US Army Corps of Engineers

Ice Jam near Minneapolis Water Works Plant Intakes, Mississippi River at Minneapolis, Minnesota. November-December, 1991

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CEMVP-ED-GH (1110-2-1403)

December 10, 1991

Pomerleau/rp/5640

MEMORANDUM FOR RECORD

SUBJECT: Ice Jam near Minneapolis Water Works Plant Intakes, Mississippi River at Minneapolis, Minnesota, November-December, 1991. (PDF)

1. An ice jam developed near the Minneapolis Water Treatment Plant intakes on November 27, 1991. Bonnie Montgomery (Water Control Center) informed me by telephone that the previous days' stage reading was 90.2 as it had been for the previous week. The morning of the 27th, Larry Cole at the Minneapolis water supply facility phoned in a stage reading of 97.0 and was quite concerned about the situation. Larry Cole's phone number is 788-5881, extension 3907.

2. After getting the basic data, I called Dave Christenson (CENCS-EM) and informed him of what information we had. Dave said he would contact his state emergency counterparts to make sure everyone was aware of the situation.

3. A meeting was held in house with Bob Post, Chief of Engineering Division, Bud Johnson, Chief of ED-GH, and others to assess the situation. Based on the information available, it appeared that the ice jam may be located near the Camden Bridge. This area is in the outside of a bend with 2 islands, and just downstream begins a series of bridge crossings for Minneapolis. It should also be pointed out that this is the upstream limit of navigation, and that the backwater from Upper St Anthony Lock and Dam would very near to the open water stage reading of 90.2 feet. I agreed to make a reconnaissance trip to the area and report back to the district office. After obtaining a 35mm camera and VHS CamCorder, I departed the District Office at about 0900 hours.

4. Crossed the Mississippi river at the Interstate 694 bridge, and looking both downstream and upstream from the bridge, one could see a continuous ice cover the consistency of concrete rubble. It was evident that ice cover had broken free upstream, transported into the area in irregular broken sheets, and then become lodged and frozen. I arrived in the vicinity of the Camden bridge (42nd Avenue North) at about 0930. The jam was quite evident from the Camden Bridge. Photographs and some video from taken from the bridge. The jam could be seen upstream as far as line of sight would permit.

5. I drove downstream to the St Anthony Falls Laboratory (SAFHL) taking photos and video of the river along the way. Just downstream of the Camden Bridge and upstream of the Soo Line Railroad bridge an opening in the river ice cover about 50-60 feet was evident. It appeared that this opening was a result of barge activity in the area. This is the upper limit of navigation in Minneapolis.

6. While at SAFHL, I phoned my observations back into the office. Back at the office, Stu Dobberpuhl and Mike Lesher made a few HEC-2 runs to assess with and without ice condition profiles.

7. After departing SAFHL, I drove over to Lower St. Anthony Falls Lock and Dam to talk to Lockmaster Bob Stahl about the situation. Bob gave me a wealth of information about what had been happening along the river during the day and how everyone was working together. Ice conditions in the upper and lower pools at St. Anthony falls were normal. A clear opening in the ice cover was evident and the discharge through the Lock and Dam was about 9400 CFS. This flow rate is about double the monthly average flow rate.

8. The gage zero of the Minneapolis Water Treatment Plant Gage (MSPM5) is at an elevation of 794.87 in the MSL 1912 adjustment. The NGVD 1929 gage zero elevation is 794.39 feet. There is a continuous strip chart recorder at the pump station which gives a stage reading referenced to the Minneapolis City Datum. The Minneapolis City Datum has a zero of 710.3 (NGVD 1929). When the personnel at the pumping station call their daily stage readings into the local office of the National Weather Service, the NWS reports a stage minus 84.

9. I departed LSAF and drove back up to the ice jam site. Deep snow in the area made getting around somewhat difficult. From the upstream side of the Camden Bridge, I could see evidence of pressure ridges in the ice pack just upstream of the bridge. I took additional footage of the jam and then returned to the district office.

10. During the Thanksgiving holiday weekend, the ice jam persisted. The weather was moderate with 14.3 inches of additional snow. The stage at MSPM5 dropped over the weekend but remained above normal. A cold snap occurred late on Sunday night, December 1 with temperatures near zero fahrenheit. The next morning, the stage was up again.

11. With a 2-3 day cold period predicted, the situation was uncertain. At the suggestion of Chief, ED-GH, I called Jon Zufelt at the Cold Regions Research and Engineering Laboratory (CRREL) in Hanover, NH. Jon and I had worked together on a few ice jam related problems. I explained the situation to Jon and expressed our concerns. I asked Jon if he had any additional thoughts on what we could do in the future should the situation warrant some intervention. Jon had the following suggestions in order of preferred solution:

a. See if there is a source of warm water upstream. Perhaps an industry or creamery has excess warm water that could be piped into the river.

b. If there are any towboats that could act as ice-breakers, they could work to break up the jam. Two boats operating in together is the recommended technique. This would not cause any disruption of bridge traffic which mechanical removal techniques from bridges would.

c. Use a crane and wrecking ball from a bridge or other access point to break the ice jam. One has to be aware of adverse effects downstream.

12. Also, Jon recommended keeping an eye on upstream conditions. If solid ice cover upstream of the jam does not form, there is a greater possibility of frazil ice being produced in the open water reaches upstream and then being transported under the ice jam cover. This could aggravate the situation.

13. On Wednesday, December 4, Marv Hrdlicka and I made a reconnaissance of the subject. The temperature was ten degrees below zero (fahrenheit) with a wind chill for minus 24. As the day progressed, the winds dropped to almost nothing and the temperature reached plus 5 in the afternoon. The sky began clear and high clouds appeared in the late morning.

14. We began by observing conditions downstream of the Camden bridge, and then proceeded to the Minneapolis Water Treatment Plant. We met with Mr. Larry Cole at the Laboratory building and had a brief discussion. We inquired about possible warm waste water sources upstream. Mr. Cole stated that the FMC plant used water to cool some of their machinery, but that this is basically a closed system, and very little if any would be available for ice jam melting needs. Mr. Cole also pointed out where discharge lines enter the river. These locations have locally thin ice or no ice at all. They are basically areas for safety concerns rather than points where the ice jam could be weakened.

15. We visited the pumping plant where the intakes for the City are located. The pumping station houses the strip chart gage recorder. Personnel at the pump station were very helpful in explaining their operations and observations they had made during the ice jam event. Some of their observations included the following: a) The ice forms later and breaks up sooner since completion of the power plant upstream at Monticello. b) The Water Works has photos showing construction of the main intakes and pipes across the river. The photos show the pipes being constructed on top of the ice. c) In recent years, beavers have moved onto the islands near the west bank. The beavers have been felling small and medium size trees which have float downstream and become lodged in the pier structure of the Soo Line Railroad Bridge, especially on the west end of the bridge. I obtained a copy of the strip chart records for November 26th and 27th. Since this is a continuous recording chart, the growth of the ice jam induced stage increase is clearly plotted.

16. After completing our business at the Water Works, we drove upstream along the East River Road noting that the ice cover remained stable and covered the river from bank to bank. Just upstream of the Interstate-694 bridge, we stopped at the Islands of Peace Park, which is located about 3 miles upstream of the jam site, and went down to the river. We measured a drop in water surface elevation of 3.0 feet since the Thanksgiving Day weekend.

17. We proceeded upstream to Anoka. Crossing the Highway 610 bridge, river conditions looked pretty much the same as they did near the I-694 bridge. The river was solidly covered, shore ice intact, and one could see where ice had moved downstream, buckled and broken near midriver. The extent of solid shore ice cover intact since initial freeze up was estimated to extend typically about 100 feet from shore.

18. We stopped at the Coon Rapids Dam to view conditions in the tailwater and the pool. Video was taken at this location. The pool area was totally covered with ice. The tailwater contained pockets of open water and some intermittent breaks in the ice cover could be seem along the left and right shorelines. In these areas the water was moving swiftly. The thickness of the ice immediately downstream of the tainter gates was estimated at 3 to 4 feet thick above the water surface. Upstream in the pool area, the ice cover appeared to be the same as that described previously at other locations downstream.

19. At Anoka, the view from the area of the new Highway 169 bridge again showed the river to be completely ice covered. Looking upstream, one could not see an end to the ice rubble near mid-channel. It appeared that the possibility of frazil ice production upstream of I-694 was minimal.

20. We proceeded back down river to the Camden area. At the Camden bridge, we again viewed ice conditions. The 14 plus inches of snow on top of the ice showed no signs of sloughing or displacement. A small stretch of open water could be seen over near the right shoreline.

21. Since river conditions appeared to be stable, I decided to try to take a few ice thickness measurements just upstream of the Camden bridge. From a late 1970's USGS HEC-2 model, we had geometric data for the location. I put on the full-body safety harness and tied the rope to it, the other end being secured at the shoreline by Marv. Using the ice chisel for a probe, I drilled 4 holes on top of the ice cover between the left shoreline and midchannel. Beyond mid channel, the ice was not safety to walk on. The data collected is shown the the field survey form attached.

22. The top ice thickness ranged from 1.8 to 3.1 feet. Immediately below the top layer of ice was a zone of frazil. When drilling the holes, frazil ice immediately filled the hole once the auger was removed. Using the ice chisel and thickness gages as probes, another layer of ice was detected below the frazil. With the equipment available, it was not possible to determine exactly how deep the jam was. The total depth readings shown on the field survey form and on the cross-section plot are really the depths at which the second ice layer was measured. At hole number 2, located 140 feet from the east bank, a total depth could not be measured as it appeared that there was an open area in which the velocity was moving the thickness gage on the end of the tape downstream. This was the last activity for the day.

23. During the course of this ice jam event, Mr. Qiz Hong Guo at the University of Minnesota SAFHL and I were in contact quite extensively. Mr. Guo has been developing a one-dimensional unsteady ice-jam model for his Doctoral. We furnished Mr. Guo additional HEC2 model data and the results of our field investigations. Mr. Guo did some numerical analysis assessing surges due

to a sudden release of the jam and predictions on amount of blockage and stage increases due to ice effects.

24. A good deal of information and experience was obtained during this ice jam event. Enclosed with this MFR is a map showing the location of the jam, a copy of the ice jam field survey, and a graph showing the rate of rise of the water surface elevation at the Minneapolis Water Works pumping station due to the ice jam.

/signed/
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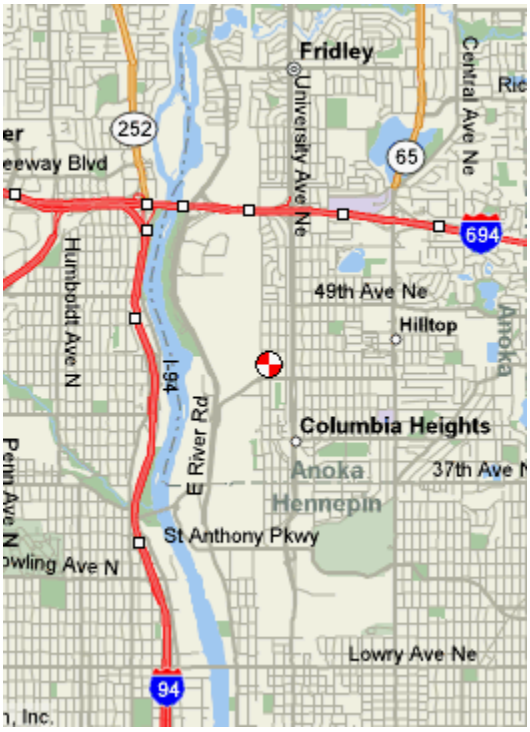
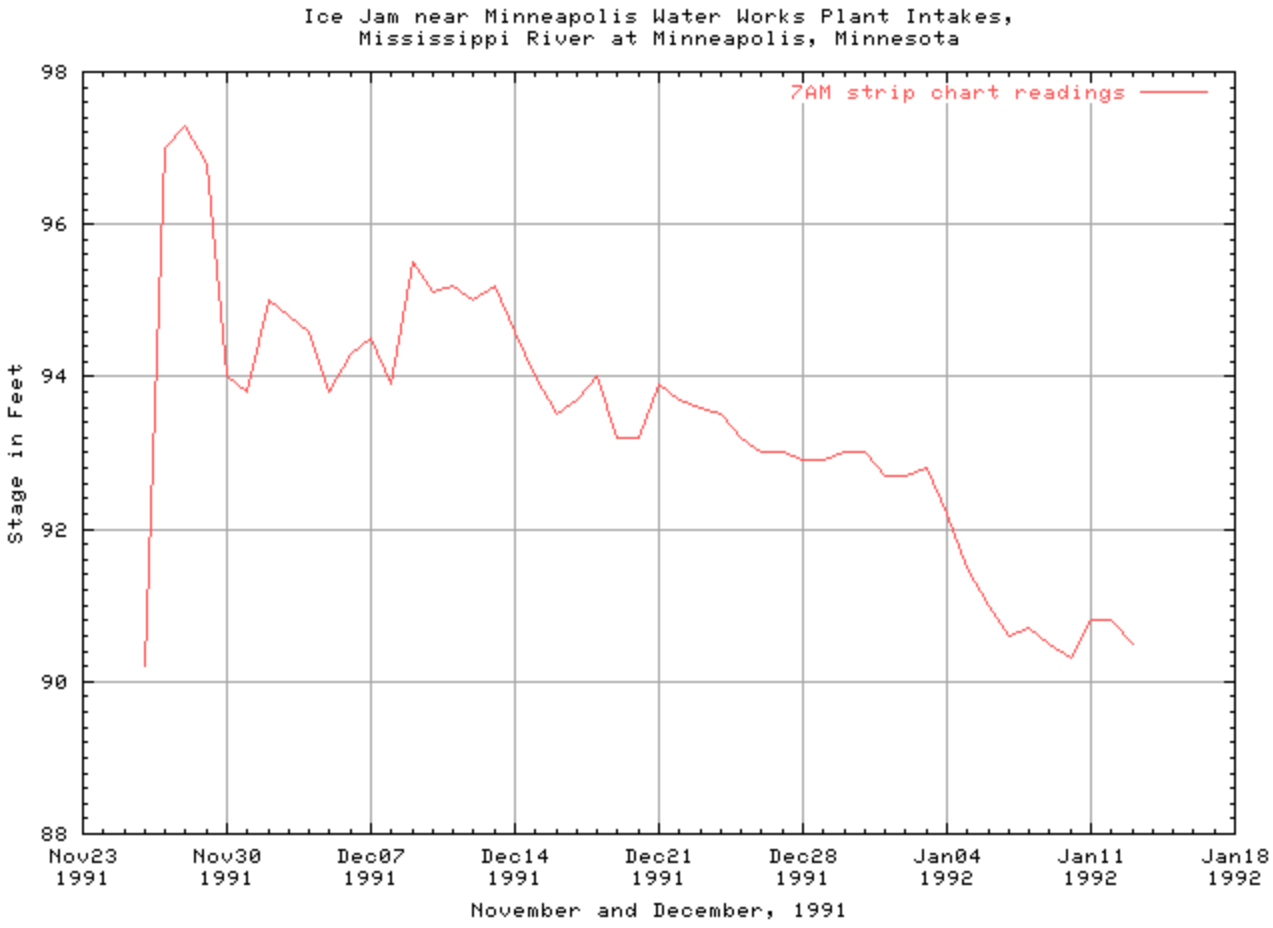


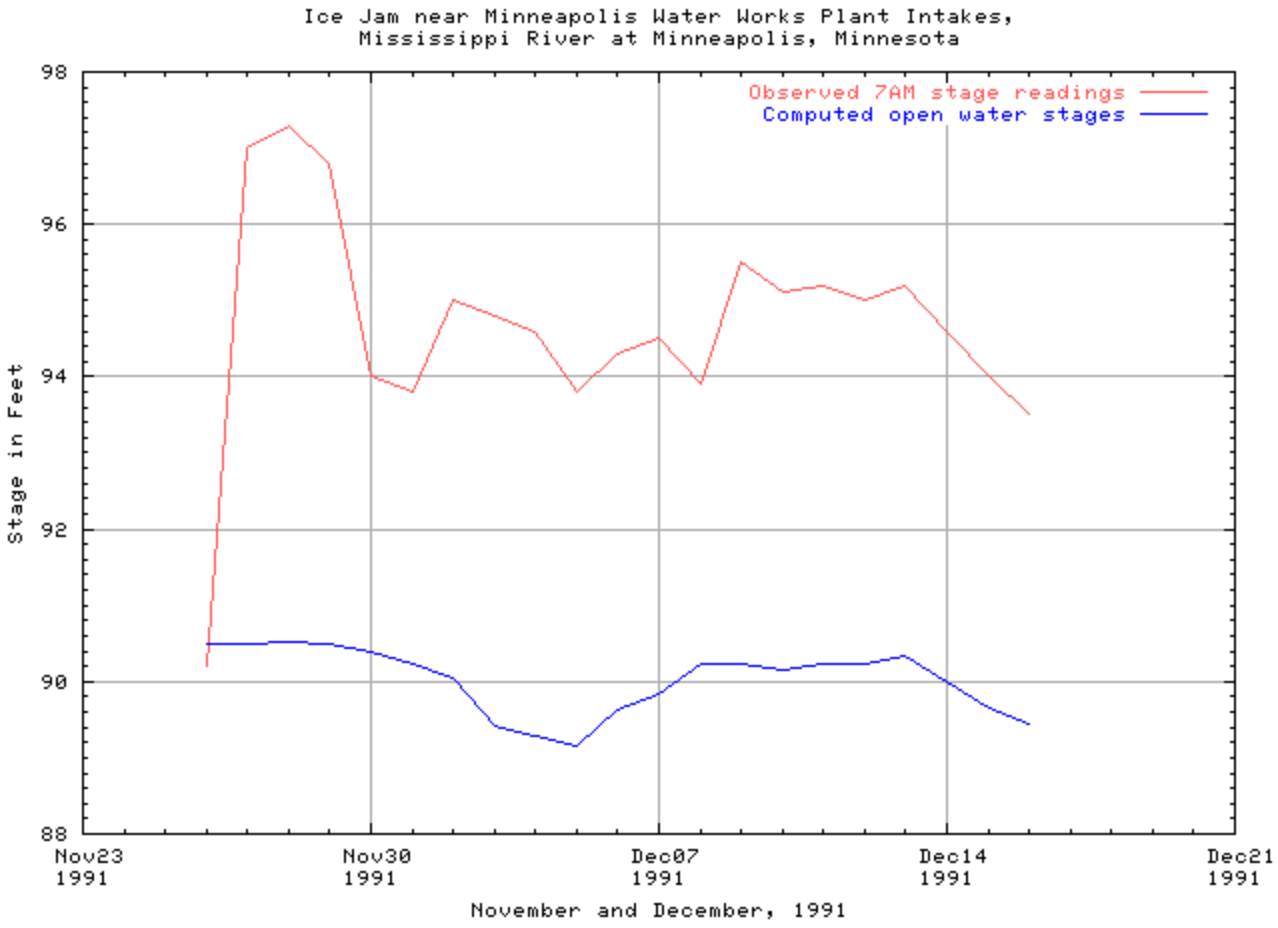
Mississippi River at Minneapolis, Minnesota
Stage Readings at Minneapolis Water Works
Strip Chart Recording Gage
November 26, 1991 to January 13, 1992

Date	8AM	7AM	Elevation

	Discharge (CFS)	Stage	(NGVD 1929)
November 26	9800	90.2	800.5
November 27	10000	97.0	807.3
November 28	10400	97.3	807.6
November 29	10000	96.8	807.1
November 30	9500	94.0	804.3
December 1	8900	93.8	804.1
December 2	8400	95.0	805.3
December 3	7000	94.8	805.1
December 4	6700	94.6	804.9
December 5	6400	93.8	804.1
December 6	7600	94.3	804.6
December 7	7900	94.5	804.8
December 8	8900	93.9	804.2
December 9	8900	95.5	805.8
December 10	8600	95.1	805.4
December 11	8900	95.2	805.5
December 12	9000	95.0	805.3
December 13	9300	95.2	805.5
December 14	8300	94.6	804.9
December 15	7400	94.0	804.3
December 16	6800	93.5	803.8
December 17	7400	93.7	804.0
December 18	8000	94.0	804.3
December 19	6800	93.2	803.5
December 20	6800	93.2	803.5
December 21	8300	93.9	804.2
December 22	7700	93.7	804.0
December 23	8000	93.6	803.9
December 24	7400	93.5	803.8
December 25	7100	93.2	803.5

December 26	7400	93.0	803.3
December 27	7100	93.0	803.3
December 28	7100	92.9	803.2
December 29	7400	92.9	803.2
December 30	7400	93.0	803.3
December 31	7100	93.0	803.3
January 1	7100	92.7	803.0
January 2	7400	92.7	803.0
January 3	7400	92.8	803.1
January 4	7400	92.2	802.5
January 5	7400	91.5	801.8
January 6	7200	91.0	801.3
January 7	7400	90.6	800.9
January 8	6500	90.7	801.0
January 9	7100	90.5	800.8
January 10	7100	90.3	800.6
January 11	6500	90.8	801.1
January 12	6800	90.8	801.1
January 13	7700	90.5	800.8


Ice Jam near Minneapolis Water Works Plant Intakes,
Mississippi River at Minneapolis, Minnesota
7AM strip chart readings
Stage in Feet
98
96
94
92
90
88
Nov23 1991
Nov30 1991
Dec07 1991
Dec14 1991
Dec21 1991
Dec28 1991
Jan04 1992
Jan11 1992
Jan18 1992
November and December, 1991



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