39	2312.2	36.42	2313.41	36.43	2315.78	36.49
2318.7	36.59	2319.63	36.63	2321.23	36.66	2324.6	36.74	2324.9	36.76
2326.69	36.81	2328.23	36.84	2328.73	36.86	2332.87	36.96	2334.85	37
2335.23	37	2337.26	37.23	2338.38	37.31	2339.48	37.33	2340.08	37.36
2341.24	37.45	2341.74	37.47	2342.59	37.54	2343.26	37.58	2344.78	37.63
2345.91	37.7	2346.76	37.7	2349.32	37.73	2349.58	37.75	2350.53	37.76
2351.22	37.8	2351.74	37.82	2353.65	37.86	2355.79	37.92	2357	37.96
2358.11	38.01	2359.38	38.09	2361.03	38.18	2361.57	38.19	2362.2	38.22
2363.37	38.25	2366.18	38.39	2366.7	38.4	2366.95	38.42	2367.8	38.46
2368.49	38.48	2369.31	38.52	2370.33	38.54	2371.46	38.58	2372.49	38.63
2374.53	38.7	2374.66	38.7	2376.56	38.76	2378.88	38.85	2380.93	38.94
2380.98	38.95	2381.79	38.98	2382.21	39	2382.5	39	2386.07	39.24
2387.55	39.33	2389.81	39.45	2390.47	39.48	2391.28	39.5	2392.16	39.54
2392.78	39.54	2394.6	39.59	2394.75	39.58	2395.18	39.62	2395.87	39.66
2398.91	39.67	2402.03	39.7	2403.69	39.77	2404.53	39.79	2404.87	39.81
2405.98	39.83	2407.44	39.87	2408.64	39.89	2409.92	39.92	2410.66	39.93
2416.6	39.95	2417.64	39.99	2421.16	39.97	2421.69	39.98	2422.96	39.98
2424.06	40	2424.57	40	2427.28	40.09	2429.97	40.17	2431.16	40.21
2433.55	40.28	2434.11	40.3	2436.47	40.37	2438.37	40.43	2438.95	40.44
2440.35	40.49	2440.71	40.51	2441.68	40.54	2442.49	40.58	2443.6	40.65
2444.27	40.67	2445.64	40.74	2446.47	40.75	2446.75	40.77	2448.42	40.76
2451.56	40.76	2453.09	40.77	2459.57	41	2473.96	41	2475.77	41.06
2477.52	41.13	2477.99	41.13	2481.53	41.23	2507.94	42	2512.07	42
2514.36	42.06	2515.09	42.07	2527.84	42.37	2534.58	42.51	2535.62	42.52
2536.42	42.52	2539.13	42.55	2542.14	42.58	2543.05	42.6	2545.01	42.63
2547.74	42.66	2547.97	42.67	2551.43	42.73	2555.62	42.81	2556.14	42.81
2556.79	42.83	2561.33	42.92	2564.84	43	2565.83	43.01	2567.61	43.14
2570.34	43.32	2571.49	43.38	2573.68	43.53	2575.8	43.68	2578.48	43.86
2580.31	44	2580.65	44.02	2584.1	44.27	2586.17	44.41	2588.6	44.58
2588.83	44.6	2590.81	44.73	2594.41	45	2595.84	45.03	2597.47	45.03
2600.96	45.17	2608.58	45.4	2612.46	45.42	2615.03	45.42	2615.84	45.43
2616.68	45.43	2631.36	46.56	2632.02	46.57	2636.06	46.67	2638.98	46.71
2640.67	47	2646.03	47	2650.04	47.15	2651.21	47.13	2651.75	47.14
2653.96	47.26	2656.25	47.16	2656.8	47.16	2657.68	47.18	2660.33	47.53
2661.39	47.71	2662.89	48	2662.99	48	2663.29	48.13	2663.91	48.44
2664.43	48.46	2664.84	48.53	2665.46	48.72	2666.35	48.86	2666.56	48.91
2667.21	49	2667.93	49.07	2668.87	49.14	2669.88	49.25	2670.56	49.34
2675.26	49.18	2677.52	49.16	2680.75	49.24	2683.49	49.3	2686.97	49.37
2692.43	49.47	2692.51	49.47	2697.01	49.57	2698.44	49.57	2698.44	49.94
2702.77	50								

Sta	n Val	Sta	n Val	Sta	n Val
1614.24	.125	2126.2	.042	2162.05	.125

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	2126.2	2162.05		74.4	68.75	45.59	.3	.5
Ineffective Flow		num=	1					
Sta L	Sta R	Elev	Permanent					
1614.24	1930.33	34.5	F					

CROSS SECTION

RIVER: FEMA-LR

REACH: LR-BL

RS: 23466

INPUT

Description:

Station Elevation Data	num=	103							
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-16	43.13	3.16	42.48	3.38	42.53	3.9	42.51	13.42	42.08
14.94	41.94	23.19	41.05	32.16	39.66	32.44	39.45	33.3	37.8
35.15	37.69	39.91	37.42	44.83	37.13	50.15	36.95	57.48	36.73
57.7	36.73	57.74	36.72	58.58	36.69	72.63	36.18	77.52	35.6
78.35	35.44	92.45	29.61	92.46	29.61	99.35	26.22	105.36	26.22
110.45	21.26	124.59	21.26	130.33	26.22	134.82	26.22	138.49	26.22
138.5	26.22	138.5	30.31	144.14	32.07	144.39	32.04	144.89	32.28
145.09	32.37	145.18	32.39	152.91	33.16	160.88	32.75	163.48	32.73
167.28	32.73	171.16	32.72	172.85	33	172.93	33.01	181.84	33.01
182.01	32.97	188.54	32.79	189.12	32.7	190.57	32.82	190.72	32.82
195.62	32.84	199.99	32.42	205.92	33.09	206.19	33.1	206.54	33.09
206.82	33.08	207.11	33.07	213.86	32.54	216.14	33.05	217.3	33.1
223.44	33.19	229.56	31.41	236.42	30.15	250.19	31.3	258.93	33.49
266.11	33.71	273.28	33.57	281.82	33.55	290.48	33.55	294.64	33.77
299.52	33.83	311.9	34.24	312.35	34.25	312.64	34.24	320.71	33.84
337.22	33.82	345.35	34.19	351.5	34.57	359.45	34.19	369.73	34.02
390.54	34.45	398.68	34.69	412.49	34.78	413.64	34.8	414.03	34.83
424.74	35.07	425.3	35.08	425.9	35.09	428.33	35.15	429.23	35.19
429.63	35.21	430.83	35.3	433.35	35.54	434.04	35.66	436	35.58
441.77	36.29	444.47	36.64	446.38	37.05	446.44	39.12	450.5	39.12
456.7	39.15	464.17	39.18	501.14	40.3				

Manning's n Values	num=	3			
Sta	n Val	Sta	n Val	Sta	n Val
-16	.12	105.36	.042	130.33	.12

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff	Contr.	Expan.
	105.36	130.33		52.58	52.58	52.58	.3	.5
Ineffective Flow		num=	2					
Sta L	Sta R	Elev	Permanent					
-16	97.04	34.5	F					
135.79	501.14	33.4	F					

BRIDGE

RIVER: FEMA-LR

REACH: LR-BL

RS: 23449

INPUT

Description: Rosemont Street Bridge

Distance from Upstream XS = 8

Deck/Roadway Width = 33

Weir Coefficient = 2.6

Upstream Deck/Roadway Coordinates

num= 83

Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord	Sta	Hi Cord	Lo Cord
-16	41		-15.62	40.97		-13.68	40.91	
-5.48	40.27		-2.24	40		-2.15	39.99	
-2.11	39.99		3.03	39.61		19.02	38.44	
19.48	38.41		30.92	37.7		39.9	37.13	
49.3	36.59		50.68	36.52		69.48	35.55	
80.85	35.12		81.79	35.09		99.89	34.5	
99.89	34.5	31.39	133.13	34	30.84	133.13	34	
154.02	33.71		156.22	33.71		173.79	33.61	
177.79	33.59		177.9	33.59		180.8	33.6	
189.34	33.55		194.48	33.52		202.21	33.47	
203.36	33.45		203.86	33.47		204.59	33.44	
218.39	33.39		218.73	33.39		219.08	33.4	
220.99	33.4		228.92	33.39		242.28	33.42	
242.9	33.47		243.56	33.39		246.61	33.43	
246.84	33.49		247.11	33.44		250.85	33.47	
258.43	33.53		262.76	33.51		267.75	33.71	
268.03	33.61		275.77	33.71		276.46	33.79	
277.23	33.68		280.6	33.7		283.44	33.79	
288.99	33.84		298.43	33.71		311.01	34.03	
316.52	34.1		317.25	34.1		318.92	34.11	
320.17	34.18		335.77	34.44		343.21	34.57	
348.95	34.66		350.47	34.82		352.25	34.63	
361.44	34.68		362.05	34.97		362.58	34.82	
365	34.86		382.33	35.12		384.72	35.16	
395.33	35.23		396.11	35.23		400.6	35.4	
403.21	35.43		411.64	35.56		415.02	35.63	
420.42	35.62		421.63	35.66		425.45	35.78	
429.86	35.88		432.76	36				

Upstream Bridge Cross Section Data

Station Elevation Data

num= 103

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-16	43.13	3.16	42.48	3.38	42.53	3.9	42.51	13.42	42.08
14.94	41.94	23.19	41.05	32.16	39.66	32.44	39.45	33.3	37.8
35.15	37.69	39.91	37.42	44.83	37.13	50.15	36.95	57.48	36.73
57.7	36.73	57.74	36.72	58.58	36.69	72.63	36.18	77.52	35.6

78.35	35.44	92.45	29.61	92.45	001	29.61	99.35	26.22	105.36	26.22
110.45	21.26	124.59	21.26	130.33		26.22	134.82	26.22	138.49	26.22
138.5	26.22	138.5	30.31	144.14		32.07	144.39	32.04	144.89	32.28
145.09	32.37	145.18	32.39	152.91		33.16	160.88	32.75	163.48	32.73
167.28	32.73	171.16	32.72	172.85		33	172.93	33.01	181.84	33.01
182.01	32.97	188.54	32.79	189.12		32.7	190.57	32.82	190.72	32.82
195.62	32.84	199.99	32.42	205.92		33.09	206.19	33.1	206.54	33.09
206.82	33.08	207.11	33.07	213.86		32.54	216.14	33.05	217.3	33.1
223.44	33.19	229.56	31.41	236.42		30.15	250.19	31.3	258.93	33.49
266.11	33.71	273.28	33.57	281.82		33.55	290.48	33.55	294.64	33.77
299.52	33.83	311.9	34.24	312.35		34.25	312.64	34.24	320.71	33.84
337.22	33.82	345.35	34.19	351.5		34.57	359.45	34.19	369.73	34.02
390.54	34.45	398.68	34.69	412.49		34.78	413.64	34.8	414.03	34.83
424.74	35.07	425.3	35.08	425.9		35.09	428.33	35.15	429.23	35.19
429.63	35.21	430.83	35.3	433.35		35.54	434.04	35.66	436	35.58
441.77	36.29	444.47	36.64	446.38		37.05	446.44	39.12	450.5	39.12
456.7	39.15	464.17	39.18	501.14		40.3				

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
-16	.12	105.36	.042	130.33	.12

Bank Sta: Left Right Coeff Contr. Expan.

92.45	001	134.82	.3	.5
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Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-16	97.04	34.5	F
135.79	501.14	33.4	F

Downstream Deck/Roadway Coordinates

num= 61											
Sta	Hi	Cord	Lo Cord	Sta	Hi	Cord	Lo Cord	Sta	Hi	Cord	Lo Cord
-7	41.01			-6.34	40.95			3.3	40.24		
9.86	39.72			16.85	39.14			17.4	39.12		
18.21	39.03			28.03	38.23			28.22	38.22		
32.78	38.29			51.74	36.94			52.62	36.84		
63.68	36.33			65.33	36.3			65.99	36.3		
66.04	36.23			66.49	36.22			68.49	36.13		
75.15	35.85			79.09	35.68			81.44	35.6		
82.06	35.58			86.43	35.43			89.67	35.33		
89.83	35.33			90.76	35.3			105.15	34.83		
106.24	34.79			108.05	34.74			115.76	34.5		
115.76	34.5	31.39		149	34	30.84		149	34		
151.54	33.94			152.07	33.94			152.75	33.93		
159.64	33.85			163.71	33.82			164.1	33.82		
168.89	33.81			169.51	33.8			194.83	33.64		
199.76	33.61			202.14	33.6			207.02	33.6		
224.78	33.57			235.05	33.56			241.68	33.54		
264.78	33.53			272.06	33.59			282.58	33.67		
290.54	33.76			296.6	33.83			303.32	33.89		
306.73	33.95			317.63	34.09			335.26	34.28		

348.8	34.44	352.03	34.47	355.49	34.52
369.77	34.75				

Downstream Bridge Cross Section Data

Station Elevation Data		num=		89					
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
-8	40.81	.23	40.8	.48	40.79	.61	40.82	5.14	41.03
6.87	41.42	21.49	39.82	26.29	39.36	27.04	39.31	28.36	39.27
40.46	38.01	44.32	37.54	45.77	37.44	46.96	37.4	53.89	37.32
62.79	36.17	70.7	35.64	82.96	34.99	84.26	34.76	84.88	34.63
96.01	32.36	100.73	29.99	107.06	27.22	115.42	26.22	120.5	26.22
125.57	21.21	138.19	21.19	144.83	26.22	151.42	26.22	152.7	28.37
156.55	29.07	163.07	29.43	167.05	29.33	174.58	29.67	178.57	29.68
181.18	29.68	200.29	30.58	201.82	30.56	202.09	30.58	204.19	30.7
206.43	31.07	216.36	32.47	218.78	32.29	225.63	32.35	232.41	32.46
235.17	32.7	238.58	32.93	248.05	33.39	248.16	33.4	262.71	33.09
263.05	33.08	263.2	33.08	268.3	32.81	268.34	32.86	270.26	32.84
285.18	33.21	286.32	33.24	286.48	33.24	293.81	33.65	302.99	33.96
303.41	33.95	313.31	33.46	317.84	33.33	317.87	33.33	326.98	33.46
335.72	33.42	338.02	33.36	343.23	33.76	344.66	33.86	345.47	33.88
354.78	34.23	362.92	34.56	363.55	34.57	364.51	34.53	370.05	34.33
383.82	34.23	388.49	34.27	389.58	34.2	393.19	34.22	393.75	34.32
415.3	34.58	420.68	34.61	432.13	34.84	457.52	35.4	459.97	35.53
461.7	36.34	479.35	36.97	479.43	37.93	502.74	38.41		

Manning's n Values		num=		3	
Sta	n Val	Sta	n Val	Sta	n Val
-8	.12	120.5	.042	144.83	.12

Bank Sta:	Left	Right	Coeff	Contr.	Expan.
	107.06	152.7		.3	.5

Ineffective Flow		num=		2	
Sta L	Sta R	Elev	Permanent		
-8	113.82	32	F		
150.88	502.74	31.5	F		

Upstream Embankment side slope	=	horiz. to 1.0 vertical
Downstream Embankment side slope	=	horiz. to 1.0 vertical
Maximum allowable submergence for weir flow	=	.98
Elevation at which weir flow begins	=	
Energy head used in spillway design	=	
Spillway height used in design	=	
Weir crest shape	=	Broad Crested

Number of Bridge Coefficient Sets = 1

Low Flow Methods and Data

Energy

Selected Low Flow Methods = Highest Energy Answer

High Flow Method

Pressure and Weir flow
 Submerged Inlet Cd =
 Submerged Inlet + Outlet Cd = .8
 Max Low Cord =

Additional Bridge Parameters

Add Friction component to Momentum
 Do not add Weight component to Momentum
 Class B flow critical depth computations use critical depth
 inside the bridge at the upstream end
 Criteria to check for pressure flow = Upstream energy grade line

CROSS SECTION

RIVER: FEMA-LR

REACH: LR-BL

RS: 23432

INPUT

Description:

Station Elevation Data				num=	89
Sta	Elev	Sta	Elev	Sta	Elev
-8	40.81	.23	40.8	.48	40.79
				.61	40.82
6.87	41.42	21.49	39.82	26.29	39.36
40.46	38.01	44.32	37.54	45.77	37.44
62.79	36.17	70.7	35.64	82.96	34.99
96.01	32.36	100.73	29.99	107.06	27.22
125.57	21.21	138.19	21.19	144.83	26.22
156.55	29.07	163.07	29.43	167.05	29.33
181.18	29.68	200.29	30.58	201.82	30.56
206.43	31.07	216.36	32.47	218.78	32.29
235.17	32.7	238.58	32.93	248.05	33.39
263.05	33.08	263.2	33.08	268.3	32.81
285.18	33.21	286.32	33.24	286.48	33.24
303.41	33.95	313.31	33.46	317.84	33.33
335.72	33.42	338.02	33.36	343.23	33.76
354.78	34.23	362.92	34.56	363.55	34.57
383.82	34.23	388.49	34.27	389.58	34.2
415.3	34.58	420.68	34.61	432.13	34.84
461.7	36.34	479.35	36.97	479.43	37.93
					502.74
					38.41

Manning's n Values				num=	3
Sta	n Val	Sta	n Val	Sta	n Val
-8	.125	120.5	.042	144.83	.125

Bank Sta:	Left	Right	Lengths:	Left Channel	Right	Coeff Contr.	Expan.
	120.5	144.83		161.37	131.63	53.58	.3
							.5

Ineffective Flow num= 2

Sta L	Sta R	Elev	Permanent
-8	113.82	32	F
150.88	502.74	31.5	F

CROSS SECTION

RIVER: FEMA-LR

REACH: LR-BL

RS: 23332

INPUT

Description: Approx Section D/S of LR9-5
(XS-5)

HEC-2 STA 23332

Station Elevation Data			num=	494						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	
1555	40	1561.28	39.89	1561.28	51.54	1562.31	51.54	1562.5	51.63	
1563.39	51.56	1564.18	51.53	1565.53	51.59	1566.02	51.58	1567.81	51.67	
1570.85	51.85	1573.13	52	1574.59	52.15	1576.94	52.4	1577.43	52.44	
1579.49	52.66	1580.44	52.74	1582.71	52.86	1584.71	52.99	1585.63	53.01	
1589.52	53.46	1591.5	53.67	1594.42	54	1618.02	54	1618.65	53.9	
1619.73	53.7	1619.94	53.68	1621.28	53.45	1623.58	53.04	1624.97	53.01	
1626.37	53	1627.08	52.92	1628.4	52.67	1629.37	52.5	1631.87	52	
1634.43	51.48	1636.41	51	1636.52	51	1640.56	50.54	1642.28	50.35	
1643.43	50.25	1644.02	50.22	1644.61	50.15	1646.16	50.02	1646.7	49.99	
1648.01	49.99	1648.97	49.98	1649.93	49.99	1652.96	49.99	1654.21	49.93	
1655.53	49.77	1656.61	49.66	1658.49	49.45	1659.68	49.31	1661.99	49	
1664.68	48.55	1669.03	48.06	1670.64	47.89	1671.94	47.77	1673.68	47.63	
1674.33	47.54	1675.25	47.44	1677.58	47.15	1678.94	47	1680.06	46.86	
1680.41	46.83	1682.69	46.54	1683.36	46.47	1684.69	46.31	1685.7	46.2	
1687.06	46	1687.44	45.93	1688.71	45.75	1691.39	45.39	1692.78	45.21	
1694.17	45	1697.19	44.56	1698.34	44.41	1699.17	44.32	1699.89	44.21	
1701.44	44	1701.68	43.98	1706.54	43.53	1709.29	43.16	1710.46	43.03	
1712.56	42.84	1713.16	42.78	1714.04	42.71	1717.31	42.42	1717.85	42.39	
1718.83	42.31	1719.64	42.23	1721.36	42.12	1722.92	42	1760.46	42	
1761.7	42.05	1776.59	42.59	1779.09	42.67	1782.44	42.79	1787.84	42.95	
1788.36	42.94	1789.06	43	1812.57	43	1814.47	42.7	1818.74	42	
1821.07	41.49	1823.48	41	1827.47	40	1827.82	39.97	1829.74	39.59	
1830.74	39.4	1832.94	39	1834.31	38.66	1835.94	38.32	1837.31	38	
1841.3	37	1843.17	36.67	1846.6	36	1849.07	35.54	1851.16	35.25	
1852.76	35	1854.41	34.81	1854.85	34.75	1856.08	34.61	1857.32	34.45	
1859.4	34.21	1861.03	34.01	1861.25	34	1863.54	33.69	1867.49	33.15	
1868.62	33	1871.53	32.6	1872.51	32.47	1875.61	32	1876.18	31.87	
1877.8	31.47	1878.98	31.22	1879.93	31	1882.73	30	1883.72	29.58	
1885.35	29	1887.05	28.51	1888.19	28.2	1888.87	28	1890	27.81	
1890.44	27.75	1891.43	27.58	1895.19	27.04	1896.64	27	1898.88	27	
1899.02	26.7	1899.45	26.57	1900.55	25.75	1909.72	23.15	1911.99	22.45	
1913.9	22.37	1931.55	21.59	1938.75	22.11	1942.36	22.42	1944.61	23.3	
1945.82	23.5	1946.7	23.74	1948.12	24.15	1950.26	24.24	1952.15	25.59	
1954.23	25.82	1954.41	25.76	1955.21	25.78	1955.65	25.85	1956.01	25.94	
1956.73	25.97	1957.01	26	1960.2	26	1962.52	26.43	1963.85	26.6	
1964.47	26.76	1965.27	26.92	1965.92	27	1975	27	1980.55	27	
1980.99	26.99	1985	26.97	1986.61	26.96	1991.78	26.99	1992.72	27	
1993.83	27	1994.84	27.01	1997.98	27.17	1998.65	27.2	2000	27.24	

2003.45	27.34	2006.59	27.42	2007.3	27.43	2008.45	27.43	2015	27.54
2019.66	27.61	2025	27.72	2038.16	27.99	2038.53	28	2044.49	28
2045.01	28.01	2047.55	28.01	2048.73	28.02	2054.73	28.45	2058.93	28.81
2060.94	28.99	2061.73	29	2062.54	29.43	2064.07	30.47	2065.25	31
2066.14	31.37	2067.26	31.97	2067.81	31.98	2068.45	31.88	2069.4	31.95
2069.93	32.01	2071.43	32.02	2072.02	32.01	2072.64	32.02	2073.25	32.01
2073.72	32.02	2074.91	32.15	2075.46	32.18	2076.78	32.32	2077.78	32.4
2079.09	32.49	2080.52	32.62	2081.4	32.69	2082.49	32.76	2083.76	32.8
2086.04	32.88	2086.76	33	2137.38	33	2140.34	32.94	2143.06	32.92
2151.2	33.2	2160.08	33.48	2168.92	33.74	2179.01	34.16	2182.82	34.03
2197.4	33.94	2206.48	34.03	2227.14	34.21	2235.07	34.32	2242.22	34.46
2268.46	35	2269.36	35	2271.04	35.11	2273.5	35.26	2275.42	35.26
2275.69	35.28	2276.94	35.3	2278.34	35.38	2279.1	35.41	2282.23	35.6
2285.44	35.74	2286.46	35.77	2286.89	35.77	2288.19	35.8	2288.65	35.82
2289.49	35.83	2290.84	35.87	2293.25	35.95	2294.77	35.97	2296.31	36
2299.27	36	2300.91	36.15	2301.78	36.25	2302.26	36.29	2302.8	36.37
2304.21	36.53	2304.6	36.59	2305.79	36.7	2307.26	36.73	2307.6	36.78
2308.35	36.79	2308.63	36.82	2309.51	36.82	2311.1	36.8	2313.27	36.83
2314.72	36.86	2315.81	36.93	2318.65	37	2319.14	37	2319.45	37.03
2319.92	37.03	2321.65	37.1	2323.65	37.16	2325.46	37.18	2326.03	37.26
2328.81	37.46	2329.67	37.5	2330.3	37.57	2331.89	37.56	2333.64	37.62
2334.3	37.68	2334.74	37.69	2335.79	37.75	2336.22	37.76	2337.32	37.85
2337.94	37.85	2339.7	37.91	2342.04	38	2342.37	38.08	2345.24	38.7
2345.67	38.77	2346.22	38.89	2346.79	38.93	2347.33	39	2351.24	39
2351.87	38.9	2351.98	38.92	2352.81	38.79	2353.07	38.82	2355.96	38.74
2358.53	38.72	2359.3	38.78	2359.84	38.79	2360.15	38.83	2363.3	38.92
2365.69	39	2366.66	39	2367.32	39.16	2367.89	39.26	2368.31	39.31
2368.47	39.29	2369.14	39.32	2370	39.39	2370.97	39.51	2371.73	39.64
2372.02	39.62	2373.04	39.66	2373.36	39.72	2374.27	39.8	2374.79	39.79
2376.91	39.82	2379.26	39.87	2379.79	39.9	2380.3	39.95	2383.72	39.97
2384.5	39.98	2384.88	39.97	2386.5	39.97	2388.8	39.99	2389.12	40
2408.09	40	2410.69	40.26	2411.01	40.26	2411.43	40.34	2412.25	40.42
2413	40.51	2413.89	40.58	2414.49	40.71	2415.01	40.78	2416.2	41
2416.83	41	2418.25	41.02	2419.31	41.02	2421.75	41.05	2422.49	41.05
2423.92	41.07	2424.93	41.07	2426.37	41.1	2426.79	41.1	2428.32	41.13
2430.08	41.48	2432.14	41.84	2433.86	42	2435.72	42.31	2436.35	42.4
2437.28	42.43	2437.95	42.7	2438.09	42.71	2438.43	42.83	2438.69	42.87
2439.16	43	2439.92	43	2440.91	42.76	2441.48	42.73	2441.92	42.6
2442.12	42.6	2444.64	42.03	2445.71	42.04	2449.35	42.51	2450.6	42.63
2452.57	42.78	2453.54	42.81	2454.86	42.88	2456.65	42.88	2458.56	42.89
2460.08	42.98	2464.48	42.98	2465.29	42.97	2466.37	42.98	2467.95	42.97
2469.82	42.99	2470.83	42.99	2470.99	43	2472.24	43	2473.07	43.07
2474.13	43.13	2475.01	43.11	2475.76	43.2	2476.53	43.27	2476.82	43.28
2477.28	43.37	2477.49	43.36	2477.75	43.42	2478.99	43.38	2480.03	43.38
2480.84	43.47	2482.47	43.54	2485.34	43.69	2486.29	43.75	2489.81	43.99
2490.71	44	2496.06	44	2496.52	44.07	2498.14	44.18	2499.21	44.23
2499.77	44.27	2500.26	44.34	2501.75	44.5	2502.34	44.53	2502.78	44.57
2504.25	44.62	2504.5	44.68	2505.68	44.67	2506.66	44.68	2506.9	44.72
2507.82	44.74	2510.53	45	2518.26	45	2518.5	45.04	2520.45	45.21
2521.92	45.28	2522.82	45.26	2523.37	45.2	2523.84	45.2	2524.41	45.26
2525.11	45.37	2525.88	45.38	2526.11	45.42	2526.55	45.42	2526.95	45.5

2527.92	45.49	2528.05	45.51	2529.11	45.51	2529.76	45.54	2530.11	45.59
2530.85	45.59	2535.99	45.98	2538.5	45.98	2539.13	45.99	2544.22	45.99
2545.3	46	2546.95	46	2548.35	46.01	2549.54	46.18	2550.99	46.32
2551.66	46.33	2561.49	46.99	2567.19	46.99	2568.2	47	2571.89	47
2581.45	47.52	2590.66	48	2593.71	48	2594.29	48.1	2595.98	48.18
2597.29	48.29	2598.79	48.29	2600.46	48.34	2601.73	48.41	2602.65	48.47
2603.65	48.55	2610.67	48.99	2610.97	49	2623.74	49	2625.04	49.13
2625.64	49.21	2626.08	49.21	2626.5	49.27	2635.57	49.93	2636.47	49.98
2639.11	49.97	2643.6	49.74	2649.77	49.46	2651.84	49.51	2652.37	49.5
2654.04	49.55	2656.2	49.64	2658.2	49.77	2660.85	49.99		

Manning's n Values			num= 3		
Sta	n Val	Sta	n Val	Sta	n Val
1555	.125	1900.55	.042	1952.15	.125

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff Contr.	Expan.
1900.55	1952.15	320	320	320	.1	.3

CROSS SECTION

RIVER: FEMA-LR

REACH: LR-BL

RS: 23012

INPUT

Description: Approximated Section (XS-6)

HEC-2 STA 23012

Station Elevation Data			num= 492						
Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
1489.07	50	1497.7	49.5	1497.7	45.06	1500.82	45.06	1501.29	45.05
1501.85	45.06	1503.34	45.04	1509.46	45.04	1509.6	45.03	1513.03	45.03
1514.67	45.02	1515.83	45.02	1521.27	45.01	1550.19	45.01	1550.99	45
1558.88	45	1560.96	44.81	1569.59	44	1570.14	44	1576.17	43.43
1580.68	43	1583.26	42.78	1592.36	42	1594.25	41.57	1595.72	41.26
1595.73	41.25	1596.78	41	1598.36	40.61	1600.81	40	1602.89	39.68
1603.27	39.63	1607.5	39	1609.5	38.69	1613.67	38.01	1613.86	38
1616.18	37.73	1617.76	37.53	1619.33	37.34	1621.98	37	1623.26	36.83
1624.8	36.67	1630.77	36.01	1631	36	1632.42	35.83	1634.44	35.63
1640.44	35	1641.19	35	1644.37	34.85	1644.51	34.84	1646.26	34.76
1649.8	34.61	1663.87	34.01	1664.4	34	1672.87	34	1673.28	33.99
1684.36	33.1	1685.71	33	1689.56	32.77	1694.81	32.48	1696.73	32.32
1697.24	32.29	1698.3	32.2	1700.41	32	1705.09	31.19	1706.14	31
1706.4	30.97	1708.83	30.75	1710.39	30.59	1711.36	30.51	1712.34	30.42
1713.79	30.28	1714.25	30.24	1716.5	30	1719.01	29.98	1719.42	29.97
1721.42	29.97	1721.92	29.98	1722.65	29.98	1725.45	30	1725.86	30.07
1727.03	30.23	1728.09	30.32	1728.27	30.32	1729.54	30.49	1730.96	30.73
1731.36	30.78	1732.18	30.93	1732.52	31	1732.98	31	1733.36	31.02
1734.75	31.07	1735	31.07	1736.41	31.12	1737.42	31.16	1738.68	31.2
1739.01	31.2	1739.63	31.22	1742.59	31.14	1746.34	31	1747.39	31
1747.83	30.99	1749.91	30.99	1750.82	31	1752.02	31	1754.37	31.12
1755.52	31.2	1756.15	31.2	1757.67	31.29	1759.27	31.33	1759.64	31.31

1760.32	31.31	1761.32	31.37	1762.54	31.4	1763.26	31.4	1766.1	31.29
1767.48	31.23	1769.06	31.18	1770.36	31.08	1771.34	31.04	1772.73	31.07
1773.36	31.06	1774.66	31.06	1775.53	31.03	1776.66	31	1777.8	30.98
1779.43	30.99	1779.98	30.98	1781.07	30.98	1782.62	31.02	1785.59	31.12
1786.63	31.12	1787.58	31.11	1788.58	31.08	1788.97	31.1	1790.13	31.11
1790.88	31.14	1791.37	31.17	1792.14	31.2	1792.8	31.24	1793.87	31.26
1794.91	31.26	1795.32	31.29	1797.57	31.29	1798.01	31.31	1799.2	31.28
1799.9	31.29	1800.35	31.32	1801.8	31.33	1802.31	31.35	1803.08	31.35
1803.95	31.34	1804.5	31.32	1805.24	31.32	1806.02	31.28	1806.39	31.27
1806.73	31.29	1807.76	31.28	1808.89	31.22	1809.61	31.14	1810.72	31.03
1812.12	30.86	1812.41	30.84	1812.88	30.78	1814.19	30.66	1814.45	30.61
1814.77	30.58	1815.48	30.44	1816.09	30.35	1817.36	30	1819.24	29.17
1819.61	29	1820.87	28.28	1821.47	28	1823.97	27.25	1824.96	27
1827.74	27	1828.75	29.18	1829.49	28.34	1831.17	26.41	1831.27	26.31
1836.39	22.63	1839.93	21.69	1845.53	20.71	1849.24	20.83	1850.62	20.88
1853.9	21.23	1856.19	22.76	1860.97	26.13	1861.49	26.14	1862.46	26.14
1862.6	26.01	1863.96	26	1865.34	26	1866.67	25.95	1866.87	25.95
1867.79	25.81	1870.1	25.56	1870.16	25.56	1872.66	25.66	1876.51	25.87
1877.15	25.96	1877.5	26	1884.02	26	1885.13	26.01	1885.2	26
1891.53	26	1893.42	25.99	1893.87	26	1896.72	26	1899.76	26.29
1901.34	26.45	1906.67	27	1908.47	27.11	1909.89	27.19	1909.99	27.19
1912.64	27.35	1914.46	27.45	1920.77	27.99	1924.81	27.99	1932.56	27.67
1934.2	27.62	1936.48	27.54	1937.26	27.52	1937.62	27.5	1940.69	27.39
1943.88	27.27	1948.78	27.06	1950.37	27	1950.75	26.99	1951.53	26.99
1952.29	26.91	1954.93	26.67	1955.19	26.67	1956.14	26.64	1957.2	26.57
1957.79	26.55	1958.39	26.54	1959.19	26.48	1959.86	26.48	1961.27	26.46
1961.53	26.44	1972.57	26	1978.5	26	1980.26	25.87	1980.33	25.87
1982	25.75	1985	25.54	1986.15	25.46	1991.13	25.09	1992.36	25
2005.49	25	2006.24	25.09	2007.69	25.28	2013.29	25.99	2013.67	26
2015	26.45	2015.65	26.67	2016.75	27	2016.99	27.09	2018	27.42
2018.28	27.52	2019.35	28	2022.06	28.77	2022.86	29	2023.96	29.4
2025.68	30	2034.76	30	2035.29	30.02	2065.13	30.97	2065.59	30.99
2066.19	31	2092.74	31	2096.29	31.17	2098.17	31.24	2098.97	31.29
2100.77	31.38	2104.45	31.58	2105.77	31.66	2107.47	31.75	2111.33	31.99
2111.56	32	2152.77	32	2157.58	32.48	2159.98	32.71	2161.59	32.85
2162.24	32.92	2162.85	32.92	2163.49	32.91	2164.24	32.88	2165.3	32.79
2166.05	32.72	2168.32	32.57	2175.37	32.01	2175.46	32	2184.62	32
2186.32	32.03	2188.77	32.09	2197.24	32.36	2203.63	32.31	2203.8	32.32
2208.7	32.33	2213.81	32.33	2214.24	32.34	2218.34	32.42	2225.38	32.58
2225.64	32.59	2228.01	32.63	2229.93	32.67	2230.63	32.68	2231.34	32.68
2236.3	32.79	2243.3	32.96	2244.6	33	2247.9	33	2249.05	32.99
2250.04	32.99	2250.21	33	2264.87	33	2265.27	33.02	2266.99	33.04
2268.46	33.07	2270.32	33.18	2270.99	33.23	2271.55	33.25	2273	33.32
2275.62	33.44	2277.42	33.55	2284.38	33.99	2285.48	33.99	2285.88	34
2286.14	33.99	2287.19	34	2288.01	34.07	2288.71	34.14	2297.07	35
2297.58	35	2299.33	35.15	2300.77	35.28	2303.82	35.55	2305.25	35.67
2308.3	35.99	2308.84	36	2309.74	36.17	2314.02	37	2314.45	37.22
2314.7	37.32	2316.16	38	2316.41	38.02	2318.68	38.62	2320.31	39
2321.54	39.56	2322.21	39.79	2322.43	40	2325.71	40	2327.56	39.84
2327.75	39.85	2328.6	39.72	2331.08	39.64	2333.14	39.6	2334.12	39.67
2335.37	39.78	2338.21	40	2339.1	40	2342.07	40.19	2344.37	40.31

2344.86	40.34	2348.02	40.56	2349.65	40.66	2350.23	40.7	2353.11	40.91
2354.1	40.99	2355.06	41.01	2356.21	41.04	2356.51	41.04	2364.38	41.52
2364.67	41.54	2369.48	41.9	2370.64	41.99	2371.59	42	2373.01	42.07
2378.55	42.32	2378.61	42.33	2392.97	42.99	2393.83	42.99	2394.09	43
2396.39	43	2398.73	43.14	2401.02	43.27	2401.77	43.32	2403.7	43.46
2405.92	43.6	2406.55	43.65	2407.11	43.68	2408.33	43.76	2408.55	43.78
2409.55	43.83	2411.07	43.92	2412.06	43.97	2412.5	44	2413.39	44.02
2414.24	44.06	2416.57	44.16	2421.72	44.37	2425.49	44.53	2429.41	44.72
2430.95	44.79	2433.33	44.93	2434.88	45	2441.01	45	2446.03	45.35
2449.31	45.53	2456.6	45.99	2457.75	45.99	2458.03	46	2458.76	46
2464.77	46.57	2466.99	46.77	2468.31	46.84	2469.44	46.91	2470.17	46.95
2470.69	46.96	2472.63	46.98	2473.72	47	2474.2	47.03	2475.34	47.06
2475.41	47.07	2476.43	47.12	2477.92	47.22	2478.17	47.22	2478.87	47.25
2479.37	47.3	2479.6	47.3	2480.57	47.37	2481.19	47.37	2481.82	47.43
2482.41	47.46	2483.55	47.45	2483.99	47.48	2484.57	47.49	2485.2	47.53
2485.76	47.55	2486.73	47.56	2487.79	47.6	2488.59	47.64	2489.52	47.7
2490.17	47.75	2491.2	47.82	2492.94	47.92	2494.01	48	2495.32	48.33
2496.4	48.62	2496.72	48.68	2498.12	49	2499.2	49.42	2499.92	49.54
2500.16	49.59	2500.75	49.63	2501.52	49.84	2502.36	50	2503.13	50.2
2504.08	50.5	2504.56	50.64	2505.01	50.81	2505.41	51	2506.28	51.24
2507.05	51.38	2508	51.68	2508.5	51.83	2509.73	52.31	2510.05	52.4
2512.36	52.83	2512.96	53	2513.14	53.03	2513.47	53.05	2513.67	53.01
2514.95	53.02	2515.6	53.04	2516.85	53.05	2518.6	53.73	2519.04	53.88
2519.23	53.87	2519.59	53.91	2520.41	53.92	2521.68	53.73	2522.42	53.63
2522.5	53.64	2523.4	53.49	2523.67	53.49	2524.05	53.46	2524.33	53.41
2525.06	53.32	2525.54	53.27						

Manning's n Values		num=	3
Sta	n Val	Sta	n Val
1489.07	.125	1831.17	.042

Bank Sta: Left	Right	Lengths: Left	Channel	Right	Coeff	Contr.	Expan.
1831.17	1861.49	1800	1800	1800	.1	.3	

CROSS SECTION

RIVER: FEMA-LR

REACH: LR-BL

RS: 21212

INPUT

Description: (M) Surveyed Section LR8

HEC-2 STA 21212

Station Elevation Data	num=	10
Sta	Elev	Sta
320	50	1710
2000	21.7	2020
2030	22.8	2080
2095	35	21212

Manning's n Values		num=	3
Sta	n Val	Sta	n Val
320	.112	1981	.042

Bank Sta:	Left	Right	Lengths:		Left	Channel	Right	Coeff	Contr.	Expan.
	1981	2020			800	800	800		.1	.3

SUMMARY OF MANNING'S N VALUES

River:FEMA-LR

Reach	River Sta.	n1	n2	n3
LR-BL	28266	.08	.04	.08
LR-BL	27691*	.08	.04	.08
LR-BL	27116	.08	.04	.08
LR-BL	26541*	.08	.04	.08
LR-BL	25966	.08	.04	.08
LR-BL	25316*	.08	.04	.08
LR-BL	24666	.08	.04	.08
LR-BL	24342	.12	.042	.12
LR-BL	23760	.125	.042	.125
LR-BL	23566	.125	.042	.125
LR-BL	23466	.12	.042	.12
LR-BL	23449	Bridge		
LR-BL	23432	.125	.042	.125
LR-BL	23332	.125	.042	.125
LR-BL	23012	.125	.042	.125
LR-BL	21212	.112	.042	.112

SUMMARY OF REACH LENGTHS

River: FEMA-LR

Reach	River Sta.	Left	Channel	Right
LR-BL	28266	575.12	575.12	575.12
LR-BL	27691*	575.13	575.13	575.13
LR-BL	27116	575	575	575
LR-BL	26541*	575	575	575
LR-BL	25966	650	650	650
LR-BL	25316*	650	650	650
LR-BL	24666	327.3	327.3	327.3
LR-BL	24342	582.42	582.42	582.42
LR-BL	23760	171.8	195.55	249.91
LR-BL	23566	74.4	68.75	45.59
LR-BL	23466	52.58	52.58	52.58
LR-BL	23449	Bridge		
LR-BL	23432	161.37	131.63	53.58

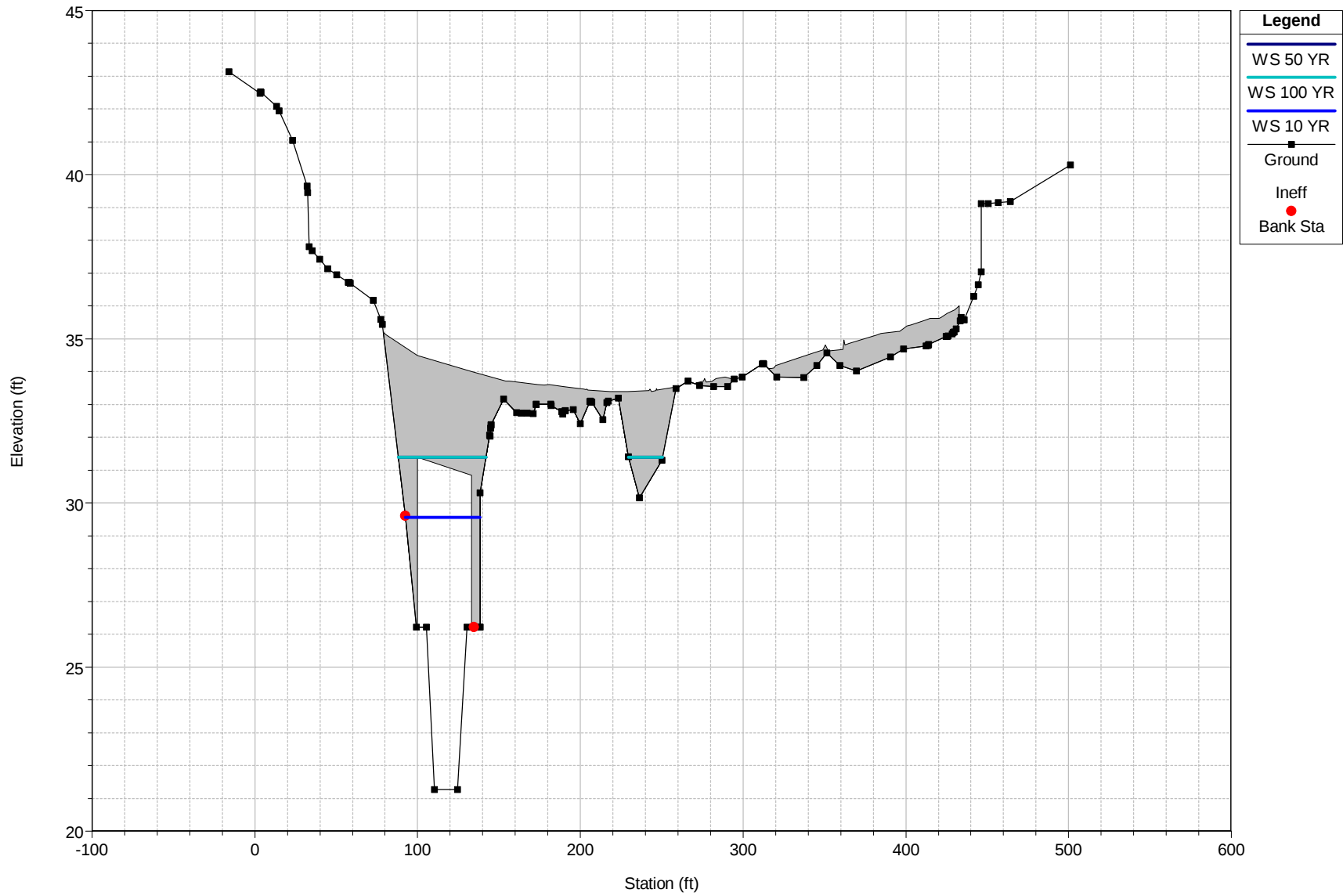
LR-BL	23332	320	320	320
LR-BL	23012	1800	1800	1800
LR-BL	21212	800	800	800

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS

River: FEMA-LR

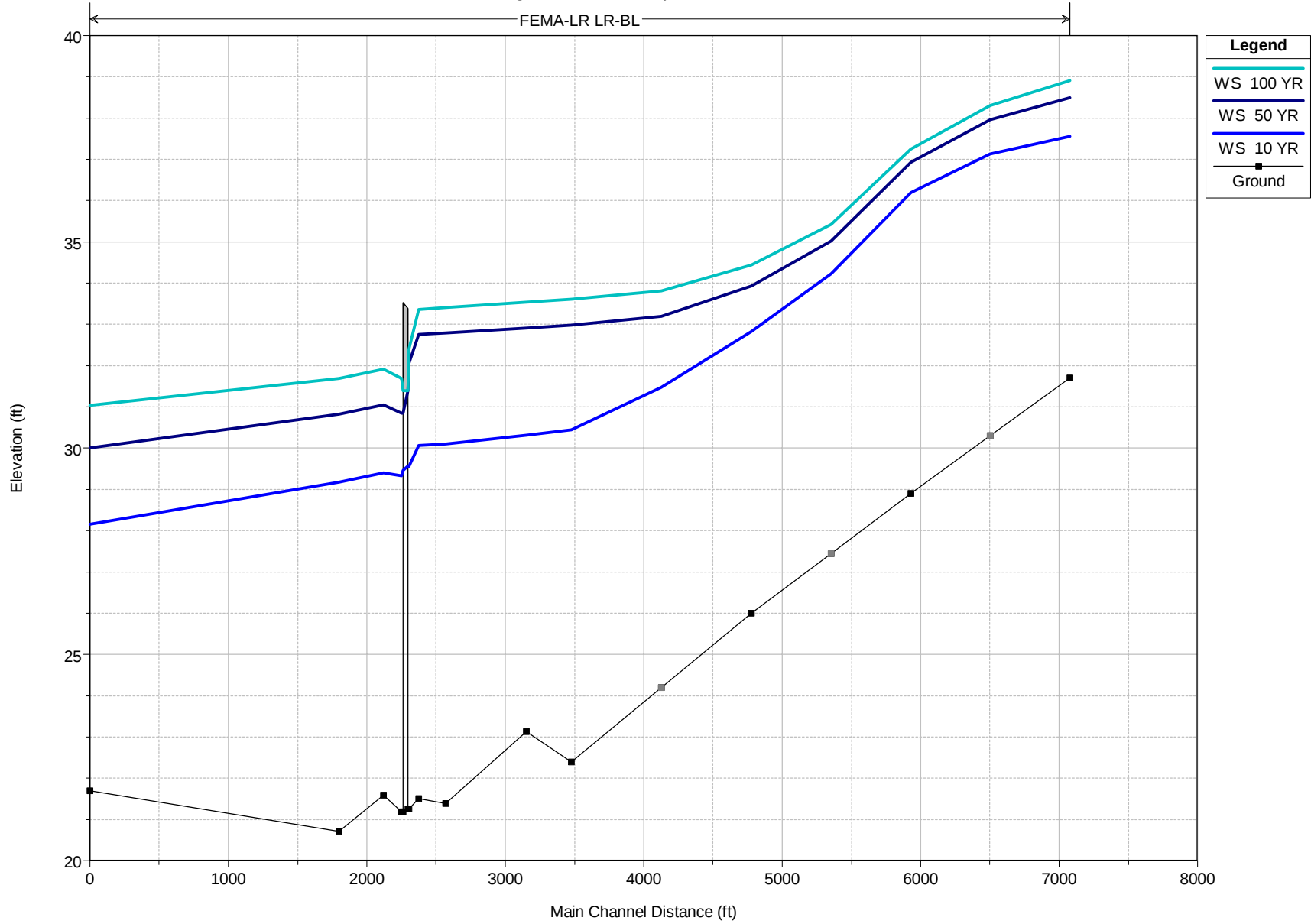
Reach	River Sta.	Contr.	Expan.
LR-BL	28266	.1	.3
LR-BL	27691*	.1	.3
LR-BL	27116	.1	.3
LR-BL	26541*	.1	.3
LR-BL	25966	.1	.3
LR-BL	25316*	.1	.3
LR-BL	24666	.1	.3
LR-BL	24342	.1	.3
LR-BL	23760	.1	.3
LR-BL	23566	.3	.5
LR-BL	23466	.3	.5
LR-BL	23449	Bridge	
LR-BL	23432		.5
LR-BL	23332		.3
LR-BL	23012		.3
LR-BL	21212		.3

Rosemont Bridge Plan: Proposed Conditions 4/24/2024
Rosemont Street Bridge



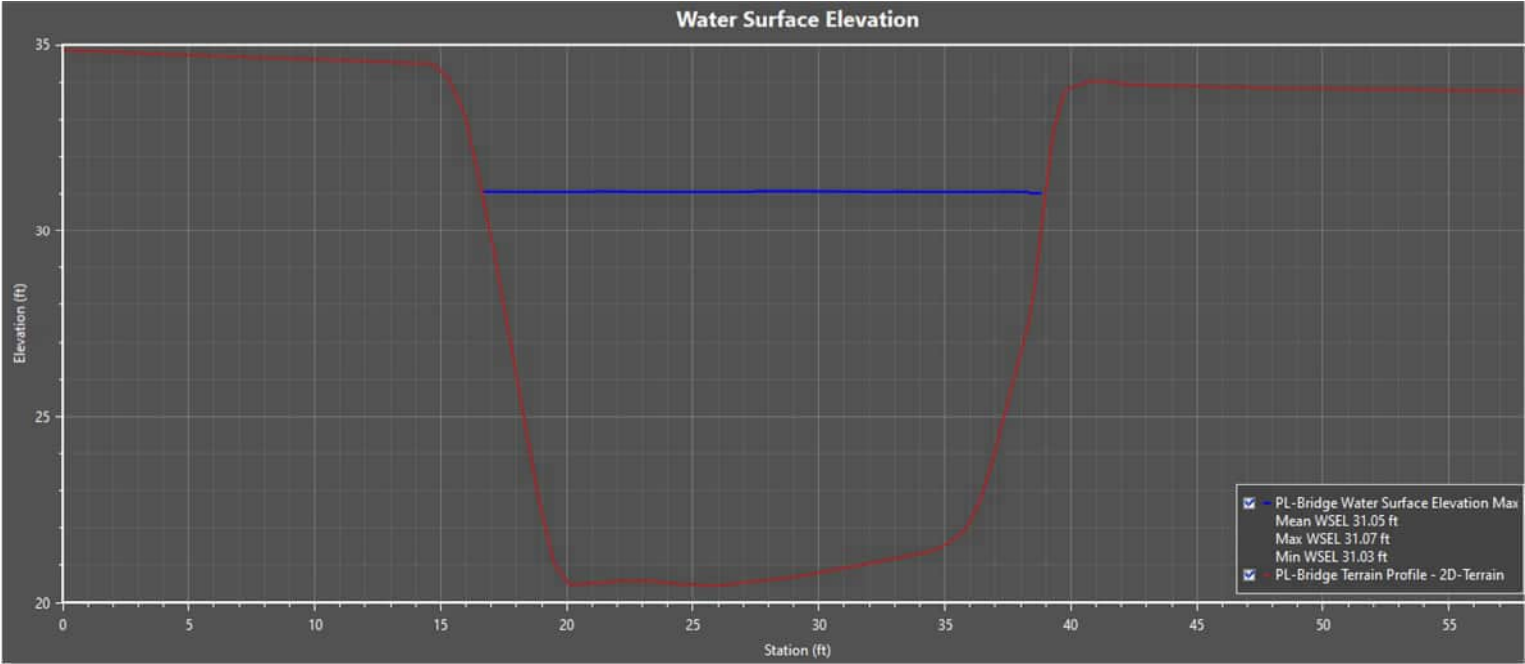
Rosemont Bridge Plan: Proposed Conditions 4/24/2024

FEMA-LR LR-BL



2D Modeling Results

Water Depth (feet)a



Velocity Magnitude (ft/s)



Water Depth (feet) and Velocity Vector at the Bridge (ft/s)

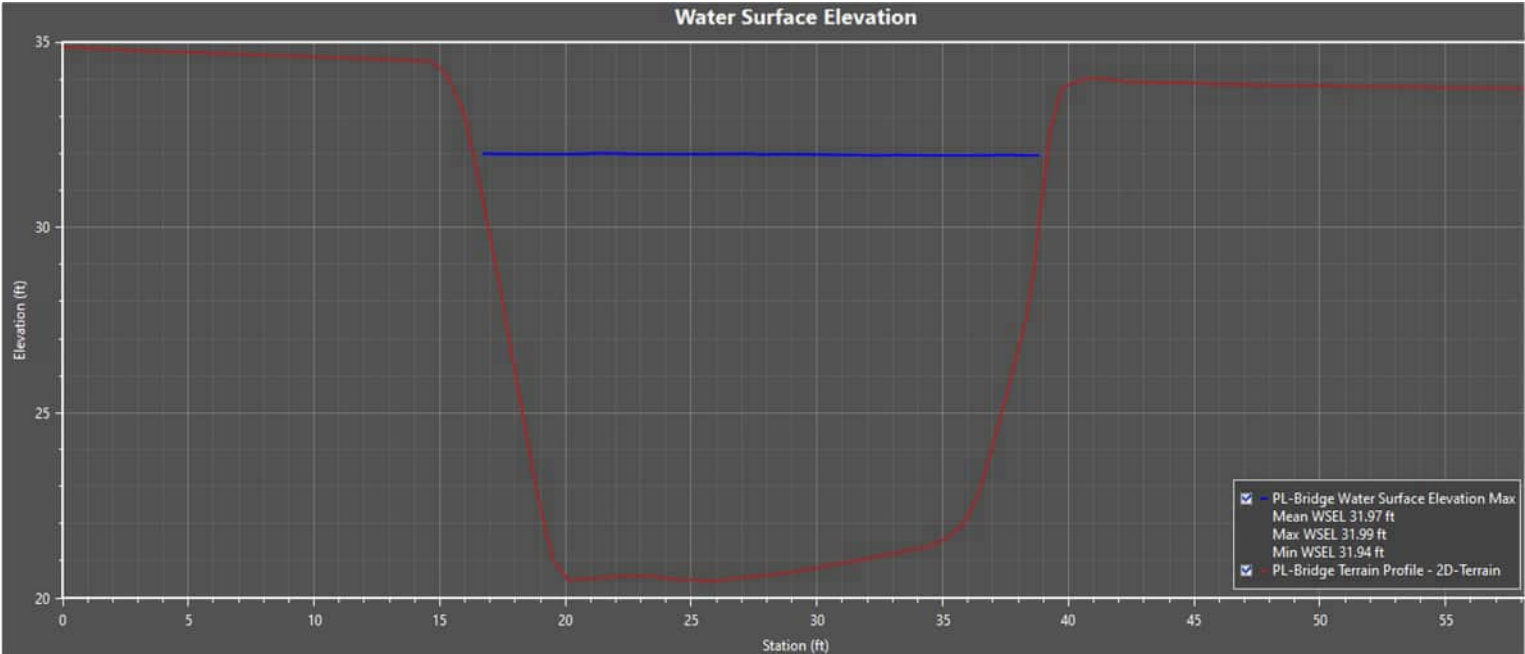


GeoHECRAS 2D Modeling Results: 10-Year Riverine Flood, Existing Conditions.

Water Depth (feet)



Water Surface Elevation



Velocity Magnitude (ft/s)

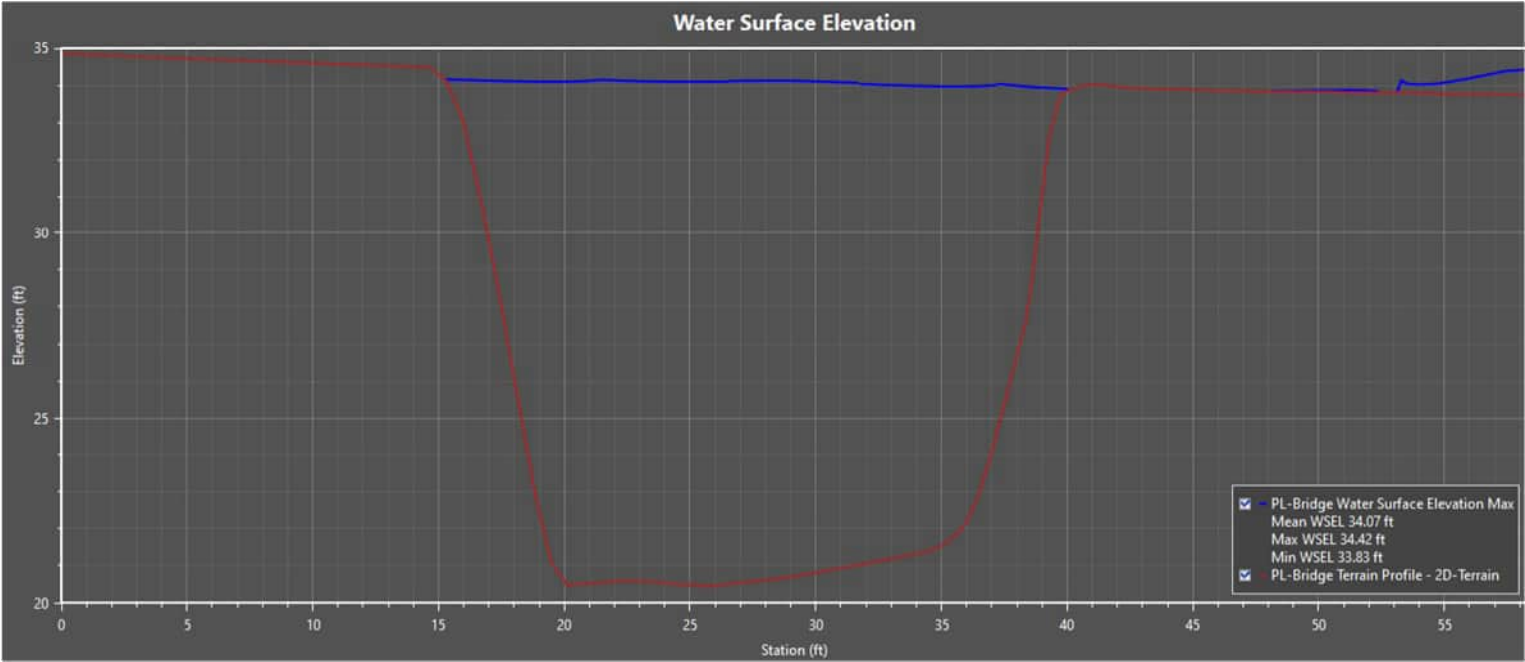
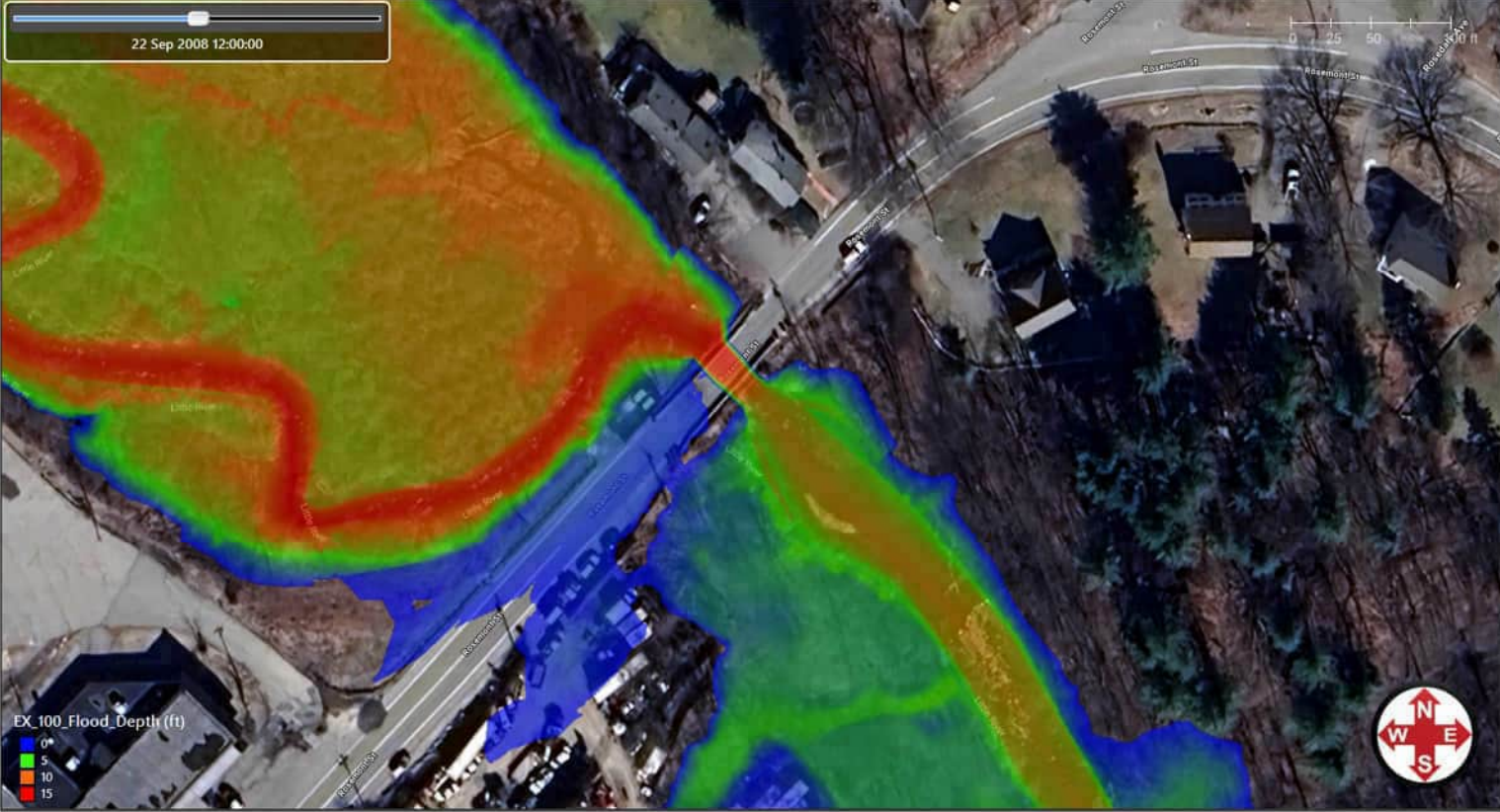


Water Depth (feet) and Velocity Vector at the Bridge (ft/s)



GeoHECRAS 2D Modeling Results: 50-Year Riverine Flood, Existing Conditions.

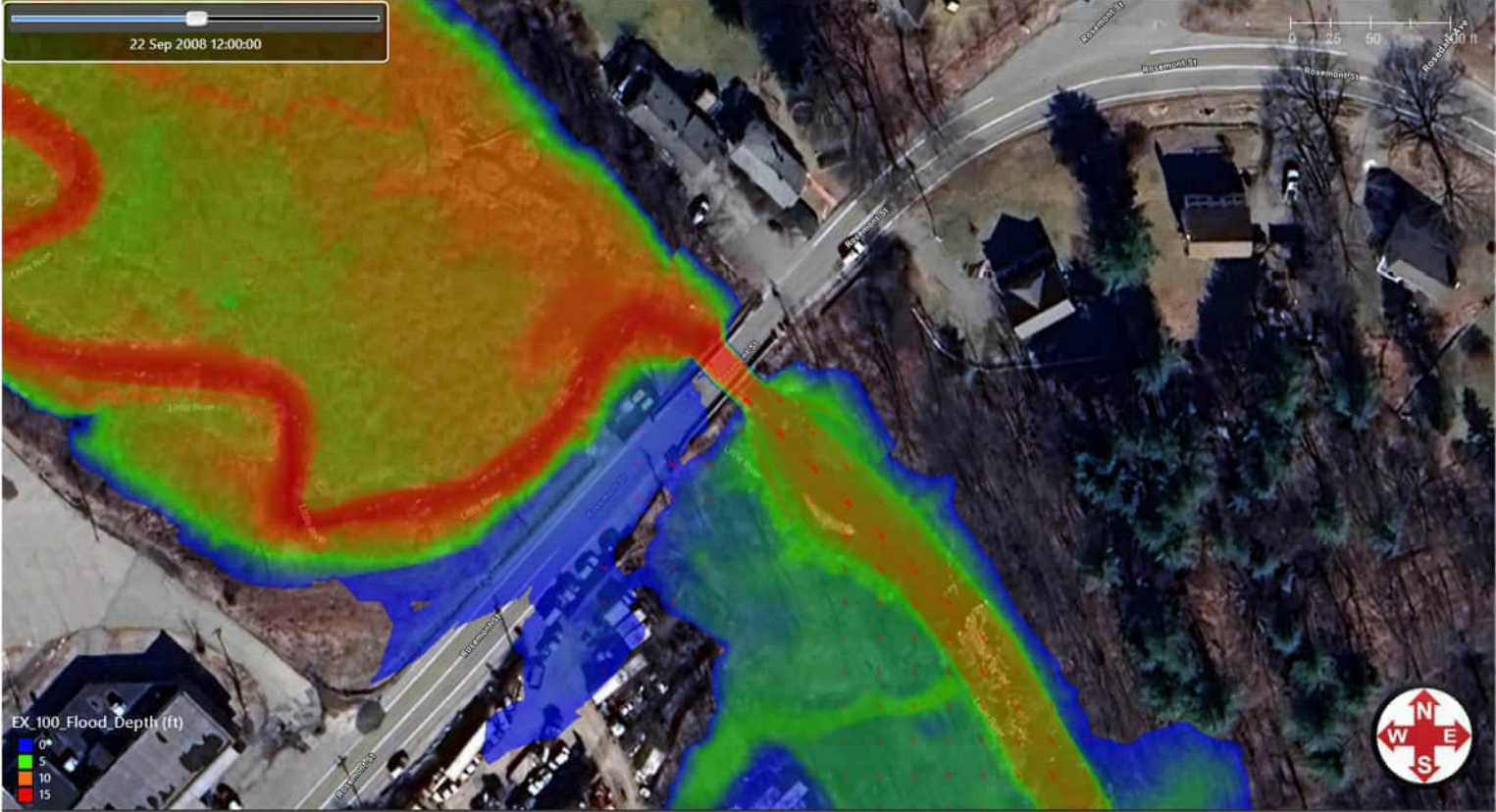
Water Depth (feet)



Velocity Magnitude (ft/s)



Water Depth (feet) and Velocity Vector at the Bridge (ft/s)

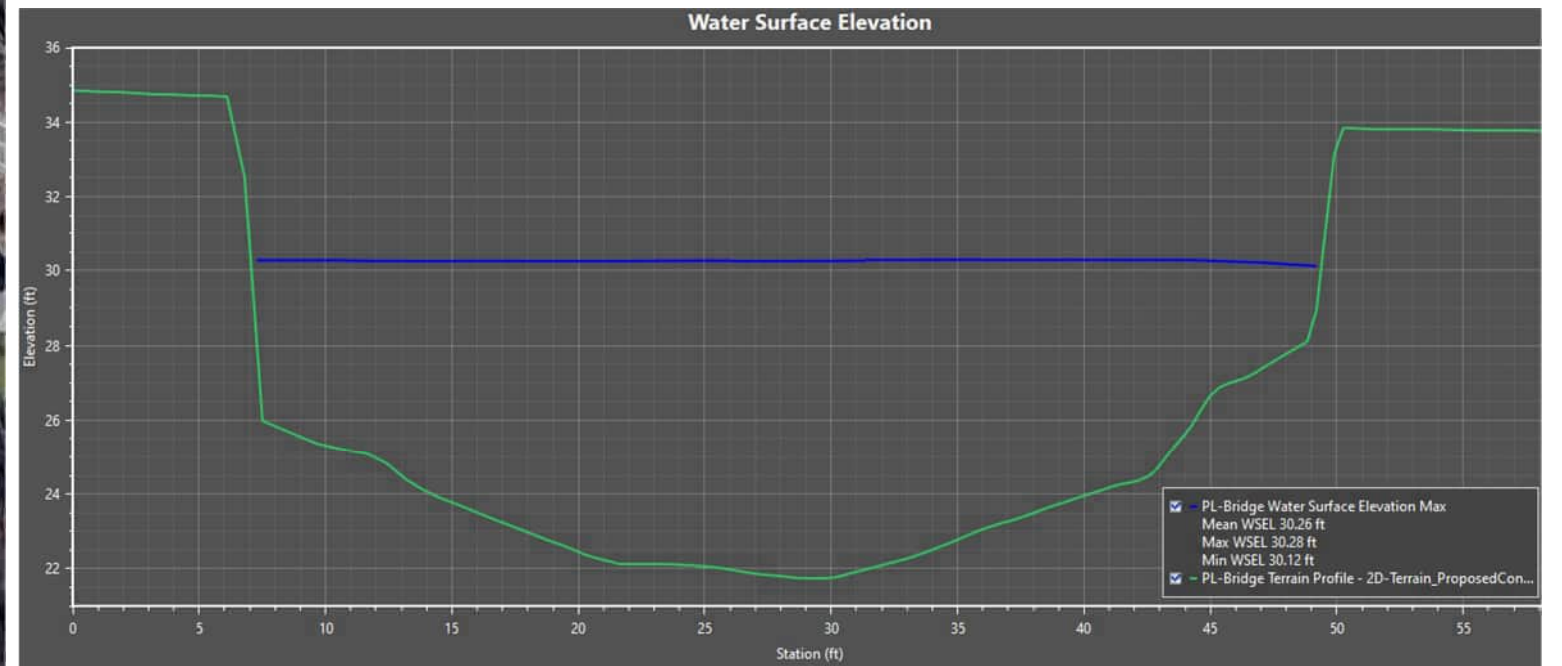


GeoHECRAS 2D Modeling Results: 100-Year Riverine Flood, Existing Conditions.

Water Depth (feet)



Water Surface Elevation



Velocity Magnitude (ft/s)



Water Depth (feet) and Velocity Vector at the Bridge (ft/s)

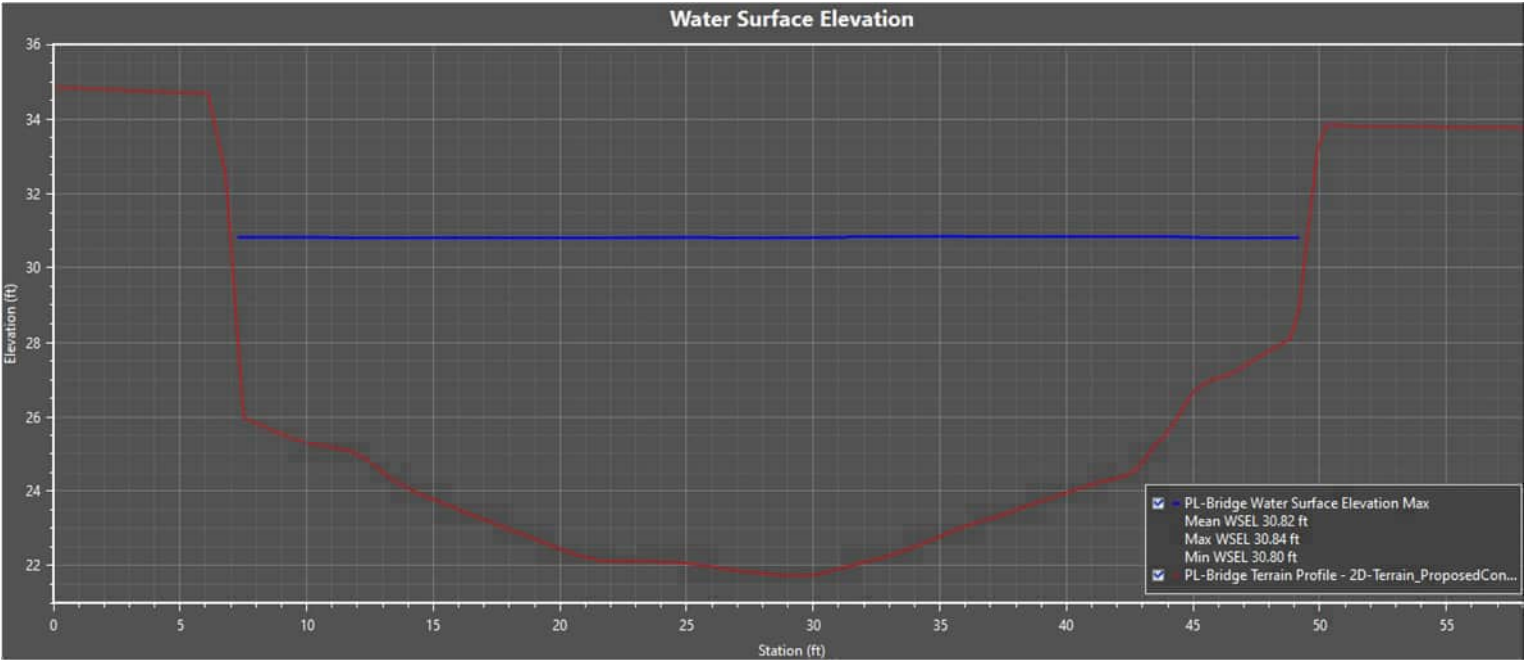


GeoHECRAS 2D Modeling Results: 25-Year Riverine Flood, Proposed Conditions.

Water Depth (feet)



Water Surface Elevation



Velocity Magnitude (ft/s)



Water Depth (feet) and Velocity Vector at the Bridge (ft/s)

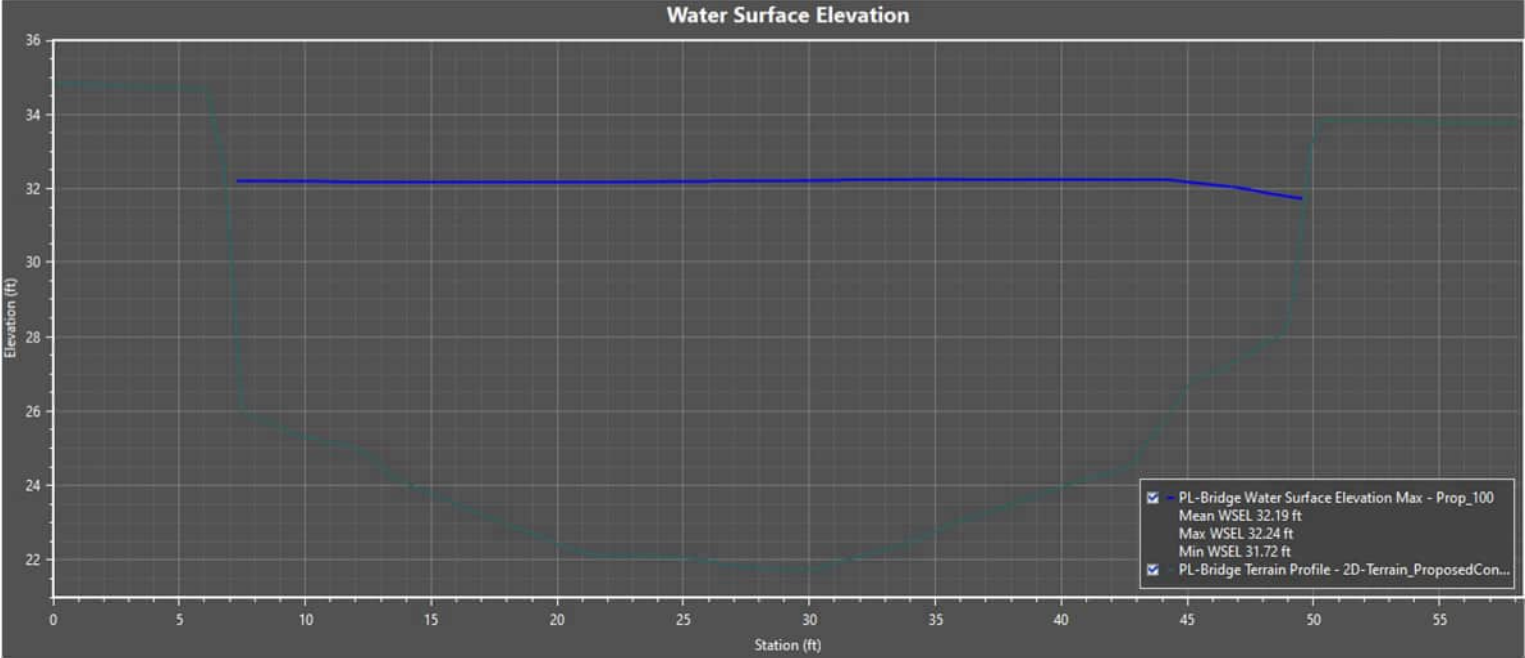


GeoHECRAS 2D Modeling Results: 50-Year Riverine Flood, Proposed Conditions.

Water Depth (feet)



Water Surface Elevation



Velocity Magnitude (ft/s)



Water Depth (feet) and Velocity Vector at the Bridge (ft/s)



GeoHECRAS 2D Modeling Results: 100-Year Riverine Flood, Proposed Conditions.

APPENDIX D

SCOUR COMPUTATIONS

Hydraulic Analysis Report

Contraction Scour

1. Determine return frequency for the Scour Design Flood and Scour Check Flood using Table 1.3.4-1:

Highway Functional Classification:	Rural Collector, Major
Scour Design Flood Return Frequency:	50 Year
Scour Check Flood Return Frequency:	100 Year

2. Determine routine

$$v_c = K_u \times y_1^{1/6} \times D_{50}^{1/3} \quad \text{Equation 1: Critical Velocity}$$

v_c = Critical Velocity (ft/s)

K_u = 11.17 (Constant)

y_1 = Average Depth of flow upstream of the bridge (ft)

D_{50} = Particle Size (ft)

Parameters	50 Year	100 Year
	Channel	Channel
K_u	11.17	11.17
y_1 (ft)	5.68	6.08
D_{50} (mm)	1.95	1.95
D_{50} (ft)	0.0064	0.0064
V_c (ft/s)	2.77	2.80
V_0 (ft/s)	3.68	4.94
$V_c - V_0$	-0.91	-2.14
Routine:	LIVE	LIVE

Equation 1

V_0 = Veclocity in the approach section(ft/s) [Value is from the model]

Clear = $V_c > V_0$; Live = $V_c < V_0$

3. Calculate Contraction Sour Based on Routine

$$\frac{y_2}{y_1} = \left(\frac{Q_2}{Q_1} \right)^{\frac{6}{5}} \times \left(\frac{W_1}{W_2} \right)^{k_1} \quad \text{Equation 2: Average depth in contracted section}$$

$$y_s = y_2 - y_0 \quad \text{Equation 3: Contraction Scour}$$

Q_1 = Flow in upstream channel (cfs)

Q_2 = Flow in contracted channel (cfs)

W_1 = Bottom width of upstream main channel (ft)

W_2 = Bottom width of main channel in contracted section (ft)

K_1 = Exponent from Table 1

y_0 = Existing depth in contracted section before scour (ft)

y_1 = Average Depth of flow upstream of the bridge (ft)

y_2 = Average depth in contracted section (ft)

y_s = Average contraction scour depth (ft)

Table 1		
V*/T	k1	Mode of Bed Material Transport
<0.5	0.59	Mostly contact bed material
0.5	0.64	Some suspended bed material discharge
>2.0	0.69	Mostly suspended bed material discharge

$V^* = (\theta_0 / \Delta)^{1/2} = (g y_1 S_1)^{1/2}$, shear velocity in the upstream section, ft/s (m/s)

T = Fall velocity of bed material based on the D_{50} , m/s (Figure 6.8)

For fall velocity in English units (ft/s) multiply T in m/s by 3.28

g = Acceleration of gravity (32.2 ft/s²) (9.81 m/s²)

S_1 = Slope of energy grade line of main channel, ft/ft (m/m)

θ_0 = Shear stress on the bed, (lb/ft²) (Pa (N/m²))

Δ = Density of water (1.94 slugs/ft³) (1000 kg/m³)

Live-Water Routine		
Channel Parameters	50 Year	100 Year
Q_1 (cfs)	1196.75	1395.01
Q_2 (cfs)	1380	1630
W_1 (ft)	41.47	41.47
W_2 (ft)	32	32
K_1	0.64	0.64
y_0 (ft)	6.8	7.31
y_2 (ft)	7.58	8.20
y_s (ft)	0.78	0.89

Channel Depth Average inside bridge opening

Equation 2

Equation 3

Contraction Scour y_s =	50 Year	100 Year
	0.78	0.89

Abutment Scour

1. Determine Computation Type and Method

Computation Method: NCHRP 24-20 Mehtod

L/B is >75%

Scour Condition (a) live-bed scour

2. Calculate Total Scour at the Abutment

$y_{max} = \alpha_A \times y_c$ Equation 4

y_{max} = Maximum flow depth resulting fromabutment scour (ft)

α_A = Amplification factor for live-bed conditions

y_c = Flow dpeth including live-bed or clear water contraction scour (ft)

$y_c = y_1 \left(\frac{q_{2c}}{q_1} \right)^{6/7}$ Equation 5

y_1 = Upstream flow depth (ft)

q_1 = Upstream unit discharge (ft²/s)

q_{2c} = Unit discharge in the constricted opening (ft²/s)

	50-YR			100-YR		
	CFS	Width	Unit Discharge (ft^2/s)	CFS	Width (ft)	Unit Discharge (ft^2/s)
Bridge (q_{2c})	1380	32	43.13	1630	32	50.94
Approach (q_1)	404	25	16.16	445	25	17.80

	50-YR	100-YR
q_1 / q_{2c}	2.67	2.86
α_A	1.11	1.10
y_1 (ft)	4.00	4.50
y_c (ft)	9.28	11.08
y_o (ft)	4.60	5.15
y_{max} (ft)	10.25	12.19

Equation 5

Equation 4

3. Calculate Abutment Scour Depth

$y_s = y_{max} - y_o$ Equation 6

y_s = Abutment scour depth, ft (m)

	50-YR	100-YR
y_{max} (ft)	10.25	12.19
y_o (ft)	4.60	5.15
y_s (ft)	5.65	7.04

Equation 6

	50-YR	100-YR
Abutment Scour y_s =	5.65	7.04

APPENDIX E

GEOTECHNICAL REPORT

Preliminary Geotechnical Recommendations
Rosemont Street Bridge,
Haverhill, Massachusetts

GEI Consultants, Inc.
GEI Project 1801408
April 9, 2019

Site and Project Description

The site is located where Rosemont Street crosses over the Little River in Haverhill, Massachusetts (Figs. 1 and 2). A sewer pump station is located close to the bridge.

We understand that the City of Haverhill plans to replace the existing bridge with a new single-span replacement bridge that will be supported on new abutments just outside the existing abutments. The existing abutments and wingwalls will be demolished. The roadway grades will remain roughly the same.

Geotechnical Data

Northern Drill Service Inc. of Northborough, Massachusetts drilled 2 borings (BB-1 and BB-2) November 1 and November 5, 2018. The locations of the borings are shown in Fig. 2. We also obtained four sediment samples, by hand, from the banks and channel of the Little River on January 18, 2019.

The soil layers encountered in the borings are described below in order of increasing depth. The approximate layer boundaries are shown in the subsurface profile in Fig. 3. Conditions are known only at the boring locations and conditions between borings may differ from those indicated below and shown in the profile.

Asphalt: All the borings were drilled in Rosemont Street, which is paved with about 6 inches of asphalt.

Fill: Fill was encountered below the pavement in both borings to depths of about 13.5 to 16 feet below the ground surface. The fill generally consisted of fine to coarse sand, with some fine to coarse gravel and trace inorganic silt. BB-2 encountered numerous boulders in the fill layer from a depth of 5 feet to 16 feet and some fine sand with some organic material at a depth of about 19 feet. SPT N-values in the fill ranged from 13 to more than 100 blows per foot, indicating a loose to very dense soil. The large range of the N-values indicates the variability of both the density and gradation of the fill. Some of the higher N-values were likely the result of the sampler encountering coarse gravel, cobbles, or boulders.

Lean Clay: Gray lean clay with trace fine to coarse sand was encountered below the fill in BB-2. The lean clay layer was 3 feet thick. The N-value obtained in the lean clay was 2 blows per foot, indicating a soft clay.

Bedrock: Bedrock was encountered below the fill and clay at depths of 13 feet in BB-1 and 22 feet in BB-2. The bedrock was classified as black, fine-grained, hard, fresh, siltstone in BB-1 and black, coarse-grained, hard, fresh, schist in BB-2 (Berwick Formation). Core recovery ranged from 95 to 100 percent. The Rock Quality Designation (RQD) ranged from 56 to 100 percent, with four out of five values greater than 80 percent, indicating fairly intact bedrock.

Groundwater Levels

Depth to groundwater was measured in boring BB-1 at a depth of 4.5 feet below ground surface after drilling (~El. 29.5) and in BB-2 at a depth of 7.9 feet below ground surface after drilling (~El. 27). Borings were drilled with water and were typically completed in a day, so the water level measurements may not represent stabilized values. We expect the groundwater elevation to be similar to, or slightly higher than, the water level in the river or about El. 25.

Recommended Foundation Types

At the northeast abutment (BB-1) bedrock was encountered close to the proposed bearing elevation of the new abutment. Therefore, we recommend that the northeast abutment be founded on spread footings bearing on rock. Some rock removal may be required to construct the new abutment at the proposed bearing elevation.

At the southeast abutment, bedrock was encountered about 6 to 8 feet below the proposed abutment bearing elevation. Supporting the abutment on a spread footing bearing on rock would require excavating about 10 to 12 feet below the groundwater table in a sheeted and braced excavation. Therefore, we recommend that the southeast abutment be founded on short driven piles driven to the top of rock or on short drilled piles drilled into rock. The pile supported foundation will still require excavation support and dewatering to reach the proposed bottom of pile cap elevation, but a significantly lesser amount than to found the abutment directly on rock.

For both options, raising the elevation of the footing or pile cap could reduce potential construction difficulties.

Figs. 1, 2, and 3 attached.

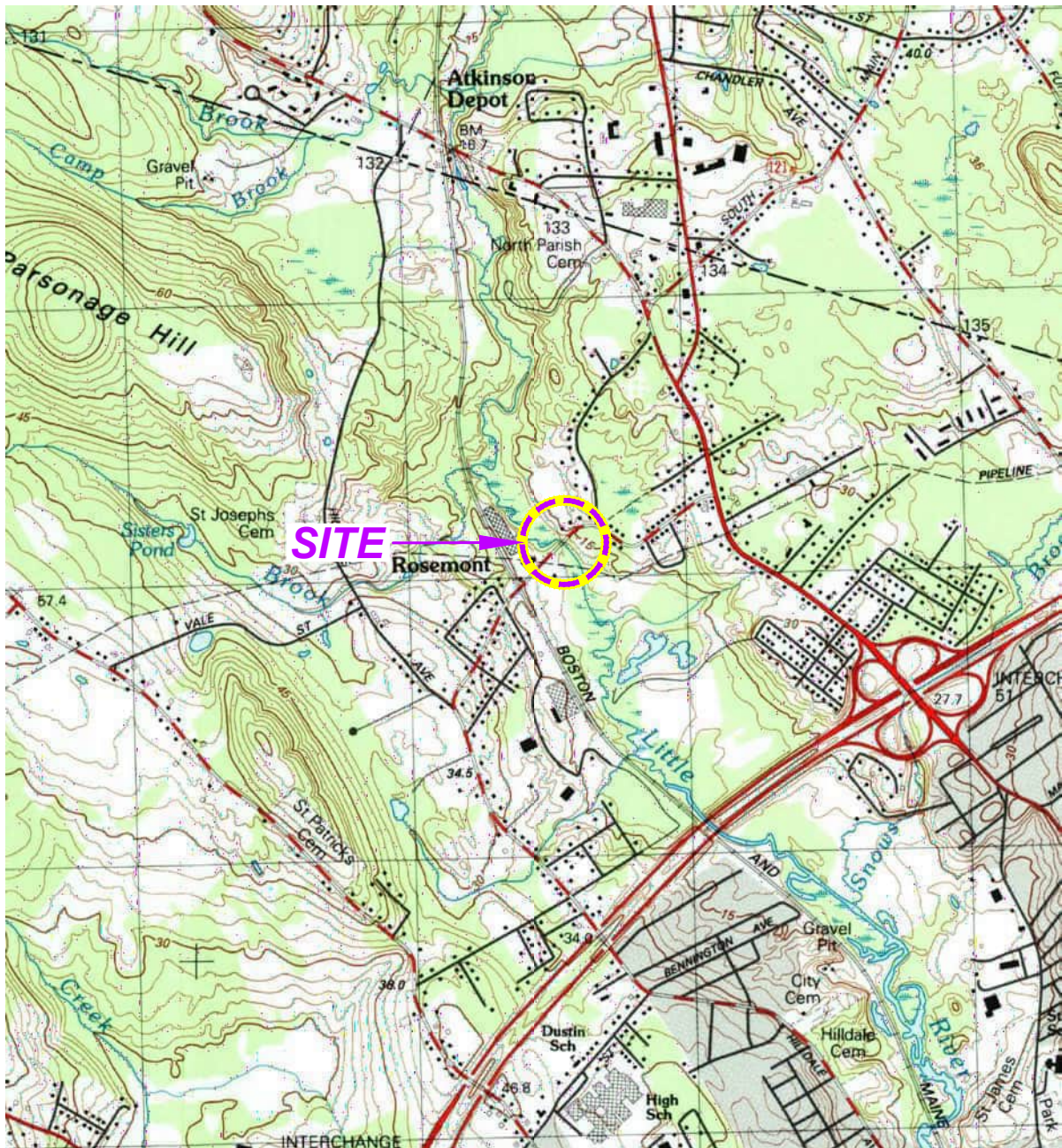
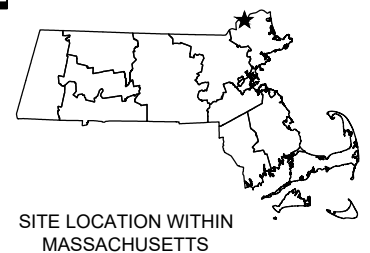


Image from U.S.G.S. Topographic 7.5 Minute Series
Haverhill, Massachusetts - New Hampshire, 1987.
Datum is National Geodetic Vertical Datum (NGVD).
Elevations are in Meters
Contour Interval is 3 Meters.



Rosemont Street Bridge Replacement
Rosemont Street Over Little River
Haverhill, Massachusetts

BETA Group, Inc.
Norwood, Massachusetts

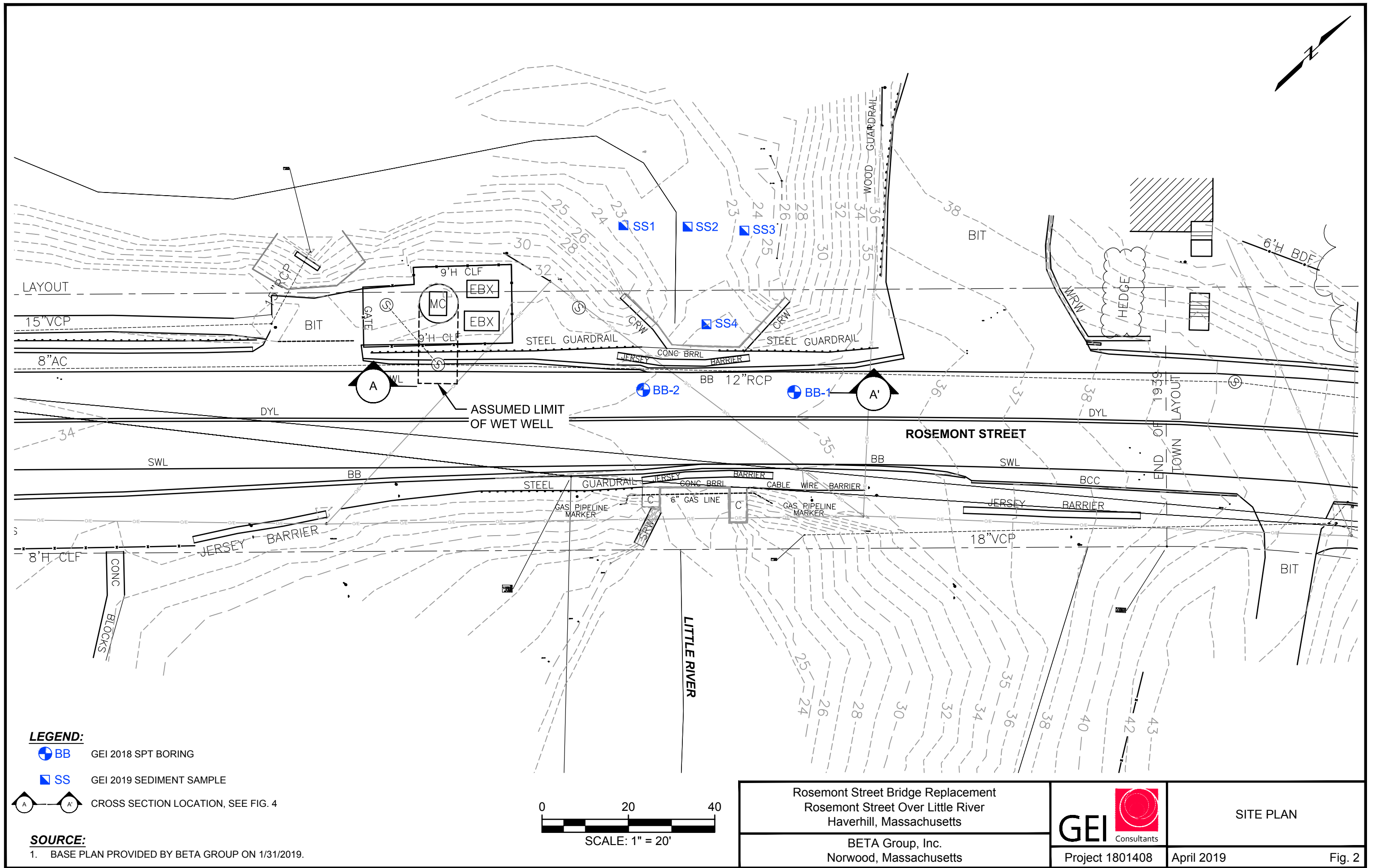


Project 1801408

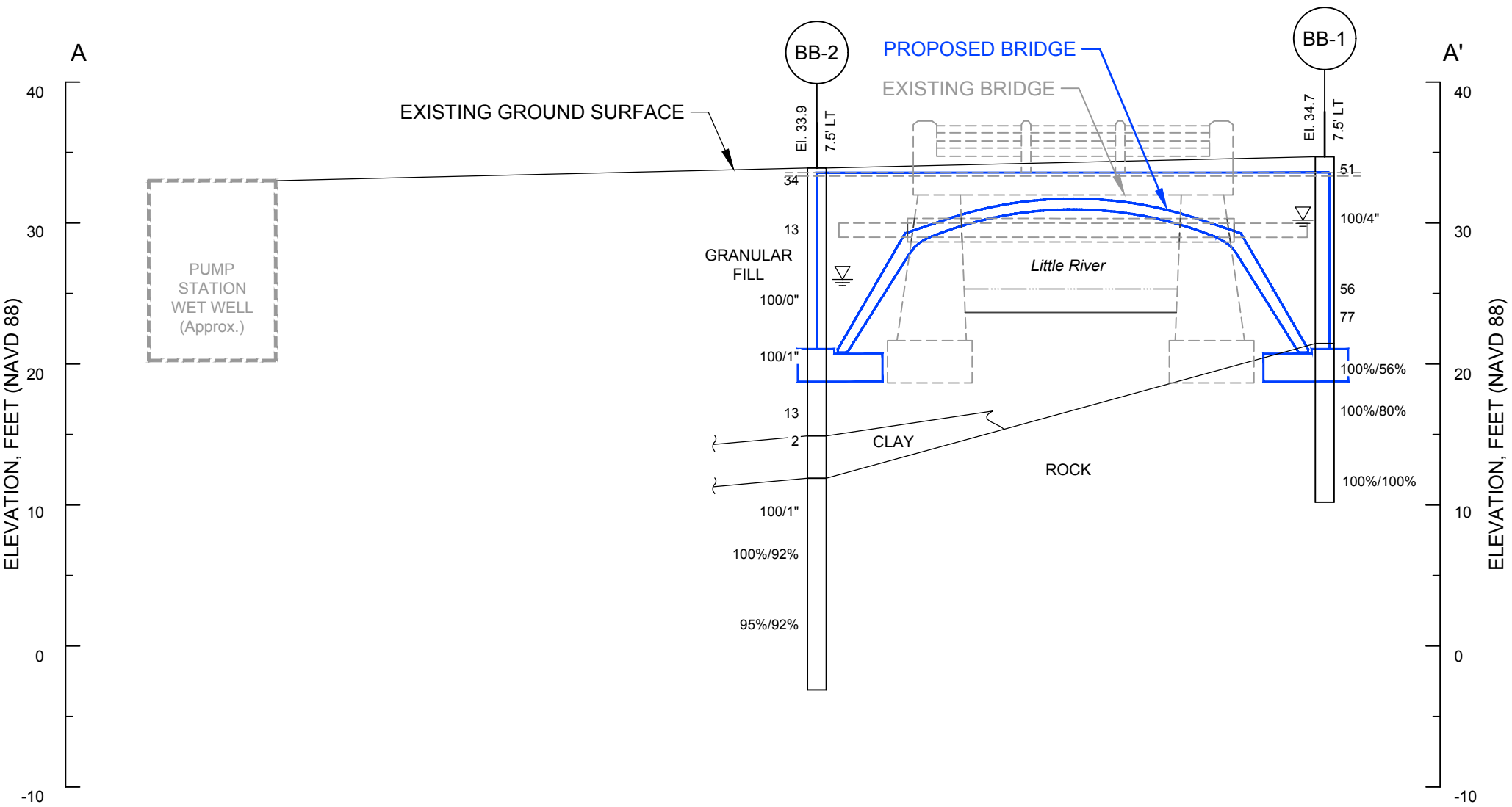
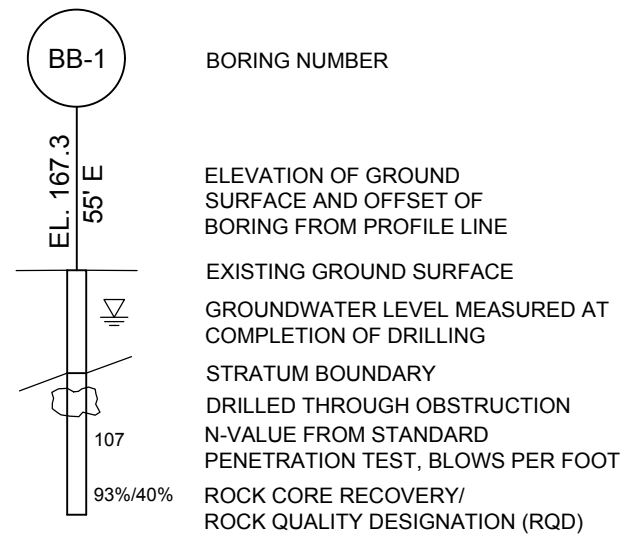
SITE LOCATION MAP

February 2019

Fig. 1

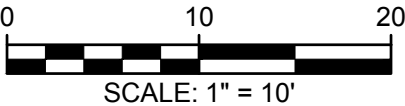


LEGEND:



NOTES:

1. BORING LOCATIONS ARE SHOWN IN FIG. 3.
2. GROUNDWATER LEVELS MAY VARY AT OTHER LOCATIONS AND AT OTHER TIMES.
3. BOUNDARIES BETWEEN SOIL STRATA MAY BE TRANSITIONAL. THE STRATA BOUNDARIES MAY VARY FROM THE INTERPOLATIONS SHOWN.
4. EXISTING AND PROPOSED BRIDGE GEOMETRY AND ESTIMATED LOCATION OF WET WELL PROVIDED BY BETA GROUP ON APRIL 4, 2019.



Rosemont Street Bridge Replacement Rosemont Street Over Little River Haverhill, Massachusetts		CROSS SECTION A - A'	
		Project 1801408	April 2019
BETA Group, Inc. Norwood, Massachusetts			Fig. 3

BORING INFORMATION

LOCATION: NE Abutment

GROUND SURFACE EL. (ft): 24.7

VERTICAL DATUM:

TOTAL DEPTH (ft): 24.5

LOGGED BY: K. Gleichauf

DATE START/END: 11/2/2018 - 11/5/2018

DRILLING COMPANY: Northern Drill Service, Inc.

DRILLER NAME: C. Beirholm

RIG TYPE: Mobile B-57

BORING**BB-1**

PAGE 1 of 2

DRILLING INFORMATION

HAMMER TYPE: Automatic

CASING I.D./O.D.: 4 inch/ NA

CORE BARREL TYPE:

AUGER I.D./O.D.: NA / NA

DRILL ROD O.D.:

CORE BARREL I.D./O.D. NA / NA

DRILLING METHOD: Driven casing and washed with rotary tooling.

WATER LEVEL DEPTHS (ft): 4.5 11/5/2018

ABBREVIATIONS:

Pen. = Penetration Length
 Rec. = Recovery Length
 RQD = Rock Quality Designation
 = Length of Sound Cores > 4 in / Pen., %
 WOR = Weight of Rods
 WOH = Weight of Hammer

S = Split Spoon Sample
 C = Core Sample
 U = Undisturbed Sample
 SC = Sonic Core
 DP = Direct Push Sample
 HSA = Hollow-Stem Auger

Qp = Pocket Penetrometer Strength
 Sv = Pocket Torvane Shear Strength
 LL = Liquid Limit
 PI = Plasticity Index
 PID = Photoionization Detector
 I.D./O.D. = Inside Diameter/Outside Diameter

NA, NM = Not Applicable, Not Measured
 Blows per 6 in.: 140-lb hammer falling
 30 inches to drive a 2-inch-O.D.
 split spoon sampler.

Elev. (ft)	Depth (ft)	Sample Information				Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
		Sample No.	Depth (ft)	Pen./ Rec. (in)	Blows per 6 in. or RQD			
		S1	0.5 to 2	18/10	9-30-21	~6" asphalt surface	GRANULAR FILL	S1: Dry, very dense, brown, FINE TO COARSE SAND, some fine to medium gravel, trace nonplastic fines.
		S2	4 to 5.3	16/6	7-5- 100/4"			S2: Wet, very dense, brown, FINE TO COARSE SAND, some fine to medium gravel, some nonplastic fines.
		S3	9 to 11	24/8	9-17-39- 29			S3: Wet, very dense, brown, FINE TO COARSE SAND AND GRAVEL, some nonplastic fines. Gravel is fractured by spoon.
		S4	11 to 13	24/9	57-35- 42-22			S4: Wet, very dense, brown, FINE TO COARSE SAND, some fine to coarse gravel, trace nonplastic fines.
						Casing driven to refusal at 13.25 ft. Core Times: 2-3-9 Advanced rollerbit to 14.5 ft., rock chips in wash, driller notes irregular advancement, possible rock fractures from blasting.	ROCK	C1: BERWICK FORMATION, very hard, black with white layers spaced about 2" at 15 degrees. Joints spaced 1-9" at 15-75 degrees, slight to no weathering. Most joints are along bedding planes.
		C1	14.5 to 17.5	36/36	56			
		C2	17.5 to 22.5	60/60	80	Core Times: 3-3-4-5-9		C2: BERWICK FORMATION, Similar to C1.
		C3	22.5 to 24.5	24/24	100	Core Times: 4-7		C3: BERWICK FORMATION, Similar to C1.

NOTES:

PROJECT NAME: Rosemont Street Bridge Replacement

CITY/STATE: Haverhill, MA

GEI PROJECT NUMBER: 1801408



Elev. (ft)	Depth (ft)	Sample Information				Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
		Sample No.	Depth (ft)	Pen./ Rec. (in)	Blows per 6 in. or RQD			
0	25							End Boring at 24.5 ft. Backfilled with cuttings and gravel, topped with cold patch.
-10	35							
-20	45							
-30	55							

NOTES:

PROJECT NAME: Rosemont Street Bridge Replacement

CITY/STATE: Haverhill, MA

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PAGE 1 of 2

RIG TYPE: Mobile B-57

WATER LEVEL DEPTHS (ft): 7.9 11/2/2018 7.6 11/1/2018

Blows per 6 in.: 140-lb hammer falling
30 inches to drive a 2-inch-O.D.
split spoon sampler.

Elev. (ft)	Depth (ft)	Sample Information				Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
		Sample No.	Depth (ft)	Pen./ Rec. (in)	Blows per 6 in. or RQD			
30 								

ment

GEI

Consultants

GEIWOBURN STD 1-LOCATION-LAYER NAME TYPED BORING LOGS.GPJ GEI DATA TEMPLATE 2011.GDT 2/11/19

LOCATION: SW Abutment

GROUND SURFACE EL. (ft): 33.9

DATE START/END: 11/1/2018 - 11/2/2018

VERTICAL DATUM:

DRILLING COMPANY: Northern Drill Service, Inc.

BORING**BB-2**

PAGE 2 of 2

Elev. (ft)	Depth (ft)	Sample Information				Drilling Remarks/ Field Test Data	Layer Name	Soil and Rock Description
		Sample No.	Depth (ft)	Pen./ Rec. (in)	Blows per 6 in. or RQD			
	25	S7	24 to 25.1	13/6	18-44- 100/1"			S7: Wet, very dense, gray, FINE TO MEDIUM GRAVEL, some fine to coarse sand, trace nonplastic fines. Possible weathered bedrock.
		C1	27 to 32	60/60	92	Core Times: 3-4-3-4-4 Advanced rollerbit to 27 ft. through rock.	ROCK	C1: BERWICK FORMATION: very hard, fine-grained, black with white coarse rectangular crystals, small pyrite crystals visible throughout. Joints spaced 2-16" at 0-60 degrees, slightly to non weathered.
		C2	32 to 37	60/57	92	Core Times: 3-3-3-3-4		C2: BERWICK FORMATION: Similar to C1. Joints spaced 1-15" at 0-30 degrees, slightly to non weathered.
								End boring at 37 ft. Backfilled with cuttings and gravel, topped with cold patch.

NOTES:

PROJECT NAME: Rosemont Street Bridge Replacement

CITY/STATE: Haverhill, MA

GEI PROJECT NUMBER: 1801408



APPENDIX F

SITE PHOTOS

**ROSEMONT STREET BRIDGE - VIEWING NORTH - FROM
EXISTING SOUTHERLY APPROACH**



LITTLE RIVER—UPSTREAM FACE – (FROM BRIDGE DECK)



NORTHWEST WINGWALL - UPSTREAM FACE (FROM BRIDGE DECK)



**SOUTHWEST WINGWALL - UPSTREAM FACE (FROM
BRIDGE DECK)**



**SOUTHEAST ABUTMENT - DOWNSTREAM FACE (FROM
BRIDGE DECK)**



**EROSION OF BRIDGE DECK - VIEWING SOUTH –
(FROM EXISTING BRIDGE DECK)**

