US Army Corps of Engineers®
Cold Regions Research & Engineering Laboratory

Ice Engineering

U.S. Army Engineer Research and Development Center, Hanover, New Hampshire

Ice Jams, Winter 2001–2002

During winter months, ice jams may form on rivers, lakes, and streams in cold regions. Ice jams form during initial ice cover formation as the ice accumulates, restricting water flow (freezeup jam), and also when the ice cover breaks apart and begins to move (breakup jam) (Fig. 1). When rivers become jammed with ice, riverine communities upstream from an ice jam can suffer severe effects as a result of backwater flooding and structural impacts of ice. Excessive water and ice associated with ice jams often causes damage to bridges, roads, and buildings. Roads and runways can be forced to close, and bridges can be damaged or destroyed, delaying or limiting emergency aid in evacuation situations. Transportation of heating fuel and other necessary cargo can be temporarily halted as both roadways and waterways are affected.

Areas downstream from jams can also be affected if they experience sudden decreases in flow as backwater occurs upstream. These decreases in flow can cause water intakes to become exposed, threatening water supplies to municipalities, industries, and power plants. Communities downstream of the jam can also be affected by the rapid surge of water and ice that occurs when a jam releases.

Ice movement can also affect the environment through scour and erosion of riverbeds and riverbanks, disturbing riparian vegetation, fish habitat, and wildlife. Because of the rapidity of ice events, engineers and other officials often have little time to evacuate or mitigate the jam to prevent costly damages. Ice jam damages have been estimated to cost the United States over $100 million annually.

Figure 1. Waits River, Bradford, Vermont, 10 March 2002. This mild jam was typical of jams during WY 2002 in the lower 48 states. (Photo courtesy of Bob Bigl.)

Engineers and Federal, State, and local officials are working together to create methods to predict when and where ice jams will occur, to prevent jams from forming, and to avoid serious damages from jams that do form. Such projects require accurate data to help prepare communities for future ice events. The U.S. Army Corps of Engineers Engineer Research and Development Center's Cold Regions Research and Engineering Laboratory (CRREL) has developed and maintains an Ice Jam Database, which is a compilation of freezeup and breakup ice jam events in the United States (White 1996). There are currently over 13,000 entries in the database, the earliest occurring in 1780. The database has entries covering 42 states, ranging from one each in Arizona, Delaware, North Carolina, and Texas, to over 1,300 in Montana. CRREL's database is a reliable resource used to research previous ice jams and to assess specific situations that may cause ice jam formation. Each entry includes river name, latitude and longitude, city and state, U.S. Geological Survey (USGS) gage number (if available), USGS hydrologic unit code, jam type and date, local and CRREL contacts, a summary of the event, and a list of publications on the jam. The database can also serve as a source of documented responses from engineers and officials who helped relieve the emergency situations.

This issue provides an overview of ice events that occurred during water year (WY) 2002, which covers the period from 1 October 2001 to 30 September 2002. There are 32 entries in the database for this year, which is an extremely low number

of events and probably reflects warmer-than-average temperatures over much of the continental United States along with lower-than-normal snowpack. Most of the ice jam information was obtained through daily bulletins from the National Weather Service (NWS). Other sources of information include Corps and CRREL personnel and Internet articles.

When and where did ice jams occur in 2002?

During WY 2002, over one-third of the ice events (34%) occurred during May in the state of Alaska. December accounted for 22% of events, and April and February followed with 16 and 13 percent, respectively. November accounted for 3 percent; January and March each experienced their share of events at 6 percent each (Fig. 2).

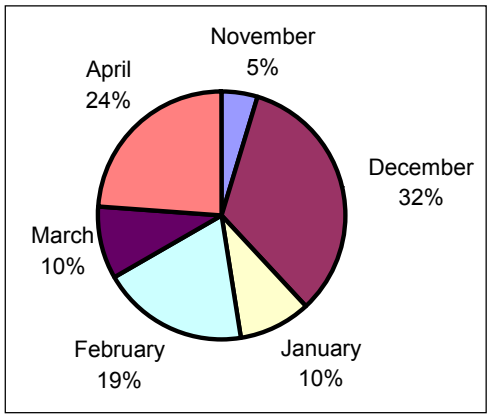

Figure 2. Months in which 2002 ice jams were reported.

Eleven states, including Maine, Colorado, and Alaska, were affected by ice jams during WY 2002 (Fig. 3). Alaska had 16 events (Fig. 4), the highest number of jams in a state this year, while Minnesota, Maine, and Nebraska each had 4, 3, and 2 ice events, respectively. The remaining states were affected by only one event (Fig. 5).

Maine's three jams were all similar: small freezeup jams that occurred around mid-January and lasted through most of February. Two of the three jams were reported on the St. John River and one was located on the Aroostook River. These small jams posed no threat to local communities (NWS 2002a).

The four jams in Minnesota appear to be unrelated in their timing. These jams occurred in early December, late December, late February, and mid-April. Two of the jams occurred on the Mississippi River at Fort Ripley, while the other two were on the Red Lake River and on Mille Lacs Lake. The ice event at Mille Lacs was an ice-out event, which occurred in April when westerly winds aided in the lake ice-cover breakup and pushed huge chunks of ice onto shore. The ice was forced into 20-foot-high piles, bringing boulders onto lawns and destroying decks and docks (*Mille Lacs Messenger* 2002).

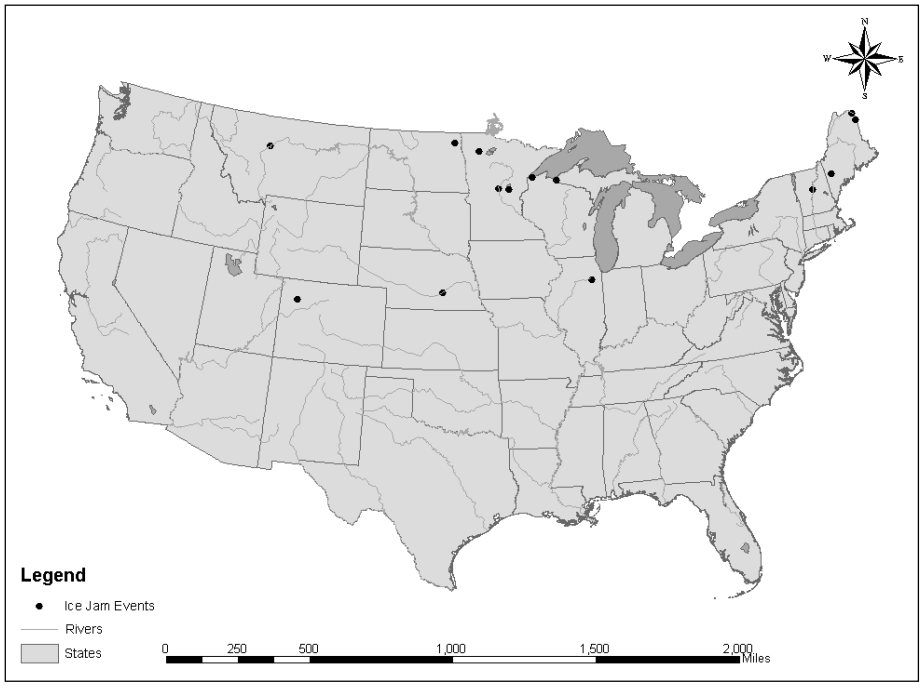

Figure 3. Ice jam locations in the lower 48 states during WY 2002.

At the beginning of March, a rain event in northern New England caused two minor breakup jams: one on the Israel River in Lancaster, New Hampshire, and the other on the Waits River in Bradford, Vermont.

Alaskan ice jams

Alaska had the earliest reported ice jam this season on 8 November 2001, when the Susitna River at Montana, Alaska, froze during a below-normal cold spell and backed up water (NWS 2001a). The remaining Alaskan ice jams formed during December (two freezeup jams) and April and May (13 breakup jams).

At the beginning of December, colder temperatures caused one major freezeup jam on the Kenai River where water rose six feet (NWS 2001b). Near the end of December warmer weather caused an increase of water flow, causing the North Fork of the Anchor River to release ice and cut off access to a few homes (NWS 2001c).

On 30 April 2002 a jam on the Stony River at Lime Village caused major damage to the local water treatment plant when ice from the jam took out one of its walls. The ice also caused a 300-gallon fuel storage tank to tip, damaged the sewer lines and runway, and caused a couple of feet of flooding in the water treatment plant. The town was advised to boil all water as a result of possible fuel contamination and flood conditions. Warm temperatures and rain caused the jam (DES 2002). The following day the Sheep River at Talkeetna released its ice, sending a surge of water through the Clear Creek area; only minor flooding was reported (NWS 2002b, 2002c).

Eleven of Alaska's 16 jams occurred during May when the ice cover broke up on the rivers. Five of these eleven events happened between the ninth and twelfth of the month. The Yukon and Kuskokwim Rivers each experienced two reported ice jams.

The first May jam occurred on the Chatanika River at Chatanika on the first of the month; this jam caused major flooding as runoff, snowmelt, and recent rain overflowed the riverbanks, washing out several portions of the Steese Highway near Mile 47 (NWS 2002d).

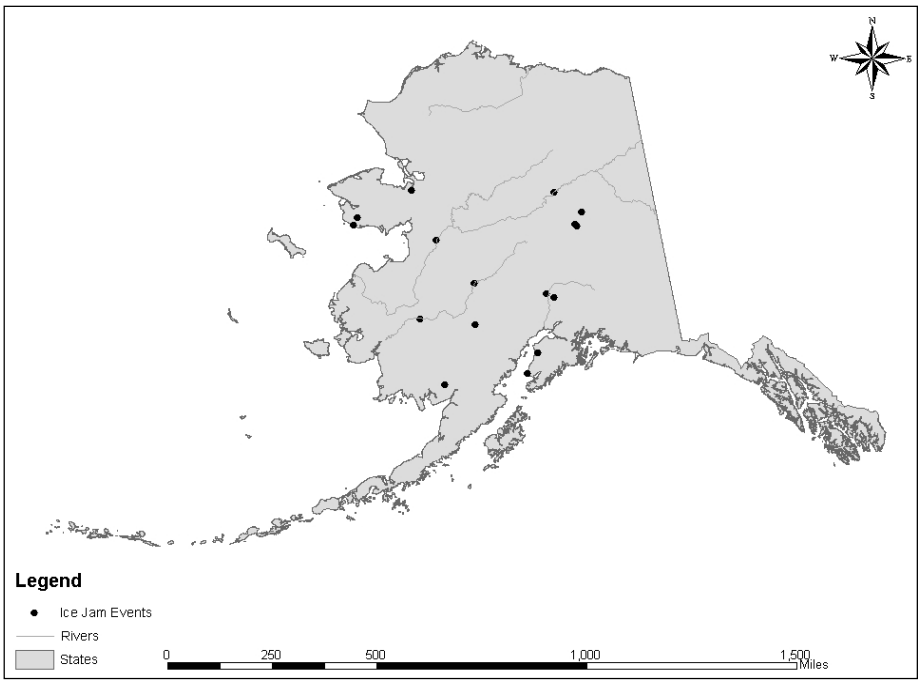

Figure 4. Ice jam locations in Alaska during WY 2002.

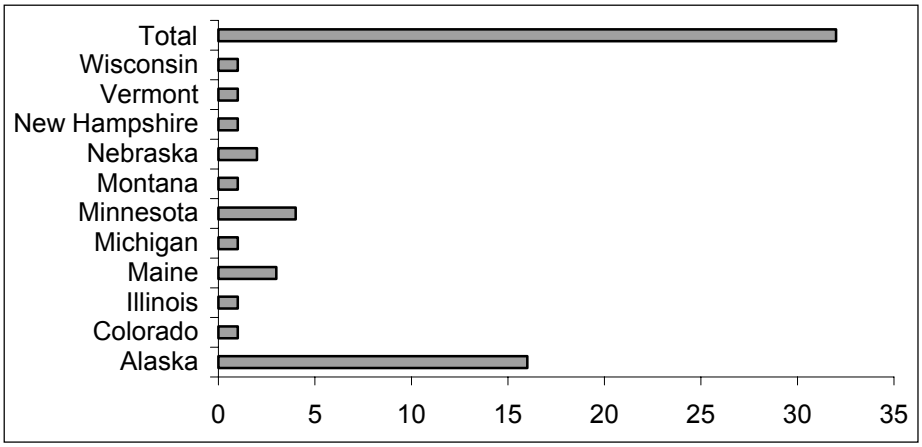

Figure 5. States where ice jams most frequently occurred during WY 2002.

One week later, the Nushagak River at Ekwok caused major flooding, which damaged fish-drying racks, smokehouses, town generators, houses, and the power plant. Two feet of water flooded several homes, and six families in a community of 135 people were evacuated. The jam also caused the power plant to be moved a half-foot off its foundation, forcing the use of a backup power plant on higher grounds to supply power. The flooding also caused an oil spill when 55-gallon drums of used motor oil were tipped over by floodwaters. The town's emergency response team, the Department of Environmental Conservation, and the Bristol Bay Area Health Corporation in Dillingham helped to clean up (Pemberton 2002).

On Thursday, 9 May 2002, the Tanana River near North Pole jammed along the Richardson Highway, flooding several homes (NWS 2002e).

Between the tenth and twelfth of May the Kuskokwim River jammed in two locations as a result of warm weather, rain, and snowmelt. At McGrath, the jam first formed upstream, releasing in the afternoon and then jamming a second time at McGrath. This jam caused significant flooding (NWS 2002f). Downstream at Aniak, a similar scenario occurred when the ice jam broke on 13 May, only to jam again less than an hour later. Here, the water overflowed the dike in four locations, causing roads to flood (NWS 2002g).

On 18 May 2002, Alaska had the most simultaneous events (three) recorded for WY 2002. Two of the three jams occurred on the Yukon River, one below Kaltag, the other near a bridge near Stevens Village. The third event, on 18 May, was on the Buckland River at Buckland when ice jammed both above and below the village. None of the jams on this date reported flooding (NWS 2002h).

Two days later, the Snake River at Nome jammed, causing the National Weather Service in Fairbanks to issue a flood warning. With a large, melting snowpack and competent sea ice at its mouth blocking the downstream movement of river ice, the jams along the Snake River caused major flooding. In some areas water prevented access to homes, and the airport's runway became partially flooded. On 23 May the water levels peaked, causing local cabins located along the Nome–Teller Highway to become flooded with three to four feet of water. The following morning water levels had receded over one foot and the flood warning was cancelled (NWS 2002i).

The last event of the year was on the Nome River in Nome on 26 May. This minor jam, along with high snowmelt, caused overbank flooding with no effects on the community (NWS 2002j).

Contributing factors to winter 2002 ice conditions

Air temperatures were generally warmer than normal over most of the continental United States during Water Year 2002. One measure of winter weather severity is accumulated freezing degree days, or AFDD. AFDD data can also be used to determine ice thickness and for predicting ice jams. Figure 6 shows AFDD for several representative first-order National Weather Stations in the United States (Fig. 7). It is clear that AFDD was far below normal for these locations, which are near rivers that normally experience frequent ice jams.

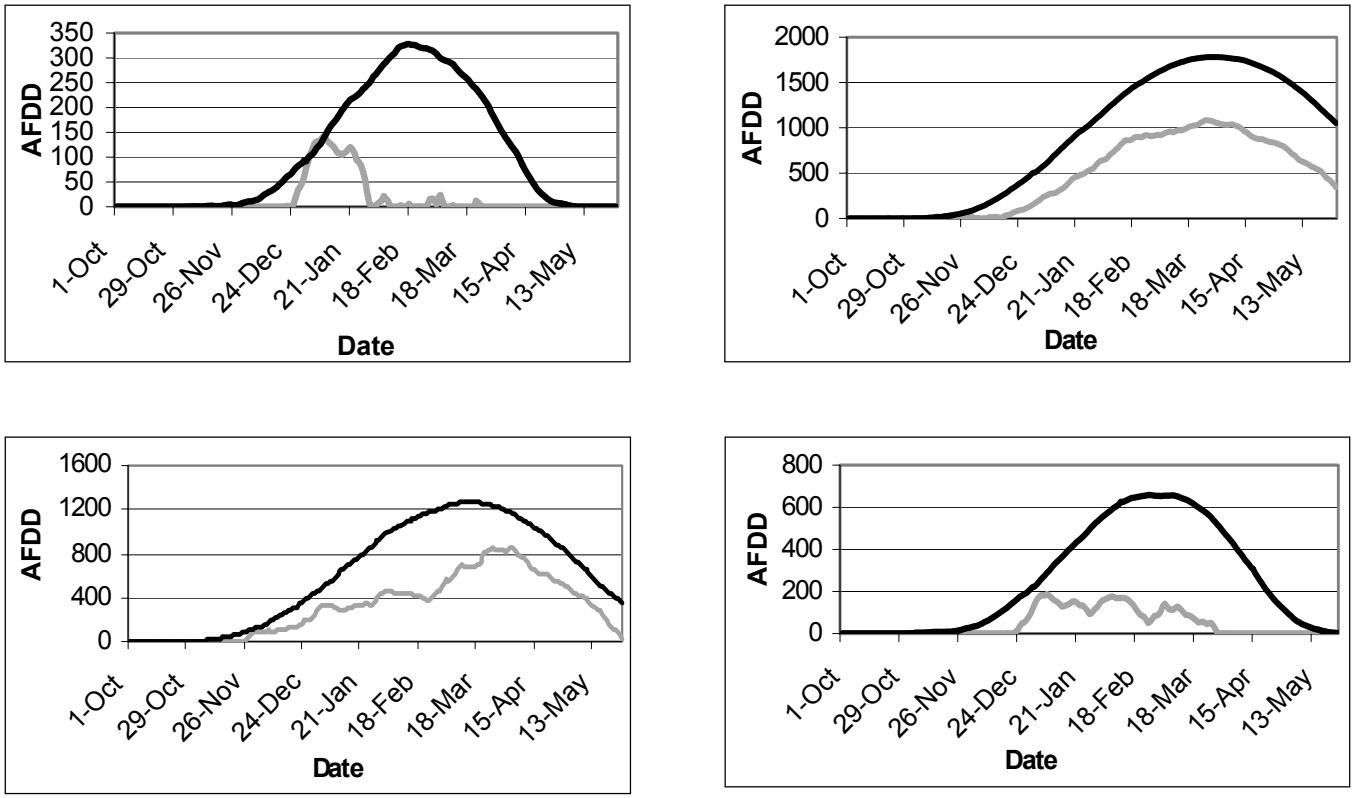

Figure 6. AFDD data for several representative first-order National Weather Stations. Selected sites include Pittsburgh, Pennsylvania (top left), Houlton, Maine (top right), Miles City, Montana (bottom left), and Omaha, Nebraska (bottom right). The heavy line is the average AFDD and the lighter line is the 2002 AFDD.

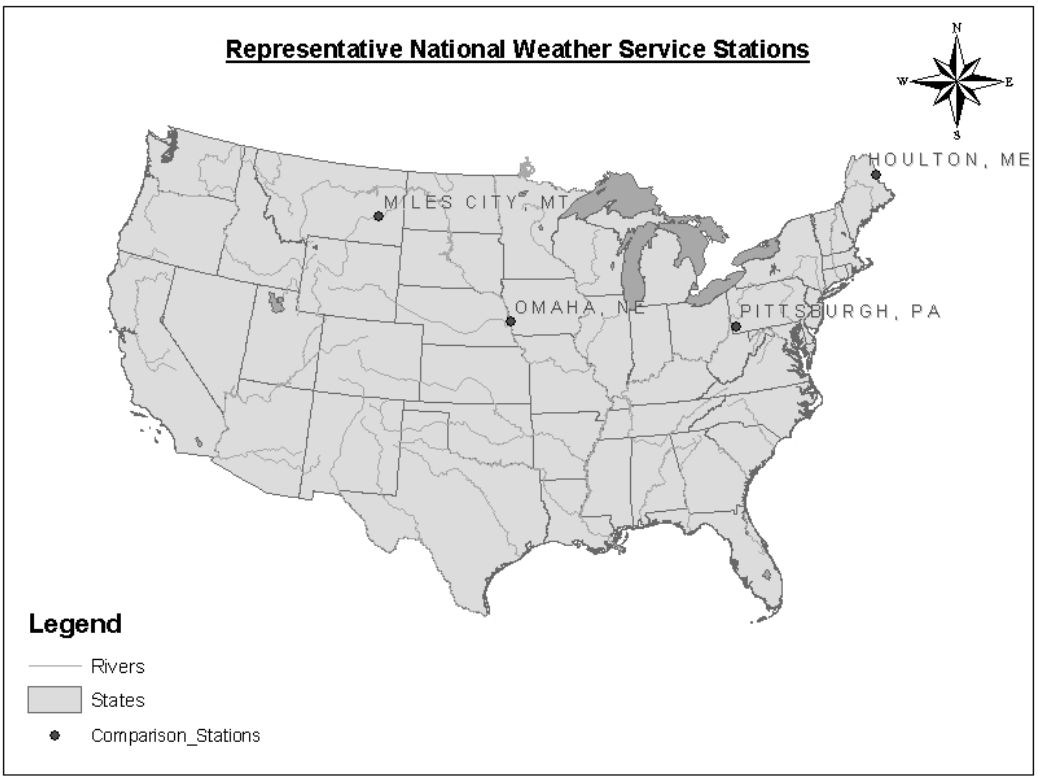

Figure 7. Locations of selected representative first-order National Weather Stations.

How is this information helpful?

This overview of WY 2002 ice jams is the seventh in a series of yearly ice jam summaries that are developed as the Ice Jam Database is updated annually to provide an accurate summary of the previous water year's ice events. This contemporary information, including date of occurrence, location, damages, and Corps response, is now being shown at near-real time on a new Web site (http://www.crrel.usace.army.mil/icejams/index.htm) that presents advance measures and technical assistance for ice jams and ice jam flooding. Historical ice jam information, including preceding weather conditions, frequent jamming locations, water stage, flooded areas, and mitigation techniques, are all necessary for emergency response officials when they try to predict ice jam occurrence or mitigate ice jam damages.

CRREL also has an Ice Jam Archive containing hard copies of the information used in annual reports. Information sources include NWS reports, newspaper articles, and other reports used for information about current and past water years. These records can be photocopied or checked out for research purposes.

Please send information for the Ice Jam Database or Ice Jam Archive to Kate White, CRREL, 72 Lyme Road, Hanover, NH 03755-1290 (e-mail Kathleen.D.White@erdc.usace.army.mil). The Ice Jam Database is available via CRREL's Web site (http://www.crrel.usace.army.mil/) or can be directly accessed at http://www.crrel.usace.army.mil/ierd/ijdb/index.html.

References

Division of Emergency Services (DES) (2002) Daily situation update. Alaska, 3 May 2002, 0800 hours.

Mille Lacs Messenger (2002) Power of Mille Lacs ice not to be underestimated. Mille Lacs, Minnesota, 24 April 2002 (http://www.millelacsmessenger.com).

National Weather Service (NWS) (2001a) Hydrometeorological discussion for the state of Alaska. Alaska-Pacific River Forecast Center, Anchorage, Alaska, 8 May 2001, 1500 hours.

National Weather Service (NWS) (2001b) River statement for Kenai River. Alaska-Pacific River Forecast Center, Anchorage, Alaska, 13 December 2001, 1430 hours.

National Weather Service (NWS) (2001c) Flood statement for the Anchor River near Homer. Anchorage, Alaska, 31 December 2001, 1130 hours.

National Weather Service (NWS) (2002a) Hydrologic Outlook. Caribou, Maine, 10 January 2002, 2329 hours.

National Weather Service (NWS) (2002b) Flood warning bulletin. Fairbanks, Alaska, 30 April 2002, 2115 hours.

National Weather Service (NWS) (2002c) Flood statement. Fairbanks, Alaska, 1 May 2002, 1000 hours.

National Weather Service (NWS) (2002d) Flood warning. Anchorage, Alaska, 1 May 2002, 1500 hours.

National Weather Service (NWS) (2002e) Fairbanks, Alaska, 9 May 2002, 2300 hours.

National Weather Service (NWS) (2002f) Alaska-Pacific River Forecast Center, Anchorage, Alaska, 7, 8, 10, 12, 13, 14, 15 May 2002.

National Weather Service (NWS) (2002g) Flood statement. Alaska–Pacific River Forecast Center, 14 May 2002, 1830 hours.

National Weather Service (NWS) (2002h) Alaska spring breakup summary. Anchorage, Alaska, 18 May 2002, 1500 hours.

National Weather Service (NWS) (2002i) Fairbanks, Alaska, 21 May 2002, 1130 hours; 22 May 2002, 24 May 2002, 1130 hours.

National Weather Service (NWS) (2002j) Anchorage, Alaska, 26 May 2002, 1430 hours.

Pemberton, Mary (2002) Village cleans up after flood. *Anchorage Daily News* (www.adn.com), 8 May 2002.

White, K.D. (1996) A New Ice Jam Database. *Water Resources Bulletin,* **32**(2): 341–348.

Acknowledgments

This work was supported by funding from the U.S. Army Corps of Engineers Civil Works Research-and-Development-funded Cold Regions Engineering Program work unit "Characterizing Ice Impacts on Operation and Maintenance," CWIS # 33202.

* * *

This issue of Ice Engineering *was written by Linnzi Furman, Engineer Aide, Ice Engineering Group, RS/GIS and Water Resources Branch, Cold Regions Research and Engineering Laboratory (CRREL), U.S. Army Engineer Research and Development Center (ERDC), Hanover, New Hampshire. Kate White, PhD, PE, Research Hydraulic Engineer, Environmental Sciences Branch, and Carrie Vuyovich, Research Hydraulic Engineer, RS/GIS and Water Resources Branch, also contributed to the report.*

Ice Engineering

Ice Engineering is published in accordance with AR 25-30 as one of the information exchange functions of the U.S. Army Corps of Engineers. It is primarily intended to be a forum whereby information on ice engineering work done or managed by Corps field offices can be disseminated to other Corps offices, other U.S. Government agencies, and the engineering community in general. The purpose of *Ice Engineering* is information exchange and not the promulgation of Corps policy; thus, guidance on recommended practice in any given area should be sought through appropriate channels or in other documents. This report's contents are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or approval of the use of such commercial products.

The Cold Regions Research and Engineering Laboratory (CRREL) is part of the U.S. Army Corps of Engineers Engineer Research and Development Center (ERDC).

Communications are welcomed. Write to ERDC-CRREL, ATTN: Tim Pangburn, 72 Lyme Road, Hanover, NH 03755-1290 (e-mail Timothy.Pangburn@erdc.usace.army.mil), or call 603-646-4296.