

Hydrology and Hydraulics Report

Webster Plt Mattagodus Bridge #5116

WIN 022266.00

HYDROLOGY AND HYDRAULIC REPORT

The Mattagodus Bridge (#5116) is located over the Mattagodus Stream and carries Route 170 in Webster Plantation in Penobscot County, Maine. The Mattagodus Stream watershed extends to the south and east from the bridge location. Approximately 4.17 miles downstream of the bridge, the Mattagodus Stream flows into the Mattawamkeag River in the township of Kingman. The slope of the Mattagodus Stream is extremely flat and it is very possible that the Mattawamkeag River elevation controls the elevation of the Mattagodus up to the bridge in Webster Plt. The area around the bridge could be described as marshy with wide, flat overbanks.



Fig. 1: Upstream View

Because the site is undeveloped, there is a lack of recorded flood water elevation information. There was no FEMA Flood Insurance Study found for the town. There was no FEMA Flood Insurance Study found for Kingman Township either, but there is one for the town of Mattawamkeag, including information for the Mattawamkeag River. Unfortunately, the limit of study in Mattawamkeag is too far downstream to have any influence on the bridge in Webster Plt.

Webster Plantation also does not appear to have a Flood Insurance Rate Map (FIRM), however Kingman Township has one effective from 1985. Comparing USGS maps along with the Kingman FIRM, the water elevation for the base flood elevation (Q100) could be anywhere from elevation 320 ft to 330 ft. The flood boundary does not always correlate well with the contours, so there is certainly some error in the FIRM. The low chord of the current bridge is at approximate elevation 324.5 and the top of curb is close to elevation 330. The low point of the road in the vicinity of the bridge to the west is about elevation 326 ft.

In addition to written records, the team reached out to Regional Maintenance for any known flood history. The sentiment from the Region is that there has never been any known flooding issues and the water hasn't come very close to the beams. When the water comes up, it seems to push out towards the overbanks and flood back into the woods. This is consistent with the topography.

The drainage basin characteristics for this river at the bridge location were provided by the Maine Department of Transportation Environmental Office, Hydrology Section. Peak flows were calculated with techniques described in the United States Geological Survey Regression Equations (Hodgkins, 1999 & Lombard/Hodgkins, 2015). Discharges calculated are as shown below:

SUMMARY		
Drainage Area	45.3	mi ²
Q1.1	390.3	ft ³ /s
Q10	1250.2	ft ³ /s
Q25	1540.8	ft ³ /s
Q50	1761.4	ft ³ /s
Q100	1997.6	ft ³ /s
Q500	2556.3	ft ³ /s

The average riverbed slope of the Mattagodus Stream can be approximated by reviewing USGS maps and the project survey data. As noted previously, the stream seems very flat. On a typical day, it is difficult to tell which direction the water flows. There isn't a single contour crossing the stream between the bridge and the confluence with the Mattawamkeag River. The closest contour found on a USGS map downstream is elevation 310 on the Mattawamkeag River just downstream from the confluence of the Mattagodus. The stream flows from south to north. It's the same situation upstream.

All of the above facts and characteristics of the site led to the determination that a standard 1-D hydraulic analysis would not be appropriate. The model would be extremely sensitive to the downstream boundary condition which would only be a guess. These types of

stream sites deserve a 2-D analysis if accuracy is the desired outcome, but a 2-D analysis would require a lot more survey and engineering time. Since there has been no known flooding issues on this extremely low volume, low priority roadway, the team felt that a qualitative hydraulic analysis should be sufficient. Considering that the stream is very flat, the floodplain is very wide and flat, and the whole area likely floods up to a consistent elevation, the recommendation is to keep the low chord of the proposed structure at or above the existing low chord. In addition, since the targeted bankfull width is larger than the existing clear span, it is likely that the clear opening under the bridge will increase. Therefore, it is believed that the new bridge will not make matters any worse, but likely improve the hydraulics.

Scour should also not be an issue for the above reasons as well since there will be hardly any velocity to the stream even at flood levels.

WIN:	22266.00		
Town:	Webster Plt		
Route No.	ME 170		
Asset ID:	5116		
Lat:	45.522948	Long:	-68.15919

Project Name:	Webster Mattagodus
Stream Name:	Mattagodus Stream
Bridge Name:	Mattagodus
Analysis by:	DFB
Date:	8/15/2017

Peak Flow Calculations by USGS Regression Equations (Hodgkins, 1999 & Lombard/Hodgkins, 2015)

Enter data in blue cells only!

	km ²	mi ²	ac
A	117.33	45.30	28992.0
W	21.35	8.2	5276.5

P _c	568978	5034571
County	Penobscot S	
pptA	39.5	
SG	0.00	

A (km ²)	117.33
W (%)	18.20

Conf Lvl

Enter data in [mi²]

Watershed Area *DRNAREA*
Wetlands area (by NWI)

watershed centroid (E, N; UTM 19N; meters)

choose county from drop-down menu

mean annual precipitation (inches; by look-up)

sand & gravel aquifer as decimal fraction of watershed A

NWI Wetlands % *STORNWI*

Worksheet prepared by:

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Maine Dept. Transportation
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207-557-1052

Charles.Hebson@maine.gov
ver. 2017 Jun. 09

References:

Hodgkins, G.A., 1999.
Estimating the magnitude of peak flows for streams
in Maine for selected recurrence intervals
WRIR 99-4008, USGS Augusta, ME

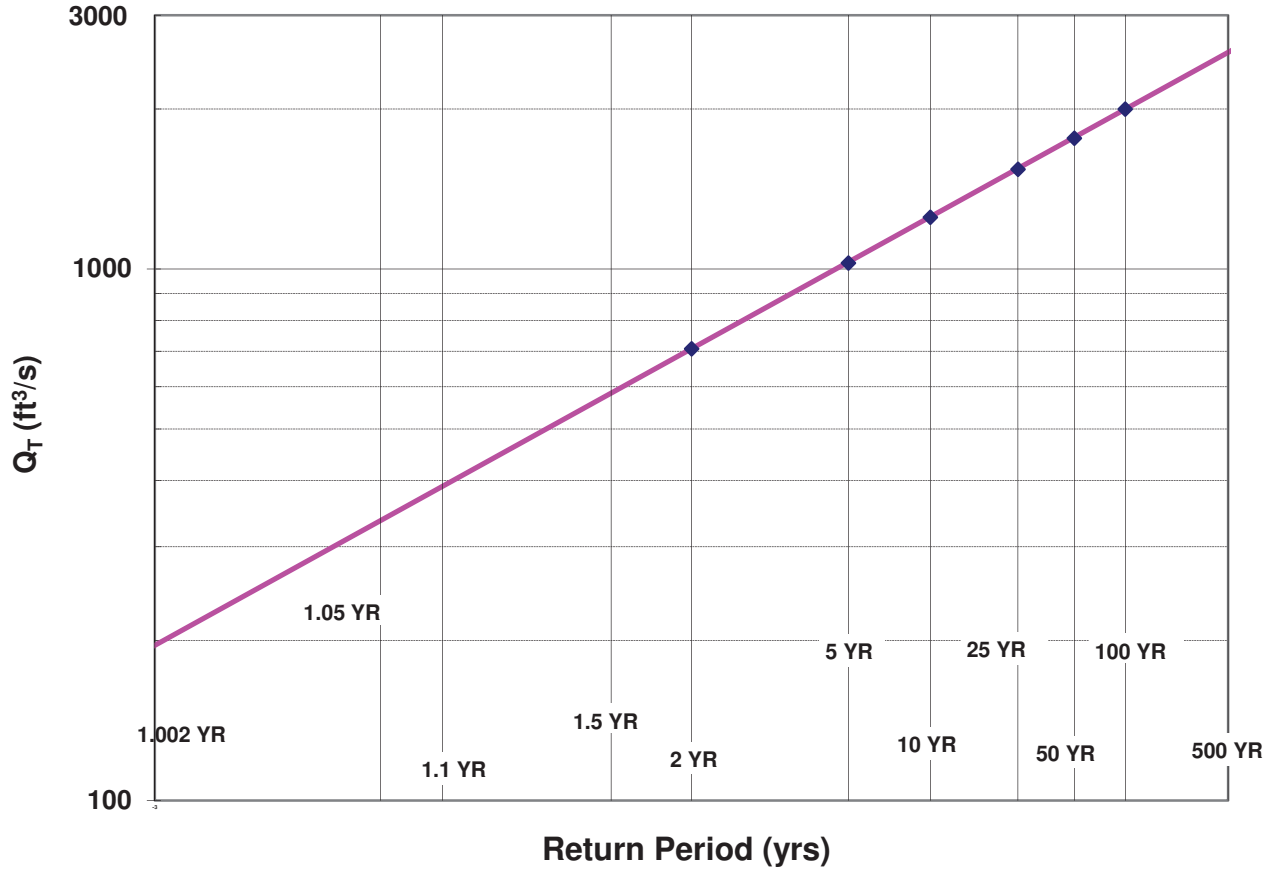
Lombard, P.J. & G.A. Hodgkins, 2015.
Peak flow regression equations for small, ungaged streams in
Maine - Comparing map-based to field-based variables
SIR 2015-4059, USGS, Augusta, ME

Ret Pd	Peak Flow Estimate		
	T (yr)	Lower	Upper
1.1		11.05	
2		20.05	
5		29.06	
10		35.41	
25		43.64	
50		49.88	
100		56.57	
500		72.40	

Q _T (ft ³ /s)
390.3
708.0
1025.9
1250.2
1540.8
1761.4
1997.6
2556.3

$$Q_T = b \times A^a \times 10^{-wW}$$

Log-Normal Probability Plot



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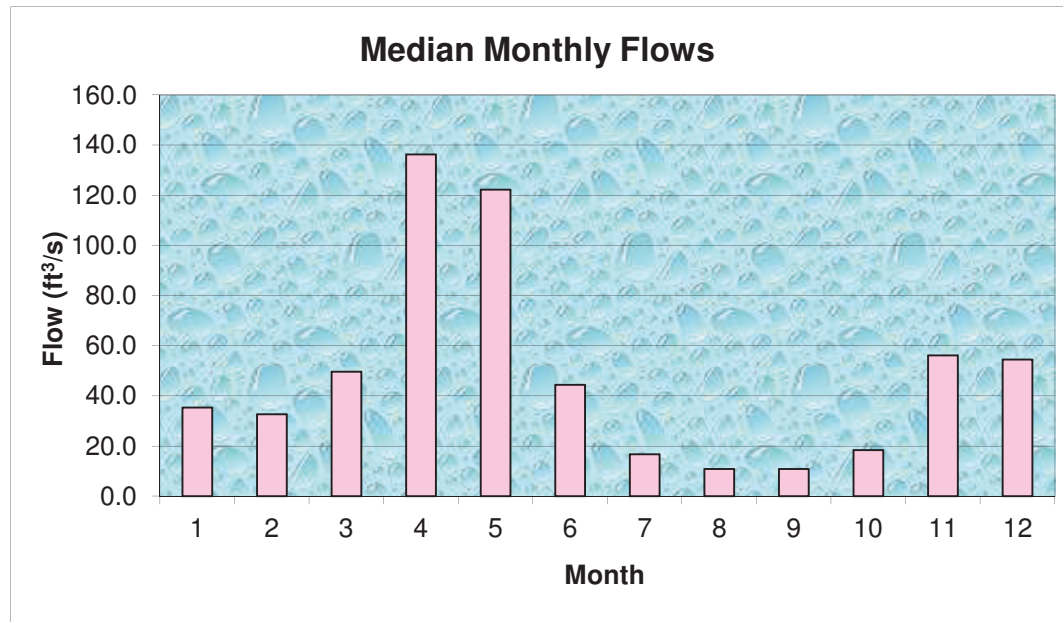
Project Name:	Webster Mattagodus
Stream Name:	Mattagodus Stream
Bridge Name:	Mattagodus
Analysis by:	DFB
Date:	8/15/2017

DO NOT ENTER ANY DATA ON THIS PAGE; EVERYTHING IS CALCULATED

MAINE MONTHLY MEDIAN FLOWS and HYDRAULIC GEOMETRY BY USGS REGRESSION EQUATIONS (2004, 2013)

Value	Variable	Explanation
45.30	A	Area (mi ²)
568977.9	P _c	Watershed centroid (E,N; UTM; Zone 19; meters)
88.28	DIST	Distance from Coastal reference line (mi)
39.5	pptA	Mean Annual Precipitation (inches)
0.00	SG	Sand & Gravel Aquifer (decimal fraction of watershed area)

Month	Q _{median} (ft ³ /s)	(m ³ /s)
Jan	35.41	1.0035
Feb	32.75	0.9280
Mar	49.70	1.4084
Apr	136.36	3.8642
May	122.29	3.4654
Jun	44.43	1.2590
Jul	16.79	0.4758
Aug	10.88	0.3084
Sep	10.91	0.3093
Oct	18.44	0.5226
Nov	56.21	1.5928
Dec	54.58	1.5467



Q _{bf}	284.5
ann avg	85.0
ann med	40.5
Q _{1.002}	195.9
Q _{1.01}	250.2
Q _{1.05}	336.1
Q _{bf}	473.7

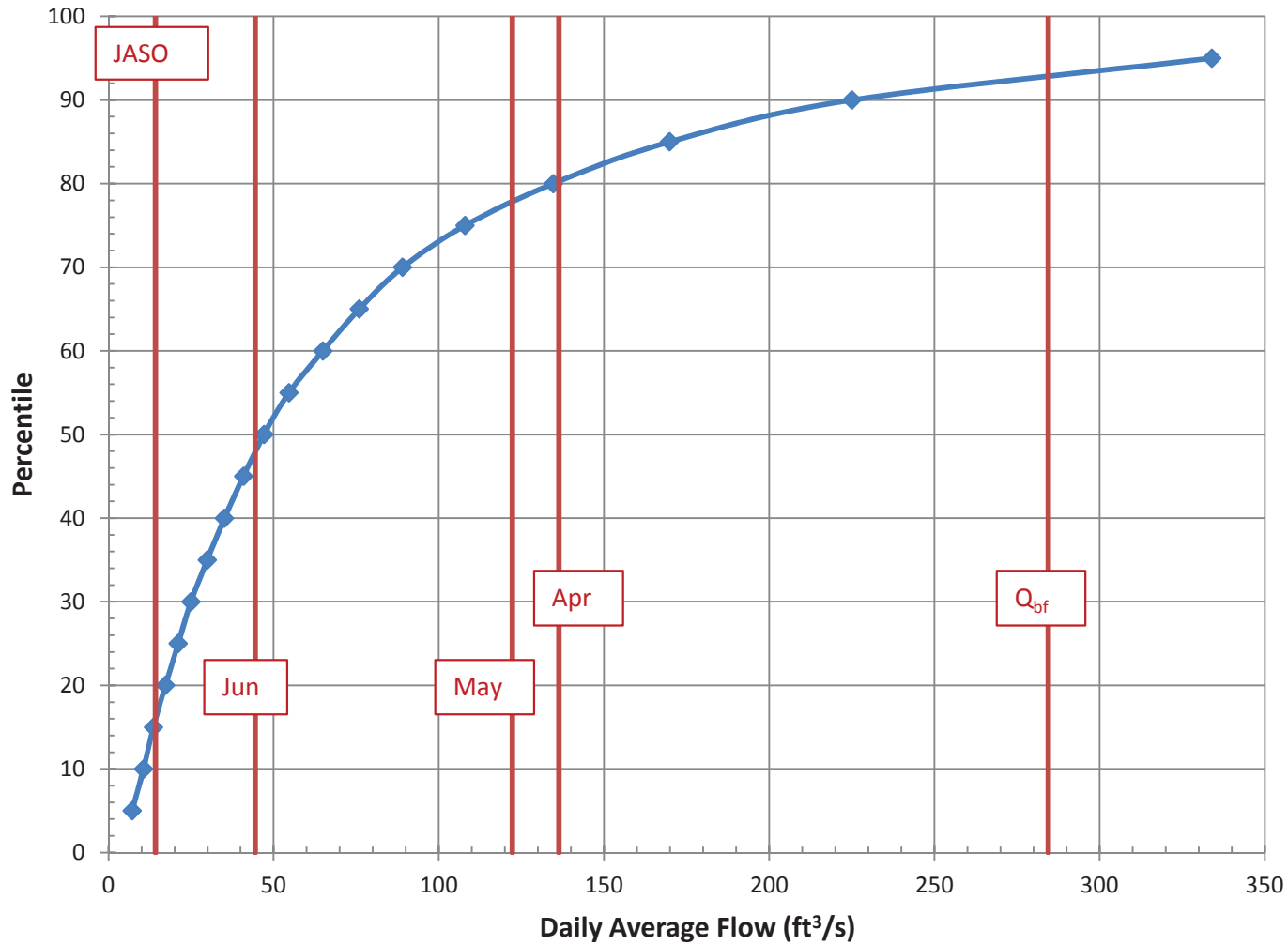
assume v = 4ft/s

W _{bf}	54.5	estimated bankfull width (ft)
d _{bf}	2.2	estimated bankfull depth (ft)
A _{bf}	120.9	estimated bankfull flow area (ft ²)

References

- Dudley, R.W., 2013. FY2013 Progress Report - Phase 1 ..., USFWS QRP Project
- Dudley, R.W., 2004. Estimating Monthly Streamflows ... , SIR 2004-5026

Daily Average Flow Distribution



Daily Avg Flow Dist

$A_{ws} = (mi^2)$ 45.3

Q (ft³/s)

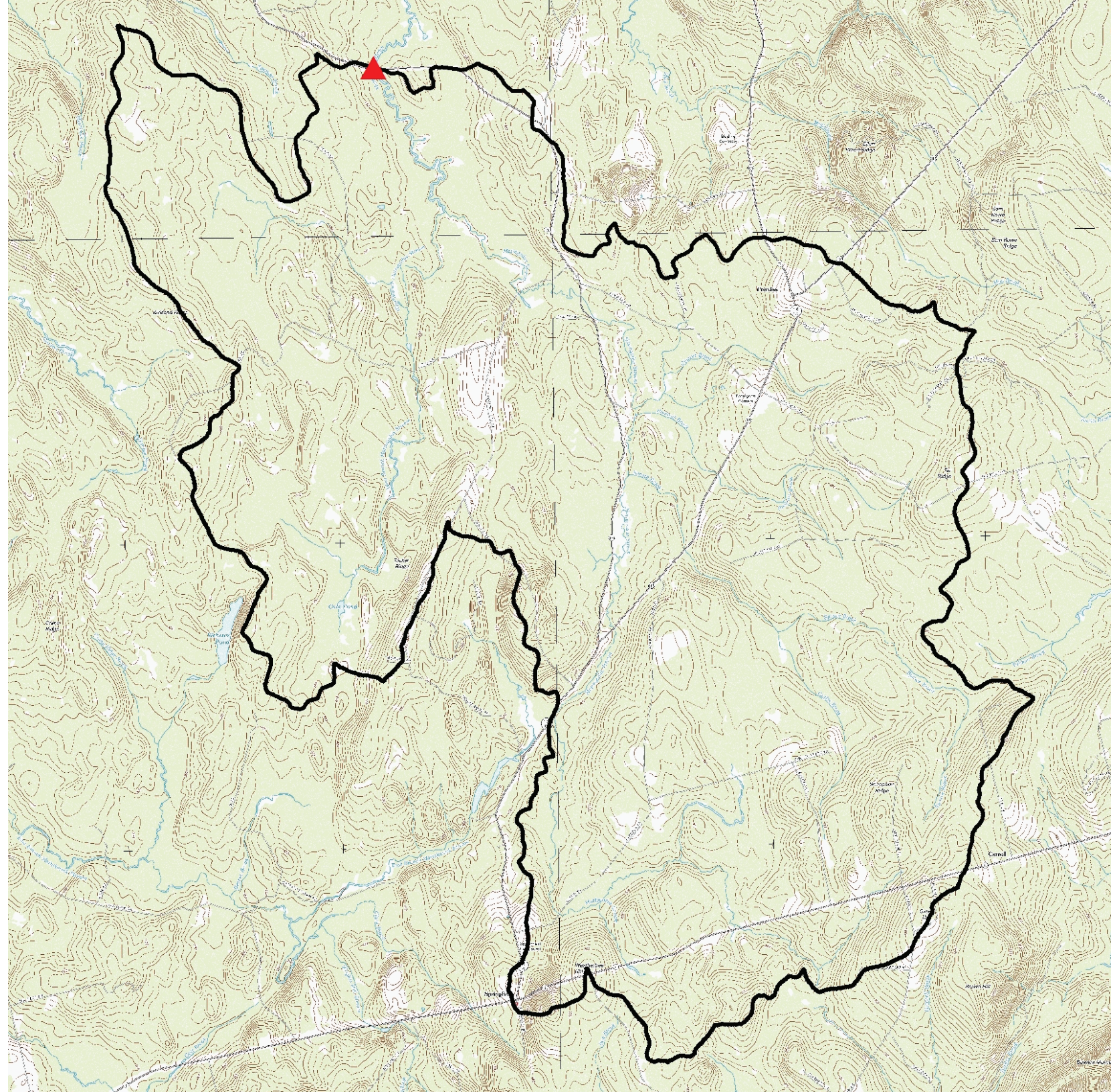
Pctl	Median	84 th pctl
5	7.13	11.48
10	10.59	15.93
15	13.61	19.89
20	17.24	24.11
25	21.09	28.27
30	24.96	32.20
35	29.90	36.80
40	35.06	42.32
45	40.87	47.85
50	47.06	56.49
55	54.65	65.74
60	64.90	77.17
65	75.92	89.91
70	89.06	104.90
75	107.96	126.14
80	134.64	150.61
85	169.89	193.00
90	225.04	259.16
95	333.98	403.02

Q_{bf} 284.5

$Q_{1.002}$ 195.9

$Q_{1.1}$ 390.3

Q_2 708.0



Webster Plt 22266 ME170 @ Mattagodus Stream Br # 5116

Region ID:

ME

Workspace ID:

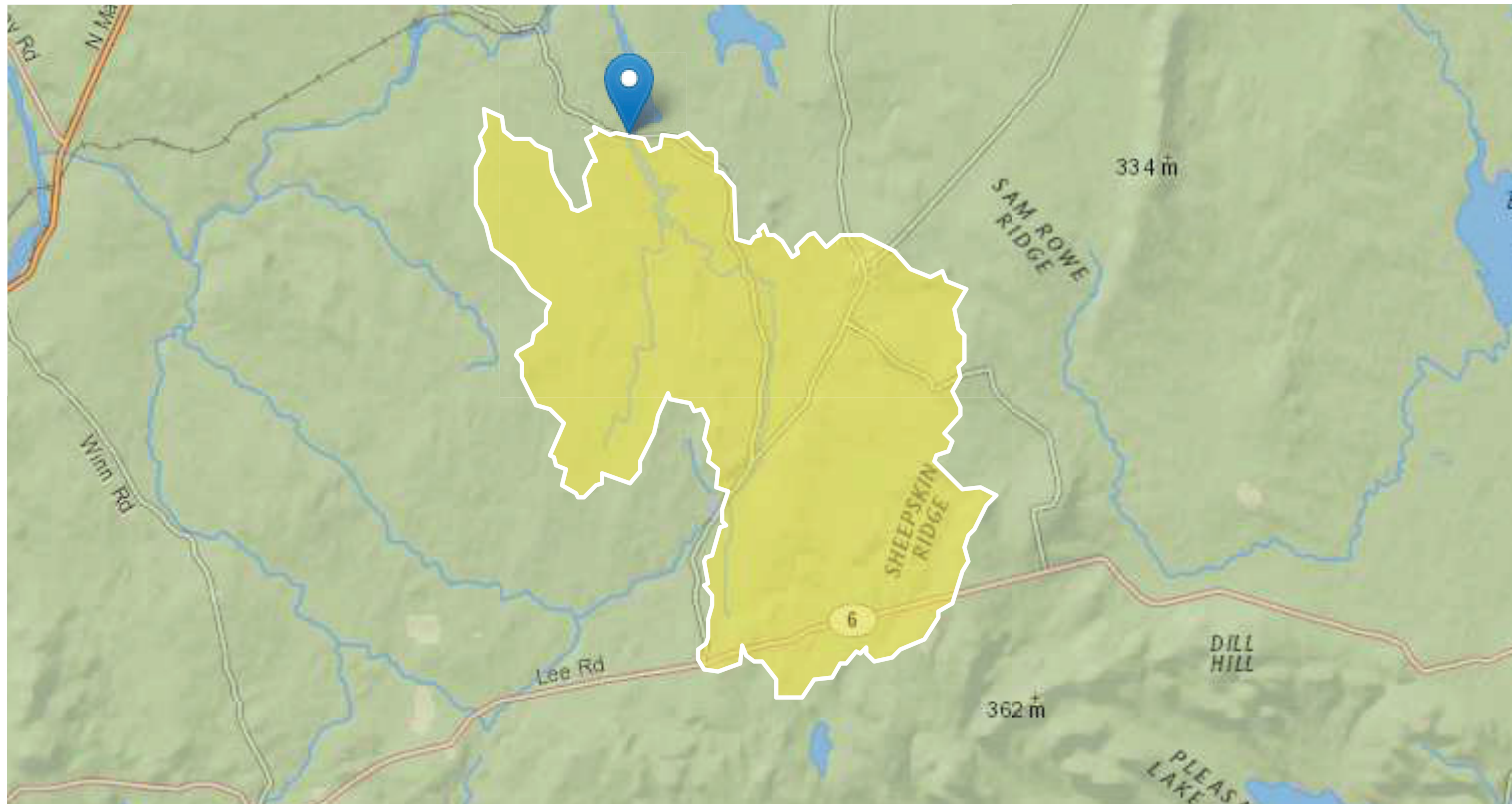
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Clicked Point (Latitude, Longitude):

45.52304, -68.15920

Time:

2017-03-14 10:38:10 -0400



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	45.3	square miles
STORNWI	Percentage of storage (combined water bodies and wetlands) from the National Wetlands Inventory	18.2	percent
ELEV	Mean Basin Elevation	494.5	feet
PRECIP	Mean Annual Precipitation	44.9	inches
SANDGRAVAP	Percentage of land surface underlain by sand and gravel aquifers	1.56	percent
COASTDIST	Shortest distance from the coastline to the basin centroid	89.5	miles
CENTROIDX	Basin centroid horizontal (x) location in state plane coordinates	568977.91	State plane coordinates
CENTROIDY	Basin centroid vertical (y) location in state plane units	5034570.63	State plane coordinates
SANDGRAVAF	Fraction of land surface underlain by sand and gravel aquifers	0.016	dimensionless
LC11IMP	Average percentage of impervious area determined from NLCD 2011 impervious dataset	0.32	percent
LC11DEV	Percentage of developed (urban) land from NLCD 2011 classes 21-24	2.42	percent
LC06WATER	Percent of open water, class 11, from NLCD 2006	0.1	percent
ELEVMAX	Maximum basin elevation	1041.6	feet
BSLDEM10M	Mean basin slope computed from 10 m DEM	4.84	percent
STATSGOA	Percentage of area of Hydrologic Soil Type A from STATSGO	3.99	percent

Peak-Flow Statistics Parameters [100 Percent (NaN square miles) Statewide Peak Flow Full GT 12sqmi WRI 99 4008]

Parameter Code	Parameter Name	Value	Units	Min Limit	Max Limit
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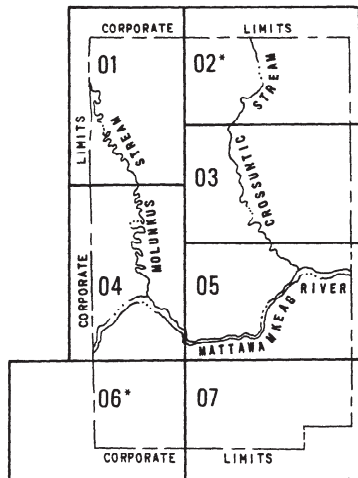
DRNAREA	Drainage Area	45.3	square miles	0.93	1653
STORNWI	Percentage of Storage from NWI	18.2	percent	0.7	26.7

Peak-Flow Statistics Flow Report [100 Percent (NaN square miles) Statewide Peak Flow Full GT 12sqmi WRI 99 4008]

Statistic	Value	Unit	Average standard error (of either estimate or prediction)	Equivalent years of record	Lower Prediction Interval	Upper Prediction Interval
2 Year Peak Flood	708	ft ³ /s	35.1	1.8	396	1270
5 Year Peak Flood	1030	ft ³ /s	36.1	2.5	568	1850
10 Year Peak Flood	1250	ft ³ /s	36.8	3.2	682	2290
25 Year Peak Flood	1540	ft ³ /s	38.6	4.1	820	2900
50 Year Peak Flood	1760	ft ³ /s	39.9	4.8	918	3380
100 Year Peak Flood	2000	ft ³ /s	41.2	5.4	1020	3920
500 Year Peak Flood	2560	ft ³ /s	44.9	6.4	1230	5300

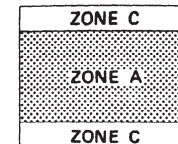
Peak-Flow Statistics Citations

Hodgkins, G. A.,1999, Estimating the Magnitude of Peak Flows for Streams in Maine for Selected Recurrence Intervals: U.S. Geological Survey Water-Resources Investigations Report 99-4008, 45 p. (<http://me.water.usgs.gov/99-4008.pdf>)



*PAGE NOT PRINTED - AREA IN ZONE C

KEY TO SYMBOLS



ZONE DESIGNATIONS*

- Base Flood Elevation Line with elevation in feet — 513 —
- Base Flood Elevation where uniform within zone (EL 987)
- Elevation Reference Mark RM7_x
- River Mile • M1.5

***EXPLANATION OF ZONE DESIGNATIONS**

A flood insurance map displays the zone designations for a community according to areas of designated flood hazards. The zone designations used by FEMA are:

- | Zone | Explanation |
|--------|--|
| A | Areas of 100-year flood, base flood elevations and flood hazard factors not determined. |
| AO | Areas of 100-year shallow flooding, flood depth 1 to 3 feet, product of flood depth (feet) and velocity (feet per second) less than 15. |
| AH | Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet, base flood elevations are shown, but no flood hazard factors are determined. |
| A1-A30 | Areas of 100-year flood, base flood elevations and flood hazard factors determined. |
| A99 | Areas of 100-year flood to be protected by a flood protection system under construction, base flood elevations and flood hazard factors not determined. |
| B | Area between limits of 100-year flood and 500-year flood, areas of 100-year shallow flooding where depths less than 1 foot. |
| C | Areas outside 500-year flood. |
| D | Areas of undetermined, but possible, flood hazards. |
| V | Areas of 100-year coastal flood with velocity (wave action), base flood elevations and flood hazard factors not determined. |
| V1-V30 | Areas of 100-year coastal flood with velocity (wave action), base flood elevations and flood hazard factor determined. |

NOTES TO USER

Certain areas not in the special flood hazard areas (zones A and V) may be protected by flood control structures.


This map is for flood insurance purposes only, it does not necessarily show all areas subject to flooding in the community or all planimetric features outside special flood hazard areas.

Refer to the FLOOD INSURANCE RATE MAP EFFECTIVE date shown on this map to determine when actuarial rates apply to structures in the zones where elevations or depths have been established.

To determine if flood insurance is available in this community, contact your insurance agent, or call the National Flood Insurance Program, at (800) 638-6920.

INITIAL IDENTIFICATION: JANUARY 24, 1975
 FLOOD HAZARD BOUNDARY MAP REVISIONS: NONE
 FLOOD INSURANCE RATE MAP EFFECTIVE: JANUARY 17, 1985
 FLOOD INSURANCE RATE MAP REVISIONS:

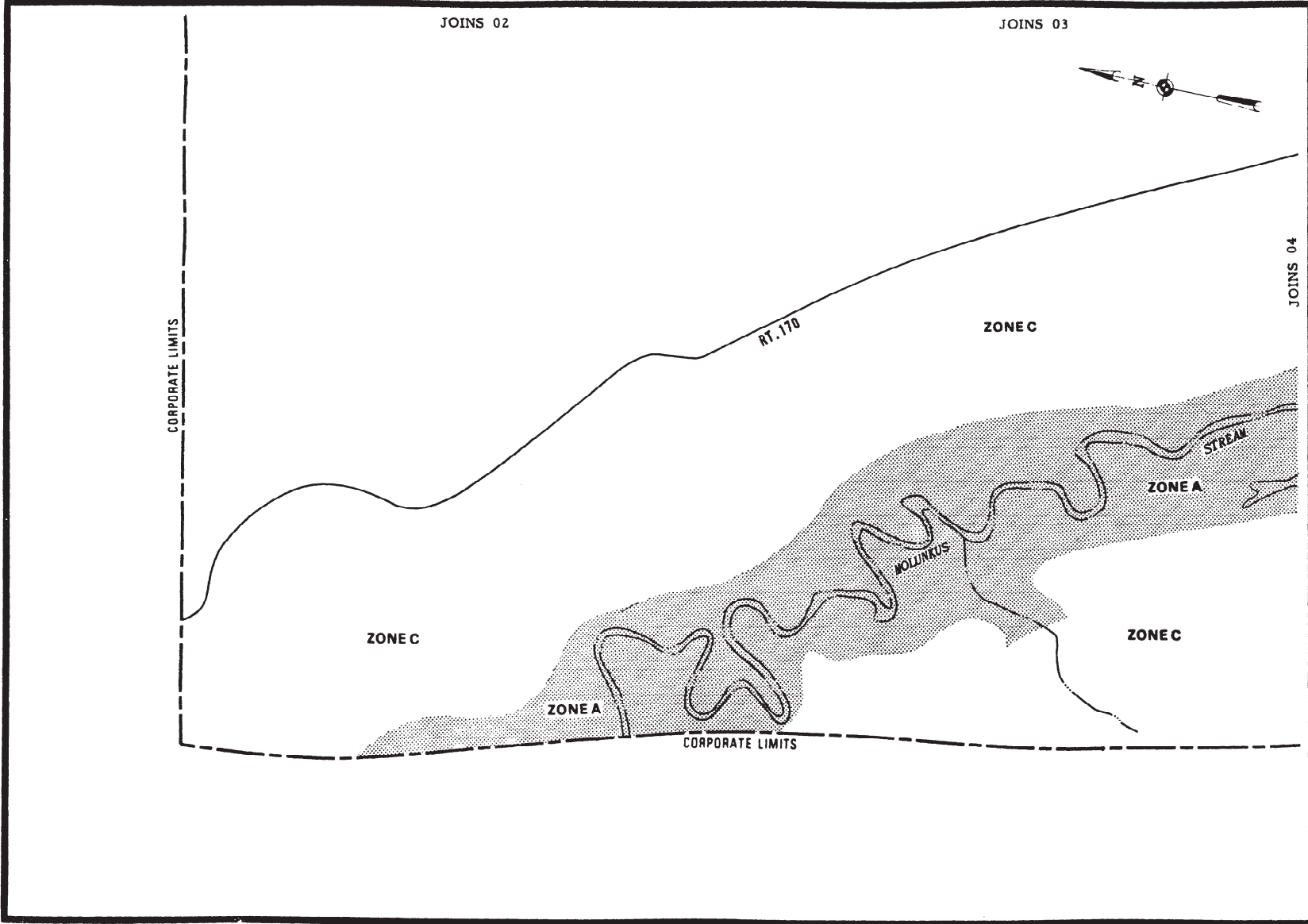
federal emergency management agency



FIRM
FLOOD INSURANCE RATE MAP 01-07
MAP INDEX

TOWNSHIP OF KINGMAN, ME
PENOBSCOT COUNTY

COMMUNITY NUMBER 230474 A



federal emergency management agency TOWNSHIP OF KINGMAN, ME PENOBSCOT COUNTY	APPROXIMATE SCALE 1000 2000 3000 FEET	EFFECTIVE DATE JANUARY 17, 1986
	FLOOD INSURANCE RATE MAP COMMUNITY NUMBER 230474 A	
01		

JOINS 04

JOINS 01

JOINS 02

JOINS 05

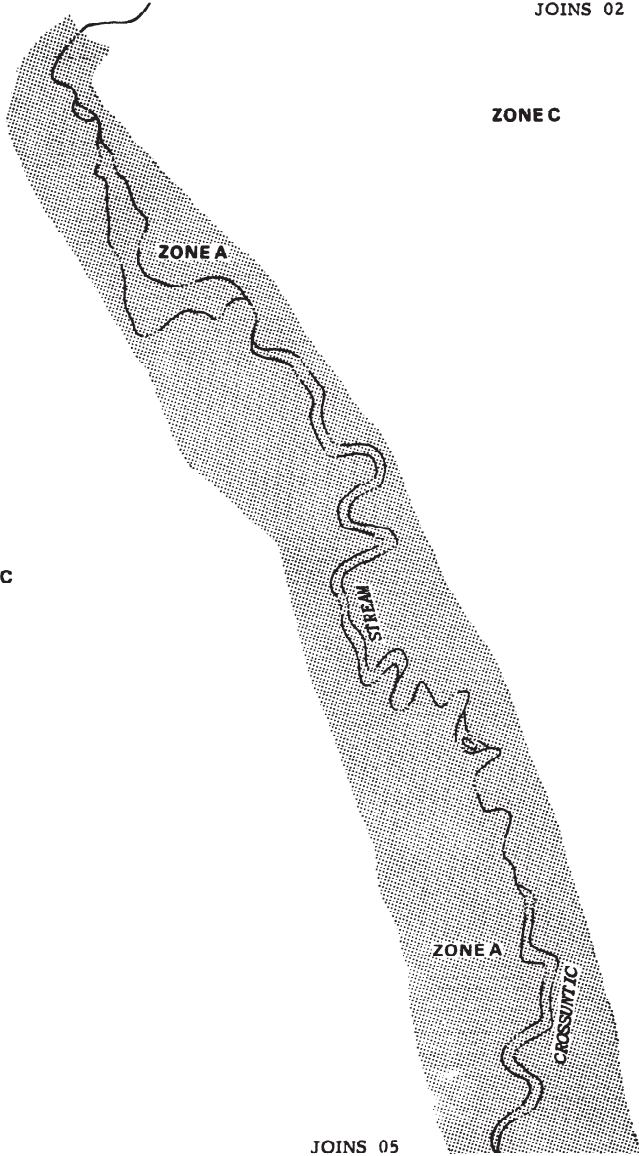
ZONE C

ZONE C

ZONE A

ZONE A

ZONE C



CORPORATE LIMITS

federal emergency management agency

TOWNSHIP OF KINGMAN, ME
PENOBSCOT COUNTY

03

APPROXIMATE SCALE

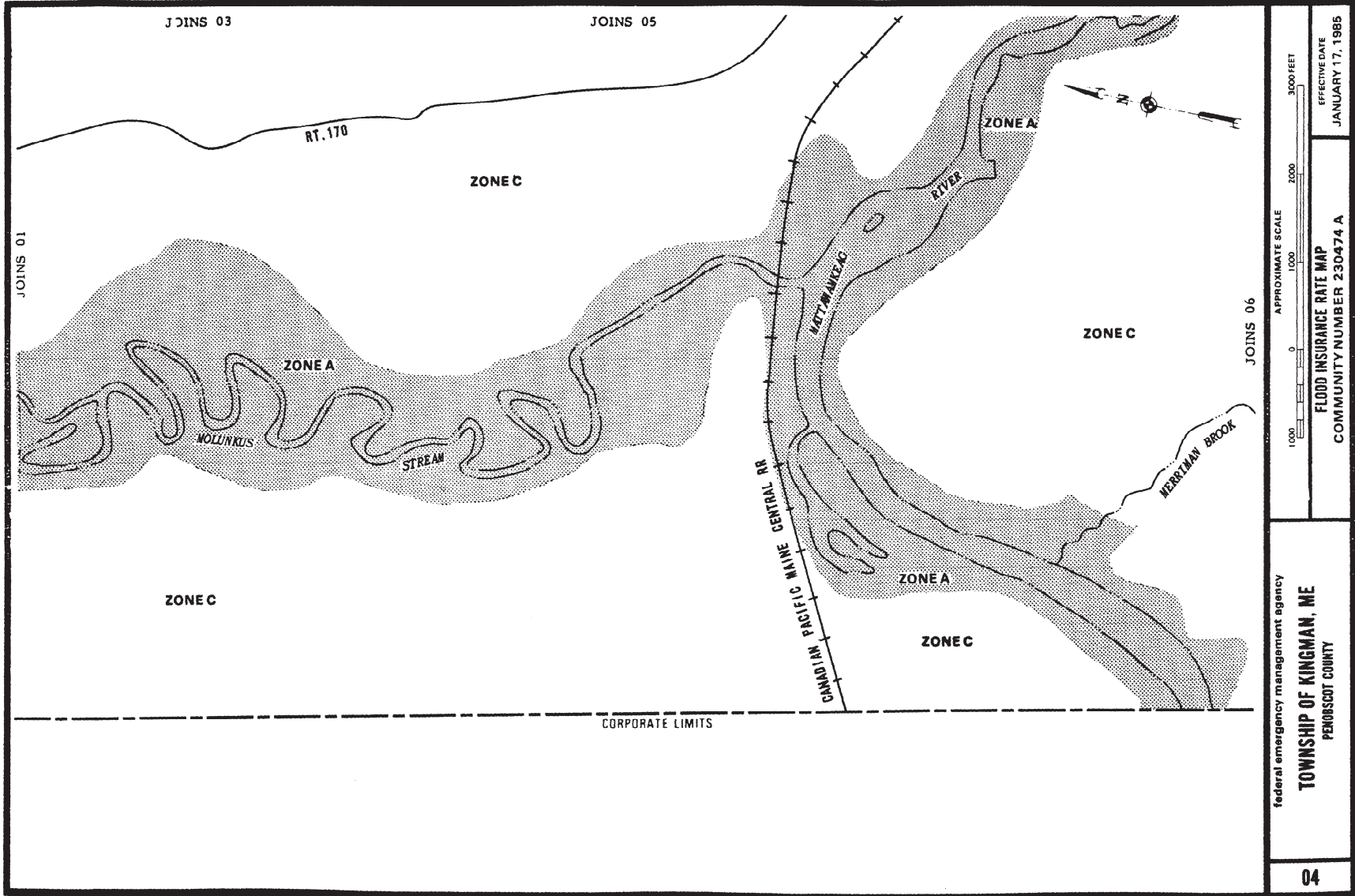


FLOOD INSURANCE RATE MAP

COMMUNITY NUMBER 230474 A

EFFECTIVE DATE

JANUARY 17, 1985



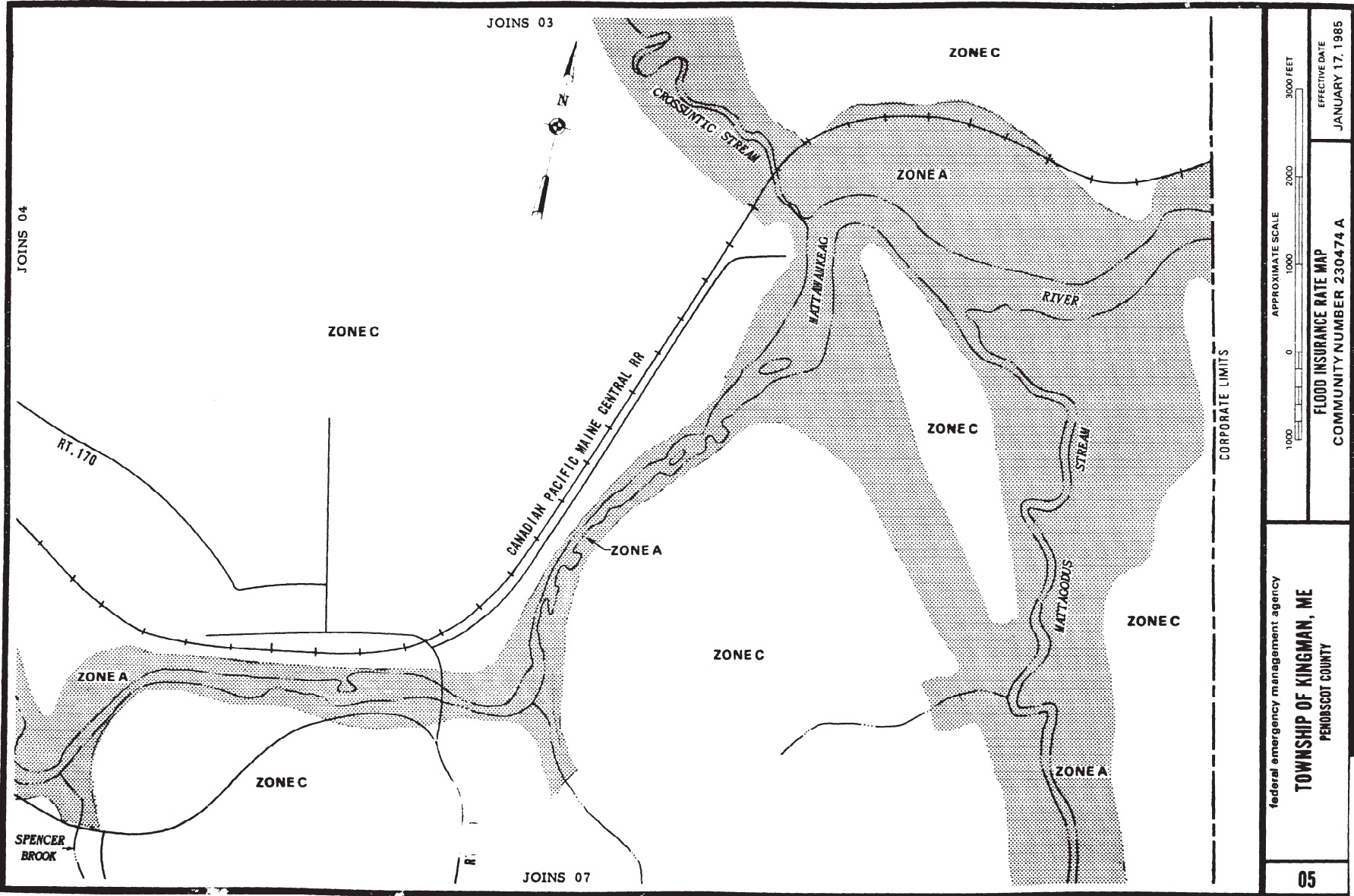
federal emergency management agency

TOWNSHIP OF KINGMAN, ME
PENOBSCOT COUNTY

APPROXIMATE SCALE
1000 0 1000 2000 3000 FEET

EFFECTIVE DATE
JANUARY 17, 1985

FLOOD INSURANCE RATE MAP
COMMUNITY NUMBER 230474 A



federal emergency management agency

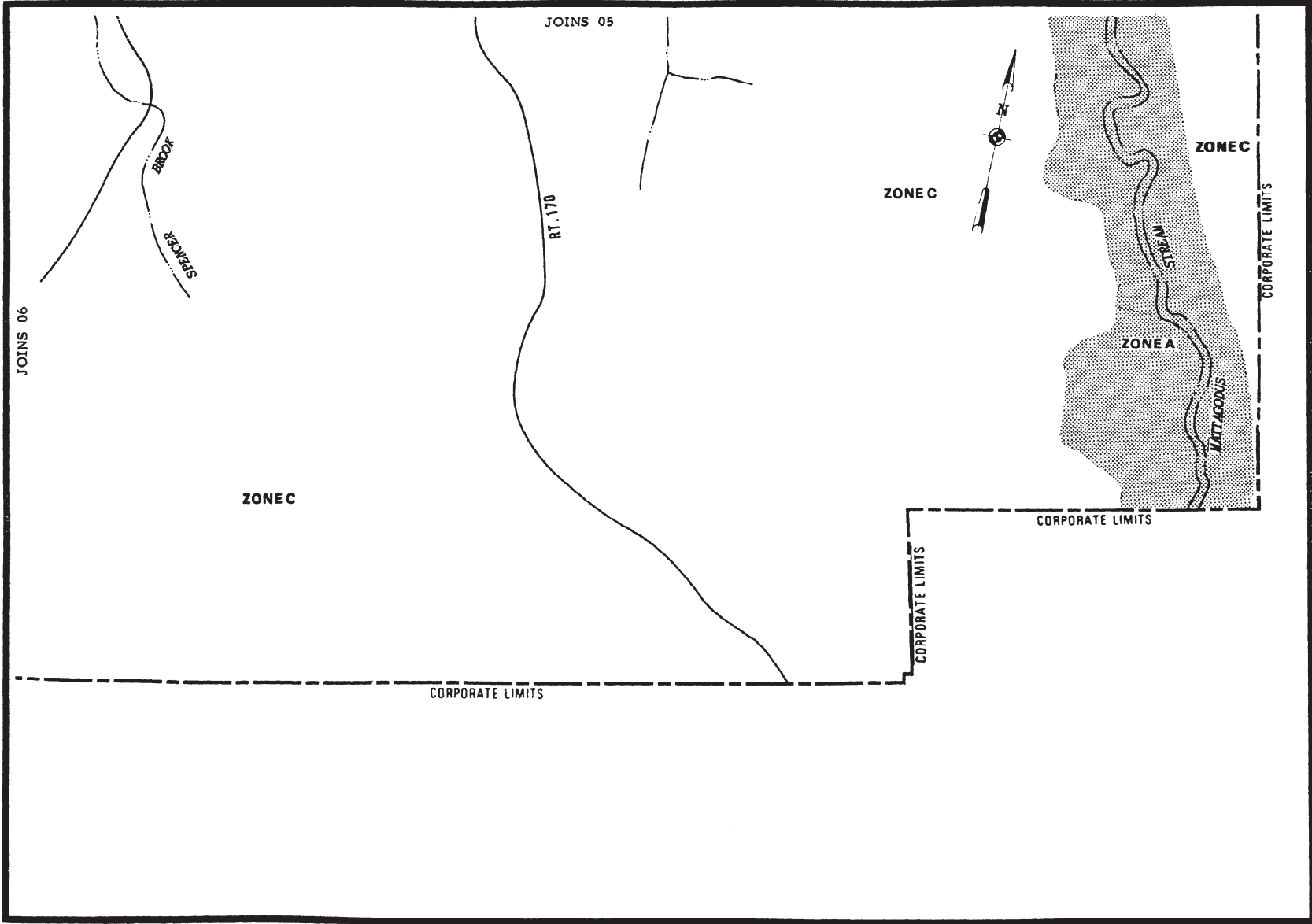
TOWNSHIP OF KINGMAN, ME
PENNSCOT COUNTY

05

FLOOD INSURANCE RATE MAP
COMMUNITY NUMBER 230474 A

EFFECTIVE DATE
JANUARY 17, 1985

CORPORATE LIMITS



federal emergency management agency

TOWNSHIP OF KINGMAN, ME
PENOBSCOT COUNTY

FLOOD INSURANCE RATE MAP
COMMUNITY NUMBER 230474 A

EFFECTIVE DATE
JANUARY 17, 1985

