
USA CRREL
Ice Engineering
Research Division
Cold Regions Engineering
Hydrology and Hydraulics

CRREL

Cold **Problem Solvers for the Nation**

Cold Regions Engineering

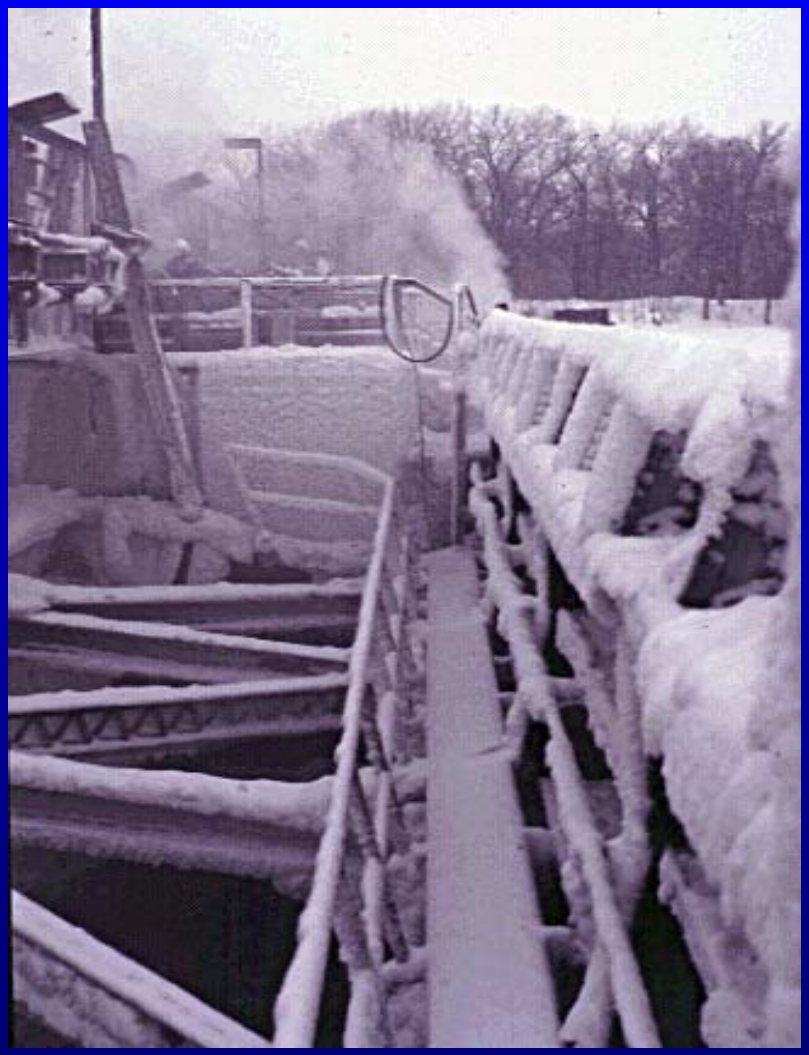
- Addresses Winter Impacts on Corps Missions
- Multidisciplinary Programs
  - Navigation
  - Flood Control
  - Water Resources
  - Sediment Control/Scour
  - Environmental

Navigation Problems

Soo Lock

Starved Rock

Winter Dam Operations



Dresden Island

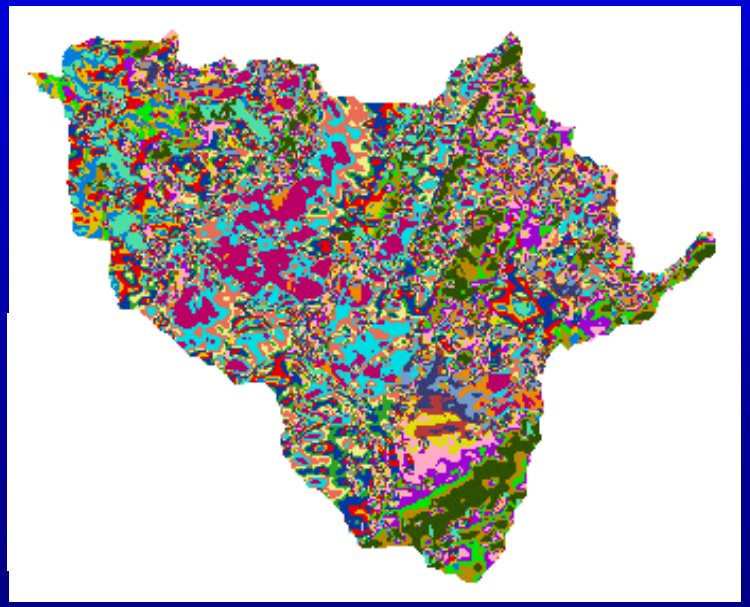
Winter Hydrology: Distributed Snowmelt Model

- Distributed snow melt for each grid element
- Sub-basin snow melt
- Snowmelt run-off hydrographs
- Flood prediction

CRREL Distributed Snowmelt Model

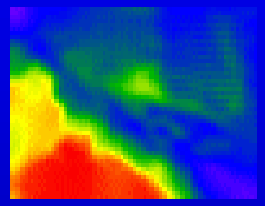
INPUTS

Surface Energy Balance Map

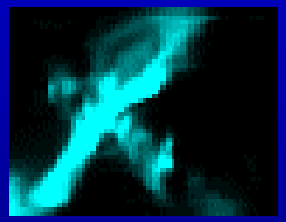


Meteorology

Temperature



Precipitation



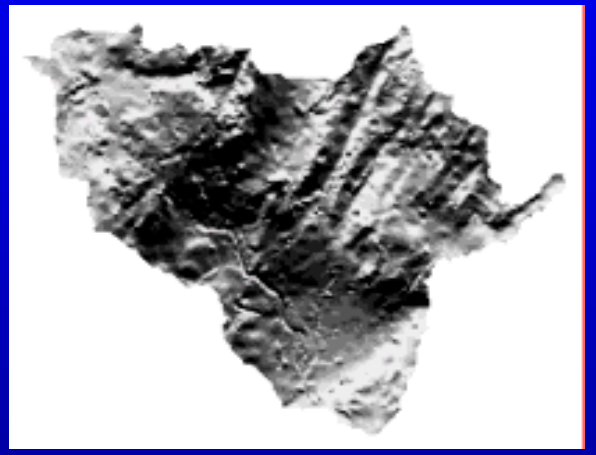
As available:

Windspeed
Relative Humidity
Cloud Cover
Radiation Data

OUTPUTS

Time Series Data

Distributed Snow Melt



Lumped Basin Snow Melt

Ice Jams

Ice Jams

- Cause flooding
- Suspend navigation
- Damage riverine structures
- Promote bed and bank erosion
- Remove or damage bank vegetation
- Flood upland wetlands
- May be important for maintaining near-stream habitat

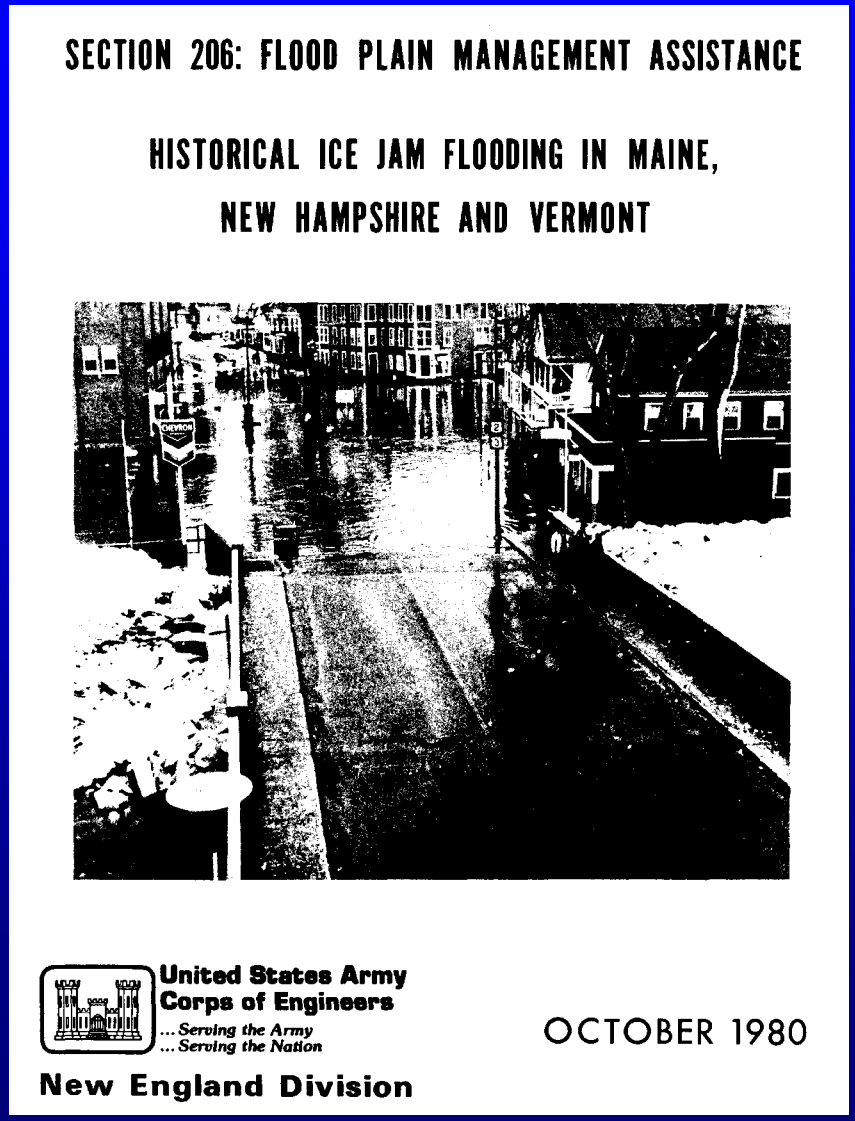
Ice Jam Database

- Geographic Data: state, river, nearest town, latitude & longitude, HUC, gaging station
- Other Data: date of event, flow, stage, likely causes, damages, mitigation measures, POC's, etc.
- Searchable on the Web: new interface
- To be linked with GIS mapping


USA-CRREL Ice Jam Database Development - Microsoft Internet Explorer
File Edit View Go Favorites Help
Back Forward Stop Refresh Home Search Favorites History Channels Fullscreen Mail Print Edit
Address http://www.mvp-wc.usace.army.mil/ijdb/
Ice Jam Database
State: All States
City:
River: White
USGS Gage Number:
WRC Unit Number:
Month(s): January December
Year(s): 1870 2000
Jam Type: All Types
Description:
Publication:
Contact:
Query results output controls:
USGS Gage
WRC Unit Number
Coordinates
Jam Description
Damages
Visuals
CRREL Contact
USACE Contact
Local Contact
Submit Request
Reset All
Done
Internet zone

Ice Jam Database

- Emergency response
- Ice jam characterization
- Reconnaissance studies
- R & U



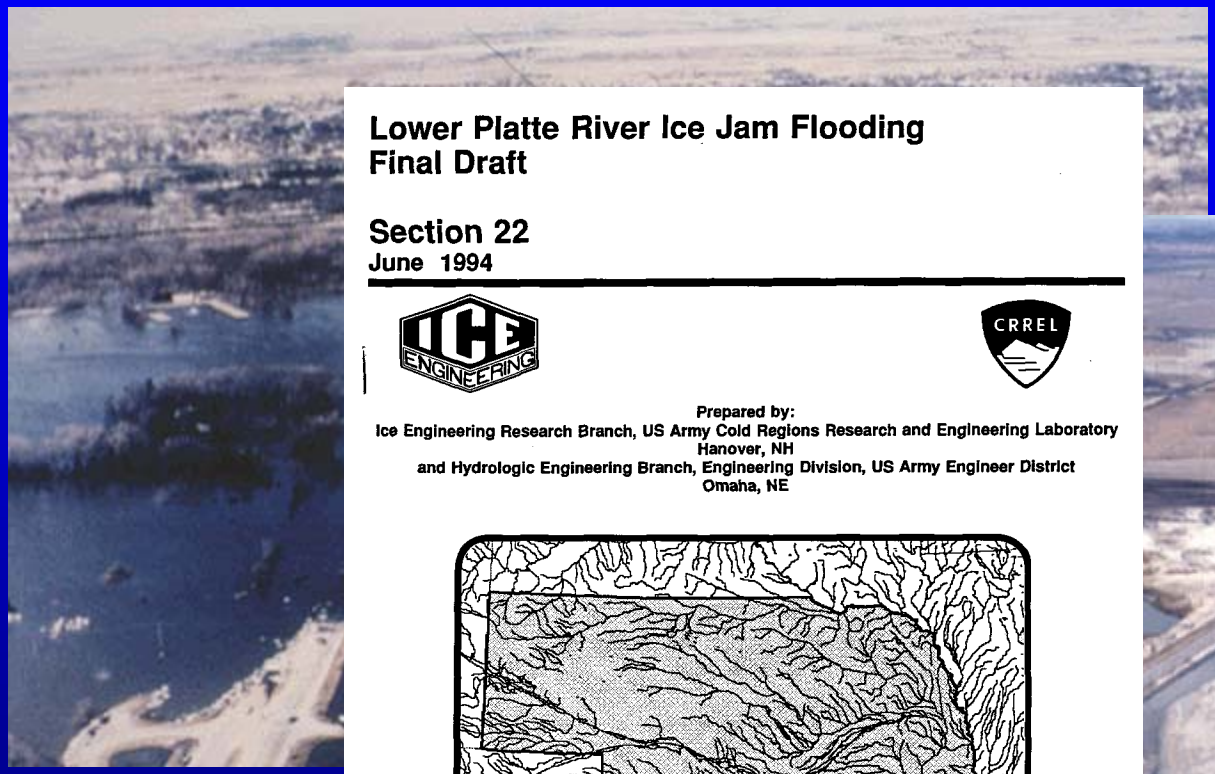
Capabilities

- Ice jam response
  - technical assistance
  - ice monitoring
- Stage-frequency for ice affected rivers
- Numerical modeling
  - determine flood inundation boundaries
  - design ice control measures
- Ice control
  - structural
  - nonstructural

Ice Jam Mitigation

- Advance Measures
- Emergency Measures
- Permanent Measures
- Freezeup Jam Control
  - Control production & transport of frazil ice
  - Displace jam initiation location
- Breakup Jam Control
  - Control timing of ice breakup
  - Displace jam location

Advance Measures



Lower Platte River Ice Jam Flooding
Final Draft

Section 22
June 1994

ICE ENGINEERING

CRREL

Prepared by:
Ice Engineering Research Branch, US Army Cold Regions Research and Engineering Laboratory
Hanover, NH
and Hydrologic Engineering Branch, Engineering Division, US Army Engineer District
Omaha, NE

US Army Corps
of Engineers
Omaha District

Welcome to the Nebraska Natural Resources Commission - Microsoft Internet Explorer

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Address http://www.nrc.state.ne.us/

Nebraska Natural Resources Commission

...dedicated to the long-term management of Nebraska's land and water resources

- About the NRC
- Subjects A-Z
- Search this Site
- Site Map/Index

- 1999 Legislative Session
- Ice Jam Report

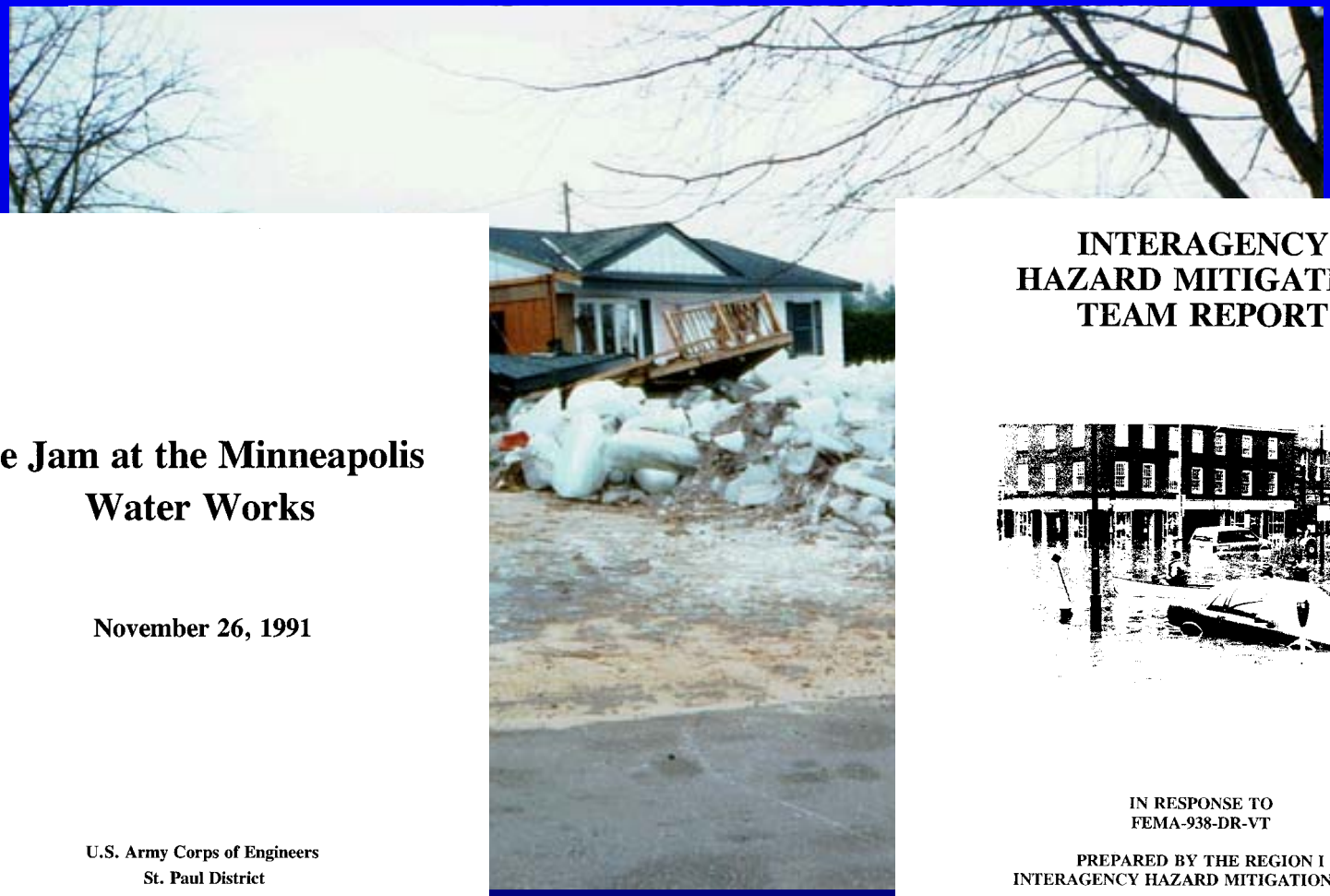
The Nebraska Natural Resources Commission
301 Centennial Mall South

Opening page www.nrc.state.ne.us ...

Internet zone

Advance Measures

Emergency Measures



Ice Jam at the Minneapolis Water Works

November 26, 1991

U.S. Army Corps of Engineers
St. Paul District

January 1992

INTERAGENCY HAZARD MITIGATION TEAM REPORT

IN RESPONSE TO FEMA-938-DR-VT

PREPARED BY THE REGION I INTERAGENCY HAZARD MITIGATION TEAM

AUGUST 1992

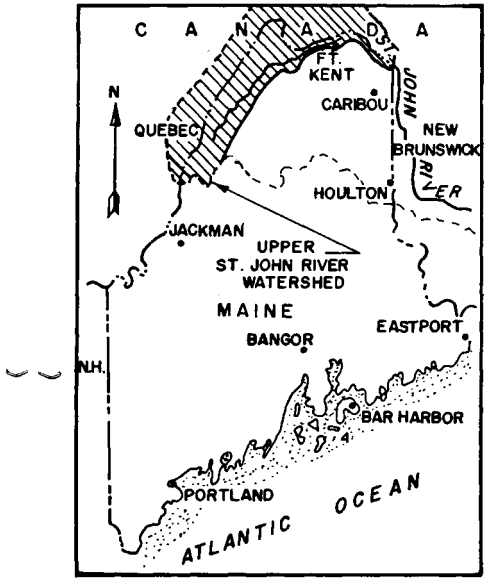
Permanent Measures

- Ice control structures (ICS's)
- Diversion channels
- Flow control
- Thermal discharge
- Levees, floodwalls
- Floodproofing
- Land management

General Investigation Study

Reconnaissance Report

SAINT JOHN RIVER, MAINE
ICE DAMAGE CONTROL



January 1993

US Army Corps
of Engineers
New England Division

Cazenovia Creek ICS

Original ~ $3M

New < $1M

Salmon River Ice Boom

US Army Corps
of Engineers
Walla Walla District

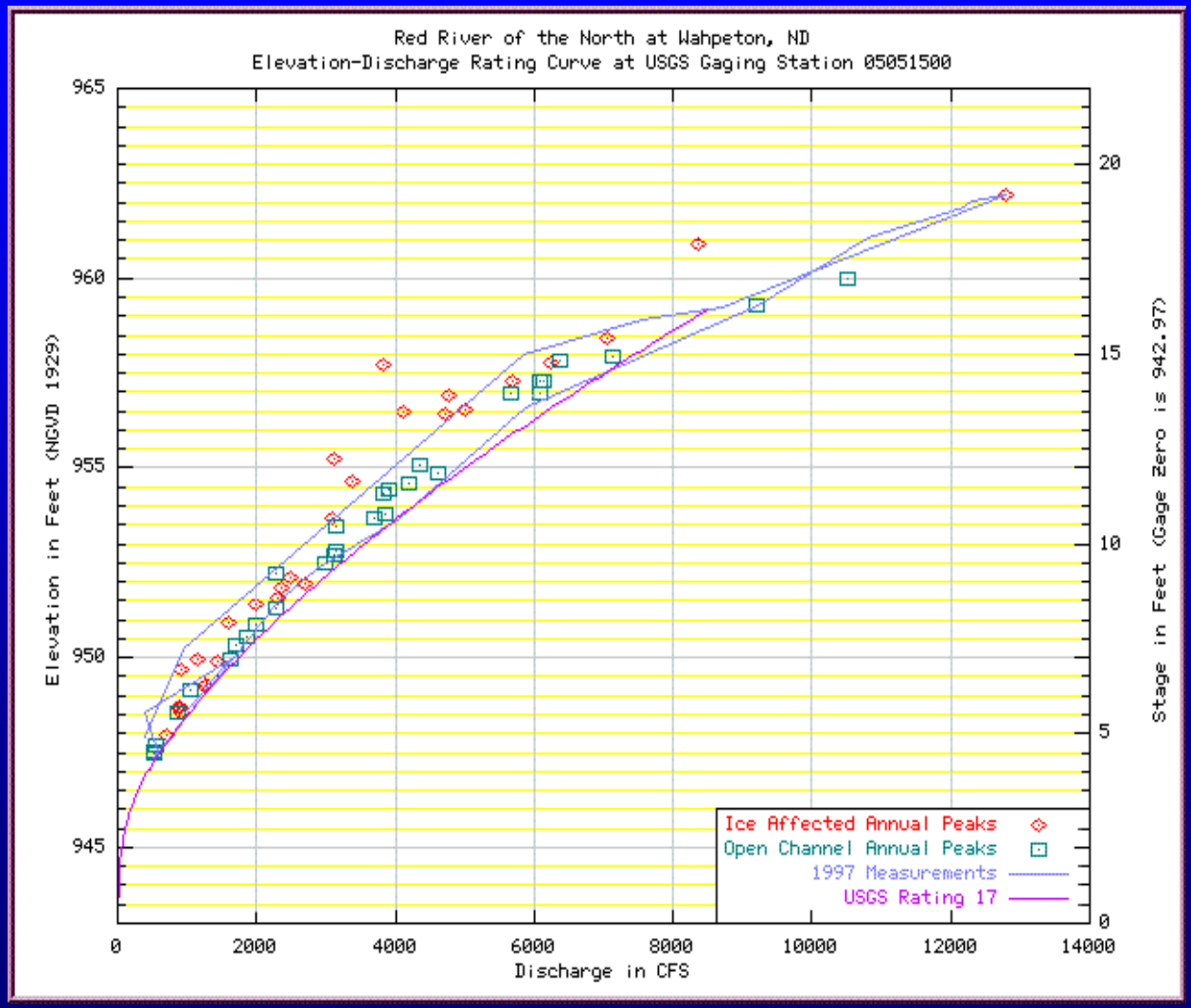
Salmon River Flood Damage Reduction

Lemhi County, Idaho

Detailed Project Report and
Environmental Impact Statement

Section 205
Small Project
March 1986

Ice-Affected Stage Frequency

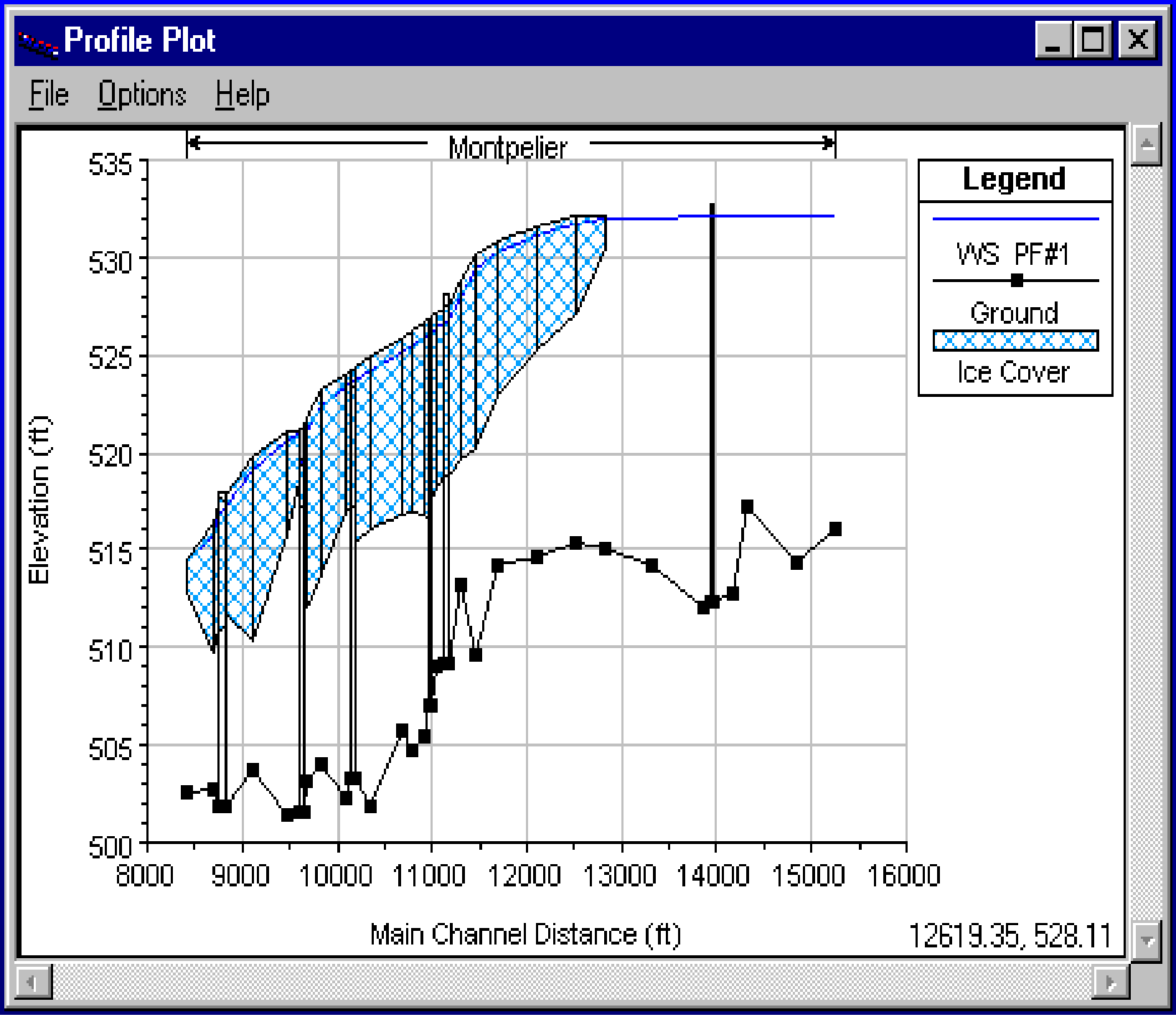


Modeling Ice-covered Rivers

- Steady Flow
  - HEC-2 with ICETHK
  - HEC-RAS
- Unsteady Flow
  - UNET
  - Discrete Element or Discrete Parcel Models
- 2 Dimensional Flow
  - Currently in development

HEC-RAS Ice Subroutine

- Developed by CRREL and HEC
- Backwater for ice-covered rivers
  - Known ice thickness, or
  - Equilibrium ice jam
- Models ice at bridges
- User inputs ice properties or selects default values
- All HEC-RAS graphical features available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Montpelier
Legend
WS PF#1
Ground
Ice Cover
535
530
525
520
515
510
505
500
Elevation (ft)
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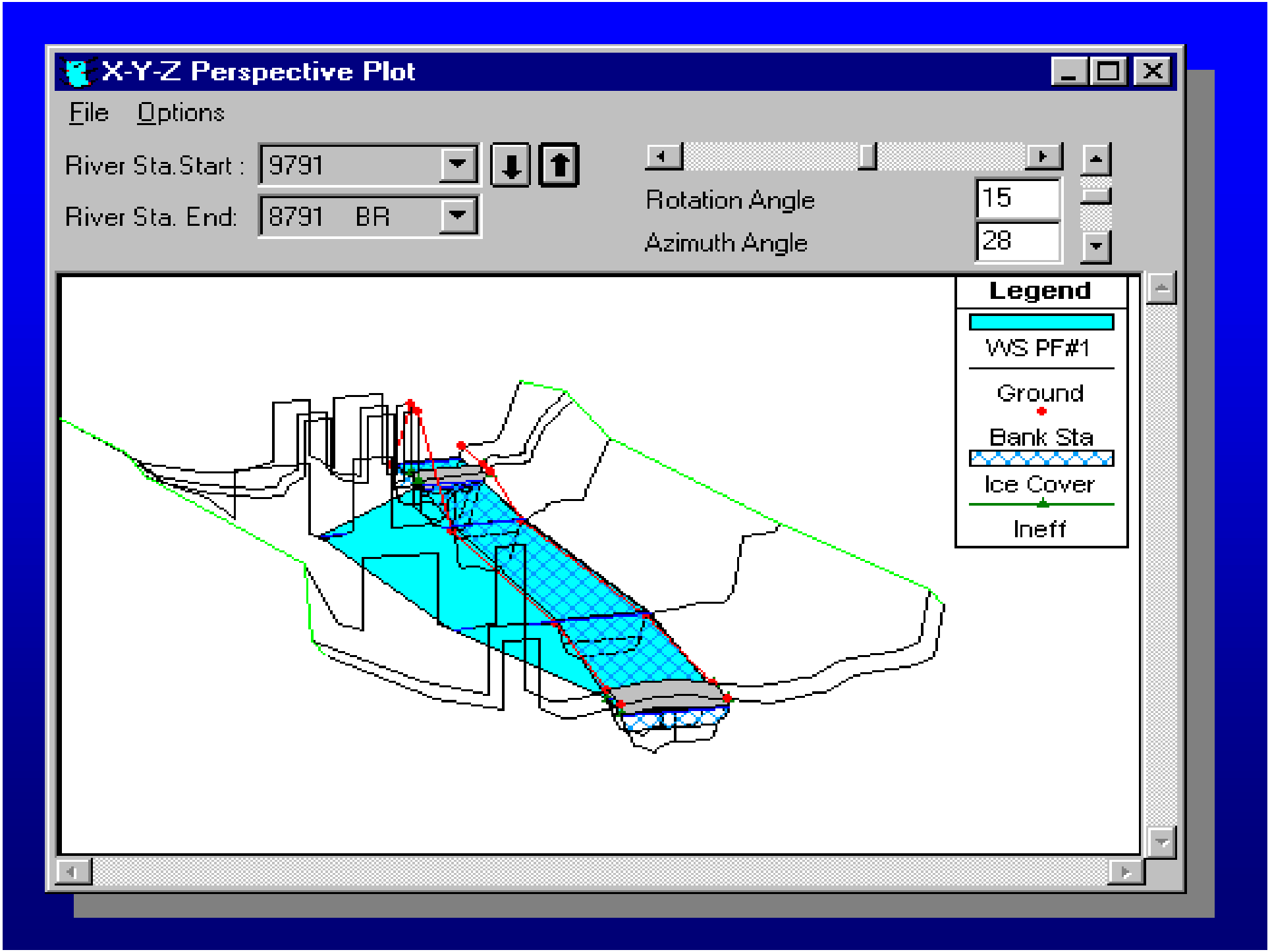
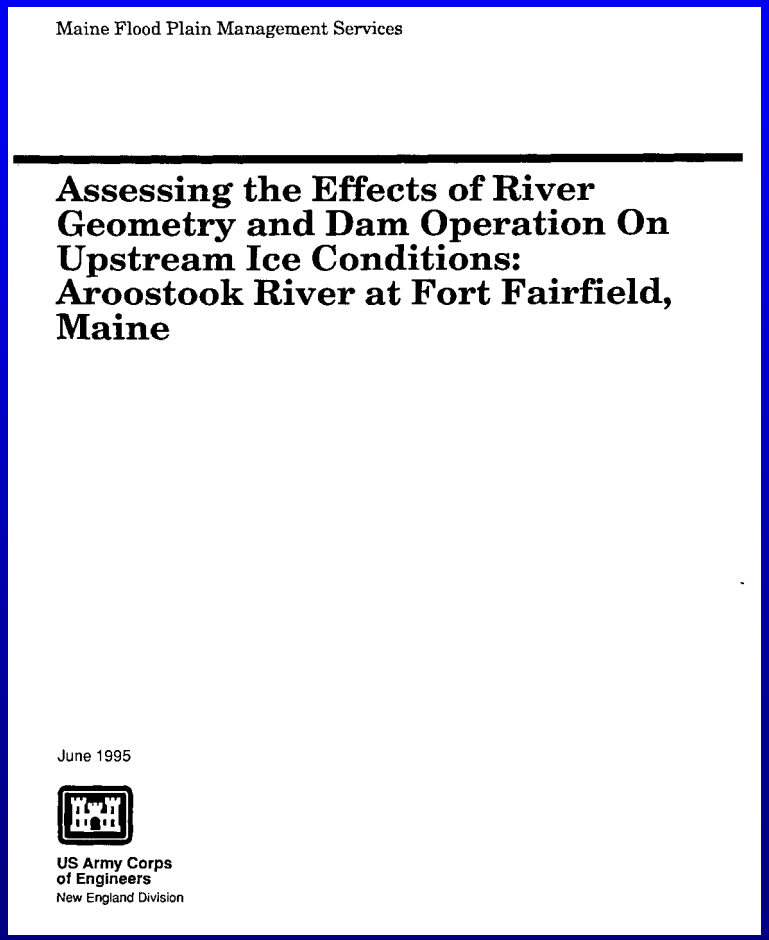
9000
10000
11000
12000
13000
14000
15000
16000
Main Channel Distance (ft)
12619.35, 528.11


X-Y-Z Perspective Plot
File
Options
River Sta.Start :
9791
River Sta. End:
8791 BR
Rotation Angle
15
Azimuth Angle
28
Legend
WS PF#1
Ground
Bank Sta
Ice Cover
Ineff

UNET Ice Subroutine

- Time dependent modeling of
  - Water temperature
  - Surface ice transport
  - Frazil ice transport
  - Extent of stationary ice cover
- Full interaction between ice cover and flow
- Model update based on observations
- All data can be written to DSS database

Numerical Modeling



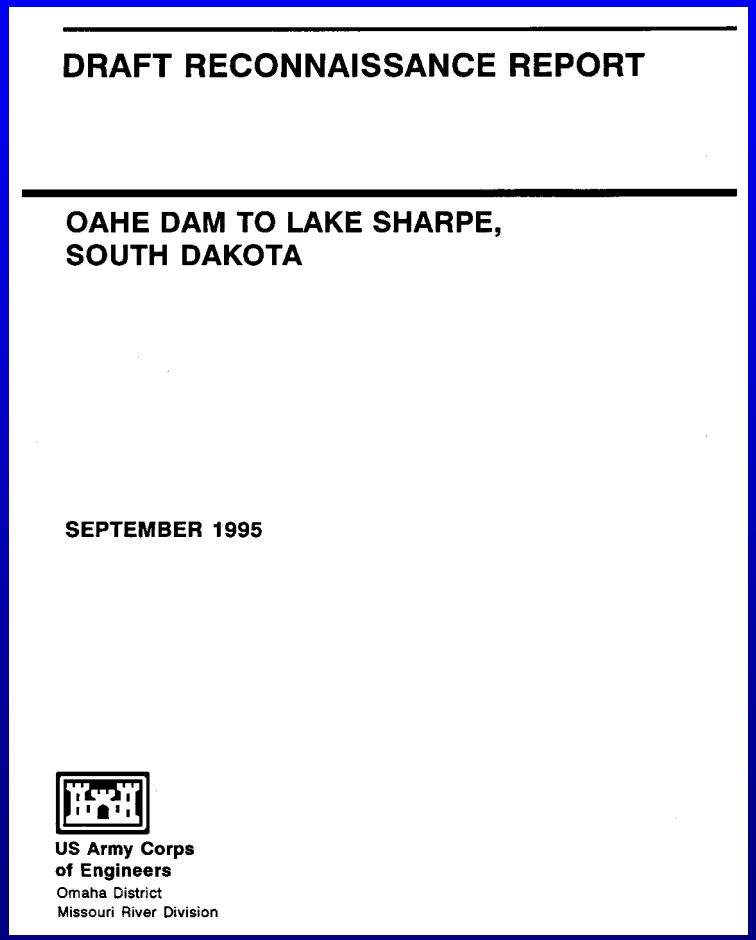
Maine Flood Plain Management Services

Assessing the Effects of River Geometry and Dam Operation On Upstream Ice Conditions: Aroostook River at Fort Fairfield, Maine

June 1995

US Army Corps of Engineers
New England Division

HEC-2 with ICETHK



DRAFT RECONNAISSANCE REPORT

OAHE DAM TO LAKE SHARPE, SOUTH DAKOTA

SEPTEMBER 1995

US Army Corps of Engineers
Omaha District
Missouri River Division

UNET

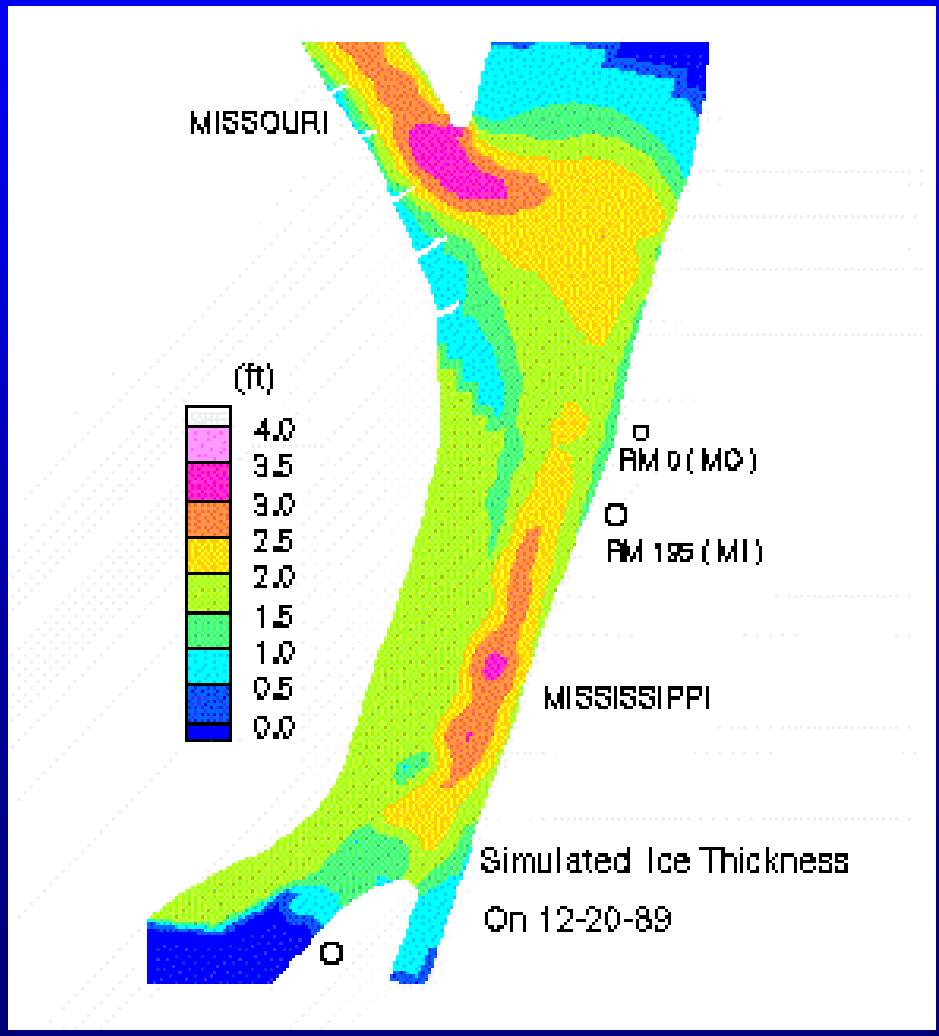
Discrete Element Simulation of Ice Transport

- Simulation tracks 2000 to 5000 ice pieces
- 2-D ice-block interaction simulation
- 1-D hydraulic model with seepage through ice mass
- Output: ice thickness, stage, flow velocity, forces on banks or structures

DynaRICE© Ice Dynamic Model

- **Developed through university contract**
- **Unsteady, 2-D, finite element, hydrodynamics coupled with ice parcel dynamics to simulate**
  - **River ice transport**
    - **spatial distribution of ice and velocity of ice parcels**
  - **Ice jam initiation and development**
    - **ice concentration and thickness**
- **Model Applications:**
  - **Analyze ice-structure interaction**
    - **bridges, dams, lock approaches, ice control structures, etc.**
  - **Estimate effect of channel changes on ice processes**
    - **dredging, bank protection, bendway weirs etc.**

DynaRICE Simulation of 20 Dec. 1989 Jam Mississippi-Missouri Confluence



Ice Jam Prediction

- Models under development:
  - Empirical threshold models
  - Multiple linear regression
  - Logistic regression
  - Discriminant function analysis
  - Canonical discriminant or cluster analysis
  - Deterministic (analytical) model

Ice Jam Prediction

- Combined empirical and discriminant function analysis for Oil City, PA (Pittsburgh District)
- Provides risk associated with incorrect prediction
- Web-based with password
- Used to predict jams
- Can be used to determine project benefits