TECHNICAL MEMORANDUM

To: CHA Records

CC: Chris Wall (CHA); Mike Culmo (CHA)

From: Kris Detlefsen (CHA)

Date: August 6, 2025

Hollis-Buxton 3708 – US 202,4 & 117 over the Saco River

Project Number: 090330 (K7)

Hydrology

Based on a review of the (July 2024) FEMA Flood Insurance Study (FIS) for York County, Maine, there is detailed hydrologic and hydraulic data available for the Route 4 crossing of the Saco River. The design flows for the study were developed utilizing historical data from USGS Gage 01067000 and the Maine Central Power Company, both located in West Buxton, Maine. A standard gage transfer analysis was applied to account for the difference in drainage area at different locations along the river. In addition, a hydrology report was provided by the Maine DOT, which provided flow estimates using a methodology similar to the FIS. This report is included as an attachment, and the recommended design flows are summarized below.

Hydrologic Summary

Drainage Area	1595	mi^2
Q1.1	8.900	ft^3/s
Q10	25.300	ft^3/s
Q25	30.900	ft^3/s
Q50	35.250	ft^3/s
Q100	40.050	ft^3/s
Q500	51.200	ft^3/s

Reported by: KKD
Date: September 6, 2024

Hydraulics

A review of the FIS indicates that the 50-year (2% AEP) and 100-year (1% AEP) water surface elevations at the approach section of the existing bridge are approximately 128 feet (ft) and 128.6 ft, resulting in 14.7 and 14.1 feet of freeboard, respectively. Although the low chord of the proposed bridge will be lowered from 142.7± to 137.1± ft due to the increase in structure depth associated with the single span, there will be no piers located in the river. The new bridge will be a steel girder structure with the abutments founded on bedrock and located behind the existing substructures, resulting in a span length of 215 ft. As such, a formal scour analysis is not required, and the hydraulic opening will increase slightly for each of the flood events investigated. However, negligible changes in water surface elevations are expected as the tailwater through the bridge is controlled by the operation of Skelton Dam approximately 1.8 miles downstream. This facility has significant spillway capacity and can maintain water surface elevations between 123 and 127 ft, with normal pool elevations ranging between 126.5 and 127 ft. As the proposed structure will maintain water surface elevations within the bridge reach and will provide sufficient freeboard during the design and check flood events, it has been designed consistent with the hydraulic criteria presented in the Maine DOT Bridge Design Guide (May 2018). A summary of the relevant hydraulic information is provided in the table below.

Hydraulic Summary

		Existing Structure	Proposed Structure
		Three-Span 200 ft long Steel Girder	Single-Span 215 ft long Steel Girder
Total Area of Waterway Opening	ft^2	5968	5488
Headwater elevation @ $Q_{1.1}$	ft	126.5	126.5
Headwater elevation @ Q_{10}	ft	127.2	127.2
Headwater elevation @ Q_{25}	ft	127.6	127.6
Headwater elevation @ Q_{50}	ft	128.0	128.0
Headwater elevation @ Q_{100}	ft	128.6	128.6
Headwater elevation @ Q_{500}	ft	130.5	130.5
Freeboard @ Q_{50}	ft	14.7	9.1
Freeboard @ Q_{100}	ft	14.1	8.5
Flood Of Record (March 1936) Flow: 58,200 cfs Elevation: Uknown			
Outlet Velocity @ $Q_{1.1}$	ft/s	2.5	2.4
Outlet Velocity @ Q_{10}	ft/s	8.5	7.9
Outlet Velocity @ Q_{25}	ft/s	10.0	9.2
Outlet Velocity @ Q_{50}	ft/s	11.1	10.3
Outlet Velocity @ Q_{100}	ft/s	12.2	11.3
Outlet Velocity @ Q_{500}	ft/s	14.1	13.0

Reported by: KKD
Date: September 6, 2024

Note: All elevations based on North American Vertical Datum (NAVD) of 1988

Environmental Office – Hydrology Section
16 State House Station
Augusta ME 04333-0016
207.557.1052
Charles.Hebson@maine.gov

Maine Department of Transportation

Memo

To: Chris Wall, Kristopher Detlefsen

From: Charles Hebson

CC: Andrea Brady, Garrett Gustafson

Date: 2024 September 09

Re: 23643 Salmon Fall Br #3708 US202 @ Saco River - Hydrology

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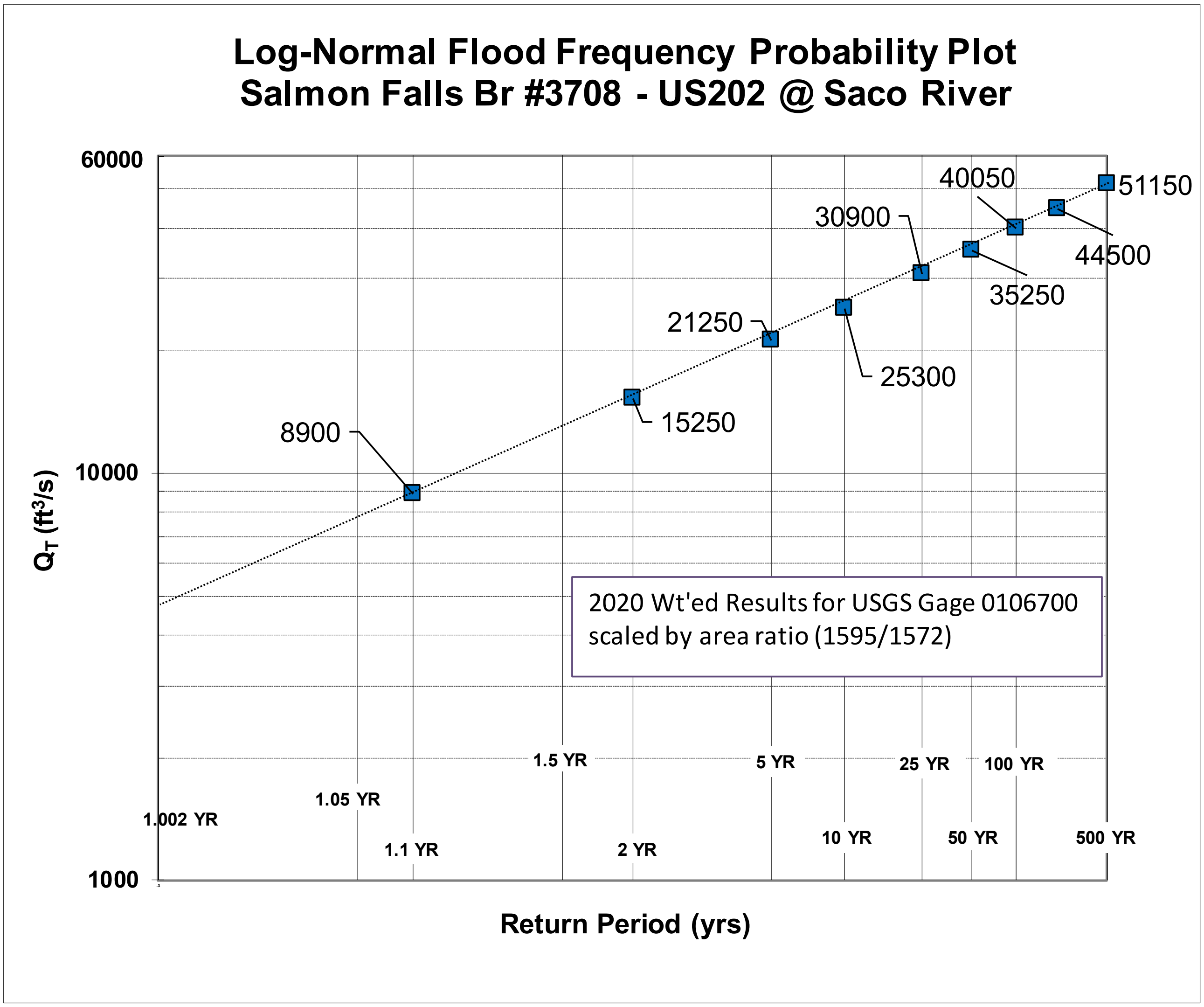
Salmon Fall Bridge #3708 carries US202 over the Saco River in Hollis. There was a USGS gage (01067500, A_{ws} = 1595 mi^2) located at the bridge from 1938 to 1948. The nearest active gage is 0106700 (A_{ws} = 1570 mi^2), located a short distance upstream in West Buxton. There is a good gage record and therefore design hydrology will be based on the gage data rather than regression. Also, the Saco is a regulated river, making regression analysis less desirable from a statistical standpoint. The gage data is transferred to the project site by simple area scaling (1595/1572) and rounded to the nearest multiple of 50. The Q1.1 event was estimated by extrapolating the scaled flood frequency. Design hydrology for Bridge #3708 is summarized in Table 1 and the probability plot in Figure 1.

Table 1. Design Hydrology (ft^3/s)

Return Period (yrs)	Gage 0106700	Bridge #3708
Aws (mi^2)	*1570*	*1595*
1.1		8900
2	15000	15250
5	20900	21250
10	24900	25300
25	30400	30900
50	34700	35250
100	39400	40050
200	43800	44500
500	50400	51200

Figure 1. Flood Frequency Plot for Salmon Falls Bridge



The bridge is located in a FEMA Regulatory Floodway and Zone AE Floodplain. The Base Flood Elevation ranges from 128-ft to 129-ft just upstream of the bridge. It is critical that we meet a No-Rise result with the new bridge design in order to avoid the complications of FEMA process.

Reference:

Lombard, P.J. and G.L. Hodgkins, 2020. Estimating Flood Magnitude and Frequency on Gaged and Ungaged Streams in Maine. SIR 202-5092. U.S. Geological Survey.

Estimating Flood Magnitude and Frequency on Gaged and Ungaged Streams in Maine

By Pamela J. Lombard and Glenn A. Hodgkins

Prepared in cooperation with the Maine Department of Transportation

Scientific Investigations Report 2020–5092

U.S. Department of the Interior
U.S. Geological Survey

Appendix 5. Peak flows for selected annual exceedance probabilities for selected streamgages in and near Maine.

[Streamgages shown in figure1; Discharges in this appendix supercede discharges reported in Hodgkins (1999); USGS, U.S. Geological Survey; EMA, Expected Probability Adjustment; ft^3/s, cubic feet per second; mi^2, square mile; %, percent; --, regression and weighted flows were not computed for regulated stations and EMA at station estimates should be used.]

Streamgage number	Streamgage name	Drainage area, mi^2	Frequency analysis method	Discharge for given annual exceedance probability, ft^3/s							
				50%	20%	10%	4%	2%	1%	0.50%	0.20%
01064380	E br Saco r @ Town Hall Road, near Lower Bartlett, NH	34.2	EMA	2,110	3,150	3,890	4,880	5,660	6,460	7,290	8,450
01064380	E br Saco r @ Town Hall Road, near Lower Bartlett, NH		Regression	2,060	3,140	3,910	4,950	5,820	6,660	7,240	8,130
01064380	E br Saco r @ Town Hall Road, near Lower Bartlett, NH		Weighted	2,100	3,150	3,890	4,900	5,710	6,540	7,270	8,300
01064400	Lucy Brook near North Conway, NH	4.71	EMA	571	1,020	1,370	1,880	2,310	2,780	3,280	4,020
01064400	Lucy Brook near North Conway, NH		Regression	356	560	716	935	1,120	1,300	1,480	1,690
01064400	Lucy Brook near North Conway, NH		Weighted	541	930	1,210	1,570	1,860	2,110	2,400	2,730
01064500	Saco River near Conway, NH	385	EMA	17,300	26,800	33,700	42,900	50,100	57,600	65,400	76,200
01064500	Saco River near Conway, NH		Regression	15,200	22,100	26,700	32,900	38,000	42,700	45,500	50,300
01064500	Saco River near Conway, NH		Weighted	17,200	26,600	33,400	42,200	49,000	55,800	62,500	71,300
01064800	Cold Brook at South Tamworth, NH	5.46	EMA	442	1,050	1,680	2,760	3,830	5,140	6,760	9,430
01064800	Cold Brook at South Tamworth, NH		Regression	405	648	829	1,080	1,290	1,500	1,690	1,980
01064800	Cold Brook at South Tamworth, NH		Weighted	425	814	1,110	1,480	1,780	2,050	2,340	2,720
01064801	Bearcamp River at South Tamworth, NH	67.5	EMA	3,500	4,540	5,190	5,980	6,560	7,120	7,680	8,400
01064801	Bearcamp River at South Tamworth, NH		Regression	2,600	3,890	4,780	5,970	6,950	7,890	8,600	9,750
01064801	Bearcamp River at South Tamworth, NH		Weighted	3,470	4,510	5,170	5,980	6,590	7,200	7,790	8,590
01065000	Ossipee River at Effingham Falls, NH	330	EMA	3,570	4,780	5,620	6,710	7,550	8,420	9,320	10,600
01065000	Ossipee River at Effingham Falls, NH		Regression	8,050	11,500	13,800	16,800	19,300	21,600	23,400	26,200
01065000	Ossipee River at Effingham Falls, NH		Weighted	3,610	4,880	5,780	7,010	8,000	9,100	10,200	11,900
01065500	Ossipee River at cornish, ME	451	EMA	4,470	6,360	7,690	9,440	10,800	12,200	13,700	15,700
01065500	Ossipee River at cornish, ME		Regression	10,300	14,700	17,600	21,400	24,500	27,400	29,600	33,100
01065500	Ossipee River at cornish, ME		Weighted	4,530	6,490	7,890	9,810	11,400	13,000	14,800	17,200
01066000	Saco River at Cornish, ME	1,290	EMA	13,600	18,800	22,300	26,700	30,000	33,300	36,700	41,200
01066000	Saco River at Cornish, ME		Regression	28,200	39,000	46,000	55,100	62,600	69,400	73,800	81,200
01066000	Saco River at Cornish, ME		Weighted	13,700	19,000	22,600	27,200	30,800	34,500	38,100	43,200
01066100	Pease Brook near Cornish, ME	4.69	EMA	159	265	347	465	564	671	788	959
01066100	Pease Brook near Cornish, ME		Regression	268	442	575	762	916	1,080	1,230	1,480
01066100	Pease Brook near Cornish, ME		Weighted	177	305	410	567	701	854	997	1,230
01066500	Little Ossipee River near south Limington, ME	166	EMA	2,100	3,330	4,270	5,590	6,670	7,840	9,090	10,900
01066500	Little Ossipee River near south Limington, ME		Regression	3,330	4,930	6,060	7,550	8,770	9,940	11,100	12,800
01066500	Little Ossipee River near south Limington, ME		Weighted	2,150	3,420	4,390	5,780	6,920	8,160	9,440	11,300

Appendix 5. Peak flows for selected annual exceedance probabilities for selected streamgages in and near Maine.

[Streamgages shown in figure1; Discharges in this appendix supercede discharges reported in Hodgkins (1999); USGS, U.S. Geological Survey; EMA, Expected Probability Adjustment; ft^3/s, cubic feet per second; mi^2, square mile; %, percent; --, regression and weighted flows were not computed for regulated stations and EMA at station estimates should be used.]

Streamgage number	Streamgage name	Drainage area, mi^2	Frequency analysis method	Discharge for given annual exceedance probability, ft^3/s							
				50%	20%	10%	4%	2%	1%	0.50%	0.20%
01067000	Saco River at West Buxton, ME	1,570	EMA	14,700	20,300	24,100	29,000	32,800	36,600	40,500	45,900
01067000	Saco River at West Buxton, ME		Regression	31,000	42,800	50,500	60,400	68,600	75,900	81,000	89,300
01067000	Saco River at West Buxton, ME		Weighted	15,000	20,900	24,900	30,400	34,700	39,400	43,800	50,400
01067950	Kennebunk River near Kennebunk, ME	26.1	EMA	837	1,250	1,550	1,960	2,290	2,640	3,010	3,530
01067950	Kennebunk River near Kennebunk, ME		Regression	549	855	1,080	1,390	1,640	1,890	2,170	2,570
01067950	Kennebunk River near Kennebunk, ME		Weighted	793	1,170	1,430	1,780	2,060	2,330	2,640	3,060
01068910	Mousam River at Route 4 near Sanford, ME	45.0	EMA	565	940	1,350	2,140	3,000	4,210	5,870	9,090
01068910	Mousam River at Route 4 near Sanford, ME		Regression	--	--	--	--	--	--	--	--
01068910	Mousam River at Route 4 near Sanford, ME		Weighted	--	--	--	--	--	--	--	--
01069500	Mousam River near West Kennebunk, ME	98.5	EMA	1,410	2,250	3,030	4,340	5,620	7,200	9,160	12,500
01069500	Mousam River near West Kennebunk, ME		Regression	--	--	--	--	--	--	--	--
01069500	Mousam River near West Kennebunk, ME		Weighted	--	--	--	--	--	--	--	--
01069700	Branch Brook near Kennebunk, ME	9.17	EMA	305	536	724	1,000	1,240	1,500	1,800	2,230
01069700	Branch Brook near Kennebunk, ME		Regression	360	592	771	1,020	1,230	1,440	1,670	2,020
01069700	Branch Brook near Kennebunk, ME		Weighted	312	544	732	1,000	1,240	1,480	1,760	2,150
01072500	Salmon Falls River near South Lebanon, ME	139	EMA	1,730	2,590	3,290	4,350	5,270	6,320	7,510	9,350
01072500	Salmon Falls River near South Lebanon, ME		Regression	--	--	--	--	--	--	--	--
01072500	Salmon Falls River near South Lebanon, ME		Weighted	--	--	--	--	--	--	--	--
01072800	Cocheco River near Rochester, NH	80.2	EMA	1,860	3,030	3,950	5,280	6,400	7,630	8,990	11,000
01072800	Cocheco River near Rochester, NH		Regression	2,350	3,660	4,620	5,920	6,970	8,040	9,110	10,800
01072800	Cocheco River near Rochester, NH		Weighted	1,900	3,110	4,060	5,430	6,560	7,770	9,030	10,900
01072850	Mohawk Brook near center Strafford, NH	7.44	EMA	290	653	1,010	1,600	2,160	2,850	3,660	4,980
01072850	Mohawk Brook near center Strafford, NH		Regression	328	545	712	946	1,140	1,340	1,550	1,900
01072850	Mohawk Brook near center Strafford, NH		Weighted	303	604	850	1,180	1,450	1,720	2,020	2,450
01072870	Isinglass River at Rochester neck road, near dover, NH	74.6	EMA	1,420	2,400	3,200	4,380	5,380	6,510	7,760	9,650
01072870	Isinglass River at Rochester neck road, near dover, NH		Regression	1,820	2,820	3,550	4,540	5,340	6,140	6,980	8,290
01072870	Isinglass River at Rochester neck road, near dover, NH		Weighted	1,470	2,480	3,290	4,430	5,360	6,340	7,380	8,910
01073000	Oyster River near Durham, NH	12.2	EMA	301	475	609	798	954	1,120	1,310	1,580
01073000	Oyster River near Durham, NH		Regression	399	650	841	1,110	1,320	1,550	1,800	2,200
01073000	Oyster River near Durham, NH		Weighted	303	480	619	819	985	1,170	1,380	1,690

FLOOD INSURANCE STUDY

FEDERAL EMERGENCY MANAGEMENT AGENCY

VOLUME 1 OF 5

YORK COUNTY, MAINE

(ALL JURISDICTIONS)

COMMUNITY NAME	NUMBER	COMMUNITY NAME	NUMBER
ACTON, TOWN OF	230190	OGUNQUIT, TOWN OF	230632
ALFRED, TOWN OF	230191	OLD ORCHARD BEACH, TOWN OF	230153
ARUNDEL, TOWN Of	230192	PARSONSFIELD, TOWN OF	230154
BERWICK, TOWN OF	230144	SACO, CITY OF	230155
BIDDEFORD, CITY OF	230145	SANFORD, CITY OF	230156
BUXTON, TOWN OF	230146	SHAPLEIGH, TOWN OF	230198
CORNISH, TOWN OF	230147	SOUTH BERWICK, TOWN OF	230157
DAYTON, TOWN OF	230148	WATERBORO, TOWN OF	230199
ELIOT, TOWN OF	230149	WELLS, TOWN OF	230158
HOLLIS, TOWN OF	230150	YORK, TOWN OF	230159
KENNEBUNK, TOWN OF	230151		
KENNEBUNKPORT, TOWN OF	230170		
KITTERY, TOWN OF	230171		
LEBANON, TOWN OF	230193		
LIMERICK, TOWN OF	230194		
LIMINGTON, TOWN OF	230152		
LYMAN, TOWN OF	230195		
NEWFIELD, TOWN OF	230196		
NORTH BERWICK, TOWN OF	230197		

EFFECTIVE:

July 17, 2024

FLOOD INSURANCE STUDY NUMBER
23031CV001A
Version Number 2.3.2.1

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<u>Appendix</u>

Appendix

Littlefield River – 1% Annual Chance Flood Data

Midlle Branch Mousam River – 1% Annual Chance Flood Data

<u>Exhibits</u>

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Chickering Creek	07 P
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Cooks Brook	13-16 P
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Published Separately

Flood Insurance Rate Map (FIRM)

Table 2: Flooding Sources Included in this FIS Report - continued

Flooding Source	Community	Downstream Limit	Upstream Limit	HUC-8 Sub-Basin(s)	Length (mi) (streams or coastlines)	Area (mi^2) (estuaries or ponding)	Floodway (Y/N)	Zone shown on FIRM	Date of Analysis
Ogunquit River Tributary	Ogunquit, Town of	Confluence with Ogunquit River	Approximately 2,950 feet upstream of confluence with Ogunquit River	01060003	0.57		Y	AE	1979 (redelineated 2013)
Ossipee River	Cornish, Town of; Parsonsfield, Town of	Confluence with Saco River	Approximately 2.06 miles upstream of confluence with South River	01060002	13.60		Y	AE	1978
Piscataqua River	Eliot, Town of	Kittery/Eliot border	Eliot/South Berwick border	01060003	10.00		N	AE	1987 (redelineated 2013)
Ponding Area 1	Alfred, Town of	Entire shoreline	Entire shoreline	01060003		0.00	N	AH	2006 (redelineated 2013)
Ponding Area 2	Alfred, Town of; Lyman, Town of	Entire shoreline	Entire shoreline	01060003		0.02	N	AH	2006 (redelineated 2013)
Ponding Area 3	Alfred, Town of	Entire shoreline	Entire shoreline	01060003		0.00	N	AH	2006 (redelineated 2013)
Roberts-Wadley Pond	Lyman, Town of	Entire shoreline	Entire shoreline	01060002		0.47	N	AE	1989 (redelineated 2013)
Saco River	Saco, City of	West Branch Dam	Saco/Buxton/Dayton border	01060002	4.61		Y	AE	1982
Saco River	Dayton, Town of; Buxton, Town of; Hollis, Town of; Limington, Town of	Biddeford/Dayton/ Saco border	Limington/Cornish border	01060002	31.50		Y	AE	1979
Saco River	Biddeford, City of	West Branch Dam	Biddeford/Dayton/ Saco border	01060002	3.40		Y	AE	1978

Table 5: Basin Characteristics - continued

HUC-8 Sub-Basin Name	HUC-8 Sub-Basin Number	Primary Flooding Source	Description of Affected Area	Drainage Area (square miles)
Saco	01060002	Saco River	This watershed includes 17 towns in the north and northeast section of York County, covering the Saco river and its tributaries.	1,701
Presumpscot	01060001	Presumpscot River	Includes portions of the towns on the Northeast edge of York County, Biddeford, Saco, Buxton, Limington and Old Orchard Beach.	1,424

4.2 Principal Flood Problems

Table 6 contains a description of the principal flood problems that have been noted for York County by flooding source.

Table 6: Principal Flood Problems

Flooding Source	Description of Flood Problems
Atlantic Ocean and York County coastline	Coastal flooding in York County occurs due to coastal storms and hurricanes. Northeasters and southeasters are most frequent but more prevalent in winter months. Hurricanes are less frequent but occur in late summer and early fall. Hurricanes rarely produce significant storm surge north of Cape Cod, MA and are smaller, more intense storms that move rapidly in northern latitudes and lose strength quickly upon landfall. Northeaster type storms represent low pressure systems that have developed off the southern Atlantic coast that travel northward along the coast collecting moisture and gathering strength during travel. Northeaster storms may be hundreds of miles in diameter and may travel slowly enough to produce heavy sustained onshore winds for as long as 48 hours. Northeasters often last through one or more tidal cycles. The combination of sustained onshore winds and high tide causes significant elevation of the water surface known as a storm surge. The worst storm surges occur in Hancock County when the winds are from the southeast quadrant. Coastal shoreline erosion is a major concern throughout the county as is damage to low coastal roads, boats, beaches and seawalls. Occasional strong onshore winds and high tides result in tidal surge and wave activity that cause extensive property damage and erosion.

Table 8: Non-Levee Flood Protection Measures - continued

Flooding Source	Structure Name	Type of Measure	Location	Description of Measure
Ogunquit River	N/A	Dam	Towns of Ogunquit and Wells	N/A
Ossipee River	Central Maine Power Company Dam	Dam	Town of Parsonsfield	N/A
Ossipee River	Central Maine Power Company Dam	Dam	Town of Parsonsfield	N/A
Ossipee River	Old Wooden Dam	Dam	Town of Parsonsfield	N/A
Saco River	Bar Mills Dam	Dam	Town of Buxton	N/A
Saco River	Bar Mills Dam	Dam	Town of Hollis	N/A
Saco River	Bonny Eagle Hydro Station	Dam	Town of Hollis	N/A
Saco River	Cataract Dam	Dam	City of Biddeford	N/A
Saco River	Cataract Dam	Dam	City of Saco	N/A
Saco River	N/A	Dam	Cities of Biddeford and Saco, Town of Hollis	N/A
Saco River	Skelton Station Dam	Dam	Town of Buxton	N/A
Saco River	Skelton Station Dam	Dam	Town of Dayton	N/A
Saco River	Springs Dam	Dam	City of Biddeford	N/A
Saco River	Springs Dam	Dam	City of Saco	N/A
Saco River	Springs Dam	Dam	City of Biddeford	N/A
Saco River	West Buxton Dam	Dam	Town of Buxton	N/A
Saco River	West Buxton Dam	Dam	Town of Hollis	N/A
Salmon Falls River	Crib Dam	Dam	Town of Lebanon	N/A
Salmon Falls River	Milton Leather Board Dam	Dam	Town of Lebanon	N/A
Salmon Falls River	Milton Three Ponds Dam	Dam	Town of Lebanon	N/A
Salmon Falls River	N/A	Dam	Towns of Acton, Berwick, Lebanon	N/A
Sawyer Brook	N/A	1% Annual Chance Flood Discharge Contained In Structure	City of Saco	N/A

$$Q = Q_g(A/A_g)^b$$

where Q is the desired 1% annual chance flood discharge at the upstream site, Q_g is the 1% annual chance flood discharge at the USGS gage, and A and A_g, are drainage areas at the respective sites. The value of the exponent b is 0.8.

Since the gage is located downstream of all regulation affecting Sanford, the peak flow data already takes into account the effects of any regulation by upstream lakes and reservoirs. The flood discharges computed at the gage were modified on the basis of drainage area relationships to compute the adopted discharges in Sanford (USGS 1975). The discharges for the Mousam River (Lower Reach) were derived from discharges calculated for Estes Lake. According to USGS Water-Supply Paper 1580-B, a useable storage capacity of less than 4.5 million cubic feet per square mile, in general, affects peak discharges by less than 10 percent (USGS 1962). The useable storage capacity of Estes Lake is less than this limit; therefore, it was not considered in the computation of upstream flood discharges. The 1% annual chance flood flow for Tributary to Middle Branch Mousam River was determined using the USGS regional regression equation for the region (USGS 1975).

Two USGS gages on the Ossipee River were used to establish the peak discharge-frequency relationships. The gage located at Effingham Falls, New Hampshire, has 34 years of record, and the gage located at Cornish, Maine, has 60 years of record (USGS 1960 and USGS 1976c). Values of the 10-, 2-, 1-, 0.2-percent annual chance peak discharges were obtained from a log-Pearson Type III distribution of annual peak flow data in accordance with the U.S. Water Resources Council Bulletin 17 (WRC 1976). Peak flows for other locations on the Ossipee River were computed by use of the drainage area proration method mentioned above, $Q = Q_g(A/A_g)^b$ (Chow 1964). The value of b applied to the Ossipee River was 0.8. This value was based on the analysis of peak discharges at the two gages listed above.

In the pre-countywide July 4, 1988, FIS for the Town of Kennebunkport, the 1% annual chance flood elevation at the Lake of the Woods area was also determined by the proportion method, with a transposition coefficient of 0.75. Reservoir routing was performed to find the water-surface elevation of that flood in this area.

The stage-frequency relationship for the Piscataqua River in the Town of Eliot was established through information obtained in a review of flood history of the area and the pre-countywide FIS's for the Towns of South Berwick and Kittery, Maine, and the Cities of Portsmouth and Dover, New Hampshire (USGS 1937, USGS 1979, FEMA 1985, FEMA 1984, FEMA 1982a, and FEMA 1980). In the pre-countywide FIS's for the downstream communities of Kittery and Portsmouth, New Hampshire, the 1% annual chance flood elevations for the Piscataqua River were determined to be 8.0 and 8.2 respectively (FEMA 1984 and FEMA 1982a). These elevations agree with high-water data obtained by USGS staff during the February 1978 flood, which was considered a 1% annual chance event. In the FIS for the City of Dover, New Hampshire, a 1% annual chance elevation of 8.4 feet was determined for the Cocheco River near its confluence of the Piscataqua River (FEMA 1980). Based on these results, a 1% annual chance flood elevation for the entire length of the Piscataqua River in Eliot was determined to be 8.3 feet.

The computation of flow past the hydro-power plant at West Buxton was the principal source of data for defining discharge frequency relationships for the Saco River. Records of annual, maximum daily discharges were furnished to the USGS by the Central Maine Power Company.

Discharges were computed from records of flow over dam, through waste gates, and through wheels of the power plant. The data cover a period of 66 years (1908-1916 and 1920-1977). Discharge figures for this station have not been published by the USGS since 1940; prior to 1940 this data was published as "Station 01067000, Saco River at West Buxton, Maine."

Values for the 10-, 2-, 1-, and 0.2-percent annual chance peak discharges were obtained from a log-Pearson Type III distribution of these annual, maximum daily flow data (WRC 1977). The results from this analysis increased by 1.7 percent to simulate instantaneous discharge because the flow data for West Buxton are values of maximum daily discharge. The 1.7-percent factor was determined to be the average amount by which instantaneous peak flows exceeded concomitant daily flows at West Buxton, and was based on a comparison of 59 events. The instantaneous peak discharges were computed from flow through wheels and gates and flow over spillways. Because of the difference in drainage area from West Buxton (1,571 square miles) to the Hollis-Dayton corporate limits (1,594 square miles), further increases in the peak flow were required to estimate flow at the downstream end of the study area. The area at the Hollis-Limington corporate limits is 1,550 square miles, so a slight decrease in flow was made for the upstream end of the reach. Flood discharges for the right and left channel around Bonny Eagle Island were computed using' split flow techniques. The largest part of the flow goes through the left channel, where the spillway section of the dam is located.

The hydrologic analyses for Salmon Falls River were taken from the pre-countywide FIS's for the Cities of Somersworth and Rochester, New Hampshire (FEMA 1982c and FEMA 1982b). Flood discharge-frequencies for the Salmon Falls River were computed using log-Pearson Type III statistical analyses (WRC 1977) of peak discharges at gage No. 01072500 located on the Salmon Falls River near South Lebanon, Maine. The gage was in operation from 1930 to 1969.

For the March 16, 1998, FIS for the City of Saco, Sawyer Brook discharges were computed using the NRCS TR-20 computer program (USDA NRCS 1983). This program used historical rainfall data for all computed frequencies. Modeled storms had 24-hour duration and a Type III rainfall distribution.

The Batson, Josias, Kennebunk, Ogunquit, Ogunquit Tributary and Little Rivers, the Bog, Goosefare, Great, and Smith Brooks, Spruce and Spinney Creeks, and miscellaneous streams and rivers throughout the County of York are ungaged. The 10-, 2-, 1-, and 0.2-percent annual chance flood peak discharges were computed based on the Maine flood magnitude and frequency formulas developed by the USGS, and were found to be applicable to these flood sources (USGS 1975 and FIA 1978). The USGS formulas predict discharges based on the parameters of watershed drainage area, main channel slope, and percentage of area of lakes and ponds.

The values of the peak flows for Cooks and Day Brooks at 10-, 2-, 1-, and 0.2-percent annual chance intervals were obtained using equations developed by R. A. Morrill and outlined in USGS Open-File Report 75-292 (USGS 1975).

The 1% annual chance flood discharge at the outlets of Bunganut Pond, Swan Pond, Kennebunk Pond, and Roberts-Wadley Pond were determined by applying a USGS regression equation (USGS 1975).

Countywide Analyses

The 10-, 2-, 1-, and 0.2-percent annual chance flood flows for Coffin Brook, Coffin Brook Tributary 1, Driscoll Brook, Ferguson Brook, Keay Brook, Little River (Town of Berwick), Mulloy Brook, Worster Brook, and Worster Brook Tributary 3 were computed with regression equations (USGS 1999). The regression equations use drainage area and percent wetlands as explanatory variables. All drainage areas were determined using a Watershed Information System (WISE) (Watershed Concepts Division 2006) and a Geographic Information System (GIS). Basin wetlands were computed with U.S. Fish and Wildlife Service National Wetland Inventory maps at a scale of 1:24,000 with GIS.

For the Mousam River (Town of Kennebunk), flood frequency curves including the 10-, 2-, 1-, and 0.2-percent annual chance flood flows at Whichers Mills Road in Kennebunk were updated after the 2007 flood in southern Maine (USGS 2007). Although continuous data were collected at this historical gage on the Mousam River near Kennebunk (USGS Station number 01069500) from 1939 through 1984, a number of historical peak flows occurred at this station outside of the period of record (1996, 2006, and 2007). Peak flows for selected recurrence intervals were estimated by use of the Expected Moments Algorithm (Cohn and Baier 1997) in order to make better use of the historical peak flow data outside of the period of record. Although station number 01069500 is not in the study area of this detailed flood insurance study, drainage area adjustments were made to the published peak discharges at West Kennebunk in order to estimate peak discharges at three locations on the Mousam River: Twine Mill Dam, the confluence with Day Brook, and US Route 1.

Peak discharges for the same three locations were estimated through drainage area adjustments by use of the following equation:

$$Q_{ungaged} = Q_{gaged}(DA_{ungaged}/DA_{gaged})b;$$

where Q is the flow in cubic feet per second, DA is the drainage area in square miles, and b is a coefficient that depends on the recurrence interval (USGS 1999). Although values of b are published for many recurrence intervals in Hodgkins' report, b was computed specifically for each location and each recurrence interval along the Mousam River in Kennebunk using the formula listed above, and solving for b. Initial values for gaged and ungaged discharge were determined through regression equations that depend on drainage area and percent wetland in the basin (USGS 1999). Regression equations used without the adjustments listed above are inappropriate along the Mousam River because of the regulation in this watershed.

Drainage areas were calculated using Watershed Information System (WISE) (Watershed Concepts Division 2006). Basin wetlands were computed with U.S. Fish and Wildlife Service National Wetland Inventory maps at a scale of 1:24,000 with GIS.

All other previously detail studied areas were re-delineated in 2013 using LiDAR information except for; Goosefare Brook, Kennebunk River, Littlefield River, Mill Brook, Mousam River, Ossipee River, and the Saco River.

For this countywide study, all existing approximate analysis reaches were restudied by approximate methods by Atkins in 2013 (Atkins 2013) and Ransom Consulting Engineers and Scientists in 2012 (Ransom 2012). For the Atkins study, the discharges were computed using the

Table 9: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)			
			10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Mousam River (Town of Kennebunk)	Twine Mill Dam	106.70	3,320	6,220	7,990	14,030
Mulloy Brook	At confluence with Worster Brook	0.47	87	148	178	258
Mulloy Brook	About 1,900 ft upstream from School Street	0.28	71	124	152	224
Ogunquit River	At breached dam	14.60	933	1,551	1,882	2,845
Ogunquit River	Downstream of Maine Turnpike	13.16	859	1,427	1,732	2,618
Ogunquit River	At mouth	13.16	933	1,551	1,882	2,845
Ogunquit River	Upstream of Maine Turnpike	12.94	847	1,408	1,709	2,583
Ogunquit River	East of Maine Turnpike	12.94	859	1,427	1,732	2,618
Ogunquit River	Upstream of North Village Road	11.94	794	1,321	1,602	2,422
Ogunquit River	West of Maine Turnpike	11.94	847	1,408	1,709	2,583
Ogunquit River Tributary	At confluence with Ogunquit River	1.01	110	182	221	334
Ossipee River	Cornish Gage (No. 01065500)	453.00	7,840	11,760	13,690	18,890
Ossipee River	At Corporate Limits	450.00	7,715	11,575	13,470	18,590
Ossipee River	Upstream of Mill Brook	388.00	6,920	10,380	12,080	16,670
Ossipee River	Upstream of South River	354.00	6,435	9,655	11,240	15,510
Roberts-Wadley Pond	At outlet	9.00	*	*	233	*
Saco River	At Springs Dam	1680.00	25,800	38,600	45,000	62,600
Saco River	Saco boundary	1623.00	25,800	38,600	45,000	62,600
Saco River	Skelton hydro-power station	1622.00	25,800	38,600	45,000	62,600
Saco River	Buxton-Dayton-Hollis corporate limits (mouth of Cooks Brook)	1594.00	25,600	38,200	44,200	61,500

Table 9: Summary of Discharges (continued)

Flooding Source	Location	Drainage Area (Square Miles)	Peak Discharge (cfs)			
			10% Annual Chance	2% Annual Chance	1% Annual Chance	0.2% Annual Chance
Saco River	At Bar Mills Dam	1594.00	25,600	38,200	44,200	61,500
Saco River	At West Buxton dam	1572.00	25,400	37,900	44,000	61,000
Saco River	At Bonny Eagle Dam	1560.00	25,300	37,700	43,800	60,600
Saco River	At the Hollis-Limington-Standish town boundary	1550.00	25,200	37,500	43,600	60,200
Saco River	At the Baldwin-Standish-Limington town boundary	1330.00	23,600	34,600	39,800	53,800
Saco River	Cornish Gage (No. 01066000)	1298.00	23,065	33,790	38,950	52,560
Saco River	At the Baldwin-Cornish-Limington town boundary	1296.00	23,100	33,800	39,000	52,600
Saco River-Left Channel	At the Buxton-Town of Standish boundary	1560.00	25,300	37,700	43,800	60,600
Salmon Falls River	At New Dam Road	235.00	4,600	7,460	9,000	13,800
Salmon Falls River	At Walnut Grove Road	149.00	3,360	5,450	6,570	10,080
Salmon Falls River	At Spaulding Avenue	130.00	3,050	4,940	5,960	9,150
Sawyer Brook	At Sawyer Street	0.004	5	9	11	18
Sawyer Brook	At Spring Street	0.26	145	281	359	608
Sawyer Brook	At Therrien Avenue	0.09	65	110	125	165
Smith Brook	At State Route 9	1.54	112	195	241	381
South Branch of West Brook	At confluence with West Brook	2.77	207	347	422	645
Spinney Creek	At confluence with the Piscataqua River	1.03	99	178	222	359
Spruce Creek	At the confluence with the Piscataqua River	2.56	167	285	349	542
Stevens Brook	At U.S. Route 1	2.01	187	336	418	668

Table 11: Stream Gage Information used to Determine Discharges

Flooding Source	Gage Identifier	Agency that Maintains Gage	Site Name	Drainage Area (Square Miles)	Period of Record	
					From	To
Little Ossipee River	01066500	USGS	Little Ossippee River near South Limington, ME	168	3/19/1936	10/22/1996
Ossipee River	01065000	USGS	Ossipee River at Effingham Falls, NH	330	4/29/1943	8/12/1990
Ossipee River	01065500	USGS	Ossipee River at Cornish, ME	452	6/18/1917	4/17/1996
Saco River	01067000	USGS	Saco River at West Buxton, ME	1572	5/4/1908	5/18/1948
Saco River	01066000	USGS	Saco River at Cornish, ME	1293	6/18/1917	4/23/2019
Salmon Falls River	01072500	USGS	Salmon Falls River near South Lebanon, ME	140	3/27/1930	4/23/1969

5.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals. Base flood elevations on the FIRM represent the elevations shown on the Flood Profiles and in the Floodway Data tables in the FIS Report. Rounded whole-foot elevations may be shown on the FIRM in coastal areas, areas of ponding, and other areas with static base flood elevations. These whole-foot elevations may not exactly reflect the elevations derived from the hydraulic analyses. Flood elevations shown on the FIRM are primarily intended for flood insurance rating purposes. For construction and/or floodplain management purposes, users are cautioned to use the flood elevation data presented in this FIS Report in conjunction with the data shown on the FIRM. The hydraulic analyses for this FIS were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

Pre-countywide Analyses

All cross sections, bridges and culverts were surveyed to obtain elevation data, structural data, and structural geometry. Cross sections were selected immediately below changes in stream configuration. Roughness coefficients (Manning's "n") were determined by field inspection at each cross section using a step-by-step procedure. Where feasible, transposed cross sections were used to reduce the number of surveyed cross sections. Transposed cross sections are surveyed sections which can be transferred either upstream or downstream to represent a location which is similar in valley shape.

WSP-2 computer program (USDA NRCS 1976). Starting water-surface elevations for the Little Ossipee River were obtained from the FIS for the Town of Newfield (described below).

Cross section data for the Littlefield River in Alfred were obtained from USGS topographic maps (USGS 1958-1983 and USGS 1956-1983). Below-water portions of the cross sections were taken from maps of Maine lakes (State of Maine 1967). Water-surface elevations of floods of the selected recurrence intervals for the Littlefield River were computed using the USGS step-backwater computer program (USGS 1988). The starting water-surface elevation at the Estes Lake outlet was determined by applying flow over broad-crested weir equations (USGS 1968b). For the Littlefield River, which was modeled without a floodway, the results of the water-surface computations are tabulated for the selected cross sections.

In Alfred, cross section data for the Mousam River (Lower Reach) and Tributary to Middle Branch Mousam River were obtained through field surveys. Water-surface elevations of floods of the selected recurrence intervals for the Mousam River (Lower Reach) and Tributary to Middle Branch Mousam River were computed using the United States Army Corps of Engineers (USACE) HEC-2 computer program (USACE 1991). The starting water-surface elevations for the Mousam River were assumed to be at critical depth downstream of Old Falls Dam in Kennebunk. Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

In Arundel, cross sections for the Kennebeck River were obtained from field surveys and photogrammetric mapping. Water-surface profiles of floods of the selected recurrence intervals on the stream studied by detailed methods were computed using the USACE HEC-2 step-backwater model (USACE 1973). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations for the Kennebunk River were taken from mean spring high tide.

Cross sections for the backwater analyses of the Salmon Falls River in Berwick were obtained from aerial photographs flown in May 1980 at a scale of 1:9,600 (Moore Survey and Mapping 1980). The below-water sections were obtained by field measurement. Water-surface elevations of floods of the selected recurrence intervals were computed using the USACE HEC-2 step-backwater computer program (USACE 1984b). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals. Starting water-surface elevations were calculated using the slope/area method.

In Biddeford, cross section data for the Little River, Saco River, Moors Brook, Thatcher Brook were obtained from topographic maps compiled from aerial photographs (J.W. Sewall 1977). Below-water sections were obtained from field surveys. Water-surface elevations of floods of the selected recurrence intervals were determined using the USACE HEC-2 step-backwater computer program (USACE 1976b). Starting water-surface elevations for the Saco River were based on the computed pool elevations behind Springs Dam and Bradbury Dam. Starting water-surf ace elevations for the Little River, Moors Brook, and Thatcher Brook were determined based on the mean spring high tide. Flood profiles were drawn showing computed water-surface elevations to an accuracy of 0.5 foot for floods of the selected recurrence intervals.

For the Saco River and Saco River-Right Channel in Buxton, cross sections for the backwater analyses were obtained from topographic maps developed from aerial photographs taken on November 13, 1978 (Hansa 1978c and Hansa 1978e). The below-water sections were obtained by field measurements. Water-surface elevations of floods of the selected recurrence intervals were computed through the use of the USGS E-341 step-backwater computer program (USGS 1976b). The downstream starting water-surface elevations were taken from the FIS's for the Town of Dayton and the City of Saco (below). These elevations were verified by computations of discharge at the Bradbury and Springs Dams in the Cities of Biddeford and Saco, respectively. The starting water-surf ace elevations upstream of Skelton Station were determined by a log-Pearson Type III analysis of annual, maximum forebay elevations. The water-surface elevations, for the years 1949 to 1978, were furnished by Central Maine Power Company. The starting elevations upstream of West Buxton and Bar Mills Dams were determined from the spillway discharge curves provided by the Central Maine Power Company. Adjustments were made for maximum flow through the hydro-stations at designated flood times. For the streams studied by approximate methods, the 1% annual chance flood elevations were estimated using a method which was developed by USGS hydrologists at the Augusta, Maine, office. A regional stage-frequency relationship indicated an estimated 10-foot rise over the mapped stream elevation as the inundation limit of the 1% annual chance flood (USGS 1972).

Cross section data for the Saco River, Ossipee River, and Little River (Town of Cornish) in Cornish were obtained from photogrammetric maps; the below-water sections were obtained by field survey J.W. Sewall 1978). Several small wooden bridges were not studied and are not shown because they are assumed to be washed out during flooding. Water-surface elevations of floods of the selected recurrence intervals were computed through the use of the USACE HEC-2 step-backwater computer program (USACE 1976b). Starting water-surface elevations for the Saco, Ossipee, and Little Rivers were calculated using the slope/area method.

Cross section data for the backwater analyses of the Saco River and Cooks Brook in Dayton and Hollis were obtained from aerial photographs taken for this study on November 13, 1978 (Hansa 1978a and Hansa 1978b). The below-water data were obtained by field measurement. Water-surface elevations of floods of the selected recurrence intervals were computed through use of the USGS E431 step-backwater computer program (USGS 1976b). The starting water-surface elevations on the Saco River were taken from the FIS's of the Cities of Biddeford and Saco (both are described within this section). These elevations were verified by computations of discharge at the Bradbury and Springs Dams in Biddeford and Saco, respectively. The starting water-surface elevations upstream of Skelton Station Dam were determined by a log-Pearson Type III analysis of annual maximum forebay elevations. Skelton Station Pond is completely flooded by backwater from the Saco River.

In the Dayton and Hollis area, the starting water-surface elevations on Cooks Brook were determined by computations of discharge over Dennett Dam and Clarks Mill Dam. To determine stage-discharge relations for each of these dams, the study contractor made direct readings of pond elevations, surveyed the dams, and recorded their physical dimensions. Reference points were set in the forebays of the dams so the head on the dams could be computed for observed and measured flows. Current-meter measurements were made at both dams, and a relationship between stages and discharges was determined. These ratings were extended on the basis of the standard flow-over-dam formulas (USGS 1968b):

$$Q = C\ L\ (H)3/2$$

where Q is the discharge being studied (in cfs), C is the coefficient of discharge, L is the length of the dam perpendicular to the direction of flow (in feet), and H is the head on the dam (in feet).

Table 12: Summary of Hydrologic and Hydraulic Analyses (continued)

Flooding Source	Study Limits Downstream Limit	Study Limits Upstream Limit	Hydrologic Model or Method Used	Hydraulic Model or Method Used	Date Analyses Completed	Flood Zone on FIRM	Special Considerations
Ossipee River	Confluence with Saco River	Approximately 2.06 miles upstream of confluence with South River	log-Pearson Type III analysis	HEC-2 step-backwater	1978	AE w/ Floodway	Primary source of peak-flow data from gage at Effingham Falls, NH and Cornish, ME
Piscataqua River	Kittery/Eliot border	Eliot/South Berwick border	review of flood history	USACE HEC-2 step-backwater computer program	1987	AE	Redelineated in 2013
Ponding Area 1	Entire shoreline	Entire shoreline	N/A	N/A	2006	AH	Redelineated in 2013
Ponding Area 2	Entire shoreline	Entire shoreline	N/A	N/A	2006	AH	Redelineated in 2013
Ponding Area 3	Entire shoreline	Entire shoreline	N/A	N/A	2006	AH	Redelineated in 2013
Roberts-Wadley Pond	Entire shoreline	Entire shoreline	USGS regression equation	USGS step-backwater computer program	1989	AE	Rating the outlet overflow weir and culvert pipe. Redelineated in 2013.
Saco River	West Branch Dam	Biddeford/Dayton/ Saco border	log-Pearson Type III analysis	HEC-2 step-backwater	1978, 1982	AE w/ Floodway	Starting water-surface elevations based on computed pool elevations behind the Springs Dam and the Bradbury Dam; City of Saco redelineated in 2006 by Woodward & Curran
Saco River	Biddeford/Dayton/ Saco border	Limington/Cornish border	log-Pearson Type III analysis	USGS E-341 step-backwater	1979	AE w/ Floodway	Computation of flow past the hydro-power plant at West Buxton

Table 14: Roughness Coefficients - continued

Flooding Source	Channel “n”	Overbank “n”
Mulloy Brook	0.045-0.060	0.090
Ogunquit River	0.030-0.050	0.090
Ossipee River	0.03-0.0450	0.070-0.090
Roberts-Wadley Pond (at outlet)	0.030-0.045	0.055-0.110
Saco River	0.030-0.055	0.040-0.110
Saco River (Cornish)	0.035-0.045	0.080-0.090
Saco River (Limington)	0.035-0.055	0.045-0.110
Saco River (Saco and Biddeford)	0.050	0.090
Saco River-Right Channel	0.030-0.055	0.040-0.110
Salmon Falls River (Berwick)	0.030-0.045	0.050-0.150
Salmon Falls River (Rochester, NH)	0.030-0.040	0.060-0.150
Salmon Falls River (Milton, NH)	0.030-0.070	0.040-0.120
Sawyer Brook	0.055-0.065	0.080-0.095
Smith Brook	0.013-0.050	0.050-0.090
South Branch of West Brook	0.050	0.090
Spinney Creek	0.013-0.050	0.050-0.090
Spruce Creek	0.013-0.050	0.050-0.090
Stevens Brook	0.013-0.050	0.050-0.090
Swan Pond (at outlet)	0.030-0.045	0.055-0.110
Thatcher Brook	0.013-0.050	0.050-0.090
Tributary 1 to Cape Neddick River	0.013-0.050	0.090
Tributary 1 to Green Brook	0.013-0.050	0.050-0.090
Tributary to Middle Branch Mousam River	0.045	0.100
Webhannet River	0.050	0.090
West Brook	0.013-0.050	0.050-0.090
Worster Brook	0.030-0.470	0.075-0.120
Worster Brook Tributary 3	0.045-0.055	0.050-0.110

FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION (FEET NAVD 88)			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQUARE FEET)	MEAN VELOCITY (FEET PER SECOND)	REGULATORY	WITHOUT FLOODWAY	WITH FLOODWAY	INCREASE
AB	53,856	300	9,390	4.8	73.7	73.7	74.7	1.0
AC	54,912	320	8,950	5.0	74.1	74.1	75.0	0.9
AD	55,704	520	13,300	3.4	74.5	74.5	75.4	0.9
AE	56,338	340	8,460	5.3	74.6	74.6	75.5	0.9
AF	57,341	490	14,400	3.1	75.1	75.1	76.1	1.0
AG	57,763	820	18,000	2.5	75.2	75.2	76.2	1.0
AH	59,189	270	8,350	5.4	75.4	75.4	76.4	1.0
AI	59,611	1,440	61,300	0.7	127.2	127.2	127.2	0.0
AJ	61,406	720	34,900	1.3	127.2	127.2	127.2	0.0
AK	62,885	830	38,700	1.2	127.2	127.2	127.2	0.0
AL	64,258	1,100	54,800	0.8	127.2	127.2	127.2	0.0
AM	66,158	680	31,000	1.4	127.2	127.2	127.2	0.0
AN	66,739	400	15,700	2.8	127.2	127.2	127.2	0.0
AO	67,162	310	13,300	3.3	127.2	127.2	127.2	0.0
AP	67,478	270	13,400	3.3	127.2	127.2	127.2	0.0
AQ	69,696	200	4,320	10.2	127.2	127.2	127.2	0.0
AR	69,854	230	4,130	10.7	128.6	128.6	128.6	0.0
AS	70,646	470	8,110	5.4	130.5	130.5	130.5	0.0
AT	71,491	270	3,620	12.2	130.8	130.8	130.8	0.0
AU	72,283	300	3,950	11.2	133.7	133.7	134.1	0.4
AV	73,022	260	4,160	10.6	136.4	136.4	136.7	0.3
AW	74,818	300	5,770	7.7	140.7	140.7	141.4	0.7
AX	74,976	490	8,470	5.2	141.1	141.1	142.1	1.0
AY	75,926	340	5,500	7.5	142.0	142.0	142.7	0.7
AZ	76,243	260	3,230	12.8	143.8	143.8	144.5	0.7
BA	76,560	500	7,720	5.7	151.5	151.5	151.5	0.0
BB	77,458	290	4,060	10.9	151.9	151.9	151.9	0.0

[1] FEET ABOVE WEST BRANCH DAM

TABLE 23

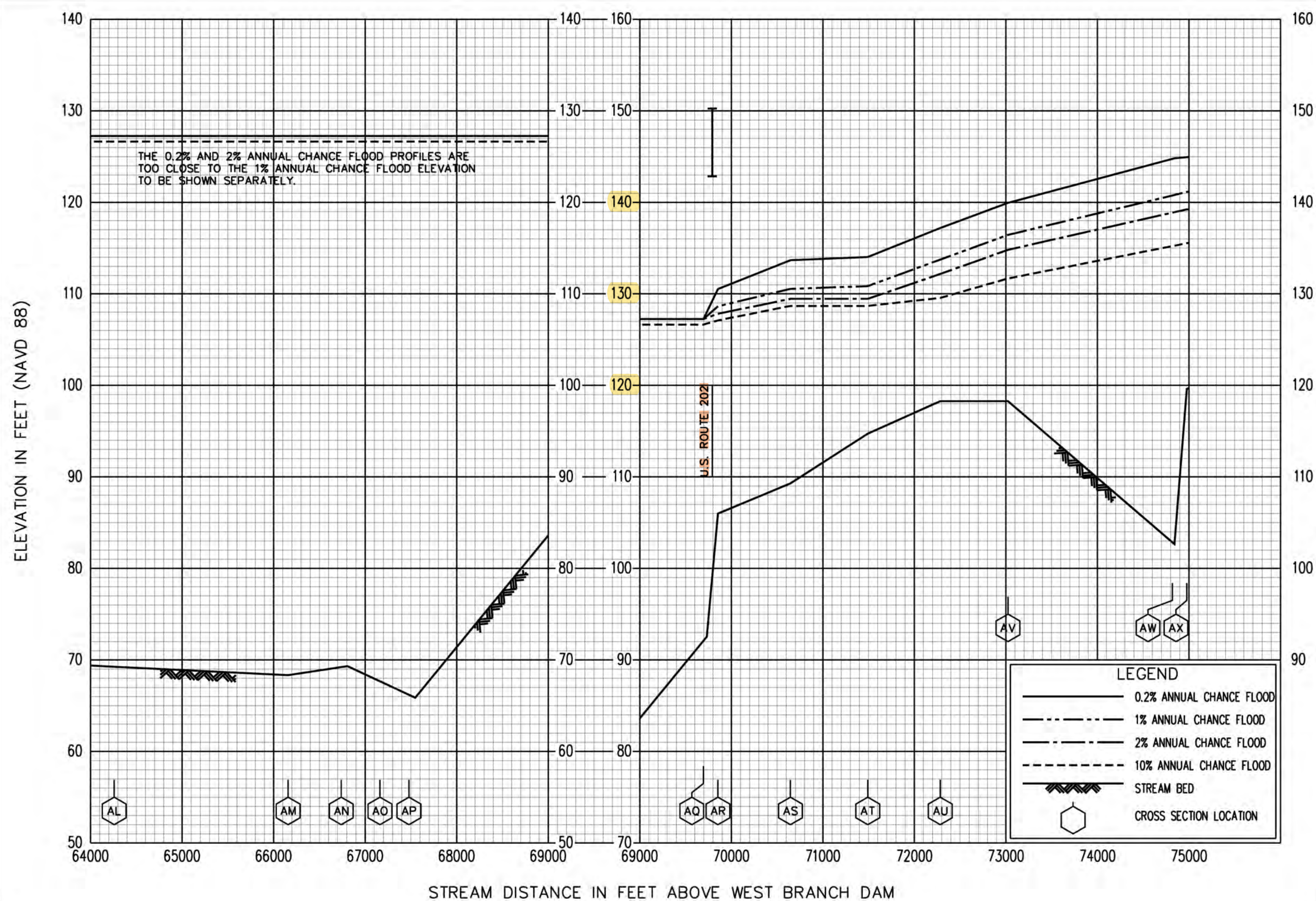
FEDERAL EMERGENCY MANAGEMENT AGENCY

YORK COUNTY, ME

(ALL JURISDICTIONS)

FLOODWAY DATA

SACO RIVER



FLOOD PROFILES

SACO RIVER

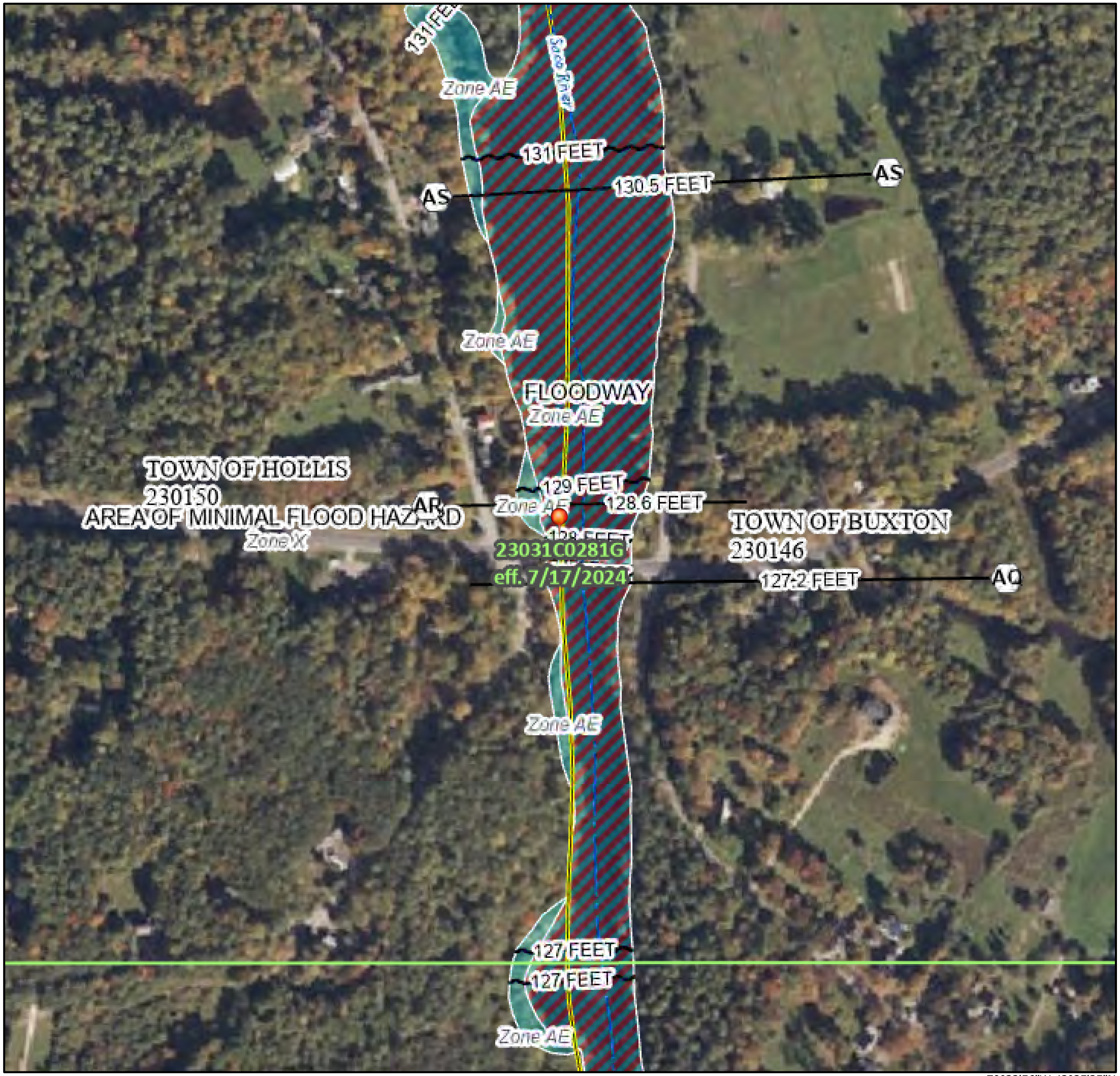
FEDERAL EMERGENCY MANAGEMENT AGENCY

YORK COUNTY, ME
(ALL JURISDICTIONS)

National Flood Hazard Layer FIRMette

FEMA

70°33'34"W 43°36'1"N



70°32'56"W 43°35'35"N

Feet

0 250 500 1,000 1,500 2,000

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN — Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- B 20.2 / 17.5 — Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 — Coastal Transect
- 513 — Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 9/9/2024 at 7:52 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

Detlefsen, Kris

From: Detlefsen, Kris
Sent: Friday, March 7, 2025 9:22 AM
To: Mather, Olin; O'Leary, Keeghan
Subject: FW: Hollis-Buxton Bridge WSE Info
Attachments: Skelton Discharge Rating Curve.png

FYI

Kristopher Detlefsen, **PE***
Section Manager, Water Resources
CHA
Office: (518) 453-4540
kdetlefsen@chasolutions.com
www.chasolutions.com

*GA, IN, MA, ME, NY

*Please note my email address has changed

Finding a better way.

From: Detlefsen, Kris
Sent: Monday, July 8, 2024 2:23 PM
To: Wall, Chris <CWall@chasolutions.com>
Cc: Culmo, Mike <MCulmo@chasolutions.com>; Lusitani, Paul <PLusitani@chasolutions.com>
Subject: Hollis-Buxton Bridge WSE Info

Chris,

I was able to get some info through a contact I have at Brookfield Power. Note the Water surface elevations presented below are referenced to NGVD29 and our survey data is tied to NAVD88.

Translation at the bridge is. NAVD88 = NGVD29- 0.62 ft

As such you need to subtract 0.62 from the elevations presented below.

Also, they provided a contact to reach out to when the bridge goes to construction.

LMK if you want to discuss further.

Kristopher Detlefsen, **PE***
Section Manager, Water Resources
CHA

Office: (518) 453-4540
kdetlefsen@chasolutions.com
www.chasolutions.com

*GA, IN, MA, ME, NY

*Please note my email address has changed

Finding a better way.

From: Karam, Chris <Chris.Karam@brookfieldrenewable.com>
Sent: Monday, July 8, 2024 12:50 PM
To: Detlefsen, Kris <KDetlefsen@chasolutions.com>; LeBlanc, Matt <matt.leblanc@brookfieldrenewable.com>
Cc: Mcdonough, Patrick <Patrick.McDonough@brookfieldrenewable.com>
Subject: RE: [--EXTERNAL--]: Fw: Dam Help - Rating curve for Skelton Hydro Facility

OK, I sit across from Matt and just discussed this with him.

You should plan on the water surface elevation in the reservoir to vary from a low of 123.5 ft to a high of 127.5 ft. The "typical" elevation is 127.0 to 127.5 ft. As indicated on the attached spillway rating curve, if we happen to get an extreme flood of more than 80,000 cfs +/-, the reservoir would get above 127.5 ft but that would be very rare. The gates have enough capacity to lower the reservoir below 123.5 ft but our license doesn't allow it unless there's a dam safety emergency.

Please coordinate with **Matt LeBlanc** (contact info below). We can typically forecast high flows about 2+/- days in advance. We might need to coordinate elevations and flows due to other projects upstream and downstream of Skelton. Keep in mind that we can manage the reservoir elevation but have very little control of the flow in the Saco River flow.

Matt LeBlanc
Operations Manager
C. 207-423-8131
matt.leblanc@brookfieldrenewable.com

What's the plan/scope, schedule and duration of the work?
Will you be installing any cofferdams or bulkheads that restricts flow?
Hopefully, you do not need a reservoir drawdown below 127 ft+/-

Chris R Karam, P.E. (ME, NH, MA, NY, CA)
Senior Dam Safety Engineer
New England, ROC (TN, NC, LA)

C 207.650.2739
Chris.karam@brookfieldrenewable.com

From: Detlefsen, Kris <KDetlefsen@chasolutions.com>
Sent: Monday, July 8, 2024 12:29 PM
To: Karam, Chris <Chris.Karam@brookfieldrenewable.com>

Cc: Dale, Gary <Gary.Dale@brookfieldrenewable.com>
Subject: RE: [--EXTERNAL--]: Fw: Dam Help - Rating curve for Skelton Hydro Facility

Chris,

To clarify, I sent the e-mail below to Matt LeBlanc on Friday and don't want to have multiple folks working on this request.

The bridge we are working on carries Route 202 over the Saco River approximately 1.8 miles US of the Skelton Dam and is within the headwater influence. We have a recent FEMA study for the larger flood events but are trying to establish a water surface elevation for the smaller events to estimate what to expect during construction. As such, I am interested in a stage discharge curve for Skelton Dam and maybe a typical summer operating level for the reservoir.

Thanks for your time,

Kristopher Detlefsen, **PE***
Section Manager, Water Resources
CHA
Office: (518) 453-4540
kdetlefsen@chasolutions.com
www.chasolutions.com

*GA, IN, MA, ME, NY

**Please note my email address has changed*

Finding a better way.

From: Karam, Chris <Chris.Karam@brookfieldrenewable.com>
Sent: Monday, July 8, 2024 12:14 PM
To: Detlefsen, Kris <KDetlefsen@chasolutions.com>
Cc: Dale, Gary <Gary.Dale@brookfieldrenewable.com>
Subject: [--EXTERNAL--]: Fw: Dam Help - Rating curve for Skelton Hydro Facility

Hi Kris,
I should be able to help you. Can you please send me an exact location? There are several bridges upstream of Skelton Dam and other dams including Bar Mills and West Buxton. I'm thinking you are working on the West Buxton Bridge.

Chris

Chris R Karam, P.E. (ME, NH, MA, NY, CA)
Senior Dam Safety Engineer
New England, ROC (TN, NC, LA)

C 207.650.2739
150 Main Street Lewiston, ME 04240
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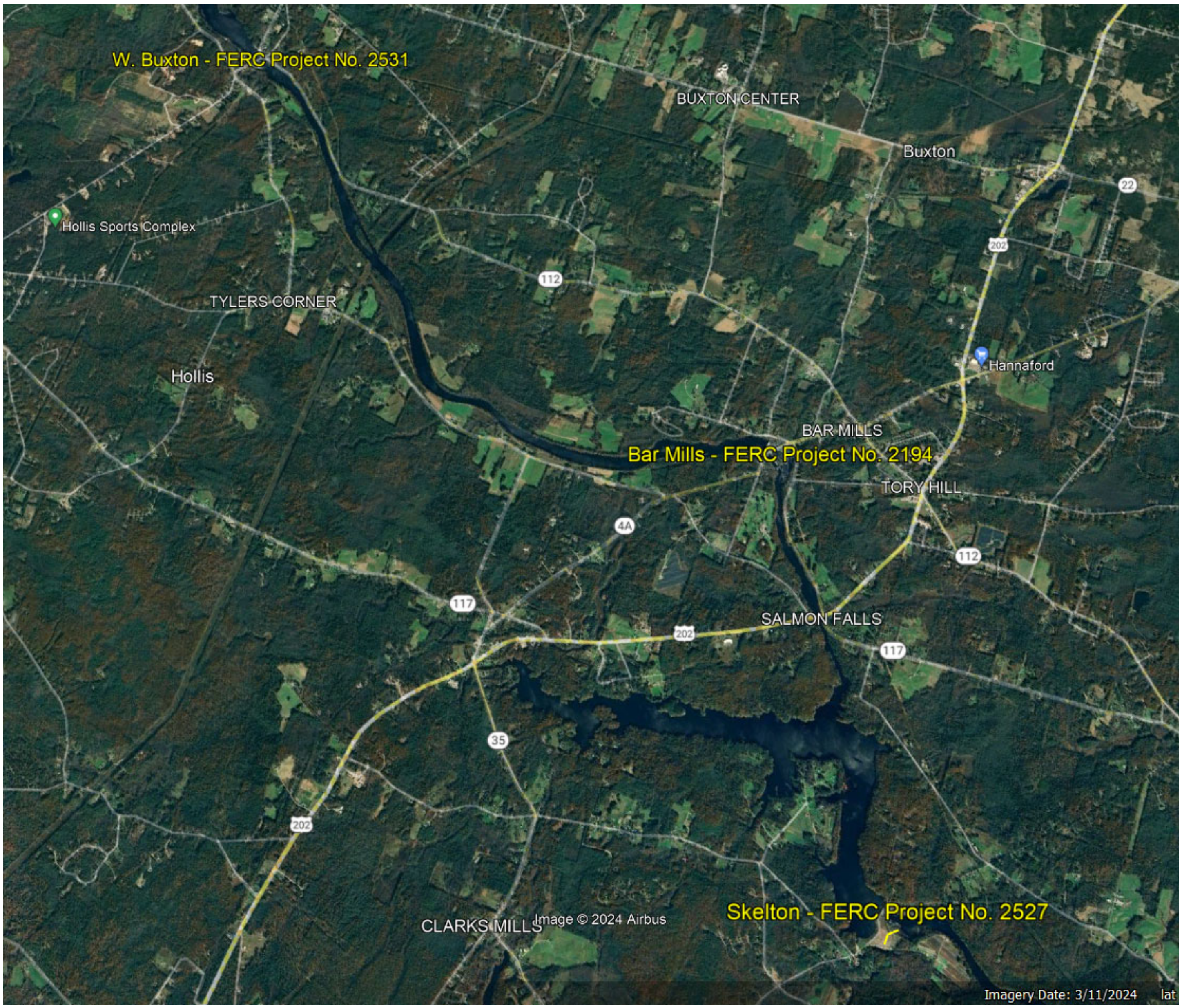
Brookfield
Renewable U.S.



From: Dale, Gary <Gary.Dale@brookfieldrenewable.com>
Sent: Wednesday, July 3, 2024 12:44 PM
To: Karam, Chris <Chris.Karam@brookfieldrenewable.com>
Subject: FW: Dam Help - Rating curve for Skelton Hydro Faciltiy

Chris,

Below is the email I received from my colleague at CHA who is looking for some information.

Thanks for the assistance.

Gary

Gary Dale, P.E.

Dam Safety Engineer

New York and Minnesota

C 518.577.0038
gary.dale@brookfieldrenewable.com

brookfieldrenewableUS.com

Brookfield
Renewable U.S.

From: gary dale <grd5851@hotmail.com>
Sent: Wednesday, July 3, 2024 12:24 PM
To: Dale, Gary <Gary.Dale@brookfieldrenewable.com>
Subject: Fwd: Dam Help - Rating curve for Skelton Hydro Faciltiy