November 2019

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2019.11.22
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Prepared for:
Naugatuck Valley Council of Governments

FLOODWAY ANALYSIS REPORT
Pedestrian Footbridge over Branch Brook

BL Project No. 1800579

Naugatuck River Greenway Multi-Use Trail
Towns of Watertown and Thomaston, CT

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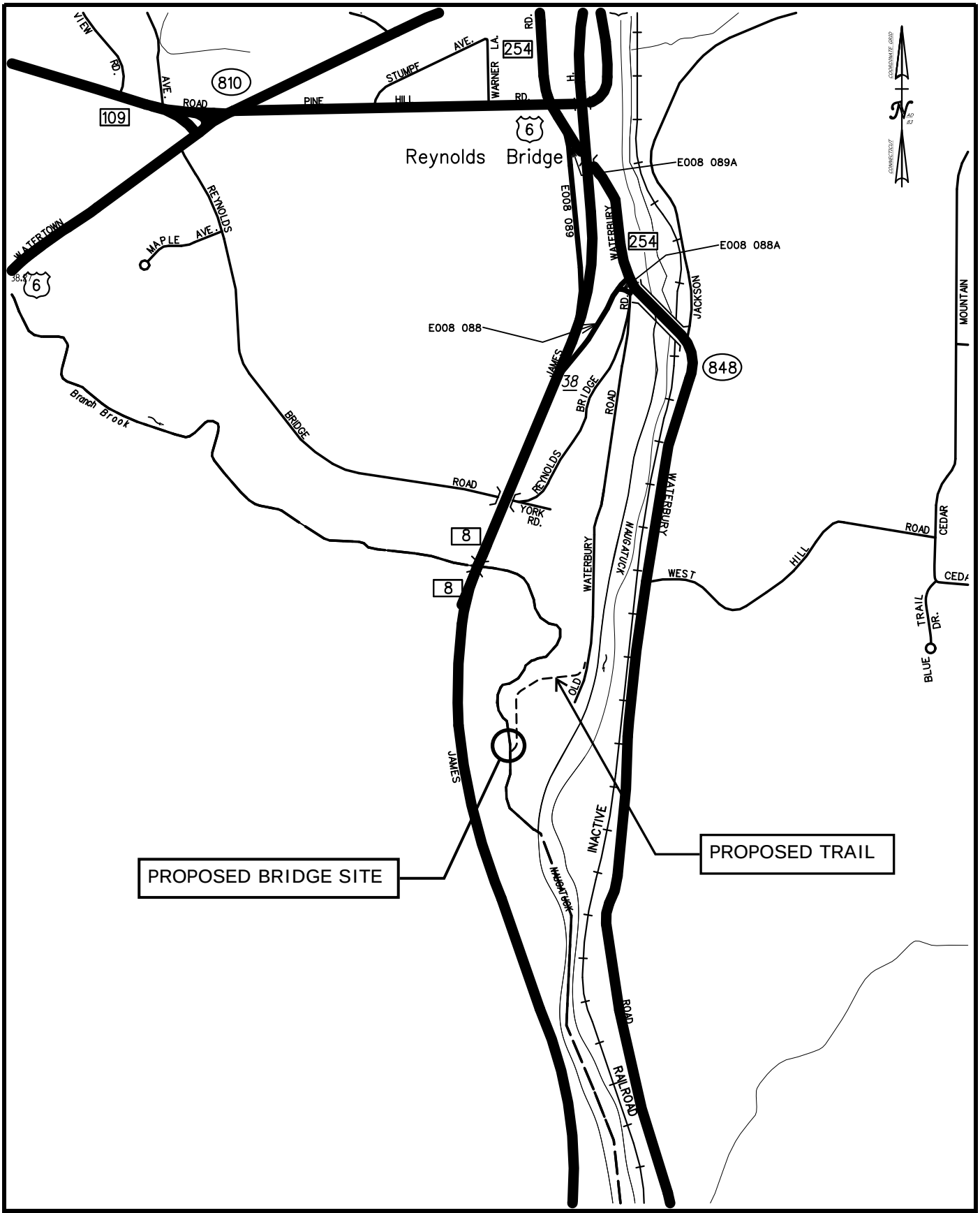
TABLE OF CONTENTS **PAGE**

FIGURES

APPENDICES



BL Companies	NAUGATUCK RIVER GREENWAY OVER BRANCH BROOK TOWNS OF WATERTOWN & THOMASTON, CONNECTICUT	LOCATION MAP	PROJ. NO.: 1800579 SCALE: 1" = 1,000'

II. INTRODUCTION

This project involves the construction of the Naugatuck River Greenway, a multi-use trail which includes a crossing over Branch Brook, a watercourse that forms the boundary between the towns of Watertown and Thomaston. The proposed trail is located east of Route 8 and west of the Naugatuck River. The trail crosses Branch Brook approximately 1,000 ft upstream of the brook's confluence with the Naugatuck River. Once the path crosses Branch Brook, it moves northeast just outside the ridgelines of the properties between the two watercourses (see Location Map), where it eventually connects to Old Waterbury Road.

At the site of the proposed bridge, the brook has a drainage area of approximately 22.6 square miles. The ConnDOT Drainage Manual designates the proposed bridge as a large structure due to the structure spanning a waterway with a drainage area between 10 mi^2 and 1,000 mi^2. Large structures require the 100-year storm to pass under the low chord with 2-ft of underclearance. Additionally, the 500-year storm is required to be checked. Table 1 below summarizes the approved flow discharges at the bridge location. The design flows were computed flows computed by the Flood Insurance Studies (FIS) for the Towns of Watertown and Thomaston, CT. For further information regarding the watershed characteristics and how the design flow was developed, see Appendix B.

TABLE 1: SUMMARY OF FLOWS (C.F.S.)

Multipurpose Bridge over Branch Brook	
Year	**Project Flows**
2	450
10	800
50	800
100	900
200	1,500
500	2,300

Branch Brook is a relatively sinuous, channelized watercourse, flowing from northwest to southeast through the project site. The normal stream channel is between approximately 35 to 40-ft wide through this section. Both banks are heavily vegetated with trees and light groundcover; flow impacts are accounted for through the Manning's n value.

The proposed bridge crossing site located approximately 0.5 miles downstream of Black Rock Dam; a large flood control structure built in 1971. The brook moves from the dam spillway under the Route 8 overpass located approximately 0.3 miles upstream of the proposed crossing. The confluence of Branch Brook and the Naugatuck River is approximately 1,000 downstream from the crossing site.

Within the vicinity of the project, the channel bottom is lined naturally with gravelly sand with smaller stones and cobbles. A dirt road bridge is located approximately 650 ft downstream of the subject bridge (approximately 265 ft upstream of the brook's confluence with Naugatuck

River). There is little evidence of erosion, drift, or degradation in the studied reach. The existing channel contains all the studied storm events including the design and check storm events, while the structures outside the project area are hydraulically adequate during storm events. There is currently no existing structure at the project site.

There are two proposed alternatives for the pedestrian crossing over Branch Brook, as described in the Structure Type Study (STS). Alternative 1 involves the installation of a prefabricated steel truss superstructure supported by precast concrete abutments and wingwalls. This structure is referred to as the preferred alternative in the STS. Alternative 2 consists of a timber glulam stringer superstructure founded on timber piles.

Alternative 1 spans 60-ft across Branch Brook and is founded on precast concrete abutments. The precast concrete abutments will be founded to a maximum depth of approximately 6-ft to 7-ft below existing grade and will not be adversely affected by scour. The analysis indicates the proposed alternative is hydraulically adequate for all studied storm events.

Alternative 2 provides a 60.4-ft clear span timber glulam stringer superstructure founded on timber piles and lagging. The hydraulic analysis indicates there is little difference in water surface elevations between the two alternatives during the 100-year design event. As with the preferred alternative, Alternative 2 is hydraulically adequate during all studied events and will not be adversely affected by scour.

While the initial construction cost of the preferred structure is higher, the life expectancy of Alternative 1 is approximately 25% greater than that of Alternative 2. The estimated construction duration for the preferred alternative is anticipated to be approximately 4 months.

III. FLOODWAY ANALYSIS

In general, a "Regulatory Floodway" means the channel of a river or other watercourse and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height. The floodway is located within the floodplain. A floodplain is generally defined as an area that will be inundated by the base flood (100-year storm event). A floodway analysis consists of an un-encroached model (without floodway) and an encroached model (with floodway). The un-encroached model defines the floodplain. The encroached model defines the floodway.

A hydraulic analysis was performed using the Hydrologic Engineering Center's River Analysis System (HEC-RAS, version 5.0.7). See Appendix C for a plan view of the river showing the arrangement of surveyed and FEMA cross-sections and the FEMA Floodway limits.

Branch Brook was studied in detail in the latest FEMA Flood Insurance Studies for the Town of Watertown and Town of Thomaston, revised May 1980. Available FEMA back-up data in HEC-2 format was obtained through the FEMA Engineering Library (see Appendix G). The back-up data contained a hard copy of the input and output data for the 10-year and 100-year storm events without the floodway encroachment limits applied, and input and output data for the encroachments applied.

The HEC-2 back-up data was transcribed into HEC-RAS geometry to create the Duplicate Effective FEMA Model with certain modifications to the original model. Before running the model, there were some considerations and assumptions required for this analysis.

The most noteworthy consideration is that the floodway encroachments determined by the original study were unavailable for the studied reach. The data received from FEMA was incomplete, and physically missing at least one page of numerical floodway data. As a result, floodway encroachment information for the modelled reach is generally assumed and approximated based on available mapping and water surface data. The next noteworthy consideration is the addition of duplicate FEMA sections at bridge cross-sections. This was done to successfully run the bridge hydraulics within the RAS environment, since the HEC-2 data was insufficient on its own.

No further changes were made to the FEMA data except eliminating cross-sections not located near the bridge and modifying the deck/roadway editor at the two bridges in the model in order to have the program run without error. The Duplicate Effective Model begins and ends at FEMA lettered cross-sections and utilizes FEMA-developed flows. In the HEC-RAS model, FEMA lettered sections were named using their station value within their studied reach in the FIS as well as to account for the repeated sections.

As a result, FEMA Sections A, B, C, D, and E are represented as 200, 200.3, 201, 202, 203, respectively. Sections 200.1, 200.2, 202.1, and 202.2 are duplicates of Sections 200 and 200.3 – the sections representing bridge geometry within the backup data.

The Duplicate Effective Model (at the FEMA lettered sections) for the 10-year, 50-year, 100-year, and 500-year storm events without the floodway matched the back-up data within 0.20 ft. With the floodway limits applied, all sections matched the 100-year encroached backup data within 0.10 ft (see Table 3) at all lettered sections.

Although not included in the HEC-2 back-up data, the 10-year floodway event was computed in the Duplicate Effective Model. The computed 10-year with floodway elevations range between 0.09 ft and 0.29-ft below the 100-year with floodway elevations.

Field cross-sections were surveyed around the proposed Branch Brook crossing location. The survey information was added to the Duplicate Effective Model to create the Existing Conditions Model. The new cross-section data in the Existing Conditions Model adds several sections (200.4, 200.45, 200.5, 200.55, 200.6, 200.65, 200.7, 200.75, 200.8). These sections were added between FEMA Sections C and B to provide a more comprehensive and accurate hydraulic model that also reflects the most recently surveyed conditions at those locations.

All FEMA sections and its duplicates retain the same geometry as the Duplicate Effective Model (Sections A, B, C, D), adjusted to the 1988 vertical datum used for the survey.

The FEMA Flood Insurance Rate Map was used to obtain the floodway encroachment stations at the new sections. To further increase accuracy, field survey information was supplemented with LiDAR where applicable.

Section 200.65 is the approach section. Section 200.6 is both the upstream bridge face and upstream right-of-way (ROW) section. Section 200.55 is both the downstream bridge face and downstream ROW section.

The un-encroached 100-year WSEL of the Existing Conditions Model is 0.66 ft lower than the Duplicate Effective Model at the furthest upstream cross-section. At Section 200, the furthest downstream section, the Existing Conditions FEMA model is also 0.66 ft lower than the Duplicate Effective Model (see Table 4).

There are two major reasons for the changes computed between the Existing Conditions Model, Duplicate Effective Model, and HEC-2 output. The first being that HEC-2 output data is determined using completely different, and obsolete computation methods than those used by the HEC-RAS software. Secondly, the Existing Conditions model uses survey data around the bridge site. Lastly, the backup data provided was incomplete – lacking defined encroachment data and needing to be assumed through concise engineering judgment.

The computed water surface remains within the channel, with greater events causing lower velocities and increases in water depth and flow area. In the Duplicate Effective model, the 100-year velocity without encroachments applied, is 8.83 ft/s at Section 203 matching the Existing Conditions Model. Similar changes (lower velocity, higher depth and flow area) are seen at all FEMA sections, with variations occurring in the added survey sections.

With the floodway limits applied, the 100-year WSEL for the Existing Conditions Model was generally lower than the Duplicate Effective Model. At all shared sections, the WSEL of the Existing Conditions Model is 0.66 ft lower than the Duplicate Effective Model. As with the un-encroached profile, the differences at the bridge location are due to the use of survey data and differed computation methods between hydraulic analyses.

For the 10-year with floodway event, the Existing Conditions Model is 0.66 ft greater than the Duplicate Effective Model at all FEMA lettered sections.

As noted above, the work proposed at the existing bridge will install a new prefabricated steel truss crossing over Branch Brook complete with reinforced concrete abutments, and scour protection measures. The proposed work has little effect on the computed water surface elevations.

The 100-year without floodway WSELs of the Proposed Alt1 Model match the Existing Conditions Model at all cross-sections in the model. With the floodway limits applied, the Proposed Alt1 Model's WSELs remain the same as the non-encroached WSELs (see Table 5).

A similar phenomenon occurs for the 10-year with and without floodway conditions in which proposed WSELs match the existing WSELs (see Table 7).

The Manning's Roughness Coefficients used for both the upstream and downstream channel reach for the existing and proposed conditions is 0.035. The river is clean, straight and stony. The coefficients used for the side slopes and overbank areas upstream and downstream of the bridge range from 0.018 to 0.075, depending on cover. Values of 0.1 and 0.3 are used for contraction and expansion dynamic head losses, except at the bridge. At the bridge, where the flow area changes more suddenly, values of 0.3 and 0.5 are used. In the HEC-2 backup data, the contraction/expansion coefficients were noted to be 0.1 and 0.3.

The HEC-RAS existing and proposed, without and with floodway outputs are included in Appendix D and E of this report. A water surface elevation comparison of the 100-year and 10-year storm events for the existing and proposed conditions can be found in Tables 5 and 7 of this report. A velocity comparison of the 100-year and 10-year storm events for the existing and proposed conditions can be found in Tables 6 and 8 of this report.

TABLE 2: FLOODWAY ENCROACHMENT TABLE

Cross-Section	Encroachment Station (L)	Encroachment Station (R)	Width (ft)
203 (FEMA E)	1794	1837	43
202.2	1684	1730	46
Route 8 Bridge	---	---	---
202.1	1684	1730	46
202 (FEMA D)	1684	1730	46
201 (FEMA C)	1604	1736	132
200.8	50.4	108.4	45
200.75	36.2	107.2	38
200.7	55.7	140.7	42
200.65	55.3	125.3	46
200.6	54.3	120.3	65
Proposed Bridge	---	---	---
200.55	22.8	85.8	63
200.5	59.4	110.4	49
200.45	88.1	148.1	56
200.4	53.8	122.8	58
200.3 (FEMA B)	1407	1495	88
200.2	1120	1208	81
Dirt Road Crossing	---	---	---
200.1	1120	1208	81
200 (FEMA A)	1120	1208	81

Note: Non-lettered sections were added to the hydraulic model. The FEMA Flood Insurance Rate Map and Flood Insurance Study were used to obtain the floodway encroachment stations.

TABLE 3: 100-YEAR DUPLICATE EFFECTIVE MODEL VS. FEMA BACK-UP DATA

	100-Year FEMA Back-up Data		100-Year Duplicate Effective FEMA Model		100-Year Duplicate Effective FEMA Model vs. Back-up Data	
Cross-Section	**WSEL without FW**	**WSEL with FW**	**WSEL without FW**	**WSEL with FW**	**WSEL without FW**	**WSEL with FW**
203 (FEMA E)	331.10	331.10	331.09	331.07	-0.01	-0.03
202.2	330.50	331.50	330.83	330.82	-0.33	-0.68
Route 8 Bridge	---	---	---	---	---	---
202.1	330.50	330.50	330.33	330.31	-0.17	-0.19
202 (FEMA D)	330.00	330.00	329.97	329.96	-0.03	-0.04
201 (FEMA C)	324.20	324.20	324.18	324.18	-0.02	-0.02
200.3 (FEMA B)	322.00	322.80	322.03	322.80	+0.03	0.00
200.2	321.80	322.70	321.85	322.70	+0.05	0.00
Dirt Road Crossing	---	---	---	---	---	---
200.1	321.80	322.70	321.82	322.69	+0.02	-0.01
200 (FEMA A)	321.60	322.60	321.60	322.60	0.00	0.00

Note: The elevations refer to the NGVD 1929 Datum.

TABLE 4: 100-YEAR EXISTING CONDITIONS FEMA MODEL VS. FEMA CALIBRATION MODEL

	100-Year Duplicate Effective Model		100-Year Existing Conditions Model		100-Year Existing Conditions Model vs. Duplicate Effective Model	
Cross-Section	**WSEL without FW**	**WSEL with FW**	**WSEL without FW**	**WSEL with FW**	**WSEL without FW**	**WSEL with FW**
203 (FEMA E)	331.09	331.07	330.43	330.41	-0.66	-0.66
202.2	330.83	330.82	330.13	330.12	-0.7	-0.7
Route 8 Bridge	---	---	---	---	---	---
202.1	330.33	330.31	329.57	329.56	-0.76	-0.75
202 (FEMA D)	329.97	329.96	328.28	328.28	-1.69	-1.68
201 (FEMA C)	324.18	324.18	325.54	325.57	+1.36	+1.39
200.8	---	---	324.85	324.86	---	---
200.75	---	---	324.80	324.79	---	---
200.7	---	---	324.79	324.78	---	---
200.65	---	---	324.63	324.63	---	---
200.6	---	---	324.46	324.46	---	---
Proposed Bridge	---	---	---	---	---	---
200.55	---	---	324.47	324.47	---	---
200.5	---	---	324.15	324.15	---	---
200.45	---	---	322.60	322.61	---	---
200.4	---	---	321.52	322.24	---	---
200.3 (FEMA B)	322.03	322.8	321.57	322.14	-0.46	-0.66
200.2	321.85	322.7	322.04	322.04	+0.19	-0.66
Dirt Road Crossing	---	---	---	---	---	---
200.1	321.82	322.69	321.19	322.03	-0.63	-0.66
200 (FEMA A)	321.6	322.6	320.94	321.94	-0.66	-0.66

Note: The elevations refer to the NAVD 1988 Datum.

TABLE 5: FLOODWAY ANALYSIS TABLE – 100-YEAR STORM WSEL

	FEMA Backup Data			Existing Conditions Model			Proposed Conditions Model			Proposed Conditions Model vs. Existing Conditions Model	
Cross-Section	**WSEL without FW**	**WSEL with FW**	**WSEL Diff.**	**WSEL without FW**	**WSEL with FW**	**WSEL Diff.**	**WSEL without FW**	**WSEL with FW**	**WSEL Diff.**	**WSEL without FW**	**WSEL with FW**
203 (FEMA E)	330.44	330.44	0.00	330.43	330.41	-0.02	330.43	330.41	-0.02	0.00	0.00
202.2	329.84	330.84	+1.00	330.13	330.12	-0.01	330.13	330.12	-0.01	0.00	0.00
Route 8 Bridge	---	---	---	---	---	---	---	---	---	---	---
202.1	329.84	329.84	0.00	329.57	329.56	-0.01	329.57	329.56	-0.01	0.00	0.00
202 (FEMA D)	329.34	329.34	0.00	328.28	328.28	0.00	328.28	328.28	0.00	0.00	0.00
201 (FEMA C)	323.54	323.54	0.00	325.54	325.57	+0.03	325.54	325.57	+0.03	0.00	0.00
200.8	---	---	---	324.85	324.86	+0.01	324.85	324.86	+0.01	0.00	0.00
200.75	---	---	---	324.80	324.79	-0.01	324.79	324.79	0.00	-0.01	0.00
200.7	---	---	---	324.79	324.78	-0.01	324.79	324.78	-0.01	0.00	0.00
200.65	---	---	---	324.63	324.63	0.00	324.63	324.63	0.00	0.00	0.00
200.6	---	---	---	324.46	324.46	0.00	324.46	324.46	0.00	0.00	0.00
Proposed Bridge	---	---	---	---	---	---	---	---	---	---	---
200.55	---	---	---	324.47	324.47	0.00	324.47	324.47	0.00	0.00	0.00
200.5	---	---	---	324.15	324.15	0.00	324.15	324.15	0.00	0.00	0.00
200.45	---	---	---	322.60	322.61	+0.01	322.60	322.61	+0.01	0.00	0.00
200.4	---	---	---	321.52	322.24	+0.72	321.52	322.24	+0.72	0.00	0.00
200.3 (FEMA B)	321.34	322.14	+0.80	321.57	322.14	+0.57	321.57	322.14	+0.57	0.00	0.00
200.2	321.14	322.04	+0.90	322.04	322.04	0.00	322.04	322.04	0.00	0.00	0.00
Dirt Road Crossing	---	---	---	---	---	---	---	---	---	---	---
200.1	321.14	322.04	+0.90	321.19	322.03	+0.84	321.19	322.03	+0.84	0.00	0.00
200 (FEMA A)	320.94	321.94	+1.00	320.94	321.94	+1.00	320.94	321.94	+1.00	0.00	0.00

Note: The elevations refer to the NAVD 1988 Datum

TABLE 6: FLOODWAY ANALYSIS TABLE – 100-YEAR VELOCITY (ft/s)

	FEMA Backup Data			Existing Conditions Model			Proposed Conditions Model			Proposed Conditions Model vs. Existing Conditions Model	
Cross-Section	**Vel. without FW**	**Vel. with FW**	**Vel. Diff.**	**Vel. without FW**	**Vel. with FW**	**Vel. Diff.**	**Vel. without FW**	**Vel. with FW**	**Vel. Diff.**	**Vel. without FW**	**Vel. with FW**
203 (FEMA E)	8.83	9.03	+0.20	8.83	9.03	+0.20	8.83	9.03	+0.20	0.00	0.00
202.2	4.81	4.88	+0.07	4.85	4.92	+0.07	4.85	4.92	+0.07	0.00	0.00
Route 8 Bridge	---	---	---	---	---	---	---	---	---	---	---
202.1	5.54	5.58	+0.04	5.70	5.73	+0.03	5.70	5.73	+0.03	0.00	0.00
202 (FEMA D)	6.18	6.19	+0.01	8.93	8.93	0.00	8.93	8.93	0.00	0.00	0.00
201 (FEMA C)	6.06	6.06	0.00	1.90	2.15	+0.25	1.90	2.15	+0.25	0.00	0.00
200.8	---	---	---	4.28	4.28	0.00	4.28	4.28	0.00	0.00	0.00
200.75	---	---	---	3.98	4.04	+0.06	3.98	4.04	+0.06	---	---
200.7	---	---	---	3.07	3.07	0.00	3.07	3.07	0.00	0.00	0.00
200.65	---	---	---	4.14	4.14	0.00	4.14	4.14	0.00	0.00	0.00
200.6	---	---	---	4.74	4.74	0.00	4.74	4.75	+0.01	0.00	+0.01
Proposed Bridge	---	---	---	---	---	---	---	---	---	---	---
200.55	---	---	---	3.97	3.97	0.00	3.97	3.97	0.00	0.00	0.00
200.5	---	---	---	5.31	5.31	0.00	5.31	5.31	0.00	0.00	0.00
200.45	---	---	---	10.21	10.18	-0.03	10.21	10.18	-0.03	---	---
200.4	---	---	---	6.74	5.33	-1.41	6.74	5.33	-1.41	0.00	0.00
200.3 (FEMA B)	2.24	1.97	-0.27	2.24	1.92	-0.32	2.24	1.92	-0.32	0.00	0.00
200.2	3.68	2.89	-0.79	3.68	2.90	-0.78	3.68	2.90	-0.78	0.00	0.00
Dirt Road Crossing	---	---	---	---	---	---	---	---	---	0.00	0.00
200.1	3.71	2.9	-0.81	3.71	2.91	-0.80	3.71	2.91	-0.80	---	---
200 (FEMA A)	3.98	2.97	-1.01	3.98	2.98	-1.00	3.98	2.98	-1.00	0.00	0.00

Note: The FEMA floodway velocities are listed on the FIS Floodway Data Table.

TABLE 7: FLOODWAY ANALYSIS TABLE – 10-YEAR STORM WSEL

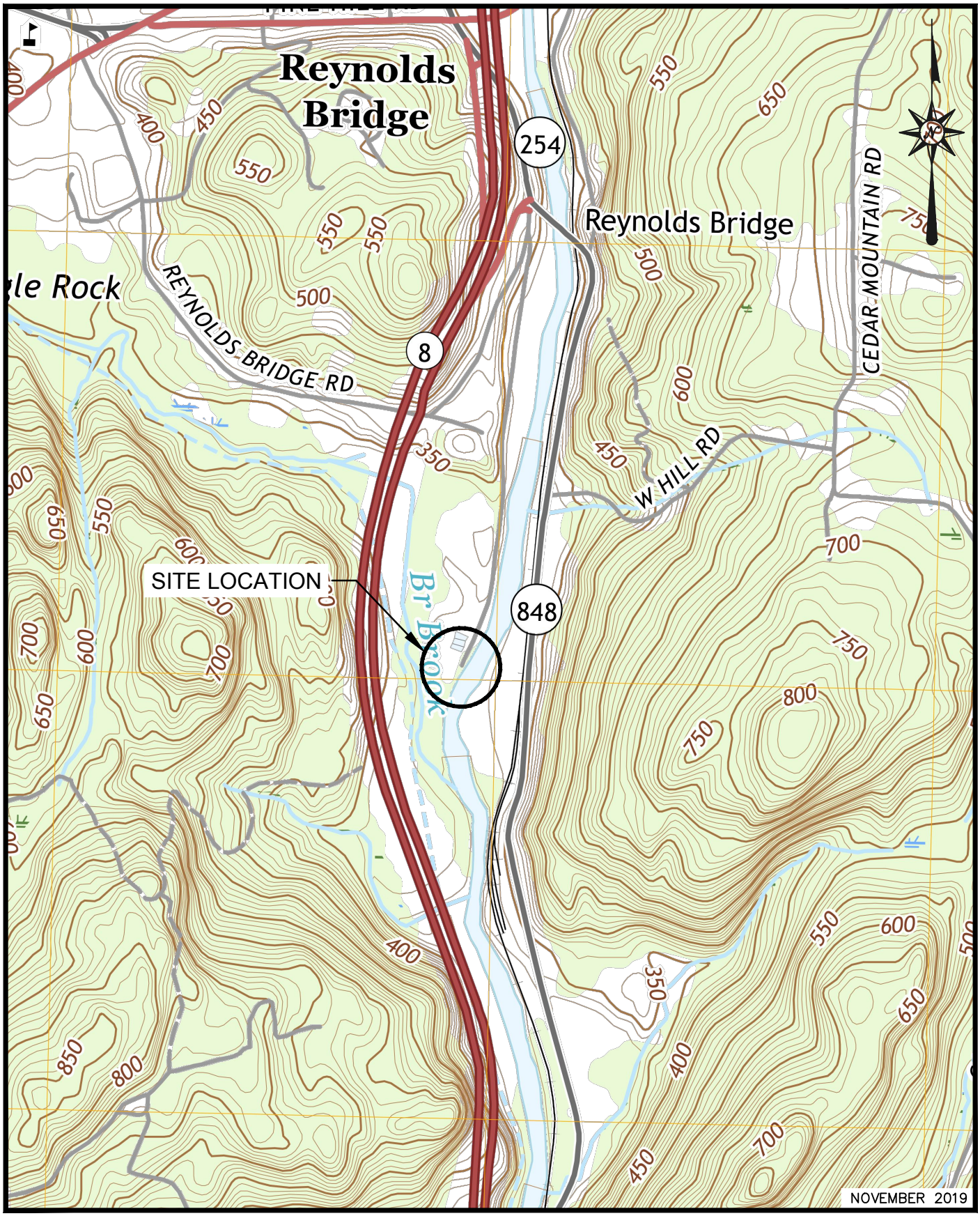
	Existing Conditions Model			Proposed Conditions Model			Proposed Conditions Model vs. Existing Conditions Model	
Cross-Section	**WSEL without FW**	**WSEL with FW**	**WSEL Diff.**	**WSEL without FW**	**WSEL with FW**	**WSEL Diff.**	**WSEL without FW**	**WSEL with FW**
203 (FEMA E)	330.22	330.20	-0.02	330.22	330.20	-0.02	0.00	0.00
202.2	329.84	329.84	0.00	329.84	329.84	0.00	0.00	0.00
Route 8 Bridge	---	---	---	---	---	---	---	---
202.1	329.31	329.31	0.00	329.31	329.31	0.00	0.00	0.00
202 (FEMA D)	328.08	328.08	0.00	328.08	328.08	0.00	0.00	0.00
201 (FEMA C)	325.23	325.25	+0.02	325.23	325.25	+0.02	0.00	0.00
200.8	324.53	324.53	0.00	324.53	324.53	0.00	0.00	0.00
200.75	324.46	324.46	0.00	324.46	324.46	0.00	0.00	0.00
200.7	324.45	324.45	0.00	324.45	324.45	0.00	0.00	0.00
200.65	324.31	324.31	0.00	324.31	324.31	0.00	0.00	0.00
200.6	324.15	324.15	0.00	324.15	324.15	0.00	0.00	0.00
Proposed Bridge	---	---	---	---	---	---	---	---
200.55	324.16	324.16	0.00	324.16	324.16	0.00	0.00	0.00
200.5	323.84	323.84	0.00	323.84	323.84	0.00	0.00	0.00
200.45	322.34	322.34	0.00	322.34	322.34	0.00	0.00	0.00
200.4	321.26	322.09	+0.83	321.26	322.09	+0.83	0.00	0.00
200.3 (FEMA B)	321.14	322.01	+0.87	321.14	322.01	+0.87	0.00	0.00
200.2	320.97	321.93	+0.96	320.97	321.93	+0.96	0.00	0.00
Dirt Road Crossing	---	---	---	---	---	---	---	---
200.1	320.95	321.92	+0.97	320.95	321.92	+0.97	0.00	0.00
200 (FEMA A)	320.74	321.84	+1.10	320.74	321.84	+1.10	0.00	0.00

Note: The 10-year FEMA elevations are not included in the FIS or backup data.

TABLE 8: FLOODWAY ANALYSIS TABLE – 10-YEAR VELOCITY (ft/s)

	Existing Conditions FEMA Model			Proposed Conditions FEMA Model			Proposed Conditions Model vs. Existing Conditions Model	
Cross-Section	**Vel. without FW**	**Vel. with FW**	**Vel. Diff.**	**Vel. without FW**	**Vel. with FW**	**Vel. Diff.**	**Vel. without FW**	**Vel. with FW**
203 (FEMA E)	8.58	8.75	+0.17	8.58	8.75	+0.17	0.00	0.00
202.2	4.68	4.71	+0.03	4.68	4.71	+0.03	0.00	0.00
Route 8 Bridge	---	---	---	---	---	---	---	---
202.1	5.48	5.49	+0.01	5.48	5.49	+0.01	0.00	0.00
202 (FEMA D)	8.66	8.66	0.00	8.66	8.66	0.00	0.00	0.00
201 (FEMA C)	1.92	2.12	+0.20	1.92	2.12	+0.20	0.00	0.00
200.8	4.10	4.10	0.00	4.10	4.10	0.00	0.00	0.00
200.75	3.86	3.89	+0.03	3.86	3.90	+0.04	0.00	+0.01
200.7	2.95	2.95	0.00	2.95	2.95	0.00	0.00	0.00
200.65	3.94	3.94	0.00	3.94	3.94	0.00	0.00	0.00
200.6	4.52	4.52	0.00	4.52	4.52	0.00	0.00	0.00
Proposed Bridge	---	---	---	---	---	---	---	---
200.55	3.74	3.74	0.00	3.74	3.74	0.00	0.00	0.00
200.5	5.15	5.15	0.00	5.15	5.15	0.00	0.00	0.00
200.45	9.86	9.86	0.00	9.86	9.86	0.00	0.00	0.00
200.4	6.60	4.96	-1.64	6.60	4.96	-1.64	0.00	0.00
200.3 (FEMA B)	2.09	1.75	-0.34	2.09	1.75	-0.34	0.00	0.00
200.2	3.50	2.66	-0.84	3.50	2.66	-0.84	0.00	0.00
Dirt Road Crossing	---	---	---	---	---	---	---	---
200.1	3.53	2.66	-0.87	3.53	2.66	-0.87	0.00	0.00
200 (FEMA A)	3.78	2.72	-1.06	3.78	2.72	-1.06	0.00	0.00

Note: The 10-year FEMA velocities are not included in the FIS or backup data.



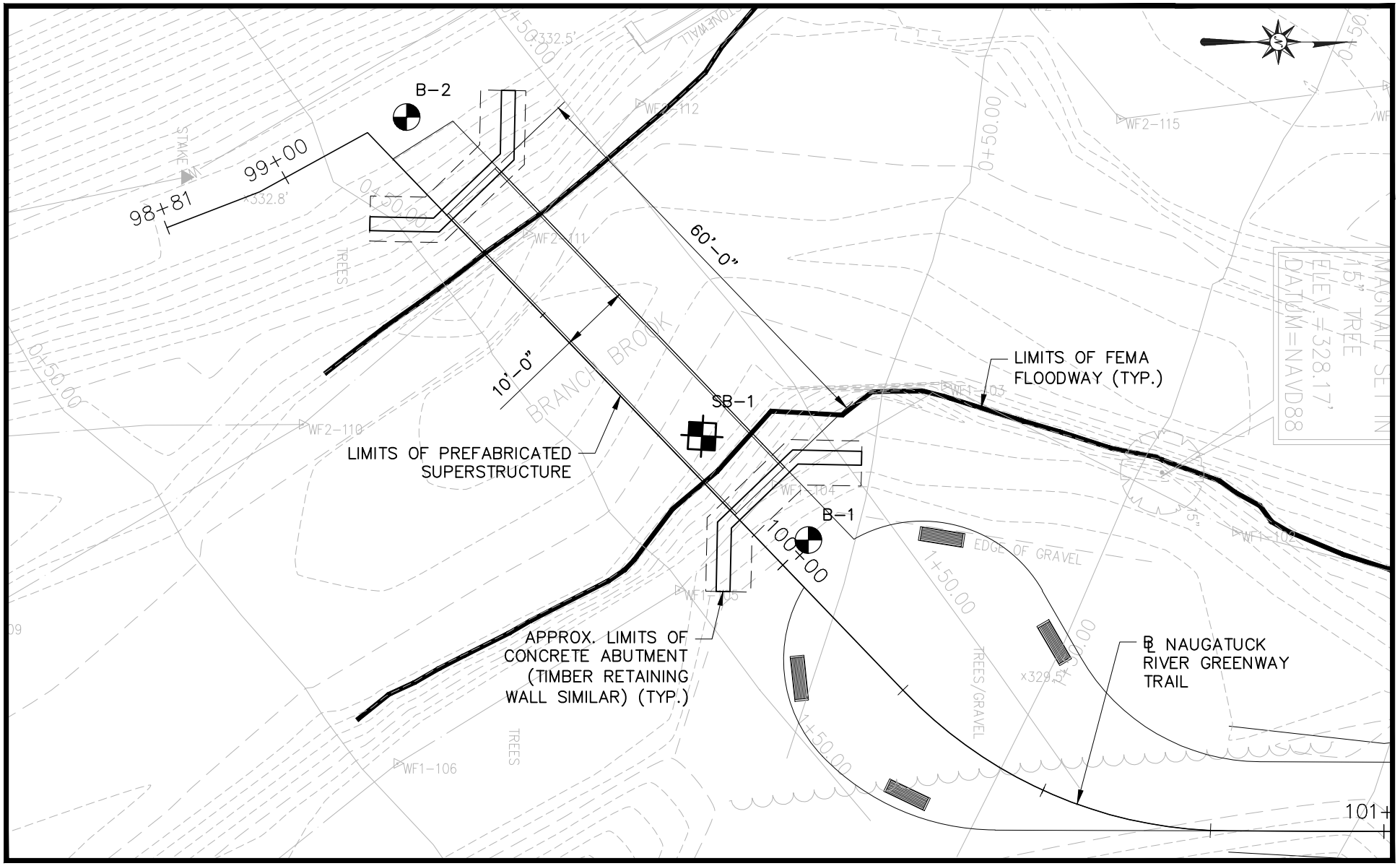
USGS LOCATION MAP
NAUGATUCK RIVER GREENWAY PEDESTRIAN
BRIDGE OVER BRANCH BROOK
THOMASTON, CT

SCALE: 1" = 1000'

FIGURE 1

BL Companies

CAD File: TLOC180057901.dwg



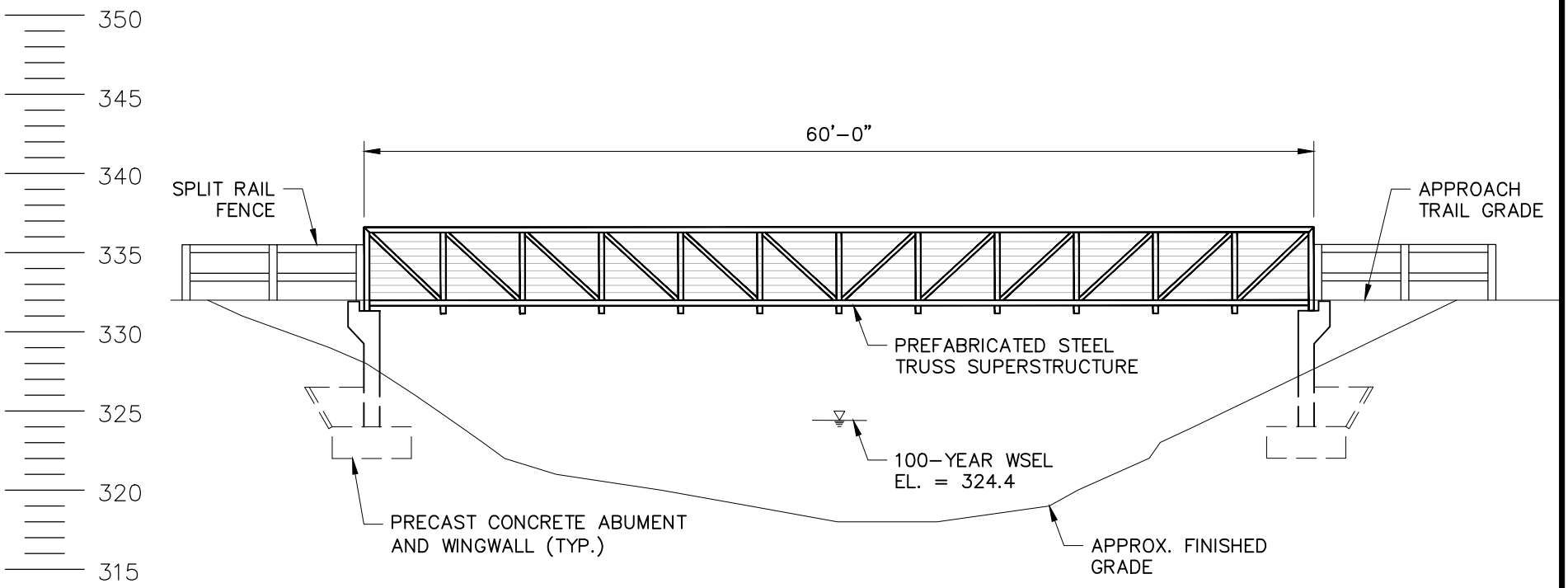
BL Companies

PROPOSED BRIDGE LOCATION

NAUGATUCK RIVER GREENWAY PEDESTRIAN
BRIDGE OVER BRANCH BROOK
THOMASTON, CONNECTICUT

Designed	M.W.
Drawn	T.B.
Checked	M.W.
Approved	C.P.
Scale	1" = 20'-0"
Project No.	1800579
Date	11/2019
CAD File	Structure Type Study Figures

FIG. 2



NOTE: PRECAST CONCRETE WINGWALLS NOT SHOWN FOR CLARITY.

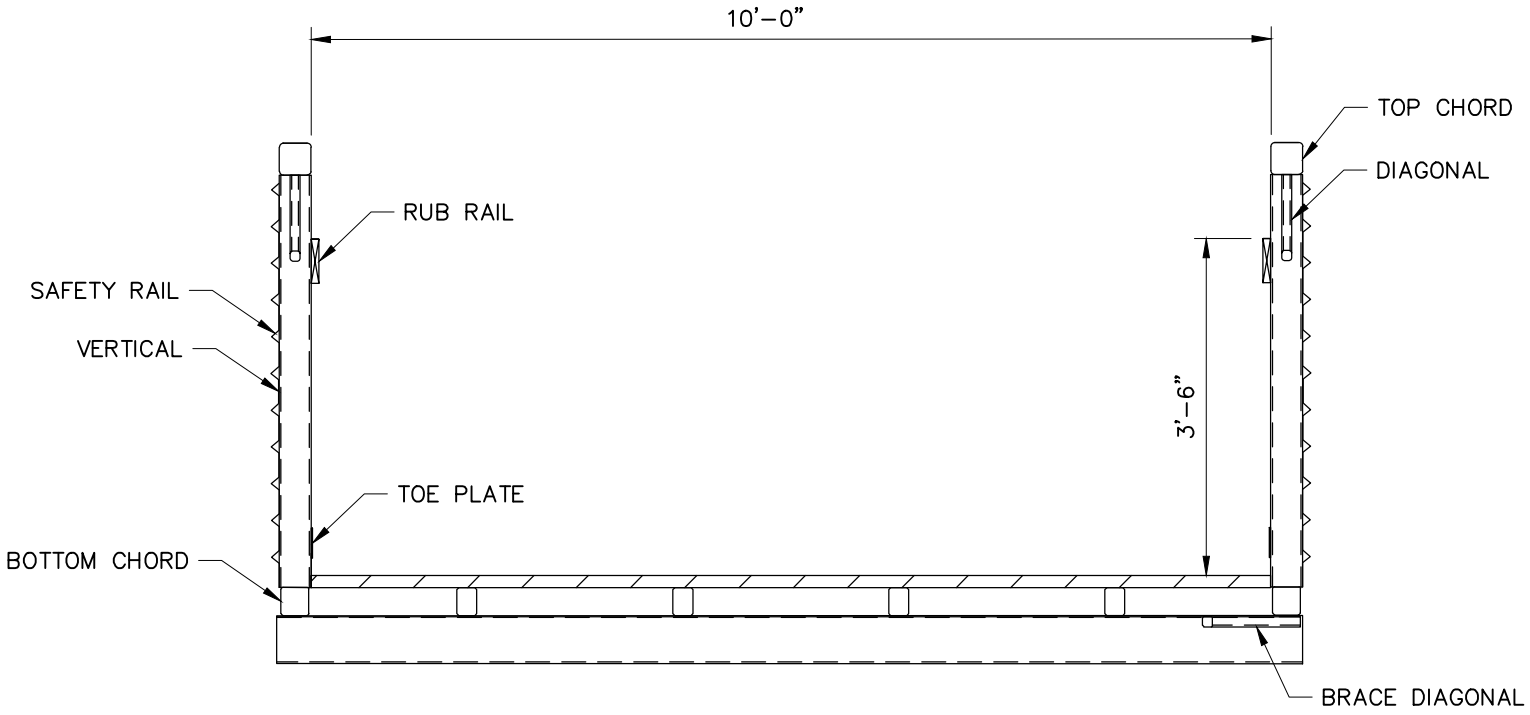
BL Companies

ALTERNATIVE 1 - DOWNSTREAM ELEVATION

NAUGATUCK RIVER GREENWAY PEDESTRIAN
BRIDGE OVER BRANCH BROOK
THOMASTON, CONNECTICUT

Designed	M.W.
Drawn	T.B.
Checked	M.W.
Approved	C.P.
Scale	1" = 10'–0"
Project No.	1800579
Date	11/2019
CAD File	Structure Type Study Figures

FIG. 3



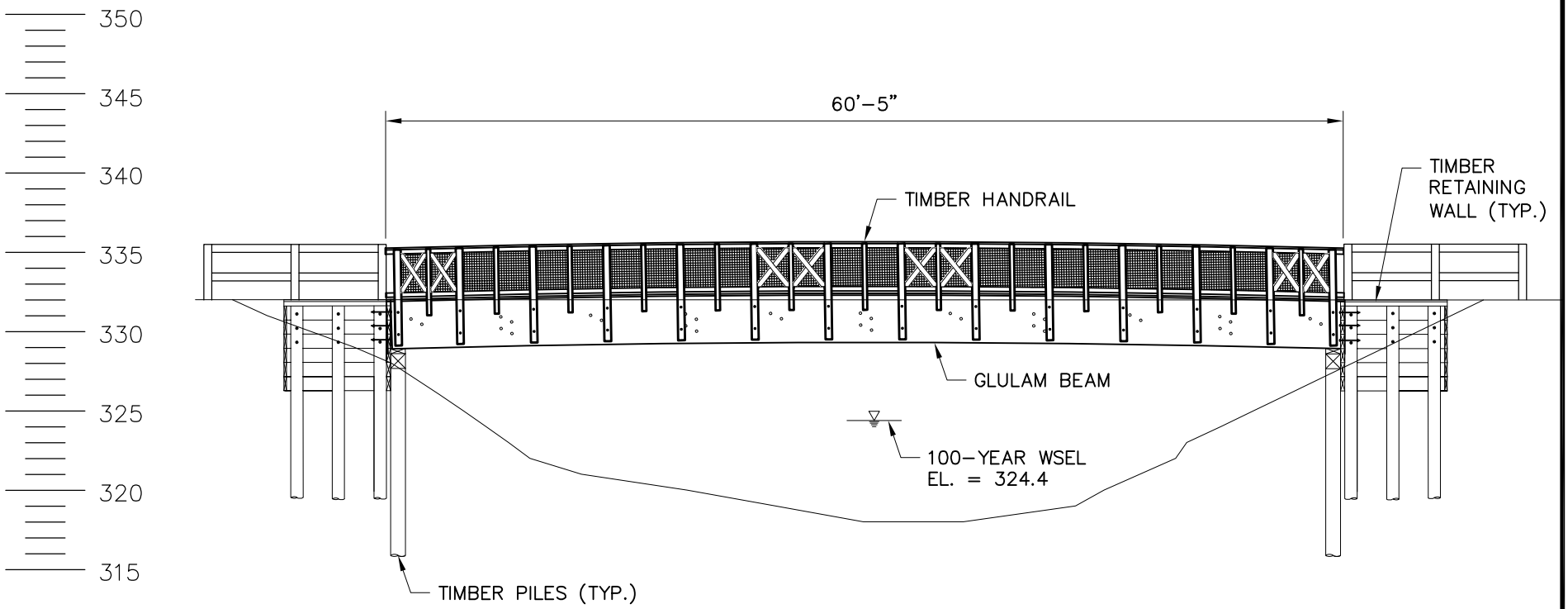
BL Companies

ALTERNATIVE 1 - TYPICAL SECTION

NAUGATUCK RIVER GREENWAY PEDESTRIAN
BRIDGE OVER BRANCH BROOK
THOMASTON, CONNECTICUT

Designed	M.W.
Drawn	T.B.
Checked	M.W.
Approved	C.P.
Scale	1/2" = 1'–0"
Project No.	1800579
Date	11/2019
CAD File	Structure Type Study Figures

FIG. 4



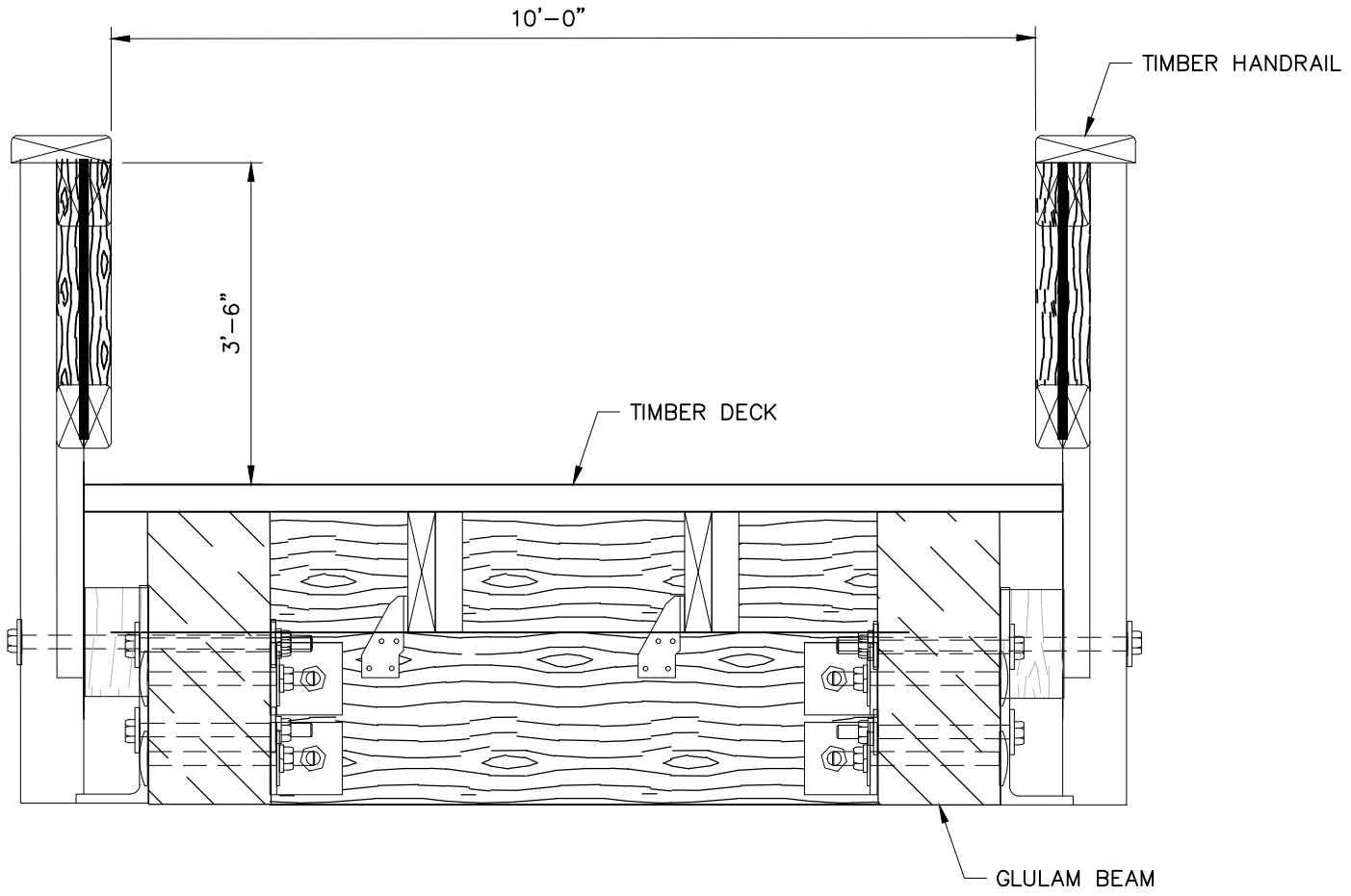
BL Companies

ALTERNATIVE 2 - DOWNSTREAM ELEVATION

NAUGATUCK RIVER GREENWAY PEDESTRIAN
BRIDGE OVER BRANCH BROOK
THOMASTON, CONNECTICUT

Designed	M.W.
Drawn	T.B.
Checked	M.W.
Approved	C.P.
Scale	1" = 10'–0"
Project No.	1800579
Date	11/2019
CAD File	XBRG1800579_101

FIG. 5



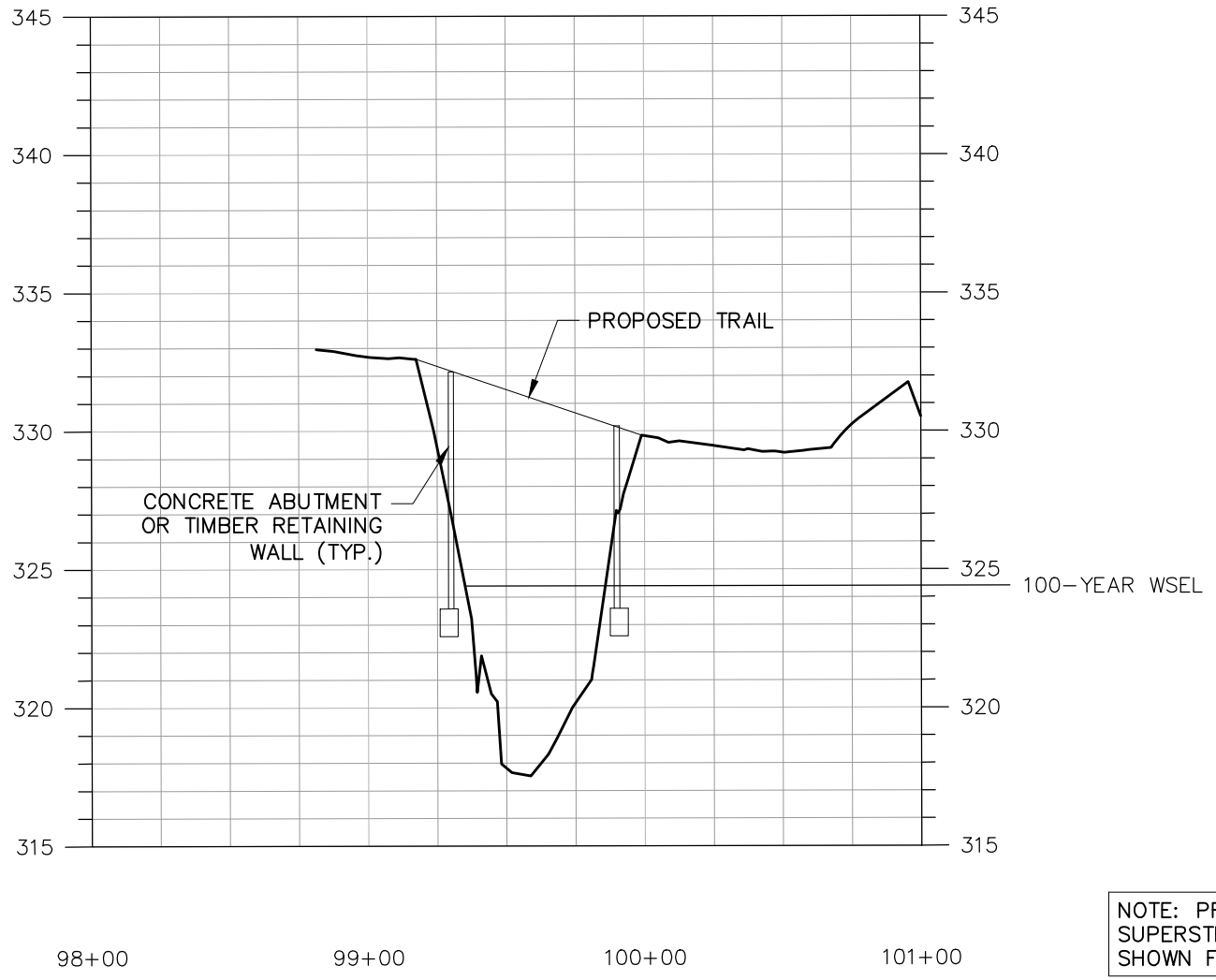
BL Companies

ALTERNATIVE 2 - TYPICAL SECTION

NAUGATUCK RIVER GREENWAY PEDESTRIAN
BRIDGE OVER BRANCH BROOK
THOMASTON, CONNECTICUT

Designed	M.W.
Drawn	T.B.
Checked	M.W.
Approved	C.P.
Scale	1/2" = 1'–0"
Project No.	1800579
Date	11/2019
CAD File	Structure Type Study Figures

FIG. 6



NOTE: PREFABRICATED SUPERSTRUCTURE NOT SHOWN FOR CLARITY.

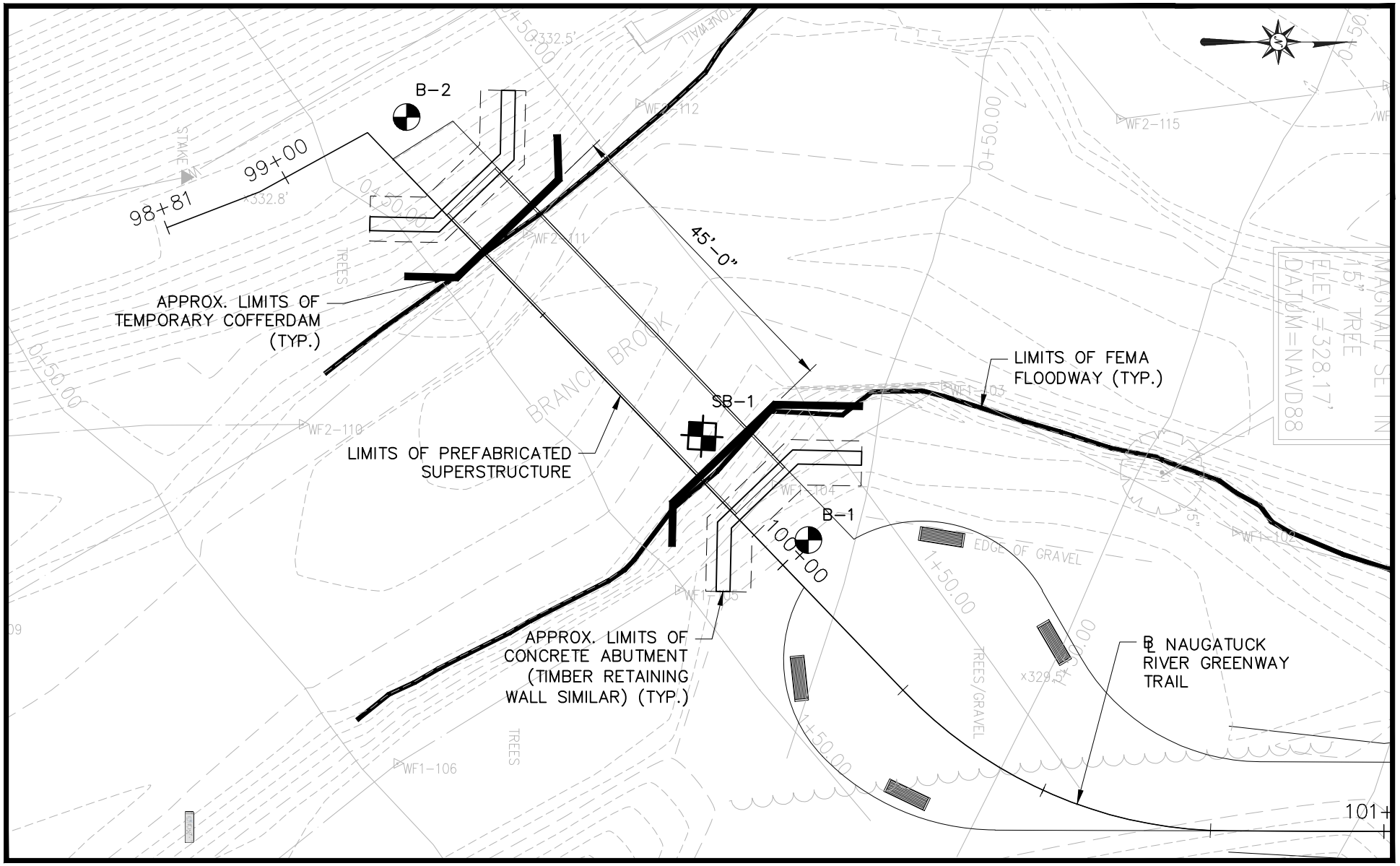
BL Companies

PROFILE

NAUGATUCK RIVER GREENWAY PEDESTRIAN
BRIDGE OVER BRANCH BROOK
THOMASTON, CONNECTICUT

Designed	M.W.
Drawn	T.B.
Checked	M.W.
Approved	C.P.
Scale	N.T.S.
Project No.	1800579
Date	10/2019
CAD File	Structure Type Study Figures

FIG. 7



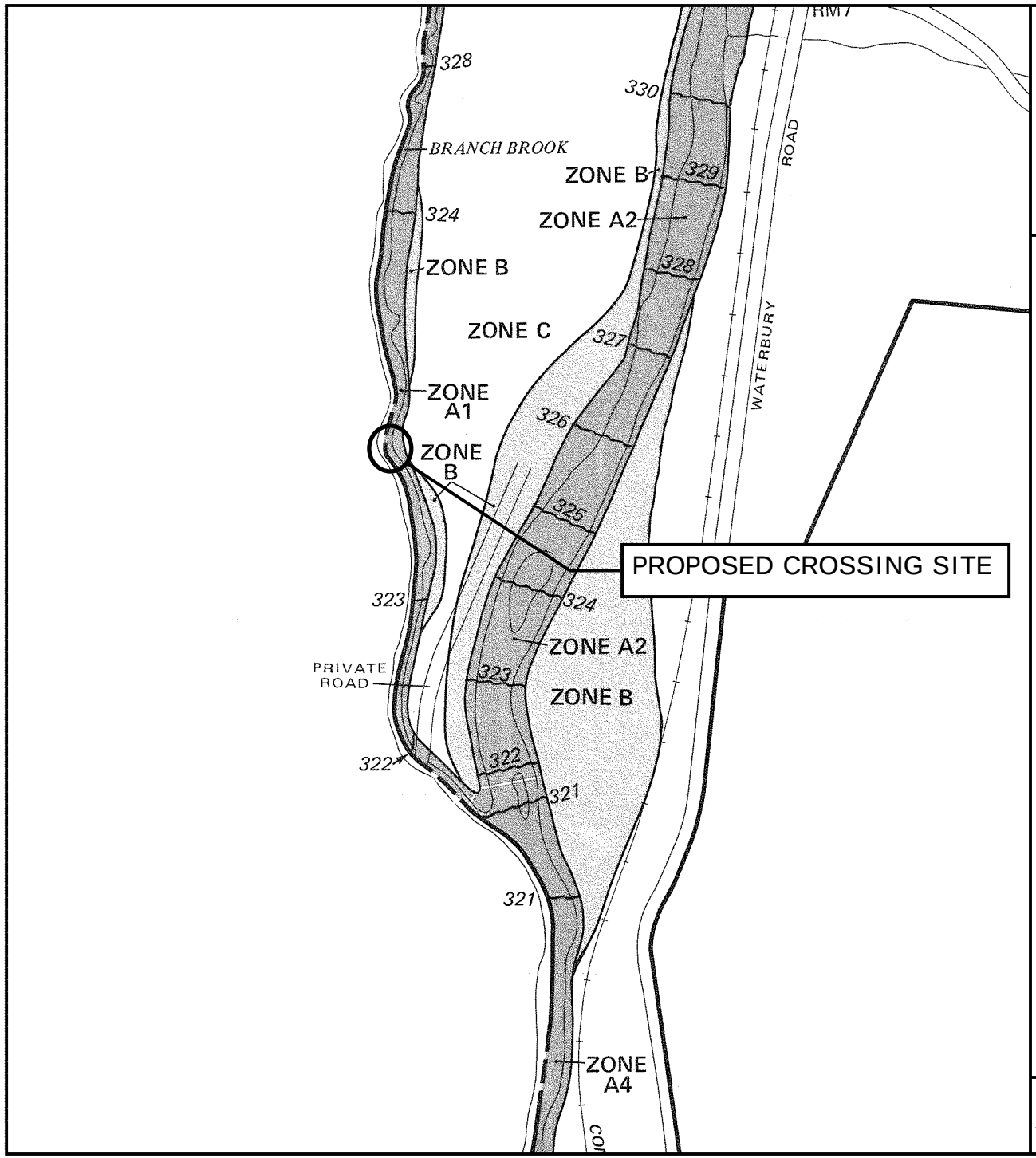
BL Companies

PROPOSE BRIDGE LOCATION WITH TEMPORARY CONDITIONS

NAUGATUCK RIVER GREENWAY PEDESTRIAN
BRIDGE OVER BRANCH BROOK
THOMASTON, CONNECTICUT

Designed	M.W.
Drawn	T.B.
Checked	M.W.
Approved	C.P.
Scale	1" = 20'-0"
Project No.	1800579
Date	11/2019
CAD File	Structure Type Study Figures

FIG. 8



APPROXIMATE SCALE

400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

TOWN OF
THOMASTON,
CONNECTICUT
LITCHFIELD COUNTY

PANEL 5 OF 6
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
090055 0005 B

EFFECTIVE DATE:
JULY 5, 1982

Federal Emergency Management Agency

APPENDIX A – HYDROLOGY

October 2019

ConnDOT Approved Hydraulic Engineer:

NVCOG

Prepared for:
Naugatuck Valley Council of Governments

HYDROLOGIC ANALYSIS REPORT
Pedestrian Footbridge over Branch Brook

BL Project No. 1800579

Naugatuck River Greenway Multi-Use Trail
Towns of Watertown and Thomaston, CT

Prepared By: _____ Date: 10/14/2019
Brandon Rojas

Checked By: _____ Date: 10/15/2019
David Cicia

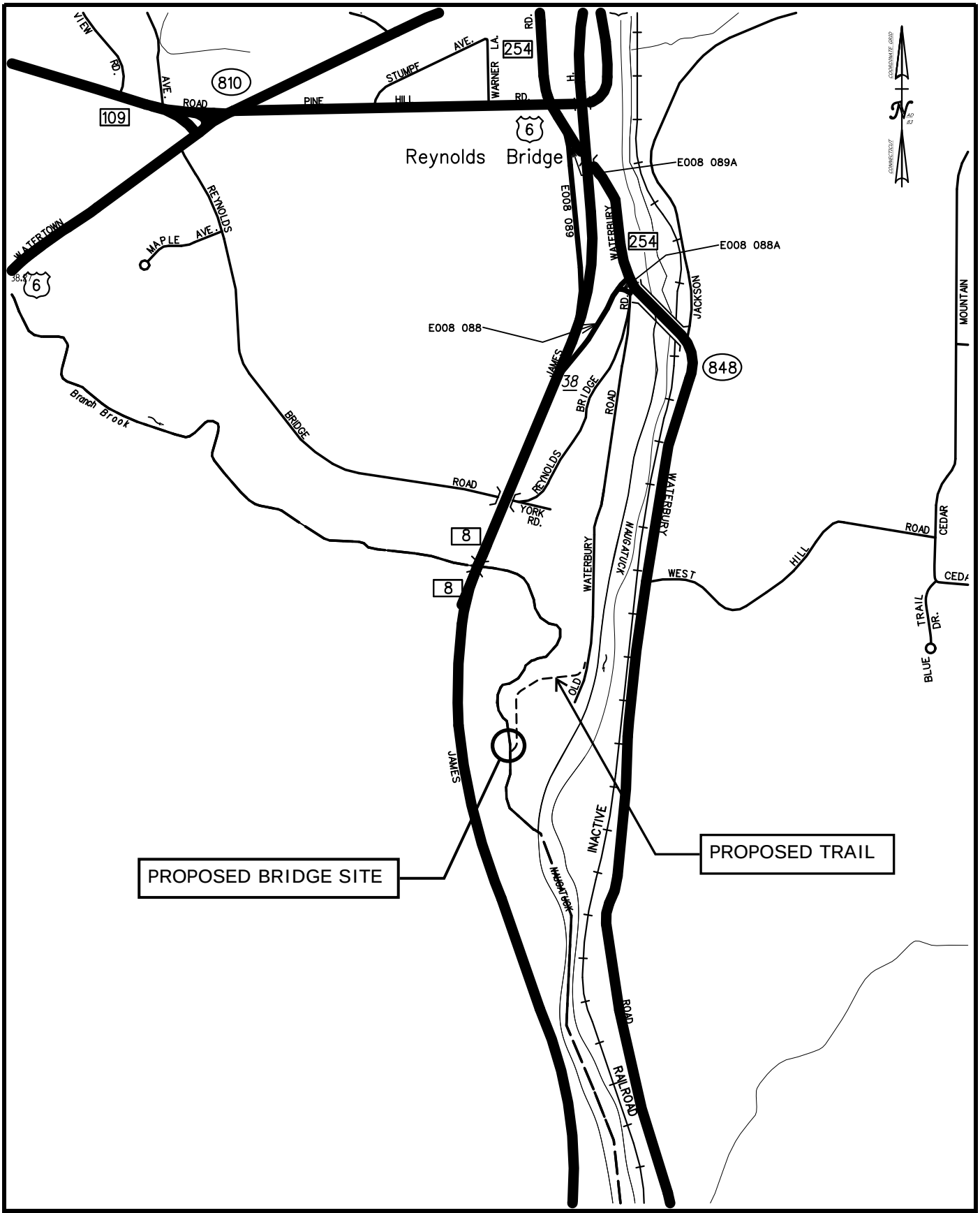
PREPARED BY:
BL Companies
100 Constitution Plaza
10th Floor
Hartford, CT 06103

BL Companies

TABLE OF CONTENTS PAGE

TABLES AND FIGURES

APPENDICES



BL Companies	NAUGATUCK RIVER GREENWAY OVER BRANCH BROOK TOWNS OF WATERTOWN & THOMASTON, CONNECTICUT	LOCATION MAP	PROJ. NO.: 1800579 SCALE: 1" = 1,000'

II. WATERSHED CHARACTERISTICS

This project involves the construction of the Naugatuck River Greenway, a multi-use trail which includes a crossing over Branch Brook, which forms the boundary between the towns of Watertown and Thomaston. The proposed trail is located east of Route 8 and west of the Naugatuck River. The trail crosses Branch Brook approximately 1,000 ft upstream of the brook's confluence with the Naugatuck River. Once the path crosses Branch Brook, it moves northeast just outside the ridgelines of the properties between the two watercourses (see Location Map), where it eventually connects to Old Waterbury Road.

Branch Brook flows primarily southeast, beginning just downstream of the Wigwam Reservoir Dam, located approximately 3.0 miles upstream from the confluence of Branch Brook and Naugatuck River. Beyond this point (upstream direction), the main watercourse is segmented into a series of reservoirs and several dams, each with branching tributaries contributing to the watershed. As a result of the large water storage area, typical flow estimation methods involving StreamStats are not feasible and will not be used in this analysis. The largest watercourses within this area by extension (not including Branch Brook) are: Wigwam River, Moosehorn Brook, Slab Meadow Brook, East Morris Brook and Fenn Brook.

The river upstream of the bridge has an average streambed slope of 29.3 ft/mi. At the site of the proposed bridge, the brook has a drainage area of approximately 22.6 square miles. The watershed was generated by the USGS StreamStats 4.2 online application and revised for accuracy using USGS Quadrangle Maps from the National Map online viewer (see Figure 2). Utilizing the USGS StreamStats online utility, the watershed area exhibits that 9.69% of the land use is developed, 1.07% is wetlands and the remainder is forested or other pervious area. Delineation of surficial materials indicates that approximately 2.21% of the watershed area consists of coarse-grained stratified drift (see Figure 3) and the remainder is composed of various postglacial deposits and till.

The watershed extends northwest to a local high point located approximately 1.1 miles east of the intersection of Route 118 and Route 202. The eastern side of the watershed follows a ridgeline south, bordering the western limits of the larger Naugatuck River watershed. These extents of the watershed continue along a series of high points within the Towns of Litchfield, Thomaston and Watertown until it meets the location of the proposed pedestrian footbridge. The western extents of the watershed move from the northern portion of the watershed south along a series of high points until the southernmost limits, following the limits of the various watersheds surrounding the subject area. The southern extents of the watershed move along ridgelines until connecting with the eastern watershed limits at the bridge.

The upper third of the watershed is characterized by large amounts of rural pasture area unlike the other two thirds of the watershed which are mostly wooded and remote. The middle third consists of rural residential area as well as some open pasture. This area also includes large undeveloped wooded and water storage areas, including multiple large reservoirs such as Morris Reservoir and Pitch Reservoir. The lower third is similar in composition to the middle third of the watershed, characterized by large areas of water storage and forested area, although with substantially less open pasture-like area. This portion of the watershed contains the Branch

Brook watercourse, Black Rock Reservoir and the bridge itself. The ConnDOT Drainage Manual classifies the proposed bridge as a large structure (providing waterway for drainage areas of more than 10 square miles and less than 1,000 square miles) with a 100-year design storm event and a 500-year check storm event. The bridge is within Zone A1 on the FEMA Flood Insurance Rate Map (see Figure 4).

The FEMA Flood Insurance Study (*FIS*) denotes an area of 20.8 square miles, approximately 1.75 miles upstream of the bridge site at Black Rock Dam (effectively the beginning of the Branch Brook watercourse). The brook is listed in the Gazetteer of Drainage Areas of Connecticut. At the brook's mouth above Naugatuck River, the gazetteer lists Branch Brook with a drainage area of 22.646 sq. mi. The mouth is located approximately 1,100 feet downstream (south) of the subject bridge. There is also a USGS stream gage approximately 1.25 miles upstream from the proposed bridge.

III. HYDROLOGIC METHODOLOGY

The flows in this hydrologic study were prepared utilizing the methods described below:

1. **Method 1 – FEMA Flood Insurance Study (*FIS*):** This data was obtained from the *Flood Insurance Study (FIS), Prepared for the Town of Watertown, Connecticut, revised May 1980 by the Federal Emergency Management Agency* (FEMA). The *FIS* contains published flows along Branch Brook at three locations along the watercourse: at the mouth of the brook (the confluence with the Naugatuck River), at Black Rock Dam and at Wigwam Dam. At these locations, the drainage areas listed in the *FIS* are 22.8, 20.4, and 17.5 sq. miles, respectively. Black Rock Dam is the first structure upstream of the proposed bridge location. It is composed of a 933-ft long and 154-ft high earthen dam, a gated 4-ft by 5-ft concrete conduit in the right abutment of the dam, and a chute spillway with a 140-ft long crest adjacent to the right abutment. The structure has storage equivalent to 8 inches of runoff from the drainage area of 20.4 sq. miles. According to the *FIS,* the flows at Black Rock Dam are estimated based on hydrographs of major events routed through the reservoir. Refer to Appendix B of this report for additional *Flood Insurance Study* information. The *FIS* flows will be utilized for the hydraulic analysis.

2. **Method 2 – PeakFq Gage Analysis:** A gage analysis was performed on Gage No. 01208013 – Branch Brook near Thomaston, CT. The USGS program PeakFq, Version 7.2, computed estimates for the gages based on the Expected Moments Algorithm (EMA). Gage flow information was found in StreamStats, and is listed in the USGS publication, *Regression Equations for Estimating Flood Flows for the 2-, 10-, 25-, 50-, 100-, and 500-Year Recurrence Intervals in Connecticut, Report 2004-5126 (Ahearn, 2004)*. Refer to Appendix D for analysis of the stream gage in PeakFq. The flows computed by PeakFq and transferred to the site using the CTDOT Drainage Manual's flow transfer equation will not be utilized for the hydraulic analysis.

The flows calculated using the above methods are listed in "Table 1: Summary of Flows".

IV. HISTORICAL FLOODING

Numerous major floods have occurred within the Naugatuck River Basin, many of which caused severe damage to property and even loss of life. According to the FEMA *FIS*, the major floods of the century within the watershed occurred in August 1955 which saw the failure of multiple dams and bridges. This includes the downstream reaches of the Thomaston Dam where the Naugatuck River claimed an estimated 36 lives and caused damages estimated at $193,000,000. Stream flow records at the USGS gaging station along upstream of Black Rock Dam indicate that the August 1955 flood was greater than that of a 100-year event (*FIS*). Refer to Atlas 14 data (see Appendix E) to view relevant rainfall data.

V. STUDY RESULTS

The flows provided in the FEMA *Flood Insurance Study* at the mouth of Branch Brook will be utilized as the design flows for the hydraulic analysis. The FEMA and PeakFq rates are similar for all but the 500-year event. As noted in the *FIS*, the FEMA discharges for the 100-year and 500-year events "are estimated based on hydrographs of major events routed through the reservoir". The PeakFq flows are from a regression-based analysis and the 500-year flow appears too low for use. The flows within the *FIS* at the mouth of Branch Brook appear most accurate for the nature and use of the contributing watershed.

TABLE 1: SUMMARY OF FLOWS (C.F.S.)

Summary of Flows (cfs) vs. Design Frequency (years) Pedestrian Bridge over Branch Brook – Watertown/Thomaston, CT								
	Drainage Area (mi^2)	2-Year	10-Year	25-Year	50-Year	100-Year	200-Year	500-Year
FEMA at Branch Brook mouth	22.8	-	800	-	800	900	-	2,300
FEMA at Black Rock Dam	20.4	-	800	-	800	900	-	2,300
PeakFq at Gage - No. 01208013	22.6	560	770	870	940	1,010	1,080	1,180

As previously mentioned, the proposed bridge is classified as a large structure. Large structures have a 100-year design storm event and a 500-year check storm event. At the location of the proposed bridge, the selected method has a 100-year flow of 900 cfs and a 500-year flow of 2,300 cfs. See Table 2 for the design flows recommended for this project.

TABLE 2: DESIGN FLOWS (C.F.S.)

Design Flows (cfs) vs. Design Frequency (years) Aircraft Road Bridge over Quinnipiac River – Southington, CT	
Year	**Flow**
Average Daily Flow	40
Average Spring Flow	80
2	450*
5	560*
10	800
25	800*
50	800
100 (Design Storm Event)	900
200	1,500*
500 (Check Storm Event)	2,300

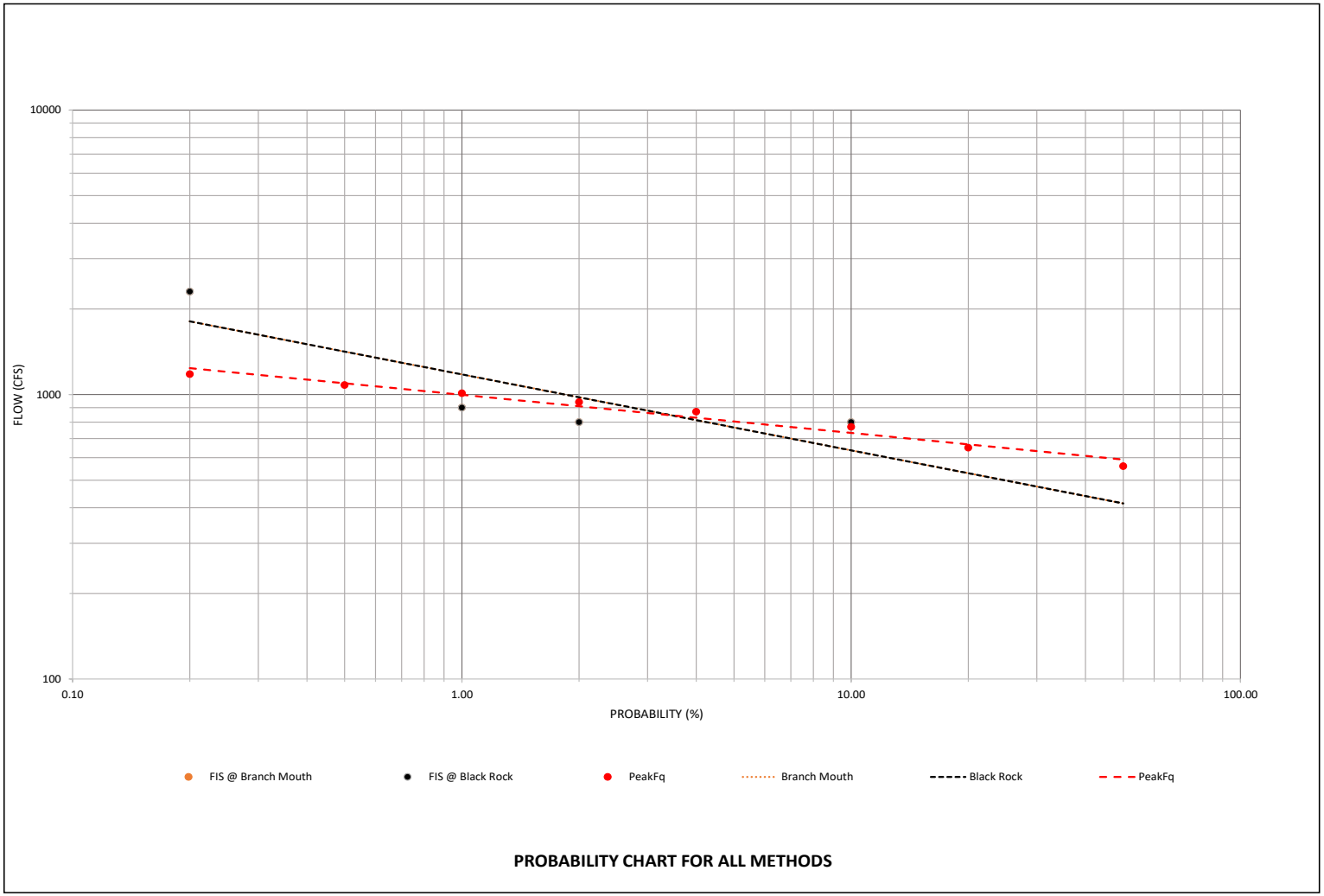
*These values were obtained based on a linear evaluation of the logarithmic chart.

To comply with the National Flood Insurance Program and the CT DEEP hydraulic guidelines for work within a regulated floodway, the FEMA FIS flows will also be used in the floodway analysis.

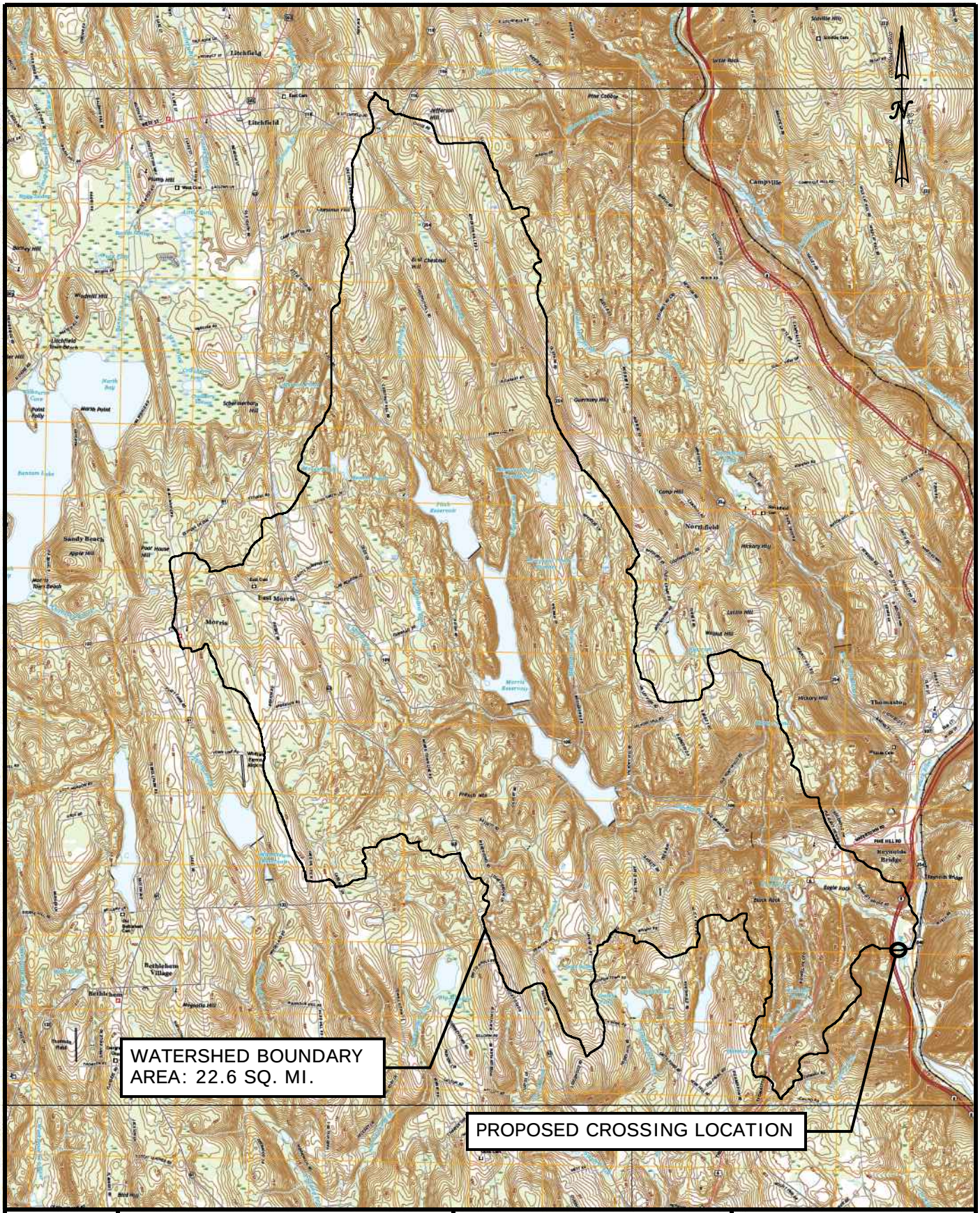
BL Companies
100 Constitution Plaza, 10th Floor
Hartford, Connecticut 06103

PROJECT: **Naugatuck River Greenway Multi-Use Trail**
Towns of Watertown & Thomaston, CT
PREPARED BY: Brandon Rojas
CHECKED BY: David Cicia

Year		PROBABILITY (%)	FEMA FIS at mouth of Branch Brook	FEMA FIS at Black Rock Dam	PeakFq at USGS Stream Gage No. 1208013
2	0.5	50			560
5	0.2	20			650
10	0.1	10	800	800	770
25	0.04	4			870
50	0.02	2	800	800	940
100	0.01	1	900	900	1,010
200	0.005	0.5			1,080
500	0.002	0.2	2,300	2,300	1,180



PROBABILITY CHART FOR ALL METHODS



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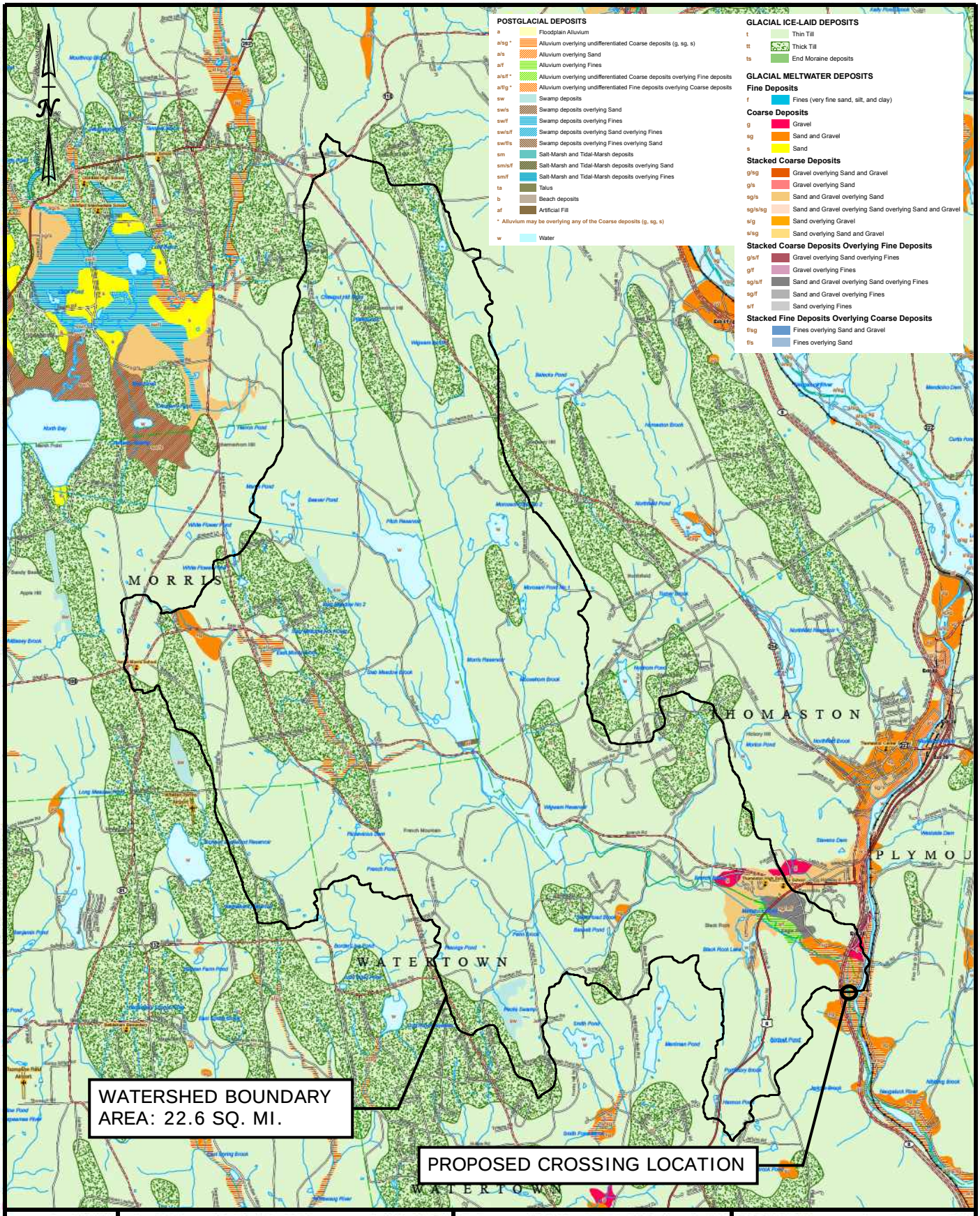
NAUGATUCK RIVER GREENWAY
OVER BRANCH BROOK
TOWNS OF WATERTOWN &
THOMASTON, CONNECTICUT

WATERSHED BOUNDARY
MAP

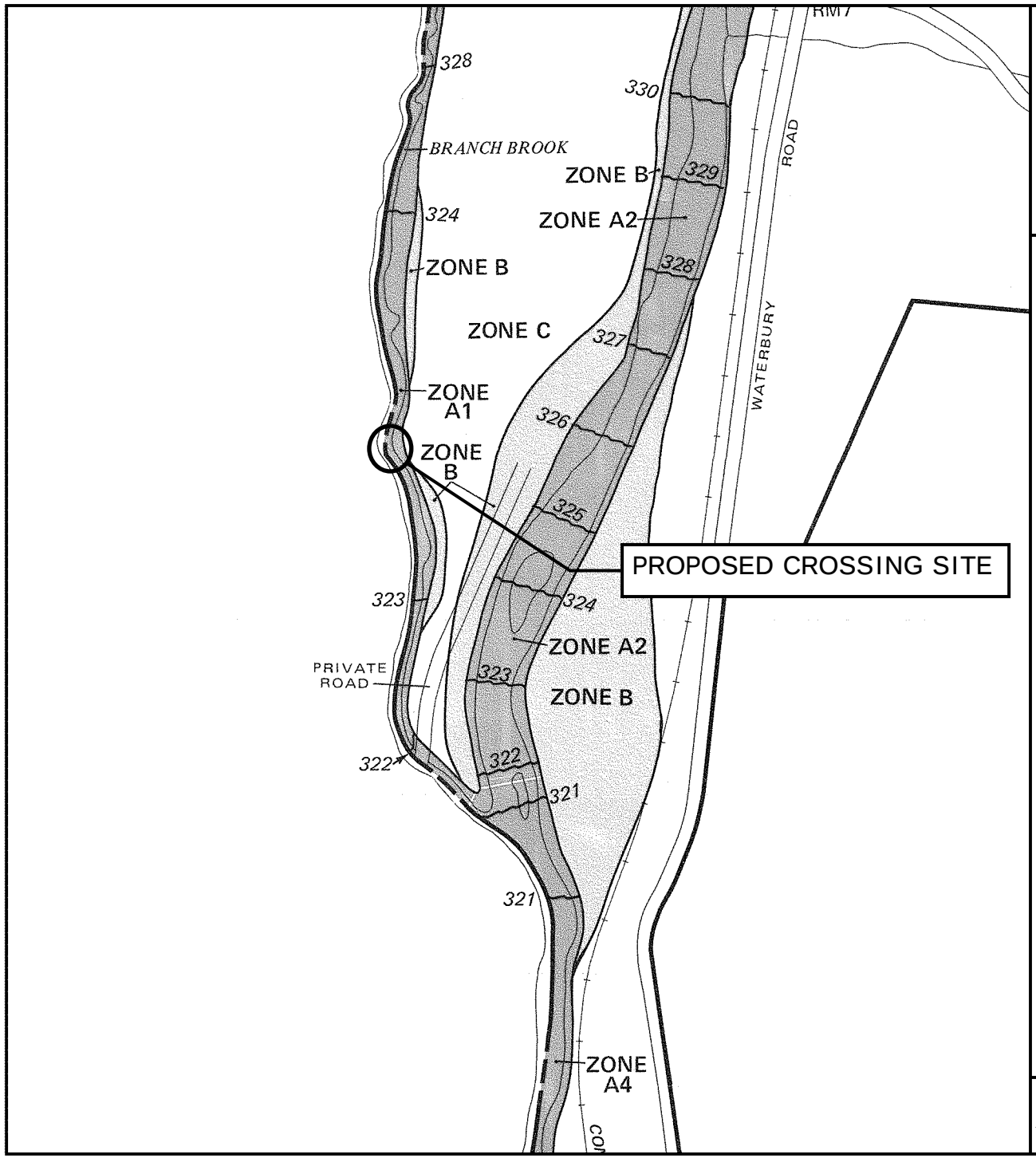
BR. NO.:

PROJ. NO.: 1800579

SCALE: 1" = 6,000'



BL Companies	NAUGATUCK RIVER GREENWAY OVER BRANCH BROOK TOWNS OF WATERTOWN & THOMASTON, CONNECTICUT	SURFICIAL MATERIALS MAP	BR. NO.: PROJ. NO.: 1800579 SCALE: 1" = 6,000'



APPROXIMATE SCALE

400 0 400 FEET

NATIONAL FLOOD INSURANCE PROGRAM

FIRM

FLOOD INSURANCE RATE MAP

TOWN OF
THOMASTON,
CONNECTICUT
LITCHFIELD COUNTY

PANEL 5 OF 6
(SEE MAP INDEX FOR PANELS NOT PRINTED)

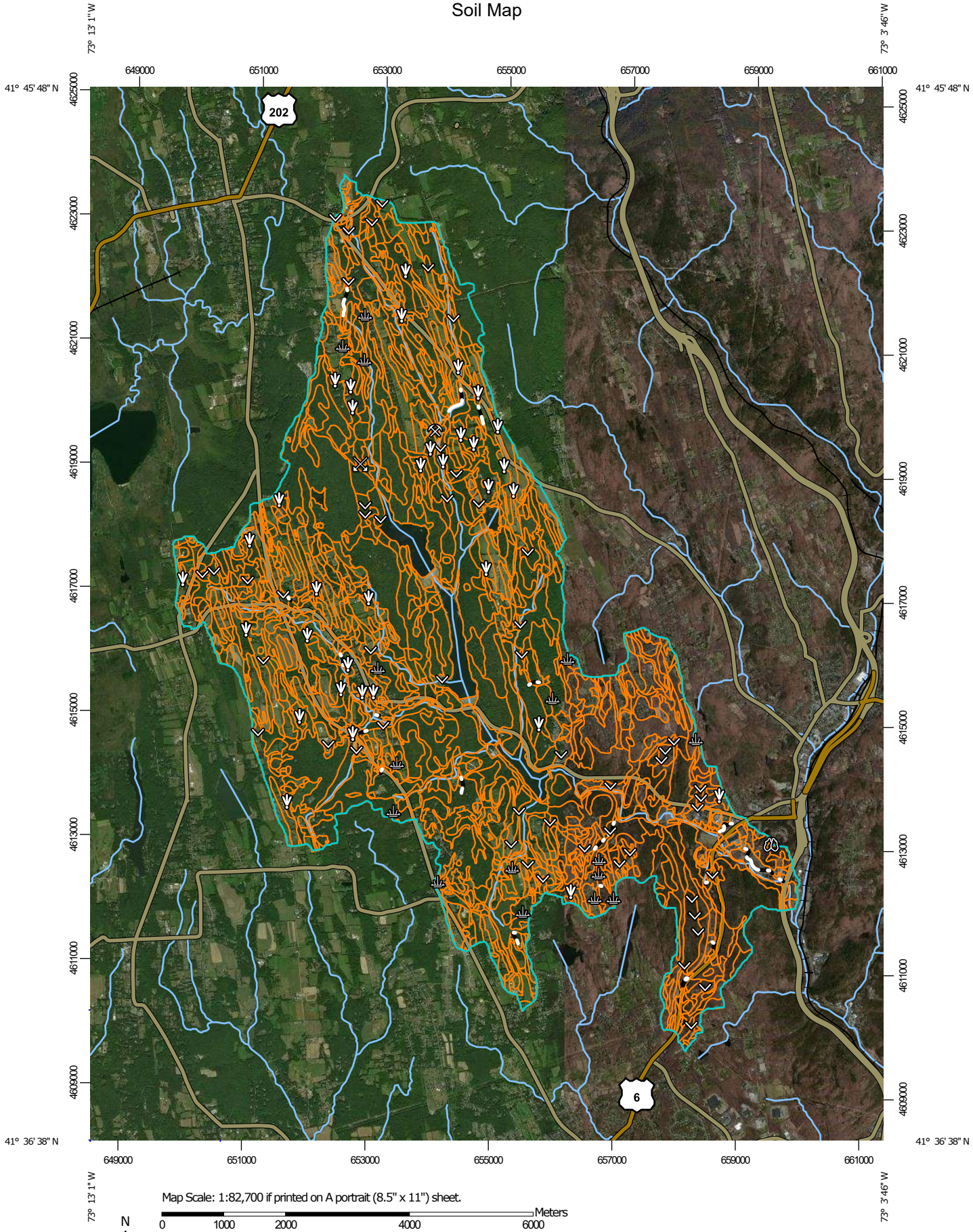
COMMUNITY-PANEL NUMBER
090055 0005 B

EFFECTIVE DATE:
JULY 5, 1982

Federal Emergency Management Agency

APPENDIX A: WEB SOIL SURVEY DATA

Custom Soil Resource Report
Soil Map



Map Scale: 1:82,700 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 1000 2000 4000 6000

Feet
0 4000 8000 16000 24000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Map Unit Polygons

Soil Map Unit Lines

Soil Map Unit Points

Special Point Features

Blowout

Borrow Pit

Clay Spot

Closed Depression

Gravel Pit

Gravelly Spot

Landfill

Lava Flow

Marsh or swamp

Mine or Quarry

Miscellaneous Water

Perennial Water

Rock Outcrop

Saline Spot

Sandy Spot

Severely Eroded Spot

Sinkhole

Slide or Slip

Sodic Spot

Spoil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:12,000.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: State of Connecticut
Survey Area Data: Version 19, Sep 13, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 28, 2011—Oct 5, 2016

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
2	Ridgebury fine sandy loam, 0 to 3 percent slopes	126.3	0.9%
3	Ridgebury, Leicester, and Whitman soils, 0 to 8 percent slopes, extremely stony	727.8	5.0%
4	Leicester fine sandy loam	23.2	0.2%
12	Raypol silt loam	9.0	0.1%
13	Walpole sandy loam, 0 to 3 percent slopes	16.5	0.1%
15	Scarboro muck, 0 to 3 percent slopes	22.1	0.2%
16	Halsey silt loam	42.4	0.3%
17	Timakwa and Natchaug soils, 0 to 2 percent slopes	11.6	0.1%
18	Catden and Freetown soils, 0 to 2 percent slopes	160.1	1.1%
30B	Branford silt loam, 3 to 8 percent slopes	12.3	0.1%
34A	Merrimac fine sandy loam, 0 to 3 percent slopes	13.8	0.1%
34B	Merrimac fine sandy loam, 3 to 8 percent slopes	122.0	0.8%
34C	Merrimac fine sandy loam, 8 to 15 percent slopes	46.3	0.3%
38A	Hinckley loamy sand, 0 to 3 percent slopes	25.2	0.2%
38C	Hinckley loamy sand, 3 to 15 percent slopes	162.5	1.1%
38E	Hinckley loamy sand, 15 to 45 percent slopes	22.3	0.2%
45A	Woodbridge fine sandy loam, 0 to 3 percent slopes	44.8	0.3%
45B	Woodbridge fine sandy loam, 3 to 8 percent slopes	431.2	3.0%
45C	Woodbridge fine sandy loam, 8 to 15 percent slopes	55.2	0.4%
46B	Woodbridge fine sandy loam, 0 to 8 percent slopes, very stony	87.5	0.6%
46C	Woodbridge fine sandy loam, 8 to 15 percent slopes, very stony	17.4	0.1%
47C	Woodbridge fine sandy loam, 3 to 15 percent slopes, extremely stony	549.8	3.8%

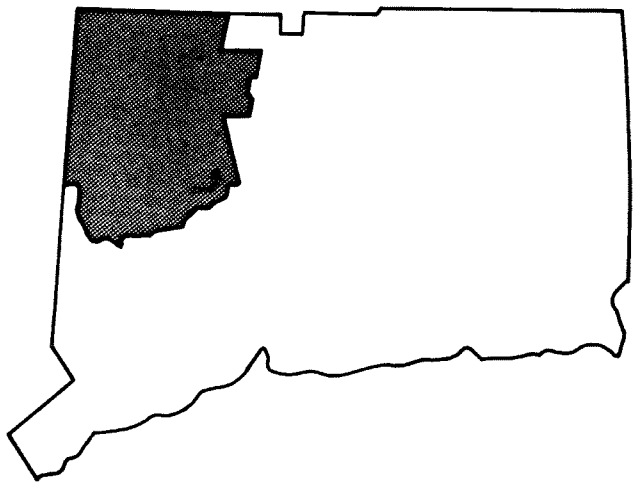
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
50A	Sutton fine sandy loam, 0 to 3 percent slopes	9.2	0.1%
50B	Sutton fine sandy loam, 3 to 8 percent slopes	29.8	0.2%
51B	Sutton fine sandy loam, 0 to 8 percent slopes, very stony	23.6	0.2%
52C	Sutton fine sandy loam, 2 to 15 percent slopes, extremely stony	77.7	0.5%
57C	Gloucester gravelly sandy loam, 8 to 15 percent slopes	0.2	0.0%
59C	Gloucester gravelly sandy loam, 3 to 15 percent slopes, extremely stony	29.1	0.2%
59D	Gloucester gravelly sandy loam, 15 to 35 percent slopes, extremely stony	17.2	0.1%
60B	Canton and Charlton fine sandy loams, 3 to 8 percent slopes	396.4	2.7%
60C	Canton and Charlton fine sandy loams, 8 to 15 percent slopes	193.8	1.3%
60D	Canton and Charlton soils, 15 to 25 percent slopes	49.9	0.3%
61B	Canton and Charlton fine sandy loams, 0 to 8 percent slopes, very stony	95.8	0.7%
61C	Canton and Charlton fine sandy loams, 8 to 15 percent slopes, very stony	70.0	0.5%
62C	Canton and Charlton fine sandy loams, 3 to 15 percent slopes, extremely stony	245.5	1.7%
62D	Canton and Charlton fine sandy loams, 15 to 35 percent slopes, extremely stony	168.1	1.2%
73C	Charlton-Chatfield complex, 0 to 15 percent slopes, very rocky	1,095.9	7.6%
73E	Charlton-Chatfield complex, 15 to 45 percent slopes, very rocky	221.1	1.5%
75C	Hollis-Chatfield-Rock outcrop complex, 3 to 15 percent slopes	2,329.2	16.1%
75E	Hollis-Chatfield-Rock outcrop complex, 15 to 45 percent slopes	1,623.2	11.2%
76E	Rock outcrop-Hollis complex, 3 to 45 percent slopes	309.2	2.1%
76F	Rock outcrop-Hollis complex, 45 to 60 percent slopes	92.8	0.6%

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
84B	Paxton and Montauk fine sandy loams, 3 to 8 percent slopes	1,590.5	11.0%
84C	Paxton and Montauk fine sandy loams, 8 to 15 percent slopes	1,000.4	6.9%
84D	Paxton and Montauk fine sandy loams, 15 to 25 percent slopes	224.3	1.5%
85B	Paxton and Montauk fine sandy loams, 3 to 8 percent slopes, very stony	156.5	1.1%
85C	Paxton and Montauk fine sandy loams, 8 to 15 percent slopes, very stony	247.6	1.7%
86C	Paxton and Montauk fine sandy loams, 3 to 15 percent slopes, extremely stony	165.4	1.1%
86D	Paxton and Montauk fine sandy loams, 15 to 35 percent slopes, extremely stony	359.5	2.5%
100	Suncook loamy fine sand	2.9	0.0%
101	Occum fine sandy loam	66.1	0.5%
102	Pootatuck fine sandy loam	8.8	0.1%
107	Limerick and Lim soils	1.6	0.0%
108	Saco silt loam	16.1	0.1%
109	Fluvaquents-Udifluvents complex, frequently flooded	26.4	0.2%
301	Beaches-Udipsamments complex, coastal	1.1	0.0%
306	Udorthents-Urban land complex	107.7	0.7%
307	Urban land	14.7	0.1%
308	Udorthents, smoothed	112.5	0.8%
309	Udorthents, flood control	49.6	0.3%
702A	Tisbury silt loam, 0 to 3 percent slopes	12.1	0.1%
702B	Tisbury silt loam, 3 to 8 percent slopes	3.3	0.0%
703B	Haven silt loam, 3 to 8 percent slopes	10.2	0.1%
703C	Haven silt loam, 8 to 15 percent slopes	2.4	0.0%
W	Water	488.6	3.4%
Totals for Area of Interest		**14,475.5**	**100.0%**

APPENDIX B: FEMA FLOOD INSURANCE STUDY

FLOOD INSURANCE STUDY

TOWN OF WATERTOWN, CONNECTICUT
LITCHFIELD COUNTY



MAY 1980

federal emergency management agency
federal insurance administration

COMMUNITY NUMBER - 090058

The population of Watertown has increased steadily from 3,100 in 1900 to 18,610 in 1970. This population growth is a reflection of the change in Watertown from rural and agricultural in character to urban and suburban. Thirty percent of the town's land area, however, is still used for agricultural purposes. A modern superhighway system, which connects Watertown to the City of Waterbury, reducing commuting time, encourages suburban development.

Residential development in Watertown, as a whole, consists mainly of single- family detached houses. The most developed portion of the town's land area is arranged in a land use pattern consisting of an elongated urban core surrounded by suburban areas, that extend northwestward into rural countryside.

Watertown has only a small supply of easily developable land available. Much of the land presents problems for urban development because of uneven topography and less than ideal subsoil conditions.

The climate in Watertown is variable, with the average annual precipitation ranging between 44 and 52 inches. Temperatures in the area range from below 0 degrees Fahrenheit (°F) to greater than 100°F, with an annual average of approximately 50°F.

2.3 Principal Flood Problems

Numerous damaging floods have occurred in the Naugatuck River basin which have affected the Town of Watertown. Floods causing significant damage in this century occurred in 1927, 1936, 1938, 1948 and 1955.

The August, 1955 flood was the greatest flood ever recorded in the Naugatuck River basin with peak discharges three to four times the magnitude of any other flood. Between August 11-15, Hurricane Connie brought 4 to 8 inches of rainfall to the basin. Due to the unusually dry antecedent conditions, very little runoff resulted from this storm. However, when Hurricane Diane deposited 10 to 13 inches of rainfall in 24 hours, runoff of major proportions occurred due to the saturated condition of the soil. The failure of many dams and bridges contributed substantially to peak discharges. Downstream of the Thomaston Dam, the Naugatuck River claimed 36 lives and caused an estimated loss of nearly 193,000,000 dollars. Over 80 percent of this loss occurred in Waterbury, Watertown, Naugatuck and Ansonia.

High-water mark data were recorded at 332.5, 326.4, 314.9 and 309.9 feet, for the Naugatuck River at the mouth of Jericho Brook, at the mouth of Nibbling Brook, at Frost Bridge, and 0.1 mile below Frost Bridge, respectively.

Major floods occurred in the upper Naugatuck River basin in November 1927, March 1936, September 1938, December 1948, August 1955, and October 1955. With the exception of the August 1955 flood, the peak discharges of the other events generally ranged from 15,000 to 20,000 cubic feet per second (cfs) in the Naugatuck River at Waterbury, with estimated frequencies ranging from approximately 15 to 30 years. The August 1955 event was the greatest flood of record, by far, with a flow in the Naugatuck River at Waterbury of 90,000 cfs, with a corresponding frequency considered in excess of 100 years. The peak discharge on Branch Brook in 1955 was estimated at 10,300 cfs, approximately equal to the Leadmine Brook peak flow of 10,400 cfs.

In addition to the Naugatuck River, Steele Brook also has a history of damaging floods, the most serious of which occurred in August 1955. Areas close to the brook are susceptible to intense and sudden floods as a result of the steep sloping streets and terrain of the basin. The floodwaters converge from the fan-shaped drainage area and due to the limited natural storage in the upper basin, quickly exceed the channel capacity and overflow into the flood plain. Additionally, numerous restrictions such as low bridges, overhanging buildings, private dams and sharp bends in the channel all contribute to the flooding problems. In June 1973, and again in July 1975, Steele Brook overflowed its banks and resulted in extensive damage to commercial and manufacturing properties, homes and town installations.

Since 1955, the COE has constructed a system of reservoirs in the basin which will modify all future floods. In a repeat of historic flood events, the system would generally reduce flows on the Naugatuck River at Waterbury by 60 to 75 percent depending on storm orientation. Black Rock Reservoir on Branch Brook would generally maintain flows to safe channel capacity.

2.4 Flood Protection Measures

Following the devastating flood of 1955 along the Naugatuck River, the COE completed seven flood control dams and reservoirs in the Naugatuck River basin. Four of these, namely Thomaston, Hancock Brook, Black Rock and Northfield Brook, provided protection to the Town of Watertown.

was developed between the log of the 2-year flood and the drainage area and it was found that for New England, discharges vary in accordance with the drainage area raised to the exponent power of 0.70.

There are no discharge records for Branch Brook. In 1970, the COE completed Black Rock Dam, located on Branch Brook about two miles above the mouth. Discharges from the dam are controlled by gate operations. The anticipated releases for the 10- and 50-year events would probably not exceed the nondamaging downstream channel capacity and these releases would not be made until downstream flood conditions subsided. The 100- and 500-year discharges are estimated based on hydrographs of major events routed through the reservoir. On Branch Brook above Wigwam Reservoir, peak discharge frequencies were determined by using relationships based on records for the USGS gaging station on nearby Leadmine Brook and then relating it to the Branch Brook watershed based on a direct drainage area relationship. A regional study was not undertaken to determine the drainage area-discharge relationship for Leadmine and Branch Brooks. However, the runoff characteristics of Leadmine Brook are considered to be similar to those of Branch Brook.

A summary of drainage area-peak discharge relationships is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
NAUGATUCK RIVER					
At downstream corporate limits	137	5,300	5,400	8,000	21,600
At upstream corporate limits	131	5,000	5,000	5,200	14,000
BRANCH BROOK					
At mouth	22.8	800	800	900	2,300
At Black Rock Dam	20.4	800	800	900	2,300
At Wigwam Dam	17.5	2,200	5,300	7,600	16,500
STEELE BROOK					
At downstream corporate limits	12.4	1,410	2,740	3,550	6,245
Above Wattles Brook	9.0	1,130	2,200	2,840	5,000
At Hemingway Pond	5.7	820	1,600	2,060	3,600
Below Smith Pond Brook confluence	4.0	640	1,250	1,600	2,800

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH [3] (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Naugatuck River (continued)								
T	20,440[1]	164	1,295	6.2	319.0	319.0	319.3	0.3
U	22,300[1]	118	884	5.7	320.5	320.5	320.6	0.1
Branch Brook								
A	100[2]	81	303	3.0	321.6	321.6	322.6	1.0
B	265[2]	88	469	1.9	322.0	322.0	322.8	0.8
C	1,700[2]	132	149	6.1	324.2	324.2	324.2	0.0
D	2,400[2]	46	146	6.2	330.0	330.0	330.0	0.0
E	2,600[2]	43	102	8.8	331.1	331.1	331.1	0.0
F	3,590[2]	68	186	4.8	338.1	338.1	338.1	0.0
G	5,410[2]	70	123	7.3	349.0	349.0	349.0	0.0
H	6,320[2]	72	218	4.1	353.6	353.6	353.7	0.1
I	7,130[2]	78	143	6.3	356.7	356.7	356.8	0.1
J	7,290[2]	54	119	7.6	357.5	357.5	357.5	0.0
K	8,400[2]	38	141	6.4	365.2	365.2	365.2	0.0
L	10,000[2]	31	92	9.8	381.9	381.9	381.9	0.0
M	20,500[2]	1,536	32,010	0.2	567.4	567.4	568.0	0.6
N	24,270[2]	370	4,953	1.5	567.4	567.4	568.0	0.6
O	24,670[2]	914	11,814	0.6	569.3	569.3	569.3	0.0

[1]Feet above corporate limits
[2]Feet above confluence with Naugatuck River
[3]This width extends beyond corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWN OF WATERTOWN, CT
(LITCHFIELD CO.)

FLOODWAY DATA

NAUGATUCK RIVER AND BRANCH BROOK

FLOODING SOURCE	PANEL[1]	ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND			FHF	ZONE	BASE FLOOD ELEVATION[3] (NGVD)
		10% (10 YR.)	2% (50 YR.)	0.2% (500 YR.)			
Naugatuck River							
Reach 1	03	-1.7	-1.6	+6.1	015	A3	Varies
Reach 2	02,03	-2.0	-1.9	+7.6	020	A4	Varies
Branch Brook							
Reach 1	01,02	-0.6	-0.3	+1.7	005	A1	Varies
Reach 2	04	-3.6	-1.7	+3.5	035	A7	Varies
Steele Brook							
Reach 1	06	-2.6	-0.8	+2.2	025	A5	Varies
Reach 2	06	-4.0	-1.4	+0.9	040	A8	Varies
Reach 3	06	-2.1	-0.5	+1.2	020	A4	Varies
Reach 4	06	-2.3	-0.7	+1.8	025	A5	Varies
Reach 5	06	-4.8	-1.5	+1.4	050	A10	Varies
Reach 6	06	-7.5	-4.1	+5.6	075	A15	Varies
Reach 7	05,06	-1.8	-0.6	+2.2	020	A4	Varies
Reach 8	05	-2.3	-0.8	+2.3	025	A5	Varies
Reach 9	05	-5.4	-1.9	+5.4	055	A11	Varies
Reach 10	05	-3.0	-1.2	+3.2	030	A6	Varies
Reach 11	05	-1.3	-0.3	+0.9	015	A3	Varies

[1]Flood Insurance Rate Map Panel
[2]Weighted average
[3]Rounded to the nearest foot - see map

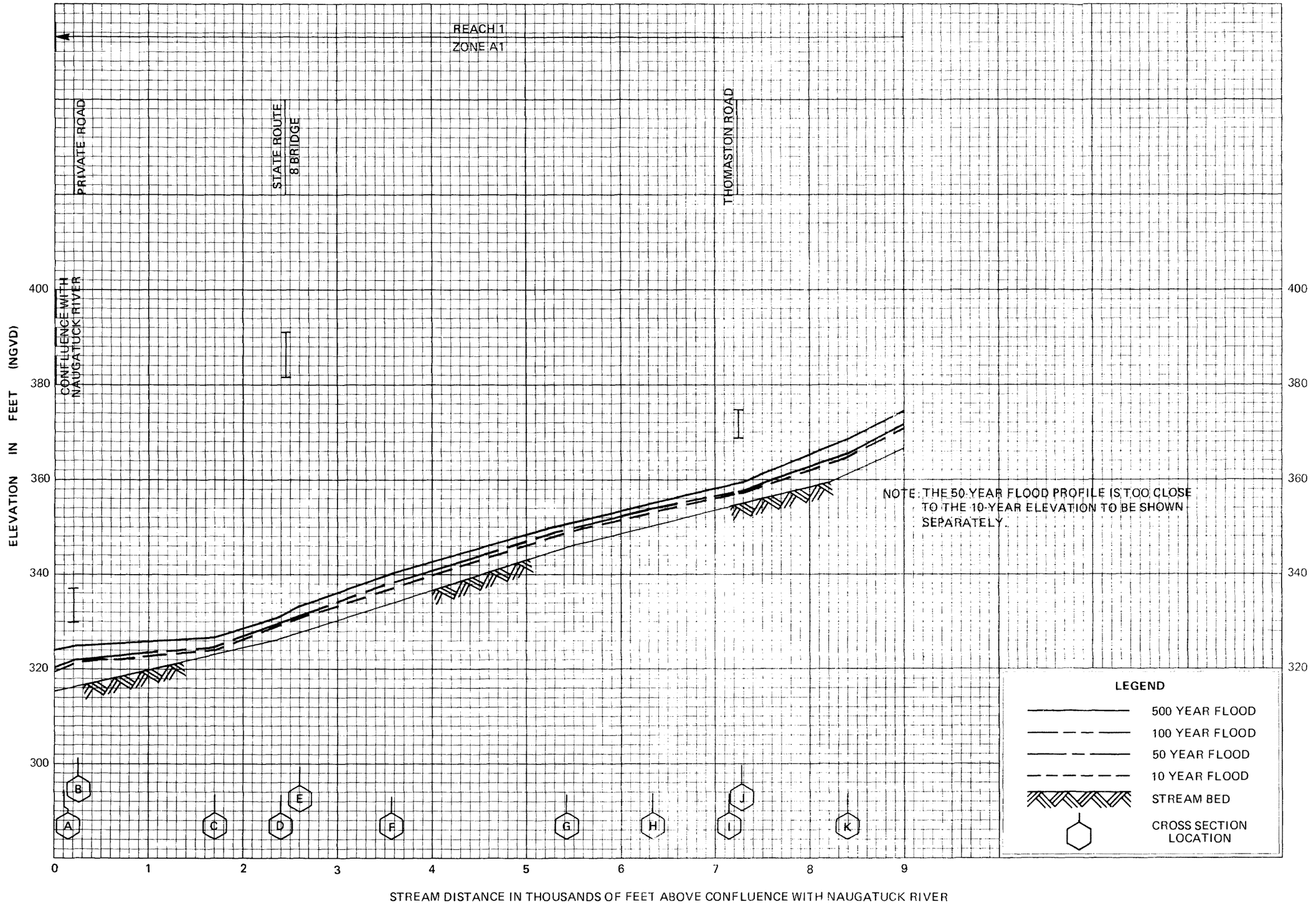
TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWN OF WATERTOWN, CT
(LITCHFIELD CO.)

FLOOD INSURANCE ZONE DATA

NAUGATUCK RIVER, BRANCH BROOK AND STEELE BROOK



FLOOD PROFILES

BRANCH BROOK

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWN OF WATERTOWN, CT
(LITCHFIELD CO.)

03P

APPENDIX C: USGS STREAM GAGE NO. 01208013 – BRANCH BROOK NEAR THOMASTON, CT

StreamStats Data-Collection Station Report

USGS Station Number	**01208013**
Station Name	**BRANCH BROOK NR THOMASTON,CT.**

Click here to link to available data on NWIS-Web for this site.

Descriptive Information

Station Type	Streamgage, continuous record
Location	
Gage	
Regulation and Diversions	
Regulated?	Unknown
Period of Record	1971-2001
Remarks	Peak flows affected by flood control.
Latitude (degrees NAD83)	41.65371
Longitude (degrees NAD83)	-73.09483
Hydrologic unit code	01100005
County	-
HCDN2009	No

Physical Characteristics

Characteristic Name	Value	Units	Citation Number
Descriptive Information			
Datum_of_Latitude_Longitude	NAD83	dimensionless	30
District_Code	09	dimensionless	30
Begin_date_of_record	10/1/1974	days	41
End_date_of_record	5/13/1993	days	41
Number_of_days_of_record	5549	days	41
Number_of_days_GT_0	5549	days	41
Basin Dimensional Characteristics			
Drainage_Area	20.8	square miles	30

Streamflow Statistics

Statistic Name	Value	Units	Citation Number	Preferred?	Years of Record	Standard Error, percent	Variance log-10	Lower 95% Confidence Interval	Upper 95% Confidence Interval	Start Date	End Date	Remarks
Flow-Duration Statistics												
1_Percent_Duration	383.06	cubic feet per second	41	Y	15							
5_Percent_Duration	111	cubic feet per second	41	Y	15							
10_Percent_Duration	68	cubic feet per second	41	Y	15							
20_Percent_Duration	43	cubic feet per	41	Y	15							

		second			
25_Percent_Duration	37	cubic feet per second	41	Y	15
30_Percent_Duration	32	cubic feet per second	41	Y	15
40_Percent_Duration	23	cubic feet per second	41	Y	15
50_Percent_Duration	18	cubic feet per second	41	Y	15
60_Percent_Duration	13	cubic feet per second	41	Y	15
70_Percent_Duration	9.92	cubic feet per second	41	Y	15
75_Percent_Duration	8.3	cubic feet per second	41	Y	15
80_Percent_Duration	7.03	cubic feet per second	41	Y	15
90_Percent_Duration	3.6	cubic feet per second	41	Y	15
95_Percent_Duration	1.5	cubic feet per second	41	Y	15
99_Percent_Duration	0.41	cubic feet per second	41	Y	15
General Flow Statistics					
Minimum_daily_flow	0.18	cubic feet per second	41	Y	15
Maximum_daily_flow	713	cubic feet per second	41	Y	15
Std_Dev_of_daily_flows	63.769	cubic feet per second	41	Y	15
Average_daily_streamflow	34.999	cubic feet per second	41	Y	15
Base Flow Statistics					
Number_of_years_to_compute_BFI	15	years	42	Y	
Average_BFI_value	0.395	dimensionless	42	Y	
Std_dev_of_annual_BFI_values	0.112	dimensionless	42	Y	

Citations

Citation Number	*Citation Name and URL*
30	Imported from NWIS file
41	Wolock, D.M., 2003, Flow characteristics at U.S. Geological Survey streamgages in the conterminous United States: U.S. Geological Survey Open-File Report 03-146, digital data set
42	Wolock, D.M., 2003, Base-flow index grid for the conterminous United States: U.S. Geological Survey Open-File Report 03-263, digital data set

APPENDIX D: PEAKFQ FLOWS – BRANCH BROOK NEAR THOMASTON, CT

1

Program PeakFq U. S. GEOLOGICAL SURVEY Seq.002.000
Version 7.2 Annual peak flow frequency analysis Run Date / Time
3/28/2018 10/09/2019 11:00

--- PROCESSING OPTIONS ---

Plot option = Graphics device
Basin char output = None
Print option = Yes
Debug print = No
Input peaks listing = Long
Input peaks format = WATSTORE peak file

Input files used:
peaks (ascii) -
G:\JOBS18\04\1800579\ENG-TECH\TRANS\Hydra\Hydrology\PEAK_01208013_TEST.TXT

specifications -
G:\JOBS18\04\1800579\ENG-TECH\TRANS\Hydra\Hydrology\PKFQWPSF.TMP

Output file(s):
main -
G:\JOBS18\04\1800579\ENG-TECH\TRANS\Hydra\Hydrology\PEAK_01208013_TEST.PRT

*** User responsible for assessment and interpretation of the following analysis ***

1

Program PeakFq U. S. GEOLOGICAL SURVEY Seq.001.001
Version 7.2 Annual peak flow frequency analysis Run Date / Time
3/28/2018 10/09/2019 11:00

Station - 01208013 BRANCH BROOK NEAR THOMASTON, CT

TABLE 1 - INPUT DATA SUMMARY

Number of peaks in record	=	25
Peaks not used in analysis	=	0
Gaged peaks in analysis	=	25
Historic peaks in analysis	=	0
Beginning Year	=	1971
Ending Year	=	1995
Historical Period Length	=	25
Skew option	=	WEIGHTED

```
Regional skew                          =    0.340
     Standard error                    =    0.510
     Mean Square error                 =    0.260
Gage base discharge                    =      0.0
User supplied high outlier threshold =   --
User supplied PILF (LO) criterion    =   --
Plotting position parameter            =     0.00
Type of analysis                         EMA
PILF (LO) Test Method                    MGBT
Perceptible Ranges:
    Start Year  End Year  Lower Bound  Upper Bound
          1971      1995          0.0          INF    DEFAULT

Interval Data                     =   None Specified
```

TABLE 2 - DIAGNOSTIC MESSAGE AND PILF RESULTS

```
WCF002J-CALCS COMPLETED.  RETURN CODE =  2
EMA002W-CONFIDENCE INTERVALS ARE NOT EXACT IF HISTORIC PERIOD > 0
```

MULTIPLE GRUBBS-BECK TEST RESULTS

```
MULTIPLE GRUBBS-BECK PILF THRESHOLD   494.0
NUMBER OF PILFS IDENTIFIED               8
    CLASSIFICATION OF PILFS:
        NUMBER OF ZERO FLOWS             0
        NUMBER OF CENSORED FLOWS         0
        NUMBER OF GAGED PEAKS            8
            GAGED PEAKS AND CORRESPONDING P-VALUES
                   145.0    (0.1052)
                   145.0    (0.0011)
                   288.0    (0.2320)
                   288.0    (0.0440)
                   308.0    (0.0155)
                   332.0    (0.0057)
                   355.0    (0.0014)
                   390.0    (0.0007)
```

Kendall's Tau Parameters

TAU	P-VALUE	MEDIAN SLOPE	No. of PEAKS

GAGED PEAKS -0.180 0.216 -9.982 25

1

Program PeakFq U. S. GEOLOGICAL SURVEY Seq.001.002
Version 7.2 Annual peak flow frequency analysis Run Date / Time
3/28/2018 10/09/2019 11:00

Station - 01208013 BRANCH BROOK NEAR THOMASTON, CT

TABLE 3 - ANNUAL FREQUENCY CURVE PARAMETERS -- LOG-PEARSON TYPE III

	LOGARITHMIC		
	MEAN	STANDARD DEVIATION	SKEW
EMA WITHOUT REG SKEW	2.7402	0.1189	-0.423
EMA WITH REG SKEW	2.7476	0.1062	0.134

EMA ESTIMATE OF MSE OF SKEW WITHOUT REG SKEW 0.2364
EMA ESTIMATE OF MSE OF SKEW W/GAGED PEAKS ONLY (AT-SITE) 0.2364

TABLE 4 - ANNUAL FREQUENCY CURVE -- DISCHARGES AT SELECTED EXCEEDANCE PROBABILITIES

ANNUAL EXCEEDANCE PROBABILITY	<- EMA ESTIMATE -> WITH REG SKEW	WITHOUT REG SKEW	<- FOR EMA ESTIMATE WITH REG SKEW -> LOG VARIANCE OF EST.	<-CONFIDENCE LIMITS-> 5% LOWER	95% UPPER
0.9950	307.2	243.7	0.0090	128.0	396.4
0.9900	324.4	267.4	0.0071	149.3	405.1
0.9500	377.6	339.9	0.0035	220.4	437.3
0.9000	410.3	383.2	0.0023	265.1	460.9
0.8000	454.6	439.9	0.0013	322.0	497.5
0.6667	501.2	496.9	0.0008	372.6	543.0
0.5000	556.3	560.5	0.0005	429.3	609.3
0.4292	581.1	588.0	0.0005	492.1	643.8
0.2000	685.9	695.0	0.0006	620.8	798.7
0.1000	767.7	769.6	0.0009	684.7	941.4
0.0400	867.7	851.5	0.0015	755.6	1160.0
0.0200	940.4	905.3	0.0021	803.9	1349.0
0.0100	1012.	954.0	0.0028	848.9	1559.0
0.0050	1083.	998.7	0.0035	891.1	1791.0
0.0020	1177.	1053.	0.0047	943.3	2136.0

*Note: If Station Skew option is selected then EMA ESTIMATE WITH REG SKEW will display values for and be equal to EMA ESTIMATE WITHOUT REG SKEW.

1

Program PeakFq U. S. GEOLOGICAL SURVEY Seq.001.003
Version 7.2 Annual peak flow frequency analysis Run Date / Time
3/28/2018 10/09/2019 11:00

Station - 01208013 BRANCH BROOK NEAR THOMASTON, CT

TABLE 5 - INPUT DATA LISTING

WATER YEAR	PEAK VALUE	PEAKFQ CODES	FLOW INTERVALS (WHERE LOWER BOUND NOT = UPPER BOUND) LOWER BOUND	UPPER BOUND	REMARKS
1971	494.0	K			
1972	390.0	K			
1973	585.0	K			
1974	555.0	K			
1975	795.0	K			
1976	590.0	K			
1977	500.0	K			
1978	705.0	K			
1979	750.0	K			
1980	145.0	K			
1981	725.0	K			
1982	805.0	K			
1983	755.0	K			
1984	683.0	K			
1985	308.0	K			
1986	538.0	K			
1987	766.0	K			
1988	145.0	K			
1989	604.0	K			
1990	539.0	K			
1991	573.0	K			
1992	288.0	K			
1993	355.0	K			
1994	288.0	K			
1995	332.0	K			

Explanation of peak discharge qualification codes

PeakFQ CODE	NWIS CODE	DEFINITION

D	3	Dam failure, non-recurrent flow anomaly
G	8	Discharge greater than stated value
X	3+8	Both of the above
L	4	Discharge less than stated value
K	6 OR C	Known effect of regulation or urbanization
H	7	Historic peak

- Minus-flagged discharge -- Not used in computation
  -8888.0 -- No discharge value given
- Minus-flagged water year -- Historic peak used in computation

Program PeakFq U. S. GEOLOGICAL SURVEY Seq.001.004
Version 7.2 Annual peak flow frequency analysis Run Date / Time
3/28/2018 10/09/2019 11:00

Station - 01208013 BRANCH BROOK NEAR THOMASTON, CT

TABLE 6 - EMPIRICAL FREQUENCY CURVES -- HIRSCH-STEDINGER PLOTTING POSITIONS

WATER YEAR	RANKED DISCHARGE	EMA ESTIMATE	FLOW INTERVALS (WHERE LOWER BOUND NOT = UPPER BOUND) LOWER BOUND	UPPER BOUND
1982	805.0	0.0383		
1975	795.0	0.0768		
1987	766.0	0.1152		
1983	755.0	0.1537		
1979	750.0	0.1922		
1981	725.0	0.2307		
1978	705.0	0.2691		
1984	683.0	0.3076		
1989	604.0	0.3461		
1976	590.0	0.3846		
1973	585.0	0.4230		
1991	573.0	0.4615		
1974	555.0	0.5000		
1990	539.0	0.5385		
1986	538.0	0.5770		
1977	500.0	0.6154		
1971	494.0	0.6539		
* 1972	390.0	0.6924		
* 1993	355.0	0.7309		
* 1995	332.0	0.7693		
* 1985	308.0	0.8078		
* 1992	288.0	0.8848		

```
  * 1994      288.0     0.8463
  * 1980      145.0     0.9617
  * 1988      145.0     0.9232

    * DENOTES PILF (LO)

1


  Program PeakFq           U. S. GEOLOGICAL SURVEY             Seq.001.005
  Version 7.2         Annual peak flow frequency analysis      Run Date / Time
  3/28/2018                                                     10/09/2019 11:00

              Station - 01208013  BRANCH BROOK NEAR THOMASTON, CT


                    TABLE 7 - EMA REPRESENTATION OF DATA

                                                        <---- USER-ENTERED
---->&lt;-------- FINAL -------&gt;
  WATER &lt;----- OBSERVED ----&gt;&lt;-------- EMA -------&gt;&lt;- PERCEPTIBLE RANGES -&gt;&lt;-
PERCEPTIBLE RANGES ->
   YEAR    Q_LOWER    Q_UPPER    Q_LOWER    Q_UPPER       LOWER       UPPER
LOWER       UPPER
   1971      494.0      494.0      494.0      494.0         0.0         INF
494.0         INF
   1972      390.0      390.0        0.0      494.0         0.0         INF
494.0         INF
   1973      585.0      585.0      585.0      585.0         0.0         INF
494.0         INF
   1974      555.0      555.0      555.0      555.0         0.0         INF
494.0         INF
   1975      795.0      795.0      795.0      795.0         0.0         INF
494.0         INF
   1976      590.0      590.0      590.0      590.0         0.0         INF
494.0         INF
   1977      500.0      500.0      500.0      500.0         0.0         INF
494.0         INF
   1978      705.0      705.0      705.0      705.0         0.0         INF
494.0         INF
   1979      750.0      750.0      750.0      750.0         0.0         INF
494.0         INF
   1980      145.0      145.0        0.0      494.0         0.0         INF
494.0         INF
   1981      725.0      725.0      725.0      725.0         0.0         INF
494.0         INF
   1982      805.0      805.0      805.0      805.0         0.0         INF
494.0         INF
   1983      755.0      755.0      755.0      755.0         0.0         INF
494.0         INF
```

```
   1984      683.0      683.0      683.0      683.0         0.0        INF
494.0        INF
   1985      308.0      308.0        0.0      494.0         0.0        INF
494.0        INF
   1986      538.0      538.0      538.0      538.0         0.0        INF
494.0        INF
   1987      766.0      766.0      766.0      766.0         0.0        INF
494.0        INF
   1988      145.0      145.0        0.0      494.0         0.0        INF
494.0        INF
   1989      604.0      604.0      604.0      604.0         0.0        INF
494.0        INF
   1990      539.0      539.0      539.0      539.0         0.0        INF
494.0        INF
   1991      573.0      573.0      573.0      573.0         0.0        INF
494.0        INF
   1992      288.0      288.0        0.0      494.0         0.0        INF
494.0        INF
   1993      355.0      355.0        0.0      494.0         0.0        INF
494.0        INF
   1994      288.0      288.0        0.0      494.0         0.0        INF
494.0        INF
   1995      332.0      332.0        0.0      494.0         0.0        INF
494.0        INF
1


 End PeakFQ analysis.
   Stations processed :       1
   Number of errors   :       0
   Stations skipped   :       0
   Station years      :      25


Data records may have been ignored for the stations listed below.
(Card type must be Y, Z, N, H, I, 2, 3, 4,  or *.)
(2, 4, and * records are ignored.)

 For the station below, the following records were ignored:

 FINISHED PROCESSING STATION:  01208013       USGS BRANCH BROOK NEAR THOMASTON,


 For the station below, the following records were ignored:

 FINISHED PROCESSING STATION:
```

APPENDIX E: SUPPLEMENTARY REFERENCE DATA

- CTDOT Drainage Manual Transfer Calculations
- StreamStats Computation at Bridge Site
- NOAA Atlas 14 Data
- USGS Reference Publications

6.11 Transferring Gaged Data

6.11.1 Procedure

Gaged data can be transferred up or downstream on the gaged stream only. If the drainage area for the location of concern is ≥ 75% and ≤ 125% of the drainage area at the gage, then the gaged data can be transferred with equation 6.12.

6.11.2 Transfer Equation

The following equation shall be used to transfer gage data:

$$\frac{Q_1 / A_1}{Q_2 / A_2} = \frac{A_1^{[(0.894 / A_1^{0.048}) - 1]}}{A_2^{[(0.894 / A_2^{0.048}) - 1]}} \qquad \textbf{(English only)}$$

(6.12)

Q_1 and A_1 represent the discharge rate and watershed area at one point in the watershed and Q_2 and A_2 represent the rate and area at the gage or known outlet which remain constant while Q_1 and A_1 are varied.

Q = discharge in cubic feet per second
A = drainage area in square miles

Source: Adopted from Mockus, V., SCS National Engineering Handbook, Section 4, Hydrology, 1972

Transfer Equation From DOT Drainage Manual

Prepared By: BGR Date: 10/9/2019
Checked By: DMC Date: 10/11/2019

A1 = 22.6 sq mi **Proposed Drain. Area**
A2 = 20.8 sq mi **Gage Drain. Area**

***PeakFQ trans. to Bridge**

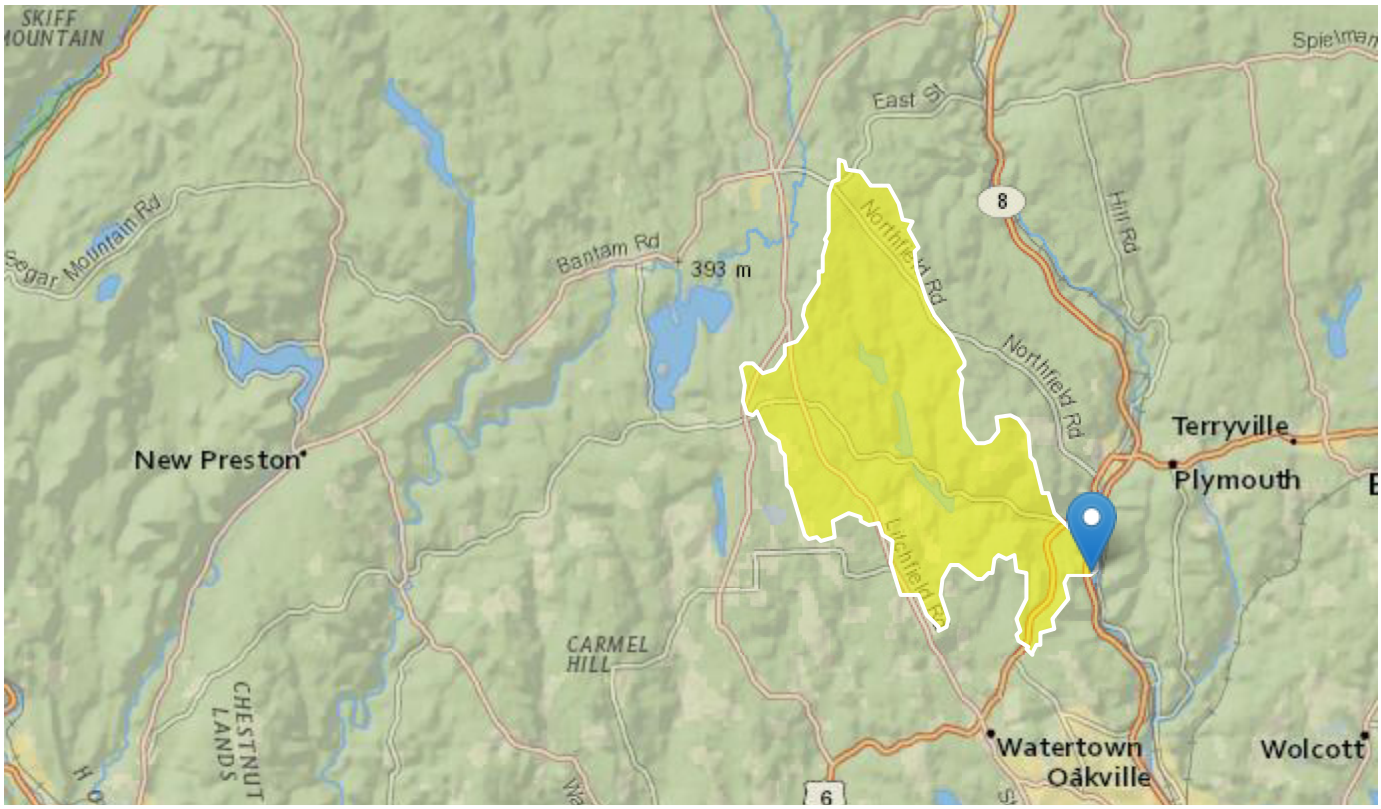
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
Q2 =	556.3	685.9	767.7	867.7	940.4	1012	1177

	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
Q1 =	587	724	811	916	993	1069	1243

***Site Flows**

StreamStats Report

Region ID: CT
Workspace ID: CT20191009150317053000
Clicked Point (Latitude, Longitude): 41.64395, -73.08096
Time: 2019-10-09 11:03:33 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	22.6	square miles
I24H2Y	Maximum 24-hour precipitation that occurs on average once in 2 years - Equivalent to precipitation intensity index	3.391	inches
ELEV	Mean Basin Elevation	859	feet
I24H10Y	Maximum 24-hour precipitation that occurs on average once in 10 years	4.807	inches
I24H25Y	Maximum 24-hour precipitation that occurs on average once in 25 years	5.867	inches

Parameter Code	Parameter Description	Value	Unit
I24H50Y	Maximum 24-hour precipitation that occurs on average once in 50 years	6.835	inches
I24H100Y	Maximum 24-hour precipitation that occurs on average once in 100 years	7.957	inches
CRSDFT	Percentage of area of coarse-grained stratified drift	2.21	percent
NOVAVPRE	Mean November Precipitation	4.5	inches
PRCWINTER	Mean annual precipitation for December through February	3.8	inches
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	9.69	percent
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	1.59	percent
MAPM	Mean Annual Precip Basin Average	51.543	inches
SGSL	Total stream length intersecting sand and gravel deposits (in miles)	6.57	miles
SOILPERM	Average Soil Permeability	2.941	inches per hour
STRMTOT	total length of all mapped streams (1:24,000-scale) in the basin	68.4	miles
WETLAND	Percentage of Wetlands	1.07	percent

General Disclaimers

The delineation point is in an exclusion area. Warning! Peak flows affected by flood control structures. Peak-flow statistics represent near natural conditions or conditions prior to flood-control.

Peak-Flow Statistics Parameters[Statewide Multiparameter]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	22.6	square miles	1.69	715
I24H2Y	24 Hour 2 Year Precipitation	3.391	inches	2.95	3.82

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
ELEV	Mean Basin Elevation	859	feet	169	1310
I24H10Y	24 Hour 10 Year Precipitation	4.807	inches	4.15	5.53
I24H25Y	24 Hour 25 Year Precipitation	5.867	inches	4.93	7
I24H50Y	24 Hour 50 Year Precipitation	6.835	inches	5.62	8.36
I24H100Y	24 Hour 100 Year Precipitation	7.957	inches	6.41	9.99

Peak-Flow Statistics Flow Report[Statewide Multiparameter]

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

Statistic	Value	Unit	SE	SEp	Equiv. Yrs.
2 Year Peak Flood	776	ft^3/s	31.8	31.8	3.5
10 Year Peak Flood	1640	ft^3/s	32.7	32.7	8.1
25 Year Peak Flood	2170	ft^3/s	34.4	34.4	10.9
50 Year Peak Flood	2630	ft^3/s	35.9	35.9	12.7
100 Year Peak Flood	3130	ft^3/s	37.6	37.6	14.3
500 Year Peak Flood	4980	ft^3/s	45	45	14.9

Peak-Flow Statistics Citations

Ahearn, E.A.,2004, Regression Equations for Estimating Flood Flows for the 2-, 10-, 25-, 50-, 100-, and 500-Year Recurrence Intervals in Connecticut: U.S. Geological Survey SRI 2004-5160, 62 p. (http://water.usgs.gov/pubs/sir/2004/5160/)

November Flow-Duration Statistics Parameters[Duration Flow 2010 5052]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	22.6	square miles	0.92	150
NOVAVPRE	Mean November Precipitation	4.5	inches	3.48	4.93
CRSDFT	Percent Coarse Stratified Drift	2.21	percent	0.1	55.1

November Flow-Duration Statistics Flow Report[Duration Flow 2010 5052]

Statistic	Value	Unit

Statistic	Value	Unit
November 25 Percent Duration	45.8	ft^3/s
November 50 Percent Duration	24.5	ft^3/s
November 75 Percent Duration	12.4	ft^3/s
November 90 Percent Duration	5.35	ft^3/s
November 99 Percent Duration	1.91	ft^3/s

November Flow-Duration Statistics Citations

Ahearn, E.A.,2010, Regional regression equations to estimate flow-duration statistics in Connecticut: U. S. Geological Survey Scientific Investigations Report 2010-5052, 45 p. (http://pubs.usgs.gov/sir/2010/5052/)

Seasonal Flow Statistics Parameters[Duration Flow 2010 5052]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	22.6	square miles	0.92	150
PRCWINTER	Mean Annual Winter Precipitation	3.8	inches	3.19	4.4
CRSDFT	Percent Coarse Stratified Drift	2.21	percent	0.1	55.1

Seasonal Flow Statistics Flow Report[Duration Flow 2010 5052]

Statistic	Value	Unit
25 Percent Duration December to February	57.1	ft^3/s
50 Percent Duration December to February	34.1	ft^3/s
75 Percent Duration December to February	20.6	ft^3/s
95 Percent Duration DEC FEB	9.31	ft^3/s
99 Percent Duration December to February	4.88	ft^3/s
25 Percent Duration March to April	96	ft^3/s
50 Percent Duration March to April	61.9	ft^3/s
75 Percent Duration March to April	38.5	ft^3/s
95 Percent Duration March to April	21.4	ft^3/s
99 Percent Duration March to April	14.9	ft^3/s

Statistic	Value	Unit
25 Percent Duration July to October	13.5	ft^3/s
50 Percent Duration July to October	5.53	ft^3/s
75 Percent Duration July to October	2.56	ft^3/s
80 Percent Duration July to October	2.16	ft^3/s
99 Percent Duration July to October	0.378	ft^3/s

Seasonal Flow Statistics Citations

Ahearn, E.A.,2010, Regional regression equations to estimate flow-duration statistics in Connecticut: U. S. Geological Survey Scientific Investigations Report 2010-5052, 45 p. (http://pubs.usgs.gov/sir/2010/5052/)

May Flow-Duration Statistics Parameters[Duration Flow 2010 5052]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	22.6	square miles	0.92	150
CRSDFT	Percent Coarse Stratified Drift	2.21	percent	0.1	55.1

May Flow-Duration Statistics Flow Report[Duration Flow 2010 5052]

Statistic	Value	Unit
May 25 Percent Duration	57.6	ft^3/s
May 50 Percent Duration	35.7	ft^3/s
May 75 Percent Duration	23.4	ft^3/s
May 95 Percent Duration	11.7	ft^3/s
May 99 Percent Duration	7.43	ft^3/s

May Flow-Duration Statistics Citations

Ahearn, E.A.,2010, Regional regression equations to estimate flow-duration statistics in Connecticut: U. S. Geological Survey Scientific Investigations Report 2010-5052, 45 p. (http://pubs.usgs.gov/sir/2010/5052/)

June Flow-Duration Statistics Parameters[Duration Flow 2010 5052]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	22.6	square miles	0.92	150
CRSDFT	Percent Coarse Stratified Drift	2.21	percent	0.1	55.1
WETLAND	Percent Wetlands	1.07	percent	0.3	18.1

June Flow-Duration Statistics Flow Report[Duration Flow 2010 5052]

Statistic	Value	Unit
June 25 Percent Duration	28	ft^3/s
June 50 Percent Duration	13.7	ft^3/s
June 75 Percent Duration	7.12	ft^3/s
June 90 Percent Duration	4.72	ft^3/s
June 99 Percent Duration	2.06	ft^3/s

June Flow-Duration Statistics Citations

Ahearn, E.A.,2010, Regional regression equations to estimate flow-duration statistics in Connecticut: U. S. Geological Survey Scientific Investigations Report 2010-5052, 45 p. (http://pubs.usgs.gov/sir/2010/5052/)

Flow-Duration Statistics Parameters[Duration Flow 2010 5052]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
DRNAREA	Drainage Area	22.6	square miles	0.92	150
ELEV	Mean Basin Elevation	859	feet	168	1287
CRSDFT	Percent Coarse Stratified Drift	2.21	percent	0.1	55.1

Flow-Duration Statistics Flow Report[Duration Flow 2010 5052]

Statistic	Value	Unit
25 Percent Duration	50.7	ft^3/s
99 Percent Duration	0.576	ft^3/s

Flow-Duration Statistics Citations

Ahearn, E.A.,2010, Regional regression equations to estimate flow-duration statistics in Connecticut: U. S. Geological Survey Scientific Investigations Report 2010-5052, 45 p. (http://pubs.usgs.gov/sir/2010/5052/)

Application Version: 4.3.8

NOAA Atlas 14, Volume 10, Version 3
Location name: Watertown, Connecticut, USA*
Latitude: 41.6436°, Longitude: -73.0809°
Elevation: 321.56 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Sandra Pavlovic, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Orlan Wilhite

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.364 (0.277-0.478)	0.433 (0.329-0.569)	0.546 (0.413-0.720)	0.639 (0.481-0.847)	0.768 (0.562-1.06)	0.866 (0.622-1.22)	0.967 (0.675-1.40)	1.07 (0.719-1.60)	1.22 (0.790-1.88)	1.34 (0.846-2.10)
10-min	0.516 (0.392-0.677)	0.613 (0.466-0.807)	0.773 (0.585-1.02)	0.906 (0.682-1.20)	1.09 (0.796-1.50)	1.23 (0.881-1.73)	1.37 (0.956-1.99)	1.52 (1.02-2.27)	1.73 (1.12-2.67)	1.89 (1.20-2.98)
15-min	0.607 (0.461-0.797)	0.722 (0.548-0.949)	0.910 (0.689-1.20)	1.07 (0.803-1.41)	1.28 (0.936-1.77)	1.45 (1.04-2.03)	1.61 (1.13-2.34)	1.79 (1.20-2.67)	2.04 (1.32-3.14)	2.23 (1.41-3.50)
30-min	0.821 (0.624-1.08)	0.977 (0.742-1.29)	1.23 (0.932-1.63)	1.44 (1.09-1.91)	1.73 (1.27-2.39)	1.95 (1.40-2.75)	2.18 (1.52-3.16)	2.42 (1.62-3.61)	2.76 (1.78-4.25)	3.02 (1.91-4.74)
60-min	1.04 (0.787-1.36)	1.23 (0.935-1.62)	1.55 (1.18-2.05)	1.82 (1.37-2.41)	2.19 (1.60-3.01)	2.47 (1.77-3.46)	2.75 (1.92-3.99)	3.06 (2.04-4.55)	3.48 (2.25-5.36)	3.81 (2.41-5.98)
2-hr	1.36 (1.04-1.78)	1.61 (1.23-2.10)	2.00 (1.52-2.63)	2.33 (1.76-3.07)	2.78 (2.04-3.81)	3.13 (2.25-4.36)	3.48 (2.43-5.01)	3.85 (2.58-5.70)	4.34 (2.82-6.66)	4.73 (3.00-7.41)
3-hr	1.58 (1.21-2.06)	1.87 (1.43-2.43)	2.33 (1.77-3.04)	2.71 (2.05-3.56)	3.23 (2.38-4.42)	3.63 (2.62-5.06)	4.04 (2.84-5.81)	4.48 (3.01-6.62)	5.07 (3.30-7.76)	5.54 (3.52-8.64)
6-hr	2.00 (1.54-2.59)	2.38 (1.83-3.09)	3.01 (2.31-3.91)	3.53 (2.69-4.62)	4.25 (3.15-5.79)	4.79 (3.48-6.66)	5.35 (3.80-7.72)	5.99 (4.04-8.82)	6.89 (4.49-10.5)	7.64 (4.87-11.9)
12-hr	2.45 (1.89-3.15)	2.98 (2.31-3.84)	3.86 (2.97-4.99)	4.59 (3.52-5.96)	5.59 (4.17-7.62)	6.33 (4.65-8.83)	7.14 (5.13-10.4)	8.10 (5.48-11.9)	9.55 (6.24-14.5)	10.8 (6.91-16.7)
24-hr	2.85 (2.22-3.65)	3.56 (2.77-4.56)	4.72 (3.65-6.06)	5.68 (4.37-7.33)	7.00 (5.27-9.53)	7.97 (5.90-11.1)	9.04 (6.58-13.2)	10.4 (7.05-15.2)	12.5 (8.21-19.0)	14.4 (9.24-22.2)
2-day	3.21 (2.50-4.07)	4.07 (3.18-5.18)	5.48 (4.26-7.00)	6.66 (5.15-8.54)	8.27 (6.26-11.2)	9.44 (7.05-13.2)	10.8 (7.91-15.8)	12.5 (8.49-18.2)	15.3 (10.1-23.1)	17.8 (11.5-27.4)
3-day	3.48 (2.73-4.41)	4.43 (3.47-5.62)	5.99 (4.67-7.61)	7.28 (5.65-9.31)	9.05 (6.88-12.3)	10.3 (7.75-14.4)	11.8 (8.71-17.3)	13.7 (9.35-20.0)	16.9 (11.1-25.4)	19.7 (12.7-30.2)
4-day	3.73 (2.93-4.71)	4.75 (3.72-6.00)	6.40 (5.01-8.12)	7.78 (6.05-9.92)	9.67 (7.36-13.1)	11.0 (8.29-15.4)	12.6 (9.32-18.4)	14.6 (10.00-21.3)	18.0 (11.9-27.1)	21.1 (13.6-32.2)
7-day	4.44 (3.50-5.58)	5.58 (4.39-7.02)	7.44 (5.84-9.39)	8.98 (7.01-11.4)	11.1 (8.48-14.9)	12.7 (9.52-17.5)	14.4 (10.6-20.9)	16.6 (11.4-24.1)	20.3 (13.4-30.4)	23.6 (15.3-36.0)
10-day	5.16 (4.08-6.47)	6.36 (5.02-7.98)	8.32 (6.55-10.5)	9.95 (7.78-12.6)	12.2 (9.31-16.3)	13.8 (10.4-19.0)	15.6 (11.5-22.5)	18.0 (12.3-25.9)	21.7 (14.4-32.4)	25.0 (16.2-38.0)
20-day	7.43 (5.90-9.25)	8.68 (6.89-10.8)	10.7 (8.48-13.4)	12.4 (9.76-15.6)	14.7 (11.3-19.5)	16.5 (12.4-22.3)	18.3 (13.5-25.9)	20.6 (14.2-29.5)	24.1 (16.0-35.8)	27.1 (17.6-41.1)
30-day	9.32 (7.43-11.6)	10.6 (8.42-13.1)	12.6 (10.0-15.8)	14.4 (11.3-18.0)	16.7 (12.8-21.9)	18.5 (13.9-24.8)	20.3 (14.9-28.4)	22.5 (15.6-32.1)	25.7 (17.1-38.0)	28.3 (18.5-42.8)
45-day	11.6 (9.30-14.4)	12.9 (10.3-16.0)	15.0 (12.0-18.7)	16.8 (13.3-21.0)	19.2 (14.7-24.9)	21.0 (15.8-27.9)	22.9 (16.7-31.5)	24.9 (17.3-35.4)	27.7 (18.5-40.8)	29.8 (19.5-45.0)
60-day	13.5 (10.8-16.7)	14.9 (11.9-18.4)	17.1 (13.6-21.1)	18.9 (15.0-23.5)	21.4 (16.4-27.6)	23.3 (17.5-30.7)	25.2 (18.2-34.3)	27.0 (18.8-38.3)	29.4 (19.7-43.3)	31.2 (20.4-46.9)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

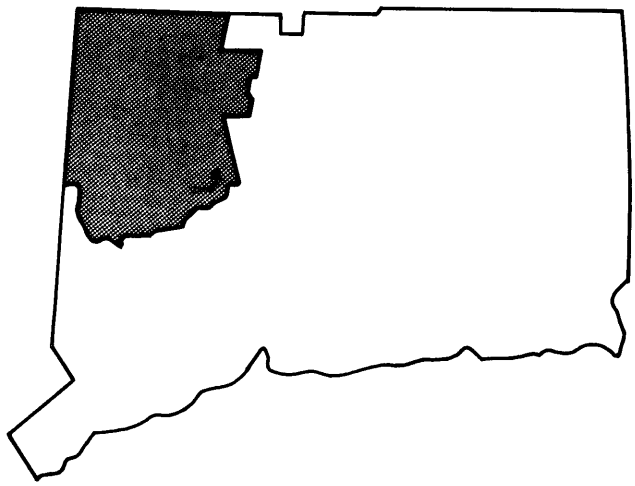
Back to Top

PF graphical

APPENDIX B – FEMA INFORMATION

FLOOD INSURANCE STUDY

TOWN OF WATERTOWN, CONNECTICUT
LITCHFIELD COUNTY



MAY 1980

federal emergency management agency
federal insurance administration

COMMUNITY NUMBER - 090058

was developed between the log of the 2-year flood and the drainage area and it was found that for New England, discharges vary in accordance with the drainage area raised to the exponent power of 0.70.

There are no discharge records for Branch Brook. In 1970, the COE completed Black Rock Dam, located on Branch Brook about two miles above the mouth. Discharges from the dam are controlled by gate operations. The anticipated releases for the 10- and 50-year events would probably not exceed the nondamaging downstream channel capacity and these releases would not be made until downstream flood conditions subsided. The 100- and 500-year discharges are estimated based on hydrographs of major events routed through the reservoir. On Branch Brook above Wigwam Reservoir, peak discharge frequencies were determined by using relationships based on records for the USGS gaging station on nearby Leadmine Brook and then relating it to the Branch Brook watershed based on a direct drainage area relationship. A regional study was not undertaken to determine the drainage area-discharge relationship for Leadmine and Branch Brooks. However, the runoff characteristics of Leadmine Brook are considered to be similar to those of Branch Brook.

A summary of drainage area-peak discharge relationships is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (sq. miles)	PEAK DISCHARGES (cfs) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
NAUGATUCK RIVER					
At downstream corporate limits	137	5,300	5,400	8,000	21,600
At upstream corporate limits	131	5,000	5,000	5,200	14,000
BRANCH BROOK					
At mouth	22.8	800	800	900	2,300
At Black Rock Dam	20.4	800	800	900	2,300
At Wigwam Dam	17.5	2,200	5,300	7,600	16,500
STEELE BROOK					
At downstream corporate limits	12.4	1,410	2,740	3,550	6,245
Above Wattles Brook	9.0	1,130	2,200	2,840	5,000
At Hemingway Pond	5.7	820	1,600	2,060	3,600
Below Smith Pond Brook confluence	4.0	640	1,250	1,600	2,800

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE	WIDTH [3] (FT.)	SECTION AREA (SQ. FT.)	MEAN VELOCITY (F.P.S.)	REGULATORY (NGVD)	WITHOUT FLOODWAY (NGVD)	WITH FLOODWAY (NGVD)	INCREASE (FEET)
Naugatuck River (continued)								
T	20,440[1]	164	1,295	6.2	319.0	319.0	319.3	0.3
U	22,300[1]	118	884	5.7	320.5	320.5	320.6	0.1
Branch Brook								
A	100[2]	81	303	3.0	321.6	321.6	322.6	1.0
B	265[2]	88	469	1.9	322.0	322.0	322.8	0.8
C	1,700[2]	132	149	6.1	324.2	324.2	324.2	0.0
D	2,400[2]	46	146	6.2	330.0	330.0	330.0	0.0
E	2,600[2]	43	102	8.8	331.1	331.1	331.1	0.0
F	3,590[2]	68	186	4.8	338.1	338.1	338.1	0.0
G	5,410[2]	70	123	7.3	349.0	349.0	349.0	0.0
H	6,320[2]	72	218	4.1	353.6	353.6	353.7	0.1
I	7,130[2]	78	143	6.3	356.7	356.7	356.8	0.1
J	7,290[2]	54	119	7.6	357.5	357.5	357.5	0.0
K	8,400[2]	38	141	6.4	365.2	365.2	365.2	0.0
L	10,000[2]	31	92	9.8	381.9	381.9	381.9	0.0
M	20,500[2]	1,536	32,010	0.2	567.4	567.4	568.0	0.6
N	24,270[2]	370	4,953	1.5	567.4	567.4	568.0	0.6
O	24,670[2]	914	11,814	0.6	569.3	569.3	569.3	0.0

[1]Feet above corporate limits
[2]Feet above confluence with Naugatuck River
[3]This width extends beyond corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY
Federal Insurance Administration

TOWN OF WATERTOWN, CT
(LITCHFIELD CO.)

FLOODWAY DATA

NAUGATUCK RIVER AND BRANCH BROOK

APPENDIX C – CROSS-SECTION LOCATIONS & CROSS-SECTIONS

ARCHITECTURE
ENGINEERING
ENVIRONMENTAL
LAND SURVEYING

BL Companies

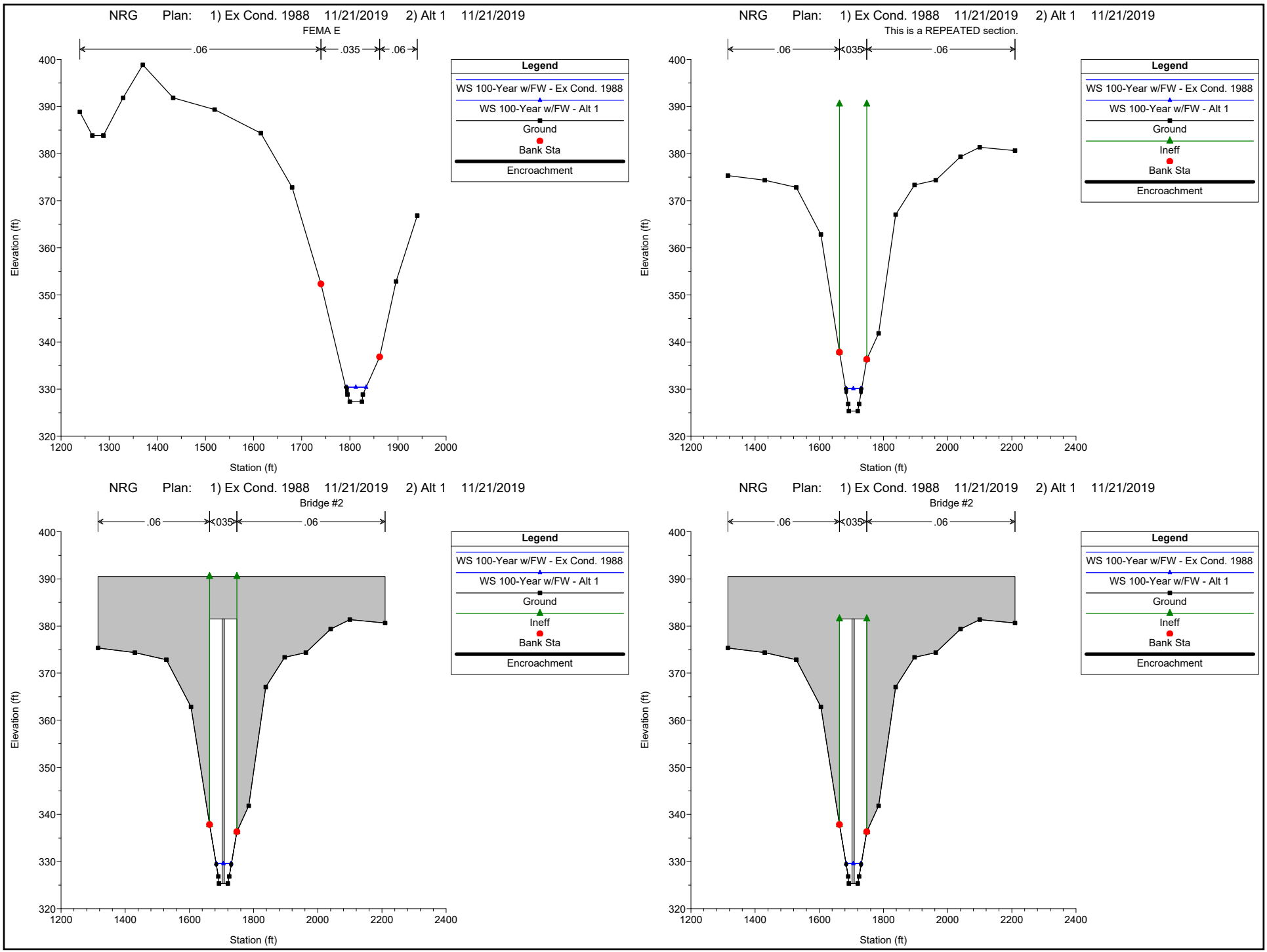
CROSS-SECTION LOCATION

NAUGATUCK RIVER GREENWAY
PEDESTRIAN BRIDGE OVER
BRANCH BROOK

Designed	B.G.R.
Drawn	B.G.R.
Reviewed	D.M.C.
Scale	1"= 400'
Project No.	1800579
Date	11/13/19
CAD File	CROSS_SECTIONS

LOC

Xref (s): ; 42224.00 Thomaston ; PR-422400 ; 8X11(port)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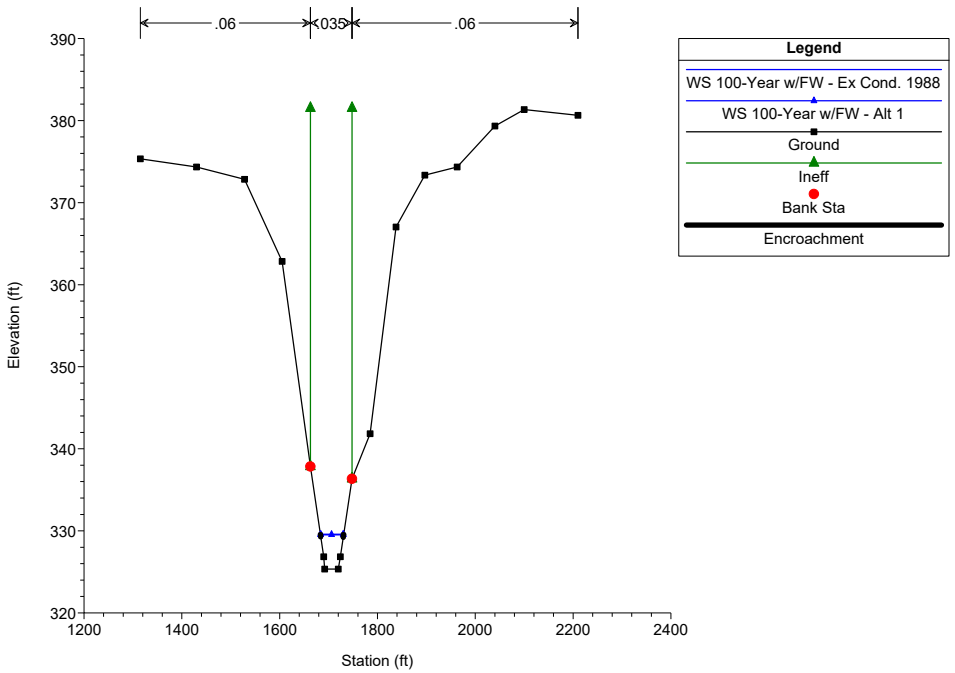
FEMA E
.06
.035
.06
Legend
WS 100-Year w/FW - Ex Cond. 1988
WS 100-Year w/FW - Alt 1
Ground
Bank Sta
Encroachment
Elevation (ft)
Station (ft)
NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019
This is a REPEATED section.
.06
.035
.06
Legend
WS 100-Year w/FW - Ex Cond. 1988
WS 100-Year w/FW - Alt 1
Ground
Ineff
Bank Sta
Encroachment
Elevation (ft)
Station (ft)
NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019
Bridge #2
.06
.035
.06
Legend
WS 100-Year w/FW - Ex Cond. 1988
WS 100-Year w/FW - Alt 1
Ground
Ineff
Bank Sta
Encroachment
Elevation (ft)
Station (ft)
NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019
Bridge #2
.06
.035
.06
Legend
WS 100-Year w/FW - Ex Cond. 1988
WS 100-Year w/FW - Alt 1
Ground
Ineff
Bank Sta
Encroachment
Elevation (ft)
Station (ft)

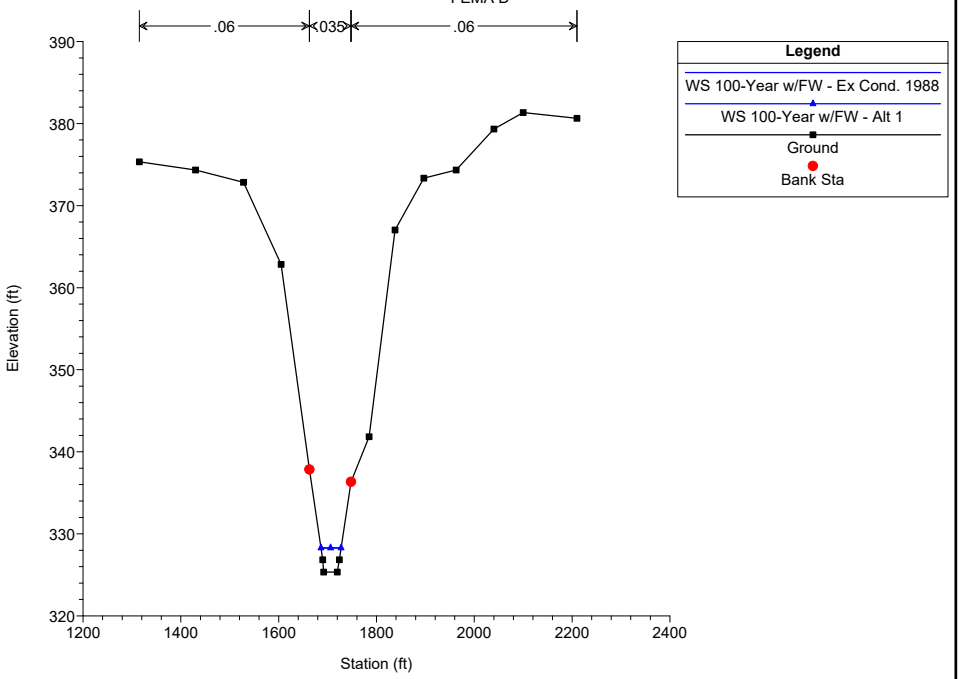
NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019

This is a REPEATED section.



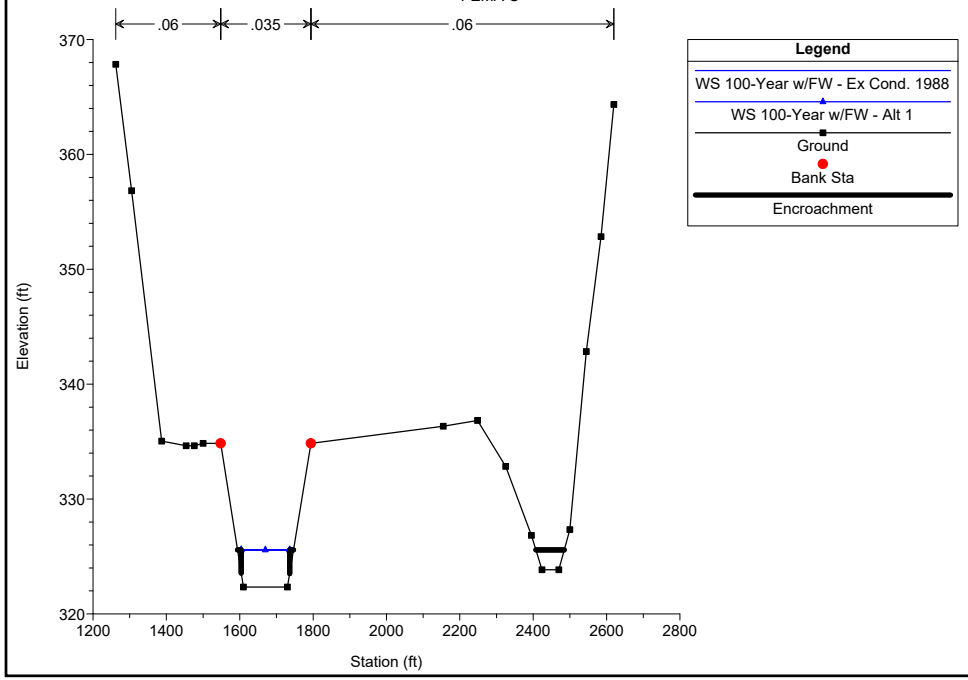
NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019

FEMA D



NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019

FEMA C



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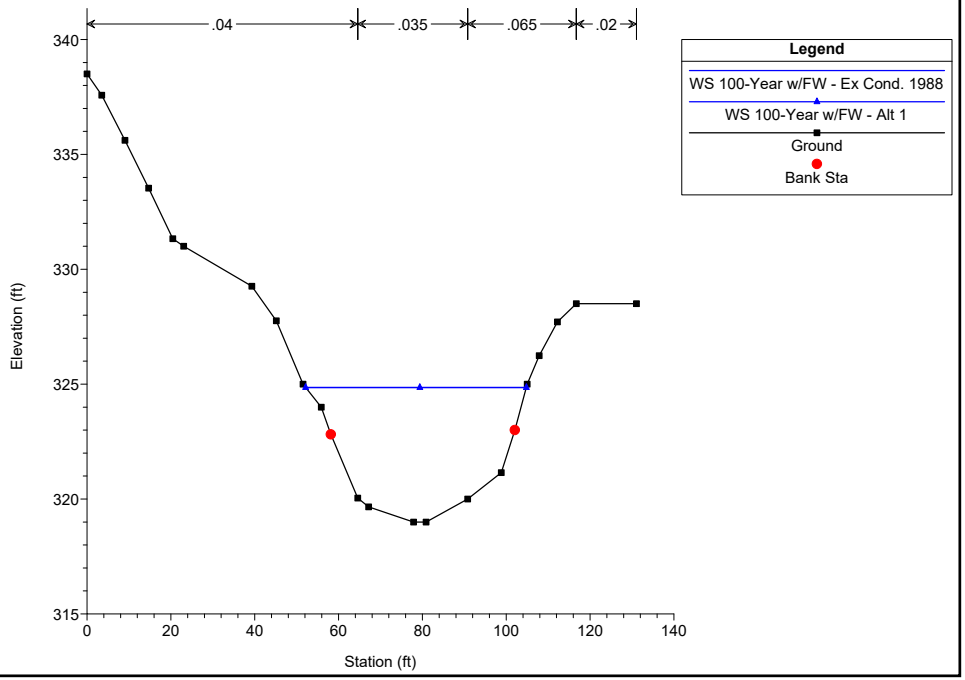

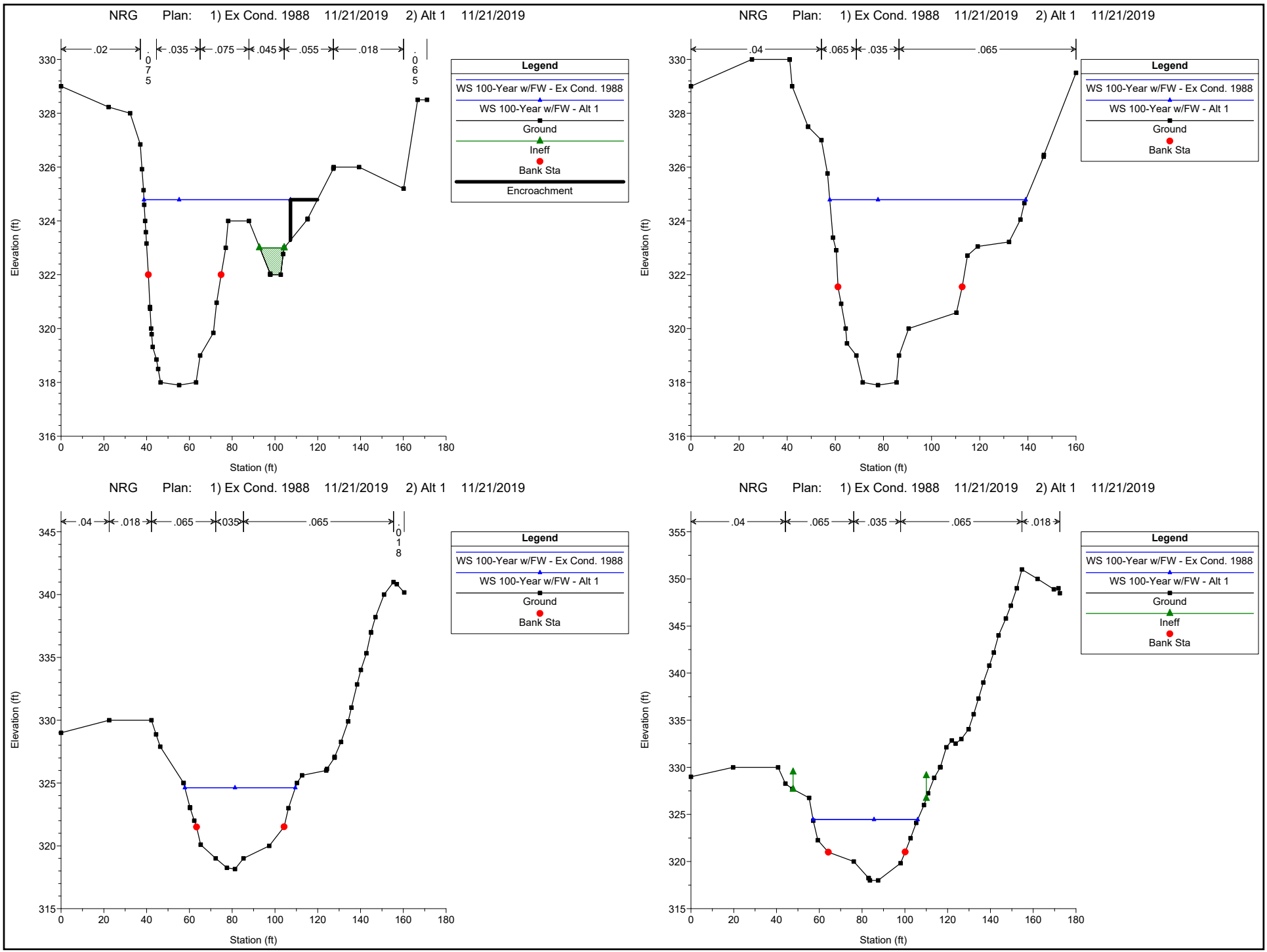
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Legend
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WS 100-Year w/FW - Alt 1
Ground
Ineff
Bank Sta
Encroachment
Elevation (ft)
Station (ft)
NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019
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Legend
WS 100-Year w/FW - Ex Cond. 1988
WS 100-Year w/FW - Alt 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019
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Legend
WS 100-Year w/FW - Ex Cond. 1988
WS 100-Year w/FW - Alt 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019
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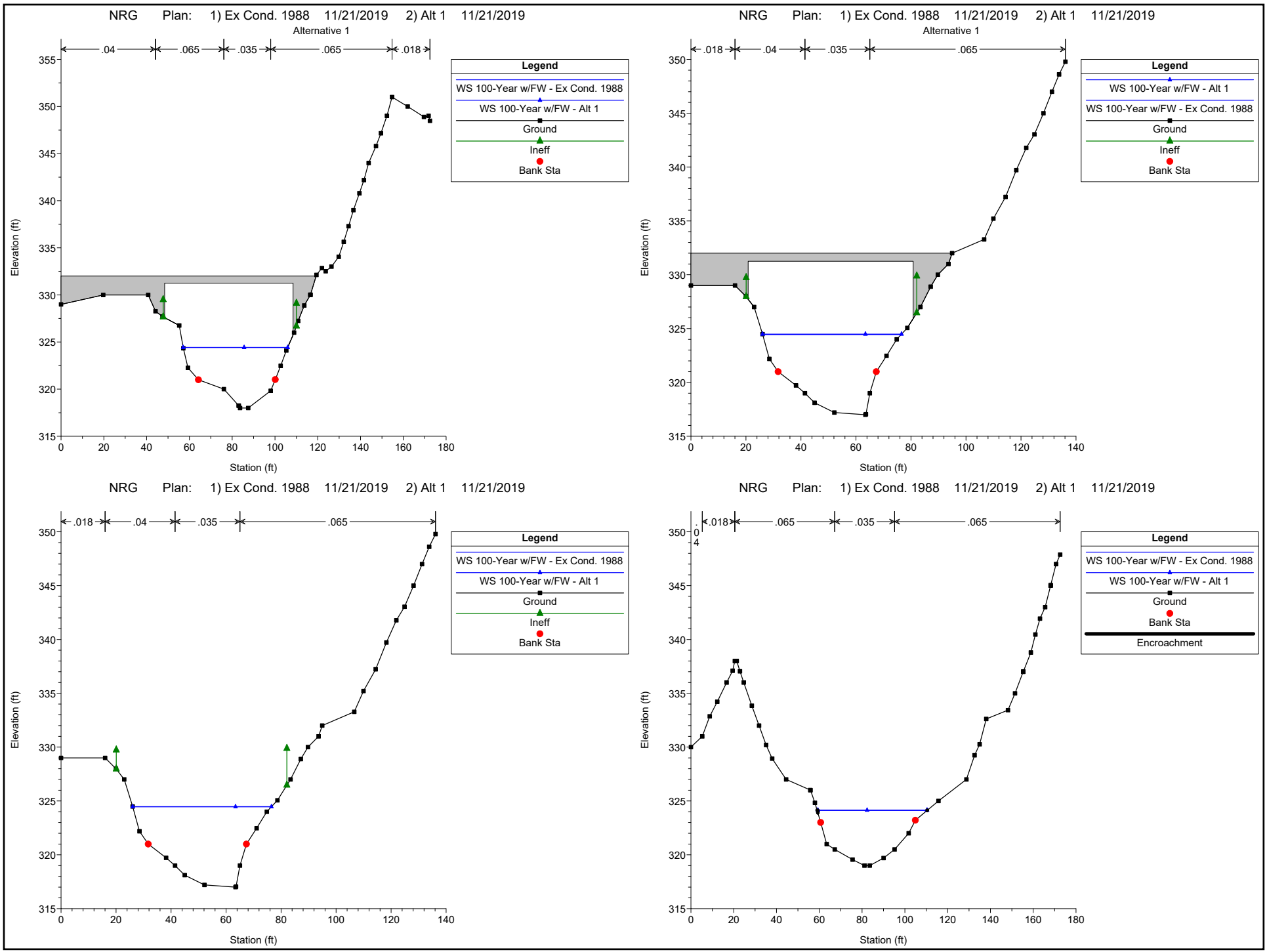
.065
.018
Legend
WS 100-Year w/FW - Ex Cond. 1988
WS 100-Year w/FW - Alt 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)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Alternative 1
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Legend
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WS 100-Year w/FW - Alt 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019
Alternative 1
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Legend
WS 100-Year w/FW - Alt 1
WS 100-Year w/FW - Ex Cond. 1988
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019
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Legend
WS 100-Year w/FW - Ex Cond. 1988
WS 100-Year w/FW - Alt 1
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019
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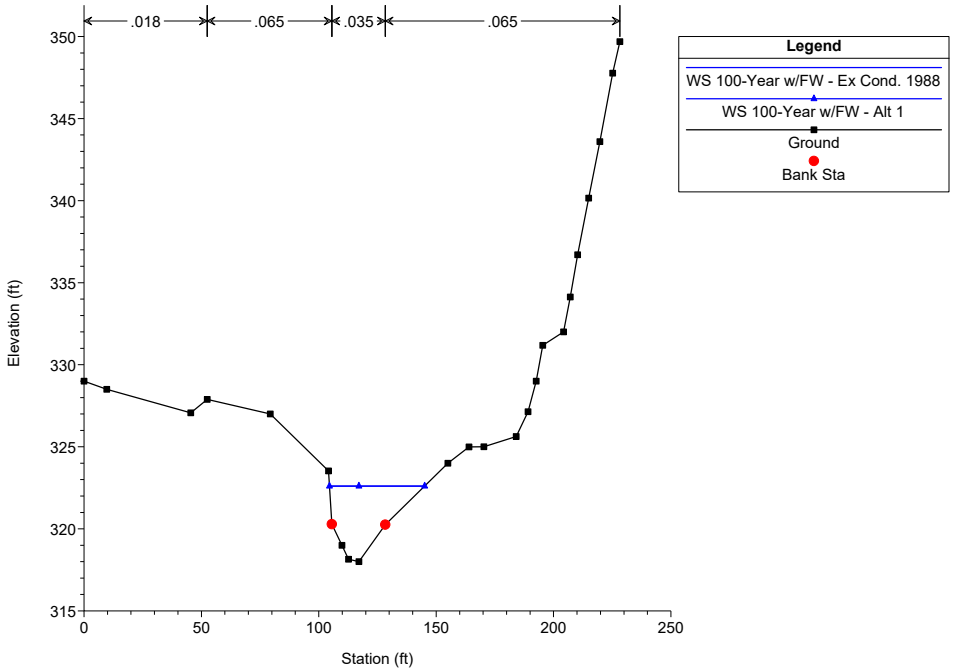
.065
.035
.065
Legend
WS 100-Year w/FW - Ex Cond. 1988
WS 100-Year w/FW - Alt 1
Ground
Bank Sta
Encroachment
Elevation (ft)
Station (ft)

NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019



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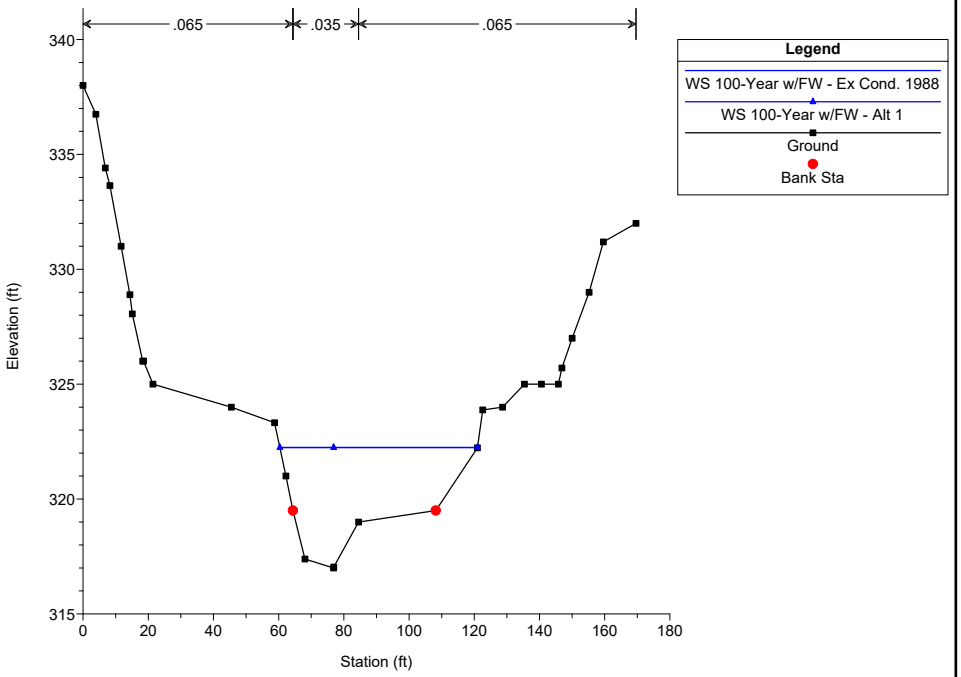
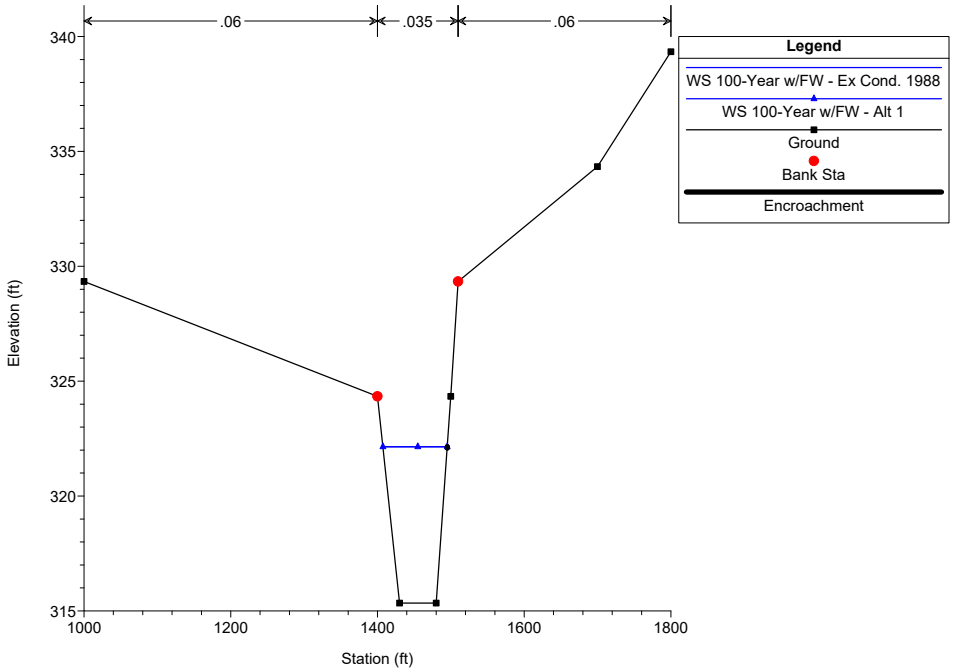


NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019

FEMA B



NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019

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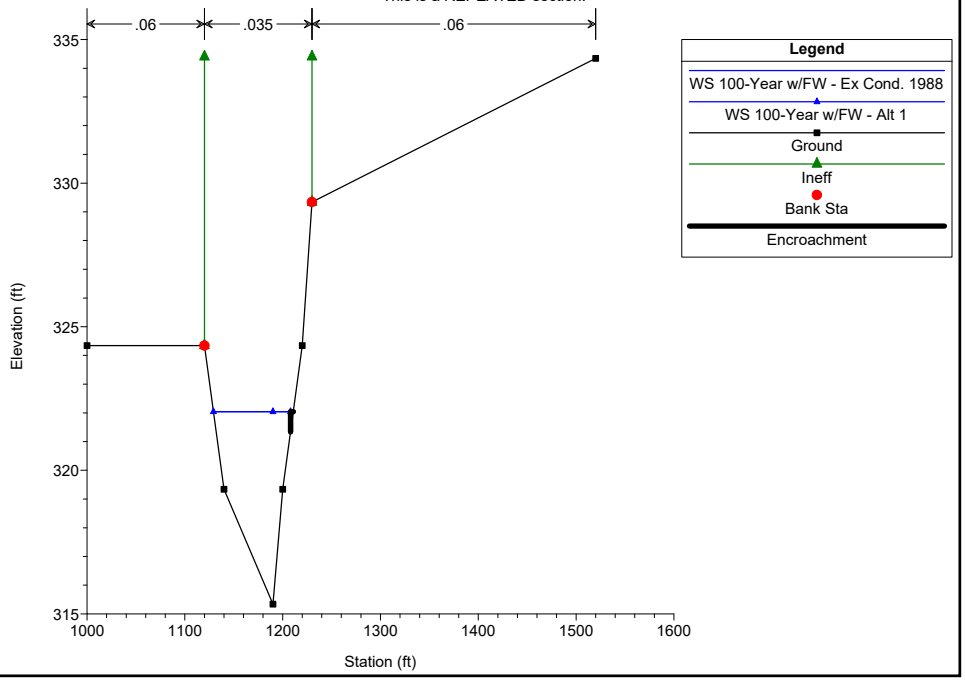
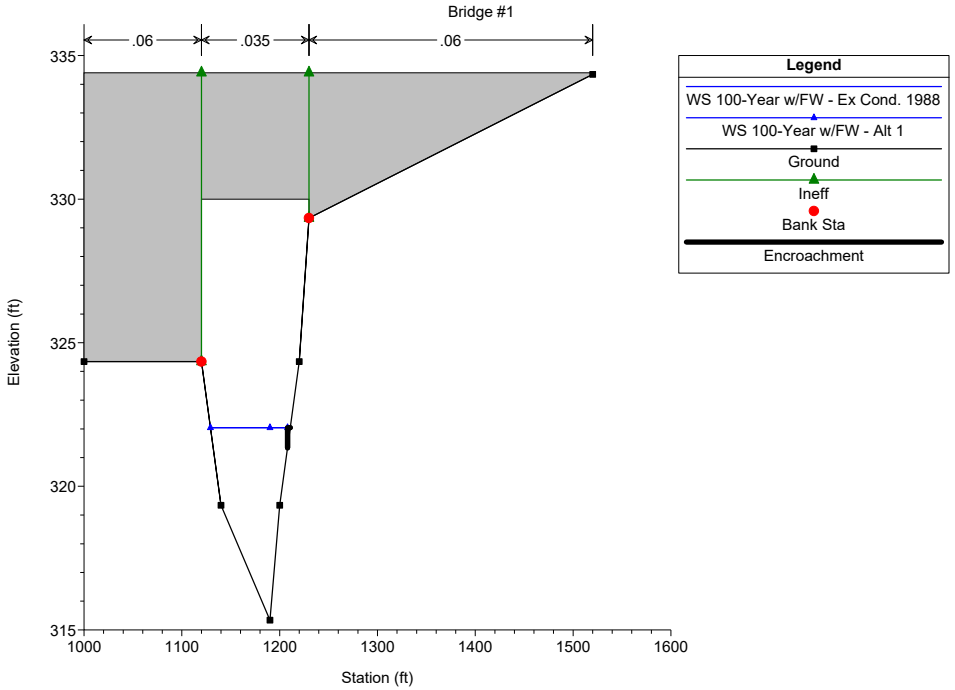
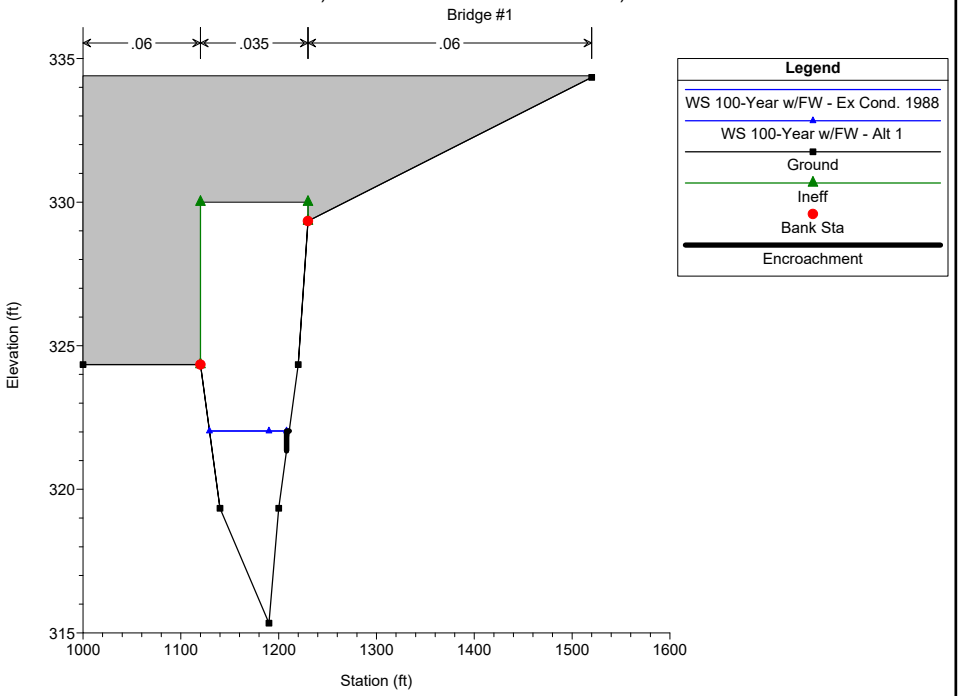


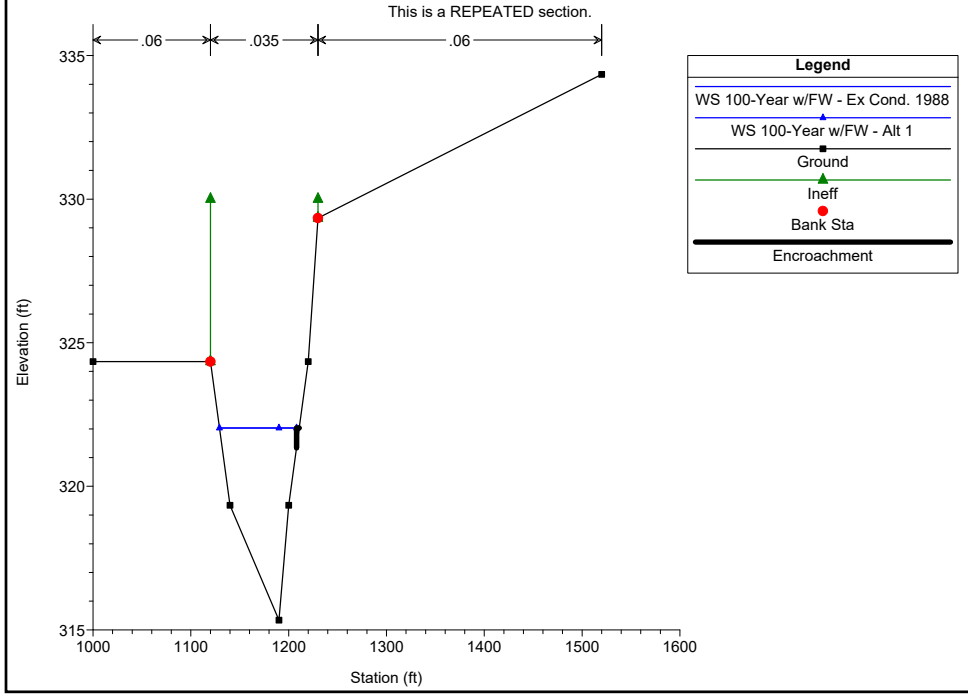
NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019



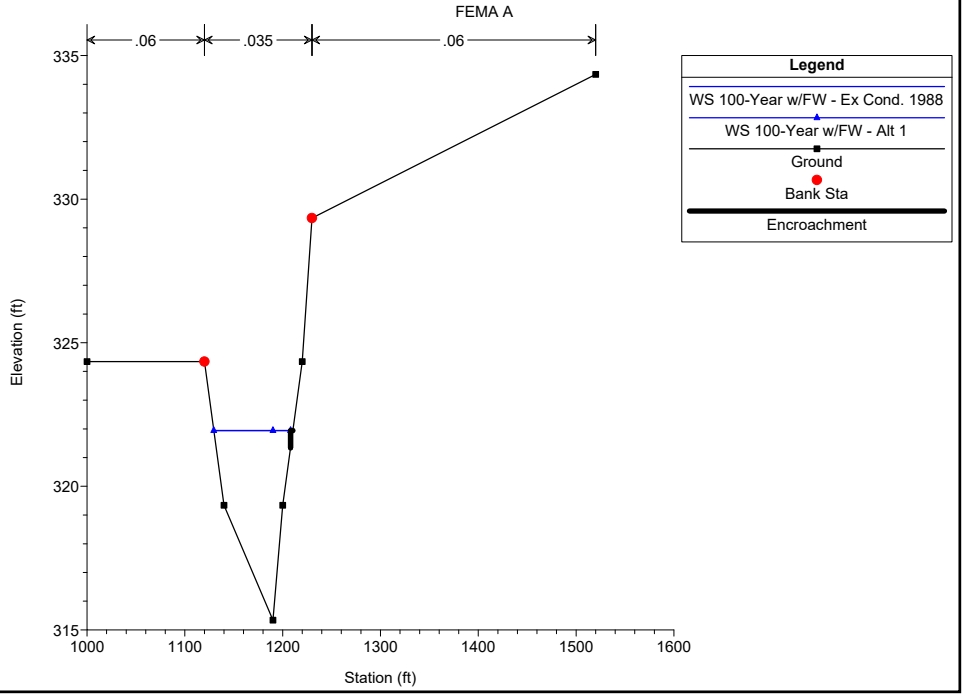
NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019



NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019



NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019

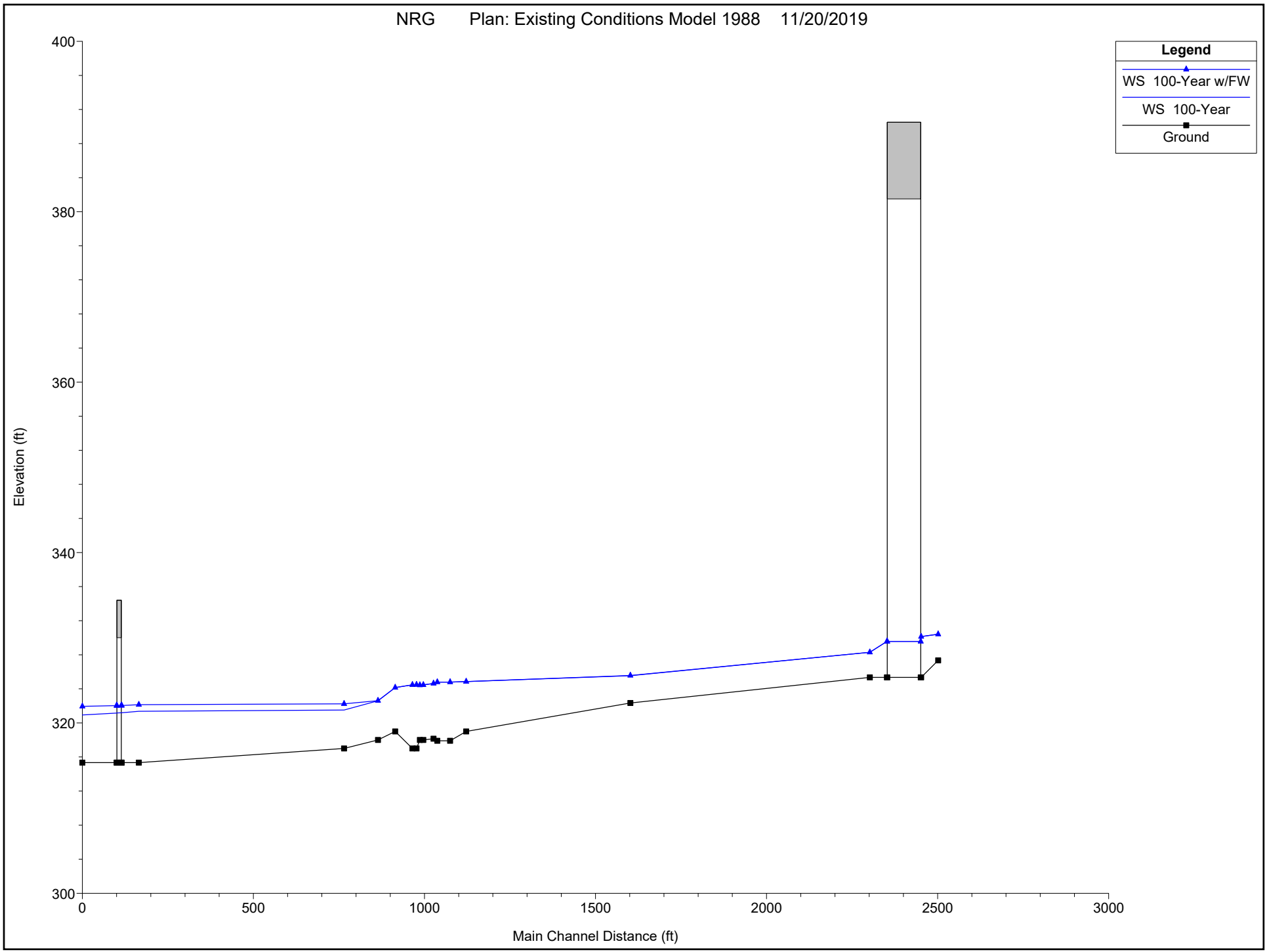


APPENDIX D – EXISTING FLOODWAY MODELS

- HEC-RAS Existing 100-Year Profile Output Table
- HEC-RAS Existing 100-Year Profiles
- HEC-RAS Existing 10-Year Profile Output Table
- HEC-RAS Existing 10-Year Profile

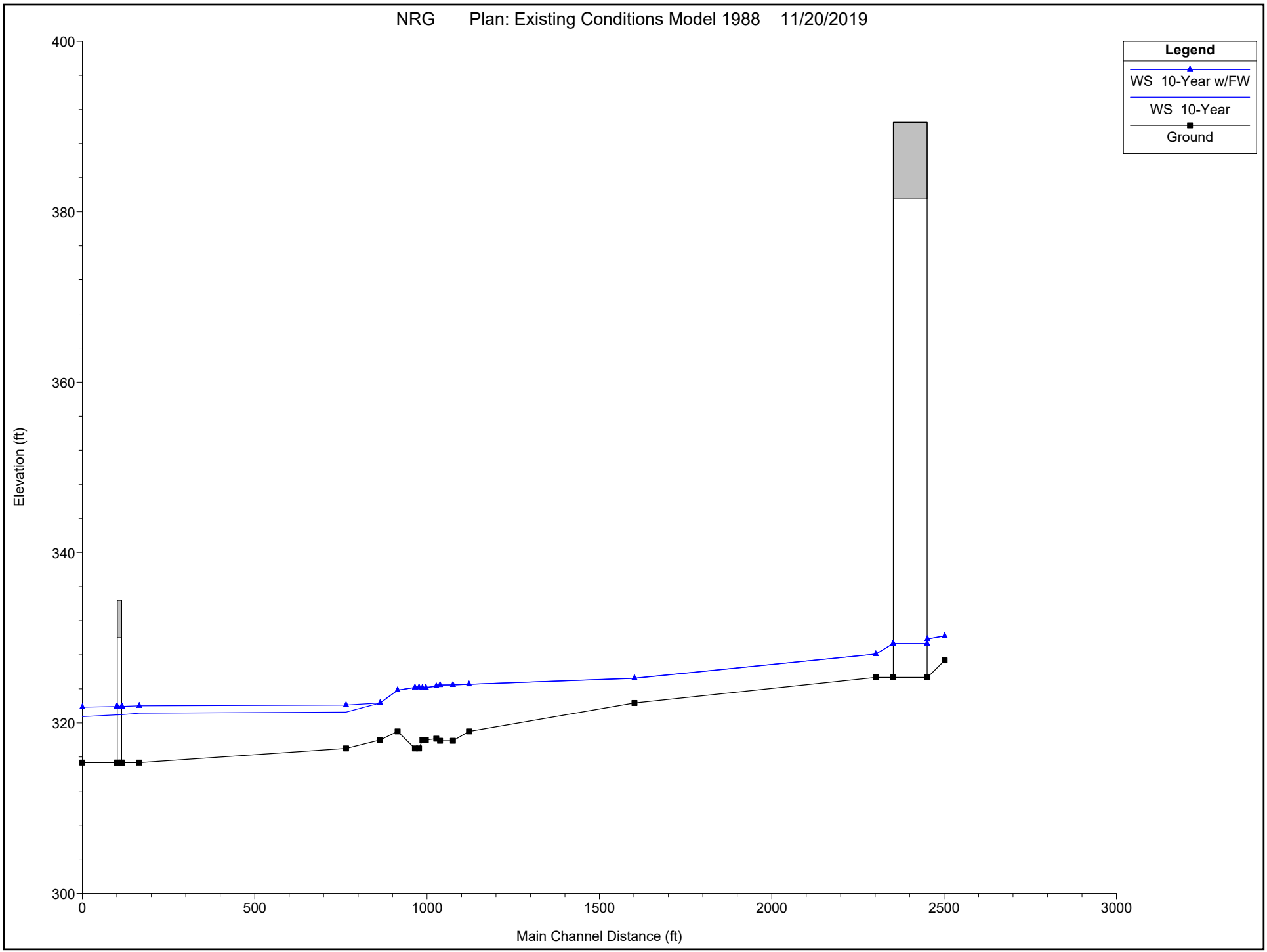
HEC-RAS Plan: Ex Cond. 1988 River: Branch Bk Reach: NRG

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
NRG	203	100-Year	900.00	327.34	330.43	330.43	331.64	0.014050	8.83	101.95	42.65	1.01
NRG	203	100-Year w/FW	900.00	327.34	330.41	330.41	331.68	0.014280	9.03	99.68	39.86	1.01
NRG	202.2	100-Year	900.00	325.34	330.13	328.30	330.50	0.002422	4.85	185.55	50.41	0.45
NRG	202.2	100-Year w/FW	900.00	325.34	330.12	328.30	330.50	0.002341	4.92	183.09	46.00	0.43
NRG	202.15		Bridge									
NRG	202.1	100-Year	900.00	325.34	329.57	328.30	330.07	0.003839	5.70	157.78	47.59	0.55
NRG	202.1	100-Year w/FW	900.00	325.34	329.56	328.30	330.07	0.003779	5.73	157.12	46.00	0.55
NRG	202	100-Year	900.00	325.34	328.28	328.28	329.52	0.013992	8.93	100.80	41.19	1.01
NRG	202	100-Year w/FW	900.00	325.34	328.28	328.28	329.52	0.013997	8.93	100.79	41.19	1.01
NRG	201	100-Year	900.00	322.34	325.54		325.59	0.000498	1.90	540.26	229.27	0.20
NRG	201	100-Year w/FW	900.00	322.34	325.57		325.64	0.000575	2.15	418.58	132.00	0.21
NRG	200.8	100-Year	900.00	319.00	324.85		325.14	0.002142	4.28	215.62	52.64	0.35
NRG	200.8	100-Year w/FW	900.00	319.00	324.86		325.14	0.002140	4.28	215.68	52.65	0.35
NRG	200.75	100-Year	900.00	317.90	324.80		325.02	0.002118	3.98	263.16	81.16	0.29
NRG	200.75	100-Year w/FW	900.00	317.90	324.79		325.02	0.002191	4.04	251.91	68.47	0.29
NRG	200.7	100-Year	900.00	317.90	324.79		324.93	0.001472	3.07	322.32	81.43	0.23
NRG	200.7	100-Year w/FW	900.00	317.90	324.78		324.92	0.001474	3.07	322.20	81.42	0.23
NRG	200.65	100-Year	900.00	318.15	324.63		324.89	0.002853	4.14	228.09	51.69	0.32
NRG	200.65	100-Year w/FW	900.00	318.15	324.63		324.89	0.002855	4.14	228.01	51.69	0.32
NRG	200.6	100-Year	900.00	318.00	324.46	322.19	324.80	0.002803	4.74	206.21	48.95	0.37
NRG	200.6	100-Year w/FW	900.00	318.00	324.46	322.19	324.80	0.002807	4.74	206.13	48.94	0.37
NRG	200.58	100-Year	900.00	318.00	324.43		324.77	0.002870	4.78	204.58	48.86	0.38
NRG	200.58	100-Year w/FW	900.00	318.00	324.43		324.77	0.002873	4.78	204.50	48.85	0.38
NRG	200.57	100-Year	900.00	317.00	324.49		324.72	0.001056	3.96	245.26	50.54	0.28
NRG	200.57	100-Year w/FW	900.00	317.00	324.48		324.72	0.001057	3.96	245.17	50.53	0.28
NRG	200.55	100-Year	900.00	317.00	324.47	321.09	324.71	0.001065	3.97	244.51	50.47	0.28
NRG	200.55	100-Year w/FW	900.00	317.00	324.47	321.09	324.71	0.001066	3.97	244.43	50.47	0.28
NRG	200.5	100-Year	900.00	319.00	324.15		324.59	0.005030	5.31	172.52	51.64	0.48
NRG	200.5	100-Year w/FW	900.00	319.00	324.15		324.59	0.005039	5.31	172.36	51.00	0.48
NRG	200.45	100-Year	900.00	318.00	322.60	322.60	324.13	0.010618	10.21	103.83	40.50	0.94
NRG	200.45	100-Year w/FW	900.00	318.00	322.61	322.61	324.13	0.010540	10.18	104.13	40.55	0.94
NRG	200.4	100-Year	900.00	317.00	321.52		322.21	0.008058	6.74	142.32	56.21	0.69
NRG	200.4	100-Year w/FW	900.00	317.00	322.24		322.66	0.004025	5.33	184.44	60.63	0.49
NRG	200.3	100-Year	900.00	315.34	321.37		321.45	0.000353	2.24	402.28	83.49	0.18
NRG	200.3	100-Year w/FW	900.00	315.34	322.14		322.20	0.000227	1.92	468.61	87.67	0.15
NRG	200.2	100-Year	900.00	315.34	321.19	319.24	321.40	0.001586	3.68	244.61	74.79	0.36
NRG	200.2	100-Year w/FW	900.00	315.34	322.04	319.24	322.17	0.000779	2.90	310.34	78.81	0.26
NRG	200.15		Bridge									
NRG	200.1	100-Year	900.00	315.34	321.16	319.24	321.37	0.001625	3.71	242.50	74.56	0.36
NRG	200.1	100-Year w/FW	900.00	315.34	322.03	319.23	322.16	0.000786	2.91	309.35	78.76	0.26
NRG	200	100-Year	900.00	315.34	320.94	319.22	321.19	0.001983	3.98	226.24	72.80	0.40
NRG	200	100-Year w/FW	900.00	315.34	321.94	319.22	322.08	0.000842	2.98	302.32	78.40	0.27


NRG Plan: Existing Conditions Model 1988 11/20/2019
Legend
WS 100-Year w/FW
WS 100-Year
Ground
Elevation (ft)
400
380
360
340
320
300
0
500
1000
1500
2000
2500
3000
Main Channel Distance (ft)

HEC-RAS Plan: Ex Cond. 1988 River: Branch Bk Reach: NRG

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
NRG	203	10-Year	800.00	327.34	330.22	330.22	331.36	0.014294	8.58	93.23	41.25	1.01
NRG	203	10-Year w/FW	800.00	327.34	330.20	330.20	331.39	0.014496	8.75	91.45	38.95	1.01
NRG	202.2	10-Year	800.00	325.34	329.84	328.08	330.18	0.002417	4.68	170.89	48.94	0.44
NRG	202.2	10-Year w/FW	800.00	325.34	329.84	328.09	330.18	0.002336	4.71	169.90	46.00	0.43
NRG	202.15		Bridge									
NRG	202.1	10-Year	800.00	325.34	329.31	328.08	329.78	0.003794	5.48	145.90	46.33	0.54
NRG	202.1	10-Year w/FW	800.00	325.34	329.31	328.09	329.78	0.003779	5.49	145.81	46.00	0.54
NRG	202	10-Year	800.00	325.34	328.08	328.08	329.24	0.014263	8.66	92.41	40.17	1.01
NRG	202	10-Year w/FW	800.00	325.34	328.08	328.08	329.24	0.014263	8.66	92.41	40.17	1.01
NRG	201	10-Year	800.00	322.34	325.23		325.29	0.000571	1.92	471.10	220.57	0.21
NRG	201	10-Year w/FW	800.00	322.34	325.25		325.32	0.000637	2.12	377.40	132.00	0.22
NRG	200.8	10-Year	800.00	319.00	324.53		324.79	0.002159	4.10	198.84	50.75	0.34
NRG	200.8	10-Year w/FW	800.00	319.00	324.53		324.79	0.002156	4.10	198.92	50.76	0.34
NRG	200.75	10-Year	800.00	317.90	324.46		324.68	0.002153	3.86	236.32	78.78	0.29
NRG	200.75	10-Year w/FW	800.00	317.90	324.46		324.68	0.002196	3.89	229.25	68.26	0.29
NRG	200.7	10-Year	800.00	317.90	324.45		324.58	0.001482	2.95	295.33	79.98	0.23
NRG	200.7	10-Year w/FW	800.00	317.90	324.45		324.58	0.001482	2.95	295.33	79.98	0.23
NRG	200.65	10-Year	800.00	318.15	324.31		324.55	0.002812	3.94	211.80	50.57	0.32
NRG	200.65	10-Year w/FW	800.00	318.15	324.31		324.55	0.002812	3.94	211.80	50.57	0.32
NRG	200.6	10-Year	800.00	318.00	324.15	321.97	324.46	0.002774	4.52	191.12	48.05	0.37
NRG	200.6	10-Year w/FW	800.00	318.00	324.15	321.97	324.46	0.002774	4.52	191.12	48.05	0.37
NRG	200.58	10-Year	800.00	318.00	324.12		324.43	0.002842	4.55	189.55	47.96	0.37
NRG	200.58	10-Year w/FW	800.00	318.00	324.12		324.43	0.002842	4.55	189.55	47.96	0.37
NRG	200.57	10-Year	800.00	317.00	324.17		324.38	0.001004	3.73	229.68	49.07	0.27
NRG	200.57	10-Year w/FW	800.00	317.00	324.17		324.38	0.001004	3.73	229.68	49.07	0.27
NRG	200.55	10-Year	800.00	317.00	324.16	320.86	324.37	0.001013	3.74	229.00	49.00	0.27
NRG	200.55	10-Year w/FW	800.00	317.00	324.16	320.86	324.37	0.001013	3.74	229.00	49.00	0.27
NRG	200.5	10-Year	800.00	319.00	323.84		324.25	0.005303	5.15	156.81	49.31	0.49
NRG	200.5	10-Year w/FW	800.00	319.00	323.84		324.25	0.005303	5.15	156.81	49.31	0.49
NRG	200.45	10-Year	800.00	318.00	322.34	322.34	323.78	0.010938	9.86	93.61	38.54	0.94
NRG	200.45	10-Year w/FW	800.00	318.00	322.34	322.34	323.78	0.010938	9.86	93.61	38.54	0.94
NRG	200.4	10-Year	800.00	317.00	321.26		321.93	0.008421	6.60	128.13	54.63	0.71
NRG	200.4	10-Year w/FW	800.00	317.00	322.09		322.46	0.003631	4.96	175.54	59.75	0.46
NRG	200.3	10-Year	800.00	315.34	321.14		321.21	0.000321	2.09	383.41	82.22	0.17
NRG	200.3	10-Year w/FW	800.00	315.34	322.01		322.06	0.000193	1.75	457.18	87.06	0.13
NRG	200.2	10-Year	800.00	315.34	320.97	319.06	321.16	0.001517	3.50	228.78	73.08	0.35
NRG	200.2	10-Year w/FW	800.00	315.34	321.93	319.06	322.04	0.000673	2.66	301.27	78.35	0.24
NRG	200.15		Bridge									
NRG	200.1	10-Year	800.00	315.34	320.95	319.05	321.14	0.001555	3.53	226.83	72.86	0.35
NRG	200.1	10-Year w/FW	800.00	315.34	321.92	319.04	322.03	0.000678	2.66	300.42	78.30	0.24
NRG	200	10-Year	800.00	315.34	320.74	319.04	320.96	0.001893	3.78	211.84	71.20	0.39
NRG	200	10-Year w/FW	800.00	315.34	321.84	319.05	321.95	0.000720	2.72	294.50	78.00	0.25

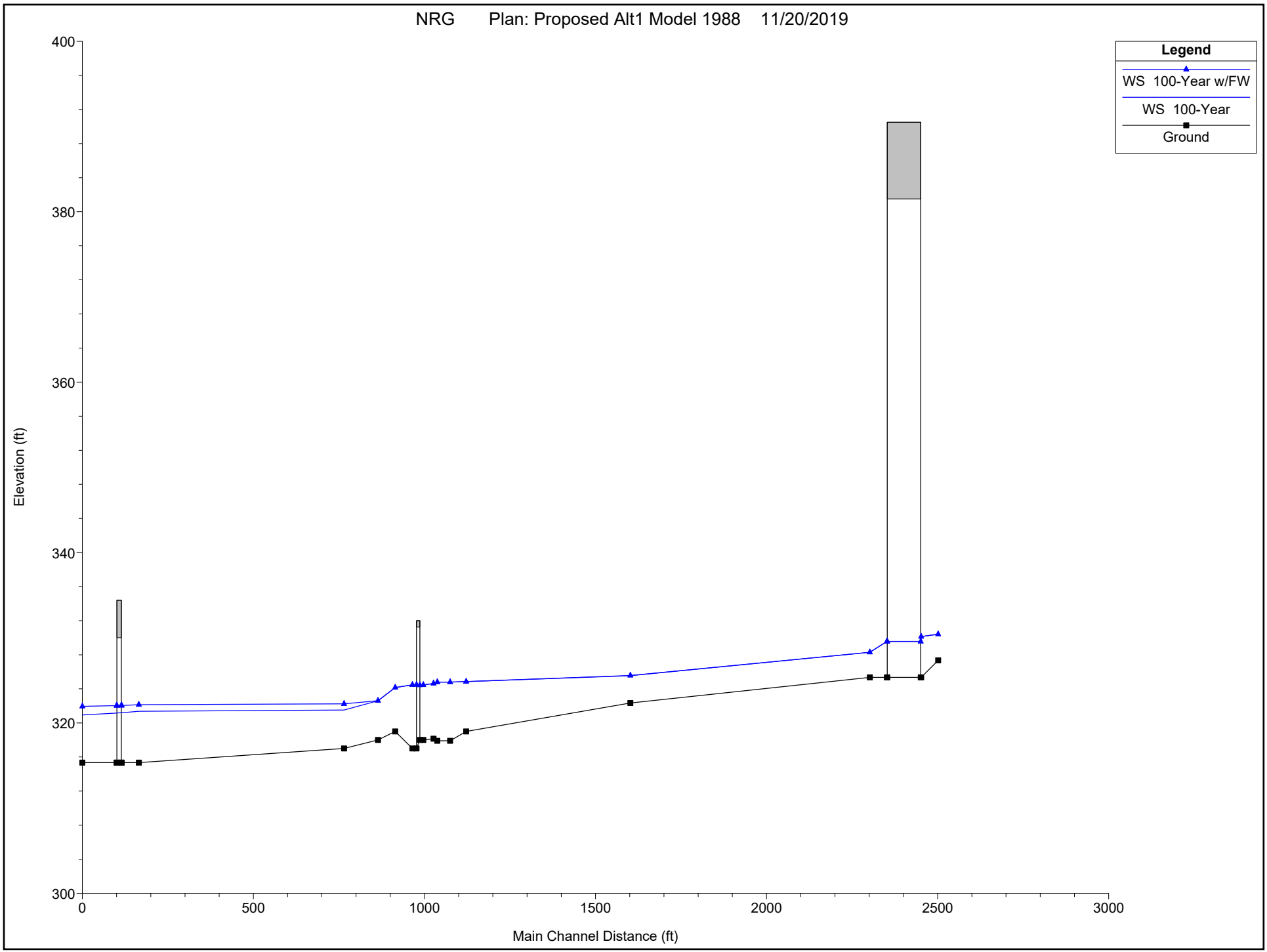

NRG Plan: Existing Conditions Model 1988 11/20/2019
Legend
WS 10-Year w/FW
WS 10-Year
Ground
Elevation (ft)
400
380
360
340
320
300
0
500
1000
1500
2000
2500
3000
Main Channel Distance (ft)

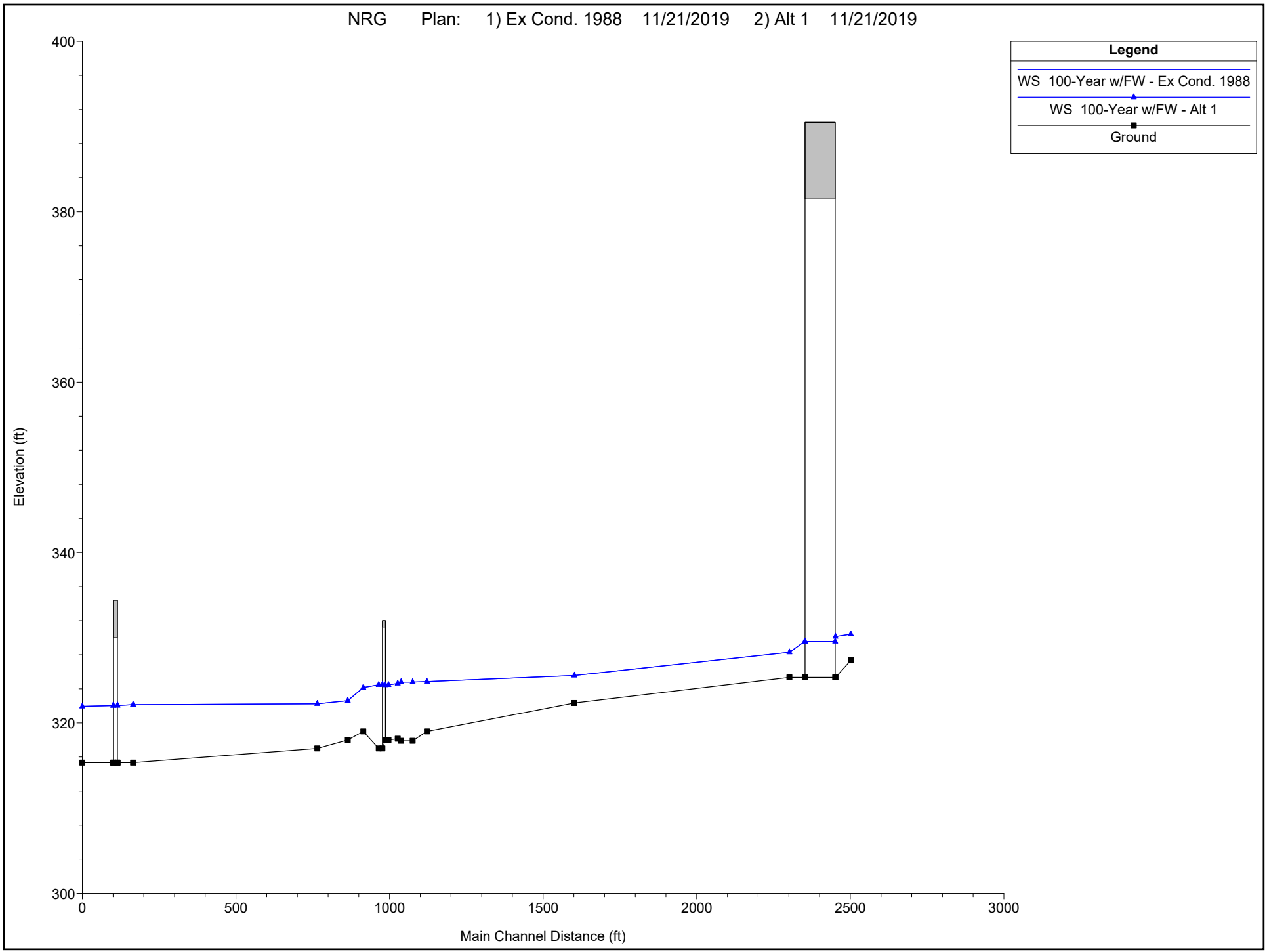
APPENDIX E – PROPOSED FLOODWAY MODELS

- HEC-RAS Proposed 100-Year Profile Output Table
- HEC-RAS Proposed 100-Year Profiles
- HEC-RAS 100-Year Floodway Comparison Profile
- HEC-RAS Proposed 10-Year Profile Output Table
- HEC-RAS Proposed 10-Year Profiles
- HEC-RAS 10-Year Floodway Comparison Profile

HEC-RAS Plan: Alt 1 River: Branch Bk Reach: NRG

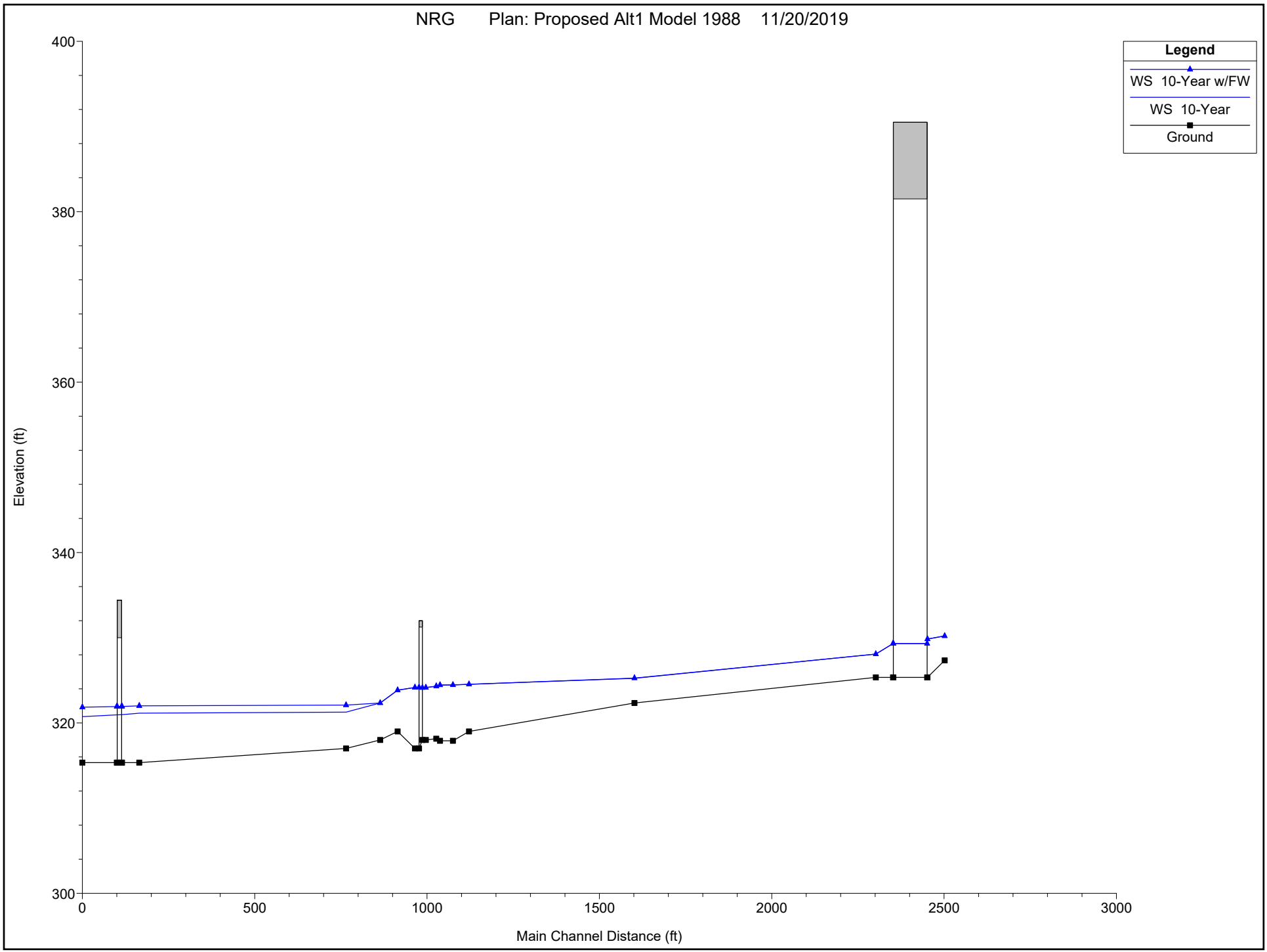
Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
NRG	203	100-Year	900.00	327.34	330.43	330.43	331.64	0.014050	8.83	101.95	42.65	1.01
NRG	203	100-Year w/FW	900.00	327.34	330.41	330.41	331.68	0.014280	9.03	99.68	39.86	1.01
NRG	202.2	100-Year	900.00	325.34	330.13	328.30	330.50	0.002422	4.85	185.55	50.41	0.45
NRG	202.2	100-Year w/FW	900.00	325.34	330.12	328.30	330.50	0.002341	4.92	183.09	46.00	0.43
NRG	202.15		Bridge									
NRG	202.1	100-Year	900.00	325.34	329.57	328.30	330.07	0.003839	5.70	157.78	47.59	0.55
NRG	202.1	100-Year w/FW	900.00	325.34	329.56	328.30	330.07	0.003779	5.73	157.12	46.00	0.55
NRG	202	100-Year	900.00	325.34	328.28	328.28	329.52	0.013992	8.93	100.80	41.19	1.01
NRG	202	100-Year w/FW	900.00	325.34	328.28	328.28	329.52	0.013997	8.93	100.79	41.19	1.01
NRG	201	100-Year	900.00	322.34	325.54		325.59	0.000498	1.90	540.22	229.27	0.20
NRG	201	100-Year w/FW	900.00	322.34	325.57		325.64	0.000575	2.15	418.56	132.00	0.21
NRG	200.8	100-Year	900.00	319.00	324.85		325.14	0.002142	4.28	215.60	52.64	0.35
NRG	200.8	100-Year w/FW	900.00	319.00	324.86		325.14	0.002140	4.28	215.66	52.65	0.35
NRG	200.75	100-Year	900.00	317.90	324.79		325.02	0.002118	3.98	263.13	81.16	0.29
NRG	200.75	100-Year w/FW	900.00	317.90	324.79		325.02	0.002192	4.04	251.89	68.47	0.29
NRG	200.7	100-Year	900.00	317.90	324.79		324.93	0.001473	3.07	322.29	81.43	0.23
NRG	200.7	100-Year w/FW	900.00	317.90	324.78		324.92	0.001474	3.07	322.18	81.42	0.23
NRG	200.65	100-Year	900.00	318.15	324.63		324.89	0.002853	4.14	228.07	51.69	0.32
NRG	200.65	100-Year w/FW	900.00	318.15	324.63		324.89	0.002856	4.14	227.99	51.69	0.32
NRG	200.6	100-Year	900.00	318.00	324.46	322.19	324.80	0.002804	4.74	206.19	48.95	0.37
NRG	200.6	100-Year w/FW	900.00	318.00	324.46	322.19	324.80	0.002808	4.75	206.11	48.94	0.37
NRG	200.58		Bridge									
NRG	200.55	100-Year	900.00	317.00	324.47	321.09	324.71	0.001065	3.97	244.51	50.47	0.28
NRG	200.55	100-Year w/FW	900.00	317.00	324.47	321.09	324.71	0.001066	3.97	244.43	50.47	0.28
NRG	200.5	100-Year	900.00	319.00	324.15		324.59	0.005030	5.31	172.52	51.64	0.48
NRG	200.5	100-Year w/FW	900.00	319.00	324.15		324.59	0.005039	5.31	172.36	51.00	0.48
NRG	200.45	100-Year	900.00	318.00	322.60	322.60	324.13	0.010618	10.21	103.83	40.50	0.94
NRG	200.45	100-Year w/FW	900.00	318.00	322.61	322.61	324.13	0.010540	10.18	104.13	40.55	0.94
NRG	200.4	100-Year	900.00	317.00	321.52		322.21	0.008058	6.74	142.32	56.21	0.69
NRG	200.4	100-Year w/FW	900.00	317.00	322.24		322.66	0.004025	5.33	184.44	60.63	0.49
NRG	200.3	100-Year	900.00	315.34	321.37		321.45	0.000353	2.24	402.28	83.49	0.18
NRG	200.3	100-Year w/FW	900.00	315.34	322.14		322.20	0.000227	1.92	468.61	87.67	0.15
NRG	200.2	100-Year	900.00	315.34	321.19	319.24	321.40	0.001586	3.68	244.61	74.79	0.36
NRG	200.2	100-Year w/FW	900.00	315.34	322.04	319.24	322.17	0.000779	2.90	310.34	78.81	0.26
NRG	200.15		Bridge									
NRG	200.1	100-Year	900.00	315.34	321.16	319.24	321.37	0.001625	3.71	242.50	74.56	0.36
NRG	200.1	100-Year w/FW	900.00	315.34	322.03	319.23	322.16	0.000786	2.91	309.35	78.76	0.26
NRG	200	100-Year	900.00	315.34	320.94	319.22	321.19	0.001983	3.98	226.24	72.80	0.40
NRG	200	100-Year w/FW	900.00	315.34	321.94	319.22	322.08	0.000842	2.98	302.32	78.40	0.27

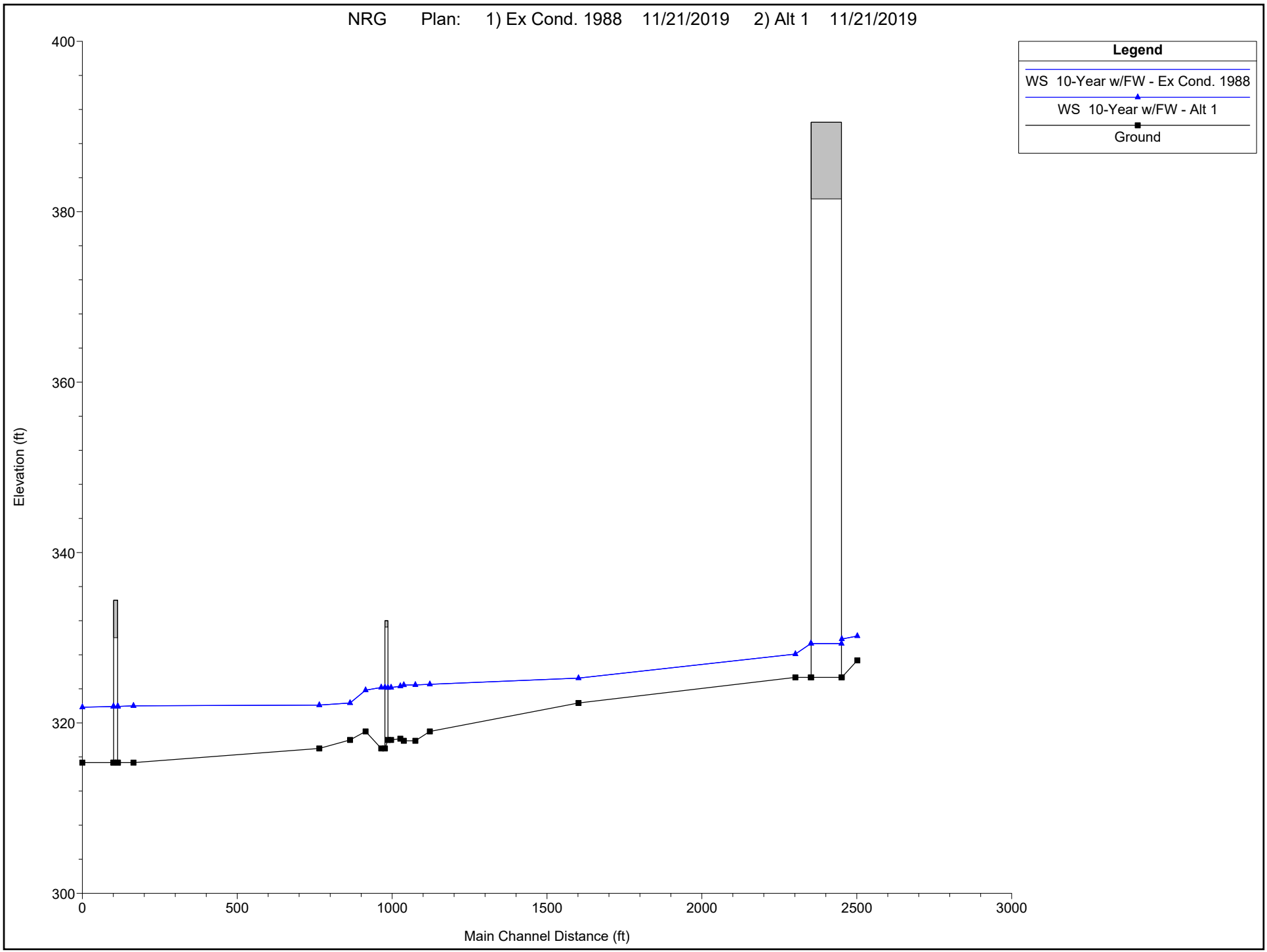

NRG Plan: Proposed Alt1 Model 1988 11/20/2019
Legend
WS 100-Year w/FW
WS 100-Year
Ground
Elevation (ft)
400
380
360
340
320
300
0
500
1000
1500
2000
2500
3000
Main Channel Distance (ft)


NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019
Legend
WS 100-Year w/FW - Ex Cond. 1988
WS 100-Year w/FW - Alt 1
Ground
Elevation (ft)
400
380
360
340
320
300
0
500
1000
1500
2000
2500
3000
Main Channel Distance (ft)

HEC-RAS Plan: Alt 1 River: Branch Bk Reach: NRG

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
NRG	203	10-Year	800.00	327.34	330.22	330.22	331.36	0.014294	8.58	93.23	41.25	1.01
NRG	203	10-Year w/FW	800.00	327.34	330.20	330.20	331.39	0.014496	8.75	91.45	38.95	1.01
NRG	202.2	10-Year	800.00	325.34	329.84	328.08	330.18	0.002417	4.68	170.89	48.94	0.44
NRG	202.2	10-Year w/FW	800.00	325.34	329.84	328.09	330.18	0.002336	4.71	169.90	46.00	0.43
NRG	202.15		Bridge									
NRG	202.1	10-Year	800.00	325.34	329.31	328.08	329.78	0.003794	5.48	145.90	46.33	0.54
NRG	202.1	10-Year w/FW	800.00	325.34	329.31	328.09	329.78	0.003779	5.49	145.81	46.00	0.54
NRG	202	10-Year	800.00	325.34	328.08	328.08	329.24	0.014263	8.66	92.41	40.17	1.01
NRG	202	10-Year w/FW	800.00	325.34	328.08	328.08	329.24	0.014263	8.66	92.41	40.17	1.01
NRG	201	10-Year	800.00	322.34	325.23		325.29	0.000571	1.92	471.06	220.56	0.21
NRG	201	10-Year w/FW	800.00	322.34	325.25		325.32	0.000637	2.12	377.37	132.00	0.22
NRG	200.8	10-Year	800.00	319.00	324.53		324.79	0.002159	4.10	198.82	50.75	0.34
NRG	200.8	10-Year w/FW	800.00	319.00	324.53		324.79	0.002157	4.10	198.90	50.75	0.34
NRG	200.75	10-Year	800.00	317.90	324.46		324.68	0.002154	3.86	236.29	78.78	0.29
NRG	200.75	10-Year w/FW	800.00	317.90	324.46		324.68	0.002197	3.90	229.23	68.26	0.29
NRG	200.7	10-Year	800.00	317.90	324.45		324.58	0.001482	2.95	295.30	79.98	0.23
NRG	200.7	10-Year w/FW	800.00	317.90	324.45		324.58	0.001482	2.95	295.30	79.98	0.23
NRG	200.65	10-Year	800.00	318.15	324.31		324.55	0.002813	3.94	211.78	50.57	0.32
NRG	200.65	10-Year w/FW	800.00	318.15	324.31		324.55	0.002813	3.94	211.78	50.57	0.32
NRG	200.6	10-Year	800.00	318.00	324.15	321.97	324.46	0.002774	4.52	191.10	48.05	0.37
NRG	200.6	10-Year w/FW	800.00	318.00	324.15	321.97	324.46	0.002774	4.52	191.10	48.05	0.37
NRG	200.58		Bridge									
NRG	200.55	10-Year	800.00	317.00	324.16	320.86	324.37	0.001013	3.74	229.00	49.00	0.27
NRG	200.55	10-Year w/FW	800.00	317.00	324.16	320.86	324.37	0.001013	3.74	229.00	49.00	0.27
NRG	200.5	10-Year	800.00	319.00	323.84		324.25	0.005303	5.15	156.81	49.31	0.49
NRG	200.5	10-Year w/FW	800.00	319.00	323.84		324.25	0.005303	5.15	156.81	49.31	0.49
NRG	200.45	10-Year	800.00	318.00	322.34	322.34	323.78	0.010938	9.86	93.61	38.54	0.94
NRG	200.45	10-Year w/FW	800.00	318.00	322.34	322.34	323.78	0.010938	9.86	93.61	38.54	0.94
NRG	200.4	10-Year	800.00	317.00	321.26		321.93	0.008421	6.60	128.13	54.63	0.71
NRG	200.4	10-Year w/FW	800.00	317.00	322.09		322.46	0.003631	4.96	175.54	59.75	0.46
NRG	200.3	10-Year	800.00	315.34	321.14		321.21	0.000321	2.09	383.41	82.22	0.17
NRG	200.3	10-Year w/FW	800.00	315.34	322.01		322.06	0.000193	1.75	457.18	87.06	0.13
NRG	200.2	10-Year	800.00	315.34	320.97	319.06	321.16	0.001517	3.50	228.78	73.08	0.35
NRG	200.2	10-Year w/FW	800.00	315.34	321.93	319.06	322.04	0.000673	2.66	301.27	78.35	0.24
NRG	200.15		Bridge									
NRG	200.1	10-Year	800.00	315.34	320.95	319.05	321.14	0.001555	3.53	226.83	72.86	0.35
NRG	200.1	10-Year w/FW	800.00	315.34	321.92	319.04	322.03	0.000678	2.66	300.42	78.30	0.24
NRG	200	10-Year	800.00	315.34	320.74	319.04	320.96	0.001893	3.78	211.84	71.20	0.39
NRG	200	10-Year w/FW	800.00	315.34	321.84	319.05	321.95	0.000720	2.72	294.50	78.00	0.25


NRG Plan: Proposed Alt1 Model 1988 11/20/2019
Legend
WS 10-Year w/FW
WS 10-Year
Ground
Elevation (ft)
400
380
360
340
320
300
0
500
1000
1500
2000
2500
3000
Main Channel Distance (ft)


NRG Plan: 1) Ex Cond. 1988 11/21/2019 2) Alt 1 11/21/2019
Legend
WS 10-Year w/FW - Ex Cond. 1988
WS 10-Year w/FW - Alt 1
Ground
Elevation (ft)
400
380
360
340
320
300
0
500
1000
1500
2000
2500
3000
Main Channel Distance (ft)

APPENDIX F – HYDRAULIC DATA SHEETS

HYDRAULIC DATA FORMS

- **Data Collection and Field Review (pages 4 to 14)**
- **Hydraulic Data (pages 15 to 18)**

A. DATA COLLECTION AND FIELD REVIEW

I. GENERAL PROJECT DATA

Bridge No.: **N/A**
Town: **Watertown & Thomaston** County: **Litchfield**
Feature carried: **Multipurpose Path** Feature crossed: **Branch Brook**
Quadrangle: **Thomaston** DEP watershed basin no.: **6910**

Functional class:

- ☐ urban principal arterial-interstate
- ☐ urban principal arterial-other expwy.
- ☐ urban principal arterial-other
- ☐ urban minor arterial
- ☐ urban collector
- ☐ urban local
- ☐ rural principal arterial-interstate
- ☐ rural principal arterial-other expwy.
- ☐ rural principal arterial-other
- ☐ rural minor arterial
- ☐ rural major collector
- ☐ rural minor collector
- ☒ Other

Year built: **New Construction** Year of reconstruction: _____
Overall NBIS structure rating: _____ NBIS Item 113: _____
USGS total scour index: _____ Sufficiency rating: _____

Plans available? ☐ yes ☒ no

II. SUPERSTRUCTURE INFORMATION

Bridge width: **N/A** ft Bridge length: **N/A** ft
Number of spans: **N/A** Bridge skew: **N/A**

Bearing connection type: ☒ Positive connection ☐ No positive connection

III. HYDROLOGIC AND HYDRAULIC INFORMATION

Watershed area: **22.6** sq. mi.

Is it tidally influenced? ☐ yes ☒ no

What information is available?

- ☐ floodway analysis report
- ☒ FEMA F.I.S.
- ☐ hydraulic report
- ☐ SCEL analysis
- ☒ Other: **FEMA HEC-2 Backup Data**
- ☐ scour report
- ☐ comparative report

	Source	2 Yr. Event	10 Yr. Event	50 Yr. Event	100 Yr. Event	500 Yr. Event
Flow rates (cfs)	**FEMA FIS**	**-**	**800**	**800**	**900**	**2,300**
	StreamStats	**780**	**1640**	**2630**	**3130**	**4980**
Precipitation (in)	**NOAA Atlas 14 24-hr**	**3.56**	**5.68**	**7.97**	**9.04**	**12.5**

Elevations (ft.)							
At Structure			Water Surface at Approach Cross-Section (200.65)				
Streambed	Low Chord	Roadway	2 Yr. Event	10 Yr. Event	50 Yr. Event	100 Yr. Event	500 Yr. Event
318.00	**NA**	**NA**	**-**	**324.31**	**324.31**	**324.63**	**327.90**

Pressure flow at design storm? ☐ yes ☐ underclearance ft.

Comments: **This is a new structure that does not currently exist. The streambed above is at Section 200.6, the location of the upstream face section of the proposed bridge. The WSELs listed above are from the Existing Conditions Model at Section 200.65, the approach section.**

IV. SITE DATA

A. Existing structure(s) – Provide sketch of culvert/structure with dimensions and brief description.

No Existing Structure
See Figures
See Appendix A (Photographs)

Comments: Include structure or culvert type and condition. Note particularly any scour adjacent to abutments or at culvert outlet and the presence of debris or sediment. Also note the location of any utilities in the area of the crossing.

B. High water marks – Describe the nature and location of any apparent high-water marks and relate to a date of occurrence, if possible.

N/A

C. Maximum allowable headwater – Describe the nature of the apparent controlling feature and note its location.

N/A

D. Fish passage requirements – Comment on the apparent need for fish passage or impediments to same; such as dams or restrictive crossings in the area.

The proposed bridge allows fish passage. Fish passage is blocked approximately 0.5 miles upstream of the subject location by the Black Rock Dam spillway.

V. PERIPHERAL SITE DATA

A. Hydraulic control – Note location and description.

The flood control structure upstream and known FEMA WSELs downstream of the project site at the mouth of Naugatuck River control.

B. Upstream and downstream structures – Provide sketches and brief descriptions of existing bridges/culverts. Include dimensions.

Upstream

- **Route 8 Overpass – twin span, 8-ft wide pier, 381.50 ft low chord, 85 ft span abutment to abutment.**

Downstream

- **Dirt road crossing – 330.00 ft low chord, 100 ft wide opening**

C. Watershed area – Check watershed boundaries for accuracy. Note current land uses within watershed.

See Appendix A

D. Flow control structures within watershed – Note the location and type of all significant flow control structures (dams, etc.) within the watershed. Provide sketches with dimensions as required.

Spillway 2,100-ft upstream.
See Appendix A.

E. Site photographs – Attach to report. Include an index and sketch of photograph locations. **No current photographs.**

VI. STREAM CHANNEL AND RELATED ASPECTS

A. Stream characterization

Twenty Groupings of Stream Characteristics (check box)

	Identifier	Drainage Area	Streambed Slope	Streambed Soils	Land Use
☐	A	Large	Low	SD	S/F
☐	B	Large	Low	SD	Urban
☒	C	Large	Moderate	SD	Forested
☐	D	Medium	Moderate	SD	Urban
☐	E	Medium	Moderate	SD	S/F
☐	F	Medium	Moderate	CLAY	S/F
☐	G	Medium	Moderate	TILL	S/F
☐	H	Medium	Moderate	SD	Forested
☐	I	Medium	Moderate	TILL	Forested
☐	J	Small	Low	SD	Urban
☐	K	Small	Moderate	TILL	Urban
☐	L	Small	Low	SD	S/F
☐	M	Small	Moderate	SD	S/F
☐	N	Small	Moderate	SD	Forested
☐	O	Small	Low	CLAY	S/F
☐	P	Small	Steep	TILL	S/F
☐	Q	Small	Moderate	TILL	S/F
☐	R	Small	Low	TILL	S/F
☐	S	Small	Moderate	TILL	Forested
☐	T	Small	Steep	TILL	Forested

Drainage area	Small	$\leq$ 64.75km^2 (25 mi^2)
	Medium	> 64.75km^2 (25 mi^2) and $\leq$ 259 km^2 (100 mi^2)
	Large	> 259 km^2 (100 mi^2)
Streambed slope	Low	$\leq$ 4.76 m/km (25 ft/mi)
	Moderate	> 4.76 m/km (25 ft/mi) and $\leq$ 19.05 m/km (100 ft. mi)
	Steep	> 19.05 m/km (100 ft. mi)
Streambed soils	SD = Stratified Drift	
Land Use	S/F = Suburban or Farming	

B. Channel stability

Previous NBIS Item 61 rating: **NA**

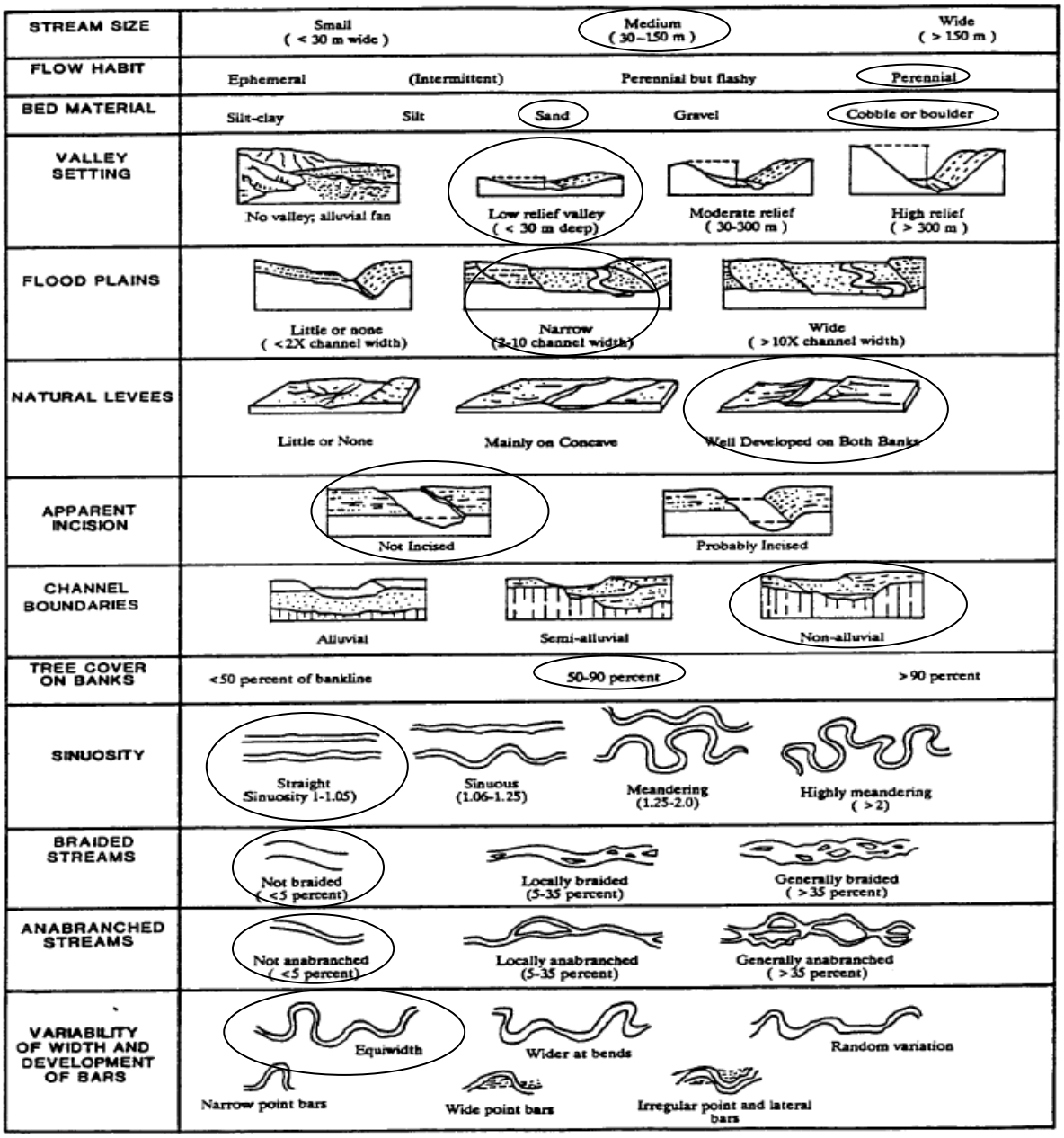
Lateral stability: ☒ stable ☐ unstable

Bank erosion:
☒ none ☐ light fluvial erosion ☐ heavy fluvial erosion ☐ mass wasting

Streambed: ☒ stable ☐ aggradating ☐ degrading

Armoring potential: ☐ none ☒ low ☐ moderate ☐ high

Geomorphic factors that affect stream stability (circle factors that apply)



Source: Adapted From Brice and Blodgett, 1978

(See also FHWA HEC-20, "Stream Stability at Highway Structures" for discussion of the above factors)

Secondary bed material: ☐ sand ☐ gravel ☒ boulders ☐ manmade ☐ silt/clay ☐ cobble ☒ bedrock

Bank protection

Type ☒ none ☐ modified ☐ intermediate ☐ standard ☐ concrete ☐ slope paving ☐ absent ☐ other

Condition ☒ n/a ☐ good ☐ weathered ☐ slumped ☐ poor ☐ missing ☐ fair

Comment on the need (if any) for training walls, cutoff walls or special slope or channel protection.

The side slopes of the brook in the vicinity of the bridge are generally stable. Backwater from the crossing downstream reduces velocities in project location.

C. Channel and overbank roughness coefficients

Basic channel description: ☐ channel in earth ☐ channel cut into rock ☐ channel fine gravel ☒ channel coarse gravel

Surface irregularity of channel:

☐ smooth – best obtainable section for materials involved
☒ minor – slightly eroded or scoured side slopes
☐ moderate – moderately sloughed or eroded side slopes
☐ severe – badly sloughed banks of natural channels or badly eroded sides of man-made channels – jagged and irregular sides or bottom sections of channels in rock

Variations in shape and size of cross sections

☐ changes in size or shape occurring gradually
☒ large and small sections alternating occasionally or shape changes causing occasional shifting of main flow from side to side
☐ moderate – moderately sloughed or eroded side slopes
☐ large and small sections alternating frequently or shape changes causing frequent shifting of main flow from side to side

Channel obstructions – (Judge the relative effect of obstructions – consider the degree to which the obstructions reduce the average cross sectional area, character of obstructions, and location and spacing of obstructions).

NOTE: Smooth or rounded objects create less turbulence than sharp, angular objects.

The effect of obstructions is:

☐ negligible
☒ minor
☐ appreciable
☐ severe

Degree of Vegetation (Note amount and character of foliage)

The effect of vegetative growth upon flow conditions is:

☐ LOW – Dense growths of flexible turf grasses where average depth of flow is 2 to 3 times the height of vegetation. Supple seedling tree switches where the average depth of flow is 3 to 4 times the height of the vegetation.

☐ MEDIUM – Turf grasses where the average depth of flow is 1 to 2 times the height of vegetation. Stemmy grasses, weeds or tree seedlings (moderate cover) where the average depth of flow is 2 to 3 times the height of vegetation. Bushy growths (moderately dense along channel side slopes with no significant vegetation along channel bottom).

☒ HIGH – Turf grasses where average height is about equal to the average depth of flow. Willow or cottonwood trees 8 to 10 years old with some weeds or brush. Bushy growths about 1 year old with some weeds. No significant vegetation along channel bottom.

☐ VERY HIGH – Turf grasses where the average depth of flow is less than ½ the height of vegetation. Bushy growths about 1-year old intergrown with weeds. Dense growth of cattails along channel bottom. Trees intergrown with weeds and brush (thick growth).

Additional Comments: **See Appendix A**

VII. HYDRAULIC VULNERABILITY

Previous Item 71 rating: **NA**

Is there confluence present?	☐	yes	☒	no
Angle of attack (flood flow):	☐	yes	☒	no
Bends in channel:	☒	upstream of bridge	☒	downstream of bridge
	☐	straight channel reach	☐	at bridge

Velocity order of magnitude: **4.14 ft/s (approach section)**

Trapping potential:	☒	low	☐	medium	☐	high	
Debris potential:	☒	low	☐	medium	☐	high	
Overtopping relief:	☒	none	☐	left approach	☐	right approach	
	☐	on bridge	☐	relief bridge	☐	cannot be determined	
Primary bed material:	☒	sand	☒	gravel	☐	boulders	☐ manmade
	☐	silt/clay	☒	cobble	☐	bedrock	

Comments: **The channel is comprised of gravelly sand, small cobbles and boulders.**

VIII. VISUAL SCOUR EVIDENCE

USGS observed scour index: **N/A**

History of scour problem: ☐ yes ☒ no

Comments: **There is no existing bridge at the crossing site.**

Note: Comment should address any evidence of scour at ALL substructure units.

CONTRACTION SCOUR SUSCEPTIBILITY

Channel width upstream: **40-ft**
Channel width under bridge: **N/A**
Channel width ratio (channel width upstream / channel width under the bridge: **N/A**

Overbank flow: ☒ yes ☐ no

Percent of flow in main channel of the approach section:
☐ >90% ☒ 75%-90% ☐ 50%-75% ☐ 25%-50% ☐ <25%

Average bed material size (D_{50}):
@ approach section **0.125 ft (field estimate)** ☐ sample taken from sieve analysis
@ bridge **0.125 ft (field estimate)** ☐ sample taken from sieve analysis

Contraction scour susceptibility rating: ☒ low ☐ medium ☐ high

Comments: **Scour with the proposed structure is unlikely due to the elevation of the substructure and velocities at the structure.**

ABUTMENT SUSCEPTIBILITY

Which abutment is worse? ☐ Left ☐ right

Observed scour depth: Remaining embedment in river bed:

Abutment shape: ☐ vertical ☐ vertical with wingwalls ☐ spillthrough

Abutment location: ☐ in channel ☐ at bank ☐ set back

Abutment foundation: ☐ unknown ☐ spread footing ☐ pile bent
☐ friction piles ☐ EB piles ☐ set in rock

Pile type: ☐ metal ☐ concrete ☐ metal ☐ stone

Pile length: _____ m (ft)

Abutment material; ☐ timber ☐ concrete ☐ metal ☐ stone

Angle of inclination: (degrees)

Primary bed material: ☐ sand ☐ gravel ☐ boulders ☐ manmade
☐ silt/clay ☐ cobble ☐ bedrock

Are borings available? ☐ yes ☐ no

Abutment protection

Type:	☐ modified	☐ intermediate	☐ standard	☐ slope
	☐ concrete	☐ other	☐ absent	☐ none
Permanent or Temporary:		☐ N/A	☐ permanent	☐ temporary
Condition:	☐ good	☐ weathered	☐ slumped	☐ missing
	☐ fair	☐ poor	☐ N/A	

Abutment exposure due to scour:

☐ none ☐ no exposure ☐ footing exposed ☐ piles exposed
☐ undermining ☐ settlement ☐ failed

Abutment susceptibility rating: ☐ low ☐ medium ☐ high

Comments: **No existing abutments**

PIER SUSCEPTIBILITY

Worst pier number: **No Existing Piers**
Observed scour depth: Remaining embedment in river bed:

Angle of attack flood flow: (degrees)

Pier foundation: ☐ unknown ☐ spread footing ☐ pile bent
☐ EB piles ☐ set in rock ☐ friction piles ☐ N/A

Pile type: ☐ metal ☐ concrete ☐ timber ☐ N/A

Pile length: _____

Pier material: ☐ stone ☐ wood ☐ metal ☐ N/A

Pier shape:
☐ solid pier with square nose ☐ solid pier with round nose
☐ solid pier with sharp nose ☐ column with square nose ☐ column with round nose
☐ column with sharp nose ☐ cylinders/group of cylinders

Pier width: _____ Pier dimensions: _____

Cap/Footing dimensions: _____

Pier exposure due to scour: ☐ none ☐ no exposure ☐ footing exposed
☐ piles exposed ☐ undermining ☐ settlement
☐ failed

Pier protection

Type:	☐ modified	☐ intermediate	☐ standard	☐ slope
	☐ concrete	☐ other	☐ absent	☐ none
Permanent or Temporary:		☐ N/A	☐ permanent	☐ temporary
Condition:	☐ good	☐ weathered	☐ slumped	☐ missing
	☐ fair	☐ poor	☐ N/A	

Primary bed material: ☐ sand ☐ gravel ☐ boulders ☐ manmade
☐ silt/clay ☐ cobble ☐ bedrock

Are borings available? ☐ yes ☐ no

Pier susceptibility rating: ☐ low ☐ medium ☐ high

Comments: _____

B. HYDRAULIC DATA

1) Location

a) Town(s): **Thomaston & Watertown** State Project No.(s): _____

b) Highway: **N/A** Station(s): **N/A**

c) Location Relative to Highway Landmark: **Approximately 0.27 miles south of Route 8 crossing over Branch Brook.**

d) Stream: **Branch Brook**

e) Location Relative to Stream Landmark: **Approximately 1,000 ft upstream of the confluence with Naugatuck River.**

2) Design Flood

a) Hydrologic Procedure Used for Design: **FEMA Flood Insurance Study Flows**

b) Hydrologic Procedure Used by FEMA: **log-Pearson Type III**

c) Drainage Area: **22.6 square miles**

d) ConnDOT Drainage Manual Structure Classification: **Large**

e) Design Storm Frequency: **100-Year, Investigate 500-Year**

f) Required Underclearance at Design Discharge: **2 ft**

g) Design Discharge: **900 cfs**

i. D.O.T. Design: **N/A**

ii. FEMA: **900 cfs**

iii. SCEL: **N/A**

3) Hydraulic Analysis Procedure

a) Model Used and Version No.: **HEC-RAS Version 5.0.7**

b) Flow Regime: **Subcritical**

c) Boundary Conditions (starting water surface at the ends of the river system – i.e. known water surface, normal depth, critical depth, rating curve, etc.):

i. Downstream: **Known WSELs**

ii. Upstream: **N/A**

d) Other Method(s): **N/A**

4) Hydraulic Control (i.e.culvert/bridge, dam (weir), channel construction, tide, known water surface elevation, etc.)

a) Type of Control: **Dam**

b) Location Relative to Proposed Construction: **0.5 miles upstream**

5) Coefficients of Roughness

a)	Downstream:	Channel	**0.035**	Overbank	**0.065-0.08**
b)	At Crossing:	Channel	**0.035**	Enclosed Conduit	**N/A**
c)	Upstream:	Channel	**0.035**	Overbank	**0.065-0.08**

6) Existing Structures

Upstream: **Route 8 bridge**

a) Type: **Two-span bridge on concrete abutments with wingwalls aligned with channel**

b) Gross Waterway Opening: **4,040 square feet (dimensions obtained from FEMA backup data)**

At Site: **None**

a) Type: **N/A**

b) Gross Waterway Opening: **N/A**

c) Effective Waterway Opening: **N/A**

d) Overall Width of Waterway Opening: **N/A**

e) Effective Depth of Waterway Opening: **N/A**

f) Minimum Low Chord Elevation: **N/A**

g) Minimum Roadway Elevation: **N/A**

h) Computed Water Surface Elevation at Approach Section Upstream of Structure at Design Discharge:
324.63-ft (Section 200.65)

i) Underclearance at Design Discharge: **N/A**

j) Mean Velocity of Channel: **4.14 ft/s (Approach Section)**

Downstream: **Dirt road crossing**

a) Type: **Clear-span bridge**

b) Gross Waterway Opening: **Approximately 1,120 square feet (dimensions from FEMA backup data)**

7) Proposed Structures

a) Type: **Prefabricated steel truss superstructure on precast concrete abutments**

b) Gross Waterway Opening: **590± sq ft**

c) Effective Waterway Opening: **208± sq ft**

d) Overall Width of Waterway Opening: **60 ft**

e) Effective Depth of Waterway Opening: **6.5 ft**

f) Minimum Low Chord Elevation: **331.25 ft**

g) Minimum Roadway Elevation: **332 ft (Proposed trail elevation)**

h) Computed Water Surface Elevation at Approach Section Upstream of Structure at Design Discharge:
324.63 ft at Section 200.65

i) Maximum Regulatory Elevation: **325.58 ft (natural conditions + 1-ft) calculated at Approach Section 200.65**

j) Other Controlling Water Surface Elevation (If Below Maximum Regulatory Elev.):
Known FEMA WSELs

k) Difference in Water Surface Elevation (Approach Section) Proposed vs. Existing and Proposed vs. Regulatory @ Design Discharge:
At Section 200.65, the Proposed WSEL is 324.63-ft, equivalent to the Existing WSEL, and approximately 0.05-ft higher than the Natural Conditions (324.58 ft). The Proposed WSEL is 0.95-ft below the Regulatory Elevation (Natural plus 1 ft).

l) Underclearance at Design Discharge with Respect to Structure Low Chord:
6.62-ft

m) Mean Velocity Through Structure: **4.40 ft/s – Bridge Open Velocity**

8) Remarks

a) Navigational Requirements: **N/A**

b) Tidal Conditions: **N/A**

c) Record Floods: **August 1955, Over 500-year storm (FIS Report/CT Drainage Manual/NOAA Data)**

d) Average Daily Flow: **39.7 cfs**
$(Q_{AD}(cfs) = [A\ (sm)]^{0.98} * 1.87)$

e) Average Spring Flow: **78.8 cfs**
$(Q_{AS}(cfs) = [A\ (sm)]^{0.988} * 3.62)$

f) Flood Hazard Zone: **Zone A1**

g) Vertical Datum: **NAVD 1988 (FEMA data in NAVD 1929)**

APPENDIX G – HEC-2 BACK-UP DATA

Branch Brook

WATERTOWN (TN) CT
SC 5992

BRANCH BROOK
FLOOD WAY
3/22/79

```
**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED  AUG 1977
  ERROR CORR =  01,02
  MODIFICATION =  50,51,52,53
**************************************************

C
T1      WATERTOWN,CONN,FLOOD INSURANCE STUDY
T2      BRANCH BROOK
T3      100 YEAR FLOOD 0.900 CFS

J1  ICHECK     INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
        0.       2.        0.        0.  0.002000        0.        0.        0.   330.000        0.

J2  NPROF      IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
    1.000         0.    -1.000        0.        0.        0.        0.        0.        0.        0.

J3  VARIABLE CODES FOR SUMMARY PRINTOUT

  200.000   110.000         0.        0.        0.        0.        0.        0.        0.        0.

NC      0.060     0.060     0.035     0.100     0.300     0.        0.        0.        0.        0.
Q1      4.000   900.000   900.000   900.000   900.000     0.        0.        0.        0.        0.
ET      0.        0.       10.400    10.400    10.400     0.        0.        0.        0.        0.

X1    200.000     8.000  1120.000  1230.000     0.        0.        0.        0.        0.        0.
GR    325.000  1000.000   325.000  1120.000   320.000  1140.000   316.000  1190.000   320.000  1200.000
GR    325.000  1220.000   330.000  1230.000   335.000  1520.000     0.        0.        0.        0.
NC      0.        0.        0.        0.300     0.500     0.        0.        0.        0.        0.
ET      0.        0.       10.410    10.510    10.610     0.        0.        0.        0.        0.

                D/S FACE DIRT ROAD

X1    200.100     0.        0.        0.       75.000    20.000   100.000     0.        0.        0.
X3     10.000     0.        0.        0.        0.        0.        0.      330.000   330.000     0.
SB      0.        1.500     2.500    75.000    50.000     0.      260.000     0.      316.000   316.000

                U/S FACE DIRT ROAD

X1    200.200     0.        0.        0.       15.000    15.000    15.000     0.        0.        0.
X2      0.        0.        1.000   330.000   334.400     0.        0.        0.        0.        0.
X3     10.000     0.        0.        0.        0.        0.        0.      334.400   334.400     0.
NC      0.        0.        0.        0.100     0.300     0.        0.        0.        0.        0.

X1    200.200     8.000  1400.000  1510.000    50.000    50.000    50.000     0.        0.        0.
GR    325.000  1000.000   325.000  1400.000   316.000  1430.000   316.000  1480.000   325.000  1500.000
GR    325.000  1510.000   330.000  1700.000   330.000  1800.000     0.        0.        0.        0.
```

GR	337,000	2155,000	337,500	2248,000	333,500	2325,000	327,500	2395,000	324,500	2424,000
GR	324,500	2470,000	328,000	2500,000	343,500	2545,000	353,500	2585,000	365,000	2620,000
X1	202,000	15,000	1663,000	1748,000	920,000	680,000	700,000	0,	0,	0,
X4	2,000	326,000	1692,000	326,000	1720,000	0,	0,	0,	0,	0,
GR	376,000	1315,000	375,000	1430,000	373,500	1528,000	363,500	1605,000	338,500	1663,000
GR	327,500	1690,000	327,500	1724,000	337,000	1748,000	342,500	1785,000	367,700	1838,000
GR	374,000	1897,000	375,000	1963,000	380,000	2040,000	382,000	2100,000	381,300	2210,000
NC	0,	0,	0,	0,300	0,500	0,	0,	0,	0,	0,

D/S FACE RTE 8 BRIDGE

X1	202,100	0,	0,	0,	50,000	50,000	50,000	0,	0,	0,
X3	10,000	0,	0,	0,	0,	0,	0,	381,500	381,500	0,
SB	1,250	1,500	2,500	240,000	90,000	7,000	5700,000	2,500	326,800	326,800

U/S FACE RTE 8 BRIDGE

X1	202,200	0,	0,	0,	100,000	100,000	100,000	0,	0,	0,
X2	0,	0,	1,000	381,500	390,500	0,	0,	0,	0,	0,
X3	10,000	0,	0,	0,	0,	0,	0,	390,500	390,500	0,
NC	0,	0,	0,	0,100	0,300	0,	0,	0,	0,	0,
X1	203,000	15,000	1740,000	1862,000	50,000	50,000	50,000	0,	0,	0,
X4	2,000	328,000	1800,000	328,000	1825,000	0,	0,	0,	0,	0,
GR	389,500	1239,000	384,500	1265,000	384,500	1288,000	392,500	1329,000	399,500	1370,000
GR	392,500	1433,000	390,000	1519,000	385,000	1615,000	373,500	1680,000	353,000	1740,000
GR	329,500	1795,000	329,500	1827,000	337,500	1862,000	353,500	1896,000	367,500	1940,000
X1	204,000	17,000	1685,000	1805,000	1000,000	1020,000	990,000	0,	0,	0,
X4	2,000	334,000	1740,000	334,000	1760,000	0,	0,	0,	0,	0,
GR	374,500	1200,000	374,500	1220,000	373,500	1240,000	352,500	1290,000	344,500	1310,000
GR	348,000	1325,000	343,500	1368,000	337,500	1420,000	339,500	1480,000	342,500	1560,000
GR	342,800	1635,000	342,000	1685,000	335,000	1735,000	335,000	1770,000	344,800	1805,000
GR	347,300	1875,000	349,500	1910,000	0,	0,	0,	0,	0,	0,
X1	205,000	23,000	3425,000	3570,000	1860,000	1600,000	1820,000	0,	0,	0,
X4	2,000	345,700	3480,000	345,700	3500,000	0,	0,	0,	0,	0,
GR	391,500	2580,000	390,300	2630,000	390,300	2670,000	389,000	2725,000	357,500	2855,000
GR	375,000	2920,000	376,500	2960,000	363,500	3010,000	358,500	3093,000	349,700	3168,000
GR	349,500	3260,000	349,700	3345,000	351,300	3425,000	347,300	3475,000	347,300	3505,000
GR	353,000	3570,000	356,000	3635,000	353,500	3700,000	350,500	3735,000	348,500	3840,000
GR	354,500	3875,000	363,500	3930,000	373,500	3980,000	0,	0,	0,	0,
X1	206,000	21,000	2840,000	2965,000	880,000	960,000	910,000	0,	0,	0,
X4	2,000	350,000	2870,000	350,000	2910,000	0,	0,	0,	0,	0,
GR	366,300	2010,000	366,000	2095,000	363,800	2185,000	366,500	2250,000	356,000	2350,000
GR	353,800	2460,000	352,500	2550,000	357,500	2620,000	353,500	2655,000	356,500	2680,000
GR	363,500	2705,000	358,500	2735,000	363,800	2760,000	364,800	2840,000	351,000	2865,000
GR	351,000	2920,000	361,000	2965,000	370,000	3015,000	370,000	3070,000	372,000	3175,000
GR	403,000	3245,000	0,	0,	0,	0,	0,	0,	0,	0,
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0,	0,	0,

D/S FACE RTE 6 BRIDGE

X1	207,100	0,	0,	0,	80,000	80,000	80,000	0,	0,	0,
X3	10,000	0,	0,	0,	0,	0,	0,	368,700	368,700	0,
SB	0,	1,500	2,500	150,000	60,000	0,	900,000	0,	354,100	354,100

U/S FACE RTE 6 BRIDGE

X1	207,200	0,	0,	0,	35,000	35,000	35,000	0,	0,	0,
X2	0,	0,	1,000	368,700	373,500	0,	0,	0,	0,	0,
X3	10,000	0,	0,	0,	0,	0,	0,	373,500	373,500	0,
NC	0,	0,	0,	0,100	0,300	0,	0,	0,	0,	0,

X1	208,000	25,000	2670,000	2810,000	45,000	45,000	45,000	0,	0,	0,
X4	2,000	354,500	2745,000	354,500	2770,000	0,	0,	0,	0,	0,
GR	386,500	2310,000	384,500	2380,000	385,700	2460,000	381,800	2535,000	378,500	2585,000
GR	373,500	2635,000	369,500	2670,000	355,500	2740,000	355,500	2775,000	362,800	2810,000
GR	362,500	2865,000	362,500	2940,000	361,500	3000,000	364,000	3050,000	364,000	3080,000
GR	362,500	3140,000	363,000	3235,000	362,500	3300,000	361,500	3360,000	359,500	3400,000
GR	361,500	3430,000	372,500	3485,000	378,500	3555,000	381,500	3620,000	399,000	3705,000

X1	209,000	25,000	2150,000	2265,000	1200,000	1050,000	1110,000	0,	0,	0,
X3	10,000	0,	0,	0,	0,	0,	0,	0,	0,	0,
X4	2,000	361,000	2170,000	361,000	2200,000	0,	0,	0,	0,	0,
GR	383,000	1390,000	380,500	1490,000	377,500	1605,000	375,500	1695,000	374,500	1785,000
GR	373,000	1850,000	362,000	1880,000	362,000	1940,000	372,500	1965,000	363,500	2000,000
GR	374,500	2030,000	362,500	2055,000	362,500	2130,000	374,300	2150,000	366,500	2165,000
GR	366,500	2205,000	370,500	2265,000	371,000	2370,000	370,500	2455,000	369,500	2560,000
GR	369,300	2645,000	372,000	2730,000	375,500	2810,000	383,500	2850,000	387,300	2920,000

X1	210,000	15,000	1735,000	1880,000	1550,000	1650,000	1600,000	0,	0,	0,
X4	1,000	376,000	1840,000	0,	0,	0,	0,	0,	0,	0,
GR	433,500	1340,000	423,500	1405,000	413,500	1560,000	411,500	1640,000	408,800	1735,000
GR	379,500	1830,000	393,500	1880,000	388,000	1930,000	392,500	1985,000	453,500	2080,000
GR	463,700	2130,000	474,500	2170,000	495,700	2230,000	490,000	2285,000	493,500	2330,000

X1	211,000	15,000	1588,000	1690,000	600,000	300,000	500,000	0,	0,	0,
GR	553,500	1350,000	542,000	1395,000	531,500	1445,000	522,000	1500,000	522,000	1520,000
GR	497,500	1588,000	488,700	1640,000	492,700	1690,000	503,500	1780,000	513,700	1863,000
GR	523,700	1945,000	533,500	2020,000	539,500	2090,000	539,500	2178,000	539,500	2301,000

50 FEET U/S BLACK ROCK DAM

X1	211,100	6,000	1062,000	1204,000	50,000	50,000	50,000	0,	0,	0,
X3	10,000	0,	0,	0,	0,	0,	0,	0,	0,	0,
X5	4,000	525,000	525,000	525,000	525,000	0,	0,	0,	0,	0,
GR	540,700	1000,000	540,700	1060,000	519,600	1062,000	519,600	1202,000	540,700	1204,000
GR	560,000	1210,000	0,	0,	0,	0,	0,	0,	0,	0,
QT	4,000	7600,000	7600,000	7600,000	7600,000	0,	0,	0,	0,	0,

JUST U/S WIGWAM DAM

X1	218,100	5,000	1200,000	1360,000	8800,000	8400,000	9540,000	0,	0,	0,
GR	570,000	1000,000	561,600	1200,000	561,600	1360,000	571,000	1361,000	571,000	1400,000

GR	569,000	1061,000	570,000	1100,000	569,300	1130,000	560,500	1160,000	560,500	2615,000
GR	564,000	2670,000	564,500	2722,000	567,500	2798,000	0,	0,	0,	0,
X1	219,100	8,000	1050,000	1420,000	4000,000	3600,000	3770,000	0,	0,	0,
GR	575,000	1000,000	570,000	1030,000	565,000	1050,000	553,500	1100,000	553,500	1400,000
GR	565,000	1420,000	570,000	1500,000	575,000	1560,000	0,	0,	0,	0,
NC	0,	0,	0,	0,300	0,500	0,	0,	0,	0,	0,

D/S FACE FOOTBRIDGE

X1	219,200	0,	0,	0,	100,000	100,000	100,000	0,	0,	0,
X3	10,000	0,	0,	0,	0,	0,	0,	566,600	566,600	0,
SR	0,	1,500	2,500	300,000	65,000	0,	800,000	0,	553,500	553,500

U/S FACE FOOTBRIDGE

X1	219,300	0,	0,	0,	15,000	15,000	15,000	0,	0,	0,
X2	0,	0,	1,000	566,600	568,800	0,	0,	0,	0,	0,
X3	10,000	0,	0,	0,	0,	0,	0,	568,800	568,800	0,
NC	0,	0,	0,	0,100	0,300	0,	0,	0,	0,	0,
X1	220,000	15,000	1290,000	2230,000	700,000	45,000	285,000	0,	0,	0,
X4	2,000	554,000	1350,000	554,000	2150,000	0,	0,	0,	0,	0,
GR	640,000	1000,000	627,500	1049,000	613,500	1100,000	592,000	1160,000	588,000	1200,000
GR	588,000	1230,000	580,000	1260,000	571,500	1290,000	560,500	1335,000	560,500	2160,000
GR	569,500	2230,000	571,500	2270,000	575,500	2335,000	576,300	2395,000	600,000	2555,000

200 FEET U/S CORPORATE LIMITS

X1	221,000	13,000	1320,000	1555,000	1650,000	2350,000	2230,000	0,	0,	0,
X4	2,000	558,000	1350,000	558,000	1500,000	0,	0,	0,	0,	0,
GR	642,500	1000,000	621,500	1060,000	605,500	1130,000	572,500	1275,000	570,000	1290,000
GR	569,500	1320,000	560,500	1340,000	560,500	1510,000	568,500	1555,000	569,500	1580,000
GR	569,700	1630,000	571,500	1705,000	575,500	1765,000	0,	0,	0,	0,
EJ	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,

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**************************************************
 HEC2 RELEASE DATED NOV 76 UPDATED  AUG1977
 ERROR CORR =  01,02
 MODIFICATION =  30,51,52,53
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T1      WATERTOWN,CONN,FLOOD INSURANCE STUDY
T2      BRANCH BROOK
T3      FLOODWAY METHOD 4

J1  ICHECK    INQ      NINV     IDIR     STRT     METRIC   AVINS    Q        WSEL     FQ
        0,       3,       0,       0,  0,           0,       0,       0,  322,600      0,

J2  NPROF     IPLOT    PRFVS    XSECV    XSECH    FN       ALLDC    IBW      CHNIM    ITRACE
    15,000       0,   -1,000       0,       0,       0,       0,       0,       0,       0,
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	SECNO	CHSEL	DIFKHS	EG	TOPWID	QLOB	QCH	QROB	PERENC	STENCL	STCHL	STCH
	207,100	357,60	0,	357,86	95,41	0,	900,00	0,	0,	0,	2720,00	2880
	207,100	357,59	-0,01	357,85	95,30	0,	900,00	0,	0,	2720,00	2720,00	2880
	207,200	357,73	0,	357,97	97,96	0,	900,00	0,	0,	0,	2720,00	2880
	207,200	357,73	-0,01	357,96	97,83	0,	900,00	0,	0,	2720,00	2720,00	2880
	208,000	357,50	0,	358,38	54,56	0,	900,00	0,	0,	0,	2670,00	2810
	208,000	357,49	-0,01	358,38	54,48	0,	900,00	0,	0,	2670,00	2670,00	2810
	209,000	365,17	0,	365,80	37,58	0,	900,00	0,	0,	0,	2150,00	2265
	209,000	365,18	0,01	365,81	37,59	0,	900,00	0,	0,	2150,00	2150,00	2265
*	210,000	381,93	0,	383,43	31,44	0,	900,00	0,	0,	0,	1735,00	1880
*	210,000	381,93	0,00	383,43	31,44	0,	900,00	0,	0,	1735,00	1735,00	1880
*	211,000	492,27	0,	493,18	65,64	0,	900,00	0,	0,	0,	1588,00	1690
*	211,000	492,27	-0,00	493,18	65,64	0,	900,00	0,	0,00	1588,00	1588,00	1690
*	211,100	525,00	0,	525,02	141,02	0,13	899,87	0,	0,	0,	1062,00	1204
*	211,100	525,00	0,	525,02	140,51	0,	900,00	0,	0,00	1062,00	1062,00	1204
*	218,100	565,50	0,	567,22	253,34	732,35	6866,92	0,73	0,	0,	1200,00	1360
*	218,100	565,71	0,20	567,78	160,00	0,	7600,00	0,	0,12	1200,00	1200,00	1360
	219,000	567,40	0,	567,40	1658,87	0,	7590,64	9,36	0,	0,	1130,00	2670
	219,000	567,99	0,60	567,99	1535,54	0,	7600,00	0,	0,00	1130,00	1130,00	2670
	219,100	567,38	0,	567,42	417,52	2,14	7589,14	8,72	0,	0,	1050,00	1420
	219,100	567,97	0,60	568,01	370,00	0,	7600,00	0,	0,00	1050,00	1050,00	1420
	219,200	567,38	0,	567,42	417,57	2,15	7589,11	8,74	0,	0,	1050,00	1420
	219,200	567,98	0,60	568,01	370,00	0,	7600,00	0,	0,00	1050,00	1050,00	1420
	219,300	569,29	0,	569,32	455,81	8,17	7558,54	33,29	0,	0,	1050,00	1420
	219,300	567,97	-1,32	568,02	417,57	0,	7600,00	0,	0,	1050,00	1050,00	1420
	220,000	569,32	0,	569,33	929,59	0,	7600,00	0,	0,	0,	1290,00	2230
	220,000	568,02	-1,30	568,03	914,16	0,	7600,00	0,	0,00	1290,00	1290,00	2230
	221,000	569,23	0,	569,42	252,71	0,	7598,41	1,59	0,	0,	1320,00	1555
	221,000	567,90	-1,33	568,16	228,09	0,	7600,00	0,	0,00	1320,00	1320,00	1555

SUMMARY OF ERRORS

CAUTION SECNO= 201,000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 201,000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 201,000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 201,000 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 201,000 PROFILE= 2 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 201,000 PROFILE= 2 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 203,000 PROFILE= 1 CRITICAL DEPTH ASSUMED

FLOODWAY DATA, 100 YEAR FLOOD Q=900 CFS
PROFILE NO, 2

STATION	FLOODWAY WIDTH (FT)	FLOODWAY SECTION AREA	FLOODWAY MEAN VELOCITY	WATER SURFACE ELEVATION WITH FLOODWAY	WITHOUT FLOODWAY	DIFFERENCE
200,000	81,	303,	3,0	322,6	321,6	1,0
200,100	82,	310,	2,9	322,7	321,8	0,9
200,200	82,	311,	2,9	322,7	321,8	0,9
200,300	88,	469,	1,9	322,8	322,0	0,8
201,000	132,	149,	6,1	324,2	324,2	0,
202,000	46,	146,	6,2	330,0	330,0	0,
202,100	48,	163,	5,5	330,3	330,3	0,
202,200	54,	222,	4,1	331,5	330,5	1,0
203,000	43,	102,	8,8	331,1	331,1	0,
204,000	66,	186,	4,8	338,1	338,1	0,
205,000	70,	123,	7,3	349,0	349,0	0,
206,000	72,	218,	4,1	353,7	353,6	0,1
207,000	78,	143,	6,3	356,8	356,7	0,1
207,100	95,	219,	4,1	357,6	357,6	0,
207,200	98,	231,	3,9	357,7	357,7	0,
208,000	54,	119,	7,6	357,5	357,5	0,
209,000	38,	141,	6,4	365,2	365,2	0,
210,000	31,	92,	9,8	381,9	381,9	0,
211,000	66,	117,	7,7	492,3	492,3	0,
211,100	141,	757,	1,2	525,0	525,0	0,
218,100	160,	657,	11,6	565,7	565,5	0,2
219,000	1536,	32010,	0,2	568,0	567,4	0,6
219,100	370,	4953,	1,5	568,0	567,4	0,6
219,200	370,	4954,	1,5	568,0	567,4	0,6
219,300	418,	4555,	1,7	568,1	569,3	-1,2
220,000	914,	11814,	0,6	568,1	569,3	-1,2
221,000	228,	1873,	4,1	568,0	569,2	-1,2

BRANCH BROOK 2
MULTIPLE RUN

W/ REACH DETERMINATION

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**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED  AUG1977
  ERROR CORR =  01,02
  MODIFICATION =  50,51,52,53
**************************************************
C
T1      WATERTOWN,CONN,FLOOD INSURANCE STUDY
T2      BRANCH BROOK
T3      10 YEAR FLOOD  0_800 CFS
J1  ICHECK    INQ      NINV     IDIR      STRT      METRIC    HVINS     Q         HSEL      FQ
        -1,      2,       0,       0,  0,002000      0.        0.        0,   324,000      0,
J2  NPROF     IPLOT    PRFVS    XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
      1.000     0.      -1.000    0.        0.        0.        0.        0.        0.        0.
J3  VARIABLE CODES FOR SUMMARY PRINTOUT
    150.000   202.000   -95.000  135.000     0.        0.        0.        0.        0.        0,
NC      0,060     0,060     0,035     0,100     0,300     0,        0,        0,        0,        0,
QT      4,000   800,000   800,000   900,000  2300,000     0,        0,        0,        0,        0,

X1    200,000     8,000  1120,000  1230,000     0,        0,        0,        0,        0,        0,
GR    325,000  1000,000   325,000  1120,000   320,000  1140,000   316,000  1190,000   320,000  1200,000
GR    325,000  1220,000   330,000  1230,000   335,000  1520,000     0,        0,        0,        0,
NC      0,        0,        0,        0,300     0,500     0,        0,        0,        0,        0,

                D/S FACE DIRT ROAD

X1    200,100     0,        0,        0,        75,000    20,000   100,000     0,        0,        0,
X3     10,000     0,        0,        0,        0,        0,        0,      330,000   330,000     0,
SB      0,        1,500     2,500    75,000    50,000     0,      260,000     0,      316,000   316,000

                U/S FACE DIRT ROAD

X1    200,200     0,        0,        0,        15,000    15,000    15,000     0,        0,        0,
X2      0,        0,        1,000   330,000   334,400     0,        0,        0,        0,        0,
X3     10,000     0,        0,        0,        0,        0,        0,      334,400   334,400     0,
NC      0,        0,        0,        0,100     0,300     0,        0,        0,        0,        0,

X1    200,300     8,000  1400,000  1510,000    50,000    50,000    50,000     0,        0,        0,
GR    330,000  1000,000   325,000  1400,000   316,000  1430,000   316,000  1480,000   325,000  1500,000
GR    330,000  1510,000   335,000  1700,000   340,000  1800,000     0,        0,        0,        0,

X1    201,000    25,000  1548,000  1794,000  1000,000  1400,000  1435,000     0,        0,        0,
      2,000   323,000  1620,000   323,000  1720,000     0,        0,        0,        0,        0,
GR    335,500  1252,000   357,500  1305,000   335,700  1387,000   335,300  1454,000   335,300  1476,000
GR    335,500  1500,000   335,500  1548,000   323,000  1610,000   323,000  1730,000   335,200  1794,000
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X4	2,000	326,000	1692,000	326,000	1720,000	0,	0,	0,	0,	0,
GR	376,000	1315,000	375,000	1430,000	373,500	1528,000	363,500	1605,000	338,500	1663,000
GR	327,500	1690,000	327,500	1724,000	337,000	1748,000	342,500	1785,000	367,700	1838,000
GR	374,000	1897,000	375,000	1963,000	380,000	2040,000	382,000	2100,000	381,300	2210,000
NC	0,	0,	0,	0,300	0,500	0,	0,	0,	0,	0,

D/S FACE RTE 8 BRIDGE

X1	202,100	0,	0,	0,	50,000	50,000	50,000	0,	0,	0,
X3	10,000	0,	0,	0,	0,	0,	0,	381,500	381,500	0,
SB	1,250	1,500	2,500	249,000	90,000	7,000	5700,000	2,500	326,800	326,800

U/S FACE RTE 8 BRIDGE

X1	202,200	0,	0,	0,	100,000	100,000	100,000	0,	0,	0,
X2	0,	0,	1,000	381,500	390,500	0,	0,	0,	0,	0,
X3	10,000	0,	0,	0,	0,	0,	0,	390,500	390,500	0,
NC	0,	0,	0,	0,100	0,300	0,	0,	0,	0,	0,

X1	203,000	15,000	1740,000	1862,000	50,000	50,000	50,000	0,	0,	0,
X4	2,000	328,000	1800,000	328,000	1825,000	0,	0,	0,	0,	0,
GR	389,500	1239,000	384,500	1265,000	384,500	1288,000	392,500	1329,000	399,500	1370,000
GR	392,500	1433,000	390,000	1519,000	385,000	1615,000	373,500	1680,000	353,000	1740,000
GR	329,500	1795,000	329,500	1827,000	337,500	1862,000	353,500	1896,000	367,500	1940,000

X1	204,000	17,000	1685,000	1805,000	1003,000	1020,000	990,000	0,	0,	0,
X4	2,000	334,000	1740,000	334,000	1760,000	0,	0,	0,	0,	0,
GR	374,500	1200,000	374,500	1220,000	373,500	1240,000	352,500	1290,000	344,500	1310,000
GR	348,000	1325,000	343,500	1368,000	337,500	1420,000	339,500	1480,000	342,500	1560,000
GR	342,800	1635,000	342,000	1685,000	335,000	1735,000	335,000	1770,000	344,800	1805,000
GR	347,300	1875,000	349,500	1910,000	0,	0,	0,	0,	0,	0,

X1	205,000	23,000	3425,000	3570,000	1860,000	1600,000	1820,000	0,	0,	0,
X4	2,000	345,700	3480,000	345,700	3500,000	0,	0,	0,	0,	0,
GR	391,500	2580,000	390,300	2630,000	390,300	2670,000	389,000	2725,000	357,500	2855,000
GR	375,000	2920,000	376,500	2960,000	363,500	3010,000	358,500	3093,000	349,700	3168,000
GR	349,500	3260,000	349,700	3345,000	351,300	3425,000	347,300	3475,000	347,300	3505,000
GR	353,000	3570,000	356,000	3635,000	353,500	3700,000	350,500	3735,000	348,500	3840,000
GR	354,500	3875,000	363,500	3930,000	373,500	3980,000	0,	0,	0,	0,

X1	206,000	21,000	2840,000	2965,000	880,000	960,000	910,000	0,	0,	0,
X4	2,000	350,000	2870,000	350,000	2910,000	0,	0,	0,	0,	0,
GR	366,300	2010,000	366,000	2095,000	363,800	2185,000	366,500	2250,000	356,000	2350,000
GR	353,800	2460,000	352,500	2550,000	357,500	2620,000	353,500	2655,000	356,500	2680,000
GR	363,500	2705,000	358,500	2735,000	363,800	2780,000	364,800	2840,000	351,000	2865,000
GR	351,000	2920,000	361,000	2965,000	370,000	3015,000	370,000	3070,000	372,000	3175,000
GR	400,000	3245,000	0,	0,	0,	0,	0,	0,	0,	0,

X1	207,000	9,000	2720,000	2880,000	850,000	850,000	810,000	0,	0,	0,
X4	2,000	354,000	2810,000	354,000	2840,000	0,	0,	0,	0,	0,
GR	383,800	2525,000	361,500	2720,000	355,300	2800,000	355,300	2850,000	359,700	2880,000
GR	359,800	2960,000	363,500	3050,000	367,500	3140,000	368,500	3160,000	0,	0,
NC	0,	0,	0,	0,300	0,500	0,	0,	0,	0,	0,

X3	10,000	0.	0.	0.	0.	0.	0.	366,700	366,700	0.
SB	0.	1,500	2,500	150,000	60,000	0.	900,000	0.	354,100	354,100

U/S FACE RTE 6 BRIDGE

X1	207,200	0.	0.	0.	35,000	35,000	35,000	0.	0.	0.
X2	0.	0.	1,000	368,700	373,500	0.	0.	0.	0.	0.
X3	10,000	0.	0.	0.	0.	0.	0.	373,500	373,500	0.
NC	0.	0.	0.	0.100	0.300	0.	0.	0.	0.	0.
X1	208,000	25,000	2670,000	2810,000	45,000	45,000	45,000	0.	0.	0.
X4	2,000	354,500	2745,000	354,500	2770,000	0.	0.	0.	0.	0.
GR	386,500	2310,000	384,500	2380,000	385,700	2460,000	381,800	2535,000	378,500	2585,000
GR	373,500	2635,000	369,500	2670,000	355,500	2740,000	355,500	2775,000	362,800	2810,000
GR	362,500	2865,000	362,500	2940,000	361,500	3000,000	364,000	3050,000	364,000	3080,000
GR	362,500	3140,000	363,000	3235,000	362,500	3300,000	361,500	3360,000	359,500	3400,000
GR	361,500	3430,000	372,500	3485,000	378,500	3555,000	381,500	3620,000	399,000	3705,000
X1	209,000	25,000	2150,000	2265,000	1200,000	1050,000	1110,000	0.	0.	0.
X3	10,000	0.	0.	0.	0.	0.	0.	0.	0.	0.
X4	2,000	361,000	2170,000	361,000	2200,000	0.	0.	0.	0.	0.
GR	383,000	1390,000	380,500	1490,000	377,500	1605,000	375,500	1695,000	374,500	1785,000
GR	373,000	1850,000	362,000	1880,000	362,000	1940,000	372,500	1965,000	363,500	2000,000
GR	374,500	2030,000	362,500	2055,000	362,500	2130,000	374,300	2150,000	366,500	2165,000
GR	366,500	2205,000	370,500	2265,000	371,000	2370,000	370,500	2455,000	369,500	2560,000
GR	369,300	2645,000	372,000	2730,000	375,500	2810,000	383,500	2850,000	387,300	2920,000
X1	210,000	15,000	1735,000	1880,000	1550,000	1650,000	1600,000	0.	0.	0.
X4	1,000	376,000	1840,000	0.	0.	0.	0.	0.	0.	0.
GR	433,500	1340,000	423,500	1405,000	413,500	1560,000	411,500	1640,000	408,800	1735,000
GR	379,500	1830,000	393,500	1880,000	388,000	1930,000	392,500	1985,000	453,500	2080,000
GR	463,700	2130,000	474,500	2170,000	495,700	2230,000	490,000	2285,000	493,500	2330,000
X1	211,000	15,000	1588,000	1690,000	600,000	300,000	500,000	0.	0.	0.
GR	553,500	1350,000	542,000	1395,000	531,500	1445,000	522,000	1500,000	522,000	1520,000
GR	497,500	1588,000	488,700	1640,000	492,700	1690,000	503,500	1780,000	513,700	1863,000
GR	523,700	1945,000	533,500	2020,000	539,500	2090,000	539,500	2178,000	539,500	2301,000

50 FEET U/S BLACK ROCK DAM

X1	211,100	6,000	1062,000	1204,000	50,000	50,000	50,000	0.	0.	0.
X3	10,000	0.	0.	0.	0.	0.	0.	0.	0.	0.
X5	4,000	525,000	525,000	525,000	525,000	0.	0.	0.	0.	0.
GR	540,700	1000,000	540,700	1060,000	519,600	1062,000	519,600	1202,000	540,700	1204,000
GR	560,000	1210,000	0.	0.	0.	0.	0.	0.	0.	0.
GT	4,000	2200,000	5300,000	7600,000	16500,000	0.	0.	0.	0.	0.

JUST U/S WIGWAM DAM

X1	218,100	5,000	1200,000	1360,000	8800,000	8400,000	9540,000	0.	0.	0.
GR	570,000	1000,000	561,600	1200,000	561,600	1360,000	571,000	1361,000	571,000	1400,000
X1	219,000	3,000	1130,000	2670,000	450,000	2060,000	410,000	0.	0.	0.
X5	2,000	540,000	540,000	540,000	2500,000	0.	0.	0.	0.	0.

X1	219,100	8,000	1050,000	1420,000	4000,000	3600,000	3770,000	0,	0,	0,
GR	575,000	1000,000	570,000	1030,000	565,000	1050,000	553,500	1100,000	553,500	1400,000
GR	565,000	1420,000	570,000	1500,000	575,000	1560,000	0,	0,	0,	0,
NC	0,	0,	0,	0,300	0,500	0,	0,	0,	0,	0,

D/S FACE FOOTBRIDGE

X1	219,200	0,	0,	0,	100,000	100,000	100,000	0,	0,	0,
X3	10,000	0,	0,	0,	0,	0,	0,	566,600	566,600	0,
SB	0,	1,500	2,500	300,000	65,000	0,	800,000	0,	553,500	553,500

U/S FACE FOOTBRIDGE

X1	219,300	0,	0,	0,	15,000	15,000	15,000	0,	0,	0,
X2	0,	0,	1,000	566,600	568,800	0,	0,	0,	0,	0,
X3	10,000	0,	0,	0,	0,	0,	0,	568,800	568,800	0,
NC	0,	0,	0,	0,100	0,300	0,	0,	0,	0,	0,

X1	220,000	15,000	1290,000	2230,000	700,000	45,000	285,000	0,	0,	0,
X4	2,000	554,000	1350,000	554,000	2150,000	0,	0,	0,	0,	0,
GR	640,000	1000,000	627,500	1049,000	613,500	1100,000	592,000	1160,000	588,000	1200,000
GR	588,000	1230,000	580,000	1260,000	571,500	1290,000	560,500	1335,000	560,500	2160,000
GR	569,500	2230,000	571,500	2270,000	575,500	2335,000	576,300	2395,000	600,000	2555,000

200 FEET U/S CORPORATE LIMITS

X1	221,000	13,000	1320,000	1555,000	1650,000	2350,000	2230,000	0,	0,	0,
X4	2,000	558,000	1350,000	558,000	1500,000	0,	0,	0,	0,	0,
GR	642,500	1000,000	621,500	1060,000	605,500	1130,000	572,500	1275,000	570,000	1290,000
GR	569,500	1320,000	560,500	1340,000	560,500	1510,000	568,500	1555,000	569,500	1580,000
GR	569,700	1630,000	571,500	1705,000	575,500	1765,000	0,	0,	0,	0,
EJ	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,

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**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED  AUG1977
  ERROR CORR =  01,02
  MODIFICATION =  50,51,52,53
**************************************************

T1      WATERTOWN,CONN,FLOOD INSURANCE STUDY
T2      BRANCH BROOK
T3      50 YEAR FLOOD  Q=800 CFS

J1  ICHECK     INQ       NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0.       3.        0.        0.   0.002000       0.        0.        0.   328.000       0.
J2  NPROF      IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
    2.000       0.       -1.000     0.        0.        0.        0.        0.        0.        0.
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**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED  AUG1977
  ERROR CORR =  01,02
  MODIFICATION =  50,51,52,53
**************************************************

T1      WATERTOWN,CONN,FLOOD INSURANCE STUDY
T2      BRANCH BROOK
T3      100 YEAR FLOOD 9,900 CFS

J1  ICHECK    INQ      NINV     IDIR     STRT     METRIC   HVINS    Q        WSEL     FQ
        0,       4,       0,       0,  0,002000     0,       0,       0,  330,000      0,
J2  NPROF     IPLOT    PRFVS    XSECV    XSECH    FN       ALLDC    IBW      CHNIM    ITRACE
    3,000        0,      -1,000    0,       0,       0,       0,       0,       0,       0,
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**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED  AUG1977
  ERROR CORR =  01,02
  MODIFICATION =  50,51,52,53
**************************************************

T1      WATERTOWN,CONN,FLOOD INSURANCE STUDY
T2      BRANCH BROOK
T3      500 YEAR FLOOD Q=2300 CFS

J1  ICHECK    INQ      NINV      IDIR      STRT      METRIC    HVINS     Q         WSEL      FQ
       0,       5,        0,        0,  0,002000       0,        0,        0,  332,000       0,

J2  NPROF     IPLOT     PRFVS     XSECV     XSECH     FN        ALLDC     IBW       CHNIM     ITRACE
    15,000       0,     -1,000       0,        0,        0,        0,        0,        0,        0,
```

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**************************************************
  HEC2 RELEASE DATED NOV 76 UPDATED  AUG1977
  ERROR CORR =  01,02
  MODIFICATION =  50,51,52,53
**************************************************

NOTE= ASTERISK (*) AT LEFT OF CROSS-SECTION NUMBER INDICATES MESSAGE IN SUMMARY OF ERRORS LIST

10 YEAR FLOOD  Q=800 CFS
SUMMARY PRINTOUT TABLE  150
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	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA
A	200.000	0.	0.	0.	316.00	800.00	321.36	0.	321.58	19.77	3.83	208
	200.000	0.	0.	0.	316.00	800.00	321.34	0.	321.57	19.99	3.85	207
	200.000	0.	0.	0.	316.00	900.00	321.59	0.	321.84	19.93	3.99	225
	200.000	0.	0.	0.	316.00	2300.00	324.15	0.	324.58	19.99	5.25	437
	200.100	100.00	0.	0.	316.00	800.00	321.57	0.	321.77	16.06	3.57	224
	200.100	100.00	0.	0.	316.00	800.00	321.56	0.	321.76	16.19	3.58	223
	200.100	100.00	0.	0.	316.00	900.00	321.82	0.	322.03	16.31	3.72	242
	200.100	100.00	0.	0.	316.00	2300.00	324.39	0.	324.78	17.37	4.99	460
	200.200	15.00	334.40	330.00	316.00	800.00	321.60	0.	321.80	15.65	3.53	226
	200.200	15.00	334.40	330.00	316.00	800.00	321.59	0.	321.79	15.77	3.54	225
	200.200	15.00	334.40	330.00	316.00	900.00	321.84	0.	322.06	15.91	3.68	244
	200.200	15.00	334.40	330.00	316.00	2300.00	324.42	0.	324.80	17.06	4.96	463
B	200.300	50.00	0.	0.	316.00	800.00	321.77	0.	321.84	3.26	2.10	381
	200.300	50.00	0.	0.	316.00	800.00	321.76	0.	321.83	3.28	2.10	380
	200.300	50.00	0.	0.	316.00	900.00	322.02	0.	322.10	3.54	2.24	401
	200.300	50.00	0.	0.	316.00	2300.00	324.67	0.	324.87	6.06	3.58	642
C *	201.000	1435.00	0.	0.	323.00	800.00	324.09	324.09	324.62	178.28	5.84	137
*	201.000	1435.00	0.	0.	323.00	800.00	324.09	324.09	324.62	178.29	5.84	137
	201.000	1435.00	0.	0.	323.00	900.00	324.18	324.18	324.75	174.05	6.06	148
	201.000	1435.00	0.	0.	323.00	2300.00	326.25	0.	326.57	30.58	4.76	550
	202.000	700.00	0.	0.	326.00	800.00	329.76	0.	330.30	46.12	5.87	136
	202.000	700.00	0.	0.	326.00	800.00	329.76	0.	330.30	46.12	5.87	136
D *	202.000	700.00	0.	0.	326.00	900.00	329.97	0.	330.56	48.32	6.18	145
	202.000	700.00	0.	0.	326.00	2300.00	331.15	331.15	333.13	121.51	11.29	203
	202.100	50.00	0.	0.	326.00	800.00	330.09	0.	330.52	34.07	5.28	151
	202.100	50.00	0.	0.	326.00	800.00	330.09	0.	330.52	34.07	5.28	151
	202.100	50.00	0.	0.	326.00	900.00	330.32	0.	330.80	35.30	5.54	162
	202.100	50.00	0.	0.	326.00	2300.00	332.87	0.	333.78	40.92	7.65	300
	202.200	100.00	390.50	381.50	326.00	800.00	330.24	0.	330.64	29.92	5.05	158
	202.200	100.00	390.50	381.50	326.00	800.00	330.24	0.	330.64	29.92	5.05	158
	202.200	100.00	390.50	381.50	326.00	900.00	330.49	0.	330.93	30.73	5.28	170
	202.200	100.00	390.50	381.50	326.00	2300.00	333.19	0.	333.99	34.14	7.17	320

		SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA
E	*	203.000	50.00	0.	0.	328.00	800.00	330.88	330.88	332.02	142.62	8.57	93
	*	203.000	50.00	0.	0.	328.00	800.00	330.88	330.88	332.02	142.62	8.57	93
	*	203.000	50.00	0.	0.	328.00	900.00	331.09	331.09	332.30	139.93	8.82	102
	*	203.000	50.00	0.	0.	328.00	2300.00	333.27	333.27	335.11	121.32	10.91	210
F		204.000	990.00	0.	0.	334.00	800.00	337.86	0.	338.19	34.11	4.67	173
		204.000	990.00	0.	0.	334.00	800.00	337.86	0.	338.19	34.11	4.67	173
		204.000	990.00	0.	0.	334.00	900.00	338.08	0.	338.44	34.15	4.82	192
		204.000	990.00	0.	0.	334.00	2300.00	340.18	0.	340.65	30.86	5.79	492
G		205.000	1820.00	0.	0.	345.70	800.00	348.78	348.77	349.59	144.81	7.21	113
		205.000	1820.00	0.	0.	345.70	800.00	348.78	348.77	349.59	144.81	7.21	113
	*	205.000	1820.00	0.	0.	345.70	900.00	348.96	348.96	349.78	138.86	7.26	129
	*	205.000	1820.00	0.	0.	345.70	2300.00	350.37	350.37	351.02	93.02	7.24	497
H		206.000	910.00	0.	0.	350.00	800.00	353.43	0.	353.66	21.04	3.87	236
		206.000	910.00	0.	0.	350.00	800.00	353.43	0.	353.66	21.04	3.87	236
		206.000	910.00	0.	0.	350.00	900.00	353.62	0.	353.86	21.48	4.03	265
		206.000	910.00	0.	0.	350.00	2300.00	355.02	0.	355.43	29.60	5.72	589
I		207.000	810.00	0.	0.	354.00	800.00	356.47	0.	357.12	113.71	6.43	124
		207.000	810.00	0.	0.	354.00	800.00	356.47	0.	357.12	113.71	6.43	124
		207.000	810.00	0.	0.	354.00	900.00	356.66	0.	357.32	108.19	6.51	138
		207.000	810.00	0.	0.	354.00	2300.00	358.45	0.	359.32	81.38	7.48	307
		207.100	80.00	0.	0.	354.00	800.00	357.42	0.	357.66	30.39	3.95	202
		207.100	80.00	0.	0.	354.00	800.00	357.42	0.	357.66	30.39	3.95	202
		207.100	80.00	0.	0.	354.00	900.00	357.60	0.	357.86	30.94	4.10	219
		207.100	80.00	0.	0.	354.00	2300.00	359.39	0.	359.85	35.01	5.46	420
		207.200	35.00	373.50	368.70	354.00	800.00	357.55	0.	357.77	26.03	3.73	214
		207.200	35.00	373.50	368.70	354.00	800.00	357.55	0.	357.77	26.03	3.73	214
		207.200	35.00	373.50	368.70	354.00	900.00	357.73	0.	357.97	26.63	3.88	231
		207.200	35.00	373.50	368.70	354.00	2300.00	359.56	0.	359.98	30.28	5.18	444
J		208.000	45.00	0.	0.	354.50	800.00	357.35	0.	358.15	106.96	7.16	111
		208.000	45.00	0.	0.	354.50	800.00	357.35	0.	358.15	106.96	7.16	111
		208.000	45.00	0.	0.	354.50	900.00	357.50	0.	358.38	112.41	7.53	119
	*	208.000	45.00	0.	0.	354.50	2300.00	359.19	359.19	360.80	125.99	10.20	225
K		209.000	1110.00	0.	0.	361.00	800.00	364.87	0.	365.46	44.37	6.16	129
		209.000	1110.00	0.	0.	361.00	800.00	364.87	0.	365.46	44.37	6.16	129
		209.000	1110.00	0.	0.	361.00	900.00	365.17	0.	365.80	44.08	6.39	140
		209.000	1110.00	0.	0.	361.00	2300.00	368.50	0.	369.38	51.44	7.50	306
L	*	210.000	1600.00	0.	0.	376.00	800.00	381.66	381.66	383.09	143.33	9.61	83
	*	210.000	1600.00	0.	0.	376.00	800.00	381.66	381.66	383.09	143.33	9.61	83
	*	210.000	1600.00	0.	0.	376.00	900.00	381.93	381.93	383.43	140.87	9.83	91
	*	210.000	1600.00	0.	0.	376.00	2300.00	384.63	384.63	386.76	120.65	11.69	196
M	*	211.000	500.00	0.	0.	488.70	800.00	492.10	492.10	492.98	155.56	7.51	106
	*	211.000	500.00	0.	0.	488.70	800.00	492.10	492.10	492.98	155.56	7.51	106
	*	211.000	500.00	0.	0.	488.70	900.00	492.27	492.27	493.18	153.13	7.69	117
	*	211.000	500.00	0.	0.	488.70	2300.00	493.85	493.85	495.31	125.86	9.71	241

	SECNO	XLCH	ELTRD	ELLC	ELMIN	Q	CWSEL	CRIWS	EG	10K*S	VCH	AREA
*	211.100	50.00	0.	0.	519.60	800.00	525.00	0.	525.02	0.69	1.06	758
*	211.100	50.00	0.	0.	519.60	800.00	525.00	0.	525.02	0.69	1.06	758
*	211.100	50.00	0.	0.	519.60	900.00	525.00	0.	525.02	0.87	1.19	758
*	211.100	50.00	0.	0.	519.60	2300.00	525.00	0.	525.14	5.66	3.04	758
*	218.100	9540.00	0.	0.	561.60	2200.00	563.36	563.36	564.19	146.29	7.47	317
*	218.100	9540.00	0.	0.	561.60	5300.00	564.70	564.70	566.10	118.48	9.83	611
*	218.100	9540.00	0.	0.	561.60	7600.00	565.50	565.50	567.22	109.16	11.00	806
	218.100	9540.00	0.	0.	561.60	16500.00	568.02	567.93	570.54	86.65	13.66	1520
	219.000	410.00	0.	0.	546.00	2200.00	564.27	0.	564.27	0.00	0.08	26325
	219.000	410.00	0.	0.	546.00	5300.00	566.24	0.	566.25	0.00	0.18	29475
	219.000	410.00	0.	0.	546.00	7600.00	567.40	0.	567.40	0.01	0.24	31366
	219.000	410.00	0.	0.	546.00	16500.00	570.80	0.	570.80	0.02	0.45	37116
	219.100	3770.00	0.	0.	553.50	2200.00	564.27	0.	564.27	0.10	0.61	3583
	219.100	3770.00	0.	0.	553.50	5300.00	566.23	0.	566.26	0.32	1.23	4323
	219.100	3770.00	0.	0.	553.50	7600.00	567.38	0.	567.42	0.48	1.60	4788
	219.100	3770.00	0.	0.	553.50	16500.00	570.74	0.	570.85	1.03	2.73	6304
	219.200	100.00	0.	0.	553.50	2200.00	564.27	0.	564.28	0.10	0.61	3583
	219.200	100.00	0.	0.	553.50	5300.00	566.24	0.	566.26	0.32	1.23	4309
	219.200	100.00	0.	0.	553.50	7600.00	567.38	0.	567.42	0.48	1.60	4789
	219.200	100.00	0.	0.	553.50	16500.00	570.75	0.	570.86	1.03	2.73	6306
	219.300	15.00	568.80	566.60	553.50	2200.00	564.27	0.	564.28	0.10	0.61	3583
	219.300	15.00	568.80	566.60	553.50	5300.00	566.24	0.	566.26	0.32	1.23	4309
	219.300	15.00	568.80	566.60	553.50	7600.00	569.29	0.	569.32	0.30	1.39	5624
	219.300	15.00	568.80	566.60	553.50	16500.00	573.50	0.	573.58	0.59	2.30	7708
	220.000	285.00	0.	0.	554.00	2200.00	564.28	0.	564.28	0.02	0.26	8478
	220.000	285.00	0.	0.	554.00	5300.00	566.26	0.	566.27	0.06	0.52	10225
	220.000	285.00	0.	0.	554.00	7600.00	569.32	0.	569.33	0.06	0.58	13012
	220.000	285.00	0.	0.	554.00	16500.00	573.58	0.	573.59	0.11	0.97	17180
	221.000	2230.00	0.	0.	558.00	2200.00	564.25	0.	564.31	2.36	2.01	1091
	221.000	2230.00	0.	0.	558.00	5300.00	566.17	0.	566.37	5.37	3.56	1489
	221.000	2230.00	0.	0.	558.00	7600.00	569.23	0.	569.42	3.50	3.48	2188
	221.000	2230.00	0.	0.	558.00	16500.00	573.41	0.	573.77	4.35	4.97	3045

10 YEAR FLOOD Q=500 CFS
SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH	
A	200,000	800,00	321,36	0,	0,	-2,64	70,84	0,	100' FROM MOUTH
	200,000	800,00	321,34	-0,01	0,	-6,66	70,75	0,	
	200,000	900,00	321,59	0,25	0,	-8,41	72,75	0,	
	200,000	2300,00	324,15	2,56	0,	-7,85	93,20	0,	
	200,100	800,00	321,57	0,	0,22	0,	72,59	100,00	
	200,100	800,00	321,56	-0,01	0,22	0,	72,52	100,00	
	200,100	900,00	321,82	0,25	0,22	0,	74,53	100,00	
	200,100	2300,00	324,39	2,57	0,24	0,	95,12	100,00	
	200,200	800,00	321,60	0,	0,03	0,	72,81	15,00	
	200,200	800,00	321,59	-0,01	0,03	0,	72,74	15,00	
	200,200	900,00	321,84	0,25	0,03	0,	74,76	15,00	
	200,200	2300,00	324,42	2,58	0,03	0,	95,38	15,00	
B	200,300	800,00	321,77	0,	0,17	0,	82,06	50,00	
	200,300	800,00	321,76	-0,01	0,17	0,	82,02	50,00	
	200,300	900,00	322,02	0,26	0,18	0,	83,47	50,00	
	200,300	2300,00	324,67	2,65	0,25	0,	98,17	50,00	
C *	201,000	800,00	324,09	0,	2,32	0,	131,01	1435,00	
*	201,000	800,00	324,09	-0,00	2,33	0,	131,01	1435,00	
*	201,000	900,00	324,18	0,09	2,16	0,	131,89	1435,00	
	201,000	2300,00	326,25	2,07	1,57	0,	230,55	1435,00	
	202,000	800,00	329,76	0,	5,67	0,	45,28	700,00	
	202,000	800,00	329,76	0,00	5,67	0,	45,28	700,00	
D *	202,000	900,00	329,97	0,20	5,79	0,	46,29	700,00	
	202,000	2300,00	331,15	1,18	4,90	0,	52,17	700,00	
	202,100	800,00	330,09	0,	0,33	0,	46,92	50,00	
	202,100	800,00	330,09	0,00	0,33	0,	46,92	50,00	
	202,100	900,00	330,32	0,23	0,36	0,	48,08	50,00	
	202,100	2300,00	332,87	2,54	1,72	0,	60,72	50,00	
	202,200	800,00	330,24	0,	0,15	0,	47,67	100,00	
	202,200	800,00	330,24	0,00	0,15	0,	47,67	100,00	
	202,200	900,00	330,49	0,25	0,17	0,	48,91	100,00	
	202,200	2300,00	333,19	2,70	0,33	0,	62,36	100,00	
E *	203,000	800,00	330,88	0,	0,64	0,	41,27	50,00	
*	203,000	800,00	330,88	0,	0,64	0,	41,27	50,00	
*	203,000	900,00	331,09	0,21	0,60	0,	42,67	50,00	
*	203,000	2300,00	333,27	2,18	0,07	0,	57,29	50,00	
F	204,000	800,00	337,86	0,	6,98	0,	79,43	990,00	
	204,000	800,00	337,86	0,	6,98	0,	79,43	990,00	
	204,000	900,00	338,08	0,23	6,99	0,	90,33	990,00	
	204,000	2300,00	340,18	2,10	6,92	0,	192,23	990,00	
G	205,000	800,00	348,78	0,	10,93	0,	81,87	1820,00	
	205,000	800,00	348,78	0,	10,93	0,	81,87	1820,00	
*	205,000	900,00	348,96	0,18	10,88	0,	96,88	1820,00	

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
	206,000	800,00	353,43	0,	4,65	0,	148,27	910,00
	206,000	800,00	353,43	0,	4,65	0,	148,27	910,00
H	206,000	900,00	353,62	0,19	4,65	0,	166,59	910,00
	206,000	2300,00	355,02	1,40	4,65	0,	292,58	910,00
	207,000	800,00	356,47	0,	3,04	0,	73,18	810,00
	207,000	800,00	356,47	0,	3,04	0,	73,18	810,00
I	207,000	900,00	356,66	0,18	3,04	0,	76,80	810,00
	207,000	2300,00	358,45	1,79	3,43	0,	112,15	810,00
	207,100	800,00	357,42	0,	0,94	0,	91,83	80,00
	207,100	800,00	357,42	0,	0,94	0,	91,83	80,00
	207,100	900,00	357,60	0,18	0,94	0,	95,41	80,00
	207,100	2300,00	359,39	1,79	0,94	0,	130,57	80,00
	207,200	800,00	357,55	0,	0,13	0,	94,36	35,00
	207,200	800,00	357,55	0,	0,13	0,	94,36	35,00
	207,200	900,00	357,73	0,18	0,14	0,	97,96	35,00
	207,200	2300,00	359,56	1,83	0,18	0,	134,07	35,00
	208,000	800,00	357,35	0,	-0,20	0,	53,17	45,00
J	208,000	800,00	357,35	0,	-0,20	0,	53,17	45,00
	208,000	900,00	357,50	0,14	-0,24	0,	54,56	45,00
*	208,000	2300,00	359,19	1,69	-0,38	0,	71,10	45,00
	209,000	800,00	364,87	0,	7,52	0,	37,05	1110,00
	209,000	800,00	364,87	0,	7,52	0,	37,05	1110,00
K	209,000	900,00	365,17	0,30	7,67	0,	37,58	1110,00
	209,000	2300,00	368,50	3,34	9,32	0,	73,92	1110,00
*	210,000	800,00	381,66	0,	16,79	0,	29,94	1600,00
*	210,000	800,00	381,66	0,	16,79	0,	29,94	1600,00
L *	210,000	900,00	381,93	0,27	16,76	0,	31,44	1600,00
*	210,000	2300,00	384,63	2,70	16,13	0,	46,37	1600,00
*	211,000	800,00	492,10	0,	110,44	0,	62,62	500,00
*	211,000	800,00	492,10	0,	110,44	0,	62,62	500,00
M *	211,000	900,00	492,27	0,16	110,33	0,	65,64	500,00
*	211,000	2300,00	493,85	1,58	109,22	0,	90,00	500,00
*	211,100	800,00	525,00	0,	32,90	0,	141,02	50,00
*	211,100	800,00	525,00	0,	32,90	0,	141,02	50,00
*	211,100	900,00	525,00	0,	32,73	0,	141,02	50,00
*	211,100	2300,00	525,00	0,	31,15	0,	141,02	50,00
*	218,100	2200,00	563,36	0,	38,36	0,	201,99	9540,00
N *	218,100	5300,00	564,70	1,35	39,70	0,	234,25	9540,00
*	218,100	7600,00	565,50	0,80	40,50	0,	253,34	9540,00
	218,100	16500,00	568,02	2,52	43,02	0,	313,61	9540,00
	219,000	2200,00	564,27	0,	0,92	0,	1551,12	410,00
O	219,000	5300,00	566,24	1,97	1,54	0,	1625,78	410,00
	219,000	7600,00	567,40	1,15	1,89	0,	1658,87	410,00
	219,000	16500,00	570,80	3,40	2,77	0,	1737,00	410,00

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
219,100	2200,00	564,27	0,	=0,00	0,	365,55	3770,00
219,100	5300,00	566,23	1,96	=0,01	0,	394,66	3770,00
219,100	7600,00	567,38	1,14	=0,02	0,	417,52	3770,00
219,100	16500,00	570,74	3,36	=0,06	0,	483,29	3770,00
219,200	2200,00	564,27	0,	0,00	0,	365,55	100,00
219,200	5300,00	566,24	1,97	0,00	0,	370,00	100,00
219,200	7600,00	567,38	1,14	0,00	0,	417,57	100,00
219,200	16500,00	570,75	3,37	0,01	0,	483,38	100,00
219,300	2200,00	564,27	0,	0,00	0,	365,56	15,00
219,300	5300,00	566,24	1,97	0,00	0,	370,00	15,00
219,300	7600,00	569,29	3,05	1,91	0,	455,81	15,00
219,300	16500,00	573,50	4,21	2,75	0,	533,04	15,00
220,000	2200,00	564,28	0,	0,01	0,	869,79	285,00
220,000	5300,00	566,26	1,98	0,02	0,	893,30	285,00
220,000	7600,00	569,32	3,06	0,03	0,	929,59	285,00
220,000	16500,00	573,58	4,26	0,08	0,	1021,15	285,00
221,000	2200,00	564,25	0,	=0,03	0,	199,40	2230,00
221,000	5300,00	566,17	1,92	=0,09	0,	214,49	2230,00
221,000	7600,00	569,23	3,06	=0,09	0,	252,71	2230,00
221,000	16500,00	573,41	4,18	=0,17	0,	462,61	2230,00

SUMMARY OF ERRORS

CAUTION SECNO= 201,000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 201,000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 201,000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 201,000 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 201,000 PROFILE= 2 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 201,000 PROFILE= 2 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 201,000 PROFILE= 3 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 201,000 PROFILE= 3 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 201,000 PROFILE= 3 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 202,000 PROFILE= 4 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 202,000 PROFILE= 4 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 202,000 PROFILE= 4 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 203,000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 203,000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 203,000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 203,000 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 203,000 PROFILE= 2 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 203,000 PROFILE= 2 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 203,000 PROFILE= 3 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 203,000 PROFILE= 3 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 203,000 PROFILE= 3 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 203,000 PROFILE= 4 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 203,000 PROFILE= 4 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 203,000 PROFILE= 4 20 TRIALS ATTEMPTED TO BALANCE WSEL

11/28/78

BRANCH BROOK

MULTIPLE RUN LISTING

5000

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*********************************************
  HEC2 RELEASE DATED NOV 76 UPDATED  AUG1977
  ERRO, CORR =  01,02
  MODIFICATION =  50,51,52,53
*********************************************
C
T1      WATERTOWN,CONN,FLOOD INSURANCE STUDY
T2      BRANCH BROOK
T3      10 YEAR FLOOD  Q>800 CFS

J1  ICHECK    INQ     NINV     IDIR     STRT     METRIC   HVINQ    Q        KSEL     FQ
      =1.       2.       0.       0.  0.002000     0.       0.       0.  324,000     0.

J2  NPROF     IPLOT    PRFVS    XSECV    XSECH    FN       ALLDC    IBW      CHNIM    ITRACE
    1,000       0.    =1,000      0.       0.       0.       0.       0.       0.       0.

J3  VARIABLE CODES FOR SUMMARY PRINTOUT
    150,000  201,000       0.       0.       0.       0.       0.       0.       0.       0.

NC      0,060    0,060    0,035    0,100    0,300       0.       0.       0.       0.       0.
QT      0,000  800,000  800,000  900,000 2300,000       0.       0.       0.       0.       0.

X1    200,000    8,000 1120,000 1230,000       0.       0.       0.       0.       0.       0.
GR    325,000 1000,000  325,000 1120,000  320,000 1140,000  316,000 1190,000  320,000 1200,000
GO    325,000 1220,000  330,000 1230,000  335,000 1520,000       0.       0.       0.       0.
NC        0.       0.       0.    0,300    0,500       0.       0.       0.       0.       0.

          O/S FACE DIRT ROAD

X1    200,100       0.       0.       0.   75,000   20,000  100,000       0.       0.       0.
X3     10,000       0.       0.       0.       0.       0.       0.  330,000  330,000       0.
SB        0.    1,500    2,500   75,000   50,000       0.  260,000       0.  316,000  316,000

          U/S FACE DIRT ROAD

X1    200,200       0.       0.       0.   15,000   15,000   15,000       0.       0.       0.
X2        0.       0.    1,000  330,000  334,400       0.       0.       0.       0.       0.
X3     10,000       0.       0.       0.       0.       0.       0.  334,400  334,400       0.
NC        0.       0.       0.    0,100    0,300       0.       0.       0.       0.       0.

X1    200,300    8,000 1400,000 1510,000   50,000   50,000   50,000       0.       0.       0.
GR    330,000 1000,000  325,000 1400,000  316,000 1830,000  316,000 1480,000  325,000 1500,000
GO    330,000 1510,000  335,000 1700,000  340,000 1800,000       0.       0.       0.       0.

X1    200,400   20,000 1500,000 1700,000 1200,000 1810,000 1700,000       0.       0.       0.
GR    330,000 1000,000  325,000 1700,000  316,000       0.       0.       0.       0.       0.
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X1	2,000	15,000	1663,000	1748,000	920,000	680,000	700,000	0,	0,	0,
X4	2,000	326,000	1692,000	326,000	1720,000	0,	0,	0,	0,	0,
GR	376,000	1315,000	375,000	1430,000	373,500	1528,000	363,500	1605,000	338,500	1663,000
GR	327,500	1690,000	327,500	1724,000	337,000	1748,000	342,500	1785,000	367,700	1838,000
GR	374,000	1897,000	375,000	1963,000	380,000	2040,000	382,000	2100,000	381,300	2210,000
NC	0,	0,	0,	0,300	0,500	0,	0,	0,	0,	0,

D/S FACE RTE 8 BRIDGE

X1	202,100	0,	0,	0,	50,000	50,000	50,000	0,	0,	0,
X3	10,000	0,	0,	0,	0,	0,	0,	381,500	381,500	0,
SB	1,250	1,500	2,500	240,000	90,000	7,000	5700,000	2,500	326,800	326,800

U/S FACE RTE 8 BRIDGE

X1	202,200	0,	0,	0,	100,000	100,000	100,000	0,	0,	0,
X2	0,	0,	1,000	381,500	390,500	0,	0,	0,	0,	0,
X3	10,000	0,	0,	0,	0,	0,	0,	390,500	390,500	0,
NC	0,	0,	0,	0,100	0,300	0,	0,	0,	0,	0,

X1	203,000	15,000	1740,000	1862,000	50,000	50,000	50,000	0,	0,	0,
X4	2,000	328,000	1800,000	328,000	1825,000	0,	0,	0,	0,	0,
GR	389,500	1239,000	384,500	1265,000	384,500	1288,000	392,500	1329,000	399,500	1370,000
GR	392,500	1433,000	390,000	1519,000	385,000	1615,000	373,500	1680,000	353,000	1740,000
GR	329,500	1795,000	329,500	1827,000	337,500	1862,000	353,500	1896,000	367,500	1940,000

X1	204,000	17,000	1685,000	1805,000	1000,000	1020,000	990,000	0,	0,	0,
X4	2,000	334,000	1740,000	334,000	1760,000	0,	0,	0,	0,	0,
GR	374,500	1200,000	374,500	1220,000	373,500	1240,000	352,500	1290,000	344,500	1310,000
GR	348,000	1325,000	343,500	1368,000	337,500	1420,000	339,500	1480,000	342,500	1560,000
GR	342,800	1635,000	342,000	1685,000	335,000	1735,000	335,000	1770,000	344,800	1805,000
GR	347,300	1875,000	349,500	1910,000	0,	0,	0,	0,	0,	0,

X1	205,000	23,000	3425,000	3570,000	1860,000	1600,000	1820,000	0,	0,	0,
X4	2,000	345,700	3480,000	345,700	3500,000	0,	0,	0,	0,	0,
GR	391,500	2580,000	390,300	2630,000	390,300	2670,000	389,000	2725,000	357,500	2855,000
GR	375,000	2920,000	376,500	2960,000	363,500	3010,000	358,500	3093,000	349,700	3168,000
GR	349,500	3260,000	349,700	3345,000	351,300	3425,000	347,300	3475,000	347,300	3505,000
GR	353,000	3570,000	356,000	3635,000	353,500	3700,000	350,500	3735,000	348,500	3840,000
GR	354,500	3875,000	363,500	3930,000	373,500	3980,000	0,	0,	0,	0,

X1	206,000	21,000	2840,000	2965,000	880,000	960,000	910,000	0,	0,	0,
X4	2,000	350,000	2870,000	350,000	2910,000	0,	0,	0,	0,	0,
GR	366,300	2010,000	366,000	2095,000	363,800	2185,000	366,500	2250,000	356,000	2350,000
GR	353,800	2460,000	352,500	2550,000	357,500	2620,000	353,500	2655,000	356,500	2680,000
GR	363,500	2705,000	358,500	2735,000	363,800	2780,000	364,800	2840,000	351,000	2865,000
GR	351,000	2920,000	361,000	2965,000	370,000	3015,000	370,000	3070,000	372,000	3175,000
GR	400,000	3245,000	0,	0,	0,	0,	0,	0,	0,	0,

X1	207,000	9,000	2720,000	2880,000	850,000	850,000	800,000	0,	0,	0,
X4	2,000	354,000	2810,000	354,000	2840,000	0,	0,	0,	0,	0,
GR	383,800	2525,000	361,500	2720,000	355,300	2800,000	355,300	2850,000	359,700	2880,000

X1	*07,100	0,	0,	0,	130,000	130,000	130,000	0,	0,	0,
X3	10,000	0,	0,	0,	0,	0,	0,	368,700	368,700	0,
SB	0,	1,500	2,500	150,000	60,000	0,	900,000	0,	354,100	354,100

U/S FACE RTE 6 BRIDGE

X1	207,200	0,	0,	0,	35,000	35,000	35,000	0,	0,	0,
X2	0,	0,	1,000	368,700	373,500	0,	0,	0,	0,	0,
X3	10,000	0,	0,	0,	0,	0,	0,	373,500	373,500	0,
NC	0,	0,	0,	0,100	0,300	0,	0,	0,	0,	0,

X1	208,000	25,000	2670,000	2810,000	30,000	30,000	30,000	0,	0,	0,
X4	2,000	354,500	2745,000	354,500	2770,000	0,	0,	0,	0,	0,
GR	386,500	2310,000	384,500	2380,000	385,700	2460,000	381,800	2535,000	378,500	2585,000
GR	373,500	2635,000	369,500	2670,000	355,500	2740,000	355,500	2775,000	362,800	2810,000
GR	362,500	2865,000	362,500	2940,000	361,500	3000,000	364,000	3050,000	364,000	3080,000
GR	362,500	3140,000	363,000	3235,000	362,500	3300,000	361,500	3360,000	359,500	3400,000
GR	361,500	3430,000	372,500	3485,000	378,500	3555,000	381,500	3620,000	399,000	3705,000

X1	209,000	25,000	2150,000	2265,000	1200,000	1050,000	1120,000	0,	0,	0,
X3	10,000	0,	0,	0,	0,	0,	0,	0,	0,	0,
X4	2,000	361,000	2170,000	361,000	2200,000	0,	0,	0,	0,	0,
GR	383,000	1390,000	380,500	1490,000	377,500	1605,000	375,500	1695,000	374,500	1785,000
GR	375,000	1850,000	362,000	1880,000	362,000	1940,000	372,500	1965,000	363,500	2000,000
GR	374,500	2030,000	362,500	2055,000	362,500	2130,000	374,300	2150,000	366,500	2165,000
GR	366,500	2205,000	370,500	2265,000	371,000	2370,000	370,500	2455,000	369,500	2560,000
GR	369,300	2645,000	372,000	2730,000	375,500	2810,000	383,500	2850,000	387,300	2920,000

X1	210,000	15,000	1735,000	1880,000	1550,000	1650,000	1600,000	0,	0,	0,
X4	1,000	376,000	1840,000	0,	0,	0,	0,	0,	0,	0,
GR	433,500	1340,000	423,500	1405,000	413,500	1560,000	411,500	1640,000	408,800	1735,000
GR	379,500	1830,000	393,500	1880,000	388,000	1930,000	392,500	1985,000	453,500	2080,000
GR	463,700	2130,000	474,500	2170,000	495,700	2230,000	490,000	2285,000	493,500	2330,000

X1	211,000	15,000	1588,000	1690,000	600,000	300,000	500,000	0,	0,	0,
GR	553,500	1350,000	542,000	1395,000	531,500	1445,000	522,000	1500,000	522,000	1520,000
GR	497,500	1578,000	488,700	1640,000	492,700	1690,000	503,500	1780,000	513,700	1863,000
GR	523,700	1945,000	533,500	2020,000	539,500	2090,000	539,500	2178,000	539,500	2301,000

50 FEET U/S BLACK ROCK DAM

X1	211,100	6,000	1062,000	1204,000	50,000	50,000	50,000	0,	0,	0,
X3	10,000	0,	0,	0,	0,	0,	0,	0,	0,	0,
X5	4,000	525,000	525,000	525,000	525,000	0,	0,	0,	0,	0,
GR	540,700	1000,000	540,700	1060,000	519,600	1062,000	519,600	1202,000	540,700	1204,000
GR	560,000	1210,000	0,	0,	0,	0,	0,	0,	0,	0,
QT	4,000	2200,000	5300,000	7600,000	16500,000	0,	0,	0,	0,	0,

50 FEET U/S KIGNAM DAM

X1	218,100	5,000	1200,000	1360,000	8800,000	8400,000	9540,000	0,	0,	0,
GR	570,000	1000,000	561,600	1200,000	561,600	1360,000	571,000	1561,000	571,000	1400,000

X1	219,100	8,000	1050,000	1420,000	4000,000	3600,000	3770,000	0,	0,	0,
GR	575,000	1000,000	570,000	1030,000	565,000	1050,000	553,500	1100,000	553,500	1400,000
GR	565,000	1420,000	570,000	1500,000	575,000	1560,000	0,	0,	0,	0,
NC	0,	0,	0,	0,300	0,500	0,	0,	0,	0,	0,

D/S FACE FOOTBRIDGE

X1	219,200	0,	0,	0,	100,000	100,000	100,000	0,	0,	0,
X3	10,000	0,	0,	0,	0,	0,	0,	566,600	566,600	0,
SB	0,	1,500	2,500	300,000	65,000	0,	800,000	0,	553,500	553,500

U/S FACE FOOTBRIDGE

X1	219,300	0,	0,	0,	15,000	15,000	15,000	0,	0,	0,
X2	0,	0,	1,000	566,600	568,800	0,	0,	0,	0,	0,
X3	10,000	0,	0,	0,	0,	0,	0,	568,800	568,800	0,
NC	0,	0,	0,	0,100	0,300	0,	0,	0,	0,	0,

X1	220,000	15,000	1290,000	2230,000	700,000	50,000	300,000	0,	0,	0,
X4	2,000	554,000	1350,000	554,000	2150,000	0,	0,	0,	0,	0,
GR	640,000	1000,000	627,500	1049,000	613,500	1100,000	592,000	1160,000	588,000	1200,000
GR	588,000	1230,000	580,000	1260,000	571,500	1290,000	560,500	1335,000	560,500	2160,000
GR	569,500	2230,000	571,500	2270,000	575,500	2335,000	576,300	2395,000	600,000	2555,000

200 FEET U/S CORPORATE LIMITS

X1	221,000	13,000	1320,000	1555,000	1650,000	2350,000	2230,000	0,	0,	0,
X4	2,000	558,000	1350,000	558,000	1500,000	0,	0,	0,	0,	0,
GR	642,500	1000,000	621,500	1060,000	605,500	1130,000	572,500	1275,000	570,000	1290,000
GR	569,500	1320,000	560,500	1340,000	560,500	1510,000	568,500	1555,000	569,500	1580,000
GR	569,700	1630,000	571,500	1705,000	575,500	1765,000	0,	0,	0,	0,
EJ	0,	0,	0,	0,	0,	0,	0,	0,	0,	0,

BRANCH BROOK

MULTIPLE RUN
SUMMARY PRINTOUT

50 YEAR FLOOD Q=800 CFS
SUMMARY PRINTOUT TABLE 150

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKHS	TOPWID	XLCH	
	200,000	800,00	321,36	0,	0,	=2,64	70,84	0,	(100' From mouth)
	200,000	800,00	321,34	=0,01	0,	=6,66	70,75	0,	
1	200,000	900,00	321,59	0,25	0,	=8,41	72,75	0,	
	200,000	2300,00	324,15	2,56	0,	=7,85	93,20	0,	
	200,100	800,00	321,57	0,	0,22	0,	72,59	100,00	
	200,100	800,00	321,56	=0,01	0,22	0,	72,52	100,00	
	200,100	900,00	321,82	0,25	0,22	0,	74,53	100,00	
	200,100	2300,00	324,39	2,57	0,24	0,	95,12	100,00	
	200,200	800,00	321,60	0,	0,03	0,	72,81	15,00	
	200,200	800,00	321,59	=0,01	0,03	0,	72,74	15,00	
	200,200	900,00	321,84	0,25	0,03	0,	74,76	15,00	
	200,200	2300,00	324,42	2,58	0,03	0,	95,38	15,00	
	200,300	800,00	321,77	0,	0,17	0,	82,06	50,00	
	200,300	800,00	321,76	=0,01	0,17	0,	82,02	50,00	
B	200,300	900,00	322,02	0,26	0,18	0,	83,47	50,00	
	200,300	2300,00	324,67	2,65	0,25	0,	98,17	50,00	
*	201,000	800,00	324,09	0,	2,32	0,	131,01	1700,00	
*C	201,000	800,00	324,09	=0,00	2,33	0,	131,01	1700,00	
*	201,000	900,00	324,18	0,09	2,16	0,	131,89	1700,00	
	201,000	2300,00	326,45	2,27	1,78	0,	236,24	1700,00	
	202,000	800,00	329,76	0,	5,67	0,	45,28	700,00	
D	202,000	800,00	329,76	0,00	5,67	0,	45,28	700,00	
	202,000	900,00	329,97	0,20	5,79	0,	46,29	700,00	
*	202,000	2300,00	331,17	1,20	4,72	0,	52,28	700,00	
	202,100	800,00	330,09	0,	0,33	0,	46,92	50,00	
	202,100	800,00	330,09	0,00	0,33	0,	46,92	50,00	
	202,100	900,00	330,32	0,23	0,36	0,	48,08	50,00	
	202,100	2300,00	332,85	2,53	1,68	0,	60,65	50,00	
	202,200	800,00	330,24	0,	0,15	0,	47,67	100,00	
	202,200	800,00	330,24	0,00	0,15	0,	47,67	100,00	
	202,200	900,00	330,49	0,25	0,17	0,	48,91	100,00	
	202,200	2300,00	333,18	2,69	0,33	0,	62,31	100,00	
*	203,000	800,00	330,88	0,	0,64	0,	41,27	50,00	
*	203,000	800,00	330,88	0,	0,64	0,	41,27	50,00	
*E	203,000	900,00	331,09	0,21	0,60	0,	42,67	50,00	
*	203,000	2300,00	333,27	2,18	0,98	0,	57,28	50,00	
	204,000	800,00	337,86	0,	6,98	0,	79,43	990,00	
F	204,000	800,00	337,86	0,	6,98	0,	79,43	990,00	CWSEL
	204,000	900,00	338,08	0,23	6,99	0,	90,33	990,00	
	204,000	2300,00	340,19	2,10	6,92	0,	192,24	990,00	348.78
									348.78
									348.86

	SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
H	206,000	800,00	353,43	0,	4,65	0,	148,27	910,00
	206,000	800,00	353,43	0,	4,65	0,	148,27	910,00
	206,000	900,00	353,62	0,19	4,65	0,	166,59	910,00
	206,000	2300,00	355,02	1,40	4,65	0,	292,58	910,00
I	207,000	800,00	356,45	0,	3,02	0,	72,79	800,00
	207,000	800,00	356,45	0,	3,02	0,	72,79	800,00
	207,000	900,00	356,64	0,18	3,02	0,	76,41	800,00
	207,000	2300,00	358,43	1,79	3,41	0,	111,72	800,00
	207,100	800,00	357,63	0,	1,18	0,	95,97	130,00
	207,100	800,00	357,63	0,	1,18	0,	95,97	130,00
	207,100	900,00	357,82	0,18	1,18	0,	99,61	130,00
	207,100	2300,00	359,65	1,83	1,22	0,	135,93	130,00
	207,200	800,00	357,73	0,	0,10	0,	97,98	35,00
	207,200	800,00	357,73	0,	0,10	0,	97,98	35,00
	207,200	900,00	357,92	0,19	0,10	0,	101,62	35,00
	207,200	2300,00	359,78	1,86	0,13	0,	137,78	35,00
J	208,000	800,00	357,48	0,	*0,25	0,	54,44	30,00
	208,000	800,00	357,48	0,	*0,25	0,	54,44	30,00
	208,000	900,00	357,63	0,15	*0,29	0,	55,92	30,00
*	208,000	2300,00	359,19	1,55	*0,59	0,	71,11	30,00
K	209,000	800,00	364,78	0,	7,30	0,	36,88	1120,00
	209,000	800,00	364,78	0,	7,30	0,	36,88	1120,00
	209,000	900,00	365,07	0,28	7,43	0,	37,40	1120,00
	209,000	2300,00	368,53	3,46	9,34	0,	74,30	1120,00
*	210,000	800,00	381,66	0,	16,88	0,	29,94	1600,00
*L	210,000	800,00	381,66	0,	16,88	0,	29,94	1600,00
*	210,000	900,00	381,93	0,27	16,86	0,	31,43	1600,00
*	210,000	2300,00	384,63	2,70	16,10	0,	46,36	1600,00
*	211,000	800,00	492,10	0,	110,44	0,	62,62	500,00
*	211,000	800,00	492,10	0,	110,44	0,	62,62	500,00
*	211,000	900,00	492,27	0,16	110,34	0,	65,64	500,00
*	211,000	2300,00	493,85	1,58	109,22	0,	90,00	500,00
*	211,100	800,00	525,00	0,	32,90	0,	141,02	50,00
*M	211,100	800,00	525,00	0,	32,90	0,	141,02	50,00
*	211,100	900,00	525,00	0,	32,73	0,	141,02	50,00
*	211,100	2300,00	525,00	0,	31,15	0,	141,02	50,00
*	218,100	2200,00	563,36	0,	38,36	0,	201,99	9540,00
*N	218,100	5300,00	564,70	1,35	39,70	0,	234,25	9540,00
*	218,100	7600,00	565,50	0,80	40,50	0,	253,34	9540,00
	218,100	16500,00	568,02	2,52	43,02	0,	313,61	9540,00
	219,000	2200,00	564,27	0,	0,92	0,	1551,12	410,00
	219,000	5300,00	566,24	1,97	1,54	0,	1625,78	410,00
	219,000	7600,00	567,39	1,15	1,69	0,	1656,87	410,00
	219,000	16500,00	570,26	4,30	2,77	0,	1737,00	410,00

SECNO	Q	CWSEL	DIFWSP	DIFWSX	DIFKWS	TOPWID	XLCH
219,100	2200,00	564,27	0,	=0,00	0,	365,55	3770,00
219,100	5300,00	566,23	1,96	=0,01	0,	394,66	3770,00
219,100	7600,00	567,38	1,14	=0,02	0,	417,52	3770,00
219,100	16500,00	570,74	3,36	=0,06	0,	483,29	3770,00
219,200	2200,00	564,27	0,	0,00	0,	365,56	100,00
219,200	5300,00	566,24	1,97	0,00	0,	370,00	100,00
219,200	7600,00	567,38	1,14	0,00	0,	417,57	100,00
219,200	16500,00	570,75	3,37	0,01	0,	483,38	100,00
219,300	2200,00	564,27	0,	0,00	0,	365,56	15,00
219,300	5300,00	566,24	1,97	0,00	0,	370,00	15,00
219,300	7600,00	569,29	3,05	1,91	0,	455,81	15,00
219,300	16500,00	573,50	4,21	2,75	0,	533,04	15,00
220,000	2200,00	564,28	0,	0,01	0,	869,79	300,00
220,000	5300,00	566,26	1,99	0,02	0,	893,30	300,00
220,000	7600,00	569,32	3,06	0,03	0,	929,59	300,00
220,000	16500,00	573,58	4,26	0,08	0,	1021,16	300,00
221,000	2200,00	564,25	0,	=0,03	0,	199,40	2230,00
221,000	5300,00	566,17	1,92	=0,09	0,	214,49	2230,00
221,000	7600,00	569,23	3,06	=0,09	0,	252,71	2230,00
221,000	16500,00	573,41	4,18	=0,17	0,	462,61	2230,00

SUMMARY OF ERRORS

CAUTION SECNO= 201,000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 201,000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 201,000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 201,000 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 201,000 PROFILE= 2 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 201,000 PROFILE= 2 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 201,000 PROFILE= 3 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 201,000 PROFILE= 3 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 201,000 PROFILE= 3 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 202,000 PROFILE= 4 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 202,000 PROFILE= 4 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 202,000 PROFILE= 4 20 TRIALS ATTEMPTED TO BALANCE WSEL

CAUTION SECNO= 203,000 PROFILE= 1 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 203,000 PROFILE= 1 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 203,000 PROFILE= 1 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 203,000 PROFILE= 2 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 203,000 PROFILE= 2 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 203,000 PROFILE= 2 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 203,000 PROFILE= 3 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 203,000 PROFILE= 3 PROBABLE MINIMUM SPECIFIC ENERGY
CAUTION SECNO= 203,000 PROFILE= 3 20 TRIALS ATTEMPTED TO BALANCE WSEL
CAUTION SECNO= 203,000 PROFILE= 4 CRITICAL DEPTH ASSUMED
CAUTION SECNO= 203,000 PROFILE= 4 PROBABLE MINIMUM SPECIFIC ENERGY

BRANCH BROOK
FLOODWAY
METHOD 4

FLOODWAY DATA, 100 YEAR FLOOD Q=900 CFS
PROFILE NO, 2

	STATION	FLOODWAY WIDTH (FT)	FLOODWAY SECTION AREA	FLOODWAY MEAN VELOCITY	WATER SURFACE ELEVATION WITH FLOODWAY	WITHOUT FLOODWAY	DIFFERENCE
A	200,000	61,	303,	3,0	322,6	321,6	1,0
	~~200,100~~	~~82,~~	~~310,~~	~~2,9~~	~~322,7~~	~~321,8~~	~~0,9~~
	~~200,200~~	~~82,~~	~~311,~~	~~2,9~~	~~322,7~~	~~321,8~~	~~0,9~~
B	~~200,300~~	~~60,~~	~~469,~~	~~1,9~~	~~322,8~~	~~322,0~~	~~0,8~~
C	201,000	132,	149,	6,1	324,2	324,2	0,
D	202,000	46,	146,	6,2	330,0	330,0	0,
	~~202,100~~	~~40,~~	~~163,~~	~~5,5~~	~~330,5~~	~~330,5~~	~~0,~~
	~~202,200~~	~~54,~~	~~202,~~	~~4,4~~	~~331,5~~	~~330,5~~	~~1,0~~
E	203,000	43,	102,	8,8	331,1	331,1	0,
F	204,000	68,	186,	4,8	338,1	338,1	0,
G	205,000	70,	123,	7,3	349,0	349,0	0,
H	206,000	72,	218,	4,1	353,7	353,6	0,1
I	207,000	78,	142,	6,3	356,7	356,6	0,1
	~~207,100~~	~~89,~~	~~239,~~	~~3,8~~	~~357,6~~	~~357,0~~	~~0,~~
	~~207,200~~	~~101,~~	~~290,~~	~~3,0~~	~~357,9~~	~~357,9~~	~~0,~~
J	208,000	56,	126,	7,1	357,6	357,6	0,
K	209,000	37,	138,	6,5	365,1	365,1	0,
L	210,000	31,	92,	9,8	381,9	381,9	0,
	~~211,000~~	~~66,~~	~~219,~~	~~4,1~~	~~492,5~~	~~492,5~~	~~0,~~
M	~~211,100~~	~~141,~~	~~752,~~	~~1,2~~	~~529,0~~	~~529,0~~	~~0,~~
N	~~211,200~~	~~160,~~	~~467,~~	~~1,6~~	~~565,7~~	~~565,5~~	~~0,2~~
O	~~212,000~~	~~1146,~~	~~32810,~~	~~0,2~~	~~567,0~~	~~567,4~~	~~0,6~~
P	~~212,100~~	~~370,~~	~~4935,~~	~~1,2~~	~~568,0~~	~~567,4~~	~~0,6~~
	~~212,200~~	~~870,~~	~~1954,~~	~~1,5~~	~~568,0~~	~~567,4~~	~~0,6~~
	~~212,300~~	~~410,~~	~~1555,~~	~~1,7~~	~~568,1~~	~~569,3~~	~~-1,2~~
Q	~~213,000~~	~~914,~~	~~11014,~~	~~0,6~~	~~568,1~~	~~569,3~~	~~-1,2~~
	~~213,100~~	~~200,~~	~~1014,~~	~~1,1~~	~~568,0~~	~~569,2~~	~~-1,2~~

219,500	24585.	-5.02	-3.05	4.21
220,000	24885.	-5.04	-3.06	4.26
221,000	27115.	-4.99	-3.06	4.18
EIGHTED AVG FOR REACH		-1.41	-0.69	2.23

HF FOR THE REACH = 015 WITH 55.2[OF THE REACH WITHIN 0.5 FEET
.0VE FOR THE REACH = A 5

BRANCH BROOK
REACH DETERMINATION

ONTINUOUS FLOOD HAZARD FACTORS BY EVEN INCREMENTS

	TOTAL LENGTH	WEIGHTED AVG DIFFERENCE BETWEEN BASE FLOOD AND		
		10[	[[	0.2[
55	10600.	-0.21	-0.21	2.24

HF FOR REACH 1 = 005 WITH 100.[OF THE REACH WITHIN 0.5 FEET
O.E FOR THE REACH = A 1

00	20000.	-1.06	-0.40	1.26

HF FOR REACH 2 = 010 WITH 75.[OF THE REACH WITHIN 0.5 FEET
O.E FOR THE REACH = A 2

35	27000.	-5.75	-1.81	3.64

HF FOR REACH 3 = 040 WITH 89.[OF THE REACH WITHIN 1.0 FEET
O.E FOR THE REACH = A 8

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HEC2 RELEASE DATED NOV 76 UPDATED AUG1977
RUN CODE = 01.02
IDENTIFICATION = 50,51,52,53
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