

## 4.0 Kennebec River Basin



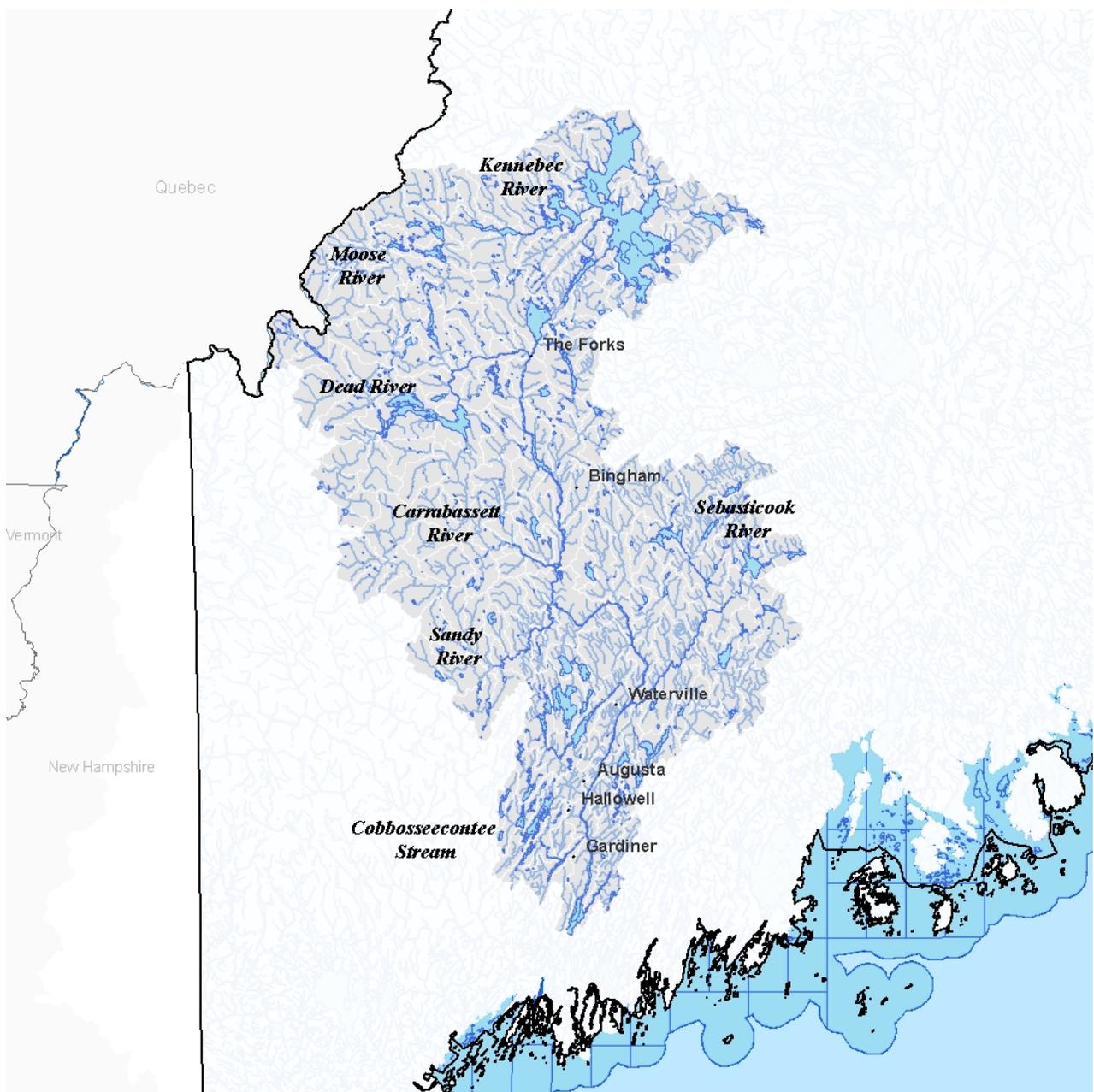
### 4.1 Watershed Description

The Kennebec River Basin occupies approximately 5,900 square miles of southwestern Maine. The headwaters of the river basin originate in the Appalachian Mountains on the international border with Canada. The upper two-thirds of the basin above Waterville are hilly and mountainous and the lower third of the basin has the gentle topography representative of a coastal drainage area. Major communities in this basin include Bingham, Anson, Madison, Norridgewock, Skowhegan, Waterville, Winslow, Augusta, Hallowell, and Gardiner.

The Kennebec River originates at Moosehead Lake and flows south approximately 145 miles to Merrymeeting Bay. Table 27 presents the major tributaries to the Kennebec River along with their respective contributing area. The Kennebec River joins the Androscoggin River in Merrymeeting Bay before exiting to the ocean at Fort Popham. The Kennebec River is influenced by tidal process as far as Augusta, 25 miles above Abagadasset Point. Figure 10 illustrates the locations of major tributaries located within the Kennebec River basin.

**Table 27. Kennebec River, Tributaries from Upstream to Downstream and Drainage Areas**

<b>Tributary</b>	<b>Contributing Area (square miles)</b>
South Branch Moose River	70
Moose River (2) above Attean Pond	180
Moose River (3) at Long Pond	310
Brassua Lake	160
Moosehead Lake	550
Kennebec River (2) above The Forks	320
North Branch Dead River	200
South Branch Dead River	150
Flagstaff Lake	170
Dead River	360
Kennebec River (4) at Wyman Dam	160
Austin Stream	90
Kennebec River (6)	110
Carrabassett River	400
Sandy River	590
Kennebec River at Waterville Dam	410
Sebastiancook River at Pittsfield	320
Sebastiancook River (3) at Burnham	270
Sebastiancook River (4) at Winslow	370
Messalonskee Stream	210
Cobbosseecontee Stream	220
Kennebec River at Merrymeeting Bay	320
<b>Total</b>	<b>5,930</b>



**Figure 10. Kennebec River Basin and Major Tributaries**

The Carrabassett and Sandy Rivers are major contributors to flooding in the Kennebec River. Both tributaries are considered hydrologically flashy and contribute approximately 40% of the peak discharge of the Kennebec River during flood events. Table 28 presents the average proportional contribution of each tributary to total flooding within the mainstem Kennebec River (ACOE, 1990).

**Table 28. Kennebec River Basin, Contribution of Tributaries to Flooding (ACOE, 1990)**

<b>Location</b>	<b>Contribution (% of total)</b>	<b>Basin Size (% of total)</b>
Sandy River	24.2	14.0
Carrabassett River	16.0	9.4
Kennebec River, Weston Dam to Waterville	13.0	7.8
Dead River	9.6	20.8
Sebasticook River	8.5	22.4
Kennebec River at the Forks	7.0	7.6
Kennebec River Forks to Bingham	5.7	3.8
Kennebec River, Bingham to Carrabassett River	4.5	2.6
Austin Stream	4.3	2.2
Waterville to Augusta Dam	3.7	7.6
Kennebec River, Carrabassett River to Weston Dam	3.5	1.8

## **4.2 Dams and Reservoirs**

In general, dams in Maine are not constructed as flood control structures. However, the dams with large impoundment capacity can be useful for controlling flood discharges if their reservoirs are below capacity. Many dams in the lower reaches of Maine's rivers are run-of-river dams, and have little or no capacity to capture and hold runoff during floods (MGS, 2005).

The collaborative dam database indicates that the Kennebec River Basin contains over 140 dams. Fifty-two are identified for recreational use, thirty-six for "other" use, nineteen for hydrologic power generation, ten for flood control and stormwater management, six for flood supply, and two for debris control. The storage capacity of impoundments in the Kennebec River Basin is approximately 826,200 acre-feet. Appendix E contains the list of dams located within the Kennebec River Basin and included in the collaborative dam database.

## **4.3 Precipitation**

The average annual precipitation in the Kennebec River Drainage Basin is approximately forty-two inches distributed uniformly throughout year. Snowfall contributes the equivalent of five to eight inches of rainfall along the coast and approximately twelve inches in the headwater areas. The average annual streamflow of the Kennebec River is approximately 1.6 cubic feet per second per square mile of contributing area, equivalent to approximately twenty-two inches of runoff.

#### 4.4 Population

The Kennebec River Basin contains all or portions of four cities (Hallowell, Augusta, Gardiner, and Waterville), eighty-six towns, 129 unincorporated areas, and falls within nine counties. Table 29 presents the historical population data within the Kennebec River Basin. The population within the river basin as a whole has increased since 1970; however the population residing within cities has decreased.

**Table 29. Kennebec River Basin, Population**

Census date	Population	Population in cities
1970	168,000	50,000
1980	193,000	49,000
1990	208,000	48,000
2000	211,000	43,000

#### 4.5 Historic Flooding Events (1970 – 2007)

Flooding within the Kennebec River Basin is most often caused by snowmelt in combination with rainfall. Flood events have also resulted from extreme precipitation events. Table 30 presents the list of major and minor flood events identified within the Kennebec River Basin between 1970 and the present using sources of data described in Section 1 of this report. The flood events indicated with an “x” are described in greater detail in the following sections of the report.

**Table 30. Kennebec River Basin. Identified Flood Events**

Date	Flood Location	Source of Flood Record	Description
February 1970	Cobbosseecontee Stream	CRREL	Major damage
x December 1973	Kennebec River, Mountain Brook, Pelton Brook, North Branch Tanning Brook, Gardiner Pond Brook	ACOE, CRREL, USGS	Major damage
May 1974	Kennebec River	USGS	
February 1978	Carrabassett River	CRREL	Peak stage of record
x April 1979		ACOE	
September 1981		USGS	
x April 1983		USGS, ACOE	
x May/June 1984	Kennebec River	USGS, ACOE	
x March/April 1987	Kennebec River, Carrabassett River, Sandy River, Seabasticook River, Johnson Brook, Mill Stream, Cobbosseecontee Stream, Togus Stream	USGS, ACOE, Photos	
January/February 1996	Kennebec River, Marsh Stream	CRREL	
April 1993		IHMT	
April 1992		(FEMA 940-DR-ME)	
x December 2003	Sandy River	Photos, CRREL	
x March 2003		Photos	
x April 2005		Photos	
x February 2006	Sandy River	Photos, CRREL	

CRREL – Ice jam database, USGS – Streamgage record, ACOE – 1990 study, FIS – Flood Insurance Study, IHMT – Interagency Hazard Mitigation Report

The USGS record of peak discharge and stage at streamgages within the Kennebec drainage basin indicate major high flow events, which may have resulted in flooding. Appendix B contains a streamgage inventory of all active and historical gages in the Kennebec River Basin. Table 31 presents the highest recorded daily discharge at selected streamgages. The streamgage record indicates that major flood events resulting from high flows occurred in March 1936, September 1981, April 1983, June 1984, April 1987, and May 2000.

**Table 31. Kennebec River Basin, Flood of Record at Streamgages**

Site	Site Name	Date	Discharge (cfs)	Gage Height
01041000	Kennebec River at Moosehead, Maine	9/25/1981	16,700	9.76
01042500	Kennebec River at The Forks, Maine	4/18/1983	32,900	14.41
01044550	Spencer Stream at mouth, near Grand Falls, Maine	5/11/2000	5,500	7.24
01046500	Kennebec River at Bingham, Maine	6/1/1984	65,200	15.61
01047000	Carrabassett River near North Anson, Maine	4/1/1987	50,700	26.66
01048000	Sandy River near Mercer, Maine	4/1/1987	51,100	19.25
01049000	Sebasticook River near Pittsfield, Maine	4/3/1987	17,600	15.53
01049205	Kennebec River near Waterville, ME	4/2/1987	224,000	-
01049265	Kennebec River at North Sidney, Maine	4/2/1987	232,000	39.31
01049500	Cobbosseecontee Stream at Gardiner, Maine	3/21/1936	5,020	-

**4.5.1 December 1973**

The Kennebec River basin received over three inches of rainfall in a 24-hour period between the 16 and 17 of December 1973. Two additional inches fell on the 20 and 21 of December. Total rainfall in December approached twelve inches. The rainfall was accompanied by warm temperatures and melting snowpack. At the beginning of this precipitation event, Moosehead and Flagstaff reservoir levels were high. Table 32 presents the observed stage, discharge, and recurrence interval (where available) for the December 1973 flood. The USGS estimated the return period of the flows on the Kennebec River to be ten to fifty years.

**Table 32. Kennebec River Basin, USGS Streamgage Peaks, December 1973**

Station	Name	Stage	Discharge (cfs)	Estimated Recurrence Interval (years)
01042500	Kennebec River at the Forks, ME	12.68	27,600	30
01046500	Kennebec River at Bingham, ME	14.41	50,300	10-25
Central Maine Power Co.	Kennebec River at Skowhegan	-	123,000	-
Hollingworth and Whitney	Kennebec River at Waterville	-	145,000	25-50
01048000	Sandy River near Mercer, ME	-	25,600	10
01047000	Carrabassett River near North Anson, ME	-	21,200	5-10

#### 4.5.2 April 1979

The Kennebec river basin received approximately 2.6 inches of rainfall between 26 and 28 April 1979. The rainfall was accompanied by warm temperatures and melting snowpack. At the beginning of this precipitation event, Moosehead and Flagstaff reservoir levels were high. Table 33 presents the observed stage, discharge, and recurrence interval (where available) for the April 1979 flood. The USGS estimated the return period of the flows on the Kennebec River and tributaries to be five to ten years.

**Table 33. Kennebec River Basin, USGS Streamgage Peaks, April 1979**

<b>Station</b>	<b>Name</b>	<b>Stage</b>	<b>Discharge (cfs)</b>	<b>Estimated Recurrence Interval (years)</b>
01042500	Kennebec River at the Forks, ME	9.15	17,200	5-10
01046500	Kennebec River at Bingham, ME	13.31	41,000	10
Central Maine Power Co.	Kennebec River at Skowhegan	-	101,000	-
Hollingworth and Whitney	Kennebec River at Waterville	-	105,000	5-10
01049265	Kennebec River at North Sidney, ME	26.4	111,000	-
01048000	Sandy River near Mercer, ME	13.48	24,900	5-10
01047000	Carrabassett River near North Anson, ME	17.46	22,400	5-10

### 4.5.3 April 1983

The Kennebec River Basin received approximately two inches of rainfall between 17 and 18 April 1983. One week later, the basin received three inches of precipitation between the 24 and 25 of April. The second precipitation event was accompanied by warm temperatures and snowmelt. At the beginning of this precipitation event, Moosehead and Flagstaff reservoir levels were high. Table 34 presents the observed stage, discharge, and recurrence interval (where available) for the April 1983 flood. The USGS estimated the return period of the flows on the Kennebec River to be ten to seventy years.

**Table 34. Kennebec River Basin, USGS Streamgauge Peaks, April 1983**

Station	Name	Stage	Discharge (cfs)	Estimated Recurrence Interval (years)
01042500	Kennebec River at the Forks, ME	14.41	32,900	60-70
01046500	Kennebec River at Bingham, ME	12.1	55,400	25-50
Central Maine Power Co.	Kennebec River at Skowhegan	-	82,000	-
Hollingworth and Whitney	Kennebec River at Waterville	-	103,000	10-25
01049265	Kennebec River at North Sidney, ME	-	107,000	-
01047000	Carrabassett River near North Anson, ME	13.55	14,100	2

### 4.5.4 May/June 1984

The Kennebec River Basin received approximately six inches of rainfall between May 29 and June 2, 1984. At the beginning of this precipitation event, Moosehead and Flagstaff reservoir levels were high and could provide little storage to mitigate this event. The flood of record was established for the upper watershed at the USGS gaging stations at the Forks and Bingham, Maine. Peak flows along the lower Kennebec River were comparable to flood levels seen during the April 1979 and April 1983 events. Table 35 presents the observed stage, discharge, and recurrence interval (where available) for the May/June 1984 flood. The USGS estimated the return period of the flows on the Kennebec River to be twenty-five to one hundred years.

**Table 35. Kennebec River Basin, USGS Streamgauge Peaks, May/June 1984**

Station	Name	Stage	Discharge (cfs)	Estimated Recurrence Interval (years)
01042500	Kennebec River at the Forks, ME	13.78	30,300	100
01046500	Kennebec River at Bingham, ME	15.61	65,200	75-100
Central Maine Power Co.	Kennebec River at Skowhegan	-	76,000	-
Hollingworth and Whitney	Kennebec River at Waterville	-	109,000	25-50
01049265	Kennebec River at North Sidney, ME	-	113,000	-
01047000	Carrabassett River near North Anson, ME	-	13,000	2-5

#### 4.5.5 March/April 1987

In April 1987, runoff caused by a high volume of rainfall following several days of warm temperatures and melting snowpack caused a new flood of record for the Kennebec River from the mouth of the Carrabassett tributary to the mouth of the Kennebec River. Reservoir storage in the upper watershed was successful at controlling the runoff from the upper subbasins. Peak flows along the lower main-stem Kennebec and tributaries were 30% higher than flows recorded in the previous flood of record, March 1936 (ACOE, 1990). The photos presented in Figure 11, Figure 12, Figure 13, and Figure 14 illustrate the extent of flooding at various points along the Kennebec River. Table 36 presents the observed stage, discharge, and recurrence interval (where available) for the March/April 1987 flood. The USGS estimated the return period of the flows on the Kennebec River and many tributaries to be greater than one hundred years.

Losses caused by the April 1987 flood were estimated to be approximately \$34 million within the Kennebec River Basin. The estimated assisted payouts totaled approximately \$9.1 million.

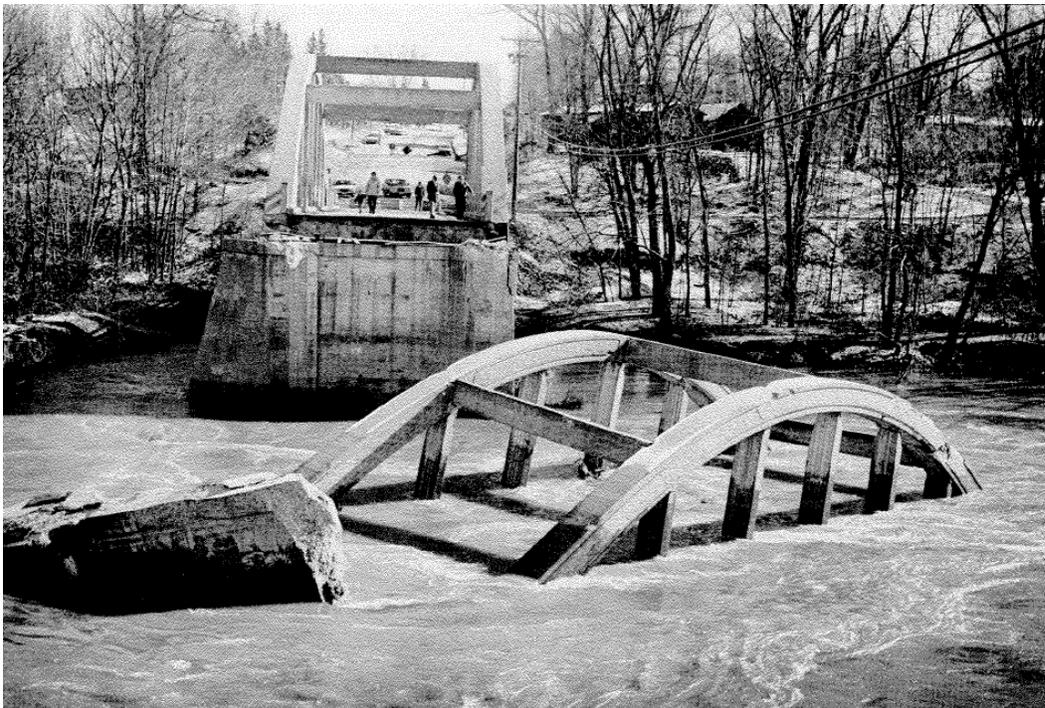
Fourteen communities including (Augusta, Randolph, Fairfield, Anson, Hartland, Hallowell, Waterville, Skowhegan, Madison, Farmington, Gardiner, Winslow, Norridgewock, and Pittsfield) incurred estimated losses of \$500,000 each or greater.

**Table 36. Kennebec River Basin, USGS Streamgage Peaks, March/April 1987**

<b>Station</b>	<b>Name</b>	<b>Stage</b>	<b>Discharge (cfs)</b>	<b>Estimated Recurrence Interval (years)</b>
01042500	Kennebec River at the Forks, ME	9.87	20,400	10-25
01046500	Kennebec River at Bingham, ME	15.46	63,400	50-75
Hollingworth and Whitney	Kennebec River at Waterville	-	224,000	>100
01049265	Kennebec River at North Sidney, ME	39.31	232,000	>100
01048000	Sandy River near Mercer, ME	19.25	51,100	>100
01047000	Carrabassett River near North Anson, ME	26.66	50,700	>100
01049000	Sebasticook River near Pittsfield, MD	15.53	17,600	>100
01049130	Johnson Brook at South Albion, ME	12.34	178	10-25
01049373	Mill Stream at Winthrop, ME	6.16	1,330	50-100
01049550	Togus Stream at Togus, ME	7.5	1,010	25-50



**Figure 11. Kennebec River, Waterville Commercial Development, April 1987 (Sun Journal)**



**Figure 12. Sandy River, Fairbanks Bridge on Route 4, Farmington, April 1987 (Sun Journal)**



Figure 13. Carrabassett River, Forster Manufacturing Co., Dryden, April 1987 (Sun Journal)



Figure 14. Kennebec River, Water Street, Gardiner, April 1987 (Sun Journal)

#### 4.5.6 December 2003

The CRREL database indicates that ice jams and moderate flows contributed to flooding along the Sandy River in December 2003. Table 37 presents the observed stage, discharge, and recurrence interval (where available) for the December 2003 flood. Figure 15, Figure 16, and Figure 17 document the flooding at Farmington. The USGS estimated the return period of the flows on the Kennebec River to be two to ten years.

**Table 37. Kennebec River Basin, USGS Streamgauge Peaks, December 2003**

Station	Name	Stage	Discharge (cfs)	Estimated Recurrence Interval (years)
01042500	Kennebec River at The Forks, Maine	7.46	11,700	<2
01044550	Spencer Stream at mouth, near Grand Falls, Maine	5.8	3,240	
01046500	Kennebec River at Bingham, Maine	12.22	29,000	2-5
01047000	Carrabassett River near North Anson, Maine	16.57	20,300	5-10
01048000	Sandy River near Mercer, Maine	13.03	24,100	5-10
01049265	Kennebec River at North Sidney, Maine	22.23	102,000	
01049500	Cobbosseecontee Stream at Gardiner, Maine	6.64	1,490	<2
01042500	Kennebec River at The Forks, Maine	7.46	11,700	<2
01044550	Spencer Stream at mouth, near Grand Falls, Maine	5.8	3,240	
01046500	Kennebec River at Bingham, Maine	12.22	29,000	2-5



**Figure 15. Sandy River in Farmington, near Route 2, December 12, 2003**



**Figure 16. Ice Jam on the Sandy River in Farmington, near Route 2, December 12, 2003**

In the photo below, the University of Maine at Farmington can be seen on the left side.



**Figure 17. Sandy River in Farmington, Flyover View, December 12, 2003**

#### 4.5.7 March 2003

Figure 18 and Figure 19 document an ice jam occurring in Augusta during March 2003. The CRREL ice jam database does not indicate flooding associated with this event. Table 38 presents the observed stage, discharge, and recurrence interval (where available) for the March 2003 event. The USGS estimated the return period of the flows on the Kennebec River and tributaries to be less than two years.

**Table 38. Kennebec River Basin, USGS Streamgauge Peaks, March 2003**

Station	Name	Stage	Discharge (cfs)	Estimated Recurrence Interval (years)
01048000	Sandy River near Mercer, Maine	7.79	7,050	<2
01049265	Kennebec River at North Sidney, Maine	12.71	35,200	
01049500	Cobbosseecontee Stream at Gardiner, Maine	6.23	1,250	<2



**Figure 18. Ice Jam in Augusta, March 26, 2003**



**Figure 19. Ice Jam in Augusta, March 26, 2003**

#### **4.5.8 April 2005**

The photo record indicates that flooding occurred along the Kennebec and Cobbosseecontee Rivers in Gardiner and Hallowell during April of 2005. Figure 20, Figure 21, Figure 22, Figure 23, Figure 24, and Figure 25 document the extent of flooding within these communities during this event. Table 39 presents the observed stage, discharge, and recurrence interval (where available) for the April 2005 event. The USGS estimated the return period of the flows on the Kennebec River to be five to ten years and the Sandy River to be ten to twenty-five years.

**Table 39. Kennebec River Basin, USGS Streamgage Peaks, April 2005**

<b>Station</b>	<b>Name</b>	<b>Stage</b>	<b>Discharge (cfs)</b>	<b>Estimated Recurrence Interval (years)</b>
01042500	Kennebec River at The Forks, Maine	10.56	19,900	5-10
01044550	Spencer Stream at mouth, near Grand Falls, Maine		5,450	
01046500	Kennebec River at Bingham, Maine	13.79	43,800	5-10
01047000	Carrabassett River near North Anson, Maine	16.7	21,500	5-10
01048000	Sandy River near Mercer, Maine	13.73	27,300	10-25
01049000	Sebasticook River near Pittsfield, Maine	10.67	9,920	5-10
01049265	Kennebec River at North Sidney, Maine	22.29	93,900	
01049500	Cobbosseecontee Stream at Gardiner, Maine	9.86	3,870	



**Figure 20. Kennebec River and Cobbosseecontee Stream near Hannaford and Route 201 Gardiner, April 29, 2005**



**Figure 21. Kennebec River and Cobbosseecontee Stream near Hannaford and Route 201 Gardiner, April 29, 2005**



**Figure 22. Kennebec River in Hallowell, April 29, 2005**



**Figure 23. Kennebec River in Hallowell, April 4, 2005**



**Figure 24. Kennebec River in Hallowell, April 4, 2005**



**Figure 25. Cobbosseecontee Stream in Gardiner near Route 201, April 4, 2005**

#### 4.5.9 February 2006

The photo record and the CRREL ice jam database indicate a flooding event caused by ice jams along the Sandy River at Farmington during February 2006. Figure 26 and Figure 27 document the extent of flooding within Farmington during this event. This event did not result in annual peak flows for any tributaries within the Kennebec River Basin.



Figure 26. Sandy River near Route 2, Flooding of Commercial Area in Farmington, February 2006



**Figure 27. Sandy River near Route 2, Farmington Showing an Ice Jam at the Bridge**