Colorado Silver Jackets
River Ice Workshop
River Ice Observer Training

CRREL Ice Engineering Group

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River Ice Observer Training

- Objective
- Ice Observer sheet
- General Observations
- Ice Conditions
- Other items to note
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Objective: Report ice conditions to provide early warning and help mitigate ice jam damages.

- Local officials and emergency managers
- State agencies
- CRREL

- What to look for, information to record
- Safety First!
**ICE REPORT**

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
<th>AM/PM</th>
</tr>
</thead>
</table>

**RIVER/STREAM NAME:**  
**LOCATION OF OBSERVATION:**
- [ ] Area/Map
- [ ] Lat: __________ Long: __________
- [ ] Location of nearest road:
- [ ] Location of nearest bridge/landmark:
- [ ] Distance to nearest Town: __________ County: __________

**IS this a changed condition:** [ ] Yes [ ] No

**IS flooding occurring:** __________

**Is damaging occurring or has occurred?**
- [ ] Yes [ ] No

**Is there a Photo?** [ ] Yes [ ] No  
**Photo description:** __________

**LOCAL WEATHER**

- **Temperature:** Air: __________ °F  
- **Precipitation:** Rain: __________ in  
- **Wind:** Average Speed: __________ mph  
- **Wind Direction:** __________

**RIVER CONDITION:**
- [ ] Breakdown  
- [ ] Estimate less than backfill  
- [ ] Nearest gage readings

**Section B**

**CHARACTER OF INTACT ICE COVER:**
- [ ] Location of downstream end of ice cover: Lat: __________ Long: __________
- [ ] Location of upstream end of ice cover: Lat: __________ Long: __________
- [ ] Distance from observation location: __________

**Surface roughness (check one):**
- [ ] Smooth __________
- [ ] Snow covered __________

**Evidence of decay:**
- [ ] Yes
- [ ] No

**If yes, check:**
- [ ] Melting snow
- [ ] Melting ice
- [ ] Candled ice

**Cracks in ice cover:**
- [ ] Yes
- [ ] No

**If yes, check:**
- [ ] Parallel to shore
- [ ] Perpendicular to shore

**Evidence of fracturing along banks:**
- [ ] Yes
- [ ] No

**If yes, check:**
- [ ] For thickness when fracture occurred: __________ in
- [ ] Estimate __________ measured

**Sketches:** Include approximate scale, illustrate character of ice cover, ice coverage, water level, etc.

**Section C**

**ICE JAMS**

- **Cause (check one):**
  - [ ] Freezeup
  - [ ] Aufer
  - [ ] Another Ice
  - [ ] Breakup

**Condition at jam initiation point (check all that apply):**
- [ ] Break ice sheet
- [ ] Level
- [ ] Bridge
- [ ] Island
- [ ] Construction

**Jam length:** __________ mi (approx.)

**Location of jam (downstream end):**
- [ ] Lat: __________ Long: __________
- [ ] Distance from observation location: __________

**Location of head of jam (upstream end):**
- [ ] Lat: __________ Long: __________
- [ ] Distance from observation location: __________

**Estimated time of jam formation:** AM/PM __________

**Estimated time of jam release:** AM/PM __________

**Height of shear walls along bank:** __________ ft

**Can you estimate ice thickness:** __________ in  
**Can you identify a high water mark:** __________

**Other Observations/Notes:**

- Comments on any aspect of ice quantity, quality, breakup, breakthroughs, jamming, weather, etc.

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**BUILDING STRONG®**
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Ice Observations

Ideal Observations

- Location of Observations
  - High elevation
  - More than one good vantage point
  - Ability to observe up and downstream
  - Near a gage station is helpful
  - Near a bridge is helpful for discharge measurements after ice is gone

- Frequency of Observations
  - Correspond to degree of river ice activity.
  - Daily during freeze-up
  - Every 2-4 weeks during established ice cover
  - Daily once any melt has been observed or warm-up is predicted
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Ice Observations: General Information

- Observer
- Date, time
- Location
  - River
  - Coordinates
  - Nearby towns
  - Landmarks
- Conditions
  - Flooding
  - Weather
  - Damages
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Ice Observations: General Information

- Taking Photos
  - Location
  - Direction
  - Other relevant details

Penobscot River at Howland looking toward Piscataquis confluence

Pleasant River in Milo

Water flowing around jam and out of river banks

Ice jam only ½ mile long and had shifted slightly downstream a couple of hours later. Water is flowing away from the viewer in this photo.
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Ice Observations

Possible Ice Conditions to report:

- Freezeup – Start of season, moving ice
- Intact Ice Cover – Majority of season, stationary ice
- Breakup – End of season, moving or melting ice
- Ice Jam – Not every year, stationary ice
Use the CRREL River Ice Guide if Necessary:

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Ice Observations: Ice Formation

- Note type, thickness and extent of border ice
- Characteristics of ice that is passing
  - Frazil concentration
  - Thickness
  - Size of pans
- Method of freeze-up once it occurs
- Final Cover
  - Roughness
  - Estimate thickness
2 Questions to Ponder During Freezeup:

1. Is There **Moving Ice** in the Open Channel?
   
   If so, what Type is it?
   (slush, frazil pans, frazil sheets, large sheets)

   How much of the OPEN channel has moving ice?

2. Is There **Border Ice**?

   If so, how far out does it extend?
Two Observers, Two Reports

60% of channel has moving ice (frazil pans)

1-15 ft size

Border ice?

50% of Channel with Border Ice

100% of Open Channel with Moving Ice (very slowly)
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Ice Observations: Ice Cover

- Locations of upstream extent and downstream extent
- Surface characteristics
  - Roughness
    - Is this a jam or a smooth cover?
  - Thickness
  - Decay
  - Cracks
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Ice Observations: Ice Cover

Questions to Ponder on a Intact Ice Cover:

1. Is there an upstream or downstream edge to the ice cover (open water)?

2. How ROUGH is the Ice Cover?

3. Is there evidence the ice cover is decaying (melting) or snow covered?
   If so, is the ice and/or snow melting? Ice ‘candling’?

4. Are there significant cracks in the ice cover?
   If so, are cracks parallel or perpendicular to shore?

5. Has the ice fractured along the banks (ice in channel drops)?
   If so, can you tell how thick the ice is in the fracture?
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Ice Observations: Ice Cover

Roughness/Smoothness
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Ice Observations: Ice Cover

Decay

- River Water Wicks Up Between Ice
- Candles to Darken Ice Surface
- Rotten Canded River Ice
- Weak, Canded Ice Seen from the Ground
Fracturing along Banks: Fracture formed in an ice cover or floe that does not divide it into two or more pieces

- Displacement
- Distance from shore
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**Ice Observations: Ice Cover**

**Hinge Crack (parallel)**: Typically, hinge cracks form along both banks. In narrow channels, a single crack may form down the middle of the channel.
Surface – smooth to 6 inches height, scattered snow on top of ice, “black” ice
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Ice Observations: Break up

- Cracks
- Water on top of ice
- Time of movement
  - Time ice cleared
- Height of shear walls
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Ice Observations: Break up

Questions to Ponder during Breakup:

1. Are there cracks in the ice? Parallel or perpendicular to shore?
   If parallel, how far from shore? If perpendicular, what is spacing?

2. Is there water on top of the ice?
   If so, is it pooling or moving?

3. When did the ice start moving? When was the channel clear of ice?

4. If there are shear walls after breakup, how high are they?
Look for Cracks and their Orientation as the Ice Begins Breakup.
Is the water on top of the ice moving or pooled?
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Ice Observations: Break up

- Lifted Ice In Place
- Lifted and Shifted Ice
Ice is beginning to shove and move. **What time is it?**  
**Where is it at?**
How Fast is the Ice Moving During Breakup?

(If it’s slowing down, may be about to jam)

(Gives approximate warning time to downstream interests)
What time did the channel clear of ice?

How high are the shear walls?
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Ice Observations: Ice Jams

- Jam Geometry and Thickness
- Types of Jams
  - Freeze-up
  - Anchor Ice
  - Aufeis
  - Breakup Jam
  - Combination/Midwinter jam
- Conditions for Jam Initiation
- High Water/Ice Marks
Questions to Ponder during Ice Jam:

1. Is it a freezeup jam or a breakup jam?

2. What is causing the jam to occur?
   Solid ice downstream, bend in river, bridge, island, other?

3. How long is the jam? (may not be possible to observe except from air)

4. Where is the downstream end of the jam located?

5. Where is the upstream end of the jam located?
   NOTE: This may change with time, so report as often as possible

6. How high are the shear walls after the ice jam releases?
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Ice Observations: Ice Jams

Extents of an Ice Jam

**Parts of a jam (toe, head):**

**Head - Upstream end of jam:**

**Toe – Downstream end of jam:**

*Breakup jam.*
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Ice Observations: Ice Jams

Estimating Thickness of Ice Jams
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Ice Observations: Ice Jams

Freeze-up Ice Jams
- Early in season
- Smooth to moderate roughness
- Monitor:
  - Stage and discharge trends
  - Extent
  - Conditions
    - head and toe of jam
    - Movement
  - Surface conditions
    - Buckled? Single layers of floes?
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Ice Observations: Ice Jams

Anchor Ice Jams

- Occur during freezeup
- Active frazil deposits on bed
- Found in shallow and turbulent areas
- Note extent and affect on water levels
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Ice Observations: Ice Jams

Aufeis Ice Jams

- Ice on ice.
- Forms when water from a spring of stream or culvert runs on top of existing ice and freezes.
- Stream aufeis can fill the channel.
- Note thickness and extent, affect on water level.

Most aufeis forms along rivers.
Breakup Ice Jams
- Can occur anytime after ice cover forms
- Generally mid to late winter
- Can form more than once
- Can lead to unsteady flow surges
- Monitor:
  - Stage and discharge
  - Extent, coverage
  - Conditions at head and toe of jam (thickness, concentration)
  - Surface conditions
    - Color and thickness
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Ice Observations: Ice Jams

Combination/Midwinter Jams

- Forms with a mid-winter thaw
- Characteristics of breakup jams with thinner ice floes
- Can refreeze in place and cause problems late in the season

Monitor:

- Stage and discharge
- Extent, coverage
- Conditions at head and toe of jam (thickness, concentration)
- Surface conditions
  - Color and thickness
Example Combination Jam

1) Breakup of Intact Ice Cover

2) Frazil Ice Jam

Platte River, Fremont NE
- Jan 1996
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Ice Observations: Ice Jams

Released Ice Jams

As the water level continues to increase, ice will be lifted until at some point it will be freed from the geometry of the channel and move downstream

- Time of release
- Height of sheer walls
Conditions for Initiation of Ice Jams

**Solid ice sheet:**

*Breakup jam.*

**Bend:**

*Kuskokwim River*

*Chunk Ice Jammed While Trying to Bypass Ice Sheet*

*Ice Sheet Jammed in River Bend*

**Bridges or other infrastructure:**
Conditions for Initiation of Ice Jams

**Constriction:**

IceSheet Jammed in Constriction on the Kuskokwim River

**Island:**
Send your Ice Jam Observations to CRREL

► We will add to weekly ice report and IJDB
► Contact and email info:

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Ice Observations: Other Items to Note

- At Your Discretion
- Make Note of Anything Unusual
- Take Photos, Try to Include Everyday Objects for Scale
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Ice Observations: Other Items to Note

During

After
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Ice Observations: Other Items to Note

Wider View VS. Narrower View
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Ice Observations: Other Items to Note
Questions?